



U.S. Department of Energy
Office of Legacy Management

Weldon Spring Site Annual Report for Calendar Year 2013

June 2014



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**Weldon Spring Site Annual Report
for Calendar Year 2013**

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Contents

Abbreviations.....	vii
Executive Summary.....	ix
1.0 Introduction.....	1
1.1 Purpose and Scope.....	1
1.2 Site Description.....	1
1.3 Site History.....	1
1.3.1 Operations History.....	1
1.3.2 Remedial Action History.....	4
1.3.2.1 Chemical Plant OU.....	5
1.3.2.2 Quarry Bulk Waste OU.....	5
1.3.2.3 Quarry Residuals OU (QROU).....	5
1.3.2.4 Groundwater OU.....	6
1.3.2.5 Southeast Drainage.....	6
1.4 Final Site Conditions.....	7
1.5 Compliance Summary.....	7
1.5.1 Federal and State Regulatory Compliance.....	7
1.5.1.1 Comprehensive Environmental Response, Compensation, and Liability Act.....	7
1.5.1.2 Resource Conservation and Recovery Act.....	9
1.5.1.3 Clean Water Act.....	9
1.5.1.4 Safe Drinking Water Act.....	9
1.5.1.5 Emergency Planning and Community Right-to-Know Act.....	10
1.5.2 DOE Order Compliance.....	11
1.5.2.1 DOE Order 458.1, Radiation Protection of the Public and the Environment.....	11
1.5.2.2 DOE Order 231.1B, Environment, Safety and Health Reporting.....	11
1.5.2.3 DOE Order 436.1, Departmental Sustainability.....	11
1.5.3 Permit and Agreement Compliance.....	12
1.5.3.1 NPDES Permits.....	12
1.5.3.2 Federal Facility Agreement.....	13
1.5.3.3 Metropolitan St. Louis Sewer District (MSD) Agreement.....	13
1.6 Geology and Hydrogeology.....	13
1.7 Surface Water System and Use.....	15
1.8 Ecology.....	16
1.9 Climate.....	16
1.10 Land Use and Demography.....	17
1.11 Non-Routine Activities.....	18
1.11.1 Installation of Protective Steel Monitoring Well Caps.....	18
1.11.2 Abandonment of MW-3031.....	18
1.11.3 Repair of Monitoring Wells.....	18
1.11.4 Tornado Damage Repair.....	18
2.0 Inspection Report.....	19
2.1 Introduction.....	19
2.2 Inspection Results.....	20
2.2.1 Institutional Controls.....	20

2.2.1.1	Land and Shallow Groundwater Use Within the Chemical Plant Site and Buffer Zone.....	20
2.2.1.2	Groundwater Use in Areas Surrounding the Chemical Plant.....	25
2.2.1.3	Groundwater (Quarry).....	25
2.2.1.4	Land Use in Quarry Area Reduction Zone	25
2.2.1.5	Southeast Drainage.....	25
2.2.1.6	State Route 94 Culvert.....	26
2.2.1.7	NPDES Discharge Pipeline from LCRS to Missouri River.....	26
2.2.2	Disposal Cell.....	28
2.2.3	Leachate Collection and Removal System (LCRS).....	28
2.2.4	Erosion.....	28
2.2.4.1	Chemical Plant Area	28
2.2.4.2	Quarry Area.....	31
2.2.5	General Site Conditions	31
2.2.5.1	Roads.....	31
2.2.5.2	Vandalism	31
2.2.5.3	Personal Injury Risks	31
2.2.5.4	Site Markers (Four Information Plaques on Top of Cell, Historical Markers, and Other Information Markers).....	31
2.2.6	Monitoring Wells.....	31
2.2.6.1	Disposal Cell Monitoring Well Network.....	32
2.2.6.2	Chemical Plant Area Monitoring Well Network	32
2.2.6.3	Quarry Monitoring Well Network	32
2.2.7	Onsite Document and Record Verification.....	32
2.3	Contacts.....	33
2.4	Recommendations/Findings	33
2.5	Photographs	34
3.0	Prairie and Garden Maintenance.....	43
4.0	Interpretive Center Update.....	45
5.0	Environmental Monitoring Summary	47
5.1	Introduction	47
5.2	Groundwater Monitoring.....	47
5.2.1	Chemical Plant Groundwater.....	47
5.2.1.1	Hydrogeologic Description.....	47
5.2.1.2	Chemical Plant Hydrogeologic Data Analysis.....	54
5.2.1.3	Groundwater Flow	56
5.2.1.4	Contaminants of Interest	56
5.2.1.5	Chemical Plant (GWOU) Monitoring Program.....	57
5.2.1.6	Baseline Monitoring Results for the GWOU.....	64
5.2.1.7	Performance Monitoring Results for the GWOU	65
5.2.1.8	Detection Monitoring Results for the GWOU	92
5.2.1.9	GWOU Special Study—Elevated Uranium in the Unweathered Unit	103
5.2.2	Quarry Groundwater.....	105
5.2.2.1	Hydrogeologic Description.....	106
5.2.2.2	Quarry Monitoring Program	107
5.2.2.3	Quarry Hydrogeologic Data Analysis.....	109

5.2.2.4	Contaminants of Interest	109
5.2.2.5	Monitoring Results for Groundwater in the Area of Impact at the Quarry.....	111
5.2.2.6	Monitoring Results for the Missouri River Alluvium.....	123
5.2.3	Disposal Cell Groundwater.....	125
5.2.3.1	Disposal Cell Monitoring Program	125
5.2.3.2	Disposal Cell Monitoring Results	127
5.3	Surface Water	129
5.3.1	Chemical Plant Surface Water	129
5.3.2	Quarry Surface Water	129
5.4	Leachate Collection and Removal System Data	132
5.5	Air.....	133
5.6	Radiation Dose Analysis	134
5.6.1	Pathway Analysis and Exposure Scenario	134
5.6.2	Total Effective Dose Estimates.....	135
6.0	Environmental Quality	137
6.1	Highlights of the Quality Assurance Program.....	137
6.2	Program Overview.....	137
6.3	Quality Control Samples	138
6.3.1	Duplicate Results Evaluation.....	138
6.3.2	Blank Sample Results	139
6.3.2.1	Trip Blank Evaluation.....	140
6.3.2.2	Equipment Rinsate Blank Evaluation	140
6.4	Data Validation Program Summary	140
7.0	References.....	143

Figures

Figure 1.	Location of the Weldon Spring, Missouri, Site.....	2
Figure 2.	Vicinity Map of the Weldon Spring, Missouri, Site.....	3
Figure 3.	Generalized Stratigraphy and Hydrostratigraphy of the Weldon Spring, Missouri, Site.....	14
Figure 4.	2013 Inspection Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site.....	21
Figure 5.	2013 Inspection Map for the Quarry Area of the Weldon Spring, Missouri, Site.....	22
Figure 6.	Institutional Controls Location Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site	23
Figure 7.	Institutional Controls Map for the Quarry Area of the Weldon Spring, Missouri, Site.....	24
Figure 8.	NPDES Discharge Pipeline Between the LCRS Support Building at the Missouri River, Weldon Spring, Missouri, Site	27
Figure 9.	Disposal Cell Inspection Transects and Rock Test Plot Locations at the Weldon Spring, Missouri, Site	29
Figure 10.	Erosion Features Within the Prairie	30
Figure 11.	Existing Monitoring Well Network.....	48
Figure 12.	2013 Potentiometric Surface of the Shallow Aquifer (Weathered Zone)	49

Figure 13.	Potentiometric Surface in the Unweathered Zone of the Burlington-Keokuk Limestone	50
Figure 14.	Preferential Flow Paths in the Burlington-Keokuk Limestone at the Chemical Plant Area.....	52
Figure 15.	Spring and Surface Water Monitoring Locations at the Chemical Plant Area of the Weldon Spring, Missouri, Site	53
Figure 16.	Groundwater Elevations in the Weathered Unit.....	55
Figure 17.	Groundwater Elevations in the Unweathered Unit.....	55
Figure 18.	Nitroaromatic Compound Production Lines	58
Figure 19.	Uranium Levels in Objective 2 Well MW-3030 Screened in the Weathered Unit.....	66
Figure 20.	Uranium Levels in Objective 2 Wells Screened in the Unweathered Unit.....	67
Figure 21.	Trend Map of Objective 2 Uranium Wells.....	69
Figure 22.	Nitrate Concentrations in Objective 2 Wells Screened in the Weathered Unit.....	71
Figure 23.	Nitrate Concentrations in Objective 2 Wells Screened in the Unweathered Unit.....	72
Figure 24.	Trend Map of Objective 2 Nitrate Wells.....	74
Figure 25.	TCE Concentrations in Objective 2 Wells	75
Figure 26.	Trend Map of Objective 2 TCE Wells	77
Figure 27.	1,3-DNB Concentrations in MW-2012	78
Figure 28.	2,4,6-TNT Concentrations in Objective 2 Wells.....	80
Figure 29.	Trend Map of Objective 2 2,4,6-TNT Wells.....	81
Figure 30.	2,4-DNT and 2,6-DNT Concentrations in MW-2012	83
Figure 31.	2,4-DNT and 2,6-DNT Concentrations in MW-2012	84
Figure 32.	2,4-DNT and 2,6-DNT Concentrations in MW-2050	84
Figure 33.	2,4-DNT and 2,6-DNT Concentrations in MW-2053	85
Figure 34.	2,4-DNT and 2,6-DNT Concentrations in MW-2014, MW-2052, and MW-2054.....	86
Figure 35.	Trend Map of Objective 2 2,4-DNT Wells	88
Figure 36.	Trend Map of Objective 2 2,6-DNT Wells	89
Figure 37.	2,4-DNT Concentrations in Objective 2 Wells in the Former Raffinate Pits Area	91
Figure 38.	Uranium Levels in Springs SP-6301 and SP-6303	94
Figure 39.	Long-term Projection of Uranium Levels in Spring SP-6301 (Uranium at or Below MCL)	94
Figure 40.	Uranium Levels in Southeast Drainage Springs (1987–2013).....	95
Figure 41.	Nitrate Concentrations in SP-6301 and SP-6303	98
Figure 42.	Unweathered Unit Network Optimization Sampling Locations	104
Figure 43.	Groundwater Monitoring Well Locations at the Quarry Area of the Weldon Spring, Missouri, Site.....	108
Figure 44.	Groundwater Flow Directions at the Weldon Spring Quarry.....	110
Figure 45.	Groundwater Elevations in the Quarry Area.....	111
Figure 46.	Uranium in Line 1 Monitoring Wells.....	112
Figure 47.	Uranium in Line 2 Bedrock Wells	114
Figure 48.	Uranium (pCi/L) in Line 2 Alluvial Wells, Above 300 pCi/L Target	115
Figure 49.	Uranium (pCi/L) in Line 2 Alluvial Wells, Below 300 pCi/L Target.....	116
Figure 50.	2013 Average Uranium Concentration in Quarry Area Wells	117
Figure 51.	90th Percentile of Uranium in Line 1 and 2 Wells.....	119
Figure 52.	2,4-DNT Concentrations in MW-1006 and MW-1027	121

Figure 53. 90th Percentile of 2,4-DNT in Line 1 and 2 Wells	122
Figure 54. Surface Water Monitoring Locations at the Quarry Area of the Weldon Spring, Missouri, Site	130
Figure 55. Uranium Levels in the Femme Osage Slough.....	131
Figure 56. Actual Uranium Concentrations in the Primary Leachate.....	132
Figure 57. Daily Averages of the Primary Leachate Flow	133

Tables

Table 1. Federal and State Water Quality Standards for the Former Chemical Plant GWOU	10
Table 2. Recycled Items and Quantities	12
Table 3. Monthly Precipitation and Average Temperatures for 2013	17
Table 4. Interpretive Center Attendance	46
Table 5. Monitoring Program for GWOU MNA Remedy	60
Table 6. Fixed Trigger Levels for Performance and Detection Monitoring for the GWOU.....	63
Table 7. 2013 Baseline Monitoring for the GWOU MNA Remedy Objective 1 Wells	65
Table 8. 2013 Uranium Data from GWOU Objective 2 Wells	66
Table 9. Trending Analysis for Uranium in Objective 2 MNA Weathered Unit Wells (2009–2013)	67
Table 10. Trending Analysis for Uranium in Objective 2 MNA Unweathered Unit Wells (2009–2013)	68
Table 11. 2013 Nitrate (as N) Data from GWOU Objective 2 Wells	70
Table 12. Trending Analysis for Nitrate (as N) in Objective 2 MNA Weathered Unit Wells (2009–2013)	71
Table 13. Trending Analysis for Nitrate (as N) in Objective 2 MNA Unweathered Unit Wells (2009–2013).....	73
Table 14. 2013 TCE Data from GWOU Objective 2 Wells.....	73
Table 15. Trending Analysis for TCE in Objective 2 MNA Wells (2009–2013)	75
Table 16. 2013 1,3-DNB Data from GWOU Objective 2 Wells.....	78
Table 17. Trending Analysis for 1,3-DNB in Objective 2 MNA Wells (2009–2013).....	79
Table 18. 2013 2,4,6-TNT Data from GWOU Objective 2 Wells	79
Table 19. Trending Analysis for 2,4,6-TNT in Objective 2 MNA Wells (2009–2013).....	80
Table 20. 2013 2,4-DNT Data from GWOU Objective 2 Wells in the Former Frog Pond Area	82
Table 21. 2013 2,6-DNT Data from GWOU Objective 2 Wells.....	83
Table 22. Trending Analysis for 2,4-DNT in Objective 2 MNA Wells in the Former Frog Pond Area (2009–2013).....	87
Table 23. Trending Analysis for 2,6-DNT in Objective 2 MNA Wells (2009–2013)	87
Table 24. 2013 2,4-DNT Data from GWOU Objective 2 Wells in the Former Raffinate Pits Area	90
Table 25. Trending Analysis for 2,4-DNT in Objective 2 MNA Wells in the Former Raffinate Pits Area (2009–2013).....	91
Table 26. 2013 Uranium Data for GWOU Objective 3, 4, and 5 Locations	93
Table 27. Trending Analysis for Uranium in SP-6301 and SP-6303 (2009–2013)	93
Table 28. Trending Analysis for Uranium in SP-5303 and SP-5304 (2009–2013)	95
Table 29. 2013 Nitrate (as N) Data for GWOU Objective 3, 4, and 5 Locations	97

Table 30. Trending Analysis for Nitrate (as N) in SP-6301 and SP-6303 (2009–2013).....	98
Table 31. 2013 TCE Data for GWOU Objective 3, 4, and 5 Locations.....	99
Table 32. 2013 1,3-DNB Data for GWOU Objective 3, 4, and 5 Locations	100
Table 33. 2013 2,4,6-TNT Data for GWOU Objective 3, 4, and 5 Locations	101
Table 34. 2013 2,4-DNT Data for GWOU Objective 3, 4, and 5 Locations.....	102
Table 35. 2013 2,6-DNT Data for GWOU Objective 3, 4, and 5 Locations.....	103
Table 36. 2013 Uranium Data from MNA Network Optimization Monitoring.....	105
Table 37. Background Uranium Levels for Units at the Quarry	107
Table 38. 2013 Total Uranium in QROU Line 1 Wells	112
Table 39. Trending Analysis for Uranium in Line 1 Groundwater Monitoring Wells (2009–2013)	113
Table 40. 2013 Total Uranium in QROU Line 2 Bedrock Wells.....	113
Table 41. 2013 Total Uranium in QROU Line 2 Alluvial Wells	115
Table 42. Trending Analysis for Uranium in Line 2 Groundwater Monitoring Wells (2009–2013)	118
Table 43. 2013 2,4-DNT Concentrations for the QROU Monitoring Locations	120
Table 44. Trending Analysis for 2,4-DNT in Selected Quarry Groundwater Monitoring Wells	121
Table 45. Geochemical Parameter Data at the Weldon Spring Quarry in 2013.....	123
Table 46. 2013 Total Uranium Levels in the Missouri River Alluvial Aquifer	124
Table 47. 2013 Geochemical Parameter Data in the Missouri River Alluvial Aquifer.....	125
Table 48. Disposal Cell Detection Monitoring—Groundwater and Surface Water Analyte List.....	126
Table 49. Disposal Cell Detection Monitoring—Leachate Analyte List	126
Table 50. 2013 Signature Parameter Results and Associated BTLs at Disposal Cell Monitoring Locations.....	127
Table 51. 2013 Disposal Cell Leachate Monitoring Data	128
Table 52. Total Uranium at Weldon Spring Chemical Plant Area Surface Water Locations	129
Table 53. 2013 Total Uranium in the Femme Osage Slough near the Quarry	129
Table 54. Quality Control Sample Description	138
Table 55. Summary of Calculated RPDs for 2013	139
Table 56. Validation Summary for Calendar Year 2013.....	141
Table 57. Validation Qualifier Summary for Calendar Year 2013	141

Appendixes

Appendix A	2013 Inspection Report Agenda
Appendix B	2012 Inspection Report Corrective Action Report
Appendix C	2013 Inspection Report Inspection Checklist
Appendix D	2013 Inspection Report LCRS Data
Appendix E	2013 Inspection Report Interviews and Contacts
Appendix F	Trend Calculation Example and Trend Data
Appendix G	Data Review and Validation Reports for the Weldon Spring Site
Appendix H	CD of Report

Abbreviations

AEC	U.S. Atomic Energy Commission
ARAR	applicable or relevant and appropriate requirement
BTLs	baseline tolerance limits
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
DCE	dichloroethene
DNB	dinitrobenzene
DNT	dinitrotoluene
DOE	U.S. Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
ESD	explanation of significant differences
ft	feet
GPS	global positioning system
GWOU	Groundwater Operable Unit
IC	institutional control
ISMS	Integrated Safety Management System
LCRS	Leachate Collection and Removal System
LM	Office of Legacy Management
LTS&M	Long-Term Surveillance and Maintenance
MCL	maximum contaminant level
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MDNR-Park	Missouri Department of Natural Resources Division of State Parks
µg/L	micrograms per liter
mg/L	milligrams per liter
MNA	monitored natural attenuation
MoDOT	Missouri Department of Transportation
mrem	millirem
MSD	Metropolitan St. Louis Sewer District
NB	nitrobenzene

NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OM	order of magnitude
ORP	oxidation-reduction potential
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/L	picocuries per liter
QROU	Quarry Residuals Operable Unit
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RPD	relative percent difference
SWRAU	Superfund sitewide ready for anticipated use
TCE	trichloroethene
TED	total effective dose
TNB	trinitrobenzene
TNT	trinitrotoluene
WSSRAP	Weldon Spring Site Remedial Action Project

Executive Summary

The Weldon Spring, Missouri, Site located in St. Charles, Missouri, is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site. The objective of this report is to summarize the activities, provide a compliance status, and report annual inspection and environmental monitoring results from the calendar year 2013 for the site. The report is prepared in accordance with the requirements of the Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site (LTS&M Plan) (December 2008a) and the Federal Facility Agreement (DOE 2006).

Compliance Summary

The Weldon Spring site is listed on the National Priorities List and is governed by CERCLA. The Weldon Spring site has been subject to meeting or exceeding applicable or relevant and appropriate requirements of federal, state, and local laws. Many of these regulations no longer apply due to reduction in physical activities and waste-handling at the site.

Compliance activities which occurred during 2013 include attainment of the Superfund Sitewide Ready for Anticipated Use designation from the U.S. Environmental Protection Agency (EPA) in a letter dated March 2, 2013, and management and termination of a storm water permit.

Inspection Summary

The Weldon Spring site was inspected November 5 through 7, 2013. The inspection was conducted in accordance with the LTS&M Plan and associated inspection checklist. Representatives from the U.S. Department of Energy (DOE), the DOE contractor S.M. Stoller Corporation (Stoller), the EPA, the Missouri Department of Natural Resources and the Missouri Department of Conservation participated in the inspection.

The main areas inspected at the site were the Quarry, the disposal cell, the Leachate Collection and Removal System (LCRS), monitoring wells, assorted general features, and areas where institutional controls have been established.

Institutional control areas were inspected to ensure that restrictions such as soil excavations, groundwater withdrawal, and residential use were not being violated. Each area was inspected and no indication of violations of the restrictions was observed.

Inspection of the disposal cell consisted of walking 10 transects over the cell and around the cell perimeter and using handheld global positioning system (GPS) equipment to navigate the transects. Inspectors examined six previously marked areas of the cell for signs of rock degradation and determined that the areas were still in good condition. An inspection of the LCRS indicated that the system was in good condition. Forty-six of the 106 groundwater monitoring wells were inspected and were in good condition. The inspection also included other site features, such as the prairie, site markers, and roads.

Environmental Monitoring Summary

The environmental monitoring program at the Weldon Spring site includes collecting groundwater samples from monitoring wells at the former Chemical Plant, the Quarry, and adjacent properties and sampling selected springs and other surface water near the former Chemical Plant and Quarry. The former Chemical Plant, the Quarry groundwater, and the disposal cell each have separate monitoring programs.

Groundwater monitoring at the former Chemical Plant focuses on the selected remedy of monitored natural attenuation (MNA) for the Groundwater Operable Unit. Total uranium, nitroaromatic compounds, trichloroethene (TCE), and nitrate have been monitored at locations throughout the former Chemical Plant area and offsite. Sampling has targeted areas of highest impact in the shallow aquifer and migration pathways associated with paleochannels in the weathered unit of the Burlington-Keokuk Limestone. The monitoring network is designed to provide data either to show that natural attenuation processes are acting as predicted or to trigger implementation of contingencies if these processes are not acting as predicted.

Performance of the MNA remedy is assessed through sampling monitoring wells within the areas of impact to verify that contaminant concentrations are declining or remaining stable and will meet cleanup standards within a reasonable time frame. Overall, natural attenuation is occurring as expected and concentrations are stable or decreasing, with the exception of uranium in the unweathered unit of the Burlington-Keokuk Limestone beneath the former Raffinate Pits area. This area of impact is the focus of an ongoing special study.

Detection monitoring of selected wells, springs, and a surface water location verifies that lateral and vertical migration remains confined to the current area of impact and that lateral downgradient migration within the paleochannels is minimal. Contaminant concentrations in downgradient and fringe locations have been behaving as expected; however, uranium levels in one downgradient well in the former Raffinate Pits area are higher than predicted. This impact is being assessed as part of the special study. Although uranium levels in the former Raffinate Pits area have changed since the implementation of the MNA remedy, increasing in some unweathered unit wells, the overall remedy remains protective. Groundwater flow directions are unchanged, and impacted groundwater is contained within the paleochannels in this area and is migrating along the expected pathways.

Long-term monitoring is the selected remedy for groundwater in the Quarry Residuals Operable Unit. Total uranium, nitroaromatic compounds, and geochemical parameters are monitored in the area of impact and in the Missouri River alluvium. Groundwater is sampled under two programs that focus on the area of impact in the Quarry proper and north of the Femme Osage Slough and the non-impacted Missouri River alluvium south of the Femme Osage Slough. Overall, uranium levels in the area of impact are decreasing or remaining stable. Analytical results of samples from monitoring wells south of the slough indicate that uranium levels are similar to background for the Missouri River alluvium. The data continue to indicate that a strongly reducing environment is prevalent in the groundwater immediately south of the slough. This type of environment is not favorable for the migration of uranium.

Groundwater, spring, and leachate samples are collected as part of the detection monitoring program for the disposal cell. Under the monitoring program, data from signature parameters (barium and uranium) from each location are compared to baseline tolerance limits to track general changes in groundwater quality and determine whether statistically significant evidence of contamination due to cell leakage exists. The data from the remainder of the parameters are 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. The results indicate that there is no evidence of leakage into the groundwater beneath the disposal cell. The general groundwater quality in the detection monitoring wells and spring is consistent with historical data. Leachate is sampled to verify its composition, and its composition has remained relatively unchanged for the past few years.

Surface water monitoring was conducted in the vicinity of the former Chemical Plant and the Quarry to measure the effects of groundwater and surface water discharge on the quality of downstream surface water. Monitoring results for the surface waters in the vicinity of the former Chemical Plant show relatively low levels of uranium that are consistent with levels from previous years. Uranium levels in the Busch Conservation Lakes 34, 35, and 36 and Dardenne Creek remain low. Uranium levels in the slough continued to be elevated, a condition that began in 2006 when the slough dried out due to drought conditions.

Historical water quality and water level data for existing wells is available on the DOE Office of Legacy Management website at <http://www.lm.doe.gov/land/sites/mo/weldon/weldon.htm>. Photographs, maps, and physical features can also be viewed on this website.

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1.0 Introduction

1.1 Purpose and Scope

This report summarizes the activities, compliance status, annual inspection, and environmental monitoring results from calendar year 2013 for the Weldon Spring, Missouri, Site. The report is prepared in accordance with the requirements of the site's Long-Term Surveillance and Maintenance (LTS&M) Plan (DOE 2008a) and the Federal Facility Agreement (DOE 2006). The Weldon Spring site is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site.

1.2 Site Description

The Weldon Spring site is located in St. Charles County, Missouri, about 30 miles west of St. Louis (Figure 1). The site comprises two geographically distinct, U.S. Department of Energy (DOE)-owned properties: the former Weldon Spring former Chemical Plant and Raffinate Pit sites (Chemical Plant) and the former Weldon Spring Quarry (Quarry). The former Chemical Plant is located about 2 miles southwest of the junction of Missouri State Route 94 and Interstate 64. The Quarry is about 4 miles southwest of the former Chemical Plant. Both sites are accessible from Missouri State Route 94.

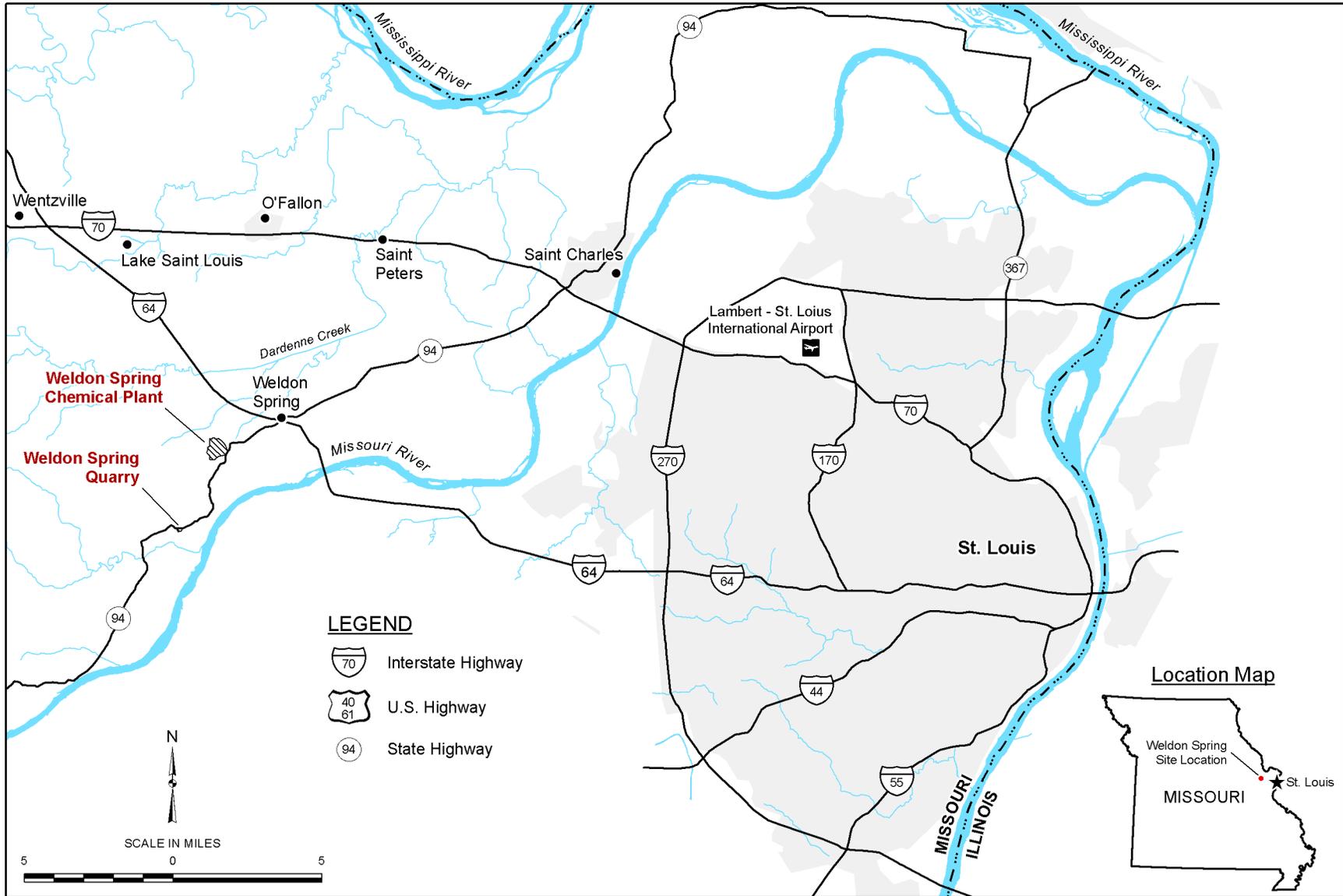
During the early 1940s, the Department of the Army acquired 17,232 acres of private land in St. Charles County for the construction of the Weldon Spring Ordnance Works facility. The former Ordnance Works site has since been divided into several contiguous areas under different ownership, as depicted in Figure 2. Current land use of the former Ordnance Works site includes the former Chemical Plant and Quarry, the U.S. Army Reserve Weldon Spring Training area, the Missouri Department of Conservation (MDC), the Missouri Department of Natural Resources (MDNR) Division of State Parks (MDNR-Parks), Francis Howell High School, a St. Charles County highway maintenance (formerly Missouri Department of Transportation [MoDOT]) facility, the Public Water Supply District #2 water treatment facility, the St. Charles County law enforcement training center, the village of Weldon Spring Heights, and a University of Missouri research park.

The former Chemical Plant and Quarry areas total 228.16 acres. The Former Chemical Plant property occupies 219.50 acres, and the Quarry occupies 8.66 acres.

1.3 Site History

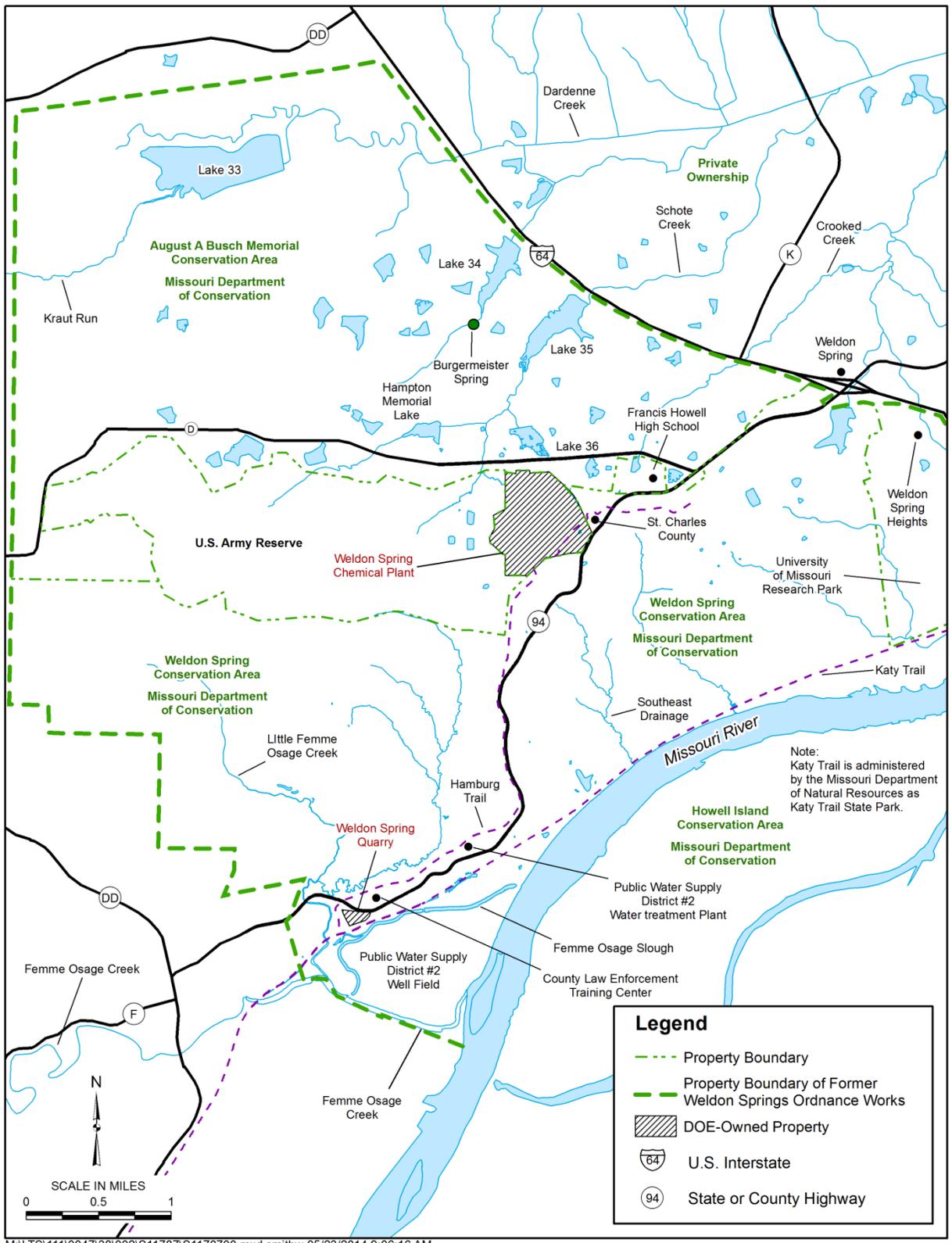
1.3.1 Operations History

In 1941, the U.S. government acquired 17,232 acres of rural land in St. Charles County to establish the Weldon Spring Ordnance Works. In the process, the towns of Hamburg, Howell, Toonerville, and 576 citizens of the area were displaced. From 1941 to 1945, the Department of the Army manufactured trinitrotoluene (TNT) and dinitrotoluene (DNT) at the Ordnance Works site. Four TNT production lines were situated on what was to be the Chemical Plant. These operations resulted in nitroaromatic contamination of soil, sediments, groundwater, and some offsite springs.



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Figure 1. Location of the Weldon Spring, Missouri, Site



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Figure 2. Vicinity Map of the Weldon Spring, Missouri, Site

Following a considerable amount of explosives decontamination of the facility by the Army and the Atlas Powder Company, 205 acres of the former Ordnance Works property were transferred to the U.S. Atomic Energy Commission (AEC) in 1956 for the construction of the Weldon Spring Uranium Feed Materials Plant, now referred to as the Weldon Spring Chemical Plant. An additional 14.88 acres were transferred to AEC in 1964. The plant converted processed uranium ore concentrates to pure uranium trioxide, intermediate compounds, and uranium metal. A small amount of thorium was also processed. Wastes generated during these operations were stored in four raffinate pits located on the Chemical Plant property. Uranium-processing operations resulted in the radiological contamination of the same locations previously contaminated by former Army operations.

The Quarry was mined for limestone aggregate used in the construction of the Ordnance Works. The Army also used the Quarry for burning wastes from explosives manufacturing and disposal of TNT-contaminated rubble during Ordnance Works operations. These activities resulted in the nitroaromatic contamination of the soil and groundwater at the Quarry. In 1960, the Army transferred the Quarry to AEC, which used it from 1963 to 1969 as a disposal area for uranium and thorium residues (both drummed and uncontained) from the former Chemical Plant.

Uranium-processing operations ceased in 1966, and on December 31, 1967, AEC returned the facility to the Army for use as a defoliant-production plant. In preparation for the defoliant-production process, the Army removed equipment and materials from some of the buildings and disposed of them principally in Raffinate Pit 4. The defoliant project was canceled before any defoliant was manufactured, and the Army transferred 50.65 acres of land encompassing the raffinate pits back to AEC while retaining the Chemical Plant. AEC, and subsequently DOE, managed the site, including the Army-owned Chemical Plant, under caretaker status from 1968 through 1985. Caretaker activities included site security oversight, fence maintenance, grass cutting, and other incidental maintenance. In 1984, the Army repaired several of the buildings at the Chemical Plant, decontaminated some of the floors, walls, and ceilings, and isolated some equipment. In 1985, the Army transferred full custody of the Chemical Plant to DOE, at which time DOE designated the control and decontamination of the Chemical Plant, raffinate pits, and Quarry as a major project.

1.3.2 Remedial Action History

The U.S. Environmental Protection Agency (EPA) placed the Quarry and former Chemical Plant areas on the National Priorities List in 1987 and 1989, respectively. Initial remedial activities at the former Chemical Plant (a series of Interim Response Actions authorized through the use of the Engineering Evaluation/Cost Analysis [EE/CA] process) included:

- Removal of electrical transformers, electrical poles and lines, and overhead piping and asbestos that presented an immediate threat to workers and the environment.
- Construction of an isolation dike to divert runoff around the Ash Pond area to reduce the concentration of contaminants going offsite in surface water.
- A detailed characterization of onsite debris, the separation of radiological and nonradiological debris, and the transport of materials to designated staging areas for interim storage.

- Dismantling of 44 Chemical Plant buildings under four separate Interim Response Actions.
- Treatment of contaminated water at the former Chemical Plant and the Quarry.

Remediation of the Weldon Spring site was administratively divided into four operable units (OUs): the Chemical Plant OU, the Quarry Bulk Waste OU, the Quarry Residuals OU (QROU), and the Groundwater OU (GWOU). The Southeast Drainage was remediated under a CERCLA removal action and documented through an EE/CA report (DOE 1996a) and the Decision Document for the Southeast Drainage (DOE 1996b). The following sections describe the selected remedies.

1.3.2.1 Chemical Plant OU

In the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1993), DOE established the remedy for controlling contaminant sources at the former Chemical Plant (except groundwater) and disposing of contaminated materials in an onsite disposal cell. The remedy included the remediation of 17 offsite vicinity properties affected by former Chemical Plant operations. The vicinity properties were remediated in accordance with Chemical Plant Record of Decision (ROD) cleanup criteria. The *Chemical Plant Operable Unit Remedial Action Report* (DOE 2004a) was finalized in January 2004.

The selected remedy included:

- Removal of contaminated soils, sludge, and sediment.
- Treatment of wastes by chemical stabilization/solidification, as appropriate.
- Disposal of wastes removed from the former Chemical Plant and stored Quarry bulk wastes in an engineered onsite disposal facility.

1.3.2.2 Quarry Bulk Waste OU

DOE implemented remedial activities for the Quarry Bulk Waste OU set forth in the *Record of Decision for Management of the Bulk Wastes at the Weldon Spring Quarry* (DOE 1990b).

The selected remedy included:

- Excavation and removal of bulk waste (i.e., structural debris, drummed and unconfined waste, process equipment, sludge, soil).
- Transportation of waste along a dedicated haul road to a temporary storage area located at the former Chemical Plant.
- Staging of bulk wastes at the temporary storage area.

1.3.2.3 Quarry Residuals OU (QROU)

The QROU remedy was described in the *Record of Decision for the Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1998). The QROU addressed residual soil contamination in the Quarry proper, surface water and sediments in the Femme Osage Slough and nearby creeks, and contaminated

groundwater. The *Quarry Residuals Operable Unit Interim Remedial Action Report* (DOE 2003b) was finalized in November 2003.

The selected remedy included:

- Long-term monitoring and institutional controls (ICs) to prevent exposure to contaminated groundwater north of the Femme Osage Slough.
- Long-term monitoring and ICs to protect the quality of the public water supply in the Missouri River alluvium and the implementation of a well-field contingency plan.
- Confirming the model assumptions regarding the extraction of contaminated groundwater and establishing controls to protect naturally occurring attenuation processes.

1.3.2.4 Groundwater OU

DOE implemented the *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (DOE 2000a), which was approved on September 29, 2000, to investigate the practicability of remediating trichloroethene (TCE) contamination in Chemical Plant groundwater using in situ chemical oxidation. It was determined, based on extensive monitoring, that in situ oxidation did not perform adequately under field conditions; therefore, the remediation of TCE was reevaluated with the remaining contaminants of concern.

In the *Record of Decision for the Final Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (DOE 2004b), DOE established the remedy of monitored natural attenuation (MNA) to address contaminated groundwater and springs. The *Interim Remedial Action Report for the Groundwater Operable Unit of the Weldon Spring Site* (DOE 2005b) was finalized in March 2005.

The selected remedy included:

- Sampling of groundwater and surface water, including springs, to verify the effectiveness of naturally occurring processes to reduce contaminant concentrations over time.
- ICs to prevent exposure to contaminated groundwater at the former Chemical Plant and to the north toward Burgermeister Spring.

1.3.2.5 Southeast Drainage

Remedial action for the Southeast Drainage was addressed as a separate action under CERCLA. The *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1996a) was prepared in August 1996 to evaluate the human and ecological health risks within the drainage. The EE/CA recommended that selected sediment in accessible areas of the drainage should be removed with track-mounted equipment and transported by off-road haul trucks to the Chemical Plant. Soil removal occurred in two phases: 1997 to 1998, and in 1999. More details are included in the *Southeast Drainage Closeout Report Vicinity Properties DA4 and MDC7* (DOE 1999).

1.4 Final Site Conditions

Contamination remains at the Weldon Spring site at the following locations:

- An onsite disposal cell contains approximately 1.48 million cubic yards of contaminated material.
- Residual groundwater contamination remains in the shallow aquifer beneath the former Chemical Plant, at the former Quarry, and at some surrounding areas.
- A few springs near the former Chemical Plant discharge contaminated groundwater.
- Residual soil and sediment contamination remain in the Southeast Drainage.
- Fixed radiological contamination remains within a culvert within the Southeast Drainage under Missouri State Route 94.
- Residual soil contamination remains at inaccessible locations within the former Quarry.

1.5 Compliance Summary

The Weldon Spring site is listed on the National Priorities List and is therefore governed by the CERCLA process. Under CERCLA, the Weldon Spring Site Remedial Action Project (WSSRAP) was subject to meeting or exceeding the applicable or relevant and appropriate requirements (ARARs) of federal, state, and local laws and statutes, such as the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Clean Air Act, the National Historic Preservation Act, the Safe Drinking Water Act, the Endangered Species Act, and Missouri State regulations. Because DOE is the lead agency for the site, DOE must incorporate National Environmental Policy Act (NEPA) requirements as well as DOE orders. Section 1.5.1 summarizes compliance with applicable federal and state regulations, Section 1.5.2, summarizes compliance with major DOE orders, and Section 1.5.3 discusses compliance agreements and permits. The physical completion of the project has reduced or, in some cases, eliminated the applicability of certain ARARs.

1.5.1 Federal and State Regulatory Compliance

1.5.1.1 *Comprehensive Environmental Response, Compensation, and Liability Act*

The Weldon Spring site has integrated the procedural and documentation requirements of CERCLA, as amended by the Superfund Amendments and Reauthorization Act, and NEPA. Section 1.3.2 discusses the remedial actions conducted under CERCLA.

The site reached construction completion under CERCLA on August 22, 2005. The site also received the EPA Superfund Sitewide Ready for Anticipated Use (SWRAU) designation from EPA in a letter dated March 20, 2013. The SWRAU performance measure reports sites documented as ready for reuse when the entire construction-completed National Priority List site meets the following requirements:

- All cleanup goals in the RODs or other remedy decision documents have been achieved for media that may affect current and reasonably anticipated future land uses of the site, so that there are no unacceptable risks; and
- All institutional or other controls required in the RODs or other remedy decision documents have been put in place.

After a review of all relevant site documents, including the RODs, LTS&M Plan, five-year reviews, annual inspections and monitoring data, and ICs documentation, EPA determined that DOE has achieved the SWRAU performance measure for all DOE-owned land at the site. This includes the former Chemical Plant and Quarry areas and totals approximately 229 acres. The SWRAU measure was recorded as completed in the EPA Comprehensive Environmental Response, Compensation, and Liability Information System database on February 13, 2013.

Because some areas of the site are still contaminated beyond levels that would allow unlimited use and unrestricted exposure, CERCLA requires that the remedial actions be reviewed at least every 5 years. These reviews are commonly called five-year reviews. DOE completed the fourth five-year review report for the site in September 2011.

DOE issued the *Explanation of Significant Differences, Weldon Spring Site* (ESD) (DOE 2005a) in accordance with CERCLA in February 2005. It clarified the use restrictions for the separate operable units that are necessary for the remedial actions specified in the RODs to remain protective over the long-term. The ESD clarified specific requirements for each site area that needed use restrictions and established how DOE would implement, maintain, and monitor the specific requirements.

DOE developed the LTS&M Plan, which addressed the full scope of the site management activities necessary to ensure that conditions at the Weldon Spring site remain protective over the long-term. The LTS&M Plan is revised periodically to ensure its applicability to changing site, regulatory, or procedural conditions. In addition to addressing such activities as long-term groundwater monitoring and disposal cell maintenance, the LTS&M Plan was developed and issued to ensure that the use restrictions identified in the ESD were properly imposed and maintained. The LTS&M Plan included a detailed IC Implementation Plan, which includes a process for evaluating and identifying specific IC mechanisms that best accomplish the objectives set out in the ESD. Consistent with EPA guidance on selecting ICs, various IC mechanisms were evaluated, including government controls, proprietary controls, enforcement tools, and informational devices. Redundant mechanisms were employed to increase the effectiveness of the ICs.

The status of implementing the additional ICs discussed in the ESD and LTS&M Plan is presented below:

- Special Use Area designation under the State Well Drillers' Act: The "Special Use Area" under the Missouri well code was finalized in the Missouri regulations and became effective August 2007 (10 CSR 23-3.100[8]). This is a special regulation that DOE and the Army pursued with MDNR that requires additional drilling protocols and construction procedures to be implemented by regulations on any well construction within the restriction boundaries. This IC is complete.
- Memorandum of Understanding with the Army: The Army and DOE signed the memorandum in September and October 2009, respectively. This IC is complete.
- Easements with surrounding affected state agency landowners (MDC, MDNR-Parks, MoDOT) for implementing the use restrictions required on state properties: DOE established easements to restrict use of the contaminated groundwater in the area of the hydraulic buffer zone, to restrict land use in the Southeast Drainage, and to restrict land use at the Quarry

reduction zone. DOE and MDNR-Parks finalized and signed the easement regarding the MDNR-Parks property in September 2009. The easement with MDC was finalized in July 2011, and the easement with MoDOT was finalized in June 2012. The MoDOT property was transferred to St. Charles County, and the restrictive easement was conveyed with the land transfer and is still in effect. This IC is complete.

1.5.1.2 Resource Conservation and Recovery Act

Hazardous wastes at the Weldon Spring site have been managed as required by RCRA, a substantive ARAR. Waste management has included the characterization, consolidation, inventory, storage, treatment, disposal, and transportation of hazardous wastes that remained onsite after the closure of the Weldon Spring Uranium Feed Materials Plant and wastes that were generated during remedial activities.

Section 121(e)(1) of CERCLA states that no federal, state, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite; therefore, a RCRA treatment, storage, and disposal permit was not required at the site during remedial activities.

The Weldon Spring site no longer routinely generates any hazardous waste and has deactivated its RCRA generator identification number.

1.5.1.3 Clean Water Act

The Weldon Spring site had three National Pollutant Discharge Elimination System (NPDES) permits during 2013. The first permit (MO 0107701), which covers discharges from the leachate collection and removal system (LCRS), is maintained as a contingency to current disposal methods. The second permit (MO 0129917) was for the sanitary sewer system for the site, which had been closed and replaced by the new wastewater treatment system. The third permit (MORA01773) was a storm water permit obtained on August 23, 2012. See Section 1.5.3.1 for additional discussion of these permits.

1.5.1.4 Safe Drinking Water Act

Safe Drinking Water Act regulations are not applicable because maximum contaminant levels (MCLs) apply only to drinking water systems, not groundwater. However, under the National Contingency Plan, MCLs are relevant and appropriate to groundwater that is a potential drinking water source. The principal ARARs for the impacted groundwater at the former Chemical Plant are the MCLs and Missouri water quality standards, which were established in the GWOU ROD (DOE 2004b) and are shown in Table 1.

Table 1. Federal and State Water Quality Standards for the Former Chemical Plant GWOU

Constituent	Standard	Citation
Nitrate (as N)	10 mg/L	40 CFR 141.62
Total Uranium	20 pCi/L	40 CFR 141
1,3-DNB	1.0 µg/L	10 CSR 20-7 ^a
2,4-DNT	0.11 µg/L	10 CSR 20-7 ^a
NB	17 µg/L	10 CSR 20-7 ^a
TCE	5 µg/L	40 CFR 141.61
2,6-DNT	1.3 µg/L	Risk-based ^b
2,4,6-TNT	2.8 µg/L	Risk-based ^c

^a Missouri Groundwater Quality Standard, *Code of State Regulations* (CSR).

^b Risk-based concentration equivalent to 10⁻⁵ for a residential scenario.

^c Risk-based concentration equivalent to 10⁻⁶ for a residential scenario.

DNB = dinitrobenzene; DNT = dinitrotoluene; NB = nitrobenzene; mg/L = milligrams per liter; µg/L = micrograms per liter; pCi/L = picocuries per liter; TNT = trinitrotoluene; TCE = trichloroethene

Long-term groundwater monitoring for the QROU consists of two programs. Groundwater monitoring is necessary to continue to ensure that uranium-contaminated groundwater has a negligible potential to affect the well field owned by Public Water Supply District #2. The first program details the monitoring of uranium and 2,4-DNT south of the slough to ensure that levels remain protective of human health and the environment. The second program consists of monitoring groundwater contaminant levels within the area north of the slough until they attain a predetermined target level indicating negligible potential to affect groundwater south of the slough.

Uranium concentrations south of the slough and in the area of production wells at the well field remain within the observed natural variation within the aquifer. The MCL for uranium of 20 picocuries per liter (pCi/L) (30 micrograms per liter [µg/L]) has been established as a trigger level only in this area. If concentrations in groundwater south of the slough exceed the MCL of 20 pCi/L, DOE will evaluate risk and take appropriate action.

Under current conditions, groundwater north of the slough poses no imminent human health risk or impact to the potable water of the well field. A target level of 300 pCi/L for uranium (10 percent of the 1999 maximum) was established to represent a significant reduction in the contaminant levels north of the slough. The target level for 2,4-DNT has been set at 0.11 µg/L, the Missouri Groundwater Quality standard.

1.5.1.5 Emergency Planning and Community Right-to-Know Act

The site no longer stores large quantities of chemicals and none above a threshold level; therefore, the site was not required to submit a 2013 Emergency Planning and Community Right-to-Know Act Tier II report.

Based on the chemical usage in 2013, the Weldon Spring site is not required to submit a Toxic Release Inventory report.

1.5.2 DOE Order Compliance

1.5.2.1 DOE Order 458.1, Radiation Protection of the Public and the Environment

DOE Order 458.1 which replaced DOE Order 5400 in June 2011, establishes primary standards and requirements for DOE operations to protect members of the public and the environment against undue risk from radiation. DOE operates its facilities and conducts its activities so that radiation exposures to members of the public are maintained within established limits.

The estimated total effective dose to the hypothetical maximally exposed individual was due to consumption of water from Spring SP-5304 in the Southeast Drainage. This dose was calculated to be 0.088 millirem (mrem), which is well below the 100 mrem guideline for all potential exposure pathways. Refer to Section 5.6.2 for additional information regarding the total effective dose calculation.

1.5.2.2 DOE Order 231.1B, Environment, Safety and Health Reporting

DOE Order 231.1B, *Environment, Safety and Health Reporting*, ensures the collection and reporting of information on environment, safety, and health that is required by law or regulation. This directive also includes requirements for occurrence reporting. There were no occurrence reports issued for the site during 2013.

1.5.2.3 DOE Order 436.1, Departmental Sustainability

DOE Order 436.1, *Departmental Sustainability*, requires that contractors integrate numerous environment-related requirements already placed on them by existing statutes, regulations, and policies through the use of an Environmental Management System (EMS) incorporated into an Integrated Safety Management System (ISMS). EMS requirements must be addressed in the contractor's ISMS, which must be submitted for DOE review and approval under Department of Energy Acquisition Regulation 970.5223-1, "Integration of Environment, Safety and Health into Work Planning and Execution" (48 CFR 970.5223-1).

DOE Order 436.1 incorporates the requirements of Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. DOE Order 436.1 also requires the implementation of an EMS that reflects the elements and framework found in the International Organization for Standardization (ISO) 14001:2004(E), *Environmental Management Systems—Requirements with Guidance for Use*, or the equivalent. DOE's Office of Legacy Management (LM) EMS integrates the four core elements of ISO 14001:2004(E): (1) planning, (2) implementation and operation, (3) checking and corrective action, and (4) management review. These elements are commonly referred to as a Plan-Do-Check-Act continuous cycle and apply to all LM and contractor work processes and activities. LM and its contractors are committed to systematically integrating environmental protection, safety, and health into management and work practices at all levels so that the LM mission is accomplished in a manner that continually integrates environmental aspects during planning, implementation, monitoring, project evaluation, and closeout. Guidance for identifying environmental aspects, objectives, and targets that are related to proposed activities is included in the EMS and ensures

that LM staff and contractors maintain compliance with applicable regulations and appropriately plan and implement activities.

The EMS provides mechanisms for planning and mitigating the negative impacts that proposed projects or actions could have on the environment by mandating environmental compliance; promoting the use of post-recycled-content materials; recycling to the extent practicable; conserving fuel, energy, and natural resources; minimizing the generation of greenhouse gases and hazardous wastes and the use of toxic chemicals; and enhancing disrupted ecosystems.

Table 2 provides a list of items recycled during 2013.

Table 2. Recycled Items and Quantities

Material Recycled	Quantity
Paper	533 pounds
Cardboard	234 pounds
Plastic	93 pounds
Batteries	40 pounds
Glass	115 pounds
Aluminum	5 pounds
Toner cartridges	6

1.5.3 Permit and Agreement Compliance

1.5.3.1 NPDES Permits

The Weldon Spring site had three NPDES permits during 2013. The first permit (MO 0107701), which covers a discharge pipeline from the LCRS, is maintained as a contingency to current disposal methods. No water has been discharged under this permit since 2002. The current permit expired in April 2013. A renewal application was submitted to the MDNR in October 2012. The MDNR transmitted a draft permit to DOE for review on January 8, 2014, and comments were provided to MDNR on January 21, 2014. The permit was sent out for public comment on March 21, 2014 and was finalized on May 21, 2014.

The second permit (MO 0129917) was for the point source discharge of treated sanitary sewage. A new wastewater treatment system was installed beginning in October 2012. The system uses a Wisconsin Mound leach field system, which does not require an NPDES permit. The wastewater is highly pretreated before being introduced into the mound system and consists of a septic tank to remove solids and a BioMicrobics system to reduce total suspended solids, biochemical oxygen demand, and fecal coliform bacteria. The system became operational on November 15, 2012. An application to terminate the NPDES permit (MO 0129917) for the previous wastewater treatment plant was submitted to MDNR on January 31, 2013. On March 5, 2014, DOE received a letter notifying them that the permit was terminated.

A storm water permit was attained for the demolition of the administration building and installation of the new wastewater treatment system, which took place in 2012 using the new MDNR e-permitting system on August 23, 2012. The permit number was MORA01773. The

permit required regular inspections and could not be terminated until approximately 70 percent vegetation coverage was established in the disturbed areas. It was determined that the areas had 70 percent vegetation coverage in July 2013, and a letter and Form H, *Termination of a General Permit*, was submitted to MDNR on July 11, 2013. An MDNR representative inspected the area on August 15, 2013, and on September 9, 2013, DOE received a letter notifying termination of the permit.

1.5.3.2 Federal Facility Agreement

EPA and DOE signed a Federal Facility Agreement in 1986 and amended it in 1992. The main purpose of the agreement is to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with CERCLA. EPA, DOE, and MDNR subsequently signed an updated Federal Facility Agreement; EPA provided the final signature on March 31, 2006 (DOE 2006).

1.5.3.3 Metropolitan St. Louis Sewer District (MSD) Agreement

The Weldon Spring site has approval from the MSD to discharge treated disposal cell leachate and purge water from groundwater sampling at their Bissell Point Plant. The MSD approval was renewed on December 16, 2013. DOE received notification in April 2004 that the leachate must meet the radiological drinking-water standard for all radionuclides, including the 30 microgram per liter ($\mu\text{g/L}$) (20 picocuries per liter [pCi/L]) standard for uranium prior to acceptance. The disposal cell untreated leachate uranium concentration was very close to this limit in 2004; therefore, DOE exercised a pretreatment contingency process and began treating the leachate through a system of cartridge filters and ion exchange media that is selective for uranium. The leachate was sampled after pretreatment and found to be significantly below the 30 $\mu\text{g/L}$ limit. The untreated levels continued to be close to the 30 $\mu\text{g/L}$ limit during 2013, so the leachate pretreatment continued, and the discharge levels remained significantly lower than the 30 $\mu\text{g/L}$ limit.

1.6 Geology and Hydrogeology

Due to lithologic differences, including geologic features that influence groundwater flow, and the geographical separation of the former Chemical Plant and Quarry areas, separate groundwater monitoring programs are established for the two sites. This section presents generalized geologic and hydrologic descriptions of the two sites, and Figure 3 provides a generalized stratigraphic description for reference. Hydrogeologic descriptions of lithologies monitored for each program are discussed in Sections 5.2.1.1 and 5.2.2.1. The Weldon Spring site is situated near the boundary between the Central Lowland and the Ozark Plateau physiographic provinces. This boundary nearly coincides with the southern edge of Pleistocene glaciation that covered the northern half of Missouri over 10,000 years ago (Kleeschulte et al. 1986).

The uppermost bedrock unit underlying the former Chemical Plant is the Mississippian Burlington-Keokuk Limestone. Overlying the bedrock are unconsolidated units consisting of fill, topsoil, loess, glacial till, and limestone residuum of thicknesses ranging from a few feet to several tens of feet.

System	Series	Stratigraphic Unit	Typical Thickness (feet) ^a	Physical Characteristics	Hydrostratigraphic Unit
Quaternary	Holocene	Alluvium	0–120	Gravelly, silty loam	Alluvial aquifer
	Pleistocene	Loess and glacial drift ^b	10–60	Silty clay, gravelly clay, silty loam, or loam over residuum from weathered bedrock	
Mississippian	Meramecian	Salem Formation ^c	0–15	Limestone, limy dolomite, finely to coarsely crystalline, massively bedded, and thin-bedded shale	Locally a leaky confining unit
		Warsaw Formation ^c	0–80	Shale and thin- to medium-bedded finely crystalline limestone with interbedded chert	
	Osagean	Burlington-Keokuk Limestone	100–200	Cherty limestone, very fine to very coarsely crystalline, fossiliferous, thickly bedded to massive	Shallow aquifer system
		Fern Glen Limestone	45–70	Cherty limestone, dolomitic in part, very fine to very coarsely crystalline, medium to thickly bedded	
	Kinderhookian	Chouteau Limestone	20–50	Dolomitic argillaceous limestone, finely crystalline, thin to medium bedded	
Devonian	Upper	Sulphur Springs Group Bushberg Sandstone ^d	40–55	Quartz arenite, fine to medium grained, friable	Upper leaky confining unit
		Lower part of Sulphur Springs Group undifferentiated		Calcareous siltstone, sandstone, oolitic limestone, and hard carbonaceous shale	
Ordovician	Cincinnatian	Maquoketa Shale ^e	0–30	Calcareous to dolomitic silty shale and mudstone, thinly laminated to massive	
	Champlainian	Kimmswick Limestone	70–100	Limestone, coarsely crystalline, medium to thickly bedded, fossiliferous and cherty near base	Middle aquifer system
		Decorah Group	30–60	Shale with thin interbeds of very finely crystalline limestone	Lower confining unit
		Plattin Limestone	100–130	Dolomitic limestone, very finely crystalline, fossiliferous, thinly bedded	
		Joachim Dolomite	80–105	Interbedded very finely crystalline, thinly bedded dolomite, limestone, and shale; sandy at base	
		St. Peter Sandstone	120–150	Quartz arenite, fine to medium grained, massive	
	Canadian	Powell Dolomite	50–60	Sandy dolomite, medium to finely crystalline, minor chert and shale	Deep aquifer system
		Cotter Dolomite	200–250	Argillaceous, cherty dolomite, fine to medium crystalline, interbedded with shale	
		Jefferson City Dolomite	160–180	Dolomite, fine to medium crystalline	
		Roubidoux Formation	150–170	Dolomitic sandstone	
Gasconade Dolomite		250	Cherty dolomite and arenaceous dolomite (Gunter Member)		
Cambrian	Upper	Eminence Dolomite	200	Dolomite, medium to coarsely crystalline, medium bedded to massive	
		Potosi Dolomite	100	Dolomite, fine to medium crystalline, thickly bedded to massive; drusy quartz common	

^a Thickness estimates vary depending on data source.

^b Glacial drift unit includes the Ferrelview Formation and is saturated in the northern portion of the Ordovician Works where this unit behaves locally as a leaky confining unit.

^c The Warsaw and Salem Formations are not present in the Weldon Spring area.

^d The Sulphur Springs Group also includes the Bachelor Sandstone and the Glen Park Limestone.

^e The Maquoketa Shale is not present in the Weldon Spring area.

Figure 3. Generalized Stratigraphy and Hydrostratigraphy of the Weldon Spring, Missouri, Site

Three bedrock aquifers underlie St. Charles County. The shallow aquifer consists of the Mississippian Burlington-Keokuk Limestone and Fern Glen Formation, and the middle aquifer consists of Ordovician Kimmswick Limestone. The deep aquifer includes formations from the top of the Ordovician St. Peter Sandstone to the base of the Cambrian Potosi Dolomite. Alluvial aquifers of Quaternary age are present near the Missouri and Mississippi Rivers.

The Weldon Spring Quarry is located in low limestone hills near the northern bank of the Missouri River. The middle Ordovician bedrock of the Quarry area includes, in descending order, Kimmswick Limestone, Decorah Formation, and Plattin Limestone. These formations are predominantly limestone and dolomite. Massive Quaternary deposits of Missouri River alluvium cover the bedrock to the south and east of the Quarry.

1.7 Surface Water System and Use

The former Chemical Plant and Raffinate Pits areas are located on the Missouri–Mississippi River surface drainage divide. Elevations on the site range from approximately 608 feet (ft) above mean sea level near the northern edge of the site to 665 ft above mean sea level near the southern edge. (The disposal cell is not included in these elevation measurements.) The natural topography of the site is gently undulating in the upland areas, typical of the Central Lowlands physiographic province. South of the site, the topography changes to the narrow ridges and valleys and short, steep streams common to the Ozark Plateau physiographic province (Kleeschulte et al. 1986).

No natural drainage channels traverse the site. Drainage from the southeastern portion of the site generally flows southward to a tributary referred to as the Southeast Drainage (or 5300 Drainage, based on the site's nomenclature) that flows to the Missouri River.

The northern and western portions of the former Chemical Plant site drain to tributaries of Schote Creek and Dardenne Creek, which ultimately drain to the Mississippi River. The manmade lakes in the August A. Busch Memorial Conservation Area, which are used for public fishing and boating, are located within these surface drainages. No water from the lakes or creeks is used for irrigation or for public drinking water supplies.

Before the remediation of the former Chemical Plant and Raffinate Pits areas began, there were six surface water bodies on the site: the four raffinate pits, the Frog Pond, and the Ash Pond. The water in the raffinate pits was treated prior to release, and the pits were remediated and confirmed clean. The Frog Pond and Ash Pond were flow-through ponds that were monitored prior to being remediated and confirmed clean. Throughout the project, retention basins and sedimentation basins were constructed and used to manage potentially contaminated surface water. During 2001, the four sedimentation basins that remained were remediated, and the entire site was brought to final grade and seeded with temporary vegetation. Final seeding was conducted during 2002.

The Weldon Spring Quarry is situated within a bluff of the Missouri River Valley about 1 mile northwest of the Missouri River at approximately River Mile 49. A 0.2-acre pond within the Quarry proper acted as a sump that accumulated direct rainfall within the Quarry. Past dewatering activities in the Quarry suggested that the sump interacted directly with the local groundwater. All water pumped from the Quarry before remediation was treated before it was released. Bulk waste removal, which included the removal of some sediment from the sump area,

was completed during 1995. The Quarry was partially backfilled, graded, and seeded during 2002.

The Femme Osage Slough, located approximately 700 ft south of the Quarry, is a 1.5 mile section of the original Femme Osage Creek and Little Femme Osage Creek. The University of Missouri redirected the creek channels between 1960 and 1963 during the construction of a levee system around the university's experimental farms (DOE 1990a). The slough is essentially landlocked. The slough is not used for drinking water or irrigation.

1.8 Ecology

The Weldon Spring site is surrounded primarily by state conservation areas that include the 6,988-acre Busch Conservation Area to the north, the 7,356-acre Weldon Spring Conservation Area to the east and south, and the 2,548-acre Howell Island Conservation Area, which is an island in the Missouri River (Figure 2).

The wildlife areas are managed for multiple uses, including timber, fish and wildlife habitat, and recreation. Fishing constitutes a relatively large portion of the recreational use. Seventeen percent of the area consists of open fields that are leased to sharecroppers for agricultural production. In these areas, a percentage of the crop is left for wildlife use. The main agricultural products are corn, soybeans, milo, winter wheat, and legumes (DOE 1992b). The Busch and Weldon Spring Conservation Areas are open year-round, and the number of annual visits to both areas totals about 1,200,000.

The Quarry is surrounded by the Weldon Spring Conservation Area, which consists primarily of forest with some old-field habitat. Prior to bulk waste removal, the Quarry floor consisted of old-field habitat containing a variety of grasses, herbs, and scattered wooded areas. When bulk waste removal began, this habitat was disturbed. The rim and upper portions of the Quarry still consist primarily of slope and upland forest, including cottonwood, sycamore, and oak (DOE 1990a).

1.9 Climate

The climate in the Weldon Spring area is continental, with warm to hot summers and moderately cold winters. Air masses that are alternately warm and cold, wet and dry converge and pass through the area, causing frequent changes in the weather. Although winters are generally cold and summers are generally hot, prolonged periods of very cold or very warm to hot weather are unusual. Occasional mild periods with temperatures above freezing occur almost every winter, and cool weather interrupts periods of heat and humidity in the summer (Ruffner and Bair 1987).

The precipitation and average temperature results in Table 3 are provided by the National Weather Service. This data is used to show general climate data for the site. The St. Louis office of the National Weather Service is located in Weldon Spring approximately 2.5 miles from the site.

Table 3. Monthly Precipitation and Average Temperatures for 2013

Month	Total Precipitation (inches)	Average Temperature (°F)
January	3.07	32.2
February	3.47	33.6
March	4.71	36.2
April	7.11	52.4
May	9.18	64.6
June	5.76	72.9
July	2.29	74.4
August	1.12	74.8
September	1.34	71.6
October	1.63	56.7
November	1.75	41.8
December	1.81	31.4

1.10 Land Use and Demography

The 2012 census (U.S. Census Bureau) estimated the population of St. Charles County to be about 368,666. The three largest communities in St. Charles County are O’Fallon (population: est. 81,979), St. Charles (population: est. 65,463), and St. Peters (population: est. 54,078) (Figure 1). The two communities closest to the site are Weldon Spring and Weldon Spring Heights, about 2 miles to the northeast. The combined population of these two communities is about 5,000. No private residences exist between Weldon Spring Heights and the site.

Francis Howell High School is about 0.6 mile northeast of the site along Missouri State Route 94 (Figure 2). The school employs approximately 150 faculty and staff members, and about 1,780 students attend school there. The school recently constructed a new school building, which was completed in time for the start of the 2011–2012 school year.

St. Charles County owns a maintenance facility adjacent to the north side of the former Chemical Plant. In the past year the county used the facility for storage and processing of concrete rubble and trees. The Army Reserve Training Area is located to the west of the former Chemical Plant. The Army is currently constructing a large reserve center on the Army property.

The University of Missouri owns about 741 acres of land east and southeast of the high school. The northern third of this land is being developed into a high-technology research park. MDC operates the conservation areas adjacent to the former Chemical Plant and employs about 50 people.

1.11 Non-Routine Activities

1.11.1 Installation of Protective Steel Monitoring Well Caps

On September 19, 2012, it was discovered that wells MW-3031 and MW-3037 had been vandalized. It was determined that the aluminum top caps had been broken off both wells. To assist in preventing this type of vandalism in the future, new steel well protective covers were fabricated and installed on all monitoring wells that had the aluminum top caps. Installation was completed on May 21, 2013.

1.11.2 Abandonment of MW-3031

After the discovery of the vandalism to MW-3031, attempts to measure the static water level in MW-3031 revealed that a large rock had been forced down MW-3031 and was lodged in the casing approximately 4.5 ft down from the top of the casing. The rock could not be removed, and it was decided to abandon this well. DOE sent a letter to the EPA and MDNR on October 2, 2012, discussing the past performance of MW-3031 and the decision to abandon the well. A drilling subcontractor performed the abandonment work on July 15, 2013.

1.11.3 Repair of Monitoring Wells

During groundwater sampling activities, the samplers observed that several wells were damaged by ground subsidence due to drought conditions. These included MW-1013, 1015, 1016, 1018, 1046, 2033, 2034, and 4001. A drilling subcontractor repaired the wells the week of July 15-19, 2013.

1.11.4 Tornado Damage Repair

On the evening of May 31, 2013, the site sustained some damage from a tornado that occurred near the site. Several repairs had to be made including replacement of three air conditioner/heating units on the Interpretive Center, straightening of telephone poles, and replacement of the front entrance signs.

2.0 Inspection Report

2.1 Introduction

The Weldon Spring site was inspected November 5–7, 2013. The inspection was conducted in accordance with the LTS&M Plan (DOE 2008a) and associated inspection checklist. Representatives from DOE, Stoller, EPA, and MDNR participated in the inspection. A representative from the MDC participated in the inspection of the Southeast Drainage.

The main areas inspected at the site were the Quarry, the disposal cell, the LCRS, monitoring wells, assorted general features, and areas where ICs have been established.

IC areas were inspected to ensure that restrictions such as soil excavation, groundwater withdrawal, and residential use were not being violated. Each area was inspected, and inspectors observed no indication of violations of the restrictions was observed.

Inspection of the disposal cell consisted of walking 10 transects over the cell and around the cell perimeter. Inspectors used hand-held global positioning system (GPS) equipment to navigate the transects. Six previously marked areas of the cell were located and observed for signs of rock degradation. The LCRS was also inspected and observed to be in good condition. Forty-six of the 106 groundwater monitoring wells were inspected and were in good condition. The inspection also included other site features, such as the prairie, site markers, and roads.

The purpose of the annual inspection was to confirm the integrity of the visible features (such as disposal cell, LCRS, and monitoring wells) at the site, document the site condition subsequent to remediation and restoration, identify changes in conditions that may affect site integrity, determine if ICs are adequately implemented, and determine the need, if any, for maintenance or additional inspections and monitoring.

At the time of the inspection, nine Stoller personnel were employed full-time at the site. Stoller is the LM's Legacy Management Support contractor. Some of these employees also support other LM sites around the nation. Also employed at the site are part-time contractor and subcontractor employees.

The following personnel from Stoller were the lead inspectors during the inspection:

- Terri Uhlmeier
- Randy Thompson

The following support personnel from Stoller participated in the inspection:

- Tom Welton
- Tim Zirbes
- Chris Papinsick
- Rex Hodges
- Yvonne Deyo

The following personnel observed the inspection and provided oversight:

- Ken Starr, DOE
- Hoai Tran, EPA Region 7
- Patrick Anderson, MDNR
- Dan Carey, MDNR
- Jerod Heubner, MDC (Southeast Drainage only)

2.2 Inspection Results

Prior to the inspection, the site inspection agenda (Appendix A) was reviewed with the inspection participants. A safety briefing was also held prior to the inspection, and the corrective action report from the 2012 annual inspection was reviewed (Appendix B). The following is a summary of the inspection results. The inspection base maps, which include the locations of the photographs, are included as Figure 4 and Figure 5. The checklist (from Appendix H of the LTS&M Plan) is included in this report as Appendix C. A letter to EPA and MDNR dated November 14, 2013, documented four items observed during the inspection and the resolution. The items are noted in the description below and were resolved the week of the inspection. There were no outstanding items to include from the inspection.

2.2.1 Institutional Controls

Section 2.3.4 of the LTS&M Plan states “DOE will conduct a formal annual inspection of the physical locations addressed by ICs. DOE also will evaluate whether the ICs remain effective in protecting human health and the environment and, in coordination with EPA and MDNR, will take appropriate action if evidence indicates the controls are not effective.”

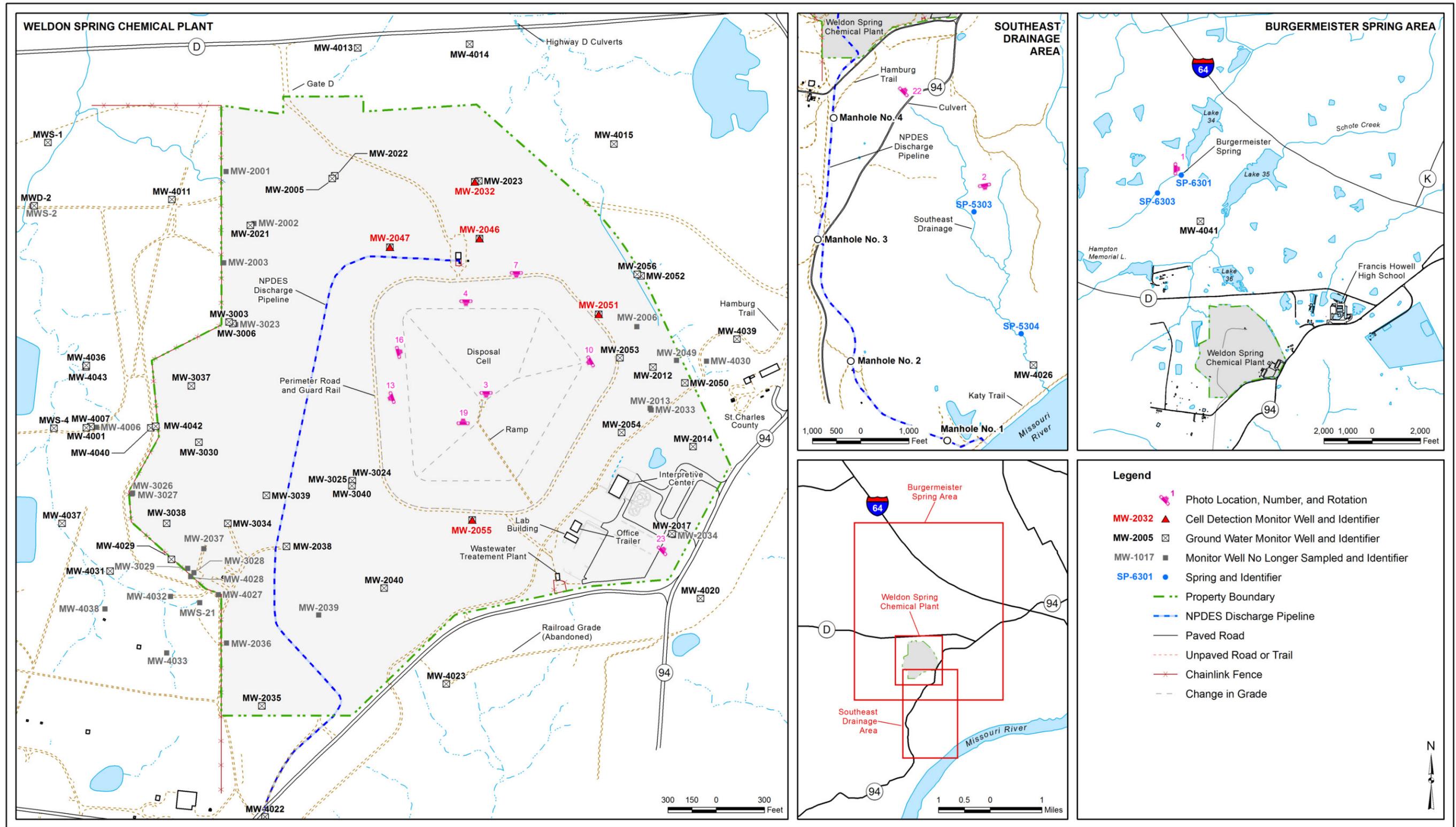
Easements have been negotiated and finalized with surrounding state agency landowners for implementing use restrictions required on the state properties. The state agencies included the Missouri Department of Conservation (MDC), MDNR-Parks, and MoDOT/St. Charles County. The easements are in place to restrict potential use of contaminated groundwater in the hydraulic buffer zone and also to restrict land use in the Southeast Drainage area and at the Quarry site. Figure 6 and Figure 7 provide the IC location maps from the LTS&M Plan.

The IC areas are listed in the following section as they are referenced in the inspection checklist.

2.2.1.1 Land and Shallow Groundwater Use Within the Chemical Plant Site and Buffer Zone

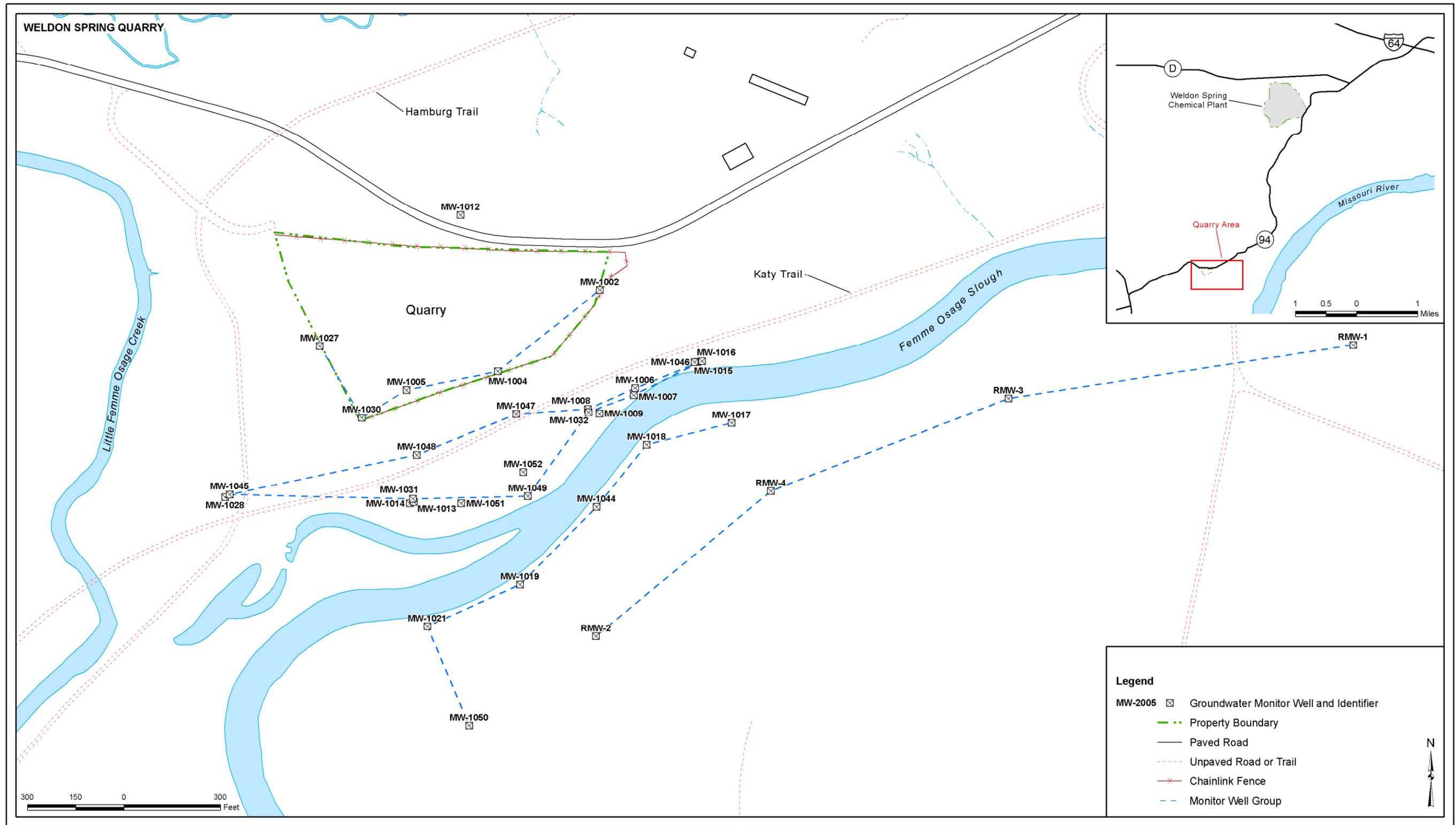
Inspection Criteria: Groundwater and land use is restricted on the Chemical Plant site. Inspect for indications of excavations into soil or bedrock and groundwater withdrawal or use in restricted areas. If any party has been granted use of portions of the former Chemical Plant area, inspect to ensure that land use is in compliance with the terms of the restrictions within the notation.

Inspection Results: This area was inspected, and observers found no indications of excavations into soil or bedrock, groundwater withdrawal, or groundwater use.



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Figure 4. 2013 Inspection Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site



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Figure 5. 2013 Inspection Map for the Quarry Area of the Weldon Spring, Missouri, Site

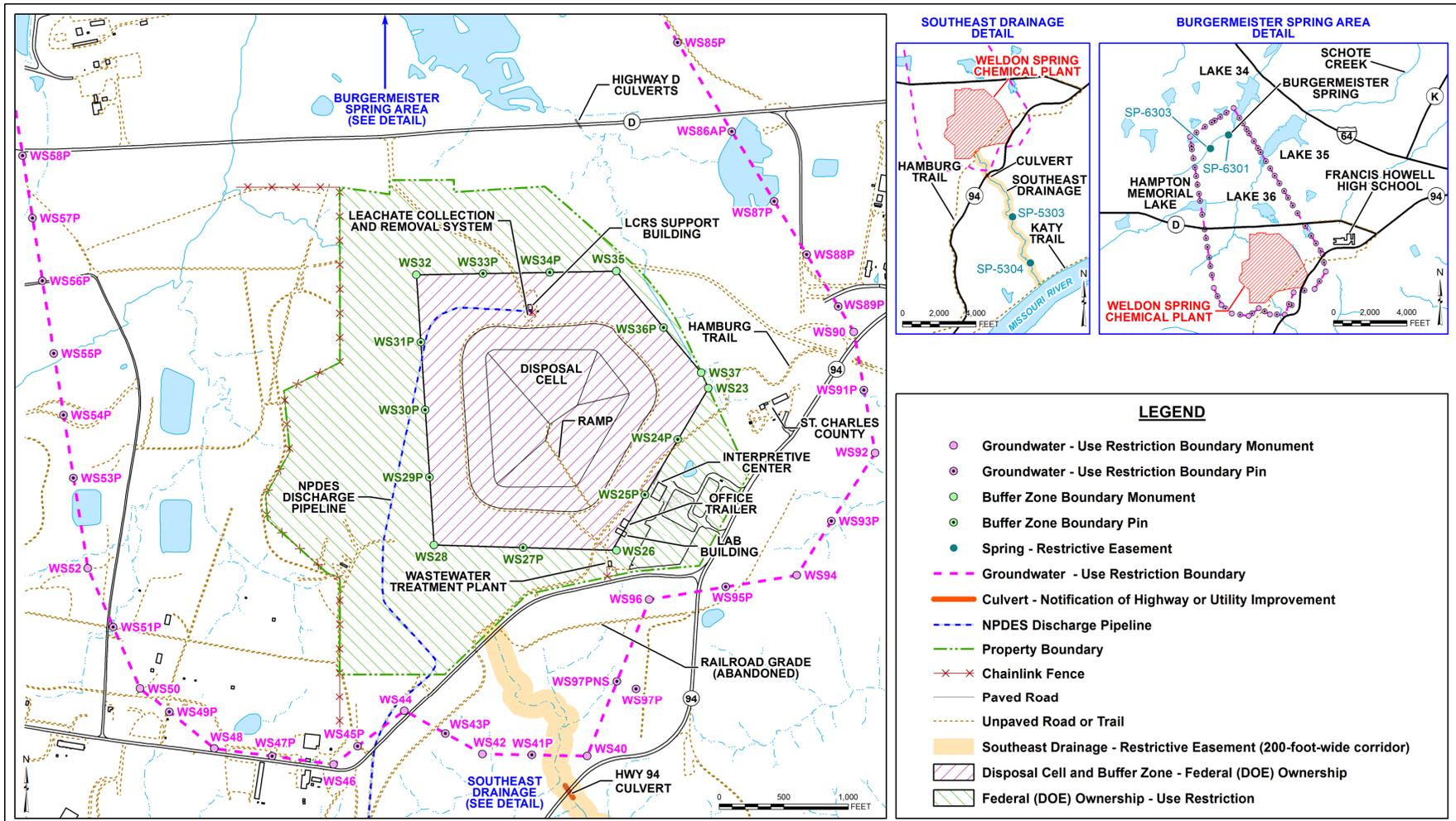


Figure 6. Institutional Controls Location Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site

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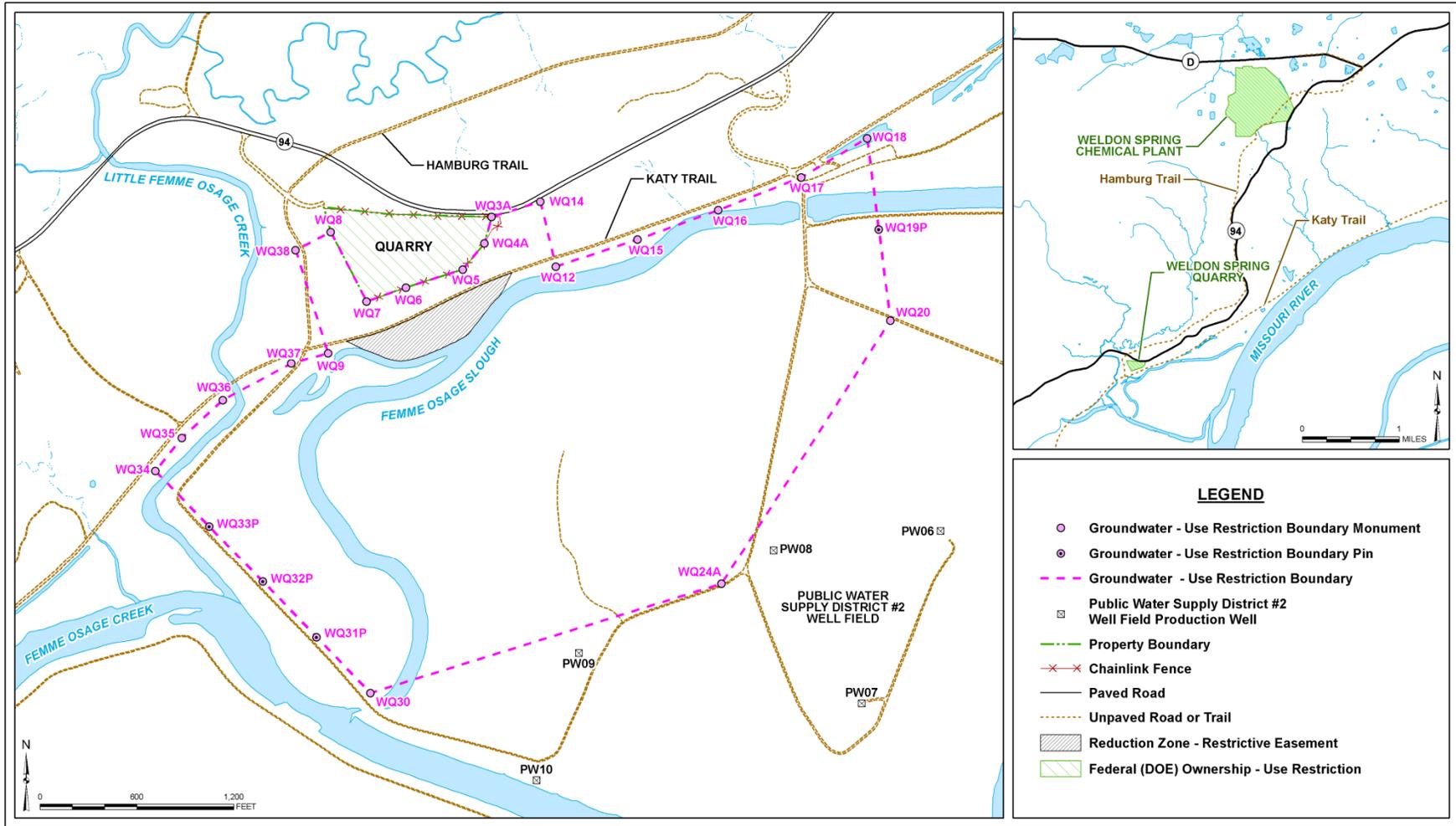


Figure 7. Institutional Controls Map for the Quarry Area of the Weldon Spring, Missouri, Site

2.2.1.2 Groundwater Use in Areas Surrounding the Chemical Plant

Inspection Criteria: Groundwater use is restricted in areas on Army, MDC, and St. Charles County (formerly MoDOT) properties, as shown on Figure 6. Inspect affected areas for groundwater or spring water (Burgermeister Spring (Spring 6301) and Spring 6303) use. Inspect to ensure that land use continues to be in compliance with the terms of the license, easement, or permit and the restrictions contained therein.

Inspection Results: The surrounding area where groundwater use is restricted was inspected. This included property owned by MDC and the Army. No evidence of groundwater use was observed, and current land use remains consistent with ICs on both properties. Burgermeister Spring 6301 (Photo 1) and Spring 6303 on MDC property were inspected, and there were no indications of spring water use. Spring 6303 was not flowing. All the monitoring wells inspected were appropriately secured. The maintenance on the monitoring wells was also sufficient. Inspectors observed that MW-4036 on the Army property did not have a contact label and that MW-4041 on the MDC property had a new steel cap, but it was rusty. Both observations were corrected by the end of the week of the inspection. Inspectors noted that the Army is continuing to build a large reserve center on their property.

2.2.1.3 Groundwater (Quarry)

Inspection Criteria: Figure 7 shows the Quarry groundwater restriction area boundary. Inspect affected areas for evidence of groundwater withdrawal or use in restricted areas. Inspect to ensure that land use continues to be in compliance with the terms of the easement and restrictions within the notation.

Inspection Results: The groundwater restricted area was inspected, and no evidence of groundwater withdrawal or use in the area was observed.

2.2.1.4 Land Use in Quarry Area Reduction Zone

Inspection Criteria: Figure 7 shows the restriction boundary. A naturally occurring reduction zone exists in soil south of the Katy Trail and north of the Femme Osage Slough. This area is restricted from excavations. Inspect for indications of excavations into soils in the uranium reduction zone. Inspect to ensure that land use continues to be in compliance with the terms of the easement and the restrictions contained therein.

Inspection Results: The Quarry reduction zone area was inspected, and no indications of excavation into soils or bedrock were observed. As required by the LTS&M Plan, information signage and contact numbers were posted on monitoring wells at the Quarry Area reduction zone. The labels indicate no digging is allowed in this area and include contact numbers for DOE and MDC. Land use remains consistent with planned ICs.

2.2.1.5 Southeast Drainage

Inspection Criteria: The Southeast Drainage is restricted for residential housing in a 200 ft corridor. Check for indications of residential use or construction in the Southeast Drainage (200 ft wide corridor), or other activity that would indicate non-recreational use of the area. Check Springs 5303 and 5304 for residential, commercial, or agricultural use of spring water.

Inspection Results: The inspectors walked down the entire Southeast Drainage (Photo 2) and observed no indications of residential use, construction, or any other activity that would indicate non-recreational use of the area. The springs also were inspected, and no indications of residential, commercial, or agricultural use of the springs were observed. Both of the springs were observed to be flowing. Current land use remains consistent with planned ICs. Inspectors observed that erosion is occurring under the culvert that crosses under the Hamburg Trail. MDC was notified of this by e-mail on November 12, 2013, as they had been notified in 2011 and 2012.

2.2.1.6 State Route 94 Culvert

Inspection Criteria: Check for signs of disturbance of the affected region where the culvert passes beneath State Route 94 and in the utility rights-of-way in the affected area.

Inspection Results: The State Route 94 culvert was inspected. It was noted during the inspection that the culvert inlet was filled with tree debris. Also during the inspection, the Missouri Department of Natural Resources (MDNR), Patrick Anderson, had some questions regarding the culvert. An e-mail sent to MoDOT representative Stowe Johnson on November 7, 2013, included pictures of the inlet and outlet sides of the culvert and stated the following:

During our recent annual Weldon Spring site inspection, the Missouri Department of Natural Resources (MDNR), Patrick Anderson, questioned the integrity of the outlet of the drainage pipeline that crosses beneath Highway 94. He inquired whether MoDOT was planning on removing or rehabilitating any of the outlet end of the drainage culvert. This information is being provided for informational purposes only, since DOE has no authority or involvement relating to this aspect of the drainage pipeline.

In addition, the inlet of this same drainage culvert appears plugged with debris. Two photographs are attached that shows the debris existing at the inlet of the pipeline.

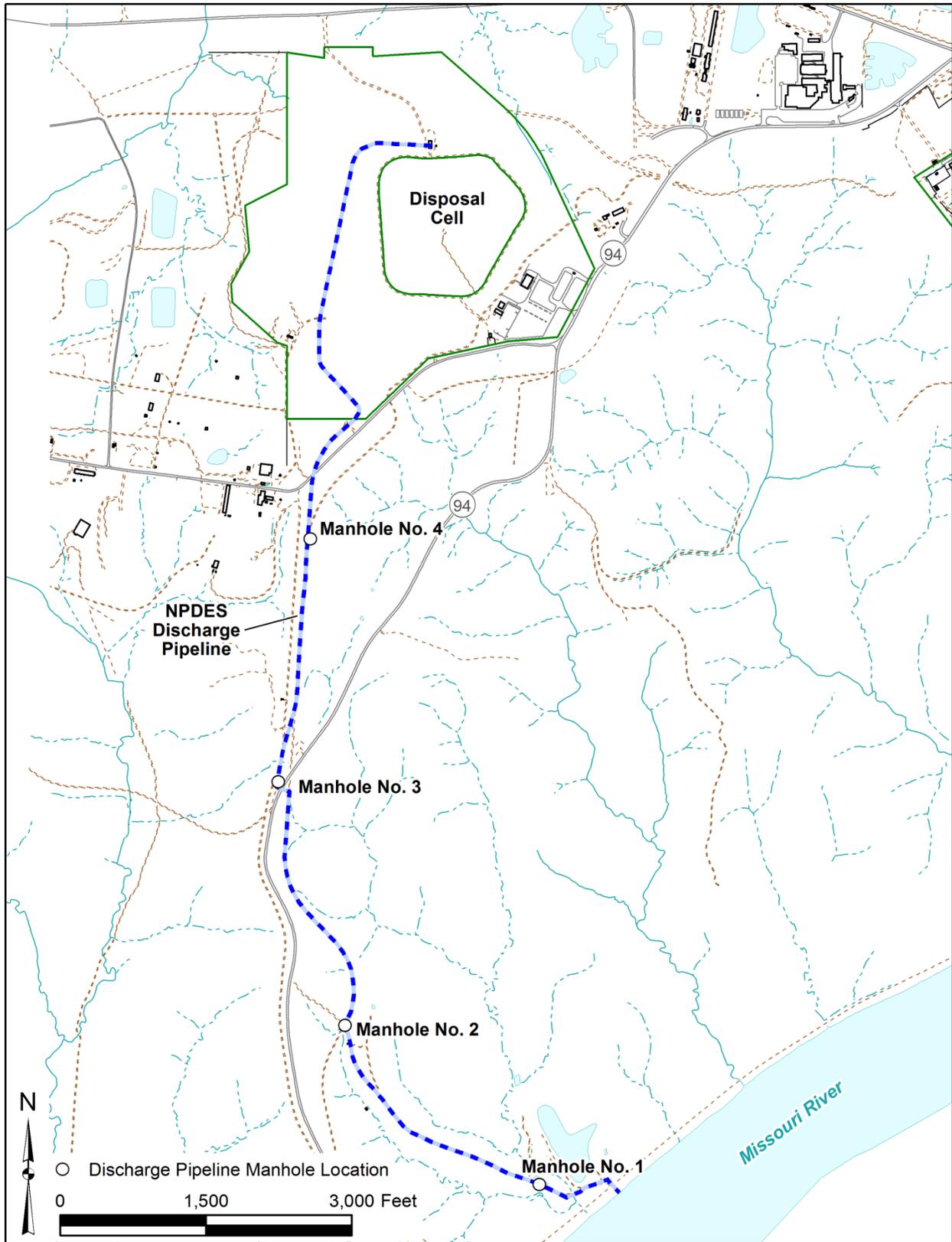
Please let me know if you have any questions or desire additional information.

Mr. Stowe responded that he would contact the maintenance shed and have them clean out the debris.

2.2.1.7 NPDES Discharge Pipeline from LCRS to Missouri River

Inspection Criteria: Inspect the entire length of the NPDES discharge pipeline and outfall for any disturbance or maintenance needs.

Inspection Results: The area of the pipeline was inspected by Stoller personnel prior to the inspection, and the manholes were cleared. Figure 8 shows a map of the pipeline and the manhole locations. Stoller inspectors noted that no onsite disturbances of the pipeline or disturbances of the offsite areas of the pipeline and manholes were apparent, and decided that additional inspection of the pipeline and manholes was unnecessary at that time. The pipeline area is inspected at least annually. This pipeline serves as a contingency for discharge of disposal cell leachate but has not been used for that purpose to date.



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Figure 8. NPDES Discharge Pipeline Between the LCRS Support Building at the Missouri River, Weldon Spring, Missouri, Site

2.2.2 Disposal Cell

The disposal cell was inspected in accordance with the LTS&M Plan and the annual inspection checklist (Photo 3). The cell inspection was divided into 10 transects (Figure 9). The inspectors separated into two groups and walked five transects each, looking for depressions, shifts of cell plane vertices, and other indications of settlement. In the past, slight depressions or bulges that were noted during the inspection were included on Figure 9; however, due to the subjectivity of visually delineating surface anomalies of the rock-covered cell, the accuracy and relevance of the practice is questioned. DOE is investigating more-objective options that may define these types of areas better than visual interpretations. Other items for inspection included vegetation, wet areas, apron drains, guardrails, the stairs, and the six rock test plot areas. The inspectors took photographs of these delineated rock test plot areas and compared them to photographs from the previous inspection of the same areas and observed no rock degradation. The test plot areas are shown from the original inspection in 2003 (2011 for Test Plot #6), 2012, and 2013 for comparison (see Photos 4 through 21). Inspectors noted during the 2010 inspection that vandals had removed some rocks from Test Plot #5. A new test plot (Test Plot #6) had been marked during 2011 in response to a request from MDNR during the 2010 inspection. This new plot is located on the southern face of the disposal cell (Figure 9).

In accordance with the inspection criteria included in the checklist, the inspectors also evaluated the cell cover for wet areas or water drainage and observed that none were present. The toe and apron drains were inspected and found to be functioning as designed. The guardrail and stairs were in good condition. No vegetation was found on the disposal cell during the inspection.

2.2.3 Leachate Collection and Removal System (LCRS)

Stoller staff discussed operations of the LCRS with the inspection participants, presented the LCRS data and the SOARS (System Operation and Analysis at Remote Sites) system, and inspected the system. The fences and doors were locked and were in good condition. The system was functioning as designed. The leachate production rates, uranium levels, and flow rates are provided in Appendix D.

DOE continues to apply its pretreatment contingency process by pretreating the leachate through a system of cartridge filters and ion exchange media that is selective for uranium. Leachate samples continue to indicate that uranium concentrations are well below the discharge limit. Leachate management will continue in this manner until uranium concentrations in the untreated leachate are consistently below the 20 pCi/L limit.

2.2.4 Erosion

2.2.4.1 Chemical Plant Area

The erosion areas were observed during the inspection. Erosion channels within the entire prairie have been mapped with GPS annually since 2007 (Figure 10). The resulting information will be used to track the nature and extent of erosion and to determine possible action if necessary.

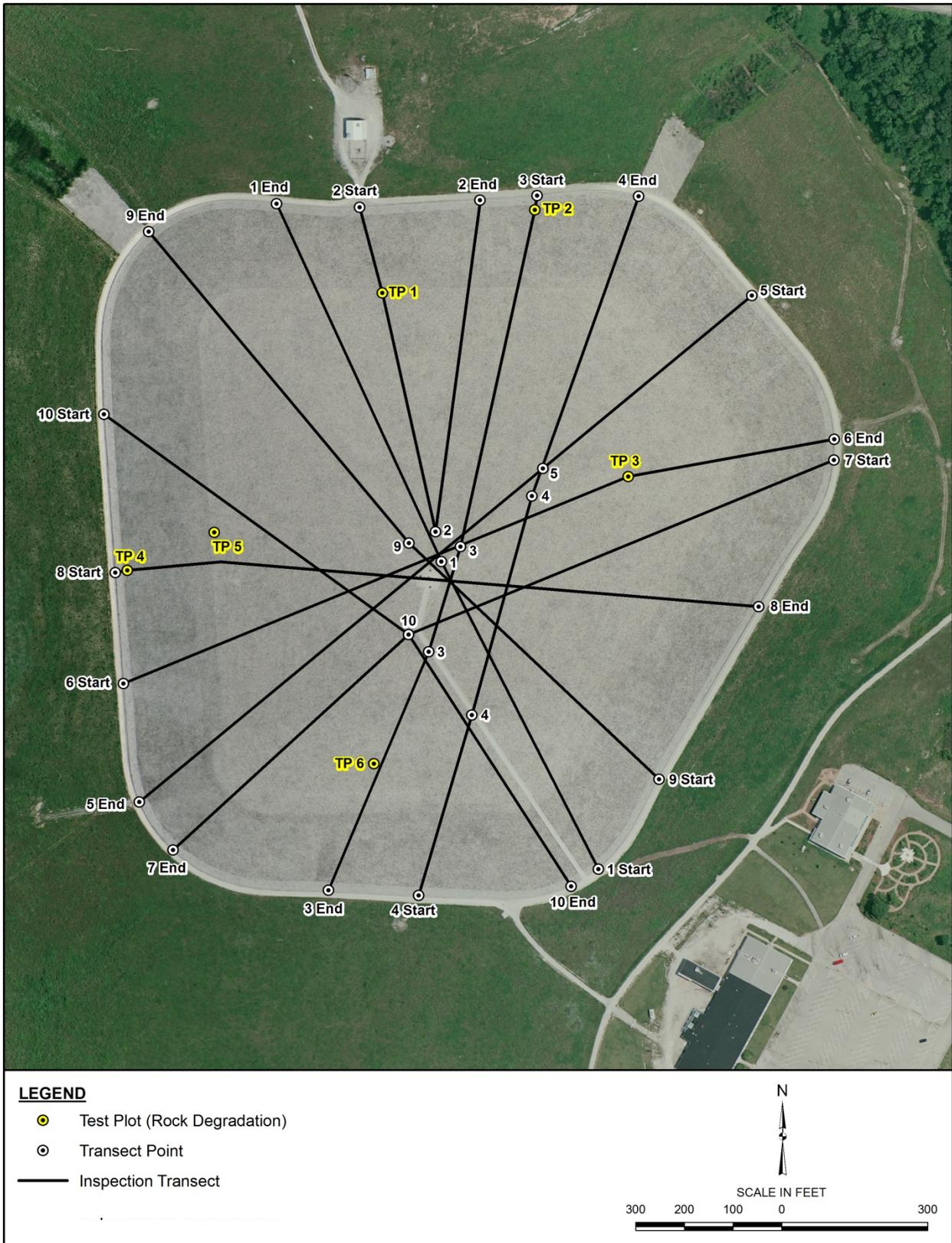


Figure 9. Disposal Cell Inspection Transects and Rock Test Plot Locations at the Weldon Spring, Missouri, Site

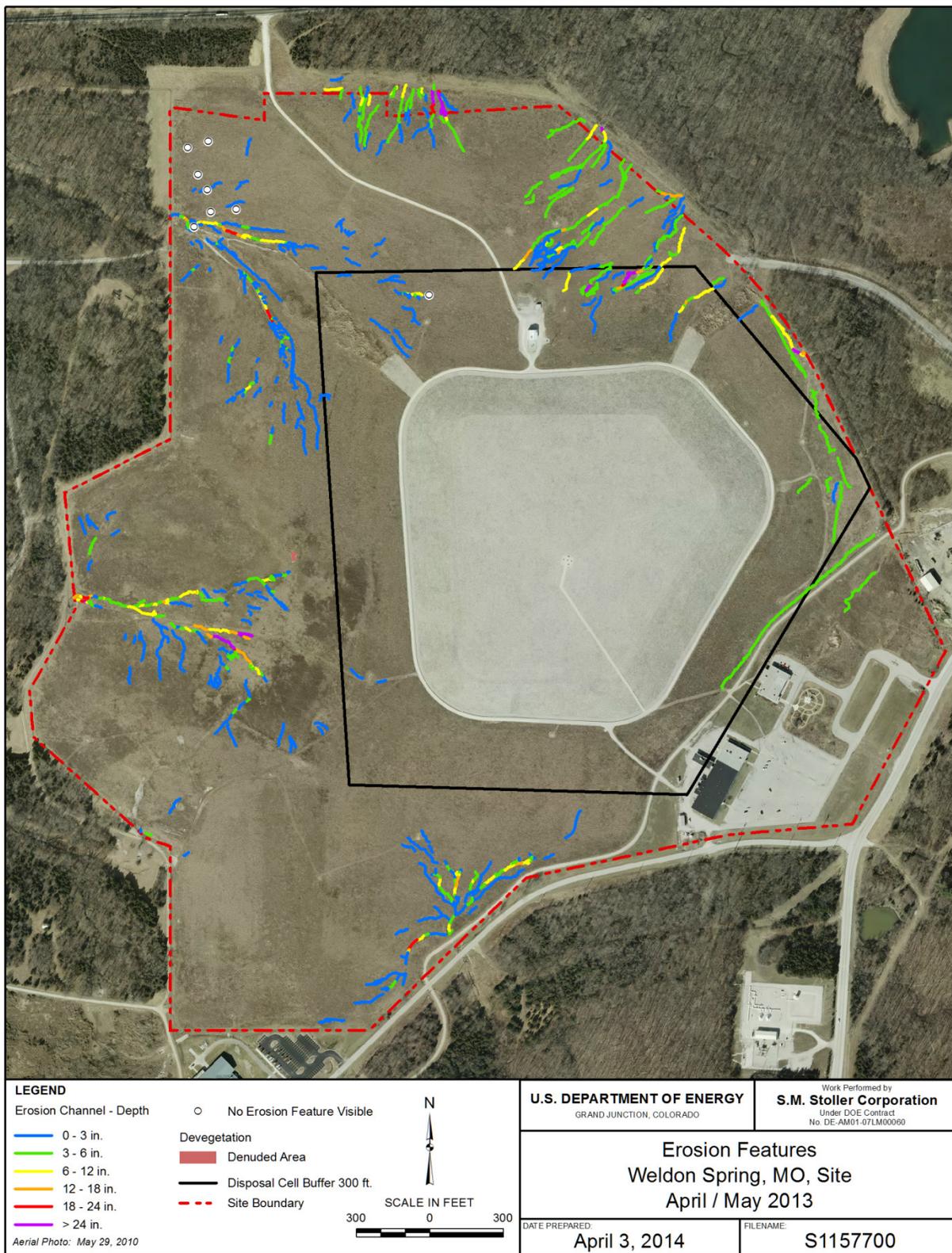


Figure 10. Erosion Features Within the Prairie

2.2.4.2 Quarry Area

No erosion areas were noted during the inspection of the Quarry area.

2.2.5 General Site Conditions

General site conditions as listed in the checklist were inspected and are discussed below.

2.2.5.1 Roads

The roads consist of asphalt roads leading into the property and a gravel road that extends around the disposal cell and to Gate D. The roads were in good condition.

2.2.5.2 Vandalism

Although the site is publicly accessible, signs are clearly posted at the disposal cell that the viewing platform is open during daylight hours only. Public use of the site continues to increase. Because of ongoing issues associated with this use (e.g., littering at various locations throughout the site, including at the top of the disposal cell, increasing evidence of nighttime access), a private security firm was hired to provide seasonal patrol coverage of the site during the evening hours. These patrols, along with the upgraded safety-oriented security system, have dramatically curtailed the degree of undesirable activities at the site. Signs were also posted at the disposal cell entrance and the top of the disposal cell that state that video surveillance is being conducted.

The disposal cell monument plaques were vandalized during 2010, as indicated by the corners of the plaques that were bent down. Subsequent inspections have documented that the plaques continue to be vandalized. The plaques are still functional, and nothing further will be done at this time.

2.2.5.3 Personal Injury Risks

No personal injury risks were observed.

2.2.5.4 Site Markers (Four Information Plaques on Top of Cell, Historical Markers, and Other Information Markers)

The four information plaques on top of the cell were generally in good condition. Inspectors noted some vandalism to the plaques where the corners had been bent down, as noted in Section 2.2.5.2. The historical markers were inspected (Photo 22) and were in good condition.

The LTS&M Plan also requires No Trespassing signs to be posted on the LCRS fence along with the DOE 24-hour security telephone number (970-248 6070 or 877-695-5322) that the public can call for information. During the 2013 inspection, inspectors noted that these signs were posted on the LCRS fence and were in good condition.

2.2.6 Monitoring Wells

Inspection of monitoring wells included wells in the disposal cell monitoring well network, former Chemical Plant monitoring well network, and Quarry monitoring well network. The inspection checklist required inspection of all the disposal cell wells and greater than 10 percent of the former Chemical Plant and Quarry wells. The checklist required the wells to be inspected

to ensure they are properly secured, locked, and in good condition and to check if they need maintenance and have the proper ID number on the well. The wells appeared to be in good condition, and the protective casing on many wells had been freshly painted. During regular sampling and inspection of the wells in 2012, inspectors noted that settling of several wells and/or well casings had damaged the wells or the concrete pads, presumably as a result of the extreme drought over the summer. The settling affected wells MW-2033, 2034, and 4001 from the former Chemical Plant and wells MW-1013, 1015, 1016, 1018, and 1046 at the Quarry. As discussed in Section 1.11.3, a drilling subcontractor repaired these wells in July 2013. The inspection included each of these wells (Photo 23).

2.2.6.1 Disposal Cell Monitoring Well Network

Each of the wells in the disposal cell network (MW-2032, 2046, 2047, 2051, 2055) were inspected and found to be in good condition.

2.2.6.2 Chemical Plant Area Monitoring Well Network

The inspection checklist requires inspection of at least 10 percent of the wells from the former Chemical Plant monitoring well network. This network consists of 67 DOE-owned wells and 4 wells owned by the Army. This number does not include the five disposal cell wells, although some of those wells are monitored for the groundwater remedy. Thirty wells were inspected (51 percent). Only 42 DOE-owned wells are monitored for the MNA groundwater remedy. The remaining wells are monitored quarterly for static water levels only. The following wells were inspected: MW-2012, 2013, 2014, 2017, 2023, 2033, 2034, 2053, 3024, 3025, 3026, 3027, 3031, 3040, 4001, 4006, 4007, 4011, 4026, 4027, 4029, 4031, 4032, 4033, 4036, 4038, 4040, 4041, 4042, 4043.

2.2.6.3 Quarry Monitoring Well Network

The inspection checklist requires inspection of greater than 10 percent of the wells in the Quarry monitoring well network. The monitoring well network consists of 34 wells. The following 11 wells (32 percent) were inspected: MW-1002, 1005, 1013, 1014, 1015, 1016, 1027, 1045, 1046, 1048, RMW-1.

2.2.7 Onsite Document and Record Verification

The following onsite documents and records were verified:

- Surveillance and Maintenance Plan: (Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site, December 2008.)
- NPDES storm water permit (MORA01773) and associated Storm Water Pollution Prevention Plan and inspection checklists. The storm water permit was obtained for the land disturbed by demolition of the administration building and installation of the wastewater treatment plant.
- NPDES permits: #MO-0107701, MO-0129917.
- MSD agreement and records.
- Teleconference and interview records.

2.3 Contacts

In accordance with the checklist, inspectors notified several stakeholders prior to the inspection. The purpose of this notification is to keep contact with the stakeholders and determine if they have any issues or concerns. The following stakeholders were contacted:

- St. Charles County Sheriff
- Cottleville Fire District
- Francis Howell High School
- Simplex-Grinnell
- St. Charles County

The IC contacts also were notified about the inspection to maintain annual contact with the representatives relevant to IC issues. This annual contact is used to verify awareness of the ICs and to reiterate the requirements and/or restrictions with each representative. The representatives contacted are listed below.

- John Vogel, MDC
- Alan Leary, MDC
- Mary Bryan, MDNR-Parks
- Quinn Kellner, MDNR-Parks
- Kevin Grimes, U.S. Army
- Tom Blair, MoDOT
- Tom Evers, MoDOT
- Stowe Johnson, MoDOT
- Craig Tajkowski, St. Charles County Engineer

The St. Charles Planning and Zoning Department also was contacted, and they verified that no planning and zoning activities were currently taking place within one-quarter mile of the Chemical Plant and Quarry property. The Notation of Land Ownership and easements with the state property owners were verified to be filed and present at the St. Charles Recorder of Deeds office by checking the county website at www.sccmo.org.

Stoller Site Manager Yvonne Deyo and Environmental Data Manager Randy Thompson were interviewed as required by the inspection checklist.

All conversations and interviews were recorded on an Interview Record form adapted from the EPA Comprehensive Five-Year Review Guidance. The forms for each of these contacts and interviews are attached as Appendix E.

2.4 Recommendations/Findings

No recommendations or findings were noted during the inspection.

2.5 Photographs



Photo 1. Burgermeister Spring



Photo 2. Southeast Drainage



Photo 3. View from the disposal cell looking toward the Army property



Photo 4. 2003-Cell cover test plot TP1; north edge of north facet



Photo 5. 2012-Cell cover test plot TP1; north edge of north facet



Photo 6. 2013 Cell cover test plot TP1; north edge of north facet



Photo 7. 2003-Cell cover test plot TP2; foot of north side slope of disposal cell



Photo 8. 2012-Cell cover test plot TP2; bottom of north side slope



Photo 9. 2013 Cell cover test plot TP2; bottom of north side slope



Photo 10. 2003-Cell cover test plot TP3; northeast ridgeline



Photo 11. 2012-Cell cover test plot TP3; northeast ridgeline



Photo 12. 2013 Cell cover test plot TP3; northeast ridgeline



Photo 13. 2003-Cell cover test plot TP4; located on upper west side



Photo 14. 2012-Cell cover test plot TP4; located on upper west side



Photo 15. 2013 Cell cover test plot TP4; located on upper west side



Photo 16. 2003-Cell cover test plot TP5; located on lower west side



Photo 17. 2012 Cell cover test plot TP5; located on lower west side



Photo 18. 2013 Cell cover test plot TP5; located on lower west side



Photo 19. 2011-Cell cover test plot TP6; located on upper south side



Photo 20. 2012-Cell cover test plot TP6; located on upper south side



Photo 21. 2013 Cell cover test plot TP6; located on upper south side



Photo 22. Historical Marker #3



Photo 23. Monitoring Well MW-2034 that had been repaired

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3.0 Prairie and Garden Maintenance

Several prairie maintenance activities were performed throughout the previous 12 months.

Unfavorable weather in the spring of 2013 prevented use of a controlled burn during this period. In June and July, spot-spraying individual small trees and *Sericea lespedeza* plants with herbicide was performed as part of ongoing efforts to reduce numbers and control encroachment of invasive weed and woody tree species throughout the prairie area.

Garden maintenance of the areas surrounding the Interpretive Center continued in 2013 and consisted of manual weeding and periodic irrigation performed throughout the growing season. The beds were mulched in spring to reduce weeds and improve moisture retention during summer months. Dried seed heads from forbs were harvested and utilized for hand overseeding on the prairie area of the site in November and December 2013. Locations in the prairie with erosion and less plant establishment were targeted for overseeding. Several volunteer individuals and organizations continued to perform garden maintenance activities throughout this period.

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4.0 Interpretive Center Update

The Interpretive Center is part of DOE's LTS&M activities at the Weldon Spring site. The purpose of this facility is to inform the public of the site's history, remedial action activities, and final conditions. The Interpretive Center provides information about the LTS&M program for the site, provides access to surveillance and maintenance information, and supports community-involvement activities.

Current exhibits in the Interpretive Center present:

- The history of the towns that once occupied the area.
- A timeline of significant events at the Weldon Spring site (from 1900 to the present).
- The legacy of the Weldon Spring Ordnance Plant and Uranium Feed Material Plant, as well as their manufacturing wastes.
- The events and community efforts to clean up the site and the people who made it happen.
- A summary of LM's mission.
- An overview of LTS&M activities at the site.
- Information pertaining to the site's natural environment, such as soil and groundwater conditions and the prairie.
- Information about LM's renewable energy initiatives.

These exhibits may be changed as appropriate to reflect changing conditions or emerging issues at and near the site. LM completed an exhibit upgrade in 2010 that included updating information in several exhibits, adding interactive and multimedia components, creating several new exhibits that address site-related topics, and improving the flow of foot traffic through the Interpretive Center.

The Interpretive Center's hours of operation are posted at the site. The current hours of operation are:

- Monday through Friday: 9:00 a.m. to 5:00 p.m.
- Saturday: 10:00 a.m. to 4:00 p.m. (10:00 a.m. to 2:00 p.m. November 1 through March 31).
- Sunday: 12:00 p.m. to 4:00 p.m.

The Interpretive Center is closed on federal holidays.

Attendance is tracked through the following types of public activities:

- Individuals that walk into the Interpretive Center from the street during normal hours of operation.
- Scheduled groups that participate in Interpretive Center educational programs.
- Community-based organizations that use the Paul T. Mydler and Howell-Hamburg meeting room to conduct business meetings.
- Scheduled groups who are unable to visit the site but are recipients of Interpretive Center outreach presentations.

A significant number of individuals also use site amenities (e.g., Hamburg Trail, disposal cell perimeter road for prairie viewing, disposal cell viewing platform, native plant garden); however, because this use does not involve entering the Interpretive Center and is often outside of normal hours of operation, it is not consistently tracked. It is estimated that between 5,000 and 15,000 individuals per year make use of site amenities in this way.

Attendance at the Interpretive Center in 2013 was 19,850 (Table 4). The attendance was affected by being shutdown for tornado damage and during the government shutdown. The kindergarten through grade 12 educational community continues to have significant interest in Interpretive Center programs. Field trips are usually scheduled at least several months in advance, and available calendar dates fill up quickly. At times, this requires reservations to be made for the following school year. For a few school districts that have limited funding for field trips, outreach activities are scheduled, and Interpretive Center personnel give educational presentations at the school. Outreach activities usually involve several classes or the entire grade level of students.

Table 4. Interpretive Center Attendance

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2002								301	224	190	40	31	786
2003	6	44	44	85	174	191	161	233	251	350	125	122	1,786
2004	52	61	166	182	104	324	192	353	379	850	556	354	3,573
2005	123	605	1,056	2,048	1,888	1,408	1,370	1,091	1,511	1,663	1,739	903	15,405
2006	542	1,136	1,595	1,874	1,685	1,226	1,465	1,431	1,176	2,215	1,740	692	16,777
2007	1,157	1,022	2,786	2,479	2,192	1,960	1,703	1,129	1,834	2,811	1,569	882	21,524
2008	1,132	1,445	2,261	3,086	2,489	1,734	1,556	1,395	2,412	2,624	1,705	1,142	22,981
2009	1,418	1,987	3,183	2,181	2,036	1,928	1,299	1,492	2,591	2,857	1,522	1,106	23,600
2010	1,440	1,441	2,465	2,378	2,968	2,002	1,904	1,117	2,615	2,696	2,396	1,534	24,956
2011	1,631	1,958	2,593	3,036	2,938	2,182	1,441	1,165	2,455	2,848	2,087	2,111	26,445
2012	1,986	1,687	2,556	2,663	2,025	2,107	1,085	1,787	2,150	2,041	1,771	1,360	23,218
2013	1,663	1,581	1,871	2,471	2,209	1,205	1,201	1,197	2,207	1,057	1,981	1,207	19,850
													200,901

Interpretive Center marketing efforts continue to be a critical component of making the public aware of Interpretive Center programs. Starting in 2010, Interpretive Center staff developed several new educational programs based on teacher requests and Missouri curriculum requirements.

5.0 Environmental Monitoring Summary

5.1 Introduction

This section includes environmental monitoring information regarding groundwater, surface water, air, leachate, and radiation dose analysis.

5.2 Groundwater Monitoring

The groundwater monitoring program at the Weldon Spring site includes sampling and analysis of water collected from wells at the former Chemical Plant, the Quarry, adjacent properties, and selected springs in the vicinity of the former Chemical Plant. The groundwater monitoring program is formally defined in the LTS&M Plan (DOE 2008a).

5.2.1 Chemical Plant Groundwater

EPA signed the GWOU ROD (DOE 2004b) on February 20, 2004. The final GWOU ROD specified a remedy of MNA with ICs to limit groundwater use during the period of remediation. MNA relies on the effectiveness of naturally occurring processes to reduce contaminant concentrations over time. The GWOU ROD establishes remedial goals and performance standards for MNA.

In July 2004, DOE initiated monitoring for MNA as outlined in the *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site* (DOE 2004c). The monitoring network as presented in the *Interim Remedial Action Report for the Groundwater Operable Unit of the Weldon Spring Site* (DOE 2005b) has been modified over time as wells are added to and dropped from the network. Figure 11 shows the current monitoring well network.

5.2.1.1 Hydrogeologic Description

The former Chemical Plant site is in a physiographic transitional area between the Dissected Till Plains of the Central Lowlands province to the north and the Salem Plateau of the Ozark Plateaus province to the south. Subsurface flow and transport in the former Chemical Plant area occurs primarily in the carbonate bedrock. The unconsolidated surficial materials are clay-rich, mostly glacially derived units, which are generally unsaturated beneath the site. These materials become saturated to the north and influence groundwater flow. The thickness of the unconsolidated materials ranges from 20 to 50 ft (DOE 1992a).

A groundwater divide is located along the southern boundary of the site (Figure 12 and Figure 13). Groundwater north of the divide flows north toward Dardenne Creek and ultimately to the Mississippi River, and groundwater south of the divide flows south to the Missouri River. Localized flow is controlled largely by bedrock topography. Groundwater movement is generally by diffuse flow through an equivalent porous media until reaching localized zones of discrete flow through secondary porosity features such as fractures and solution channels.

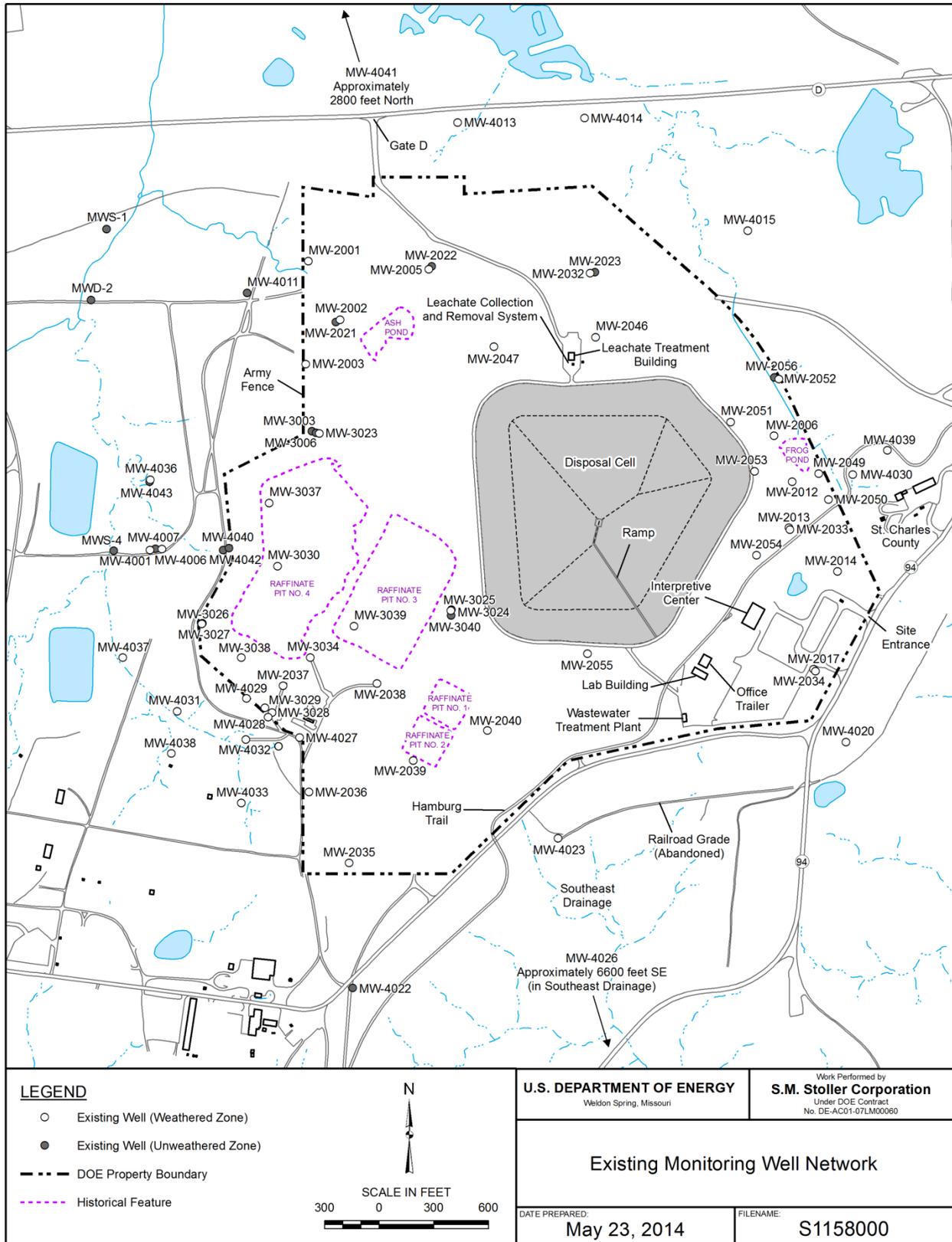
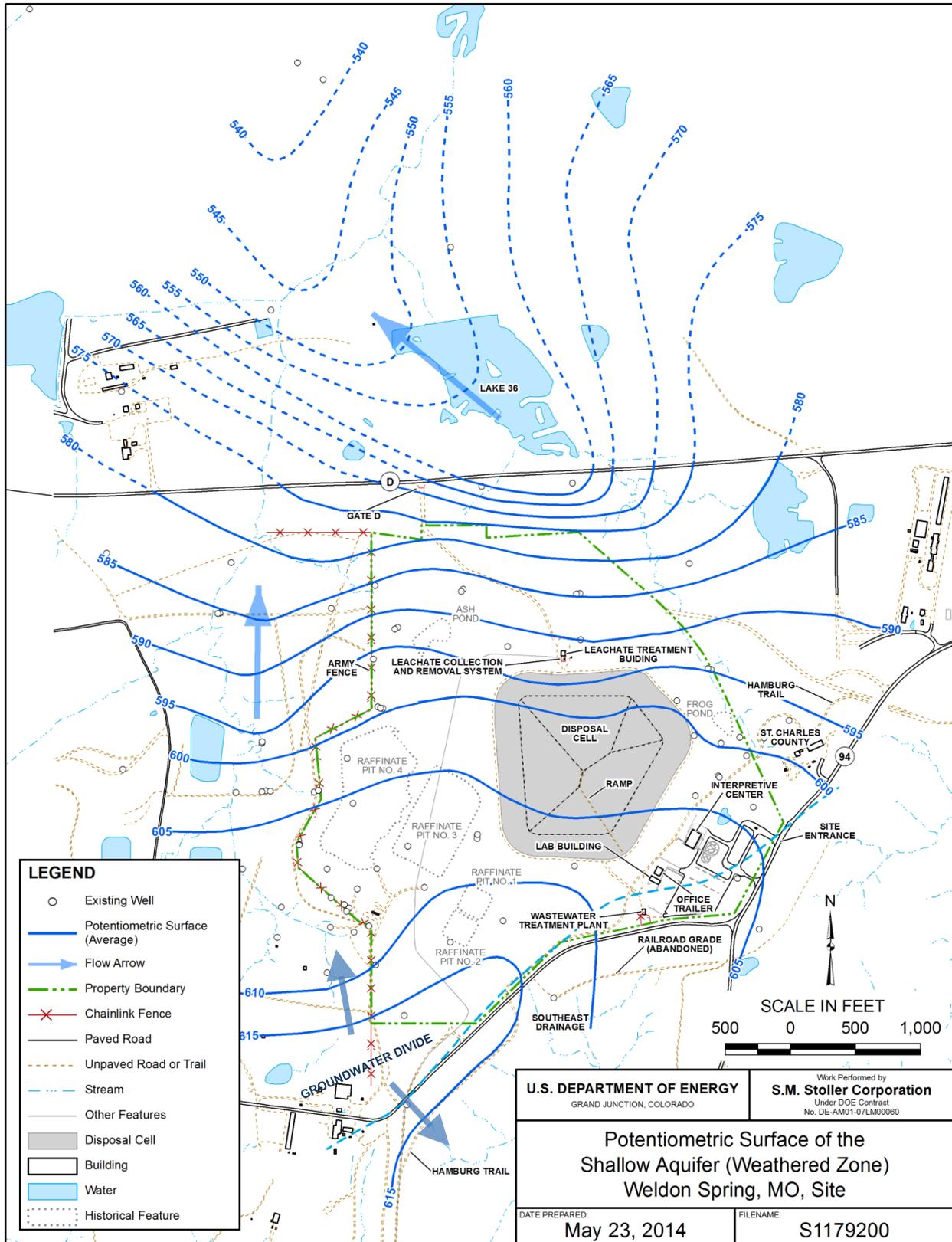


Figure 11. Existing Monitoring Well Network



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Figure 12. 2013 Potentiometric Surface of the Shallow Aquifer (Weathered Zone)

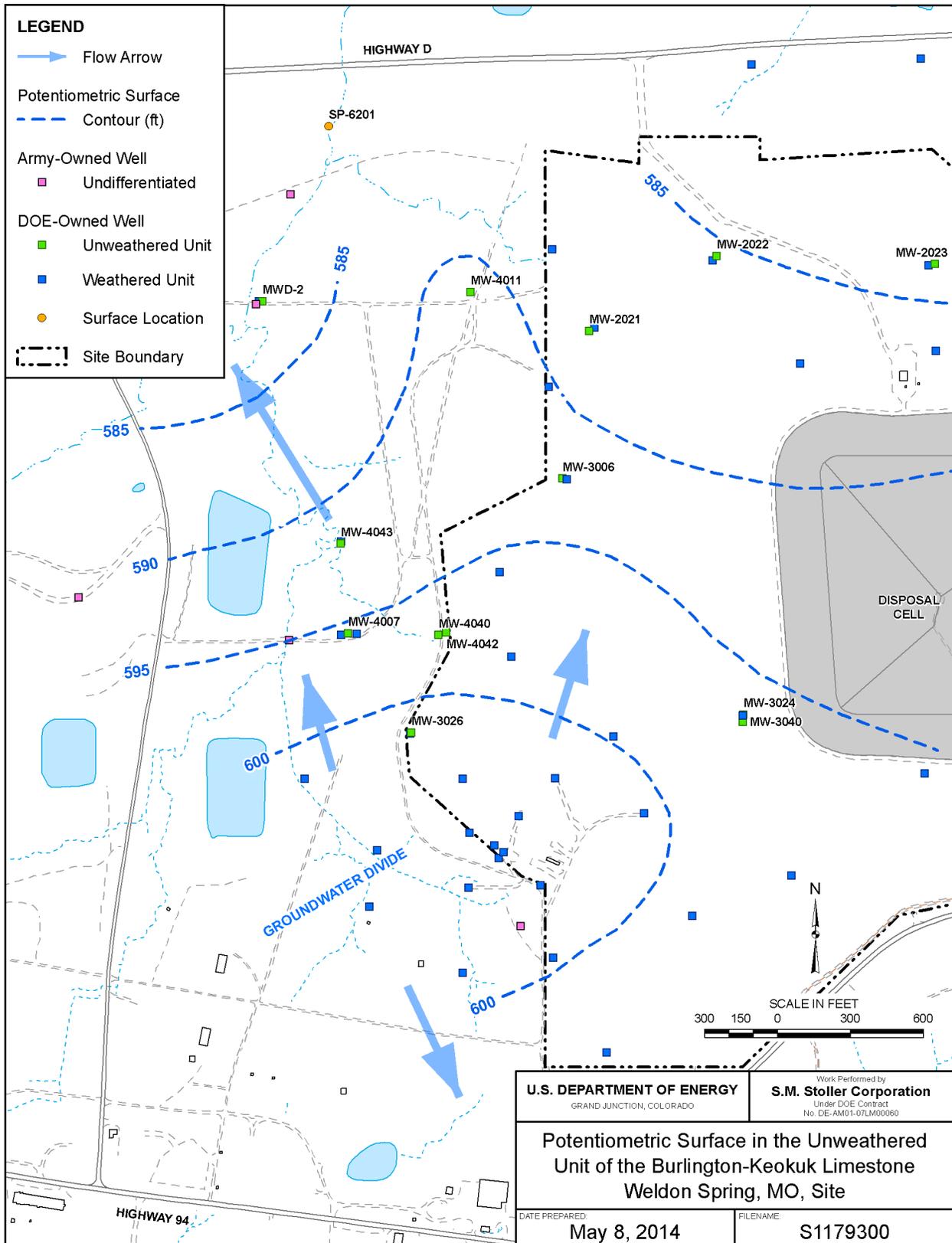


Figure 13. Potentiometric Surface in the Unweathered Zone of the Burlington-Keokuk Limestone

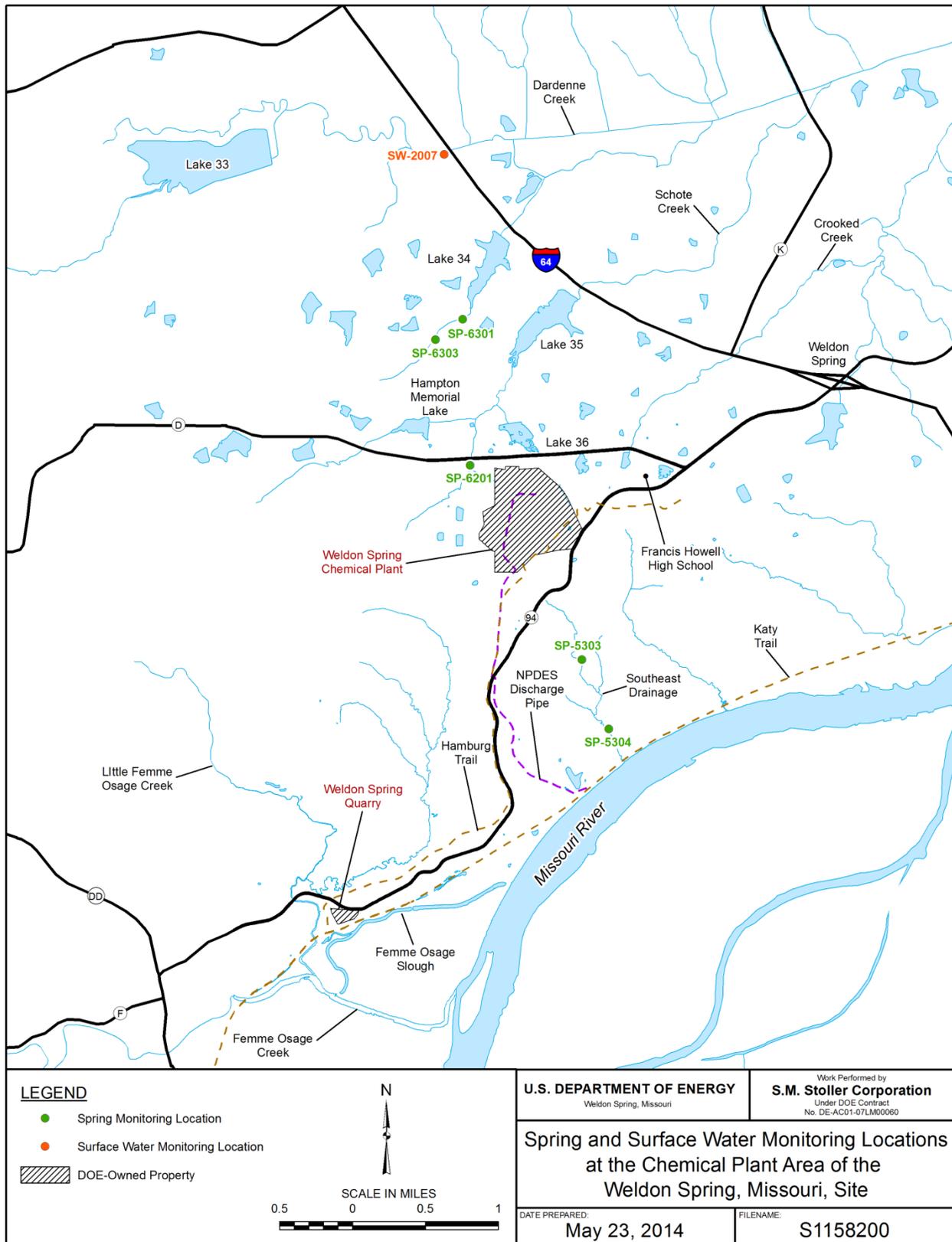
The aquifer of concern beneath the former Chemical Plant is the shallow bedrock aquifer in the Mississippian Burlington-Keokuk Limestone (the uppermost bedrock unit) and the underlying Fern Glen Formation. The Burlington-Keokuk Limestone has two different lithologic zones—a shallow, weathered zone and an underlying unweathered zone. The weathered portion of this formation is highly fractured and exhibits solution voids and enlarged fractures. These features may also be present on a limited scale in the unweathered zone, particularly in the vicinity of buried preglacial stream channels (paleochannels). Localized aquifer properties are controlled by fracture spacing, solution voids, and preglacial weathering, including structural troughs along the bedrock–overburden interface. The unweathered portion of the Burlington-Keokuk Limestone is thinly to massively bedded. Fracture densities are significantly less in the unweathered zone than in the weathered zone. References to the “shallow aquifer” without specifying weathered or unweathered zone, refers to the combination of both zones.

All monitoring wells at the former Chemical Plant are completed in the Burlington-Keokuk Limestone. Most of the wells are completed in the weathered zone of the bedrock where groundwater has the greatest potential to be contaminated. Some wells screened in the underlying unweathered zone of the Burlington-Keokuk Limestone are used to assess the vertical migration of contaminants. Monitoring wells within the boundaries of the former Chemical Plant are located near historical contaminant sources and preferential flow pathways (paleochannels) to assess the movement of contaminated groundwater in the shallow aquifer. Additional wells are located outside the former Chemical Plant boundary to detect and evaluate the potential offsite migration of contaminants (Figure 14).

Preferential flow zones (Figure 14) have been inferred from bedrock topography, groundwater surface maps, hydraulic conductivity data, and subsurface tracer results (DOE 2005b). Subsurface data indicate the presence of linear bedrock lows that are likely paleochannels (also referred to as preglacial drainages) in the top of the weathered Burlington-Keokuk Limestone near the northern and western boundaries of the former Chemical Plant site. The contact between the weathered and unweathered units is lower, and hydraulic conductivities are typically higher in the paleochannel areas. This results in preferential flow paths that coincide with the north-trending bedrock lows that are indicated on the groundwater elevation maps of both the weathered (Figure 12) and unweathered (Figure 13) units.

Numerous springs, a common feature in carbonate terrains, are present in the vicinity of the site. Five springs that are monitored routinely (Figure 15) have been historically influenced by former Chemical Plant discharge water or by groundwater that contained one or more of the contaminants of concern.

The presence of elevated total uranium and nitrate levels at Burgermeister Spring (SP-6301), which is approximately 1.2 miles north of the site, indicates that discrete subsurface flow paths are present in the vicinity of the site. Groundwater tracer tests performed in 1995 (DOE 1997a) confirmed that a discrete and rapid subsurface hydraulic connection exists between the northern portion of the former Chemical Plant and Burgermeister Spring. These flow paths are associated with the preglacial stream channels present beneath the site.



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Figure 15. Spring and Surface Water Monitoring Locations at the Chemical Plant Area of the Weldon Spring, Missouri, Site

5.2.1.2 Chemical Plant Hydrogeologic Data Analysis

Hydrogeologic conditions at the site are being monitored using all the wells in the MNA network (Objectives 1, 2, 3, and 4 wells) and additional wells (Objective 6 wells) that were selected to provide adequate coverage to identify changes in groundwater flow that might affect the protectiveness of the remedy. The static groundwater levels of the monitoring network are measured to establish that groundwater flow directions are not changing significantly and causing shifts in potential contaminant migration.

The 2013 average groundwater elevations measured in the available wells at the former Chemical Plant were compared to the current potentiometric surface maps of the weathered and unweathered units of the shallow aquifer (Figure 12 and Figure 13). The relatively minor water level changes did not alter the configuration of the potentiometric surfaces from 2012. Groundwater elevations decreased in several portions of the site from the late 1990s through about 2009 in response to the extensive remediation activities at the site. Even though changes have occurred in groundwater elevations, the groundwater flow directions continue to be predominantly to the north. A groundwater divide is present along the southern boundary of the Chemical Plant site in both the weathered and unweathered units. Troughs in the groundwater surfaces occur where paleochannels are located.

Groundwater flow directions within the unweathered zone are similar to those in the weathered zone, with a groundwater divide along the southern site boundary, troughs in the groundwater surface where paleochannels are located, and north to northwest flow directions (Figure 13). This figure was constructed using the data from all available unweathered zone wells and lacks the detail of the potentiometric map for the weathered unit due to fewer wells screened in the unweathered unit. A groundwater high is present near well MW-3026 in the southwest corner of the site, where Raffinate Pit #4 was located.

Groundwater elevations have generally decreased in the weathered unit of the Burlington-Keokuk Limestone in response to the site remediation activities (Figure 16). Well MW-3028 was pumped during 2001 (drawdown on Figure 16) as part of the field studies in support of the Groundwater Operable Unit (DOE 2002). An exception to the decreasing groundwater elevations is in the Frog Pond area, where surface-water infiltration increased after the remediation activities, causing a slight increase in groundwater elevations. Groundwater elevations in both the weathered and unweathered units have decreased in the Raffinate Pits area (Figure 17) in response to the removal of large surface water impoundments, such as the Raffinate Pits, during site remediation.

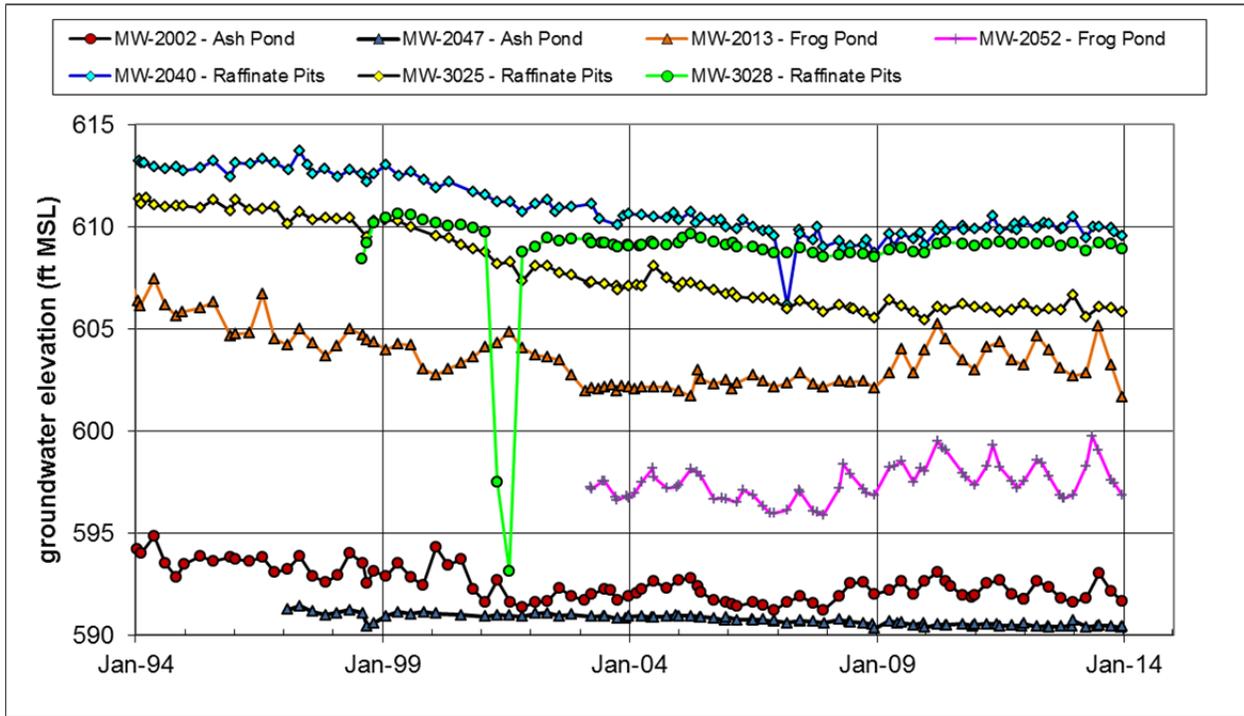


Figure 16. Groundwater Elevations in the Weathered Unit

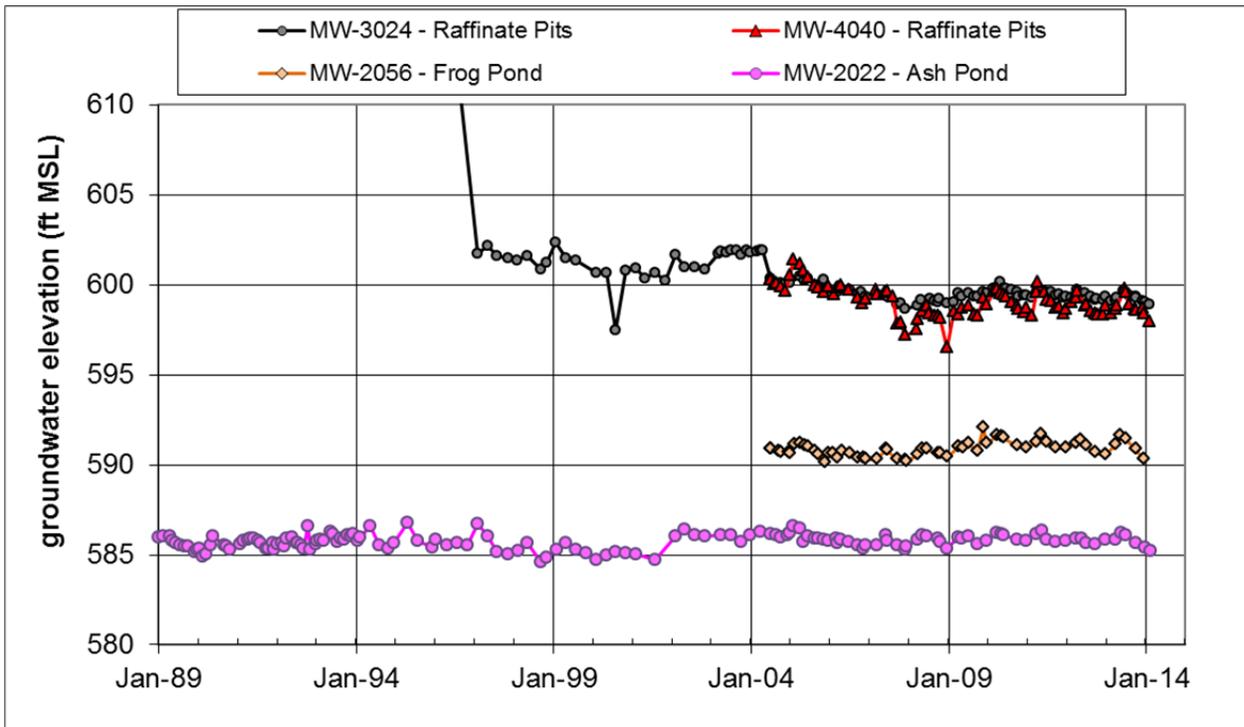


Figure 17. Groundwater Elevations in the Unweathered Unit

5.2.1.3 Groundwater Flow

Groundwater flow rate and direction are evaluated annually as specified in Appendix K of the LTS&M Plan (DOE 2008a). The potentiometric surface map of the weathered unit shallow aquifer at the Chemical Plant indicates a generally northward groundwater flow direction (Figure 12). The configuration of the potentiometric surface has remained relatively unchanged since the construction of the disposal cell. A groundwater divide is present along the southern boundary of the site.

The average groundwater flow rate (average linear velocity) is calculated using the following equation:

$$v = \left(\frac{K}{n}\right)\left(\frac{dh}{dl}\right)$$
$$v = \left(\frac{20 \text{ ft/day}}{0.10}\right)\left(\frac{606.1 \text{ ft} - 582.9 \text{ ft}}{2100 \text{ ft}}\right) = 2.2 \text{ ft/day}$$

Where: v = velocity
 K = average hydraulic conductivity
 n = effective porosity
 dh/dl = hydraulic gradient

The average hydraulic conductivity (K) of the weathered zone, using data from the cell monitoring wells, is 7×10^{-3} centimeters per second (20 ft/day) and ranges from 10^{-2} to 10^{-7} centimeters per second (DOE 2005b). An effective porosity (n) of 0.10 was selected to estimate the maximum groundwater flow rate in this area. The hydraulic gradient (dh/dl) in the disposal cell area is 0.011 ft/ft and is based on water elevation data from MW-2055 (606.1 ft above mean sea level) and MW-2032 (582.9 ft above mean sea level), which are located about 2,100 ft apart. This approach is consistent with the calculations presented in Appendix K of the LTS&M Plan (DOE 2008a). The average flow rate for 2013 was 2.2 ft/day, which is the same as the average flow rate calculated since 2005.

5.2.1.4 Contaminants of Interest

Contaminated groundwater remains beneath the former Chemical Plant. Contaminants include uranium, nitrate, TCE, and nitroaromatic compounds. Nitrate was reported from the laboratory as “Nitrate as N” prior to 2006, and as “Nitrate + nitrite as N”, with “N” being nitrogen, since 2006. In the text, it will be referred to as “nitrate”. In tables and section headings it will be referred to as “nitrate (as N)”. Contamination in groundwater is generally confined to the shallow, weathered portion of the Burlington-Keokuk Limestone. Some contamination occurs in the deeper, unweathered portion of the bedrock, primarily beneath the former raffinate pits. The groundwater at the former Chemical Plant has been contaminated by past operations that resulted in multiple source areas. The primary source zones for groundwater contamination have been removed by remediation activities at the site. The distribution of contaminants in the shallow aquifer at the site is controlled by several processes, such as transformation, adsorption, desorption, dilution, or dispersion; the primary attenuation mechanisms are dilution and dispersion.

The raffinate pits were the primary historical source for uranium contamination in groundwater. Uranium entered the shallow aquifer via infiltration through the thin overburden beneath the pits. The extent of uranium in groundwater was limited, because uranium is partially sorbed to the clays in the overburden materials. At locations where uranium-contaminated water migrated beneath the overburden, it entered the limestone conduit system and subsequently discharged to springs north of the site. The oxidizing conditions of the shallow aquifer are not favorable for the precipitation of uranium from solution. Uranium-contaminated sediments were also discharged offsite during past operations. These sediments accumulated in subsurface cracks and fissures in the losing stream segments and act as residual sources to groundwater and springs. Total uranium concentration results are reported in milligrams per liter from the laboratory. This value is converted to an activity, picocuries per liter (pCi/L), by dividing the uranium concentration in mg/L by the Weldon Spring mass to activity conversion factor of 0.0015 mg/pCi (DOE 1997b). For example, a uranium concentration of 0.03 mg/L (30 µg/L) is equivalent to an activity of 20 pCi/L. Uranium activities in pCi/L will be referred to as concentrations throughout this report.

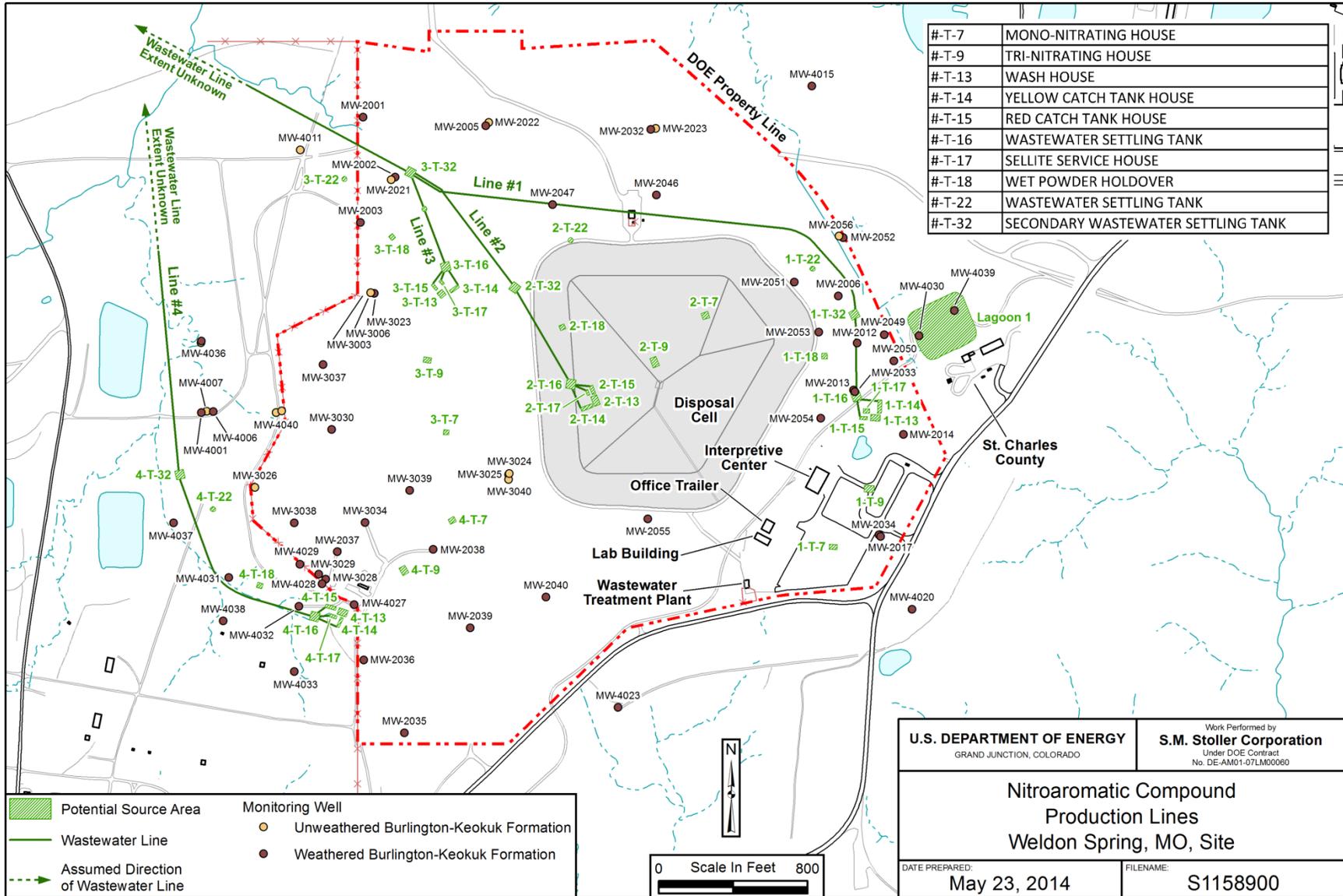
Nitrate is present in the groundwater near the former Raffinate Pits and the Ash Pond area, which are the historical sources of this contaminant. Nitrate is mobile in the shallow groundwater system, as it is not readily sorbed to subsurface materials. Conditions for natural denitrification have not been identified in the shallow aquifer, so nitrate persists in groundwater, enters the limestone conduit system, and subsequently discharges to springs north of the site.

Groundwater contaminated with TCE is localized in the weathered portion of the bedrock aquifer in the vicinity of the former location of Raffinate Pit 4. The source of TCE contamination was drums that were disposed of in Raffinate Pit 4. The oxidizing conditions in the shallow bedrock aquifer do not promote the biodegradation of organic compounds.

Nitroaromatic compounds (1,3-dinitrobenzene [DNB]; 2,4,6-TNT; 2,4-DNT; 2,6-DNT; and nitrobenzene) in the groundwater system coincide with former production line locations. The presence of nitroaromatic compounds in groundwater is a result of leakage from former TNT process lines, discharges from water lines, and leaching from contaminated soils and waste lagoons (Figure 18). The mobility of nitroaromatic compounds in the bedrock aquifer is high due to little sorption to the bedrock materials. Microorganisms indigenous to the soils and the shallow aquifer have the ability to transform and degrade TNT and DNT.

5.2.1.5 Chemical Plant (GWOU) Monitoring Program

Monitoring at the former Chemical Plant was changed in July 2004 to focus on MNA, the selected remedy. Under the new monitoring program, total uranium, nitroaromatic compounds, TCE, and nitrate are monitored at selected locations throughout the former Chemical Plant area.



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Figure 18. Nitroaromatic Compound Production Lines

The sampling locations target areas of highest impact in the shallow aquifer and migration pathways associated with paleochannels in the Burlington-Keokuk Limestone. Deeper wells are sampled to assess potential vertical migration.

The Chemical Plant monitoring network consists of 46 wells, 5 springs, and 1 surface water location. The locations are depicted on Figure 11 (wells) and Figure 15 (springs and surface water). Each well was selected to fulfill objectives specified in the GWOU ROD (DOE 2004b) for the MNA monitoring network (Table 5). The objectives are as follows:

- Objective 1 is to monitor the non-impacted water quality at upgradient locations to maintain a baseline of naturally occurring constituents from which to evaluate changes in downgradient locations. This objective will be met by using wells upgradient of the contaminant plumes.
- Objective 2 is to verify that contaminant concentrations are declining at a rate and in a manner that will meet cleanup standards in approximately 100 years, as established by predictive modeling. This objective will be met using wells at or near the locations with the highest concentrations of contaminants, both near the former source areas and along expected migration pathways. The objective will be to evaluate the most contaminated zones. Long-term trend analysis will be performed to confirm downward trends in contaminant concentrations over time. Performance will be gauged against long-term trends. It is expected that some locations could show temporary upward trends due to the recent source control remediation (which tends to temporarily mobilize some of the remaining contamination), seasonal fluctuations, analytical variability, or other factors. However, concentrations are not expected to exceed historical maximums.
- Objective 3 is to ensure that lateral migration remains confined to the current area of impact. Contaminants are expected to continue to disperse within known preferential flow paths associated with bedrock lows (paleochannels) in the upper Burlington-Keokuk Limestone and become more dilute over time as rain events continue to recharge the area. This objective will be met by monitoring various downgradient fringe locations that are either not impacted or minimally impacted. Contaminant impacts in these locations are expected to remain minimal or nonexistent.
- Objective 4 is to monitor locations underlying the impacted groundwater system to confirm that there is no significant vertical migration of contaminants. This will be evaluated using deeper wells screened in and influenced by the unweathered zone. No significant impacts should be observed at these locations.
- Objective 5 is to monitor contaminant levels at the impacted springs that are the only potential points of exposure under current land use conditions. The springs discharge groundwater that includes contaminated groundwater originating at the former Chemical Plant area. Presently, contaminant concentrations at these locations are protective of human health and the environment under current recreational land uses. Continued improvement of the water quality in the affected springs should be observed.
- Objective 6 is to monitor for hydrologic conditions at the site over time to identify any changes in groundwater flow that might affect the protectiveness of the selected remedy. The static groundwater elevation of the monitoring network will be measured to establish that groundwater flow is not changing significantly and resulting in changes in contaminant migration.

Table 5. Monitoring Program for GWOU MNA Remedy

Location	Objective	Unit	TCE	Nitrate (as N)	Uranium	1,3-DNB	2,4,6-TNT	2,4-DNT	2,6-DNT	NB
MW-2017	1	Weathered				✓	✓	✓	✓	✓
MW-2035	1	Weathered	✓	✓	✓			✓		
MW-4022	1	Unweathered		✓	✓					
MW-4023	1	Weathered		✓	✓					
MW-2012	2	Weathered				✓	✓	✓	✓	✓
MW-2014	2	Weathered						✓	✓	
MW-2038	2	Weathered		✓				✓		
MW-2040	2	Weathered		✓						
MW-2046	2	Weathered					✓			
MW-2050	2	Weathered						✓	✓	
MW-2052	2	Weathered						✓	✓	
MW-2053	2	Weathered					✓	✓	✓	
MW-2054	2	Weathered						✓	✓	
MW-3003	2	Unweathered		✓	✓ (B)					
MW-3024	2	Unweathered			✓ (B)					
MW-3030	2	Weathered	✓		✓			✓		
MW-3034	2	Weathered	✓	✓				✓		
MW-3039	2	Weathered						✓		
MW-3040	2	Unweathered		✓	✓ (B)					
MW-4013	2	Weathered		✓						
MW-4029	2	Weathered	✓	✓						
MW-4031	2	Weathered		✓						
MW-4036	2	Weathered		✓						
MW-4040	2	Unweathered		✓	✓ (Q)					
MW-2032	3	Weathered				✓	✓	✓	✓	✓
MW-2051	3	Weathered				✓	✓	✓	✓	✓
MW-3031 ^a	3	Weathered	✓		✓ (S)					
MW-3037	3	Weathered	✓		✓ (S)			✓		
MW-4013	3	Weathered						✓	✓	✓

Table 5 (continued). Monitoring Program for GWOU MNA Remedy

Location	Objective	Unit	TCE	Nitrate (as N)	Uranium	1,3-DNB	2,4,6-TNT	2,4-DNT	2,6-DNT	NB
MW-4014	3	Weathered		✓		✓	✓	✓	✓	✓
MW-4015	3	Weathered						✓	✓	✓
MW-4026	3	Alluvium/SED			✓ (S)					
MW-4036	3	Weathered	✓		✓ (Q)					
MW-4039	3	Weathered				✓	✓	✓	✓	✓
MW-4040	3	Unweathered	✓					✓		
MW-4041	3	Weathered	✓	✓	✓ (B)	✓	✓	✓	✓	✓
MWS-1	3	Weathered	✓	✓	✓ (B)			✓		
MWS-4	3	Weathered	✓	✓	✓ (S)					
MW-2021	4	Unweathered		✓						
MW-2022	4	Unweathered	✓			✓	✓			
MW-2023	4	Unweathered				✓	✓	✓	✓	✓
MW-2056	4	Unweathered				✓	✓	✓	✓	✓
MW-3006	4	Unweathered	✓	✓	✓ (B)			✓		
MW-4007	4	Unweathered	✓	✓	(B)					
MW-4042	4	Unweathered		✓	✓ (B)					
MW-4043	4	Unweathered	✓	✓	✓ (B)		✓	✓		✓
MWD-2	4	Unweathered		✓	✓ (B)					
SP-5303	5	Spring/SED			✓					
SP-5304	5	Spring/SED			✓					
SP-6301	5	Spring	✓	✓	✓ (B)	✓	✓	✓	✓	✓
SP-6303	5	Spring	✓	✓	✓	✓	✓	✓	✓	✓
SW-2007	5	Stream			✓					

Objective 1 = Upgradient locations
 Objective 2 = Area of groundwater impact
 Objective 3 = Downgradient and lateral locations
 Objective 4 = Locations beneath the area of groundwater impact
 Objective 5 = Springs or surface water locations

SED = Southeast Drainage;
 A = annual; B = Bi-monthly; Q = quarterly; S = semiannual
 DNT = dinitrotoluene; NB = nitrobenzene; DNB = dinitrobenzene; TNT = trinitrotoluene
^a MW-3031 was decommissioned on 7/13/2013
 Frequencies in parentheses support unweathered unit evaluation.

The monitoring network is designed to provide data either to show that natural attenuation processes are acting as predicted or to trigger the implementation of contingencies when these processes are not acting as predicted (e.g., unexpected expansion of the plume or sustained increases in concentrations within the area of impact). The data analysis and interpretation will satisfy the following:

- Baseline conditions (Objective 1) have remained unchanged.
- Performance monitoring locations (Objective 2) indicate that concentrations within the area of impact are decreasing or remaining stable, as expected.
- Detection monitoring locations (Objectives 3, 4, and 5) indicate when a trigger has been exceeded, indicating unacceptable expansion of the area of impact.
- Hydrogeologic monitoring locations (Objectives 1, 2, 3, 4, and 6) indicate any changes in groundwater flow that might affect the protectiveness of the MNA remedy at the site over time.

Trigger levels were set for each contaminant at the performance and detection monitoring locations in the event that unexpected increases occur. There are two trigger levels for each contaminant. The first trigger level is set at what would be considered a statistically significant increase of a contaminant concentration at a location, and is defined as the mean of the previous eight data points plus three standard deviations. This trigger is designed to alert to the possibility that a contaminant plume is no longer stable and is expanding. The first response is to determine if the result is valid (resample), and if it is confirmed, to then increase sampling frequency to track possible future increases in concentration. It is most useful for downgradient wells with relatively low and stable concentrations. It is less useful for higher concentration wells adjacent to an impacted area where results are typically more variable. Higher concentration zones in remediated areas where contamination was previously stable could be subject to a period of unstable, increasing concentrations before the trend reverses.

The second trigger level is a fixed concentration established to provide a level above which increases in concentration would be considered unacceptable (Table 6). At the Weldon Spring Site, the fixed trigger levels were based on a review of data collected prior to 2004 and are used to evaluate MNA performance and to minimize risk to potential receptors. They are typically set at higher levels near impacted areas and at lower levels, such as the MCL, in downgradient non-impacted areas. These triggers were formalized in the *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site, July 2004* (DOE 2004b).

The fixed triggers were set for each contaminant and are different for the area of impact (Objective 2), outside the area of impact (Objectives 3 and 4), or at discharge points (Objective 5). Objective 3 wells are sub-classified into “near” and “far”. “Near” wells include both close wells that delineate the plume and farther away wells that confirm no migration to that location. “Far” wells are those that are at a distance beyond where concentrations that might pose a risk would reasonably be expected to migrate, essentially a downgradient background well. If a fixed trigger is exceeded, consideration is given as to whether site conditions have changed unexpectedly. Exceeding a fixed trigger at a downgradient location could indicate that the contaminant plume is expanding, though not fast enough to trip the trigger of the average plus three standard deviations. In impacted areas, where concentrations are expected to be variable, exceeding the fixed trigger may not be as important when considered in context with all other

data. For example, uranium levels in three wells adjacent to the former raffinate pits (contained within institutional controls) currently exceed the fixed trigger level for uranium in impacted areas (100 pCi/L). This trigger level was set a few years after contaminated material was removed from the raffinate pits and prior to installation of two of the three “high” concentration wells. The concentration in the third well later increased to exceed the trigger, in response to the nearby remediation operations that tend to mobilize remnant contamination. The 100 pCi/L trigger was set to provide a goal to judge MNA performance in the impacted area, not as a trigger that has risk implications. For instance, the average uranium concentration in 2 of the 3 wells is below the 150 pCi/L limit for downgradient discharge areas where receptors have potential access. Data collected since 2004 indicate that the uranium fixed trigger for the impacted area was set prematurely. The 2004 to 2006 baseline study (DOE 2008b) did not include the new wells in the reevaluation of initial concentrations and suggested that additional data was needed to better establish baseline concentrations. Uranium levels in two of the wells are beginning to stabilize and concentrations in the third, MW-4040, continue to rise. Concentrations of more mobile constituents in the raffinate pits, such as nitrate, initially increased in MW-4040 but have since begun to decline. Given enough time uranium concentrations should also peak and then decline. Appropriate responses to exceeding fixed triggers would be to increase sampling frequency to assure the trend is not seasonally affected, add additional downgradient sampling locations, or revise the trigger as warranted. The fixed trigger levels are provided in Table 6 and the average plus 3 standard deviation trigger level is provided in Appendix F.

Table 6. Fixed Trigger Levels for Performance and Detection Monitoring for the GWOU

Analyte	Cleanup Standard	Objective 2	Objective 3 (near)	Objective 3 (far)	Objective 4	Objective 5
Nitrate as N (mg/L)	10	1,350	30	10	20	20
Uranium (pCi/L)	20	100	50	20	40	150
TCE (µg/L)	5	1,000	15	5	10	5
2,4-DNT (µg/L)—FP	0.11	2,300	1.1	0.11	0.22	0.22
2,4-DNT (µg/L)—RP		5	0.55			
2,6-DNT (µg/L)	1.3	2,000	13	1.3	2.6	1.3
2,4,6-TNT (µg/L)	2.8	500	11.2	2.8	5.6	2.8
1,3-DNB (µg/L)	1.0	20	4	1	2	1
NB (µg/L)	17	50	34	17	17	17

DNB = dinitrobenzene; DNT = dinitrotoluene; FP = Frog Pond; mg/L = milligrams per liter; µg/L = micrograms per liter; NB = nitrobenzene; pCi/L = picocuries per liter; RP = Raffinate Pits; TNT = trinitrotoluene

Groundwater data from the upgradient locations are compared with the previously collected data from each respective location. If a statistically significant increase (mean plus 3 standard deviations for the previous eight data points) is measured, then the value is evaluated for its validity. For those locations that are “nondetect,” a statistically significant increase is considered to be a result that exceed the respective cleanup standard for two consecutive sampling periods. Contingency actions are defined in Appendix M of the LTS&M Plan.

Testing for temporal trends was performed using uranium, nitrate, TCE, and nitroaromatic compound data, as required in the *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site* (DOE 2004c) using data from the previous 5 years (2009 through 2013). Results for the trending analysis are reported for the Objective 2 wells and the Objective 5 springs because these locations monitor the area of groundwater impact and the discharge points. The trend analysis is conducted using the Visual Sampling Plan (VSP) Method (VSP 2013; Gilbert 1987; Hirsch, Slack, and Smith 1982).

The Mann-Kendall test is used for temporal trend identification because it can easily facilitate missing data and does not require the data to conform to a particular distribution (such as a normal or lognormal distribution). The nonparametric method is valid for scenarios that include a high number of nondetect data points. Data reported as trace (estimated) concentrations or as nondetects can be used by assigning them a common value that is smaller than the smallest measured value in the data set (i.e., one-half the specified detection limit). This approach is valid because only the relative magnitudes of the data, rather than their measured values, are used in the method. A possible consequence of this approach is that the test can produce biased results if a large fraction of data within a given time series are nondetects and if detection limits change between sampling events. One-half the specified detection limit (on the date of analysis) was used in place of all concentrations reported at or below the detection limit. Estimated time frames of when contaminant concentrations at a location may reach the MCL are provided only for locations where statistically significant downward trends were identified. A trend is considered statistically significant if there is a 5 percent or less chance of incorrectly concluding that a trend exists.

In the trend tables, the “No. of Samples” column is the total number of sample results collected at a location during the previous 5 years, less duplicates and rejected values. The “Trend” column indicates whether there is a statistically significant “Up” or “Down” trend, based only on the previous 5 years of data. “None” refers to no statistically significant trend, not that there is no trend. The “Slope” column gives the magnitude of the trend (not necessarily significant based on the 95% criterion), positive for up (increasing) and negative for down (decreasing). The lower and upper “Confidence Intervals” columns give the lower and upper bounds of the probable slope magnitude (95% confident that the slope falls in this range). The upper and lower “Confidence Intervals” will typically both be negative for a statistically significant “Down” trend and both positive for an “Up” trend. An example calculation and data used for all trend calculations are in Appendix F.

5.2.1.6 Baseline Monitoring Results for the GWOU

Baseline conditions are monitored in four upgradient wells to determine if possible changes in downgradient areas of impact are the result of changes in upgradient conditions (horizontal gradient and flow direction maps are provided in Section 5.2.1.2). The objective of this monitoring is to determine if baseline conditions have remained unchanged. Each of these wells was sampled once during 2013. Table 7 presents the concentration for each parameter. The concentrations measured in 2013 are similar to those from previous years and indicate no change in upgradient groundwater quality.

5.2.1.7 Performance Monitoring Results for the GWOU

The performance of the MNA remedy is assessed through the sampling of the Objective 2 monitoring wells. Objective 2 wells are within the areas of impact and monitor both the weathered and unweathered units of the Burlington-Keokuk Limestone. Objective 2 of the MNA strategy is to verify that contaminant concentrations at or near locations with the highest concentrations of contaminants are declining or remaining stable as expected and that cleanup standards will be met in a reasonable time frame.

Table 7. 2013 Baseline Monitoring for the GWOU MNA Remedy Objective 1 Wells

Location	MW-2017	MW-2035	MW-4022	MW-4023
Zone	Weathered	Weathered	Unweathered	Weathered
Sample Date	May 6, 2013	May 14, 2013	May 13, 2013	May 13, 2013
Parameters				
Uranium (pCi/L)	NR	0.39	2.8	1.8
Nitrate (as N) (mg/L)	NR	0.74	0.5	0.73
TCE (µg/L)	NR	ND (<0.16)	NR	NR
1,3-DNB (µg/L)	ND (<0.014)	ND (<0.014)	NR	NR
2,4,6-TNT (µg/L)	ND (<0.021)	ND (<0.022)	NR	NR
2,4-DNT (µg/L)	ND (<0.018)	ND (<0.019)	NR	NR
2,6-DNT (µg/L)	ND (<0.021)	ND (<0.022)	NR	NR
Nitrobenzene (µg/L)	ND (<0.032)	ND (<0.033)	NR	NR

DNB = dinitrobenzene; DNT = dinitrotoluene; mg/L = milligram per liter; µg/L = microgram per liter; ND = analyte not detected above reporting limit indicated in parentheses; NR = analyte not required; pCi/L = picocurie(s) per liter; TNT = trinitrotoluene
Objective 1 locations monitor unimpacted water quality at upgradient locations

Contaminant concentrations are monitored using 20 wells (Figure 11) within the areas of highest impact of each contaminant plume at the site. These wells were sampled at least semiannually during 2013. The data are discussed in the following sections. Note that all trends are calculated based on the last 5 years of data using the Mann-Kendall method. Statistically significant trends are those with a probability of less 5% of the indicated trend direction being incorrect ($p < 0.05$).

Well MW-3003 is presently monitored under the MNA program as part of the network to monitor uranium in the weathered unit. At the time of developing the MNA monitoring program, this well was categorized as a weathered-unit well, as the filter pack crossed both units. With the change to a micro-purge sampling method, water samples are obtained solely from the unweathered unit. It has been decided that water samples collected from this well represent the water quality in the unweathered unit, and the well has been re-categorized as an unweathered-unit well.

Uranium

The area of uranium impact is in the former Raffinate Pits area in the western portion of the site. Uranium levels exceed the MCL of 20 pCi/L in both the weathered and unweathered units of the Burlington-Keokuk Limestone. Table 8 presents a summary of the uranium data for 2013.

Sampling frequencies were increased to bimonthly starting in April 2010 in support of a special study (see Section 5.2.1.9).

Table 8. 2013 Uranium Data from GWOU Objective 2 Wells

Location	Uranium (pCi/L)					
	B1	B2	B3	B4	B5	B6
Weathered Unit						
MW-3030	27.3 Feb 12, 2013	26.4 Apr 1, 2013	30.5 June 18, 2013	27.4 Aug 1, 2013	28.0 Oct 7, 2013	28.7 Dec 9, 2013
Unweathered Unit						
MW-3003	2.9 Feb 12, 2013	3.0 Apr 1, 2013	3.7 June 10, 2013	2.7 Aug 1, 2013	2.9 Oct 7, 2013	2.9 Dec 2, 2013
MW-3024	117 Feb 12, 2013	118 Apr 1, 2013	144 June 10, 2013	132 Aug 1, 2013	141 Oct 3, 2013	134 Dec 2, 2013
MW-3040	114 Feb 12, 2013	110 Apr 1, 2013	144 June 12, 2013	119 Aug 1, 2013	135 Oct 3, 2013	130 Dec 2, 2013
MW-4040	315 Feb 13, 2013	307 Apr 2, 2013	339 June 17, 2013	329 Aug 1, 2013	355 Oct 3, 2013	360 Dec 2, 2013

pCi/L = picocuries per liter; B1, B2, B3, B4, B5, B6 = bimonthly sampling periods

NS = Not sampled

Objective 2 locations monitor to verify that contaminant concentrations are declining

Uranium impact in the weathered unit is monitored in well MW-3030 (an Objective 2 well), which is installed within the footprint of the former Raffinate Pits. Uranium concentrations in MW-3030 have been steadily decreasing since its installation in 2001 (Figure 19).

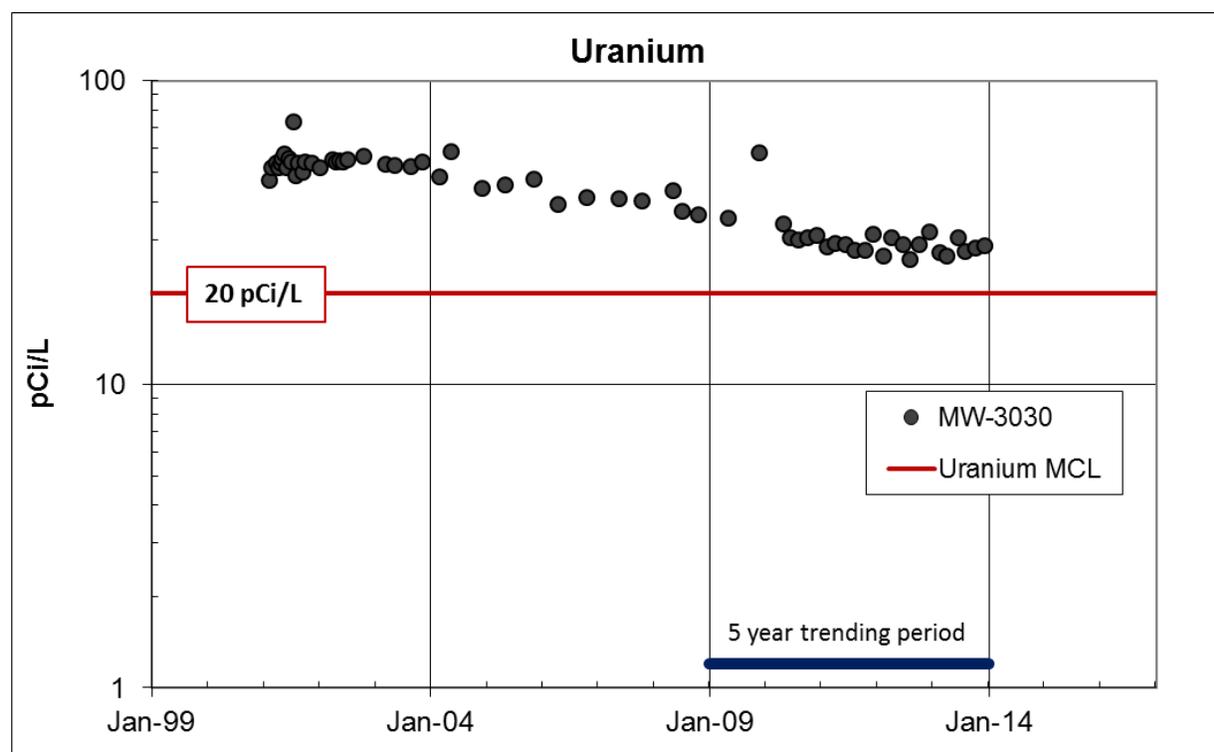


Figure 19. Uranium Levels in Objective 2 Well MW-3030 Screened in the Weathered Unit

Trend analysis of data from weathered unit well MW-3030 (Table 9) confirms that uranium levels have continued to decline over the past 5 years. A statistically significant downward trend (probability greater than 95%) for data within this time frame was determined from the MW-3030 uranium data. If the downward slope of -1.0 pCi/L/year continues, uranium concentrations could reach the MCL in about 10 years. The anomalously high value in late 2009 (Figure 19) was lab qualified as estimated and excluded from the trend calculations.

Table 9. Trending Analysis for Uranium in Objective 2 MNA Weathered Unit Wells (2009–2013)

Location	No. of Samples	Trend	Slope (pCi/L/yr)	Confidence Intervals	
				Lower	Upper
MW-3030	24	Down	-1.00	-1.81	0.00

pCi/L/yr = picocurie(s) per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Uranium impact is greatest in the wells that are screened in the unweathered unit within the footprint and immediately downgradient of the former Raffinate Pits. Removal of the raffinate pits was completed in 2000. Wells MW-3040 and MW-4040 were installed in 2004 to provide uranium data for the unweathered unit in this area. Uranium concentrations in wells MW-3024, MW-3040, and MW-4040 have consistently been greater than the MCL of 20 pCi/L (Figure 20). Overall, the uranium levels in these two wells have increased since installation. Trigger values for uranium impact in the unweathered unit are being evaluated through the continuation of a special study that began in 2008 (see Section 5.2.1.9). Uranium levels in MW-3003, which is located on the northwestern corner of former Raffinate Pit 4, have been less than the MCL since 2000.

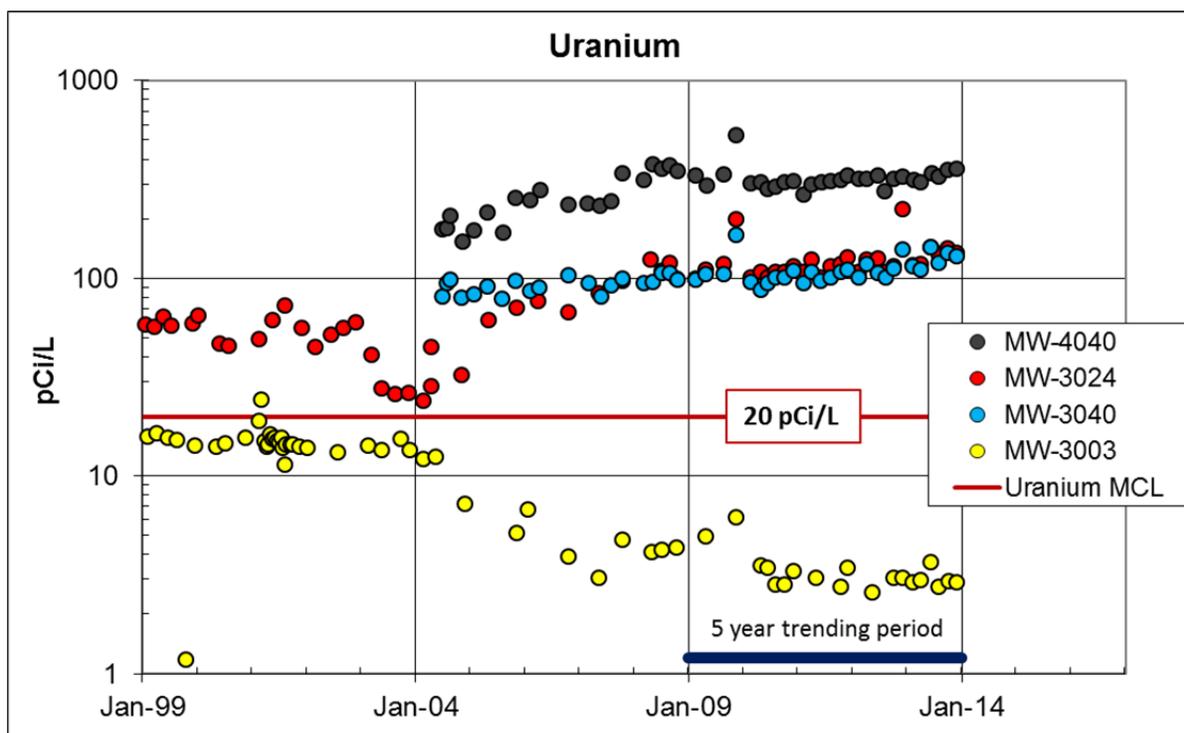


Figure 20. Uranium Levels in Objective 2 Wells Screened in the Unweathered Unit

Mann-Kendall trend analysis of uranium data from the unweathered unit Objective 2 wells (near source area wells) indicate that uranium levels are increasing in three of the wells (Table 10). A statistically significant (greater than 95% probability) upward trend in uranium concentrations was calculated for wells MW-3040, MW-3024, and MW-4040 using data from the past 5 years. The anomalously high values in late 2009 for each of the four wells (Figure 20) were lab qualified as estimated and excluded from the trend calculations. The low concentration well MW-3003 is trending downward.

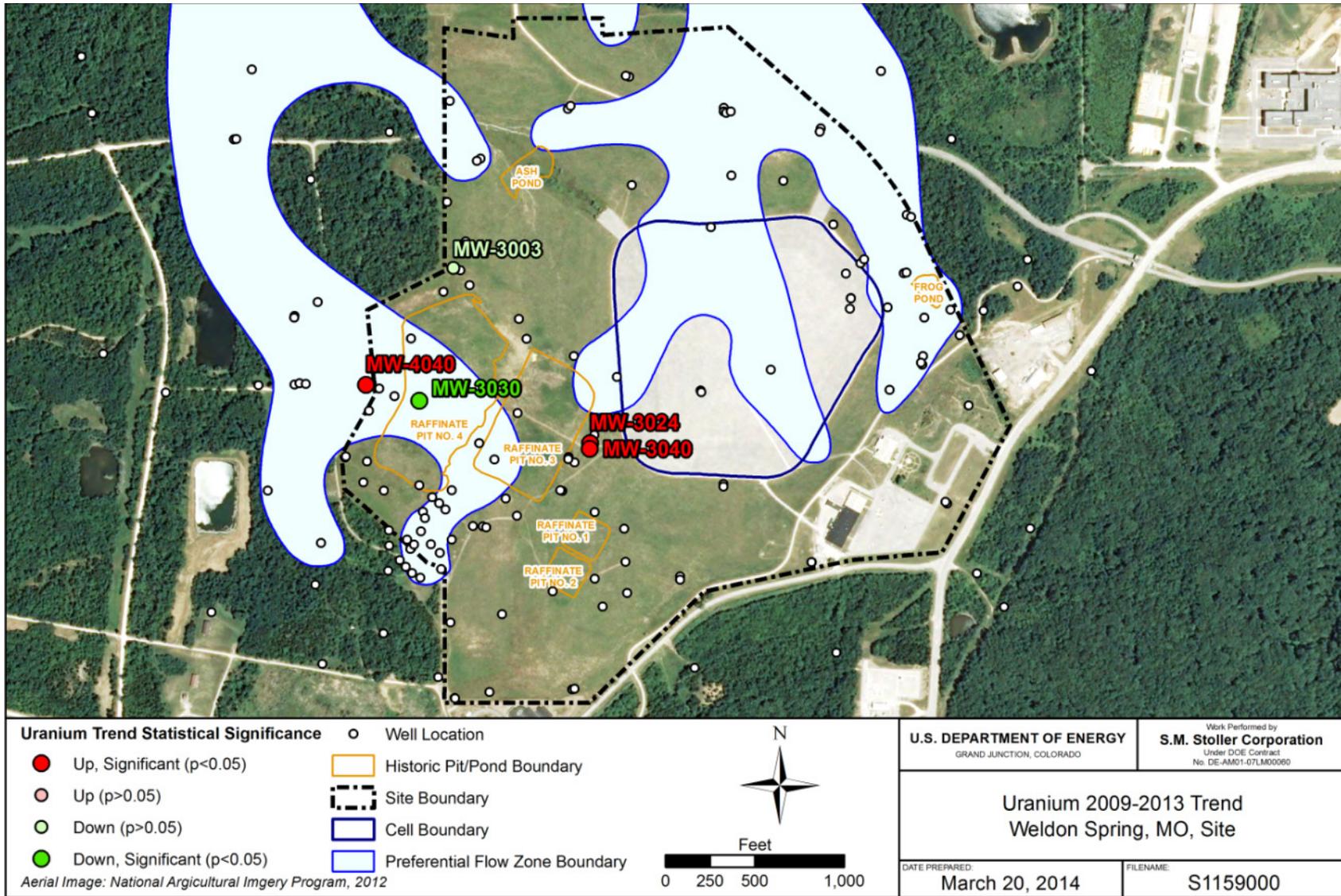
Table 10. Trending Analysis for Uranium in Objective 2 MNA Unweathered Unit Wells (2009–2013)

Location	No. of Samples	Trend	Slope (pCi/L/yr)	Confidence Intervals	
				Lower	Upper
MW-3003	18	Down	-0.15	-0.29	0.02
MW-3024	27	Up	7.1	3.6	9.7
MW-3040	27	Up	6.9	3.6	10.2
MW-4040	27	Up	9.1	4.5	14.6

pCi/L/yr = picocurie(s) per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Overall, uranium impact is contained within the upper portion of the shallow aquifer (weathered and upper unweathered units of the Burlington-Keokuk Limestone). Uranium levels in the weathered unit are decreasing as a result of source removal and natural attenuation (dilution and dispersion). The MCL for uranium could be attained in this portion of the shallow aquifer within a few years if decreases continue at the 5-year rate. However, the potential for trend variability due to external factors should be considered. An example is the current drought conditions in the area that have reduced dilution and temporarily increased concentrations in the weathered section over the past year (Figure 19). Uranium levels within the less-permeable unweathered unit are increasing due to desorption of uranium from residual materials as a result of reduced recharge at greater depths in the aquifer, where flushing is more limited. Any recharge that does enter the system is more likely to move horizontally through the weathered unit than vertically into the unweathered unit. Lateral hydraulic conductivity is much greater in the weathered section, and the decreased downward vertical gradient that resulted from removal of water in the Raffinate Pits limits flushing of the unweathered section. Figure 21 shows the locations of the uranium Objective 2 wells and their relative trends.



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Figure 21. Trend Map of Objective 2 Uranium Wells
Statistically significant trends are those with $p < 0.05$ (less than a 5% chance incorrectly concluding there is a trend)

Nitrate (as N)

The highest concentrations of nitrate have been measured in the former Raffinate Pits area, and elevated nitrate concentrations are also present in the former Ash Pond area. Both are historical source areas of this contaminant. The higher mobility of nitrate, compared to other contaminants at the site, has resulted in a larger distribution in the shallow aquifer. Nitrate levels exceed the MCL of 10 milligrams per liter (mg/L) in both the weathered and unweathered units of the Burlington-Keokuk Limestone. Table 11 presents a summary of the nitrate data for 2013.

Table 11. 2013 Nitrate (as N) Data from GWOU Objective 2 Wells

Location	Nitrate (as N) Concentration (mg/L)	
	S1	S2
Weathered Unit		
MW-2038	380 May 14, 2013	720 Oct 22, 2013
MW-2040	78 May 14, 2013	96 Oct 22, 2013
MW-3034	180 May 14, 2013	166 Dec 9, 2013
MW-4013	96 May 14, 2013	120 Oct 21, 2013
MW-4029	420 May 13, 2013	380 Dec 3, 2013
MW-4031	160 May 13, 2013	300 Oct 21, 2013
MW-4036	7.6 June 17, 2013	54 Oct 3, 2013
Unweathered Unit		
MW-3003	365 June 10, 2013	379 Oct 7, 2013
MW-3040	80 June 12, 2013	75 Oct 3, 2013
MW-4040	100 June 17, 2013	114 Oct 3, 2013

mg/L = milligrams per liter; S1, S2 = semiannual sampling periods.

Objective 2 locations monitor to verify that contaminant concentrations are declining

Nitrate concentrations are generally higher in the weathered unit of the Burlington-Keokuk Limestone, with the highest concentrations in wells MW-2038 and MW-4029 in the former Raffinate Pits area (Figure 22). Recent data show little change in nitrate concentrations in all of the wells over the past 4 or 5 years. The overall general decline in concentrations is attributed to source removal in the former Raffinate Pits and Ash Pond areas.

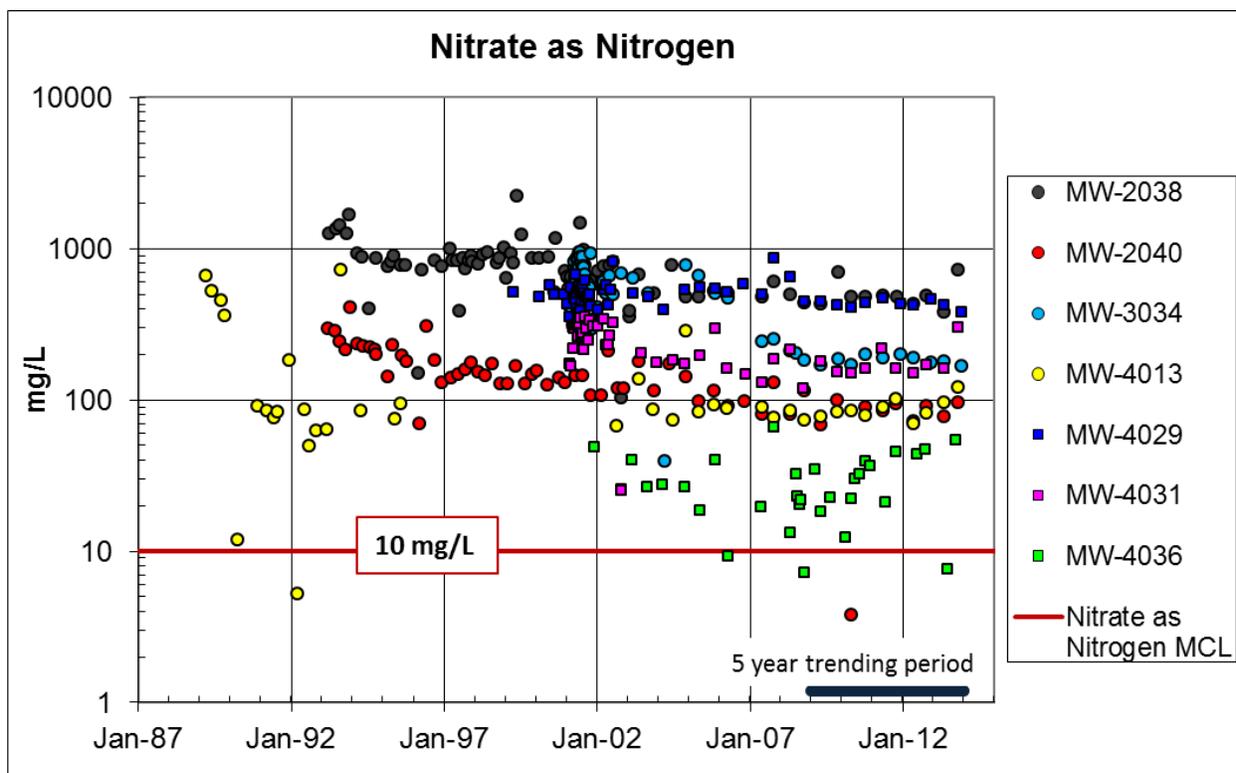


Figure 22. Nitrate Concentrations in Objective 2 Wells Screened in the Weathered Unit

Mann-Kendall trending of nitrate data from the weathered unit wells indicates no statistically significant trends over the last 5 years except for low-concentration well MW-4036, which is increasing (Table 12). A visual inspection of the full data set indicates that nitrate in MW-4036 is variable with no long-term trend, although it is located downgradient of the former Raffinate Pit area, and the recent increase should be closely watched to see if it persists. The higher-concentration wells (Figure 22) have no trend based on the last 5 years of data (Table 12), however data over a 15- to 20-year period indicate concentrations in these wells have generally been declining.

Table 12. Trending Analysis for Nitrate (as N) in Objective 2 MNA Weathered Unit Wells (2009–2013)

Location	No. of Samples	Trend	Slope (mg/L/yr)	Confidence Intervals	
				Lower	Upper
MW-2038	10	None	0	-56.6	43.9
MW-2040	10	None	2.3	-6.5	18.4
MW-3034	10	None	-0.9	-10.8	6.8
MW-4013	10	None	5.9	-1.5	11.9
MW-4029	10	None	-6.4	-24.1	10.2
MW-4031	10	None	3.6	-7.9	34.6
MW-4036	15	Up	7.0	1.3	11.2

mg/L/yr = milligram(s) per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Nitrate concentrations in the unweathered unit exceed the MCL only in wells located near the former Raffinate Pits area. Nitrate concentrations in MW-3003, located on the northwestern corner of the former Raffinate Pit 4, increased slightly from 2002 through 2008 but have stabilized since 2009. Concentrations in well MW-3040 have decreased since monitoring began in 2004 (Figure 23). Nitrate concentrations in well MW-4040 (Figure 23, blue) increased from 2004 (when it was installed) to 2008; however, the concentrations have declined since that time. Wells MW-3003 and MW-4040 are downgradient of the former Raffinate Pits area, and increases are likely the result of groundwater with higher nitrate concentrations beneath the former Raffinate Pits having migrated to these wells in response to remediation activities. It is expected that uranium concentrations in MW-4040 will eventually respond similarly and begin to decrease. The transition to a downward trend in uranium at MW-4040 has been delayed because uranium migrates more slowly than nitrate.

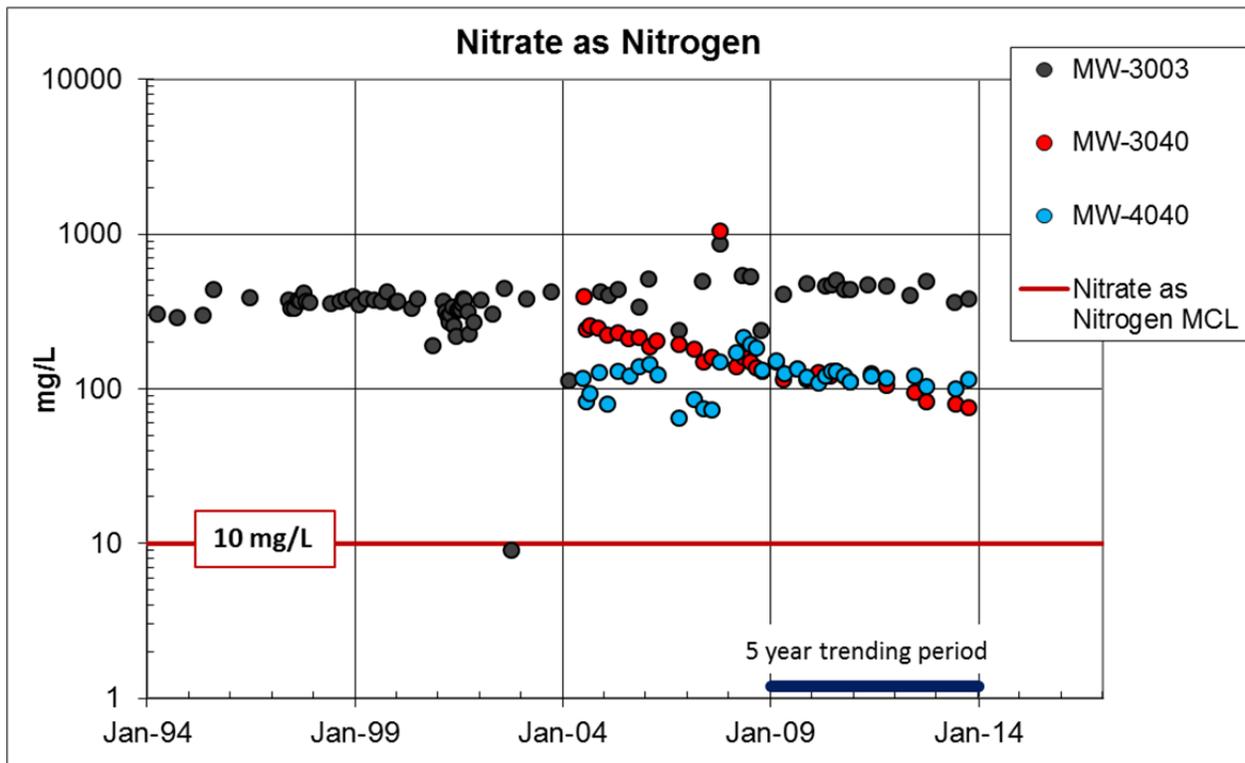


Figure 23. Nitrate Concentrations in Objective 2 Wells Screened in the Unweathered Unit

Mann-Kendall trend analysis of the last 5 years of nitrate data from wells MW-3040 and MW-4040 show statistically significant downward trends (Table 13). If the current rates of decrease in nitrate concentration continue, the MCL of 10 mg/L could be reached in 20 years at MW-3040 and in about 25 years at well MW-4040, based on estimates derived from an exponential curve model.

Table 13. Trending Analysis for Nitrate (as N) in Objective 2 MNA Unweathered Unit Wells (2009–2013)

Location	No. of Samples	Trend	Slope (mg/L/yr)	Confidence Intervals	
				Lower	Upper
MW-3003	13	None	-16.3	-32.6	19.3
MW-3040	16	Down	-13.7	-16.5	-8.4
MW-4040	16	Down	-5.1	-10.3	-1.5

mg/L/yr = milligram(s) per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Overall, nitrate impact is contained within the upper portion of the shallow aquifer (weathered and upper unweathered units of the Burlington-Keokuk Limestone). Nitrate concentrations in the weathered and unweathered units are decreasing except possibly along the leading edge of the area of impact in the weathered unit (near MW-4036). Some locations were expected to show temporary upward trends due to nitrate being mobilized by recent source remediation; however, concentrations are not expected to exceed historical maximums seen within the areas of highest impact. Trigger values have not been exceeded. The higher mobility of nitrate, compared to other contaminants at the site, has resulted in more-rapid flushing of this contaminant from the aquifer system. Figure 24 shows the locations of the nitrate Objective 2 wells and their relative trends.

Trichloroethene

TCE contamination in the shallow groundwater is located in the vicinity of former Raffinate Pit 4, where drums containing TCE residues are suspected to have been discarded. TCE impact is detected in only the weathered unit of the Burlington-Keokuk Limestone. Table 14 presents a summary of the TCE data for 2013.

Table 14. 2013 TCE Data from GWOU Objective 2 Wells

Location	TCE Concentration (µg/L)	
	S1	S2
MW-3030	200 June 18, 2013	228 Dec 9, 2013
MW-3034	120 May 14, 2013	115 Dec 9, 2013
MW-4029	380 May 13, 2013	201 Dec 3, 2013

µg/L = micrograms per liter; S1, S2 = semiannual sampling periods

Objective 2 locations monitor to verify that contaminant concentrations are declining

The TCE concentrations in wells MW-3030, MW-3034, and MW-4029 have varied over time but have been generally declining since 2004 (Figure 25). The changes observed from 2001 through 2005 are a result from field studies (in situ chemical oxidation and pump-and-treat) performed in 2001 and 2002 and subsequent rebound. Concentrations of TCE in all of the Objective 2 wells continue to exceed the MCL of 5 µg/L, but are significantly below their 1,000 µg/L trigger value.

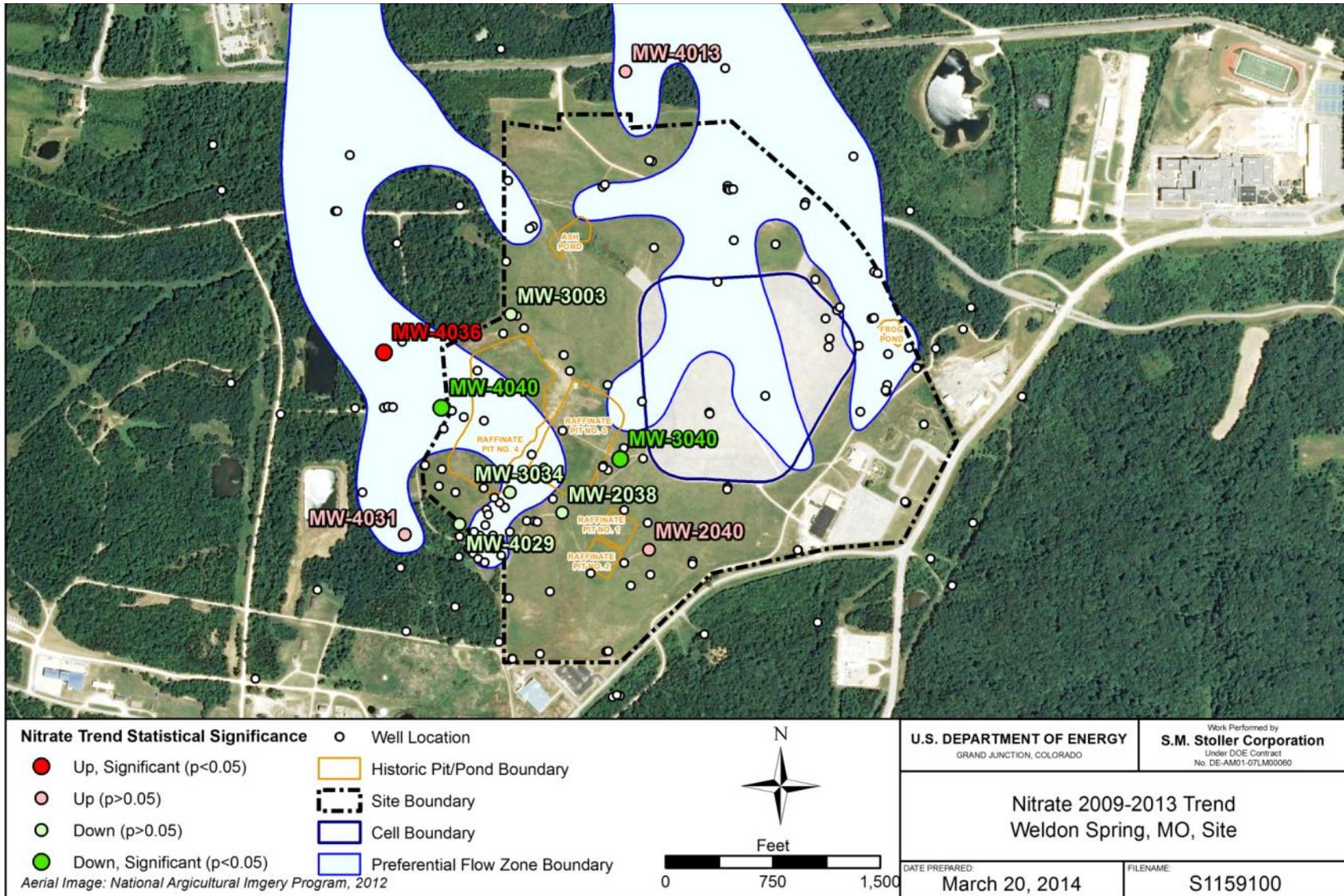


Figure 24. Trend Map of Objective 2 Nitrate Wells
 Statistically significant trends are those with $p < 0.05$ (less than a 5% chance incorrectly concluding there is a trend)

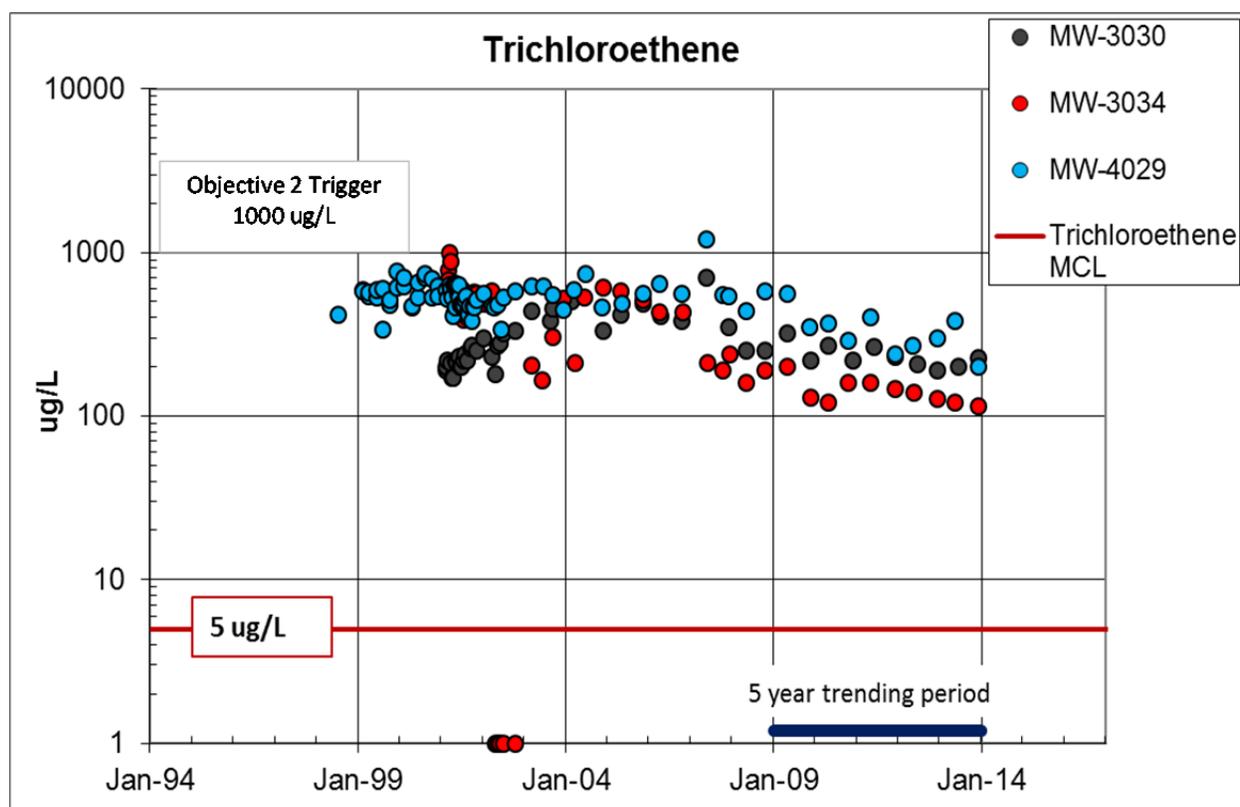


Figure 25. TCE Concentrations in Objective 2 Wells

Low levels of the TCE degradation product *cis*-1,2-dichloroethene (DCE) are measured in the three Objective 2 wells, and the concentrations are significantly less than the MCL of 70 µg/L. Estimated detections of *trans*-1,2-DCE less than 1 µg/L are reported in the three Objective 2 wells. No detectable concentrations of vinyl chloride were reported in any of the Objective 2 wells. Oxidizing conditions are present in groundwater at the former Chemical Plant; therefore, reductive dechlorination of TCE is limited. Dilution and dispersion are the primary attenuation mechanisms for TCE in groundwater.

Mann-Kendall trend analysis of the well data confirms that TCE concentrations in groundwater are decreasing (Table 15). Downward trends for MW-3034 and MW-3030 were calculated from the last 5 years of data. A statistically significant downward trend was previously calculated for well MW-4029 using 2008–2012 data (last year’s annual report). Visual inspection of the data indicates that TCE concentrations in all three wells have been declining since 2004.

Table 15. Trending Analysis for TCE in Objective 2 MNA Wells (2009–2013)

Location	No. of Samples	Trend	Slope (µg/L/yr)	Confidence Intervals	
				Lower	Upper
MW-3030	10	Down	-14.8	-36.0	0.4
MW-3034	10	Down	-15.4	-19.9	-0.5
MW-4029	10	None	-44.4	-80.8	18.3

µg/L/yr = micrograms per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Overall, TCE impact is confined to a discrete area near the former Raffinate Pits site and is limited to the weathered unit of the Burlington-Keokuk Limestone. Figure 26 shows the locations of the TCE Objective 2 wells and their relative trends.

Nitroaromatic Compounds—Former Frog Pond Area

The primary area of nitroaromatic compound impact on groundwater at the site is in the former Frog Pond area. Vertically, the impacted area is limited to the weathered unit of the Burlington-Keokuk Limestone. Groundwater in this area has historically had concentrations of 1,3-DNT; 2,4,6-TNT; 2,4-DNT; 2,6-DNT; and nitrobenzene (NB) above their respective cleanup standard. Recent data have indicated that several Objective 2 wells have concentrations less than cleanup standards for some compounds.

The distribution of nitroaromatic compounds suggests that the primary source area is former production line #1 (Figure 18), most notably the former wash house (T-13) and the former wastewater settling tank (T-16). Some contribution to the nitroaromatic contamination originates from former Army Lagoon 1. The preferential flow path in the vicinity of the former Frog Pond has been identified from the bedrock topography, and the contaminant distribution is controlled somewhat by the topography. Nitroaromatic compound impact in the former Frog Pond area is isolated to the weathered unit of the Burlington-Keokuk Limestone.

Nitroaromatic compound concentrations, primarily the DNT isomers, have varied in the former Frog Pond area. In 1997, increases in concentrations were reported, and concentrations increased dramatically during and after two activities: (1) the completion of soil excavation in this area and (2) remedial activities performed by the U.S. Army Corps of Engineers in nearby Army Lagoon 1. Also during this time frame, groundwater elevations steadily decreased, likely in response to the removal of the Frog Pond and redirection of surface water runoff, both of which reduced the amount of infiltration into the groundwater system. Concentrations of nitroaromatics in several wells in this area decreased dramatically in 2004. The suspected cause was the infiltration of surface water runoff into the groundwater system through a subsidence feature that formed near MW-2012. Continued influence of surface water infiltration has been observed in the fluctuation of groundwater elevations in this area. In recent years, groundwater elevations have generally increased in wells along the preferential flow pathway, and the increase is likely attributable to surface water contribution in a natural drainage channel that is beginning to establish in this area.

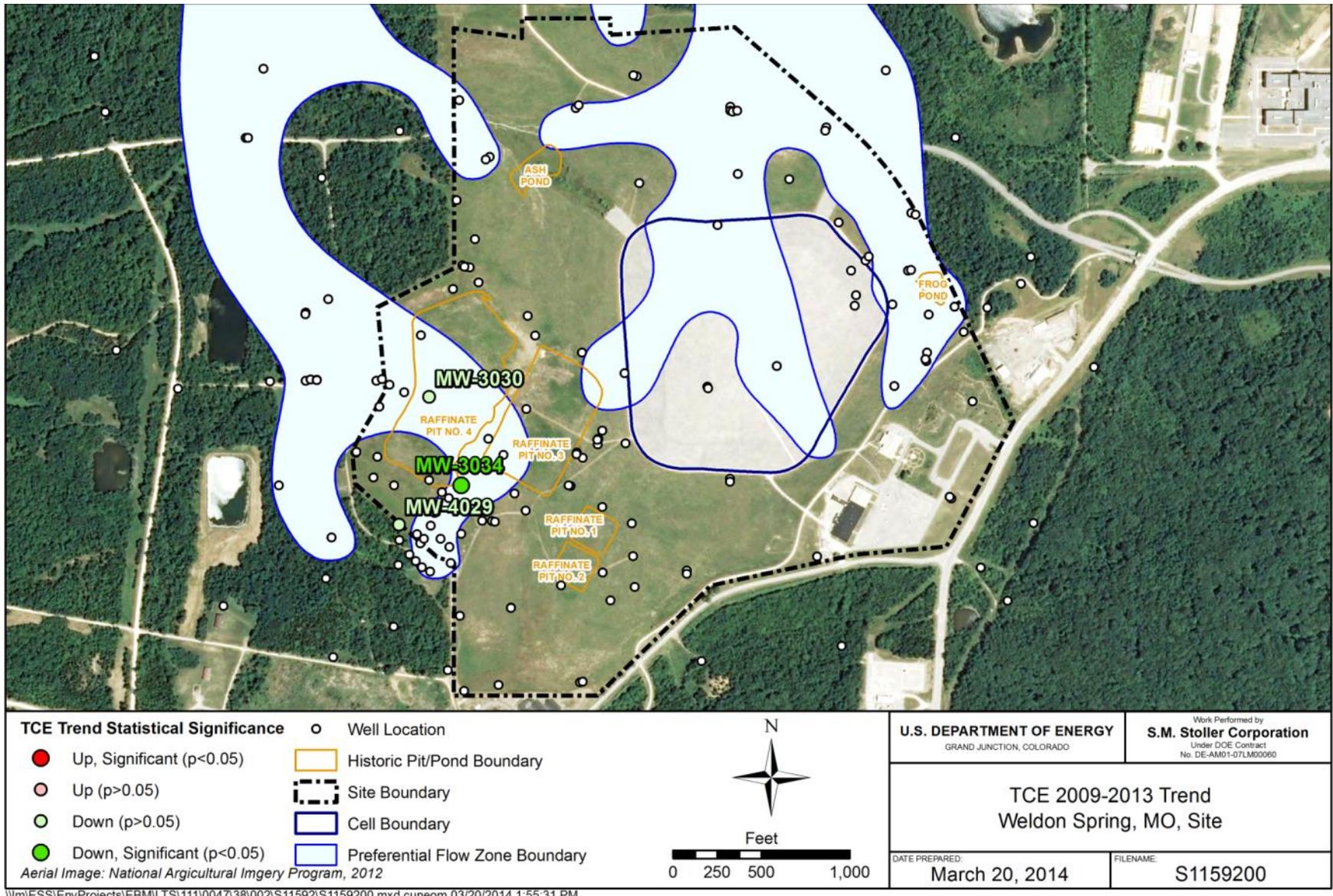


Figure 26. Trend Map of Objective 2 TCE Wells
Statistically significant trends are those with $p < 0.05$ (less than a 5% chance incorrectly concluding there is a trend)

1,3-DNB

Concentrations of 1,3-DNB in MW-2012 were reported as estimated values (Table 16). Estimated values are “J” or “E” qualified by the laboratory for reasons such as interference or if the value is outside the instrument calibration range. Starting in 2006, the average concentration decreased below the cleanup standard of 1.0 µg/L (Figure 27). Decreases in 1,3-DNB are expected, as this nitroaromatic compound is a photodegradation breakdown product of 2,4-DNT. Concentration increases of this compound began during the period that 2,4-DNT–impacted soils were being excavated in this area. Exposure of impacted soil likely resulted in some photodegradation and subsequent infiltration into the aquifer system.

Table 16. 2013 1,3-DNB Data from GWOU Objective 2 Wells

Location	1,3-DNB Concentration (µg/L)	
	S1	S2
MW-2012	0.021 (J) May 6, 2013	0.047 (J) Oct 22, 2013

µg/L = microgram per liter; J = estimated value less than the reporting limit

S1, S2 = semiannual sampling periods

Objective 2 locations monitor to verify that contaminant concentrations are declining

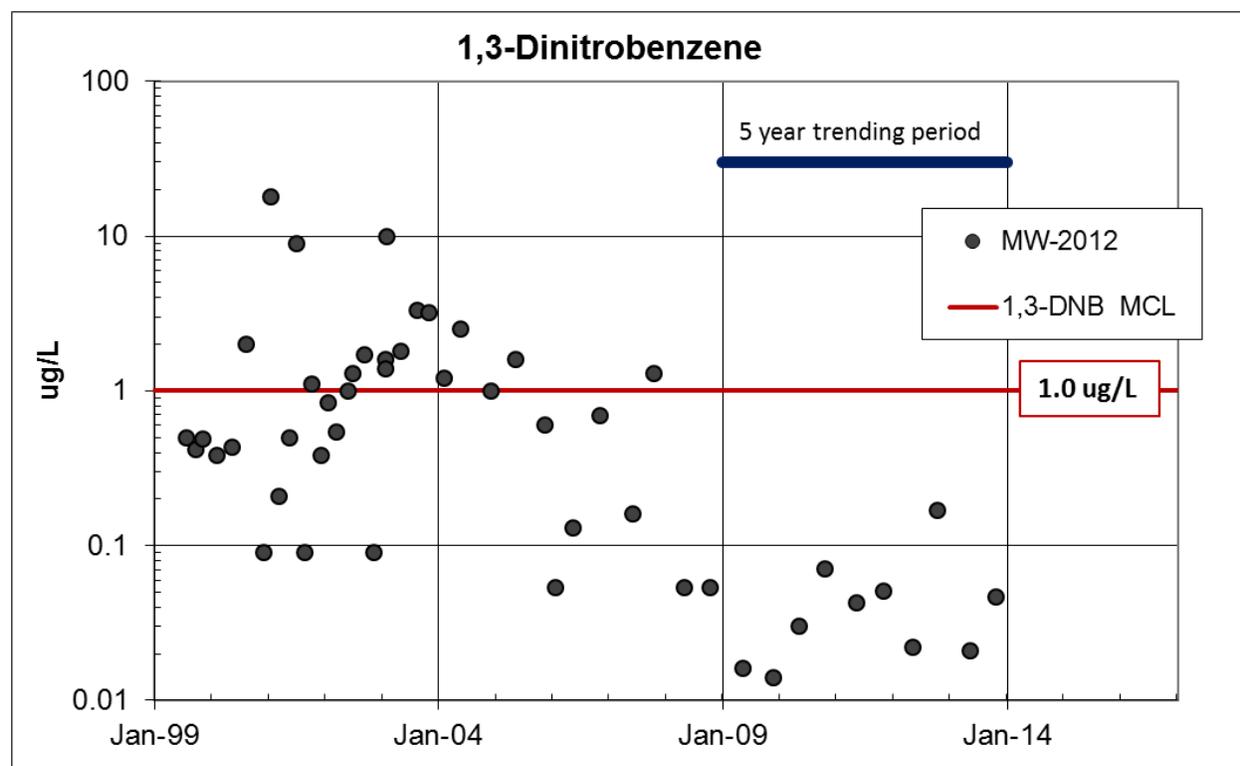


Figure 27. 1,3-DNB Concentrations in MW-2012

Mann-Kendall trend analysis of 1,3-DNB data from well MW-2012 in the former Frog Pond area indicates no concentration trend over the last 5 years (Table 17). Visual inspection of the data indicates that 1,3-DNB concentrations decreased from above the cleanup standard in 2004 to consistently below the standard in 2007 and have since stabilized.

Table 17. Trending Analysis for 1,3-DNB in Objective 2 MNA Wells (2009–2013)

Location	No. of Samples	Trend	Slope (µg/L/yr)	Confidence Intervals	
				Lower	Upper
MW-2012	10	None	0.007	-0.006	0.037

µg/L/yr = microgram per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

2,4,6-TNT

The highest 2,4,6-TNT concentrations are found in samples from wells MW-2012 and MW-2053, which are near former TNT production building locations (Table 18). Concentrations of TNT have generally decreased in the former Frog Pond area (Figure 28), with the largest decrease in MW-2012. Well MW-2046 monitors a discrete area of TNT impact located in the north-central portion of the site. Concentrations of 2,4,6-TNT were variable in MW-2012 and MW-2053 and may be the result of fluctuating groundwater levels. The annual average TNT concentrations in all of the Objective 2 wells have been less than the cleanup standard of 2.8 µg/L since 2009.

Table 18. 2013 2,4,6-TNT Data from GWOU Objective 2 Wells

Location	2,4,6-TNT Concentration (µg/L)	
	S1	S2
MW-2012	0.058 (J) May 6, 2013	1.1 Oct 22, 2013
MW-2046	0.76 June 18, 2013	0.54 Dec 9, 2013
MW-2053	ND (<0.21) May 6, 2013	1.2 Oct 23, 2013

µg/L = microgram(s) per liter;

J = estimated concentration (below reporting limit)

ND = not detected above detection limit indicated in parentheses

S1, S2 = semiannual sampling periods

Objective 2 locations monitor to verify that contaminant concentrations are declining

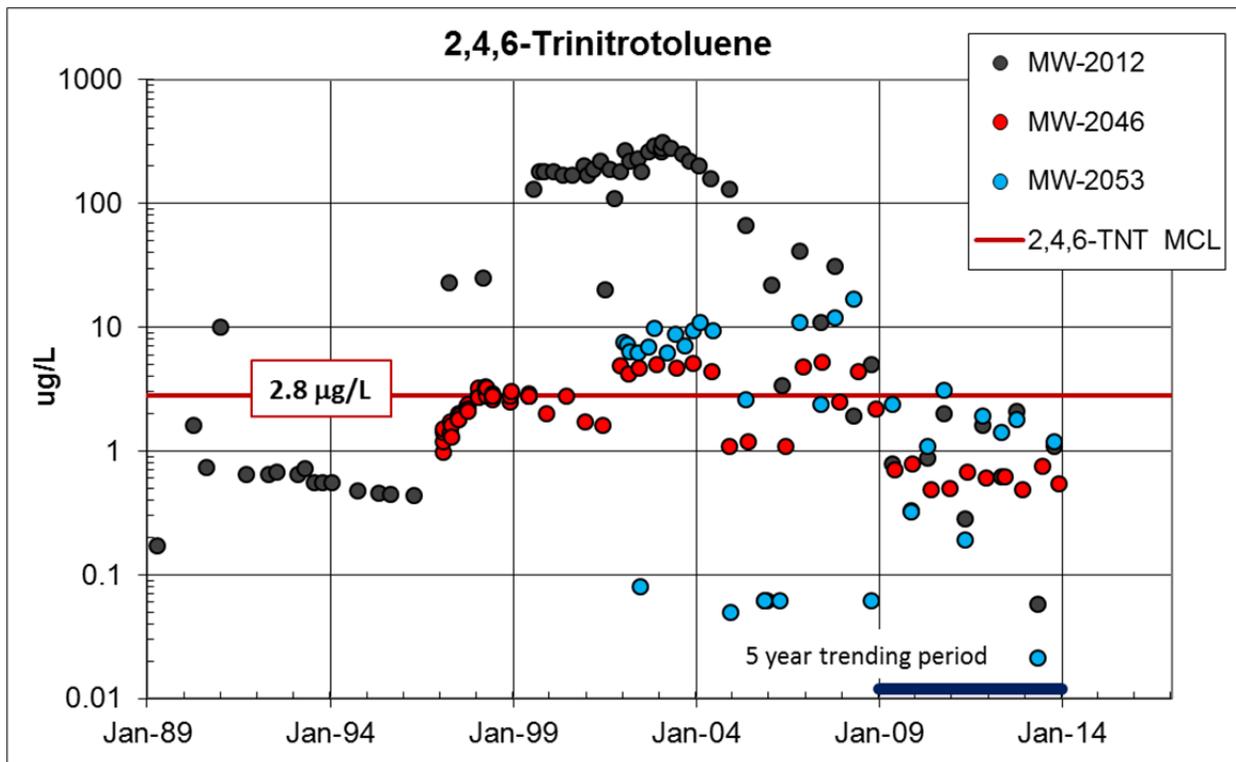


Figure 28. 2,4,6-TNT Concentrations in Objective 2 Wells

Mann-Kendall trend analysis of 2,4,6-TNT data collected from 2009 through 2013 indicates relatively stable concentrations in all three of the Objective 2 wells with no statistically significant trends observed (Table 19). Visual inspection of the data indicates a declining trend in each of the wells since 2004. Figure 29 shows the locations of the 2,4,6-TNT Objective 2 wells and their relative trends.

Table 19. Trending Analysis for 2,4,6-TNT in Objective 2 MNA Wells (2009–2013)

Location	No. of Samples	Trend	Slope ($\mu\text{g/L/yr}$)	Confidence Intervals	
				Lower	Upper
MW-2012	10	None	0.07	-0.34	0.52
MW-2046	10	None	-0.01	-0.08	0.07
MW-2053	10	None	-0.14	-0.93	0.50

$\mu\text{g/L/yr}$ = microgram(s) per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

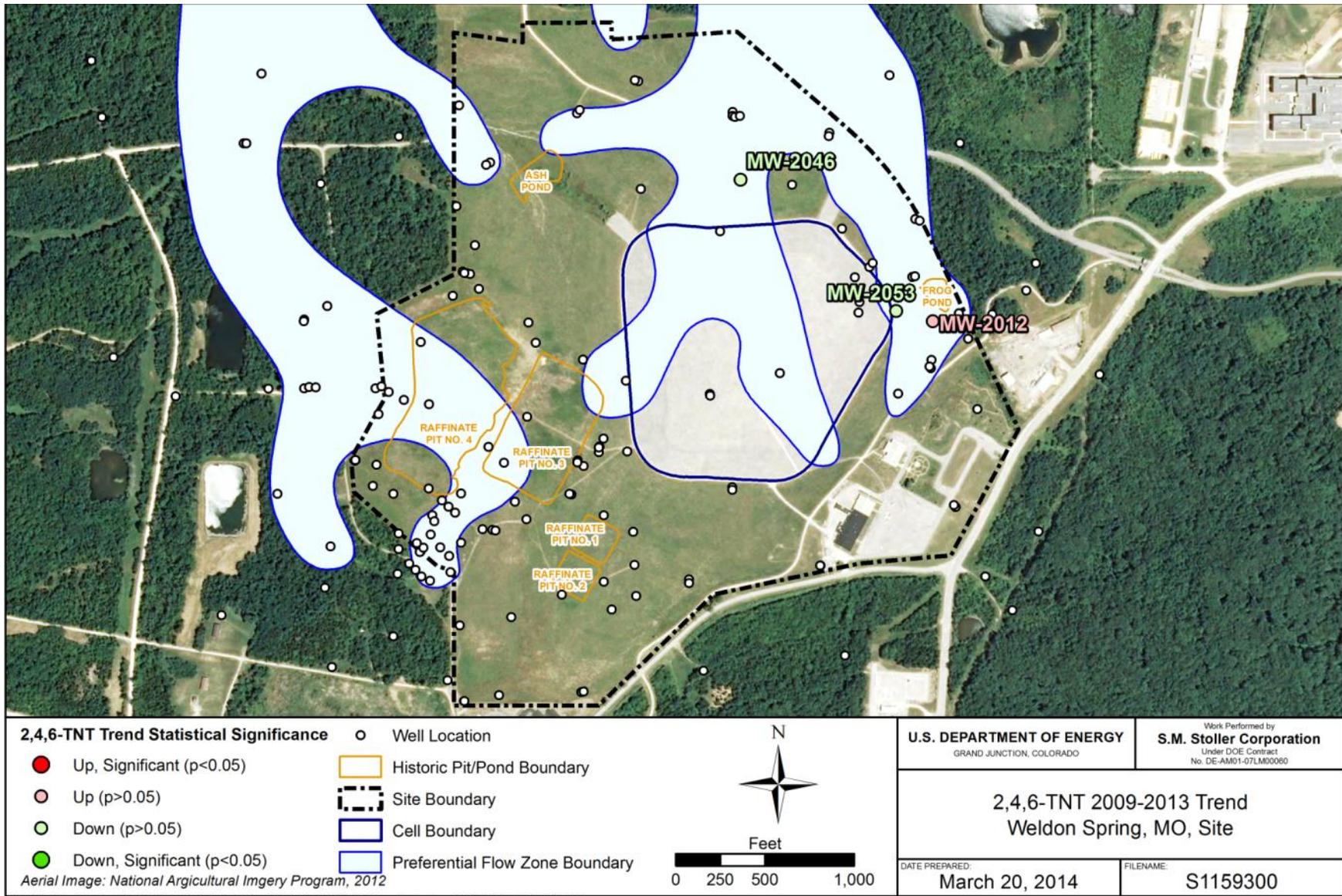


Figure 29. Trend Map of Objective 2 2,4,6-TNT Wells
No wells have statistically significant trends (less than a 5% chance incorrectly concluding there is a trend).

2,4-DNT and 2,6-DNT

The nitroaromatic compounds 2,4-DNT and 2,6-DNT are the most persistent in groundwater at the site. Data continue to indicate that concentrations of DNT are variable in most of the Objective 2 wells (Table 20 and Table 21). The concentrations of these compounds can vary significantly between sampling events. This variability in 2,4-DNT and 2,6-DNT may be attributable to the introduction of surface water into the groundwater system during wet periods. Concentrations of these compounds are typically higher during periods of low groundwater elevations and decrease as groundwater elevations rise. The introduction of surface water infiltration temporarily dilutes the concentrations in groundwater. This effect can be seen in a chart of 2,4-DNT concentrations with water level elevations for well MW-2012, where high concentrations and low water levels are more typical in the fall (Figure 30). Red lines on the chart indicate where high concentrations correlate with relatively low water levels and green lines indicate where low concentrations correlate with relatively low water levels. Water levels in this well vary 2 to 5 ft from wet and dry seasons.

Table 20. 2013 2,4-DNT Data from GWOU Objective 2 Wells in the Former Frog Pond Area

Location	2,4-DNT Concentration (µg/L)	
	S1	S2
MW-2012	0.062 (J) May 6, 2013	5.9 Oct 22, 2013
MW-2014	0.15 May 6, 2013	0.12 Oct 22, 2013
MW-2050	3.5 May 8, 2013	7.2 Oct 22, 2013
MW-2052	0.046 (J) May 8, 2013	0.078 (J) Oct 22, 2013
MW-2053	ND (<0.22) May 6, 2013	0.75 Oct 23, 2013
MW-2054	0.094 (J) May 6, 2013	0.078 (J) Oct 23, 2013

µg/L = microgram(s) per liter

S1, S2 = semiannual sampling periods

ND = analyte not detected above reporting limit indicated in parentheses

J = estimated value less than the reporting limit

Objective 2 locations monitor to verify that contaminant concentrations are declining

Table 21. 2013 2,6-DNT Data from GWOU Objective 2 Wells

Location	2,6-DNT Concentration (µg/L)	
	S1	S2
MW-2012	0.2 May 6, 2013	35 Oct 22, 2013
MW-2014	0.35 May 6, 2013	0.37 Oct 22, 2013
MW-2050	31 May 8, 2013	27 Oct 22, 2013
MW-2052	0.077 (J) May 8, 2013	0.21 Oct 22, 2013
MW-2053	0.1 May 6, 2013	6.9 Oct 23, 2013
MW-2054	0.24 May 6, 2013	0.18 Oct 23, 2013

µg/L = microgram(s) per liter

S1, S2 = semiannual sampling periods

Objective 2 locations monitor to verify that contaminant concentrations are declining

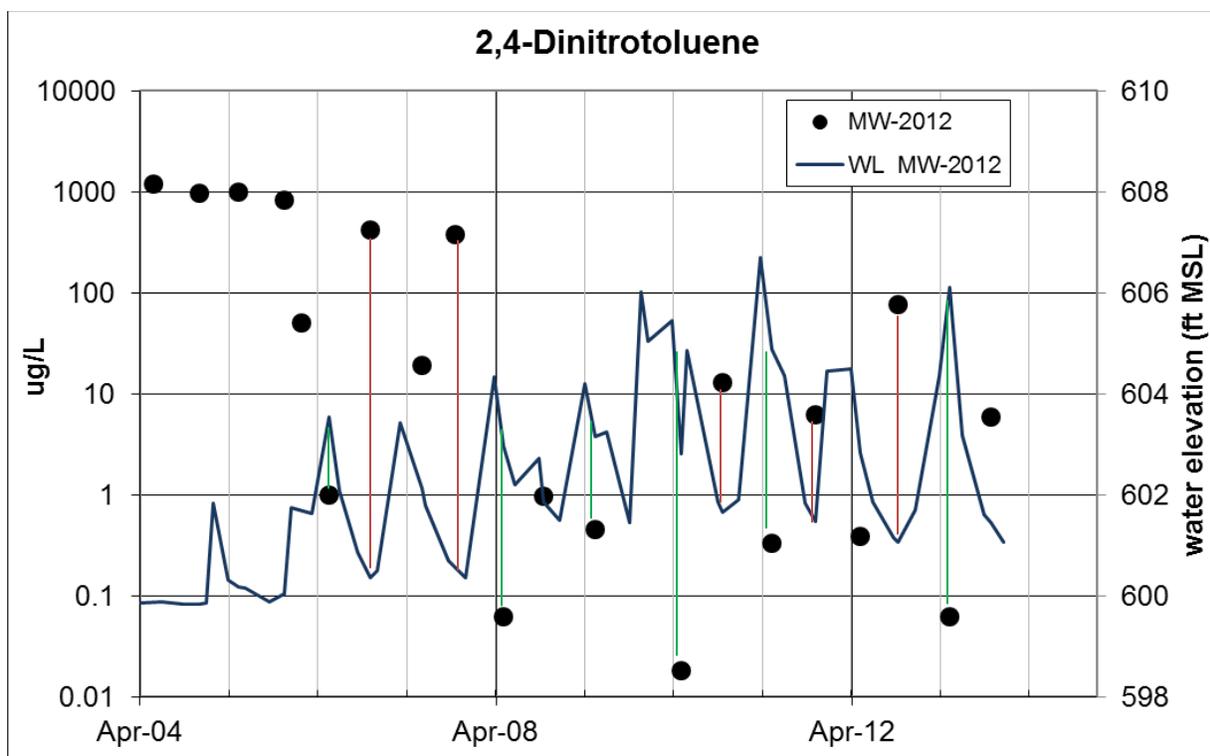


Figure 30. 2,4-DNT and 2,6-DNT Concentrations in MW-2012

The highest concentrations of 2,4-DNT and 2,6-DNT are reported in MW-2012, MW-2050, and MW-2053 (Figure 31, Figure 32, and Figure 33), which are downgradient of the former TNT-production buildings and Army Lagoon 1. Concentrations in these wells are somewhat variable but typically exceed the cleanup standards for both 2,4-DNT and 2,6-DNT.

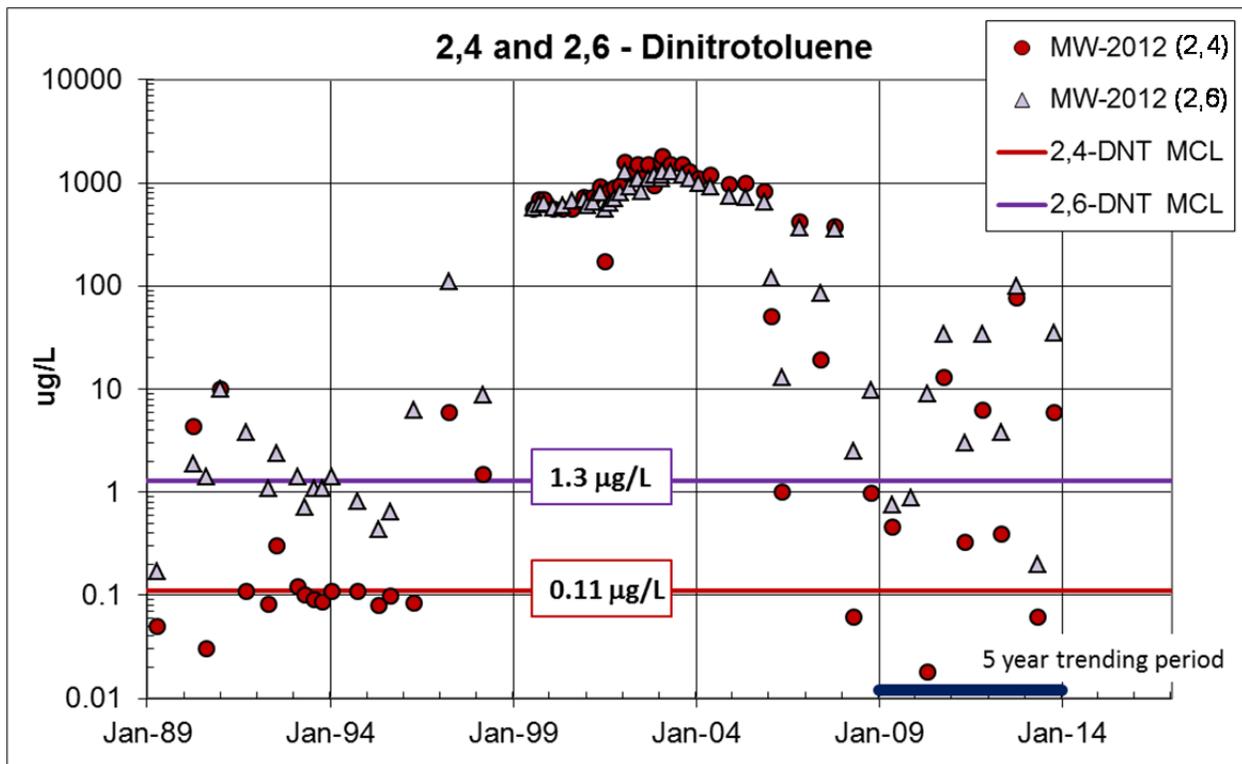


Figure 31. 2,4-DNT and 2,6-DNT Concentrations in MW-2012

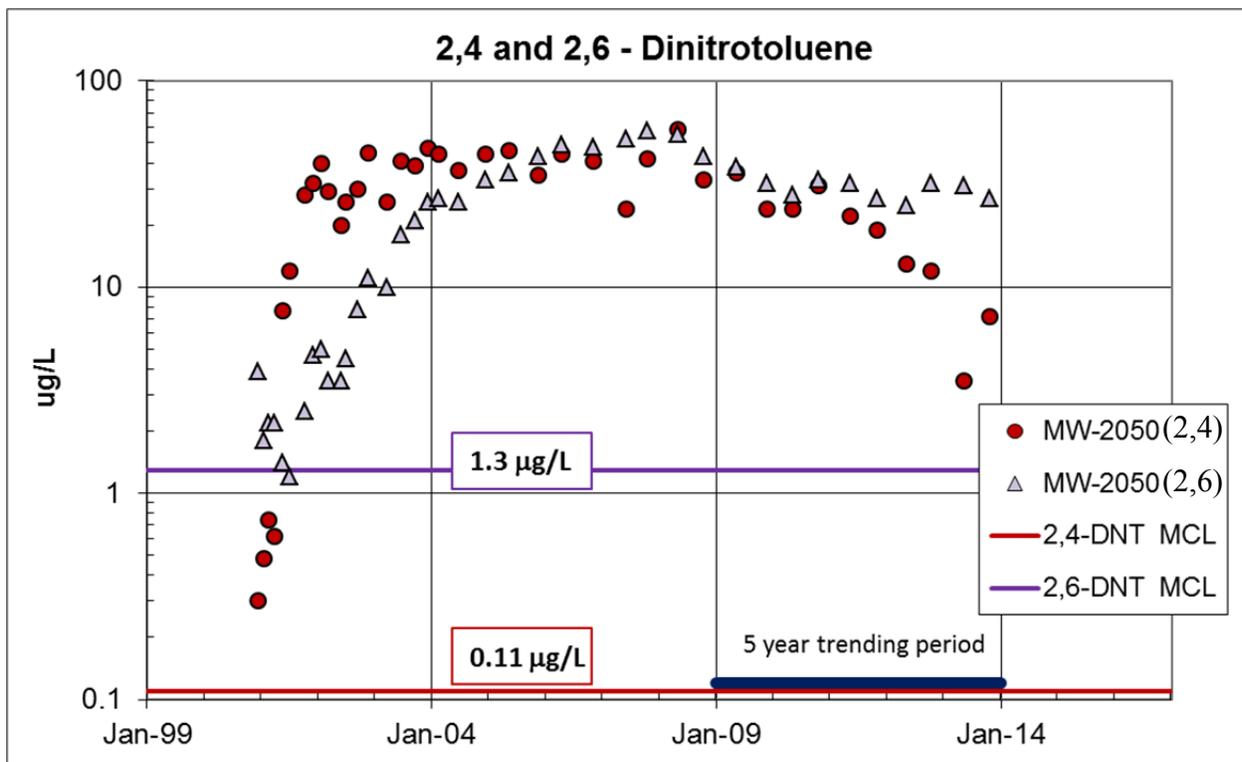


Figure 32. 2,4-DNT and 2,6-DNT Concentrations in MW-2050

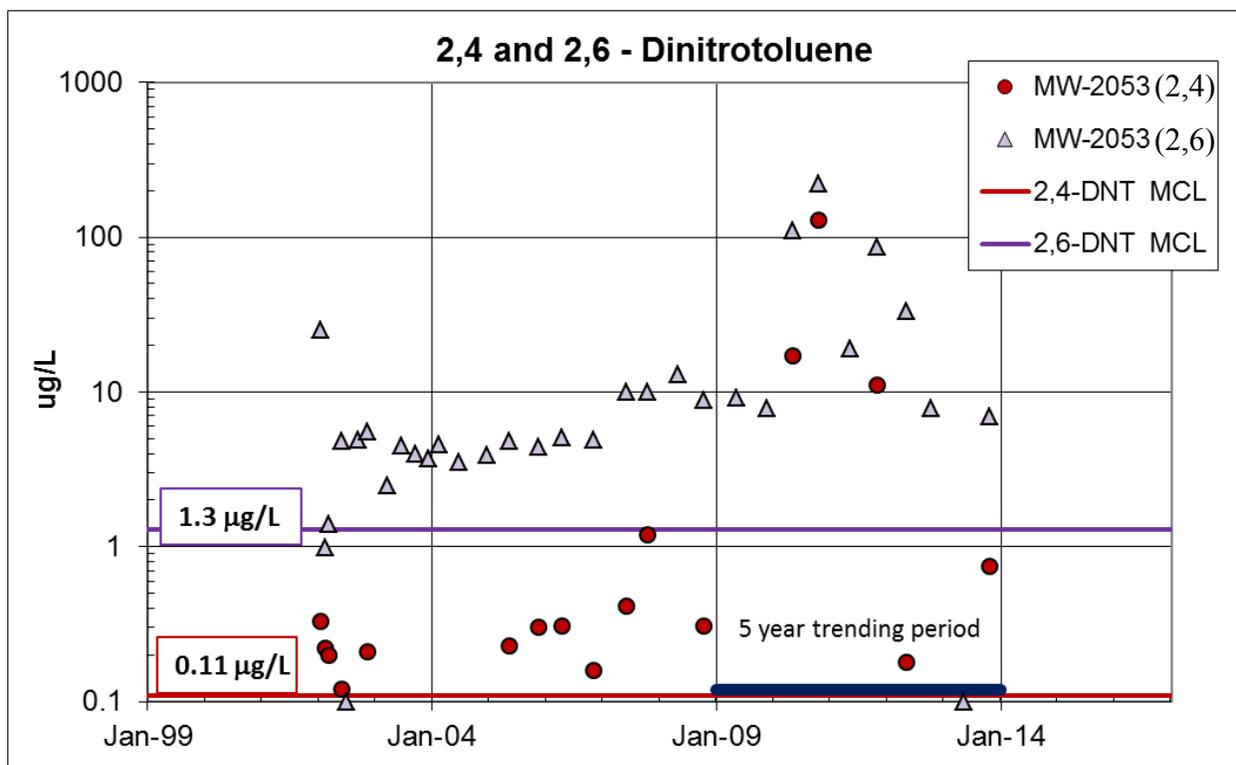
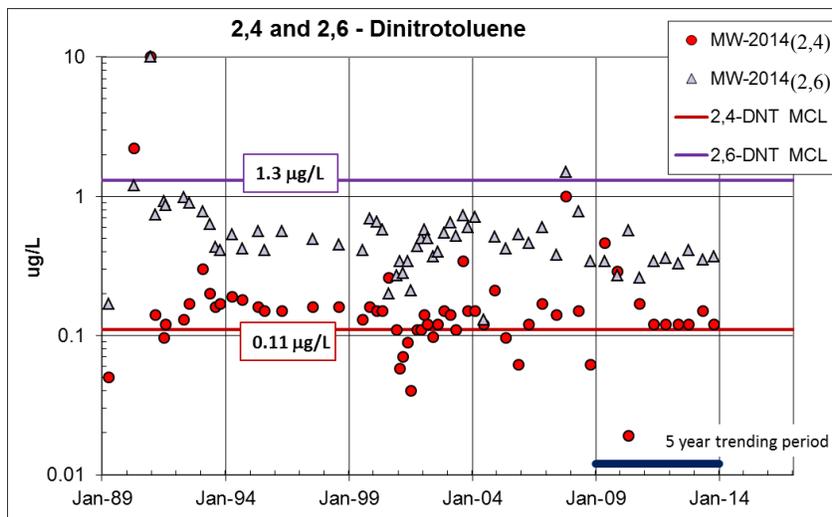


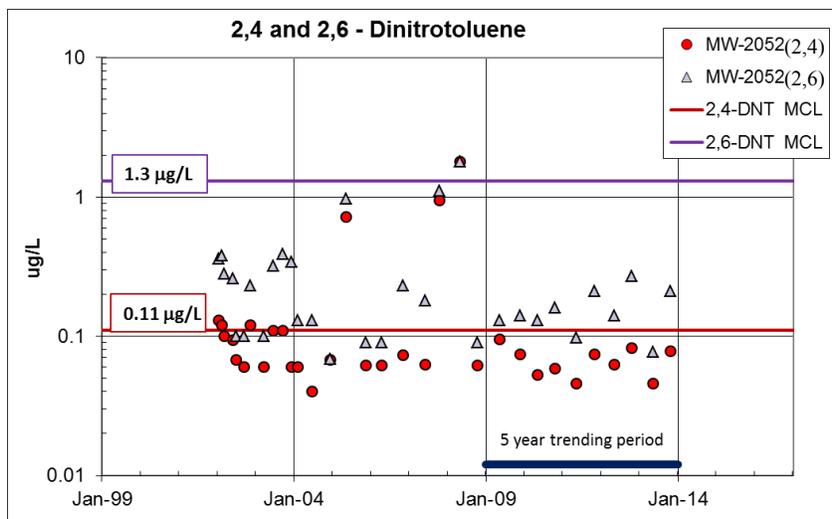
Figure 33. 2,4-DNT and 2,6-DNT Concentrations in MW-2053

Concentrations in MW-2012 decreased significantly in 2008 and have increased slightly since that time (Figure 31). Concentrations in well MW-2050 have decreased since 2008 (Figure 32). The concentrations reported for MW-2053 in 2010 were new highs and decreased significantly in 2011 and 2012 (Figure 33). The concentrations reported for these locations are significantly less than the Objective 2 triggers (Table 6). Concentrations of 2,4-DNT in MW-2014, MW-2052, MW-2053, and MW-2054 were less than the cleanup standard of 0.11 $\mu\text{g/L}$, and concentrations of 2,6-DNT in MW-2014, MW-2052, and MW-2054 were less than the cleanup standard of 1.3 $\mu\text{g/L}$ in 2012 (Figure 34).

Mann-Kendall trend analysis of the last 5 years of 2,4-DNT data (2009 through 2013) indicate that only well MW-2050 (Figure 32) has a statistically significant decreasing concentration trend (Table 22). Data from the other wells exhibit no trend except for MW-2012, which has a positive slope, though fails the $p < 0.05$ significance test. If the current rate of decrease in MW-2050 continues, the cleanup standard of 0.11 $\mu\text{g/L}$ for 2,4-DNT could be attained in the next 5 years. A review of the trend data suggests that concentrations of 2,4-DNT are relatively stable in wells MW-2014, MW-2052, and MW-2054. Figure 35 shows the locations of the 2,4-DNT Objective 2 wells and their relative trends.



2,4-DNT and 2,6-DNT Concentrations in MW-2014



2,4-DNT and 2,6-DNT Concentrations in MW-2052

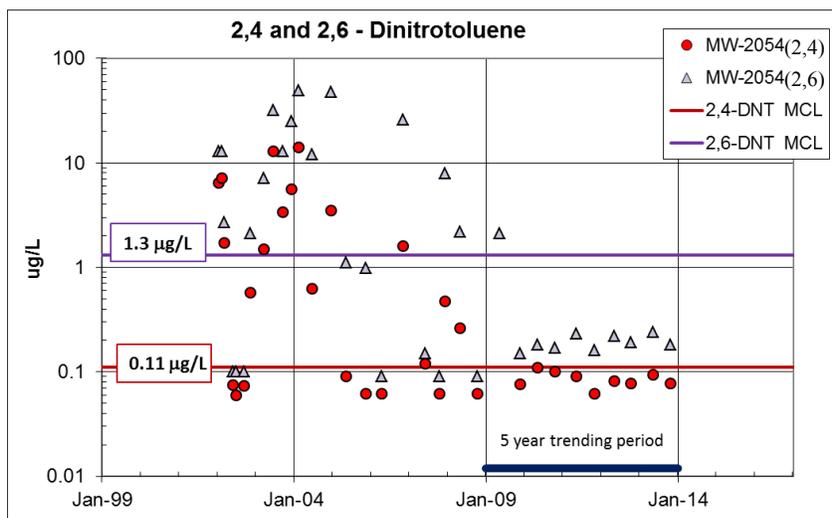


Figure 34. 2,4-DNT and 2,6-DNT Concentrations in MW-2014, MW-2052, and MW-2054

Table 22. Trending Analysis for 2,4-DNT in Objective 2 MNA Wells in the Former Frog Pond Area (2009–2013)

Location	No. of Samples	Trend	Slope (µg/L/yr)	Confidence Intervals	
				Lower	Upper
MW-2012	10	None	0.18	-0.39	10.41
MW-2014	10	None	-0.02	-0.09	0.01
MW-2050	10	Down	-6.47	-9.36	-4.07
MW-2052	10	None	0.00	0.02	0.01
MW-2053	10	None	0.00	-7.09	0.34
MW-2054	10	None	0.00	-0.01	0.02

µg/L/yr = microgram(s) per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Trend analysis of the last 5 years of 2,6-DNT data indicates no trends in any of the wells except MW-2050, which has a slight decreasing trend that is statistically significant based on the Mann-Kendall criteria (Table 23). Concentrations of 2,6-DNT are relatively stable in wells MW-2014, MW-2052, and MW-2054, where slopes and confidence intervals are small. Figure 36 shows the locations of the 2,6-DNT Objective 2 wells and their relative trends.

Table 23. Trending Analysis for 2,6-DNT in Objective 2 MNA Wells (2009–2013)

Location	No. of Samples	Trend	Slope (µg/L/yr)	Confidence Intervals	
				Lower	Upper
MW-2012	10	None	1.44	-1.97	25.89
MW-2014	10	None	0.01	-0.05	0.05
MW-2050	10	Down	-1.72	-4.10	0.00
MW-2052	10	None	0.02	-0.02	0.05
MW-2053	10	None	-4.92	-48.75	9.00
MW-2054	10	None	0.004	-0.10	0.03

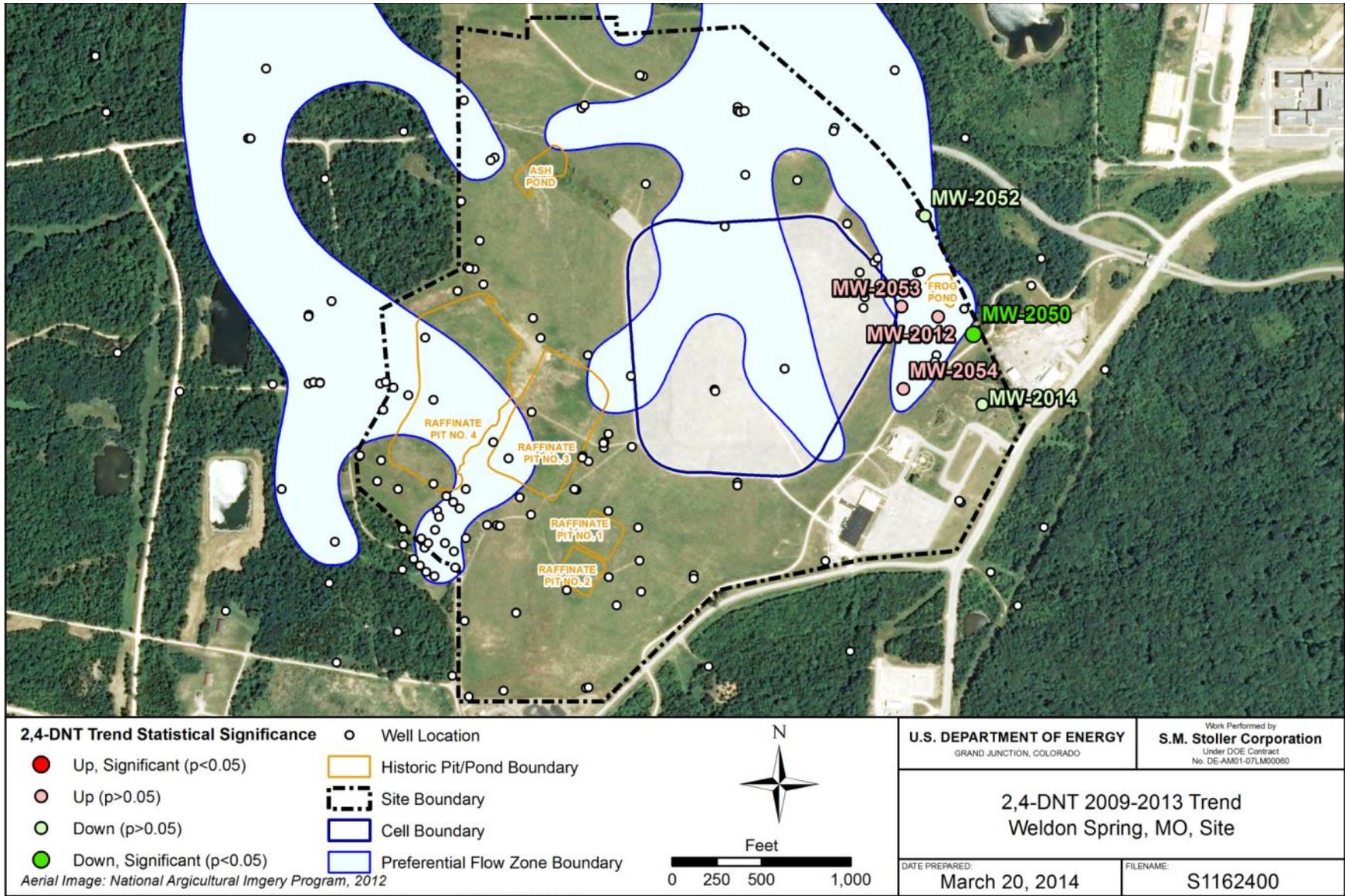
µg/L/yr = microgram(s) per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Nitrobenzene

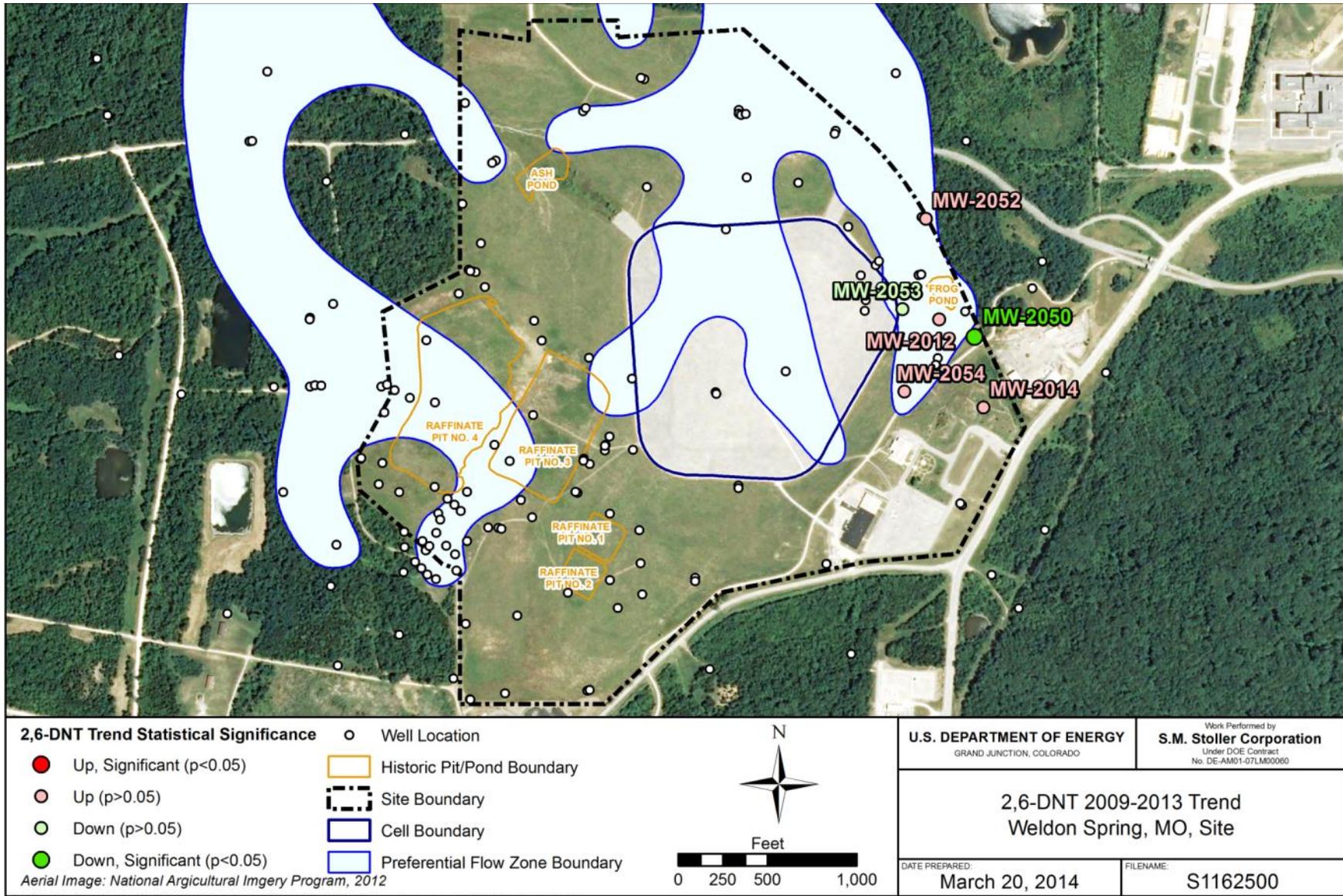
Well MW-2012 is the only location where NB is monitored. NB has not been detected at this location since 2002, when a one-time detection of 69 µg/L was reported. The cleanup standard for NB is 17 µg/L.

Overall, nitroaromatic compound impact in the vicinity of the former Frog Pond area is confined to the weathered unit of the Burlington-Keokuk Limestone. The concentrations of 2,4-DNT and 2,6-DNT continue to be variable; however, samples from only a few locations exceed the cleanup standards, and no statistically significant upward trends have been identified in the data from the past 5 years. Concentrations of 1,3-DNB, 2,4,6-TNT, and NB are less than the cleanup standards in the Objective 2 wells.



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Figure 35. Trend Map of Objective 2 2,4-DNT Wells



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Figure 36. Trend Map of Objective 2 2,6-DNT Wells

Nitroaromatic Compounds—Former Raffinate Pits Area

The other area of nitroaromatic compound impact at the former Chemical Plant site is in the former Raffinate Pits area, where portions of TNT-production lines #3 and #4 (Figure 18) were located. Groundwater in this area is impacted by 2,4-DNT in concentrations that exceed the cleanup standard of 0.11 µg/L. Nitroaromatic compound impact is isolated to the weathered unit of the Burlington-Keokuk Limestone. Table 24 presents a summary of the 2,4-DNT data from the former Raffinate Pits area for 2013.

Table 24. 2013 2,4-DNT Data from GWOU Objective 2 Wells in the Former Raffinate Pits Area

Location	2,4-DNT Concentration (µg/L)	
	S1	S2
MW-2038	0.11 May 14, 2013	0.13 Oct 22, 2013
MW-3030	0.62 June 18, 2013	0.58 Dec 9, 2013
MW-3034	0.058 (J) May 14, 2013	0.055 (J) Dec 9, 2013
MW-3039	0.17 May 14, 2013	0.12 Oct 22, 2013

µg/L = microgram per liter

S1, S2 = semiannual sampling periods

J = estimated value less than the reporting limit

Objective 2 locations monitor to verify that contaminant concentrations are declining

The highest concentrations of 2,4-DNT in this area are in well MW-3030 (Figure 37). Concentrations in wells MW-2038, MW-3034, and MW-3039 have been variable, showing substantial decreases since 2004. The concentrations of 2,4-DNT in MW-3034 have been less than or equal to the cleanup standard of 0.11 µg/L since late 2009, and 2,4-DNT concentrations in MW-2038 and MW-3039 are approaching the cleanup standard.

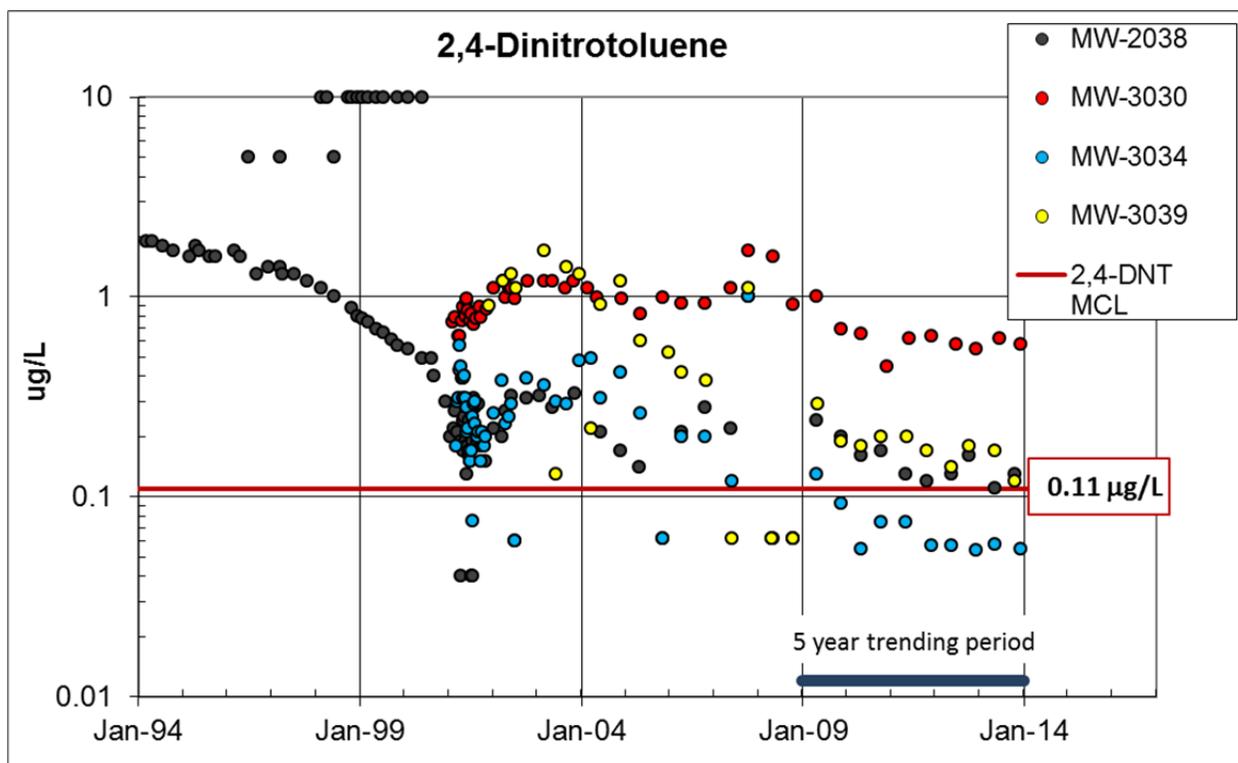


Figure 37. 2,4-DNT Concentrations in Objective 2 Wells in the Former Raffinate Pits Area

Mann-Kendall trend analysis of 2,4-DNT data from the past 5 years from wells in the former Raffinate Pits area indicates concentrations are decreasing with statistically significant downward trends (Table 25). Concentrations of 2,4-DNT in wells MW-2038 and MW-3039 are expected to reach the cleanup standard of 0.11 $\mu\text{g/L}$ within the next few years if the current trends continue.

Table 25. Trending Analysis for 2,4-DNT in Objective 2 MNA Wells in the Former Raffinate Pits Area (2009–2013)

Location	No. of Samples	Trend	Slope ($\mu\text{g/L/yr}$)	Confidence Intervals	
				Lower	Upper
MW-2038	10	Down	-0.023	-0.039	-0.003
MW-3030	10	Down	-0.033	-0.093	0.000
MW-3034	10	Down	-0.009	-0.018	0.000
MW-3039	10	Down	-0.018	-0.041	-0.003

$\mu\text{g/L/yr}$ = microgram per liter per year

Objective 2 locations monitor to verify that contaminant concentrations are declining

Overall, nitroaromatic compound impact in the former Raffinate Pits area is confined to the weathered unit of the Burlington-Keokuk Limestone. The concentrations of 2,4-DNT are decreasing in all Objective 2 wells, and concentrations in wells MW-2038 and MW-3039 will likely reach the cleanup standard in the next several years.

5.2.1.8 *Detection Monitoring Results for the GWOU*

Detection monitoring consists of sampling to fulfill Objectives 3, 4, and 5 of the MNA strategy. Wells along the fringes and downgradient (both laterally and vertically) of the areas of impact are monitored to ensure that lateral and vertical migration remains within the current area of impact and that expected lateral downgradient migration within the paleochannels is minimal or nonexistent. Springs and a surface water location on Dardenne Creek are also monitored as part of this program, as these are the closest groundwater discharge points for the shallow aquifer in the vicinity of the former Chemical Plant. These locations are monitored to ensure that concentrations remain protective of human health and the environment and that water quality continues to improve in the springs.

Contaminant concentrations are monitored using 21 wells, 4 springs, and 1 surface water location situated along the fringes or downgradient of the areas of highest impact of the different contaminant plumes at the site. The monitoring well locations were sampled at least once in 2013 and the springs were sampled quarterly, though not for every constituent. Several wells and Burgermeister Spring were sampled bimonthly as part of a special study (see Section 5.2.1.9).

Uranium

Data from the detection monitoring network indicate that uranium is migrating along the preferential flow pathways (paleochannels), as expected. Uranium levels exceeding the MCL of 20 pCi/L were reported in MW-4036 (located in the western paleochannel limb) during the second and third bimonthly sampling periods. The uranium levels in the remainder of the wells screened in either the weathered or unweathered unit are low and have been stable over time. Table 26 presents a summary of the uranium values for samples collected in 2013.

Uranium levels in Burgermeister Spring (SP-6301) have been variable but within historical ranges and well below the trigger level of 150 pCi/L (Figure 38). The variability is also apparent in the results of the six samples taken in 2013 where the three samples in the last part of the year are approximately double those taken during the first part of the year (Table 26). Periodic increases in uranium levels in Burgermeister Spring may be related to the infrequent increases that occur in groundwater in the former Raffinate Pits area (DOE 2012). Samples taken from Burgermeister Spring Branch (SP-6303) during 2013 had very low uranium concentrations (Table 26). Uranium levels in Dardenne Creek have been low since monitoring resumed at location SW-2007 in 2001.

Mann-Kendall trend analysis of the last 5 years of data indicates that uranium levels in SP-6301 were trending upward and that no trend was detected in the low concentrations of SP-6303 during this time frame (Table 27). A visual inspection of the data suggests that focusing on the last 5 years of data for SP-6301 is likely misleading in that there is an apparent long-term downward trend. A plot of the data with an attenuation line that decreases an order of magnitude in 60 years indicates that uranium concentrations in SP-6301 will decline to levels at which most results will be below the cleanup standard by 2045 (Figure 39).

Table 26. 2013 Uranium Data for GWOU Objective 3, 4, and 5 Locations

Sample ID	Unit/Location	Uranium (pCi/L)					
Weathered Unit (Objective 3 wells)							
MW-3037	Fringe	2.4 May 14, 2013			2.8 Oct 7, 2013		
MW-4026	Southeast Drainage (alluvium)	ND (<0.034) May 13, 2013			0.085 Oct 1, 2013		
MW-4036	Downgradient	17.2 Feb 13	50.8 Apr 1	61.8 June 17	8.2 Aug 1	5.0 Oct 13	4.8 Dec 2
MW-4041	Downgradient	1.3 Feb 12	1.4 Apr 4	1.5 June 17	1.7 Aug 1	1.5 Oct 1	1.5 Dec 3
MWS-1	Downgradient	0.67 Feb 13	0.72 Apr 2	0.95 June 17	0.74 Aug 1	0.78 Oct 1	0.73 Dec 2
MWS-4	Downgradient	0.39 May 13, 2013			0.44 Oct 1, 2013		
Unweathered Unit (Objective 4 wells)							
MW-3006	Fringe	0.61 Feb 26	0.54 Apr 1	0.58 June 17	0.52 Aug 1	0.63 Oct 7	0.63 Dec 2
MW-4042	Downgradient	0.24 Feb 13	0.21 Apr 2	0.20 June 11	0.25 Aug 1	0.25 Oct 3	0.27 Dec 2
MWD-2	Downgradient	0.16 Feb 13	0.22 Apr 2	0.16 June 10	0.22 Aug 1	0.20 Oct 1	0.21 Dec 2
Springs and Surface Water (Objective 5 locations)							
SP-5303	Southeast Drainage	39.3 Feb 12, 2013		32.5 Apr 4, 2013	57.5 July 23, 2013		dry
SP-5304	Southeast Drainage	45.2 Feb 12, 2013		39.9 Apr 4, 2013	56.0 July 23, 2013		81.9 Oct 1, 2013
SP-6301	Burgermeister Spring	29.8 Feb 25	27.8 Apr 4	23.4 June 17	48.1 Aug 6	48.3 Oct 1	58.2 Dec 10
SP-6303	Burgermeister Spring Branch	0.18 Mar 11	0.32 Apr 4	dry	dry	dry	dry
SW-2007	Dardenne Creek	1.44 Apr 2, 2013			0.77 Oct 1, 2013		

Semi-annual samples	S1			S2			
Quarterly samples	Q1		Q2		Q3		Q4
Bimonthly samples	B1	B2	B3	B4	B5	B6	

J = estimated value less than the reporting limit; pCi/L = picocurie(s) per liter

Values in **bold** exceed the MCL of 20 pCi/L

NS = Not Sampled

ND = analyte not detected above reporting limit indicated in parenthesis

Objective 3 locations monitor for lateral migration of contamination

Objective 4 locations monitor for vertical migration of contamination

Objective 5 locations monitor contaminant levels at the impacted springs

Table 27. Trending Analysis for Uranium in SP-6301 and SP-6303 (2009–2013)

Location	No. of Samples	Trend	Slope (pCi/L/yr)	Confidence Intervals	
				Lower	Upper
SP-6301	30	Up	4.53	0.56	7.95
SP-6303	11	None	-0.08	-0.24	0.09

pCi/L/yr = picocurie(s) per liter per year

Objective 5 locations monitor contaminant levels at the impacted springs

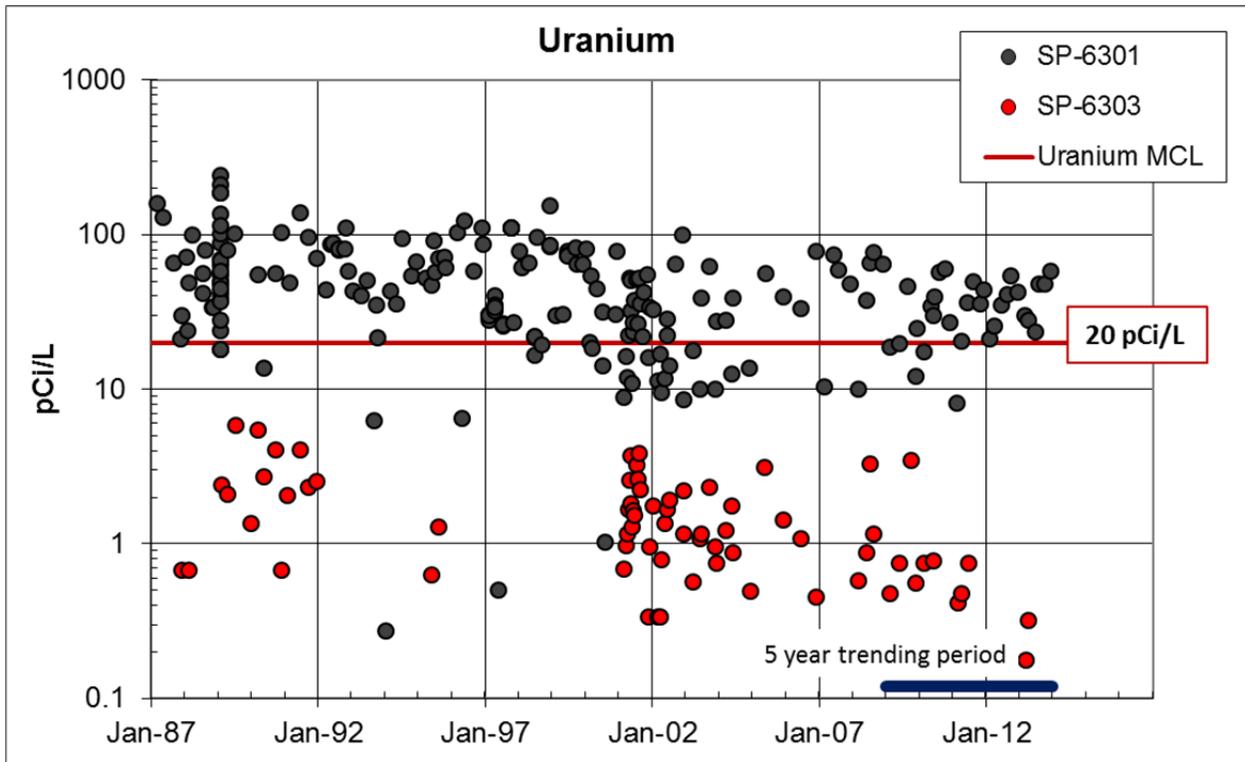
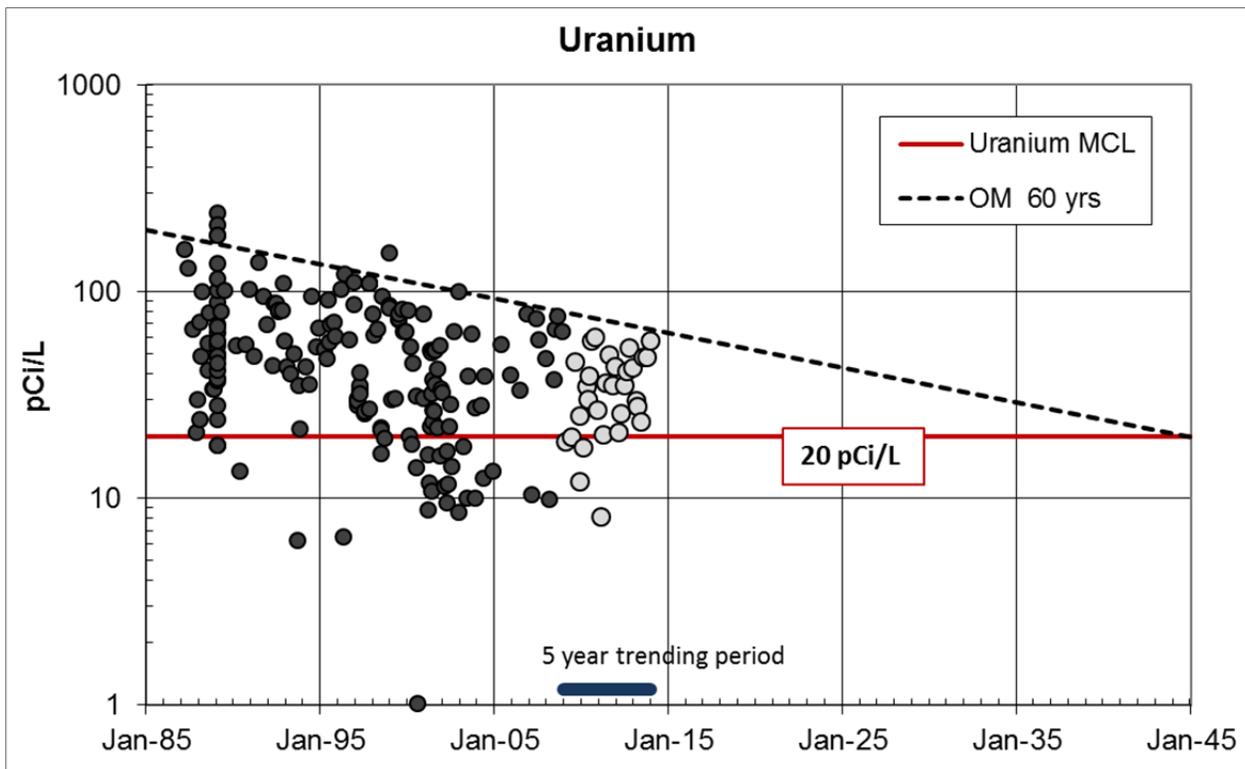


Figure 38. Uranium Levels in Springs SP-6301 and SP-6303



Note: The results from the 5 year trending period are gray.
 OM = order of magnitude decrease for the given time period

Figure 39. Long-term Projection of Uranium Levels in Spring SP-6301 (Uranium at or Below MCL)

Uranium impact in the Southeast Drainage is the result of historical discharges to this drainage during plant operation that resulted in the contamination of soil and sediment. The source of uranium in the two springs is residually contaminated sediments within the bedrock fracture system. The uranium levels in the two Southeast Drainage springs monitored under this program have been less variable in the past few years (Figure 40), and the behavior of uranium is similar in both springs. Uranium levels in both springs exceed the MCL but are less than the trigger level of 150 pCi/L. Uranium levels in MW-4026, downgradient of the two springs, were within the range of background levels.

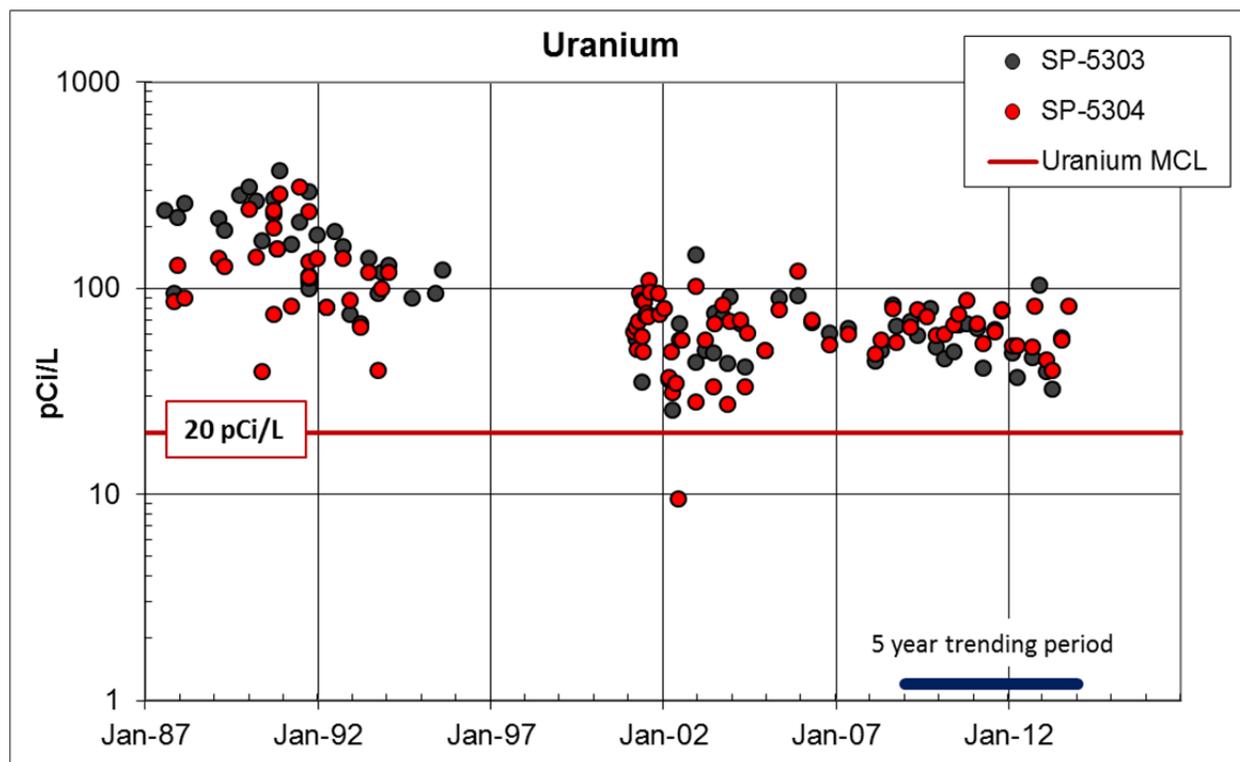


Figure 40. Uranium Levels in Southeast Drainage Springs (1987–2013)

Mann-Kendall trend analysis of the last 5 years of data from SP-5303 and SP-5304 indicates that uranium levels were relatively stable during this time period, as indicated by small confidence interval slopes (Table 28). Analysis of the data indicates downward uranium trends for both springs and a statistically significant downward trend for SP-5303. A visual inspection of the data confirms the long-term downward trend of uranium at both springs.

Table 28. Trending Analysis for Uranium in SP-5303 and SP-5304 (2009–2013)

Location	No. of Samples	Trend	Slope (pCi/L/yr)	Confidence Intervals	
				Lower	Upper
SP-5303	19	Down	-4.0	-10.4	2.2
SP-5304	20	None	-4.0	-8.1	1.4

pCi/L/yr = picocuries per liter per year

Objective 5 locations monitor contaminant levels at the impacted springs

In summary, while uranium levels in the Raffinate Pits area have changed since implementation of the MNA remedy for uranium (increases in several Objective 2 wells), overall, the remedy remains protective, as indicated by data from the Objective 3, 4, and 5 monitoring locations. Groundwater flow directions are unchanged in the Raffinate Pits area. Impacted groundwater is contained within the paleochannel in this area and is migrating along the expected pathways. Discharge from the impacted portion of the unweathered unit into the weathered unit is monitored at MW-4036. Uranium levels in Objective 3–far wells remain low, and levels in Burgermeister Spring, while variable, are declining when considered in the context of a 25 year timeframe.

Nitrate (as N)

The nitrate concentrations in the detection monitoring wells indicate that the movement of impacted groundwater is behaving as expected. Nitrate concentrations in well MWS-1 exceeded the 10 mg/L MCL for nitrate. Data from MWS-1 were consistent with historical data and are less than the trigger level of 30 mg/L (as N). The nitrate concentrations in the remainder of the wells screened in either the weathered or unweathered unit were below the MCL and continue to be stable. Nitrate data reported in the springs were consistent with historical data. Table 29 presents a summary of the data.

The nitrate concentrations in Burgermeister Spring are less than the 10 mg/L MCL, ranging between 1.6 mg/L and 4.4 mg/L in 2013. Nitrate concentrations in Burgermeister Spring have been less than the MCL since 2005, and nitrate concentrations in SP-6303 have been less than the MCL since monitoring resumed in 2006 (Figure 41). The two high 2011 sample results were rejected during data validation and were excluded from trend calculations.

Table 29. 2013 Nitrate (as N) Data for GWOU Objective 3, 4, and 5 Locations

Sample ID	Unit/Location	Nitrate (as N) (mg/L)			
Weathered Unit					
MW-4014	Fringe	7.2 May 14, 2013			
MW-4041	Downgradient	0.31 June 17, 2013			
MWS-1	Downgradient	17.9 June 17, 2013			
MWS-4	Downgradient	2.3 May 13, 2013			
Unweathered Unit					
MW-2021	Vertical Extent	0.041 (J) May 13, 2013			
MW-2022	Vertical Extent	0.034 (J) May 14, 2013			
MW-3006	Fringe	ND (<0.017) June 17, 2013			
MW-4007	Downgradient	ND (<0.017) June 11, 2013			
MW-4042	Downgradient	ND (<0.017) June 11, 2013		ND (<0.017) Oct 3, 2013	
MWD-2	Downgradient	ND (<0.017) June 10, 2013			
Springs and Surface Water					
SP-6301	Burgermeister Spring	1.6 Feb 25, 2013	1.6 June 17, 2013	4.4 Aug 6, 2013	4.3 Dec 10, 2013
SP-6303	Burgermeister Spring Branch	1.5 Mar 11, 2013	dry	dry	dry

Values in **bold** exceed the MCL of 10 mg/L.

mg/L = milligram(s) per liter; ND = not detected above the reporting limit

Note 1: Data were rejected through verification/validation process.

Objective 3 locations monitor for lateral migration of contamination

Objective 4 locations monitor for vertical migration of contamination

Objective 5 locations monitor contaminant levels at the impacted springs

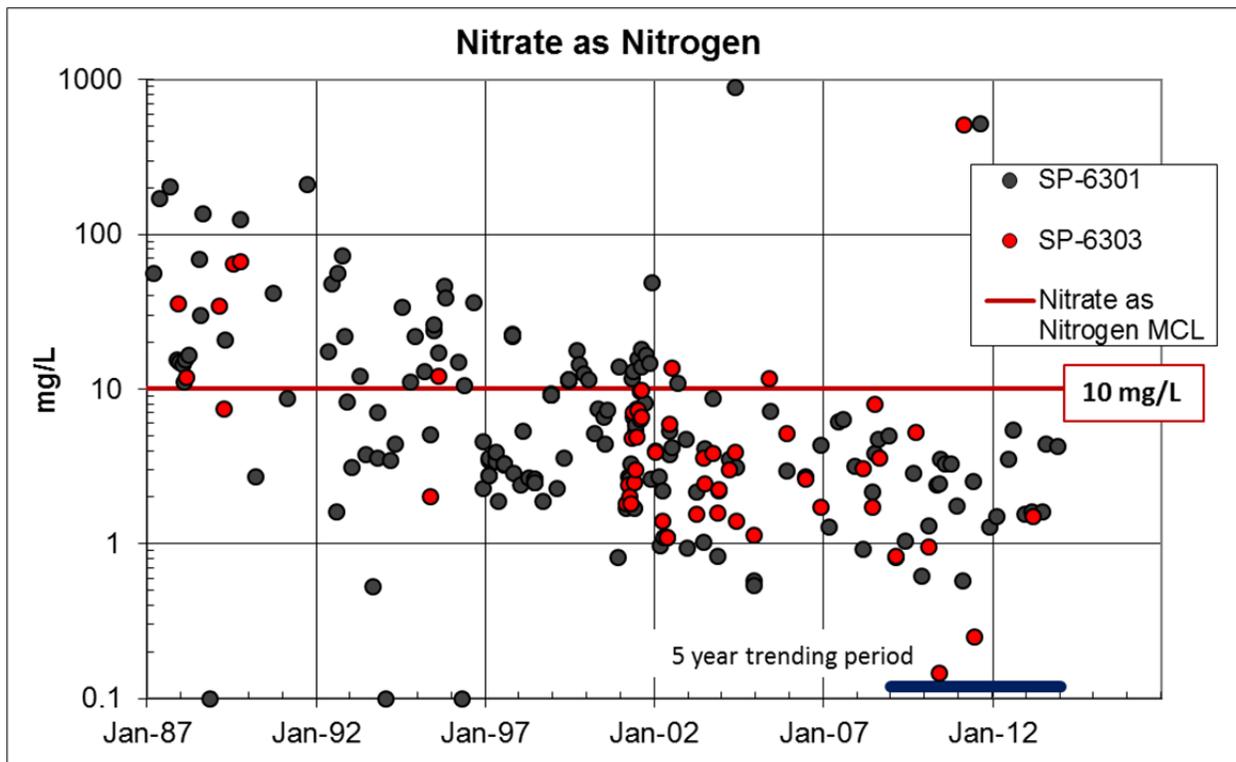


Figure 41. Nitrate Concentrations in SP-6301 and SP-6303

Mann-Kendall trend analysis of the last 5 years of data from Burgermeister Spring (SP-6301) and SP-6303 indicates that nitrate concentrations are increasing, as indicated by positive slopes (Table 30). A visual inspection of the data suggests the trend results using only 2009–2013 data are likely misleading in that there is an apparent long-term downward trend in the data. As with the uranium data from these springs, the natural variability in results is fairly large, about an order of magnitude. This makes the timing of the beginning and end of the trending period critical to the calculated trend results. All nitrate concentration results have been below the MCL in both springs for almost 10 years and should begin to stabilize at a low value.

Table 30. Trending Analysis for Nitrate (as N) in SP-6301 and SP-6303 (2009–2013)

Location	No. of Samples	Trend	Slope (mg/L/yr)	Confidence Intervals	
				Lower	Upper
SP-6301	22	Up	0.31	0.01	0.81
SP-6303	8	None	0.11	-2.64	0.48

mg/L/yr = milligrams per liter per year

Objective 5 locations monitor contaminant levels at the impacted springs

Trichloroethene

Detections of TCE were not reported in the detection monitoring wells or SP-6301. The data from the past 5 years indicate that the area of TCE impact has not expanded, either laterally or vertically. No detectable concentrations of the degradation products *cis*-1,2-DCE,

trans-1,2-DCE, or vinyl chloride were reported in any of the detection monitoring locations. Table 31 presents a summary of the TCE data.

Table 31. 2013 TCE Data for GWOU Objective 3, 4, and 5 Locations

Sample ID	Unit/Location	TCE (µg/L)			
Weathered Unit					
MW-3037	Fringe	ND (<0.16) May 14, 2013			
MW-4036	Downgradient	ND (<0.3) June 17, 2013			
MW-4041	Downgradient	ND (<0.3) June 17, 2013			
MWS-1	Downgradient	ND (<0.3) June 17, 2013			
MWS-4	Downgradient	ND (<0.16) May 13, 2013			
Unweathered Unit					
MW-3006	Fringe	ND (<0.3) June 17, 2013			
MW-4007	Downgradient	ND (<0.3) June 11, 2013			
MW-4040	Vertical Extent	ND (<0.3) June 17, 2013			
Springs and Surface Water					
SP-6301	Burgermeister Spring	ND (<0.16) Feb 25, 2013	ND (<0.3) June 17, 2013	ND (<0.16) Aug 6, 2013	ND (<0.3) Dec 10, 2013
SP-6303	Burgermeister Spring Branch	ND (<0.16) Mar 11, 2013	dry	dry	dry

µg/L = microgram per liter

ND = not detected above the detection limit shown in parentheses.

Objective 3 locations monitor for lateral migration of contamination

Objective 4 locations monitor for vertical migration of contamination

Objective 5 locations monitor contaminant levels at the impacted springs

Nitroaromatic Compounds

Detection monitoring results for 1,3-DNB indicate that the impacted groundwater in the overlying weathered unit has not migrated from the area of known impact (Table 32). Fringe location MW-2051 had an estimated concentration of 1,3-DNB less than the reporting limit and is consistent with historical data. An estimated concentration of 1,3-DNB was reported in the third quarter results from SP-6301.

The concentrations of 2,4,6-TNT reported in the weathered unit detection monitoring wells indicate that impacted groundwater has not migrated beyond the area of known impact (Table 33). Fringe location MW-2051 had estimated concentrations of 2,4,6-TNT less than the reporting limit; this concentration is consistent with historical data. No detectable concentrations of 2,4,6-TNT were reported in unweathered unit wells or in Burgermeister Spring.

Table 32. 2013 1,3-DNB Data for GWOU Objective 3, 4, and 5 Locations

Sample ID	Location	1,3-DNB (µg/L)			
Weathered Unit					
MW-2032	Fringe	ND (<0.014) June 19, 2013		ND (<0.014) Dec 9, 2013	
MW-2051	Fringe	0.031 (J) June 18, 2013		0.035 (J) Dec 10, 2013	
MW-4014	Downgradient	ND (<0.014) May 14			
MW-4039	Fringe	ND (<0.013) May 8, 2013		ND (<0.014) Oct 23, 2013	
MW-4041	Downgradient—Far	ND (<0.014) June 17, 2013			
Unweathered Unit					
MW-2022	Vertical Extent	ND (<0.014) May 14, 2013			
MW-2023	Vertical Extent	ND (<0.013) May 14, 2013			
MW-2056	Vertical Extent	ND (<0.014) May 8, 2013			
Springs					
SP-6301	Burgermeister Spring	ND (<0.014) Feb 25, 2013	ND (<0.013) June 17, 2013	0.014 (J) Aug 6, 2013	ND (<0.013) Dec 10, 2013
SP-6303	Burgermeister Spring Branch	0.016 (J) Mar 11, 2013	dry	dry	dry

J = estimated value less than reporting limit; µg/L = microgram per liter;

ND = nondetect above method detection limit indicated in parentheses

Objective 3 locations monitor for lateral migration of contamination

Objective 4 locations monitor for vertical migration of contamination

Objective 5 locations monitor contaminant levels at the impacted springs

Table 33. 2013 2,4,6-TNT Data for GWOU Objective 3, 4, and 5 Locations

Sample ID	Location	2,4,6-TNT (µg/L)			
Weathered Unit					
MW-2032	Fringe	ND (<0.021) June 19, 2013		ND (<0.021) Dec 9, 2013	
MW-2051	Fringe	0.078 (J) June 18, 2013		0.060 (J) Dec 10, 2013	
MW-4014	Downgradient	ND (<0.021) May 14, 2013			
MW-4039	Fringe	ND (<0.021) May 8, 2013		ND (<0.022) Oct 23, 2013	
MW-4041	Downgradient—Far	ND (<0.021) June 17, 2013			
Unweathered Unit					
MW-2022	Vertical Extent	ND (<0.021) May 14, 2013			
MW-2023	Vertical Extent	ND (<0.021) May 14, 2013			
MW-2056	Vertical Extent	ND (<0.021) May 8, 2013			
Springs					
SP-6301	Burgermeister Spring	ND (<0.022) Feb 25, 2013	ND (<0.021) June 17, 2013	ND (<0.022) Aug 6, 2013	ND (<0.021) Dec 10, 2013
SP-6303	Burgermeister Spring Branch	0.031 (J) Mar 11, 2013	dry	dry	dry

J = estimated value less than reporting limit; µg/L = microgram per liter;

ND = nondetect above method detection limit indicated in parentheses

Objective 3 locations monitor for lateral migration of contamination

Objective 4 locations monitor for vertical migration of contamination

Objective 5 locations monitor contaminant levels at the impacted springs

Results from detection monitoring wells in the former Frog Pond area indicate that 2,4-DNT migration in the weathered unit is limited (Table 34), and the concentrations reported in MW-4015 did not exceed the trigger level set for the Objective 3 wells near the Frog Pond area. The concentrations did exceed the cleanup standard of 0.11 µg/L but are consistent with historical data. The data from the unweathered unit wells indicate that the impacted groundwater in the overlying weathered unit has not moved downward. Estimated concentrations below the reporting limit were reported in Burgermeister Spring and are consistent with historical data.

Detection monitoring results from wells in the former Raffinate Pits area show that 2,4-DNT migration continues to be minimal from this area (Table 34). The source of the estimated concentration of 2,4-DNT reported in MW-4036 may be the former Chemical Plant site, the Army property, or both. This estimated concentration did not exceed the trigger level set for the Objective 3 wells. Concentrations of 2,4-DNT in well MW-3037 exceeded the cleanup standard but did not exceed the 0.55 µg/L trigger level set for the Objective 3 wells near the former Raffinate Pits. Analytical results for well MW-3037 are typically nondetect for 2,4-DNT, and monitoring will continue for future developments. The data from the unweathered unit wells, all nondetects, verified that the 2,4-DNT-impacted groundwater in the overlying weathered unit has not migrated downward.

Table 34. 2013 2,4-DNT Data for GWOU Objective 3, 4, and 5 Locations

Sample ID	Location	2,4-DNT (µg/L)			
Weathered Unit					
MW-2032	Fringe—FP	ND (<0.018) June 19, 2013		ND (<0.018) Dec 9, 2013	
MW-2051	Fringe—FP	0.060 (J) June 18, 2013		0.057 (J) Dec 10, 2013	
MW-3037	Fringe—RP	0.29 May 14, 2013			
MW-4013	Downgradient—FP	0.068 (J) May 14, 2013			
MW-4014	Downgradient—FP	0.031 (J) May 14, 2013			
MW-4015	Downgradient—FP	0.12 May 14, 2013			
MW-4036	Downgradient—RP	0.026 (J) June 17, 2013			
MW-4039	Fringe—FP	ND (<0.018) May 8, 2013		ND (<0.019) Oct 23, 2013	
MW-4041	Downgradient—Far	ND (<0.018) June 17, 2013			
MWS-1	Downgradient—RP	ND (<0.018) June 17, 2013			
Unweathered Unit					
MW-2023	Vertical Extent—FP	ND (<0.018) May 14, 2013			
MW-2056	Vertical Extent—FP	ND (<0.018) May 8, 2013			
MW-3006	Vertical Extent—RP	ND (<0.018) June 17, 2013			
MW-4040	Vertical Extent—RP	ND (<0.018) June 17, 2013			
Springs					
SP-6301	Burgermeister Spring	ND (<0.019) Feb 25, 2013	ND (<0.018) June 17, 2013	0.019 (J) Aug 6, 2013	ND (<0.018) Dec 10, 2013
SP-6303	Burgermeister Spring Branch	0.071 (J) Mar 11, 2013	dry	dry	dry

FP = Frog Pond area; J = estimated value less than reporting limit; µg/L = microgram per liter; ND = nondetect above method detection limit indicated in parentheses; RP = Raffinate Pits area
 Objective 3 locations monitor for lateral migration of contamination
 Objective 4 locations monitor for vertical migration of contamination
 Objective 5 locations monitor contaminant levels at the impacted springs

Potential downgradient migration of 2,6-DNT from the former Frog Pond area is monitored by the Objective 3 wells listed in Table 35. Concentrations in these wells are consistent with historical data. No 2,6-DNT was detected in samples from wells in the unweathered unit. The concentrations reported in Burgermeister Spring are low and consistent with historical data. None of the reported concentrations exceeded the trigger levels set for the Objective 3 or 4 wells or the Objective 5 springs.

The nitroaromatic compound NB has not been detected in any of the Objective 3, 4, or 5 monitoring locations since the MNA program began in 2004.

Table 35. 2013 2,6-DNT Data for GWOU Objective 3, 4, and 5 Locations

Sample ID	Location	2,6-DNT (µg/L)			
Weathered Unit					
MW-2032	Fringe	ND (<0.021) June 19, 2013		ND (<0.021) Dec 9, 2013	
MW-2051	Fringe	0.024 (J) June 18, 2013		0.027 (J) Dec 10, 2013	
MW-4013	Downgradient	0.54 May 14, 2013			
MW-4014	Downgradient	0.18 May 14, 2013			
MW-4015	Downgradient	1.0 May 14, 2013			
MW-4039	Fringe	ND (<0.021) May 8, 2013		ND (<0.022) Oct 23, 2013	
MW-4041	Downgradient—Far	ND (<0.021) June 17, 2013			
Unweathered Unit					
MW-2023	Vertical Extent	ND (<0.021) May 14, 2013			
MW-2056	Vertical Extent	ND (<0.021) May 8, 2013			
Springs					
SP-6301	Burgermeister Spring	0.026 (J) Feb 25, 2013	0.047 (J) June 17, 2013	0.11 Aug 6, 2013	0.071 (J) Dec 10, 2013
SP-6303	Burgermeister Spring Branch	0.23 Mar 11, 2013	dry	dry	dry

J = estimated value less than reporting limit;

µg/L = microgram per liter;

ND = nondetect above method detection limit indicated in parentheses

Objective 3 locations monitor for lateral migration of contamination

Objective 4 locations monitor for vertical migration of contamination

Objective 5 locations monitor contaminant levels at the impacted springs

5.2.1.9 GWOU Special Study—Elevated Uranium in the Unweathered Unit

An issue identified in the Fourth Five-Year Review (DOE 2011) was that a specific monitoring program has not been established for uranium in the unweathered unit of the Burlington-Keokuk Limestone unit at the site. The uranium impact in this deeper unit was identified after design and implementation of the MNA remedy for the site. The Five-Year Review recommended (1) that the MNA program should be evaluated and possibly modified with regard to uranium impact in the unweathered unit, and (2) the MNA modification might involve the development of new trigger values and additional monitoring locations.

Ten wells and two springs (Figure 42) were selected to monitor the uranium impact in the unweathered unit in the former Raffinate Pits area. Five of these wells (MW-3024, MW-3040, MW-4040, MW-4042, and MWD-2) are presently included in the MNA monitoring network and used to evaluate uranium impact in the unweathered bedrock unit. Five additional wells (MW-3006, MW-4007, MW-4041, MW-4043, MWS-2) and two springs (SP-6201 and SP-6301) were added to evaluate the groundwater quality for evaluation of adequately fulfilling Objectives 3 and 5. An eleventh well, MW-3003, was added to the special study in late 2012 at

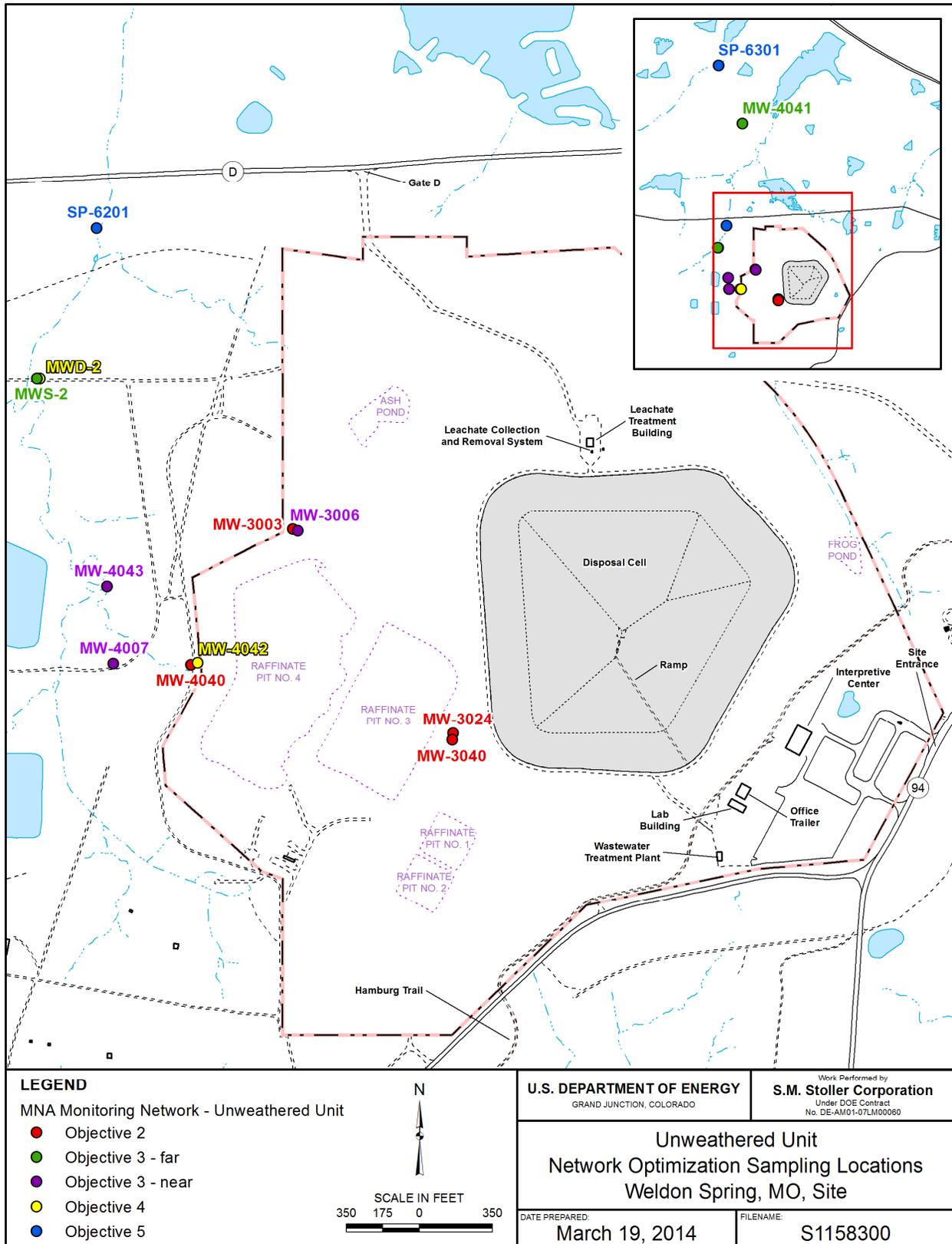


Figure 42. Unweathered Unit Network Optimization Sampling Locations

the request of MDNR. All of the wells are existing wells, and several locations are presently part of the MNA network used for collecting data to evaluate other contaminants of concern. Sampling in support of this evaluation began during the second bimonthly period in 2012 and was completed after the first bimonthly period in 2014.

Samples will be analyzed for total uranium and field parameters (pH, oxidation-reduction potential [ORP], dissolved oxygen, specific conductivity, and turbidity). After 2 years of monitoring, a data set consisting of at least 8 data points will be obtained. These data will be used to determine if the selected monitoring locations fulfill the proposed monitoring objectives outlined in Table 36. Also, these data will be used to establish appropriate triggers. The selected triggers will be consistent with those established in the *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site* (DOE 2004b).

Table 36 is a summary of 2013 data from the wells and springs included in the special study.

Table 36. 2013 Uranium Data from MNA Network Optimization Monitoring

Uranium Concentration (pCi/L)						
Location	B1	B2	B3	B4	B5	B6
MW-3003	2.9 Feb 12, 2013	3.0 Apr 1, 2013	3.7 June 10, 2013	2.7 Aug 1, 2013	2.9 Oct 7, 2013	2.9 Dec 2, 2013
MW-3006	0.61 Feb 26, 2013	0.54 Apr 1, 2013	0.58 June 17, 2013	0.52 Aug 1, 2013	0.63 Oct 7, 2013	0.63 Dec 2, 2013
MW-3024	117 Feb 12, 2013	118 Apr 1, 2013	144 June 10, 2013	132 Aug 1, 2013	141 Oct 3, 2013	134 Dec 2, 2013
MW-3040	114 Feb 12, 2013	110 Apr 1, 2013	144 June 12, 2013	119 Aug 1, 2013	135 Oct 3, 2013	130 Dec 2, 2013
MW-4007	2.2 Feb 26, 2013	2.3 Apr 1, 2013	2.6 June 11, 2013	2.6 Aug 1, 2013	2.6 Oct 3, 2013	2.6 Dec 2, 2013
MW-4041	1.3 Feb 12, 2013	1.4 Apr 4, 2013	1.5 June 17, 2013	1.7 Aug 1, 2013	1.5 Oct 1, 2013	1.5 Dec 3, 2013
MW-4042	0.24 Feb 13, 2013	0.21 Apr 2, 2013	0.20 June 11, 2013	0.25 Aug 1, 2013	0.25 Oct 3, 2013	0.27 Dec 2, 2013
MW-4043	74 Feb 26, 2013	71 Apr 1, 2013	63 June 17, 2013	68 Aug 6, 2013	79 Oct 3, 2013	81 Dec 9, 2013
MWS-2	1.7 Feb 26, 2013	1.5 Apr 2, 2013	1.6 June 10, 2013	1.6 Aug 1, 2013	1.7 Oct 1, 2013	1.7 Dec 2, 2013
MWD-2	0.16 Feb 13, 2013	0.22 Apr 2, 2013	0.16 June 10, 2013	0.22 Aug 1, 2013	0.20 Oct 1, 2013	0.21 Dec 2, 2013
SP-6201	3.6 Feb 13, 2013	2.3 Apr 4, 2013	7.9 June 17, 2013	3.8 Aug 1, 2013	Dry	Dry
SP-6301	30 Feb 25, 2013	28 Apr 4, 2013	23 June 17, 2013	48 Aug 6, 2013	48 Oct 1, 2013	58 Dec 10, 2013

pCi/L = picocuries per liter

B1, B2, B3, B4, B5, B6 = Bimonthly sampling periods

5.2.2 Quarry Groundwater

EPA signed the QROU ROD (DOE 1998) on September 30, 1998. The QROU ROD specified long-term groundwater monitoring and ICs to limit groundwater use during the monitoring period. Groundwater north of the Femme Osage Slough will be monitored until a target level of

300 pCi/L for uranium is attained. In addition, groundwater south of the slough will be monitored to ensure protection of human health and the environment.

In 2000, DOE initiated a long-term monitoring program as outlined in the *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit* (DOE 2000b). This network was modified to add wells upgradient of the Quarry (MW-1012), downgradient of the area of impact (MW-1028), and within the area of highest uranium impact (MW-1051 and MW-1052).

5.2.2.1 Hydrogeologic Description

The geology of the Quarry area is separated into three units: upland overburden, Missouri River alluvium, and bedrock. The unconsolidated upland material overlying the bedrock consists of up to 30 ft of silty clay soil and loess deposits and is not saturated (DOE 1989). Three Ordovician formations constitute the bedrock: the Kimmswick Limestone, the limestone and shale of the Decorah Formation, and the Plattin Limestone. The alluvium associated with the Missouri River consists of clays, silts, sands, and gravels and overlies bedrock. The alluvium thickness increases with distance from the edge of the river floodplain toward the river, where the maximum thickness is approximately 100 ft.

Alluvium at the Quarry is truncated by an erosional contact with the Ordovician bedrock bluff consisting of Kimmswick, Decorah, and Plattin Formations. These formations also form the rim wall of the Quarry. The bedrock unit underlying alluvial materials north of Femme Osage Slough is the Decorah Group. Primary sediments between the bluff and the slough are intermixed and interlayered clays, silts, and sands. Organic material is intermixed throughout the sediments. The area between the bedrock bluff and the Femme Osage Slough contains a naturally occurring oxidation-reduction front, which acts as a barrier to the migration of dissolved uranium in groundwater by inducing its precipitation. This reduction zone is the primary mechanism controlling uranium distribution south of the Quarry.

The uppermost groundwater flow systems at the Quarry are composed of alluvial and bedrock aquifers. Water levels in the alluvial aquifer are primarily controlled by surface water levels in the Missouri River and infiltration of precipitation and overland runoff that recharges the bedrock aquifer.

Eight monitoring wells in the Darst Bottom area were used to study the water quality of the Missouri River alluvium upgradient of the Quarry and provide a reference for background values of uranium. Several other bedrock wells were installed north of the quarry to provide background values for uranium in the bedrock units. Table 37 provides a summary of the uranium background values (DOE 1998).

Table 37. Background Uranium Levels for Units at the Quarry

Unit	Uranium (pCi/L)	
	Background Value (UCL ₉₅)	Background Range
Alluvium ^a	2.77	0.1–16
Kimmswick/Decorah ^b	3.41	0.5–8.5
Plattin ^c	3.78 ^d	1.2–5.1

^a Based on data from Darst Bottom wells (U.S. Geological Survey and DOE)

^b Based on data from MW-1034 and MW-1043 (DOE)

^c Based on data from MW-1042 (DOE)

^d This background value is lower than previously published as a result of recent data evaluation.

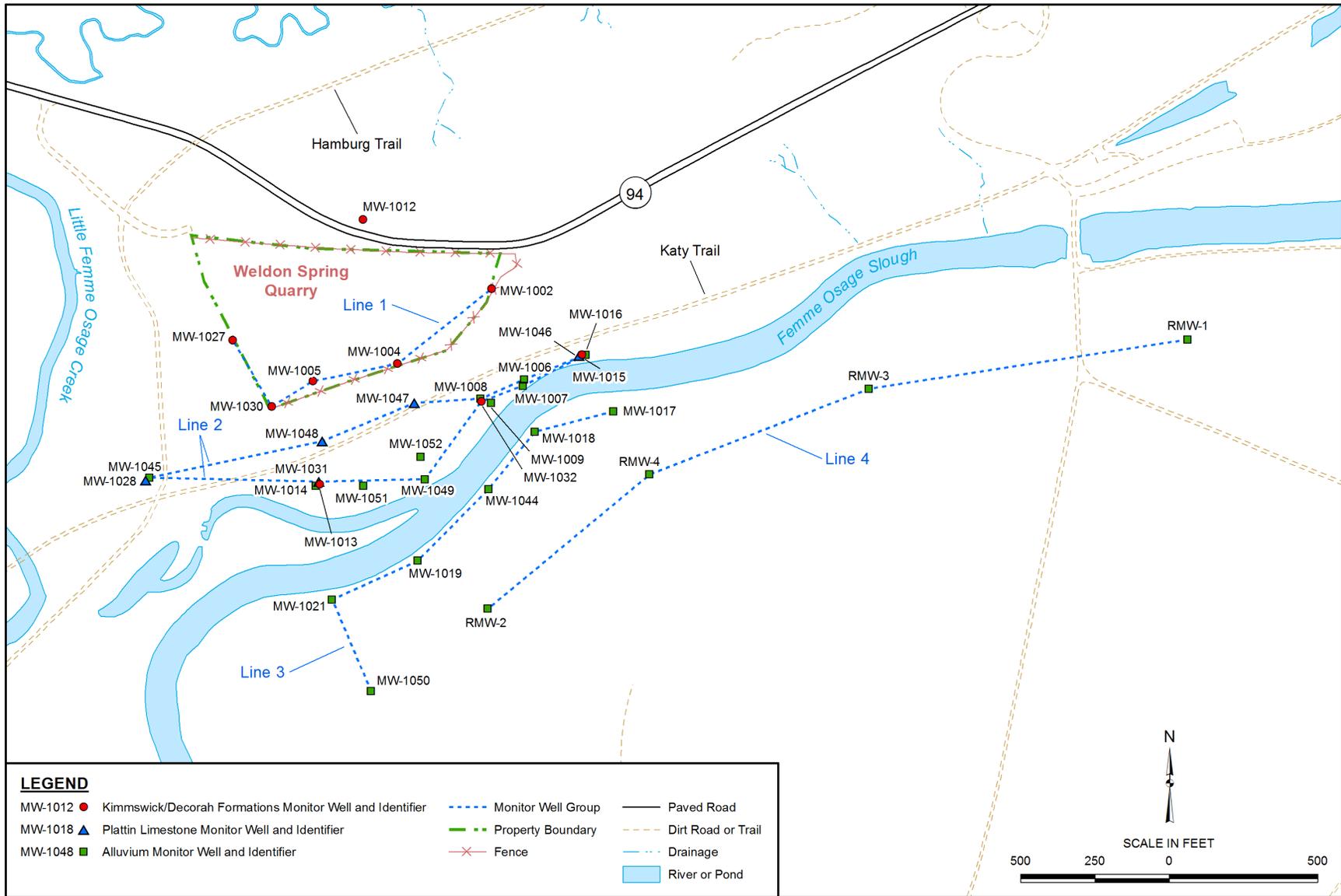
pCi/L = picocurie(s) per liter; UCL₉₅ = 95th percentile upper confident limit on the mean concentration

5.2.2.2 Quarry Monitoring Program

Long-term monitoring at the Quarry is designed to (1) monitor uranium concentrations south of the slough to ensure that they remain protective of human health and the environment, and (2) monitor uranium and 2,4-DNT levels within the area of groundwater impact north of the slough until they attain target levels that have been identified as having a negligible impact on the groundwater south of the slough (DOE 2000a).

The wells were categorized into monitoring lines to address these two monitoring objectives (Figure 43). Each line provides specific information relevant to long-term goals at the Quarry:

- The first line of wells (Line 1) monitors the area of impact within the bedrock rim of the Quarry proper. These wells (MW-1002, MW-1004, MW-1005, MW-1027, and MW-1030) are sampled to establish trends in contaminant concentrations within areas of higher impact.
- The second line of wells monitors the area of impact within alluvial materials and shallow bedrock south of the quarry and north of Femme Osage Slough (MW-1006, MW-1007, MW-1008, MW-1009, MW-1013, MW-1014, MW-1015, MW-1016, MW-1028, MW-1031, MW-1032, MW-1045, MW-1046, MW-1047, MW-1048, MW-1049, MW-1051, and MW-1052). These wells are sampled to establish trends in contaminant concentrations within the area of higher impact and to monitor the oxidizing and reducing conditions within this area that limit uranium migration.
- The third line of wells monitors the alluvium directly south of the slough. These wells (MW-1017, MW-1018, MW-1019, MW-1021, MW-1044, and MW-1050) have shown no impact from Quarry contaminants and are monitored as the first line of warning for potential migration of uranium south of the slough.
- The fourth line of wells monitors the same portion of the alluvial aquifer that supplies the Public Water Supply District #2 (formerly St. Charles County) well field. These wells (RMW-1, RMW-2, RMW-3, and RMW-4) are sampled to monitor the groundwater quality of the productive portions of the alluvial aquifer and to detect potential occurrences of uranium outside the range of natural variation.



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Figure 43. Groundwater Monitoring Well Locations at the Quarry Area of the Weldon Spring, Missouri, Site

Monitoring well MW-1012 has been retained as a background location for the Quarry proper. This well, included with the Line 1 wells, is located north of the Quarry and is screened in the Kimmswick Limestone and Decorah Group.

The sampling frequency for each location was selected to provide adequate reaction time on the basis of travel times from the residual sources and areas of impact to potential receptors. The monitoring frequency of wells on the Quarry rim was decreased from quarterly to semiannually in 2009 due to declining uranium levels. Monitoring wells between the quarry and the Femme Osage Slough, the area of highest impact, are sampled quarterly. Locations south of the slough are sampled semiannually or annually. In 2013, all locations in the Quarry area were sampled for uranium, sulfate, and dissolved iron. A selected group of wells north of the slough was sampled for nitroaromatic compounds.

Testing for temporal trends using the Mann-Kendall method was performed for total uranium and 2,4-DNT data collected between 2009 and 2013. Results for the trending analysis are reported for wells in Lines 1 and 2 of the Quarry monitoring network, as these wells monitor the area of groundwater impact. Trending is used as a general indicator of changes in the groundwater quality in this area.

5.2.2.3 Quarry Hydrogeologic Data Analysis

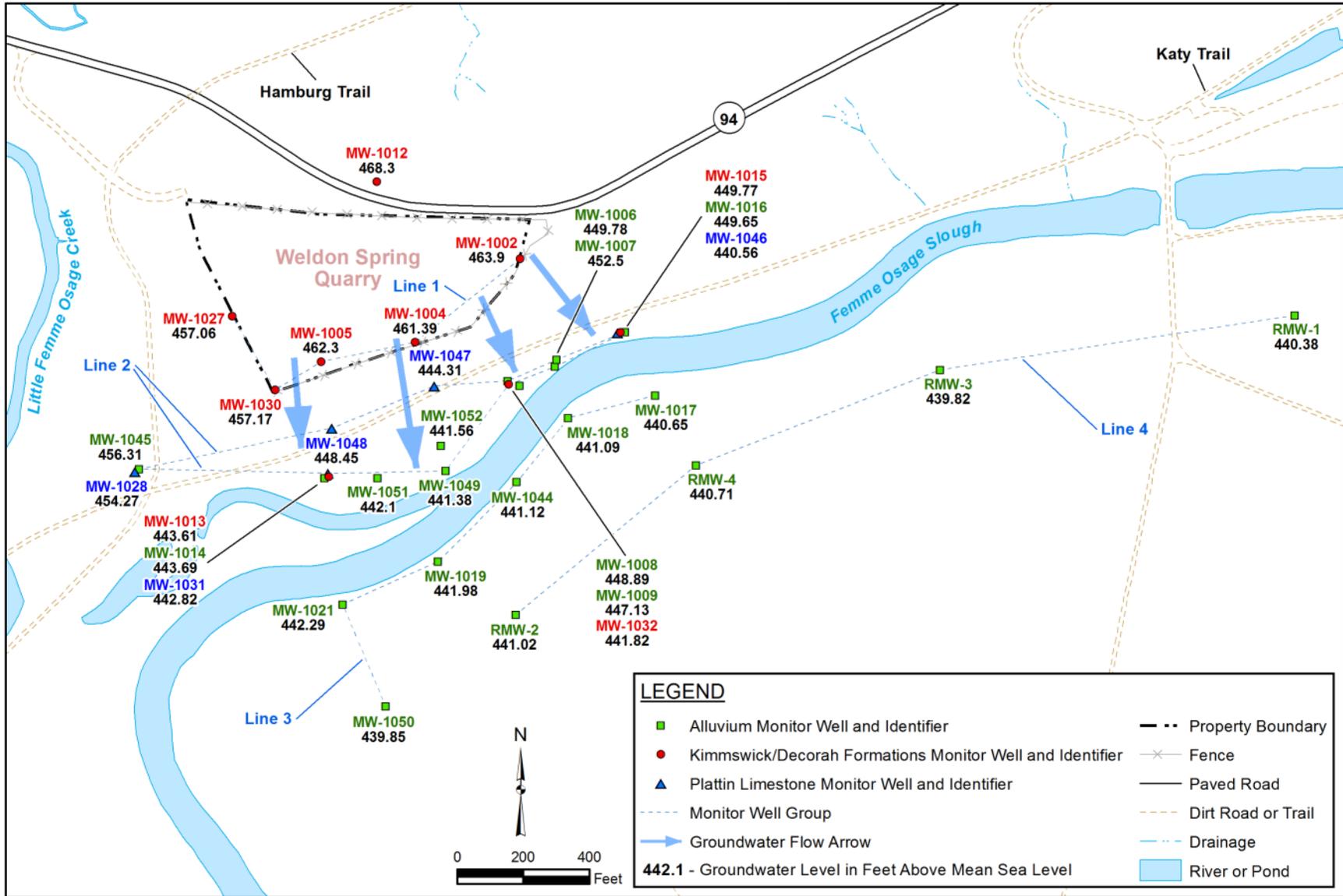
Groundwater flow at the Quarry is monitored using all the wells in the long-term monitoring network. The static groundwater levels of the monitoring network are measured at least quarterly to establish that groundwater flow has not changed significantly and resulted in shifts in potential contaminant migration. Groundwater flow is generally to the south from the bedrock bluff of the Quarry toward the Femme Osage Slough. The flow directions of the shallow groundwater (Figure 44) have remained relatively unchanged from previous years.

Groundwater elevations in the quarry area fluctuate significantly (Figure 45), primarily in response to the level of the Missouri River. The bedrock wells along the quarry rim (Line 1) are less influenced by river levels and have a smaller range of water level variability than wells near the slough and those screened in the Missouri River alluvium (Lines 2, 3, and 4). Water levels of wells in the Quarry area were lower on average in 2013 in response to lower-than-typical river stages caused by drought conditions in the area and upstream.

5.2.2.4 Contaminants of Interest

Uranium and nitroaromatic compounds that leached from wastes in the Quarry proper contaminated the groundwater beneath and downgradient of the Quarry. Contaminant levels have decreased since removal of the wastes from the Quarry. The remaining sources of groundwater contamination are residual material in the fractures and uranium that has precipitated or sorbed onto the alluvial materials north of the Femme Osage Slough.

Uranium entered the shallow aquifer via migration through bedrock fractures in the Kimmswick Limestone and Decorah Formation that constitute the Quarry. Naturally reducing conditions north of the slough limit uranium migration in groundwater by a chemical reduction process that causes uranium precipitation and adsorption onto aquifer materials.



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Figure 44. Groundwater Flow Directions at the Weldon Spring Quarry

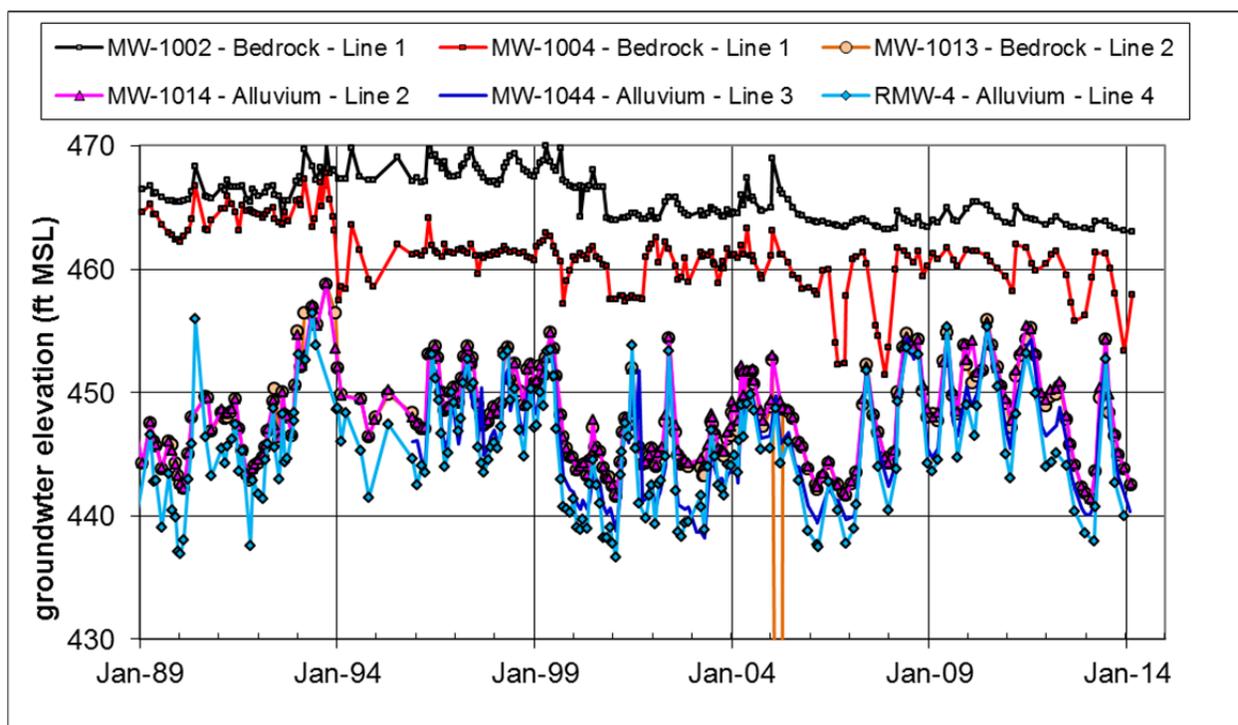


Figure 45. Groundwater Elevations in the Quarry Area

Nitroaromatic compounds in the groundwater system, primarily 2,4-DNT, result from the disposal of these wastes in the Quarry proper. Nitroaromatic compounds entered the shallow aquifer via migration through bedrock fractures in the Quarry. The mobility of nitroaromatic compounds in the bedrock aquifer is relatively high because these compounds do not tend to sorb to bedrock materials. The potential exists for microorganism activity to transform and degrade TNT and DNT in the alluvial materials north of the slough.

5.2.2.5 Monitoring Results for Groundwater in the Area of Impact at the Quarry

Contaminant concentrations are monitored using 24 wells screened in either the bedrock or alluvial materials in the area of uranium and 2,4-DNT impact north of the Femme Osage Slough. The data are discussed in the following sections.

Uranium

Uranium is monitored in both the bedrock and the adjoining alluvial materials north of the Femme Osage Slough. These wells are monitoring the declining concentrations in groundwater north of the slough until there is a negligible potential for impact on the groundwater south of the slough.

Uranium levels in the Line 1 wells have generally been decreasing for over 20 years (Figure 46). In 2013, MW-1004 and MW-1005 had uranium levels that exceeded the target level of 300 pCi/L (Table 38). Uranium concentrations in MW-1002, MW-1027, and MW-1030 have been less than the target level of 300 pCi/L established for groundwater north of the Femme Osage Slough since 2006. Uranium levels in MW-1002 and MW-1030 have consistently been less than the MCL of 20 pCi/L since 2001.

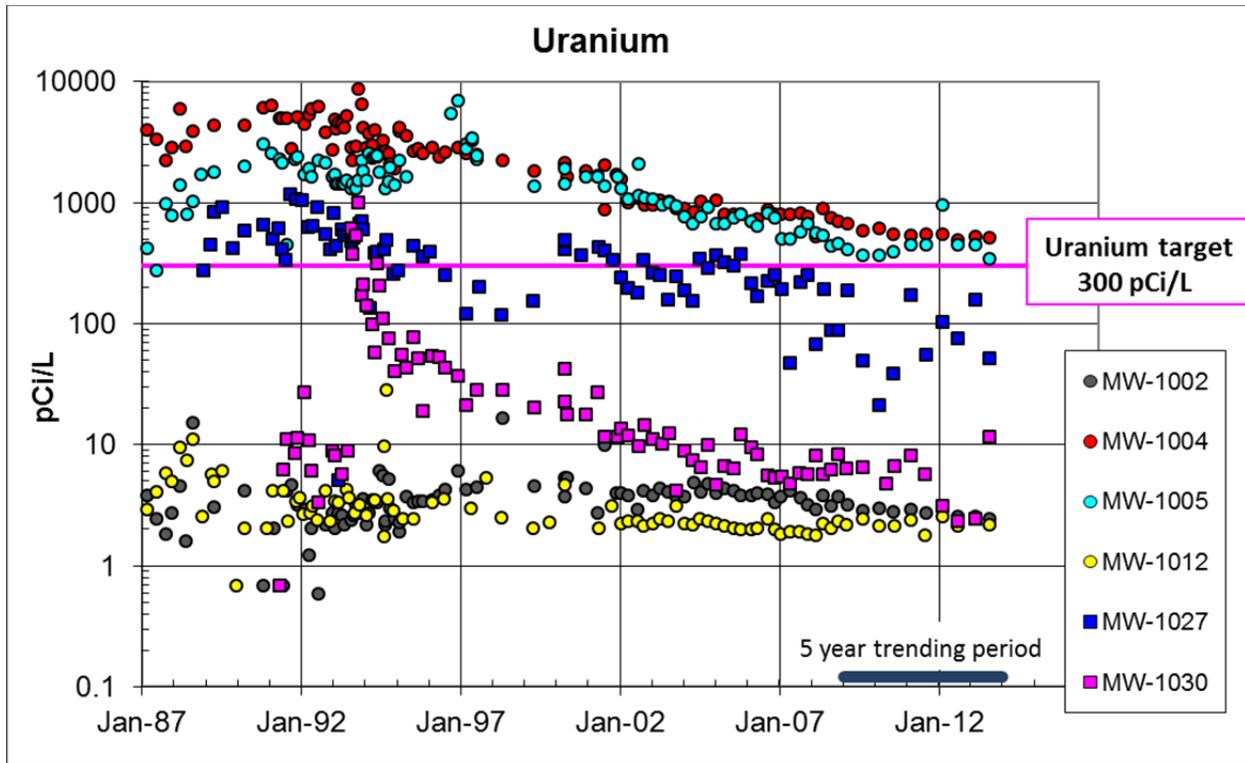


Figure 46. Uranium in Line 1 Monitoring Wells

Table 38. 2013 Total Uranium in QROU Line 1 Wells

Location	Line	Geologic Unit	Uranium (pCi/L)	
			S1	S2
MW-1002	1	Kimmswick-Decorah	2.4 Feb 25, 2013	2.4 Aug 5, 2013
MW-1004	1	Kimmswick-Decorah	515 Feb 25, 2013	508 Aug 5, 2013
MW-1005	1	Kimmswick-Decorah	440 Feb 25, 2013	339 Aug 5, 2013
MW-1012	1 ^a	Kimmswick-Decorah	2.5 Feb 25, 2013	2.2 Aug 5, 2013
MW-1027	1	Kimmswick-Decorah	156 Feb 26, 2013	51 Aug 5, 2013
MW-1030	1	Kimmswick-Decorah	2.4 Feb 25, 2013	11.5 Aug 5, 2013

^a Upgradient location

Concentrations in **bold** exceed the target level of 300 picocuries per liter

pCi/L = picocuries per liter

S1, S2 = semiannual sampling periods

Mann-Kendall trend analysis of the last 5 years of data for the Line 1 wells (Table 39) indicate that uranium levels in recent years have been decreasing in most of these wells, as indicated by negative slopes. Statistically significant downward trends have been calculated for MW-1002

and MW-1004. If the current overall decline in uranium levels continues, MW-1004 and MW-1005 could reach the target level of 300 pCi/L in the next 5 to 10 years. Uranium levels in MW-1002 and MW-1030 are stable at concentrations below the uranium MCL.

Table 39. Trending Analysis for Uranium in Line 1 Groundwater Monitoring Wells (2009–2013)

Location	No. of Samples	Trend	Slope (pCi/L/yr)	Confidence Intervals	
				Lower	Upper
MW-1002	10	Down	-0.1	-0.2	-0.1
MW-1004	10	Down	-27.4	-41.9	-13.1
MW-1005	10	None	12.0	-14.3	46.2
MW-1027	10	None	2.7	-40.6	39.5
MW-1030	10	None	-0.8	-1.7	1.2

pCi/L/yr = picocurie(s) per liter per year

Several bedrock wells located between the Quarry rim and Femme Osage Slough (Line 2) continue to have elevated uranium levels (Table 40). However, only MW-1032 had uranium levels that exceeded the 300 pCi/L target level. Uranium levels in the Line 2 bedrock wells have generally decreased since 2000, with the higher concentration wells continuing to decline and the wells with low concentrations (below the MCL) stable or beginning to stabilize (Figure 47). The well with the highest levels of uranium (MW-1032) is screened beneath the area of highest uranium impact in the overlying alluvium. The average levels of uranium in MW-1015, MW-1028, MW-1031, MW-1046, MW-1047, and MW-1048 have been less than the target level of 300 pCi/L since 2009.

Table 40. 2013 Total Uranium in QROU Line 2 Bedrock Wells

Location	Line	Geologic Unit	Uranium (pCi/L)			
			Q1	Q2	Q3	Q4
MW-1013	2	Kimmswick-Decorah	244 Feb 5, 2013	210 May 1, 2013	233 July 31, 2013	196 Oct 28, 2013
MW-1015	2	Kimmswick-Decorah	104 Feb 4, 2013	64 Apr 30, 2013	100 July 30, 2013	105 Oct 28, 2013
MW-1028	2	Plattin	2.4 Feb 11, 2013	1.8 May 1, 2013	1.8 July 31, 2013	2.1 Oct 29, 2013
MW-1031	2	Plattin	15.6 Feb 11, 2013	8.8 May 1, 2013	9.4 July 31, 2013	10.0 Oct 28, 2013
MW-1032	2	Kimmswick-Decorah	406 Feb 26, 2013	406 May 6, 2013	372 Aug 5, 2013	359 Oct 21, 2013
MW-1046	2	Plattin	1.0 Feb 4, 2013	0.95 Apr 30, 2013	0.65 July 30, 2013	0.67 Oct 28, 2013
MW-1047	2	Plattin	0.70 Feb 11, 2013	2.7 May 1, 2013	1.5 July 31, 2013	1.2 Oct 29, 2013
MW-1048	2	Plattin	225 Feb 11, 2013	203 May 1, 2013	218 July 30, 2013	58 Oct 29, 2013

Concentrations in **bold** exceed the target level of 300 picocuries per liter.

pCi/L = picocuries per liter

Q1, Q2, Q3, Q4 = Quarterly sampling periods

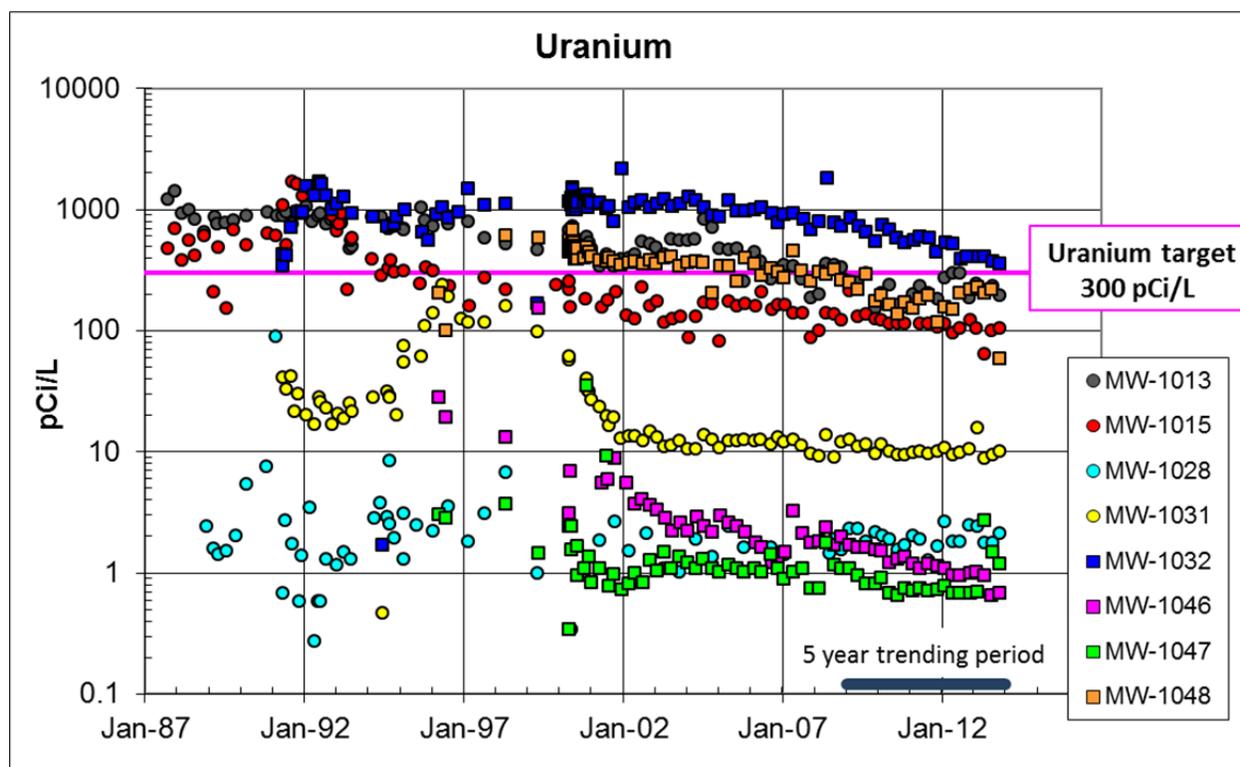


Figure 47. Uranium in Line 2 Bedrock Wells

The highest levels of uranium in groundwater are in the alluvial materials between the Quarry rim and Femme Osage Slough (Table 41). In 2013, five of these locations had uranium levels that exceeded the target level of 300 pCi/L (Figure 48). These wells are in the center of the area of uranium impact. The average levels of uranium in MW-1009, MW-1045, and MW-1049 remain low and represent the limits of uranium impact in the groundwater. Uranium levels in most Line 2 wells (<300 pCi/L target) have been consistent over time with the exception of MW-1007, where levels rose in 2006–2007 and returned to historical norms by 2011 (Figure 49). Figure 50 shows the 2013 average uranium concentration for wells in the quarry area.

Mann-Kendall trending of the last 5 years of data for the Line 2 wells (screened in the saturated alluvium or bedrock between the Quarry Rim and the Femme Osage Slough) shows decreases in uranium levels in this area (Table 42), as indicated by negative slopes in 11 of the 18 wells sampled. The data collected in 2009 through 2013 were evaluated for statistically significant trends (probability of concluding an incorrect trend is less than 5%). No upward trends were identified in the Line 2 wells.

Statistically significant downward trends were identified in 3 of the 8 bedrock wells and in 6 of the 10 alluvial wells. Well MW-1032 is the only bedrock well with uranium levels above the target level of 300 pCi/L, and if the current decreasing trend continues, the target level could be reached in the next 5 years in the bedrock groundwater. A visual inspection of the data indicates that uranium levels in wells MW-1013 and MW-1048 are in a long-term declining trend.

Table 41. 2013 Total Uranium in QROU Line 2 Alluvial Wells

Location	Line	Geologic Unit	Uranium (pCi/L)			
			Q1	Q2	Q3	Q4
MW-1006	2	Alluvium	1016 Feb 26, 2013	1422 May 6, 2013	880 Aug 5, 2013	948 Oct 21, 2013
MW-1007	2	Alluvium	46.1 Feb 5, 2013	122 Apr 30, 2013	16.9 July 30, 2013	15.2 Oct 24, 2013
MW-1008	2	Alluvium	1056 Feb 5, 2013	1422 Apr 30, 2013	3250 July 30, 2013	2038 Oct 28, 2013
MW-1009	2	Alluvium	0.22 Feb 5, 2013	10.8 Apr 30, 2013	9.7 July 30, 2013	0.89 Oct 28, 2013
MW-1014	2	Alluvium	900 Feb 5, 2013	1016 May 1, 2013	1131 July 31, 2013	765 Oct 28, 2013
MW-1016	2	Alluvium	122 Feb 4, 2013	88 Apr 30, 2013	104 July 30, 2013	95 Oct 28, 2013
MW-1045	2	Alluvium	1.8 Feb 26, 2013	1.6 May 6, 2013	2.2 Aug 5, 2013	3.2 Oct 21, 2013
MW-1049	2	Alluvium	0.064(J) Feb 26, 2013	0.035 (J) May 6, 2013	ND (<0.034) Aug 6, 2013	ND (<0.034) Oct 21, 2013
MW-1051	2	Alluvium	765 Feb 11, 2013	1016 Apr 30, 2013	1124 July 30, 2013	1273 Oct 29, 2013
MW-1052	2	Alluvium	1151 Feb 11, 2013	2302 Apr 30, 2013	1489 July 30, 2013	258 Oct 29, 2013

Concentrations in **bold** exceed the target level of 300 pCi/L.
 J = estimated value less than the reporting limit; pCi/L = picocurie(s) per liter
 ND = Not detected at or above the detection limit indicated in parentheses
 Q1, Q2, Q3, Q4 = Quarterly sampling periods

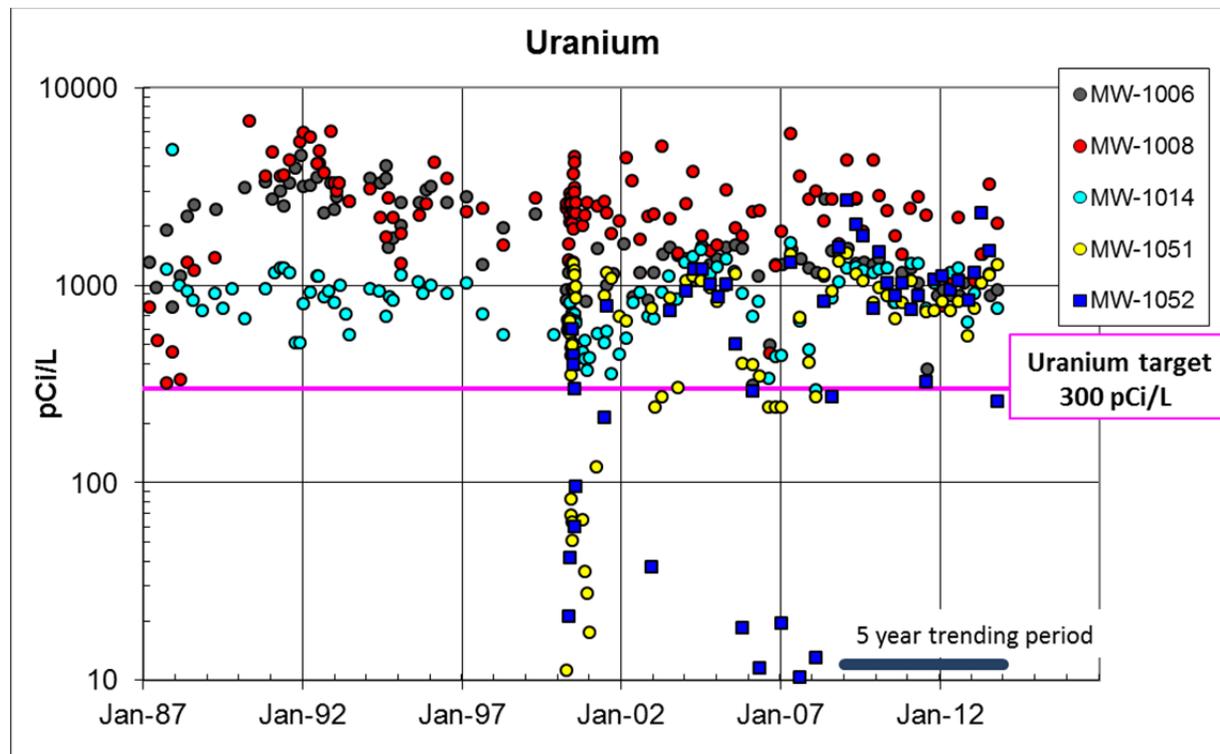


Figure 48. Uranium (pCi/L) in Line 2 Alluvial Wells, Above 300 pCi/L Target

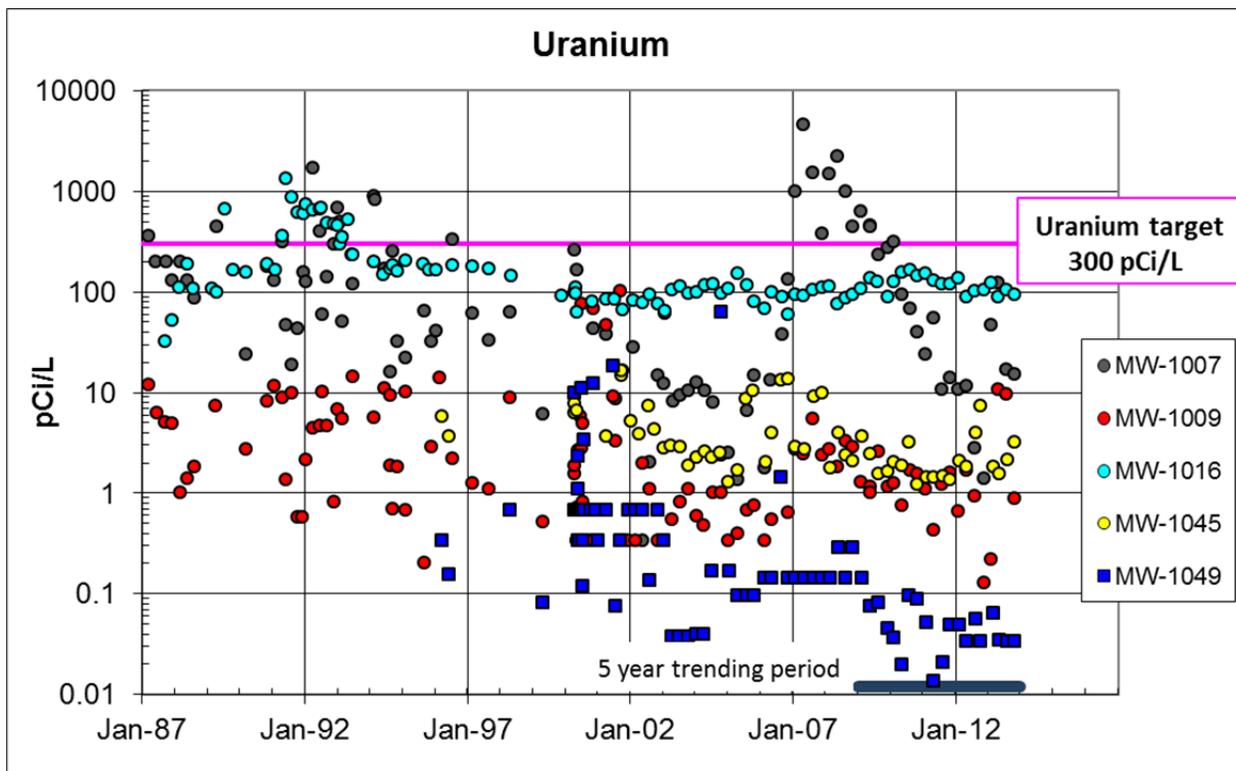


Figure 49. Uranium (pCi/L) in Line 2 Alluvial Wells, Below 300 pCi/L Target

Table 42. Trending Analysis for Uranium in Line 2 Groundwater Monitoring Wells (2009–2013)

Location	Unit	No. of Samples	Trend	Slope (pCi/L/yr)	Confidence Intervals	
					Lower	Upper
MW-1006	Alluvium	20	Down	-99.7	-145.8	0.0
MW-1007	Alluvium	20	Down	-50.3	-106.2	-17.1
MW-1008	Alluvium	19	Down	-330.8	-689.8	-17.2
MW-1009	Alluvium	20	None	-0.1	-0.3	0.3
MW-1013	Bedrock	20	None	0.00	-15.7	16.4
MW-1014	Alluvium	20	Down	-47.7	-110.4	0.0
MW-1015	Bedrock	19	Down	-7.2	-11.7	-4.2
MW-1016	Alluvium	20	Down	-8.1	-16.4	0.0
MW-1028	Bedrock	20	None	-0.04	-0.1	0.1
MW-1031	Bedrock	20	None	-0.2	-0.5	0.1
MW-1032	Bedrock	20	Down	-82.8	-103.3	-63.7
MW-1045	Alluvium	20	None	0.1	-0.2	0.4
MW-1046	Bedrock	20	Down	-0.2	-0.2	-0.2
MW-1047	Bedrock	20	None	-0.02	-0.1	0.1
MW-1048	Bedrock	20	None	-7.2	-30.0	13.2
MW-1049	Alluvium	20	Down	-0.01	-0.02	0.0
MW-1051	Alluvium	20	None	-40.3	-122.6	45.0
MW-1052	Alluvium	20	None	-127.9	-340.8	74.7

pCi/L/yr = picocuries per liter per year

Statistically significant downward trends were identified in six of the 10 alluvial wells (Table 42). Alluvial wells MW-1006, MW-1008, MW-1014, MW-1051, and MW-1052 have uranium levels greater than the target level of 300 pCi/L. A visual inspection of the data allows a longer time period to be considered and suggests that several of the wells have calculated down trends due to natural variability and the timing of the 5-year trending period. Wells MW-1006, MW-1008, MW-1014, and MW-1016 have uranium concentrations consistent with the last 15 years of data and appear to be more stable than trending downward.

The attainment objective for the long-term monitoring of uranium in groundwater north of the slough is for the 90th percentile of the data within a monitoring year to reach a target level of 300 pCi/L (DOE 2000b). The average uranium levels in eight wells north of the slough exceeded the target level in 2013. The 90th percentile associated with the data from the Line 1 and 2 wells collectively was 1,130 pCi/L (508 pCi/L for only Line 1 wells and 1,149 pCi/L for only Line 2 wells). Viewed separately (Figure 51), the 90th percentile for Lines 1 and 2 indicate that the metric is controlled by changes in the Line 2 wells, primarily the uranium levels measured in the Line 2 alluvial wells.

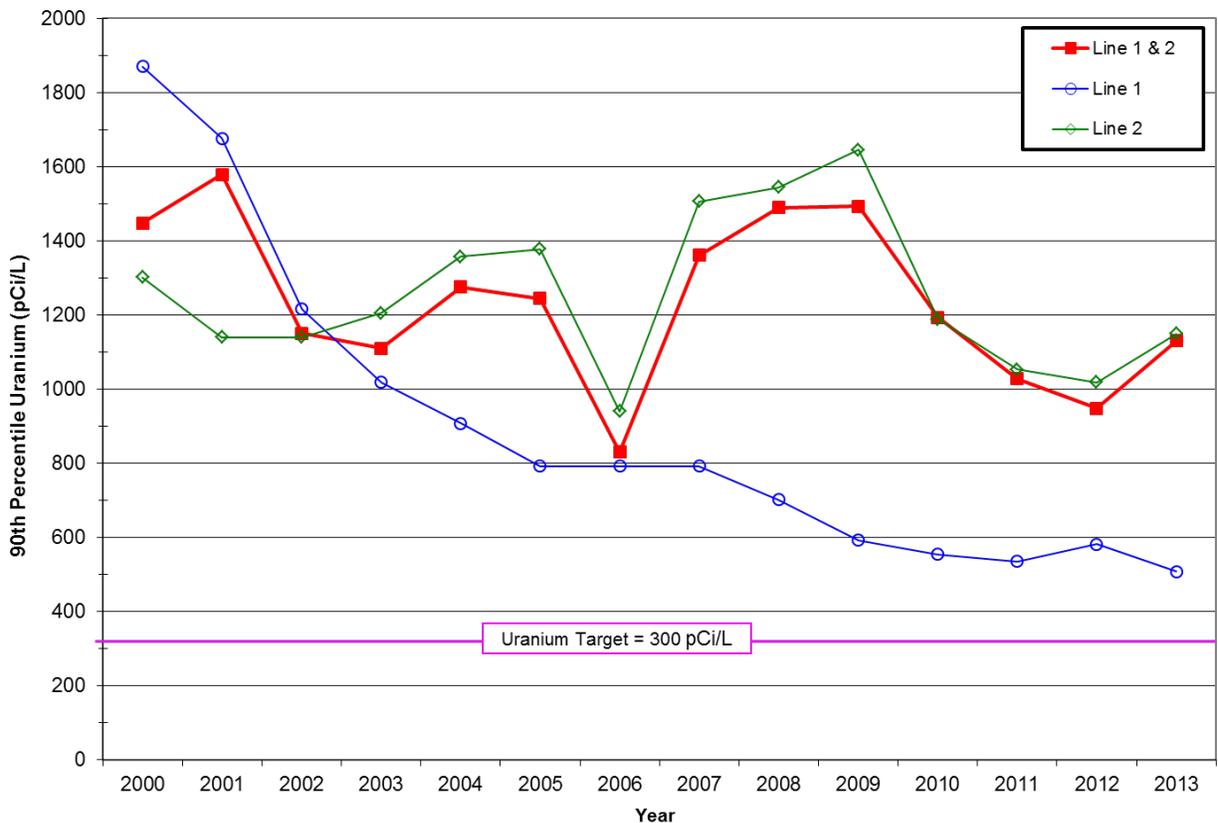


Figure 51. 90th Percentile of Uranium in Line 1 and 2 Wells

Overall, the decreasing uranium levels in the Quarry rim and area north of the Femme Osage Slough are the result of bulk waste removal and restoration activities in the Quarry proper. Remedial activities in the Quarry reduced and possibly prevented infiltration of precipitation and storm water into the residually contaminated fracture system in the Quarry proper. Uranium does not bind as readily to the bedrock as it does to the alluvial materials; therefore, decreases should occur more readily in the bedrock as groundwater flushes through the system. The distribution of uranium in groundwater is still predominantly controlled by the precipitation of uranium along the oxidizing/reducing front north of the Femme Osage Slough. Although uranium levels have increased in some of the alluvial wells north of the slough, levels are far below historical highs. Monitoring in wells screened in the reducing portion of the area north of the slough indicates that uranium levels continue to remain low.

Nitroaromatic Compounds

In 2013, samples from eight monitoring wells were analyzed for the nitroaromatic compound 2,4-DNT (Table 43). These monitoring wells have historically been impacted by nitroaromatic compounds along the Quarry rim or between the Quarry and Femme Osage Slough. Concentrations of 2,4-DNT in MW-1027 were above the Missouri Water Quality Standard of 0.11 µg/L. Also, MW-1006 had a concentration that exceeded the cleanup standard during the second sampling event but is consistent with historical data (Figure 52). MW-1027 is the only well in which average 2,4-DNT levels have exceeded the target level of 0.11 µg/L since 2009.

Table 43. 2013 2,4-DNT Concentrations for the QROU Monitoring Locations

Location	Line	Geologic Unit	Concentration (µg/L)			
			S1		S2	
MW-1002	1	Kimmswick-Decorah	ND (<0.018) Feb 25, 2013		ND (<0.018) Aug 5, 2013	
MW-1004	1	Kimmswick-Decorah	ND (<0.019) Feb 25, 2013		0.018 (J) Aug 5, 2013	
MW-1005	1	Kimmswick-Decorah	ND (<0.019) Feb 25, 2013		ND (<0.018) Aug 5, 2013	
MW-1006	2	Alluvium	0.098 Feb 26, 2013	0.078 (J) May 6, 2013	0.076 (J) Aug 5, 2013	0.21 Oct 21, 2013
MW-1027	1	Kimmswick-Decorah	2.3 Feb 26, 2013		ND (<0.019) Aug 5, 2013	
MW-1032	2	Kimmswick-Decorah	ND (<0.019) Feb 26, 2013	ND (<0.019) May 6, 2013	ND (<0.019) Aug 5, 2013	ND (<0.020) Oct 21, 2013
MW-1045	2	Alluvium	ND (<0.019) Feb 26, 2013	ND (<0.018) May 6, 2013	ND (<0.019) Aug 5, 2013	ND (<0.019) Oct 21, 2013
MW-1049	2	Alluvium	ND (<0.019) Feb 26, 2013	ND (<0.019) May 6, 2013	ND (<0.019) Aug 6, 2013	ND (<0.019) Oct 21, 2013

Concentrations in **bold** exceed the Missouri Water Quality Standard of 0.11 µg/L for 2,4-DNT.
 µg/L = microgram per liter; ND = analyte not detected above method detection limit indicated in parentheses.
 J = estimated value less than the reporting limit; S1, S2 = semiannual sampling periods.

The concentrations of 2,4-DNT in MW-1006 and MW-1027 have fluctuated since bulk waste removal was completed in the Quarry (Figure 52). Increased concentrations have been observed in well MW-1027 recently, though it is not uncommon for 2,4-DNT concentrations to vary by more than 2 orders of magnitude in wells MW-1006 and MW-1027. Concentrations in MW-1045 and MW-1049, the farthest downgradient wells in the vicinity of wells MW-1006 and MW-1027, have historically been less than the detection limit.

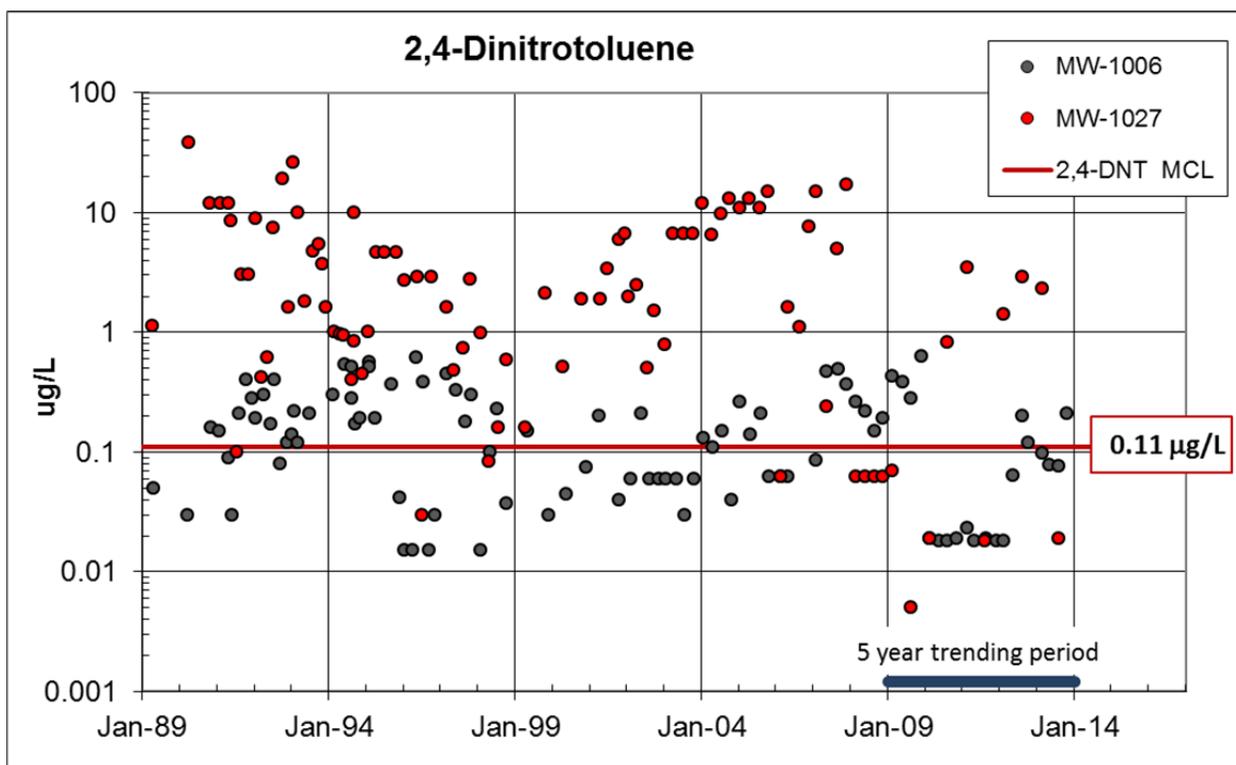


Figure 52. 2,4-DNT Concentrations in MW-1006 and MW-1027

Mann-Kendall trend analysis of the last 5 years of data was calculated for wells MW-1006 and MW-1027 (Table 44), as these are the only Quarry locations that had detectable 2,4-DNT concentrations in the last 5 years. The concentrations of 2,4-DNT are decreasing at MW-1006, as indicated by negative slopes. In MW-1027, the concentrations are increasing, as indicated by a positive slope. No statistically significant trends, either upward or downward, were calculated for the two wells. A visual inspection of the data suggests that 2,4-DNT concentrations, though highly variable, have been decreasing over the last 25 years.

Table 44. Trending Analysis for 2,4-DNT in Selected Quarry Groundwater Monitoring Wells (2009–2013)

Location	No. of Samples	Trend	Slope (µg/L/yr)	Confidence Intervals	
				Lower	Upper
MW-1006	20	None	0	-0.06	0.02
MW-1027	10	None	0.45	-0.19	0.99

µg/L/yr = microgram(s) per liter per year

The attainment objective for the long-term monitoring of 2,4-DNT in groundwater north of the slough is that the 90th percentile of the data within a monitoring year is below the target level of 0.11 µg/L (DOE 2000b). The eight monitoring wells that were selected for continued long-term monitoring were used to calculate this metric. The 90th percentile associated with the data from the eight wells was 0.092 µg/L, based on data collected in 2013. This value is consistent with historical data and lower than the 2012 measurement (Figure 53).

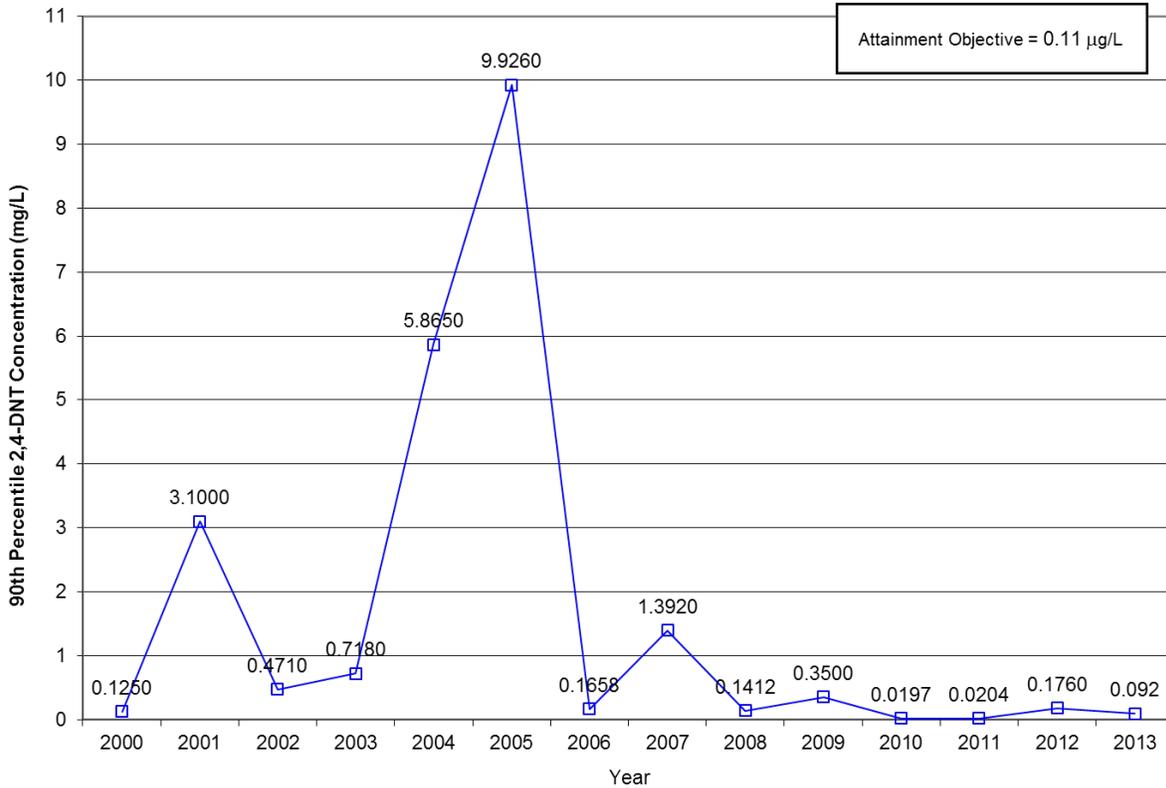


Figure 53. 90th Percentile of 2,4-DNT in Line 1 and 2 Wells

Overall, 2,4-DNT impact in groundwater is located within two discrete areas. Concentrations, although variable, have generally decreased since the removal of the bulk wastes in the quarry. Present concentrations in groundwater pose little potential impact to the groundwater in the Missouri River alluvium.

Geochemical Parameters

The geochemistry of the shallow aquifer is monitored to verify the presence of the reducing zone and to confirm that the reducing zone is capable of the ongoing attenuation of uranium in groundwater. Groundwater is analyzed for sulfate, dissolved iron, ferrous iron, and oxidation-reduction potential. Sulfate is monitored as an indicator of redox conditions in the groundwater in the vicinity of the Quarry. Higher sulfate concentrations are generally observed in an oxidizing environment. Iron (total dissolved and ferrous) is also monitored as an indicator of redox conditions in the groundwater. Iron concentrations generally increase in a reducing environment. These results generally correlate with observed uranium concentrations upgradient and downgradient of the reducing zone, as uranium is typically more mobile in an oxidizing environment and precipitates in a reducing environment. Table 45 presents a summary of the geochemical parameters for each monitoring location.

Table 45. Geochemical Parameter Data at the Weldon Spring Quarry in 2013

Location	Line	Geologic Unit	Average Values			
			Sulfate (mg/L)	Dissolved Iron (µg/L)	Ferrous Iron (µg/L)	ORP ^a (mV)
MW-1002	1	Kimmswick-Decorah	79	38	5	48
MW-1004	1	Kimmswick-Decorah	86	185	100	66
MW-1005	1	Kimmswick-Decorah	100	1,050	400	15
MW-1012	1	Kimmswick-Decorah	33.5	22	10	127
MW-1027	1	Kimmswick-Decorah	61	346	355	44
MW-1030	1	Kimmswick-Decorah	52	5,270	1,560	-11
MW-1006	2	Alluvium	75	236	160	113
MW-1007	2	Alluvium	17.5	42,900	2,198	-104
MW-1008	2	Alluvium	70	28	18	85
MW-1009	2	Alluvium	19.7	17,050	1,320	-100
MW-1013	2	Kimmswick-Decorah	60	3,945	1,590	-33
MW-1014	2	Alluvium	112	161	123	139
MW-1015	2	Kimmswick-Decorah	88	68	58	31
MW-1016	2	Alluvium	78	35	13	70
MW-1028	2	Plattin	30.8	73	53	155
MW-1031	2	Alluvium	30.3	31	8	167
MW-1032	2	Kimmswick-Decorah	90	22	15	96
MW-1045	2	Alluvium	21.5	56	98	94
MW-1046	2	Plattin	46.8	90	73	54
MW-1047	2	Plattin	76	29	5	97
MW-1048	2	Plattin	43.2	1,653	1,085	-52
MW-1049	2	Alluvium	4.0	44,750	8,090	-137
MW-1051	2	Alluvium	112	1,910	613	84
MW-1052	2	Alluvium	47.0	14,194	5,548	-34

^a Convert oxidation-reduction potential to Eh by adding 200 millivolts to the ORP value.

J = estimated value less than the reporting limit; mg/L = milligrams per liter; mV = millivolts; µg/L = micrograms per liter; ND = analyte not detected above method detection limit included in parentheses; ORP = oxidation-reduction potential

A review of the 2013 geochemical data indicates that although the area of highest impact has an oxidizing environment, reducing conditions are prevalent along the northern edge of the slough, as shown by data for wells MW-1007, MW-1009, and MW-1049. This is consistent with the uranium data where low levels are detected, especially in MW-1049, where very low sulfate and high dissolved iron concentrations are also observed. The location of this reducing area has been consistent, and the attenuation of uranium in this area continues.

5.2.2.6 Monitoring Results for the Missouri River Alluvium

Groundwater quality in the Missouri River alluvium is monitored using 10 wells screened in the alluvial materials. These wells are sampled for uranium and geochemical parameters to ensure that water quality remains protective of human health.

Uranium

The six monitoring wells immediately south of the slough (Line 3) and the four RMW-series wells (Line 4) were sampled for uranium during 2013 to verify that uranium levels remain within the natural range of variation for Missouri River alluvium (Table 46). The results indicate that uranium levels were less than the statistical background value in the alluvium (Table 37). None of the locations south of the slough have uranium levels that exceed the drinking water standard of 20 pCi/L.

Table 46. 2013 Total Uranium Levels in the Missouri River Alluvial Aquifer

Location	Line	Uranium (pCi/L)			
		MW-1017	3	ND (<0.045) Feb 4, 2013	
MW-1018	3	ND (<0.045) Feb 4, 2013	ND (<0.034) Apr 29, 2013	ND (<0.045) July 29, 2013	ND (<0.045) Oct 24, 2013
MW-1019	3	ND (<0.045) Feb 4, 2013		ND (< 0.045) July 29, 2013	
MW-1021	3	ND (<0.045) Feb 4, 2013		ND (<0.045) July 29, 2013	
MW-1044	3	ND (<0.045) Feb 4, 2013	0.196 Apr 29, 2013	ND (<0.045) July 29, 2013	ND (<0.045) Oct 24, 2013
MW-1050	3	ND (<0.045) Feb 4, 2013		ND (<0.045) July 29, 2013	
RMW-1	4	0.64 Mar 13, 2013			
RMW-2	4	2.0 Mar 13, 2013			
RMW-3	4	0.45 Mar 13, 2013			
RMW-4	4	0.40 Mar 13, 2013			

J = estimated value less than the reporting limit

ND = analyte not detected above method detection limit indicated in parentheses

pCi/L = picocurie(s) per liter

Geochemical Parameters

The monitoring wells south of the slough were sampled for sulfate, dissolved and ferrous iron, and ORP to assess redox conditions in the Missouri River alluvium downgradient of the area of uranium impact (Table 47). The data continue to indicate that a strongly reducing environment is prevalent in the groundwater immediately south of the slough, as shown by high dissolved iron concentrations, low sulfate concentrations, and low ORP values. This environment is not favorable for the migration of uranium if it were to pass beyond the reduction zone north of the slough. Data from the review period were consistent with previous results for all locations except MW-1044.

Table 47. 2013 Geochemical Parameter Data in the Missouri River Alluvial Aquifer

Location	Average Values			
	Sulfate (mg/L)	Dissolved Iron (µg/L)	Ferrous Iron (µg/L)	ORP ^a (mV)
MW-1017	0.94	22,200	5,225	-147
MW-1018	2.2	41,500	12,415	-77
MW-1019	0.29	14,450	4,250	-142
MW-1021	8.6	20,150	4,850	-137
MW-1044	37.3	29,650	6,705	-169
MW-1050	4.1	16,550	4,470	-164
RMW-1	15.0	7,700	3,140	-54
RMW-2	5.0	8,300	1,970	-63
RMW-3	12.0	15,000	6,500	-126
RMW-4	17.0	17,000	2,340	NS

^a Convert oxidation-reduction potential to Eh by adding 200 millivolts to the oxidation-reduction value. mg/L = milligram(s) per liter; mV = millivolts; µg/L = micrograms per liter; ORP = oxidation-reduction potential J = estimated values less than the reporting limit; NS = not sampled

Increased sulfate concentrations in MW-1044 were reported beginning in 2008 and peaked in late 2010 and have consistently declined through 2013. A slight increase in sulfate in nearby MW-1018 was also observed 2010–2012 but has since reverted to historical norms. The increases may have been caused by infiltration of water from the slough that has exhibited high sulfate concentrations. The water in the slough is currently at very low elevations. High iron concentrations and low ORP values continued to support the interpretation that a reducing environment is prevalent in this area. Uranium levels remain low at the locations along the southern edge of the Femme Osage Slough.

5.2.3 Disposal Cell Groundwater

Five groundwater monitoring wells, one spring, and disposal cell leachate were sampled during 2013 as part of the detection monitoring program for the permanent disposal cell. This monitoring is performed to meet the substantive requirements of 40 CFR 264 Subpart F; 10 CSR 25-7.264(2)(F), and 10 CSR 80-3.010(8). These federal and state hazardous and solid waste regulations were identified as ARARs for the selected remedy in the *Record of Decision for the Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1993). These wells, the spring, and the leachate were monitored in accordance with Appendix K of the LTS&M Plan (DOE 2008a).

5.2.3.1 Disposal Cell Monitoring Program

The disposal cell groundwater detection monitoring network consists of one upgradient well (MW-2055), four downgradient wells (MW-2032, MW-2046, MW-2047, and MW-2051), one downgradient spring (SP-6301), and leachate from the disposal cell (LW-DC10) (Figure 11). Semiannual detection monitoring began in mid-1998, after cell construction and waste placement activities had begun.

The monitoring program for the disposal cell consisted of semiannual sampling of the monitoring wells, spring, and leachate. Groundwater and surface water samples were analyzed for the list of analytes in Table 48. Leachate was analyzed for the list of analytes in Table 49. Sampling was performed as specified in Appendix K of the LTS&M Plan (DOE 2008a).

Table 48. Disposal Cell Detection Monitoring—Groundwater and Surface Water Analyte List

Radionuclides	Metals	Nitroaromatic Compounds	Other	General Indicator Parameters
Radium-226 Radium-228 Thorium-228 Thorium-230 Thorium-232	Arsenic Barium Chromium Lead Manganese Nickel Selenium Thallium Uranium	1,3,5-TNB 1,3-DNB 2,4,6-TNT 2,4-DNT 2,6-DNT NB	PCBs PAHs	pH Temperature Specific Conductance

PAHs = polycyclic aromatic hydrocarbons; PCBs = polychlorinated biphenyls; DNB = dinitrobenzene; DNT = dinitrotoluene; NB = nitrobenzene; TNT = trinitrotoluene; TNB = Trinitrobenzene

Table 49. Disposal Cell Detection Monitoring—Leachate Analyte List

Radionuclides	Inorganic Ions	Metals	Nitroaromatic Compounds	Other	General Indicator Parameters
Radium-226 Radium-228 Thorium-228 Thorium-230 Thorium-232	Chloride Fluoride Nitrate (as N) Sulfate	Arsenic Barium Chromium Cobalt Iron Lead Manganese Nickel Selenium Thallium Uranium	1,3,5-TNB 1,3-DNB 2,4,6-TNT 2,4-DNT 2,6-DNT NB	PCBs PAHs	pH Temperature Specific Conductance COD TDS TOC Turbidity

COD = chemical oxygen demand; PAHs = polycyclic aromatic hydrocarbons; PCBs = polychlorinated biphenyls; TDS = total dissolved solids; TOC = total organic carbon; DNB = dinitrobenzene; DNT = dinitrotoluene; NB = nitrobenzene; TNT = trinitrotoluene; TNB = Trinitrobenzene

Under the monitoring program, signature parameter (barium and uranium) data from each monitoring event are compared to the baseline tolerance limits (BTLs) to trace general changes in groundwater quality and determine whether statistically significant evidence of contamination due to cell leakage exists. Tolerance limits for signature parameters have been calculated using the data set from 1997 through 2002 (baseline monitoring period), using 95 percent confidence limits.

The data from the remainder of the parameters are reviewed to evaluate the general groundwater quality in the vicinity of the disposal cell and to determine if there are changes in the groundwater system. Data are compared to the three most recent years of data to determine if statistically significant changes in concentrations are present. A measured concentration is

considered statistically significant if it is greater than the arithmetic mean plus 3 times the standard deviation for a given location.

Wells with data showing statistically significant increases are resampled to confirm the exceedance. If the results of the resampling confirm the exceedance, historical leachate analytical data and volumes are evaluated to assess the integrity of the disposal cell. If the leachate data do not indicate that the exceedance could be the result of leakage from the cell, the analytical data are assessed, and sitewide monitoring data are reviewed. If the exceeding parameter is a contaminant of concern for the GWOU, this information is evaluated under the monitoring program for that operable unit.

5.2.3.2 Disposal Cell Monitoring Results

The 2013 monitoring results for the signature parameters are presented in Table 50 along with applicable BTLs. The results were less than the applicable BTLs, which indicates that there is no statistical evidence of leakage of leachate into the groundwater beneath the disposal cell. Data indicating general groundwater quality in the detection monitoring wells and springs during this period were consistent with historical data. The detections of polychlorinated biphenyls (PCBs) in 2012 in a few wells were back to the historically typical nondetect for PCBs in 2013. The polycyclic aromatic hydrocarbon benzo[*k*]fluoranthene was detected in well MW-2051. These estimated detects are sporadic and not considered to represent actual groundwater quality; however, the results could not be rejected.

Table 50. 2013 Signature Parameter Results and Associated BTLs at Disposal Cell Monitoring Locations

Parameter	Location	BTL	Results	
			June 2013	December 2013
Barium (µg/L)	MW-2032	337	152	167
	MW-2046	277	158	198
	MW-2047	471	376	339
	MW-2051	285	279	260
	MW-2055	98	19.8	19.5
	SP-6301	180	116	135
Uranium (pCi/L)	MW-2032	6.4	2.2	2.0
	MW-2046	1.8	1.2	1.2
	MW-2047	2.7	1.2	1.3
	MW-2051	4.5	1.5	1.2
	MW-2055	7.5	1.7	1.8
	SP-6301	159	23.4	58.2

µg/L = micrograms per liter; pCi/L = picocuries per liter

Table 51 presents the disposal cell leachate 2013 monitoring results. The LCRS is sampled semiannually, and the data are used for comparison with corresponding concentrations in wells if elevated levels of constituents are identified in the groundwater. In general, the composition of the leachate has remained stable over the past 5 years, with the exception of iron, manganese, and uranium. Concentrations of these three constituents have shown a general decline.

Table 51. 2013 Disposal Cell Leachate Monitoring Data

Parameter	Concentrations	
	June 2013	December 2013
Chloride (mg/L)	48.5	39.6
Fluoride (mg/L)	0.20 (J)	0.34 (J)
Nitrate (as N) (mg/L)	3.7	2.9
Sulfate (mg/L)	78.8	68.5
Arsenic (µg/L)	3.7	ND(<1.7)
Barium (µg/L)	469(J)	375
Chromium (µg/L)	ND (<2.0)	ND (<2.0)
Cobalt (µg/L)	1.7	1.2
Iron (µg/L)	388	316
Lead (µg/L)	ND (<0.5)	ND (<0.5)
Manganese (µg/L)	464 (J)	420 (J)
Nickel (µg/L)	10.2	5.9
Selenium (µg/L)	10.5	5.6
Thallium (µg/L)	ND (<0.45)	ND (<0.450)
COD (mg/L)	32.9 (J)	23.7
TDS (mg/L)	739	610
TOC (mg/L)	12.4	10.3
1,3,5-TNB (µg/L)	ND (<0.017)	ND (<0.018)
1,3-DNB (µg/L)	ND (<0.014)	ND (<0.015)
2,4,6-TNT (µg/L)	ND (<0.022)	ND (<0.023)
2,4-DNT (µg/L)	ND (<0.019)	ND (<0.020)
2,6-DNT (µg/L)	ND (<0.022)	ND (<0.023)
NB (µg/L)	ND (<0.032)	ND (<0.034)
Radium-226 (pCi/L)	ND(<0.511)	0.63
Radium-228 (pCi/L)	ND(<0.711)	ND(<0.690)
Thorium-228 (pCi/L)	ND (<0.982)	ND (<0.590)
Thorium-230 (pCi/L)	ND (<0.789)	ND (<0.521)
Thorium-232 (pCi/L)	ND (<0.351)	ND (<0.395)
Uranium (pCi/L)	23.9 (J)	21.9
PAHs (µg/L)	ND (<0.182)	(<0.0577) Note 1
PCBs(µg/L)	ND (<0.0333)	ND (<0.0333)
DO (mg/L)	9.5	5.1
ORP (mV)	151.9	172.9
pH (s.u.)	7.0	7.2
SC (µmho/cm)	1249	1033
Temperature (°C)	14.7	13.5
Turbidity (NTU)	1.33	3.26

COD = chemical oxygen demand; DNB = dinitrobenzene; DO = dissolved oxygen; µmho/cm = micromhos per centimeter; J = estimated value

ND = analyte not detected above method detection limit indicated in parentheses;

NTU = nephelometric turbidity units; ORP = oxidation-reduction potential; PAHs = polycyclic aromatic hydrocarbons;

PCBs = polychlorinated biphenyls; R = data point rejected during validation process; SC = specific conductance;

s.u. = standard units; TDS = total dissolved solids; TOC = total organic carbon

Note 1: Detection of fluoranthene and pyrene. Estimated detections of benzo [a] anthracene, benzo[b] fluoranthene, benzo[g,h,i] perylene, benzo [k]fluoranthene, dibenz [a,h] anthracene, indeno[1,2,3-cd] pyrene. Field duplicates were all ND.

5.3 Surface Water

5.3.1 Chemical Plant Surface Water

The surface water locations at Schote Creek, Dardenne Creek, and Busch Lakes 34, 35, and 36 (Figure 15) were sampled once during 2013 for total uranium. This monitoring was conducted to measure the effects of groundwater and surface water discharges from the site on the quality of downstream surface water.

Table 52 presents the results for the Chemical Plant surface water sampling along with the previous 5-year high for each location for comparison. The uranium levels at Busch Lake 34 continue to be higher compared those at the remainder of the locations; however, uranium levels at the Busch Lake outlets have shown an overall decline since remediation at the Chemical Plant site. The Schote Creek and Dardenne Creek locations are downstream of the lakes and have always shown relatively low levels because the Chemical Plant portion of the watershed is much smaller than the total watershed area. These results are consistent with data from previous years.

Table 52. Total Uranium at Weldon Spring Chemical Plant Area Surface Water Locations

Location	Uranium (2013) (pCi/L)	Previous 5-Year High ^a
SW-2004 (Busch Lake 34)	5.4 (Apr 2, 2013)	5.7 (2012)
SW-2005 (Busch Lake 36)	0.4 (Apr 2, 2013)	3.3 (2008)
SW-2012 (Busch Lake 35)	0.9 (Apr 2, 2013)	2.0 (2008)
SW-2016 (Dardenne Creek)	1.4 (Apr 2, 2013)	1.4 (2009)
SW-2024 (Schote Creek)	3.0 (Apr 2, 2013)	2.4 (2009)

^a 2008–2012

pCi/L = picocuries per liter

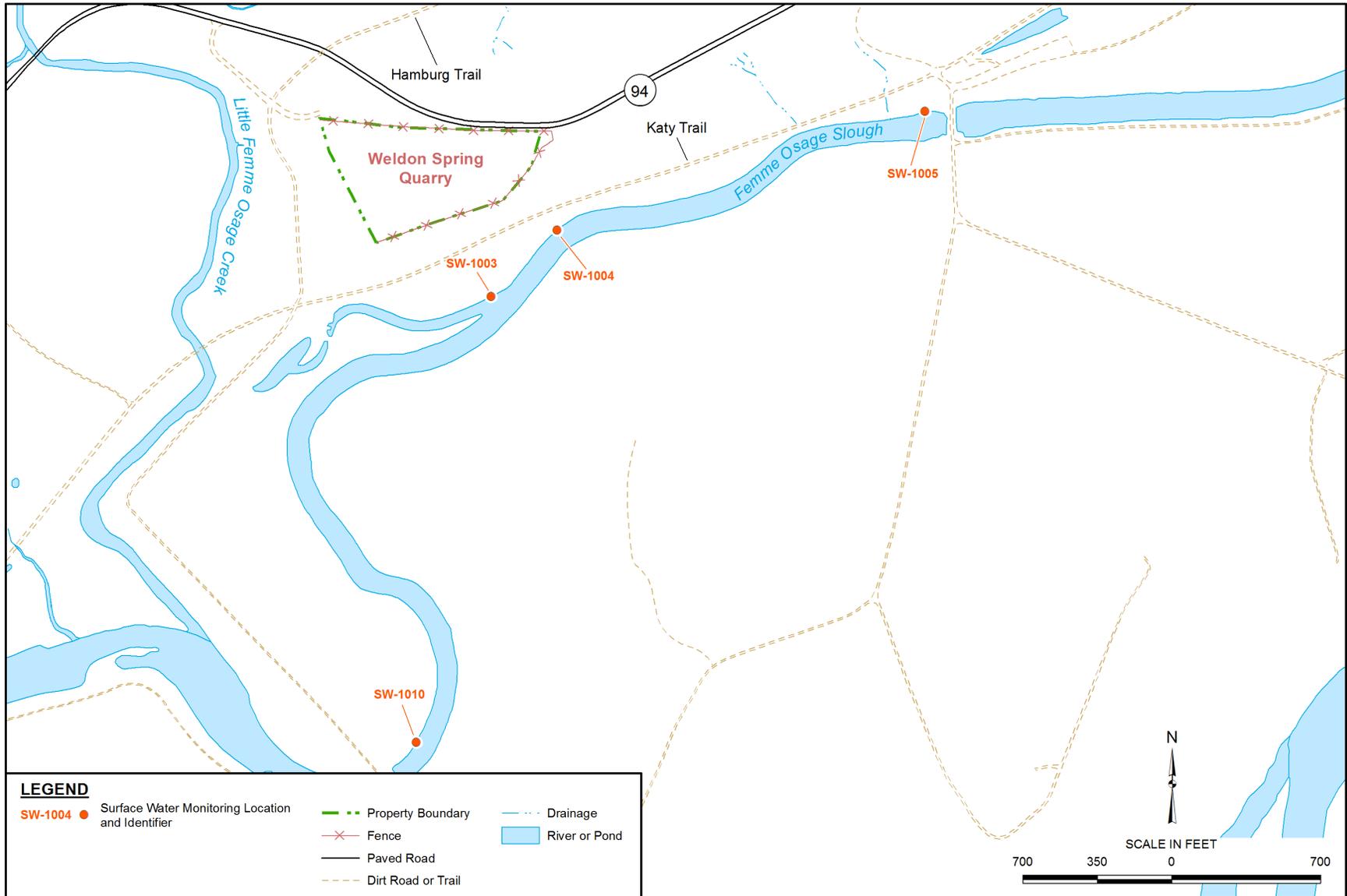
5.3.2 Quarry Surface Water

Four locations within Femme Osage Slough (Figure 54) were sampled quarterly in 2013 to assess the water quality in the slough and the potential impact from groundwater north of the slough (Table 53). These sampling sites are in the upper section of the slough, which is adjacent to the area of groundwater impact. Occasionally, groundwater north of the slough will discharge into the slough when the water table is high. The slough also receives water from the Missouri River during high stages.

Table 53. 2013 Total Uranium in the Femme Osage Slough near the Quarry

Location	Uranium (pCi/L)			
	Q1	Q2	Q3	Q4
SW-1003	65.4 Feb 13, 2013	81.2 May 1, 2013	12.9 July 23, 2013	52.1 Oct 24, 2013
SW-1004	73.1 Feb 13, 2013	169 May 1, 2013	17 July 23, 2013	43.9 Oct 24, 2013
SW-1005	37 Mar 12, 2013	64 May 1, 2013	15.2 July 23, 2013	53.8 Oct 24, 2013
SW-1010	60 Mar 12, 2013	41 May 1, 2013	13.3 July 23, 2013	75.1 Oct 24, 2013

pCi/L = picocuries per liter; Q1, Q2, Q3, Q4 = quarterly sampling periods



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Figure 54. Surface Water Monitoring Locations at the Quarry Area of the Weldon Spring, Missouri, Site

Elevated uranium levels were identified for the four surface water monitoring locations along the Femme Osage Slough in May 2008, and a special study was initiated to evaluate the changes in condition and to identify mechanisms causing the increase in uranium levels. Prior to the May 2008 sampling event, the slough had been completely dewatered for several months, and sampling was performed a short period after water had begun to pond within the slough.

From the special study, it was concluded that after periods when the slough was dry or very low and portions of the slough bottom became exposed, elevated uranium values were reported in the samples collected soon after the slough refilled and inundated. Sorption of uranium onto the sediments is not permanent and can be reversed. Desorption from organics likely occurs when the areas are resaturated with surface water runoff and river water after the sediments have dried out. The reversal of precipitated uranium may occur to a minor extent. The period that uranium is released from sediments is not long, and levels measured in the surface water return to typical values when the water covers the bottom of the slough.

Uranium levels in the Femme Osage Slough (Figure 55) have been elevated since this water body has been partially or completely dewatered starting in late 2006. Elevated uranium levels are reported during periods when the slough levels are low, as reflected in the second quarter values. Similar conditions were present in the early 1990s. Average uranium values decreased from 2009 through 2012 but have shown a slight increase in 2013. Quarterly sampling of the slough will continue in 2014.

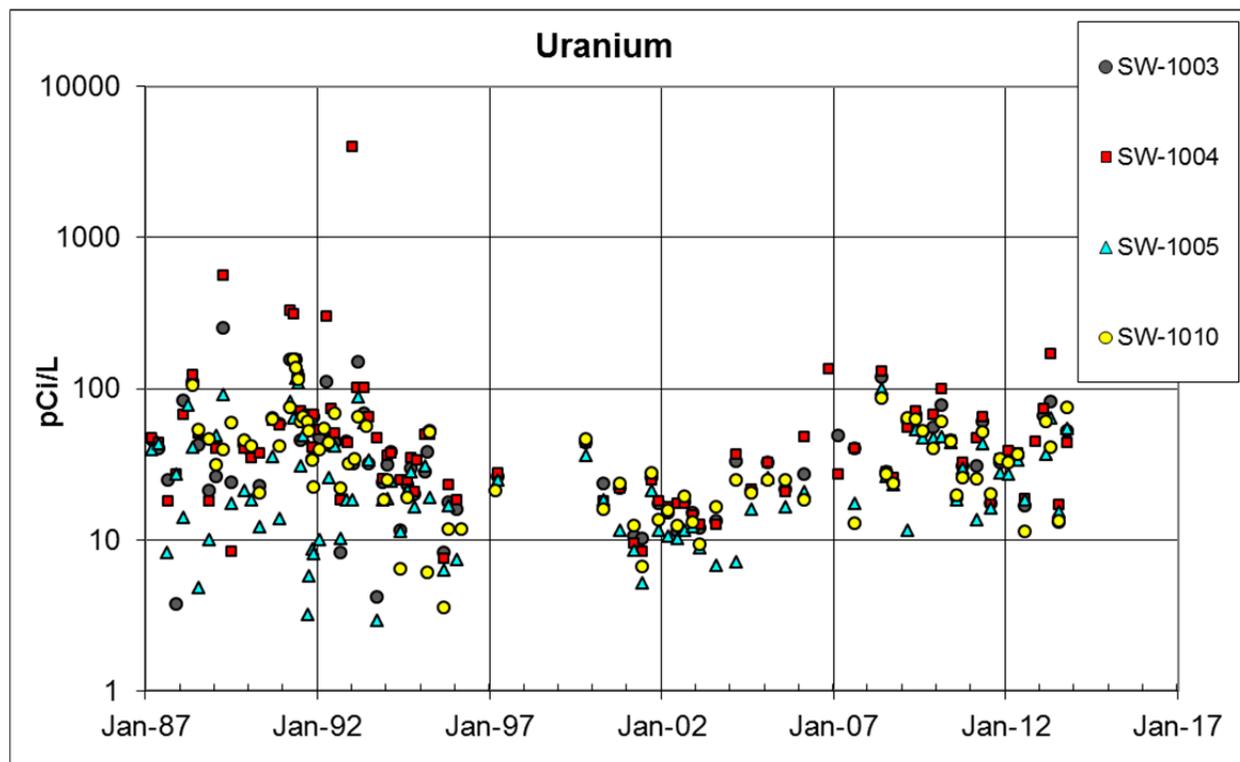


Figure 55. Uranium Levels in the Femme Osage Slough

5.4 Leachate Collection and Removal System Data

The LCRS collects leachate from the disposal cell. Leachate sampling continued in 2013 in accordance with the Disposal Cell Groundwater Monitoring Plan in Appendix K of the LTS&M Plan (DOE 2008a). The leachate analytical data for 2013 are discussed in Section 5.2.3.2 and are shown in Table 51.

During 2013, the leachate was pumped from the sump on a quarterly basis (January, April, July, and October) and pretreated. The pretreated leachate was transported to St. Louis Metropolitan Sewer District (MSD) and discharged into their headworks at their Bissell Point wastewater treatment facility in April and October. A sample of treated leachate is collected and analyzed in accordance with MSD requirements for each hauling event. MSD requirements for the leachate are discussed in Section 1.5.3.3.

Uranium concentrations in untreated leachate during 2013 averaged approximately 22.7 pCi/L. The uranium concentrations have increased slightly since 2010, when levels were near 16 pCi/L. A high uranium concentration of 32.6 pCi/L was observed in January 2013. Figure 56 shows the uranium concentrations in untreated leachate for the past 8 years.

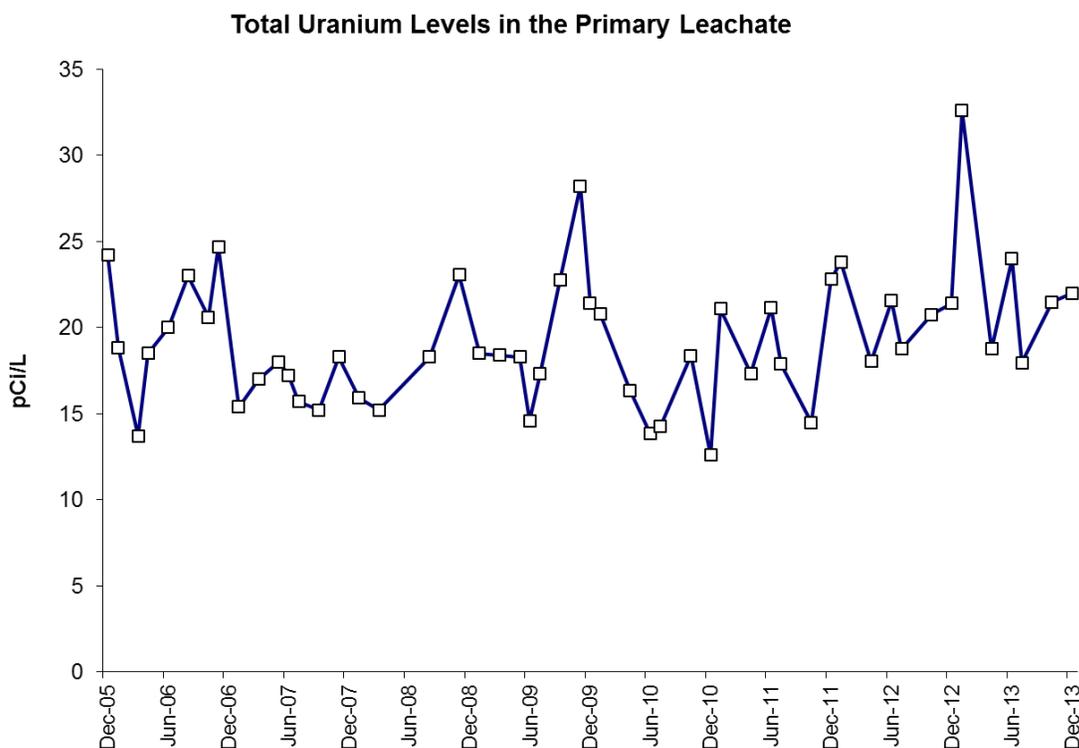


Figure 56. Actual Uranium Concentrations in the Primary Leachate

On a monthly basis, the leachate flow rates from the disposal cell are calculated and a report generated. Every 2 weeks the LCRS facility is inspected, and the secondary liner is pumped and

the volume recorded. The leachate levels are recorded on a datalogger and downloaded remotely at least once per day. The regulations in 40 CFR 264.303(c) only require monthly recording and, if the levels are stable, quarterly flow recording thereafter. Secondary leachate (east and west secondary and burrito) flow rates are reported in units of gallons per day and compared to the action leakage rate of 100 gallons per acre per day established for the secondary (or lower) leachate collection system.

During 2012 and 2013, discharge from the primary leachate collection system generated approximately 79 gallons per day and 77 gallons per day, respectively. Figure 57 shows the daily averages for the primary leachate flow rates. The combined leachate flow rate from the secondary leachate collection system averaged approximately 10.7 gallons per day during 2012 and 10.1 gallons per day in 2013. On a per-acre basis, the average leakage rate for the secondary leachate collection system in 2012 and 2013 was approximately 0.47 and 0.42 gallon per acre per day, respectively. This rate continues to be significantly less than 1 percent of the action leakage rate of 100 gallons per acre per day.

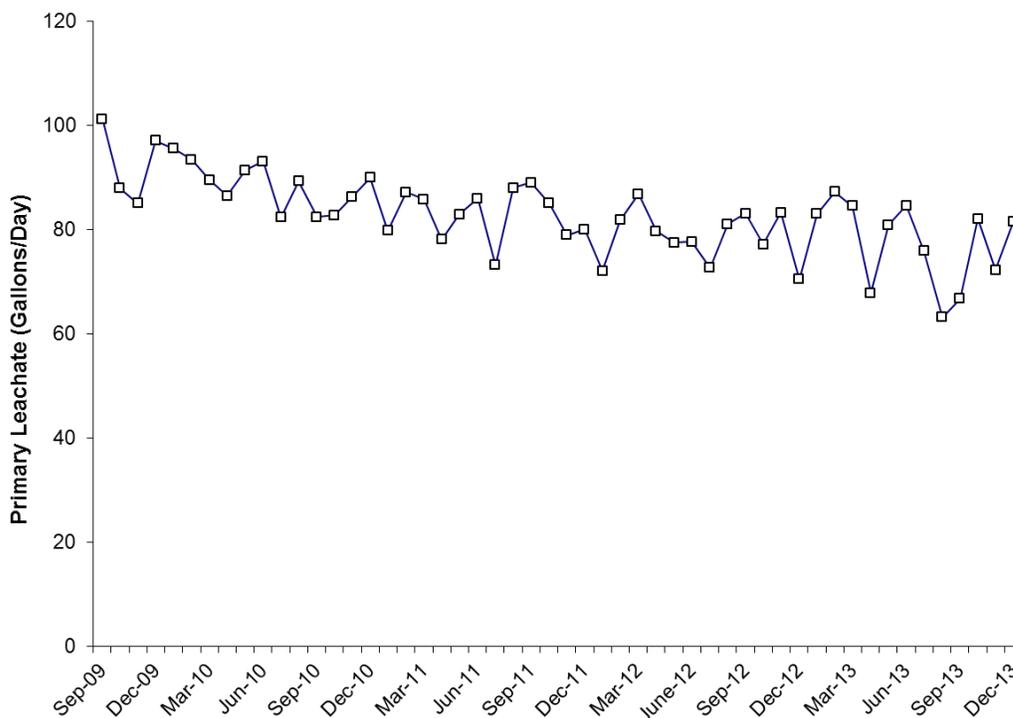


Figure 57. Daily Averages of the Primary Leachate Flow

5.5 Air

During active site remediation, the Weldon Spring site operated an extensive environmental airborne monitoring and surveillance program in accordance with DOE orders, EPA and National Emission Standards for Hazardous Air Pollutants regulations, and the WSSRAP Environmental Monitoring Plan (DOE 2003a). Throughout the remediation of contaminated soils

and materials, the potential for airborne releases and atmospheric migration of radioactive contaminants was closely monitored by measuring gamma exposure rates and concentrations of radon, airborne radioactive particulates, airborne asbestos, and fine particulate matter at various site perimeter and offsite locations. The potential for the airborne release of radionuclides was eliminated with the final emplacement of contaminated materials in the permanent disposal cell. No air monitoring has been required or conducted since 2001 (DOE 2001).

5.6 Radiation Dose Analysis

This section evaluates the potential effects of remaining surface water and groundwater discharges of radiological contaminants from the Weldon Spring site in 2013. The total effective dose (TED) has been calculated for 2013 based on the applicable exposure pathway. Doses resulting from airborne emissions are no longer calculated, since the potential for the airborne release of radiological contaminants has been eliminated, and, therefore, the regulations of 40 CFR 61 Subpart H, “National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities,” are no longer relevant. Similarly, doses resulting from external gamma radiation are no longer calculated since the radon sources have been remediated and are contained within the permanent disposal cell. The cell cover effectively mitigates radon releases to levels comparable to those at background locations.

For this report, the potential exposure in terms of dose to an individual who consumes spring water contaminated with uranium is calculated. Because this calculation uses data from the spring with the highest uranium concentration (SP-5304 in the Southeast Drainage, where the highest 2013 uranium concentration was 81.9 pCi/L), the calculated dose represents the dose for the reasonable maximally exposed individual. The estimated TED to this maximally exposed individual is about 0.088 mrem. This result is compared to DOE limits established in DOE Order 458.1 to demonstrate compliance with regulatory requirements.

5.6.1 Pathway Analysis and Exposure Scenario

In developing specific elements of the Weldon Spring site environmental monitoring program, potential exposure pathways and health effects of the radioactive and chemical materials present onsite are evaluated to determine if potential pathways of exposure exist. Under current site conditions, the only potential pathway to consider is that of a recreational visitor to the Weldon Spring Conservation Area possibly coming into contact with spring water, specifically at SP-5304 in the Southeast Drainage. A dose calculation for a population within 49.6 miles of the site is not estimated, since the airborne release of radioactive contaminants is not a factor.

Consumption of contaminated groundwater at both the Chemical Plant/former Raffinate Pits and the Quarry areas is not currently a pathway of concern, as no drinking water wells are located near the contaminated groundwater in the Chemical Plant and former Raffinate Pits area, and there is no access to the impacted groundwater at the Quarry area. Concentrations of uranium in the production wells near the Weldon Spring Quarry are comparable to background concentrations.

Inhalation of airborne particulates, inhalation of radon gas, and external gamma irradiation are also no longer pathways of concern, since the contaminated soils and other materials have been

remediated and placed in the onsite cell. Hence, these pathways were not included in the dose estimates for 2013.

The radiological public dose guideline in DOE Order 458.1 is applicable for comparing potential doses at the Weldon Spring site. This guideline provides for an annual limit of 100 mrem TED, accounting for all exposure pathways (excluding background).

5.6.2 Total Effective Dose Estimates

The TED estimate for the exposure scenario was calculated using 2013 environmental monitoring data. The annual dose is well below the standards set by DOE for public exposure.

This section discusses the estimated TED to a hypothetical individual assumed to frequent the Southeast Drainage of the Weldon Spring Conservation Area. No private residences are adjacent to the Southeast Drainage, which is situated on land currently managed by MDC. Therefore, the calculation of dose equivalent is based on a recreational user of the Conservation Area who drank from SP-5304 20 times per year during 2013.

Exposure scenario assumptions particular to this dose calculation include the following:

- The maximally exposed individual drank 1 cup (0.2 liter [L]) of water from the spring 20 times per year (equivalent to 1.05 gallons [4.0 L] of water for the year).
- The maximum uranium concentration in water samples taken from spring locations during 2013 was at SP-5304 in the Southeast Drainage (81.9 pCi/L). This concentration was assumed to be present in all of the water ingested by the maximally exposed individual.

On the basis of the natural uranium activity ratios of 49.1 percent for U-234, 2.3 percent for U-235, and 48.6 percent for U-238, the dose conversion factors (DCFs) for ingestion for U-238, U-235 and U-234 were used for calculating the dose. These DCFs are 2.54×10^{-4} mrem/pCi, 2.66×10^{-4} mrem/pCi, and 2.83×10^{-4} mrem/pCi for U-238, U-235, and U-234, respectively (Eckerman et al. 1988). The DCF for total uranium at the site is $0.49 \text{ DCF U-234} + 0.023 \text{ DCF U-235} + 0.48 \text{ DCF U-238}$ or 2.69×10^{-4} mrem/pCi.

The TED is calculated as shown below:

TED (ingestion of contaminated water for uranium) = Concentration (pCi/L) \times Volume of Water Ingested (L) \times DCF U-total (mrem/pCi).

TED (total uranium) = $81.9 \text{ pCi/L} \times 4 \text{ L} \times (2.69 \times 10^{-4} \text{ mrem/pCi}) = 0.088 \text{ mrem}$.

This value represents less than 0.1 percent of the DOE standard of 100 mrem TED above background. In comparison, the annual average exposure to natural background radiation in the United States results in a TED of approximately 300 mrem (BEIR 1990).

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6.0 Environmental Quality

6.1 Highlights of the Quality Assurance Program

Quality assurance for 2013 sampling activities followed the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351).

- Average relative percent differences were calculated for duplicate samples of groundwater, surface water, and springs.
- Trip and equipment blanks were assessed and summarized.
- The data validation program accepted 99.8 percent of the all data in 2013 (including field data).
- Appendix G provides the 2013 Data Review and Validation Reports that were generated during 2013.

6.2 Program Overview

The environmental quality assurance program includes management of the plans and procedures governing environmental monitoring activities at the Weldon Spring site and at the subcontracted offsite laboratories. This section discusses the environmental monitoring standards at the Weldon Spring site and the goals for these programs, plans, and procedures.

The environmental quality assurance program provides the Weldon Spring site with reliable, accurate, and precise monitoring data. The program furnishes guidance and directives to detect and prevent quality problems from the time a sample is collected until the associated data are evaluated and utilized. Key elements in achieving the goals of this program are compliance with the quality assurance requirements, the use of quality control samples, complete documentation of field activities and laboratory analyses, and validation and reviews of data documentation for precision, accuracy, and completeness.

The *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* summarizes the data quality requirements for collecting and analyzing environmental data. The LTS&M Plan (DOE 2008a) lists the sampling locations and provides site-specific detail for quality control samples. These plans describe administrative procedures for environmental data management, data validation, database administration, and data archiving.

Analytical data are received from subcontracted analytical laboratories. These data are reviewed, validated, and qualified according to the *Environmental Procedures Catalog* (LMS/PRO/S04325).

Applicable standards for environmental quality assurance include (1) use of the approved analytical and field measurement methods; (2) collection and evaluation of quality control samples; (3) accurate, precise, and completeness evaluations; and (4) preservation and security of all applicable documents and records pertinent to the environmental monitoring program.

6.3 Quality Control Samples

Quality control samples for environmental monitoring are collected in accordance with the required sampling plan, which specifies how frequently quality control samples should be collected. Table 54 describes the quality control samples collected at the Weldon Spring site.

Table 54. Quality Control Sample Description

Type of Quality Control Sample	Description
Equipment Rinsate Blank	Monitors the effectiveness of decontamination procedures used on nondedicated sampling equipment. Equipment blanks include rinsate and filter blanks.
Trip Blank	Monitors volatile organic compounds that may be introduced during transportation or handling at the laboratory. Trip blanks are collected with distilled water in the Weldon Spring site laboratory.
Field Duplicate	Monitors field conditions that may affect the reproducibility of samples collected from a given location. Field duplicates are collected in the field at the same location.
Matrix Spike ^a	Assesses the matrix and accuracy of laboratory measurements for a given matrix type. The results of this analysis and the routine sample are used to compute the percent recovery for each parameter.
Matrix Duplicate ^a	Assesses the matrix and precision of laboratory measurements for inorganic parameters in a given matrix type. The results of the matrix duplicate and the routine sample are used to compute the relative percent difference for each parameter.
Matrix Spike Duplicate ^a	Assesses the matrix and precision of laboratory measurements for organic compounds. The matrix spike duplicate is spiked in the same manner as the matrix spike sample. The results of the matrix spike and matrix spike duplicate are used to determine the relative percent difference for organic parameters.

^a A laboratory sample is split from the parent sample.

6.3.1 Duplicate Results Evaluation

Subcontracted laboratories performed field duplicate analyses from split samples collected at the Weldon Spring site in 2013. Field duplicates were used to assess the precision of analyses and also to aid in evaluating the homogeneity of samples or analytical interference of sample matrixes. Additionally, field and matrix duplicates were assessed during the data validation process for each sample group.

Generally, field duplicate samples were analyzed for the same parameters as the original samples and were collected at the rate of approximately one for every 10 samples. In 2013, 39 field duplicates were collected from 465 field locations sampled (8.4 percent). Typically, duplicate samples were analyzed for the common parameters (e.g., uranium, inorganic anions, metals).

When field duplicate samples were available, the average relative percent difference (RPD) was calculated. This difference represents an estimate of precision and uses the following equation:

$$RPD = \frac{|S - D|}{\left(\frac{S + D}{2}\right)} \times 100$$

Where: S = analytical result of the original sample, and
 D = analytical result of the duplicate sample.

Table 55 summarizes the calculated average RPD for field duplicate samples for groundwater, springs, and surface water samples. Parameters that were not commonly analyzed for or that were not contaminants of concern were not evaluated. The RPD was calculated only for samples with analytical results that exceeded 5 times the detection limit and had no quality control problems (e.g., blank contamination).

Table 55. Summary of Calculated RPDs for 2013

Parameter	Number of Samples	Average RPD
Uranium	21	7.0
Iron	12	7.6
Sulfate	11	2.4
Nitrate (as Nitrogen)	9	11.0
Chemical Oxygen Demand	4	10.1
Barium	4	13.6
Manganese	4	9.8
Nickel	4	6.8
Chloride	2	1.6
Cobalt	2	2.8
Fluoride	2	1.5
Total Dissolved Solids	2	4.2
Total Organic Carbon	2	2.1
Selenium	2	15.0
Volatile Organics	1	0.5

The results in Table 55 demonstrate that average RPDs calculated were within the 20 percent criterion. Also, several individual parameters exceeded the 20 percent criterion and were assessed and discussed in the individual Data Review and Validation Reports (Appendix G).

6.3.2 Blank Sample Results

Various types of blanks are collected to assess the conditions or contaminants that may be introduced during sample collection and transportation. These conditions and contaminants are monitored by collecting blank samples to ensure that environmental samples are not being contaminated. The following types of blank samples were evaluated:

- The environmental conditions under which the samples (i.e., for analysis of volatile organic compounds) were shipped (trip blanks).
- The ambient conditions in the field that may affect a sample during collection (trip blanks).
- The effectiveness of the decontamination procedure for sampling equipment used to collect samples (equipment rinsate blanks).

6.3.2.1 Trip Blank Evaluation

Trip blanks are collected to assess the impact of sample collection and shipment on groundwater and surface water samples analyzed for volatile organic compounds. Trip blanks are sent to the laboratory with each shipment of volatile organic samples.

In 2013, five trip blanks were analyzed for volatile organic compounds. No reported compounds were detected in the trip blanks, and therefore, no volatile organic contamination was associated with the handling of these samples and their shipment to the laboratory.

6.3.2.2 Equipment Rinsate Blank Evaluation

Equipment rinsate blanks are samples that are collected by rinsing decontaminated equipment with distilled or deionized water. The collected rinse water is then analyzed for selected constituents. This procedure is used to determine the effectiveness of the decontamination process. At the Weldon Spring site, most of the groundwater samples are collected from dedicated equipment (e.g., pumps, dedicated bailers), and spring water is collected by placing the sample container directly into the spring water. Therefore, no equipment blanks are required for groundwater or spring locations.

Surface water may be collected by transferring samples directly into an appropriate container, using a dip cup or a stainless-steel bucket. When the dip cup or stainless-steel bucket is used, an equipment rinsate blank is collected to assess the cleanliness of the equipment. All surface water samples collected in 2013 were placed directly into the sample container, and no equipment rinsate blank samples were collected.

6.4 Data Validation Program Summary

The data validation program at the Weldon Spring site follows the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*. This program involves reviewing and qualifying 100 percent of the data collected during a calendar year. Attached in Appendix G are the completed Data Review and Validation Reports that are prepared for each sample lot or set of samples submitted to a laboratory for analysis. These reports provide detailed results on laboratory and field quality control, associated data qualifier summary, and specific information on methodologies used for analyzing associated samples. The reports provide information on potential data outliers, evaluation of sampling protocol, and assessment of field instruments' calibration and measurement.

Table 56 identifies the number of quarterly and total data points that were validated in 2013 and indicates the percentage of those selected that were complete. Data points in this table include all sample types (including field parameters).

Table 56. Validation Summary for Calendar Year 2013

Calendar Quarter	No. of Data Points Validated	No. of Validated Data Points Rejected	Completeness ^a
Quarter 1	644	2	99.7
Quarter 2	1,492	2	99.9
Quarter 3	570	0	100
Quarter 4	1194	2	99.8
2013 Total	3900	6	99.8

^a Completeness is a measure of acceptable data. The value is determined by the following equation:
 Completeness = $\frac{(\# \text{ validated} - \# \text{ rejected})}{\# \text{ validated}}$

Reflects all validatable data for the calendar year.

Table 57 identifies validation qualifiers assigned to the selected data points as a result of data validation. The Weldon Spring site validation technical review was performed in accordance with the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*. For calendar year 2013, 100 percent of data validation was completed. Data points in this table include samples of groundwater, leachate, surface water, and spring water.

Table 57. Validation Qualifier Summary for Calendar Year 2013

Number of Data Points									
	Field	Anions	Metals	Misc.	Nitro-aromatics	Radio-chemical	Semi-volatiles	Volatiles	Total
Accepted	883	140	701	962	546	108	368	186	3,894
Rejected	2	0	2	2	0	0	0	0	6
Not Validatable	0	0	0	0	0	0	0	0	0
Total	885	140	703	964	546	108	368	186	3,900
Percentages									
Accepted	99.8%	100%	99.7%	99.8%	100%	100%	100%	100%	99.8%
Rejected	0.2%	0%	0.3%	0.2%	0%	0%	0%	0%	0.2%
Not Validatable	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Appendix G provides 2013 Data Review and Validation Reports for the Weldon Spring site, which detail the data qualifiers applied to individual data points.

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7.0 References

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Appendix A

2013 Inspection Report Agenda

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WELDON SPRING ANNUAL INSPECTION
AGENDA

Tuesday, November 5, 2013

8:30 – 9:00 am

Inspectors/observers will divide into 2 separate groups. Review agenda, inspection teams, and safe work issues. Review inspection report and findings/corrective actions on last year's inspection. Team 1 (Team Leader - Terri Uhlmeier) will cover the Chemical Plant Area. Team 2 (Team Leader – Randy Thompson) will cover the Southeast Drainage and the Quarry Area.

9:00 – 11:30 am

Team 1: Inspect land & shallow groundwater use on Army property and DOE property:

- Monitoring wells along Army property roads
- Drive Army roads in IC area and note any land disturbance
- Disposal Cell buffer zone
- Monitoring wells on DOE Chemical Plant property

Team 2: Inspect land & shallow groundwater use on Missouri Department of Conservation property, Weldon Spring Conservation Area:

- Southeast Drainage from Army Road to Hwy 94
- Hwy 94 culvert
- Southeast Drainage from Hwy 94 to Missouri River, incl Springs 5303 & 5304

11:30 am – 12:30 pm

Lunch

12:30 – 4:00 pm

Team 1: Inspect land & shallow groundwater use on Missouri Department of Conservation property, August A. Busch Conservation Area:

- Burgermeister Spring
- Spring 6303
- Monitoring wells along MDC roads

Team 2: Inspect land & shallow groundwater use on Missouri Department of Conservation property, Weldon Spring Conservation Area and DOE property:

- DOE Quarry Property (Quarry rim wells)
- DOE Quarry Property (Quarry proper)
- Reduction zone area
- Public Water District #2 well field area

4:00 – 4:30 pm

- Summarize observations and prepare for next day

Wednesday, November 6, 2013

8:30 – 9:00 am

Review previous day's findings and current day's inspection objectives.
Inspectors/observers divide into 2 separate groups to cover 5 transects each on the disposal cell. The Team Leaders will be Terri Uhlmeyer and Randy Thompson

9:00 – 11:30 am

Disposal Cell Inspection – Potential settlement, rock degradation, vegetation
Team 1: Walk 5 Transects
Team 2: Walk 5 Transects

11:30 am – 12:30 pm

Lunch

12:30 pm – 1:00 pm

Teams 1 & 2: reconvene for trip to LCRS.

1:00– 3:00 pm

Inspection of LCRS (No confined space entry planned).
Walk disposal cell buffer zone inspecting for erosion issues.

3:00 – 4:00 pm

Document and paperwork review

4:00 – 4:30 pm

Debriefing for DOE and Stoller management of preliminary inspection findings

Thursday, November 7, 2013

8:30-11:30

This time period will be used to formalize the inspection findings.

11:30-12:30

Lunch

12:30-4:30

Meeting with DOE, EPA, and MDNR (to include an update on the uranium sampling in the unweathered bedrock unit)

Appendix B

2012 Inspection Report Corrective Action Report

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Corrective Actions from 2012 Weldon Spring LTS&M Annual Inspection

- 1. Recommendation:** Repair wells which have been observed to be damaged by ground subsidence. These include MW-1013, 1015, 1016, 1018, 1046, 2033, 2034, and 4001.
Action: A contract was issued to a drilling company and the wells were repaired the week of July 15-19.
Completed Date: July 15-19
- 2. Recommendation:** Continue to monitor and evaluate erosion control on the Chemical Plant Site.
Action: Continue to monitor and evaluate erosion control on the Chemical Plant Site.
Completed Date: Ongoing

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Appendix C

2013 Inspection Report Inspection Checklist

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Annual Site Inspection Checklist

Purpose of the Checklist

This checklist has been developed from the EPA guidance document *Comprehensive Five Year Review Guidance* dated June 2001 (OSWER No. 9355.7-03B-P) and from Section 2.3 of the *Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site*. The checklist was modified to site-specific conditions as recommended by the guidance document. The checklist will be completed annually during the Weldon Spring Site annual surveillance and maintenance inspection. The checklist will also be used to assist in compiling information for the five-year review.

I. SITE INFORMATION	
Site name: DOE Weldon Spring Site	Date(s) of inspection: Nov. 5, 6, 2013
Location: St. Charles, MO	EPA ID: MO6210022830
Agencies accompanying DOE for portions of the annual inspection: <input checked="" type="checkbox"/> EPA, Region 7 <input checked="" type="checkbox"/> MDNR <input type="checkbox"/> Other (list): _____	Weather: Cloudy cold some showers
Remedy Includes: Disposal Cell Institutional controls Monitored Natural Attenuation Long Term Monitoring Other _____	
Inspectors Terri Uhlmeier (stoller) Randy Thompson (stoller)	
Participants Ken Starr (DOE)	
Hoai Tran (EPA)	
Patrick Anderson (MDNR)	
Dan Carey (MDNR)	
Jerod Huebner (MDC)	
Yvonne Deyo (stoller)	
Tom Welton (stoller)	
Rex Hodges (stoller)	
Tim Zirbas (stoller)	
Chris Papinsick (stoller)	

II. INTERVIEWS (Check all that apply)

1. **Local Site Manager** Yvonne Deyo Site Manager 10/28/13
Name Title Date

Interviewed at site at office by phone Phone no. 636-300-2612
 Problems, suggestions; Report attached _____

2. **Environmental Data Manager** Randy Thompson Operations Manager 10/23/13
Name Title Date

Interviewed at site at office by phone Phone no. _____
 Check to ensure that environmental data is reviewed and trended.
 Problems, suggestions; Report attached _____

3. **Other Staff (as applicable)** _____
Name Title Date

Interviewed at site at office by phone Phone no. _____
 Problems, suggestions; Report attached _____

4. **Local response agencies:** Contact to notify of annual inspection and to determine if there are any concerns or issues.

Agency: St. Charles County Sheriff **Contact Name:** Captain Jim Hudson

Date Contacted: 10/28/13

Email: _____ **Phone No.** 636-949-7325

Problems; suggestions; Report attached _____

Agency: Cottleville Fire Department **Contact Name:** Mark Boehle, Assistant Fire Chief

Date Contacted: 10/9/13

Email: maboehle@cottlevillefpd.org **Phone No.** 636-447-6655, ext. 8703

Problems; suggestions; Report attached _____

Agency: SimplexGrinnel (LCRS and Interpretive Center Alarm Company)

Contact David _____ 10/31/13 888-746-7539
Name Title Date Phone no.

Problems; suggestions; Report attached _____

5. **Stakeholders:** Contact to notify of annual inspection and to determine if there are any concerns or issues.

Agency: Francis Howell High School **Contact Name:** Robert Gaugh, Assistant Principal

Date Contacted: 10/22/13

Email: Robert.Gaugh@fhsdschools.org

Phone No. 636-851-4700

Problems; suggestions; Report attached

Agency: St. Charles County **Contact Name:** Ryan Tilley, Environmental Public Health Manager

Date Contacted: 10/8/13

Email: rtalley@sccmo.org

Phone No. 636-949-7406

Problems; suggestions; Report attached

6. **Other interviews** Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **Documents**

Surveillance and Maintenance Plan

Readily available

Up to date

N/A

Remarks

2. **Permits and Service Agreements**

NPDES Permits

Readily available

Up to date

N/A

MSD agreement and records

Readily available

Up to date

N/A

Other permits

Readily available

Up to date

N/A

Remarks

3.

4.

IV. INSTITUTIONAL CONTROLS

Institutional Control (IC) Inspections

1. Land and Shallow Groundwater Use within the Chemical Plant Site and Buffer Zone

Groundwater and land use is restricted on the Chemical Plant Site. Inspect for indications of excavations into soil and groundwater withdrawal or use in restricted areas. If any party has been granted use of portions of the Chemical Plant or Quarry area, inspect to ensure that land use is in compliance with the terms of the restrictions within the notation.

Note any observations: No evidence of excavations or groundwater use.

2. Groundwater Use in Areas Surrounding the Chemical Plant

Groundwater use is restricted in areas on Army, MDC and St. Charles County (formerly MoDOT properties). Inspect affected areas for evidence of groundwater or spring water use (Burgermeister Spring and Spring 6303). Inspect to ensure that land use continues to be in compliance with the terms of the license, easement, or permit and the restrictions contained therein.

Note any observations: Inspected wells at Army. MW-4036 did not have contact label (replaced 11/7/13). Inspected MW-4041 at Busch, the ea new cap was rusty and it was repainted on 11/7/13. Inspected springs.

3. Groundwater (Quarry)

Groundwater use is restricted in areas. Inspect affected areas for evidence of groundwater withdrawal or use in the area of impact. Inspect to ensure that land use continues to be in compliance with the terms of the license and the restrictions contained therein.

Note any observations: No evidence of groundwater use.

4. Land Use in Quarry Area Reduction Zone

Land use is restricted in the Quarry Area Reduction Zone. A naturally occurring reduction zone exists in soil south of the Katy Trail and north of the Femme Osage Slough. Inspect for indications of excavations into soils in the reduction zone. Inspect to ensure that land use continues to be in compliance with the terms of the easement and the restrictions contained therein.

Note any observations: No evidence of excavations. The "No Dig" labels were present on wells in reduction zone.

5. Southeast Drainage

The Southeast Drainage is restricted for residential housing in 200 foot corridor, Check for indications of residential use or construction in the Southeast Drainage (200-foot-wide corridor), or other activity that would indicate nonrecreational use of the area. Check Springs 5303 and 5304 for residential, commercial, or agricultural use of spring water.

Note any observations: No evidence of residential use or construction. Springs were not being used.

6. **State Route 94 Culvert**

Check for signs of disturbance of the affected region where the culvert passes beneath State Route 94 and in the utility rights-of-way in the affected area. Observe culvert that has been cut.

Note any observations: The culvert inlet was covered with debris.
An email was sent to Stouwe Johnson from MoDot on 11/7/13.

7. **Pipeline from LCRS to Missouri River**

Inspect the entire length of the pipeline and outfall for any disturbances or maintenance needs.

Note any observations: The pipeline was inspected previous to
the inspection. No disturbances were noted.

Institutional Control Annual Contact Log

In accordance with the LTS&M Plan, the following will be contacted to verify cognizance of institutional controls and real estate agreements. Fill in all that apply.

1. **Agency:** Missouri Department of Conservation
Contact Name: John Vogel, Wildlife Regional Supervisor
Address: August A. Busch Memorial Conservation Area, 2360 Highway D, St. Charles, MO 63304
Institutional Control and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction, Quarry Area Groundwater Use Restriction, Quarry Reduction Zone Land Use Restriction, Southeast Drainage Residential Use Restriction, North Gate Access, Well Sampling Access Agreement, Effluent Discharge Pipeline, Hamburg Trail Use Agreement.

Date Contacted: 11/12/13

Email: john.vogel@mdc.mo.gov Phone No. 636-300-1953, ext. 4131

Problems; suggestions; Report attached _____

2. **Agency:** Missouri Department of Conservation
Contact Name: Alan Leary, Policy Coordinator
Address: P.O. Box 180, Jefferson City, MO 65102
Institutional Control and Real Estate Licenses to Verify: See No. 1

Date Contacted: 10/23/13

Email: alan.leary@mdc.mo.gov Phone No. 573-522-4115, ext. 3346

Problems; suggestions; Report attached _____

3. **Agency:** Missouri Department of Natural Resources
Contact Name: Mary Bryan, Real Estate Manager
Address: P.O. Box 176, Jefferson City, MO 65102
Institutional Controls and Real Estate Licenses to Verify: Quarry Area Groundwater Use Restriction, Southeast Drainage Residential Use Restriction, Well Sampling Access Agreement, Effluent Discharge Pipeline
Date Contacted: 10/8/13
Email: mary.bryan@dnr.mo.gov Phone No. 573-751-7987
Problems; suggestions; Report attached _____

4. **Agency:** Missouri Department of Natural Resources
Contact Name: Quinn Kellner, Natural Resource Manager, Jones-Confluence Point State Park
Address: P.O. Box 67, West Alton, MO 63386
Institutional Controls and Real Estate Licenses to Verify: Quarry Area Groundwater Use Restriction, Southeast Drainage Residential Use Restriction, Well Sampling Access Agreement, Effluent Discharge Pipeline
Date Contacted: 10/8/13
Email: quinn.kellner@dnr.mo.gov Phone No. 636-899-1135
Problems; suggestions; Report attached _____

5. **Agency:** Missouri Department of Transportation
Contact Name: Tom Blair, Asst. District Engineer
Address: 1590 Woodlake Dr., Chesterfield, MO 63017
Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction (transfer to St. Charles County), and discuss the Missouri State Highway 94 Culvert.
Date Contacted: 10/8/13
Email: tom.blair@modot.mo.gov Phone No.: 314-340-4203
Problems; suggestions; Report attached _____

6. **Agency:** Missouri Department of Transportation
Contact Name: Stowe Johnson, Sr. Environmental Specialist
Address: P.O. Box 270, Jefferson City, MO 65102
Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction (transferred to St. Charles County), and discuss Missouri State Highway 94 Culvert.
Date Contacted: 10/8/13
Email: stowe.johnson@modot.mo.gov Phone No.: _____
Problems; suggestions; Report attached _____

7. **Agency:** Missouri Department of Transportation
Contact Name: Tom Evers, St. Charles County Area Engineer
Address: 6780 Old Hwy. N. St. Charles, MO 63304
Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction (transferred to St. Charles County) , and discuss Missouri State Highway 94 Culvert.
Date Contacted: 10/8/13
Email: Thomas.Eversjr@modot.mo.gov Phone No.: 636-240-5277
Problems; suggestions; Report attached _____

8. **Agency:** St. Charles County
Contact Name: Craig Tajkowski, County Engineer
Address: 201 N. 2nd St., Ste. 429, St. Charles, MO 63301
Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction (former MoDOT property)
Date Contacted: 10/28/13
Email: ctajkows@sccmo.org Phone No. 636-949-7305
Problems; suggestions; Report attached _____

9. **Agency:** U.S. Dept. of Army
Contact Name: Kevin Grimes, Facility Manager
Address: Weldon Spring Training Area, 7301 Hwy 94 S. St. Charles, MO 63304
Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction, Memorandum of Understanding
Date Contacted: 10/28/13
Email: _____ Phone No. 636-329-1200, ext. 2403
Problems; suggestions; Report attached cell no. 913-669-0148

10. **Agency:** St. Charles County Recorder of Deeds
Address: 201 N 2nd, St. Charles, MO 63301
Institutional Controls to and Real Estate Licenses to Verify: Recorded real estate restrictions at the Recorder of Deeds Office or on the Internet at www.sccmo.org
Date verified: 10/30/13
Problems; suggestions; Report attached copied all information off of website

11. Agency: St. Charles County Planning and Zoning Department
Contact Name: Wayne Anthony
Address: 201 N 2nd, St. Charles, MO 63301
Institutional Controls to and Real Estate Licenses to Verify: Awareness of Restrictions

Date Contacted: 10/31/13

Email: _____ Phone No. 636-949-7900, ext. 7221

Problems; Report attached suggestions; _____

General

1. Land Use Changes On Site Yes No
Remarks _____

2. Land Use Changes Off Site that could affect site Yes No
Remarks _____

VI. GENERAL SITE CONDITIONS

1. Roads Location shown on site map Roads adequate Yes No
Remarks _____

2. Vandalism Location shown on site map Vandalism noted Yes No
Remarks _____

3. Personal Injury Risks Housekeeping maintained Yes No
Remarks _____

VIII. CHEMICAL PLANT DISPOSAL CELL

1. Settlement /Bulges Location shown on site map New settlement noted Yes No

A. Annually: Walk along the grade break at the top of the side slopes, around the cell perimeter, and along 10 transects across the cell surface. Inspect for local depressions, regional departures from planar surfaces, and shifts in intersections (vertices) of cell surface planes. Inspect for vertical shear of the cover layers indicated by sudden, abrupt steps that exceed an approximately 6-inch change of surface level over no more than 10 feet distance.

B. During 5-Year Review Inspections (Beginning 2005 and at 5-year Intervals): Conduct an aerial mapping survey with a vertical resolution not less precise than 0.5 feet. Produce and record maps and survey data for the cell surface represented by 1.0 foot contour intervals. Evaluate the data for indications of settlement. Consider the position and spacing of contour lines as indications of elevation change and possible settlement.

Remarks The inspectors walked the 10 transects -

2. Rock Cover Signs of degradation Yes No Signs of intrusion Yes No

A. Annually: During settlement monitoring inspection also visually inspect for departures from original rock conditions or from the previous inspection. Note observable discoloration on areas larger than 2,500 square feet, presence of finer materials at surface and apparent rock gradation changes. Document rock conditions annually with photographs.

B. During 5-Year Review Inspections (Beginning 2005 and at 5-year Intervals): Inspect cell cover for gradation changes by walking 10 transects across the cell. Concentrations of degraded, split, or weathered pieces of limestone will be mapped, photodocumented and visually assessed as a percentage of rock exposed within each mapped area. If degraded rock is evenly distributed, inspectors will estimate the overall percentage of degraded rock. If the amount of degraded rock appears to be increasing, based on a review of previous annual rock quality assessments, additional monitoring or gradation testing will be performed. If rock does not appear degraded, photodocumentation of several GPS located areas will establish rock conditions for future reference.

Remarks The six rock degradation test plots were compared to previous years photos. The rocks had not changed or degraded.

3. Vegetative Growth Weeds or Plants on Cell Yes No

Remarks

4.	Wet Areas/ Water Damage	Wet areas <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Location shown on site map Areal extent _____ Ponding <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Location shown on site map Areal extent _____ Seeps <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Location shown on site map Areal extent _____ Remarks _____ _____ _____	
5.	Toe/Apron Drains	Proper drainage <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Silting <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Erosion <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Remarks _____ _____ _____	
6.	Slope Instability	<input type="checkbox"/> Location shown on site map Evidence of slope instability <input type="checkbox"/> Yes <input type="checkbox"/> No Remarks _____ _____ _____	
7.	Leachate Collection and Removal System	<input checked="" type="checkbox"/> Fence/Gates/Locks in good condition <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> No Trespassing sign posted <input checked="" type="checkbox"/> Correct Phone Numbers Posted Data Issues <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Flow Rate Issues <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Remarks _____ _____ _____ _____	
8.	Condition of 300 Ft. Buffer Zone	Erosion <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Remarks _____ _____ _____	
9.	Condition of Prairie	Erosion <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Remarks _____ _____ _____	
IX. GROUNDWATER MONITORING			
1.	Disposal Cell Monitoring Well Network	<input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Evidence of surface water infiltration at casing <input type="checkbox"/> Needs maintenance <input checked="" type="checkbox"/> Proper ID on each well Remarks _____ _____ _____ _____	

2. **Chemical Plant Groundwater Monitoring Well Network**

Properly secured/locked Functioning
 Good condition Evidence of surface water infiltration at casing Needs maintenance

List wells checked by number (> 10% of wells)

MW-2012, 2013, 2014, 2017, 2023, 2033, 2034, 2053, 3024, 3025, 3026, 3027, 3031,
3040, 4001, 4006, 4007, 4011, 4026, 4027, 4029, 4031, 4032, 4033, 4036, 4038

Remarks 4040, 4041, 4042, 4043

3. **Quarry Monitoring Well Network**

Properly secured/locked Functioning
 Good condition Evidence of surface water infiltration at casing Needs maintenance

List wells checked by number (> 10% of wells) MW-1002, 1005, 1013, 1014, 1015, 1016,
1027, 1045, 1046, 1048, RMW-1.

Remarks

X. OVERALL OBSERVATIONS

Implementation of the Remedies

Describe issues and observations relating to whether the remedies are effective and functioning as designed.

No issues

Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedies.

No issues

Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of one or more of the remedies may be compromised in the future.

No issues

Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedies.

process of current unweathered bedrock groundwater study

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Appendix D

2013 Inspection Report LCRS Data

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Table D-1. Leachate Production Summary Table

Month/Year	Days	Sump Volume Start (gal)	Sump Volume End of Month (gal)	Transferred from sump (gal)	Transferred to Sump from the Burrito (gal)	Purge water transferred to Sump (gal)	East Secondary Total per Month (gal)	West Secondary Total per Month (gal)	Primary Leachate Total Volume per month (gal)	Primary Leachate (gal/day)	East Secondary (gal/day)	West Secondary (gal/day)	Burrito Flow (gal/day)	Combined Leachate Flow Rate from Primary, Secondary and Burrito Water (gal/day)	Combined Secondary and Burrito Water Leak Rate (gal/acre/day)
Jan-06	31	2,967	833	6,946	163	51	175	18	4406	142	5.6	0.6	5.3	154	0.43
Feb-06	28	833	5,292	0	154	53	165	20	4068	145	5.9	0.7	5.5	157	0.46
Mar-06	31	5,292	3,808	6,112	162	0	172	18	4275	138	5.6	0.6	5.2	149	0.43
Apr-06	30	3,808	881	7,658	155	55	175	19	4327	144	5.8	0.6	5.2	156	0.44
May-06	31	881	5,615	0	173	0	165	17	4379	141	5.3	0.5	5.6	153	0.43
Jun-06	30	5,615	2,324	7,792	198	0	171	20	4112	137	5.7	0.7	6.6	150	0.49
Jul-06	31	2,324	6,893	0	211	0	166	21	4171	135	5.4	0.7	6.8	147	0.48
Aug-06	31	6,893	4,318	6,873	217	15	149	20	3898	126	4.8	0.6	7.0	138	0.47
Sep-06	30	4,318	8,714	0	198	0	148	20	4029	134	4.9	0.7	6.6	147	0.46
Oct-06	31	8,714	4,091	8,584	211	0	148	17	3585	116	4.8	0.6	6.8	128	0.46
Nov-06	30	4,091	1,222	7,236	204	86	137	15	3925	131	4.6	0.5	6.8	143	0.45
Dec-06	31	1,222	5,500	0	194	0	146	21	3917	126	4.7	0.7	6.3	138	0.44
Jan-07	31	5,500	1,444	8,268	186	0	135	18	3874	125	4.3	0.6	6.0	136	0.41
Feb-07	28	1,444	5,333	0	144	0	119	19	3607	129	4.3	0.7	5.1	139	0.38
Mar-07	31	5,333	2,176	7,254	147	50	125	17	3759	121	4.0	0.5	4.7	131	0.35
Apr-07	30	2,176	6,571	0	142	279	124	18	3832	128	4.1	0.6	4.7	137	0.36
May-07	31	6,571	2,176	8,453	178	0	122	23	3735	120	3.9	0.8	5.7	131	0.39
Jun-07	30	2,176	6,182	0	207	0	119	16	3664	122	4.0	0.5	6.9	134	0.43
Jul-07	31	6,182	3,167	6,878	244	0	117	18	3483	112	3.8	0.6	7.9	125	0.46
Aug-07	31	3,167	7,250	0	231	0	118	18	3716	120	3.8	0.6	7.5	132	0.45
Sep-07	30	7,250	2,235	8,578	226	47	109	20	3161	105	3.6	0.7	7.5	117	0.45
Oct-07	31	2,235	6,091	0	218	0	109	17	3513	113	3.5	0.5	7.0	124	0.42
Nov-07	30	6,091	2,294	7,484	189	0	107	24	3367	112	3.6	0.8	6.3	123	0.40
Dec-07	31	2,294	6,147	0	208	0	105	16	3524	114	3.4	0.5	6.7	124	0.40
Jan-08	31	6,147	810	9,229	188	0	108	17	3579	115	3.5	0.5	6.1	126	0.38
Feb-08	29	810	4,240	0	148	0	91	14	3177	110	3.1	0.5	5.1	118	0.33
Mar-08	31	4,240	2,145	5,917	131	41	105	14	3531	114	3.4	0.5	4.2	122	0.34
Apr-08	30	2,145	5,868	0	156	0	96	14	3457	115	3.2	0.5	5.2	124	0.37
May-08	31	5,868	8,168	1,547	186	48	102	17	3495	113	3.3	0.5	6.0	123	0.41
Jun-08	30	8,168	3,559	8,288	198	0	99	14	3368	112	3.3	0.5	6.6	123	0.43
Jul-08	31	3,559	7,000	0	240	0	97	16	3088	100	3.1	0.5	7.7	111	0.47
Aug-08	31	7,000	1,778	9,168	246	22	100	15	3563	115	3.2	0.5	7.9	127	0.49
Sep-08	30	1,778	5,317	0	259	0	127	17	3136	105	4.2	0.6	8.6	118	0.56
Oct-08	31	5,317	8,835	0	203	0	87	19	3209	104	2.8	0.6	6.5	113	0.42
Nov-08	30	8,835	5,104	7,056	188	20	87	12	3018	101	2.9	0.4	6.3	110	0.40
Dec-08	31	5,104	8,755	0	198	0	92	18	3343	108	3.0	0.6	6.4	118	0.41
Jan-09	31	8,755	3,417	8,710	157	0	87	14	3114	100	2.8	0.5	5.1	109	0.35
Feb-09	28	3,417	6,542	0	125	0	78	14	2908	104	2.8	0.5	4.5	112	0.32
Mar-09	31	6,542	2,455	7,303	154	32.8	90	16	2923	94	2.9	0.5	5.0	103	0.35

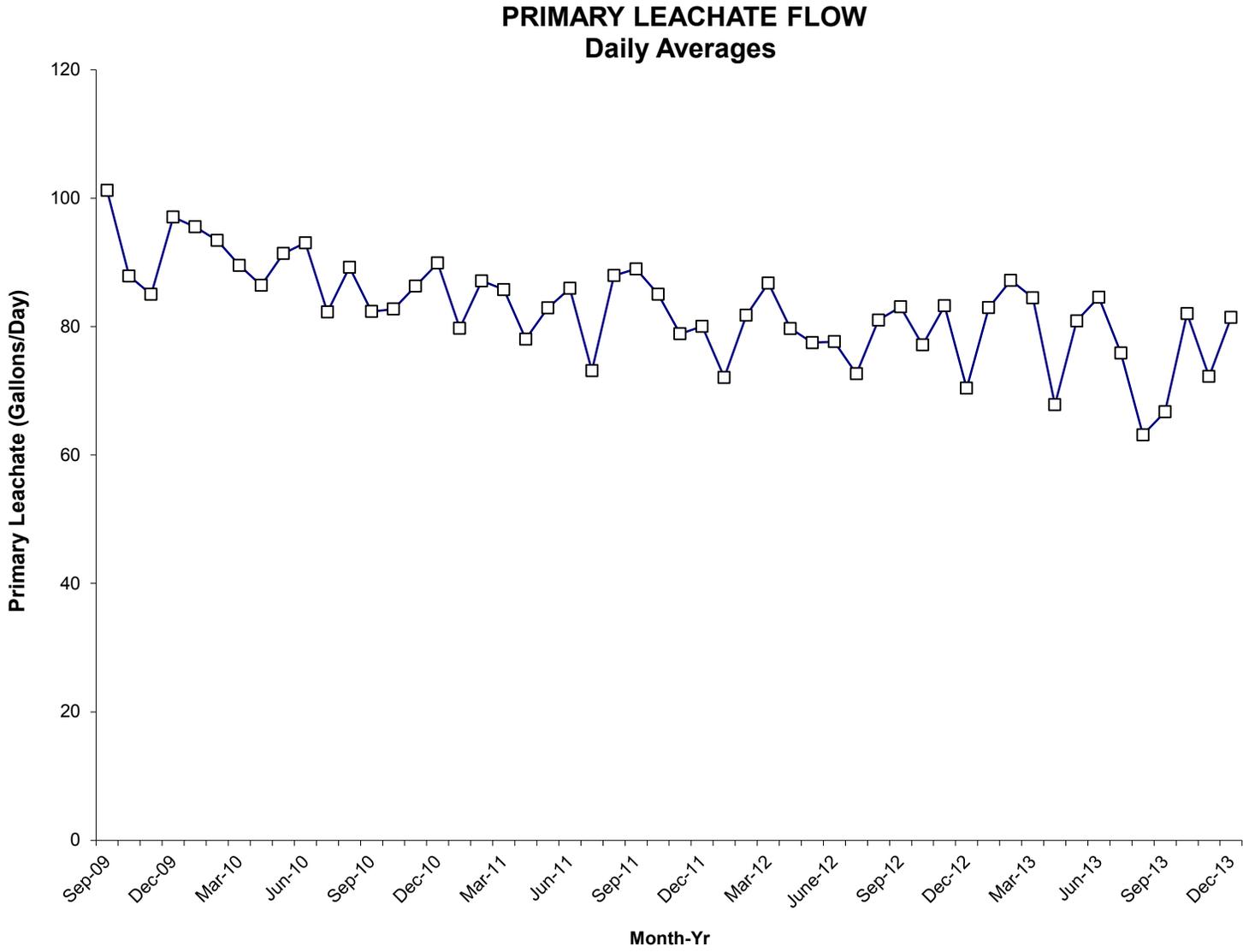
Table D-1 (continued). Leachate Production Summary Table

Month/Year	Days	Sump Volume Start (gal)	Sump Volume End of Month (gal)	Transferred from sump (gal)	Transferred to Sump from the Burrito (gal)	Purge water transferred to Sump (gal)	East Secondary Total per Month (gal)	West Secondary Total per Month (gal)	Primary Leachate Total Volume per month (gal)	Primary Leachate (gal/day)	East Secondary (gal/day)	West Secondary (gal/day)	Burrito Flow (gal/day)	Combined Leachate Flow Rate from Primary, Secondary and Burrito Water (gal/day)	Combined Secondary and Burrito Water Leak Rate (gal/acre/day)
Apr-09	30	2,445	5,493	0	176	0	83	14	2775	93	2.8	0.5	5.9	102	0.38
May-09	31	5,493	2,012	7,037	195	0	77	14	3270	105	2.5	0.5	6.3	115	0.38
Jun-09	30	2,012	5,338	0	220	28	86	17	2975	99	2.9	0.6	7.3	110	0.45
Jul-09	31	5,388	1,275	7,222	268	0	86	14	2741	88	2.8	0.5	8.6	100	0.49
Aug-09	31	1,275	4445	0	250	0	87	15	2818	91	2.8	0.5	8.1	102	0.47
Sep-09	30	4,445	3398	4,486	253	55.7	82	13	3035	101	2.7	0.4	8.4	113	0.48
Oct-09	31	3,398	6,509	0	292	0	83	12	2724	88	2.7	0.4	9.4	100	0.52
Nov-09	30	6,509	1815	7,578	244	0	78	12	2550	85	2.6	0.4	8.1	96	0.46
Dec-09	31	1,815	5,138	0	228	0	74	13	3008	97	2.4	0.4	7.4	107	0.42
Jan-10	31	5,138	2,149	6,250	201	0	81	18	2961	96	2.6	0.6	6.5	105	0.40
Feb-10	28	2,149	5,038	0	155	35.9	72	11	2615	93	2.6	0.4	5.5	102	0.35
Mar-10	31	5,038	8,077	0	169	0	82	13	2775	90	2.6	0.4	5.5	98	0.35
Apr-10	30	8,077	3347	7,587	177	0	77	11	2592	86	2.6	0.4	5.9	95	0.37
May-10	31	3,347	6509	0	236	0	81	13	2832	91	2.6	0.4	7.6	102	0.44
Jun-10	30	6,509	9,651	0	265	0	75	11	2791	93	2.5	0.4	8.8	105	0.49
Jul-10	31	9,651	2755	9,826	294	0	76	10	2550	82	2.5	0.3	9.5	95	0.51
Aug-10	31	2755	5906	0	301	0	73	11	2766	89	2.4	0.4	9.7	102	0.52
Sep-10	30	5906	8740	0	285	0	69	10	2470	82	2.3	0.3	9.5	94	0.51
Oct-10	31	8740	3955	7,685	255	0	69	12	2564	83	2.2	0.4	8.2	94	0.45
Nov-10	30	3955	6888	0	229	38	67	10	2589	86	2.2	0.3	7.6	97	0.43
Dec-10	31	6888	9981	0	228	0	69	10	2786	90	2.2	0.3	7.4	100	0.41
Jan-11	31	9981	3142	9586	202	0	65	8	2472	80	2.1	0.3	6.5	89	0.37
Feb-11	28	3142	5826	0	171	0	63	11	2439	87	2.3	0.4	6.1	96	0.36
Mar-11	31	5826	8744	0	178	0	71	10.5	2659	86	2.3	0.3	5.7	94	0.35
Apr-11	30	8744	3834	7536	198	23.5	56	7	2342	78	1.9	0.2	6.6	87	0.36
May-11	31	3834	6711	0	232	0	66	9.4	2570	83	2.1	0.3	7.5	93	0.41
Jun-11	30	6711	9644	0	274	0	70	11	2578	86	2.3	0.4	9.1	98	0.49
Jul-11	31	9644	2573	9696	287	0	63	9	2266	73	2.0	0.3	9.3	85	0.48
Aug-11	31	2573	5643	0	276	0	60	8	2726	88	1.9	0.3	8.9	99	0.46
Sep-11	30	5643	8621	0	250	0	52	7	2669	89	1.7	0.2	8.3	99	0.43
Oct-11	30	8621	3650	7853	260	0	62	9	2551	85	2.1	0.3	8.7	96	0.46
Nov-11	31	3650	6426	0	271	0	53	7	2445	79	1.7	0.2	8.7	90	0.44
Dec-11	31	6426	9246	0	273	0	57	9	2481	80	1.8	0.3	8.8	91	0.46
Jan-12	31	9246	2707	9069	231	0	57	8	2234	72	1.8	0.3	7.5	82	0.40
Feb-12	29	2707	5380	0	206	40.3	49	7	2371	82	1.7	0.2	7.1	91	0.38
Mar-12	31	5380	8367	0	229	0	57	11	2690	87	1.8	0.4	7.4	96	0.40
April-12	30	8367	1147	9934	267	0	49	7	2391	80	1.6	0.2	8.9	90	0.45
May-12	31	1147	3869	0	263	0	56	1.1	2402	77	1.8	0.0	8.5	88	0.43
June-12	30	3869	6530	0	281	0	51		2329	78	1.7	0.0	9.4	89	0.46
Jul-12	31	6530	3248	5887	277	31	45		2252	73	1.5	0.0	8.9	83	0.43

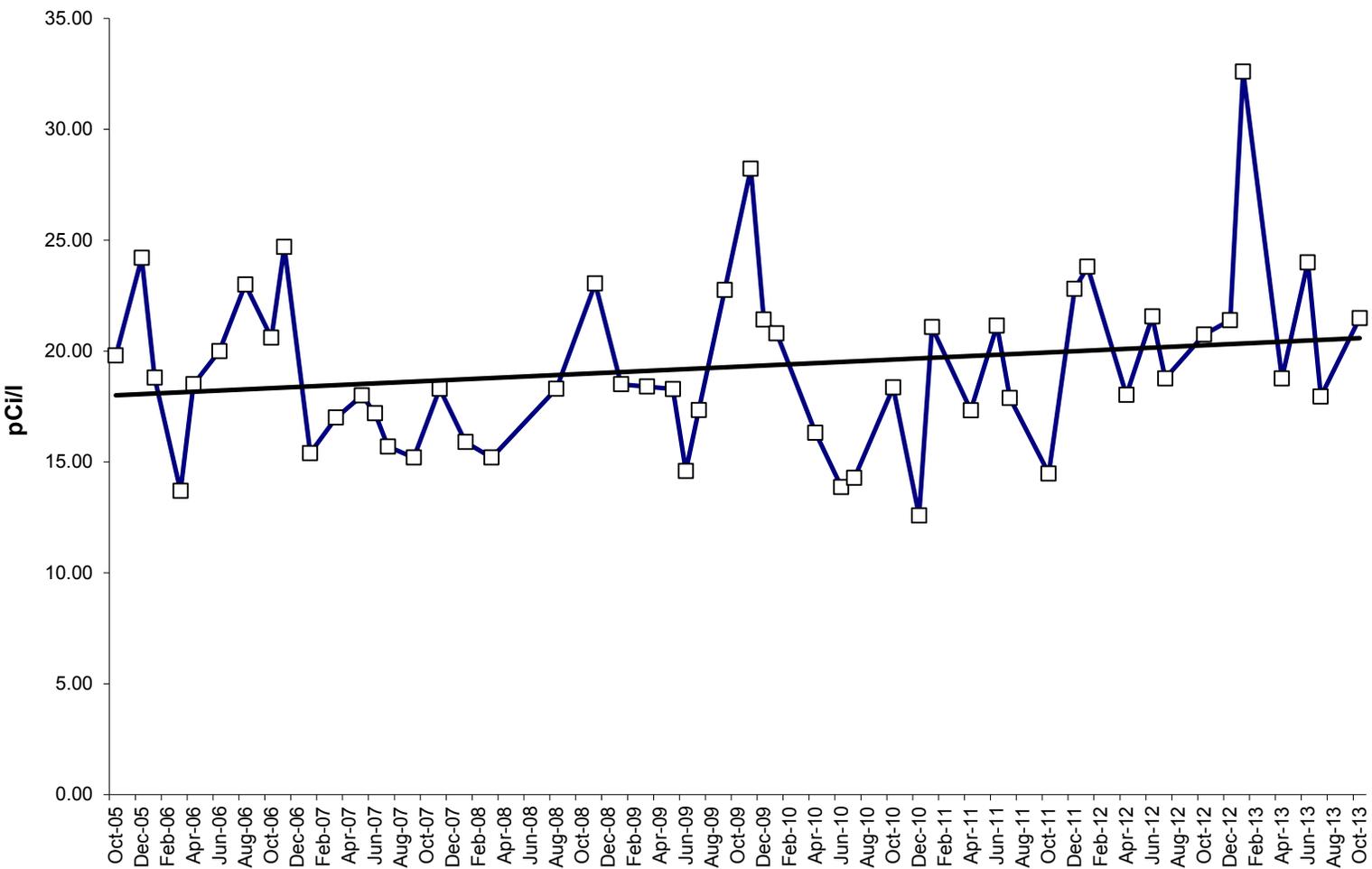
Table D-1 (continued). Leachate Production Summary Table

Month/Year	Days	Sump Volume Start (gal)	Sump Volume End of Month (gal)	Transferred from sump (gal)	Transferred to Sump from the Burrito (gal)	Purge water transferred to Sump (gal)	East Secondary Total per Month (gal)	West Secondary Total per Month (gal)	Primary Leachate Total Volume per month (gal)	Primary Leachate (gal/day)	East Secondary (gal/day)	West Secondary (gal/day)	Burrito Flow (gal/day)	Combined Leachate Flow Rate from Primary, Secondary and Burrito Water (gal/day)	Combined Secondary and Burrito Water Leak Rate (gal/acre/day)
Aug-12	31	3248	6096	0	286	0	51		2511	81	1.6	0.0	9.2	92	0.45
Sep-12	30	6096	8976	0	335	0	53		2492	83	1.8	0.0	11.2	96	0.54
Oct-12	31	8976	2567	9179	330	0	49		2391	77	1.6	0.0	10.6	89	0.51
Nov-12	30	2567	5390	0	278	0	48		2497	83	1.6	0.0	9.3	94	0.45
Dec-12	31	5390	7953	0	283	47.4	44	6.1	2183	70	1.4	0.2	9.1	81	0.45
Jan-13	31	7953	2867	7964	241	0	57	9.4	2571	83	1.8	0.3	7.8	93	0.41
Feb-13	28	2867	5630	0	212	62	42	6	2441	87	1.5	0.2	7.6	96	0.39
Mar-13	31	5630	8516	0	223	0	40	3.9	2619	84	1.3	0.1	7.2	93	0.36
Apr-13	30	8516	2250	8562	212	0	44	5.6	2034	68	1.5	0.2	7.1	77	0.36
May-13	31	2250	5075	0	259	0	51	7.8	2507	81	1.6	0.3	8.4	91	0.43
Jun-13	30	5075	7942	0	278	0	46	5.9	2537	85	1.5	0.2	9.3	96	0.46
Jul-13	31	7942	3397	7286	298	39.6	45	6.3	2352	76	1.5	0.2	9.6	87	0.47
Aug-13	31	3397	5689	0	280	0	48	7.2	1957	63	1.5	0.2	9.0	74	0.45
Sep-13	30	5689	8006	0	264	0	46	5.4	2002	67	1.5	0.2	8.8	77	0.44
Oct-13	31	8006	2922	7941	262	0	46	6.6	2542	82	1.5	0.2	8.5	92	0.42
Nov-13	30	2922	5460	0	298	30.1	39	4.3	2167	72	1.3	0.1	9.9	84	0.47
Dec-13	31	5460	8271	0	240	0.0	41	5.9	2524	81	1.3	0.2	7.7	91	0.39

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Total Uranium Levels in the Primary Leachate



Appendix E

2013 Inspection Report Interviews and Contacts

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INTERVIEW RECORD

Site Name: Weldon Spring Site	EPA ID No.: MO6210022830	
Subject: Annual Inspection	Time: 8:49 am	Date: 10/9/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email Location of Visit: NA	<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.
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Individual Contacted:

Name: Mark Boehle	Title: Assistant Fire Chief	Organization: Cottleville Fire Dept
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Telephone No: 636-447-6655 ext. 8703	Street Address: PO Box 385
Fax No:	City, State, Zip: Cottleville, MO 63338
E-Mail Address:	

Summary Of Conversation

I contacted Mark Boehle of the Cottleville Fire Department and sent him the following information via email:

Just wanted to contact you regarding the upcoming Department of Energy – Weldon Spring Site annual long-term surveillance and maintenance inspection, which is scheduled for November 5 and 6. As part of the inspection we contact stakeholders to maintain contact with them and to determine if they have any concerns or issues about the site. I have attached a new site figure for you which shows the new configuration since the administration building was torn down and the office trailers have been installed. A question we wanted to ask you is: We have Knox boxes on the Leachate Treatment Building and the Lab Building doors, is there anywhere else we should mount a Knox box, such as the Interpretive center or the office trailer? Please respond and let me know if you have any questions, issues or concerns. Thanks!

Mark responded as follows: Thanks Terri.

INTERVIEW RECORD

Site Name: Weldon Spring Site	EPA ID No.: MO6210022830	
Subject: Annual Inspection	Time: 10:47 am	Date: 10/28/13
Type: <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> Visit <input type="checkbox"/> Other Location of Visit: NA	<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.
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Individual Contacted:

Name: Jim Hudson	Title: Captain	Organization: St. Charles County Sheriff Office
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Telephone No: 636-949-7325 Fax No: 636-949-7525 E-Mail Address:	Street Address: City, State, Zip:
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Summary Of Conversation

I contacted Captain Jim Hudson of the St. Charles County Sheriff's Office and informed him that the annual LTS&M inspection would be taking place on November 5-7, 2013. I had talked to Captain Hudson the last ten years and reminded him that we would be contacting the Sheriff's office annually to keep in contact with them and check to see if they had any issues or concerns. Captain Hudson said he did not know of any concerns at this time. We discussed the use of security patrols and signs which have helped curtail vandalism at the site. I did inform him of the tornado which occurred in May and the damage to the AC units at the interpretive center.

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 10:35 am	Date: 10/2/13
Type: <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> Visit <input type="checkbox"/> Other		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: Weldon Spring Site			
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.	
Individual Contacted:			
Name: John Vogel	Title: Wildlife Regional Supervisor	Organization: August A. Busch Memorial Conservation Area, Missouri Dept. of Conservation	
Telephone No: 636-300-1953 ext. 4131		Street Address: 2360 Hwy D	
Fax No:		City, State, Zip: St. Charles, MO 63304	
E-Mail Address:			

Summary Of Conversation

I contacted John Vogel, to notify him of the annual inspection that was going to take place on November 5-7, 2013. John had been promoted this year and took over Joel Porath's former position. Joel has moved to the MDC office in Jefferson City. DOE had previously sent John a copy of the notification and agenda for the inspection. He said he could not attend but planned to send someone from his office to participate in the inspection of the Southeast Drainage. We discussed the status of the MDC groundwater easement. He said that the only hunting that would be going on, would be the possibility of squirrel hunters in the area. John said he did not have any issues or concerns at this time.

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 11:10 am	Date: 10/8/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: NA			
Contact Made By:			
Name: Terri Uhlmeyer		Title: Compliance Manager	Organization: SM Stoller, Corp.
Individual Contacted:			
Name: Ryan Tilley		Title: Director, Division of Environmental Health and Protection	Organization: St. Charles County
Telephone No: 636-949-7406		Street Address: 201 North Second Street, Suite 537	
Fax No:		City, State, Zip: St. Charles, MO 63301	
E-Mail Address: RTilley@sccmo.org			
Summary Of Conversation			
<p>I contacted Ryan Tilley, Director, Division of Environmental Health and Protection for St. Charles County by email. The email stated the following:</p> <p>Ryan, just wanted to contact you regarding the upcoming Department of Energy – Weldon Spring Site annual long-term surveillance and maintenance inspection, which is scheduled for November 5 and 6. You were copied on the notification letter with the agenda which was dated September 6, 2013. As part of the inspection we contact stakeholders to maintain contact with them and to determine if they have any concerns or issues about the site. Please respond and let me know us know if you have any questions, issues or concerns. Thanks!</p> <p>Ryan responded as follows:</p> <p>Terri, We have no concerns at this time. Also, we will not be participating in the inspections this year. Thanks for asking. Ryan</p>			

INTERVIEW RECORD

Site Name: Weldon Spring Site	EPA ID No.: MO6210022830	
Subject: Annual Inspection	Time: 12:38 pm	Date: 10/28/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email	<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: NA		

Contact Made By:

Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.
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Individual Contacted:

Name: Craig Tajkowski	Title: County Engineer	Organization: St. Charles County
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Telephone No: 636-949-7305	Address: 201 N. 2 nd St, Ste. 429 City, State, Zip: St. Charles, Mo 63301
Fax No:	
E-Mail Address: ctajkows@sccmo.org	

Summary Of Conversation

I contacted Craig Tajkowski of St. Charles County by email. They have taken over the former MoDOT facility and the groundwater restriction easement on that property was transferred from the MoDOT to the county.

Craig, I am contacting you to notify you of the Department of Energy Weldon Spring Site annual inspection which will take place on November 5-6. This is considered our long-term surveillance and maintenance (LTS&M) inspection which we have conducted every year since we completed remediation of the site. This is actually our 11th LTS&M inspection. . We use this time to walk over the areas that we have institutional controls in place to ensure that the restrictions are not being violated. We also inspect the disposal cell, check monitoring wells, go through records and different inspection type activities. We also use this time to maintain contact with certain stakeholders, nearby property owners and institutional control contacts, such as yourself. We just like to remind the IC contacts about the ICs we have in place, such as the easement that was signed with MoDOT and transferred to the County and check if there are any concerns or issues. Please respond to this email or call me to let me know if you have any questions, concerns or issues. Thanks.

Craig responded as follows:

We have no issues or concerns. Our site is not being utilized on a daily basis, but we do periodic activities there. There is construction of a new radio antennae tower currently underway, but that is not a function of my department.

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 3:18 am	Date: 10/8/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: NA			

Contact Made By:

Name: Terri Uhlmeier	Title: Compliance Manager	Organization: SM Stoller, Corp.
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Individual Contacted:

Name: Quinn Kellner	Title: Natural Resource Manager Jones-Confluence State Park	Organization: MDNR-Parks
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Telephone No: 636-899-1135	Street Address: PO Box 67
Fax No:	City, State, Zip: West Alton, MO 63386
E-Mail Address: Quinn.kellner@dnr.mo.gov	

Summary Of Conversation

I contacted Quinn Kellner, MDNR-Parks and emailed him of the LTS&M annual inspection at the Weldon Spring site on November 5 and 6, 2013. He had been previously notified by copy of the regulator 30-day notification letter and a copy of the agenda. He stated that he would not be attending the inspection this year and that he did not have any concerns. He attended the 2008 inspection and came familiar with the areas along the Katy Trail referenced in the DOE easement with MDNR-Parks. He did not foresee any work in the affected areas in the future at this time. I told Quinn I would send him an email so that he would have my email address and telephone number in case he ever had any concerns or issues.

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 12:55 pm	Date: 10/23/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: NA			
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.	
Individual Contacted:			
Name: Alan Leary	Title: Policy Coordinator	Organization: Missouri Department of Conservation	
Telephone No: 573-522-4115 x3346		Address: P.O. Box 180	
Fax No:		City, State, Zip: Jefferson City, Mo 65102	
E-Mail Address:			
Summary Of Conversation			
<p>I contacted Alan Leary of the Missouri Department of Conservation (MDC) by email. He replaced Doyle Brown as the Policy Coordinator for the MDC last year. I stated the following in the email:</p> <p>Alan, I am contacting you to notify you of the Department of Energy Weldon Spring Site annual inspection which will take place on November 5-7. This is considered our long-term surveillance and maintenance (LTS&M) inspection which we have conducted every year since we completed remediation of the site. This is actually our 11th LTS&M inspection. We have a prepared checklist that we use and the agenda that was sent to you. We use this time to walk over the areas that we have institutional controls in place to ensure that the restrictions are not being violated. We also inspect the disposal cell, check monitoring wells, go through records and different inspection type activities. We also use this time to maintain contact with certain stakeholders, nearby property owners and institutional control contacts, such as yourself. We just like to remind the IC contacts about the ICs we have in place, such as the easement that was signed and the licenses that we recently renewed and check if there are any concerns or issues. I have been in contact with John Vogel and John usually participates in the walk down the southeast drainage. He said he might send someone else to accompany us this year. Please respond to this email or call me to let me know if you have any questions, concerns or issues. Thanks.</p> <p>Alan responded as follows:</p> <p>Terri, Thank you for the reminder. I will talk with John to see who will attend. Al</p>			

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 10:29 am	Date: 10/8/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: NA			
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.	
Individual Contacted:			
Name: Stowe Johnson	Title: Sr. Environmental Specialist	Organization: Missouri Department of Transportation	
Telephone No: 573-526-4171		Address: P.O. Box 270	
Fax No:		City, State, Zip: Jefferson City, Mo 65102	
E-Mail Address:			
Summary Of Conversation			
<p>I contacted Stowe Johnson of the Missouri Department of Transportation by email and emailed the following information to him:</p> <p>As discussed in the past several years, I represent the Department of Energy as a contractor at the Weldon Spring Site and every year we conduct an annual long-term surveillance and maintenance inspection at the Site. This is our eleventh inspection. We also use this time to contact our stakeholders and surrounding property owners to maintain contact with them and to determine if they have any concerns or issues about the site. Our inspection this year will be November 5-6.</p> <p>Regarding our history and relationship with MoDOT, the culvert on Highway D was removed by DOE as the shoulders were widened a couple years ago, so that is no longer a concern for DOE and will no longer be inspected. We still have the culvert on Hwy 94 where we have fixed radiological contamination inside the culvert. We cut a part of that off for MoDOT a couple years ago. We were also successful in getting the easement signed with MoDOT on the property that is next to the site. This property was transferred to St. Charles county since within the past year, therefore we will be contacting them regarding the easement. Anyway, I just wanted to catch up with you and maintain contact. I would appreciate it if you could respond to this email and let me know if there are any issues or concerns.</p> <p>Thanks!</p> <p>His response was as follows: I don't have any questions or concerns. I also won't be able to make the November dates as I will be in training and inspections in the Kansas City district. Thanks for the update.</p>			

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 10:29 pm	Date: 10/8/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email Location of Visit: NA		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.	
Individual Contacted:			
Name: Tom Blair	Title: Assistant District Engineer	Organization: Missouri Department of Transportation	
Telephone No: 314-453-1803 Fax No: E-Mail Address: Thomas.blair@modot.mo.gov		Street Address: 1590 Woodlake Dr. City, State, Zip: Chesterfield, Mo 63017	
Summary Of Conversation			
<p>I contacted Tom Blair of the Missouri Department of Transportation by email and emailed the following information to him:</p> <p>As discussed in the past several years, I represent the Department of Energy as a contractor at the Weldon Spring Site and every year we conduct an annual long-term surveillance and maintenance inspection at the Site. This is our eleventh inspection. We also use this time to contact our stakeholders and surrounding property owners to maintain contact with them and to determine if they have any concerns or issues about the site. Our inspection this year will be November 5-6.</p> <p>Regarding our history and relationship with MoDOT, the culvert on Highway D was removed by DOE as the shoulders were widened a couple years ago, so that is no longer a concern for DOE and will no longer be inspected. We still have the culvert on Hwy 94 where we have fixed radiological contamination inside the culvert. We cut a part of that off for MoDOT a couple years ago. We were also successful in getting the easement signed with MoDOT on the property that is next to the site. This property was transferred to St. Charles county since within the past year, therefore we will be contacting them regarding the easement. Anyway, I just wanted to catch up with you and maintain contact. I would appreciate it if you could respond to this email and let me know if there are any issues or concerns.</p> <p>Thanks!</p>			

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 12:10 pm	Date: 10/22/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email Location of Visit: NA		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.	
Individual Contacted:			
Name: Dave Wedlock/Rob Gaugh	Title: Principal/Assistant Principal	Organization: Francis Howell High School	
Telephone No: 636-851-4080 Fax No: E-Mail Address: Dave.Wedlock@fhdschools.org Robert.Gaugh@fhdschools.org		Street Address: 7001 Hwy 94 South City, State, Zip: St. Charles, MO 63304	
Summary Of Conversation			
<p>I contacted Dave Wedlock, the principal of Francis Howell High School, by email. I asked him about a new contact as I had noted on their website that Randy Carter, was no longer at the school. Randy has been my contact for the past 7 years. I also explained the following information in the email:</p> <p>Our annual long-term surveillance and maintenance inspection will be held November 5-7 this year. This is when DOE does a thorough inspection of the site, disposal cell, records, maintenance, groundwater wells, institutional controls, etc., accompanied by the EPA and State regulators. We also use this time to contact our stakeholders to stay in contact and see if you all have any concerns or issues. We have our interpretive center for anyone who wants to visit it and gather information and your students use the disposal cell and trail by the site for their PE classes. We are here if the school ever has any concerns or issues or any other kind of requests. I have included a link to our website below.</p> <p>http://www.lm.doe.gov/weldon/Sites.aspx</p> <p>Please respond and let me know if you have any questions, issues or concerns. Thanks!</p> <p>Mr. Wedlock responded that Rob Gaugh, assistant principal, would be our new contact and that he (Mr. Wedlock) is also available if needed.</p>			

INTERVIEW RECORD

Site Name: Weldon Spring Site	EPA ID No.: MO6210022830	
Subject: Annual Inspection	Time: 3:45 pm	Date: 10/8/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email Location of Visit: NA	<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.
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Individual Contacted:

Name: Mary Bryan	Title: Real Estate Manager	Organization: MDNR-Parks
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Telephone No: 573-751-7987 Fax No: E-Mail Address: mary.bryan@dnr.mo.gov	Street Address: PO Box 176 City, State, Zip: Jefferson City, MO 65102
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Summary Of Conversation

I contacted Mary Bryan, MDNR-Parks, by email and explained as I discussed with her the last several years, DOE conducts an annual Long-Term Surveillance and Maintenance inspection each year and as part of the inspection we contact certain stakeholders to maintain contact with them, to discuss the ICs and to determine if they had any concerns or issues about the site. I informed Ms. Bryan that our inspection this year would be on November 5 and 6. I told her that I had also contacted Quinn Kellner and sent him a copy of the agenda. I also stated the following:

Regarding our history and relationship with MDNR-Parks, we have the easement that was signed a few years ago. The main purpose of this easement is to restrict the drilling of groundwater wells in certain areas of the Katy Trail. Also, we have a couple of licenses with MDNR-Parks that were renewed this year. These are for the DOE discharge pipeline to cross MDNR-Parks property and to monitor the wells which are within the Katy Trail Easement. This discharge pipeline is not currently in use but is still in place as a contingency in case DOE ever needs to use it.

Mary responded that there were no concerns at this time and they would let us know if there are any in the future.

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 10:00 am	Date: 10/28/13
Type: <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> Visit <input type="checkbox"/> Email		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: NA			
Contact Made By:			
Name: Terri Uhlmeyer		Title: Compliance Manager	Organization: SM Stoller, Corp.
Individual Contacted:			
Name: Kevin Grimes		Title: Facility Manager	Organization: Army
Telephone No: 636-329-1243 ext2403		Street Address: 7301 Hwy. 94 South	
Cell No: 913-669-0148		City, State, Zip: St. Charles, MO 63304	
E-Mail Address:			
Summary Of Conversation			
<p>I contacted Kevin Grimes of the 88th Regional Readiness Command at the Weldon Spring Army site by telephone and notified him that DOE would be conducting the annual LTS&M inspection at the Weldon Spring Site on November 5-7, and that we would be on Army property on the morning of the 5th. I told him we would be driving around on the Army site and inspecting our wells. He requested we check in with him at building S-40 and if he is not present in the building to call his cell phone, so that he is aware of who is on-site.</p>			

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 10:29 am	Date: 10/8/13
Type: <input type="checkbox"/> Telephone <input type="checkbox"/> Visit <input checked="" type="checkbox"/> Email		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit: NA			
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.	
Individual Contacted:			
Name: Tom Evers	Title: St. Charles County Area Engineer	Organization: Missouri Department of Transportation	
Telephone No: 636-240-5277		Address: 6780 Old Hwy. N	
Fax No:		City, State, Zip: St. Charles, Mo 63304	
E-Mail Address: Thomas.Evers@modot.mo.gov			
Summary Of Conversation			
<p>I contacted Tom Evers of the Missouri Department of Transportation by email and emailed the following information to him:</p> <p>As discussed in the past several years, I represent the Department of Energy as a contractor at the Weldon Spring Site and every year we conduct an annual long-term surveillance and maintenance inspection at the Site. This is our eleventh inspection. We also use this time to contact our stakeholders and surrounding property owners to maintain contact with them and to determine if they have any concerns or issues about the site. Our inspection this year will be November 5-6.</p> <p>Regarding our history and relationship with MoDOT, the culvert on Highway D was removed by DOE as the shoulders were widened a couple years ago, so that is no longer a concern for DOE and will no longer be inspected. We still have the culvert on Hwy 94 where we have fixed radiological contamination inside the culvert. We cut a part of that off for MoDOT a couple years ago. We were also successful in getting the easement signed with MoDOT on the property that is next to the site. This property was transferred to St. Charles county since within the past year, therefore we will be contacting them regarding the easement. Anyway, I just wanted to catch up with you and maintain contact. I would appreciate it if you could respond to this email and let me know if there are any issues or concerns.</p> <p>Thanks!</p> <p>His response was as follows: No concerns from my end Terri. Thanks for the updated information!</p>			

INTERVIEW RECORD

Site Name: Weldon Spring Site	EPA ID No.: MO6210022830	
Subject: Annual Inspection	Time: 11:00 am	Date: 10/31/13
Type: <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> Visit <input type="checkbox"/> Other	<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit:		

Contact Made By:

Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.
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Individual Contacted:

Name: Wayne Anthony	Title:	Organization: St. Charles Planning and Zoning Department
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Telephone No: 636-949-7900 x7221	Street Address:
Fax No:	City, State, Zip:
E-Mail Address:	

Summary Of Conversation

I contacted Wayne Anthony of the St. Charles Planning and Zoning Department. Mr. Anthony had been the project's previous contact in this department in regards to the county's master plan. I informed Mr. Anthony that DOE would be conducting their annual LTS&M inspection on November 5-7 and I asked him if there were any planning and zoning activities currently in the one-quarter mile surrounding the chemical plant and quarry properties. Mr. Anthony verified that there were not any such activities that he was aware of.

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 8:30am	Date: 10/28/13
Type: ___ Telephone <u> x </u> Visit ___ Other Location of Visit: Administration Building		___ Incoming ___ Outgoing	
Contact Made By:			
Name: Terri Uhlmeier	Title: Compliance Manager	Organization: S.M. Stoller Corp.	
Individual Contacted:			
Name: Yvonne Deyo	Title: Site Manager	Organization: S.M. Stoller Corp.	
Telephone No: 636-300-2612 Fax No: 636-300-2626 E-Mail Address: Yvonne Deyo@lm.doe.gov		Street Address: 7295 Hwy. 94 South City, State, Zip: St. Charles, MO 63304	
Summary Of Conversation			
<p>I interviewed Yvonne Deyo, the S.M. Stoller Site Manager at the Weldon Spring Site. The interviewing of the Site Manager is a requirement included in the Annual Inspection Checklist. Most of the interview questions were from the CERCLA Five-year Review Guidance.</p> <ol style="list-style-type: none"> 1. Current Status of the Project: Long-term surveillance and maintenance. 2. Any problems encountered with the remedies? None at this time. 3. Are the remedies functioning as expected? Yes. 4. Any vandalism or trespassing issues? As discussed in past Annual Inspection interviews, public use of the site is frequent. Nighttime access of the disposal cell viewing platform and other undesirable behaviors been reduced in 2013 due a private security firm's seasonal patrol coverage of the site during evening hours. Several monitoring wells at the chemical plant were also discussed have been vandalized in September and are working to see if any modifications are necessary to secure some of the well caps. 5. What is the current on-site presence? Describe staff and activities. There are 9 full-time contractor employees and numerous part-time contractor and subcontractor employees. Activities include long-term surveillance and maintenance operations, project management, data evaluation, operation of the interpretive center, preparation of site-related regulatory documents, support in establishment of institutional controls, support of site IT and telephone issues, landscape management and general administrative support. On-site staffs also provide support on other DOE sites such as Mound, Fernald, and Pinellas and to other projects such as Reuse and Property Management. Environmental sampling personnel support sampling activities at other sites in the Legacy Management system. Since April 2011 when Lindenwood University terminated the use-agreement with DOE, SM Stoller continues to operate and maintain the site facilities and associated property that Lindenwood was providing for DOE. 6. Are there any issues associated with the site at this time? None concerning site protectiveness to the environment or the public. Recently completed the demolition of the Administration Building and moved into new trailers/laboratory. Also, the replacement of the current waste water treatment plant with a smaller non-permitted plant and leachate field is close to completion. 7. Any suggestions or comments regarding annual inspection? The inspection continues to provide as useful mechanism to have regulators on-site and evaluate the site including the protectiveness to environment and public. 			

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 1:00 pm	Date: 10/23/13
Type: ___ Telephone <input checked="" type="checkbox"/> Visit ___ Other Location of Visit: Weldon Spring Site		___ Incoming ___ Outgoing	
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller Corp.	
Individual Contacted:			
Name: Randy Thompson	Title: Site/Operation Manager	Organization: SM Stoller Corp.	
Telephone No: 636-300-2640		Street Address: Weldon Spring Site	
Fax No: 636-300-2626		City, State, Zip:	
E-Mail Address: Randy.Thompson@lm.doe.gov			

I interviewed Randy Thompson, Operations Manager, who is responsible for sampling programs at the Weldon Spring Site. The interviewing of the data (operations) manager is a requirement included in the Annual Inspection Checklist.

1. **What is the current status of data validation/reporting?** Data validation and review is completed for data through July 2013. The data validation and review is being worked for samples collected during August through September 2013. October sampling has not been reported from the laboratories.
2. **How is the data reported?** After data merge, validation and review, the qualification flags are applied and the data is then available on the LM/Weldon Spring website the next day. We continue to prepare data validation reports and the quality control data are summarized in the annual report.
3. **What is the current status of the data on the website? Are we meeting our 90-day commitment as stated in the LTSM?** Yes, we are meeting our 90-day commitment. The data are reviewed and validated through July 2013 and are available online. The August through October 2013 data are either not reported or are being validated. Data will be released once the validation process is completed.
4. **Are there any trends that show contaminants increasing or decreasing?** Trend analysis is performed annually by site hydrogeologist and results are summarized within the Annual Report.

INTERVIEW RECORD

Site Name: Weldon Spring Site		EPA ID No.: MO6210022830	
Subject: Annual Inspection		Time: 11:20 am	Date: 10/31/13
Type: <input checked="" type="checkbox"/> Telephone <input type="checkbox"/> Visit <input type="checkbox"/> Other		<input type="checkbox"/> Incoming <input checked="" type="checkbox"/> Outgoing	
Location of Visit:			
Contact Made By:			
Name: Terri Uhlmeyer	Title: Compliance Manager	Organization: SM Stoller, Corp.	
Individual Contacted:			
Name: David	Title:	Organization: Simplex/Grinnell	
Telephone No: 888-746-7539		Street Address:	
Fax No:		City, State, Zip:	
E-Mail Address:			
Summary Of Conversation			
<p>I contacted Simplex/Grinnell, the alarm company for the project, and talked to David. I verified that they had the correct three people as contacts and that they also had the correct work, home and cell number for each person.</p>			

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Appendix F

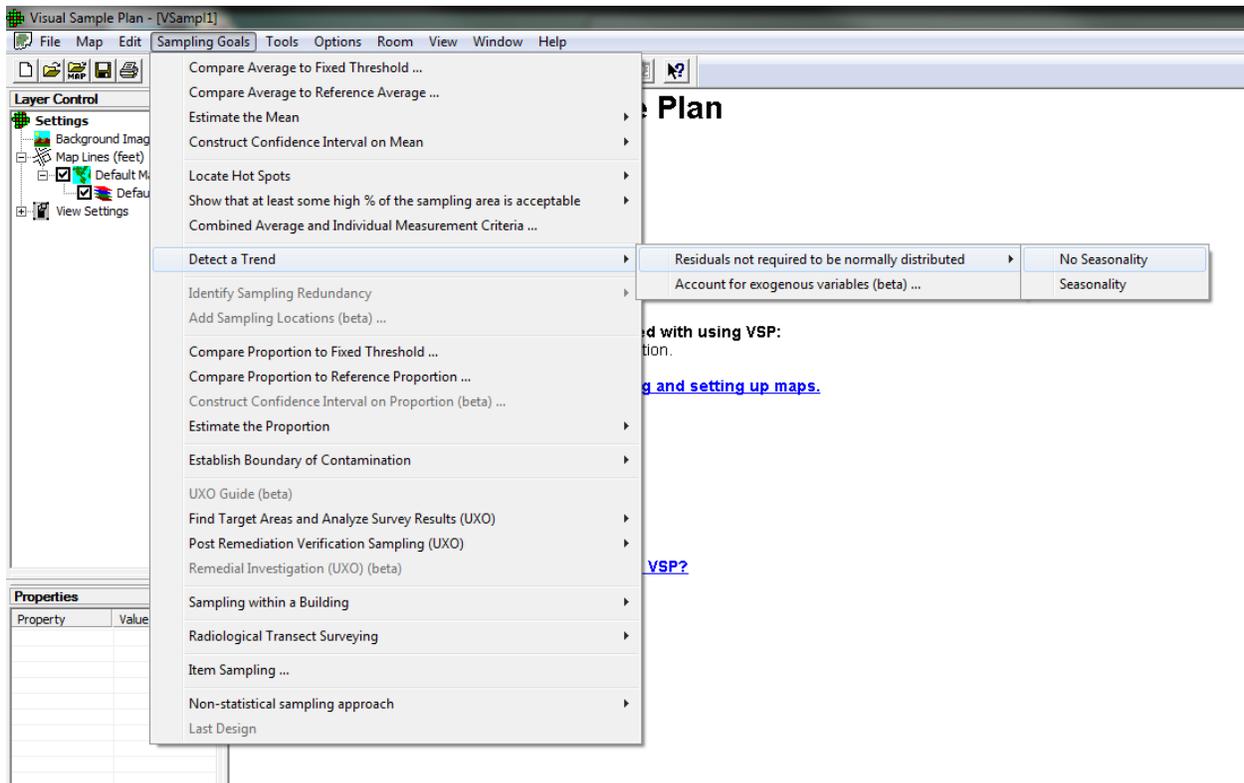
Trend Calculation Example and Trend Data

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Testing for temporal trends is required in the *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site* (DOE 2004c) using data from the previous 5 years (2009 through 2013 for the 2013 Annual Report). The trend analysis is conducted using the Visual Sampling Plan (VSP) Method (VSP 2013; Gilbert 1987; Hirsch, Slack, and Smith 1982). VSP can be downloaded at <http://vsp.pnnl.gov/>.

Trend Calculation Example:

After installing and opening VSP, under **Sampling Goals**, select **Detect a Trend**, then select **No Seasonality**.



Enter data.

This example uses nitrate data for Burgermeister Spring (SP-6301). Under the **Data Analysis, Data Entry** tab, the data was pasted from Excel. Select the proper headings during this step.

Location	Sampling Date	Nitrate as Nitrogen (mg/L)
SP-6301	2/17/2009	0.813
SP-6301	6/2/2009	1.04
SP-6301	8/25/2009	2.83
SP-6301	11/23/2009	0.62
SP-6301	2/16/2010	1.3
SP-6301	5/6/2010	2.4
SP-6301	6/2/2010	2.45
SP-6301	6/14/2010	3.5
SP-6301	8/2/2010	3.3
SP-6301	10/6/2010	3.3
SP-6301	12/7/2010	1.76
SP-6301	2/14/2011	0.58
SP-6301	6/6/2011	2.51
SP-6301	12/7/2011	1.28
SP-6301	2/15/2012	1.5
SP-6301	6/20/2012	3.52
SP-6301	8/14/2012	5.4
SP-6301	12/12/2012	1.56
SP-6301	2/25/2013	1.6
SP-6301	6/17/2013	1.61
SP-6301	8/6/2013	4.4
SP-6301	12/10/2013	4.28

Welcome to Visual Sample Plan

VSP
Visual Sample Plan

Here are a few simple instructions to get you started with VSP. Click on the underlined blue links to find detailed information.

- [Use the Expert Mentor to help with sample planning and data entry.](#)
- [What Does VSP Do?](#)
- [How Do I Draw or Import a Map?](#)
- [How Do I Create a Sample Plan?](#)
- [Can I See Graphs and Detailed Reports?](#)
- [What is the Fastest Way to Learn About Features in VSP?](#)
- [Where Can I Get Help on Sampling Designs?](#)
- [Where Can I Find On-Line Help?](#)

Mann-Kendall Trend Analysis

Mann-Kendall | Data Analysis | Analytes |

Data Entry | Summary Statistics | Tests | Plots |

Paste | Paste new data from the clipboard | Copy | Copy the data to the clipboard

Import | Import new data from a file | Delete All | Delete all existing samples and data

Manual | Manually enter new data | Columns | Configure which columns to display

	Analyte	Value	Location ID	Date/Time
1	Analyte 1	0.813000	SP-6301	2/17/2009
2	Analyte 1	1.040000	SP-6301	6/2/2009
3	Analyte 1	2.830000	SP-6301	8/25/2009
4	Analyte 1	0.620000	SP-6301	11/23/2009
5	Analyte 1	1.300000	SP-6301	2/16/2010
6	Analyte 1	2.400000	SP-6301	5/6/2010
7	Analyte 1	2.450000	SP-6301	6/2/2010
8	Analyte 1	3.500000	SP-6301	6/14/2010
9	Analyte 1	3.300000	SP-6301	8/2/2010
10	Analyte 1	3.300000	SP-6301	10/6/2010
11	Analyte 1	1.760000	SP-6301	12/7/2010
12	Analyte 1	0.580000	SP-6301	2/14/2011
13	Analyte 1	2.510000	SP-6301	6/6/2011
14	Analyte 1	1.280000	SP-6301	12/7/2011
15	Analyte 1	1.500000	SP-6301	2/15/2012
16	Analyte 1	3.520000	SP-6301	6/20/2012
17	Analyte 1	5.400000	SP-6301	8/14/2012
18	Analyte 1	1.560000	SP-6301	12/12/2012
19	Analyte 1	1.600000	SP-6301	2/25/2013
20	Analyte 1	1.610000	SP-6301	6/17/2013
21	Analyte 1	4.400000	SP-6301	8/6/2013
22	Analyte 1	4.280000	SP-6301	12/10/2013

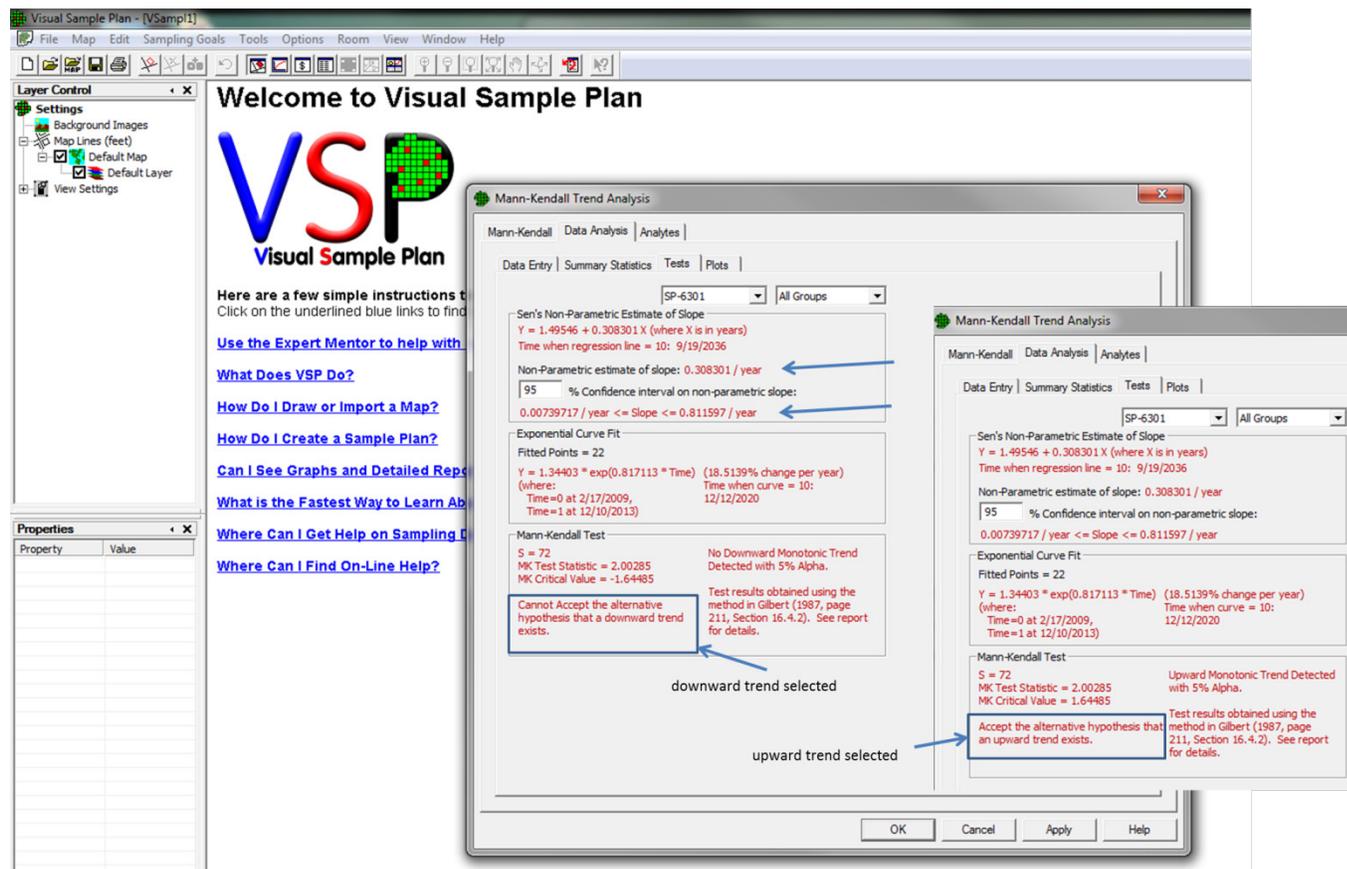
Account for non-detects in my data

Transform Data | Apply a transform to all data values

Filter Data | Use filters to create a subset of the data

OK | Cancel | Apply | Help

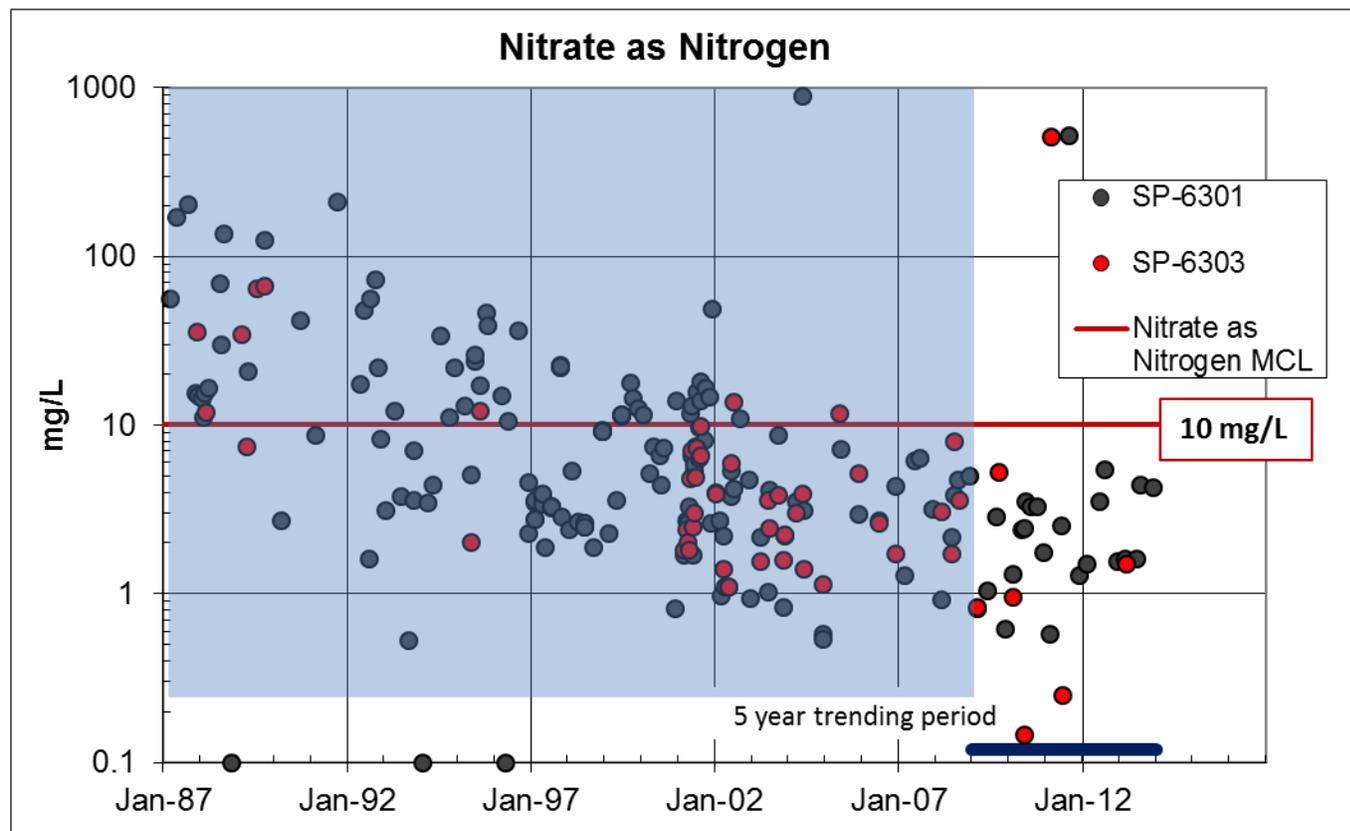
Results are under the **Data Analysis, Tests** tab.
 Results for selecting an upward and a downward trend are shown on the figure.



Example of table included in the main text of the report.

Location	No. of Samples	Trend	Slope	Confidence Intervals	
			(mg/L/yr)	Lower	Upper
SP-6301	22	Up	0.31	0.01	0.81

Plot of data collected since 1987, including duplicates and questionable values. The blue bar at the base of the chart indicates the 5-year time period of data used for trending calculations.



Tables of Trend Data:

In addition to location, date, and result, the tables include lab qualifiers, along with the average and standard deviations for the trigger test. Results at or below the detection limit are assigned a value of half the detection limit. The average includes the current sample result plus the previous seven samples. The standard deviation is calculated based on the previous eight samples, excluding the current sample. This allows significant changes to be identified and addressed without unnecessary false triggers for locations that have little variability. Results that exceed the trigger are shaded yellow in the tables.

Duplicates are excluded from the table and from trend calculations. Questionable results, more than the average of the 5-year data set plus 3 standard deviations of the 5-year data set and assigned a lab qualifier such as “J” (estimated), are excluded from the trending calculations. These results are shaded gray in the tables.

Table of Lab Qualifiers

VALID_VALUES	DESCRIPTION
*	Replicate analysis not within control limits.
+	Correlation coefficient for MSA < 0.995.
>	Result above upper detection limit.
A	TIC is a suspected aldol-condensation product.
B	Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: Analyte also found in method blank.
C	Pesticide result confirmed by GC-MS.
D	Analyte determined in diluted sample.
E	Inorganic: Estimated value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
H	Holding time expired, value suspect.
I	Increased detection limit due to required dilution.
J	Estimated
M	GFAA duplicate injection precision not met.
N	Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compound (TIC).
P	> 25% difference in detected pesticide or Aroclor concentrations between 2 columns.
S	Result determined by method of standard addition (MSA).
U	Analytical result below detection limit.
W	Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.

MSA = method of standard additions
TIC = tentatively identified compound
IDL = instrument detection limit
CRDL = contract-required detection limit
GC-MS = gas chromatograph–mass spectrometer

Trend Data for Table 9

MW-3030

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	35.2				
11/23/2009	58	NE			
4/28/2010	33.9				
6/15/2010	30.5	B			
8/2/2010	29.8	B			
10/6/2010	30.5				
12/6/2010	30.9				
2/8/2011	28.4			9.7	
4/4/2011	29.2		33.9	9.9	63
6/7/2011	28.8		30.2	1.7	60
8/8/2011	27.8		29.5	1.1	34.6
10/18/2011	27.6		29.1	1.2	32.4
12/7/2011	31.1		29.3	1.4	32.9
2/13/2012	26.4		28.8	1.6	32.9
4/3/2012	30.4		28.7	1.5	33.6
6/21/2012	28.9		28.8	1.5	33.4
8/7/2012	25.7		28.3	1.9	32.9
10/1/2012	28.8		28.3	1.9	33.9
12/11/2012	31.9		28.9	2.2	34.4
2/12/2013	27.3		28.8	2.2	35.4
4/1/2013	26.4		28.2	2.2	34.9
6/18/2013	30.5	E	28.7	2.1	35.2
8/1/2013	27.4		28.3	2.1	34.8
10/7/2013	28.0		28.2	2.1	34.5
12/9/2013	28.7		28.6	1.8	34.8

Trend Data for Table 10

MW-3003

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
4/28/2009	4.9				
11/16/2009	6.2	NE			
4/27/2010	3.5				
6/15/2010	3.5	B			
8/2/2010	2.8	B			
10/6/2010	2.8				
12/1/2010	3.3				
5/4/2011	3.0			1.2	
10/18/2011	2.8		3.5	1.1	7.0
12/1/2011	3.4		3.2	0.31	6.5
5/14/2012	2.6		3.0	0.33	4.0
10/1/2012	3.1		3.0	0.29	4.0
12/3/2012	3.0		3.0	0.28	3.9
2/12/2013	2.9		3.0	0.28	3.9
4/1/2013	3.0		3.0	0.25	3.8
6/10/2013	3.7	E	3.1	0.35	3.8
8/1/2013	2.7		3.1	0.35	4.1
10/7/2013	2.9		3.0	0.32	4.0
12/2/2013	2.9		3.0	0.27	4.0

MW-3024

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/16/2009	100				
4/28/2009	110				
8/24/2009	118				
11/16/2009	200	NE			
2/22/2010	102				
4/26/2010	108				
6/14/2010	102	B			
8/2/2010	108	B		33.6	
10/6/2010	108		120	33.1	220
12/1/2010	115		120	32.9	219
2/8/2011	108		119	33.2	218
4/4/2011	124		109	7.3	209
6/2/2011	102		109	7.3	131
8/8/2011	115		110	7.5	132
10/18/2011	118		112	7.1	135
12/1/2011	127		115	8.5	136
2/13/2012	108		115	8.5	140
4/3/2012	125		116	9.2	142
6/18/2012	127		118	9.3	146
8/8/2012	108		116	9.6	144
10/1/2012	114		118	7.7	147
12/3/2012	223		131	37.7	154
2/12/2013	117		131	37.8	244
4/1/2013	118		130	38.0	243
6/10/2013	144	E	135	37.2	249
8/1/2013	132		135	37.0	247
10/3/2013	141		137	36.9	248
12/2/2013	134		141	35.1	251

Trend Data for Table 10 (continued)

MW-3040

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/16/2009	99				
4/28/2009	105				
8/24/2009	105				
11/17/2009	167	NE			
2/22/2010	95				
4/27/2010	88				
6/14/2010	95	B			
8/2/2010	102	B		24.8	
10/6/2010	102		107	24.7	182
12/1/2010	109		108	24.6	182
2/8/2011	95		106	25.1	180
4/4/2011	108		99	7.3	174
6/2/2011	97		99	7.2	121
8/8/2011	102		101	5.5	123
10/18/2011	108		103	5.3	119
12/1/2011	110		104	5.9	120
2/13/2012	102		104	5.9	122
4/3/2012	118		105	7.8	123
6/18/2012	107		106	6.6	130
8/8/2012	102		106	6.8	125
10/1/2012	112		107	6.0	128
12/4/2012	140		112	12.5	130
2/12/2013	114		113	12.4	151
4/1/2013	110		113	12.4	150
6/12/2013	144	E	118	15.3	156
8/1/2013	119		118	15.3	164
10/3/2013	135		122	15.6	168
12/2/2013	130		126	13.3	172

MW-4040

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	332				
5/5/2009	296				
8/25/2009	337				
11/16/2009	527	NE			
2/22/2010	302				
4/28/2010	305				
6/15/2010	284	B			
8/2/2010	291	B		80	
10/7/2010	305		331	81	572
12/2/2010	311		333	80	576
2/8/2011	264		324	84	564
4/4/2011	300		295	15.1	546
6/7/2011	308		296	15.6	341
8/8/2011	311		297	16.3	344
10/18/2011	315		301	16.7	350
12/1/2011	331		306	19.2	356
2/13/2012	318		307	19.7	365
4/2/2012	320		309	20.2	368
6/20/2012	330		317	10.5	377
8/7/2012	278		314	16.8	346
10/3/2012	319		315	16.6	366
12/3/2012	328		317	17.1	367
2/13/2013	315		317	17.1	369
4/2/2013	307		314	16.5	366
6/17/2013	339	E	317	18.6	366
8/1/2013	329		318	19.1	374
10/3/2013	355		321	22.9	378
12/2/2013	360		332	18.6	400

Trend Data for Table 12

MW-2038

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	427				
11/23/2009	702				
5/5/2010	480				
10/19/2010	480				
5/10/2011	490				
10/31/2011	480				
5/16/2012	430				
10/9/2012	490	B		87	
5/14/2013	380		492	93	751
10/22/2013	720		494	99	774

MW-2040

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
4/28/2009	69				
11/16/2009	100				
4/26/2010	3.8				
10/7/2010	89				
5/10/2011	85				
10/19/2011	94				
5/16/2012	72				
10/9/2012	91	B		30.7	
5/14/2013	78		76	30.6	169
10/22/2013	96		76	30.3	168

MW-3034

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	170				
11/23/2009	187				
5/4/2010	170				
10/19/2010	200				
5/10/2011	190				
12/7/2011	199				
5/16/2012	190				
12/11/2012	177			11.9	
5/14/2013	180		187	10.5	222
12/9/2013	166		184	12.8	215

Trend Data for Table 12 (continued)

MW-4013

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/5/2009	77				
11/16/2009	83				
5/4/2010	84				
10/7/2010	79				
5/9/2011	90				
10/19/2011	101				
5/16/2012	70				
10/8/2012	82	B		9.2	
5/14/2013	96		86	9.8	113
10/21/2013	120		90	15.5	120

MW-4029

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
4/29/2009	446				
11/17/2009	426				
5/4/2010	410				
10/19/2010	440				
5/5/2011	470				
12/5/2011	427				
5/14/2012	420				
12/11/2012	461			20.7	
5/13/2013	420		434	21.2	496
12/3/2013	380		429	28.7	492

MW-4031

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
4/27/2009	178				
11/17/2009	154				
4/26/2010	150				
10/7/2010	160				
5/3/2011	220				
10/19/2011	161				
5/14/2012	150				
10/8/2012	170	B		23.2	
5/13/2013	160		166	22.9	235
10/21/2013	300		184	52	253

Trend Data for Table 12 (continued)

MW-4036

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/24/2009	34.4	J			
4/30/2009	18.1				
8/25/2009	22.5				
2/22/2010	12.2				
4/28/2010	22.0				
6/15/2010	30.0				
8/2/2010	32.0				
10/7/2010	39.0			9.0	
12/2/2010	36.5		26.5	9.3	54
6/7/2011	21.0		26.9	9.0	55
10/18/2011	45.5		29.8	10.9	57
6/20/2012	43.4		33.7	9.1	66
10/3/2012	47.0		36.8	8.8	64
6/17/2013	7.6		34.0	13.6	61
10/3/2013	54		36.7	15.2	77

Trend Data for Table 13

MW-3003

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
4/28/2009	406				
11/16/2009	476				
4/27/2010	460				
6/15/2010	470				
8/2/2010	500				
10/6/2010	440				
12/1/2010	442				
5/4/2011	470			28.4	
10/18/2011	462		465	19.2	550
5/14/2012	400		456	29.2	513
10/1/2012	497		460	32.7	548
6/10/2013	365		447	46.4	545
10/7/2013	379		432	46.4	571

MW-3040

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/16/2009	150				
4/28/2009	114				
8/24/2009	135				
11/17/2009	115				
2/22/2010	127				
4/27/2010	120				
6/14/2010	120				
8/2/2010	130			12.0	
10/6/2010	120		123	7.4	159
12/1/2010	111		122	7.9	144
6/2/2011	125		121	6.2	145
10/18/2011	106		120	8.0	139
6/18/2012	95		116	11.2	140
10/1/2012	82		111	16.2	145
6/12/2013	80		106	18.9	155
10/3/2013	75		99	19.0	156

Trend Data for Table 13 (continued)

MW-4040

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	151				
5/5/2009	125				
8/25/2009	134				
11/16/2009	119				
2/22/2010	109				
4/28/2010	120				
6/15/2010	130				
8/2/2010	130			12.4	
10/7/2010	120		123	8.0	161
12/2/2010	110		122	9.3	146
6/7/2011	122		120	7.8	148
10/18/2011	116		120	7.9	143
6/20/2012	122		121	6.7	145
10/3/2012	103		119	9.3	139
6/17/2013	100		115	10.3	143
10/3/2013	114		113	8.5	144

Trend Data for Table 15

MW-3030

Sampling Date	Trichloroethene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	320	D			
11/23/2009	220	BD			
4/28/2010	270				
12/6/2010	219				
6/7/2011	265				
12/8/2011	232				
6/21/2012	207				
12/11/2012	190			42.1	
6/18/2013	200		225	29.1	352
12/9/2013	228		226	29.0	314

MW-3034

Sampling Date	Trichloroethene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	200	D			
11/23/2009	130	BD			
5/4/2010	120				
10/19/2010	160				
5/10/2011	160				
12/7/2011	146				
5/16/2012	140				
12/11/2012	127			25.7	
5/14/2013	120		138	16.3	215
12/9/2013	115		136	18.1	185

MW-4029

Sampling Date	Trichloroethene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
4/29/2009	560	D			
11/17/2009	350	D			
5/4/2010	370				
10/19/2010	290				
5/5/2011	400				
12/5/2011	239				
5/14/2012	270				
12/11/2012	297			101	
5/13/2013	380		325	58	629
12/3/2013	201		306	71	481

Trend Data for Table 17

MW-2012

Sampling Date	1,3-Dinitrobenzene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/12/2009	0.016	J			
11/19/2009	0.014	U			
5/3/2010	0.030	J			
10/18/2010	0.071	J			
5/9/2011	0.043	J			
11/1/2011	0.051	J			
5/7/2012	0.022	J			
10/8/2012	0.170	J		0.051	
5/6/2013	0.021	J	0.053	0.051	0.21
10/22/2013	0.047	J	0.057	0.049	0.21

Trend Data for Table 19

MW-2012

Sampling Date	2,4,6-Trinitrotoluene (ug/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/12/2009	0.79				
11/19/2009	0.33				
5/3/2010	0.87				
10/18/2010	2.0				
5/9/2011	0.28				
11/1/2011	1.6				
5/7/2012	0.62				
10/8/2012	2.1			0.73	
5/6/2013	0.058	J	0.98	0.81	3.2
10/22/2013	1.1		1.1	0.77	3.5

MW-2046

Sampling Date	2,4,6-Trinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
6/4/2009	0.71				
12/7/2009	0.78				
6/1/2010	0.49				
12/6/2010	0.50				
6/6/2011	0.68				
12/6/2011	0.61				
6/19/2012	0.62				
12/10/2012	0.49			0.110	
6/18/2013	0.76		0.62	0.118	0.95
12/9/2013	0.54		0.59	0.099	0.94

MW-2053

Sampling Date	2,4,6-Trinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/12/2009	2.4				
11/19/2009	0.32				
5/3/2010	1.1				
10/18/2010	3.1				
5/9/2011	0.190				
11/1/2011	1.9				
5/7/2012	1.4				
10/8/2012	1.8			0.99	
5/6/2013	0.021	U	1.2	1.0	4.2
10/23/2013	1.2		1.3	0.98	4.5

Trend Data for Table 22

MW-2012

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/12/2009	0.46				
11/19/2009	0.005	U			
5/3/2010	0.018	U			
10/18/2010	13.0				
5/9/2011	0.33				
11/1/2011	6.3				
5/7/2012	0.39				
10/8/2012	77			26.6	
5/6/2013	0.062	J	12.1	26.6	92
10/22/2013	5.9		12.9	26.3	93

MW-2014

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	0.46				
11/19/2009	0.29				
5/3/2010	0.019	U			
10/18/2010	0.170				
5/9/2011	0.120				
11/1/2011	0.120				
5/7/2012	0.120				
10/8/2012	0.120			0.137	
5/6/2013	0.150		0.139	0.075	0.55
10/22/2013	0.120		0.117	0.044	0.34

MW-2050

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	36.0	D			
11/19/2009	24.0	D			
5/3/2010	24.0				
10/18/2010	31.0				
5/9/2011	22.0				
11/1/2011	19.0				
5/7/2012	13.0				
10/8/2012	12.0			8.2	
5/8/2013	3.5		18.6	8.7	43.2
10/22/2013	7.2		16.5	9.2	42.5

Trend Data for Table 22 (continued)

MW-2052

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	0.095				
11/19/2009	0.074	J			
5/3/2010	0.053	J			
10/18/2010	0.059	J			
5/9/2011	0.046	J			
11/1/2011	0.074	J			
5/7/2012	0.063	J			
10/15/2012	0.082	J		0.016	
5/8/2013	0.046	J	0.062	0.014	0.110
10/22/2013	0.078	J	0.063	0.014	0.103

MW-2053

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/12/2009	0.005	U			
11/19/2009	0.005	U			
5/3/2010	17.0				
10/18/2010	130				
5/9/2011	0.019	U			
11/1/2011	11.0				
5/7/2012	0.180	U			
10/8/2012	0.092	U		45.0	
5/6/2013	0.022	J	19.8	45.0	155
10/23/2013	0.75		19.9	45.0	155

MW-2054

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	0.005	U			
11/19/2009	0.076	J			
5/3/2010	0.110				
10/18/2010	0.100				
5/9/2011	0.091	J			
11/1/2011	0.062	J			
5/7/2012	0.082	J			
10/8/2012	0.078	J		0.032	
5/6/2013	0.094	J	0.087	0.015	0.183
10/23/2013	0.078	J	0.087	0.015	0.132

Trend Data for Table 23

MW-2012

Sampling Date	2,6-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/12/2009	0.75				
11/19/2009	0.88				
5/3/2010	9.1				
10/18/2010	34.0				
5/9/2011	3.0				
11/1/2011	34.0				
5/7/2012	3.8				
10/8/2012	100			34.1	
5/6/2013	0.20		23.1	34.1	125
10/22/2013	35.0		27.4	33.0	130

MW-2014

Sampling Date	2,6-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	0.34				
11/19/2009	0.27				
5/3/2010	0.57				
10/18/2010	0.26				
5/9/2011	0.34				
11/1/2011	0.36				
5/7/2012	0.33				
10/8/2012	0.41			0.097	
5/6/2013	0.35		0.36	0.097	0.65
10/22/2013	0.37		0.37	0.090	0.67

MW-2050

Sampling Date	2,6-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	38.0	D			
11/19/2009	32.0	D			
5/3/2010	28.0				
10/18/2010	33.0				
5/9/2011	32.0				
11/1/2011	27.0				
5/7/2012	25.0				
10/8/2012	32.0			4.1	
5/8/2013	31.0		30.0	2.9	42.3
10/22/2013	27.0		29.4	3.0	38.2

Trend Data for Table 23 (continued)

MW-2052

Sampling Date	2,6-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	0.130				
11/19/2009	0.140	J			
5/3/2010	0.130				
10/18/2010	0.160				
5/9/2011	0.098	J			
11/1/2011	0.21				
5/7/2012	0.140				
10/15/2012	0.27			0.055	
5/8/2013	0.077	J	0.153	0.062	0.32
10/22/2013	0.21		0.162	0.064	0.35

MW-2053

Sampling Date	2,6-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/12/2009	9.2				
11/19/2009	7.8				
5/3/2010	110				
10/18/2010	220				
5/9/2011	19.0				
11/1/2011	86				
5/7/2012	33.0				
10/8/2012	7.9			75	
5/6/2013	0.100		60	76	285
10/23/2013	6.9		60	76	288

MW-2054

Sampling Date	2,6-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/11/2009	2.1				
11/19/2009	0.150	J			
5/3/2010	0.180				
10/18/2010	0.170				
5/9/2011	0.23				
11/1/2011	0.160				
5/7/2012	0.22				
10/8/2012	0.190			0.68	
5/6/2013	0.24		0.193	0.034	2.2
10/23/2013	0.180		0.196	0.030	0.30

Trend Data for Table 25

MW-2038

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	0.24	B			
11/23/2009	0.20				
5/5/2010	0.160				
10/19/2010	0.170				
5/10/2011	0.130	*			
10/31/2011	0.120				
5/16/2012	0.130				
10/9/2012	0.160			0.0	
5/14/2013	0.110	*	0.1	0.0	0.3
10/22/2013	0.130		0.1	0.0	0.2

MW-3030

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	1.0	B			
11/23/2009	0.69				
4/28/2010	0.65				
12/6/2010	0.45				
6/7/2011	0.62				
12/7/2011	0.64				
6/21/2012	0.58				
12/11/2012	0.55			0.2	
6/18/2013	0.62		0.6	0.1	1.1
12/9/2013	0.58		0.6	0.1	0.8

MW-3034

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/4/2009	0.130	B			
11/23/2009	0.093	J			
5/4/2010	0.055	J			
10/19/2010	0.075	J			
5/10/2011	0.075	J*			
12/7/2011	0.057	J			
5/16/2012	0.057	J			
12/11/2012	0.054	J		0.026	
5/14/2013	0.058	J*	0.066	0.014	0.144
12/9/2013	0.055	J	0.061	0.009	0.103

MW-3039

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
5/6/2009	0.29	B			
11/23/2009	0.190	J			
5/4/2010	0.180				
10/18/2010	0.20				
5/11/2011	0.20	*			
10/31/2011	0.170				
5/16/2012	0.140				
10/9/2012	0.180			0.043	
5/14/2013	0.170	*	0.179	0.020	0.31
10/22/2013	0.120		0.170	0.028	0.23

Trend Data for Table 27

SP-6301

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	18.8				
6/2/2009	19.7	E			
8/25/2009	46.0				
11/23/2009	12.1	E			
12/8/2009	24.9	E			
2/16/2010	17.6				
5/6/2010	34.5				
6/2/2010	30.1			11.0	
6/14/2010	39.3	B	28.0	11.6	61
8/2/2010	58	B	32.8	14.9	67
10/6/2010	60		34.5	17.4	79
12/7/2010	26.9		36.4	15.3	89
2/14/2011	8.1		34.3	18.0	80
4/7/2011	20.4		34.6	17.7	89
6/6/2011	36.2		34.9	17.7	88
8/16/2011	49.4		37.3	18.3	90
10/24/2011	35.4		36.8	18.2	92
12/7/2011	43.7		35.1	16.6	90
2/15/2012	21.0		30.1	13.6	80
4/2/2012	25.6		30.0	13.6	71
6/20/2012	35.2		33.4	10.4	74
8/14/2012	41.3		36.0	9.3	67
10/3/2012	54		38.2	11.2	66
12/12/2012	42.8		37.3	10.5	71
2/25/2013	29.8		36.6	10.8	68
4/4/2013	27.8		34.6	10.8	67
6/17/2013	23.4	E	35.0	10.4	67
8/6/2013	48.1		37.8	10.5	69
10/1/2013	48.3		39.4	11.1	71
12/10/2013	58		41.5	12.9	75

Trend Data for Table 27 (continued)

SP-6303

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	0.47	B			
6/2/2009	0.74	E			
9/29/2009	3.45				
11/23/2009	0.56	BE			
2/16/2010	0.74				
6/2/2010	0.77				
3/3/2011	0.41				
4/5/2011	0.47			1.0	
6/21/2011	0.74		0.99	1.0	4.0
3/11/2013	0.176		0.92	1.0	3.9
4/4/2013	0.32		0.52	0.22	3.7

Trend Data for Table 28

SP-5303

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/24/2009	69				
5/21/2009	60	E			
9/29/2009	80				
12/1/2009	52	E			
3/2/2010	45.3				
6/3/2010	49.4	B			
7/28/2010	66	B			
10/12/2010	67			11.7	
2/10/2011	64		60	11.3	95
4/5/2011	41.2		58	13.2	92
8/10/2011	63		56	10.3	96
10/24/2011	78		59	12.6	90
2/13/2012	48.6		60	12.1	98
4/5/2012	37.0		58	14.2	95
9/13/2012	45.9		56	14.4	98
11/20/2012	104		60	22.4	103
2/12/2013	39.3		57	23.5	124
4/4/2013	32.5		56	24.5	126
7/23/2013	58		55	24.4	129

SP-5304

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/24/2009	65				
5/21/2009	79	E			
8/26/2009	73				
12/1/2009	59	E			
3/2/2010	60				
6/3/2010	66	B			
7/28/2010	74	B			
10/12/2010	88			9.9	
2/10/2011	67		71	9.7	100
4/5/2011	54		68	10.7	97
8/10/2011	62		66	10.7	99
10/24/2011	79		69	11.1	101
2/13/2012	52		68	12.2	101
4/5/2012	52		66	13.4	103
9/13/2012	52		63	13.8	104
10/4/2012	82		63	12.4	104
2/12/2013	45.2		60	13.6	97
4/4/2013	39.9		58	15.3	99
7/23/2013	56		57	15.2	103
10/1/2013	82		58	15.8	103

Trend Data for Table 30

SP-6301

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	0.81				
6/2/2009	1.0				
8/25/2009	2.8				
11/23/2009	0.62				
2/16/2010	1.3				
5/6/2010	2.4				
6/2/2010	2.5				
6/14/2010	3.5			1.1	
8/2/2010	3.3		2.2	1.1	5.4
10/6/2010	3.3		2.5	1.0	5.7
12/7/2010	1.8		2.3	1.0	5.4
2/14/2011	0.58		2.3	1.1	5.4
6/6/2011	2.5		2.5	0.97	5.6
12/7/2011	1.3		2.3	1.1	5.2
2/15/2012	1.5		2.2	1.1	5.4
6/20/2012	3.5		2.2	1.1	5.5
8/14/2012	5.4		2.5	1.5	5.8
12/12/2012	1.6		2.3	1.5	6.9
2/25/2013	1.6		2.2	1.5	6.9
6/17/2013	1.6		2.4	1.4	7.0
8/6/2013	4.4		2.6	1.6	6.9
12/10/2013	4.3		3.0	1.6	7.8

SP-6303

Sampling Date	Nitrate as Nitrogen (mg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	0.84				
6/2/2009	0.020	B			
9/29/2009	5.3				
11/23/2009	0.055				
2/16/2010	0.95				
6/2/2010	0.146	J			
6/21/2011	0.25			1.9	
3/11/2013	1.5		1.1	1.8	6.8

Trend Data for Table 39

MW-1002

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	3.2				
8/18/2009	2.8				
2/16/2010	3.0				
8/3/2010	2.8				
2/15/2011	2.9				
8/16/2011	2.7				
2/14/2012	3.0				
8/13/2012	2.5			0.21	
2/25/2013	2.4		2.8	0.22	3.4
8/5/2013	2.4		2.7	0.24	3.4

MW-1004

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	659				
8/18/2009	586				
2/16/2010	603				
8/3/2010	548				
2/15/2011	535				
8/16/2011	548				
2/14/2012	542				
8/13/2012	481			53	
2/25/2013	515		545	38.2	704
8/5/2013	508		535	36.0	649

MW-1005

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/17/2009	406				
8/18/2009	360				
2/16/2010	366				
8/3/2010	386				
2/15/2011	440				
8/16/2011	440				
2/14/2012	948				
8/13/2012	440			195	
2/25/2013	440		477	193	1061
8/5/2013	339		475	195	1055

Trend Data for Table 39 (continued)

MW-1027

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/18/2009	185				
8/19/2009	48.7				
2/17/2010	21.0				
8/3/2010	38.6				
2/14/2011	169				
8/16/2011	54				
2/14/2012	102				
8/13/2012	74			61	
2/26/2013	156		83	55	266
8/5/2013	51		83	54	247

MW-1030

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/11/2009	6.4	N			
8/18/2009	6.4				
5/12/2010	4.7				
8/11/2010	6.6				
2/15/2011	8.1				
8/3/2011	5.7	E			
2/14/2012	3.1				
8/2/2012	2.3			1.9	
2/25/2013	2.4		4.9	2.1	10.7
8/5/2013	11.5		5.6	3.2	12.0

Trend Data for Table 42

MW-1006

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/18/2009	1530				
5/26/2009	1219				
5/26/2009	1286				
8/19/2009	1300				
12/2/2009	1273				
2/15/2010	1354				
5/17/2010	1219				
8/3/2010	812			202	
11/3/2010	1151		1202	169	1809
2/14/2011	1219		1202	169	1708
5/2/2011	1016		1168	177	1675
8/17/2011	372		1052	322	1581
12/7/2011	880		1003	313	1969
2/14/2012	948		952	279	1892
5/8/2012	880		910	258	1748
8/13/2012	880		918	256	1692
10/9/2012	1016		901	242	1668
2/26/2013	1016		876	213	1602
5/6/2013	1422		927	287	1565
8/5/2013	880		990	184	1850
10/21/2013	948		999	180	1551

Trend Data for Table 42 (continued)

MW-1007

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/9/2009	621	N			
5/18/2009	452				
5/18/2009	449				
8/18/2009	234				
11/30/2009	274				
2/3/2010	309				
5/11/2010	95				
8/17/2010	68			188	
11/1/2010	39.9		240	163	805
1/31/2011	23.8		186	153	674
4/26/2011	56		137	115	597
8/4/2011	10.6		109	116	455
11/8/2011	14.0		77	98	424
2/6/2012	10.8		39.6	30.9	334
4/30/2012	11.5		29.2	22.5	122
7/31/2012	2.8		21.1	17.9	89
11/14/2012	1.4		16.3	17.3	70
2/5/2013	46.1		19.1	20.2	71
4/30/2013	122		27.4	40.6	88
7/30/2013	16.9		28.2	40.3	150
10/24/2013	15.2	E	28.3	40.2	149

Trend Data for Table 42 (continued)

MW-1008

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	4258	N			
5/19/2009	2728				
5/19/2009	2762				
8/11/2009	1875				
12/1/2009	4265				
2/3/2010	2837				
5/11/2010	2370				
8/10/2010	1760			954	
11/2/2010	1422		2502	884	5366
1/31/2011	2451		2468	879	5119
4/26/2011	2776		2469	880	5106
8/2/2011	2261		2518	853	5157
11/8/2011	1029		2113	648	4671
2/6/2012	779		1856	724	3801
5/1/2012	1083		1695	736	3867
7/31/2012	2200		1750	758	3959
2/5/2013	1056		1704	791	3979
4/30/2013	1422		1576	734	3949
7/30/2013	3250		1635	854	3837
10/28/2013	2038	E	1607	834	4169

Trend Data for Table 42 (continued)

MW-1009

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	1.3	N			
5/19/2009	1.2				
5/19/2009	1.0				
8/18/2009	2.6				
11/30/2009	1.2				
2/3/2010	1.3				
5/11/2010	0.74				
8/10/2010	1.7			0.56	
11/2/2010	1.6		1.4	0.56	3.1
1/31/2011	1.1		1.4	0.57	3.1
4/26/2011	0.43		1.3	0.65	3.0
8/2/2011	1.2		1.1	0.41	3.1
11/8/2011	1.6		1.2	0.44	2.4
2/6/2012	0.65		1.1	0.48	2.4
5/1/2012	1.7		1.2	0.49	2.7
7/31/2012	0.93		1.1	0.46	2.6
11/14/2012	0.127	B	0.97	0.55	2.3
2/5/2013	0.22		0.86	0.60	2.5
4/30/2013	10.8		2.2	3.6	4.0
7/30/2013	9.7		3.2	4.4	13.9
10/28/2013	0.89	E	3.1	4.4	16.3

Trend Data for Table 42 (continued)

MW-1013

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	255	N			
5/19/2009	250				
8/12/2009	298				
11/30/2009	152				
2/4/2010	206				
5/12/2010	237				
8/10/2010	162				
11/2/2010	156			54	
2/7/2011	198		207	52	370
4/27/2011	230		205	49.9	360
8/2/2011	202		193	33.0	343
11/7/2011	181		196	29.2	295
2/7/2012	273		205	39.9	292
5/1/2012	298		212	51	332
7/31/2012	298		229	55	383
11/15/2012	187		233	49.4	397
2/5/2013	244		239	47.3	387
5/1/2013	210		237	48.3	378
7/31/2013	233		240	46.4	385
10/28/2013	196	E	242	43.9	382

Trend Data for Table 42 (continued)

MW-1014

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	1212	N			
5/19/2009	1225				
8/12/2009	1192				
11/30/2009	1158				
2/4/2010	1198				
5/12/2010	1219				
8/10/2010	812				
11/2/2010	1016			145	
2/7/2011	1286		1138	153	1573
4/27/2011	1286		1146	159	1605
8/2/2011	765		1093	206	1571
11/7/2011	1022		1076	206	1695
2/7/2012	1110		1065	201	1682
5/1/2012	1151		1056	195	1658
7/31/2012	1219		1107	174	1690
11/15/2012	651		1061	237	1582
2/5/2013	900		1013	224	1725
5/1/2013	1016		979	195	1651
7/31/2013	1131		1025	180	1611
10/28/2013	765	E	993	202	1533

Trend Data for Table 42 (continued)

MW-1015

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/9/2009	215	N			
5/18/2009	131				
8/12/2009	136				
12/1/2009	125				
2/2/2010	122				
5/11/2010	115				
8/16/2010	115				
11/1/2010	115			33.4	
1/31/2011	162		128	15.9	228
4/26/2011	115		126	16.4	173
8/1/2011	113		123	16.3	172
11/7/2011	107		121	17.2	169
2/6/2012	114		119	17.3	171
4/30/2012	95		117	19.4	169
7/31/2012	104		116	20.0	174
11/19/2012	122		116	20.1	176
2/4/2013	104		109	8.4	170
4/30/2013	64		103	17.5	128
7/30/2013	100		101	17.1	154
10/28/2013	105	E	101	17.0	152

Trend Data for Table 42 (continued)

MW-1016

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/9/2009	106	N			
5/18/2009	135				
8/12/2009	126				
12/1/2009	88				
2/2/2010	127				
5/11/2010	156				
8/16/2010	162				
11/1/2010	142			24.6	
1/31/2011	154		136	23.7	210
4/26/2011	129		135	23.8	206
8/1/2011	120		135	24.3	206
11/7/2011	118		138	17.4	211
2/6/2012	138		140	16.8	192
4/30/2012	88		131	23.4	182
7/31/2012	103		124	21.5	194
11/19/2012	106		119	20.9	184
2/4/2013	122		115	15.9	178
4/30/2013	88		110	17.4	158
7/30/2013	104		108	17.1	161
10/28/2013	95	E	105	17.2	157

Trend Data for Table 42 (continued)

MW-1028

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	2.3	N			
5/18/2009	2.3				
8/18/2009	1.8				
12/1/2009	2.2				
2/15/2010	2.0				
5/12/2010	1.9				
8/9/2010	1.6				
11/2/2010	1.7			0.28	
2/7/2011	2.0		1.9	0.24	2.8
4/27/2011	1.9		1.9	0.194	2.6
8/1/2011	1.3	E	1.8	0.29	2.4
11/9/2011	1.7		1.8	0.26	2.6
2/7/2012	2.6		1.8	0.40	2.6
5/2/2012	1.8		1.8	0.40	3.0
8/1/2012	1.8		1.8	0.39	3.1
11/15/2012	2.5		1.9	0.44	3.1
2/11/2013	2.4		2.0	0.47	3.3
5/1/2013	1.8		2.0	0.47	3.4
7/31/2013	1.8		2.0	0.39	3.5
10/29/2013	2.1	E	2.1	0.36	3.3

Trend Data for Table 42 (continued)

MW-1031

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	12.5	N			
5/20/2009	11.1				
8/18/2009	11.4				
12/1/2009	9.5				
2/4/2010	11.4				
5/12/2010	10.2				
8/9/2010	9.5				
11/2/2010	9.5			1.1	
1/31/2011	9.8		10.3	0.86	13.6
4/27/2011	10.2		10.2	0.79	12.7
8/2/2011	9.7		10.0	0.63	12.3
11/7/2011	10.0		10.0	0.61	11.9
2/7/2012	10.8		9.9	0.43	11.8
5/1/2012	9.5		9.9	0.45	11.1
7/31/2012	9.9		9.9	0.42	11.3
11/15/2012	10.4		10.0	0.41	11.3
2/11/2013	15.6		10.7	2.0	12.0
5/1/2013	8.8		10.6	2.1	16.6
7/31/2013	9.4		10.5	2.1	16.9
10/28/2013	10.0	E	10.5	2.1	16.9

Trend Data for Table 42 (continued)

MW-1032

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/18/2009	839				
5/26/2009	718				
8/19/2009	648				
12/2/2009	538				
2/15/2010	745				
5/17/2010	677				
8/3/2010	582				
11/3/2010	528			108	
2/14/2011	555		624	84	948
5/2/2011	596		609	76	862
8/17/2011	575		599	75	826
11/2/2011	447		588	90	812
2/15/2012	528		561	66	833
5/8/2012	521		542	47.3	740
8/14/2012	386		517	69	659
10/9/2012	406		502	79	709
2/26/2013	406		483	82	720
5/6/2013	406		460	72	706
8/5/2013	372		434	60	649
10/21/2013	359		423	65	603

Trend Data for Table 42 (continued)

MW-1045

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/18/2009	3.7				
5/26/2009	2.4				
8/19/2009	1.6				
12/2/2009	1.6				
2/15/2010	2.0				
5/17/2010	1.9				
8/3/2010	3.2				
11/3/2010	1.2			0.84	
2/14/2011	1.4		1.9	0.64	4.4
5/2/2011	1.4		1.8	0.62	3.7
8/16/2011	1.5		1.8	0.62	3.6
11/2/2011	1.4		1.8	0.64	3.6
2/14/2012	2.1		1.8	0.65	3.7
5/8/2012	1.8		1.8	0.64	3.7
8/13/2012	3.9		1.8	0.89	3.8
10/9/2012	7.4		2.6	2.1	5.3
2/26/2013	1.8		2.7	2.1	9.1
5/6/2013	1.6	B	2.7	2.1	9.0
8/5/2013	2.2		2.8	2.0	9.0
10/21/2013	3.2		3.0	2.0	9.1

Trend Data for Table 42 (continued)

MW-1046

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/9/2009	1.7	N			
5/20/2009	1.6				
8/13/2009	1.6				
12/2/2009	1.6				
2/2/2010	1.5				
5/11/2010	1.2				
8/16/2010	1.3				
11/2/2010	1.4			0.176	
1/31/2011	1.2		1.4	0.181	2.0
4/26/2011	1.1		1.4	0.196	1.9
8/2/2011	1.2		1.3	0.171	1.9
11/7/2011	1.1		1.2	0.144	1.8
2/6/2012	1.1		1.2	0.096	1.6
5/1/2012	0.95		1.2	0.127	1.4
7/31/2012	0.95		1.1	0.133	1.5
11/19/2012	1.00		1.1	0.095	1.5
2/4/2013	1.0		1.0	0.082	1.3
4/30/2013	0.95	B	1.0	0.087	1.3
7/30/2013	0.65		0.96	0.143	1.2
10/28/2013	0.67	E	0.91	0.159	1.3

Trend Data for Table 42 (continued)

MW-1047

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	1.1	N			
5/20/2009	0.95				
8/12/2009	0.81				
11/30/2009	0.81				
2/4/2010	0.91				
5/12/2010	0.68				
8/9/2010	0.65				
11/3/2010	0.74			0.146	
2/7/2011	0.71		0.78	0.108	1.2
4/27/2011	0.74		0.76	0.085	1.1
8/1/2011	0.71		0.75	0.084	1.0
11/9/2011	0.72		0.73	0.080	0.98
2/7/2012	0.78		0.72	0.041	0.96
5/1/2012	0.68		0.72	0.041	0.84
8/1/2012	0.67		0.72	0.035	0.84
11/19/2012	0.68		0.71	0.036	0.82
2/11/2013	0.70		0.71	0.036	0.82
5/1/2013	2.7	B	0.96	0.71	1.1
7/31/2013	1.5		1.1	0.72	3.2
10/29/2013	1.2	E	1.1	0.71	3.3

Trend Data for Table 42 (continued)

MW-1048

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	248	N			
5/20/2009	219				
8/17/2009	293				
12/1/2009	176				
2/4/2010	195				
5/12/2010	162				
8/9/2010	135				
11/2/2010	169			51	
2/7/2011	152		188	49.7	342
4/27/2011	183		183	48.1	332
8/2/2011	196		171	21.0	315
11/9/2011	116		164	28.5	227
2/7/2012	154		159	25.6	244
5/2/2012	149		157	25.7	234
8/1/2012	205		166	29.0	243
11/19/2012	216		171	34.1	258
2/11/2013	225		181	37.8	283
5/1/2013	203	B	183	38.7	297
7/30/2013	218		186	40.4	302
10/29/2013	58	E	179	57	300

Trend Data for Table 42 (continued)

MW-1049

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/18/2009	0.142	U			
5/27/2009	0.074	B			
8/19/2009	0.081	B			
12/2/2009	0.045	U			
2/15/2010	0.037	J			
5/17/2010	0.020	J			
8/3/2010	0.095				
11/3/2010	0.088			0.039	
2/14/2011	0.051	J	0.061	0.027	0.178
5/2/2011	0.014	U	0.054	0.031	0.135
8/17/2011	0.021	J	0.046	0.031	0.140
11/2/2011	0.049	J	0.047	0.031	0.139
2/14/2012	0.049	J	0.048	0.031	0.141
5/8/2012	0.034	U	0.050	0.029	0.142
8/14/2012	0.056	J	0.045	0.023	0.132
10/9/2012	0.034	J	0.039	0.016	0.108
2/26/2013	0.064	J	0.040	0.018	0.087
5/6/2013	0.035	JB	0.043	0.014	0.096
8/6/2013	0.034	U	0.044	0.012	0.087
10/21/2013	0.034	U	0.042	0.012	0.079

Trend Data for Table 42 (continued)

MW-1051

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	1456	N			
5/19/2009	1137	E			
8/12/2009	1049				
11/30/2009	812	E			
2/4/2010	968				
5/11/2010	880				
8/10/2010	677				
11/2/2010	812			243	
2/7/2011	1056		924	155	1653
4/26/2011	880		892	129	1357
8/2/2011	731		852	123	1239
11/8/2011	745		844	128	1211
2/6/2012	819		825	118	1209
5/1/2012	745		808	118	1161
7/31/2012	819		826	106	1181
11/19/2012	548		793	145	1110
2/11/2013	765		757	98	1191
4/30/2013	1016	B	773	129	1068
7/30/2013	1124		823	177	1210
10/29/2013	1273	E	889	233	1419

Trend Data for Table 42 (continued)

MW-1052

Sampling Date	Uranium (pCi/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/10/2009	2694	N			
5/19/2009	2031	E			
8/12/2009	1760				
11/30/2009	765	E			
2/4/2010	1469				
5/11/2010	1016				
8/10/2010	880				
11/2/2010	1016			671	
2/7/2011	751		1211	484	3225
4/26/2011	880		1067	360	2518
8/2/2011	321		887	322	1968
11/9/2011	1070		925	323	1891
2/6/2012	1110		880	255	1851
4/30/2012	948		872	251	1637
7/31/2012	1049		893	259	1646
11/26/2012	833		870	254	1646
2/11/2013	1151		920	267	1683
4/30/2013	2302	B	1098	554	1898
7/30/2013	1489		1244	468	2907
10/29/2013	258	E	1143	584	2545

Trend Data for Table 44

MW-1006

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/18/2009	0.43				
5/26/2009	0.38				
8/19/2009	0.28				
12/2/2009	0.63				
2/15/2010	0.019	U			
5/17/2010	0.018	U			
8/3/2010	0.018	U			
11/3/2010	0.019	U		0.24	
2/14/2011	0.023	U	0.173	0.23	0.89
5/2/2011	0.018	U	0.128	0.22	0.83
8/17/2011	0.019	U	0.096	0.22	0.76
12/7/2011	0.018	U	0.019	0.002	0.67
2/14/2012	0.018	U	0.019	0.002	0.024
5/8/2012	0.063	J	0.025	0.016	0.030
8/13/2012	0.20		0.047	0.064	0.094
10/9/2012	0.120		0.060	0.067	0.25
2/26/2013	0.098		0.069	0.066	0.27
5/6/2013	0.078	J	0.077	0.063	0.28
8/5/2013	0.076	J	0.084	0.059	0.27
10/21/2013	0.21		0.108	0.067	0.28

MW-1027

Sampling Date	2,4-Dinitrotoluene (µg/L)	Lab Qualifiers	Average (last 8 samples)	Standard Deviation (last 8 samples)	Average (plus 3 standard deviations)
2/18/2009	0.069				
8/19/2009	0.005	U			
2/17/2010	0.019	U			
8/3/2010	0.83				
2/14/2011	3.5				
8/16/2011	0.018	J			
2/14/2012	1.4				
8/13/2012	2.9			1.4	
2/26/2013	2.3		1.4	1.4	5.6
8/5/2013	0.019	U	1.4	1.4	5.5

Appendix G

Data Review and Validation Reports for the Weldon Spring Site

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Data Review and Validation Report

General Information

Report Number (RIN): 13015090
Sample Event: January 7 – February 13, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 320443
Analysis: Metals and Wet Chemistry
Validator: Stephen Donivan
Review Date: March 27, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/PRO/S04325, continually updated) “Standard Practice for Validation of Laboratory Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Iron	LMM-01	SW-846 3005A	SW-846 6010B
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3005A	SW-846 6020

Data Qualifier Summary

None of the analytical reports required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 61 water samples on February 15, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm

that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at 2 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibration of instrument IC7 was performed on January 22, 2013 and of instrument IC8 on October 8, 2012, using six calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration check results within the acceptance criteria. Reporting limit verification checks were made to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range.

Method SW-846 6010B, Iron

Calibrations were performed on February 19–20, 2013, using three calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the

linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on February 27 and March 5 –12, 2013, using a two point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Matrix Spike Analysis

Matrix spike (MS) samples are used to measure method performance in the sample matrix. The MS data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike. The spike recoveries met the acceptance criteria of 75 to 125 percent for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for replicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for sulfate data. All analyte peak integrations were acceptable.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on March 18, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

Two result was identified as potentially anomalous. There were no errors noted during the further review of these data. The data for this RIN are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2003

Laboratory: GEL Laboratories

RIN: 13015090

Report Date: 03/28/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier		
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers			N	N Below Detect
						Lab	Data		Lab	Data		Lab	Data			
WEL01	LW-DC10	N001	01/07/2013	Uranium	0.0481			0.0468			0.004			94	0	No
WEL02	MW-1014	N001	02/05/2013	Sulfate	67.2			162	F		72.9		F	41	0	No
WEL02	MW-1018	0001	02/04/2013	Iron	39.7			38.7	F		23.2		F	22	0	No
WEL02	MW-1031	N001	02/11/2013	Uranium	0.023			0.0205	FQ		0.0133	E	FQ	40	0	Yes
WEL02	SW-1003	N001	02/13/2013	Sulfate	259			42.4			13.2			9	0	Yes

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

Sampling Protocol

Sampling at all monitoring wells met the Category I, II, or III low-flow sampling criteria and results were qualified with an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method. The ground water sample results for the wells listed in Table 3 were qualified with a “Q” flag in the database indicating the data are considered qualitative because of the sampling protocol (either category II or category III).

Table 3. Category II and III Wells

Well	Category II	Category III
MW-1007		X
MW-1008		X
MW-1009		X
MW-1016		X
MW-1028	X	
MW-1031	X	
MW-1046	X	
MW-1047	X	
MW-1051		X
MW-1052		X
MW-3003	X	
MW-3024	X	
MW-3040	X	
MW-4040	X	
MWD-2	X	
MWS-1	X	

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples were collected from locations MW-1013 and MW-1021. The relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. The duplicate results met the criteria, demonstrating acceptable overall precision.

Field Measurements

The pre-sampling purge criteria were met for all wells.

A calibration parameter at pH 4 was below the acceptance criterion, but acceptable at pH 7. All samples had pH values near 7 and no data were qualified.

 Stephen E. Donivan
2013.03.28
10:17:18 -06'00'

Report Prepared By: _____
Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13015090 Lab Code: GEN Validator: Stephen Donovan Validation Date: 03/28/2013

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 61 Matrix: Water Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There were 4 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13015090 Lab Code: GEN Project: Weldon Spring Validation Date: 03/28/2013

Duplicate: MW-1113

Sample: MW-1013

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	4400			1.00	4320			1.00	1.83		ug/L
Sulfate	56.2			10.00	63.0			20.00	11.41		mg/L
Uranium	361			1.00	416			10.00	14.16		ug/L

Duplicate: MW-1121

Sample: MW-1021

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	20200			1.00	20400			1.00	0.99		ug/L
Sulfate	0.587	J		1.00	0.562	J		1.00			mg/L
Uranium	0.067	U		1.00	0.622			1.00			ug/L

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13015090 Lab Code: GEN Date Due: 03/15/2013
 Matrix: Water Site Code: WEL01 Date Completed: 03/15/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Iron	ICP/ES	02/19/2013	0.0000	1.0000	OK	OK	OK	99.6	93.6		2.0	98.0	6.0	104.0
Iron	ICP/ES	02/19/2013										0.2		102.0
Iron	ICP/ES	02/20/2013	0.0000	1.0000	OK	OK	OK	107.0	107.0		1.0	99.0		108.0
Uranium	ICP/MS	02/27/2013			OK	OK	OK	110.0			1.0	111.0	6.0	107.0
Uranium	ICP/MS	03/05/2013			OK	OK	OK					102.0		75.0
Uranium	ICP/MS	03/08/2013			OK	OK	OK					102.0		93.0
Uranium	ICP/MS	03/09/2013			OK	OK	OK	105.0	105.0			97.0		88.0
Uranium	ICP/MS	03/12/2013			OK	OK	OK					89.0		93.0

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13015090 **Lab Code:** GEN **Date Due:** 03/15/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 03/15/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R ²	CCV	CCB						
Sulfate	02/27/2013	0.000	0.9999	OK	OK	OK	95.40	98.4		0	
Sulfate	02/28/2013	0.000	0.9986	OK	OK	OK	102.00	96.9		1.00	
Sulfate	03/01/2013							96.3		7.00	



Data Review and Validation Report

General Information

Report Number (RIN): 13025119
Sample Event: February 25–26, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-39342
Analysis: Metals, Organics, and Wet Chemistry
Validator: Stephen Donovan
Review Date: March 29, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/PRO/S04325, continually updated) “Standard Practice for Validation of Laboratory Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Iron	LMM-01	SW-846 3010A	SW-846 6010B
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3010A	SW-846 6020
Volatiles	LMV-06	SW-846 5030B	SW-846 8260B

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-39342-8	MW-1006	2,4-Dinitrotoluene	J	Analyte peak resolution
280-39342-11	MW-1027	Iron	J	Field duplicate precision
280-39342-21	MW-1027 Duplicate	Iron	J	Field duplicate precision

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 29 water samples on February 28, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced coolers at 2.2 and 2.4 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

The reported MDLs for all metal, organic, and wet chemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibrations were performed using six calibration standards on March 11, 2013. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than three times the MDL. Initial and continuing calibration verification

checks were made at the required frequency with all calibration check results within the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method EPA 353.2, Nitrate + Nitrite as N

Calibrations were performed on March 8, 2013, using six calibration standards. The absolute values of the intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method SW-846 6010B, Iron

Calibrations were performed on March 1, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on March 1, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8260B, Volatiles

The volatile compounds requested were 1,2-dichloroethane, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. Initial calibration was performed February 21, 2013, using six calibration standards. The average response factor and associated relative standard deviation met the acceptance criteria for all analytes. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent. The mass spectrometer calibration and resolution was checked at the beginning of each analytical run in accordance with the procedure.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on March 8, 2013, using seven calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis.

Metals and Wet Chemistry

All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Organics

The method blank results were below the MDL for all target compounds.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Nitroaromatics and Volatiles Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. All surrogate recoveries were within the acceptance ranges. The recovery of the internal standards added to the samples is monitored to measure the purging efficiency. Internal standard recoveries associated with target compounds were stable and within acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike concentration. The spikes met the recovery and precision criteria for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the practical quantitation limit (PQL) should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than the PQL, the range should be no greater than the PQL. The results for all replicates met these criteria, demonstrating acceptable laboratory precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the practical quantitation limit for method 6010 or greater than 100 times the practical quantitation limit for method 6020. All evaluated serial dilution data were acceptable.

Detection Limits/Dilutions

Samples were diluted in a consistent and acceptable manner when required. The required detection limits were met for all analytes.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics, sulfate, and volatiles data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20% of the analyte peak height. Sample results associated with analyte peaks that do not meet this criteria are qualified with a "J" flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each reported volatile and nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on March 19, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

There were no outliers identified and the data from this event are acceptable as qualified.

Sampling Protocol

All monitoring wells were purged and sampled using the low-flow sampling method, meeting the Category I, II, or III low-flow sampling criteria. Sample results from wells meeting the low-flow criteria are qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method. The groundwater sample results for the wells listed in Table 3 are further qualified with a "Q" flag indicating the data are considered qualitative because they are Category II or III wells.

Table 3. Category II or III Wells

Category II	Category III
MW-3006	MW-1005
MW-4007	MW-1006
MW-4043	

Category II	Category III
MWS-2	
MW-1012	
MW-1027	
MW-1030	
MW-1032	

Trip Blank

A trip blank was prepared and analyzed for volatile organics to document contamination attributable to shipping and field handling procedures. There were no target analytes detected in the trip blank.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for duplicate results that are greater than five times the PQL should be less than 20 percent. For results that are less than the PQL, the range should be no greater than the PQL. Duplicate samples were collected from locations MW-1027 and SP-6301. The duplicate results met the criteria, demonstrating acceptable overall precision, for all analytes except iron. The sample and duplicate iron results are qualified with a "J" flag as estimated values.

Field Measurements

The pre-sampling purge criteria were met for all wells. Daily calibration checks were performed as required with acceptable results.

Stephen E. Donivan



2013.03.29 09:01:44
-06'00'

Report Prepared By: _____

Stephen Donivan
Laboratory Coordinator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2003

Laboratory: TestAmerica Denver

RIN: 13025119

Report Date: 03/28/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
WEL01	MW-4043	N001	02/26/2013	Nitrate + Nitrite as Nitrogen	0.51			7.02		F	0.55		FQ	18	0	No
WEL02	MW-1002	N001	02/25/2013	2,6-Dinitrotoluene	0.076	J		2		F	0.084	J	FQ	43	1	No
WEL02	MW-1002	N001	02/25/2013	Sulfate	80			118		F	81.9		F	44	0	No
WEL02	MW-1006	0001	02/26/2013	Iron	0.022	U		6.27		F	0.0391	B	FJ	40	1	No
WEL02	MW-1032	N001	02/26/2013	Sulfate	96			139		FQ	97		FQ	39	0	No
WEL02	MW-1045	N001	02/26/2013	Sulfate	19			60.9		F	19.8	J	F	42	0	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13025119 Lab Code: STD Validator: _____ Validation Date: 03/28/2013

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 29 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13025119 Lab Code: STD Project: Weldon Spring Validation Date: 03/28/2013

Duplicate: MW-1127

Sample: MW-1027

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	650			1	1000			1	42.42		ug/L
Sulfate	61			5	60			5	1.65		mg/L
Uranium	230			1	210			1	9.09		ug/L

Duplicate: SP-6311

Sample: SP-6301

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,2-Dichloroethane	0.13	U		1	0.13	U		1			ug/L
1,3,5-Trinitrobenzene	0.017	U		1	0.016	U		1			ug/L
1,3-Dinitrobenzene	0.014	U		1	0.014	U		1			ug/L
2,4,6-Trinitrotoluene	0.022	U		1	0.021	U		1			ug/L
2,4-Dinitrotoluene	0.019	U		1	0.018	U		1			ug/L
2,6-Dinitrotoluene	0.026	J		1	0.021	U		1			ug/L
cis-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Nitrate+Nitrite as N	1.6			1	1.7			1	6.06		mg/L
Nitrobenzene	0.033	U		1	0.032	U		1			ug/L
Tetrachloroethene	0.20	U		1	0.20	U		1			ug/L
trans-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Trichloroethene	0.16	U		1	0.16	U		1			ug/L
Uranium	44			1	45			1	2.25		ug/L
Vinyl Chloride	0.10	U		1	0.10	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13025119

Project: Weldon Spring

Lab Code: STD

Validation Date: 03/29/2013

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13025119 Lab Code: STD Date Due: 03/28/2013
 Matrix: Water Site Code: WEL01 Date Completed: 03/21/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Iron	ICP/ES	03/02/2013			OK	OK	OK	96.0	88.0	89.0	1.0	92.0		100.0
Uranium	ICP/MS	03/02/2013			OK	OK	OK	102.0	89.0	93.0	1.0	99.0	4.4	84.0
Uranium	ICP/MS	03/04/2013			OK	OK	OK	101.0	100.0	100.0	0.0	97.0	0.8	101.0

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13025119 **Lab Code:** STD **Date Due:** 03/28/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 03/21/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R ²	CCV	CCB						
Nitrate+Nitrite as N	03/08/2013	0.000	1.0000	OK	OK	OK	95.00	99.0	108.0	6.00	
Sulfate	03/11/2013	0.000	1.0000	OK	OK	OK	99.00	99.0	101.0	1.00	



Data Review and Validation Report

General Information

Report Number (RIN): 13035172
Sample Event: February 25–26, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-39993
Analysis: Metals, Organics, and Wet Chemistry
Validator: Stephen Donovan
Review Date: April 29, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Iron	LMM-01	SW-846 3010A	SW-846 6010B
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3010A	SW-846 6020
Volatiles	LMV-06	SW-846 5030B	SW-846 8260B

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-39993-1	SP-6303	2,4-Dinitrotoluene	J	Analyte peak resolution
280-39993-2	SP-6303 Duplicate	2,4-Dinitrotoluene	J	Analyte peak resolution
280-39993-5	RMW-2	Dissolved Oxygen	R	Equipment malfunction
280-39993-5	RMW-2	Specific Conductance	R	Equipment malfunction

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 15 water samples on March 15, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at 3.1 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

The reported MDLs for all metal, organic, and wet chemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibrations were performed using six calibration standards on March 28, 2013. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the

intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration check results within the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method EPA 353.2, Nitrate + Nitrite as N

Calibrations were performed on March 22, 2013, using six calibration standards. The absolute values of the intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method SW-846 6010B, Iron

Calibrations were performed on March 28-29, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on March 20, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8260B, Volatiles

The volatile compounds requested were 1,2-dichloroethane, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. Initial calibration was performed March 5, 2013, using six calibration standards. The average response factor and associated relative standard deviation met the acceptance criteria for all analytes. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent. The mass spectrometer calibration and resolution was checked at the beginning of each analytical run in accordance with the procedure.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on March 27, 2013, using seven calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis.

Metals and Wet Chemistry

All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Organics

The method blank results were below the MDL for all target compounds.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Nitroaromatics and Volatiles Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. All surrogate recoveries were within the acceptance ranges. The recovery of the internal standards added to the samples is monitored to measure the purging efficiency. Internal standard recoveries associated with target compounds were stable and within acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike concentration. The spikes met the recovery and precision criteria for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the practical quantitation limit (PQL) should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than the PQL, the range should be no greater than the PQL. The results for all replicates met these criteria, demonstrating acceptable laboratory precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable.

Detection Limits/Dilutions

Samples were diluted in a consistent and acceptable manner when required. The required detection limits were met for all analytes.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics, sulfate, and volatiles data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20% of the analyte peak height. Sample results associated with analyte peaks that do not meet this criteria are qualified with a "J" flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each reported volatile and nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on April 5, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

The sulfate and specific conductance values from locations SW1005 and SW-1010 were identified as potential outliers. The samples from these locations were collected from pooled water because of low water conditions which likely contributed to increased analyte concentrations.

Many of the field measurements from location RMW-02 were identified as potentially anomalous. It was noted during the collection of these data that there were some equipment malfunctions encountered. Based on the extreme values recorded, the dissolved oxygen and specific conductance results from this location are qualified with an "R" flag as rejected.

Sampling Protocol

All monitoring wells were purged and sampled using the high-flow sampling method, with dedicated submersible pumps.

Trip Blank

A trip blank was prepared and analyzed for volatile organics to document contamination attributable to shipping and field handling procedures. There were no target analytes detected in the trip blank.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for duplicate results that are greater than five times the PQL should be less than 20 percent. For results that are less than the PQL, the range should be no greater than the PQL. Duplicate samples were collected from locations RMW-03 and SP-6303. The duplicate results met the criteria, demonstrating acceptable overall precision.

Field Measurements

Daily calibration checks were performed as required with acceptable results.



Stephen E. Donovan
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Report Prepared By: _____

Stephen Donovan
Laboratory Coordinator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2003

Laboratory: TestAmerica Denver

RIN: 13035172

Report Date: 04/29/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current			Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		N	N Below Detect	
						Lab	Data		Lab	Data		Lab	Data			
WEL01	SP-6303	N001	03/11/2013	Uranium	0.00026			0.0051			0.00061			28	1	No
WEL01	SP-6303	N002	03/11/2013	Uranium	0.00028			0.0051			0.00061			28	1	No
WEL02	RMW-1	N001	03/13/2013	Sulfate	15			57			20.3			10	0	No
WEL02	RMW-2	N001	03/13/2013	Sulfate	5			48.9			7.5			10	0	No
WEL02	SW-1005	N001	03/12/2013	Sulfate	240			28			12.3			8	0	Yes
WEL02	SW-1010	N001	03/12/2013	Sulfate	510			39.1			14.6			8	0	Yes

Data Validation Outliers Report - Field Parameters Only

Comparison: All historical Data Beginning 01/01/2003

Laboratory: Field Measurements

RIN: 13035172

Report Date: 04/29/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current			Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		N	N Below Detect	
						Lab	Data		Lab	Data		Lab	Data			
WEL01	SP-6303	N001	03/11/2013	Specific Conductance	230			712			290			27	0	No
WEL02	RMW-2	N001	03/13/2013	Dissolved Oxygen	11.74			8.35			1.2	F		10	0	Yes
WEL02	RMW-2	N001	03/13/2013	Oxidation Reduction Potential	-62.9			-67.3	F		-131.6			9	0	No
WEL02	RMW-2	N001	03/13/2013	Specific Conductance	7			978			769			10	0	Yes

Data Validation Outliers Report - Field Parameters Only

Comparison: All historical Data Beginning 01/01/2003

Laboratory: Field Measurements

RIN: 13035172

Report Date: 04/29/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier		
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers			N	N Below Detect
						Lab	Data		Lab	Data		Lab	Data			
WEL02	RMW-2	N001	03/13/2013	Temperature	9.78			14.26			13.3			10	0	Yes
WEL02	RMW-2	N001	03/13/2013	Turbidity	12.3			6.56			3			10	0	Yes
WEL02	RMW-4	N001	03/13/2013	Turbidity	13.5			10			0.62	F		11	0	No
WEL02	SW-1005	N001	03/12/2013	Oxidation Reduction Potential	245.8			234.9			-34.9			25	0	No
WEL02	SW-1005	N001	03/12/2013	Specific Conductance	905			594			287			27	0	Yes
WEL02	SW-1010	N001	03/12/2013	Specific Conductance	1174			615			202			26	0	Yes

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13035172 Lab Code: STD Validator: Stephen Donovan Validation Date: 04/29/2013

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 15 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There was 1 trip/equipment blank evaluated.

There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13035172 Lab Code: STD Project: Weldon Spring Validation Date: 04/29/2013

Duplicate: RMW-5

Sample: RMW-3

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	15000			1	16000			1	6.45		ug/L
Sulfate	12			1	12			1	0		mg/L
Uranium	0.66			1	0.67			1	1.50		ug/L

Duplicate: SP-6313

Sample: SP-6303

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,2-Dichloroethane	0.13	U		1	0.13	U		1			ug/L
1,3,5-Trinitrobenzene	0.017	U		1	0.016	U		1			ug/L
1,3-Dinitrobenzene	0.016	J		1	0.013	U		1			ug/L
2,4,6-Trinitrotoluene	0.031	J		1	0.035	J		1	NA		ug/L
2,4-Dinitrotoluene	0.071	J		1	0.096			1	NA		ug/L
2,6-Dinitrotoluene	0.23			1	0.31			1	NA		ug/L
cis-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Nitrate+Nitrite as N	1.5			1	1.6			1	6.45		mg/L
Nitrobenzene	0.033	U		1	0.032	U		1			ug/L
Tetrachloroethene	0.20	U		1	0.20	U		1			ug/L
trans-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Trichloroethene	0.16	U		1	0.16	U		1			ug/L
Uranium	0.26			1	0.28			1	7.41		ug/L
Vinyl Chloride	0.10	U		1	0.10	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13035172 Lab Code: STD Date Due: 04/12/2013
 Matrix: Water Site Code: WEL01 Date Completed: 04/10/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Iron	ICP/ES	03/28/2013			OK	OK	OK	98.0				96.0	1.2	115.0
Iron	ICP/ES	03/30/2013			OK	OK		115.0	119.0	0.0		95.0		97.0
Uranium	ICP/MS	03/21/2013					OK	106.0	110.0	110.0	0.0	87.0		101.0
Uranium	ICP/MS	03/21/2013							113.0	113.0	0.0	89.0		

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13035172

Project: Weldon Spring

Lab Code: STD

Validation Date: 04/29/2013

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13035172 **Lab Code:** STD **Date Due:** 04/12/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 04/10/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Nitrate+Nitrite as N	03/22/2013			OK	OK	OK	101.00	95.0	93.0	2.00	
Sulfate	03/28/2013	0.000	1.0000	OK	OK	OK	100.00	109.0	109.0	0	



Data Review and Validation Report

General Information

Report Number (RIN): 13035214
Sample Event: April 1-9, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 323727
Analysis: Metals, Organics, Radiochemistry, and Wet Chemistry
Validator: Stephen Donivan
Review Date: June 6, 2013

This validation was performed according to the Environmental Procedures Catalog, (LMS/POL/S04325, continually updated) "Standard Practice for Validation of Environmental Data." The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1. All analyses were successfully completed.

Table 1. Analytes and Methods

Table with 4 columns: Analyte, Line Item Code, Prep Method, Analytical Method. Rows include Chemical Oxygen Demand, Gross Alpha / Beta, Metals: Hg, Metals: Ag, As, Ba, Cr, Cu, Fe, Mn, Ni, Pb, Se, U, Zn, Radium-226, Radium-228, Thorium Isotopes, Total Suspended Solids.

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Table with 5 columns: Sample Number, Location, Analyte(s), Flag, Reason. Row 1: 323727002, LW-DC12, Copper, J, Field duplicate result

Sample Number	Location	Analyte(s)	Flag	Reason
323727002	LW-DC12	Gross Alpha	J	Less than the Determination Limit
323727002	LW-DC12	Mercury	R	Matrix spike recovery
323727002	LW-DC12	Selenium	J	Matrix spike recovery
323727004	LW-DC12 Duplicate	Copper	J	Field duplicate result
323727004	LW-DC12 Duplicate	Gross Alpha	J	Less than the Determination Limit
323727004	LW-DC12 Duplicate	Mercury	R	Matrix spike recovery
323727004	LW-DC12 Duplicate	Radium-228	J	Less than the Determination Limit
323727004	LW-DC12 Duplicate	Selenium	J	Matrix spike recovery
323727004	LW-DC12 Duplicate	Thorium-230	J	Less than the Determination Limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 30 water samples on April 11, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at 3 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

For radiochemical analytes (those measured by radiometric counting) the MDL and PQL are not applicable, and these results are evaluated using the minimum detectable concentration (MDC), Decision Level Concentration (DLC), and Determination Limit (DL). The MDC is a measure of radiochemical method performance and was calculated and reported as specified in *Quality Systems for Analytical Services*. The DLC is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, and is estimated as 3 times the one-sigma total propagated uncertainty. Results that are greater than the MDC, but less than the DLC are qualified with a “U” flag (not detected). The DL for radiochemical results is the lowest concentration that can be reliably measured, and is defined as 3 times the MDC. Results not previously “U” qualified that are less than the DL are qualified with a “J” flag as estimated values.

The reported MDLs for all metal, organic, and wet chemical analytes; and MDCs for radiochemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All initial calibration and calibration check standards were prepared from independent sources.

Method SM 2540D, Total Suspended Solids

There is no initial or continuing calibration requirement associated with the determination of total dissolved solids.

Method EPA 410.4, Chemical Oxygen Demand

The initial calibration was performed using a single point calibration on April 22, 2013. Initial and continuing calibration verification checks were made at the required frequency resulting in two verification checks. All calibration checks met the acceptance criteria.

Method SW-846 6020, Metals

Calibrations were performed on May 7–8, 2013, using two calibration standards. The absolute values of the intercepts were less than three times the method detection limit. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 7470A, Mercury

Calibration was performed on April 25, 2013, using two calibration standards. The absolute values of the intercepts were less than three times the method detection limit. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range.

Radiochemical Analysis

Thorium Isotopes

Alpha spectrometry calibrations and instrument backgrounds were performed within a month previous to sample analysis. Calibration standards were counted to obtain a minimum of 10,000 counts per peak. Daily instrument checks met the acceptance criteria. The tracer recoveries met the acceptance criteria of 30 to 110 percent for all samples. The full width at half maximum (FWHM) was reviewed to evaluate the spectral resolution. None of the tracer FWHM values exceeded 100 kiloelectron volts (keV). All ROIs were satisfactory.

Radium-226

Emanation cell plateau voltage determinations and cell efficiency calibrations were performed within a year previous to sample analysis.

Gross Alpha/Beta, Radium-228

Plateau voltage determinations and detector efficiency calibrations were performed within a year previous to sample analysis. The chemical recoveries met the acceptance criteria of 40 to 110 percent for all samples.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration. The radiochemistry method blank results were less than the DLC for all analytes.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the frequency to verify the instrumental interelement and background correction factors. All ICSAB check sample results met the acceptance criteria.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike concentration. The spike results met the recovery and precision criteria for all analytes evaluated with the exception of mercury and selenium. The associated sample mercury results are qualified with an “R” flag because the MS recovery was less than 30%. The associated sample selenium results are qualified with a “J” flag as estimated values.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for non-radiochemical replicate results that are greater than 5 times the practical quantitation limit (PQL) should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than the PQL, the range should be no greater than the PQL. The replicate results met these criteria, demonstrating acceptable laboratory precision. The relative error ratio for radiochemical replicate results (calculated using the one-sigma total propagated uncertainty) was less than three, indicating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample

preparation. All control sample results were acceptable with the following exception. The recovery naphthalene from the PAH control sample did not meet the acceptance criteria. Naphthalene was not detected in any of the associated samples, not requiring qualification.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable with the exception of manganese. The associated sample manganese result is qualified with a “J” flag as an estimated value.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers. The analytical report included the method detection limit (minimum detectable concentration for radiochemistry) and practical quantitation limit for all analytes and all required supporting documentation.

Electronic Data Deliverable (EDD) File

The EDD file arrived on May 13, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Field Measurements

The pre-sampling purge criteria were met for all wells.

Sampling Protocol

Sample results for all monitor wells met the Category I or II low-flow sampling criteria and were qualified with an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The ground water sample results for the wells listed in Table 3 were qualified with a “Q” flag in the database indicating the data are considered qualitative because of the sampling protocol (either category II or category III).

Table 3. Category II and III Wells

Well	Category II
LW-DC12	X
MW-3003	X
MW-3006	
MW-3024	X

MW-3040	X
MW-4007	X
MW-4040	X
MW-4043	X
MWD-2	X
MWS-1	X
MWS-2	X

Equipment Blank Assessment

An equipment blank was not collected because all sampling was performed with dedicated equipment or new pump tubing.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for non-radiochemical replicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical duplicate results, the relative error ratio for duplicate results (calculated using the one-sigma total propagated uncertainty) should be less than three. Duplicate samples were collected from locations LW-DC12 and MW-4040. The duplicate results met these criteria, demonstrating acceptable overall precision, with the following exception. The copper duplicate results from location LW-DC12 did not meet the acceptance criteria. The sample and duplicate copper results are qualified with a "J" flag as estimated values.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the
-

historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.

2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition.

The barium result from location LW-DC12 and the uranium result from location SW-2005 were identified as potential anomalous. Location LW-DC12 was sampled in duplicate with reproducible barium results, indicating that sampling and analytical errors are unlikely. There were no errors noted during the in depth review of the analytical data and the data from this event are acceptable as qualified.



Stephen E. Donivan

2013.06.06

11:21:52 -06'00'

Report Prepared By: _____

Stephen Donivan
Laboratory Coordinator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2003

Laboratory:

RIN: 13035214

Report Date: 06/06/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current			Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Qualifiers <i>Lab Data</i>		Result	Qualifiers <i>Lab Data</i>		Result	Qualifiers <i>Lab Data</i>		N	N Below Detect	
WEL01	LW-DC12	N001	04/09/2013	Barium	0.065900			0.975			0.0697			28	0	Yes
WEL01	LW-DC12	N001	04/09/2013	Copper	0.042200	E		0.019			0.00064	B		28	5	NA
WEL01	LW-DC12	N001	04/09/2013	Manganese	0.036200			1.26			0.103			30	0	NA
WEL01	MW-4042	N001	04/02/2013	Uranium	0.000307			0.0046		F	0.00034		F	25	1	NA
WEL01	SW-2005	N001	04/02/2013	Uranium	0.000574			0.0058			0.0028	B		12	0	Yes
WEL01	SW-2007	N001	04/02/2013	Uranium	0.002130			0.0015			0.00019	BE	J	17	3	No
WEL01	SW-2024	N001	04/02/2013	Uranium	0.004490			0.0035			0.0014		U	14	1	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13035214 Lab Code: GEN Validator: Stephen Donovan Validation Date: 06/06/2013
Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics
of Samples: 30 Matrix: Water Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

Holding Times

All analyses were completed within the applicable holding times.

Detection Limits

There are 0 detection limit failures.

Field/Trip Blanks

Field Duplicates

There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 13035214 Lab Code: GEN Project: Weldon Spring Validation Date: 06/06/2013

Duplicate: LW-DC99

Sample: LW-DC12

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
ALPHA	4.12		1.68	1.00	2.80		1.37	1.00		1.2	pCi/L
Arsenic	3.19	B		1.00	2.53	B		1.00			ug/L
Barium	65.9			1.00	55			1.00	18.03		ug/L
BETA	5.98		1.31	1.00	7.12		1.66	1.00		1.1	pCi/L
Chemical Oxygen Demand	24.9			1.00	29.8			1.00			mg/L
Chromium	2.00	U		1.00	2.00	U		1.00			ug/L
Copper	42.2	E		1.00	8.38	E		1.00	133.73		ug/L
Iron	194			1.00	181			1.00	6.93		ug/L
Lead	1.7	B		1.00	0.500	U		1.00			ug/L
Manganese	36.2			1.00	33.2			1.00	8.65		ug/L
Mercury	0.067	UN		1.00	0.067	UN		1.00			ug/L
Nickel	5.51	B		1.00	5.22	B		1.00	5.41		ug/L
Radium-226	0.360	U	0.268	1.00	0.272	U	0.241	1.00		0.5	pCi/L
Radium-228	0.833	U	0.595	1.00	0.899		0.486	1.00		0.2	pCi/L
Selenium	6.53	N		1.00	5.74	N		1.00			ug/L
Silver	0.200	U		1.00	0.200	U		1.00			ug/L
Thorium-228	-0.0411	U	0.171	1.00	0.0725	U	0.314	1.00		0.6	pCi/L
Thorium-230	0.333	U	0.456	1.00	1.83		0.797	1.00		3.2	pCi/L
Thorium-232	0.0722	U	0.225	1.00	0.192	U	0.264	1.00		0.7	pCi/L
Total Suspended Solids	0.525	U		1.00	1.09	U		1.00			mg/L
Uranium	5.03			1.00	4.93			1.00	2.01		ug/L
Zinc	45.5			1.00	14.1	B		1.00			ug/L

Duplicate: MW-4140

Sample: MW-4040

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Uranium	454			10.00	438			10.00	3.59		ug/L

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 13035214

Lab Code: GEN

Date Due: 05/09/2013

Matrix: Water

Site Code: WEL01

Date Completed: 05/13/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Arsenic	ICP/MS	05/08/2013			OK	OK	OK	104.0	110.0			110.0		89.0
Barium	ICP/MS	05/08/2013			OK	OK	OK	99.5	82.9		9.0	101.0	2.0	103.0
Chromium	ICP/MS	05/08/2013			OK	OK	OK	105.0	104.0			97.0		102.0
Copper	ICP/MS	05/08/2013			OK	OK	OK	110.0	105.0		4.0	97.0	10.0	111.0
Iron	ICP/MS	05/08/2013			OK	OK	OK	103.0	104.0		11.0	106.0		105.0
Lead	ICP/MS	05/08/2013			OK	OK	OK	106.0	104.0			98.0		105.0
Manganese	ICP/MS	05/08/2013			OK	OK	OK	103.0	104.0		0.0	104.0	7.0	102.0
Mercury	CVAA	04/25/2013	0.0000	1.0000	OK	OK	OK	104.0	9.0					91.0
Nickel	ICP/MS	05/08/2013			OK	OK	OK	107.0	105.0		1.0	97.0		107.0
Selenium	ICP/MS	05/08/2013			OK	OK	OK	109.0	127.0		14.0	106.0		106.0
Silver	ICP/MS	05/08/2013			OK	OK	OK	108.0	103.0			99.0		102.0
Uranium	ICP/MS	05/07/2013			OK	OK	OK	99.9	102.0		4.0	95.0	0.8	99.0
Uranium	ICP/MS	05/08/2013			OK	OK	OK	99.5			1.0	93.0	1.2	107.0
Zinc	ICP/MS	05/08/2013			OK	OK	OK	114.0	115.0		1.0	94.0		104.0

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13035214 **Lab Code:** GEN **Date Due:** 05/09/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 05/13/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Chemical Oxygen Demand	04/22/2013					OK	101.00	90.0		0	
Total Suspended Solids	04/15/2013					OK	99.20				

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 13035214 Lab Code: GEN Date Due: 05/09/2013
 Matrix: Water Site Code: WEL01 Date Completed: 05/13/2013

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate
LW-DC12	ALPHA	05/05/2013						2.38
Blank	ALPHA	05/05/2013	0.1290	U				
LW-DC12	ALPHA	05/05/2013					95.3	
Blank_Spike	ALPHA	05/05/2013				114.00		
LW-DC12	BETA	05/05/2013						0.27
Blank	BETA	05/05/2013	0.1960	U				
LW-DC12	BETA	05/05/2013					113.0	
Blank_Spike	BETA	05/05/2013				111.00		
LW-DC12	Radium-226	04/25/2013						1.33
Blank	Radium-226	04/25/2013	0.1240	U				
LW-DC12	Radium-226	04/25/2013					94.8	
Blank_Spike	Radium-226	04/25/2013				87.50		
LW-DC12	Radium-228	04/23/2013			91.0			
LW-DC99	Radium-228	04/23/2013			102.0			
LW-DC12	Radium-228	04/23/2013			98.0			0.44
Blank	Radium-228	04/23/2013	0.2680	U				
LW-DC12	Radium-228	04/23/2013			95.0		115.0	
Blank	Radium-228	04/23/2013			97.0			
Blank_Spike	Radium-228	04/23/2013			105.0	96.00		
LW-DC99	Thorium-228	04/13/2013			81.0			
LW-DC12	Thorium-228	04/13/2013			87.0			0.05
Blank	Thorium-228	04/13/2013	0.0300	U	101.0			
LW-DC12	Thorium-228	04/15/2013			92.0			
LW-DC12	Thorium-230	04/13/2013						1.31
Blank_Spike	Thorium-230	04/13/2013				101.00		
Blank	Thorium-230	04/13/2013	-0.1560	U				
LW-DC12	Thorium-232	04/13/2013						0.34
Blank	Thorium-232	04/13/2013	0.0400	U				



Data Review and Validation Report

General Information

Report Number (RIN): 13045277
Sample Event: April 29 – May 8, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-42087
Analysis: Metals, Organics, and Wet Chemistry
Validator: Stephen Donovan
Review Date: June 6, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Iron	LMM-01	SW-846 3010A	SW-846 6010B
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3010A	SW-846 6020

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-42087-2	MW-1006	2,4-Dinitrotoluene	J	Analyte peak resolution
280-42087-17	MW-1018	Uranium	J	Field duplicate precision

Sample Number	Location	Analyte(s)	Flag	Reason
280-42087-33	MW-1049	Uranium	U	Less than 5 times the method blank
280-42087-39	MW-1018 Duplicate	Uranium	J	Field duplicate precision
280-42087-42	MW-2014	2,4-Dinitrotoluene	J	Analyte peak resolution
280-42087-45	MW-2050	2,4-Dinitrotoluene	J	Analyte peak resolution
280-42087-46	MW-2052	2,4-Dinitrotoluene	J	Analyte peak resolution
280-42087-47	MW-2053	2,4-Dinitrotoluene	J	Analyte peak resolution
280-42087-48	MW-2054	2,4-Dinitrotoluene	J	Analyte peak resolution

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 54 water samples on May 9, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced coolers at 3.4 and 3.6 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

The reported MDLs for all metal, organic, and wet chemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibrations were performed using six calibration standards on May 1, 2013. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the

intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration check results within the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method SW-846 6010B, Iron

Calibrations were performed on May 20, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on May 14, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on May 14, 2013, using seven calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis.

Metals and Wet Chemistry

All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Organics

The method blank results were below the MDL for all target compounds.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Nitroaromatics and Volatiles Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. All surrogate recoveries were within the acceptance ranges. The recovery of the internal standards added to the samples is monitored to measure the purging efficiency. Internal standard recoveries associated with target compounds were stable and within acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike concentration. The spikes met the recovery and precision criteria for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the practical quantitation limit (PQL) should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than the PQL, the range should be no greater than the PQL. The results for all replicates met these criteria, demonstrating acceptable laboratory precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the practical quantitation limit for method 6010 or greater than 100 times the practical quantitation limit for method 6020. All evaluated serial dilution data were acceptable.

Detection Limits/Dilutions

Samples were diluted in a consistent and acceptable manner when required. The required detection limits were met for all analytes.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics, sulfate, and volatiles data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20% of the analyte peak height. Sample results associated with analyte peaks that do not meet this criteria are qualified with a "J" flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each reported volatile and nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on May 30, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
 2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric
-

test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.

3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

There were no outliers identified and the data from this event are acceptable as qualified.

Sampling Protocol

All monitoring wells were purged and sampled using the low-flow sampling method, meeting the Category I, II, or III low-flow sampling criteria. Sample results from wells meeting the low-flow criteria are qualified with an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method. The groundwater sample results for the wells listed in Table 3 are further qualified with a “Q” flag indicating the data are considered qualitative because they are Category II or III wells.

Table 3. Category II or III Wells

Category II	Category III
MW-1006	MW-2017
MW-1008	
MW-1009	
MW-1028	
MW-1031	
MW-1032	
MW-1046	
MW-1047	
MW-1052	
MW-2014	
MW-2050	
MW-2056	
MW-4039	

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for duplicate results that are greater than five times the PQL should be less than 20 percent. For results that are less than the PQL, the range should be no greater than the PQL. Duplicate samples were collected from locations MW-1018 and MW-1045. The duplicate results met the criteria, demonstrating acceptable overall precision, for all analytes except uranium at location MW-1018. The sample and duplicate uranium results for that location are qualified with a “J” flag as estimated values.

Field Measurements

The pre-sampling purge criteria were met for all wells. Daily calibration checks were performed as required with acceptable results.

Report Prepared By:  Stephen E. Donivan
2013.06.06 14:38:38
-06'00'

Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13045277 Lab Code: STD Validator: Stephen Donovan Validation Date: 06/06/2013

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 54 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13045277 Lab Code: STD Project: Weldon Spring Validation Date: 06/06/2013

Duplicate: MW-1118

Sample: MW-1018

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Sulfate	1.5	J		1	0.63	J		1			mg/L
Uranium	0.050	U		1	1.8	B		1			ug/L

Duplicate: MW-1145

Sample: MW-1045

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,3,5-Trinitrobenzene	0.016	U		1	0.016	U		1			ug/L
1,3-Dinitrobenzene	0.013	U		1	0.013	U		1			ug/L
2,4,6-Trinitrotoluene	0.021	U		1	0.021	U		1			ug/L
2,4-Dinitrotoluene	0.018	U		1	0.018	U		1			ug/L
2,6-Dinitrotoluene	0.021	U		1	0.021	U		1			ug/L
Iron	22	U		1	22	U		1			ug/L
Nitrobenzene	0.032	U		1	0.032	U		1			ug/L
Sulfate	18			1	18			1	0		mg/L
Uranium	2.3	B		1	2.6	B		1	12.24		ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13045277

Project: Weldon Spring

Lab Code: STD

Validation Date: 06/06/2013

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13045277

Lab Code: STD

Date Due: 06/06/2013

Matrix: Water

Site Code: WEL01

Date Completed: 06/04/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Iron	ICP/ES	05/20/2013			OK	OK	OK	97.0	94.0	96.0	2.0	93.0		101.0
Uranium	ICP/MS	05/15/2013			OK	OK	OK	99.0	97.0	96.0	1.0	89.0		91.0
Uranium	ICP/MS	05/16/2013			OK	OK	OK	105.0	98.0	104.0	5.0	102.0		

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13045277 **Lab Code:** STD **Date Due:** 06/06/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 06/04/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R ²	CCV	CCB						
Sulfate	05/20/2013	0.000	1.0000	OK	OK	OK	97.00	110.0	112.0	2.00	
Sulfate	05/20/2013					OK	93.00	112.0	114.0	1.00	
Sulfate	05/20/2013						98.0	99.0	1.00		



Data Review and Validation Report

General Information

Report Number (RIN): 1305322
Sample Event: May 13–14, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-42303
Analysis: Metals, Organics, and Wet Chemistry
Validator: Stephen Donivan
Review Date: July 26, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A
Uranium	LMM-02	SW-846 3010A	SW-846 6020
Volatiles	LMV-06	SW-846 5030B	SW-846 8260B

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-42303-4	MW-2035	Nitrate + Nitrite as N	J	Matrix spike recovery
280-42303-12	MW-4013	2,4-Dinitrotoluene	J	Analyte peak resolution

Sample Number	Location	Analyte(s)	Flag	Reason
280-42303-13	MW-4014	2,4-Dinitrotoluene	J	Analyte peak resolution
280-42303-14	MW-4015	2,4-Dinitrotoluene	J	Analyte peak resolution

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 20 water samples on May 16, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at at 0.4 °C and 1.6 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

The reported MDLs for all metal, organic, and wet chemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 353.2, Nitrate + Nitrite as N

Calibrations were performed on March 22, 2013, using six calibration standards. The absolute values of the intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method SW-846 6020, Uranium

Calibrations were performed on May 21, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8260B, Volatiles

The volatile compounds requested were 1,2-dichloroethane, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. Initial calibration was performed April 24, 2013, using six calibration standards. The average response factor and associated relative standard deviation met the acceptance criteria for all analytes. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent. The mass spectrometer calibration and resolution was checked at the beginning of each analytical run in accordance with the procedure.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on June 3, 2013, using six calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All detected target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis.

Metals and Wet Chemistry

All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a "U" flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Organics

The method blank results were below the MDL for all target compounds.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Nitroaromatics and Volatiles Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. All surrogate recoveries were within the acceptance ranges with the following exception. The method 8321A surrogate recovery from sample MW-2022 did not meet the acceptance criteria. There were no method 8321A analytes detected in this sample and qualification is not required.

The recovery of the internal standards added to the samples is monitored to measure the purging efficiency. Internal standard recoveries associated with target compounds were stable and within acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike concentration. The spikes met the recovery and precision criteria for all analytes evaluated with the following exception. The nitrate + nitrite as N spike duplicate recovery from sample MW-2035 did not meet the acceptance criteria. The associated sample nitrate + nitrite as N result is qualified with a “J” flag as an estimated value.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the practical quantitation limit (PQL) should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than the PQL, the range should be no greater than the PQL. The results for all replicates met these criteria, demonstrating acceptable laboratory precision.

Laboratory Control Sample

Laboratory control samples (LCS) were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable with the following exception. The method 8321A LCS duplicate (LCSD) recoveries did not meet the acceptance criteria, however the recoveries for the LCS were acceptable. Sample data were not further qualified because the poor performance was isolated to the LCSD.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable.

Detection Limits/Dilutions

Samples were diluted in a consistent and acceptable manner when required. The required detection limits were met for all analytes.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics, sulfate, and volatiles data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20% of the analyte peak height. Sample results associated with analyte peaks that do not meet this criteria are qualified with a "J" flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each reported volatile and nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on June 7, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental
-

database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.

2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

None of the results were identified as potentially anomalous.

Sampling Protocol

Sample results for all monitor wells met the Category I or II low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The ground water sample results for the wells listed in Table 3 were qualified with a "Q" flag in the database indicating the data are considered qualitative because of the sampling protocol (Category II).

Table 3. Category II Wells

Well	Category II
MW-2021	X
MW-2022	X
MW-2023	X
MW-2035	X
MW-2040	X
MW-3037	X
MW-4015	X
MW-4022	X

Trip Blank

A trip blank was prepared and analyzed for volatile organics to document contamination attributable to shipping and field handling procedures. There were no target analytes detected in the trip blank.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for duplicate results that are greater than five times the PQL should be less than 20 percent. For results that are less than the PQL, the range should be no greater than the PQL. A duplicate sample was collected from location MW-2035. The duplicate results met the criteria, demonstrating acceptable overall precision.

Field Measurements

Daily calibration checks were performed as required with acceptable results.



Stephen E. Donovan

2013.07.26 10:24:49

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Report Prepared By: _____

Stephen Donovan
Laboratory Coordinator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2003

Laboratory: TestAmerica Denver

RIN: 13055322

Report Date: 07/26/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current			Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		N	N Below Detect	
						Lab	Data		Lab	Data		Lab	Data			
WEL01	MW-2021	N001	05/13/2013	Nitrate + Nitrite as Nitrogen	0.041	J		0.019	U	FQ	0.0047	U	FQ	5	5	No
WEL01	MW-2022	N001	05/14/2013	Nitrate + Nitrite as Nitrogen	0.034	J		0.019	U	FQ	0.0047	U	FQ	5	5	No
WEL01	MW-2038	N001	05/14/2013	1,3,5-Trinitrobenzene	0.035	J*		0.081		F	0.036	J	F	22	13	No
WEL01	MW-3034	N001	05/14/2013	2,6-Dinitrotoluene	0.049	J*		0.23		F	0.05	J	F	26	8	NA
WEL01	MW-3034	N001	05/14/2013	trans-1,2-Dichloroethene	0.15	U		2	U	F	0.18	J	F	14	5	NA
WEL01	MW-3037	N001	05/14/2013	2,4-Dinitrotoluene	0.29	*		0.068	U	FQ	0.005	U	FQ	15	15	NA
WEL01	MW-4014	N001	05/14/2013	2,6-Dinitrotoluene	0.18	*		0.15		F	0.069	U	F	17	13	No
WEL01	MW-4022	N001	05/13/2013	Nitrate + Nitrite as Nitrogen	0.48			0.33		FQ	0.205		FQJ	5	0	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13055322 Lab Code: STD Validator: Stephen Donovan Validation Date: 07/26/2013

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 20 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

There are 0 detection limit failures.

There was 1 trip/equipment blank evaluated.

There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

Page 1 of 1

RIN: 13055322 Lab Code: STD Project: Weldon Spring Validation Date: 07/26/2013

Duplicate: MW-2135

Sample: MW-2035

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,2-Dichloroethane	0.13	U		1	0.13	U		1			ug/L
1,3,5-Trinitrobenzene	0.017	U*		1	0.017	U*		1			ug/L
1,3-Dinitrobenzene	0.014	U*		1	0.014	U*		1			ug/L
2,4,6-Trinitrotoluene	0.022	U*		1	0.021	U*		1			ug/L
2,4-Dinitrotoluene	0.019	U*		1	0.019	U*		1			ug/L
2,6-Dinitrotoluene	0.022	U*		1	0.021	U*		1			ug/L
cis-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Nitrate+Nitrite as N	0.74			1	0.73			1	1.36		mg/L
Nitrobenzene	0.033	U*		1	0.032	U*		1			ug/L
Tetrachloroethene	0.20	U		1	0.20	U		1			ug/L
trans-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Trichloroethene	0.16	U		1	0.16	U		1			ug/L
Uranium	0.57			1	0.60			1	5.13		ug/L
Vinyl Chloride	0.10	U		1	0.10	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13055322 Lab Code: STD Date Due: 06/13/2013
 Matrix: Water Site Code: WEL01 Date Completed: 06/10/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Uranium	ICP/MS	05/21/2013			OK	OK	OK	97.0	99.0	96.0	4.0	98.0		99.0
Uranium	ICP/MS	05/22/2013			OK	OK	OK	95.0	94.0			100.0	1.5	106.0

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13055322

Project: Weldon Spring

Lab Code: STD

Validation Date: 07/26/2013

LCS Recovery: There were 5 LCS failures.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: There were 2 surrogate failures.

SAMPLE MANAGEMENT SYSTEM
Non-Compliance Report: LCS Recovery

RIN: 13055322 Lab Code: STD

Project: Weldon Spring

Validation Date: 07/26/2013

LCS/LCSD	Date Analyzed	Method	Analyte	Recovery	Lower Limit	Upper Limit
LCSD	05/28/2013	8321A	1,3,5-Trinitrobenzene	38	54	145
LCSD	05/28/2013	8321A	1,3-Dinitrobenzene	43	68	131
LCSD	05/28/2013	8321A	2,4-Dinitrotoluene	33	66	130
LCSD	05/28/2013	8321A	2,6-Dinitrotoluene	33	64	133
LCSD	05/28/2013	8321A	Nitrobenzene	34	42	141

SAMPLE MANAGEMENT SYSTEM

RIN: 13055322 Lab Code: STD

Non-Compliance Report: Surrogate Recovery

Project: Weldon Spring

Validation Date: 07/26/2013

Ticket	Location	Lab Sample ID	Method	Dilution	Surrogate	Recovery	Lower Limit	Upper Limit
LCSD			8321A		Nitrobenzene-d5	35	48	130
LGT 149	MW-2022	280-42303-2	8321A	1	Nitrobenzene-d5	34	48	130

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13055322 **Lab Code:** STD **Date Due:** 06/13/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 06/10/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Nitrate+Nitrite as N	06/03/2013	0.000	1.0000	OK	OK	OK	109.00	79.0	126.0	38.00	
Nitrate+Nitrite as N	06/03/2013					OK	101.00	91.0	111.0	17.00	
Nitrate+Nitrite as N	06/03/2013					OK	103.00				
Nitrate+Nitrite as N	06/03/2013						110.00			2.00	
Nitrate+Nitrite as N	06/03/2013						104.00			2.00	
Nitrate+Nitrite as N	06/03/2013						99.00			2.00	



Data Review and Validation Report

General Information

Report Number (RIN): 13065390
Sample Event: June 17-19, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-43650-1
Analysis: Organics
Validator: Gretchen Baer
Review Date: October 10, 2013

This validation was performed according to the *Environmental Procedures Catalog* (LMS/POL/S04325, continually updated), "Standard Practice for Validation of Environmental Data." The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-43650-3	MW-2046	2,6-Dinitrotoluene	J	Poor analyte peak resolution
280-43650-4	MW-2047	2,4-Dinitrotoluene	J	Poor analyte peak resolution

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 15 water samples on June 20, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received with the temperatures inside the iced coolers at 3.2 °C and 3.6 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL. The reported MDLs for all analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on July 1, 2013, using seven calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. The blank results were below the MDL for all target compounds.

Nitroaromatics Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. All surrogate recoveries were within the acceptance ranges. The surrogate recovery calculated for the dilution prepared for sample MW-2046 is not valid and not evaluated.

The recovery of the internal standards added to the samples is monitored to measure the purging efficiency. Internal standard recoveries associated with target compounds were stable and within acceptance ranges with the following exception. The recovery of internal standards one and two from many of the samples was below the acceptance criteria. There were no analytes detected in these samples associated with this internal standard and no qualification is required.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spikes met the recovery and precision criteria for all analytes.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the PQL should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20 percent of the analyte peak height. Sample results associated with analyte peaks that do not meet this criterion are qualified with a "J" flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on July 12, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
 2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
 3. Scientifically review statistical outliers and decide on their disposition.
-

The 2,6-dinitrotoluene result for location MW-4036 was identified as anomalously low. Multiple analytes trending in the same direction indicate the data are likely not outliers. The data associated with this result were further reviewed. There were no errors noted and the data for this RIN are acceptable as qualified.

Field Measurements

The pre-sampling purge criteria were met for all wells. Daily calibration checks were performed as required with acceptable results.

Sampling Protocol

Sample results for all monitoring wells met the Category I, II, or III low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The groundwater sample results for wells MW-2046, MW-2047, MW-2055, MW-3006, MW-4040, MW-4043, and MWS-1 were further qualified with a "Q" flag in the database indicating the data are considered qualitative because these are Category II wells.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. A duplicate sample was collected from location MW-2051. The relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. The duplicate results met the criteria, demonstrating acceptable overall precision.



Gretchen Baer

2013.10.11

11:23:25 -06'00'

Report Prepared By: _____

Gretchen Baer
Data Validator

Data Validation Outliers Report - No Field Parameters

Comparison: All Historical Data

Laboratory: TestAmerica Denver

RIN: 13065390

Report Date: 10/11/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
WEL01	MW-4036	N002	06/17/2013	1,3,5-Trinitrobenzene	0.037	J	F	0.7		F	0.056	U	F	21	5	No
WEL01	MW-4036	N002	06/17/2013	1,3-Dinitrobenzene	0.014	U	F	0.09	U		0.022	J	F	21	16	No
WEL01	MW-4036	N002	06/17/2013	2,4-Dinitrotoluene	0.026	J	F	0.13		J	0.046			20	12	NA
WEL01	MW-4036	N002	06/17/2013	2,6-Dinitrotoluene	0.036	J	F	1.4	P	FJ	0.09	U	F	21	2	Yes

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13065390 Lab Code: STD Validator: Gretchen Baer Validation Date: 10/10/2013
Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics
of Samples: 15 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

Page 1 of 1

RIN: 13065390 Lab Code: STD Project: Weldon Spring Validation Date: 10/10/2013

Duplicate: MW-2151

Sample: MW-2051

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,3,5-Trinitrobenzene	0.045	J		1	0.056	J		1			ug/L
1,3-Dinitrobenzene	0.031	J		1	0.023	J		1			ug/L
2,4,6-Trinitrotoluene	0.078	J		1	0.070	J		1			ug/L
2,4-Dinitrotoluene	0.060	J		1	0.056	J		1			ug/L
2,6-Dinitrotoluene	0.024	J		1	0.021	U		1			ug/L
Nitrobenzene	0.033	U		1	0.032	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13065390

Project: Weldon Spring

Lab Code: STD

Validation Date: 10/10/2013

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.



Data Review and Validation Report

General Information

Report Number (RIN): 13065391
Sample Event: June 10-19, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 327975
Analysis: Metals, Organics, Radiochemistry, and Wet Chemistry
Validator: Gretchen Baer
Review Date: October 21, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/PRO/S04325, continually updated) “Standard Practice for Validation of Laboratory Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1. All analyses were successfully completed.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Chemical Oxygen Demand	WCH-A-010	EPA 410.4	EPA 410.4
Chloride, Fluoride, Sulfate	MIS-A-045	EPA 300.0A	EPA 300.0A
Metals: As, Ba, Co, Cr, Fe, Mn, Ni, Pb, Se, Tl, U	LMM-02	SW-846 3005A	SW-846 6020
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
PAH Compounds	LMS-02	SW-846 3510C	SW-846 8310
PCBs	PEP-A-006	SW-846 3535A	SW-846 8082
Radium-226	GPC-A-018	SW-846 9315 Mod	SW-846 9315 Mod
Radium-228	GPC-A-020	SW-846 9320 Mod	SW-846 9320 Mod
Thorium Isotopes	ASP-A-008	EML A-01-R Mod	EML A-01-R Mod
Total Dissolved Solids	WCH-A-033	EPA 160.1	EPA 160.1
Total Organic Carbon	WVH-A-025	EPA 415.1	EPA 415.1
Volatiles (VOAs)	LMV-06	GL-OA-E-038	SW-846 8260B

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
327975001	MW-2051	Radium-226	J	Less than the Determination Limit
327975002	LW-DC10	Barium	J	Field duplicate RPD > 20%
327975002	LW-DC10	Chemical Oxygen Demand	J	MS recovery > upper limit
327975002	LW-DC10	Manganese	J	Serial dilution result
327975002	LW-DC10	Uranium	J	Serial dilution result
327975004	SP-6301	Radium-226	U	Less than the Decision Level Concentration
327975005	MW-2047	Radium-228	J	Less than the Determination Limit
327975007	MW-2046	Radium-226	J	Less than the Determination Limit
327975007	MW-2046	Radium-228	J	Less than the Determination Limit
327975014	MW-4036	Nitrate + Nitrite as N	J	MS recovery > upper limit
327975014	MW-4036	Uranium	J	Field duplicate RPD > 20%
327975024	LW-DC10 Dup	Arsenic	U	Less than 5 times the method blank
327975024	LW-DC10 Dup	Barium	J	Field duplicate RPD > 20%
327975024	LW-DC10 Dup	Chemical Oxygen Demand	J	MS recovery > upper limit
327975024	LW-DC10 Dup	Manganese	J	Serial dilution result
327975024	LW-DC10 Dup	Radium-226	J	Less than the Determination Limit
327975024	LW-DC10 Dup	Uranium	J	Serial dilution result
327975025	MW-4036 Dup	Uranium	J	Field duplicate RPD > 20%

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 25 water samples on June 20, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times. The COC form was complete with no errors or omissions, with one exception: the sample date and time was incorrect on the COC for sample SP-6201. The errors were corrected upon entry into the environmental database. The bottle for PCB and PAH analyses from location MW-2051 was broken during shipment. This location was re-sampled and submitted for PCB and PAH under a different RIN. Two bottles for PCB and PAH analyses from location LW-DC10 were broken during shipment; there was sufficient sample volume in the unbroken bottle to complete the analysis.

Preservation and Holding Times

The sample shipment was received intact with the temperatures inside the iced coolers between 2 °C and 3 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

For radiochemical analytes (those measured by radiometric counting) the MDL and PQL are not applicable, and these results are evaluated using the minimum detectable concentration (MDC), Decision Level Concentration (DLC), and Determination Limit (DL). The MDC is a measure of radiochemical method performance and was calculated and reported as specified in *Quality Systems for Analytical Services*. The DLC is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, and is estimated as 3 times the one-sigma total propagated uncertainty. Results that are greater than the MDC, but less than the DLC are qualified with a “U” flag (not detected). The DL for radiochemical results is the lowest concentration that can be reliably measured, and is defined as 3 times the MDC. Results not previously “U” qualified that are less than the DL are qualified with a “J” flag as estimated values.

The reported MDLs for all metal, organic, and wet chemical analytes; and MDCs for radiochemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All initial calibration and calibration check standards were prepared from independent sources.

Method EPA 160.1, Total Dissolved Solids

There is no initial or continuing calibration requirement associated with the determination of total dissolved solids.

Method EPA 300.0A, Chloride, Fluoride, Sulfate

The initial calibrations were performed using six calibration standards on April 30, 2013. The correlation coefficient values were greater than 0.995 and intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method EPA 353.2, Nitrate + Nitrite as N

The initial calibrations were performed using five calibration standards on June 25, 2013, resulting in calibration curve correlation coefficient values greater than 0.995. The absolute value

of the intercept of the calibration curve was less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method EPA 410.4, Chemical Oxygen Demand

The initial calibration was performed using a single point calibration on July 8, 2013. Initial and continuing calibration verification checks were made at the required. All calibration checks met the acceptance criteria.

Method EPA 415.1, Total Organic Carbon

The initial calibrations were performed using five calibration standards on June 21, 2013, resulting in calibration curve correlation coefficient values greater than 0.995. The absolute value of the intercept of the calibration curve was less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method SW-846 6020, Metals

Calibrations were performed on July 5-17, 2013, using two calibration standards. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8082, PCBs

The initial calibration for PCBs was performed using five calibration standards on July 2, 2013. The initial calibration data met the acceptance criteria for all analytes on both gas chromatography columns. Initial and continuing calibration checks were made at the required frequency. All continuing calibration verifications were within the acceptance criteria.

Method SW-846 8260B, Volatiles

The volatile compounds requested were 1,2-dichloroethane, *cis*-1,2-dichloroethene, tetrachloroethene, *trans*-1,2-dichloroethene, trichloroethene, and vinyl chloride. Initial calibration of instrument VOA6 was performed on June 11, 2013, using seven calibration standards. The average response factor and associated relative standard deviation met the acceptance criteria for all analytes where the averaged response factor approach was used. In cases where the linear calibration curve approach was used, the calibration curve correlation coefficient value was greater than 0.99 and the intercept was less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. The mass spectrometer calibration and resolution were checked at the beginning of each analytical run in accordance with the procedure. Internal standard recoveries were stable and within acceptance ranges. All surrogate recoveries were within the acceptance ranges.

Method SW-846 8310, PAH Compounds

The initial calibration for PAHs was performed using eight calibration standards on March 28, 2013. The initial calibration data met the acceptance criteria for all analytes. Initial and

continuing calibration checks were made at the required frequency. All continuing calibration verifications were within the acceptance criteria.

Radiochemical Analysis

Thorium Isotopes

Alpha spectrometry calibrations and instrument backgrounds were performed within a month previous to sample analysis. Calibration standards were counted to obtain a minimum of 10,000 counts per peak. Daily instrument checks met the acceptance criteria. The tracer recoveries met the acceptance criteria of 30 to 110 percent for all samples. The full width at half maximum (FWHM) was reviewed to evaluate the spectral resolution. For some samples, the tracer FWHM exceeded 100 kiloelectron volts (keV), which is expected for isotopes such as thorium-229 with alpha emissions at multiple energies. Thorium-228, -230, and -232 results were corrected for tracer impurity. All ROIs were satisfactory.

Radium-226

Emanation cell plateau voltage determinations and cell efficiency calibrations were performed within a year previous to sample analysis.

Radium-228

Plateau voltage determinations and detector efficiency calibrations were performed within a year previous to sample analysis. The chemical recoveries met the acceptance criteria of 40 to 110 percent for all samples.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the PQL for all analytes with the exception of uranium in a calibration blank on July 15, 2013. The samples associated with this blank had uranium concentrations greater than 10 times the blank. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a "U" flag (not detected) when the sample result is greater than the MDL but less than 5 times the blank concentration. The radiochemistry method blank results were less than the DLC.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Volatiles, PAHs, and PCBs Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate spike recoveries are evaluated to identify data quality effects due to such factors as interference or high concentrations of analytes. Surrogate recoveries may also be influenced by the success in

recoveries of the internal standards. Internal standard recoveries were stable and within acceptance ranges. All sample surrogate recoveries were within the acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spike results met the recovery and precision criteria for all analytes evaluated, with the following exceptions. The spike recoveries for chemical oxygen demand and nitrate + nitrite as N were slightly above the laboratory acceptance range. There is no evidence of systematic matrix interference; the sample results associated with the failed spike results are qualified with a “J” flag as estimated values. (A barium matrix spike performed on a sample from location MW-3003 slightly exceeded the acceptance criteria; however, barium was not requested or reported for this location. There is no evidence of systematic matrix interference and no qualification is necessary.)

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for non-radiochemical replicate results that are greater than 5 times the PQL should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable with the following exceptions. The percent difference for the manganese and uranium dilutions at location LW-DC10 were above the acceptance range. Because of the possible reduced accuracy due to matrix interference, the associated results are qualified with a “J” flag as estimated values.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for ion chromatography, PAH, PCB, and volatiles data. All peak integrations, including manual integrations, were satisfactory.

Compound Identification

The mass spectral data were reviewed for each reported organic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers. The analytical report included the MDL (MDC for radiochemistry) and PQL for all analytes and all required supporting documentation.

Electronic Data Deliverable (EDD) File

The EDD file arrived on July 18, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Field Measurements

The pre-sampling purge criteria were met for all wells.

One calibration check for turbidity (for standard value = 49.9 NTU) was slightly above the acceptance criteria. Since all associated samples had low turbidity values that were bracketed by an acceptable calibration check, no turbidity results required qualification.

Sampling Protocol

Sample results for all monitoring wells met the Category I, II, or III low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The groundwater sample results for wells MW-2046, MW-2047, MW-2055, MW-3003, MW-3006, MW-3024, MW-3040, MW-4007, MW-4040, MW-4043, MWD-2, MWS-1, and MWS-2 were further qualified with a "Q" flag in the database indicating the data are considered qualitative because these are Category II wells.

Equipment Blank Assessment

An equipment blank was not collected because all sampling was performed with dedicated equipment or new pump tubing.

Trip Blank Assessment

Trip blanks are prepared and analyzed to document contamination attributable to shipping and field handling procedures. One trip blank was submitted with these samples. There were no analytes detected in the trip blank.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples were collected from locations LW-DC10 and MW-4036 (field duplicate IDs LW-DA10 and MW-4136). For non-radiochemical measurements, the relative percent difference (RPD) for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. The duplicate results met the criteria with the exception of the barium RPD at LW-DC10 and the uranium RPD at MW-4036, which were above the criteria at 26 and 24 percent, respectively. There were no analytical errors identified during the review of the data. The associated results are qualified with a "J" flag as estimated values.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
 2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
 3. Scientifically review statistical outliers and decide on their disposition.
-

Three laboratory results were identified as potentially anomalous. The radium-226 result for location MW-2046 had a concentration higher than previously observed. Recent results for radium-226 indicate upward trending at this location. Thorium-230 results at MW-2046 and MW-2047 were high outliers, but were below required detection limits. Potential anomalies in the field parameters were also examined for patterns of repeated high or low bias, which suggest a systematic error due to instrument malfunction. No such patterns were found. The data for this RIN are acceptable as qualified.



Gretchen Baer

2013.10.28

11:07:10 -06'00'

Report Prepared By: _____

Gretchen Baer
Data Validator

Data Validation Outliers Report - No Field Parameters

Comparison: All Historical Data

Laboratory: GEL Laboratories

RIN: 13065391

Report Date: 10/28/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current			Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		N	N Below Detect	
						Lab	Data		Lab	Data		Lab	Data			
WEL01	LW-DC10	N001	06/18/2013	Nitrate + Nitrite as Nitrogen	3.7			2.76			0.0137	B		14	0	No
WEL01	LW-DC10	N003	06/18/2013	Nitrate + Nitrite as Nitrogen	3.88			2.76			0.0137	B		14	0	No
WEL01	LW-DC10	N003	06/18/2013	Selenium	0.00885			0.00792			0.00024	U		37	13	NA
WEL01	LW-DC10	N001	06/18/2013	Selenium	0.0105			0.00792			0.00024	U		37	13	NA
WEL01	LW-DC10	N001	06/18/2013	Sulfate	78.8			72.9			18.5			25	0	No
WEL01	LW-DC10	N003	06/18/2013	Sulfate	79.6			72.9			18.5			25	0	No
WEL01	MW-2046	N001	06/18/2013	Radium-226	0.886		JFQ	0.593		UFQ	0.12	U	FQ	24	14	Yes
WEL01	MW-2046	N001	06/18/2013	Selenium	0.00665		FQ	0.00587		FQ	0.0032	B	FQ	24	7	NA
WEL01	MW-2046	N001	06/18/2013	Thorium-230	0.803	U	FQ	0.63	J	FQJ	0.055	B	FQ	24	14	Yes
WEL01	MW-2047	N001	06/18/2013	Chromium	0.0174		FQ	0.0157		FQ	0.0012	B		24	6	NA
WEL01	MW-2047	N001	06/18/2013	Thorium-230	0.651	U	FQ	0.45	J	FQJ	0.04	B	FQ	23	10	Yes
WEL01	MW-2051	N001	06/18/2013	Barium	0.279	N	F	0.268		F	0.144		FQ	22	1	No
WEL01	MW-2051	N001	06/18/2013	Radium-226	1.6		JF	1.14		F	0.132	J	UFJ	22	8	NA
WEL01	MW-2055	N001	06/18/2013	Manganese	0.00122	BE	FQ	0.0225		FQ	0.0025	U	FQ	21	4	NA
WEL01	MW-3030	N001	06/18/2013	cis-1,2-Dichloroethene	5.54		F	21.8		F	6.86		F	12	0	NA
WEL01	MW-3030	N001	06/18/2013	trans-1,2-Dichloroethene	0.52	J	F	2		F	0.54	J	F	12	0	NA
WEL01	MW-3040	N001	06/12/2013	Nitrate + Nitrite as Nitrogen	80.3		FQ	150		FQJ	82		FQ	18	0	No

Data Validation Outliers Report - No Field Parameters

Comparison: All Historical Data

Laboratory: GEL Laboratories

RIN: 13065391

Report Date: 10/28/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
WEL01	MW-4007	N001	06/11/2013	Uranium	0.00384	E	FQ	0.00378		FQ	0.00056		FQ	15	0	NA
WEL01	MW-4040	N001	06/17/2013	Nitrate + Nitrite as Nitrogen	99.8		FQ	195		FQ	103		FQ	20	0	NA
WEL01	MW-4041	N001	06/17/2013	Nitrate + Nitrite as Nitrogen	0.307		F	0.28		F	0.113		F	7	0	No
WEL01	MW-4042	N001	06/11/2013	Uranium	0.000297	E	F	0.0046		F	0.000307		F	26	1	NA
WEL01	MW-4043	N001	06/17/2013	Nitrate + Nitrite as Nitrogen	0.445		FQ	7.02		F	0.51		FQ	19	0	No
WEL01	MW-4043	N001	06/17/2013	Uranium	0.093	E	FQ	0.14		QF	0.0994		F	25	0	No
WEL01	MWS-1	N001	06/17/2013	Uranium	0.00141	E	FQ	0.0014	B	FQ	0.0009	BE	UFQ	24	2	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

SAMPLE MANAGEMENT SYSTEM
General Data Validation Report

RIN: 13065391 Lab Code: GEN Validator: Gretchen Baer Validation Date: 10/14/2013
Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics
of Samples: 25 Matrix: Water Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

There are 0 detection limit failures.

There was 1 trip/equipment blank evaluated.

There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13065391 Lab Code: GEN Project: Weldon Spring Validation Date: 10/14/2013

Duplicate: LW-DA10

Sample: LW-DC10

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Acenaphthene	0.150	U		1.00	0.150	U		1.00			ug/L
Acenaphthylene	0.150	U		1.00	0.150	U		1.00			ug/L
Anthracene	0.150	U		1.00	0.150	U		1.00			ug/L
Aroclor 1016	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1221	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1232	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1242	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1248	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1254	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1260	0.0333	U		1.00	0.0333	U		1.00			ug/L
Arsenic	3.55	B		1.00	3.73	B		1.00			ug/L
Barium	469	N		1.00	609	N		1.00	25.97		ug/L
Benzo(a)anthracene	0.016	U		1.00	0.016	U		1.00			ug/L
Benzo(a)pyrene	0.016	U		1.00	0.016	U		1.00			ug/L
Benzo(b)fluoranthene	0.016	U		1.00	0.016	U		1.00			ug/L
Benzo(g,h,i)perylene	0.016	U		1.00	0.016	U		1.00			ug/L
Benzo(k)fluoranthene	0.008	U		1.00	0.008	U		1.00			ug/L
Chemical Oxygen Demand	32.9			1.00	36.5			1.00	10.37		mg/L
Chloride	48.5			10.00	49.2			10.00	1.43		mg/L
Chromium	2.00	U		1.00	2.00	U		1.00			ug/L
Chrysene	0.016	U		1.00	0.016	U		1.00			ug/L
Cobalt	1.69	B		1.00	1.76	B		1.00	4.06		ug/L
Dibenz(a,h)anthracene	0.016	U		1.00	0.016	U		1.00			ug/L
Fluoranthene	0.016	U		1.00	0.016	U		1.00			ug/L
Fluorene	0.150	U		1.00	0.150	U		1.00			ug/L
Fluoride	0.198	J		1.00	0.194	J		1.00	2.04		mg/L
Indeno(1,2,3-cd)pyrene	0.016	U		1.00	0.016	U		1.00			ug/L
Iron	388			1.00	381			1.00	1.82		ug/L
Lead	0.500	U		1.00	0.500	U		1.00			ug/L
Manganese	464	E		1.00	457	E		1.00	1.52		ug/L
Naphthalene	0.150	U		1.00	0.150	U		1.00			ug/L
Nickel	10.2			1.00	11.3			1.00	10.23		ug/L
NO2+NO3 as N	3.70			5.00	3.88			5.00	4.75		mg/L
Phenanthrene	0.182	U		1.00	0.182	U		1.00			ug/L
Pyrene	0.016	U		1.00	0.016	U		1.00			ug/L
Radium-226	0.213	U	0.298	1.00	0.719		0.380	1.00		2.1	pCi/L
Radium-228	0.137	U	0.397	1.00	0.228	U	0.244	1.00		0.4	pCi/L
Selenium	10.5			1.00	8.85			1.00	17.05		ug/L
Sulfate	78.8			10.00	79.6			10.00	1.01		mg/L

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13065391 Lab Code: GEN Project: Weldon Spring Validation Date: 10/14/2013

Duplicate: LW-DA10

Sample: LW-DC10

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Thallium	0.450	U		1.00	0.450	U		1.00			ug/L
Thorium-228	-0.162	U	0.398	1.00	-0.0389	U	0.440	1.00		0.4	pCi/L
Thorium-230	0.347	U	0.505	1.00	0.439	U	0.485	1.00		0.3	pCi/L
Thorium-232	-0.00777	U	0.178	1.00	0.201	U	0.303	1.00		1.2	pCi/L
Total Dissolved Solids	739			1.00	734			1.00	0.68		mg/L
Total Organic Carbon	12.4			1.00	12.8			1.00	3.17		mg/L
Uranium	35.3	E		1.00	38.9	E		1.00	9.70		ug/L

Duplicate: MW-4136

Sample: MW-4036

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,2-Dichloroethane	0.300	U		1.00	0.300	U		1.00			ug/L
cis-1,2-Dichloroethene	0.300	U		1.00	0.300	U		1.00			ug/L
NO2+NO3 as N	7.62			10.00	6.90			10.00	9.92		mg/L
Tetrachloroethene	0.300	U		1.00	0.300	U		1.00			ug/L
trans-1,2-Dichloroethene	0.300	U		1.00	0.300	U		1.00			ug/L
Trichloroethene	0.300	U		1.00	0.300	U		1.00			ug/L
Uranium	91.3	E		1.00	116	E		5.00	23.83		ug/L
Vinyl Chloride	0.300	U		1.00	0.300	U		1.00			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13065391

Project: Weldon Spring

Lab Code: GEN

Validation Date: 10/15/2013

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): There was 1 method blank result above the MDL.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.

SAMPLE MANAGEMENT SYSTEM
Non-Compliance Report: Method Blanks

RIN: 13065391 Lab Code: GEN

Project: Weldon Spring

Validation Date: 10/15/2013

Method Blank	Date Analyzed	Method	Analyte	Result	Flag(s)	MDL
1202896908	6/28/2013	EPA 8310	Benzo(k)fluoranthene	0.01	J	0.01

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 13065391Lab Code: GENDate Due: 7/18/2013Matrix: WaterSite Code: WEL01Date Completed: 7/19/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Arsenic	ICP/MS	07/10/2013			OK	OK	OK	114.0	117.0			107.0		118.0
Arsenic	ICP/MS	07/10/2013										109.0		105.0
Arsenic	ICP/MS	07/12/2013			OK	OK	OK	105.0	105.0			111.0		113.0
Barium	ICP/MS	07/10/2013			OK	OK	OK	109.0			6.0	103.0	9.0	102.0
Barium	ICP/MS	07/12/2013			OK	OK	OK	102.0			2.0	103.0	9.0	106.0
Chromium	ICP/MS	07/05/2013			OK	OK	OK	101.0	103.0			105.0		101.0
Chromium	ICP/MS	07/12/2013			OK	OK	OK	108.0	97.3			99.0		105.0
Cobalt	ICP/MS	07/05/2013			OK	OK	OK	101.0	97.8			103.0		101.0
Cobalt	ICP/MS	07/12/2013			OK	OK	OK	107.0	95.0		1.0	99.0		107.0
Iron	ICP/MS	07/05/2013			OK	OK	OK	105.0	107.0		9.0	96.2		101.0
Iron	ICP/MS	07/12/2013			OK	OK	OK	110.0	97.7		3.0	96.0		110.0
Lead	ICP/MS	07/05/2013			OK	OK	OK	99.1	101.0			105.0		106.0
Lead	ICP/MS	07/12/2013			OK	OK	OK	106.0	99.2			100.0		109.0
Manganese	ICP/MS	07/05/2013			OK	OK	OK	104.0	102.0			106.0	11.1	103.0
Manganese	ICP/MS	07/12/2013			OK	OK	OK	108.0	84.9		1.0	101.0		108.0
Nickel	ICP/MS	07/05/2013			OK	OK	OK	104.0	95.8		5.0	104.0		101.0
Nickel	ICP/MS	07/12/2013			OK	OK	OK	111.0	93.2		2.0	100.0		109.0

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 13065391Lab Code: GENDate Due: 7/18/2013Matrix: WaterSite Code: WEL01Date Completed: 7/19/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Selenium	ICP/MS	07/10/2013			OK	OK	OK	115.0	119.0		1.0	102.0		103.0
Selenium	ICP/MS	07/10/2013										108.0		105.0
Selenium	ICP/MS	07/12/2013			OK	OK	OK	107.0	108.0		4.0	107.0		104.0
Thallium	ICP/MS	07/05/2013			OK	OK	OK	90.6	93.7			99.0		98.0
Thallium	ICP/MS	07/12/2013			OK	OK	OK	97.0	93.0			95.0		104.0
Uranium	ICP/MS	07/08/2013			OK	OK	OK	115.0	124.0		2.0	106.0	22.0	103.0
Uranium	ICP/MS	07/11/2013										104.0	8.0	108.0
Uranium	ICP/MS	07/15/2013			OK	OK	OK	115.0	103.0		3.0	102.0		105.0
Uranium	ICP/MS	07/16/2013										105.0		109.0
Uranium	ICP/MS	07/16/2013										103.0		112.0
Uranium	ICP/MS	07/17/2013			OK	OK	OK	98.5	96.0		2.0	100.0		105.0
Uranium	ICP/MS	07/17/2013										103.0		97.0

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13065391

Lab Code: GENDate Due: 7/18/2013Matrix: WaterSite Code: WEL01Date Completed: 7/19/2013

Analyte	Date Analyzed	CALIBRATION			Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R ²	CCV/CCB						
Chemical Oxygen Demand	07/08/2013			OK	OK	OK	106	113		5
Chloride	07/12/2013	0.000	0.9997	OK	OK	OK	98.7			
Chloride	07/13/2013							105		1
Fluoride	07/12/2013	0.000	0.9999	OK	OK	OK	105	93.5		1
Fluoride	07/12/2013							99.9		3
NO ₂ +NO ₃ as N	06/25/2013	-0.012	0.9994	OK	OK	OK	98.9	110		2
NO ₂ +NO ₃ as N	06/25/2013							112		1
Sulfate	07/12/2013	0.000	0.9997	OK	OK	OK	104			
Sulfate	07/13/2013							105		1
Total Dissolved Solids	06/20/2013					OK	95.7			0
Total Organic Carbon	06/21/2013	0.000	0.9999	OK	OK	OK	100	104		5

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 13065391 Lab Code: GEN Date Due: 7/18/2013
 Matrix: Water Site Code: WEL01 Date Completed: 7/19/2013

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate
Blank	Radium-226	06/28/2013	0.213	U				
Blank_Spike	Radium-226	06/28/2013				87.7		
LW-DC10	Radium-226	06/28/2013					93.7	
LW-DC10	Radium-226	06/28/2013						2.53
LW-DA10	Radium-228	07/03/2013			82			
LW-DC10	Radium-228	07/03/2013			91			
MW-2032	Radium-228	07/03/2013			96			
MW-2046	Radium-228	07/03/2013			97			
MW-2047	Radium-228	07/03/2013			100			
MW-2051	Radium-228	07/03/2013			99			
MW-2055	Radium-228	07/03/2013			95			
SP-6301	Radium-228	07/03/2013			102			
LW-DC10	Radium-228	07/03/2013			90			1.53
Blank_Spike	Radium-228	07/03/2013			93	89.1		
Blank	Radium-228	07/03/2013	0.179	U	95			
LW-DA10	Thorium-228	06/25/2013			96			
LW-DC10	Thorium-228	06/25/2013			85			
MW-2032	Thorium-228	06/25/2013			90			
MW-2046	Thorium-228	06/25/2013			78			
MW-2047	Thorium-228	06/25/2013			93			
MW-2051	Thorium-228	06/25/2013			83			
MW-2055	Thorium-228	06/25/2013			78			
SP-6301	Thorium-228	06/25/2013			88			
LW-DC10	Thorium-228	06/25/2013			86			0.72
Blank	Thorium-228	06/25/2013	-0.162	U	73			
LW-DC10	Thorium-230	06/25/2013						0.65
Blank_Spike	Thorium-230	06/25/2013	0.347	U		97.8		
LW-DC10	Thorium-232	06/25/2013						0.16
Blank_Spike	Thorium-232	06/25/2013	-0.008	U		97.8		



Data Review and Validation Report

General Information

Report Number (RIN): 13065434
Sample Event: June 24, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 328282
Analysis: Organics
Validator: Gretchen Baer
Review Date: October 28, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/PRO/S04325, continually updated) “Standard Practice for Validation of Laboratory Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1. All analyses were successfully completed.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
PAH Compounds	LMS-02	SW-846 3510C	SW-846 8310
PCBs	PEP-A-006	SW-846 3535A	SW-846 8082

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
328282001	MW-2051	Benzo(k)fluoranthene	J	LCS recovery < lower limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received one water sample on June 26, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that the sample was listed with the collection date and time. The COC form was complete with no errors or omissions. The bottle for PCB and PAH analyses from location MW-2051 under RIN 13065391 was broken during shipment. This location was re-sampled and submitted for PCB and PAH under this RIN.

Preservation and Holding Times

The sample shipment was received intact with the temperatures inside the iced cooler at 3 °C, which complies with requirements. The sample was received in the correct container type and had been preserved correctly for the requested analyses. The sample was analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL. The reported MDLs for all analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All initial calibration and calibration check standards were prepared from independent sources.

Method SW-846 8082, PCBs

The initial calibration for PCBs was performed using five calibration standards on July 2, 2013. The initial calibration data met the acceptance criteria for all analytes on both gas chromatography columns. Initial and continuing calibration checks were made at the required frequency. All continuing calibration verifications were within the acceptance criteria.

Method SW-846 8310, PAH Compounds

The initial calibration for PAHs was performed using eight calibration standards on July 8, 2013. The initial calibration data met the acceptance criteria for all analytes. Initial and continuing calibration checks were made at the required frequency. All continuing calibration verifications were within the acceptance criteria.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. The method blank results were below the MDL for all target compounds.

PAHs and PCBs Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate spike recoveries are evaluated to identify data quality effects due to such factors as interference or high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. Internal standard recoveries were stable and within acceptance ranges. All sample surrogate recoveries were within the acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spike results met the recovery and precision criteria for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the PQL should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable except for benzo(k)fluoranthene in the LCS duplicate, which was recovered slightly below the laboratory acceptance level; the benzo(k)fluoranthene result is qualified with a "J" flag (estimated).

Chromatography Peak Integration

The integration of analyte peaks was reviewed for PAH and PCB data. All peak integrations, including manual integrations, were satisfactory.

Compound Identification

The mass spectral data were reviewed for each reported organic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers. The analytical report included the MDL and PQL for all analytes and all required supporting documentation.

Electronic Data Deliverable (EDD) File

The EDD file arrived on July 25, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Field Measurements

The pre-sampling purge criteria were met for all wells.

Sampling Protocol

Sample results for this monitoring well met the Category I low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the well was purged and sampled using the low-flow sampling method.

Equipment Blank Assessment

An equipment blank was not collected because all sampling was performed with dedicated equipment or new pump tubing.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the
-

historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.

2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition.

No values from this sampling event were identified as potential outliers. The data for this RIN are acceptable as qualified.



Gretchen Baer

2013.10.28

12:36:09 -06'00'

Report Prepared By: _____

Gretchen Baer
Data Validator

SAMPLE MANAGEMENT SYSTEM
General Data Validation Report

RIN: 13065434 Lab Code: GEN Validator: Gretchen Baer Validation Date: 10/28/2013
Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics
of Samples: 1 Matrix: Water Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13065434

Project: Weldon Spring

Lab Code: GEN

Validation Date: 10/28/2013

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.



U.S. DEPARTMENT OF
ENERGY

Legacy
Management

Data Review and Validation Report

General Information

Report Number (RIN): 13075506
Sample Event: July 9 – august 1, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 330938
Analysis: Metals and Wet Chemistry
Validator: Stephen Donivan
Review Date: January 8, 2014

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Iron	LMM-01	SW-846 3005A	SW-846 6010B
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3005A	SW-846 6020

Data Qualifier Summary

Analytical results were qualified as listed in

Table 1. Refer to the attached validation worksheets and the sections below for an explanation of the data qualifiers applied.

Table 1. Data Qualifiers

Sample Number	Location	Analyte	Flag	Reason
330938034	MW-1017	Dissolved oxygen	J	Calibration check criteria not met
330938036	MW-1018	Dissolved oxygen	J	Calibration check criteria not met
330938038	MW-1019	Dissolved oxygen	J	Calibration check criteria not met
330938040	MW-1021	Dissolved oxygen	J	Calibration check criteria not met
330938046	MW-1044	Dissolved oxygen	J	Calibration check criteria not met
330938054	MW-1050	Dissolved oxygen	J	Calibration check criteria not met

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 67 water samples on August 6, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at 4 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibration of instrument IC7 was performed on April 30, 2013 and of instrument IC8 on August 3, 2013, using six calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration check results within the acceptance criteria. Reporting limit verification checks were made to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range.

Method SW-846 6010B, Iron

Calibrations were performed on August 23, 2013, using three calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on August 27 and 28, 2013, using a two point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Matrix Spike Analysis

Matrix spike (MS) samples are used to measure method performance in the sample matrix. The MS data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike. The spike recoveries met the acceptance criteria of 75 to 125 percent for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for replicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for sulfate data. All analyte peak integrations were acceptable.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on March 18, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

There were no anomalous data identified and the data for this RIN are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2004

Laboratory: GEL Laboratories

RIN: 13075506

Report Date: 01/08/2014

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier		
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers			N	N Below Detect
						Lab	Data		Lab	Data		Lab	Data			
WEL01	MW-4007	N001	08/01/2013	Uranium	0.0039			0.00384	E	FQ	0.00056		FQ	12	0	NA
WEL02	MW-1018	0001	07/29/2013	Iron	43.3			39.7		F	24.2	N	F	19	0	No
WEL02	MW-1046	N001	07/30/2013	Uranium	0.000961			0.0048	E	FQJ	0.0014	B	FQ	38	1	No
WEL02	MW-1048	0001	07/30/2013	Iron	1.77			1.66		F	0.54		F	44	0	No
WEL02	MW-1052	0001	07/30/2013	Iron	0.506			50.6		FQJ	0.617		F	38	0	No
WEL02	SW-1003	N001	07/23/2013	Uranium	0.0191			0.174			0.0248			31	0	No
WEL02	SW-1004	N001	07/23/2013	Uranium	0.025			0.25	B		0.0261	E		32	0	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

Sampling Protocol

Sampling at all monitoring wells met the Category I, II, or III low-flow sampling criteria and results were qualified with an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method. The ground water sample results for the wells listed in Table 3 were qualified with a “Q” flag in the database indicating the data are considered qualitative because of the sampling protocol (either category II or category III).

Table 3. Category II Wells

Well	Category II
MW-1008	X
MW-1009	X
MW-1028	X
MW-1031	X
MW-1046	X
MW-1047	X
MW-1051	X
MW-1052	X
MW-3003	X
MW-3006	X
MW-3024	X
MW-3040	X
MW-4007	X
MW-4040	X
MWD-2	X
MWS-1	X
MWS-2	X

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples were collected from locations MW-1013, MW-1015 and MW-4036. The relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. The duplicate results met the criteria, demonstrating acceptable overall precision.

Field Measurements

The pre-sampling purge criteria were met for all wells with the following exceptions. The Category I turbidity criteria was not met when purging wells MW-1017 and MW-1044. The slightly elevated turbidity was judged not to impact the data quality and the data from these wells were not further qualified.

The dissolved oxygen operational check performed on July 29, 2013 did not meet the acceptance criteria. The dissolved oxygen measurements recorded on that day are qualified with a "J" flag as estimated values.

Stephen Donovan

Stephen E. Donovan

2014.01.08

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Report Prepared By: _____

Stephen Donovan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13075506 Lab Code: GEN Validator: Stephen Donovan Validation Date: 01/08/2014
Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics
of Samples: 67 Matrix: Water Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There were 5 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13075506 Lab Code: GEN Project: Weldon Spring Validation Date: 01/08/2014

Duplicate: MW-1113

Sample: MW-1013

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	3970			1.00	3800			1.00	4.38		ug/L
Sulfate	66.6			10.00	62.3			10.00	6.67		mg/L
Uranium	344			5.00	335			10.00	2.65		ug/L

Duplicate: MW-1115

Sample: MW-1015

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	30.0	U		1.00	30.0	U		1.00			ug/L
Sulfate	105			10.00	105			10.00	0		mg/L
Uranium	147			2.00	151			2.00	2.68		ug/L

Duplicate: MW-4136

Sample: MW-4036

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Uranium	12.1			1.00	12.4			1.00	2.45		ug/L

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13075506 Lab Code: GEN Date Due: 09/03/2013
 Matrix: Water Site Code: WEL01 Date Completed: 09/04/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R ²	CCV	CCB								
Iron	ICP/ES	08/23/2013	0.0000	1.0000	OK	OK	OK	103.0	103.0		2.0	96.0	3.0	109.0
Iron	ICP/ES	08/23/2013			OK	OK	OK	107.0	102.0			98.0		108.0
Uranium	ICP/MS	08/27/2013			OK	OK	OK	103.0	102.0		1.0	102.0	0.1	104.0
Uranium	ICP/MS	08/28/2013			OK	OK	OK	101.0	119.0		7.0	101.0	3.0	101.0
Uranium	ICP/MS	08/28/2013			OK	OK	OK	99.9	103.0		2.0	98.0	4.0	111.0

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13075506 **Lab Code:** GEN **Date Due:** 09/03/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 09/04/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Sulfate	08/13/2013	0.000	0.9997	OK	OK	OK	102.00	107.0		0	
Sulfate	08/17/2013	0.000	0.9999	OK	OK	OK	98.30	106.0		1.00	
Sulfate	08/18/2013							108.0		0	



Data Review and Validation Report

General Information

Report Number (RIN): 13085527
Sample Event: August 5–6, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-45263
Analysis: Metals, Organics, and Wet Chemistry
Validator: Stephen Donovan
Review Date: January 8, 2014

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Iron	LMM-01	SW-846 3005A	SW-846 6010B
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3010A	SW-846 6020
Volatiles	LMV-06	SW-846 5030B	SW-846 8260B

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-45263-4	SP-6301	2,4-Dinitrotoluene	J	Analyte peak resolution
280-45263-12	MW-1006	2,6-Dinitrotoluene	J	Analyte peak resolution

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 26 water samples on August 8, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at at 4.3 °C and 5.8 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

The reported MDLs for all metal, organic, and wet chemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 353.2, Nitrate + Nitrite as N

Calibrations were performed on August 9, 2013, using six calibration standards. The absolute values of the intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the

acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method EPA 300.0, Sulfate

Calibration of instrument IC8 on August 5, 2013, using six calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration check results within the acceptance criteria. Reporting limit verification checks were made to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range.

Method SW-846 6010B, Iron

Calibrations were performed on August 13, 2013, using two calibration standards. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on August 13, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8260B, Volatiles

The volatile compounds requested were 1,2-dichloroethane, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. Initial calibration was performed July 18, 2013, using six calibration standards. The average response factor and associated relative standard deviation met the acceptance criteria for all analytes. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent. The mass spectrometer calibration and resolution was checked at the beginning of each analytical run in accordance with the procedure.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on August 16, 2013, using six calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All detected target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis.

Metals and Wet Chemistry

All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Organics

The method blank results were below the MDL for all target compounds.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Nitroaromatics and Volatiles Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. All surrogate recoveries were within the acceptance ranges with the following exception. The method 8321A surrogate recovery from sample MW-1049 did not meet the acceptance criteria. There were no method 8321A analytes detected in this sample and qualification is not required.

The recovery of the internal standards added to the samples is monitored to measure the purging efficiency. Internal standard recoveries associated with target compounds were stable and within acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike concentration. The spikes met the recovery and precision criteria for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the practical quantitation limit (PQL) should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than the PQL, the range should be no greater than the PQL. The results for all replicates met these criteria, demonstrating acceptable laboratory precision.

Laboratory Control Sample

Laboratory control samples (LCS) were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable.

Detection Limits/Dilutions

Samples were diluted in a consistent and acceptable manner when required. The required detection limits were met for all analytes.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics, sulfate, and volatiles data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20% of the analyte peak height. Sample results associated with analyte peaks that do not meet this criteria are qualified with a "J" flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each reported volatile and nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on August 28, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

None of the results were identified as potentially anomalous.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2004

Laboratory: TestAmerica Denver

RIN: 13085527

Report Date: 01/08/2014

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum	Qualifiers		Historical Minimum	Qualifiers		Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
WEL01	MW-4043	N001	08/06/2013	Nitrate + Nitrite as Nitrogen	0.26			7.02		F	0.445		FQ	20	0	No
WEL02	MW-1002	N001	08/05/2013	2,6-Dinitrotoluene	0.063	J		1.4		F	0.076	J	F	40	1	NA
WEL02	MW-1002	N001	08/05/2013	Sulfate	78			118		F	80		F	41	0	No
WEL02	MW-1005	N001	08/05/2013	Uranium	0.5			1.4		F	0.532		FQ	29	0	No
WEL02	MW-1012	N001	08/05/2013	Sulfate	32			56		FQ	32.7		FQ	30	0	No
WEL02	MW-1032	N001	08/05/2013	Uranium	0.55			2.69		FQ	0.57		FQ	38	0	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

Sampling Protocol

Sample results for all monitor wells met the Category I or II low-flow sampling criteria and were qualified with an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The ground water sample results for the wells listed in Table 3 were qualified with a “Q” flag in the database indicating the data are considered qualitative because of the sampling protocol (Category II).

Table 3. Category II Wells

Well	Category II
MW-1002	X
MW-1005	X
MW-1012	X
MW-1027	X
MW-1030	X
MW-1032	X
MW-1045	X
MW-4043	X

Trip Blank

A trip blank was prepared and analyzed for volatile organics to document contamination attributable to shipping and field handling procedures. There were no target analytes detected in the trip blank.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for duplicate results that are greater than five times the PQL should be less than 20 percent. For results that are less than the PQL, the range should be no greater than the PQL. Duplicate samples were collected from locationa MW-1004 and MW-4043. The duplicate results met the criteria, demonstrating acceptable overall precision.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Stephen E. Donovan

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Report Prepared By: _____

Stephen Donovan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13085527 Lab Code: STD Validator: Stephen Donovan Validation Date: 01/08/2014

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 26 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There was 1 trip/equipment blank evaluated.

There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13085527 Lab Code: STD Project: Weldon Spring Validation Date: 01/08/2014

Duplicate: MW-1104

Sample: MW-1004

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	200			1	190			1	5.13		ug/L
Sulfate	88			5	87			5	1.14		mg/L
Uranium	750			1	780			1	3.92		ug/L

Duplicate: MW-4143

Sample: MW-4043

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,2-Dichloroethane	0.13	U		1	0.13	U		1			ug/L
1,3,5-Trinitrobenzene	0.018	U		1	0.017	U		1			ug/L
1,3-Dinitrobenzene	0.015	U		1	0.014	U		1			ug/L
2,4,6-Trinitrotoluene	0.023	U		1	0.021	U		1			ug/L
2,4-Dinitrotoluene	0.020	U		1	0.019	U		1			ug/L
2,6-Dinitrotoluene	0.023	U		1	0.021	U		1			ug/L
cis-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Nitrate+Nitrite as N	0.26			1	0.30			1	14.29		mg/L
Nitrobenzene	0.034	U		1	0.032	U		1			ug/L
Tetrachloroethene	0.20	U		1	0.20	U		1			ug/L
trans-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Trichloroethene	0.16	U		1	0.16	U		1			ug/L
Uranium	100			1	100			1	0		ug/L
Vinyl Chloride	0.10	U		1	0.10	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13085527

Project: Weldon Spring

Lab Code: STD

Validation Date: 01/08/2014

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: There was 1 surrogate failure.

SAMPLE MANAGEMENT SYSTEM

RIN: 13085527 Lab Code: STD

Non-Compliance Report: Surrogate Recovery

Project: Weldon Spring

Validation Date: 01/08/2014

Ticket	Location	Lab Sample ID	Method	Dilution	Surrogate	Recovery	Lower Limit	Upper Limit
LJS 656	MW-1049	280-45263-24	8321A	1	Nitrobenzene-d5	43.0	48.0	130.0

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13085527 Lab Code: STD Date Due: 09/05/2013
 Matrix: Water Site Code: WEL01 Date Completed: 08/30/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Iron	ICP/ES	08/13/2013			OK	OK	OK	108.0	99.0	108.0	7.0	92.0		107.0
Uranium	ICP/MS	08/13/2013			OK	OK	OK	97.0	96.0		2.0	101.0	3.3	98.0
Uranium	ICP/MS	08/13/2013						100.0	104.0	1.0				

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13085527 **Lab Code:** STD **Date Due:** 09/05/2013
Matrix: Water **Site Code:** WEL01 **Date Completed:** 08/30/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Nitrate+Nitrite as N	08/09/2013	0.000	1.0000	OK	OK	OK	102.00	107.0	107.0	0	
Sulfate	08/20/2013	0.000	1.0000	OK	OK	OK	100.00	92.0	92.0	0	



Data Review and Validation Report

General Information

Report Number (RIN): 13095645
Sample Event: October 1-8, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 335281
Analysis: Metals, Radiochemistry, and Wet Chemistry
Validator: Gretchen Baer
Review Date: February 21, 2014

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1. All analyses were successfully completed.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Chemical Oxygen Demand	WCH-A-010	EPA 410.4	EPA 410.4
Gross Alpha/Beta	GPC-A-001	EPA 900.0, SW-846 9310	EPA 900.0, SW-846 9310
Metals: Hg	LMM-01	SW-846 7470A	SW-846 7470A
Metals: Ag, As, Ba, Cr, Cu, Fe, Mn, Ni, Pb, Se, U, Zn	LMM-02	SW-846 3005A	SW-846 6020
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Radium-226	GPC-A-018	EPA 903.1 Mod	EPA 903.1 Mod
Radium-228	GPC-A-020	EPA 904.0, SW-846 9320 Mod	EPA 904.0, SW-846 9320 Mod
Thorium Isotopes	ASP-A-008	HASL-300, Th-01-RC Mod	HASL-300, Th-01-RC Mod
Total Suspended Solids	WCH-A-034	SM 2540D	SM 2540D

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
335281002	LW-DC12	Barium	J	Matrix spike recovery
335281002	LW-DC12	Gross Beta	J	Less than the Determination Limit
335281002	LW-DC12	Manganese	J	Matrix spike recovery
335281002	LW-DC12	Mercury	J	Matrix spike recovery
335281002	LW-DC12	Radium-226	J	Less than the Determination Limit
335281003	MW-4040	Uranium	J	CCV recovery above limit
335281006	MW-3024	Uranium	J	CCV recovery above limit
335281007	MW-3040	Uranium	J	CCV recovery above limit
335281018	LW-DC12 Dup	Barium	J	Matrix spike recovery
335281018	LW-DC12 Dup	Manganese	J	Matrix spike recovery
335281018	LW-DC12 Dup	Mercury	J	Matrix spike recovery
335281018	LW-DC12 Dup	Radium-226	J	Less than the Determination Limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 24 water samples on October 10, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at 5 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

For radiochemical analytes (those measured by radiometric counting) the MDL and PQL are not applicable, and these results are evaluated using the minimum detectable concentration (MDC), Decision Level Concentration (DLC), and Determination Limit (DL). The MDC is a measure of radiochemical method performance and was calculated and reported as specified in *Quality Systems for Analytical Services*. The DLC is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, and is estimated as 3 times the one-sigma total propagated uncertainty. Results that are greater than the MDC, but less than the DLC are qualified with a “U” flag (not detected). The DL for radiochemical results is the lowest concentration that can be reliably measured, and is

defined as 3 times the MDC. Results not previously “U” qualified that are less than the DL are qualified with a “J” flag as estimated values.

The reported MDLs for all metal, organic, and wet chemical analytes; and MDCs for radiochemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All initial calibration and calibration check standards were prepared from independent sources.

Method EPA 353.2, Nitrate + Nitrite as N

The initial calibrations were performed using five calibration standards on October 14, 2013. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method EPA 410.4, Chemical Oxygen Demand

The initial calibration was performed using five calibration standards on October 16, 2013. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method SM 2540D, Total Suspended Solids

There is no initial or continuing calibration requirement associated with the determination of total dissolved solids.

Method SW-846 6020, Metals

Calibrations were performed on October 21 and November 5-7, 2013, using two calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. The calibration checks met the acceptance criteria with the exception of one check for uranium, which was recovered slightly above the limit at 110.2 percent. All associated uranium results above the MDL are qualified with a “J” flag as estimated values. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 7470A, Mercury

Calibration was performed on October 29, 2013, using two calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the

intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range.

Radiochemical Analysis

Thorium Isotopes

Alpha spectrometry calibrations and instrument backgrounds were performed within a month prior to sample analysis. Calibration standards were counted to obtain a minimum of 10,000 counts per peak. Daily instrument checks met the acceptance criteria. The tracer recoveries met the acceptance criteria of 30 to 110 percent for all samples. The full width at half maximum (FWHM) was reviewed to evaluate the spectral resolution. For some samples, the tracer FWHM exceeded 100 kiloelectron volts (keV), which is expected for isotopes such as thorium-229 with alpha emissions at multiple energies. These tracer peaks did not appear to compromise the data by contributing significantly to the thorium-230 region of interest. All internal standard peaks were within 50 keV of the expected position. The regions of interest (ROIs) for analyte peaks were reviewed. Manual integrations were performed and all ROIs were satisfactory. Results were corrected for tracer impurities.

Radium-226

Emanation cell plateau voltage determinations and cell efficiency calibrations were performed within a year previous to sample analysis.

Gross Alpha/Beta

Plateau calibrations were performed more than one year previous to the sample analysis. Alpha and beta attenuation calibrations were performed within a year previous to sample analysis, covering a range of 1 to 109 milligrams (mg). All standards were counted to a minimum of 10,000 counts. All calibration and background checks met acceptance criteria. The residual mass was less than 100 mg for all samples.

Radium-228

Plateau voltage determinations and detector efficiency calibrations were performed more than one year previous to the sample analysis. Daily instrument checks met the acceptance criteria. The chemical recoveries met the acceptance criteria of 40 to 110 percent for all samples.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the PQLs for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a "U" flag (not detected) when the sample result is greater than the MDL but less than 5 times the blank concentration. The radiochemistry method blank results were less than the DLC for all analytes.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples were analyzed at the required frequency to verify the instrumental interference and background correction factors. All check sample results met the acceptance criteria.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not usually evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spike results met the recovery and precision criteria for all analytes evaluated with the following exceptions. The spike recovery for mercury was below 30 percent. Historically, spike recoveries are low and mercury is not detected at this location (LW-DC12); the affected results are qualified with a "J" flag (estimated). Also at location LW-DC12 (and the associated field duplicate), the concentration of barium and manganese in the unspiked sample was greater than 4 times the spike concentration; however, in this case, the unspiked result was approximately 10 times the spike result and the spike recoveries were significantly outside the acceptance criteria at 10 and 133 percent for barium and -19 and 160 percent for manganese. The associated sample results are qualified with a "J" flag as estimated values.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for non-radiochemical replicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. All replicate results met these criteria, demonstrating acceptable precision. For the total suspended solids analysis, laboratory control samples (LCSs) were analyzed in duplicate in lieu of replicates because of limited sample volume provided to the laboratory.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers. The analytical report included the MDL (MDC for radiochemistry) and PQL for all analytes and all required supporting documentation.

Electronic Data Deliverable (EDD) File

The EDD file arrived on November 8, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Field Measurements

The pre-sampling purge criteria were met for all wells. A parameter for dissolved oxygen was slightly outside of range for the instrument check on October 3, 2013. All previous and subsequent parameters were within range; no qualification is necessary.

Sampling Protocol

Sample results for all monitoring wells met the Category I or II low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The groundwater sample results for wells MW-3003, MW-3006, MW-3024, MW-3037, MW-3040, MW-4007, MW-4040, MW-4043, MWD-2, MWS-1, and MWS-2 were further qualified with a "Q" flag in the database indicating the data are considered qualitative because these are Category II wells.

Equipment Blank Assessment

An equipment blank was not collected because all sampling was performed with dedicated equipment or new pump tubing.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples were collected from locations LW-DC12 and MW-4042. For non-radiochemical measurements, the relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. All duplicate results met these criteria, demonstrating acceptable precision with the following

exception. The manganese duplicate results from location LW-DC12 did not meet the acceptance criteria. The manganese results have been previously qualified with a “J” flag (estimated).

Outliers Report

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition.

One result was identified as potentially anomalous. The selenium result for location LW-DC12 had a concentration higher than previously observed. Recent results for selenium indicate upward trending at this location. Location LW-DC12 was sampled in duplicate with reproducible selenium results, indicating that sampling and analytical errors are unlikely. The data for this RIN are acceptable as qualified.



Gretchen Baer
2014.02.21 13:54:52 -07'00'

Report Prepared By: _____

Gretchen Baer
Data Validator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2003

Laboratory:

RIN: 13095645

Report Date: 2/21/2014

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum	Qualifiers		Historical Minimum	Qualifiers		Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
WEL01	LW-DC12	N001	10/08/2013	Radium-228	0.292	U		1.26			0.51	J	J	30	14	No
WEL01	LW-DC12	N001	10/08/2013	Selenium	0.009200			0.00665			0.00048	U		30	13	Yes
WEL01	MW-3040	N001	10/03/2013	NO2+NO3 as N	75.2		FQ	150		FQJ	80.3		FQ	19	0	No
WEL01	MW-4036	N001	10/03/2013	NO2+NO3 as N	53.9		F	47		F	0.0031	U	F	25	1	No
WEL01	MW-4043	N001	10/03/2013	NO2+NO3 as N	0.194		FQ	7.02		F	0.26		FQ	22	0	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

SAMPLE MANAGEMENT SYSTEM
General Data Validation Report

RIN: 13095645 Lab Code: GEN Validator: Gretchen Baer Validation Date: 2/21/2014
Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics
of Samples: 24 Matrix: Water Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

There are 0 detection limit failures.

There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 13095645 Lab Code: GEN Project: Weldon Spring Validation Date: 2/21/2014

Duplicate: LW-DC99

Sample: LW-DC12

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
ALPHA	1.08	U	2.52	1.00	-0.108	U	2.55	1.00		0.6	pCi/L
Arsenic	3.53	B		1.00	2.2	B		1.00			ug/L
Barium	422			10.00	391			5.00	7.63		ug/L
BETA	7.71		2.13	1.00	9.23		2.25	1.00		1.0	pCi/L
Chemical Oxygen Demand	20.8			1.00	22.8			1.00			mg/L
Chromium	2.00	U		1.00	2.00	U		1.00			ug/L
Copper	6.62			1.00	4.95			1.00	28.87		ug/L
Iron	305			1.00	327			1.00	6.96		ug/L
Lead	0.500	U		1.00	0.500	U		1.00			ug/L
Manganese	560			10.00	451			5.00	21.56		ug/L
Mercury	0.067	UN		1.00	0.067	UN		1.00			ug/L
Nickel	6.82	B		1.00	7.51	B		1.00	9.63		ug/L
Radium-226	0.521		0.300	1.00	0.708		0.366	1.00		0.8	pCi/L
Radium-228	0.292	U	0.317	1.00	0.443	U	0.321	1.00		0.7	pCi/L
Selenium	9.2			1.00	8.73			1.00	5.24		ug/L
Silver	0.200	U		1.00	0.200	U		1.00			ug/L
Thorium-228	-0.0366	U	0.0959	1.00	-0.00199	U	0.081	1.00		0.5	pCi/L
Thorium-230	0.170	U	0.183	1.00	0.228	U	0.186	1.00		0.4	pCi/L
Thorium-232	0.00938	U	0.0752	1.00	0.0424	U	0.0985	1.00		0.5	pCi/L
Total Suspended Solids	0.558	U		1.00	1.11	U		1.00			mg/L
Uranium	4.71			1.00	4.59			1.00	2.58		ug/L
Zinc	19.1			1.00	14.6	B		1.00			ug/L

Duplicate: MW-4142

Sample: MW-4042

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
NO2+NO3 as N	0.017	U		1.00	0.017	U		1.00			mg/L
Uranium	0.364			1.00	0.481			1.00	27.69		ug/L

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13095645Lab Code: GENDate Due: 11/7/2013Matrix: WaterSite Code: WEL01Date Completed: 11/8/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Mercury	CVAA	10/29/2013						21.5						
Mercury	CVAA	10/29/2013	-0.0600	0.9999	OK	OK	OK	102.0	19.2	19.6	2.0		81.0	
Arsenic	ICP/MS	11/06/2013			OK	OK	OK	107.0	94.1			106.0	98.0	
Arsenic	ICP/MS	11/06/2013			OK	OK	OK	101.0	108.0			108.0	102.0	
Barium	ICP/MS	11/06/2013			OK	OK	OK	105.0	10.0		17.0	99.0	2.0	105.0
Barium	ICP/MS	11/06/2013			OK	OK	OK	89.8	133.0		3.0		3.0	
Chromium	ICP/MS	11/06/2013			OK	OK	OK	87.7	94.7					
Chromium	ICP/MS	11/06/2013			OK	OK	OK	97.8	89.1			95.0	99.0	
Copper	ICP/MS	11/06/2013			OK	OK	OK	98.4	94.7		4.0	90.0	108.0	
Copper	ICP/MS	11/07/2013			OK	OK	OK	105.0	98.6			94.0	97.0	
Iron	ICP/MS	11/06/2013			OK	OK	OK	94.2	97.9		7.0	94.0	102.0	
Iron	ICP/MS	11/06/2013			OK	OK	OK	95.4	94.3		5.0	92.0	105.0	
Lead	ICP/MS	11/06/2013			OK	OK	OK	92.6	94.7					
Lead	ICP/MS	11/06/2013			OK	OK	OK	102.0	86.1			94.0	100.0	
Manganese	ICP/MS	11/06/2013			OK	OK	OK	88.0	160.0		6.0		3.8	
Manganese	ICP/MS	11/06/2013			OK	OK	OK	96.1	-19.4		18.0	95.0	9.3	102.0
Nickel	ICP/MS	11/06/2013			OK	OK	OK	97.8	94.0		6.0	93.0	102.0	

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13095645Lab Code: GENDate Due: 11/7/2013Matrix: WaterSite Code: WEL01Date Completed: 11/8/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Nickel	ICP/MS	11/06/2013			OK	OK	OK	99.0	94.9		4.0	90.0		103.0
Selenium	ICP/MS	11/06/2013			OK	OK	OK	107.0	111.0		10.0			
Selenium	ICP/MS	11/06/2013			OK	OK	OK	111.0	104.0		12.0	113.0		106.0
Silver	ICP/MS	11/06/2013			OK	OK	OK	100.0	104.0					
Silver	ICP/MS	11/06/2013			OK	OK	OK	112.0	100.0			94.0		105.0
Uranium	ICP/MS	11/06/2013			OK	OK	OK	92.0	103.0		3.0	100.0	7.6	104.0
Uranium	ICP/MS	11/06/2013			OK	OK	OK	104.0	92.7		5.0	102.0	4.5	106.0
Uranium	ICP/MS	11/05/2013			110.2	OK	OK	110.0	107.0		3.0	99.0	2.0	108.0
Uranium	ICP/MS	10/21/2013			OK	OK	OK	108.0	112.0		13.0	104.0	5.0	105.0
Zinc	ICP/MS	11/07/2013			OK	OK	OK	113.0	106.0		7.0	87.0		98.0
Zinc	ICP/MS	11/06/2013			OK	OK	OK	112.0	93.7		4.0	96.0		103.0

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13095645

Lab Code: GENDate Due: 11/7/2013Matrix: WaterSite Code: WEL01Date Completed: 11/8/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Chemical Oxygen Demand	10/16/2013	3.200	0.9999	OK	OK	OK	101.00	102.0		0	
NO2+NO3 as N	10/14/2013	-0.008	0.9958	OK	OK	OK	106.00	104.0		0	
NO2+NO3 as N	10/14/2013							102.0			
Total Suspended Solids	10/11/2013					OK	101.00				

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 13085645 Lab Code: GEN Date Due: 11/7/2013
 Matrix: Water Site Code: WEL01 Date Completed: 11/8/2013

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate
Blank_Spike	ALPHA	10/16/2013				91.30		
LW-DC12	ALPHA	10/16/2013					92.9	
LW-DC12	ALPHA	10/27/2013						0.74
Blank_Spike	BETA	10/16/2013				109.00		
LW-DC12	BETA	10/16/2013					105.0	
LW-DC12	BETA	10/27/2013						1.48
Blank	Gross Alpha	10/27/2013	-0.1440	U				
Blank	Gross Beta	10/27/2013	-0.4480	U				
LW-DC12	Radium-226	10/29/2013						2.87
Blank_Spike	Radium-226	10/29/2013				95.90		
LW-DC12	Radium-226	10/29/2013					85.1	
Blank	Radium-226	10/29/2013	0.3130	U				
LW-DC12	Radium-228	11/05/2013			98.0			
LW-DC99	Radium-228	11/05/2013			87.0			
LW-DC12	Radium-228	11/05/2013			97.0			0.68
Blank_Spike	Radium-228	11/05/2013			102.0	95.50		
Blank	Radium-228	11/05/2013	0.2650	U	102.0			
LW-DC12	Thorium-228	10/15/2013			82.0			
LW-DC99	Thorium-228	10/15/2013			90.0			
LW-DC12	Thorium-228	10/15/2013			83.0			0.73
Blank	Thorium-228	10/15/2013	0.1210	U	82.0			
LW-DC12	Thorium-230	10/15/2013						1.45
Blank_Spike	Thorium-230	10/15/2013				97.00		
Blank	Thorium-230	10/15/2013	0.0383	U				
LW-DC12	Thorium-232	10/15/2013						0
Blank	Thorium-232	10/15/2013	0.0624	U				



Data Review and Validation Report

General Information

Report Number (RIN): 13105683
Sample Event: October 21–23, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-48359
Analysis: Metals, Organics, and Wet Chemistry
Validator: Stephen Donivan
Review Date: February 28, 2014

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Iron	LMM-01	SW-846 3010A	SW-846 6010B
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3010A	SW-846 6020

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-48359-2	MW-1006	2,4-Dinitrotoluene	J	Analyte peak resolution
280-48359-2	MW-1006	2,6-Dinitrotoluene	J	Analyte peak resolution

Sample Number	Location	Analyte(s)	Flag	Reason
280-48359-11	MW-2012	2,4-Dinitrotoluene	J	Analyte peak resolution
280-48359-15	MW-2050	2,4-Dinitrotoluene	J	Analyte peak resolution
280-48359-16	MW-2052	2,4-Dinitrotoluene	J	Analyte peak resolution
280-48359-16	MW-2052	2,6-Dinitrotoluene	J	Analyte peak resolution
280-48359-18	MW-2054	Specific Conductance	R	Equipment malfunction
280-48359-21	MW-4031	Nitrate+Nitrite as N	R	Dilution error
280-48359-22	MW-4039	1,3-Dinitrobenzene	J	Surrogate recovery
280-48359-22	MW-4039	2,4-Dinitrotoluene	J	Surrogate recovery
280-48359-22	MW-4039	2,6-Dinitrotoluene	J	Surrogate recovery
280-48359-22	MW-4039	Nitrobenzene	J	Surrogate recovery
280-48359-22	MW-4039	1,3,5-Trinitrobenzene	J	Surrogate recovery
280-48359-22	MW-4039	2,4,6-Trinitrobenzene	J	Surrogate recovery

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 23 water samples on October 24, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced coolers of 0.5 °C and 2.4 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

The reported MDLs for all metal, organic, and wet chemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument

calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibrations were performed using six calibration standards on October 14, 2013. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration check results within the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method EPA 353.2, Nitrate + Nitrite as N

Calibrations were performed on November 6, 2013, using six calibration standards. The absolute values of the intercepts were less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. A reporting limit verification check was made to verify the linearity of the calibration curve near the practical quantitation limit and all results were acceptable.

Method SW-846 6010B, Iron

Calibrations were performed on October 29, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on October 29, 2013, using a single point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on November 4, 2013, using seven calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than three times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis.

Metals and Wet Chemistry

All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Organics

The method blank results were below the MDL for all target compounds.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Nitroaromatics Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards.

The surrogate recovery for all samples was within the acceptance range with the exception of sample MW-4039. The nitroaromatic results for this sample are qualified with a “J” flag as estimated values.

The recovery of the internal standards added to the samples is monitored to measure instrument performance. Internal standard recoveries associated with target compounds were stable and within acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike concentration. The spikes met the recovery and precision criteria for all analytes evaluated.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the practical quantitation limit (PQL) should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than the PQL, the range should be no greater than the PQL. The results for all replicates met these criteria, demonstrating acceptable laboratory precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable.

Detection Limits/Dilutions

Samples were diluted in a consistent and acceptable manner when required. The required detection limits were met for all analytes.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics and sulfate data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20% of the analyte peak height. Sample results associated with analyte peaks that do not meet this criteria are qualified with a “J” flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each reported nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on November 18, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

The nitrate + nitrite as N result for location MW-4031 was identified as an anomalous value. Review of the associated data indicated that the analysis was performed twice at different dilutions with values of 180 mg/L and the reported value of 300 mg/L. The field duplicate sample for this location had a result of 180 mg/L. The reported value of 300 mg/L is qualified with an "R" flag as rejected because of the likelihood of a dilution error.

The specific conductance value from location MW-2054 was identified as a potential outlier. The specific conductance measurement was made using an un-calibrated hand-held meter. The specific conductance result for this location is qualified with an "R" flag as rejected.

Sampling Protocol

Sample results for all monitoring wells met the Category I or II low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The groundwater sample results for wells MW-1006, MW-1032, MW-2014, MW-2040, MW-2050, and MW-4039 were further qualified with a "Q" flag in the database indicating the data are considered qualitative because these are Category II wells.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for duplicate results that are greater than five times the PQL should be

less than 20 percent. For results that are less than the PQL, the range should be no greater than the PQL. Duplicate samples were collected from locations MW-1049 and MW-4031. The duplicate results met the criteria, demonstrating acceptable overall precision, with the following exception. The nitrate + nitrite as N duplicate results for location MW-4031 did not meet the acceptance criteria. The sample value of 300 mg/L has been qualified with an "R" flag as rejected because of the likelihood of a dilution error.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Stephen Donovan

Stephen E. Donovan

2014.03.05

08:01:01 -07'00'

Report Prepared By: _____
Stephen Donovan
Laboratory Coordinator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2004

Laboratory: TestAmerica Denver

RIN: 13105683

Report Date: 03/05/2014

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
WEL01	MW-2038	N001	10/22/2013	Nitrate + Nitrite as Nitrogen	720		F	702		F	0.0031	U	F	12	1	NA
WEL01	MW-2050	N001	10/22/2013	1,3,5-Trinitrobenzene	5.6		FQ	14		FJ	5.8		FQ	21	0	No
WEL01	MW-2053	N001	10/23/2013	1,3,5-Trinitrobenzene	13		F	12		F	0.016	U	F	23	1	No
WEL01	MW-4013	N001	10/21/2013	Nitrate + Nitrite as Nitrogen	120		F	101		F	0.0031	U	F	12	1	NA
WEL01	MW-4031	N001	10/21/2013	Nitrate + Nitrite as Nitrogen	300		F	220		F	118		FJ	12	0	Yes
WEL02	MW-1032	N001	10/21/2013	Uranium	0.53		FQ	2.69		FQ	0.55		FQ	39	0	No

Data Validation Outliers Report - Field Parameters Only

Comparison: All historical Data Beginning 01/01/2004

Laboratory: Field Measurements

RIN: 13105683

Report Date: 03/05/2014

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
WEL01	MW-2054	N001	10/23/2013	Specific Conductance	10		F	843		F	583		F	21	0	Yes
WEL01	MW-4013	N001	10/21/2013	Dissolved Oxygen	6.46		F	9.63		F	6.64		F	19	0	No
WEL02	MW-1049	N001	10/21/2013	Field Ferrous Iron	1.05		F	48.5		F	1.1		F	38	0	NA

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13105683 Lab Code: STD Validator: Stephen Donovan Validation Date: 02/28/2014

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 23 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody		
Present: <u>OK</u>	Signed: <u>OK</u>	Dated: <u>OK</u>

Sample		
Integrity: <u>OK</u>	Preservation: <u>OK</u>	Temperature: <u>OK</u>

Select Quality Parameters	
<input checked="" type="checkbox"/> Holding Times	
<input checked="" type="checkbox"/> Detection Limits	
<input type="checkbox"/> Field/Trip Blanks	
<input checked="" type="checkbox"/> Field Duplicates	

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13105683 Lab Code: STD Project: Weldon Spring Validation Date: 02/28/2014

Duplicate: MW-1149

Sample: MW-1049

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,3,5-Trinitrobenzene	0.017	U		1	0.017	U		1			ug/L
1,3-Dinitrobenzene	0.014	U		1	0.014	U		1			ug/L
2,4,6-Trinitrotoluene	0.022	U		1	0.022	U		1			ug/L
2,4-Dinitrotoluene	0.019	U		1	0.019	U		1			ug/L
2,6-Dinitrotoluene	0.022	U		1	0.022	U		1			ug/L
Iron	50000			1	48000			1	4.08		ug/L
Nitrobenzene	0.033	U		1	0.033	U		1			ug/L
Sulfate	0.23	U		1	0.23	U		1			mg/L
Uranium	0.050	U		1	0.050	U		1			ug/L

Duplicate: MW-4031

Sample: MW-4131

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Nitrate+Nitrite as N	180			20	300			40	50.00		mg/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13105683

Project: Weldon Spring

Lab Code: STD

Validation Date: 02/28/2014

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: There was 1 surrogate failure.

SAMPLE MANAGEMENT SYSTEM

Non-Compliance Report: Surrogate Recovery

RIN: 13105683 Lab Code: STD

Project: Weidon Spring

Validation Date: 02/28/2014

Ticket	Location	Lab Sample ID	Method	Dilution	Surrogate	Recovery	Lower Limit	Upper Limit
LLQ 819	MW-4039	280-48359-22	8321A	1	Nitrobenzene-d5	40.0	48.0	130.0

SAMPLE MANAGEMENT SYSTEM
Metals Data Validation Worksheet

RIN: 13105683 Lab Code: STD Date Due: 11/21/2013
 Matrix: Water Site Code: WEL01 Date Completed: 11/20/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Iron	ICP/ES	10/29/2013			OK	OK	OK	98.0			1.0	92.0	1.8	97.0
Uranium	ICP/MS	10/29/2013			OK	OK	OK	104.0	95.0	98.0	2.0	93.0		94.0
Uranium	ICP/MS	10/29/2013							97.0					

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13105683

Lab Code: STD

Date Due: 11/21/2013

Matrix: Water

Site Code: WEL01

Date Completed: 11/20/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Nitrate+Nitrite as N	11/06/2013	0.000	1.0000	OK	OK	OK	105.00	61.0	72.0	4.00	
Nitrate+Nitrite as N	11/06/2013						106.00			1.00	
Nitrate+Nitrite as N	11/06/2013						108.00			1.00	
Nitrate+Nitrite as N	11/06/2013						107.00				
Sulfate	11/11/2013	0.000	1.0000	OK	OK	OK	99.00	97.0	99.0	2.00	
Sulfate	11/11/2013						99.00			0	



Data Review and Validation Report

General Information

Report Number (RIN): 13105699
Sample Event: October 24 - 29, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 336585
Analysis: Metals and Wet Chemistry
Validator: Alison Kuhlman
Review Date: January 29, 2014

This validation was performed according to the Environmental Procedures Catalog, (LMS/POL/S04325, continually updated) "Standard Practice for Validation of Environmental Data." The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Table with 4 columns: Analyte, Line Item Code, Prep Method, Analytical Method. Rows include Iron, Sulfate, and Uranium.

Data Qualifier Summary

Analytical results were qualified as listed in

Table 1. Refer to the attached validation worksheets and the sections below for an explanation of the data qualifiers applied.

Table 1. Data Qualifiers

Table with 5 columns: Sample Number, Location, Analyte, Flag, Reason

336585020	MW-1047	pH	J	Calibration check criteria not met
336585021	MW-1048	pH	J	Calibration check criteria not met
336585022	MW-1051	pH	J	Calibration check criteria not met
336585023	MW-1052	pH	J	Calibration check criteria not met
336585024	MW-1048	pH	J	Calibration check criteria not met
336585025	MW-1051	pH	J	Calibration check criteria not met
336585026	MW-1052	pH	J	Calibration check criteria not met
336585029	MW-1028	pH	J	Calibration check criteria not met
336585030	MW-1028	pH	J	Calibration check criteria not met
336585037	SW-1004	Uranium	J	% difference for serial dilution > 10%
336585031	SW-1004 Duplicate	Uranium	J	% difference for serial dilution > 10%

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 37 water samples on October 31, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions. The air waybill number was listed in the receiving documentation.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler for general chemical analysis at 2 °C and at ambient temperature of 18 °C for metals, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibration of instrument IC6 was performed on July 18, 2013 and of instrument IC7 on August 19, 2013, using six calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration check results within the acceptance criteria. Reporting limit verification checks were made to verify the linearity of the calibration curve near the practical quantitation limit and all results were within the acceptance range.

Method SW-846 6010B, Iron

Calibrations were performed on November 18, 2013 and November 20, 2013, using three calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the practical quantitation limit. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on November 24, 2013 and November 27, 2013, using a two point calibration. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the practical quantitation limits for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a "U" flag (not detected) when the sample result is greater than the MDL but less than five times the blank concentration.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than four times the spike. The spike recoveries met the acceptance criteria for all analytes evaluated.

For sulfate, the spikes were prepared from diluted samples and thus not used to qualify data. No further action is required.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for replicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable, with the following exception.

For uranium, the undiluted sample was greater than 50 times the MDL and the serial dilution percent difference was greater than 10. The sample result and its duplicate are qualified with “J” flags as estimated values.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for sulfate data. All analyte peak integrations were acceptable.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on December 2, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

The iron result for location MW-1048 was identified as a statistical outlier. Review of these data did not identify any errors and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2004

Laboratory:

RIN: 13105699

Report Date: 1/29/2014

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier		
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers			N	N Below Detect
						Lab	Data		Lab	Data		Lab	Data			
WEL02	MW-1048	0001	10/29/2013	Iron	1.910000			1.77		F	0.54		F	45	0	Yes
WEL02	MW-1048	N001	10/29/2013	Sulfate	35.7			79.2	H	FJ	39.7		F	45	0	No
WEL02	MW-1048	N001	10/29/2013	Uranium	0.085600	E		0.664	E	FJ	0.171		F	45	0	No

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

Sampling Protocol

Sampling at all monitoring wells met the Category I, II, or III low-flow sampling criteria and results were qualified with an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method. The ground water sample results for the wells listed in Table 3 were qualified with a “Q” flag in the database indicating the data are considered qualitative because of the sampling protocol (either category II or category III).

Table 3. Category II Wells

Well	Category II	Category III
MW-1007	X	
MW-1008	X	
MW-1009	X	
MW-1028	X	
MW-1031	X	
MW-1046	X	
MW-1047	X	
MW-1051	X	
MW-1052	X	

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples were collected from locations MW-1013 and SW-1004. The relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. The duplicate results met the criteria, demonstrating acceptable overall precision.

Field Measurements

The pre-sampling purge criteria were met for all wells.

The pH check performed on October 29, 2013 did not meet the acceptance criteria. The pH measurements recorded on that day are qualified with a “J” flag as estimated values.

Report Prepared By: *Alison Kuhlman* Alison E. Kuhlman
2014.01.31 09:32:51 -07'00'
Alison Kuhlman
Data Validator

Stephen Donovan
Report Reviewed By: Stephen E. Donovan
2014.01.30
10:49:53 -07'00'
Stephen Donovan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13105699 **Lab Code:** GEN **Validator:** Alison Kuhlman **Validation Date:** 1/29/2014
Project: Weldon Spring **Analysis Type:** Metals General Chem Rad Organics
of Samples: 37 **Matrix:** Water **Requested Analysis Completed:** Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

Page 1 of 1

RIN: 13105699 **Lab Code:** GEN **Project:** Weldon Spring **Validation Date:** 1/29/2014

Duplicate: MW-1113

Sample: MW-1013

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Iron	3610			1.00	3480			1.00	3.67		ug/L
Sulfate	60.3			5.00	61.4			10.00	1.81		mg/L
Uranium	289	E		10.00	303	E		10.00	4.73		ug/L

Duplicate: SW-1104

Sample: SW-1004

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Sulfate	33.4			5.00	33.1			5.00	0.90		mg/L
Uranium	64.8	E		1.00	69.2	E		1.00	6.57		ug/L



Data Review and Validation Report

General Information

Report Number (RIN): 13115774
Sample Event: December 2-11, 2013
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 339202
Analysis: Metals, Organics, Radiochemistry, and Wet Chemistry
Validator: Gretchen Baer
Review Date: February 28, 2014

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/PRO/S04325, continually updated) “Standard Practice for Validation of Laboratory Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1. All analyses were successfully completed.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Chemical Oxygen Demand	WCH-A-010	EPA 410.4	EPA 410.4
Chloride, Fluoride, Sulfate	MIS-A-045	EPA 300.0	EPA 300.0
Metals: As, Ba, Co, Cr, Fe, Mn, Ni, Pb, Se, Tl, U	LMM-02	SW-846 3005A	SW-846 6020
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
PAH Compounds	LMS-02	SW-846 3510C	SW-846 8310
PCBs	PEP-A-006	SW-846 3535A	SW-846 8082
Radium-226	GPC-A-018	EPA 903.1 Mod	EPA 903.1 Mod
Radium-228	GPC-A-020	EPA 904.0 SW-846 9320 Mod	EPA 904.0 SW-846 9320 Mod
Thorium Isotopes	ASP-A-008	HASL-300, Th-01-RC Mod	HASL-300, Th-01-RC Mod
Total Dissolved Solids	WCH-A-033	SM 2540C	SM 2540C
Total Organic Carbon, TOC	WCH-B-025	SM 5310D	SM 5310D
Volatiles (VOAs)	LMV-06	SW-846 8260B	SW-846 8260B

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
339202-001	MW-2051	Radium-226	J	Less than the Determination Limit
339202-001	MW-2051	Radium-228	J	Less than the Determination Limit
339202-002	LW-DC10	Benzo(g,h,i)perylene	U	False positive
339202-002	LW-DC10	Dibenz(a,h)anthracene	U	False positive
339202-002	LW-DC10	Indeno(1,2,3-cd)pyrene	U	False positive
339202-002	LW-DC10	Manganese	J	Serial dilution result
339202-002	LW-DC10	Radium-226	J	Less than the Determination Limit
339202-003	MW-2032	Radium-226	J	Less than the Determination Limit
339202-005	MW-2047	Radium-228	J	Less than the Determination Limit
339202-006	MW-2055	Radium-226	J	Less than the Determination Limit
339202-007	MW-2046	Radium-226	J	Less than the Determination Limit
339202-008	LW-DC10 Dup	Manganese	J	Serial dilution result
339202-008	LW-DC10 Dup	Radium-226	J	Less than the Determination Limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 27 water samples on December 12, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions. One or two volatile organics vials each for samples MW-4029 and SP-6301 were received broken. There was sufficient sample volume in the remaining vial or vials to complete the analysis.

Preservation and Holding Times

The sample shipment was received intact with the temperatures inside the iced coolers between 2 °C and 3 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

For radiochemical analytes (those measured by radiometric counting) the MDL and PQL are not applicable, and these results are evaluated using the minimum detectable concentration (MDC), Decision Level Concentration (DLC), and Determination Limit (DL). The MDC is a measure of radiochemical method performance and was calculated and reported as specified in *Quality Systems for Analytical Services*. The DLC is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, and is estimated as 3 times the one-sigma total propagated uncertainty. Results that are greater than the MDC, but less than the DLC are qualified with a “U” flag (not detected). The DL for radiochemical results is the lowest concentration that can be reliably measured, and is defined as 3 times the MDC. Results not previously “U” qualified that are less than the DL are qualified with a “J” flag as estimated values.

The reported MDLs for all metal, organic, and wet chemical analytes; and MDCs for radiochemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All initial calibration and calibration check standards were prepared from independent sources.

Method EPA 300.0A, Chloride, Fluoride, Sulfate

The initial calibrations were performed using six calibration standards on August 19, 2013. The correlation coefficient values were greater than 0.995 and intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method EPA 353.2, Nitrate + Nitrite as N

The initial calibrations were performed using six calibration standards on December 16, 2013, resulting in calibration curve correlation coefficient values greater than 0.995. The absolute value of the intercept of the calibration curve was less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method EPA 410.4, Chemical Oxygen Demand

The initial calibrations were performed using four calibration standards on January 8, 2014. The correlation coefficient values were greater than 0.995 and intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method SM 2540 C, Total Dissolved Solids

There is no initial or continuing calibration requirement associated with the determination of total dissolved solids.

Method SM 5310 D, Total Organic Carbon

The initial calibrations were performed using five calibration standards on December 13, 2013, resulting in calibration curve correlation coefficient values greater than 0.995. The absolute value of the intercept of the calibration curve was less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria.

Method SW-846 6020, Metals

Calibrations were performed January 6-14, 2013, using two calibration standards. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 8082, PCBs

The initial calibration for PCBs was performed using five calibration standards on December 13, 2013. The initial calibration data met the acceptance criteria for all analytes on both gas chromatography columns. Initial and continuing calibration checks were made at the required frequency. All checks met the acceptance criteria with some exceptions. Some Aroclor-1016 peaks (column 1) were slightly above the range; however, the average concentration of the five quantified peaks met the acceptance criteria and no results above the MDL were associated with these checks. PCBs were not detected in any field sample.

Method SW-846 8260B, Volatiles

The volatile compounds requested were 1,2-dichloroethane, *cis*-1,2-dichloroethene, tetrachloroethene, *trans*-1,2-dichloroethene, trichloroethene, and vinyl chloride. Initial calibration of instrument VOAA was performed on December 11, 2013, using seven calibration standards. The average response factor and associated relative standard deviation met the acceptance criteria for all analytes where the averaged response factor approach was used. In cases where the linear calibration curve approach was used, the calibration curve correlation coefficient value was greater than 0.99 and the intercept was less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. Target compound 1,2-dichloroethane had a percent drift value greater than 20 percent. There were no sample results greater than the MDL associated with this calibration verification compound, so no qualification is necessary. The mass spectrometer calibration and resolution were checked at the beginning of each analytical run in accordance with the procedure. Internal standard recoveries were stable and within acceptance ranges. All surrogate recoveries were within the acceptance ranges.

Method SW-846 8310, PAH Compounds

The initial calibration for PAHs was performed using eight calibration standards on November 21, 2013. The initial calibration data met the acceptance criteria for all analytes. Initial and continuing calibration checks were made at the required frequency. All continuing calibration verifications were within the acceptance criteria. Benzo(g,h,i)perylene, dibenz(a,h)anthracene,

and indeno(1,2,3-cd)pyrene were detected on both columns in sample LW-DC10, but these results were qualified by the laboratory as false positives due to matrix interference and/or comparison to the diode array detector generated spectrum. These compounds are qualified with a “U” flag as not detected.

Radiochemical Analysis

Thorium Isotopes

Alpha spectrometry calibrations and instrument backgrounds were performed within a month previous to sample analysis. Calibration standards were counted to obtain a minimum of 10,000 counts per peak. Daily instrument checks met the acceptance criteria. The tracer recoveries met the acceptance criteria of 30 to 110 percent for all samples. The full width at half maximum (FWHM) was reviewed to evaluate the spectral resolution. For some samples, the tracer FWHM exceeded 100 kiloelectron volts (keV), which is expected for isotopes such as thorium-229 with alpha emissions at multiple energies. Thorium-228, -230, and -232 results were corrected for tracer impurity. All ROIs were satisfactory.

Radium-226

Emanation cell plateau voltage determinations and cell efficiency calibrations were performed within a year previous to sample analysis.

Radium-228

Plateau voltage determinations and detector efficiency calibrations were performed more than one year previous to the sample analysis. Daily instrument checks met the acceptance criteria. The chemical recoveries met the acceptance criteria of 40 to 110 percent for all samples.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the PQL for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a “U” flag (not detected) when the sample result is greater than the MDL but less than 5 times the blank concentration. The radiochemistry method blank results were less than the DLC.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

Volatiles, PAHs, and PCBs Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate spike recoveries are evaluated to identify data quality effects due to such factors as interference or high concentrations of analytes. Surrogate recoveries may also be influenced by the success in

recoveries of the internal standards. Internal standard recoveries were stable and within acceptance ranges. All sample surrogate recoveries were within the acceptance ranges.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spike results met the recovery and precision criteria for all analytes evaluated. The spike recovery of chemical oxygen demand exceeded the laboratory's acceptance criteria, but was within the ± 25 percent requirement.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for non-radiochemical replicate results that are greater than 5 times the PQL should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable with the following exception. The percent difference for the manganese dilution at location LW-DC10 was above the acceptance range. Because of the possible reduced accuracy due to matrix interference, the associated results are qualified with a "J" flag as estimated values.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for ion chromatography, PAH, PCB, and volatiles data. All peak integrations, including manual integrations, were satisfactory.

Compound Identification

The mass spectral data were reviewed for each reported organic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers. The analytical report included the MDL (MDC for radiochemistry) and PQL for all analytes and all required supporting documentation.

Electronic Data Deliverable (EDD) File

The EDD file arrived on January 24, 2014. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Field Measurements

The pre-sampling purge criteria were met for all wells.

Sampling Protocol

Sample results for all monitoring wells met the Category I or II low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The groundwater sample results for wells MW-2046, MW-2047, MW-2055, MW-3003, MW-3006, MW-3024, MW-3040, MW-4007, MW-4040, MW-4043, MWD-2, MWS-1, and MWS-2 were further qualified with a "Q" flag in the database indicating the data are considered qualitative because these are Category II wells.

Equipment Blank Assessment

An equipment blank was not collected because all sampling was performed with dedicated equipment or new pump tubing.

Trip Blank Assessment

Trip blanks are prepared and analyzed to document contamination attributable to shipping and field handling procedures. One trip blank was submitted with these samples. There were no analytes detected in the trip blank.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples were collected from locations LW-DC10, MW-4029, and MWD-2. For non-radiochemical measurements, the relative percent difference for duplicate results that are greater

than 5 times the PQL should be less than 20 percent. For results less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. All duplicate results met these criteria, demonstrating acceptable precision.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition.

No values from this sampling event were identified as potential outliers. The data for this RIN are acceptable as qualified.



Gretchen Baer
2014.02.28 12:21:28 -07'00'

Report Prepared By: _____

Gretchen Baer
Data Validator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2003

Laboratory:

RIN: 13115774

Report Date: 2/27/2014

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier		
					Result	Qualifiers		Result	Qualifiers		Result	Qualifiers			N	N Below Detect
						Lab	Data		Lab	Data		Lab	Data			
WEL01	LW-DC10	N001	12/11/2013	Iron	0.316000			21.6			0.327	E	J	38	2	NA

STATISTICAL TESTS:

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

SAMPLE MANAGEMENT SYSTEM
General Data Validation Report

RIN: 13115774 Lab Code: GEN Validator: Gretchen Baer Validation Date: 2/27/2014
Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics
of Samples: 27 Matrix: Water Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

There are 0 detection limit failures.

There was 1 trip/equipment blank evaluated.

There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13115774 Lab Code: GEN Project: Weldon Spring Validation Date: 2/27/2014

Duplicate: LW-DD10

Sample: LW-DC10

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Acenaphthene	0.150	U		1.00	0.150	U		1.00			ug/L
Acenaphthylene	0.150	U		1.00	0.150	U		1.00			ug/L
Anthracene	0.150	U		1.00	0.150	U		1.00			ug/L
Aroclor 1016	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1221	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1232	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1242	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1248	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1254	0.0333	U		1.00	0.0333	U		1.00			ug/L
Aroclor 1260	0.0333	U		1.00	0.0333	U		1.00			ug/L
Arsenic	1.70	U		1.00	1.7	B		1.00			ug/L
Barium	375			1.00	385			1.00	2.63		ug/L
Benzo(a)anthracene	0.0286	J		1.00	0.016	U		1.00			ug/L
Benzo(a)pyrene	0.016	U		1.00	0.016	U		1.00			ug/L
Benzo(b)fluoranthene	0.0206	J		1.00	0.016	U		1.00			ug/L
Benzo(g,h,i)perylene	0.0212	JPX		1.00	0.016	U		1.00			ug/L
Benzo(k)fluoranthene	0.0221	J		1.00	0.008	U		1.00			ug/L
Chemical Oxygen Demand	23.7			1.00	24.4			1.00	2.91		mg/L
Chloride	39.6			10.00	40.3			10.00	1.75		mg/L
Chromium	2.00	U		1.00	2.00	U		1.00			ug/L
Chrysene	0.016	U		1.00	0.016	U		1.00			ug/L
Cobalt	1.24	B		1.00	1.26	B		1.00	1.60		ug/L
Dibenz(a,h)anthracene	0.0223	JX		1.00	0.016	U		1.00			ug/L
Fluoranthene	0.0577			1.00	0.016	U		1.00			ug/L
Fluorene	0.150	U		1.00	0.150	U		1.00			ug/L
Fluoride	0.340	J		1.00	0.337	J		1.00	0.89		mg/L
Indeno(1,2,3-cd)pyrene	0.0236	JX		1.00	0.016	U		1.00			ug/L
Iron	316			1.00	339			1.00	7.02		ug/L
Lead	0.500	U		1.00	0.500	U		1.00			ug/L
Manganese	420	E		1.00	453	E		1.00	7.56		ug/L
Naphthalene	0.150	U		1.00	0.150	U		1.00			ug/L
Nickel	5.92	B		1.00	6.04	B		1.00	2.01		ug/L
NO2+NO3 as N	2.89			10.00	2.92			10.00	1.03		mg/L
Phenanthrene	0.182	U		1.00	0.182	U		1.00			ug/L
Pyrene	0.0519			1.00	0.016	U		1.00			ug/L
Radium-226	0.633		0.304	1.00	0.435		0.253	1.00		1.0	pCi/L
Radium-228	0.315	U	0.413	1.00	0.351	U	0.351	1.00		0.1	pCi/L
Selenium	5.57			1.00	5.98			1.00			ug/L
Sulfate	68.5			10.00	69.7			10.00	1.74		mg/L

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13115774 Lab Code: GEN Project: Weldon Spring Validation Date: 2/27/2014

Duplicate: LW-DD10

Sample: LW-DC10

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Thallium	0.450	U		1.00	0.450	U		1.00			ug/L
Thorium-228	-0.162	U	0.273	1.00	0.079	U	0.140	1.00		1.5	pCi/L
Thorium-230	0.0146	U	0.273	1.00	-0.128	U	0.229	1.00		0.8	pCi/L
Thorium-232	-0.0712	U	0.176	1.00	0.153	U	0.167	1.00		1.8	pCi/L
Total Dissolved Solids	610			1.00	659			1.00	7.72		mg/L
Total Organic Carbon	10.3			1.00	10.2			1.00	0.98		mg/L
Uranium	32.4			1.00	33.2			1.00	2.44		ug/L

Duplicate: MW-4129

Sample: MW-4029

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,2-Dichloroethane	1.50	U		5.00	0.300	U		1.00			ug/L
1,2-Dichloroethane	1.50	U		5.00	1.50	U		5.00			ug/L
cis-1,2-Dichloroethene	1.75	J		5.00	2.71			1.00			ug/L
cis-1,2-Dichloroethene	1.75	J		5.00	1.75	J		5.00			ug/L
NO2+NO3 as N	380			500.00	361			500.00	5.13		mg/L
Tetrachloroethene	1.50	U		5.00	0.380	J		1.00			ug/L
Tetrachloroethene	1.50	U		5.00	1.50	U		5.00			ug/L
trans-1,2-Dichloroethene	1.50	U		5.00	0.300	U		1.00			ug/L
trans-1,2-Dichloroethene	1.50	U		5.00	1.50	U		5.00			ug/L
Trichloroethene	201			5.00	295	E		1.00	NA		ug/L
Trichloroethene	201			5.00	202			5.00	0.50		ug/L
Vinyl Chloride	1.50	U		5.00	0.300	U		1.00			ug/L
Vinyl Chloride	1.50	U		5.00	1.50	U		5.00			ug/L

Duplicate: MWR-2

Sample: MWD-2

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Uranium	0.303			1.00	0.324			1.00			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13115774

Project: Weldon Spring

Lab Code: GEN

Validation Date: 2/27/2014

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 13115774Lab Code: GENDate Due: 1/9/2014Matrix: WaterSite Code: WEL01Date Completed: 1/24/2014

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Arsenic	ICP/MS	01/09/2014			OK	OK						100.0		97.0
Arsenic	ICP/MS	01/14/2014			OK	OK	OK	109.0	118.0			100.0		107.0
Barium	ICP/MS	01/10/2014			OK	OK	OK	98.8			1.0	97.0	4.0	97.0
Chromium	ICP/MS	01/09/2014			OK	OK	OK	101.0	97.2			92.0		100.0
Cobalt	ICP/MS	01/09/2014			OK	OK	OK	99.4	98.0		2.0	97.0	4.0	100.0
Iron	ICP/MS	01/09/2014			OK	OK	OK	102.0	99.1		0.0	102.0		100.0
Lead	ICP/MS	01/10/2014			OK	OK	OK	98.3	95.8			96.0		99.0
Manganese	ICP/MS	01/10/2014			OK	OK	OK	101.0	93.4		2.0	96.0	16.0	99.0
Nickel	ICP/MS	01/09/2014			OK	OK	OK	102.0	95.2		1.0	92.0		101.0
Selenium	ICP/MS	01/09/2014			OK	OK	OK	108.0	107.0		13.0	96.0		101.0
Thallium	ICP/MS	01/10/2014			OK	OK	OK	86.3	86.7			91.0		104.0
Uranium	ICP/MS	01/06/2014			OK	OK	OK	103.0	103.0		3.0	106.0	4.0	114.0
Uranium	ICP/MS	01/10/2014			OK	OK	OK	99.7	93.1		0.0	102.0		107.0
Uranium	ICP/MS	01/11/2014			OK	OK						102.0		106.0

SAMPLE MANAGEMENT SYSTEM
Wet Chemistry Data Validation Worksheet

RIN: 13115774

Lab Code: GENDate Due: 1/9/2014Matrix: WaterSite Code: WEL01Date Completed: 1/24/2014

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Chemical Oxygen Demand	01/08/2014	0.400	0.9995	OK	OK	OK	99.80	120.0		18.00	
Chloride	12/18/2013	0.020	0.9995	OK	OK	OK	95.40				
Chloride	12/19/2013							110.0		0	
Fluoride	12/18/2013	0.050	0.9997	OK	OK	OK	96.40	100.0		2.00	
NO2+NO3 as N	12/16/2013	-0.010	0.9990	OK	OK	OK	100.00	103.0		3.00	
NO2+NO3 as N	12/16/2013							103.0		10.00	
Sulfate	12/18/2013	0.040	0.9998	OK	OK	OK	98.40				
Sulfate	12/19/2013							107.0		0	
Total Dissolved Solids	12/13/2013					OK	96.20			0	
Total Organic Carbon	12/13/2013	-0.088	0.9998	OK	OK	OK	99.50				
Total Organic Carbon	12/14/2013							109.0		1.00	

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 13115774 Lab Code: GEN Date Due: 1/9/2014
 Matrix: Water Site Code: WEL01 Date Completed: 1/24/2014

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate
Blank	Radium-226	12/30/2013	0.0794	U				
LW-DC10	Radium-226	12/30/2013						1.30
LW-DC10	Radium-226	12/30/2013					80.4	
Blank_Spike	Radium-226	12/31/2013				82.70		
MW-2046	Radium-228	12/26/2013			82.0			
LW-DC10	Radium-228	12/26/2013			65.0			0.11
Blank	Radium-228	12/26/2013	-0.1930	U	91.0			
MW-2047	Radium-228	12/26/2013			56.0			
Blank_Spike	Radium-228	12/26/2013			77.0	95.70		
MW-2032	Radium-228	12/26/2013			95.0			
SP-6301	Radium-228	12/26/2013			88.0			
LW-DC10	Radium-228	12/26/2013			80.0			
LW-DD10	Radium-228	12/26/2013			80.0			
MW-2051	Radium-228	12/26/2013			83.0			
MW-2055	Radium-228	12/26/2013			79.0			
LW-DC10	Thorium-228	12/17/2013			66.0			1.17
MW-2055	Thorium-228	12/17/2013			91.0			
Blank	Thorium-228	12/17/2013	0.0672	U	83.0			
LW-DC10	Thorium-228	12/17/2013			44.0			
MW-2032	Thorium-228	12/17/2013			81.0			
LW-DD10	Thorium-228	12/17/2013			60.0			
MW-2047	Thorium-228	12/17/2013			73.0			
MW-2046	Thorium-228	12/17/2013			90.0			
SP-6301	Thorium-228	12/17/2013			95.0			
MW-2051	Thorium-228	12/20/2013			71.0			
LW-DC10	Thorium-230	12/17/2013						0.76
Blank_Spike	Thorium-230	12/17/2013				98.70		
Blank	Thorium-230	12/17/2013	-0.0700	U				
LW-DC10	Thorium-232	12/17/2013						0.40
Blank	Thorium-232	12/17/2013	0.0094	U				



Data Review and Validation Report

General Information

Report Number (RIN): 13115775
Sample Event: December 9–11, 2013
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-50244-1
Analysis: Organics
Validator: Stephen Donivan
Review Date: February 28, 2014

This validation was performed according to the *Environmental Procedures Catalog* (LMS/POL/S04325, continually updated), “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. See attached Data Validation Worksheets for supporting documentation on the data review and validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Nitroaromatics	LMN-03	SW-846 3535	SW-846 8321A

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte(s)	Flag	Reason
280-50244-4	MW-2046	2,6-Dinitrotoluene	J	Poor analyte peak resolution
280-50244-6	MW-2051	2,6-Dinitrotoluene	J	Poor analyte peak resolution

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 11 water samples on December 12, 2013, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received with the temperatures inside the iced coolers at 0.1 °C and 1.5 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL. The reported MDLs for all analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

Method SW-846 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on December 21, 2013, using seven calibration standards. Linear or higher order regression calibrations had correlation coefficient values greater than 0.99 and intercepts less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. All target compounds had percent drift values less than 20 percent.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. The blank results were below the MDL for all target compounds.

Nitroaromatics Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. All surrogate recoveries were within the acceptance ranges. The surrogate recovery calculated for the dilution prepared for sample MW-2046 is not valid and not evaluated.

The recovery of the internal standards added to the samples is monitored to measure the purging efficiency. Internal standard recoveries associated with target compounds were stable and within acceptance ranges with the following exception. The recovery of internal standards one and two from many of the samples was below the acceptance criteria. There were no analytes detected in these samples associated with this internal standard and no qualification is required.

Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spikes met the recovery and precision criteria for all analytes.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for results that are greater than 5 times the PQL should be less than 20 percent (or less than the laboratory-derived control limits for organics). For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics data. Manual peak integrations were performed during nitroaromatics analysis. All analyte peak integrations were acceptable.

Nitroaromatic analyte peaks that share a common ion mass should be resolved such that the height of the valley between peaks is less than 20 percent of the analyte peak height. Sample results associated with analyte peaks that do not meet this criterion are qualified with a "J" flag as estimated values.

Compound Identification

The mass spectral and retention time data were reviewed for each nitroaromatic compound to verify that analytes were identified correctly.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on January 2, 2014. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

Potential Outliers

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition.

None of the analytical results were identified as potentially anomalous.

Field Measurements

The pre-sampling purge criteria were met for all wells. Daily calibration checks were performed as required with acceptable results.

Sampling Protocol

Sample results for all monitoring wells met the Category I, II, or III low-flow sampling criteria and were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The groundwater sample results for wells MW-2046, MW-2047, MW-2055, and MW-4043 were further qualified with a "Q" flag in the database indicating the data are considered qualitative because these are Category II wells.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. A duplicate sample was collected from location LW-DC10. The relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. The duplicate results met the criteria, demonstrating acceptable overall precision.

Stephen E. Donivan

2014.02.28

11:39:16 -07'00'



Report Prepared By: _____

Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 13115775 Lab Code: STD Validator: Stephen Donovan Validation Date: 02/27/2014

Project: Weldon Spring Analysis Type: Metals General Chem Rad Organics

of Samples: 11 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 13115775 Lab Code: STD Project: Weldon Spring Validation Date: 02/27/2014

Duplicate: LW-DD10

Sample: LW-DC10

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
1,3,5-Trinitrobenzene	0.018	U		1	0.017	U		1			ug/L
1,3-Dinitrobenzene	0.015	U		1	0.014	U		1			ug/L
2,4,6-Trinitrotoluene	0.023	U		1	0.022	U		1			ug/L
2,4-Dinitrotoluene	0.020	U		1	0.019	U		1			ug/L
2,6-Dinitrotoluene	0.023	U		1	0.022	U		1			ug/L
Nitrobenzene	0.034	U		1	0.032	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 13115775

Project: Weldon Spring

Lab Code: STD

Validation Date: 02/28/2014

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.