Appendix I
Leachate Collection and Removal System Operating Plan

I1.0 Purpose

The purpose of this document is to provide information necessary for the proper operation and maintenance of the Leachate Collection and Removal System (LCRS). Specifically, the subsequent sections will provide the information relating to the management of leachate, maintenance and calibration of liquid level, general equipment maintenance, and reporting requirements.

I2.0 Facility Description

The LCRS facility is located at the north end of the disposal cell and consists of an 11,500-gallon horizontal below-grade pipe storage sump, four pipes from the disposal cell (east and west primary and east and west secondary) to convey the leachate to the sump, liquid level monitoring instruments, and other related equipment. An 8-foot chain link and barbed wire fence surrounds the sump area. An approximately 1,200-square-foot building houses supplies and instrumentation. This building is the LCRS Support Building and is located adjacent to the sump on the north side.

The sump has a secondary containment system that provides an additional barrier to the environment and a means to collect leakage and infiltration. The containment is known as the "burrito" and consists of a high density polyethylene (HDPE) liner system that totally encloses the primary and secondary leachate collection systems as well as the sump.

A 4-inch-diameter HPDE pipeline connects the LCRS Support Building to the Missouri River (NPDES outfall 007). This pipeline was extended to support the LCRS/Train 3 before approval was obtained to haul leachate to the Metropolitan Sewer District (MSD), and is available for use if the treatment system contingency plan is implemented or if the NPDES permit is modified.

A drawing of the LCRS system is presented in Appendix 1.

I3.0 Leachate Management

I3.1 Leachate Flow and Level Monitoring

The LCRS has been equipped to measure the volume of the primary and secondary leachate generated from the disposal cell. The east and west secondary leachate is monitored separately and the data are displayed (CTR [Counter] 401 and CTR 403) and recorded automatically at the instrumentation cabinet located in the LCRS Support Building. The data are periodically downloaded for trend analysis and other reporting needs.

A resistance-type probe (LS-1) installed in the sump monitors the total (east and west) primary leachate volume. This information is also digitally displayed and recorded at the instrumentation cabinet (LI-1) in the LCRS Support Building. The primary leachate volume is calculated by taking the measured volume in the sump minus the volume of secondary collection leachate that has accumulated. The primary leachate flow rate is calculated by taking the primary leachate volume (calculated above) divided by the number of days of accumulation. A dedicated resistance-type probe (LSH-3) is installed to alarm when a high level is reached in the sump. The leachate flow rate was approximately 200 gallons per day in 2004 and continuing a slow downward trend.

The sump has a secondary containment system capable of collecting any leachate or infiltration generated outside of the normal primary and secondary collection systems. The burrito water level is manually measured and pumped to the sump. The level probe that was previously installed has been removed to allow access to all the burrito water. The burrito water is periodically pumped, and the volume is measured and composited with the leachate in the sump. The current flow rate is approximately 5 gallons per day. It is expected that infiltration into the burrito will decrease at the same rate as the leachate collected in the primary and secondary collections systems. Flow to the secondary containment system has remained consistent. Certain flow mechanisms are intentionally created inside the disposal cell to comply with regulatory requirements (overflow when leachate head exceeds one foot over the primary liner or long-term clogging of the transport pipes).

The procedure for transferring and measuring the burrito water volume is presented in Exhibit 1.

I3.2 Leachate Hauling

The Weldon Spring Site (WSS) was granted approval to haul the leachate to the MSD Bissell Point Plant (Appendix 2) and was later granted approval to haul monitor well purge water withthe leachate (see Appendix 3). Purge water is water that is generated during the sampling ofmonitor wells. MSD imposed a revised uranium acceptance criteria in a letter dated April 15, 2004, which required the uranium level to meet the drinking water standard of 30 µg/L (Appendix 4). Pretreatment of leachate may be necessary to reduce the uranium concentration to a level below the 30 µg/L standard.

WSS hauls leachate approximately every 3 to 4 months through a contract hauler. As the daily flow rate decreases in the LCRS, the hauling frequency will also decrease. The frequency of hauling must be such that leachate is not allowed to accumulate to a point that causes damage or inundates the LCRS instrumentation. The leachate flow rate is predictable and steady. The contract hauler is responsible for hookup and pumping, hauling, and manifesting the leachate. The hauler typically uses a 3,000-gallon tank truck with an integral vacuum pump to extract and haul the leachate. WSS personnel are responsible for scheduling the haul, performing pretreatment if necessary, providing access to the LCRS, sampling leachate, recording the volume of leachate hauled, and general oversight of the activity.

The procedure for hauling leachate is presented in Exhibit 2.

I3.3 Metropolitan Sewer District Agreement and Requirements

WSS has monitoring and reporting obligations to the MSD that are conditions of the approval for hauling leachate. These obligations include sampling the leachate hauled to MSD and a 25,000 gallon per month maximum limit (see Appendix 4). The specific requirements are presented in Appendix 2 and Appendix 4. Hauling reports that present volume and chemical data must be submitted to MSD for review by the 28th day of the month following a haul event. The current authorization to haul leachate is valid through December 21, 2006. To continue past that date, a new application must be submitted by DOE and approved by MSD.

I4.0 Leachate Characteristics and Trends

I4.1 Characteristics

The leachate meets all permitted discharge limits and goals with the exception of manganese concentration, which was approximately 1.5 mg/L in 2004. The NPDES permit effluent limit is 0.5 mg/L for discharge to the Missouri River. Uranium concentrations average approximately 20 pCi/L, which is below the goal of 30 pCi/L average and 100 pCi/L for discharge to the Missouri River. Concentrations of all other constituents, including radionuclides, are within permit limits. The leachate characterization data for 2002 through 2004 are presented in Appendix 5.

I4.2 Trends

The leachate flow rate has been decreasing and is predicted to continue decreasing until the flow rate is essentially zero. This trend is consistent with the disposal cell design in that the cell cap/cover was designed to eliminate infiltration and subsequent leachate generation. Leachate will continue to be hauled and the flow monitored until leachate flow ceases.

Manganese concentration has continued to decrease during 2004. Uranium concentration has also been decreasing over that time period. The average uranium concentration in leachate hauled to MSD in 2003 was 25.7 pCi/L and 2004 through July was 19.3 pCi/L. The NPDES drinking water maximum contaminant level (MCL) is 30 µg/L (approximately 20 pCi/L), effective December 2003.

I4.3 LCRS Sump Methane Monitoring System

The methane monitoring system has been removed. It was determined that the system no longer provided a useful function. Methane monitoring has indicated that the passive vent system for methane removal continues to function properly. Administrative procedures for confined space entry into the sump are in place to govern access and maintenance for the sump. See Exhibit 3 for a confined space procedure. Monitoring will be conducted and the blower will remain in place to provide ventilation when confined space entry is required.

I5.0 Discharge to the Missouri River

If the LCRS/Train 3 contingency plan is implemented or the NPDES permit is reissued with changes, the treated leachate may be discharged to the Missouri River via NPDES outfall 007. The procedure for discharging through the pipeline to outfall 007 is presented in Exhibit 4.

I6.0 Facility Maintenance

LCRS monitoring instrumentation should be calibrated no less than once per year.

I6.1 LS-1/LT-1/LI-1

I6.1.1 Calibration of LT-1

LT-1 is in the blue explosion-proof junction box located inside the LCRS cabinet (approximately 3 feet off the bottom of the cabinet, on the left side of the cabinet). LT-1 receives information from LS-1 (level sensor 1) via communication cable. LT-1 translates the LS-1 signal to a level indicator that can be read on LT-1.

LT-1 also communicates the sump water level to the digital display (LI-1) red LED indicator on the outside of the LCRS cabinet and to chart recorder CR1. LT-1 accomplishes this by driving a 4 to 20 milliamp loop, in series, through the LED indicator and through chart recorder CR1.

LS-1/LT-1/LI-1 is used to monitor and record the leachate level in the sump. This instrument should be calibrated once a year. The procedure for calibrating LS-1/LT-1/LI-1 is presented in Exhibit 5.

I6.2 LS-2/LT-2/LI-2

The burrito water level probe has been removed. See discussion in Section I3.1.

I7.0 Methane System

The methane system has been removed. See discussion in Section I4.3.

I8.0 Routine Inspections and Rounds

I8.1 Rounds

Rounds should be conducted at least monthly. This inspection is intended to evaluate the general condition of the LCRS facility. The general round procedure is presented in Exhibit 6.

I8.2 LCRS

The LCRS rounds should be conducted at least monthly. This inspection is intended to check the status of the equipment specifically related to the sump and level monitoring equipment and verify that all equipment associated with the LCRS is working properly. This includes noting level instrument display readouts and recovering stored data. The LCRS round sheet is presented in Exhibit 6.

I8.3 Equipment Maintenance

Equipment corrective and preventive maintenance should be performed as needed in accordance with the manufacturers’ recommendations. The equipment manuals are located in the LCRS Support Building.

I9.0 Notifications and Reporting

I9.1 Metropolitan Sewer District Reports

The reporting requirements for leachate hauled to MSD are described in Appendix 2 and Appendix 4. In general, WSS is required to present analytical data, volume hauled information, and radioactive content data for the leachate hauled during the reporting period. WSS is also required to track the sources (by individual monitor well) and the total volume of purge water sent with any shipment of leachate to MSD.

I9.2 NPDES Reporting

A revised NPDES permit was issued on March 5, 2004 (Appendix 6).

I9.3 Emergency Points of Contact

The DOE/Grand Junction Office will be responsible for providing the local contact list to Central Station, the notification service.

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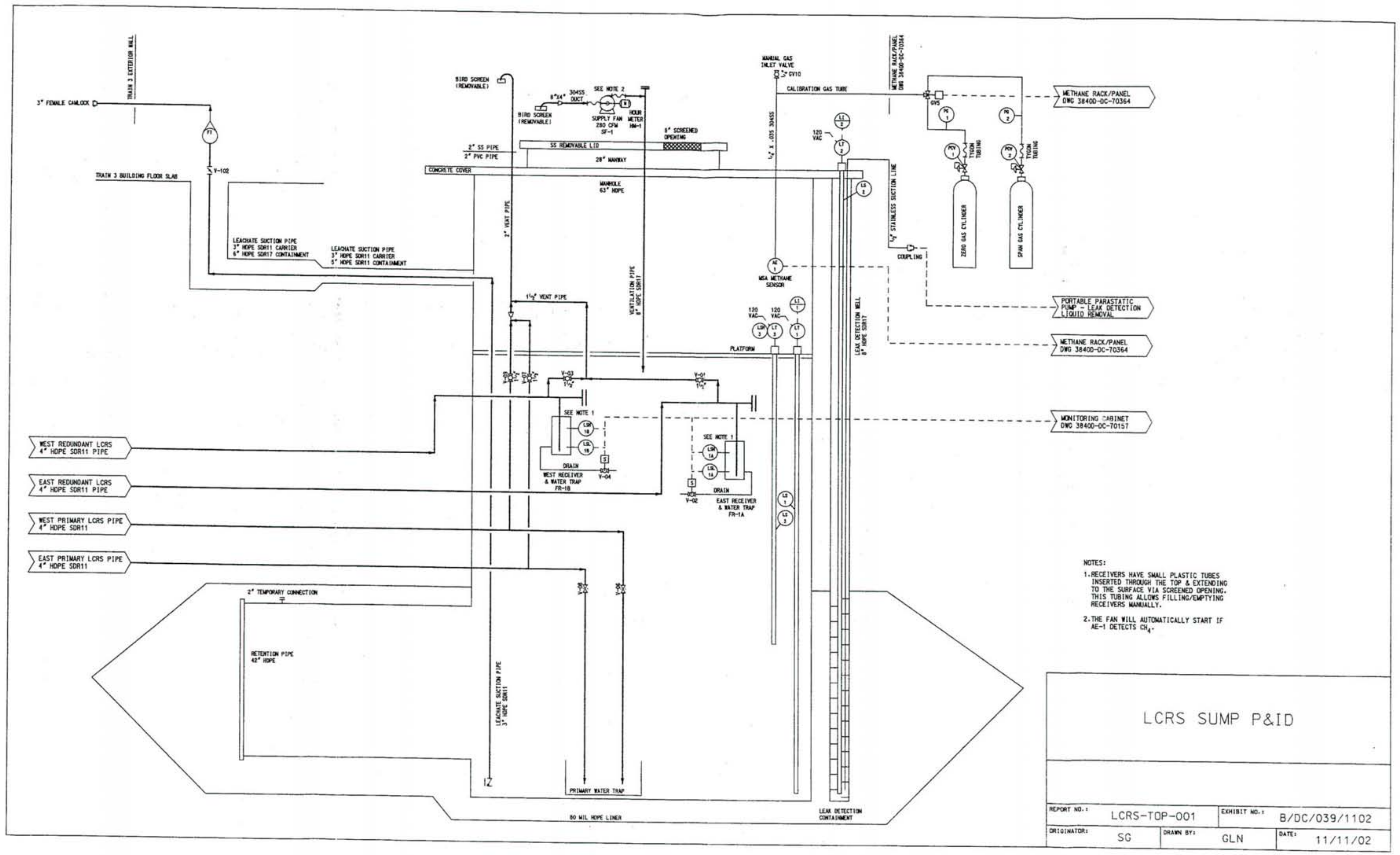
Appendix 1

Schematic of the Leachate Collection and Removal System (LCRS)



Appendix 2

Initial MSD Approval Letter

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

December 21, 2001

Thomas Pauling
U.S. Department of Energy
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Pauling:

We have reviewed your application dated October 24, 2001 requesting approval to discharge up to 15,000 gallons of wastewater per month to the Metropolitan St. Louis Sewer District. This wastewater is leachate from the covered storage cell at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri. The storage cell contains waste associated with the remediation activities of former TNT production and uranium processing at the site.

Based on the analytical results, this material meets our criteria for acceptance as a hauled waste and is approved for discharge at the Bissell Point Hauled Waste Receiving Station. The material may be discharged only by a hauler having a valid MSD identification number and presenting an original. completed Hauled Waste Receipt (form HWR-S). The annual allocation for radioactivity from the WSSRAP storage cell discharging at the MSD Bissell Point Hauled Waste Receiving Station is 0.15 milliCuries (0.15 mCi/year). This approval is valid for 5 years from the date of this letter. As a condition of this approval, you must notify us of any changes which would affect the characteristics of this discharge.

You must submit monthly self-monitoring reports, analyzing for the following parameters:

Total Uranium	Total suspended solids
Thorium-228	Volatile organic priority pollutants
Thorium-230	Arsenic
Thorium-232	Barium
Radium-226	Copper
Radium-228	Iron
- Americium-241	Lead
- Neptunium-237	Chromium
- Plutonium-238	Mercury
. Plutonium-239/240	Nickel
- Technetium-99	Selenium
Gross alpha	Silver
Chemical oxygen demand	Zinc

We will require that each batch of wastewater be analyzed for all the radionuclides listed above plus gross alpha. We will only require one batch of wastewater be analyzed per month for the remaining parameters. Self-monitoring reports are due 28 days after the end of each month. The frequency of the self-monitoring may be reduced in the future if the analytical results warrant.

A monthly sum of the ratios must be calculated for all radionuclides listed above, and the result must be less than 1.0 according to the Nuclear Regulatory Commission regulations in 10 CFR 20. These calculations must be included with the self-monitoring reports.

To demonstrate the solubility of the radioactive materials, as required by 10 CFR 20, you will need to provide the results of one filtered versus unfiltered test for total uranium using a 0.45 micrometer (0.45 micron) filter. This information must be included with the self-monitoring reports.

In addition to the monthly self-monitoring reports, the MSD Radioactive Materials Discharge Report (attached) must also be completed and certified. This report lists the total radioactivity discharged during the current calendar quarter to ensure compliance with the 0.15 milliCurie per year limit. These reports are due 28 days after the end of the calendar quarter.

This discharge has been approved based upon the information and sample analysis you provided, and is subject to the conditions stated above. This approval may be revoked by the District at any time if any of the information is found to be incorrect, or if the conditions of this approval are violated. Also, if the discharge causes any operational or maintenance problem within the District's collection or treatment system, or results in violations of any conditions of the District's NPDES permit, MK-Ferguson Corporation and the property owner, U.S. Department of Energy, will be considered responsible for damages.

If you have any questions, please call me at (314)436-8742.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Associate Engineer

bv

pc Bernie Rains
Doug Mendoza
Fabian Grabski
Ed Cope
Darin Lewis
Paul Taylor
Thomas M. Siegel, P.E. Chief, Permits and Engineering – MO DNR

File: SD, Weldon Springs Site Remedial Action Plan

METROPOLITAN ST. LOUIS SEWER DISTRICT
INDUSTRIAL USER RADIOACTIVE MATERIALS DISCHARGE REPORT

PART I: IDENTIFYING INFORMATION

Company Name: ______________________________

Permit No: ______________________________

Premise Address: ______________________________

Reporting Period: ☐(JAN-MAR) ☐(APR-JUNE) ☐(JULY-SEPT) ☐(OCT-DEC)

PART II: RECORD OF DISPOSAL OF RADIOACTIVE MATERIALS TO THE SEWER SYSTEM

RADIONUCLIDE	ACTIVITY DISCHARGED (millicuries)
TOTAL ACTIVITY DISCHARGED:	

PART III: CERTIFICATION STATEMENTS

Place your initials in the box under item A.
Everyone must complete the information under items A & B and sign this report.

A. CERTIFICATION OF COMPLIANCE WITH STATE AND FEDERAL REGULATIONS

☐ I certify that to the best of my knowledge & belief, all requirements of 10 CFR Part 20.2003 and 19 CSR Part 20-10.090 governing disposal by release into sanitary sewage for material regulated by the Nuclear Regulatory Commission and the Missouri Department of Health, respectively, have been met for the period covered by this report.

B. RADIOACTIVE MATERIALS DISCHARGE REPORT CERTIFICATION

I certify under penalty of Law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Print/type name of signing official: ______________________________

Title: ______________________________ Telephone: ______________

Signature: ______________________________ Date: ______________

radrpt.doc 2/

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Appendix 3

Purge Water Approval Letter from MSD

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

May 17, 2002

Steven D. Warren
MK-FERGUSON CORPORATION
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Warren:

We have reviewed your application dated April 23, 2002 requesting approval to discharge up to 200 gallons of wastewater per month to the Metropolitan St. Louis Sewer District. This wastewater is monitoring well purge water at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri. We understand that the purge water is generated from the following monitoring wells related to the former TNT production and uranium processing at the site.

Monitoring well identification numbers:

1002	1015	OW05	2049	3028	4028
1004	1016	OW06	2050	3029	4029
1005	1027	2003	2051	3030	4030
1006	1032	2006	2052	3034	4039
1007	1048	2012	2053	3037	S004
1008	OW01	2013	2054	3038	
1009	OW02	2033	2055	3039	
1013	OW03	2045	3023	4001	
1014	OW04	2046	3024	4015	

Based on the historical analytical results of samples collected from the above referenced monitoring wells, this material meets our criteria for acceptance as a hauled waste and is approved for discharge at the Bissell Point Hauled Waste Receiving Station. The material may be discharged only by a hauler having a valid MSD identification number and presenting an original, completed Hauled Waste Receipt (form HWR-S). We understand that the purge water will be included with the leachate which is currently approved for discharge at the Bissell Point Hauled Waste Receiving Station. The annual allocation for radioactivity from the WSSRAP leachate and monitoring well purge water discharging at the MSD Bissell Point Hauled Waste Receiving Station is 0.15 milliCuries (0.15 mCi/year). This approval will expire on December 21, 2006. As a condition of this approval, you must notify us of any changes which would affect the characteristics of this discharge.

Since the monitoring well purge water will be included with the leachate, we understand that future WSSRAP self-monitoring reports will include composite sample data representing both waste streams and will identify the volumes attributable to purge water and leachate. Based on this information, all self-monitoring conditions of the December 21, 2001 leachate special discharge will remain in effect and apply to the monitoring well purge water.

This discharge has been approved based upon the information and sample analysis you provided, and is subject to the conditions stated above. This approval may be revoked by the District at any time if any of the information is found to be incorrect, or if the conditions of this approval are violated. Also, if the discharge causes any operational, maintenance or other problem within the District's collection or treatment system, or results in violations of any conditions of the District's NPDES permit, MK-Ferguson Corporation and the property owner, U.S. Department of Energy, will be considered responsible for damages or mitigative actions.

If you have any questions, please call me at (314)436-8742.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Associate Engineer

bv

pc Bernie Rains
Darin Lewis
Paul Taylor

File: SD, Weldon Springs Site Remedial Action Plan

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

June 28, 2002

Pamela Thompson
U.S. DEPARTMNT OF ENERGY
WELDON SPRING SITE REMEDIAL ACTION PROJECT OFFICE
7295 Highway 94 South
St. Charles, MO 63304

Dear Ms. Thompson:

We have reviewed your letter dated June 17, 2002 requesting approval to add seven monitoring wells (2014, 5303, 4006, 5304, 4031, 6301, and 4036) to the special discharge permit originally approved on May 17, 2002. The original approval was for monitoring well purge water at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri.

Based on the historical analytical results of samples collected from the above referenced monitoring wells, your request is granted. All other conditions of the original approval remain in effect.

If you have any questions, please call me at (314)436-8742.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Associate Engineer

FILE: SD, Weldon Spring Site Remedial Action Project (WSSRAP), 7295 Highway 94 South, St. Charles, Missouri

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Appendix 4

Monthly Volume Increase Approval Letter

96684

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

September 13, 2004

Thomas C. Pauling
DEPARTMENT OF ENERGY
WELDON SPRINGS SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Pauling:

We have reviewed your letter dated September 10, 2004 requesting a volume increase and change in self-monitoring reporting to the special discharge permits approved in our letters dated December 21, 2001, May 17, 2002, and April 15, 2004. The approvals were for the covered storage cell leachate and monitoring well purge water at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri.

Based on the information you provided and historical analytical results, your request to increase the monthly volume to 25,000 gallons and remove the volatile organics from the list of required monitoring parameters is granted. In addition, your request to change from composite truck sampling to one sample per hauling event is approved. All other conditions of the above referenced approvals remain in effect.

Please contact me at (314) 436-8742 with questions or comments.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Assistant Engineer

FILE: SD, Weldon Spring Remedial Action project, 7295 Highway 94 South, St. Charles, Missouri

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Appendix 5

Leachate Characterization Data for 2002

Leachate Sump Data (DC10) from January 2002 to January 2003

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
ANIONS					
CHLORIDE	mg/L	31.10	38.80	33.80	6
FLUORIDE	mg/L	0.24	0.28	0.27	6
NITRATE-N	mg/L	ND (0.05)	3.80	0.68	6
SULFATE	mg/L	49.70	80.10	67.93	6
METALS					
ALUMINUM	µg/L	ND (16.5)	65.40	31.28	14
ANTIMONY	µg/L	ND (1.6)	ND (16.0)	NC	14
ARSENIC	µg/L	ND (1.2)	9.90	4.66	14
BARIUM	µg/L	509.00	1090.00	806.50	14
BERYLLIUM	µg/L	ND (0.19)	1.40	0.58	14
CADMIUM	µg/L	ND (0.31)	ND (2.0)	NC	14
CALCIUM	µg/L	144000.00	188000.00	165142.86	14
CHROMIUM	µg/L	ND (0.73)	ND (3.8)	NC	14
COBALT	µg/L	8.10	23.50	14.19	14
COPPER	µg/L	ND (1.4)	7.70	5.96	14
IRON	µg/L	4540.00	27900.00	15160.00	14
LEAD	µg/L	ND (0.93)	ND (2.1)	NC	14
LITHIUM	µg/L	ND (6.4)	23.90	10.87	14
MAGNESIUM	µg/L	51000.00	57800.00	55185.71	14
MANGANESE	µg/L	2360.00	6290.00	3904.29	14
MERCURY	µg/L	ND (0.01)	0.46	0.12	14
MOLYBDENUM	µg/L	ND (4.9)	7.40	6.55	14
NICKEL	µg/L	ND (6.9)	12.00	10.81	14
POTASSIUM	µg/L	3230.00	6960.00	5405.71	14
SELENIUM	µg/L	ND (1.2)	ND (2.4)	NC	14
SILVER	µg/L	ND (0.8)	ND (7.0)	NC	14
SODIUM	µg/L	62200.00	77100.00	70092.86	14
STRONTIUM	µg/L	599.00	719.00	653.79	14
THALLIUM	µg/L	ND (2.2)	4.90	3.03	14
VANADIUM	µg/L	ND (0.88)	2.30	1.96	14
ZINC	µg/L	3.50	27.70	13.96	14
MISCELLANEOUS					
ALKALINITY	mg/L	604.00	682.00	640.80	5
BIOCHEMICAL OXYGEN DEMAND	mg/L	ND (5.0)	10.00	6.00	5
CHEMICAL OXYGEN DEMAND	mg/L	15.00	36.00	27.43	14
CYANIDE, AMENABLE	mg/L	ND (5.0)	ND (5.0)	NC	5
CYANIDE, TOTAL	mg/L	ND (5.0)	6.10	5.22	5
PHOSPHORUS, TOTAL	mg/L	ND (0.03)	0.17	0.07	5
TOTAL DISSOLVED SOLIDS	mg/L	784.00	883.00	820.17	6
TOTAL ORGANIC CARBON	mg/L	8.40	11.20	9.60	6
TOTAL SUSPENDED SOLIDS	mg/L	12.00	68.00	37.64	14
NITROAROMATICS					
1,3,5-TRINITROBENZENE	µg/L	ND (0.03)	ND (0.06)	NC	6
1,3-DINITROBENZENE	µg/L	ND (0.05)	ND (0.18)	NC	6
2,4,6-TRINITROTOLUENE	µg/L	ND (0.03)	ND (0.08)	NC	6

Leachate Sump Data (DC10) from January 2002 to January 2003

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
2,4-DINITROTOLUENE	µg/L	ND (0.04)	ND (0.08)	NC	6
2,6-DINITROTOLUENE	µg/L	ND (0.06)	ND (0.12)	NC	6
NITROBENZENE	µg/L	ND (0.03)	ND (0.08)	NC	6
RADIOCHEMICAL					
GROSS ALPHA	pCi/L	16.80	66.70	43.98	14
GROSS BETA	pCi/L	13.20	30.80	19.80	6
RADIUM-226	pCi/L	ND (0.07)	0.51	0.32	14
RADIUM-228	pCi/L	ND (0.01)	1.81	0.65	14
THORIUM-228	pCi/L	ND (0.01)	0.43	0.15	14
THORIUM-230	pCi/L	ND (0.07)	0.78	0.32	14
THORIUM-232	pCi/L	ND (0.01)	0.38	0.14	14
URANIUM, TOTAL	pCi/L	16.00	57.30	37.88	14
AMERICIUM-241	pCi/L	ND (0.015)	0.749	0.28	13
NEPTUNIUM-237	pCi/L	ND (0.035)	1.010	0.34	13
PLUTONIUM-238	pCi/L	ND (0.007)	0.445	0.15	13
PLUTONIUM-239-240	pCi/L	ND (0.024)	0.975	0.18	13
TECHNETIUM-99	pCi/L	ND (0.122)	2.230	0.98	13
SEMI-VOLATILES					
1,2,4-TRICHLOROBENZENE	µg/L	ND (10.0)	ND (20.0)	NC	6
1,2-DICHLOROBENZENE	µg/L	ND (5.0)	ND (20.0)	NC	5
1,2-DIPHENYLHYDRAZINE	µg/L	ND (10.0)	ND (10.0)	NC	5
1,3-DICHLOROBENZENE	µg/L	ND (5.0)	ND (20.0)	NC	5
1,4-DICHLOROBENZENE	µg/L	ND (5.0)	ND (20.0)	NC	5
2,4,6-TRICHLOROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2,4-DICHLOROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2,4-DIMETHYLPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2,4-DINITROPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
2,4-DINITROTOLUENE	µg/L	ND (10.0)	ND (20.0)	NC	6
2,6-DINITROTOLUENE	µg/L	ND (10.0)	ND (20.0)	NC	6
2-CHLORONAPHTHALENE	µg/L	ND (10.0)	ND (20.0)	NC	5
2-CHLOROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2-NITROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
3,3'-DICHLOROBENZIDINE	µg/L	ND (50.0)	ND (100)	NC	6
4,6-DINITRO-2-METHYLPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
4-BROMOPHENYL PHENYL ETHER	µg/L	ND (10.0)	ND (20.0)	NC	6
4-CHLORO-3-METHYL PHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
4-CHLOROPHENYL PHENYL ETHER	µg/L	ND (10.0)	ND (20.0)	NC	6
4-NITROPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
ACENAPHTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
ACENAPHTHYLENE	µg/L	ND (5.0)	ND (20.0)	NC	6
ANTHRACENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZIDINE	µg/L	ND (100)	ND (200)	NC	5
BENZO(A)ANTHRACENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(A)PYRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(B)FLUORANTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(G,H,I)PERYLENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(K)FLUORANTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BIS(2-CHLOROETHOXY)METHANE	µg/L	ND (10.0)	ND (20.0)	NC	6
BIS(2-CHLOROETHYL)ETHER	µg/L	ND (10.0)	ND (20.0)	NC	6
BIS(2-CHLOROISOPROPYL)ETHER	µg/L	ND (10.0)	ND (20.0)	NC	5

Leachate Sump Data (DC10) from January 2002 to January 2003

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
BIS(2-ETHYLHEXYL)PHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
BUTYLBENZYLPHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
CHRYSENE	µg/L	ND (5.0)	ND (20.0)	NC	6
DIBENZO(A,H)ANTHRACENE	µg/L	ND (5.0)	ND (20.0)	NC	6
DIETHYLPHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
DIMETHYLPHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
DI-N-BUTYL PHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
DI-N-OCTYL PHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
FLUORANTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
FLUORENE	µg/L	ND (5.0)	ND (20.0)	NC	6
HEXACHLOROBENZENE	µg/L	ND (10.0)	ND (20.0)	NC	6
HEXACHLOROBUTADIENE	µg/L	ND (10.0)	ND (20.0)	NC	6
HEXACHLOROCYCLOPENTADIENE	µg/L	ND (50.0)	ND (100)	NC	6
HEXACHLOROETHANE	µg/L	ND (10.0)	ND (20.0)	NC	6
INDENO(1,2,3-CD)PYRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
ISOPHORONE	µg/L	ND (10.0)	ND (20.0)	NC	6
NAPHTHALENE	µg/L	ND (5.0)	ND (20.0)	NC	6
NITROBENZENE	µg/L	ND (10.0)	ND (20.0)	NC	6
N-NITROSODIMETHYLAMINE	µg/L	ND (10.0)	ND (20.0)	NC	5
N-NITROSO-DI-N-PROPYLAMINE	µg/L	ND (10.0)	ND (20.0)	NC	6
N-NITROSODIPHENYLAMINE	µg/L	ND (10.0)	ND (20.0)	NC	6
PENTACHLOROPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
PHENANTHRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
PHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
PYRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
VOLATILES					
1,1,1-TRICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1,2,2-TETRACHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1,2-TRICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1-DICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1-DICHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,2-DICHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	5
1,2-DICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,2-DICHLOROETHENE (TOTAL)	µg/L	ND (5.0)	ND (5.0)	NC	14
1,2-DICHLOROPROPANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,3-DICHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	5
1,4-DICHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	5
2-CHLOROETHYL VINYL ETHER	µg/L	ND (50.0)	ND (50.0)	NC	14
ACROLEIN	µg/L	ND (100)	ND (100)	NC	14
ACRYLONITRILE	µg/L	ND (5.0)	ND (5.0)	NC	14
BENZENE	µg/L	ND (5.0)	ND (5.0)	NC	14
BROMODICHLOROMETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
BROMOFORM	µg/L	ND (5.0)	ND (5.0)	NC	14
BROMOMETHANE	µg/L	ND (10.0)	ND (10.0)	NC	14
CARBON TETRACHLORIDE	µg/L	ND (5.0)	ND (5.0)	NC	14
CHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	14
CHLOROETHANE	µg/L	ND (10.0)	ND (10.0)	NC	14
CHLOROFORM	µg/L	ND (5.0)	ND (5.0)	NC	14
CHLOROMETHANE	µg/L	0.67	ND (10.0)	NC	14
CIS-1,3-DICHLOROPROPENE	µg/L	ND (5.0)	ND (5.0)	NC	14

Leachate Sump Data (DC10) from January 2002 to January 2003

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
DIBROMOCHLOROMETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
ETHYL BENZENE	µg/L	ND (5.0)	ND (5.0)	NC	14
METHYLENE CHLORIDE	µg/L	1.30	6.90	3.76	14
TETRACHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	14
TOLUENE	µg/L	0.66	ND (5.0)	NC	14
TRANS-1,2-DICHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	6
TRANS-1,3-DICHLOROPROPENE	µg/L	ND (5.0)	ND (5.0)	NC	14
TRICHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	14
TRICHLOROFLUOROMETHANE	µg/L	ND (10.0)	ND (10.0)	NC	14
VINYL CHLORIDE	µg/L	ND (10.0)	ND (10.0)	NC	14
XYLENES, TOTAL	µg/L	ND (5.0)	ND (5.0)	NC	14
PESTICIDE/PCBS					
4,4'-DDD	µg/L	ND (0.05)	0.210	0.08	5
4,4'-DDE	µg/L	ND (0.05)	0.068	0.05	5
4,4'-DDT	µg/L	ND (0.025)	ND (0.05)	NC	5
ALDRIN	µg/L	ND (0.025)	ND (0.05)	NC	5
ALPHA-BHC	µg/L	ND (0.025)	ND (0.05)	NC	5
ALPHA-CHLORDANE	µg/L	ND (0.025)	ND (0.05)	NC	5
AROCLOR-1016	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1221	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1232	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1242	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1248	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1254	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1260	µg/L	ND (0.5)	ND (1.0)	NC	6
BETA-BHC	µg/L	0.10	0.150	0.08	5
DELTA-BHC	µg/L	0.035	0.061	0.05	5
DIELDRIN	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDOSULFAN I	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDOSULFAN II	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDOSULFAN SULFATE	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDRIN	µg/L	0.15	0.210	0.10	5
ENDRIN ALDEHYDE	µg/L	ND (0.025)	ND (0.05)	NC	5
GAMMA-BHC (LINDANE)	µg/L	ND (0.025)	0.062	0.05	5
GAMMA-CHLORDANE	µg/L	ND (0.025)	ND (0.05)	NC	5
HEPTACHLOR	µg/L	0.10	0.310	0.19	5
HEPTACHLOR EPOXIDE	µg/L	ND (0.05)	0.110	0.06	5
TOXAPHENE	µg/L	ND (0.5)	ND (2.0)	NC	5

NOTES:

ND (Value) = Not Detected, Dectection Limit given in parentheses
NC = Not Calculated. The average is calculated using all values. Where a ND value exists for both the minimum and maximum, an average could not be calculated

Appendix 6

NPDES Permit No. MO-0107701
Weldon Spring Site Chemical Plant Area

USDOE, Weldon Spring Chemical Plant
MO-01107701, St. Charles County

STATE OF MISSOURI

Bob Holden, Governor • Stephen M. Mahfood, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.state.mo.us

March 5, 2004

US Department of Energy (USDOE)
7295 Highway 94 South
Weldon Spring, MO 63304

Dear Permittee:

State Operating Permit No. MO-0107701 originally issued on July 14, 2000 is hereby modified as per the enclosed. This modification is to remove Outfall #006, which is now permitted by Lindenwood University under State Operating Permit No. MO-0129917.

Please read your permit and attached Standard Conditions. They contain important information on monitoring requirements, effluent limitations, sampling frequencies and reporting requirements.

This modification does not affect any monitoring or analysis of the effluent that may be necessary to comply with other requirements of your permit or other state regulations and does not in any way relieve you of your obligations to achieve the final effluent limitations as provided in the permit.

This permit is both your federal discharge permit and your new state operating permit and replaces all previous state operating permits for this facility. In all future correspondence regarding this facility, please refer to your state operating permit number and facility name as shown on page one of the permit.

If you have any questions concerning this permit, please do not hesitate to contact our St. Louis Regional Office, 7545 South Lindbergh, Suite 210, St. Louis, MO 63125. (314) 416-2960.

Sincerely,

ST. LOUIS REGIONAL OFFICE

Mohamad Alhalabi, P.E.
Regional Director

MA:TAH
Enclosure

c: WPCP
Lindenwood University

Integrity and excellence in everything we do

Recycled Paper 026298

MAR - 8 2004

End of current text

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

MISSOURI STATE OPERATING PERMIT

In compliance with the Missouri Clean Water Law, (Chapter 644 R.S. Mo. as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended,

Permit No.:	MO-0107701
Owner:	U.S. Department of Energy (USDOE)
Owner's Address:	7295 Highway 94 South, Weldon Spring, MO 63304
Continuing Authority:	Same as above
Continuing Authority's Address:	Same as above
Facility Name:	USDOE, Weldon Spring Chemical Plant
Facility Address:	7295 Highway 94 South, Weldon Spring, MO 63304
Legal Description:	All or parts of Sec. 31 projected, T46N, R3E, St. Charles County & SW ¼, NW ¼, Sec. 8, T45N, R3E, St. Charles County
Receiving Stream & Basin:	See Page 2

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein:

FACILITY DESCRIPTION

See Page 2

This permit authorizes only wastewater discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System; it does not apply to other regulated areas. This permit may be appealed in accordance with Section 644.051.6 of the Law.

July 14, 2000 — Effective Date

March 5, 2004 — Revised

July 13, 2005 — Expiration Date

MO 780-0041 (10-93)

Stephen M. Mahfood, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

Mohamad Alhalabi, P. E., Regional Director

FACILITY DESCRIPTION (continued)

Outfalls #001, #002 #003, #004, and #005 - These outfalls have been eliminated. Tributary areas have been stabilized.

Outfall #006 - this outfall is now permitted by State Operating Permit No. MO-0129917. (Lindenwood University)

Outfall #007 - Discharge of treated wastewater from personnel and equipment decontamination wastewaters, leachate from the disposal cell and contaminated storm water runoff from the disposal cell and other miscellaneous waters generated during remediation. One physical/chemical treatment system is provided.
Design average flow is 0.432 million gallons per day.

Outfall #008 - Outfall has been eliminated. Area is stabilized.

Outfall #009 - Outfall has been eliminated. Area is stabilized.

RECEIVING STREAMS & BASINS

Outfall #007 - Missouri River via pipeline (Missouri River and Eastern Tributaries Basin) (10300200-10-00)(P)

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS	PAGE NUMBER 3 of 9 PERMIT NUMBER MO-0107701

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
Outfall #007 (Note 1)						
Flow	MGD	*		*	once/week****	24 hr. total
Chemical Oxygen Demand	mg/L	90		60	once/week****	grab
Total Suspended Solids	mg/L	50		30	once/week****	grab
pH - Units	SU	***		***	once/week****	grab
Arsenic, Total Recoverable	mg/L	0.20		*	once/week****	grab
Aluminum, Total Recoverable	mg/L	7.5		*	once/week****	grab
Chromium, Total Recoverable	mg/L	0.40		*	once/week****	grab
Lead, Total Recoverable	mg/L	0.20		*	once/week****	grab
Manganese, Total Recoverable	mg/L	0.50		*	once/week****	grab
Mercury, Total Recoverable	mg/L	0.005		*	once/week****	grab
Selenium, Total Recoverable	mg/L	0.05		*	once/week****	grab
Cyanide (Amenable to chlorination)	µg/L	0.05		*	once/week****	grab
2-4 Dinitrotoluene	µg/L	1.1		*	once/week****	grab
Fluoride, Total	mg/L	12		*	once/week****	grab

MONITORING REPORTS SHALL BE SUBMITTED QUARTERLY; THE FIRST REPORT IS DUE July 28, 2004. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Parts I & III STANDARD CONDITIONS DATED October 1, 1980 & August 15, 1994, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

MO 780-0010 (8/91)

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS	PAGE NUMBER 4 of 9 PERMIT NUMBER MO-0107701

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
Outfall #007 (Note 1) (continued)						
Nitrate and Nitrite as N	mg/L	100		*	once/week****	grab
Sulfate as SO_4	mg/L	1000		*	once/week****	grab
Chloride	mg/L	*		*	once/week****	grab
Gross Alpha Activity	pCi/L	*		*	once/week****	grab
Gross Beta Activity	pCi/L	*		*	once/week****	grab
Uranium, Total Recoverable (Note 2)	mg/L	*		*	once/week****	grab
Radium-226	pCi/L	*		*	once/month	grab
Radium-228	pCi/L	*		*	once/month	grab
Thorium-230	pCi/L	*		*	once/month	grab
Thorium-232	pCi/L	*		*	once/month	grab
Whole Effluent Toxicity (WET) Test	% Survival	See Special Conditions			once/quarter**	grab
MONITORING REPORTS SHALL BE SUBMITTED QUARTERLY, THE FIRST REPORT IS DUE July 28, 2004.						
Priority Pollutants (Note 3)	mg/L	*		*	once/year	grab

MONITORING REPORTS SHALL BE SUBMITTED ANNUALLY; THE FIRST REPORT IS DUE October 28, 2004. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Parts I & III STANDARD CONDITIONS DATED October 1, 1980 & August 15, 1994, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

MO 780-0010 (8/91)

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

* Monitoring requirement only.

** Once per quarter in the months of January, April, July and October.

*** pH is measured in pH units and is not to be averaged. The pH is limited to the range of 6.0-9.0 pH units.

**** Not to exceed once/batch.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

Note 1 - The first quarterly report due date for this reissued permit is based on a complete calendar quarter monitoring period. Monitoring shall be reported once per quarter for the entire life of the permit. The permittee is still responsible for reporting for the preceding calendar quarter under the previous permit.

Note 2 - The design of the treatment plant is based on achieving an average discharge of 30 pCi/L Uranium with the maximum never to exceed 100 pCi/L.

Note 3 - Monitoring shall be conducted for the priority pollutants listed under 40 CFR 122.21, Appendix D, Tables II and III.

C. SPECIAL CONDITIONS

1. This permit may be modified, or alternatively revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2) (C), and (D), 304(b)(2) and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

   (a) Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
   (b) Controls any pollutant not limited in the permit.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

2. Changes in Discharges of Toxic Substances

   The permittee shall notify the Director as soon as it knows or has reason to believe:

   a. That any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels:"
      (1) One hundred micrograms per liter (100 ug/L);
      (2) Two hundred micrograms per liter (200 ug/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/L) for 2,5 dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
      (3) Five (5) times the maximum concentration value reported for the pollutant in the permit application;
      (4) The level established in Part A of the permit by the Director.

   b. That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

3. Samples shall be representative of monitoring period discharges and if any discharge occurs during the monitoring period at least one sample per outfall must be collected and analyzed. (ANo Discharge≅ shall be used only to indicate no releases during the entire reporting period).

4. This permit may be reopened and modified or alternatively revoked and reissued, to incorporate new or modified effluent limitations or other conditions, if the result of a wasteload allocation study, toxicity test, or other information indicates changes are necessary to ensure compliance with Missouri's Water Quality Standards.

5. Permittee shall comply with the requirements of 10 CSR 20-6.010(4)(D) regarding construction permits. A construction permit will be issued after approval of the engineering submittals. As-built plans and specifications will be provided to the Department upon completion of construction.

C. SPECIAL CONDITIONS (continued)

6. Sludge and Biosolids Use For Domestic Wastewater Treatment Facilities

   (a) Permittee shall comply with the pollutant limitations, monitoring, reporting, and other requirements in accordance with the attached permit Standard Conditions.

7. Permittee will cease discharge by connection to areawide wastewater treatment system within 90 days of notice of its availability.

8. Report as no-discharge when a discharge does not occur during the report period.

9. There shall be no release of polychlorinated biphenyl compounds (PCBs) to waters of the state at or above the level of quantification currently defined as 0.5 ug/L or 0.5 ppb.

10. Discharge of wastewater from this facility must not alone or in combination with other sources cause the receiving stream to violate the following:

    (a) Water temperatures and temperature differentials specified in Missouri Water Quality Standards shall be met.

11. Any pesticide discharge from any point source shall comply with the requirements of Federal Insecticide, Fungicide and Rodenticide Act, as amended (7 U.S.C. 136 et. seq.) and the use of such pesticides shall be in a manner consistent with its label.

12. Except for any untreated overflow from facilities designed, constructed and operated to treat the volume of material storage runoff and construction runoff which is associated with a 10-year, 24-hour rainfall event; discharges resulting from material storage runoff and construction runoff shall comply with the following limitations:

    (a) Total suspended solids shall not exceed 50 mg/l at any time.
    (b) The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units at any time.

13. Copies of the quarterly monitoring reports will be available for public review at the Weldon Spring site and sent to the St. Louis Regional Office where they will also be available for public review.

14. All outfalls must be clearly marked in the field.

15. Whole Effluent Toxicity (WET) tests will be conducted as follows:

SUMMARY OF WET TESTING FOR THIS PERMIT				
OUTFALL	A.E.C. %	FREQUENCY	SAMPLE TYPE	MONTH
#007	10%	QUARTERLY	Grab	January, April, July, & October

a. Test Schedule and Follow-Up Requirements

(1) Perform a single-dilution test in the months and at the frequency specified above.

If the test passes the effluent limit do not repeat test until the next test period. Submit results with the annual report.
If the test fails the effluent limit a multiple dilution test shall be performed within 30 days, and biweekly thereafter until one of the following conditions are met:

(a) THREE CONSECUTIVE MULTIPLE-DILUTION TESTS PASS. No further tests need to be performed until next regularly scheduled test period.
(b) A TOTAL OF THREE MULTIPLE-DILUTION TESTS FAIL.

C. SPECIAL CONDITIONS (continued)

15. Whole Effluent Toxicity (WET) tests (continued)

a. Test Schedule and Follow-Up Requirements (continued)

(2) The permittee shall submit a summary of all test results for the test series to the Planning Section of the WPCP, DNR, Box 176, Jefferson City, MO within 14 days of the third failed test. DNR will contact the permittee with initial guidance on conducting a toxicity identification evaluation (TIE) or toxicity reduction evaluation (TRE). The permittee shall submit a plan for conducting a TIE or TRE to the Planning Section of the WPCP within 60 days of the date of DNR's letter. This plan must be approved by DNR before the TIE or TRE is begun. A schedule for completing the TIE or TRE shall be established in the plan approval.

(3) Upon DNR's approval, the TIE/TRE schedule may be modified if toxicity is intermittent during the TIE/TRE investigations. A revised WET test schedule may be established by DNR for this period.

(4) If a previously completed TIE has clearly identified the cause of toxicity, additional TIEs will not be required as long as effluent characteristics remain essentially unchanged and the permittee is proceeding according to a DNR approved schedule to complete a TRE and reduce toxicity. Regularly scheduled WET testing as required in part b.(1) will be required during this period.

(5) In addition to the WET test summary report required in part (2), all failing test results shall be reported to DNR within 14 days of the availability of results.

(6) All WET test results for the reporting period shall be summarized and submitted to DNR by the end of the following October. When WET test sampling is required to run over one DMR period, each DMR report shall contain information generated during the reporting period.

b. PASS/FAIL procedure and effluent limitations

(1) To pass a single-dilution test, mortality observed in the AEC test concentration shall not be significantly different (at the 95% confidence level; $p = 0.05$) than that observed in the upstream receiving-water control. The appropriate statistical tests of significance will be those outlined in the most current USEPA acute toxicity manual or those specified by the MDNR.

(2) To pass a multiple-dilution test:

(a) the computed percent effluent at the edge of the zone of initial dilution (AEC) must be less than three-tenths (0.3) of the LC_{50} concentration for the most sensitive of the test organisms, or,

(b) all dilutions equal to or greater than the AEC must be nontoxic. Failure of one multiple-dilution test is considered an effluent limit violation.

C. SPECIAL CONDITIONS (continued)

15. Whole Effluent Toxicity (WET) tests (continued)

c. Test Conditions

(1) Test species: Ceriodaphnia dubia and fathead minnows, Pimephales promelas. Organisms used in WET testing should come from cultures reared for the purpose of conducting toxicity tests and should be cultured in a manner consistent with the most current USEPA guidelines. All test animals should be cultured as described in EPA-600/4-90/027.

(2) Test period: 48 hours at the "Acceptable Effluent Concentration" (AEC) specified above.

(3) When dilutions are required, upstream receiving stream water will be used as dilution water. If upstream water is unavailable or if mortality in the upstream water exceeds 10%, "reconstituted" water will be used. Procedures for generating reconstituted water will be supplied by the Department of Natural Resources (DNR).

(4) Tests should be initiated immediately after the sample is collected, but tests must be initiated no later than 36 hours after collection.

(5) Single-dilution tests will be run with:

(a) Effluent at the AEC concentration;
(b) 100% receiving-stream water (if available), collected upstream of the outfall at a point beyond any influence of the effluent; and
(c) reconstituted water.

(6) Multiple-dilution tests will be run with:

(a) 100%, 50%, 25%, 12.5%, and 6.25% effluent, unless the AEC is less than 25% effluent, in which case dilutions will be 4 times the AEC, two times the AEC, AEC, 1/2 AEC and 1/4 AEC.
(b) 100% receiving-stream water (if available), collected upstream of the outfall at a point beyond any influence of the effluent; and
(c) reconstituted water.

(7) If reconstituted-water control mortality for a test species exceeds 10%, the entire test will be rerun.

SUMMARY OF TEST METHODOLOGY FOR WHOLE-EFFLUENT TOXICITY TESTS

Whole-effluent-toxicity test required in NPDES permits shall use the following test conditions when performing single or multiple dilution methods. Any future changes in methodology will be supplied to the permittee by the Missouri Department of Natural Resources (MDNR). Unless otherwise specified by MDNR, procedures should be consistent with Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA/600/4-90/027.

Test conditions for *Ceriodaphnia dubia*:

Test duration:	48 h
Temperature:	25 ± 2°C
Light Quality:	Ambient laboratory illumination
Photoperiod:	16 h light, 8 h dark
Size of test vessel:	30 mL (minimum)
Volume of test solution:	15 mL (minimum)
Age of test organisms:	<24 h old
No. of animals/test vessel:	5
No. of replicates/concentration:	4
No. of organisms/concentration:	20 (minimum)
Feeding regime:	None (feed prior to test)
Aeration:	None
Dilution water:	Upstream receiving water; if no upstream flow, synthetic water modified to reflect effluent hardness.
Endpoint:	Mortality (Statistically significant difference from upstream receiving water control at p# 0.05)
Test acceptability criterion:	90% or greater survival in controls

Test conditions for (*Pimephales promelas*):

Test duration:	48 h
Temperature:	25 ± 2°C
Light Quality:	Ambient laboratory illumination
Photoperiod:	16 h light/ 8 h dark
Size of test vessel:	250 mL (minimum)
Volume of test solution:	200 mL (minimum)
Age of test organisms:	1-14 days (all same age)
No. of animals/test vessel:	10
No. of replicates/concentration:	4 (minimum) single dilution method 2 (minimum) multiple dilution method
No. of organisms/concentration:	40 (minimum) single dilution method 20 (minimum) multiple dilution method
Feeding regime:	None (feed prior to test)
Aeration:	None, unless DO concentration falls below 4.0 mg/L; rate should not exceed 100 bubbles/min.
Dilution water:	Upstream receiving water; if no upstream flow, synthetic water modified to reflect effluent hardness.
Endpoint:	Mortality (Statistically significant difference from upstream receiving water control at p# 0.05)
Test Acceptability criterion:	90% or greater survival in controls

End of current text

STANDARD CONDITIONS FOR NPDES PERMITS
ISSUED BY
THE MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION
Revised
October 1, 1980

PART I - GENERAL CONDITIONS
SECTION A - MONITORING AND REPORTING

1. **Representative Sampling**
   a. Samples and measurements taken as required herein shall be representative of the nature and volume, respectively, of the monitored discharge. All samples shall be taken at the outfall(s), and unless specified, before the effluent joins or is diluted by any other body of water or substance.
   b. Monitoring results shall be recorded and reported on forms provided by the Department, postmarked no later than the 28th day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to the respective Department Regional Office, the Regional Office address is indicated in the cover letter transmitting the permit.

2. **Schedule of Compliance**
   No later than fourteen (14) calendar days following each date identified in the "Schedule of Compliance", the permittee shall submit to the respective Department Regional Office as required therein, either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements, or if there are no more scheduled requirements, when such noncompliance will be corrected. The Regional Office address is indicated in the cover letter transmitting he permit.

3. **Definitions**
   Definitions as set forth in the Missouri Clean Water Law and Missouri Clean Water Commission Definition Regulation 10 CSR 20-2.010 shall apply to terms used herein.

4. **Test Procedures**
   Test procedures for the analysis of pollutant shall be in accordance with the Missouri Clean Water Commission Effluent Regulation 10 CSR 20-7015.

5. **Recording of Results**
   a. For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:
      (i) the date, exact place, and time of sampling or measurements;
      (ii) the individual(s) who performed the sampling or measurements;
      (iii) the date(s) analyses were performed;
      (iv) the individual(s) who performed the analyses;
      (v) the analytical techniques or methods used; and
      (vi) the results of such analyses.
   b. The Federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six (6) months per violation, or both.
   c. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

6. **Additional Monitoring by Permittee**
   If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monitoring Report Form. Such increased frequency shall also be indicated.

7. **Records Retention**
   The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recording for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three (3) years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

SECTION B - MANAGEMENT REQUIREMENTS

1. **Change in Discharge**
   a. All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant not authorized by this permit or any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.
   b. Any facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants shall be reported by submission of a new NPDES application at least sixty (60) days before each such changes, or, if they will not violate the effluent limitations specified in the permit, by notice to the Department at least thirty (30) days before such changes.

2. **Noncompliance Notification**
   a. If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Department with the following information, in writing within five (5) days of becoming aware of such conditions:
      (i) a description of the discharge and cause of noncompliance, and
      (ii) the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent `recurrence of the noncomplying discharge.
   b. Twenty-four hour reporting. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally with 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided with five (5) days of the time the permittee becomes aware of the circumstances. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

3. **Facilities Operation**
   Permittees shall operate and maintain facilities to comply with the Missouri Clean Water Law and applicable permit conditions. Operators or supervisors of operations at publicly owned or publicly regulated wastewater treatment facilities shall be certified in accordance with 10 CSR 209.020(2) and any other applicable law or regulation. Operators of other wastewater treatment facilities, water contaminant source or point sources, shall, upon request by the Department, demonstrate that wastewater treatment equipment and facilities are effectively operated and maintained by competent personnel.

4. **Adverse Impact**
   The permittee shall take all necessary steps to minimize any adverse impact to waters of the state resulting from noncompliance with any effluent limitations specified in this permit or set forth in the Missouri Clean Water Law and Regulations (hereinafter the Law and Regulations), including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. **Bypassing**
   a. Any bypass or shut down of a wastewater treatment facility and tributary sewer system or any part of such a facility and sewer system that results in a violation of permit limits or conditions is prohibited except:
      (i) where unavoidable to prevent loss of life, personal injury, or severe property damages; and
      (ii) where unavoidable excessive storm drainage or runoff would catastrophically damage any facilities or processes necessary for compliance with the effluent limitations and conditions of this permit;
      (iii) where maintenance is necessary to ensure efficient operation and alternative measures have been taken to maintain effluent quality during the period of maintenance.
   b. The permittee shall notify the Department in writing of all bypasses or shut down that result in a violation of permit limits or conditions. This section does not excuse any person from liability, unless such relief is otherwise provided by the statute.

6. **Removed Substances**
   Solids, sludges, filter backwash, or any other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutants from entering waters of the state unless permitted by the Law, and a permanent record of the date and time, volume and methods of removal and disposal of such substances shall be maintained by the permittee.

7. **Power Failures**
   In order to maintain compliance with the effluent limitations and other provisions of this permit, the permittee shall either:
   a. in accordance with the "Schedule of Compliance", provide an alternative power source sufficient to operate the wastewater control facilities; or,
   b. if such alternative power source is not in existence, and no date for its implementation appears in the Compliance Schedule, halt or otherwise control production and all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

8. **Right of Entry**
   For the purpose of inspecting, monitoring, or sampling the point source, water contaminant source, or wastewater treatment facility for compliance with the Clean Water Law and these regulations, authorized representatives of the Department, shall be allowed by the permittee, upon presentation of credentials and at reasonable times;
   a. to enter upon permittee's premises in which a point source, water contaminant source, or wastewater treatment facility is located or in which any records are required to be kept under terms and conditions of the permit;
   b. to have access to, or copy, any records required to be kept under terms and conditions of the permit;
   c. to inspect any monitoring equipment or method required in the permit;
   d. to inspect any collection, treatment, or discharge facility covered under the permit; and
   e. to sample any wastewater at any point in the collection system or treatment process.

9. **Permits Transferable**
   a. Subject to Section (3) of 10 CSR 20-6.010 an operating permit may be transferred upon submission to the Department of an application to transfer signed by a new owner. Until such time as the permit is officially transferred, the original permittee remains responsible for complying with the terms and conditions of the existing permit.
   b. The Department, within thirty (30) days of receipt of the application shall notify the new permittee of its intent to revoke and reissue or transfer the permit.

10. **Availability of Reports**
    Except for data determined to be confidential under Section 308 of the Act, and the Law and Missouri Clean Water Commission Regulation for Public Participation, Hearings and Notice to Governmental Agencies 10 CSR 20-6.020, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by statute, effluent data shall not be considered confidential. Knowingly making any false statement on any such report shall be subject to the imposition of criminal penalties as provided in Section 204.076 of the Law.

11. **Permit Modification**
    a. Subject to compliance with statutory requirements of the Law and Regulations and applicable Court Order, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:
       (i) violation of any terms or conditions of this permit or the Law;
       (ii) having obtained this permit by misrepresentation or failure to disclose fully any relevant facts;
       (iii) a change in any circumstances or conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge, or
       (iv) any reason set forth in the Law and Regulations.
    b. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

12. **Permit Modification - Less Stringent Requirements**
    If any permit provisions are based on legal requirements which are lessened or removed, and should no other basis exist for such permit provisions, the permit shall be modified after notice and opportunity for a hearing.

13. **Civil and Criminal Liability**
    Except as authorized by statute and provided in permit conditions on "Bypassing" (Standard Condition B-5) and "Power Failures" (Standard Condition B-7) nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

14. **Oil and Hazardous Substance Liability**
    Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act, and the Law and Regulations. Oil and hazardous materials discharges must be reported in compliance with the requirements of the Federal Clean Water Act.

15. **State Laws**
    Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state statute or regulations.

16. **Property Rights**
    The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, no does it authorize any injury to private property or any invasion of personal rights, nor any infringement of or violation of federal, state or local laws or regulations.

17. **Duty to Reapply**
    If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for a new permit 180 days prior to expiration of this permit.

18. **Toxic Pollutants**
    If a toxic effluent standard, prohibition, or schedule of compliance is established, under Section 307(a) of the Federal Clean Water Act for a toxic pollutant in the discharge of permittee's facility and such standard is more stringent than the limitations in the permit, then the more stringent standard, prohibition, or schedule shall be incorporated into the permit as one of its conditions, upon notice to the permittee.

19. **Signatory Requirement**
    All reports, or information submitted to the Director shall be signed (see 40 CFR-122.6).

20. **Rights Not Affected**
    Nothing in this permit shall affect the permittee's right to appeal or seek a variance from applicable laws or regulations as allowed by law.

21. **Severability**
    The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY

NPDES MONITORING REPORT FOR NON-MUNICIPAL WASTEWATER DISCHARGES

INSTRUCTIONS:

1. Mail to: St. Louis Regional Office, 7545 S. Lindbergh, Suite 210, St. Louis, MO 63125.
2. Report must be signed by owner and by analyst. Report should be typed or neatly printed.
3. Part A of the permit specifies the parameters to be monitored, frequency of monitoring and frequency of reporting results. If quarterly reports are required, they are due on April 28, July 28, October 28, and January 28, each report covering the preceding 3-month period not including the reporting month. See the permit for reporting dates if other than quarterly.
4. Report results of all analyses, even if performed more frequently than required by Part A of the permit.
5. File a report even if discharge is intermittent and no discharge occurred during the monitoring period. Complete the identification section, write "ND" in the appropriate columns for the dates the facility was checked, and sign the report. NOTE: If a discharge occurs any time during the monitoring period, it must be reported.
6. Under "Sample Type" indicate whether sample analyzed was: (a) grab sample; (b) 24-hour composite sample; or (c) modified composite sample. NOTE: See permit for type of sample required for each parameter.
7. Under "Sample Type" for Flow indicate whether figures shown are based on (a) instantaneous measurements or (b) actual 24-hour measured flow. Figure recorded is to represent the total 24-hour flow for the date shown or a reasonable estimate.
8. Indicate whether samples were collected by owner or by personnel of the lab performing the analyses.

NOTE: This reporting form is a universal reporting form for non-municipal sewage treatment plants, industries, and other point-source discharges.
Industries and individuals who have their own report forms designed for their specific needs are encouraged to substitute their forms. A suitable substitute must meet the following specifications.
(a) Form must be 8½" x 11".
(b) Report must show all of the information indicated on this standard form.

FACILITY NAME	PERMIT NUMBER	COUNTY	OWNER	TYPE OF FACILITY
REQUIRED FREQUENCY OF MONITORING		THIS REPORT COVERS PERIOD ______, 19___ THROUGH ______, 19___		

DATES SAMPLED															(RECORD, AS APPROPRIATE, SUCH INFORMATION AS METHOD OF PRESERVATION, METHODS OF SAMPLE COLLECTION, ABNORMAL AGE OF SAMPLE, EXPLANATION OF UNUSUAL RESULTS, ETC.)
TIME OF DAY SAMPLED															
SAMPLES COLLECTED BY															
DATES OF ANALYSES															
PARAMETERS	PERMITTED FINAL LIMITS	RECORD ACTUAL RESULTS OF ANALYSIS — DO NOT AVERAGE											SAMPLE TYPE (SEE NOTES 6 AND 7)	ANALYTICAL METHOD (BE SPECIFIC)	REMARKS AND COMMENTS
FLOW GPD															
BOD mg/l															
SUS. SOLIDS mg/l															
pH UNITS															
FECAL COLI. /100 ml.															

ANALYSES PERFORMED BY	SIGNATURE OF ANALYST
REPORT APPROVED BY OWNER	DATE

MO 780-1296 (10-91)

WQP 109 Rev. 10/91

End of current text

Exhibits

Exhibit 1

Secondary Containment (Burrito) Water Transfer and Measurement Procedure

STEP	ACTION
1	Connect a peristaltic pump or other positive-displacement pump to the burrito dip tube. Do not select a pump that cannot run dry unless the pump will be closely monitored by personnel that can shut off the pump when the dip tube runs dry.
2	Set up the pumping system to measure the amount of water pumped out of the Burrito by placing a flow meter on the discharge side of the pump or by directing the water into a tank or other container that can be used to measure the amount of water pumped.
3	Record the volume removed from the burrito on the round sheet then discharge the quantified burrito water to the sump.

End of current text

Exhibit 2

Leachate Hauling Procedure

Background: Water in the sump must be removed on a schedule that does not allow any equipment installed in the sump to be damaged or overflow of the sump causing a release to the environment. The water will be vacuumed from the sump using a vacuum truck and hauled to Metropolitan Sewer District Bissell Point Facility (MSD). The hauling is performed by a specialty subcontractor. Currently, the leachate in the sump is hauled to MSD approximately once every 3 or 4 months. However, the daily accumulation is expected to decrease over time thus decreasing the frequency of hauling to MSD.

CAUTION
The maximum level of water in the LCRS is 47 inches. If the level exceeds 53 inches, electrical equipment will be submerged and may be damaged.

NOTE: The maximum amount of water that can be hauled to MSD monthly is 25,000 gallons. This limit has been set by MSD.

The following steps shall be followed to transfer LCRS water to the MSD Bissell Point Facility.

Procedure

STEP	ACTION
1	Confirm the appropriate sections of the LCRS Sump Water Disposition form have been completed. Copy attached.
2	Record the reading indicated by Flowmeter (Fl-1).
3	Record the water level indicated by LT 1 and LT 2 in the Operations Log Book. Record the level indicated by LT 1 on the LCRS Sump Water Disposition Form.
4	Place a watertight pan under the hose connection to catch water that will spill when the hose is disconnected.
5	Connect the vacuum truck suction line to the 3-inch camlock fitting on the south side of the Train 3 Building.
6	Direct the vacuum truck driver to begin pulling a vacuum on the sump dip tube.
7	Slowly open the sump dip tube valve V-102.
8	Monitor the flow at the flow meter Fl-1.
9	Load the vacuum truck to near capacity. The density of the sump water can be assumed as 8.4 lbs. per gallon. Ensure that a water sample is taken from each load of water so it can be analyzed for MSD and reported under Step #22.
10	As the vacuum truck nears its capacity, slowly close the sump dip tube valve.
11	Close the inlet valve on the vacuum truck but maintain a vacuum within the tank truck.

STEP	ACTION
12	Loosen the Camlock fitting at the Train 3 Building connection.
13	Slowly pull the hose away from the Train 3 Building connection while opening the vacuum truck inlet valve. This allows most of the water in the hose and in the building piping to be vacuumed into the truck.
14	Close the vacuum truck inlet valve and shut off the vacuum truck vacuum pump.
15	Remove hose from the vacuum truck. Blind cap the vacuum truck inlet connection and the Train 3 Building connection.
16	Record the reading on flow meter Fl-1 on the LCRS Sump Water Disposition Form.
17	Record the indication of LT 1 and LT 2 in the Operations Log Book and on the LCRS Sump Water Disposition Form.
18	Complete the shipping manifest required by MSD. Copy attached for reference only. Contact MSD for actual forms to be used.
19	Keep the generator copy of the shipping manifest and ensure the driver keeps the shipping manifest in the truck.
20	Repeat Steps 2 through 18 until the desired sump level has been reached.
21	File the LCRS Sump Water Disposition Form.

HS-550.01 Confined-Space Entry

1. Introduction

1.1 Purpose

This procedure establishes Health and Safety (H&S) practices and procedures to protect all Grand Junction Office (GJO) and subcontractor employees from the hazards associated with entering, exiting, and working in confined spaces at normal atmospheric pressure.

1.2 Scope

This procedure describes the process for writing, approving, and terminating Confined-Space Entry Permits (CSEPs) (Form GJ0 1824e). Initiation of the confined-space entry procedure does not automatically require an additional work permit (i.e., Safe Work Permit). However, any additional permits, if required, shall be attached to the CSEP to address specific hazards associated with work to be performed in conjunction with a confined-space entry (e.g., welding). Standards 2.3, "Safe Work Permit," and 2.8, "Job Safety Analysis" in the *GJO Health and Safety Manual* (GJO 2). Likewise, a Radiological Work Permit (RWP) (Form GJO 1588e) shall be prepared if applicable, in accordance with *GJO Site Radiological Control Manual* (GJO 3), Article 323, "Radiological Work Permit Preparation."

1.3 Applicability

This procedure implements the *Code of Federal Regulations*, 29 CFR 1910.146, "Permit-Required Confined Spaces for General Industry," and 29 CFR 1926.21 "Safety Training and Education," and applies to all GJO-controlled operations.

2. Precautions and Limitations

2.1 Precautions

None

2.2 Limitations

Authorized entrants, attendants, and entry supervisors shall receive training in accordance with 29 CFR 1910.146(g) and 29 CFR 1926.21(b)(6)(I) prior to performing any confined-space entry duties (e.g. HS324).

If entry into a permit space becomes necessary for work in progress, a confined-space evaluation shall be developed and a CSEP generated before work continues.

3. Prerequisite Actions

Qualified personnel knowledgeable in the disciplines of Safety, Industrial Hygiene, and Radiological Protection shall evaluate any suspected confined spaces in the workplace and document the evaluation on the Confined-Space Evaluation form (Form GJO 1938e).

Ensure real time monitoring equipment calibration is current, and has been satisfactorily response checked prior to use.

The entry supervisor or a sub-contractor representative shall notify H&S of the need to enter a permit space. If feasible, notification should be given at least 3 days prior to the day entry is required.

4. Confined-Space Entry

4.1 Entry Supervisor and Requesting Supervisor

[1] Obtain the most current Confined-Space Evaluation from H&S.

[2] Review the hazard information in the Confined-Space Evaluation to determine whether conditions have changed since the last characterization, if so, a re-evaluation is required.

[3] Review the Confined-Space Evaluation with the supervisor from the work group responsible for the activity to be performed.

[4] Review past work and tasks of a like or similar nature to help determine if the anticipated work will affect the atmospheric conditions of the confined space.

[5] Evaluate the actual work that will be completed in the permit space to determine its impact on the hazard evaluation of the confined space. Control of hazards associated with both work activities and the space itself must be considered.

NOTE *If entry into the Permit Required Confined Space will require the support of a Confined Space Rescue Team, the Emergency Preparedness Coordinator (or equivalent) shall be notified immediately.*

NOTE *If the space is designated as Non-permit Required Confined Space (NPRCS), and the work to be performed will not change that designation, go to Section 4.4.*

4.2 Generating the Confined-Space Entry Permit

4.2.1 Line Supervisor

[1] Enter (print) the following data obtained from the Confined-Space Evaluation on the CSEP.

- [a] Date and Time of entry,
- [b] Location and identification number of the permit space,
- [c] Requesting supervisor name and signature,
- [d] Description of confined space,
- [e] Purpose of the entry,
- [f] Hazards of the space,
- [g] Special requirements, such as additional permits (SWP, RWP), measures to be taken for isolation of the permit space, measures used to remove or control potential hazards, (i.e. lockout/tag out), and equipment and procedures for purging, ventilating, or flushing hazards,

[h] Personal protective equipment (PPE) required for entry, such as respirators, clothing, and retrieval equipment,
IF respiratory protection is prescribed,
THEN
1. Complete a Respirator Selection Checklist (Form GJO 1855e) in accordance with HS-400.01, "Respirator Selection."
2. Enter the Respirator Selection Checklist Number on the CSEP.

[i] Communication procedures and equipment used by authorized entrants and attendants to maintain contact,
[j] Rescue and other services that would be summoned in case of emergency and the means of communication with those services,
[k] Rescue team contact number and means of communication, if applicable,
[l] Atmospheric testing and monitoring equipment used,
[m] Name(s) of person(s) monitoring,
[n] Names of the attendants, authorized entrants, and entry supervisor.

4.2.2 H&S Staff

[1] Assign a unique alpha-numeric identifier to the CSEP using the following scheme

[a] Select the appropriate alphabetic designator indicating the controlling project,
[b] Enter the last two digits of the year in which the CSEP was generated,
[c] Enter the next sequential three digit number from the CSEP Issue Log (GJO 2052e),
[d] Enter the confined space identification number.

GJ-97-001-070

- 070 — Confined Space Identification Number
- 001 — Sequential number - the first CSEP written in the calendar year shall use "001"
- 97 — Year - Calendar year in which the CSEP was issued
- GJ — Project Designator - alphabetic designator
  GJ = Grand Junction Facility
  MPS = Moab, Utah
  UM = UMTRA

Note - If there is a need for additional alphabetic designator, the Health and Safety Manager (or equivalent) should designate a new, unique designator

[e] Assign the expiration date to the CSEP, (not to exceed 3 days).

[f] Enter the following information on the project CSEP Issue Log:

1. Confined-Space Entry Permit Number,
2. Issue Date,
3. Lead Work Group Supervisor,
4. Additional Permit Number(s), if applicable,
5. Expiration Date,
6. Person responsible for atmospheric monitoring.

4.3 Entering a Permit Required Confined Space

4.3.1 Entry Supervisor

[1] Conduct and document a safety briefing for the attendants and all authorized entrants prior to entry. The briefing will consist of a review of the Confined-Space Evaluation and the CSEP and include the potential hazards in the permit space, safe work practices, and emergency procedures. Your signature on the confined-space entry permit signifies you understand the hazards and controls associated with your entry purpose.

[2] Ensure atmospheric monitoring is performed by adequately trained personnel, and documented on the CSEP, before entry or re-entry into any permit space. As a minimum, monitoring will be conducted for oxygen deficiency and flammable gases or vapors.

[3] Determine the need for monitoring for toxic gases (with assistance from H&S) on the basis of characteristics of the permit space and work activities to be conducted, and the appropriate intervals in which to monitor

[4] Verify that all tests specified by the CSEP have been conducted and that all procedures and equipment specified are in place.

[5] Ensure entry operations remain consistent with the terms of the CSEP and that acceptable entry conditions are maintained whenever responsibility for a permit-space entry operation is transferred, and at intervals dictated by the hazards and operations performed within the space.

4.3.2 Health and Safety Staff

Authorize entry into the permit space by signing the CSEP after the entry supervisor has verified that all the actions and conditions necessary for safe entry have been met and that the attendants and authorized entrants listed on the CSEP have received proper training.

4.3.3 Confined-Space Attendant

Make the CSEP available, at the time of entry, to all authorized entrants by posting it or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

4.3.4 Entry Supervisor

[1] Inform designated personnel and rescue personnel, as applicable, of the following:

- [a] Name and organization,
- [b] Confined-Space Identification Number and location,
- [c] Number of entrants.

[2] Following job completion, or if space is vacated for an extended length of time, notify designated personnel and rescue personnel, if applicable, of the completion of the confined-space entrance.

[3] Enter the time and date of the permit cancellation.

[4] Indicate the reason for termination.

NOTE *The cancellation of a CSEP because of inadequate controls or practices may require an Incident/Safety Report (Form GJO 1743e) to evaluate the causes leading up to the CSEP cancellation.*

[5] Print name, sign, and date permit cancellation.

[6] Return the terminated CSEP and any associated forms to H&S.

4.3.5 Health and Safety

[1] Enter the termination date in the CSEP Issue Log.

[2] Review and file permit, as applicable

4.4 Non-permit Required Confined-Space Entry

NOTE *Entry into a NPRCS without an attendant may be authorized for a period up to 1 year.*

4.4.1 Job Site Supervisor

[1] Notify H&S of any NPRCS entry and provide the following information:

- [a] Confined-Space Number,
- [b] Date of entry,
- [c] Entry supervisor and/or Name of entrant(s),
- [d] Reason for entry,
- [e] Estimated job duration,
- [f] Additional Permit Number(s), if applicable,
- [g] Person responsible for atmospheric monitoring, if applicable.

[2] Review the Confined-Space Evaluation with the work group responsible for the activity to be performed.

[3] Verify that all tests specified by the confined-space evaluation have been conducted and that all procedures and equipment specified are in place before allowing entry to begin.

[4] Ensure atmospheric monitoring performed for NPRCS is documented on a Real Time Monitoring Record (Form GJO 2051e).

[5] Enter information in the NPRCS Entry Log (Form GJO 2053e)

5. Records

5.1 Review

[1] Review the completed documentation in accordance with HS-100.02, "Documentation," to ensure completeness, accuracy, legibility, and reproducibility.

[2] Compare the data recorded with specified limits and procedural controls to determine if trends are developing or unexpected results were obtained.

[3] Notify the H&S Manager of any trends or unexpected results.

[4] Record the applicable file index number in the bottom right hand corner of each record generated by this procedure.

5.2 Record Disposition

Maintain the documentation generated by this procedure as Q-level quality records in accordance with the records management procedures provided in the *GJO Records Management Manual* (GJO 9), and specific program/project records management plans, if applicable.

6. References

29 CFR 1910.146

29 CFR 1926.21

GJO Health and Safety Manual (GJO 2)

GJO Records Management Manual (GJO 9)

7. Forms and Appendices

7.1 Forms

Confined-Space Evaluation (GJO 1938e)
Confined-Space Entry Permit (GJO 1824e)
Real Time Monitoring Record (GJO 2051e)
Confined Space Entry Permit Issue Log (GJO 2052e)
Non-Permit Required Confined Space Entry Log (GJO 2053e)

7.2 Appendices

None

Exhibit 4

Discharge to Missouri River (NPDES Outfall 007) Procedure

NOTE: Before pumping water through the pipeline to the Missouri River, the NPDES permit must be reviewed to ensure that all criteria including sampling, notifications, and treatment requirements are met.

Background Information:

The pipeline to the Missouri River is an HDPE pipeline with a nominal maximum working pressure of 100 psi. The maximum flow rate through the pipe has been established as 400 gpm due to a 3 inch diameter constriction at a manhole located at Sta 9+75. See Drawing 0284D-CP-5112.

Notable features and facts on the pipeline are:

1) The pipeline is 4 inches in diameter from the Train 3 building to the gate valve located at the South end of the WSSRAP property. (See Drawing 0284D-CP-5124). At this location, the pipe diameter increases to 6 inches.

2) There is a gate valve that must be opened for the pipeline to flow. The valve is located at the South end of the WSSRAP Property. See Drawing 0284D-CP-5124.

3) The pipeline was placed on the surface of the ground and then covered with several feet of soil, as indicated on Drawing 0284D-CP-5123. The earth mound is located along the Hamburg Hike and Bike Trail. The pipeline was placed on the ground and covered at this location because the line crossed a wooden TNT wastewater line that was thought to be potentially explosive. The TNT line was removed from beneath the water line by the Army, as part of the Weldon Spring Ordnance Works remedial activities.

4) Within the earth mound a manhole containing a vacuum breaker was constructed. The vacuum breaker has been disabled, due to repeated problems. Therefore, it is imperative that vacuum relief be provided inside the Train 3 Building.

5) The 6-inch pipe reduces to a 3-inch pipe (see Drawing 0284D-CP-5112). This was to improve performance of a flow meter that has been removed. Debris that enters the line may bridge this constriction.

6) The outfall structure for the pipeline is located near the Hamburg Quarry. The structure should be inspected for damage and vandalism before it is used. Signs indicating the purpose of the pipe are present and face the River.

7) A pressure versus flow rate curve was established for the pipeline in the year 2000. The chart is presented in the Appendix. Since the chart was established, several elbows and approximately 100 feet of 4-inch pipe were added to bring the line inside the Train 3 Building. Pipeline performance may be slightly below that indicated on the chart.

STEP	ACTION
1	Confirm that all NPDES requirements for discharge to the river have been met.
2	Open the gate Valve located at the south end of the WSSRAP property.
3	Check the vacuum breaker valve in the ant hill manhole to ensure that it is valved closed.
4	Walk or drive the line to ensure that excavations, vandalism and/or flooding have not affected the system.
5	Provide vacuum relief for the pipeline at the connection in the Northeast corner of the Train 3 Building.
6	Provide flow measuring capability at the pipeline connection in the Northeast corner of the Train 3 Building. (Vacuum relief should be downstream of the flow meter).
7	Connect the pumping system to the flowmeter.
8	Begin pumping to the river at a flow rate below 100 gpm.
9	Over a period of 10 minutes, the flow rate may be ramped up to the maximum rate of 400 gpm. However, the maximum working pressure of 100 psi must not be exceeded.
10	Walk or drive the line to check for problems.

Procedure for Shutting Down Flow to the Missouri River:

STEP	ACTION
1	Shut off the pumping system.
2	Record the final totalizer flow meter reading.

Procedure for Pneumatic Blow down of the Pipeline:

For long term shutdown of the pipeline, it may be desired that the line be blown dry with an air compressor.

The following steps have proven to be effective and successful in blowing down the pipeline.

STEP	ACTION
1	Follow all the steps to discharge water to the Missouri River listed in the section above.
2	Station an individual at the discharge to the river if the discharge is not covered with river water. This individual must be in radio or telephone contact with personnel in Train 3. He/she is responsible for keeping the public away from the connection during blow down and for ordering a shut down of the operation if the action at the river is too violent.
3	Connect a pressure-regulated airline to the pipeline flange fitting in Train 3.
4	Slowly apply pressurized air to the line until 25 psi is reached. Maintain this pressure for a minimum of 10 minutes.
5	Over a 10 minute period, increase air pressure at the head of the line to 50 psi. Reduce pressure if violent air or water surging occurs at the discharge to the river.
6	Maintain 50 psi air pressure at the head of the line until satisfied that the line is as clear as desired. A minimum of 20 minutes at 50 psi is recommended to clear the line of most of the water.

End of current text

Exhibit 5

Calibration Procedure for LS-1/LT-1/LI-1

Allow the LCRS sump to fill to at least 40 inches, as measured manually, at the sump. The greater the depth of the water, the more accurate the calibration will be. However, do not allow the sump to exceed the maximum depth of 50 inches, as damage to instrumentation will result. The depth of the sump as measured from the top of the manway ring is 189.5 inches. Because the top of the manway ring is not perfectly level, measurements shall be taken at the North side of the ring, adjacent to the West ladder rail.

STEP	ACTION
1	Subtract the distance from the top of the manway ring to the sump water level from 189.5 inches to obtain the height of the water level in the sump. (189.5 inches – distance between top of manway ring and top of water).
2	Remove the cover from the LT 1 junction box by turning the cover counter clockwise. Once the cover is completely unscrewed, lift straight up on the cover to ensure that LT 1 is not damaged.
3	Follow the directions in the LT 1 O&M Manual to program the measurement taken in Step 1 into LT 1 as the new high level.
4	Pump the LCRS sump down to between 10 and 15 inches. This can be done over one or two days.
5	Measure the sump manually, as described above.
6	Program the value determined in Step 5 into LT 1 as the low point calibration.
7	Insert a loop calibrator into the LT 1 4-to-20 milliamp loop.
8	Follow the directions in the LT 1 O&M Manual to drive the loop from 4-to-20 milliamps.
9	Use the loop calibrator to check the current flow through the LT 1 4-to-20 milliamp loop. At 4 milliamps, the red LT 1 LED indicator should read 4.7, and at 20 milliamps, the LED indicator should read 53.0.
10	Likewise, at 4 milliamps, Chart Recorder CR 1 should read 4.7, and at 20 milliamps, Chart Recorder CR 2 should read 53.0.
11	Follow the O&M Manual directions to calibrate the LED indicator and Chart Recorder CR 1 so that these instruments match the LCD indication on LT 1.

NOTE: The accuracy of the sensor probe in the sump diminishes below 10 inches, so lower levels are not recommended. The minimum indication programmed into LT 1 is 4.7. Even if no water is in the sump, LT 1 will give this indication. This was done because a portion of the bottom portion of the probe must be covered before the probe can begin to give an indication

End of current text

Exhibit 6
General Roundsheets for LCRS Facility

STEP	ACTION
1	Complete the LCRS round sheets (See Exhibit 7).
2	Check the Methane J Vent for obstructions.
3	Check the sump manhole cover for integrity. Ensure that it is locked.
4	Open the sump manhole cover and look inside for any obvious problems.
5	Check for indications that the sump secondary solenoid valve is leaking. Listen for dripping water and look for rings on the surface of the water in the sump.
6	Record the reading on the sump for SF-1 hour meter HM-1. Operate unit for approximately 5 minutes.
7	Check the LCRS sump area for proper labeling, signs of vandalism, loose or missing bolts, no smoking signs, etc.
8	Enter the Train 3 Building.
9	Log the status of the building ventilators BV-1 and BV-2.
10	Open the LCRS monitoring cabinet.
11	Log the values indicated by LT 1 and secondary leachate counters Leachate Counter East (LCE) and Leachate Counter West (LCW).
12	If the level indicated by LT 1 is forty inches or greater, schedule an LCRS pump out as necessary to keep the water level in the sump from exceeding 47 inches.
13	Compare the indication on LT 1 with the measurement taken in step 7.
14	Take the memory card offline by touching the floppy disk icon on the touch screen.
15	Remove the memory card and insert a replacement card. **NOTE: The card must be placed in the bottom PCI card slot if it is to constantly receive data from the recorder.**
16	Ensure the new card is on line by following these steps on the CRX-2 touch screen:
	a) From the main menu, pick the **OPERATOR'S HAND** icon.
	b) Touch **"DISK"** on the menu, followed by the **DOWN MENU** icon.
	c) Select **"LOG 2"**.
	d) Select the **"UP MENU"** icon several times, until the main menu is reached.
	e) If the top of the touch screen indicates an alarm and that the data was lost, clear the alarm by selecting pick the **OPERATOR'S HAND** icon.
	f) Touch **"DISK"** on the menu, followed by the **DOWN MENU** icon.
	g) Touch **"CLR DISK ERROR"** on the touch screen.
	h) Use the **"UP MENU"** icon on the touch screen to go back to the main menu.

STEP	ACTION
17	Open the inner door of the LCRS cabinet and check for signs of problems.
18	Check the breakers in the breaker panel and note any that are tripped or in the off position in the comments section of the round sheets (spare breakers excluded).
19	Close the breaker panel door, the inner door and the outer door of the LCRS monitoring cabinet.
20	Tour the building. Check for signs of electrical problems, leaks, storm damage, vandalism, animal intrusion and proper operation of the radiant heaters.

Exhibit 7

LCRS Roundsheet

Weldon Spring Site Leachate Collection and Recovery System (LCRS) Roundsheet

Leachate Monitoring System

Date	Sump Leachate Level (LI-1)		Leachate Flow Meter (FI-1)			Sump Leak Detection Level			East Secondary System			West Secondary System			Comments
	Sump Level Before Pumping	Sump Level After Pumping	Totalizer Reading Before Pumping	Totalizer Reading After Pumping	Total Pumped	Before Pumping	After Pumping	Total Pumped	Previous 403 Counter	Current 403 Counter	Flow (Number of Counts X 0.58)	Previous 401 Counter	Current 401 Counter	Flow (Number of Counts X 0.50)	
	Inches	Inches	Gallons	Gallons	Gallons	Inches	Inches	Gallons			Gallons			Gallons	

End of current text

Appendix J
LCRS/Train 3 Treatment Contingency Plan

J1.0 Contingency Plan Overview

J1.1 Background

The disposal cell at the Weldon Spring Site currently (August 2004) generates approximately 200 gallons of leachate per day, and manganese concentrations in the leachate exceeds the permitted effluent limit. The LCRS sump capacity is approximately 11,000 gallons, or 45 days of storage at the current flow rate. The uranium activity is below the discharge goal stated in the NPDES permit. This leachate is currently being hauled to the Metropolitan Sewer District (MSD) via commercial hauler for disposal and treatment under an approval granted to DOE on December 21, 2001, by the MSD. DOE had originally expected to treat the leachate on-site and discharge the treated leachate through a dedicated pipeline to an NPDES permitted outfall at the Missouri River. However, when MSD approved disposal of the leachate at their facility, construction was suspended on the Train 3 treatment facility. A metal industrial building was already under construction, and the major equipment required for the treatment process had already been purchased. DOE decided to complete the building construction and store or surplus the process equipment that remained. This plan was prepared as a contingency for treating the leachate in the event that the primary leachate management option (i.e., hauling to the MSD treatment facility) was no longer available. The objective was to use as much of the existing equipment as possible in a configuration that would support a rapid start-up, if needed.

Prior t August 2004, the leachate was hauled to MSD without any pretreatment requirements. Beginning in September 2004, the Weldon Spring Site initiated a pretreatment process to reduce the uranium concentration in the leachate to below 30 μg/L. This was in order to comply with a new MSD requirement for the leachae to be below drinking water standards prior to acceptance. The treatment process included filtration and ion exchange. The process successfully reduces uranium to below the MSD acceptance criteria. The WSS anticipates pretreating the leachate until the uranium concentration falls below 30 μg/L.

J1.2 Current State

The LCRS Support Building is completed and operational. The building is heated, and roof-mounted ventilation fans are installed and operational. There is adequate electrical service to support all operational needs. No potable water is supplied to the building. The building currently houses electrical equipment used to support the LCRS operation, four fiberglass reinforced plastic (FRP) tanks (500, 4,500, 4,500, and 7,600 gallon), two ion exchange vessels, four cartridge filter housings, and miscellaneous related equipment. The tanks were anchored in their permanent locations during the building construction. The ion exchange vessels and filter cartridge housings were recovered from other treatment processes that were used at WSS and are in good condition. Ion exchange resin and filter cartridges are in the building. Two air-driven diaphragm pumps are in the building. There is no compressed air supply in the building.

The building was modified to facilitate haul truck loading of leachate by installing piping and a flowmeter that penetrates the south wall and is equipped with a quick disconnect fitting that is compatible with the leachate haulers' hoses. This piping connects the leachate influent piping located inside the building to the exterior of the building.

The building is used regularly by WSS staff to download instrument records from the instrument display cabinet in the building and for storage of supplies and equipment used for leachate sampling. Purge water generated from certain monitor wells is passed through granular activated carbon and stored in the 500-gallon FRP tank. The purge water is consolidated with the leachate and hauled to MSD for disposal as needed.

J1.3 Operational Philosophy

The original process was intended to be automated because it was planned to be a permanent activity. However, the current plan is a contingency and a less automated approach is appropriate. Leachate will be pumped from the sump and through the various processes using an air-driven diaphragm pump and a portable air compressor. The pump will be repositioned after each step of the process to convey the leachate to the next process. Heavy-duty rubber hoses with quick-disconnect fittings will be used for leachate transfer. These hoses are not currently on site and will have to be fabricated if the contingency plan is exercised. Manual addition of the dilute consumer-grade chlorine bleach to oxidize the manganese was in the original plan and remains unchanged. The ion exchange process equipment will not be used if uranium concentration is below the permit goal of 100 pCi/L.

J1.4 Process Overview

Leachate will be transferred to TK-100 via the air-driven pump. Commercially available household bleach (6 percent sodium hypochlorite by weight) will be added at a rate of 1.5 gallons bleach per 1,000 gallons leachate. TK-100 will be mixed for one hour using the air-driven pump connected in a loop. The TK-100 contents will be pumped with the air-driven pump through the cartridge filters for serial filtration through 10 micrometer (nominal) then 5 micrometer (nominal) cartridges to TK-300. The water will be sampled for the constituents described in the NPDES permit (MO-0107701) and discharged. If uranium concentration is above the permit goal of 100 pCi/L, anchoring, piping, and media loading will be required for the ion exchange system. Current uranium concentrations have been averaging approximately 50 pCi/L, and the manganese concentration has been decreasing (averaging approximately 4.5 mg/L) but is still above permit limit (0.5 mg/L) for discharge to the Missouri River. If the contingency plan is exercised after July 13, 2005, the expiration date of the current NPDES permit, it is anticipated that the new uranium drinking water standard of 20 µg/L (30 pCi/L) would be applicable and that the discharge goal would be revised to 10 times the drinking water standard (300 pCi/L), as were the discharge goals for the other pollutants identified in the permit.

J1.5 Process Start-Up

The equipment will require several actions prior to startup. Four heavy-duty rubber hoses with quick-disconnect fittings will require fabrication. The lengths of the hoses will be field determined. A portable compressed air supply capable of providing 50 cubic feet per minute at 50 pounds per square inch (psi) will be needed to operate the diaphragm pumps. The cartridge filters and ion exchange vessels (if required) must be field located and anchored, and the interconnecting piping must be completed in accordance with the drawings. Consumer grade bleach can be purchased at any supermarket. The piping used to load out the leachate haul trucks must be modified to provide a connection on the inside of the building.

J2.0 Train 3/LCRS Equipment Setup Procedure

The Train 3 Process equipment should be installed in accordance with the referenced drawings for WP-565A.

All major equipment items and supplies required to set up and operate the treatment process are, as of this writing, located in the Train 3 building, with the exception of the heavy-duty rubber hoses, compressed air supply, and miscellaneous piping materials and hardware that will be required for assembly.

Cartridge filter housings and ion exchange vessels will be loaded according to manufacturer recommendations.

If the uranium concentration exceeds the discharge goals, use of the ion exchange system will be necessary prior to discharge.

J2.1 Transfer of Leachate from LCRS Sump to TK-100

1. Align valves as follows (Caution: Open valves slowly to avoid equipment damage):

   V-102 Closed
   V-103 Closed
   V-106 Closed
   V-104 Closed
   V-105 Closed

2. Connect hose line 2”-INF-1006-R1 from the tee fitting QD to the P-100 suction QD.

3. Connect hose line 2”-INF-1002-R1 between the P-100 discharge QD and the T-100 fill line QD.

4. Connect the air supply to P-100.

5. Align valves as follows (Caution: Open valves slowly to avoid equipment damage):

   V-102 Open
   V-103 Closed
   V-106 Open
   V-104 Open
   V-105 Closed

6. Turn on compressed air supply to P-100 and adjust to 50 psi. Check hoses and pumps for leaks.

7. Verify flow and proper operation of P-100.

8. Fill TK-100 with 3,000 gallons of leachate (this will be approximately 8’ of leachate in TK-100 and will leave 4’ of freeboard). Use FI-1 or direct measurement of the height of liquid in TK-100 to determine the volume of leachate in TK-100.

9. Close V-106.

10. Approximately one minute after closing V-106, turn off compressed air supply.

11. Close V-104

12. Disconnect 2”-INF-1006-R1 from P-100 and cap end of hose. Use a drip pan to prevent spillage on floor.

J2.2 Manganese Treatment/Chemical Precipitation

1. Connect one end of 2”-REC-1005-R1 to TK-100 discharge nozzle and the other end to P-100.

2. Open V-104 and V-105.

3. Turn on compressed air supply and verify 50 psi output to P-100.

4. Verify recirculation flow in TK-100.

5. Add 4.5 gallons (1.5 gallons consumer grade bleach/1,000 gallons leachate) of bleach through the manhole (M1) located on top of TK-100.

6. Allow TK-100 contents to recirculate for one hour

NOTE: A bleach/chlorine odor may be observed in the building. This does not present any hazard.

7. Close V-105.

8. Approximately one minute after closing V-105, turn off compressed air supply to P-100.

9. Close V-104.

10. Disconnect 2”-INF-1002-R1. Use a drip pan to prevent spillage on floor.

J2.3 Filtration

1. Reposition P-100 closer to filter cartridge vessels. (It may be necessary to disconnect 2”-REC-1005-R1 in order to reposition P-100. If this is done, make sure 2”-REC-1005-R1 is reconnected after repositioning.)

2. Connect 2”-FIL-1004-R1 to P-100 and cartridge filter unit inlet QD.

3. Connect 2”-FEFF-2003-R1 to cartridge filter unit outlet and TK-300 QD.

4. Align valves as follows (Caution: Open valves slowly to avoid equipment damage):

V-105	Open	V-210	Closed	V-205	Closed	V-301	Open
V-201	Open	V-211	Closed	V-215	Open	V-302	Closed
V-202	Open	V-212	Open	V-217	Open		
V-207	Open	V-213	Open	V-216	Closed		
V-209	Open	V-214	Open	V-218	Closed		
V-204	Open	V-219	Open	V-220	Closed		
V-208	Closed	V-221	Open	V-222	Closed		
V-206	Open	V-203	Closed	V-223	Open		

5. Turn on compressed air supply to P-100.

6. Vent F-201, F-202, F-203, and F-204 by slowly opening V-203, V-205, V-216 and V-218, respectively.

7. Pump contents of TK-100 through the cartridge filter unit to TK-300.

8. When TK-100 is empty, close V-105.

9. Approximately one minute after closing V-105, turn off compressed air supply to P-100.

10. Close V-301.

NOTE: After final run, drain cartridge filters to building sump.

11. Disconnect 2”-REC-1005-R1 and 2”-FIL-1004-R1 from P-100 and cap ends of hose. Use a drip pan to prevent spillage on floor.

J2.4 Ion Exchange Treatment

NOTE: If ion exchange treatment is not required, go to Procedure J2.5.

1. Reposition P-100 between TK-300 and the ion exchange vessels (IX-401 and IX-402).

2. Connect 2”-IX-4001-R1 to suction side of P-100.

3. Connect 2”-IX-4002-R1 to discharge side of P-100 and ion exchange unit inlet QD.

4. Connect 2”-IX-4006-R1 to ion exchange outlet and TK-500 fill QD.

5. Align valves as follows (Caution: Open valves slowly to avoid equipment damage):

V-302	Open	V-409	Closed	V-403	Open
V-401	Open	V-407	Closed	V-404	Open
V-402	Open	V-408	Closed	V-411	Open
V-405	Closed	V-410	Closed	V-501	Closed
V-406	Closed				

6. Turn on compressed air supply to P-100.

7. When TK-300 is empty, close V-302.

8. Approximately one minute after closing V-302, turn off compressed air supply to P-100.

9. Close V-401, V-402, V-403, V-404 and V-411.

J2.5 Transfer Treated Leachate to the Missouri River 007 Outfall

1. Connect hose line 2"-EFF-5001-R1 between TK-500 discharge nozzle QD and P-500 Suction side QD. (Note: If the ion exchange system is not used, connect hose line 2"-IX-4001-R1 to P-500 suction QD instead of hose line 2"-EFF-5001-R1. Drain contents of TK-300 to Missouri River 007Outfall.)

2. Connect hose line 2"-EFF-5002-R1 between P-500 and effluent pipeline plant stub-out flange.

3. Connect compressed air supply to P-500.

4. Open V-501 and V-502.

5. Turn on compressed air supply to P-500.

6. When contents of TK-500 (or TK-300, if applicable) are empty close V-502 (or V-302, if TK-300 contents were emptied).

7. Approximately 5 minutes after closing V-502 (or V302, if appropriate), turn off air supply to P-500.

8. Drain and secure all equipment and hoses when complete.

Appendix K
Disposal Cell Groundwater Monitoring Plan

DOE/GJ/79491-646

Weldon Spring Site Remedial Action Project

Weldon Spring Site Disposal Cell Groundwater Monitoring Plan

Revision 2

March 2004

Prepared by

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For the

U.S. DEPARTMENT OF ENERGY
Grand Junction Operations Office
Under Contract DE-AC13-02GJ79491

ABSTRACT

The *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan , Rev. 2* describes the approach that will be used to develop tolerance limits on concentrations of contaminants for the cell groundwater monitoring network; the sampling strategy to be implemented for compliance with long-term groundwater monitoring requirements; and outlines the statistical methods to be used in data analysis. The Plan also identifies monitoring well locations, depths and construction details.

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1. INTRODUCTION

1.1 Scope

This plan describes the disposal cell groundwater monitoring program for the U.S. Department of Energy's (DOE's) Weldon Spring Site, which is being conducted according to the substantive requirements of 40 CFR 264, Subpart F, and 10 CSR 25-7.264(2)(F). This plan includes a description of the sampling locations, frequency, parameters, and associated analysis and sampling procedures. A discussion about the data evaluation and the development of the evaluation approach are also included.

1.2 Purpose

The purpose of this plan is to summarize the disposal cell groundwater monitoring program. The following specific elements are addressed: the design of the monitoring network; the results of baseline monitoring; the long-term monitoring program, which includes detection monitoring, compliance monitoring, and corrective action; and data review and reporting.

1.3 Applicable or Relevant and Appropriate Requirements

In the *Record of Decision for the Chemical Plant Area of the Weldon Spring Site* (Ref. 1), the substantive requirements of 40 CFR 264, Subpart F of the *Resource Conservation and Recovery Act (RCRA)*, and 10 CSR 25-7.264(2)(F) of the Missouri Hazardous Waste Regulations, were identified as applicable or relevant and appropriate requirements (ARARs) for the selected remedy (i.e., construction and operation of an engineered disposal cell). Table 1-1 provides a summary of these ARARs and indicates the sections of this plan that discuss the strategy for meeting each requirement. In addition to these ARARs, relevant portions of 10 CSR 80-3.010(8) were also used as guidance in developing this monitoring plan.

1.4 Background

Groundwater at the chemical plant is contaminated with trichloroethylene (TCE), nitrate, uranium, and nitroaromatic compounds. The groundwater contamination originated with the Raffinate Pits and other source areas of the chemical plant site and former ordnance works area, that have been removed. Contamination is primarily limited to the weathered portion of the uppermost bedrock unit, the Burlington-Keokuk Limestone. Nitroaromatic compounds are present east and north of the disposal cell and is elevated in several of the disposal cell monitoring wells. Nitrate is present north and west of the disposal cell and is elevated in several of the disposal cell monitoring wells. Uranium is present southwest of the disposal cell; however, elevated levels are not observed in any of the disposal cell monitoring wells. TCE is also present southwest of the disposal cell, but elevated levels are not observed in any of the disposal cell monitoring wells.

Table 1-1 ARARs Summary for Disposal Cell Groundwater Monitoring

SUMMARY OF REGULATION	PERTINENT SECTION OF MONITORING PLAN
40 CFR 264.90 APPLICABILITY Specifies the applicability requirements and exemptions for owners or operators of facilities that treat, store, or dispose of hazardous waste.	Section 1.3, Applicable or Relevant and Appropriate Requirements
40 CFR 264.91 REQUIRED PROGRAMS Specifies the criteria for determining which monitoring and response program (i.e., detection monitoring, compliance monitoring, or corrective action) should be instituted at a regulated facility.	Section 4.0, Detection Monitoring Program Section 5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.92 GROUNDWATER PROTECTION STANDARD Requires compliance with certain conditions when hazardous constituents are detected in groundwater underlying a regulated unit.	Section 5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.93 HAZARDOUS CONSTITUENTS Specifies the criteria for defining "hazardous constituents" to which the groundwater protection standard applies.	Section 5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.94 CONCENTRATION LIMITS Specifies the criteria for establishing concentration limits for hazardous constituents detected in the groundwater underlying a regulated unit.	Section 3.3.3, Revised Baseline Tolerance Limits
40 CFR 264.95 POINT OF COMPLIANCE Defines the point of compliance at which the groundwater protection standard applies and monitoring must be conducted.	Section 2.2, Groundwater Monitoring Wells
40 CFR 264.96 COMPLIANCE PERIOD Defines the compliance period during which the groundwater protection standard applies.	Section 5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.97 GENERAL GROUNDWATER MONITORING REQUIREMENTS Specifies general requirements for the groundwater monitoring program, such as well installation, sampling and analysis procedures, determination of groundwater surface elevation, and statistical methods to be used.	Section 2.0, Monitoring Network Design Section 3.3.3, Revised Baseline Tolerance Limits Section 4.4, Groundwater Elevation Measurements Section 6.0, Quality Control
40 CFR 264.98 DETECTION MONITORING PROGRAM Specifies requirements for detection monitoring programs, including monitoring parameters, sampling frequency, determination of groundwater flow, determination of statistically significant evidence of contamination, and required response to positive evidence of contamination.	Section 4.0, Detection Monitoring Program
40 CFR 264.99 COMPLIANCE MONITORING PROGRAM Specifies requirements for compliance monitoring programs, including monitoring parameters, sampling frequency, determination of groundwater flow, determination of statistically significant evidence of contamination, and required response to exceedance of the groundwater protection standard.	Section 5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.100 CORRECTIVE ACTION Specifies requirements for corrective actions to be instituted to ensure compliance with the groundwater protection standard.	Section 5.0, Compliance Monitoring and Corrective Action Programs
10 CSR 25-7.264(2)(F) RELEASES FROM SOLID WASTE MANAGEMENT UNITS Specifies that efforts made to monitor groundwater or implement corrective action be documented, and that daily precipitation be measured. Also requires a surface water monitoring program to represent the quality of surface water hydrologically downgradient of the facility.	Section 2.3, Surface Water Monitoring Location Section 4.5, Precipitation Data Section 4.8, Detection Monitoring Reporting Section 5.0, Compliance Monitoring and Corrective Action Programs

2. MONITORING NETWORK DESIGN

Groundwater monitoring requirements under 40 CFR 264, Subpart F, of the *Resource Conservation and Recovery Act* (RCRA) specify that the monitoring system for a regulated unit must "consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that: (1) represent the quality of background water that has not been affected by leakage from the regulated unit…; (2) represent the quality of groundwater passing the point of compliance; and (3) allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer." The disposal cell monitoring network at the Weldon Spring Site has been designed to meet these requirements, as described below.

2.1 Basis of Design

The following criteria constitute the basis for design of the disposal cell groundwater monitoring network at the Weldon Spring Site:

- Regulatory requirements,
- Potentiometric surface of the shallow groundwater beneath the disposal cell,
- Design aspects of the disposal cell, and
- Physical site conditions.

The Subpart F regulations of RCRA specify that groundwater monitoring must be conducted at the point of compliance, which consists of a vertical surface that is located hydraulically downgradient of the waste management area and extends down into the uppermost aquifer. The RCRA regulations provide flexibility regarding the number, spacing, and depths of monitoring wells; however, the Missouri Sanitary Landfill regulations in 10 CSR 80-3.010, specify a minimum of one upgradient and three downgradient wells for landfills. The disposal cell network was designed to incorporate one upgradient and four downgradient wells, allowing for the possibility that wells could be added or removed as necessary. Since the original network was installed, two wells have been added and two have been eliminated. Thus, the current network still consists of one upgradient well and four downgradient wells. The location of these wells is discussed in Section 2.2.

To supplement groundwater monitoring, Missouri Hazardous Waste regulations in 10 CSR 25-7.264(2)(F) require that a surface water component be included in monitoring releases from waste management units. The surface water monitoring system must "consist of a sufficient number of points at appropriate locations to yield surface water samples that: (a) represent the quality of background surface water that has not been affected by any contamination from the facility…; and (b) represent the quality of surface water hydrologically downgradient of the facility or regulated units." The surface water monitoring location incorporated in this plan is discussed in Section 2.3.

The potentiometric surface of the shallow groundwater indicates that the flow gradient beneath the disposal cell is generally to the north and northwest, as shown in Figure 2-1. The general direction of groundwater flow has remained relatively unchanged since the cell monitoring system was designed, throughout remediation of the site and construction of the disposal cell. However, since construction of the disposal cell and previous remedial activities, the groundwater elevation has decreased due to dewatering of ponds/basins and diversion of surface water flow and reduced infiltration (recharge) to the shallow aquifer.

Design aspects of the disposal cell that were considered in determining the original locations of the monitoring wells included the locations of the clean fill dikes and leachate collection sump, the 1% to 1.5% northward slope along the base of the cell, and the double liner/leachate collection system. Since the monitoring network was installed while physical site conditions were undergoing frequent change due to remediation and construction activities, existing and planned locations of excavations, roads, structures, surface water bodies, staging areas, and the footprint of the disposal cell were also considered to ensure availability and access to the planned monitoring locations.

2.2 Groundwater Monitoring Wells

The original disposal cell monitoring network was established in 1996. It included five wells: one upgradient well (MW-2048) and four downgradient wells (MW-2032, MW-2045, MW-2046, and MW-2047). The well locations, which are shown in Figure 2-2, were chosen based on the criteria discussed above. Well MW-2048 was installed south of the cell to monitor water quality upgradient of the disposal cell. Wells MW-2045, MW-2046, and MW-2047 were installed northeast, north, and northwest of the cell, respectively, to monitor potential groundwater impacts downgradient of the disposal cell. Well MW-2032 was an existing well that was retained to monitor potential groundwater impacts downgradient (i.e., north) of the leachate sump. Figure 2-3 provides a cross-sectional view of the monitoring system, in relation to the disposal cell and leachate sump.

While the original monitoring network consisted of five wells, it was the intent of the plan to provide flexibility for reacting to the dynamics of the system being monitored. The heterogeneous nature of the fractured bedrock aquifer and the complexities associated with monitoring a previously contaminated groundwater system created uncertainty in the actual performance of the proposed monitoring wells. Additional wells were to be incorporated into the network on an as-needed basis during both the active life and the post-closure period to replace or supplement data from poorly performing wells. Thus, since MW-2045 demonstrated consistently poor hydraulic performance and yielded widely variable analytical data, a fifth downgradient well (MW-2051) was installed in 2001 northeast of the disposal cell, as shown in Figure 2-2. Under the present revision of this plan, MW-2051 replaces MW-2045 as the monitoring location for the northeast side of the disposal cell. Monitoring well MW-2051 exhibits higher hydraulic conductivities and will better represent the shallow groundwater system than MW-2045.

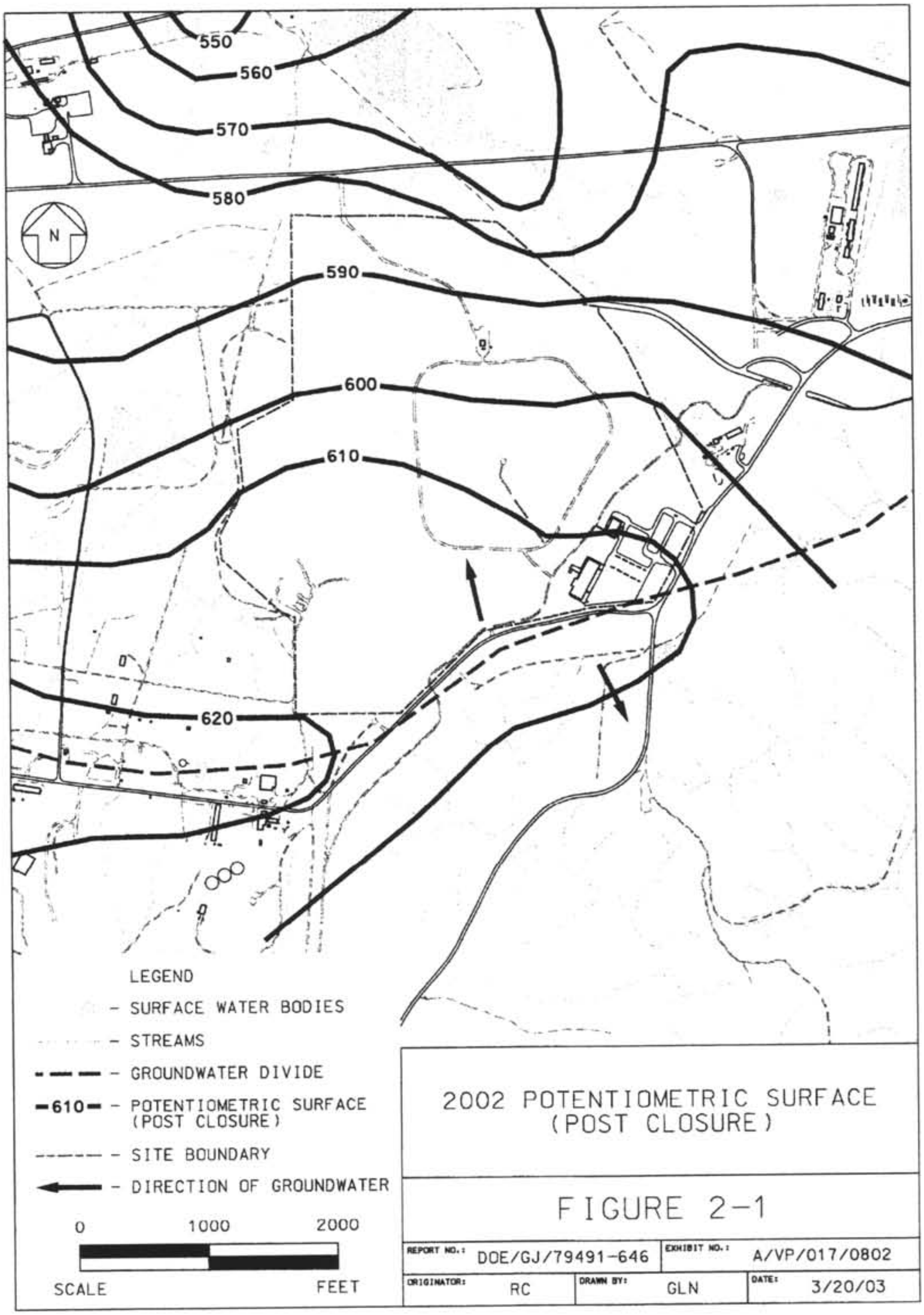

Figure 2-1 2002 Potentiometric Surface (Post Closure)

The original upgradient well, MW-2048 was damaged during construction activities in 2001. This well was determined to be damaged beyond repair, which led to its abandonment and installation of a replacement well shortly thereafter. The new well, MW-2055, is located approximately 20 feet upgradient (i.e., south) of MW-2048 and has replaced it as the upgradient monitoring well (see Figure 2-2). Data review conducted for both monitoring wells indicated comparable upgradient water quality. No PCBs, PAHs or nitroaromatic compounds were detected at either location. Concentration ranges of ions, metals, radiological and indicator parameters were similar, with the exception of three metals (iron, manganese, and nickel) and one indicator parameter (total organic carbon). However, the concentrations are within typical ranges for the groundwater in the weathered Burlington-Keokuk Limestone.

All wells in the disposal cell monitoring network were installed and developed in accordance with 10 CSR 23, *Missouri Water Well Construction Code*. Each well is constructed of 2-inch ID Grade 316 stainless steel casing, with a 10-foot length of 0.010-inch slotted screen. Total depths of the wells range from approximately 45 to 75 feet below ground surface, depending on the respective depth to water at each location. Borehole logs, well diagrams, packer test calculations, and well development forms for the original wells are contained in the *WSSRAP Disposal Cell Monitoring Well Program Installation Report* (Ref. 2). Appendix A of this plan contains the well diagrams, packer test calculations, and well development forms for the two newly installed wells, as well as the borehole logs for all disposal cell wells.

2.3 Surface Water Monitoring Location

The surface water location used to detect downgradient impacts from the disposal cell is Burgermeister Spring (SP-6301) (see Figure 2-4). Historical dye tests have indicated that this spring is the primary localized point of emergence for groundwater from the vicinity of the chemical plant (Ref. 3). Thus, sampling of Burgermeister Spring will yield results that are representative of both surface water and groundwater hydraulically downgradient of the disposal cell. Burgermeister Spring represents the first surface water impacted by groundwater originating from the site, including the disposal cell area. Downstream Lake 34 was not chosen as a monitoring point as Burgermeister Spring represents the worst case conditions for surface water and Lake 34 does not receive surface water contribution from the chemical plant area. It is common practice in aquifer systems dominated by fracture or conduit flow to supplement the monitoring well system by sampling springs that are hydraulically connected to the uppermost aquifer and that have shown a connection to the facility (Ref. 17). This spring has been monitored routinely since 1987 under the *Environmental Monitoring Plan* (Ref. 4), which contains the overall environmental monitoring requirements for the Weldon Spring site and is a long-term monitoring locations for the Groundwater Operable Unit. There is no upgradient surface water body included in this monitoring plan. The disposal cell is situated near both the regional surface water and groundwater divides; therefore, no surface water bodies are located upgradient of the disposal cell.

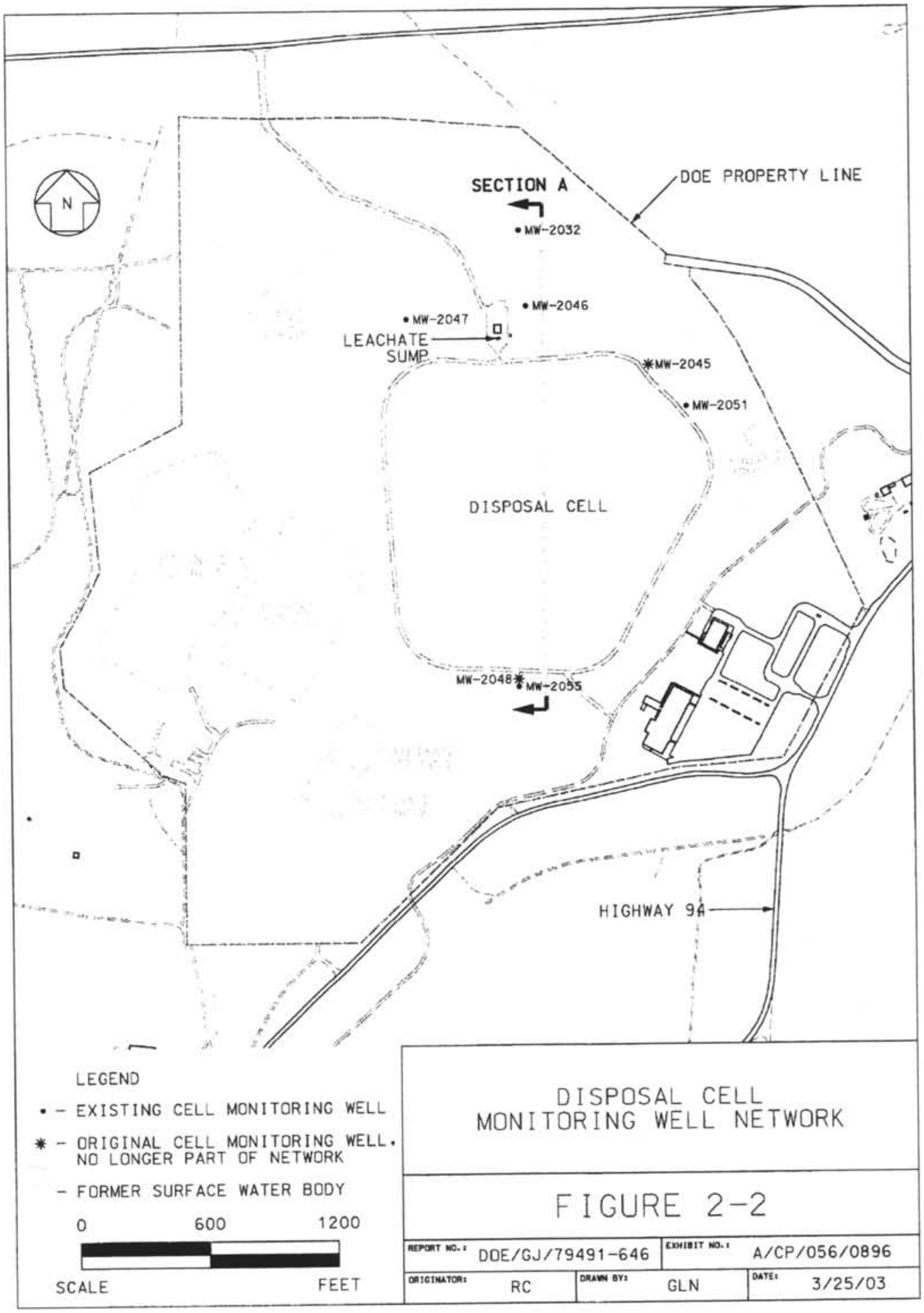

Figure 2-2 Disposal Cell Monitoring Well Network

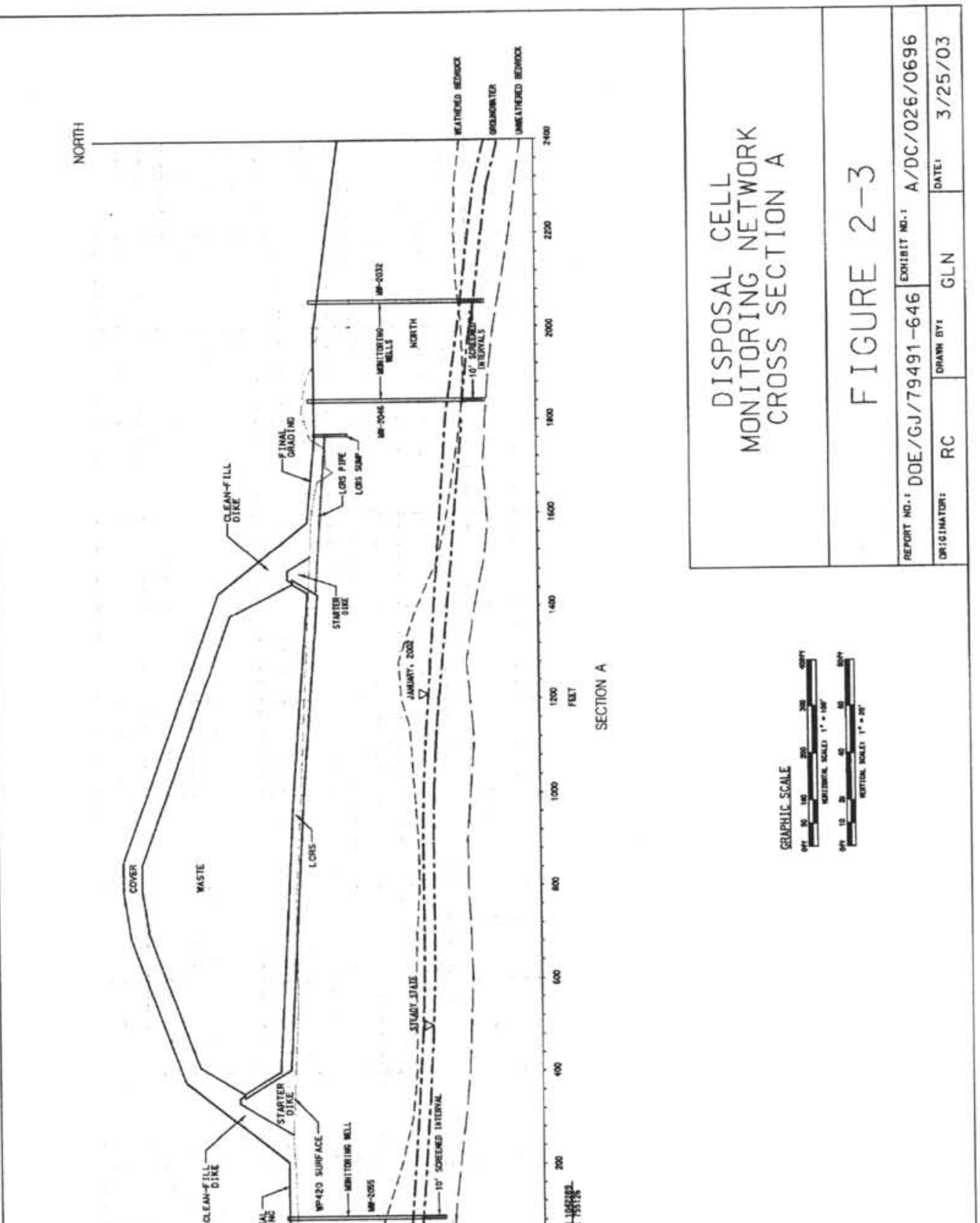

Figure 2-3 Disposal Cell Monitoring Network Cross Section A

Ecological evaluations (including toxicity testing) for Burgermeister Spring have been conducted previously under site environmental monitoring and remedial investigation programs, and these results may be used for a determination of baseline ecological conditions for this plan. Results of ecological studies conducted for Burgermeister Spring as part of the *Remedial Investigation for the Groundwater Operable Unit* (Ref. 3) indicate that current conditions within the surface water and sediments in Burgermeister Spring, while exhibiting above background concentrations of both nitrate and uranium, have not measurably affected the biological community that uses the drainage. Therefore, while sampling for both radiological and chemical constituents will be conducted at Burgermeister Spring as specified in this plan, routine monitoring of biological activity will not be incorporated.

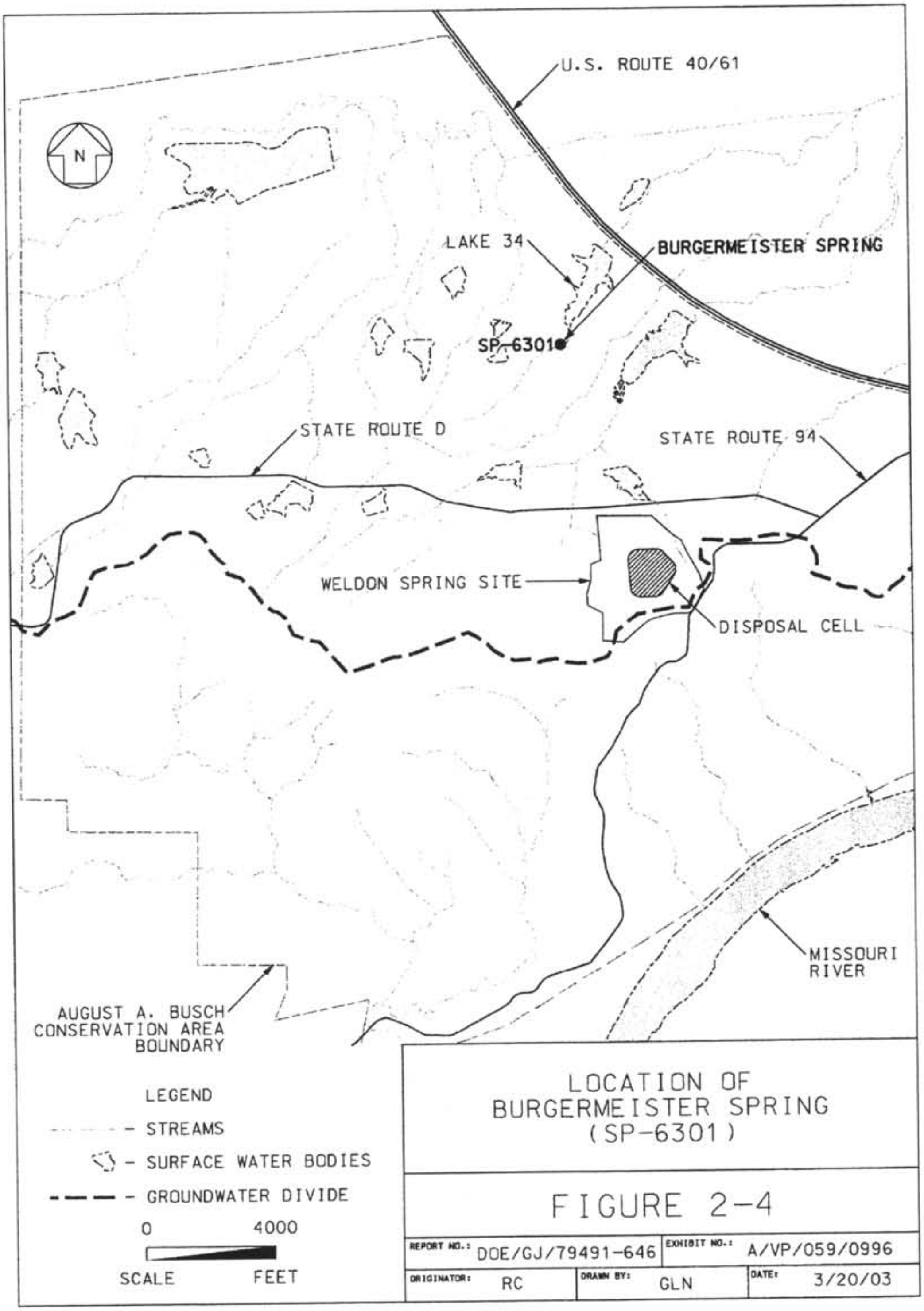

Figure 2-4 Location of Burgermeister Spring (SP-6301)

3. BASELINE MONITORING

In accordance with 40 CFR 264.97, baseline monitoring was conducted to obtain data that represents the quality of groundwater that has not been affected by leakage from the disposal cell. The intent was to establish a baseline data set that could be used in statistical comparisons with detection monitoring data, in accordance with regulatory requirements, to detect and characterize hazardous constituents in the uppermost aquifer that may be due to leakage from the disposal cell.

Review of the initial approach to baseline monitoring and the groundwater system beneath the chemical plant has indicated that in some cases an established baseline may not be appropriate for monitoring of the disposal cell at the Weldon Spring site. The shallow aquifer beneath the chemical plant has been impacted by previous operation of the former ordnance works and the uranium feeds material plant. This limits the reliability of results obtained using the statistical methods specified in the Subpart F regulations to evaluate long term monitoring data, which is discussed further in Section 4.7 and Appendix B. It is expected that groundwater conditions for the contaminants of concern for the Groundwater Operable Unit (nitrate, uranium, trichloroethylene, and nitroaromatic compounds) will improve over time due to source removal activities. Baseline values established for these contaminants using prior data may be biased high due to existing groundwater contamination or contamination resulting from contaminated soil remediation. Later comparisons to this baseline may mask trends in the groundwater.

3.1 Initial Baseline Monitoring

Baseline monitoring of locations MW-2032, MW-2045 through MW-2048, and SP-6301 was conducted throughout 1997 and early 1998, prior to waste placement activities. Four replicate samples were obtained from each location on a quarterly basis for approximately one year (i.e., five separate sampling events resulting in twenty individual samples per well). The initial baseline data indicated a large degree of temporal and spatial variability in water quality at the monitoring locations, as evidenced by the wide range of mean concentrations among monitoring locations and the high standard deviations calculated for many of the parameters. This variability is due to several contributing factors, such as the heterogeneity of the naturally occurring geochemistry, the variations in historical contaminant distribution throughout the site, and the unpredictable flow patterns in the fractured bedrock environment. Thus, the baseline conditions represented by the data were actually an indication of the groundwater quality at a particular location over a particular time period, and not a definitive characterization of background as intended by the Subpart F regulations.

Baseline monitoring of wells MW-2051 and MW-2055 began in 2001 and 2002, respectively. Samples from these wells are considered to be representative of water quality not impacted by the disposal cell since previous groundwater and leachate monitoring have indicated no reason to suspect leakage from the cell. Elements of the baseline sampling at these two wells have been similar to those listed above for the original six locations, except that the sampling events have consisted of a single sample (i.e., no replicates other than for QC purposes).

3.2 Previous Leachate Monitoring Evaluation

Regulations contained in 40 CFR 264.301 require leachate to be monitored during the active operation and post-closure period of a hazardous waste landfill. Although not specifically addressed by groundwater monitoring regulations, leachate monitoring is discussed in this plan because of the need to correlate the two programs to effectively monitor the potential migration of contaminants from the disposal cell.

Leachate production and analytical data have been collected routinely since waste placement activities began, in accordance with the *Disposal Cell Leachate Monitoring Plan* (Ref. 5) and the *Long-Term Stewardship Plan for the Weldon Spring, Missouri, Site* (Ref. 6). Samples were collected at least quarterly and analyzed for the entire list of parameters shown in Table 3-1. A summary of the average and maximum concentrations of analytical constituents detected in the leachate since the sump was completed (2000) is also presented in Table 3-1.

Table 3-1 Leachate Monitoring Data (10/18/00 to 5/8/02)

Parameter	Units	Concentration in Leachate (10-18-2000 to 5-8-2002)	
		Average	Maximum
Chloride[(b)]	(mg/l)	30.40	38.80
Fluoride[(b)]	(mg/l)	0.24	0.29
Nitrate-N[(b)]	(mg/l)	0.56	3.10
Sulfate[(b)]	(mg/l)	94.63	163.00
Aluminum	(μg/l)	33.12	70.50
Antimony	(μg/l)	ND	ND
Arsenic[(b)]	(μg/l)	3.73	9.36
Barium[(b)]	(μg/l)	606.88	832.00
Beryllium	(μg/l)	0.41	0.92
Cadmium	(μg/l)	ND	ND
Calcium	(mg/l)	176.25	198.00
Chromium[(b)]	(μg/l)	ND	ND
Cobalt[(b)]	(μg/l)	17.23	25.90
Copper	(μg/l)	3.48	9.90
Iron[(b)]	(μg/l)	12,083.00	22,100.00
Lead[(b)]	(μg/l)	ND	ND
Lithium	(μg/l)	7.99	13.20
Magnesium	(mg/l)	52.41	55.70
Manganese[(b)]	(μg/l)	5,396.00	9,970.00
Mercury	(μg/l)	ND	ND
Molybdenum	(μg/l)	5.82	7.75
Nickel[(b)]	(μg/l)	9.71	14.70
Potassium	(mg/l)	5.40	6.29

Table 3-2 Leachate Monitoring Data (10/18/00 to 5/8/02) (Continued)

Parameter	Units	Concentration in Leachate (10-18-2000 to 5-8-2002)	
		Average	Maximum
Selenium[b]	(μg/l)	1.24	3.95
Silver	(μg/l)	ND	ND
Sodium	(mg/l)	69.49	77.10
Thallium[b]	(μg/l)	3.45	10.60
Vanadium	(μg/l)	0.99	2.00
Zinc	(μg/l)	22.76	40.90
C.O.D.[b]	(mg/l)	28.60	35.00
Cyanide	(μg/l)	2.91	6.10
T.D.S.[b]	(mg/l)	867.20	970.00
T.O.C.[b]	(mg/l)	9.42	10.50
1,3,5-TNB[b]	(μg/l)	ND	ND
1,3-DNB[b]	(μg/l)	ND	ND
2,4,6-TNT[b]	(μg/l)	ND	ND
2,4-DNT[b]	(μg/l)	ND	ND
2,6-DNT[b]	(μg/l)	ND	ND
Nitrobenzene[b]	(μg/l)	ND	ND
Gross alpha	(pCi/l)	66.44	180.00
Gross beta	(pCi/l)	28.56	59.60
Ra-226[b]	(pCi/l)	0.32	0.68
Ra-228[b]	(pCi/l)	0.60	1.37
Th-228[b]	(pCi/l)	0.10	0.34
Th-230[b]	(pCi/l)	0.23	0.36
Th-232[b]	(pCi/l)	0.09	0.25
Total Uranium[b]	(pCi/l)	75.54	278.00
Pesticides	(μg/l)	ND[a]	0.26
PCBs[b]	(μg/l)	ND	ND
PAHs[b]	(μg/l)	ND	ND
VOCs	(μg/l)	ND[a]	5.20

Notes:

ND = non-detect

[a] All data were reported as non-detect, except for 3 or 4 isolated detections of individual compounds.

[b] These parameters are retained for leachate analysis as of the date of this plan.

3.3 Evaluation of Baseline Data

The original disposal cell monitoring plan specified that groundwater and surface water samples obtained under the plan be analyzed for all constituents presented in Table 3-2. This comprehensive list included general water quality indicator parameters (e.g., pH, temperature, total organic carbon, etc.), chemical and radiological contaminants, and naturally occurring constituents. The list included many parameters in addition to those that would be considered "hazardous constituents" under 40 CFR 264.93, and provided the basis for a thorough assessment of groundwater quality in the vicinity of the cell.

It was anticipated that the original list of analytical parameters would be evaluated periodically and modified as necessary to eliminate constituents that could provide no conclusive information regarding the presence of hazardous constituents due to a potential breach in the cell liner system. The first such modification was instituted in December 1999, after the initial baseline data had been evaluated and the detection monitoring program had begun (Ref. 7). Several parameters were eliminated from the list due to the lack of measurable detections in either the groundwater or the leachate, or because they were naturally occurring parameters that were not site contaminants of concern (see footnote "a" on Table 3-1).

Table 3-3 Constituents Monitored in Groundwater and Surface Water

General Indicator Parameters	Contaminants				
	Metals	Nitroaromatic Compounds	Radiological	Inorganic Ions	Other
pH[b]	Aluminum[c]	**1,3,5-TNB**[b]	**Radium-226**[b]	**Chloride**[b]	**PCBs**[a][b]
Temperature[b]	Antimony[c]	**1,3-DNB**[b]	**Radium-228**[b]	**Fluoride**[b]	**PAHs**[a][b]
Specific Conductance[b]	**Arsenic**[b]	**2,4,6-TNT**[b]	**Thorium, Isotopic**[b]	**Nitrate-N**[b]	VOCs[a]
COD[b]	**Barium**[b]	**2,4-DNT**[b]	**Uranium, Total**[b]	**Sulfate**[b]	Pesticides[c]
Cyanide[c]	Beryllium[a]	**2,6-DNT**[b]			
TDS[b]	Cadmium[a]	**Nitrobenzene**[a][b]			
TOC[b]	Calcium[a]				
TOX[c]	**Chromium**[b]				
	Cobalt[b]				
	Copper[c]				
	Iron[a][b]				
	Lead[b]				
	Lithium[c]				
	Magnesium[c]				
	Manganese[a][b]				
	Mercury[a]				
	Molybdenum[c]				
	Nickel[b]				
	Potassium[a]				
	Selenium[b]				
	Silver[c]				
	Sodium[a]				
	Thallium[a][b]				
	Vanadium[c]				
	Zinc[c]				

COD Chemical Oxygen Demand
TDS Total Dissolved Solids
TOC Total Organic Carbon
VOCs Volatile Organic Compounds
TOX Total Organic Halogen
PCBs Polychlorinated Biphenyls: Aroclor 1248, 1254, 1260
PAHs Polyaromatic Hydrocarbons: benz(a)anthracene, benzo(b)fluorancene, benzo(k)fluorancene, benzo(a)pyrene, chrysene, indeno(1,2,3-cd)pyrene

[a] These parameters were deleted from the list in December 1999 because either they had not been detected previously in any measurable quantities or they were naturally occurring parameters that were not contaminants of concern (Ref. 7).
[b] These parameters are retained or reinstated for groundwater and surface water analysis as of the date of this plan.
[c] These parameters are eliminated as of the date of this plan.

3.3.1 Identification of Long-Term Monitoring Parameters

This revision further modifies the list of groundwater monitoring parameters based on a review of the Chemical Plant and Quarry Bulk Waste Operable Units contaminants of concern, materials known to be present in the disposal cell waste, and leachate analytical data. The following contaminants of concern were identified in wastes from the chemical plant and/or the quarry bulk waste: arsenic, chromium, lead, nickel, selenium, thallium, nitroaromatic compounds (specifically 2,4,6-DNT), radium, thorium, uranium, polychlorinated biphenyls (PCBs), and polyaromatic hydrocarbons (PAHs) (Refs. 1 and 8). In addition, barium, manganese, and selenium were determined to be present in the water treatment processing wastes during the remediation of contaminated surface water. As leachate analytical data have become available, the following constituents have been identified as being present at relatively higher concentrations in the leachate than in the underlying groundwater: arsenic, barium, cobalt, iron, manganese, uranium, and COD. These parameters are important to the cell monitoring network because a breach of the cell liner system could result in detectable increases in the levels of these constituents in the groundwater.

Since the above contaminants are known to be present in the disposal cell waste, it is possible that they may become constituents in the cell leachate and, if there is a breach in the system, eventually be detected in the underlying groundwater. Thus, the above contaminants are identified as monitoring parameters for this program.

3.3.2 Identification of Signature Parameters

Detection monitoring data obtained from the cell well network from 1998 through 2001 were evaluated using several of the suggested statistical methods in an attempt to identify statistically significant evidence of contamination due to the disposal cell. Results of these evaluations, which are summarized in Appendix B, demonstrate the uncertainties associated with applying the prescribed methods to data from an aquifer with preexisting contamination and where a high degree of spatial variation in contaminant distribution exists among the monitoring wells. Each type of evaluation resulted in numerous "false positive" statistical failures that, rather than providing reliable and conclusive evidence of cell leakage, were attributable to fluctuations in preexisting groundwater contamination.

The list of monitoring parameters in Table 3-2 includes indicator parameters and waste constituents that for an uncontaminated aquifer would provide a reliable indication of the presence of hazardous constituents in groundwater due to leakage from the disposal cell. However, most of these parameters are already present in the groundwater at higher levels than in the leachate, either naturally or due to historical contamination, or are not present in either the groundwater or the leachate at concentrations above the detection limit. Thus, most of the parameters on this list are not able to provide conclusive evidence of cell leakage since impacts from the leachate would not cause detectable changes in the underlying groundwater.

The most reliable means of detecting potential impacts due to leakage of the disposal cell is to focus on parameters that exist at significantly higher concentrations in the leachate than in the groundwater. An increasing trend in these parameters in the groundwater would be detectable and, most likely, attributable to cell leachate since all other sources have been remediated.

To this end, the following constituents have been identified as "signature parameters" for the disposal cell detection monitoring program: barium, uranium, iron, and manganese. All four of these parameters have been detected at concentrations at least an order of magnitude higher in the leachate (Table 3-1) than in the underlying groundwater or Burgermeister Spring (with the exception of uranium), which enhances the reliability of any conclusions that are drawn based on fluctuations in groundwater constituents. Increasing trends of these four parameters in the groundwater will be considered a signature of cell leachate that has migrated to the underlying aquifer and additional actions will be taken as described in Section 4.7. also, these four parameters are naturally occurring and with the exception of uranium should not change via attenuation overtime. Uranium, a contaminant of concern for the Groundwater Operable Unit, is expected to attenuate with time where uranium impact occurs. However, the activity measured in the disposal cell monitoring wells is similar to background and likely will not change substantially over time. It is anticipated that the list of signature parameters may be modified, as necessary, based on future changes in leachate and/or groundwater concentrations.

It should be noted that the uranium concentrations in Burgermeister Spring can be similar or higher than those exhibited in the leachate. This location is impacted by not only contaminated groundwater originating from the Raffinate Pit area, but also residual contamination that is present in the losing stream segment that extends from the Ash Pond area of the site to Burgermeister Spring. Increasing trends in uranium should not be used as the only indicator of possible leakage from the disposal cell.

3.4 Statistical Analysis of Data

3.4.1 Distribution of Data

The data for the signature parameters at the cell wells locations were examined to determine whether the data is normal or log-normal (Appendix B). The data shows a stronger evidence of log-normality than normality. However, to demonstrate that there is little difference in the method used to calculate the baseline tolerance limits, values were calculated for the signature parameters at three of the locations using six methods. The methods used were: EPA guidance suggested method on normal and log-normal data, tolerance limits on normal and log-normal data, and the mean plus 3 standard deviations on normal and log-normal data. All of the data from each location was used in this evaluation. The values calculated using the six methods yielded similar values for each of the signature parameters. Based on the evaluation (Appendix B), it is recommended to maintain the existing methodology of calculating baseline tolerance limits for the signature parameters and assume the data is distributed normally. Every 5 years, likely in conjunction with the CERCLA five-year reviews, the distribution of the data will be reevaluated.

3.4.2 Revised Baseline Tolerance Limits

Tolerance limits for signature parameters have been calculated using the dataset from 1997 through 2002, using 95% confidence and 95% coverage, based on the assumption that the data are normally distributed (Table 3-3). In the case of the newer wells (MW-2051 and MW-2055), the available data used is fairly small: however the tolerance limits for these wells are representative of groundwater conditions at these locations. Every 5 years, likely in conjunction with the CERCLA five-year reviews, the baseline tolerance limits will be recalculated.

Table 3-3 Baseline Tolerance Limits for Signature Parameters in Groundwater and Surface Water

Location	Signature Parameter			
	Barium (μg/l)	Iron (μg/l)	Manganese (μg/l)	Uranium (pCi/l)
MW-2032	377	1,125	57	6.4
MW-2046	277	1,578	187	1.8
MW-2047	471	1,485	171	2.7
MW-2051	285	2,896	265	4.5
MW-2055	98	10,579	179	7.5
SP-6301	180	2,608	88	159

In calculating these values, results reported as non-detect (ND) or less than the detection limit (DL) were assigned a value of one-half the DL. Estimated values less than the detection limit, when reported, were used rather than one-half the DL.

In accordance with the U. S. EPA guidance on *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (Ref. 10), the following formula was used to calculate baseline tolerance limits (BTLs):

$$BTL = x + k(s)$$

where: x = arithmetic mean of the baseline data
s = standard deviation of the baseline data
k = one-sided normal tolerance factor, based on number of values in the data set

The tolerance limits for each location using data collected through December 2002 is included in Appendix B. One-sided tolerance factors can be found in Table 5 - Appendix B of the EPA guidance (Ref. 10) and are also included in Appendix B.

4. DETECTION MONITORING PROGRAM

The goal of the detection monitoring program is to be able to detect releases of hazardous constituents from the disposal cell to the underlying aquifer. Detection monitoring is conducted in accordance with 40 CFR 264.98 throughout the life of the disposal cell to allow for the detection of hazardous constituents that may be migrating from the disposal cell.

The detection monitoring program, which began at this site in June 1998, has evolved since its inception as additional groundwater and leachate data have been obtained and evaluated in light of the relevant regulatory requirements. Resulting modifications to the plan have been incorporated through correspondence (Ref. 7 and 11), annual revisions to the site *Environmental Monitoring Plan* (Ref. 4), and this revision of the *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan*.

4.1 Sampling Locations

Samples will be collected from monitoring wells MW-2032, MW-2046, MW-2047, MW-2051, and MW-2055. Samples will also be collected from Burgermeister Spring (SP-6301).

4.2 Parameters

Samples collected from the monitoring wells and Burgermeister Spring will be analyzed for the list of parameters given in Table 4-1. Quality control sampling is discussed in Section 7.

Table 4-1 Detection Monitoring Parameter List for Groundwater and Surface Water

Radiological	Inorganic Ions	Metals	Nitroaromatic Compounds	Other	General Indicator Parameters
Radium-226 Radium-228 Thorium, Isotopic Uranium, Total *	Chloride Fluoride Nitrate (as N) Sulfate	Arsenic Barium * Chromium Cobalt Iron * Lead Manganese * Nickel Selenium Thallium	1,3,5-TNB 1,3-DNB 2,4,6-TNT 2,4-DNT 2,6-DNT Nitrobenzene	PCBs PAHs	pH Temperature Specific Conductance COD TDS TOC Turbidity

* Signature parameters (see Section 3.3.2)

4.3 Sampling Frequency

Each monitoring well and Burgermeister Spring will be sampled on a semiannual frequency. Samples will be collected during June and December of each year. This sampling frequency will provide an adequate dataset for use in developing a moving baseline for each location (Section 3.3), and assists in eliminating the spatial and temporal variability seen in earlier datasets. Burgermeister Spring will be sampled during baseflow conditions, which is the stage of spring discharge when the water is least influenced by active surface runoff. Samples will be collected no sooner than 1 week following the end of a precipitation event of sufficient intensity to result in surface runoff. The flow rate of the spring will be estimated and recorded at each sampling event.

The original disposal cell groundwater monitoring plan called for collecting four replicates at each monitoring location on a semi-annual basis. In 1999, the monitoring frequency was reduced to a single sample collected semi-annually from each location since independent replicates could not be collected within a short time period because of slow groundwater flow rates.

4.4 Groundwater Elevation Measurements

Groundwater elevations will be measured semiannually at each of the disposal cell monitoring well locations prior to each sampling event. Results for 1997 through 2002 are presented in Figure 4-1. Groundwater elevations have remained relatively constant since the wells were installed. Groundwater flow rates and flow directions will be evaluated annually. A presentation of the potentiometric surface and determination of the flow rates and directions for 1998 through 2002 are presented in Appendix C.

4.5 Precipitation Data

To support leachate monitoring activities at a regulated unit, Missouri Hazardous Waste regulations require the collection of local precipitation data. An onsite meteorological station was used to monitor daily and hourly precipitation until December 2001, as described in the *Environmental Monitoring Plan* (Ref. 4). More recent and future regional precipitation data (e.g., from the Spirit of St. Louis Airport in Chesterfield, MO) is obtained as needed through the National Oceanographic and Atmospheric Administration at the following internet address:

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4.6 Leachate Monitoring

Regulations contained in 40 CFR 264.301 require leachate to be monitored during the active operation and post-closure period of a hazardous waste landfill. Although not specifically addressed by groundwater monitoring regulations, leachate monitoring is discussed in this plan because of the need to correlate the two programs to effectively monitor the potential migration of contaminants from the disposal cell.

This plan revision modifies the leachate monitoring parameters to be the same as the list of parameters monitored in the groundwater. The leachate will continue to be monitored

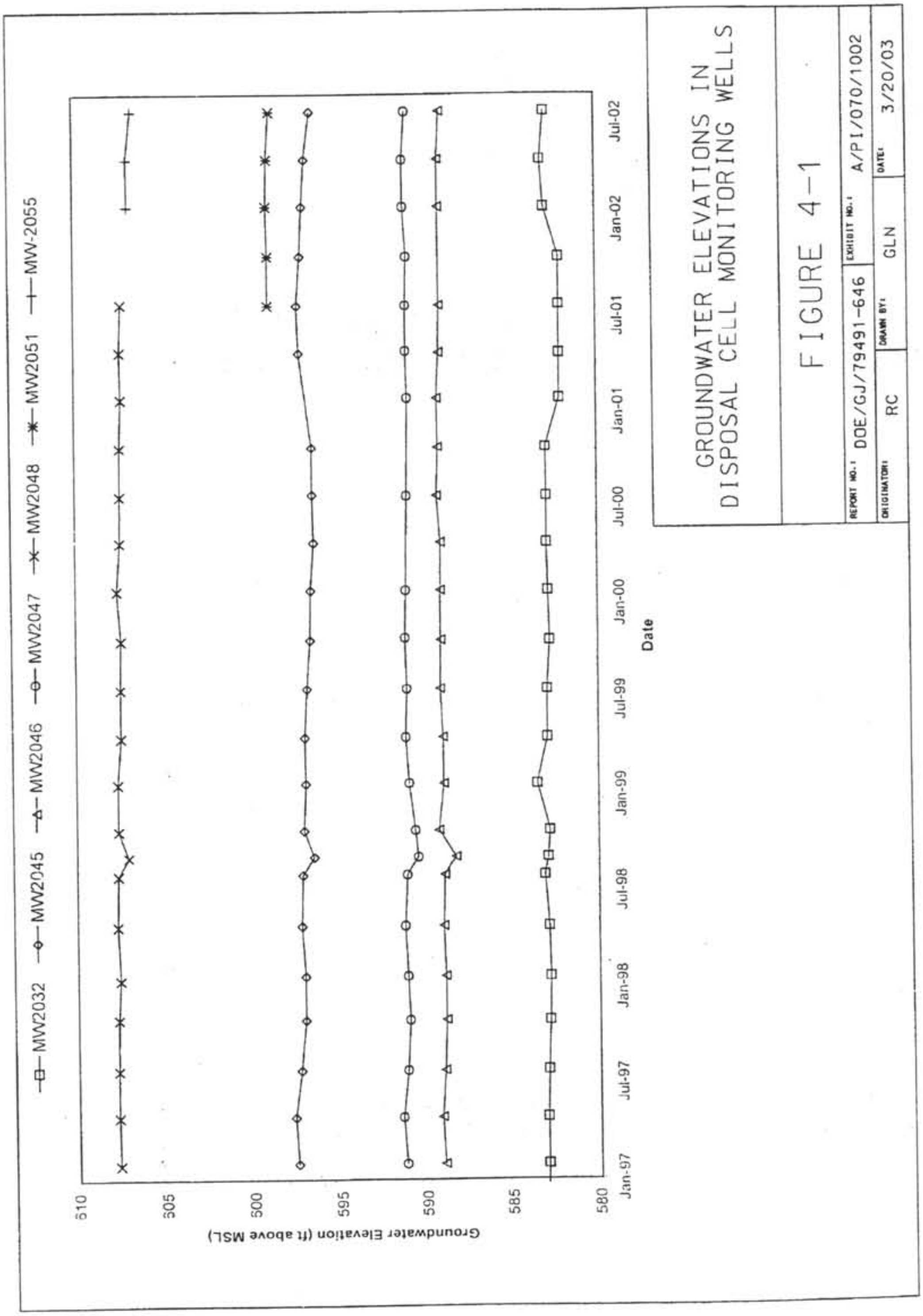

Figure 4-1 Groundwater Elevations in Disposal Cell Monitoring Wells

semiannually for the parameters outlined in Table 4-1. Samples will be collected in June and December of each year.

4.7 Detection Monitoring Data Review

4.7.1 Signature Parameters

Under the detection monitoring program, data for only the signature parameters from each monitoring event will be compared to baseline tolerance limits (Table 3-3) to track general changes in groundwater quality and determine whether statistically significant increases in these parameters has occurred. Previously, all the parameters were evaluated against the appropriate baseline tolerance limits and exceedances were attributable to variations in existing groundwater quality, interference from turbid samples, leaching of metals (chromium, nickel, cobalt, and molybdenum) from stainless steel (Type 316) well materials, sample preservation or analytical error, or inherent uncertainties in data that are less than five times greater than the detection limit.

For signature parameters (barium, iron, manganese, and uranium) that are determined to exceed the baseline tolerance limits, the following actions will be taken:

- The location will be resampled to confirm the exceedence. If the exceedence is not confirmed, detection monitoring will continue and no further action is necessary.
- If resampling results confirm the exceedence, a thorough evaluation will be performed to determine whether it is due to leakage from the disposal cell. This evaluation may include an assessment of groundwater gradients, review of leachate production and analytical data, review of sitewide monitoring data, and additional sampling. If it is shown that the upward trend is not due to leakage from the cell, a demonstration report will be prepared in accordance with the substantive requirements of 40 CFR 264.98, and detection monitoring will continue.

4.7.2 Other Parameters

The data from the remainder of the parameters will be reviewed to evaluate the general groundwater quality in the vicinity of the disposal cell and to determine if changes are occurring in the groundwater system. Data will be compared to the 3 most recent years of data to determine if statistically significant increases or trends in concentrations are present. A "moving average" approach, as discussed in the October 11, 1989 Federal Register (Ref, 9), is used to better reflect naturally occurring changes in site hydrogeology, minimize temporal variations, and account for the natural attenuation of contaminants in the shallow aquifer. Data will be considered statistically significant if it is greater than the arithmetic mean plus 3 times the standard deviation for each location.

Data that are determined to be statistically significant will be evaluated as follows:

- The location will be resampled to confirm the exceedence. If the exceedence is not confirmed, no further action is necessary.
- If results of the resampling confirm the exceedence, the data will be compared to the leachate data. If the leachate data do not indicate that the exceedence could be the result of leakage from the cell (parameter is not elevated in the leachate), an assessment of the analytical data and review of sitewide monitoring data will be performed. If the exceeding parameter is a contaminant of concern for the Groundwater Operable Unit (nitrate, nitroaromatic compounds, or trichloroethylene), this information will be evaluated under the monitoring program for the Groundwater Operable Unit at the chemical plant.
- If results of the resampling confirm the exceedence, the data will be compared to the leachate data. If the leachate data indicate that the exceedence could be the result of leakage from the cell (parameter is also elevated in the leachate), the entire disposal cell monitoring network will be sampled for the full list of parameters shown in Table 3-2. A revised monitoring plan, which incorporates the results of the enhanced sampling and outlines the specific details of the compliance monitoring program (Section 5), and an engineering feasibility plan for corrective action will be prepared in accordance with substantive requirements of 40 CFR 264.99.

4.7.3 Leachate

Analytical data from the leachate will be compared to the analytical data from the monitoring well network to determine the adequacy of the signature parameters for this plan. If the composition of the leachate changes substantially, a parameter may be included or removed from the signature parameter list. If the concentration of a parameter decreases so that it is not distinguishable from concentrations (similar in concentrations) in groundwater, that parameter will be removed from the signature parameter list. Conversely, if the concentration of a parameter increases to a level that distinguishable from the concentrations in groundwater (order of magnitude greater), it would warrant its inclusion in the signature parameter list. This evaluation will be performed annually.

4.8 Detection Monitoring Reporting

4.8.1 Annual Reporting

Disposal cell monitoring data are reported annually in the *Weldon Spring Site Environmental Reports* (Refs. 12, 13, 14, and 15). Data to be reported includes all detectable analytical results, as well as groundwater flow rate and direction. However, since only analytical results were reported prior to 2002, groundwater flow rates and direction for the years 1998 through 2002 are included in Appendix C of this plan.

Confirmed exceedances of signature parameters are investigated further by evaluating water levels and precipitation data and reviewing historical analytical and field monitoring data to determine the likely cause and contributing factors. A summary of the exceedances and results of the investigations are reported both in the annual site environmental report and in the quarterly *Federal Facilities Agreement (FFA) Report.*

4.8.2 Demonstration Reporting

A demonstration report will be prepared if it is shown that an upward trend in a signature parameter is not due to leakage from the cell. This report will document the evaluation used to derive the conclusion that leakage has not occurred from the disposal cell. This evaluation may include an assessment of data quality, groundwater gradients, review of leachate production and analytical data, review of sitewide monitoring data, and additional sampling.

5. COMPLIANCE MONITORING AND CORRECTIVE ACTION PROGRAMS

If it is determined that leakage from the cell has resulted in deterioration of the groundwater at the chemical plant, a review of the remedy will be necessary. This is based on the condition that the remedy is not behaving as expected and may no longer be protective of human health and the environment. Modifications or actions would be documented under CERCLA and would be consistent with 40 CFR 264.100, if appropriate. Identification of applicable or relevant and appropriate regulations (ARARs) would be make at that time and my include groundwater protection standards as outlined in 40 CFR 264.92, if appropriate. At that time, a modification of this program would be documented in collaboration with the U.S. Environmental Protection Agency – Region VII and the Missouri Department of Natural Resources. The monitoring program will continue as prescribed in Section 4 and the nature and extent of the release will be investigated.

6. QUALITY CONTROL

6.1 Sampling and Analysis Procedures

The general groundwater monitoring requirements in 40 CFR 264.97 specify that the monitoring program for a regulated unit must incorporate consistent, reliable, appropriate, and accurate sampling and analysis procedures. The *Ground Water and Surface Water Sampling and Analysis Plan for GJO Projects* (Ref. 16) establishes the data quality requirements for all environmental data collected at the Weldon Spring Site, including data obtained in support of the disposal cell groundwater monitoring plan. Standard operating procedures (SOPs) have been developed and implemented to provide consistency in sample collection methodology and documentation of environmental activities. The appropriate sections of the *Sampling and Analysis Plan* identified below apply to all monitoring activities conducted under this plan.

6.1.1 Field Documentation

Water elevations, sample locations, water temperatures, and other physical parameters are recorded in the field. This information will be recorded and documented as provided in Section 4.3 of the *Sampling and Analysis Plan.*

6.1.2 Field Measurements and Equipment Calibration

Prior to sample collection, specific field parameters are measured. These include the physical parameters listed above and groundwater elevations. Procedures for obtaining these measurements and calibration of equipment are provided in Section 3.6 of the *Sampling and Analysis Plan.*

6.1.3 Sample Identification

All samples, including quality control samples, collected under this monitoring plan are identified with a unique sample identification number, according to Section 6.0 of the *Sampling and Analysis Plan.*

6.1.4 Sample Collection, Preparation, and Preservation

Procedures for collecting groundwater and spring samples are defined in Section 3.7 of the *Sampling and Analysis Plan.* All samples collected under this plan will be unfiltered. Table 7-1 lists the general sample preparation and preservation requirements for each parameter. All samples taken are collected in certified-clean plastic, clear glass, or amber glass bottles, as appropriate for analysis. Sample packaging and shipping conforms to Section 6.0 of the *Sampling and Analysis Plan.*

Table 6-1 Sample Preparation and Preservation Requirements

ANALYSIS	SAMPLE CONTAINER SIZE/TYPE	PRESERVATION	HOLDING TIME[a]	VOLUME REQUIRED (Minimum)	MS/MD OR DU VOLUME REQUIRED
Nitroaromatic Compounds	1-liter amber glass	4°C (ice)	7 days	1000 ml	3000 ml
Metals	1-liter plastic	HNO_3 - pH of <2	6 months (Hg: 28 days)	500 ml	1000 ml
Sulfate Fluoride Chloride TDS	1-liter plastic	4°C (ice)	28 days (TDS-7 days)	300 ml	1000 ml
Uranium, total Thorium, isotopic Radium-226 Radium-228	4-liter plastic cubit	HNO_3 - pH of <2	6 months	4 liters	12 liters
PCBs	1-liter amber glass	4°C (ice)	7 days	1000 ml	3000 ml
PAHs	1-liter amber glass	4°C (ice)	7 days	1000 ml	3000 ml
Nitrate (as N) TOC TOX COD	500-ml amber glass	H_2SO_4 - pH of <2	28 days	300 ml	1000 ml
VOCs	40-ml vial	4°C (ice) HCl - pH of <2	14 days	80 ml (2 vials)	160 ml (4 vials)

MS Matrix Spike; MD Matrix Spike Duplicate; DU Duplicate
HNO_3 – Nitric Acid; H_2SO_4 – Sulfuric Acid; HCl – Hydrochloric Acid
[a] Actual extraction/analysis holding times are variable. Samples should be shipped immediately after collection.

6.1.5 Chain-of-Custody

Chain-of-Custody forms are maintained for all environmental samples collected. The chain-of-custody process is detailed in Section 6.0 of the *Sampling and Analysis Plan.* This section also outlines specific instructions for ensuring that samples are not tampered with or altered prior to analysis.

6.1.6 Sampling Equipment Decontamination

All groundwater wells have dedicated bladder pumps and hoses. Other sampling equipment is decontaminated as necessary according to Section 7.0 of the *Sampling and Analysis Plan.*

6.1.7 Analytical Procedures

Analytical testing is conducted by either the GJO Analytical Chemistry Lab or by subcontracted laboratories (nitroaromatic compounds) that follow the EPA Contract Laboratory Program (CLP) requirements for metals and organic compounds, the EPA drinking water and radiochemical methodologies for other parameters, or alternate methods, as described in Section 5.0 of the *Sampling and Analysis Plan*.

Detection limits are specified in contracts established with the laboratories. In general, these detection limits follow CLP protocol and standard analytical methodology. Table 7-2 provides the detection limits and analytical methods used for the disposal cell groundwater monitoring program.

Table 6-2 Specified Detection Limits and Analytical Methods

Analytical Parameter	Analytical Method	Required Detection Limit
WET CHEMISTRY PARAMETERS		
Total Organic Halides	SW-846 9020A	0.5 mg/l
Chemical Oxygen Demand	EPA 410	5.0 mg/l
Total Organic Carbon	EPA 415.1	0.1 mg/l
Total Dissolved Solids	EPA 160.2	1.0 mg/l
RADIOLOGICAL CONSTITUENTS		
Total Uranium	ASTM 5174-91 (Fluorimetry or KPA) or equivalent	1.0 pCi/l
Isotopic Thorium	ASTM, EPA, EML or equivalent	0.2 pCi/l (each isotope)
Radium-226	ASTM, EPA, EML or equivalent	1.0 pCi/l
Radium-228	ASTM, EPA, EML or equivalent	5.0 pCi/l
NITROAROMATIC COMPOUNDS		
2,4-DNT	USATHAMA or EPA 8330	0.030 µg/l
2,6-DNT	USATHAMA or EPA 8330	0.010 µg/l
2,4,6-TNT	USATHAMA or EPA 8330	0.030 µg/l
1,3,5-TNB	USATHAMA or EPA 8330	0.030 µg/l
1,3-DNB	USATHAMA or EPA 8330	0.090 µg/l
Nitrobenzene	USATHAMA or EPA 8330	0.030 µg/l
INORGANIC IONS		
Nitrate-N	EPA 300/340	0.10 mg/l
Sulfate	EPA 300/375	2.0 mg/l
Fluoride	EPA 300/375	0.1 mg/l
Chloride	EPA 300/375	0.25 mg/l
METALS		
All	Contract Lab Program	Instrument Detection Limits (IDLs)
ADDITIONAL CONSTITUENTS		
PAHs	SW846 8310	5.0 µg/l (each parameter)
PCBs	EPA 608 or SW846 8081a/8082	1.0 µg/l (each parameter)

6.2 Quality Control Samples

Quality control (QC) samples are collected to ensure consistent and accurate performance of sample collection and laboratory analysis activities. Section 4.0 of the *Sampling and Analysis Plan* defines the QC samples to be collected, the recommended collection frequency, and the collection procedures. Table 7-3 lists the types of quality control samples that will be collected under this plan and identifies their purpose in support of the monitoring program.

Table 6-3 Field Quality Control Sample Summary

QUALITY CONTROL SAMPLE TYPE	FREQUENCY	PURPOSE
Duplicate/Matrix Spike/Matrix Spike Duplicate	1 per 20 samples	Assess laboratory method variability.
Field Replicate	1 per 20 samples	Assess matrix variability.
Deionized Water Blank	1 per month	Assess quality of deionized water used to decontaminate water level meter.

6.3 Data Review

The *Sampling and Analysis Plan* (Section 5 and Appendix B) describes the verification, validation, and technical review process to which data obtained under this plan are subject. Analytical data obtained under this plan are maintained in the GJO SEEPro database. This database allows for data input, storage, and retrieval so that the statistical analyses required under this plan can be performed.

7. REFERENCES

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7. *Disposal Cell Detection Monitoring Status.* Letter from D. Steffen to S. McCracken, December 3, 1999.

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17. U.S Environmental Protection Agency, Office of Solid Waste. *RCRA Ground-Water Monitoring: Draft Technical Guidance.* EPA/530-R-93-001. Washington, D.C. November 1992

APPENDIX A

Monitoring Well Installation Logs

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

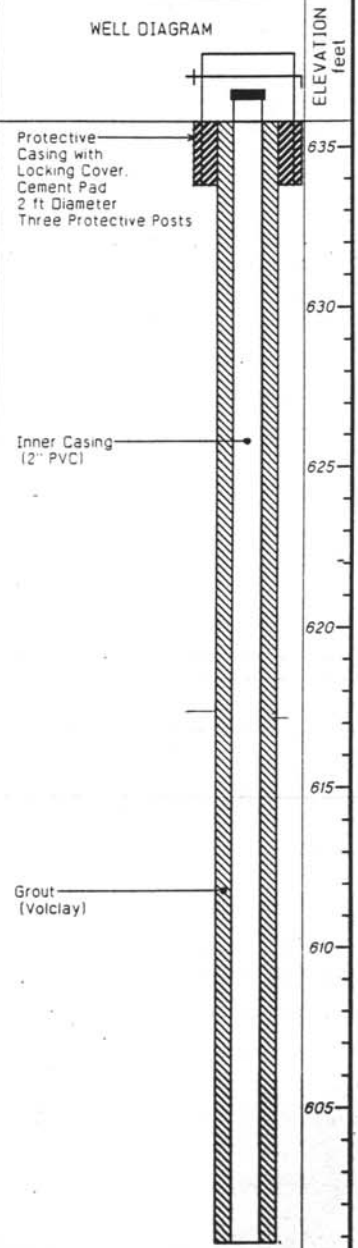
HOLE NUMBER	MW-2032
SHEET 1 OF 2	
NORTH (Y):	1044508.74
EAST (X):	755016.39
TOC ELEVATION	637.48
GROUND ELEVATION	635.81
STICKUP	1.67
HYDR CONDUCTIVITY (cm/sec)	K= N/A

WELL STATUS/COMMENTS	ACTIVE
LOCATION	27'SW MW2023, 30' SE MW2024 (AEC)
DRILLING CONTRACTOR	HANIBAL TESTING LABS
DRILL RIG MAKE & MODEL	CME 55/75, NO WIRELINE
HOLE SIZE & METHOD	7 5/16 "O.D. 4 1/4" I.D.
ANGLE FROM HORIZONTAL & BEARING	90
BOTTOM OF HOLE (TD)	60.0
DRILL FLUIDS & ADDITIVES	WATER
CASING TYPE, DEPTH, SIZE	2" PVC
BEDROCK	48.5
DATE START	08-11-1989
DATE FINISH	07-15-1989
WATER LEVELS & DATES	▽12-04-92 ▼05-31-91

DEPTH (FT.) FROM GROUND ELEV. TO

LITHOLOGY BY A.BENFER

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
0				ML	CLAYEY SILT, dark gray to brownish yellow, low plasticity, damp, medium stiff, MnOx & FeOx.	Qlv
	SS-1	10/18"	7			
5	ST-2	27/30"		CL	SILTY CLAY, brownish yellow, medium plastic, 20% sand, trace rounded gravel, moist, very stiff. Becomes mottled with light gray and MnOx at 9 feet. Light yellowish brown with caliche, very stiff with silt pockets at 12.5.	Qct
	SS-3	15/18"	10			
10	ST-4	25/30"				
	SS-5	16/18"	9			
15	ST-6	24/30"				
	SS-7	18/18"	14		SILTY CLAY, brownish yellow, medium plasticity, 10% sand, fine gravel, stringers of light gray and MnOx, damp, hard. ft.	
20	ST-8	30/30"				
	SS-9	18/18"	16	CH	SILTY CLAY, as above, highly plastic.	
25	ST-10	11/12"		ML CL	SILT to SILTY CLAY, light brownish gray, medium plasticity, moist, very stiff. Minor gravel, angular, up to 1.5 inches at 30 feet.	
	SS-11	18/18"	13	CH	CLAY, brownish yellow, highly plastic, moist, very stiff, contains 5% sand, 15% fine gravel and MnOx.	
30	ST-12	18/18"	34		Minor gravel, angular, up to 1.5 inches at 30 feet.	
	SS-13	13/18"	18			
35	SB-14	16/18"	33	ML		



■ Sample Interval □ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

HOLE NUMBER: MW-2032

SHEET 2 OF 2

NORTH (Y): 1044508.74

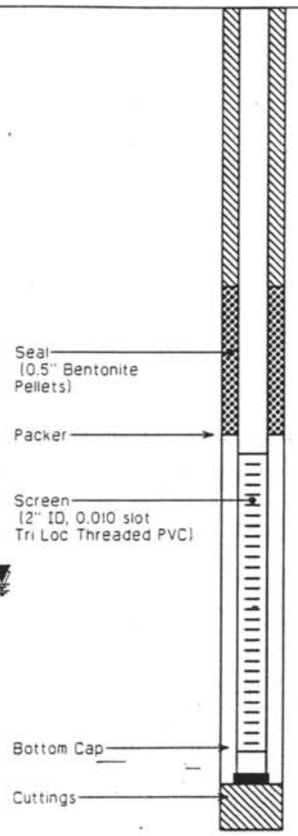
EAST (X): 755016.39

WELL STATUS/COMMENTS: ACTIVE

LOCATION: 27' SW MW2023, 30' SE MW2024 (AEC)

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
		16/18"		ML	SILT, reddish yellow, low plasticity, abundant FeOx, minor gravel, very soft.	Qct
	SS-15	16/18"	24	GC	CLAYEY GRAVEL, yellowish red, angular white chert gravel, plastic, moist, dense, hard.	pPr
40	SB-16	12/18"	39		Highly fractured and weathered chert and 25% clay, very moist at 40 feet. Stiff at 45 feet.	
45	SS-17	18/18"	15			
	NQ-1	7/54"	10	GC chrt	CHERT fragments, white, weathered, minor MnOx and FeOx.	MDksw
50						
	NQ-2	66/66"	64	lms	LIMESTONE, yellow, silty, moderately weathered, contains finely disseminated oxidized pyrite. Chert, white, fresh.	MDkw
55					LIMESTONE and CHERT, as above, 50% chert distributed throughout providing a breccia appearance. Chert, white to bluish to pinkish.	
	NQ-3	18/18"	57			
60					Total depth 60.0 feet.	
65						
70						
75						

WELL DIAGRAM



ELEVATION feet: 600, 595, 590, 585, 580, 575, 570, 565

Sample Interval · No Sample Taken · minimum · maximum · average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

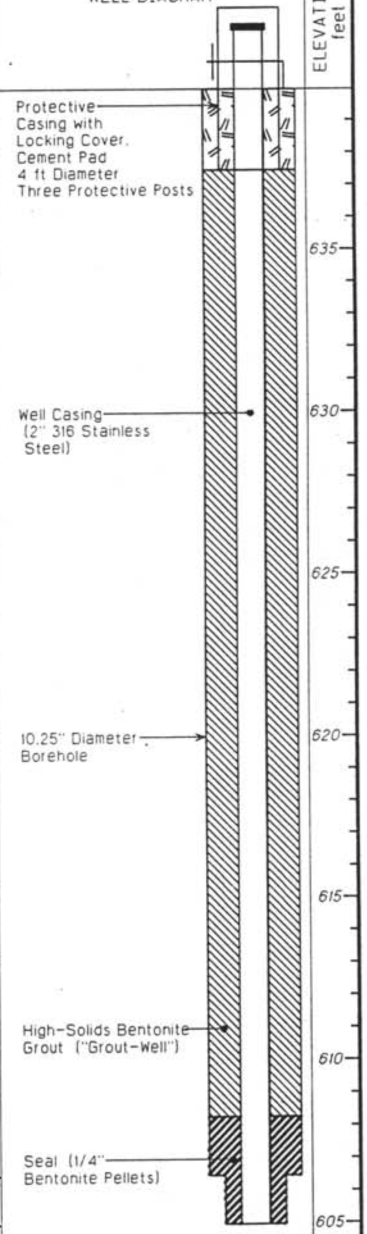
HOLE NUMBER	MW-2045 (C2)
SHEET 1 OF 2	
NORTH (Y):	1043883.98
EAST (X):	755615.24
TOC ELEVATION	641.82
GROUND ELEVATION	639.95
STICKUP	1.87
HYDR CONDUCTIVITY (cm/sec)	K= 1.44x10^{-3} (Packer Test)

WELL STATUS/COMMENTS	ACTIVE
LOCATION	Downgradient of Disposal Cell
DRILLING CONTRACTOR	GEOTECHNOLOGY INC.
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	10 1/4" HSA to 33.5' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	90
DEPTH (FT.) FROM GROUND ELEV. TO: BOTTOM OF HOLE (TD)	50.0
BEDROCK	33.5
WATER LEVELS & DATES	▽ ▼
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
DATE START	10-15-1996
DATE FINISH	11-1-1996

LITHOLOGY BY P. PATCHIN/S. VINCENT

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
0	CME-1	42/42"		TS	0-.2' TOPSOIL, brownish gray with roots.	Qp
				CL ML	.2 - 1.0' SILTY CLAY/CLAYEY SILT, mottled yellowish brown (10YR 5/6) with minor brownish yellow (10YR 6/8), non-plastic to low plasticity, slightly moist, very stiff (pp=3.0), roots.	Qrx
				CH	1.0 - 1.9' SILTY CLAY/CLAYEY SILT color as above, nonplastic, dry to damp, hard (pp=4.0+), minor MnOx stain, roots, FeOx blebs.	Qfv
	CME-2	60/60"			1.9 - 5.8' SILTY CLAY, mottled yellowish brown (10YR 5/8), and minor grayish brown (10YR 5/2), medium to high plasticity, slightly moist, very stiff (pp=2.75), minor (<5%) angular chert gravel to 1/2".	Qfv
5				CL	5.8 - 18.0' SILTY, SANDY CLAY with GRAVEL, yellowish brown (10YR 5/8) with minor light brownish gray leaching along fractures, low plasticity, dry, hard (pp=4.5+), very sandy (v.fine) with approx. 5-10% gravel (v.fine to 2"+) which is rounded (igneous) and angular (limestone and chert), very fractured with abundant MnOx along fracts., gray granular CaCO3 in thin lenses at 15.0' and 17.5'.	Qct
	CME-3	60/60"				
10						
	CME-4	60/60"				
15						
	CME-5	48/48"		CL CH	18.0 - 20.0' CLAY, strong brown (7.5 YR 4/6) with minor reddish mottling, medium to high plasticity, slightly moist hard (pp=4.5+), little to no sand or gravel, grayish silty pockets (occasional), abund. FeOx nodules, abund. MnOx on fractures.	
20				CL	20.0 - 22.2' CLAY, slightly silty, mottled dark red (2.5YR 4/6) and minor light brownish gray (2.5YR 6/2), low plasticity, damp to slightly moist, very stiff (pp=2.25-3.25), very crumbly and blocky structure, waxy, with silty pockets from 21.0 - 22.2'.	pPr
	SS-6	11/11"	+50	GC	22.2' CLAYEY GRAVEL, color as above but with weathered chert gravel (60%-70%) to >2", very angular and "shattered". Chert gravel is generally white (10YR 8/1), hard to very hard, moderately weathered. Interstitial clay is as above, damp to slightly moist.	
25				CL GC	GRAVELLY CLAY/CLAYEY GRAVEL, (alternating broken chert gravel and clay with gravel), clays is strong brown (10YR 4/6), med. to high plasticity, slightly moist, very stiff, with minor fine chert gravel as above.	
	SS-7	12/24"	43			
30					Top of Bedrock @ 33.5 ft.	Mbksw
	RUN-1	78/120"	30	lms chrt	33.5 - 43.7' ARGILLACOUS LIMESTONE AND CHERT, interbedded and brecciated (approximately 60/40). Limestone is grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2), mottled with	
35						

WELL DIAGRAM



Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

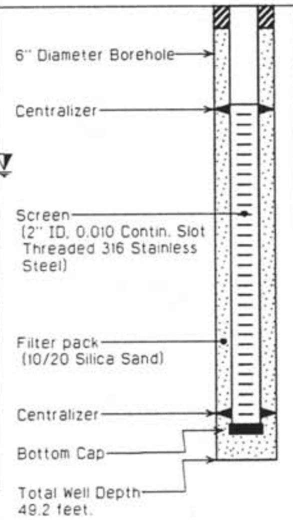
HOLE NUMBER	MW-2045 (C2)
SHEET 2 OF 2	
NORTH (Y):	1043883.98
EAST (X):	755615.24

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Downgradient of Disposal Cell

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT	ELEVATION feet
					lms chrt	very light gray (N8) chert. Limestone is fine to medium-grained, very argillaceous, thin-bedded, mod. hard, mod. weathered with vugs pinpoint to 1", abundant FeOx staining and closely fractured. Minor stylolites and fossils. Chert is brecciated and interbedded with limestone and as nodules (to 5"), very hard, fossiliferous with MnOx staining on micro-fractures and in matrix. "Strongly Weathered Burlington-Keokuk Limestone" from 34.0-39 ft. then "Weathered Burlington-Keokuk Limestone" to total depth.	MDksw	
40					lms chrt		MDkw	600
		RUN-2	70/72"	70		43.7 - 49.1' ARGILLACEOUS LIMESTONE AND CHERT, as above but increased clay content and very fine grained (micritic), less chert (approx. 30%), moderate to high porosity.		
45						Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TESTS 37.3 to 44.0 ft. K=1.4E-3 cm/sec 39.6 to 50.0 ft. k=8.8E-4 cm/sec		595
					chrt	49.1 - 50.0' CHERT, mottled very light gray (N8) and brownish gray (5YR 4/1), very hard, slightly weathered, closely fractured with heavy FeOx staining on fracture surfaces.		
50						Total cored depth 50.0 feet. Switched to 6" air rotary and reamed hole to 49.2'.		590
55						Note: Soil and rock color are indexed on the Muncell soil color chart.		585
60								580
65								575
70								570
75								565

WELL DIAGRAM



Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

HOLE NUMBER	MW-2046 (C3)
SHEET 1 OF 2	
NORTH (Y):	1044158.17
EAST (X):	755046.76
TOC ELEVATION	653.54
GROUND ELEVATION	649.77
STICKUP	3.77
HYDR CONDUCTIVITY (cm/sec)	$K = 4.85 \times 10^{-6}$ (Packer Test)

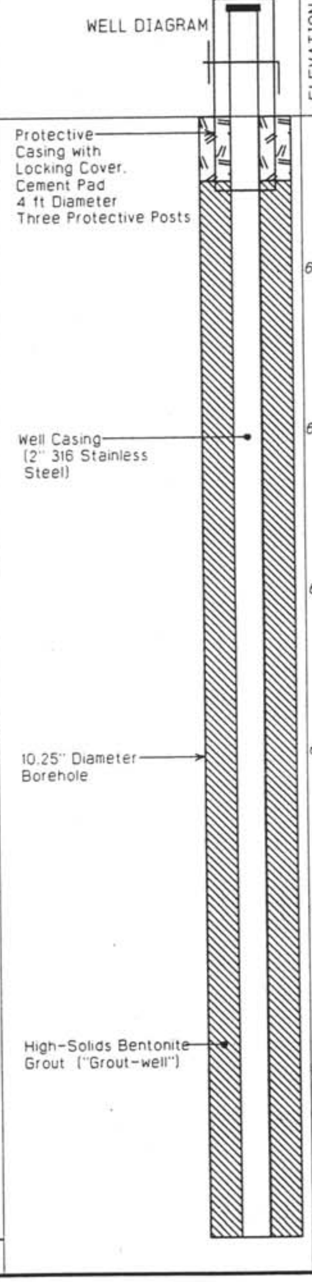
WELL STATUS/COMMENTS	ACTIVE
DRILLING CONTRACTOR	GEOTECHNOLOGY
HOLE SIZE & METHOD	10 1/4" HSA to 51.8' then 6" Air
DRILL FLUIDS & ADDITIVES	WATER/AIR
DATE START	11-5-1996
LOCATION	Upgradient of Disposal Cell
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
ANGLE FROM HORIZONTAL & BEARING	90
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
DATE FINISH	11-15-1996
BOTTOM OF HOLE (TD)	74.0
BEDROCK	51.8
WATER LEVELS & DATES	

DEPTH (FT.) FROM GROUND ELEV. TO:

LITHOLOGY BY: SEAN VINCENT/PAUL PATCHIN

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT	ELEVATION feet
				Fill	0 - 1.5' FILL, gravel drill pad (3" minus rock)	Fill	
	SS-1	18/24"	19	CL ML	SILTY CLAY/CLAYEY SILT, yellowish brown (10YR 5/6), low plasticity, slightly moist, very stiff (pp=3.0).	Qrx	
	SS-2	19/24"	18	CH	2.1 - 13.8' CLAY, mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2), medium to high plasticity, slightly moist, very stiff (pp=2.75).	Qfv	
5							645
	SS-3	24/24"	12				
	SS-4	24/24"	17		CLAY, as above, black MnOx staining is common.		
10							640
	SS-5	24/24"	20		CLAY, as above, very stiff (pp=3.5).		
	SS-6	24/24"	25	CL CH	13.8 - 32.0' SILTY CLAY, yellowish brown (10YR 5/8) with light greenish gray (5GY 7/1) along fractures, medium to high plasticity, approx. 5% angular chert gravel to 1" with trace subrounded to rounded igneous gravel, hard (pp=4.5), grading to higher silt and fine sand content with depth.	Qct	
15							635
	SS-7	24/24"	19				
	SS-8	24/24"	27				
20							630
	SS-9	24/24"	32				
	SS-10	24/24"	32	CL	SILTY CLAY, as above, medium plasticity, waxy appearance, hard (pp=4.0).		
25							625
	SS-11	24/24"	27				
	SS-12	24/24"	28				
30							620
	SS-13	24/24"	28		32.0 - 34.0' SILTY CLAY, as above but with red (2.5YR 5/6) color and includes occasional subangular to angular chert fragments.		
	SS-14	24/24"	29		34.0 - 37.5' SILTY CLAY, as above but color is yellowish brown (10YR 5/6) with light gray (10YR 7/2) silt in fractures, occasional FeOx nodules		615
35							

WELL DIAGRAM



Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

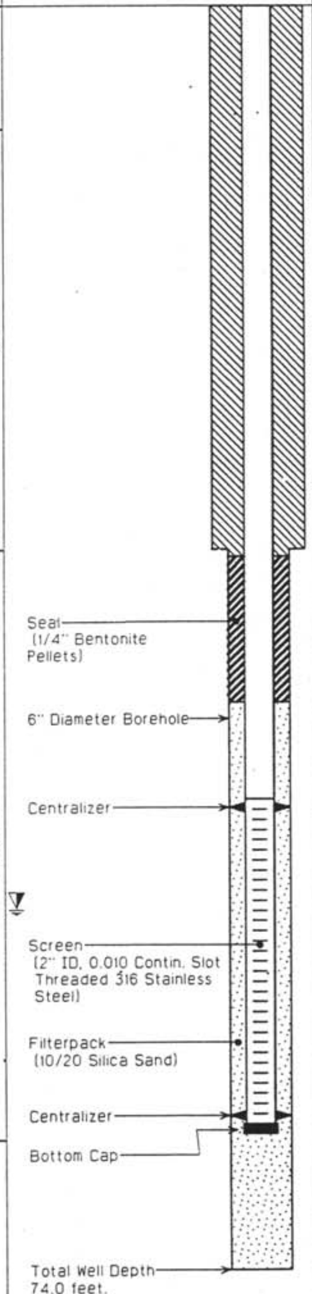
HOLE NUMBER	MW-2046 (C3)
SHEET 2 OF 2	
NORTH (Y):	1044158.17
EAST (X):	755046.76

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Upgradient of Disposal Cell

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery (0–100)	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT	ELEVATION feet
						CL	slightly moist, very stiff (pp=3.5).	Qct	
		SS-15	24/24"	16			37.5 - 38.8' SILTY CLAY, weak red (2.5YR 6/4) some fine sand, soft (pp=1.75).		
40		SS-16	11/11"	87+		GC Chrt	38.8 - 41.5' CLAYEY GRAVEL, dry, relict angular chert fragments, matrix is predominantly silt and fine sand.	dPr	610
		SS-17	24/24"	70			41.5 - 46.5' CLAYEY GRAVEL, angular white chert fragments to 2", hard to very hard, interstitial clay is dark red (2.5YR 4/8), moist.		
45		SS-18	24/24"	51			46.5 - 51.8' CLAYEY GRAVEL, as above but strong brown (7.5YR 5/8), increased weathering of chert gravel (coarse sand size to 1").		605
		SS-19	22/24"	19					
50		SS-20	20/24"	22					600
		SS-21	4/4"	>50			Top of Bedrock @ 51.8 ft.		
		RUN-1	60/72"	52		lms chrt	51.8 - 65.6' ARGILLACOUS LIMESTONE (65%) AND CHERT (35%), brecciated and interbedded together. Limestone is grayish orange (10YR 7/4), very fine-grained, thin to very thin-bedded, moderately hard, moderately weathered with occasional vugs, slight to moderate porosity, slightly fossiliferous, closely fractured with FeOx staining. Chert is very light gray (N8), very hard, very fossiliferous. "Weathered Burlington-Keokuk Limestone".	Mbkw	
55									595
		RUN-2	53/60"	80			Increased vugginess below 58.5 feet.		
60									590
							Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TESTS 55.2 to 63.5 ft. K < test method quantitation limit. 60.0 to 70.0 ft. K=4.9E-6 cm/sec		
		RUN-3	78/78"	59					
65									585
							65.6 - 70.0' ARGILLACEOUS LIMESTONE AND CHERT, as above but with less chert (25%), color is grayish orange (10YR 7/4) increased porosity and softer rock with silt on fractures. Chert is brecciated in "shattered"-looking schards. "Weathered Burlington- Keokuk Limestone"		
70							Total cored depth 70.0 feet. Switched to 6" air rotary and reamed hole to 74.0'.		580
							Note: Soil and rock color are indexed on the Muncell soil color chart. Split spoon sampler is 3" O.D., 2-1/2" I.D., therefore SPT results qualitative.		
75									575

WELL DIAGRAM



Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSMLOG-C

HOLE NUMBER	MW-2047 (C4)
SHEET 1 OF 2	
NORTH (Y):	1044105.67
EAST (X):	754487.53
TOC ELEVATION	640.30
GROUND ELEVATION	637.48
STICKUP	2.82
HYDR CONDUCTIVITY (cm/sec)	K= 8.03x10^{-6} (Packer Test)

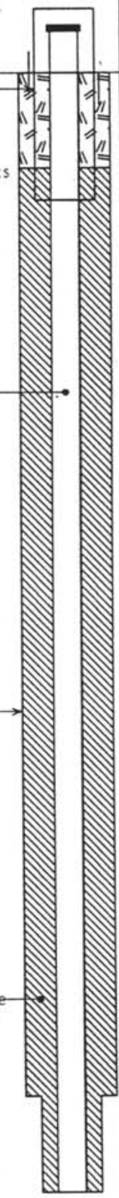
WELL STATUS/COMMENTS	ACTIVE
LOCATION	Upgradient of Disposal Cell
DRILLING CONTRACTOR	GEOTECHNOLOGY INC
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	10 1/4" HSA to 32.0' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	90
DEPTH (FT.) FROM GROUND ELEV. TO: BOTTOM OF HOLE (TD)	60.2
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
BEDROCK	44.5
DATE START	12-3-1996
DATE FINISH	12-10-1996
WATER LEVELS & DATES	▽ ▼

LITHOLOGY BY PAUL PATCHIN

SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
			Fill	0 - 4.5' FILL, 3/4" crushed rock to 1 ft, 3" clean rock to 3.5', then silty clay fill with limestone gravel to 4.5'.	Fill
SS-1	17/24"	31	ML	SILT, light gray (2.5Y7/2), nonplastic, dry, hard (pp=4.5+) minor FeOx mottling.	Qpl
SS-2	14/24"	24	ML	CLAYEY SILT, mottled yellowish brown (10YR5/6) and light brownish gray (2.5Y 6/2), low plasticity, slightly moist, hard (pp=4.5+), minor FeOx and MnOx.	Qrx
SS-3	16/24"	18	CL	SILTY CLAY, mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6), low to medium plasticity, slightly moist, very stiff to hard (pp=4.5), minor silt as lenses in clay and minor fine chert gravel, FeOx nodules and MnOx streaking (fracture fill).	Qfv
SS-4	20/24"	22	CL	SANDY CLAY with GRAVEL, mottled yellowish brown (10YR 5/8) (primary) and minor light brownish gray (10YR 6/2), slightly moist, sandy with approx. 10% gravel (very fine to 2"), mostly angular chert with minor subrounded igneous, abundant FeOx and MnOx stain, very stiff to hard (pp= 3.75-4.5+) with near-vertical fractures exhibiting leaching (gray color) and MnOx staining.	Qct
SS-5	20/24"	16			
SS-6	21/24"	22	CL CH	SILTY CLAY, distinctive yellowish-red (5YR 4/6) moderate to high plasticity, slightly moist, no gravel or sand, soapy, very hard (pp=4.5+) stiff (pp=3.0).	pPr
SS-7	23/24"	65	GC	Harder drilling @ 19.0 ft. CLAYEY GRAVEL, approx. 75 - 80% angular chert gravel with plastic interstitial clay and minor sand pockets. Gravel is exclusively chert until approx. 26.0' then includes very weathered (to powder) limestone. Interstitial clay is dusky red (2.5YR 4/4), high plasticity, slightly moist, with pockets of distinctive yellow fine sand, abundant FeOx and minor MnOx stain on gravel, very dense.	
SS-8	7/7"	>50			
SS-9	11/11"	>50			
				Very hard drilling @ 27 ft.	
SS-10	22/24"	43		CLAYEY GRAVEL, as above, with weathered limestone pieces and powder.	
				Sampler refusal @31.9 ft. Weathered limestone in sampler. Auger refusal @ 32.0 ft. Started NQ wireline coring.	
RUN-1	37/102"	8	chrt	32.0 - 35.6' CHERT, brecciated with minor argillaceous limestone and as nodules to .5' (minor) chert is light gray (N7) to minor mottled medium gray (N5), slightly weathered, very hard, very fossiliferous, closely fractured. Minor limestone is grayish- orange (10YR 7/4), argillaceous, moderately hard, brecciated, moderately	

Depth (feet): 5, 10, 15, 20, 25, 30, 35

WELL DIAGRAM



Protective Casing with Locking Cover, Cement Pad 4 ft Diameter Three Protective Posts

Well Casing (2" 316 Stainless Steel)

10.25" Diameter Borehole

High-Solids Bentonite Grout ("Grout-Well")

ELEVATION feet: 635, 630, 625, 620, 615, 610, 605

Sample Interval ☐ No Sample Taken ▽ minimum ▼ maximum ▼ average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

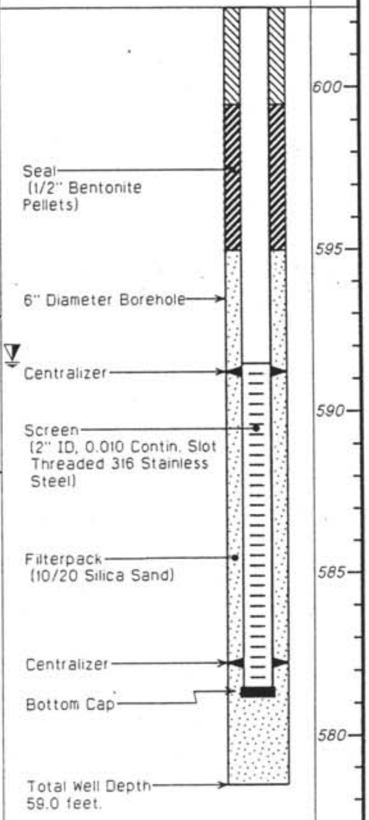
HOLE NUMBER	MW-2047 (C4)
SHEET 2 OF 2	
NORTH (Y):	1044105.67
EAST (X):	754487.53

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Upgradient of Disposal Cell

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
				chrt	weathered, with FeOx stain, vuggy.	
				CL GC	35.6 - 44.4' GRAVELLY CLAY/CLAYEY GRAVEL, (Residuum), most of clay /gravel in interval not recovered in core barrel.	pPr
40	RUN-2	17/48"	0			pPr
					44.4 - 44.5' CHERT, very light gray (N8), very hard, moderately weathered.	pPr
45	RUN-3	72/72"	55	chrt	Top of Bedrock @ 44.5 ft.	
				lms chrt	44.5 - 49.8' ARGILLACEOUS LIMESTONE (60%) and CHERT (40%), brecciated and interbedded. Limestone is grayish orange (10YR 7/4) with minor dark yellowish orange (10YR 6/6), very argillaceous, very fine-grained, very thin-bedded (interbedding) and irregular brecciation with chert, moderate to high porosity, medium hardness, moderately to highly weathered, closely fractured, some secondary calcite. Chert is very light gray (N8) to pale orange (10YR 8/2), brecciated in thin irregular "beds" with limestone, slightly weathered, very hard, very fractured with MnOx infilling. "Strongly weathered Burlington-Keokuk Limestone"	Mbksw
50	RUN-4	116/116"	73	chrt	49.8 - 50.2' CHERT, mottled grayish orange (10YR 7/2) and very light gray (N8), very shattered and brecciated, very hard.	Mbkw
55				lms chrt	50.2 - 60.2' ARGILLACEOUS DOLOMITIC LIMESTONE (70%) and CHERT (30%), in brecciated texture. Limestone is as above but is dolomitic with thicker bedding (thin-bedded), high porosity, and chert exhibiting a very anglular, brecciated and "shattered" texture. Color change (gradual) to more olive color and vuggy (bone-marrow) texture at about 58.5'. Overall, moderately hard, moderate to highly weathered, with MnOx commonly lining fractures in chert. "Weathered Burlington- Keokuk Limestone"	Mbkw
60					Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TEST 46.0 to 60.2 ft. K=8.0E-6 cm/sec	
					Total cored depth 60.2 feet. Switched to 6" air rotary and reamed hole to 59.0'.	
65					Note: Soil and rock color are indexed on the Muncell soil color chart. Split spoon sampler is 3" O.D., 2-1/2" I.D., therefore SPT results are qualitative.	
70						
75						

WELL DIAGRAM



Sample Interval · No Sample Taken · minimum · maximum · average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

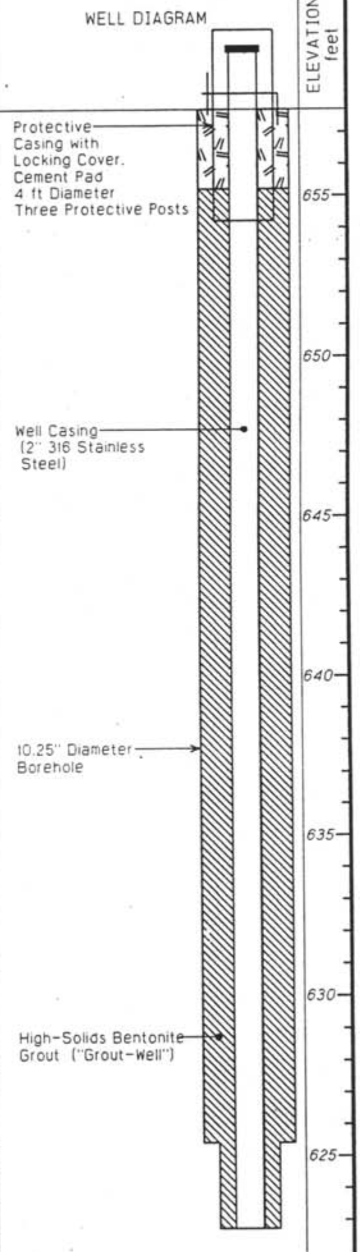
BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

HOLE NUMBER	MW-2048 (C1)
SHEET 1 OF 2	
NORTH (Y):	1042435.46
EAST (X):	755000.96
TOC ELEVATION	659.85
GROUND ELEVATION	657.72
STICKUP	2.13
HYDR CONDUCTIVITY (cm/sec)	$K = 7.91 \times 10^{-4}$ (Packer Test)

WELL STATUS/COMMENTS	ACTIVE
LOCATION	Upgradient of Disposal Cell
DRILLING CONTRACTOR	GEOTECHNOLOGY INC.
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	10 1/4" HSA to 32.3' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	90
DEPTH (FT.) FROM GROUND ELEV. TO: BOTTOM OF HOLE (TD)	60.0
DEPTH (FT.) FROM GROUND ELEV. TO: BEDROCK	32.3
DEPTH (FT.) FROM GROUND ELEV. TO: WATER LEVELS & DATES	▽ ▼
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
DATE START	12-12-1996
DATE FINISH	12-19-1996
LITHOLOGY BY	PAUL PATCHIN

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
0				Fill	FILL, silty clay, dark brown, damp.	Fill
	SS-1	15/24"	9	CL	SILTY CLAY, light brownish gray (2.5Y 6/2) with minor yellowish brown (10Y 5/6) mottling, medium plasticity, slightly moist, very stiff (pp=3.25), abundant FeOx nodules (2mm) and MnOx streaks.	Qtv
5	SS-2	14/24"	19	CH	CLAY, as above but with increased plasticity (high) and yellowish brown mottling, very stiff (pp=3.0), decrease in silt content and no gravel.	Qtv
	SS-3	21/24"	16		CLAY, as above, very stiff (pp+3.0).	Qtv
10	SS-4	23/24"	13		CLAY, as above, very stiff (pp=2.75), minor coarse sand-size chert at bottom.	Qtv
	SS-5	22/24"	12	CL/CH	SILTY CLAY, as above, increase in yellowish brown color, MnOx streaking, and coarse sand and fine gravel content at bottom of sample, very stiff (pp=3.0).	Qtv
15	SS-6	23/24"	19	CL	SANDY CLAY with GRAVEL, yellowish brown (10YR 5/8) with minor light brownish gray (2.5Y 6/2) mottling, medium plasticity, slightly moist, hard (pp=4.5+), contains approx. 10% angular weathered chert gravel (coarse sand size to 1"), abundant MnOx streaks and FeOx stain.	Qct
20	SS-7	24/24"	16		SANDY CLAY with GRAVEL, as above, increased moisture (moist), very stiff (pp=2.75), with minor softer zones.	Qct
	SS-8	24/24"	15	CL/CH	CLAY, mottled strong brown (7.5YR 5/6) and dark red (2.5YR 4/6), medium to high plasticity, moist, no sand, trace v. fine gravel, abundant MnOx, streaks.	Qct
25	SS-9	24/24"	18	CL/CH	CLAY with GRAVEL, strong brown (7.5YR 5/6) with minor light gray, medium to high plasticity, slightly moist, very stiff (pp=3.5+), contains no sand and approx. 10-15% very fine to 1.5" gravel (chert and igneous), abundant MnOx streaks (increasing with depth), last .5' very gravelly with very abundant MnOx and FeOx nodules.	Qct
	SS-10	19/24"	30	CL	GRAVELLY CLAY, strong brown (7.5 YR 5/6), high plasticity, approx. 40% angular chert gravel and minor limestone gravel, clay is moist with FeOx nodules and MnOx streaks and conspicuous calcareous sand pocket (decomposed rock?) at 26.5-27.0'.	pPr
30	SS-11	9/14"	+91			pPr
	SS-12	11/18"	24	CL/GC	GRAVELLY CLAY, as above but siltier and sandier, contains decomposed limestone, chert, hard, damp.	pPr
	RUN-1	36/78"	9	lms chrt	GRAVELLY CLAY/CLAYEY GRAVEL, as above but increased gravel (approx. 50%), hard, damp. Top of Bedrock @ 32.3 ft.	Mdksw
35					32.3 - 41.6' ARGILLACOUS LIMESTONE AND CHERT, interbedded and breccieated. Approximately 70% limestone which is grayish orange (10YR 7/4), fine-grained, thin-bedded, slightly to highly	Mdksw



◧ Sample Interval ☐ No Sample Taken ▽ minimum ▼ maximum ▽ average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

HOLE NUMBER	MW-2048 (C1)
SHEET 2 OF 2	
NORTH (Y):	1042435.46
EAST (X):	755000.96

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Upgradient of Disposal Cell

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class
~35				lms chrt
~39	RUN-2	18/34"	0	
~42	RUN-3	60/64"	49	GC chrt
~43				CL chrt
~44.5				lms chrt
~47.5	RUN-4	12/24"	20	
~49.5	RUN-5	54/60"	54	
~54.5	RUN-6	60/60"	66	

STRAT. UNIT: Mdksw

DESCRIPTION AND REMARKS

weathered, moderately hard to hard, with weathered pyrite crystals in matrix and locally heavy FeOx staining and vugginess. Closely to very closely fractured with minor clay, stylolites, and fossils. Chert is brecciated and interbedded with limestone and in beds up to .8'. Color varies from white (N9) to grayish orange (10YR 7/4) to light bluish gray (5B 7/1), generally very hard, cryptocrystalline, fossiliferous with sealed fractures and MnOx infilling. Entire interval has numerous small void zones (bit drops) with a void from 40.5-41.2' showing very weathered residual chert gravel and clay. Overall, slight to moderate porosity. "Strongly Weathered Burlington-Keokuk Limestone"

41.8 - 43.0' CHERT GRAVEL, (void fill) with minor clay. Chert is very weathered and vuggy, providing a breccia appearance. Chert, white to bluish to pinkish.

43.0 - 44.5 SILTY CLAY with GRAVEL, brown (10YR 5/3), void fill.

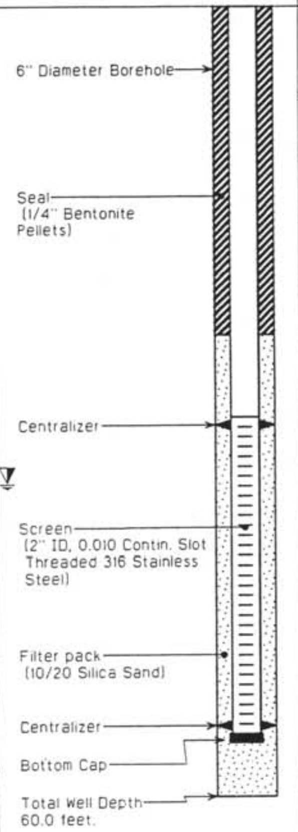
44.5 - 59.3 ARGILLACEOUS LIMESTONE and CHERT, as above. Limestone exhibits stronger iron oxide staining (color to dark yellowish orange 10YR 6/6), moderate to high porosity, abundant solution features (vugs) pinpoint to 1/2", numerous small voids (bit drops) to approx. 51.5. Less vugs below 53.5. Minor intervals of medium crystalline limestone. Some secondary calcite in matrix. Chert is brecciated, bedded (to .5'), and nodular. "Strongly Weathered Burlington-Keokuk Limestone"

Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TESTS
35.5 to 47.3 ft. K=7.9E-4 cm/sec
46.4 to 59.3 ft. K=6.8E-4 cm/sec

Total cored depth 59.3 feet. Switched to 6" air rotary and reamed hole to 60.0.

Note: Split spoon sampler is 3" O.D., 2-1/2" I.D., therefore SPT results are qualitative. Soil and rock colors are indexed on the Muncell soil color chart.

WELL DIAGRAM



DEPTH (feet): 40, 45, 50, 55, 60, 65, 70, 75

ELEVATION (feet): 620, 615, 610, 605, 600, 595, 590, 585

Sample Interval ☐ No Sample Taken ▽ minimum ▼ maximum ▼ average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSMLOG-C

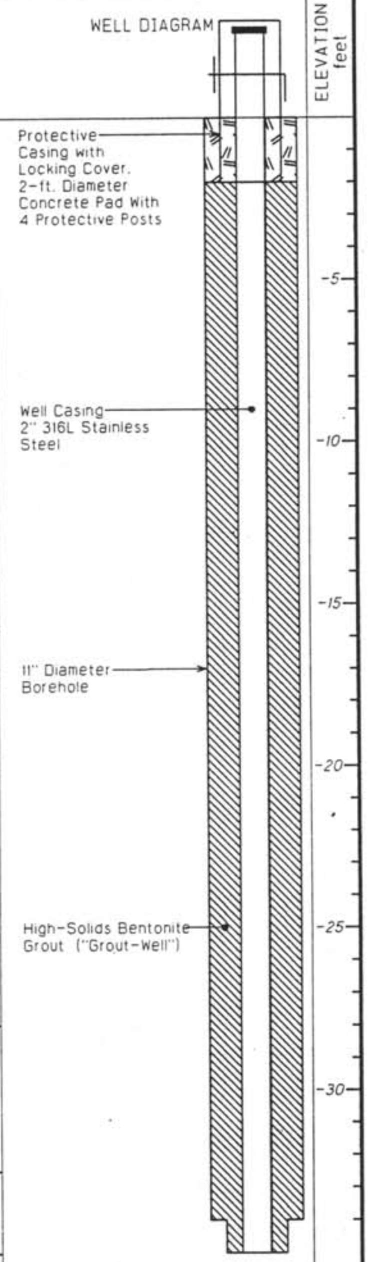
HOLE NUMBER	MW-2048 (a)
SHEET 1 OF 2	
NORTH (Y):	
EAST (X):	
TOC ELEVATION	
GROUND ELEVATION	
STICKUP	
HYDR CONDUCTIVITY (cm/sec)	K= 7.91×10^{-4} (Packer Test)

WELL STATUS/COMMENTS: ACTIVE		LOCATION: SO. OF DISPOSAL CELL; PERIMETER WELL
DRILLING CONTRACTOR: LAYNE WESTERN Inc.		DRILL RIG MAKE & MODEL: CME-750 HSA/NQWL; I-R TH-60 AIR ROTARY
HOLE SIZE & METHOD: 9" HSA-34; NQ-62; 6" AIR-63	ANGLE FROM HORIZONTAL & BEARING: Vertical	BOTTOM OF HOLE (TD): 63.0, 62.0 Mon. Well
DRILL FLUIDS & ADDITIVES: Water core; Air ream	CASING TYPE, DEPTH, SIZE: 2" 316 SS Mon. Well	BEDROCK: 32.5
DATE START: 11-9-01	DATE FINISH: 12-5-01, Mon. Well	WATER LEVELS & DATES: ▽ ▼

DEPTH (FT.) FROM GROUND ELEV. TO:

LITHOLOGY BY: ALAN BENFER

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery (0–100)	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
0–28							Soil not sampled or logged from the surface to 28.0-ft.	Qct/Qrc undiff.
28	■	SPT-1		9		CH	CLAY, high plasticity, ~40% angular chert and weathered limestone gravel, mostly yellow brown, moist, firm CH. Residuum.	pPr
30	■	SPT-2		14			CLAY, gravelly to clayey gravel, high plasticity clay, reddish brown, moist, hard, CH-GC. Residuum.	pPr
32	■	SPT-3		76+				
32.5						CHRT LMS	LIMESTONE, weathered, white to yellowish brown, dry, hard.	Mbk
34	■	NQ-1	31/66"	15			Auger refusal at 34.0-ft. Continue with NQ core.	Mbk
35							NQ-1, 34.0'- 39.5'. Poor recovery, loss zones unknown. Lost circulation at 34.5' permaently.	



■ Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

HOLE NUMBER: MW-2048 (a)

SHEET 2 OF 2

NORTH (Y):

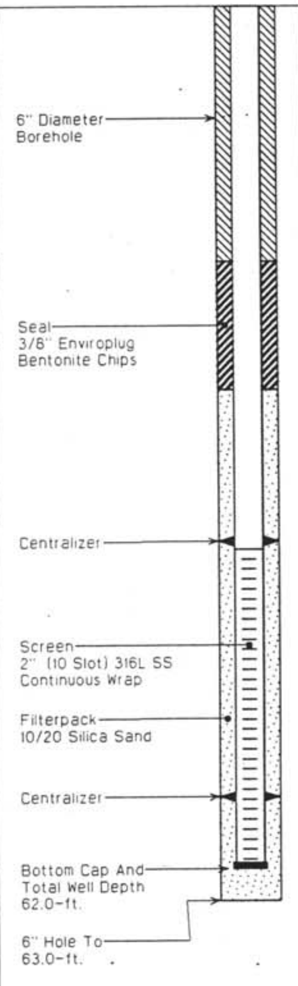
EAST (X):

WELL STATUS/COMMENTS: ACTIVE

LOCATION: SO. OF DISPOSAL CELL; PERIMETER WELL

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
				CHRT / LMS	LIMESTONE, slightly weathered, crystalline-grained, locally argillaceous, with specks and thin streaks of MnOx, fossiliferous, light gray to light yellowish brown, vugs up to 1" near bottom of core, some interbedded light gray chert. Rock is relatively fresh, hard, with minimal oxidation. Two clay seams near core bottom; one is 3-1/2" thick with angular chert fragments, lower one is 6" of massive clay with some fine gravel, high plasticity, yellow brown, minor MnOx. Burlington-Keokuk Limestone.	Mbk
40	NQ-2	28/40"	62		@ 39.5'- 42.8'. LIMESTONE as above, becoming oxidized at ~39.7', some stylolites, ~30% scattered chert, appears brecciated, fossiliferous, mostly light gray. Up to 4+ fractures per foot, rough, open, oxidized.	
	NQ-3	52/70"	13		@ 41.5'. Scattered oxidized sulfides, increased limestone weathering at 42.7'. Bit dropped at ~41.8' to ~42.5'. Weathered Burlington- Keokuk Limestone.	Mbkw
45					@ 43.5'- 44.1'. CHERT, hard, white, light and blue gray.	
					@44.6'- 45.0'. Silty clay with limestone fragments.	Mbksw
	NQ-4	58/67"	54		@ 45.4'- 48.6'. LIMESTONE, moderately weathered, moderate solutioning with vugs up to 1", generally coarse-grained, some argillaceous, FeOx staining with thin streaks of MnOx, mostly light yellow brown, with ~ 30% scattered interbedded chert, generally light gray.	
50					@ 48.2'- 52.0'. CHERT, hard, with thin streaks of MnOx, fracture surfaces oxidized, white to pale yellow, with up to ~25% thinly interbedded limestone, strongly weathered at 49.2-ft., soft, argillaceous, dark yellowish orange. At 50.1 to 52.0-ft., limestone is very vuggy along bedding; clayey. One to 4+ fractures per foot, rough; broken. Strongly Weathered Burlington-Keokuk Limestone.	
55	NQ-5	91/94"	77		@ 52.0'- 53.8'. CHERT, hard, bluish gray with ~40% limestone, strongly weathered, argillaceous, generally interbedded, a few vugs, yellowish orange.	
					@ ~53.7'. Cut fast. Very vuggy at 53.8-ft.	
60					CHERT AND LIMESTONE as above, ~40% limestone, strongly weathered, locally can be scratched with fingernail, a few vugs. Chert is bluish gray, locally fossiliferous. One to 3+ fractures per foot, rough, open, some broken.	
					@ 60.5'. 1/2" patch of oxidized pyrite.	
65					Total cored depth 62.0', 11-15-01. Hole reamed to 6" diameter to 63.0' and a 2" monitoring well was constructed.	
					Packer testing was not performed.	
70						
75						

WELL DIAGRAM



ELEVATION feet: -40, -45, -50, -55, -60, -65, -70

Sample Interval   No Sample Taken   minimum   maximum   average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

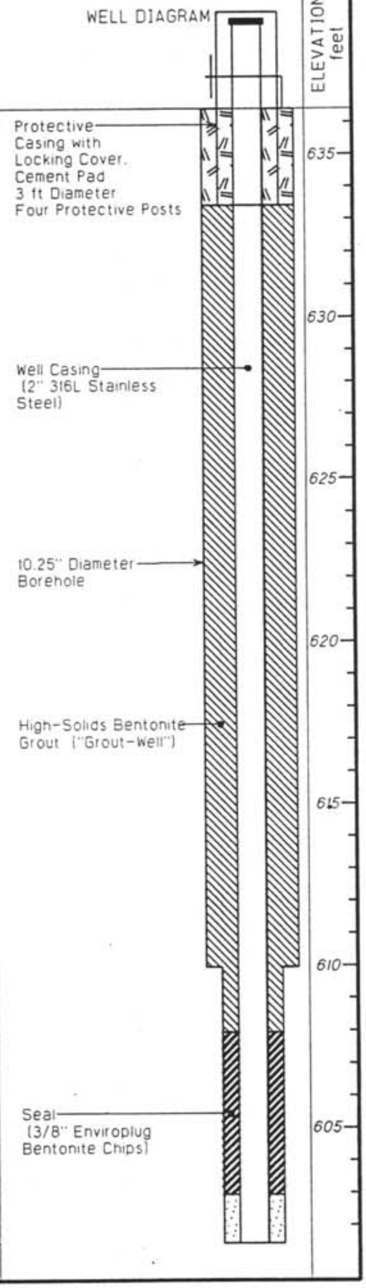
WSWLOG-C

HOLE NUMBER	MW-2051
SHEET 1 OF 2	
NORTH (Y):	1042175.97
EAST (X):	753129.19
TOC ELEVATION	639.77
GROUND ELEVATION	636.43
STICKUP	3.34
HYDR CONDUCTIVITY (cm/sec)	$K = 8.7 \times 10^{-3}$ (Packer Test)

WELL STATUS/COMMENTS	ACTIVE
LOCATION	NORTHEAST EDGE OF DISPOSAL CELL
DRILLING CONTRACTOR	LAYNE WESTERN Inc.
DRILL RIG MAKE & MODEL	CME-750ATV HSA/NQWL CORE/SCHRAMM AIR ROT
HOLE SIZE & METHOD	7 1/4" Auger to 26.5' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	Vertical
DEPTH (FT.) FROM GROUND ELEV. TO: BOTTOM OF HOLE (TD)	49.0
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316L Stainless Steel
BEDROCK	26.5
DATE START	5-2-2000
DATE FINISH	5-30-2000
WATER LEVELS & DATES	▽ ▼

LITHOLOGY BY ALAN BENFER/PAUL PATCHIN

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
0				fill	FILL, (silty clay)	Fill
				CH	CLAY, high plasticity, mottled yellow brown and light gray, approx. 10% fine white sand, moderate black MnOx, firm, moist, CH.	Qct
	SPT-2		5	CH	CLAY, high plasticity with some sand and gravel (angular), MnOx, mottled yellow brown and light gray and black, moist, hard, CH.	Qct
	SPT-3		12			Qct
5					Lenses of clean fine sand between 5 and 6 ft.	Qct
	SPT-4		18		CLAY, as above, approx. 10% fine sand and some fine gravel, hard, MnOx on vertical fracture surfaces, CH.	Qct
	SPT-5		12			Qct
10	SPT-6		14			Qct
	SPT-7		23	CL	SILTY CLAY, low plasticity, with weathered FeOx nodules, light gray, moist, hard, CL.	Qct
	SPT-8		14	CH	CLAY, high plasticity, FeOx nodules, trace fine gravel, mottled light brown and light gray, moist, hard, CH.	Qct
15				CH	CLAY, as above but more reddish brown, high plasticity, with some angular chert gravel, CH.	dPr
	SPT-9		10			dPr
	SPT-10		8			dPr
20	SPT-11		7			dPr
	SPT-12		15			dPr
	SPT-13		19			dPr
25					Sampler refusal at 25.9 ft. Augered to top of rock at 26.5 ft (auger refusal).	dPr
	RUN-1	38/60"	8	chrt lms	26.5' - 35.3' CHERT AND ARGILLACEOUS LIMESTONE (approx 65%/35%). Chert is very light gray (N8) to minor medium light gray (N6), brecciated to very thinnly bedded with limestone, very hard, slightly to moderately weathered, fossiliferous, with MnOx and FeOx staining (MnOx on microfractures in chert). Limestone is grayish orange (10YR7/4), mod. weathered, mod. hard, with vugs pinpoint to 3 mm, fine grained, very thinly bedded (interbedded with chert), slightly fossiliferous with FeOx staining (particularly in possible void zones at 28.0' - 28.5' and 34.0'-34.7').	Mbkw
30	RUN-2	47/60"	46		Lost circulation at 29.0'	Mbkw
35					Possible voids from 34.0 - 34.7'	Mbkw



■ Sample Interval □ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

HOLE NUMBER	MW-2051
SHEET 2 OF 2	
NORTH (Y):	1042175.97
EAST (X):	753129.19

WELL STATUS/COMMENTS: ACTIVE

LOCATION: NORTHEAST EDGE OF DISPOSAL CELL

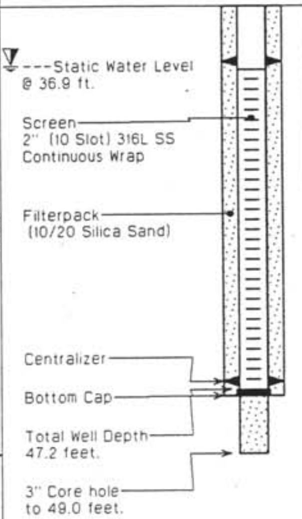
DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
35.3–43.7		RUN-3	43/60"	48		chrt / lms / lms chrt	35.3' - 43.7' ARGILLACEOUS LIMESTONE (70%) and CHERT (30%) as above but increased limestone. Inreased vugs (to 1") parallel with bedding, moderately weathered. Probable voids @34.0' - 34.7' and 36.5' - 38.0' with heavy FeOx staining and residual chert gravel. Semi-fresh pyrite specks @33.5'. MnOx specks @39.5' with increased FeOx and weathering. Yellowish coloring (clay) at 40.3' - 41.5' with hematite blebs.	Mbkw
		RUN-4	46/90"	37			41.5 - 43.2' Core loss possibly caused by caved material grinding core.	Mbkw
43.7–49.0						lms chrt	43.7' - 49.0' ARGILLACEOUS LIMESTONE, as above but color to more gray and porosity increase with CHERT (<30%) brecciated but also as large 4" irregular nodules, very fossiliferous, occasional calcite-rich (as medium grained crystals), bands to 1.5", occasional vugs, slightly weathered, abundant MnOx specks.	Mbkw
49.0							Total cored depth 49.0'. Reamed hole to 6" to 47.2' and installed 2" monitoring well.	
							Note: Color is from the GSA rock color chart.	

CONSTANT HEAD SINGLE PACKER TEST RESULTS:
30.5 - 41.5 ft. K=8.7E-3 cm/sec
36.1 - 49.0 ft. K=7.2E-3 cm/sec

Depth scale (feet): 40, 45, 50, 55, 60, 65, 70, 75

Elevation scale (feet): 600, 595, 590, 585, 580, 575, 570, 565

WELL DIAGRAM



Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

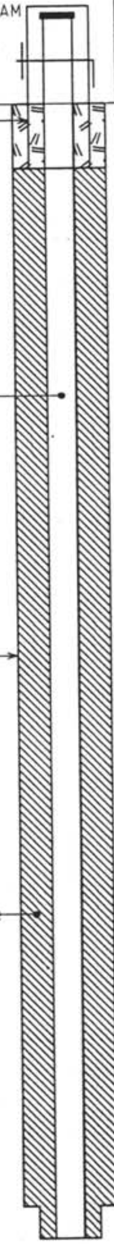
WSWLOG-C

HOLE NUMBER	MW-2055
SHEET 1 OF 2	
NORTH (Y):	1042419.92
EAST (X):	755000.58
TOC ELEVATION	662.62
GROUND ELEVATION	659.86
STICKUP	2.76
HYDR CONDUCTIVITY (cm/sec)	K= 1.5x10^{-5} (Packer Test)

WELL STATUS/COMMENTS	ACTIVE
LOCATION	SO. OF DISPOSAL CELL; PERIMETER WELL
DRILLING CONTRACTOR	LAYNE WESTERN Inc.
DRILL RIG MAKE & MODEL	CME-750 HSA/NQWL; I-R TH-60 AIR ROTARY
HOLE SIZE & METHOD	9" HSA-34; NQ-62; 6" AIR-63
ANGLE FROM HORIZONTAL & BEARING	Vertical
BOTTOM OF HOLE (TD) (DEPTH (FT.) FROM GROUND ELEV. TO:)	63.0
DRILL FLUIDS & ADDITIVES	Water core; Air ream
CASING TYPE, DEPTH, SIZE	2" 316 SS Mon. Well
BEDROCK	32.5
DATE START	11-9-01
DATE FINISH	12-5-01, Mon. Well
WATER LEVELS & DATES	
LITHOLOGY BY	ALAN BENFER

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery (0–100)	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT	ELEVATION feet
0–28							Soil not sampled or logged from the surface to 28.0-ft.	Qct/Qfc undiff.	655 (approx. 5 ft), 650 (approx. 10 ft), 645 (approx. 15 ft), 640 (approx. 20 ft), 635 (approx. 25 ft)
28		SPT-1		9		CH	CLAY, high plasticity, ~40% angular chert and weathered limestone gravel, mostly yellow brown, moist, firm CH. Residuum.	pPr	
30		SPT-2		14			CLAY, gravelly to clayey gravel, high plasticity clay, reddish brown, moist, hard, CH-GC. Residuum.	pPr	630
32		SPT-3		76+		CHRT LMS	LIMESTONE, weathered, white to yellowish brown, dry, hard.	Mbk	
34		NQ-1	31/66"	15			Auger refusal at 34.0-ft. Continue with NQ core.	Mbk	625
35							NQ-1, 34.0'- 39.5'. Poor recovery, loss zones unknown. Lost circulation at 34.5' permaently.		

WELL DIAGRAM



Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

HOLE NUMBER	MW-2055
SHEET 2 OF 2	
NORTH (Y):	1042419.92
EAST (X):	755000.58

WELL STATUS/COMMENTS: ACTIVE

LOCATION: SO. OF DISPOSAL CELL; PERIMETER WELL

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	STRAT. UNIT
40	NQ-2	28/40"	62	CHRT LMS	Mdk
43	NQ-3	52/70"	13		Mdkw
49	NQ-4	58/67"	54		Mdksw
55	NQ-5	91/94"	77		Mdksw

DESCRIPTION AND REMARKS

LIMESTONE, slightly weathered, crystalline-grained, locally argillaceous, with specks and thin streaks of MnOx, fossiliferous, light gray to light yellowish brown, vugs up to 1" near bottom of core, some interbedded light gray chert. Rock is relatively fresh, hard, with minimal oxidation. Two clay seams near core bottom; one is 3-1/2" thick with angular chert fragments, lower one is 6" of massive clay with some fine gravel, high plasticity, yellow brown, minor MnOx. Burlington-Keokuk Limestone.

@ 39.5'- 42.8'. LIMESTONE as above, becoming oxidized at ~39.7', some styolites, ~30% scattered chert, appears brecciated, fossiliferous, mostly light gray. Up to 4+ fractures per foot, rough, open, oxidized.

@ 41.5'. Scattered oxidized sulfides, increased limestone weathering at 42.7'. Bit dropped at ~41.8' to ~42.5'. Weathered Burlington- Keokuk Limestone.

@ 43.5'- 44.1'. CHERT, hard, white, light and blue gray.

@44.6'- 45.0'. Silty clay with limestone fragments.

@ 45.4'- 48.6'. LIMESTONE, moderately weathered, moderate solutioning with vugs up to 1", generally coarse-grained, some argillaceous, FeOx staining with thin streaks of MnOx, mostly light yellow brown, with ~ 30% scattered interbedded chert, generally light gray.

@ 48.2'- 52.0'. CHERT, hard, with thin streaks of MnOx, fracture surfaces oxidized, white to pale yellow, with up to ~25% thinly interbedded limestone, strongly weathered at 49.2-ft., soft, argillaceous, dark yellowish orange. At 50.1 to 52.0-ft., limestone is very vuggy along bedding; clayey. One to 4+ fractures per foot, rough; broken. Strongly weathered Burlington-Keokuk Limestone.

@ 52.0'- 53.8'. CHERT, hard, bluish gray with ~40% limestone, strongly weathered, argillaceous, generally interbedded, a few vugs, yellowish orange.

@ ~53.7'. Cut fast. Very vuggy at 53.8-ft.

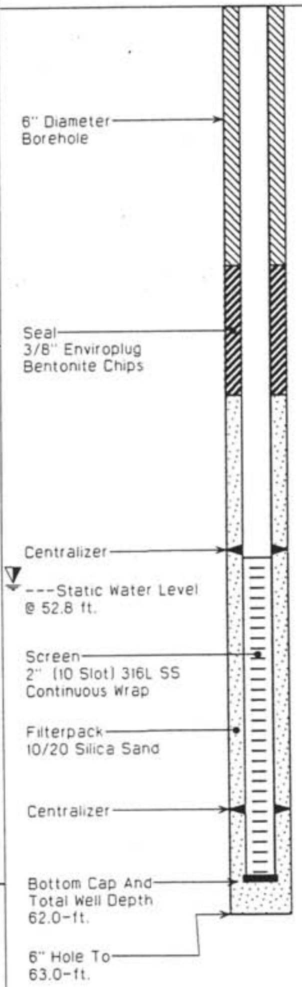
CHERT AND LIMESTONE as above, ~40% limestone, strongly weathered, locally can be scratched with fingernail, a few vugs. Chert is bluish gray, locally fossiliferous. One to 3+ fractures per foot, rough, open, some broken.

@ 60.5'. 1/2" patch of oxidized pyrite.

Total cored depth 62.0', 11-15-01. Hole reamed to 6" diameter to 63.0' and a 2" monitoring well was constructed.

Packer testing was not performed.

WELL DIAGRAM



Depth scale (feet): 40, 45, 50, 55, 60, 65, 70, 75

Elevation scale (feet): 620, 615, 610, 605, 600, 595, 590, 585

Sample Interval   No Sample Taken   minimum   maximum   average

APPENDIX B

Statistical Evaluation of Detection Monitoring Data (1998 to 2001)

Statistical Evaluation of Detection Monitoring Data

B.1 Evaluation Summary – 1998 through 2001

Under the original version of this plan, the elements of the detection monitoring program included:

- Collecting four replicate samples at each location on a semiannual basis,
- Measuring groundwater elevation at each well location, as well as flow rate for the spring, on a quarterly schedule and immediately prior to each semiannual sampling event,
- Analyzing for the entire list of constituents presented in Table 3-2 of the main text of this report, and noting any unusual colors, odors, or turbidity,
- Evaluating analytical data in comparison with background levels to identify statistically significant increases that may indicate an impact from the disposal cell, and
- For parameters that appear to exceed background levels: reviewing analytical results for potential errors, evaluating cell leachate volume data to confirm liner integrity, and resampling individual locations for the suspect parameters.

The detection monitoring data obtained from 1998 to 2001 were evaluated in accordance with the U. S. EPA guidance on *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (Ref. B-1). This document provides guidance on conducting various types of statistical analyses under the RCRA groundwater monitoring regulations (40 CFR 264, Subpart F). The foundational assumption of each statistical method is that the waste management unit is situated on a uncontaminated aquifer and that the only source of increases in contaminant concentrations in the groundwater is leakage from the waste management unit. The guidance cautions against the use of the prescribed methods in evaluating data from wells that have shown evidence of preexisting contamination or where a high degree of spatial variation exists between the background wells and compliance wells, both of which are true for the Weldon Spring site.

In the absence of regulatory guidance on more appropriate statistical methods for use at a site with preexisting groundwater contamination, detection monitoring data have been evaluated by several different methods, as discussed below.

B.1.1 1998 Results

Detection monitoring data from 1998 were evaluated by means of both parametric and nonparametric analysis of variances (ANOVA) analyses. Results of these analyses, which are presented in the *Weldon Spring Site Environmental Report for Calendar Year 1998* (Ref. B-2), are based on a comparison of data from the compliance wells, MW-2032 and MW-2045 through MW-2047, with data from the upgradient (i.e., "background") well, MW-2048. These analyses resulted in a large number of statistical failures which, if they had been based on data from a previously uncontaminated aquifer, would have provided evidence of groundwater impact due to the disposal cell.

Many of the test failures were determined to be attributable to preexisting concentrations of certain parameters being higher in the compliance wells than in the upgradient well prior to waste placement (March 1998). However, after disregarding the parameters in which this was the case, the following parameters still failed at least one of the statistical tests:

- MW-2032 Chromium, silver, thallium
- MW-2045 Calcium, radium-228
- MW-2046 Silver, vanadium, TOX
- MW-2047 Vanadium, zinc, 1,3,5-TNB

The monitoring data for parameters that failed the interwell comparisons were further evaluated by means of ANOVA procedures based on intrawell comparisons with baseline data from the same locations. This testing resulted in the following statistical failures:

- MW-2045 Calcium
- MW-2046 Vanadium
- MW-2047 Vanadium, 1,3,5-TNB

All of the above statistical failures were attributed to natural fluctuations in the existing groundwater quality. It was not reasonable to consider these test failures to be indicators of cell leakage because waste placement, and subsequent leachate production, began only a few months before the first 1998 detection monitoring event, and contaminant fate and transport analyses had predicted a 53-year interval before contaminants leaking from the cell would be detected in the monitoring wells (Ref. B-3). In addition, the use of the upgradient well, MW-2048, as a "background" well was determined to be inappropriate since several constituents were already higher in this well than in any of the compliance wells before waste placement began.

B.1.2 1999 Results

The detection monitoring program was modified in 1999, after review of the previous two years of groundwater and leachate data. Several parameters were eliminated from the monitoring list. Also, the monitoring frequency was reduced to a single sample obtained semiannually from each location instead of the four replicates previously collected.

In an effort to derive a more reliable means of evaluating data, an intrawell tolerance interval approach was used to evaluate the 1999 data instead of the ANOVA procedures used the previous year. A intrawell tolerance limit approach was considered the preferred method of evaluating data because this approach resulted in fewer false positive results that any of the other types of statistical analyses performed to date. Also, due to the heterogeneous nature of the aquifer it can be expected that each well would act independently because it monitors a discrete portion of the aquifer. By this method, each monitoring location (including the upgradient well) was considered to be a point of compliance, and "background" conditions were described by the contaminant concentrations measured at each location during baseline monitoring. Tolerance limits were calculated for each parameter at each monitoring location according to the methodology in *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (Ref. 10).

Using the baseline data collected prior to waste placement, upper tolerance limits were established based on the assumptions of a normal data distribution and a 95% level of confidence. Data from the two semiannual monitoring events were compared to the baseline values, and any exceedances were investigated through the data verification process, sample reanalysis, and/or resampling. All confirmed exceedances were reported as statistically significant increases. The *Weldon Spring Site Environmental Report for Calendar Year 1999* (Ref. B-4) summarizes the results of statistical analysis of the 1999 data, in which the following parameters exceeded baseline for at least one of the sampling events:

- MW-2032 Chemical oxygen demand (COD), chromium, nickel
- MW-2045 Arsenic, chromium, molybdenum, nickel
- MW-2046 Aluminum, barium, chromium, magnesium, nickel, COD
- MW-2047 COD
- MW-2048 Magnesium, sulfate

As in the previous two years, the above statistical failures were attributed to natural fluctuations in the existing groundwater quality. However, in accordance with the original version of this plan, a thorough study of the monitoring network was conducted in 2000 to confirm that the recurring baseline exceedances were not true indicators of cell leakage. This study was documented in the *Weldon Spring Site Cell Groundwater Monitoring Demonstration Report* (Ref. B-5). It included an evaluation of historical site-wide groundwater quality, review of leachate flow rate and analytical data, analysis of groundwater elevation fluctuations, comparison of filtered and unfiltered samples for metals analysis, and review of cell well construction and performance information.

The demonstration report concluded that the baseline exceedances were not due to contaminant migration from the cell, but rather were the result of variations in previously existing groundwater contamination compounded by poor hydraulic performance of some of the wells. The following actions were recommended to alleviate the recurrence of similarly false positive results in future sampling events:

- Attempt to improve the flow rate and clarity of groundwater in MW-2045 by redeveloping it prior to the next sampling event,
- Install an additional compliance well in the vicinity of MW-2045 to provide supplemental monitoring on the northeast side of the disposal cell, and
- Recalculate the upper tolerance limit for the baseline values of each parameter at each well. The new limits should be based on the assumption that the four replicates obtained during each quarterly baseline event were not truly independent samples but represented a single event.

Results of the filtered metals analyses confirmed that most of the metals exceedances coincided with high turbidity and likely resulted from metals adhering to suspended clay particles in the groundwater. Although the filtering of groundwater samples for metals analyses is an acceptable sampling procedure, it was not listed as a recommendation in the demonstration report because baseline values were already established using unfiltered samples.

B.1.3 2000 Results

The recommendations from the demonstration report were implemented, and the 2000 data were evaluated using the tolerance interval approach with the recalculated tolerance limits. The *Weldon Spring Site Environmental Report for Calendar Year 2000* (Ref. 13) contains the results of this evaluation, in which the following parameters exceeded the new baseline tolerance limits during at least one of the semiannual sampling events:

- MW-2045 Chromium, molybdenum
- MW-2046 Molybdenum
- MW-2047 Chromium
- MW-2048 Chromium, magnesium, molybdenum, sulfate

B.1.4 2001 Results

Results of the 2001 detection sampling, which were evaluated in the same manner as in the previous year, are presented in the *Weldon Spring Site Environmental Report for Calendar Year 2001* (Ref. 14). The following parameters were identified as exceeding baseline tolerance limits during at least one of the semiannual sampling events:

- MW-2045 Chromium, molybdenum, nickel
- MW-2046 Nickel, 2,4,6-TNT
- MW-2048 Sulfate

Two new wells were installed and one was abandoned under the disposal cell monitoring program in 2001. MW-2051 and MW-2055 were installed and MW-2048 was abandoned.

Baseline monitoring data was collected from these wells in 2001 and 2002, and they were added to the detection monitoring program in 2002.

B.2 Evaluation Summary –2004

In response to a comment from the MDNR regarding the distribution of the groundwater data from the disposal cell wells, a statistical evaluation of the data was performed. This analysis consisted of a determination of the data distribution and the appropriateness of the baseline tolerance limits for evaluation of the detection monitoring data.

B.2.1 Data Distribution

The data for the signature parameters at locations MW-2032, MW-2046, MW-2047, MW-2051, MW-2055, and SP-6301 were reexamined to determine whether the data is Normal or log-Normal. Testing for Normality or log-Normality were done by three (3) different methods, as suggested as alternative tests in the *EPA Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Addendum to Interim Final Guidance* (Ref. B-6). These tests were:

1. Probability Plot Correlation Coefficient
2. Shaprio-Wilk Test of Normality (n<50) or Shaprio-Francia Test of Normality (n>50)
3. Coefficient of Skewness

The tests were performed for both the non-transformed data and log-transformed data for each of the four signature parameters at each location. Each of the signature parameters at each of the locations passed at least one of the three tests for Normality and log-Normality. For example, at location MW-2051 the results were:

Analyte	Test Method					
	PPCC	CS	SW/SF	PPCC	CS	SW/SF
	Non-transformed Data			Log-transformed Data		
Barium	N		N	N	N	N
Iron		N			N	
Manganese	N	N	N	N	N	N
Uranium	N		N	N	N	N

PPCC – Probability Plot Correlation Coefficient
CS – Coefficient of Skewness
SW – Shapiro-Wilk Test of Normality (n<50)
SF – Shapiro-Francia Test of Normality (n>50)
N – Criteria for Normality met

The other locations show similar results. Although the data shows a slightly stronger evidence of log-Normality than Normality, the data can be treated as Normal because of the difficulty in calculating the mean and variance/standard deviation for a log-Normal distribution.

B.2.2 Review of Baseline Tolerance Limits

All the available data was used in calculating baseline tolerance limits. Data points that may have been compromised in some manner should be excluded. Compromised data may include data collected after any disturbance of the sub-surface such as by drilling, excavation, soil sampling, etc. that may dramatically increase the mobility/solubility of some contaminants.

To demonstrate that there is little difference in the method used to calculate the baseline tolerance limit, values for the signature parameters at three of these locations were calculated using six methods (Table B-1). All of the data for each location were used in the calculations.

Table B-1 Calculated Baseline Tolerance Limits for MW-2032, MW-2046, and MW-2051

Location	Method	Ba (μg/l)	Fe (μg/l)	Mn (μg/l)	U (pCi/l)
MW-2032	EPA Guidance – Normal Data (a)	338.8	889.9	45.2	5.60
	Tolerance Limit – Normal Data (b)	376.7	1125.2	56.6	6.42
	xbar+3s – Normal Data	389.9	117.8	56.3	6.73
	EPA Guidance – log-Normal Data (a,c)	334.2	926.7	45.7	6.96
	Tolerance Limit – log-Normal Data (b,c)	370.7	1178.1	57.4	9.35
	xbar+3s – log-Normal Data (c)	383.4	1170.3	57.0	9.89
MW-2046	EPA Guidance – Normal Data (a)	256.5	1238.6	147.7	1.67
	Tolerance Limit – Normal Data (b)	276.7	1577.5	186.9	1.76
	xbar+3s – Normal Data	287.0	1566.9	185.7	1.84
	EPA Guidance – log-Normal Data (a,c)	249.9	1156.0	151.2	1.48
	Tolerance Limit – log-Normal Data (b,c)	268.3	1464.2	191.9	1.92
	xbar+3s – log-Normal Data (c)	277.6	1454.6	190.7	2.02
MW-2051	EPA Guidance – Normal Data (a)	253.2	2200.8	205.5	3.68
	Tolerance Limit – Normal Data (b)	285.3	2895.9	265.4	4.51
	xbar+3s – Normal Data	236.4	1657.9	158.7	3.12
	EPA Guidance – log-Normal Data (a,c)	248.5	1384.8	286.7	3.27
	Tolerance Limit – log-Normal Data (b,c)	278.9	1799.4	374.9	4.64
	xbar+3s – log-Normal Data (c)	232.6	1061.0	217.8	3.20

a Calculated by method outlined in EPA Addendum to Interim Final Guidance for Statistical Analysis of Ground-Water Monitoring at RCRA Facilities

b Bowker, Albert H. and Gerald J. Liberman, Engineering Statistics, Section 8.12 and 8.13.

c Mean and standard deviation for log-Normal calculated by method from Gilbert, Richard O., Statistical Methods for Environmental Pollution Monitoring, Section 13.1.1.

The method outlined in the EPA Guidance (Refs. B-1 and B-6) is designed to treat below detection limit values differently from other methods of calculating a benchmark or baseline tolerance limit where below detection limit values are typically set at one-half the detection limit. However, the EPA Guidance method assumes that all the below detection limit values have the same detection limit, which is seldom the case and complicates the analysis.

The values in the table for MW-2051 show more variation than the other locations, particularly for iron, manganese, and uranium. This is likely due to the small data sets, where only 5 or 6 values for each of the signature parameters have been collected, and one or two extreme or outlier values can skew the calculated value.

Comparison of the six different calculation methods yielded the following conclusions:

1. There is not much difference in the EPA Guidance Normal Data values and the EPA Guidance log-Normal Data values except for iron and manganese at MW-2051. Although the below detection limit values are treated the same in both these calculations, the difference is likely due to small sample size and outlier values as noted above.

2. The EPA Guidance Normal Data values and the Tolerance Limit Normal Data show some variation in many cases. The difference is probably attributable to the difference in the treatment of below detection limit values. The same argument can be stated for the EPA Guidance log-Normal Data values and the Tolerance Limit log-Normal Data values.

3. The Tolerance Limit Normal Data values and the "xbar+3s" Normal Data values are very similar, except at MW-2051. This is expected because the only difference is the tolerance factor multiplier. The Tolerance Limit is calculated as "xbar+ks", where the tolerance factor multiplier 'k' is from a table depending on the sample size and the probability that the calculated interval contains a give percent of the distribution. For the "xbar+3s" method the multiplier factor is always 3. The range for this factor is from approximately 2.2 to 10.5. As the sample size decrease the tolerance factor multiplier increases. This accounts for the difference in the values at MW-2051. The same argument can be stated for the Tolerance Limit log-Normal Data values and the "xbar+3s" log-Normal values.

Based on the analysis discussed above, it was not recommend to change the method currently used (tolerances limits) for calculation of benchmarks for the signature parameters. All of the available data that has not been compromised should be used. In addition, the 'arithmetic mean plus 3 standard deviations' is appropriate for the non-signature parameters since they are not a concern in the leachate.

B.5 References

B-1 U.S. Environmental Protection Agency, Office of Solid Waste, Waste Management Division. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance.* EPA/530-SW-89-026. Washington, D.C. April 1989.

B-2 MK-Ferguson Company and Jacobs Engineering Group. *Weldon Spring Site Environmental Report for Calendar Year 1998.* Rev. 0. DOE/OR/21548-773. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. Weldon Spring, Missouri. July 1999..

B-3 Tomasko, D., J. J. Quinn, L. A. Durham. *Groundwater Flow at the Chemical Plant Area of the Weldon Spring Site: Simulations of the Effect of the Disposal Cell on the Flow Field.* Prepared by Argonne National Laboratory, Environmental Assessment Division, Argonne, IL. October 1996.

B-4 MK-Ferguson Company and Jacobs Engineering Group. *Weldon Spring Site Environmental Report for Calendar Year 1999.* Rev. 0. DOE/OR/21548-845. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. Weldon Spring, Missouri. July 2000.

B-5 MK-Ferguson Company and Jacobs Engineering Group. *Weldon Spring Site Cell Groundwater Monitoring Demonstration Report.* Rev. 0. DOE/OR/21548-864. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. November 2000.

B-6 U.S. Environmental Protection Agency, Office of Solid Waste, Waste Management Division. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance.* EPA/530-SW-93-001. Washington, D.C. November 1992.

TABLE 5. TOLERANCE FACTORS (K) FOR ONE-SIDED NORMAL TOLERANCE INTERVALS WITH PROBABILITY LEVEL (CONFIDENCE FACTOR) Y = 0.95 AND COVERAGE P = 95%

n	K	n	K
3	7.655	75	1.972
4	5.145	100	1.924
5	4.202	125	1.891
6	3.707	150	1.868
7	3.399	175	1.850
8	3.188	200	1.836
9	3.031	225	1.824
10	2.911	250	1.814
11	2.815	275	1.806
12	2.736	300	1.799
13	2.670	325	1.792
14	2.614	350	1.787
15	2.566	375	1.782
16	2.523	400	1.777
17	2.486	425	1.773
18	2.543	450	1.769
19	2.423	475	1.766
20	2.396	500	1.763
21	2.371	525	1.760
22	2.350	550	1.757
23	2.329	575	1.754
24	2.309	600	1.752
25	2.292	625	1.750
30	2.220	650	1.748
35	2.166	675	1.746
40	2.126	700	1.744
45	2.092	725	1.742
50	2.065	750	1.740
55	2.036	775	1.739
60	2.017	800	1.737
65	2.000	825	0.736
70	1.986	850	1.734
		875	1.733
		900	1.732
		925	1.731
		950	1.729
		975	1.728
		1000	1.727

<u>SOURCE</u>: (a) for sample sizes ≤ 50: Lieberman, Gerald F. 1958. "Tables for One-sided Statistical Tolerance Limits." *Industrial Quality Control.* Vol. XIV, No. 10. (b) for sample sizes ≥ 50: K values were calculated from large sample approximation.

U.S. Environmental Protection Agency, Office of Solid Waste, Waste Management Division. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance.* EPA/530-SW-89-026. Washington, D.C. April 1989.

APPENDIX C

Groundwater Flow Rate Determination

Groundwater Flow Rate Determination

Groundwater flow rates and flow directions will be evaluated annually as specified in Section 4.4 of the main text of this report. Results for 1998 through 2002 are presented in this appendix.

C.1 Groundwater Flow Direction

The groundwater flow direction was determined by constructing a potentiometric surface map of the shallow aquifer using the available wells at the chemical plant (Figure C-1). Potentiometric surface maps (Figures C-2 through C-6) were constructed using the average of the groundwater elevations measured during each year. A summary of the average groundwater elevations for each well is included in this appendix.

The potentiometric surface has remained relatively unchanged from 1998 through 2002. The groundwater flow direction is to the north. A groundwater divide is present along the southern boundary of the chemical plant site.

C.2 Groundwater Flow Rates

The calculation of the average groundwater flow rate (average linear velocity) is a function of the hydraulic conductivity (K), the hydraulic gradient (I) and the effective porosity (n_e) of the shallow aquifer:

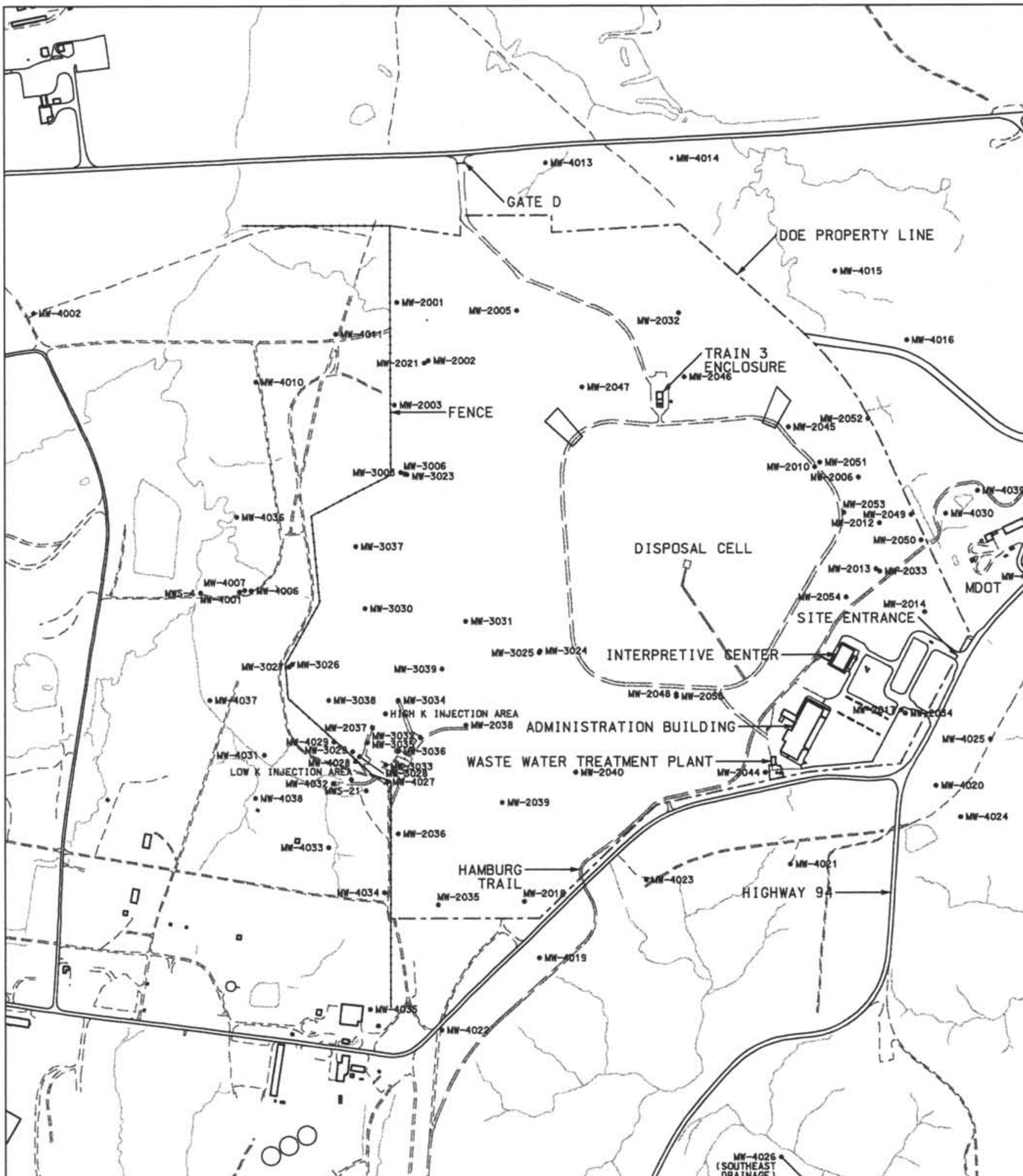
$$v = -Ki / n_e$$

The average groundwater flow rate for each year is summarized in Table C-1.

Table C-1 Average Groundwater Flow Rate From 1998 Through 2002

YEAR	Hydraulic Conductivity (cm/s) [1]	Effective Porosity [2]	GW Elevation		Hydraulic Gradient (ft/ft) [4]	Average Flow Rate (ft/day)
			MW-2048 [3]	MW-2032		
1998	0.007	0.10	607.5	582.9	0.012	2.4
1999			607.5	583.0	0.012	2.4
2000			607.5	582.9	0.012	2.4
2001			607.3	582.9	0.012	2.4
2002			606.8	582.9	0.011	2.2

1 Average hydraulic conductivity using data from the cell monitoring wells.
2 Value selected to estimate maximum groundwater flow rate.
3 Groundwater elevation from MW-2055 was used for 2002.
4 Horizontal distance between MW-2032 and MW-2048 is 2,100 ft.



N

• - MONITORING WELL

0 800 1600

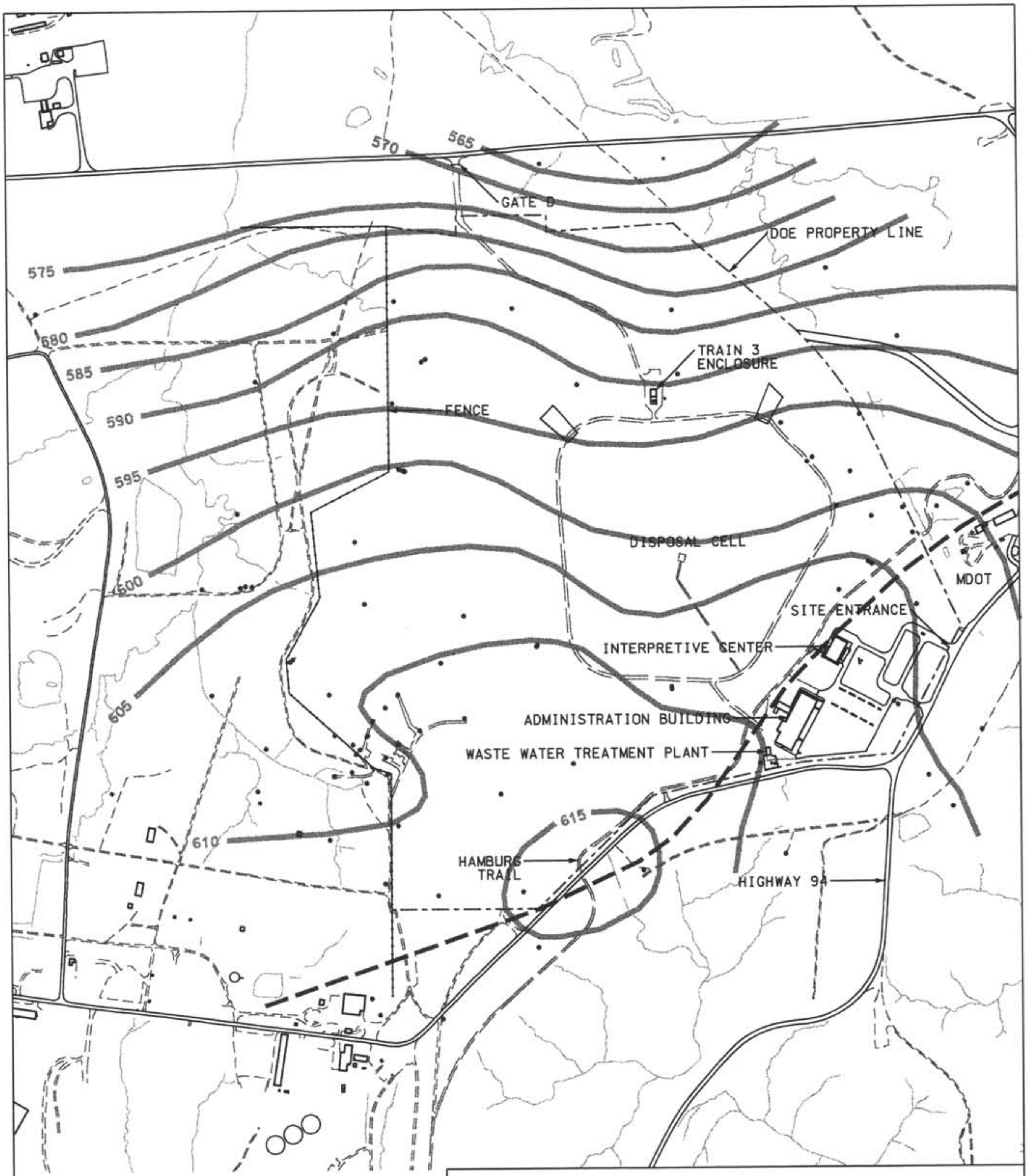
SCALE FEET

MONITORING WELL NETWORK

FIGURE C-1

REPORT NO.:	DOE/GJ/79491-646	EXHIBIT NO.:	A/CP/016/0303

ORIGINATOR:	RC	DRAWN BY:	GLN	DATE:	3/20/03



LEGEND

• - MONITORING WELL

- SURFACE WATER BODIES

- STREAMS

- GROUNDWATER DIVIDE

615 - POTENTIOMETRIC SURFACE (AVERAGE)

N

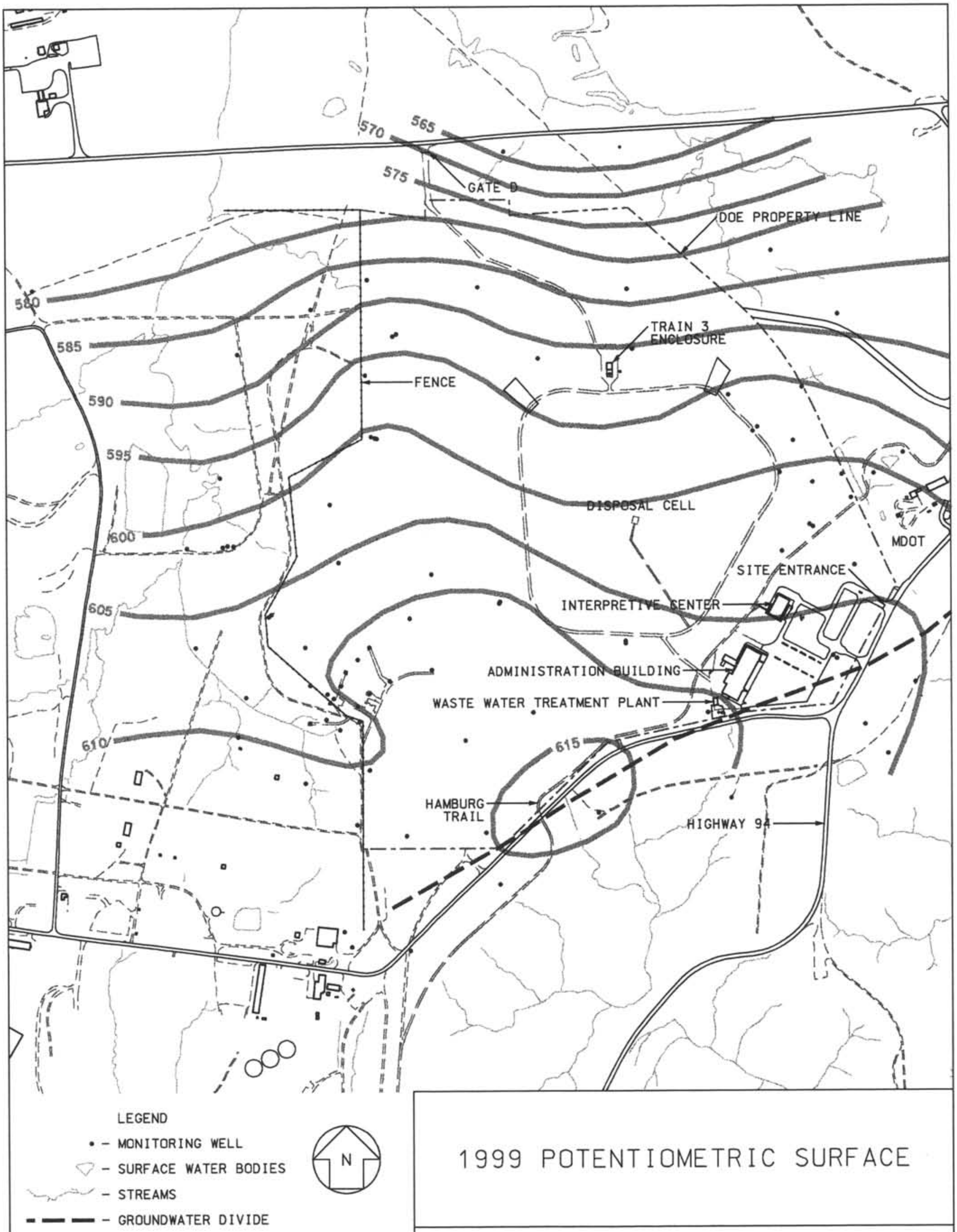
0 800 1600

SCALE FEET

1998 POTENTIOMETRIC SURFACE

FIGURE C-2

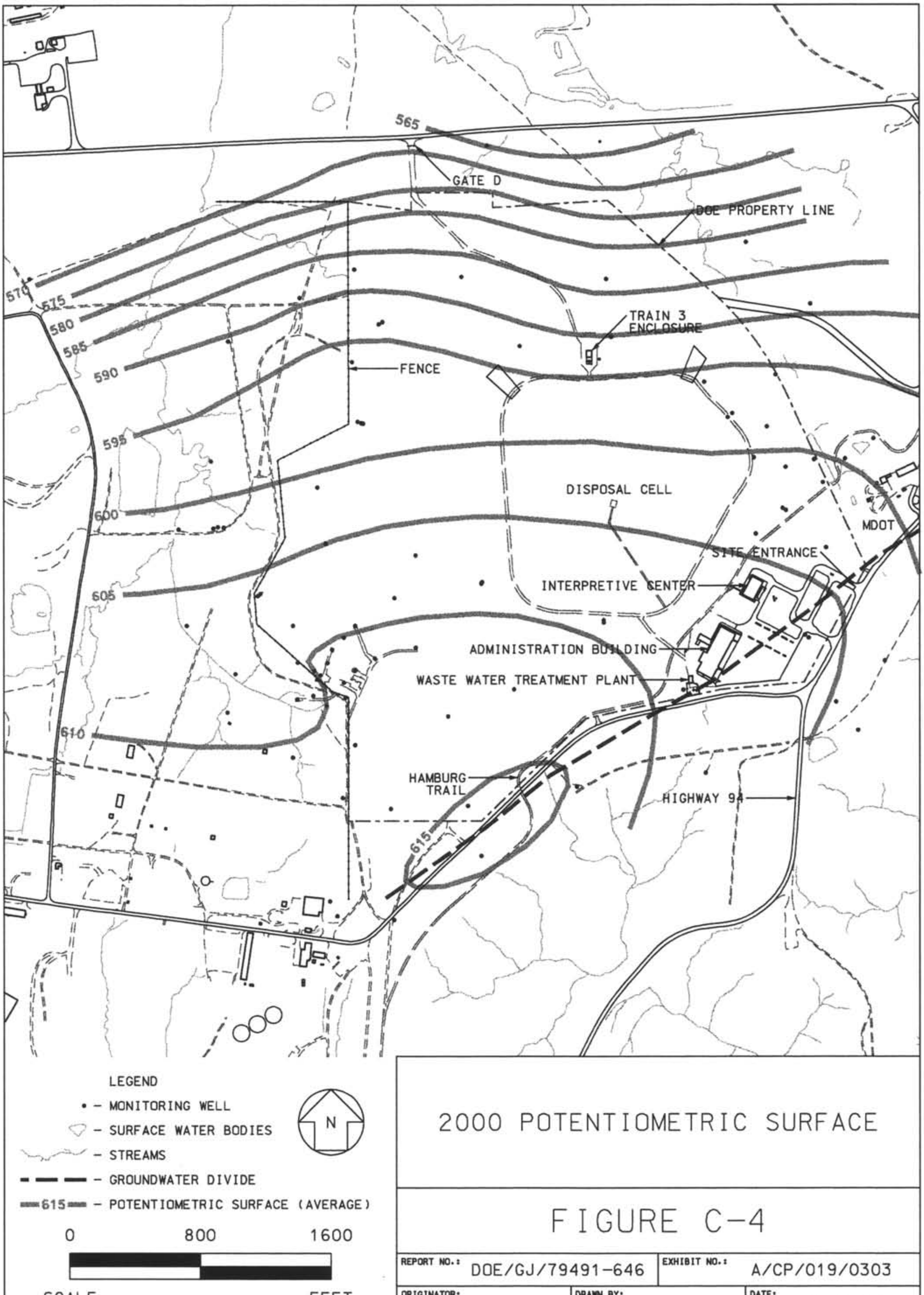
REPORT NO.: DOE/GJ/79491-646		EXHIBIT NO.: A/CP/017/0303	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 3/20/03	



1999 POTENTIOMETRIC SURFACE

FIGURE C-3

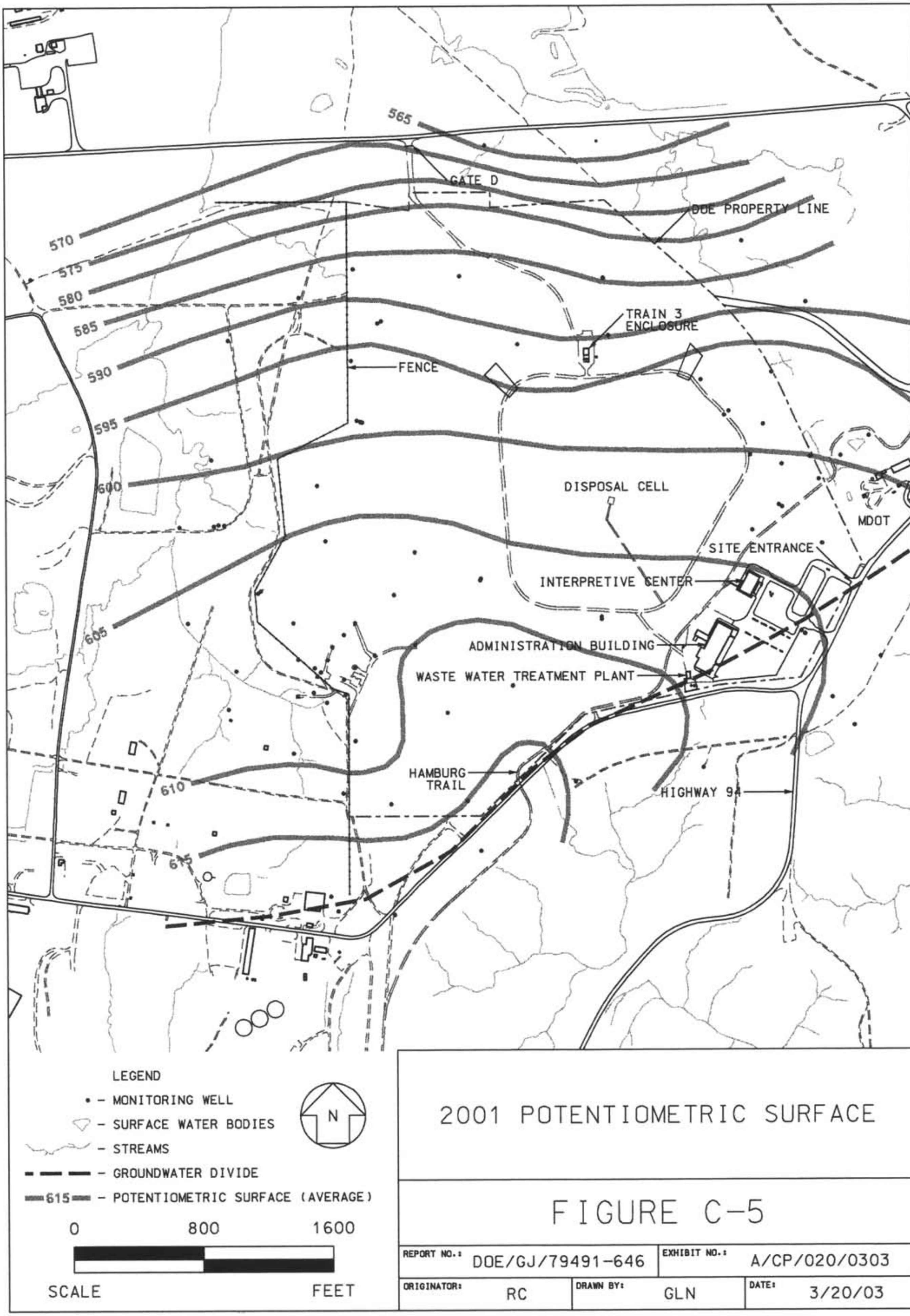
REPORT NO.: DOE/GJ/79491-646		EXHIBIT NO.: A/CP/018/0303	
ORIGINATOR: RC	DRAWN BY: GLN		DATE: 3/20/03



2000 POTENTIOMETRIC SURFACE

FIGURE C-4

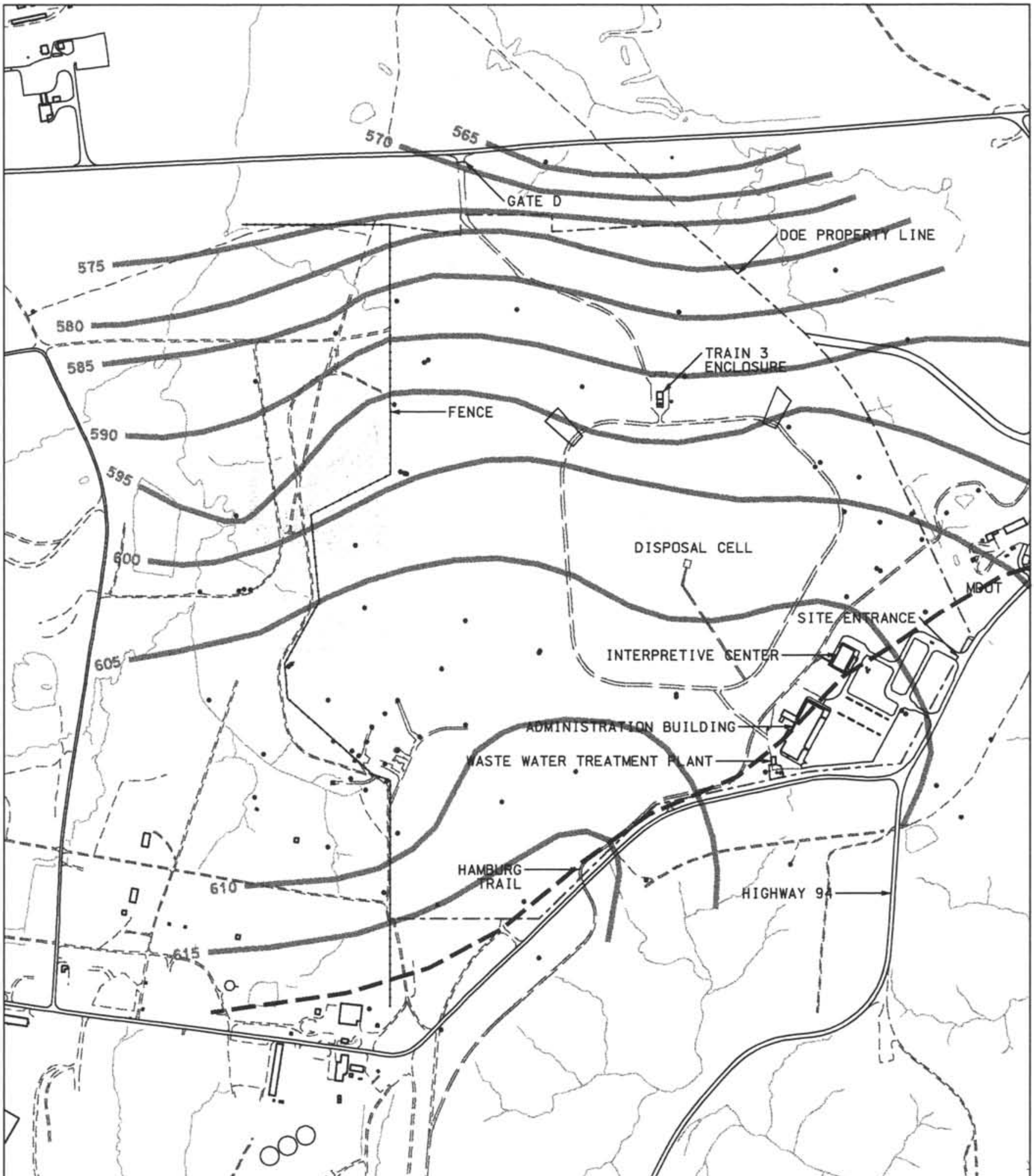
REPORT NO.: DOE/GJ/79491-646		EXHIBIT NO.: A/CP/019/0303
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 3/20/03



2001 POTENTIOMETRIC SURFACE

FIGURE C-5

REPORT NO.: DOE/GJ/79491-646		EXHIBIT NO.: A/CP/020/0303	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 3/20/03	



LEGEND

• – MONITORING WELL
– SURFACE WATER BODIES
– STREAMS
– GROUNDWATER DIVIDE
615 – POTENTIOMETRIC SURFACE (AVERAGE)

N

0 800 1600

SCALE FEET

2002 POTENTIOMETRIC SURFACE

FIGURE C-6

REPORT NO.: DOE/GJ/79491-646		EXHIBIT NO.: A/CP/021/0303	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 3/20/03	

		YEAR				
LOCATION_	Data	1998	1999	2000	2001	2002
MW-2001	Average of WATER_ELEVATION	588.115	588.2175	587.9475	587.5625	588.0725
	Max of WATER_ELEVATION	588.73	588.58	588.48	587.69	588.43
	Min of WATER_ELEVATION	587.47	587.78	587.73	587.41	587.84
	Count of WATER_ELEVATION	4	4	4	4	4
MW-2002	Average of WATER_ELEVATION	593.214	592.9025	593.41	591.815	591.86
	Max of WATER_ELEVATION	593.99	593.51	594.3	592.68	592.29
	Min of WATER_ELEVATION	592.53	592.41	592.22	591.36	591.61
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2003	Average of WATER_ELEVATION	597.335	597.4875	597.0975	596.765	597.2525
	Max of WATER_ELEVATION	597.63	597.73	597.6	596.99	597.79
	Min of WATER_ELEVATION	596.98	597.19	596.33	596.47	596.79
	Count of WATER_ELEVATION	4	4	4	4	4
MW-2005	Average of WATER_ELEVATION	587.424	587.6	587.4175	587.233333	595.4425
	Max of WATER_ELEVATION	587.74	587.83	587.47	587.33	612.25
	Min of WATER_ELEVATION	587	587.44	587.38	587.16	589.79
	Count of WATER_ELEVATION	5	4	4	3	4
MW-2006	Average of WATER_ELEVATION	599.094	598.2475	597.62	598.545	598.05
	Max of WATER_ELEVATION	599.59	598.6	597.93	598.67	598.05
	Min of WATER_ELEVATION	598.67	598.01	597.22	598.29	598.05
	Count of WATER_ELEVATION	5	4	3	4	1
MW-2010	Average of WATER_ELEVATION	599.565				
	Max of WATER_ELEVATION	599.76				
	Min of WATER_ELEVATION	599.37				
	Count of WATER_ELEVATION	2				
MW-2012	Average of WATER_ELEVATION	602.936	601.0925	600.5925	600.9375	600.68
	Max of WATER_ELEVATION	604.2	601.28	600.72	601.07	600.81
	Min of WATER_ELEVATION	601.87	600.86	600.51	600.82	600.45
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2013	Average of WATER_ELEVATION	604.518	603.8475	603.1675	604.31	603.3725
	Max of WATER_ELEVATION	604.97	604.27	603.59	604.81	603.71
	Min of WATER_ELEVATION	604.15	603	602.73	604.03	602.72
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2014	Average of WATER_ELEVATION	603.934	603.5825	603.2625	603.7825	603.705
	Max of WATER_ELEVATION	604.2	603.84	603.55	604.05	603.91
	Min of WATER_ELEVATION	603.58	603.38	602.71	603.4	603.5
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2017	Average of WATER_ELEVATION	605.15	605.23	604.615	604.675	604.8425
	Max of WATER_ELEVATION	605.36	605.54	604.84	605.3	605.07
	Min of WATER_ELEVATION	604.71	604.85	604.32	604.06	604.61
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2018	Average of WATER_ELEVATION	615.482				
	Max of WATER_ELEVATION	615.82				
	Min of WATER_ELEVATION	614.87				
	Count of WATER_ELEVATION	5				
MW-2019	Average of WATER_ELEVATION	591.878				
	Max of WATER_ELEVATION	592.26				
	Min of WATER_ELEVATION	591.47				
	Count of WATER_ELEVATION	5				
MW-2021	Average of WATER_ELEVATION	589.256	589.1225	589.3025	588.27	588.6675
	Max of WATER_ELEVATION	589.98	589.66	591.44	588.5	589.21
	Min of WATER_ELEVATION	588.42	588.58	588.48	587.98	588.29
	Count of WATER_ELEVATION	5	4	4	4	4

MW-2022	Average of WATER_ELEVATION	585.07	585.31	584.99	590.95	586.145
	Max of WATER_ELEVATION	585.67	585.65	585.14	603.07	586.44
	Min of WATER_ELEVATION	584.58	585.07	584.71	584.74	586.01
	Count of WATER_ELEVATION	4	4	4	3	4
MW-2023	Average of WATER_ELEVATION	582.964	583.18	583.075	583.1025	583.19
	Max of WATER_ELEVATION	583.19	583.33	583.18	583.2	583.34
	Min of WATER_ELEVATION	582.4	583.11	582.96	582.99	583.08
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2024	Average of WATER_ELEVATION	566.956	567.255	566.67	566.6925	567.2875
	Max of WATER_ELEVATION	567.66	567.87	567	566.94	567.76
	Min of WATER_ELEVATION	566.2	566.88	566.49	566.16	566.83
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2026	Average of WATER_ELEVATION	590.855				
	Max of WATER_ELEVATION	591.18				
	Min of WATER_ELEVATION	590.53				
	Count of WATER_ELEVATION	2				
MW-2027	Average of WATER_ELEVATION	591.95				
	Max of WATER_ELEVATION	592.24				
	Min of WATER_ELEVATION	591.66				
	Count of WATER_ELEVATION	2				
MW-2032	Average of WATER_ELEVATION	582.886	583.01	582.8675	582.09	582.92
	Max of WATER_ELEVATION	583.09	583.49	582.9	582.09	582.92
	Min of WATER_ELEVATION	582.79	582.74	582.82	582.09	582.92
	Count of WATER_ELEVATION	5	4	4	1	1
MW-2033	Average of WATER_ELEVATION	605.096	604.645	604.52	605.08	604.34
	Max of WATER_ELEVATION	605.55	604.85	604.71	605.27	604.69
	Min of WATER_ELEVATION	604.69	604.32	604.27	604.82	603.44
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2034	Average of WATER_ELEVATION	606.302	606.495	605.61	605.63	605.6725
	Max of WATER_ELEVATION	606.81	606.71	605.68	606.6	606.11
	Min of WATER_ELEVATION	605.69	606.02	605.41	604.77	605.13
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2035	Average of WATER_ELEVATION	613.708	613.7275	613.2475	612.636667	615.7125
	Max of WATER_ELEVATION	614.08	613.97	613.36	612.91	615.79
	Min of WATER_ELEVATION	612.92	613.45	613.19	612.49	615.59
	Count of WATER_ELEVATION	5	4	4	3	4
MW-2036	Average of WATER_ELEVATION	610.552	610.755	609.9875	608.7975	609.4725
	Max of WATER_ELEVATION	611.57	610.91	610.21	610.21	609.61
	Min of WATER_ELEVATION	609.57	610.56	609.42	607.43	609.22
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2037	Average of WATER_ELEVATION	610.422	610.6875	610.19	609.42	609.51
	Max of WATER_ELEVATION	612.21	610.8	610.38	609.86	609.78
	Min of WATER_ELEVATION	608.62	610.53	610.09	608.98	609.17
	Count of WATER_ELEVATION	5	4	4	2	4
MW-2038	Average of WATER_ELEVATION	611.146	612.125	613.025	610.0675	609.9025
	Max of WATER_ELEVATION	611.87	614.65	619.63	611.1	610.06
	Min of WATER_ELEVATION	610.45	611.01	610.66	609.02	609.81
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2039	Average of WATER_ELEVATION	612.602	611.8925	612.45	615.13	611.24
	Max of WATER_ELEVATION	613.05	612.86	612.45	615.13	611.39
	Min of WATER_ELEVATION	611.86	609.6	612.45	615.13	611.05
	Count of WATER_ELEVATION	5	4	1	1	4

MW-2040	Average of WATER_ELEVATION	612.508	612.6325	611.933333	611.1675	611.065
	Max of WATER_ELEVATION	612.76	613.04	612.18	611.53	611.32
	Min of WATER_ELEVATION	612.21	612.31	611.71	610.74	610.91
	Count of WATER_ELEVATION	5	4	3	4	4
MW-2041	Average of WATER_ELEVATION	612.384	612.25	616.06		
	Max of WATER_ELEVATION	612.69	612.43	616.06		
	Min of WATER_ELEVATION	612.21	611.97	616.06		
	Count of WATER_ELEVATION	5	4	1		
MW-2042	Average of WATER_ELEVATION	613.822	613.4975	613.28		
	Max of WATER_ELEVATION	614.12	613.97	613.28		
	Min of WATER_ELEVATION	613.58	613.09	613.28		
	Count of WATER_ELEVATION	5	4	1		
MW-2043	Average of WATER_ELEVATION	611.088	613.2925	613.09		
	Max of WATER_ELEVATION	613.8	613.69	613.09		
	Min of WATER_ELEVATION	601.9	612.98	613.09		
	Count of WATER_ELEVATION	5	4	1		
MW-2044	Average of WATER_ELEVATION	613.805				
	Max of WATER_ELEVATION	613.84				
	Min of WATER_ELEVATION	613.77				
	Count of WATER_ELEVATION	2				
MW-2045	Average of WATER_ELEVATION	597.01	596.8625	596.48	599.355	596.65
	Max of WATER_ELEVATION	597.25	597	596.6	605.88	596.94
	Min of WATER_ELEVATION	596.5	596.64	596.4	597.08	596.44
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2046	Average of WATER_ELEVATION	588.842	589	589.105	589.086667	589.01
	Max of WATER_ELEVATION	589.21	589.08	589.22	589.18	589.06
	Min of WATER_ELEVATION	588.25	588.92	589.02	589.02	588.93
	Count of WATER_ELEVATION	5	4	4	3	4
MW-2047	Average of WATER_ELEVATION	590.878	591.045	595.643333	590.9275	591.01
	Max of WATER_ELEVATION	591.21	591.11	604.91	590.97	591.08
	Min of WATER_ELEVATION	590.43	590.93	590.97	590.89	590.92
	Count of WATER_ELEVATION	5	4	3	4	4
MW-2048	Average of WATER_ELEVATION	607.54	607.51	607.485	607.343333	
	Max of WATER_ELEVATION	607.72	607.66	607.64	607.39	
	Min of WATER_ELEVATION	607.08	607.43	607.42	607.3	
	Count of WATER_ELEVATION	5	4	4	3	
MW-2049	Average of WATER_ELEVATION				599.5225	599.365
	Max of WATER_ELEVATION				599.6	599.47
	Min of WATER_ELEVATION				599.43	599.23
	Count of WATER_ELEVATION				4	4
MW-2050	Average of WATER_ELEVATION				601.1825	601.03
	Max of WATER_ELEVATION				601.35	601.13
	Min of WATER_ELEVATION				600.99	600.9
	Count of WATER_ELEVATION				4	4
MW-2051	Average of WATER_ELEVATION				598.94	598.88
	Max of WATER_ELEVATION				598.95	598.99
	Min of WATER_ELEVATION				598.93	598.79
	Count of WATER_ELEVATION				2	4
MW-2055	Average of WATER_ELEVATION					606.795
	Max of WATER_ELEVATION					606.93
	Min of WATER_ELEVATION					606.66
	Count of WATER_ELEVATION					4

MW-3003	Average of WATER_ELEVATION	598.5175	598.4475	598.05	597.5275	597.72
	Max of WATER_ELEVATION	599.22	598.85	598.11	597.86	597.95
	Min of WATER_ELEVATION	597.88	598.01	597.96	597.17	597.43
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3006	Average of WATER_ELEVATION	592.5375	592.57	592.0475	591.1925	591.77
	Max of WATER_ELEVATION	593.5	593.08	592.74	591.45	592.35
	Min of WATER_ELEVATION	591.85	591.94	591.49	590.78	591.22
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3019B	Average of WATER_ELEVATION	606.37				
	Max of WATER_ELEVATION	606.68				
	Min of WATER_ELEVATION	606.06				
	Count of WATER_ELEVATION	2				
MW-3023	Average of WATER_ELEVATION	600.935	601.17	598.3225	599.4375	599.8675
	Max of WATER_ELEVATION	601.74	601.27	600.34	599.96	599.9
	Min of WATER_ELEVATION	600.19	601.07	592.58	598.23	599.83
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3024	Average of WATER_ELEVATION	601.28	601.74	599.9	600.5425	601.115
	Max of WATER_ELEVATION	601.64	602.38	600.77	600.95	601.65
	Min of WATER_ELEVATION	600.84	601.35	597.49	600.24	600.84
	Count of WATER_ELEVATION	4	3	4	4	4
MW-3025	Average of WATER_ELEVATION	610.1375	610.193333	609.235	608.1475	607.865
	Max of WATER_ELEVATION	610.4	610.33	609.52	608.78	608.06
	Min of WATER_ELEVATION	609.48	609.99	608.88	607.33	607.61
	Count of WATER_ELEVATION	4	3	4	4	4
MW-3026	Average of WATER_ELEVATION	607.3675	606.7475	605.8725	605.26	606.0375
	Max of WATER_ELEVATION	608.49	607.22	606.27	605.36	606.53
	Min of WATER_ELEVATION	606.14	606.39	605.05	605.14	605.67
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3027	Average of WATER_ELEVATION	608.49	608.1425	607.9625	606.6825	607.005
	Max of WATER_ELEVATION	609.59	608.46	609.46	607.41	607.31
	Min of WATER_ELEVATION	607.66	607.89	607.31	606.36	606.7
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3028	Average of WATER_ELEVATION	609.27	610.495	610.055	602.2625	609.2775
	Max of WATER_ELEVATION	610.17	610.62	610.19	609.72	609.45
	Min of WATER_ELEVATION	608.42	610.33	609.95	593.11	608.98
	Count of WATER_ELEVATION	3	4	4	4	4
MW-3029	Average of WATER_ELEVATION	609.146667	610.3725	609.9	607.515	609.15
	Max of WATER_ELEVATION	610.04	610.5	610.04	609.59	609.31
	Min of WATER_ELEVATION	608.3	610.21	609.77	604.89	608.84
	Count of WATER_ELEVATION	3	4	4	4	4
MW-3030	Average of WATER_ELEVATION				607.103333	607.425
	Max of WATER_ELEVATION				607.29	607.55
	Min of WATER_ELEVATION				606.87	607.3
	Count of WATER_ELEVATION				3	4
MW-3031	Average of WATER_ELEVATION				608.76	608.6025
	Max of WATER_ELEVATION				608.93	609.01
	Min of WATER_ELEVATION				608.51	608.01
	Count of WATER_ELEVATION				3	4
MW-3032	Average of WATER_ELEVATION				608.93	609.3525
	Max of WATER_ELEVATION				608.93	609.51
	Min of WATER_ELEVATION				608.93	609.11
	Count of WATER_ELEVATION				1	4

MW-3033	Average of WATER_ELEVATION				585.386667	
	Max of WATER_ELEVATION				587.7	
	Min of WATER_ELEVATION				582.38	
	Count of WATER_ELEVATION				3	
MW-3034	Average of WATER_ELEVATION				608.313333	609.245
	Max of WATER_ELEVATION				610.1	609.46
	Min of WATER_ELEVATION				606.07	608.96
	Count of WATER_ELEVATION				3	4
MW-3035	Average of WATER_ELEVATION				607.773333	609.2975
	Max of WATER_ELEVATION				608.97	609.48
	Min of WATER_ELEVATION				605.59	608.99
	Count of WATER_ELEVATION				3	4
MW-3036	Average of WATER_ELEVATION				607.976667	609.2925
	Max of WATER_ELEVATION				609.61	609.46
	Min of WATER_ELEVATION				605.54	609.01
	Count of WATER_ELEVATION				3	4
MW-3037	Average of WATER_ELEVATION					601.956667
	Max of WATER_ELEVATION					602.09
	Min of WATER_ELEVATION					601.78
	Count of WATER_ELEVATION					3
MW-3038	Average of WATER_ELEVATION					609.303333
	Max of WATER_ELEVATION					609.4
	Min of WATER_ELEVATION					609.16
	Count of WATER_ELEVATION					3
MW-3039	Average of WATER_ELEVATION					608.82
	Max of WATER_ELEVATION					608.89
	Min of WATER_ELEVATION					608.76
	Count of WATER_ELEVATION					3
MW-4001	Average of WATER_ELEVATION	602.814	602.1575	601.5775	601.7725	602.48
	Max of WATER_ELEVATION	603.71	602.72	601.89	602.85	603.83
	Min of WATER_ELEVATION	601.8	601.54	601.28	601.1	601.87
	Count of WATER_ELEVATION	5	4	4	4	4
MW-4002	Average of WATER_ELEVATION	575.842	570.5225	568.86	570.436667	577.0675
	Max of WATER_ELEVATION	584.9	576.37	569.15	573.8	587.56
	Min of WATER_ELEVATION	568.16	568.27	568.71	568.75	568.8
	Count of WATER_ELEVATION	5	4	4	3	4
MW-4003	Average of WATER_ELEVATION	614.318	615.08			
	Max of WATER_ELEVATION	615.28	615.08			
	Min of WATER_ELEVATION	612.61	615.08			
	Count of WATER_ELEVATION	5	1			
MW-4004	Average of WATER_ELEVATION	612.094	612.12			
	Max of WATER_ELEVATION	612.66	612.12			
	Min of WATER_ELEVATION	611.56	612.12			
	Count of WATER_ELEVATION	5	1			
MW-4005	Average of WATER_ELEVATION	610.19	610.31			
	Max of WATER_ELEVATION	610.96	610.31			
	Min of WATER_ELEVATION	609.32	610.31			
	Count of WATER_ELEVATION	5	1			
MW-4006	Average of WATER_ELEVATION	602.938	602.1175	601.61	601.5025	602.26
	Max of WATER_ELEVATION	603.74	602.46	601.84	601.75	603.33
	Min of WATER_ELEVATION	602.27	601.64	601.4	601.14	601.66
	Count of WATER_ELEVATION	5	4	4	4	4

MW-4007	Average of WATER_ELEVATION	596.358	596.0175	594.8825	594.4625	595.325
	Max of WATER_ELEVATION	597.25	596.67	595.01	594.91	596.38
	Min of WATER_ELEVATION	595.68	595.15	594.65	593.93	594.48
	Count of WATER_ELEVATION	5	4	4	4	4
MW-4008	Average of WATER_ELEVATION	597.67	598.1			
	Max of WATER_ELEVATION	598.38	598.1			
	Min of WATER_ELEVATION	597.01	598.1			
	Count of WATER_ELEVATION	5	1			
MW-4009	Average of WATER_ELEVATION	594.2	594.73			
	Max of WATER_ELEVATION	595.45	594.73			
	Min of WATER_ELEVATION	593.21	594.73			
	Count of WATER_ELEVATION	5	1			
MW-4010	Average of WATER_ELEVATION	589.39	590.54			
	Max of WATER_ELEVATION	591.04	590.54			
	Min of WATER_ELEVATION	588.02	590.54			
	Count of WATER_ELEVATION	5	1			
MW-4011	Average of WATER_ELEVATION	592.01	591.935	591.9275	591.5875	592.76
	Max of WATER_ELEVATION	592.79	592.45	592.93	591.86	593.3
	Min of WATER_ELEVATION	591.32	591.3	591.17	591.27	591.76
	Count of WATER_ELEVATION	5	4	4	4	4
MW-4012	Average of WATER_ELEVATION	570.8725	571.08			
	Max of WATER_ELEVATION	571.25	571.08			
	Min of WATER_ELEVATION	570.72	571.08			
	Count of WATER_ELEVATION	4	1			
MW-4013	Average of WATER_ELEVATION	560.2375	560.2525	561.0325	561.0625	560.4125
	Max of WATER_ELEVATION	560.38	560.33	563.2	563.35	560.5
	Min of WATER_ELEVATION	560.16	560.22	560.22	560.29	560.36
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4014	Average of WATER_ELEVATION	560.4875	560.6375	560.5975	560.9825	561.23
	Max of WATER_ELEVATION	561.02	561.06	561.05	561.1	561.66
	Min of WATER_ELEVATION	560.21	560.33	560.07	560.8	561.04
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4015	Average of WATER_ELEVATION	581.39	581.47	580.8175	581.74	581.9575
	Max of WATER_ELEVATION	582.51	582.53	580.98	581.98	583.01
	Min of WATER_ELEVATION	580.65	580.87	580.64	581.51	581.34
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4016	Average of WATER_ELEVATION	589.14	589.25			
	Max of WATER_ELEVATION	589.42	589.25			
	Min of WATER_ELEVATION	588.82	589.25			
	Count of WATER_ELEVATION	4	1			
MW-4018	Average of WATER_ELEVATION	598.095	598.08			
	Max of WATER_ELEVATION	598.56	598.08			
	Min of WATER_ELEVATION	597.46	598.08			
	Count of WATER_ELEVATION	4	1			
MW-4019	Average of WATER_ELEVATION	613.105				
	Max of WATER_ELEVATION	613.26				
	Min of WATER_ELEVATION	612.95				
	Count of WATER_ELEVATION	2				
MW-4020	Average of WATER_ELEVATION	604.9875	605.26	604.2475	604.06	604.6225
	Max of WATER_ELEVATION	605.3	605.73	604.43	604.32	604.89
	Min of WATER_ELEVATION	604.4	604.83	604.02	603.59	604.24
	Count of WATER_ELEVATION	4	4	4	3	4

MW-4021	Average of WATER_ELEVATION	607.516667				
	Max of WATER_ELEVATION	607.65				
	Min of WATER_ELEVATION	607.32				
	Count of WATER_ELEVATION	3				
MW-4022	Average of WATER_ELEVATION	596.65	597.105	594.18	593.3225	594.0825
	Max of WATER_ELEVATION	597.22	597.62	594.67	593.49	595.69
	Min of WATER_ELEVATION	595.6	596.54	593.78	592.95	592.81
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4023	Average of WATER_ELEVATION	615.5125	615.37	614.7725	614.5775	614.5025
	Max of WATER_ELEVATION	615.95	615.64	614.94	615.08	615.07
	Min of WATER_ELEVATION	614.7	614.98	614.58	613.87	613.93
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4024	Average of WATER_ELEVATION	605.09	605.3525	604.2375	603.893333	604.5025
	Max of WATER_ELEVATION	605.45	605.86	604.38	604.18	604.84
	Min of WATER_ELEVATION	604.46	604.89	604.08	603.34	604.04
	Count of WATER_ELEVATION	4	4	4	3	4
MW-4025	Average of WATER_ELEVATION	604.9475	604.87			
	Max of WATER_ELEVATION	605.83	604.87			
	Min of WATER_ELEVATION	604.07	604.87			
	Count of WATER_ELEVATION	4	1			
MW-4026	Average of WATER_ELEVATION	459.89	459.9325	459.6	459.68	459.7525
	Max of WATER_ELEVATION	460.06	460.51	459.82	459.83	460.13
	Min of WATER_ELEVATION	459.65	459.51	459.38	459.53	459.15
	Count of WATER_ELEVATION	6	4	2	2	4
MW-4027	Average of WATER_ELEVATION	609.326667	610.5	610.0575	609.38	609.2825
	Max of WATER_ELEVATION	610.23	610.64	610.22	609.97	609.41
	Min of WATER_ELEVATION	608.41	610.42	609.93	608.79	609.03
	Count of WATER_ELEVATION	3	4	4	2	4
MW-4028	Average of WATER_ELEVATION	609.5025	610.6125	609.785	607.6625	609.34
	Max of WATER_ELEVATION	610.18	611.02	610.03	609.72	609.73
	Min of WATER_ELEVATION	608.57	610.38	609.2	605.22	608.98
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4029	Average of WATER_ELEVATION	609.465	610.435	610.0225	608.0775	609.2475
	Max of WATER_ELEVATION	610.15	610.58	610.19	609.7	609.42
	Min of WATER_ELEVATION	608.55	610.35	609.87	605.85	608.95
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4030	Average of WATER_ELEVATION				597.1625	597.21
	Max of WATER_ELEVATION				597.29	597.36
	Min of WATER_ELEVATION				597.06	597.13
	Count of WATER_ELEVATION				4	4
MW-4031	Average of WATER_ELEVATION				608.366667	609.3725
	Max of WATER_ELEVATION				608.66	609.61
	Min of WATER_ELEVATION				608.03	609.24
	Count of WATER_ELEVATION				3	4
MW-4032	Average of WATER_ELEVATION				608.54	609.5
	Max of WATER_ELEVATION				608.88	609.72
	Min of WATER_ELEVATION				608.2	609.25
	Count of WATER_ELEVATION				2	4
MW-4033	Average of WATER_ELEVATION				608.5	609.3
	Max of WATER_ELEVATION				608.72	609.42
	Min of WATER_ELEVATION				608.28	609.06
	Count of WATER_ELEVATION				2	4

MW-4034	Average of WATER_ELEVATION				610.71	611.1525
	Max of WATER_ELEVATION				610.78	611.21
	Min of WATER_ELEVATION				610.64	611.02
	Count of WATER_ELEVATION				2	4
MW-4035	Average of WATER_ELEVATION				623.24	623.8925
	Max of WATER_ELEVATION				623.42	624.08
	Min of WATER_ELEVATION				623.06	623.43
	Count of WATER_ELEVATION				2	4
MW-4036	Average of WATER_ELEVATION					592.51
	Max of WATER_ELEVATION					593.23
	Min of WATER_ELEVATION					591.63
	Count of WATER_ELEVATION					4
MW-4037	Average of WATER_ELEVATION					608.2525
	Max of WATER_ELEVATION					609.61
	Min of WATER_ELEVATION					607.19
	Count of WATER_ELEVATION					4
MW-4038	Average of WATER_ELEVATION					609.51
	Max of WATER_ELEVATION					609.64
	Min of WATER_ELEVATION					609.23
	Count of WATER_ELEVATION					4
MWS-21	Average of WATER_ELEVATION	609.33875	606.25	609.89	608.44	609.4075
	Max of WATER_ELEVATION	610.28	610.47	609.89	610.28	609.68
	Min of WATER_ELEVATION	608.93	602.03	609.89	606.6	609.19
	Count of WATER_ELEVATION	8	2	1	4	4
MWS-3	Average of WATER_ELEVATION	594.303333	598.915			
	Max of WATER_ELEVATION	594.73	603.11			
	Min of WATER_ELEVATION	593.97	594.72			
	Count of WATER_ELEVATION	3	2			
MWS-4	Average of WATER_ELEVATION	602.581429	602.675	601.39	601.556667	602.41
	Max of WATER_ELEVATION	602.94	602.85	601.39	601.94	603.53
	Min of WATER_ELEVATION	601.62	602.5	601.39	601.12	601.84
	Count of WATER_ELEVATION	7	2	1	3	4

Appendix L
Well Field Contingency Plan

L1.0 Planning and Preparation

Under this contingency plan, which supersedes the *Well Field Contingency Plan* (DOE 1992b), any production capacity lost to the existing well field due to confirmed contaminant migration from the Weldon Spring Quarry (Quarry) will be replaced. While it is highly unlikely that such measures will be implemented, this plan defines the minimum planning and preparation required to facilitate a rapid and effective response. Planning and preparation measures include the following:

- Selection of a reliable alternate source of water to replace or supplement the existing well field.

- Preparation of a plan for data collection to facilitate development of the selected alternate source.

- Development of design criteria for use in design and construction of the alternate source infrastructure.

L1.1 Selection of Alternate Source

Criteria and alternatives for contingency planning were developed using modified value engineering principles. Modified value engineering is an alternative evaluation process that parallels the CERCLA philosophy of remedial alternative development that is not based upon cost unless all other criteria (i.e., effectiveness, implementability, etc.) are equal. This process was performed as outlined in *Alternative Evaluation Study Manual* (DOE 2000).

Two broad potential scenarios were considered as part of alternative evaluation: (1) a portion of the well field is threatened, requiring partial replacement of the water supply; and (2) the entire well field is threatened, requiring replacement of the entire water supply from the existing well field.

The criteria used to evaluate the alternatives were effectiveness, technical feasibility, degree of disruption, public acceptance, regulatory requirements, cost, and impact on the present treatment system. By applying these criteria, all but the top three alternatives for each scenario were quickly eliminated (Table L−1). Further evaluation of the remaining alternatives led to the selection of a proposed alternative. The evaluation and selection process is described in the report *St. Charles County Well Field Summary of Alternatives for Contingency Plans* (DOE 1992a).

Table L−1. Alternatives Considered for Water Supply Replacement Scenarios

Alternative	Rank of Alternative	
	Partial Replacement Scenario	**Full Replacement Scenario**
New well(s) in existing well field	2	7
New well(s) in Darst Bottoms upstream of existing well field	1	1
Modify existing well system	10	10
Change pumping scheme of existing wells	6	9
Utilize existing pipeline from St. Louis	5	11
New pipeline to Howard Bend Plant	4	3
Treat Missouri River surface water	3	2
Find bedrock source of water at another site	7	6
Treat and use contaminated water	11	8
Protect well field with a slurry wall	8	4
Redirection of existing capacities	9	5
No action	Not appropriate	Not appropriate

The selected alternative is the installation of additional water supply wells in the Darst Bottoms to the south of the present well field (Figure L−1). Although this location is within the same aquifer as the present well field, the replacement location is upgradient of the contaminant source, the Quarry. Hence, given that action levels for contaminants are conservative (low), the replacement well field location would be unaffected by contaminant migration either from the Quarry or a potentially tainted well field to the north.

L1.2 Preparation of a Plan for Hydrogeologic Investigation

A plan will be prepared for a hydrogeologic investigation required to obtain the information necessary to develop the alternate source of groundwater. This plan will identify the activities, sampling, and testing required to assess the hydrogeologic characteristics of the replacement well field area. While the hydrogeologic characteristics of the replacement well field location are probably quite similar to the present well field, additional data and testing will be required to ensure an adequate assessment, and to ensure that engineering design is optimized to meet production needs.

L1.3 Design Criteria

Engineering design criteria will be established for use in design and construction of the alternate water supply. Design criteria will address:

- Functional requirements relative to interface with the existing well field and treatment plant.
- Performance requirements relative to production capacity.
- Phased response (requirements for partial versus full replacement).
- Water quality requirements.
- Well sitting and construction.

In the event an alternate source of drinking water is required, engineering design and construction shall proceed based on the design criteria established under this plan.

L1.4 Access

Should the need arise, access for data collection purposes, well installation, and pipe line construction will be coordinated with the affected private landowners and St. Charles County officials. As an interim measure, private landowners who would be affected by construction of a replacement well field were contacted by a U.S. Department of Energy (DOE) representative who explained the contingency plan and outlined the potential for a request for access to be made at some future time.

L1.5 Installation of Replacement Wells

In the event that contaminants from the Quarry are detected above action levels established under this plan, the following steps will be taken to install a replacement well field:

- Access will be obtained from affected landowners.
- Subcontractor services will be procured for drilling of production and test wells and acquisition of other data prescribed as part of the hydrogeologic investigation.
- Field activities will be initiated as detailed in the hydrogeologic investigation plan.
- Design of components necessary to perform drilling, install wells, pumps, and piping, and construct pumping facilities and controls will be accelerated.
- Procurement of materials will be accelerated for pumps, piping, casing, screens, and all appurtenances required to complete construction of the replacement well field to production standards.
- The replacement well field will be installed under the direction of DOE.

L1.6 Permits

Construction permits would be required from the MDNR and St. Charles County as well as a permit from the Darst Bottoms Levee District in order to install the replacement wells. The permit process is estimated to take between 60 and 90 days (DOE 1992b).

L1.7 Schedule

Assuming that construction would proceed on several tasks simultaneously, it is estimated that a minimum of 2 months will be required for construction after permits are obtained. Allowing 60 days for engineering and the preparation of permit applications, about 200 days would be required from the start of engineering through the start up of the pumps (DOE 1992b). The estimated implementation schedule is illustrated in Figure L−2.

During the period of time required to complete installation of the replacement well field, the present well field would operate without the reserve provided by the affected wells. In a worst case scenario, the present well field might not meet production demands during the period of new well field construction. In this instance, service demands for St. Charles County Plant No. 1 would have to be met through an alternate source or rationing (such as water used for lawn care and car washing, etc.) until the replacement well field went on line or demand subsided due to the normal demand cycle.

L1.8 Well Design

Figure L−3 illustrates the preliminary design of the replacement wells.

L2.0 References

U.S. Department of Energy (DOE), 1992a. *St. Charles County Well Field Summary of Alternatives for Contingency Plans,* DOE/OR/21548-285, prepared by L.G. Zambrana Consultants, Inc. and Woodward-Clyde Consultants for the U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, May.

———, 1992b. *Well Field Contingency Plan,* DOE/OR/21548-340, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, November.

———, 2000. *Alternative Evaluation Study Manual,* Rev. 1, DOE/OR/21548-640, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

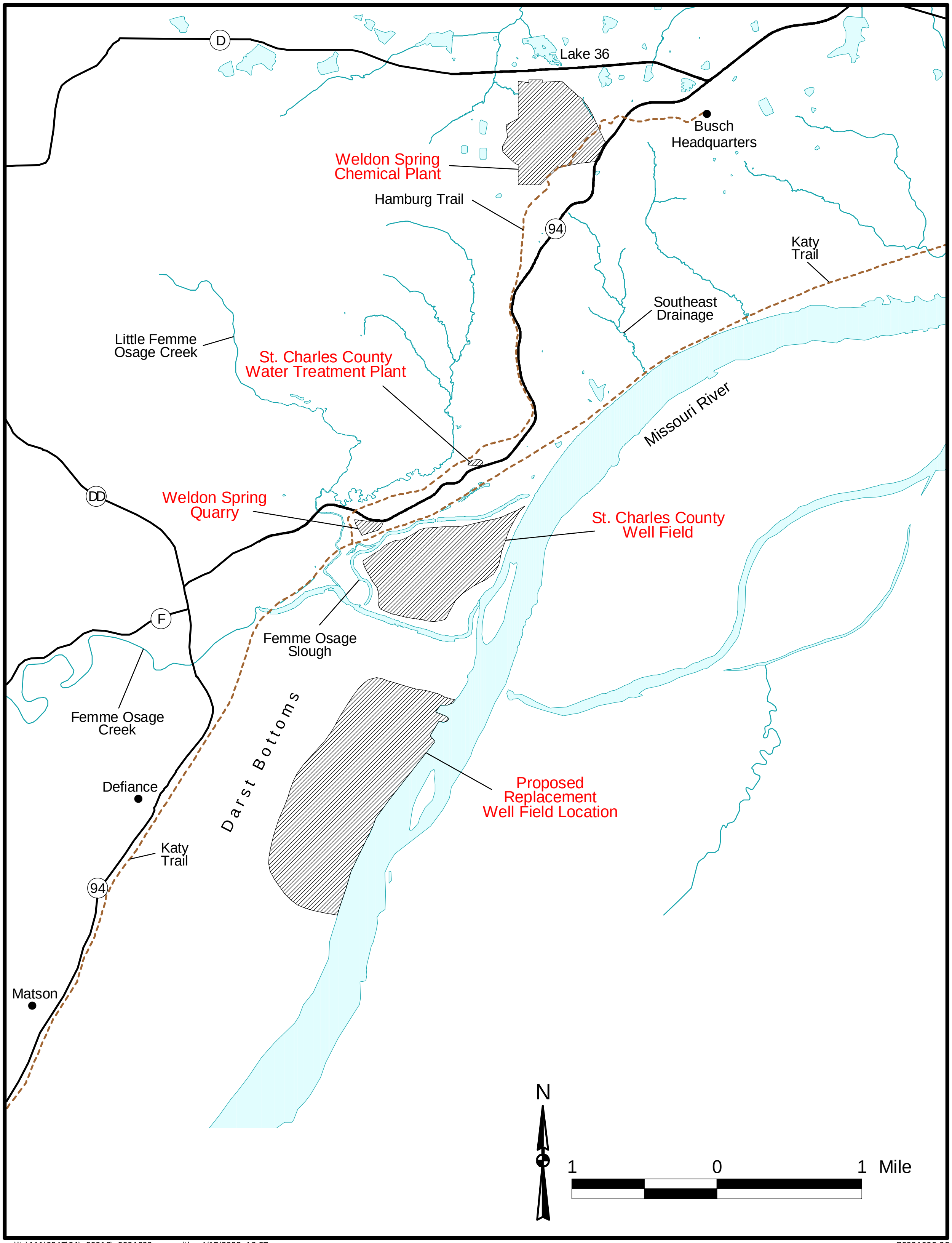


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Figure L–1. Proposed Replacement Well Field Location

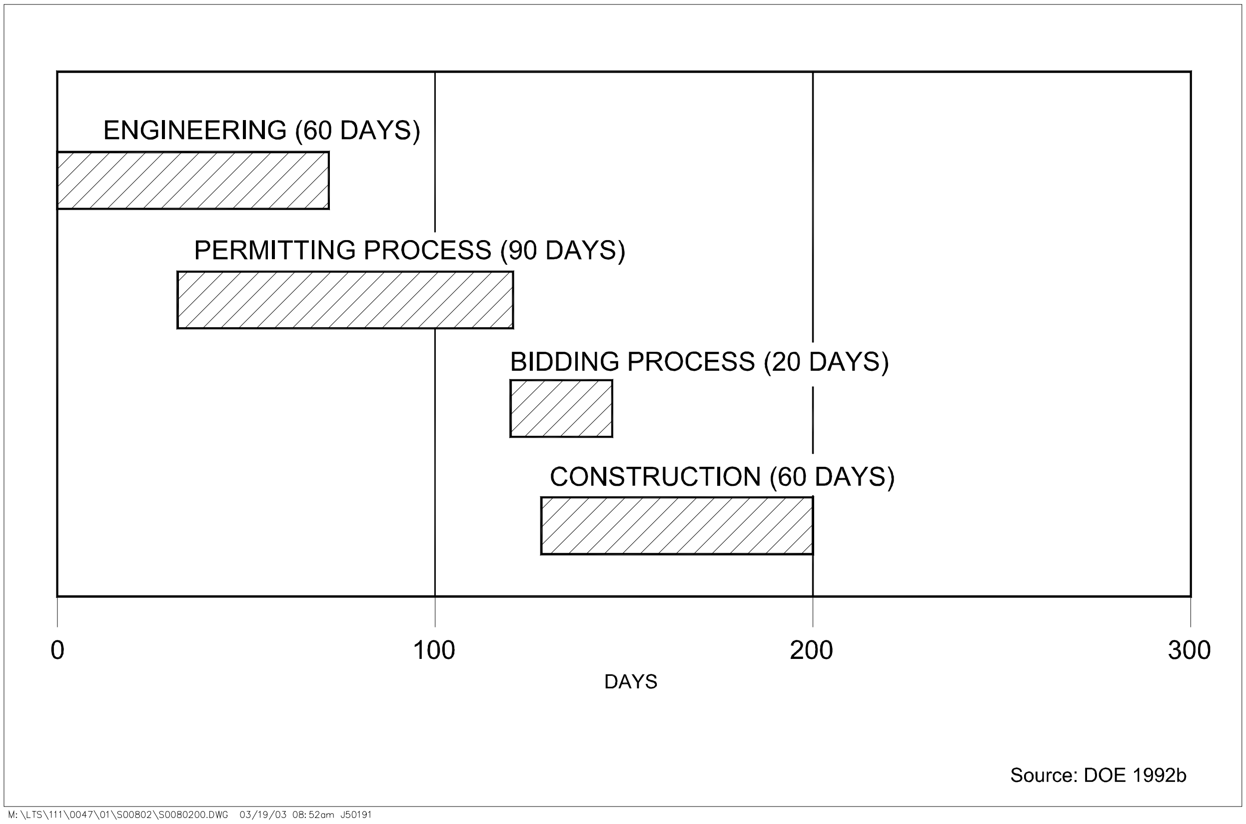

Figure L−2. Estimated Replacement Well field Installation Schedule

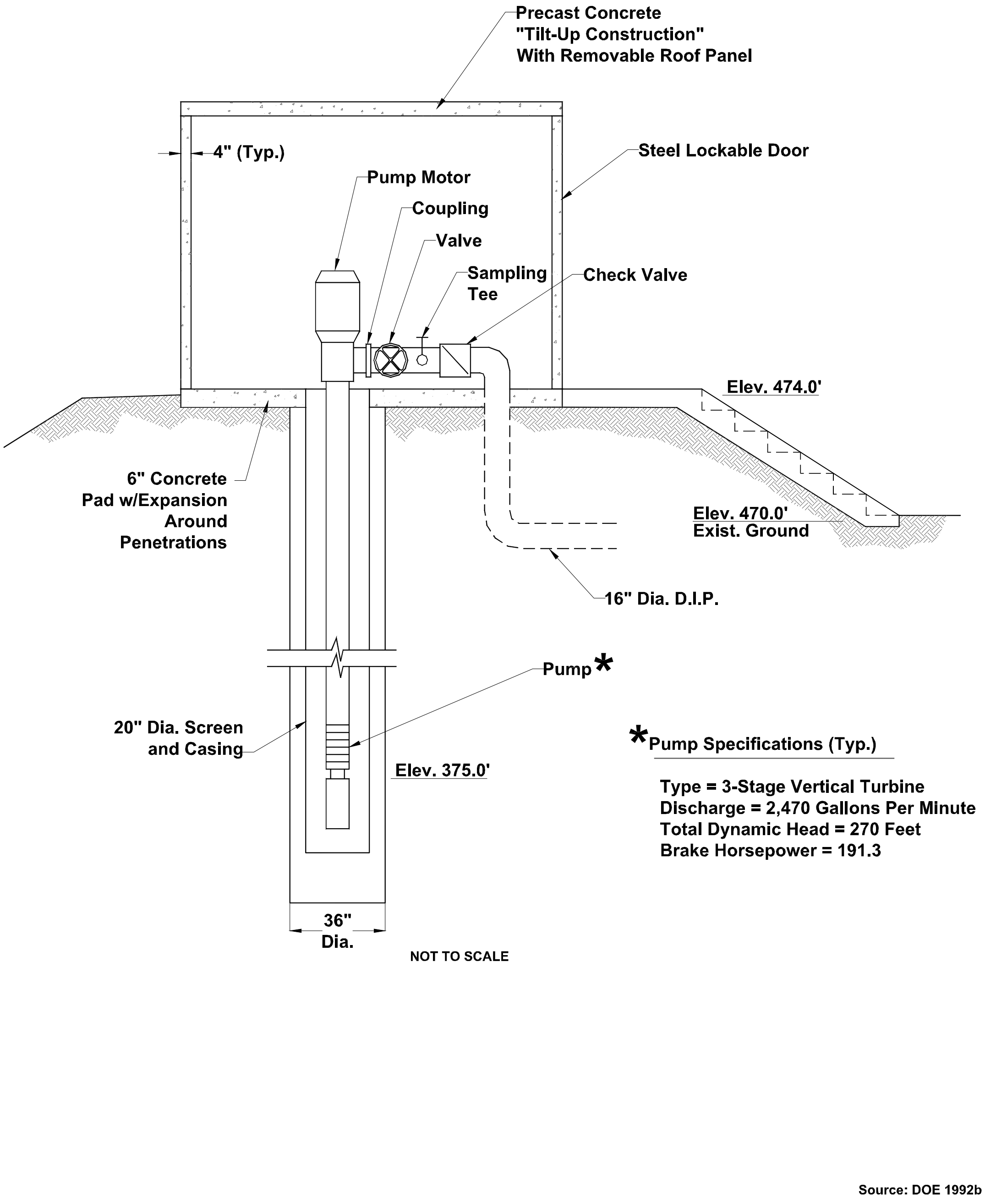

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Figure L−3. Proposed Typical Replacement Well Schematic

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Appendix M
Groundwater Operable Unit
Contingency Trees

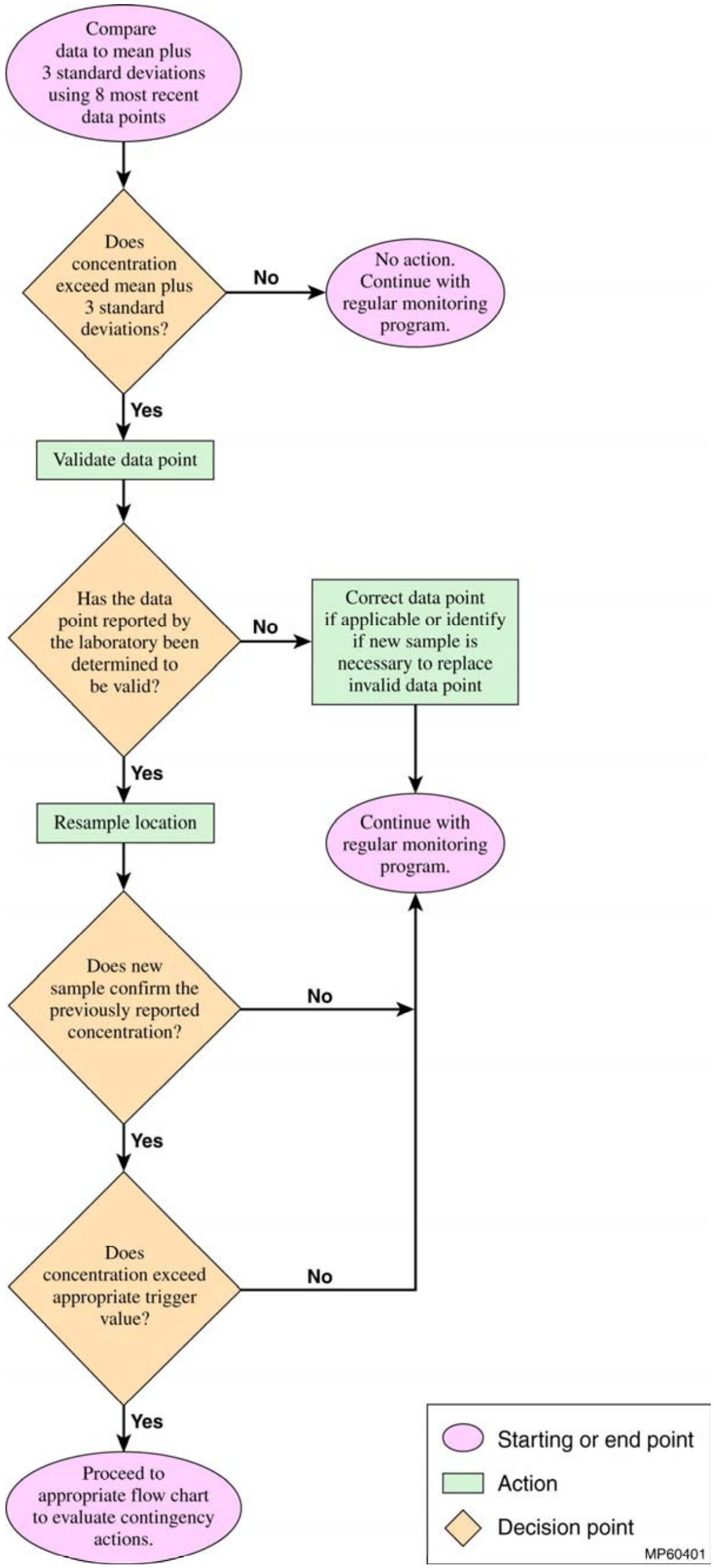

Figure M−1. Validation and Statistical Evaluation Scheme

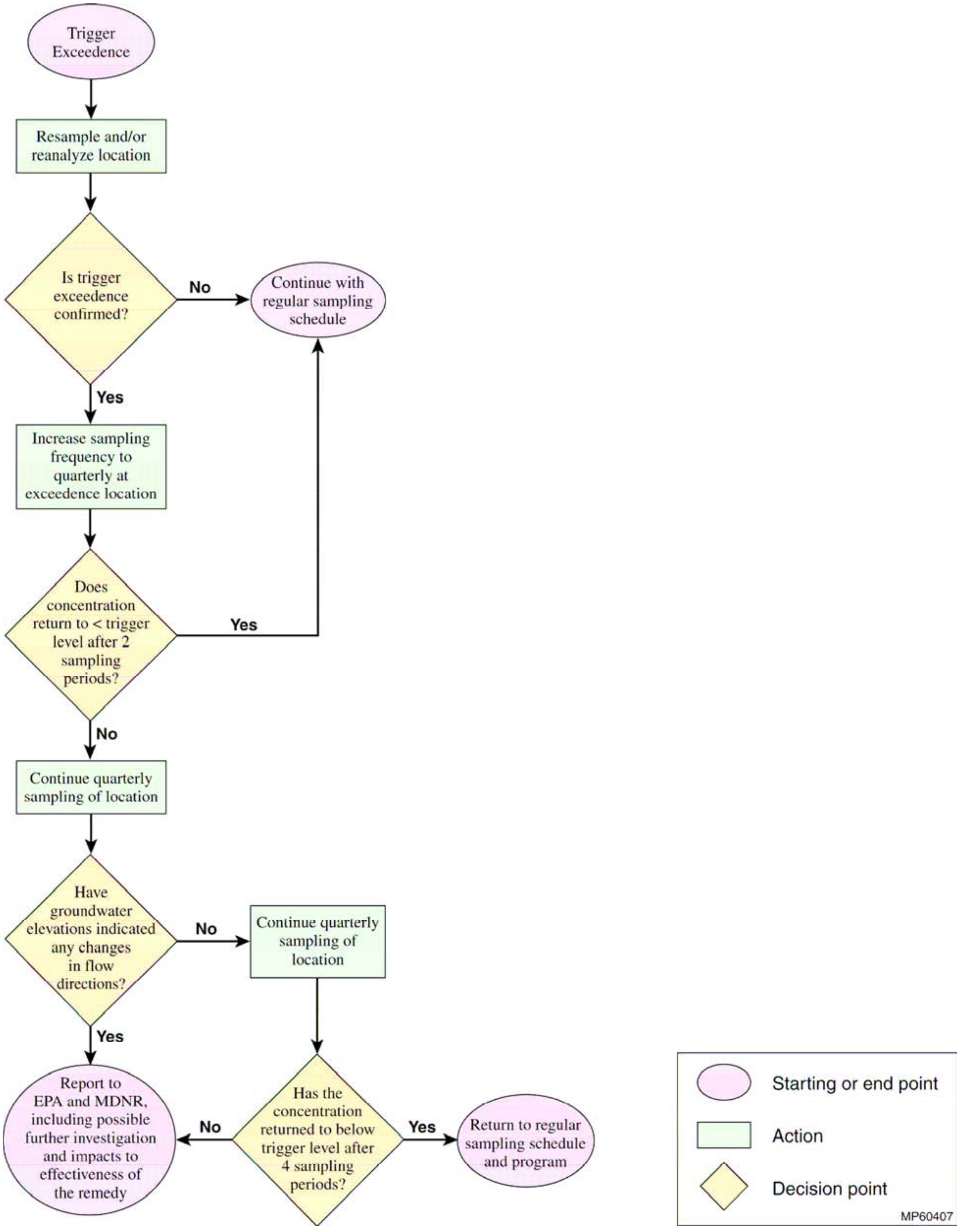

Figure M−2. Decision Tree for Objective 1 Data

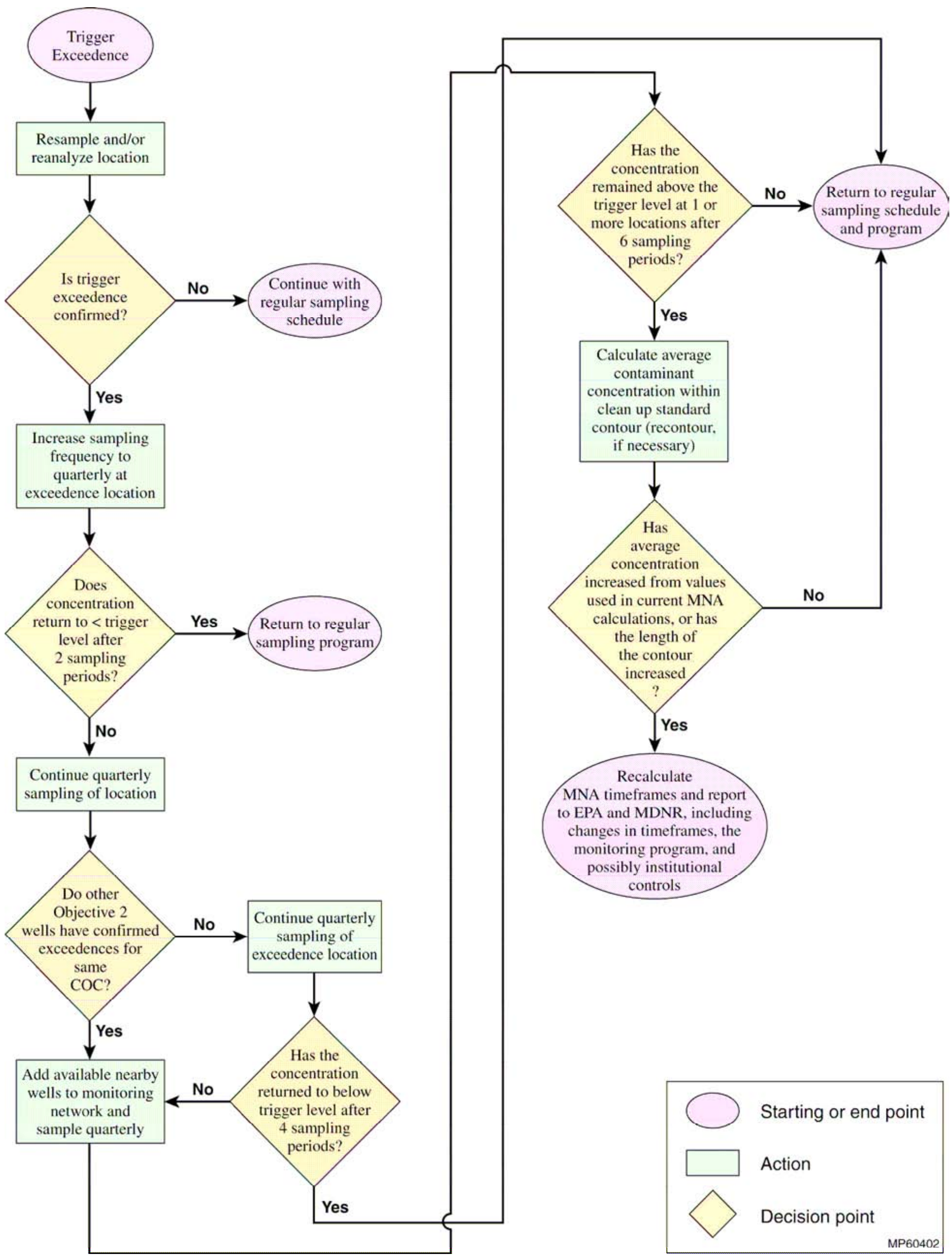

Figure M−3. Decision Tree for Objective 2 Data

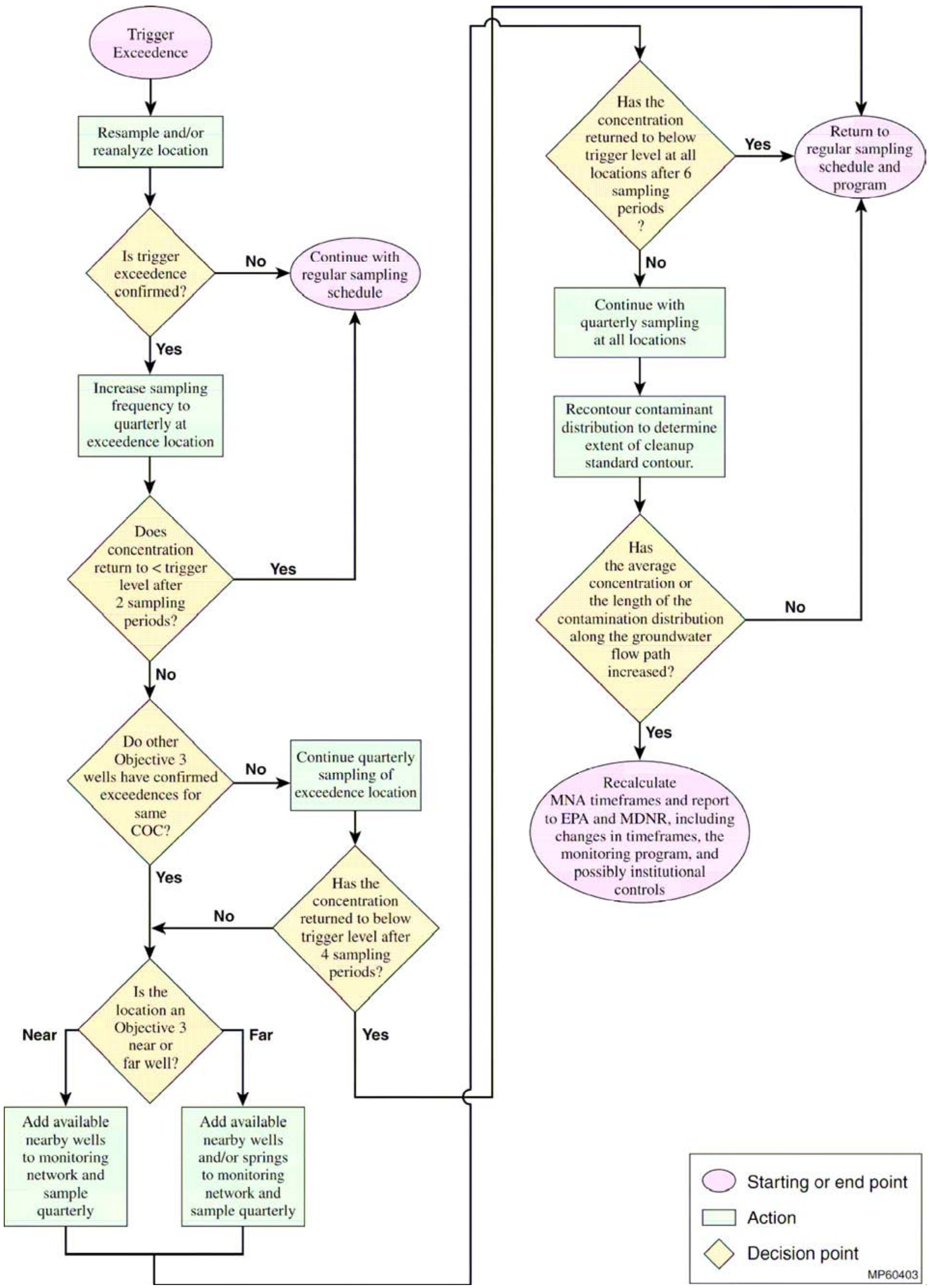

Figure M−4. Decision Tree for Objective 3Data

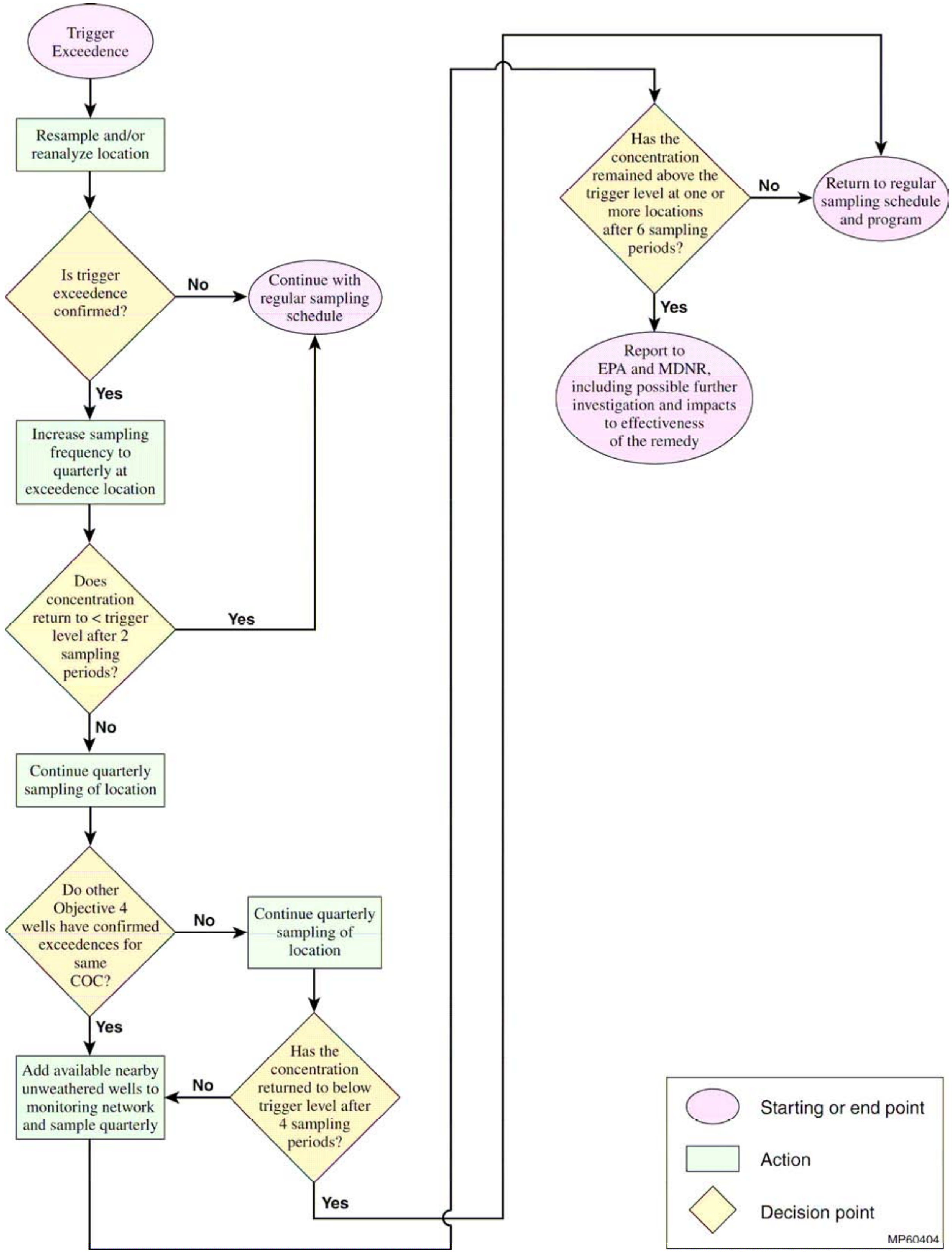

Figure M−5. Decision Tree for Objective 4 Data

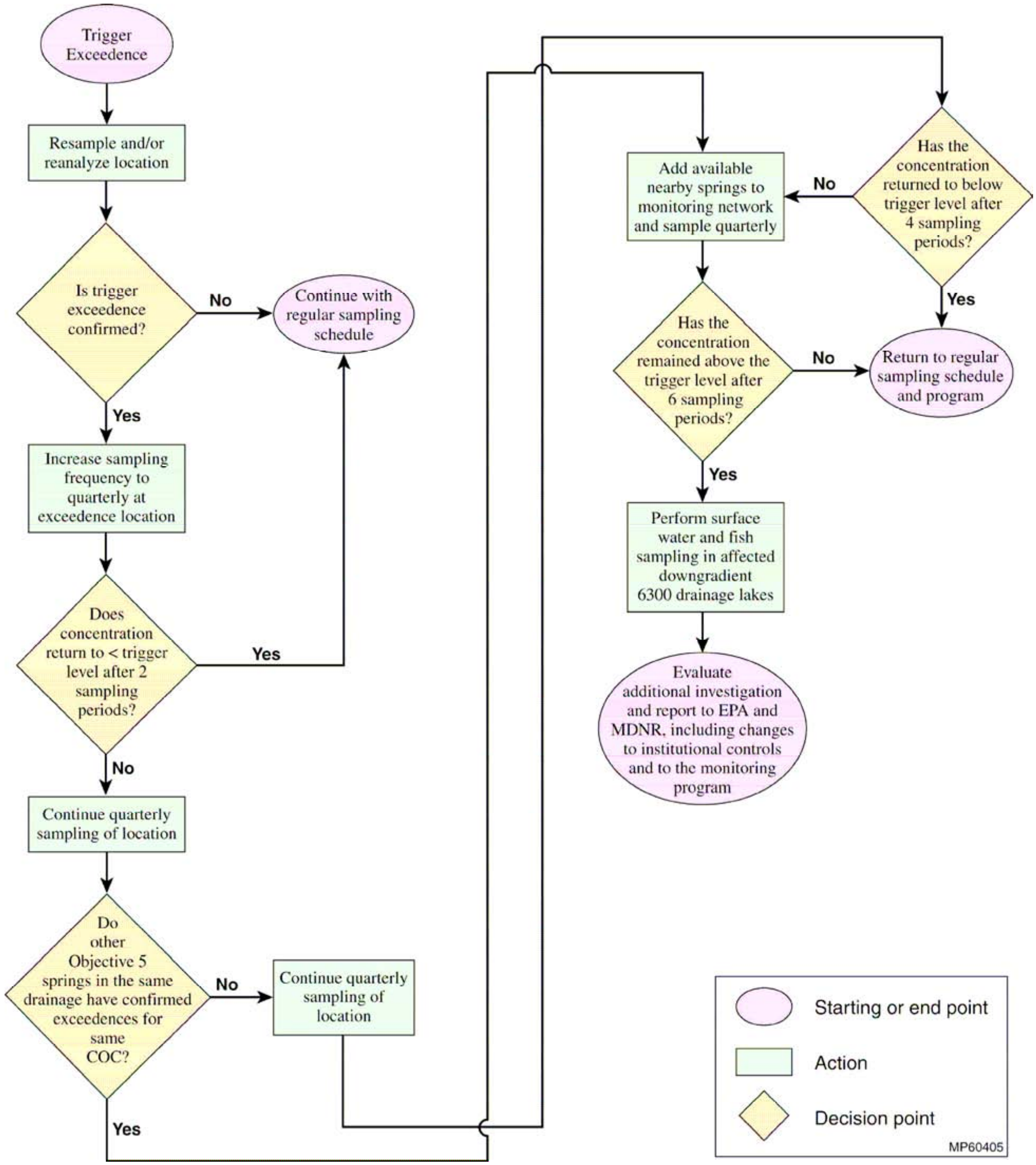

Figure M−6. Decision Tree for Objective 5 Data