LMS/WEL/S13544

U.S. Department of Energy
Office of Legacy Management

Weldon Spring, Missouri, Site Annual Report for Calendar Year 2015

June 2016

U.S. DEPARTMENT OF ENERGY | Legacy Management

Contents

Figures

Tables

Appendixes

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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
CFR	*Code of Federal Regulations*
CSR	*Code of State Regulations*
DCE	dichloroethene
DCF	dose conversion factor
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
EPRCA	Emergency Planning and Community Right-to-Know Act
ESD	Explanation of Significant Differences
ft	feet
GWOU	Groundwater Operable Unit
IC	institutional control
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
LCRS	Leachate Collection and Removal System
LiDAR	Light Detection and Radar
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-Parks	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
MSL	mean sea level
NB	nitrobenzene
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OM	order of magnitude
ORP	oxidation-reduction potential
OU	operable unit
pCi/L	picocuries per liter
QROU	Quarry Residuals Operable Unit
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RPD	relative percent difference
SOARS	System Operation and Analysis at Remote Sites
SWRAU	(EPA superfund) sitewide ready for anticipated use
TCE	trichloroethene
TED	total effective dose
TNB	trinitrobenzene
TNT	trinitrotoluene
VSP	Visual Sampling Plan (software)
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 2015 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) (DOE 2008a) and the *Federal Facility Agreement for the Weldon Spring Site* (DOE 2006).

Compliance Summary

The Weldon Spring site is on the National Priorities List and is governed by CERCLA. The site has been subject to meeting 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.

Inspection Summary

The Weldon Spring site was inspected December 1 and 2, 2015. The inspection was conducted in accordance with the LTS&M Plan and associated inspection checklist. Representatives from the U.S. Department of Energy (DOE) Office of Legacy Management; the Legacy Management Support contractor, Navarro Research and Engineering, Inc.; the U.S. Environmental Protection Agency; 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 on activities 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 using handheld GPS (Global Positioning System) 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 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, 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.

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 a special study. Although uranium levels in the former Raffinate Pits area have changed since 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 in 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 presence of the slough creates conditions that are favorable for a strongly reducing environment. This type of environment limits uranium migration because uranium is much less mobile in the reduced state. Data from groundwater samples collected in downgradient wells immediately south of the slough confirm the limited migration of uranium in the reducing zone.

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 that uranium levels continue (since the late 1990s) to be below the Maximum Contaminant Level (MCL) in Busch Conservation Lakes 34, 35, and 36 as well as in Dardenne Creek. Uranium levels in the slough continued to be elevated during the early part of 2015 with sample results typically above the uranium MCL, a condition that began in 2006 when the slough dried out due to drought conditions. The drought conditions were alleviated in mid-2015 through the remainder of the year with heavy rains refilling and occasionally overtopping the banks of the slough. Uranium concentrations of samples collected from slough surface water locations during the second part of 2015 were typically below the uranium MCL.

Historical water quality and water level data for existing wells are 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 2015 for the Weldon Spring, Missouri, Site. The U.S. Department of Energy (DOE) prepares this annual report as part of the site's long-term surveillance and maintenance (LTS&M) activities, in accordance with the requirements of the *Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site* (LTS&M Plan) (DOE 2008a) and the *Federal Facility Agreement for the Weldon Spring Site* (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, Missouri (Figure 1). The site comprises two geographically distinct, DOE-owned properties: the former Weldon Spring 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 No. 2 water supply 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.

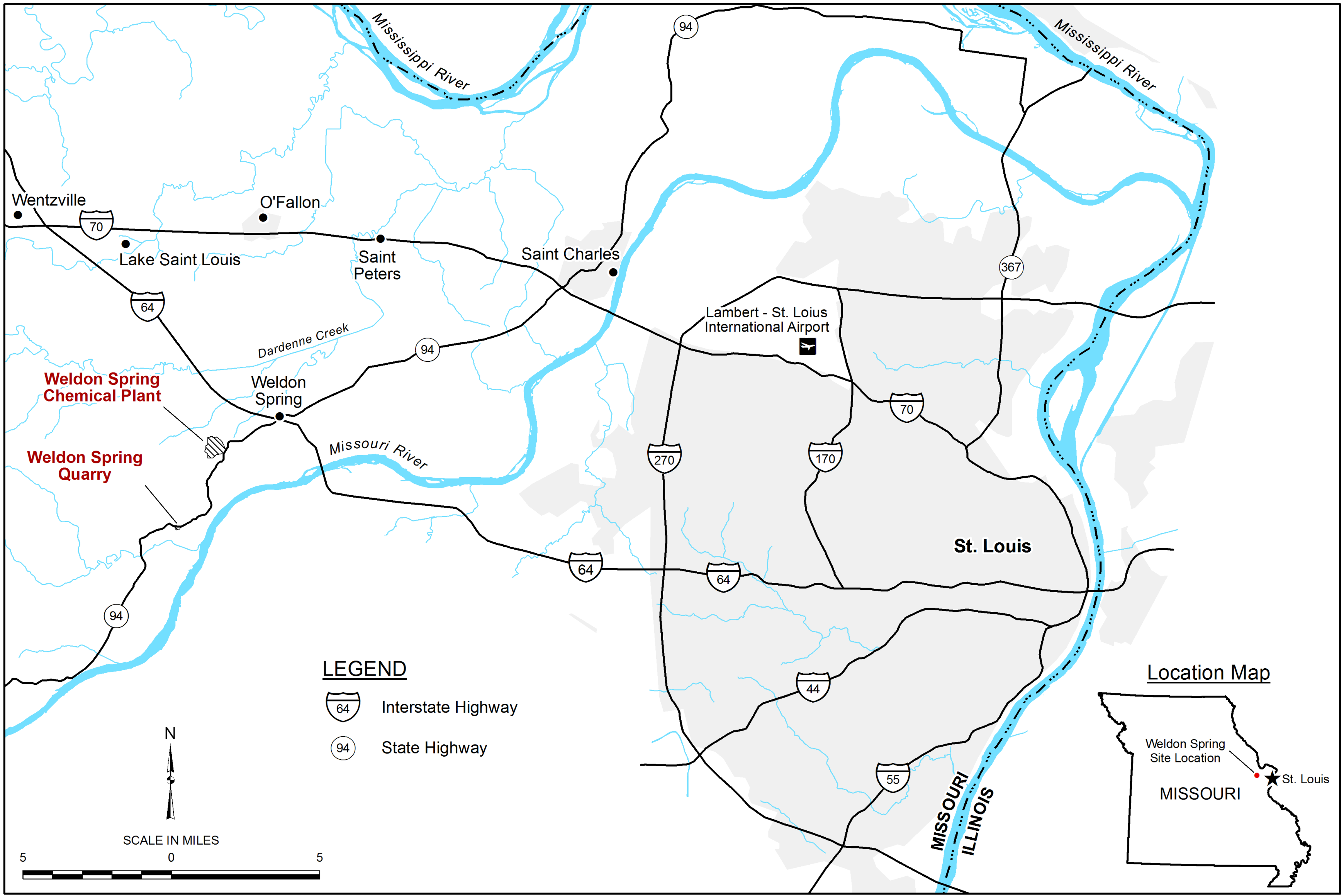

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Figure 1. Location of the Weldon Spring, Missouri, Site

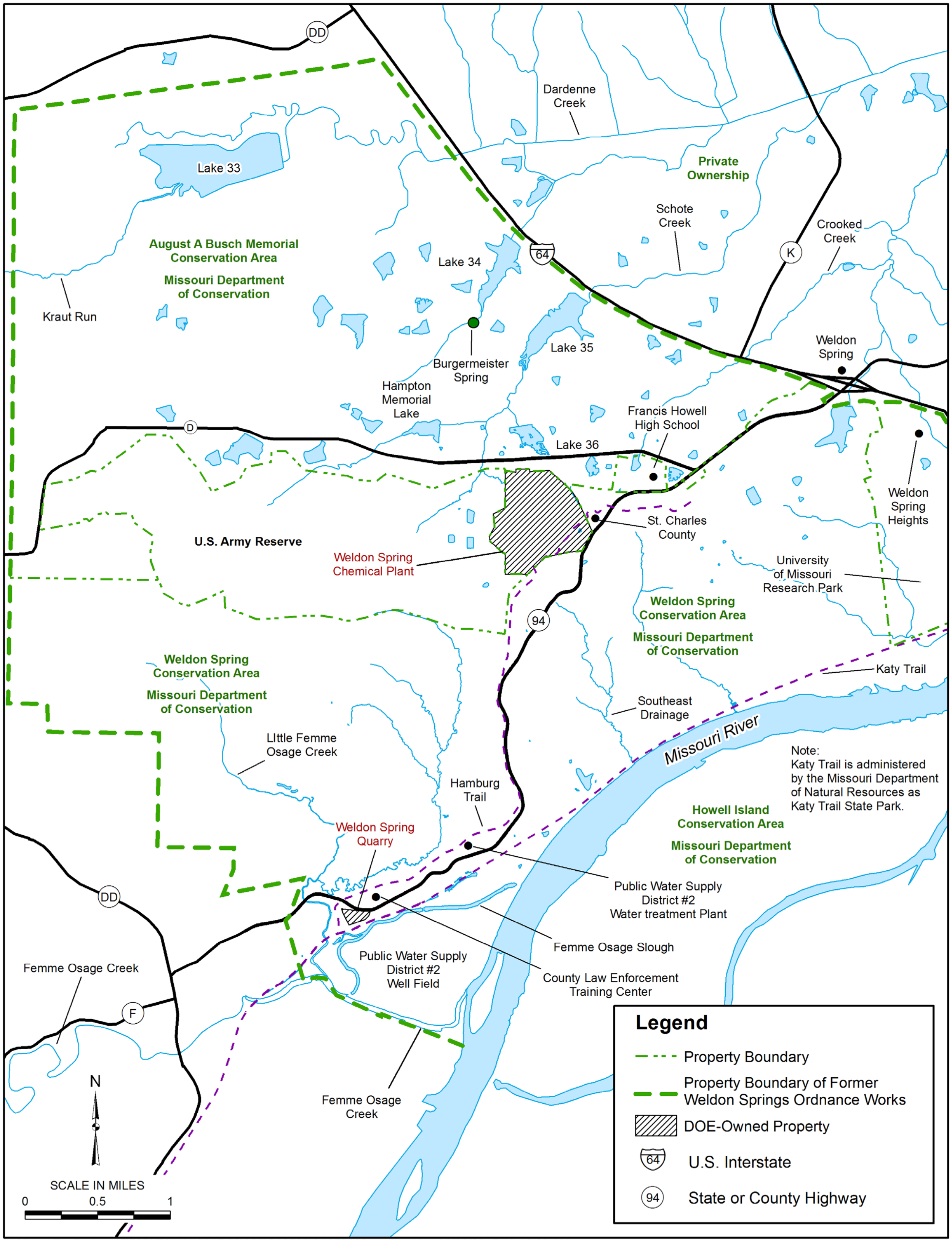

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Figure 2. Vicinity Map of the Weldon Spring, Missouri, Site

Following a considerable amount of explosives decontamination of the facility by the Army, 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 similar 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.

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 (NPL) 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 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 remains 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 NPL 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, 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 is subject to the National Environmental Policy Act 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 the National Environmental Policy Act. 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 NPL 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.
- 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, the 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. The next five-year review report is due September 2016. The annual inspection that occurred in December 2015 also served as the five-year review inspection.

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 as Title 10 *Code of State Regulations* 23-3.100(8) (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 one National Pollutant Discharge Elimination System (NPDES) permit during 2015. The permit (MO 0107701), which covers discharges from the Leachate Collection and Removal System (LCRS), is maintained as a contingency to current disposal methods. This permit was renewed on May 21, 2014. The permit expires on June 30, 2016, and a permit renewal application was submitted to MDNR on December 16, 2015. See Section 1.5.3.1 for additional discussion of this permit.

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]

Notes:

[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.

Abbreviations:

DNB = dinitrobenzene; DNT = dinitrotoluene; µg/L = micrograms per liter; mg/L = milligrams per liter;
NB = nitrobenzene; pCi/L = picocuries per liter; 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 No. 2. The first program details the monitoring of uranium and 2,4-dinitrotoluene (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 (EPCRA)

The site no longer stores large quantities of chemicals and none above a threshold level; therefore, the site was not required to submit a 2015 Emergency Planning and Community Right-to-Know Act Tier II report.

Based on the chemical usage in 2015, the Weldon Spring site is also not required to submit a Toxic Release Inventory report under EPCRA.

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 5400.1 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 0.067 millirem (mrem), which is well below the 100 mrem guideline for all potential exposure pathways. Refer to Section 5.5.2 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 2015.

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" (Title 48 *Code of Federal Regulations* [CFR] Section 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 and biobased materials; recycling to the extent practicable; conserving fuel, energy, and natural resources; minimizing the generation of greenhouse gases and hazardous waste/solid wastes and the use of toxic chemicals; and enhancing disrupted ecosystems.

Table 2 provides a list of items recycled during 2015.

Table 2. Recycled Items and Quantities

Material Recycled	Quantity
Paper	1044 pounds
Cardboard	418 pounds
Plastic	257 pounds
Glass	10 pounds
Light bulbs	45 pounds
Electronics	640 pounds
Batteries	290 pounds
Metal	69,085 pounds[a]
Concrete	6,000,000 pounds[b]

[a] Includes 54,085 pounds of rebar generated from the Administrative Building Foundation Reclamation Project and 14,280 pounds from the recycling of conex boxes

[b] Includes 2157 cubic yards of concrete from the Administrative Building Foundation Reclamation Project that was crushed onsite and recycled into gravel used onsite.

1.5.3 Permit and Agreement Compliance

1.5.3.1 NPDES Permits

The Weldon Spring site had one NPDES permit during 2015. The permit (MO 0107701), which authorizes a discharge to the Missouri River 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 was renewed on May 21, 2014. The permit expires on June 30, 2016, and a permit renewal application was submitted to MDNR on December 16, 2015.

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. Subsequently, EPA, DOE, and MDNR 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 transport treated disposal cell leachate and purge water from groundwater sampling to their Bissell Point Plant. The MSD approval was renewed on December 17, 2015. DOE received notification in April 2004 that the leachate must meet the radiological drinking-water standard for all radionuclides, including the 30 µg/L (20 pCi/L) standard for uranium. 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 µg/L limit. The untreated levels continued to be slightly above the 30 µg/L limit for uranium during 2015, so the leachate pretreatment continued, and the uranium levels for the treated leachate remained significantly lower than the 30 µg/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. Sections 5.2.1.1 and 5.2.4.1 provide hydrogeologic descriptions of lithologies monitored for each program. 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 with unit thicknesses ranging from a few feet to several tens of feet.

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, the Kimmswick Limestone, the Decorah Group, and the Plattin Limestone. These units are predominantly limestone and dolomite. Massive Quaternary deposits of Missouri River alluvium cover the bedrock to the south and east of the Quarry.

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	Locally a leaky confining unit
Mississippian	Meramecian	Salem Formation[c]	0–15	Limestone, limey dolomite, finely to coarsely crystalline, massively bedded, and thin-bedded shale	
		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	Upper leaky confining unit
Devonian	Upper	Sulphur Springs Group Bushberg Sandstone[d]	40–55	Quartz arenite, fine to medium grained, friable	
		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	Deep aquifer system
	Canadian	Powell Dolomite	50–60	Sandy dolomite, medium to finely crystalline, minor chert and shale	
		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	

Notes:

[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 Ordnance 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

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 (MSL) near the northern edge of the site to 665 ft above MSL 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), which 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, Frog Pond, and 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 after remediation. 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 and 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 1.2 million.

The Weldon Spring Conservation Area surrounds the Quarry and 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. These data are 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 2015

Month	Total Precipitation (inches)	Average Temperature (°F)
January	1.06	30.2
February	1.02	24.8
March	3.47	43.0
April	6.47	57.7
May	5.06	66.0
June	9.82	73.7
July	4.35	76.6
August	5.11	73.9
September	0.70	71.9
October	1.27	58.0
November	7.31	49.2
December	13.37	43.3

1.10 Land Use and Demography

According to the US Census Bureau, the estimated population of St. Charles County in 2015 was 385,590. The three largest communities in St. Charles County are O'Fallon, St. Charles, and St. Peters. The two communities closest to the site are Weldon Spring and Weldon Spring Heights, about 2 miles to the northeast. 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.

St. Charles County owns a maintenance facility adjacent to the north side of the former Chemical Plant. The Army Reserve Training Area is located to the west of the former Chemical Plant. The Army has constructed 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 has been 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 Administration Building Foundation Reclamation

The Weldon Spring site administration building was a 32,800-square-foot building erected at the site in 1990 to support the Weldon Spring Site Remedial Action Project. During the 1990s, it provided project office space for hundreds of cleanup workers. The space was not necessary for site LTS&M needs, and the building was demolished in the fall of 2012. The concrete foundation slab was left in place at that time to determine options for its removal and to evaluate whether disposal presented any concerns. DOE decided to remove the concrete slab and run the slab through a rock crusher to recycle the concrete for use onsite. The subcontractors mobilized to the site on March 19, 2015, and began excavation of the slab on March 23, 2015. Before crushing began, DOE performed a radiological scan to document that the slab presented no radiological contamination issues. All scanning results were within the range of background. Crushing operations began on April 6, 2015. The project specifications required the rock crusher to be permitted in accordance with Missouri regulations. The rock crusher did have the required portable rock crusher permit that was specific to that piece of equipment.

The rock crusher was also used to crush concrete that remained from former projects and had been stored on an onsite debris storage pad. Concrete from the administration building slab and the former projects produced approximately 2,157 cubic yards of gravel. The gravel was recycled onsite and used to backfill the area from which the concrete slab was removed. The metal rebar, which was automatically separated by the rock crusher machine, was sent offsite for recycling and totaled 54,640 pounds. The project was completed on April 22, 2015.

1.11.2 Installation of Tornado Shelter No. 2

The evening of May 31, 2013, an F3 tornado touched down, leaving a path of damage more than 32 miles long and 250 yards wide at its peak. The funnel twisted its way through several Missouri communities, including the Weldon Spring site. According to a National Weather Service Damage Survey, the tornado stayed on the ground for approximately 35 minutes, moving 32.5 miles from start to finish. The Weldon Spring site Interpretive Center sustained damage. However, because the storm event occurred after the site had closed for the day, no employees or visitors were injured. DOE evaluated several options for installing a storm shelter at the site. A standalone, aboveground, 10 ft by 56 ft shelter, constructed with prefabricated steel that can withstand winds up to 250 miles per hour, was selected and installed adjacent to the Interpretive Center. The installation was completed in June 2014.

Because the maximum field trip size for the Interpretive Center could exceed the capacity of the shelter, DOE decided to build a second shelter. In March 2015, the same subcontractor completed installation of an additional shelter of the same size and type as the first.

2.0 Inspection Report

2.1 Introduction

The Weldon Spring site was inspected December 1 and 2, 2015. The inspection was conducted in accordance with the LTS&M Plan (DOE 2008a) and associated inspection checklist. Representatives from LM; LM's Legacy Management Support contractor, Navarro Research and Engineering, Inc. (Navarro); EPA; and MDNR participated in the inspection. A representative from MDC participated in the inspection of the Southeast Drainage. This inspection also served as the five-year review inspection to support the site's CERCLA Five-Year Review Report.

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.

An aerial survey of the disposal cell was flown in December 2014. This survey is required by the LTS&M Plan and checklist to be conducted every 5 years in conjunction with the five-year review inspection. This aerial survey utilized the Light Detection and Radar (LiDAR) technology. The survey generated 6-inch elevation contours. The previous aerial surveys were conducted in 2005 and 2010 in conjunction with the previous five-year reviews and in 2003 in conjunction with the first annual LTS&M inspection. The previous surveys generated 1-ft contours using photogrammetric methods. The survey results were discussed during the inspection.

Inspection of the disposal cell consisted of walking 10 transects over the cell and around the cell perimeter. Inspectors used hand-held 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 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, 13 Navarro employees were employed full-time at the site. 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 Navarro were the lead inspectors during the inspection:

- Terri Uhlmeyer
- Randy Thompson

The following Navarro personnel participated in the inspection:

- Tom Welton
- Tim Zirbes
- Chris Papinsick
- Rex Hodges
- Yvonne Deyo
- Dave Parker
- Darrell Landers

The following personnel were present during the site inspection:

- Ken Starr, DOE
- Hoai Tran, EPA Region 7
- Patrick Anderson, MDNR
- Dan Carey, MDNR
- Raenhard Wesselschmidt, MDC (inspection of Southeast Drainage only)

2.2 Inspection Results

Prior to the inspection, the site inspection agenda (included as Appendix A) was reviewed with the inspection participants. A safety briefing was also held prior to the inspection. The sign-in sheets of all the participants from both days of the inspection is included in 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.

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 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. Sections 2.2.1.1 through 2.2.1.7 list the IC areas as they are referenced in the inspection checklist.

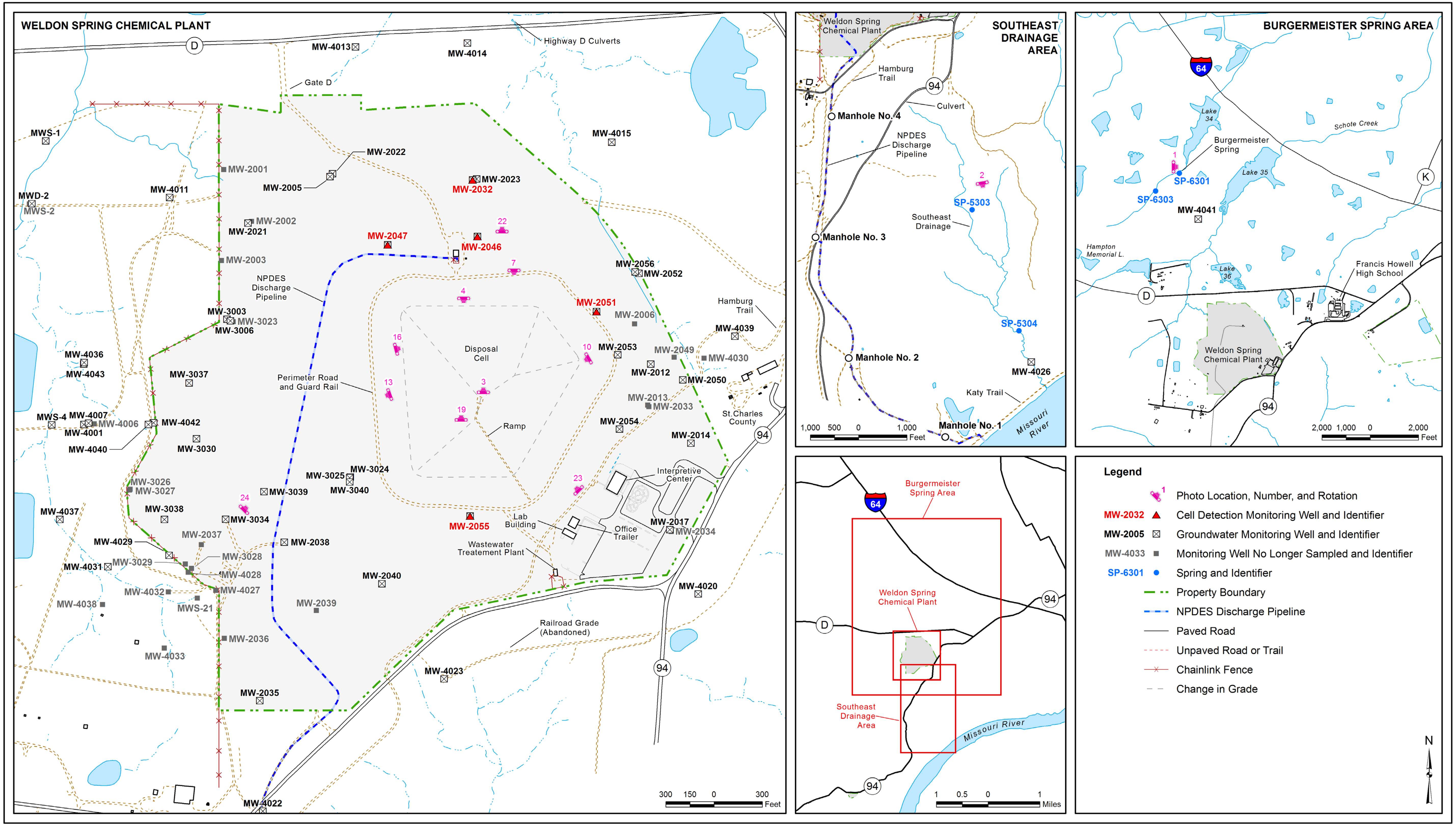

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Figure 4. 2015 Inspection Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site

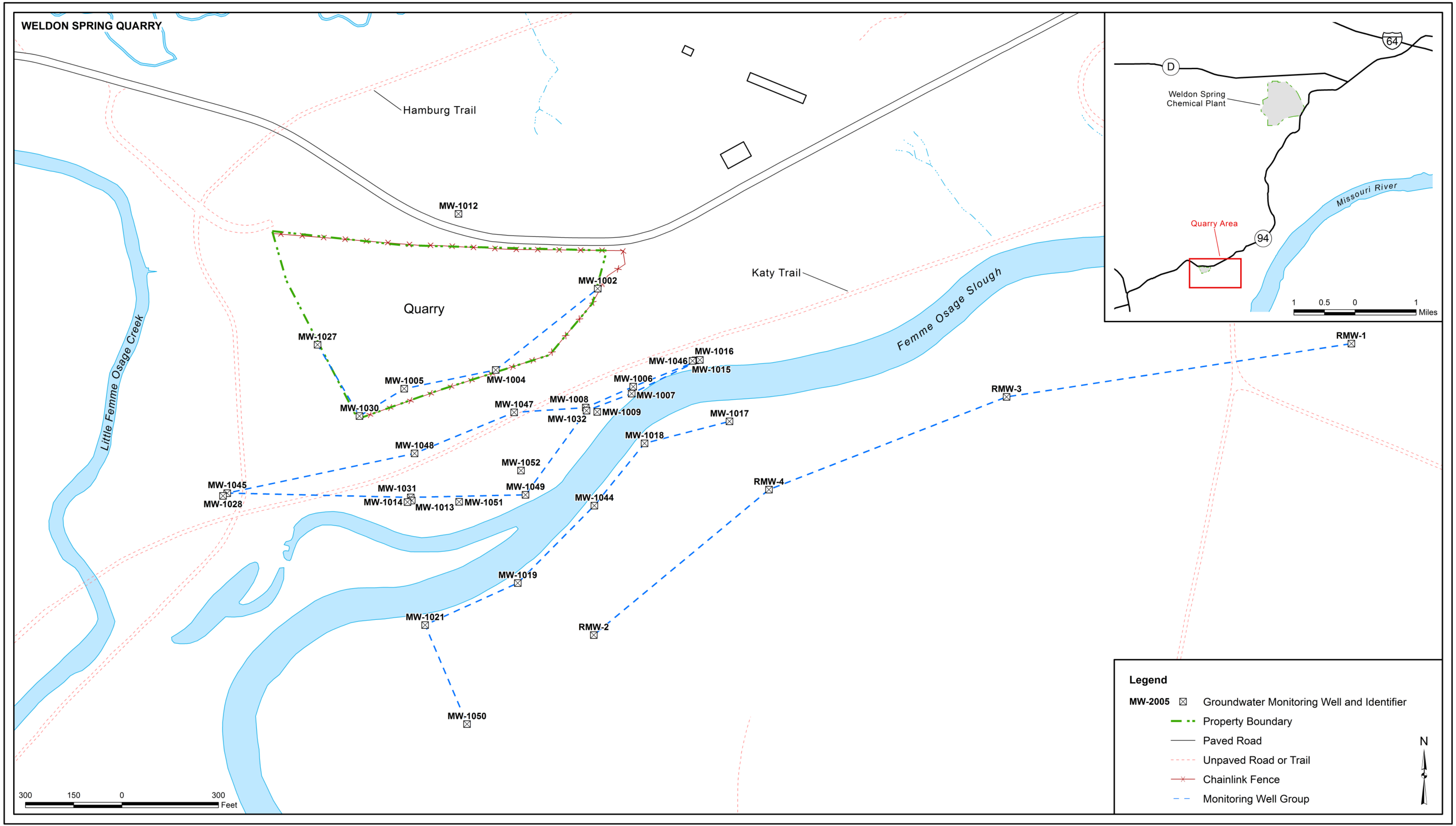

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Figure 5. 2015 Inspection Map for the Quarry Area of the Weldon Spring, Missouri, Site

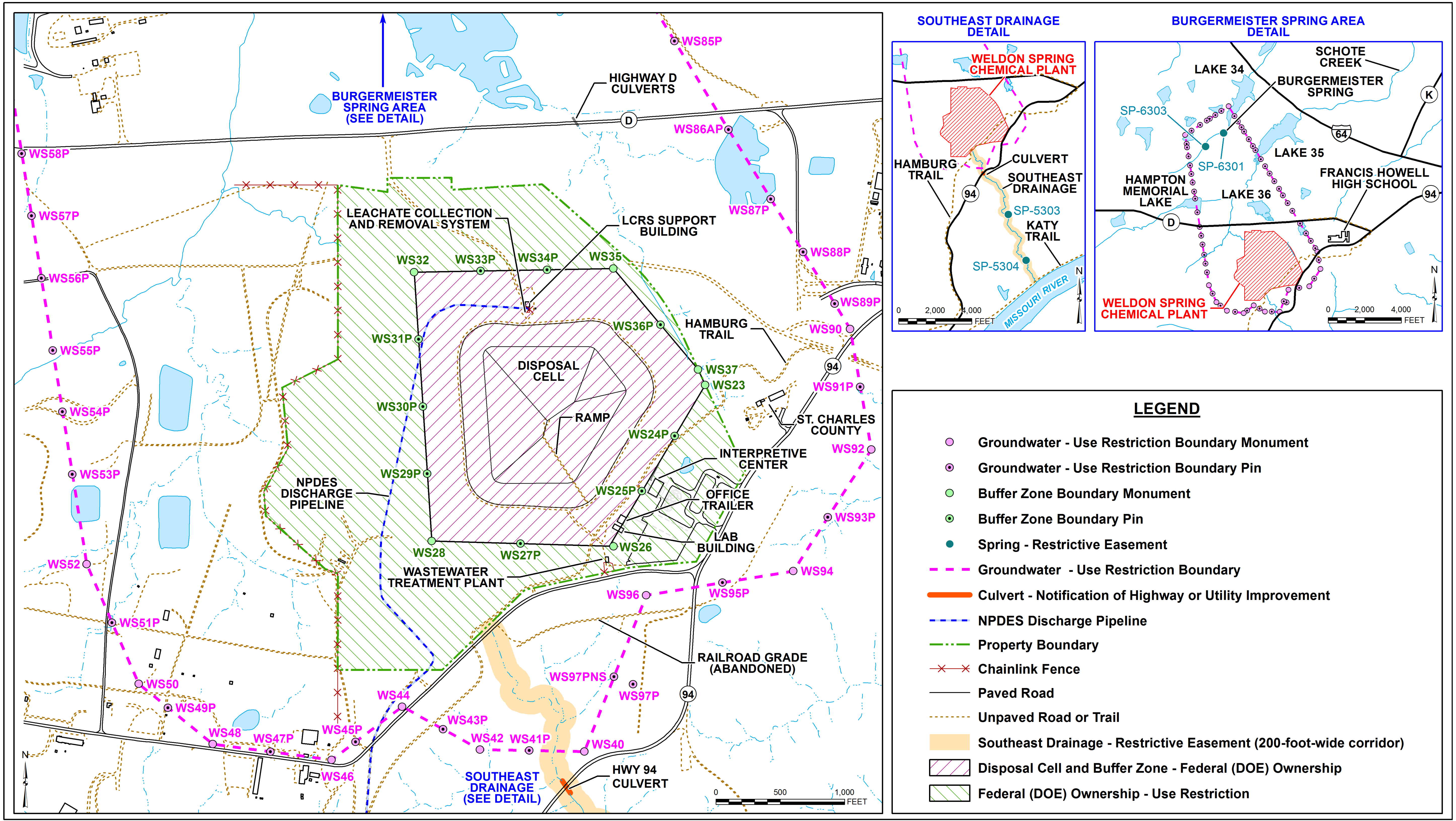

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Figure 6. Institutional Controls Location Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site

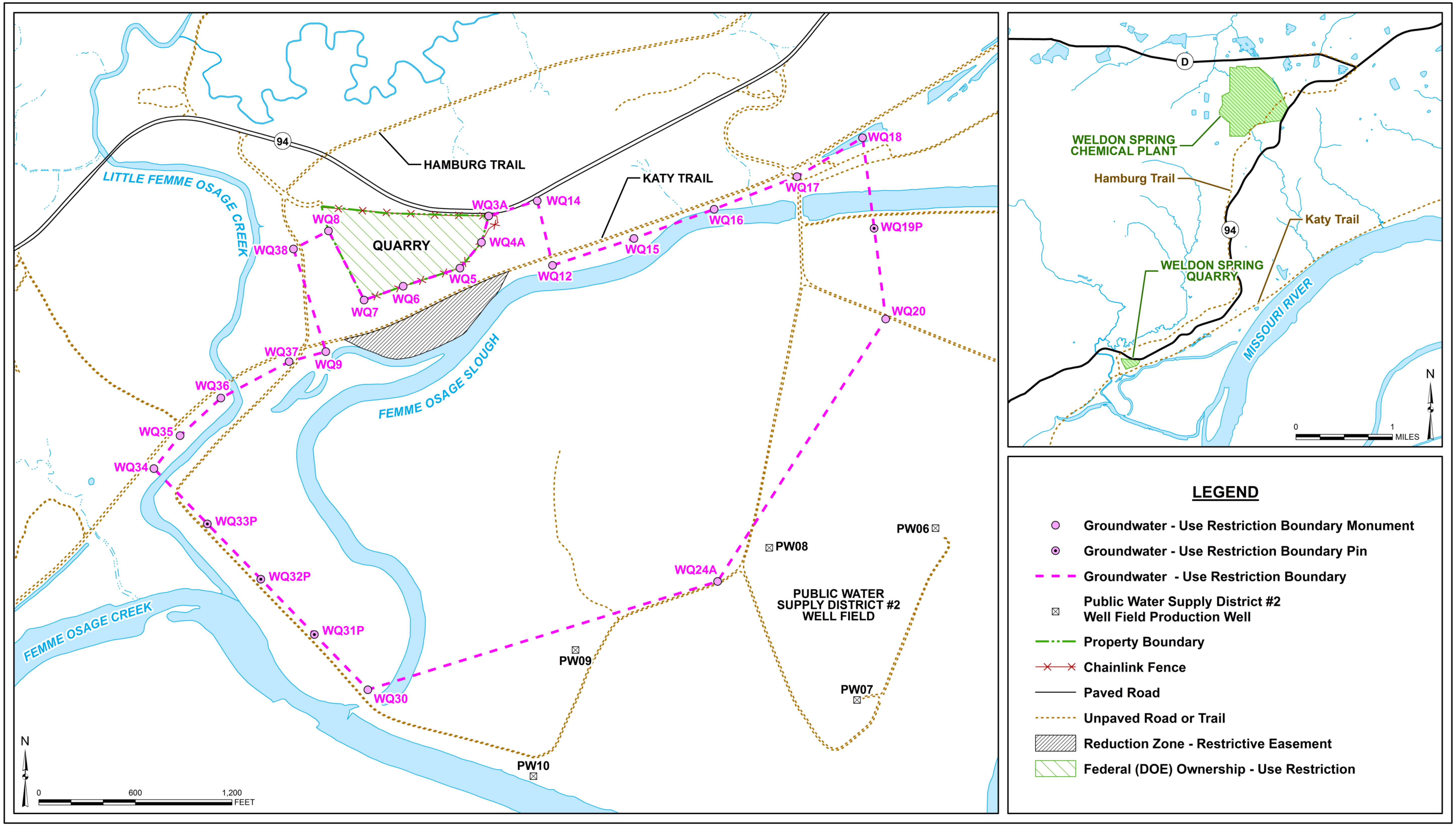

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Figure 7. Institutional Controls Map for the Quarry Area of the Weldon Spring, Missouri, Site

2.2.1.1 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. No party has been granted use of portions of the former Chemical Plant area.

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, including property owned by MDC and the Army. Inspectors observed no evidence of groundwater use, and current land use remains consistent with ICs on both properties. Burgermeister Spring 6301 (Section 2.5 Photo 1) and Spring 6303 on MDC property were inspected, and there were no indications of spring water use. Spring 6303 was not flowing during the time of the inspection. The last time it was observed to be flowing was in 2013. All the monitoring wells inspected were appropriately secured.

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 established ICs.

2.2.1.5 Southeast Drainage

Inspection Criteria: The Southeast Drainage is restricted for residential housing in a 200 ft corridor (100 ft from the center line on each side). Check for indications of residential use or construction in the Southeast Drainage (200 ft 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.

Inspection Results: The inspectors walked down the entire Southeast Drainage (Section 2.5, 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 springs were observed to be flowing. Current land use remains consistent with established ICs. Inspectors observed that some erosion is occurring under the culvert that crosses under the Hamburg Trail. Raenhard Wesselschmidt of MDC noted the condition during the 2015 inspection. John Vogel of MDC had been notified of this by email in October, 2011; October, 2012; November, 2013; and December, 2014.

2.2.1.6 State Route 94 Culvert

Inspection Criteria: Check for signs of disturbance of the affected area 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 covered with leaves but no other debris. Stowe Johnson of MoDOT was emailed a picture of the culvert on December 1, 2015.

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 on August 26, 2015, by DOE, MDNR and Navarro personnel. This inspection is documented in Appendix D, and the report was provided to participants during the inspection. It was noted that no onsite disturbances of the pipeline or disturbances of the offsite areas of the pipeline and manholes were apparent. 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.

2.2.2 Disposal Cell

The disposal cell was inspected in accordance with the LTS&M Plan and the annual inspection checklist (Section 2.5, Photo 3). The cell inspection was divided into 10 transects (Figure 8). 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 previous annual reports, slight depressions or bulges that were noted during the inspection were included on Figure 8; however, due to the subjectivity of visually delineating surface anomalies of the rock-covered cell, the accuracy and relevance of the practice was questioned. DOE began investigating more objective options that may define these types of areas better than visual interpretations. LiDAR was conducted on the disposal cell in December 2014. DOE has determined that this technology will provide sufficient detail for assessing the disposal cell cover topography, with regulator concurrence as discussed below. 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), 2013, and 2014 for comparison (Section 2.5, Photos 4 through 21). A test plot (Test Plot 6) had been marked during 2011 in response to a request from MDNR during the 2010 inspection. This plot is located on the south face of the disposal cell (Figure 8).

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.

Aerial surveys are required by the LTS&M Plan to be performed in conjunction with the CERCLA five-year reviews. The survey is required to be conducted with a vertical resolution no less precise than 0.5 ft and map and survey data to be produced with the cell surface represented by 1.0-foot contour intervals. The data are reviewed for indications of possible settlement. The first survey was performed in 2003 as a baseline, and subsequent surveys were performed in 2005 and 2010 in conjunction with the CERCLA five-year reviews.

An aerial survey of the disposal cell was flown in December 2014 (Figure 9). This aerial survey utilized the Light Detection and Radar (LiDAR) technology that generated 6-inch contours. The previous surveys generated 1-foot contours using photogrammetric methods. The survey results were discussed during the inspection. DOE informed EPA and MDNR that they plan to conduct the Aerial LiDAR survey every 2 years (at least initially) and have the aerial survey contractor compare the data and perform change detection between the surveys. DOE proposed that the detailed LiDAR survey and evaluation take the place of walking the transects on the disposal cell starting in 2016. As indicated above, results of visually delineating surface anomalies during the transect walk have historically been subjective and have not added any quantitative value. The LiDAR survey is more objective and is supported by technological data. The use of the LiDAR survey would also reduce the hazards to personnel performing the inspection of the disposal cell. It would still be planned to walk to the rock degradation areas and perform the routine inspection of these areas each year by comparing the test plot area to the previous year’s photograph and photographing the test plot. EPA and MDNR were agreeable with the proposal.

2.2.3 Leachate Collection and Removal System (LCRS)

Navarro staff discussed operation of the LCRS and the SOARS (System Operation and Analysis at Remote Sites) system with the inspection participants, presented the LCRS data, and inspected the system. The leachate is pretreated for uranium and then disposed of by hauling to the MSD Bissel Point Plant. 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 E.

2.2.4 Erosion

2.2.4.1 Chemical Plant Area

The erosion areas were observed during the inspection (Section 2.5 Photo 22). Erosion channels within the entire prairie have been mapped with GPS annually since 2007 (Figure 10). The information is used to track the nature and extent of erosion and to determine action, if necessary. During the inspection, it was noted that the erosion and plant growth in the erosion areas has improved over past years and is not considered an issue at this time.

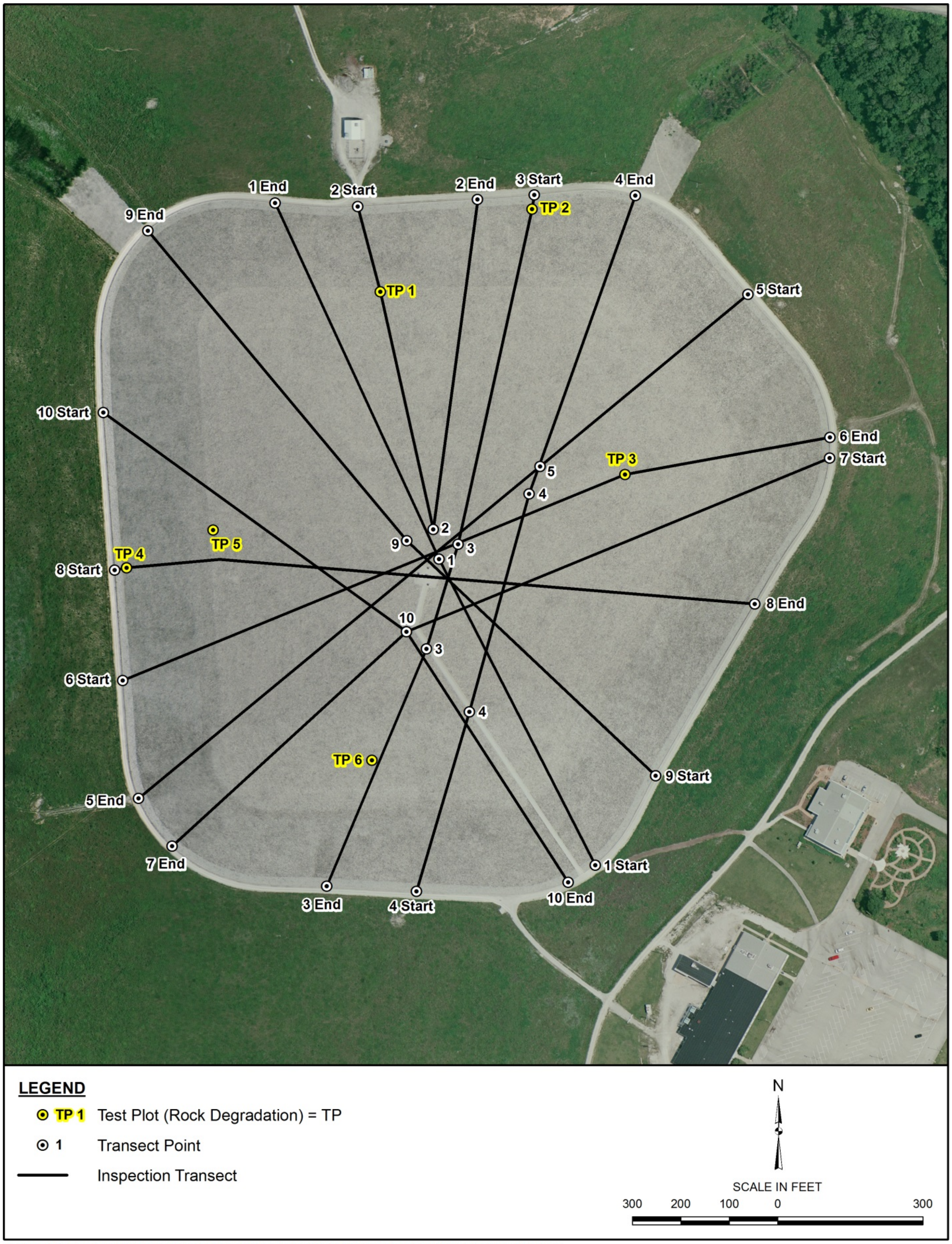

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Figure 8. Disposal Cell Inspection Transects and Rock Test Plot Locations at the Weldon Spring, Missouri, Site

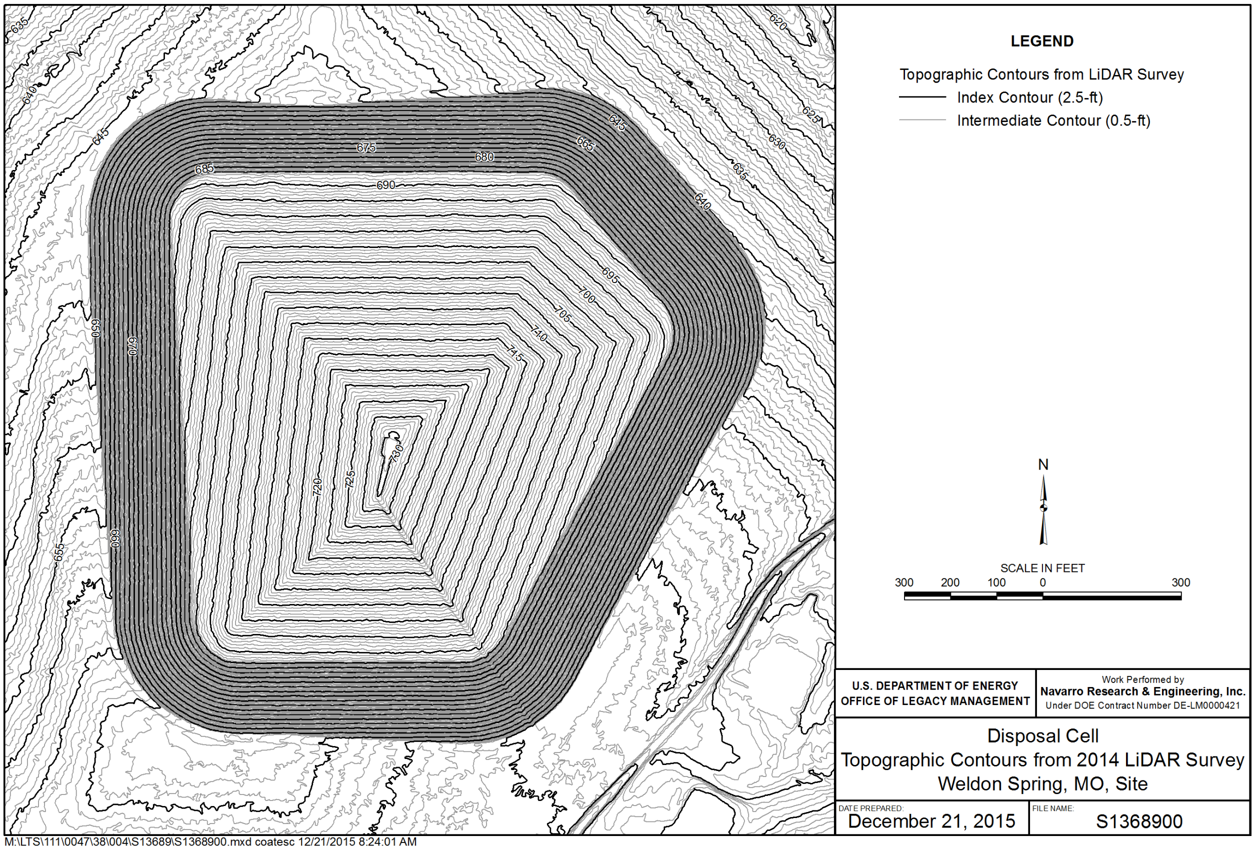

Figure 9. LiDAR Aerial Survey

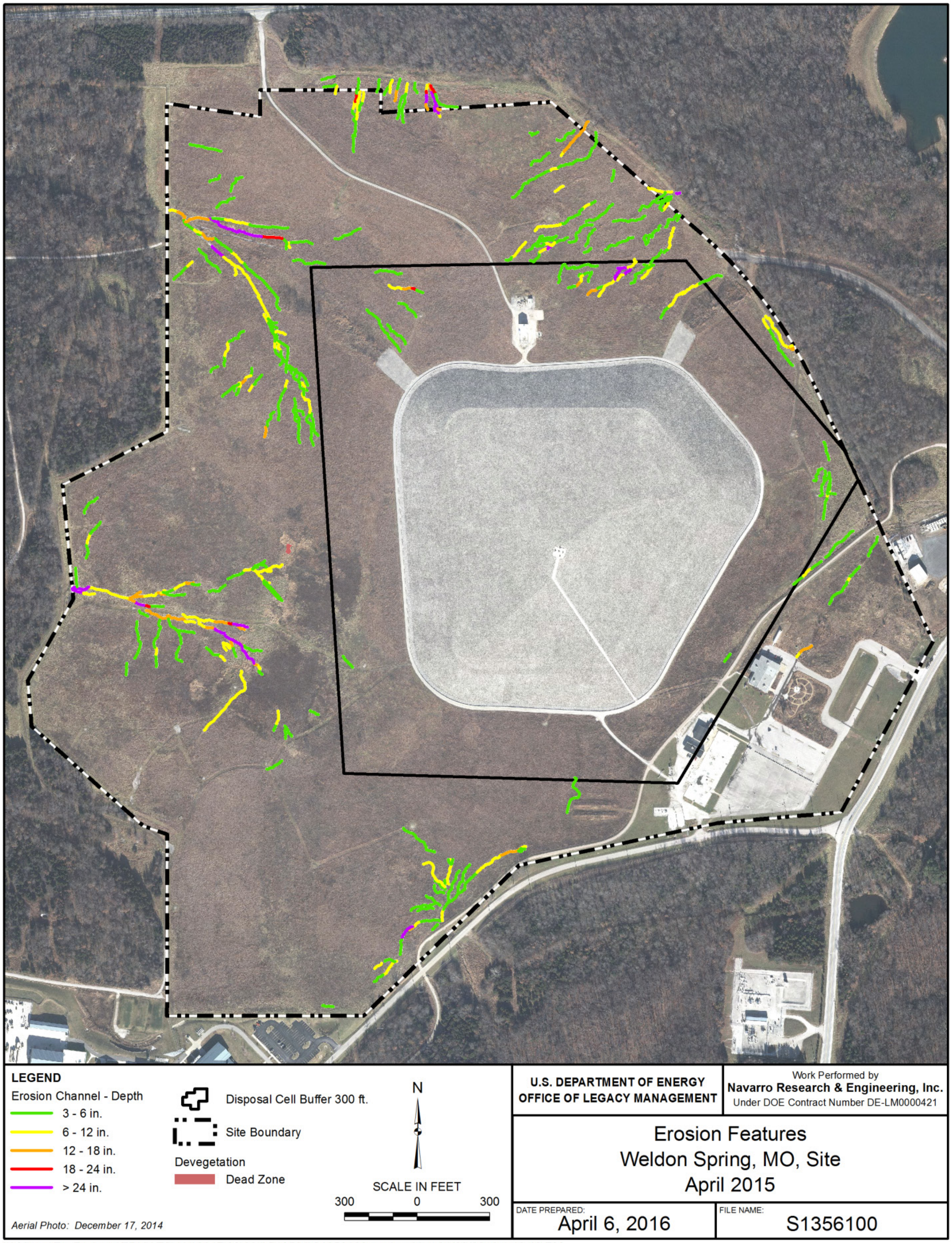

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Figure 10. Erosion Features Within the Prairie

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. Security patrols have been increased over the past 5 years for visibility and to reduce vandalism and increase safety at the site. Signs stating that the area is under video surveillance were also posted at the disposal cell entrance and at the top of the disposal cell. Vandalism is presently not an issue.

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. The historical markers were inspected (Section 2.5 Photo 23) and were in good condition. The actual signs had recently been replaced prior to the inspection.

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 2015 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 (Figure 11). 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 identification number on the well. The wells appeared to be in good condition.

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. Twenty-seven wells were inspected (39 percent). The following wells were inspected: MW-2035, 2036, 2037, 2038, 2039, 2040, 3026, 3027, 3028, 3029, 3030, 3034, 3037, 3038, 3039, 4001, 4006, 4007, 4026, 4027, 4029, 4031, 4032, 4038, 4040, 4041, 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 10 wells (29 percent) were inspected: MW-1006, 1008, 1009, 1012, 1014, 1017, 1018, 1044, 1052, RMW-4.

2.2.7 Onsite Document and Record Verification

The following onsite documents and records were available during the inspection:

- LTS&M Plan (DOE 2008a)
- NPDES permit: No. MO-0107701
- 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 restrictions with each representative. The representatives contacted are listed below.

- John Vogel, MDC
- Audrey Beres, MDC
- Danny Lyskowski, MDNR-Parks
- Quinn Kellner, MDNR-Parks
- John Downing, 88th Regional Support Command, U.S. Army
- Tom Blair, MoDOT
- Jim Wright, 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.

Navarro 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 (EPA 2001). The forms for each of these contacts and interviews are attached as Appendix F.

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: Disposal Cell Inspection

Photo 4: 2003 Cell cover test plot TP1: north edge of north facet

Photo 5: 2014 Cell cover test plot TP1: north edge of north facet

Photo 6: 2015 Cell cover test plot TP1: north edge of north facet

Photo 7: 2003 Cell cover test plot TP2: bottom of north side slope

Photo 8: 2014 Cell cover test plot TP2: bottom of north side slope

Photo 9: 2015 Cell cover test plot TP2: bottom of north side slope

Photo 10: 2003 Cell cover test plot TP3: northeast ridgeline

Photo 11: 2014 Cell cover test plot TP3: northeast ridgeline

Photo 12: 2015 Cell cover test plot TP3: northeast ridgeline

Photo 13: 2003 Cell cover test plot TP4: located on upper west side

Photo 14: 2014 Cell cover test plot TP4: located on upper west side

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Photo 15: 2015 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: 2014 Cell cover test plot TP5: located on lower west side

Photo 18: 2015 Cell cover test plot TP5: located on lower west side

Photo 19: 2011 Cell cover test plot TP6: located on lower west side

Photo 20: 2014 Cell cover test plot TP6: located on lower west side

Photo 21: 2015 Cell cover test plot TP6: located on lower west side

Photo 22: Erosion area north of the disposal cell

Photo 23: Historical marker No. 2

Photo 24: Monitoring well MW-3039

3.0 Prairie and Garden Maintenance

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

Unfavorable weather and other project priorities in the spring and fall of 2015 prevented performing a controlled burn during that 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 2015 and consisted of manual weeding performed throughout the growing season. The beds were mulched in spring to reduce weeds and improve moisture retention during summer months. In September 2015 partner organizations donated native plants, which were installed in numerous locations throughout the garden.

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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 behind the efforts.
- 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 visit the Interpretive Center during normal hours of operation to view exhibits and learn about the site.
- 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 and educational events.
- Scheduled groups that are unable to visit the site but are recipients of Interpretive Center outreach presentations.

- Individuals attending Interpretive Center educational programming targeted to public audiences.
- Individuals engaged in Interpretive Center educational activities hosted offsite at a partner organization public participation events.

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 these activities do not involve entering the Interpretive Center and are often outside of normal hours of operation, they are not consistently tracked.

Attendance at the Interpretive Center in 2015 was 27,079 (Table 4). 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	1226	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
2014	1168	1401	2478	2298	2891	1379	1491	696	2026	3187	1951	1056	22,022
2015	1,491	1,746	2,524	3,592	2,169	1,308	934	1,099	3,417	5,403	1,747	1,649	27,079
													250,002

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 located along the southern boundary of the site can be seen on potentiometric maps of both the weathered and unweathered units (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. Dashed contours are used on the maps in areas where data are less abundant.

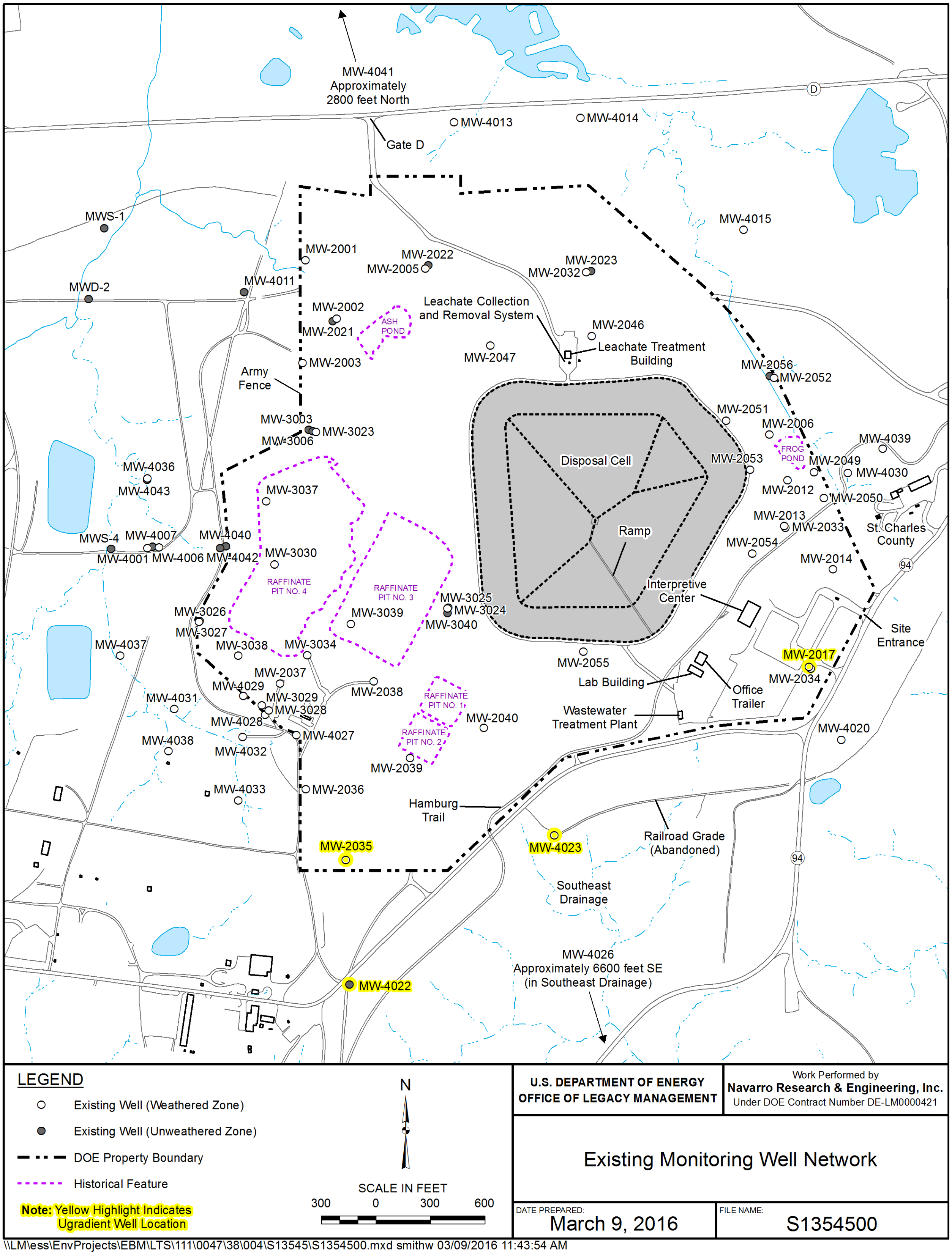

Figure 11. Existing Monitoring Well Network

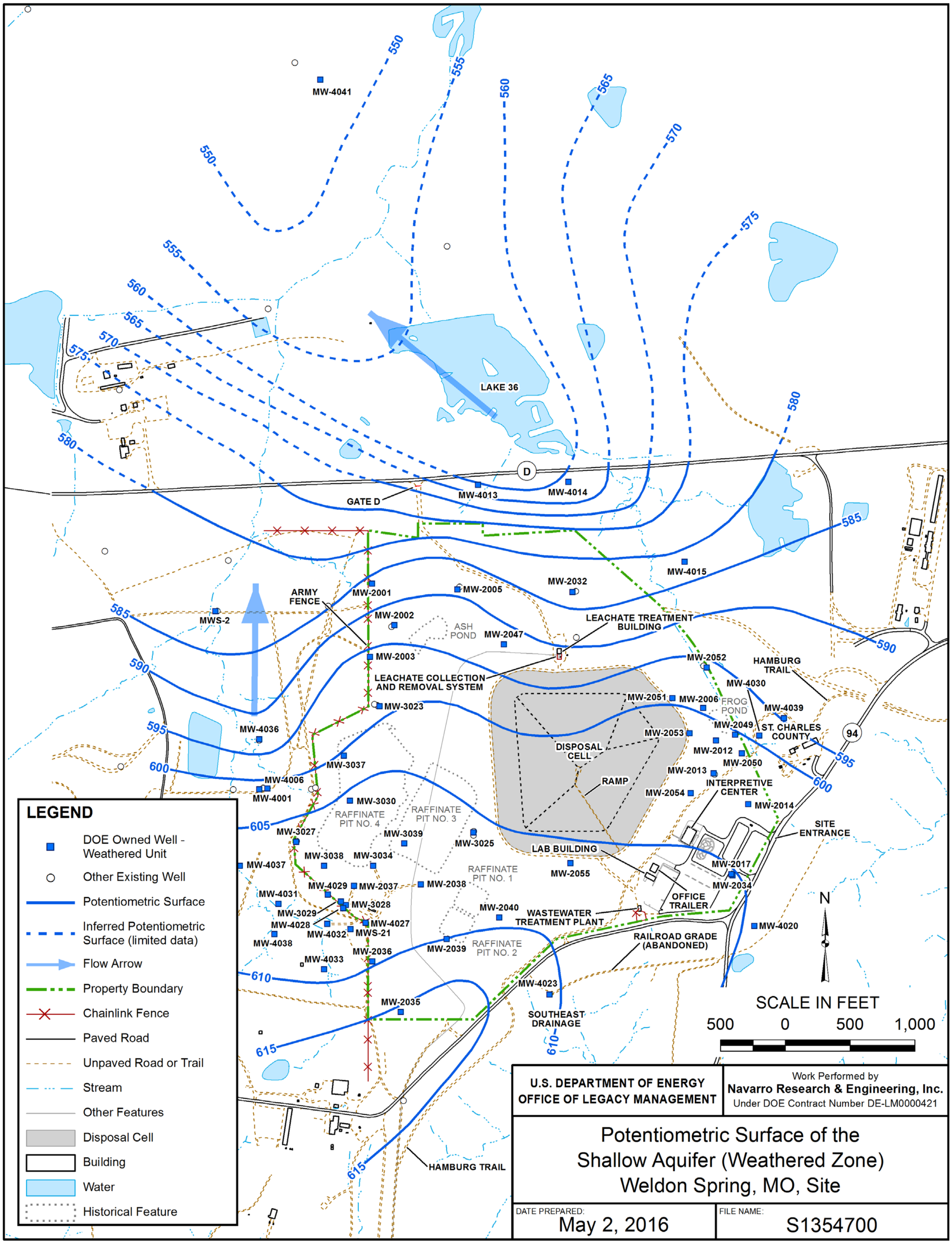

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Figure 12. Weathered Unit Groundwater Surface at the Weldon Spring Former Chemical Plant (Fall 2015)

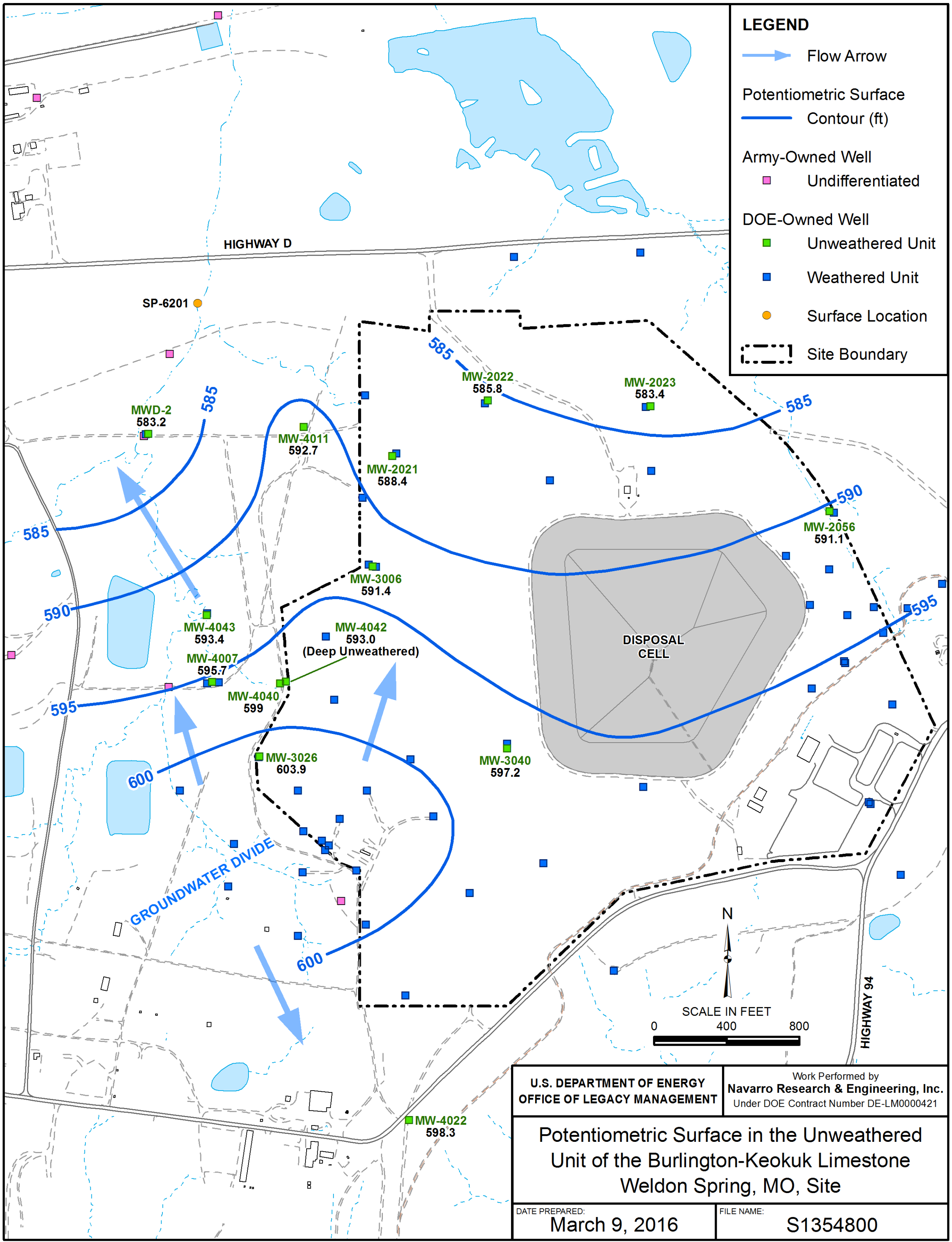

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Figure 13. Unweathered Unit Groundwater Surface at the Weldon Spring Former Chemical Plant (Fall 2015)

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. Wells screened in the underlying unweathered zone of the Burlington-Keokuk Limestone are used to assess the vertical migration of contaminants and to monitor for any horizontal migration in this zone. 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 provides 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 contaminants of concern.

The presence of elevated total uranium and nitrate levels at Burgermeister Spring (SP-6301), 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.

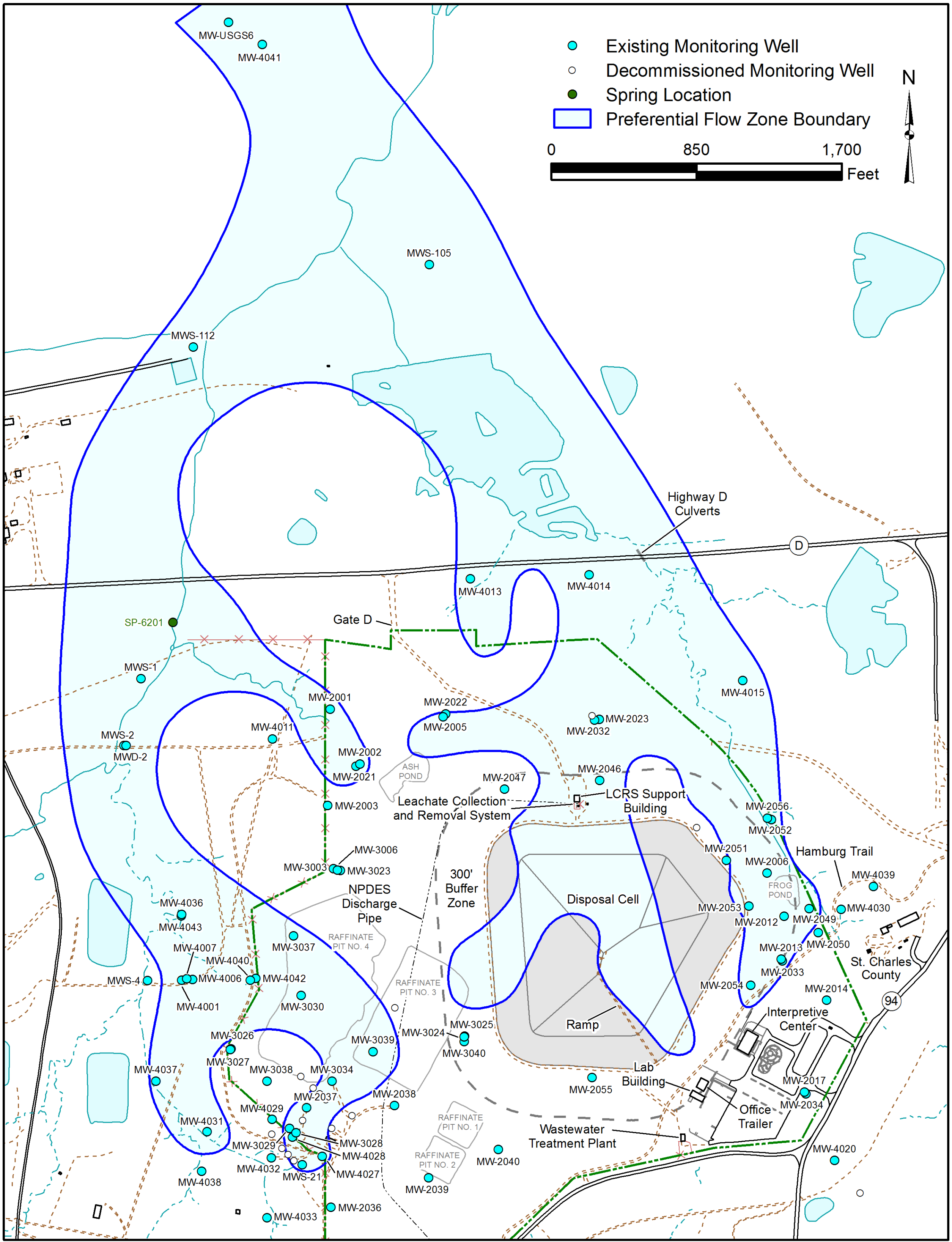

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Figure 14. Preferential Flow Paths in the Burlington-Keokuk Limestone at the Chemical Plant Area

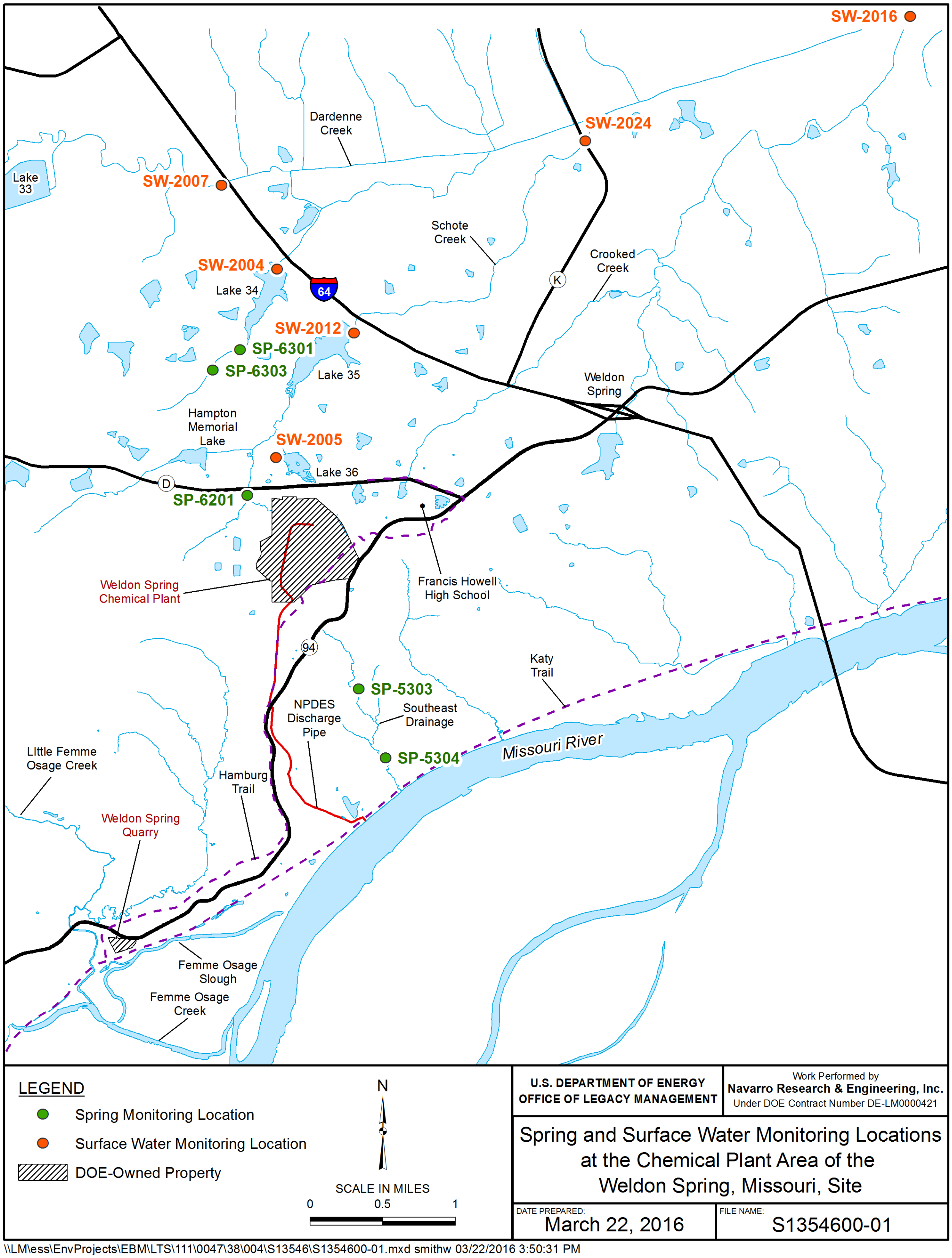

Figure 15. Spring and Surface Water Monitoring Locations at the Chemical Plant Area of the Weldon Spring, Missouri, Site

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; see description of objectives in Section 5.2.1.4) 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. Groundwater levels in monitoring network wells are regularly measured to determine site groundwater flow directions at different times of the year. This allows the variability in flow directions to be monitored and the adequacy of the network to be assessed for shifts in potential contaminant migration.

The groundwater elevations measured in the fall of 2015 (September 28 to September 30) were used to construct potentiometric surface maps of the weathered and unweathered units of the shallow aquifer using the available wells at the Chemical Plant (Figure 12 and Figure 13). The configuration of the potentiometric surfaces has remained relatively unchanged from previous years. Even though the groundwater elevations vary somewhat during the year in response to wet and dry periods, the groundwater flow direction has been consistently to the north. Troughs in the groundwater surfaces coincide with the location of paleochannels. Note that MW-4042 is screened in the deep portion of the unweathered unit and has a lower head than the upper part of the unweathered unit (Figure 13).

Groundwater elevations generally decreased in the weathered unit of the Burlington-Keokuk Limestone in response to the site remediation activities in the late 1990s and early 2000s but have since stabilized (Figure 16). Spring SP-6303, northwest of the site, has been dry since the April 4, 2013 sample was collected. Well MW-3028 was pumped during 2001 (drawdown on Figure 16) as part of the field studies on 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 and variability. Groundwater elevations in both the weathered and unweathered units have decreased in the Raffinate Pits area (MW-3024, Figure 17) in response to the removal of large surface water impoundments, such as the raffinate pits, during site remediation.

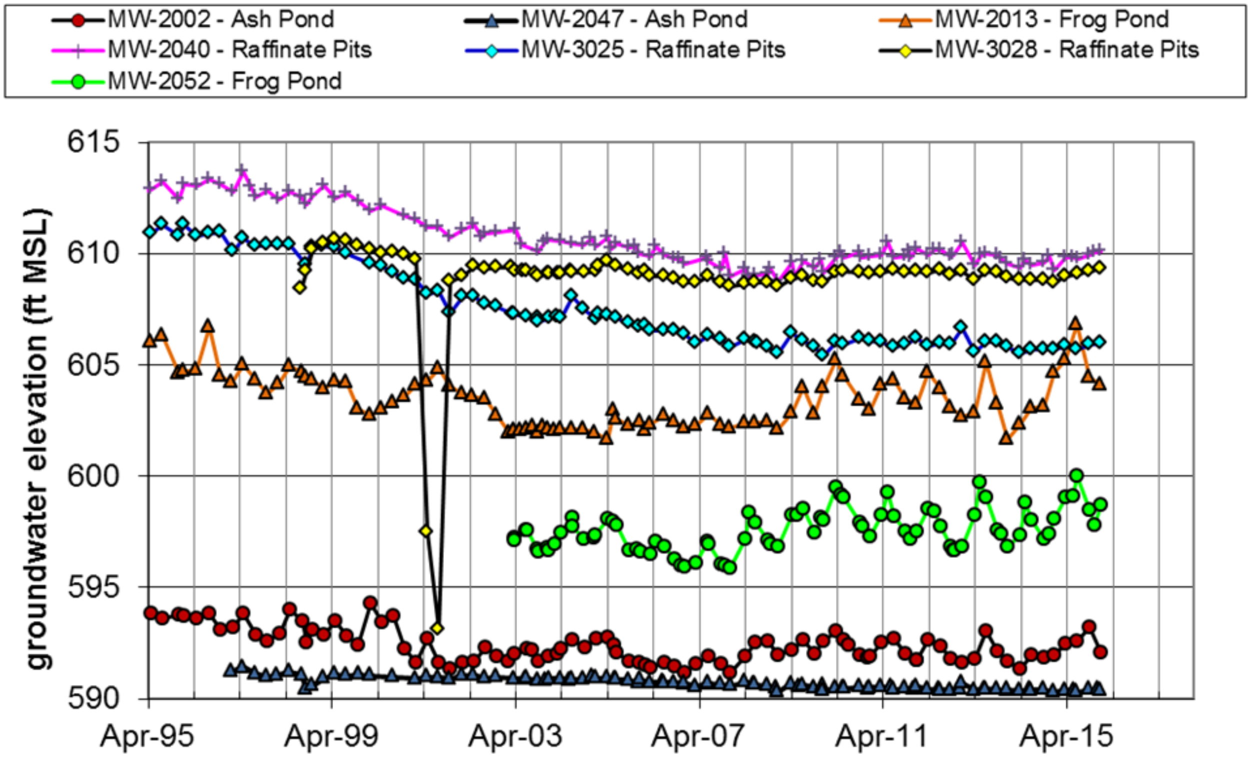

Figure 16. Groundwater Elevations in the Weathered Unit

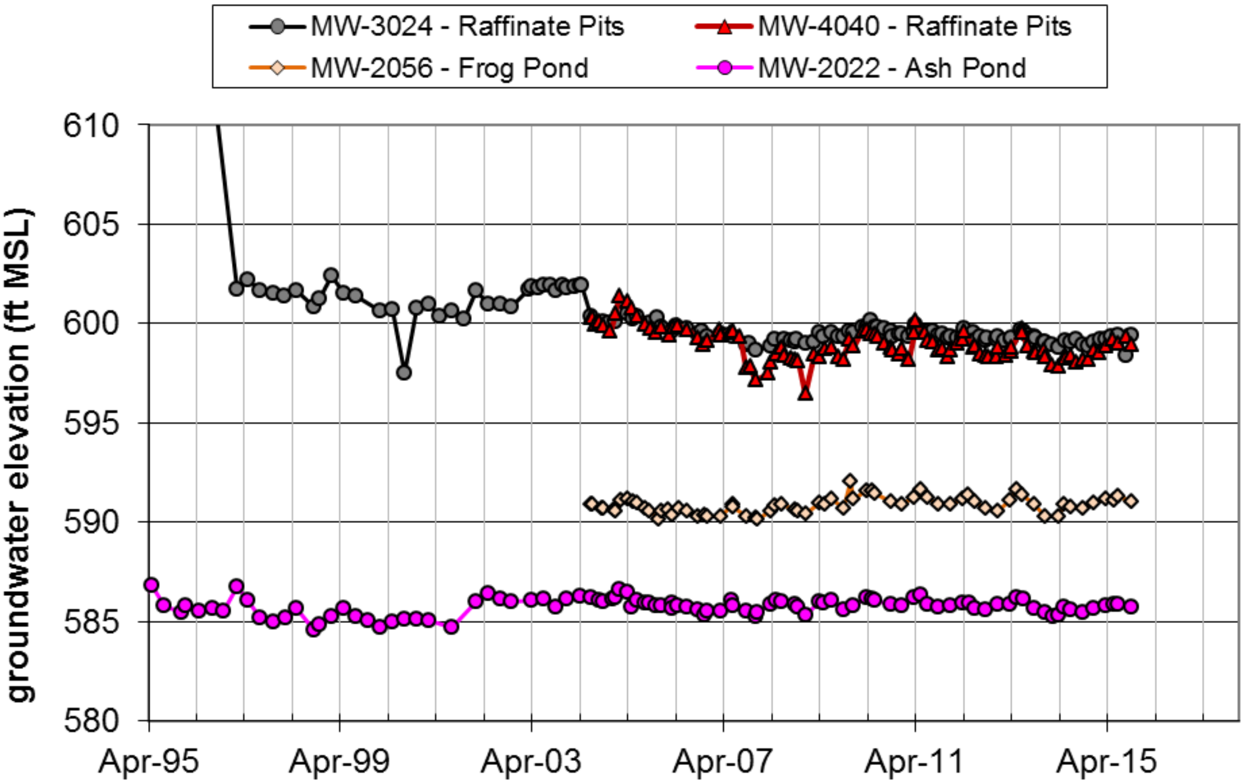

Figure 17. Groundwater Elevations in the Unweathered Unit

5.2.1.3 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. Nitrite is typically not detectable when measured separately. Throughout the document, “nitrate as N” will be referred to as “nitrate.” Contamination in groundwater is generally limited 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. Remediation activities at the site have removed the primary source zones for groundwater contamination. 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 mass concentrations are reported in milligrams per liter (mg/L) from the laboratory. This value is converted to picocuries per liter by dividing the uranium mass concentration 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 picocuries per liter will be referred to as concentrations throughout this report.

Nitrate is present in the groundwater near the former Raffinate Pits area 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 former 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 [NB]) 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.

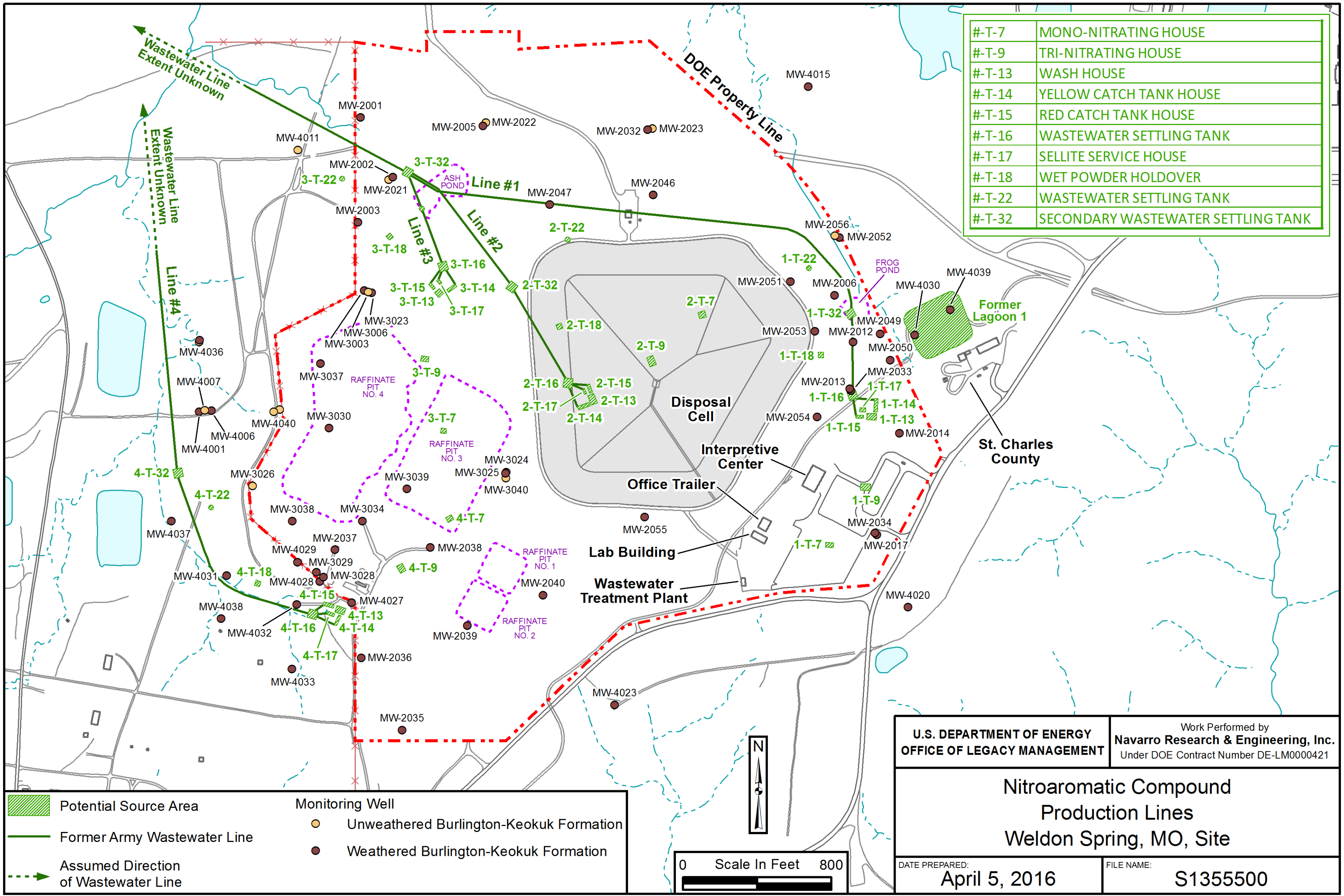

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Figure 18. Nitroaromatic Compound Production Lines

5.2.1.4 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. 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.

There were 48 wells, 4 springs (SP-6303 was dry), and 1 surface water location sampled at the former Chemical Plant during 2015. 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 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:

- Upgradient locations (Objective 1) indicate that baseline conditions remain unchanged.
- Performance monitoring locations (Objective 2) indicate that concentrations within the area of impact are decreasing or remaining stable. 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. 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.
- Detection monitoring locations (Objectives 3, 4, and 5) monitor for unacceptable expansion of the area of impact. Objective 3 locations ensure that lateral migration remains confined to the current area of impact. Objective 4 locations monitor groundwater underlying the impacted areas to confirm that there is no significant vertical migration of contaminants. Objective 5 locations monitor contaminant levels at 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.
- 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. Only water levels are monitored at Objective 6 locations.

Table 5. Monitoring Program for GWOU MNA Remedy

Location	Objective	Unit	TCE	Nitrate	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	Weathered [a]		✓	✓					
MW-3024	2	Unweathered			✓					
MW-3026	2	Unweathered								
MW-3030	2	Weathered	✓		✓			✓		
MW-3034	2	Weathered	✓	✓				✓		
MW-3039	2	Weathered						✓		
MW-3040	2	Unweathered		✓	✓					
MW-4013	2	Weathered		✓						
MW-4029	2	Weathered	✓	✓						
MW-4031	2	Weathered		✓						
MW-4040	2	Unweathered		✓	✓					
MW-2032	3	Weathered				✓	✓	✓	✓	✓
MW-2051	3	Weathered				✓	✓	✓	✓	✓
MW-3037	3	Weathered	✓		✓			✓		
MW-4013	3	Weathered						✓	✓	✓
MW-4014	3	Weathered		✓		✓	✓	✓	✓	✓
MW-4015	3	Weathered						✓	✓	✓

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

Location	Objective	Unit	TCE	Nitrate	Uranium	1,3-DNB	2,4,6-TNT	2,4-DNT	2,6-DNT	NB
MW-4026	3	Alluvium/SED			✓					
MW-4036	3	Weathered	✓	✓	✓					
MW-4039	3	Weathered				✓	✓	✓	✓	✓
MW-4040	3	Unweathered	✓					✓		
MW-4041	3	Weathered	✓	✓	✓	✓	✓	✓	✓	✓
MWS-1	3	Weathered	✓	✓	✓			✓		
MWS-4	3	Weathered	✓	✓	✓					
MW-2021	4	Unweathered		✓						
MW-2022	4	Unweathered	✓			✓	✓			
MW-2023	4	Unweathered				✓	✓	✓	✓	✓
MW-2056	4	Unweathered				✓	✓	✓	✓	✓
MW-3006	4	Unweathered	✓	✓	✓			✓		
MW-4007	4	Unweathered	✓	✓						
MW-4042	4	Unweathered		✓	✓					
MW-4043	4	Unweathered	✓	✓	✓		✓	✓		✓
MWD-2	4	Unweathered		✓	✓					
SP-5303	5	Spring/SED			✓					
SP-5304	5	Spring/SED			✓					
SP-6201	5	Spring		✓	✓					
SP-6301	5	Spring	✓	✓	✓	✓	✓	✓	✓	✓
SP-6303	5	Spring	✓	✓	✓	✓	✓	✓	✓	✓
SW-2007	5	Stream			✓					

Notes:
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.
[a] MW-3003 is screened across the weathered/unweathered unit interface.

Abbreviations:
SED = Southeast Drainage; DNT = dinitrotoluene; NB = nitrobenzene; DNB = dinitrobenzene; TNT = trinitrotoluene; TCE = trichloroethene

Trigger Levels

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 of which is independent of the specific 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 3 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 the result 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* (DOE 2004c).

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 subclassified 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 3 standard deviations.

In impacted areas, where concentrations are expected to be variable, exceeding the fixed trigger may not be as significant 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 uranium fixed trigger level for 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 two of the three 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 were needed to better establish baseline concentrations. Uranium levels in the wells are beginning to stabilize, though concentrations continued to rise slowly during 2015 Concentrations of more mobile constituents in the raffinate pits, such as nitrate, initially increased in impacted area well MW-4040 but have since begun to decline. Given sufficient time, uranium concentrations should also peak and then decline. Appropriate responses to exceeding fixed triggers would be to increase sampling frequency to ensure that the trend is not seasonally affected, add additional downgradient sampling locations, or revise the trigger as warranted. A detailed discussion of the recommendations is available in the *Optimization for the Groundwater Operable Unit Monitored Natural Attenuation Network for Uranium Impact in the Unweathered Unit of the Burlington-Keokuk Limestone at the Weldon Spring, Missouri, Site* (DOE 2014). The fixed trigger levels are provided in Table 6.

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 (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

Notes:

Cleanup standards from the National Primary Drinking Water Regulations (40 CFR 141) and Missouri Groundwater Quality Standard, *Code of State Regulations*.

Abbreviations:

DNB = dinitrobenzene; DNT = dinitrotoluene; FP = Frog Pond; NB = nitrobenzene; RP = Raffinate Pits;
TNT = trinitrotoluene; TCE - trichloroethene

Groundwater data from locations that have detectable results 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 (confirm result with the analytical laboratory, and if necessary, resample). For those locations with "nondetect" sample results, a statistically significant increase is considered to be a result that exceeds the respective cleanup standard for two consecutive sampling periods. Contingency actions are defined in Appendix M of the LTS&M Plan. The data are currently being reviewed quarterly.

Non-Parametric Trend Analysis

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 2004d) using data from the previous 5 years (2011 through 2015). Results for the trending analysis are reported for the Objective 2 wells and the Objective 5 springs because these locations monitor groundwater impact at discharge points. The trend analysis is conducted using the Mann-Kendall test described in Helsel and Hirsch (2002). The Mann-Kendall test is implemented in the Visual Sampling Plan (VSP) software (VSP 2013; Gilbert 1987; Hirsch et al. 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 is nondetects and if detection limits change between sampling events. One-half of the specified detection limit was used for nondetect sample results (those reported at or below the detection limit). Results classified as nondetect are shown on the data charts as empty or white symbols (identified in the legend as a location name preceded by an "n", e.g., "nMW-1001") and are the same shape as the corresponding color-filled symbol for results classified as "detect." A trend is considered statistically significant if there is less than a 5 percent probability of concluding that a trend exists that could simply be the result of random chance. A calculated trend also requires at least 10 values to be considered statistically significant.

Trends are calculated from sample results collected at a location during the previous 5 years, less duplicates and rejected values. Trend results are shown on the data charts with their *p*-value and slope. If the *p*-value is less than 0.05, then the trend is considered statistically significant and either "up" or "down," depending on the slope. If the *p*-value is greater than 0.05, then there is no statistically significant trend ("none"). It has been shown that the false discovery rate for a *p*-value of 0.05 is close to 30% (Colquhoun 2014), or a 30% chance of concluding that a trend exists that could simply be the result of random chance. A more rigorous 2-tailed test (essentially a *p*-value of 0.025 for a 1-tailed test) for determining if a trend exists is being used to reduce the number of false trends. Trending requires 10 or more samples, especially for locations with variable results.

The data are plotted on a log-scale, since the rate of concentration increase or decrease typically slows with time, and it allows changes in lower-concentration wells to be compared with changes in higher-concentration wells. A linear regression line (Isaaks and Srivastava 1989) is plotted with the data on the charts to visually show the slope and the time period of data used for trending. If concentrations increase or decrease significantly over the trend calculation time period, the linear fit line will curve (plotted on a log-scale). Appendix G provides an example trending calculation using VSP.

5.2.1.5 Baseline Monitoring Results for the GWOU

Baseline conditions are monitored in four upgradient wells (Figure 11) to determine if possible changes in downgradient areas of impact are the result of changes in upgradient conditions. The objective of this monitoring is to determine if baseline conditions have remained unchanged. Each of these wells was sampled once during 2015. Table 7 presents the concentration for each parameter. The concentrations measured in 2015 are similar to those from previous years and indicate no change in upgradient groundwater quality.

Table 7. 2015 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 18, 2015	May 11, 2015	May 5, 2015	May 4, 2015
Parameters				
Uranium (pCi/L)	NR	0.44	3.4	1.8
Nitrate (mg/L)	NR	0.73	0.30	0.69
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 (<0.022)	ND (<0.021)	NR	NR
2,4-DNT (μg/L)	ND (<0.019)	ND (<0.019)	NR	NR
2,6-DNT (μg/L)	ND (<0.022)	ND (<0.021)	NR	NR
Nitrobenzene (μg/L)	ND (<0.032)	ND (<0.032)	NR	NR

Notes:
Objective 1 locations monitor unimpacted water quality at upgradient locations.

Abbreviations:
DNB = dinitrobenzene; DNT = dinitrotoluene; ND = analyte not detected above reporting limit indicated in parentheses; NR = analyte not required; TNT = trinitrotoluene

5.2.1.6 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 are declining or remaining stable as expected and that cleanup standards will be met in a reasonable time frame.

Performance of the remedy is gauged against long-term trend analysis as outlined in the MNA Baseline Concentrations Report (DOE 2008b) and the LTS&M Plan. Some locations are expected to show temporary upward trends due to ongoing dispersion, analytical variability, or other factors; however, concentrations are not expected to exceed historical maximums. Concentration-versus-time graphs serve as visual indicators of MNA progress.

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 (due to dispersion) within the paleochannels is minimal. Springs and surface water locations are also monitored, as these are the closest groundwater discharge points for the shallow aquifer in the vicinity of the 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.

Uranium GWOU Performance Monitoring Results

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 values for the 2011 through 2015 period. Figure 19 shows performance (red) and detection (blue) monitoring locations with 2015 uranium averages.

Table 8. Average Uranium Concentrations in GWOU Performance Monitoring Wells

Location	Uranium (pCi/L)				
	2011	2012	2013	2014	2015
Weathered Unit					
MW-3003	3.1	2.9	3.0	2.8	2.8
MW-3030	29	29	28	25	26
Unweathered Unit					
MW-4040	306	317	336	358	350
MW-3040	104	114	126	115	129
MW-3024	116	135	132	123	136
MW-3026	NS	NS	NS	44	54

[a] MW-3003 is screened across the transition from the weathered to the unweathered zone.

Uranium impact in the weathered unit is monitored in two wells. The highest uranium levels in this unit are measured in MW-3030 (Figure 20), installed beneath the former raffinate pits. The Objective 2 wells screened in the weathered unit have generally shown gradually decreasing uranium levels since the removal of the pits. The levels in MW-3003 have consistently been less than the MCL since 2000. Well MW-3003 is screened where the weathered unit transitions to the unweathered unit. Uranium concentrations have dropped since low-flow sampling was adopted at the beginning of 2004. Uranium levels in MW-3003 have declined to low levels and are beginning to stabilize near background levels.

Uranium levels in wells screened in the weathered unit have continued to decrease over the past 5 years. A statistically significant downward trend is indicated for MW-3030. The rate of decline appears to be decreasing, but uranium levels in MW-3030 could be consistently below the 20 pCi/L uranium MCL by 2025 to 2030.

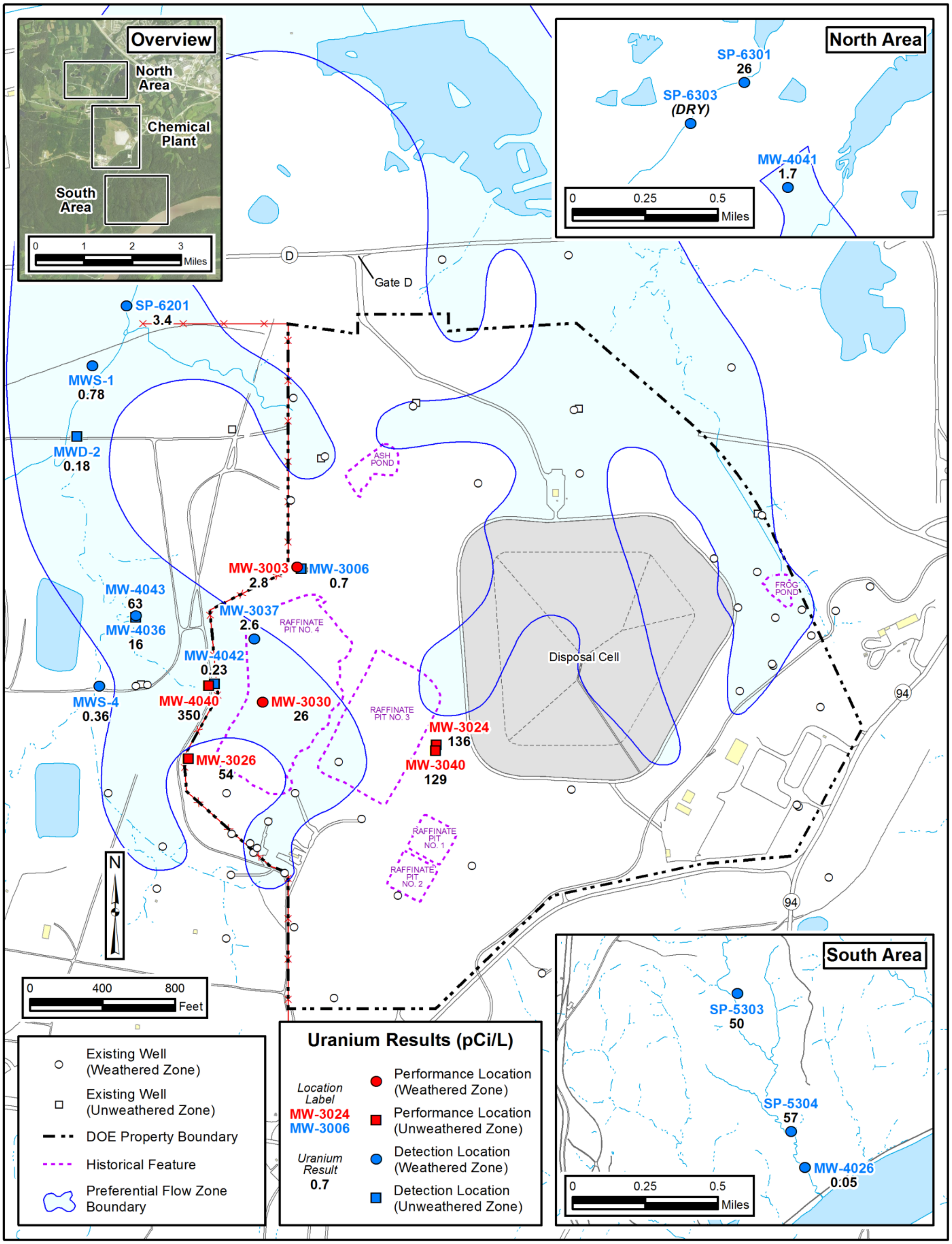

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Figure 19. Uranium Monitoring Locations with 2015 Average Concentrations

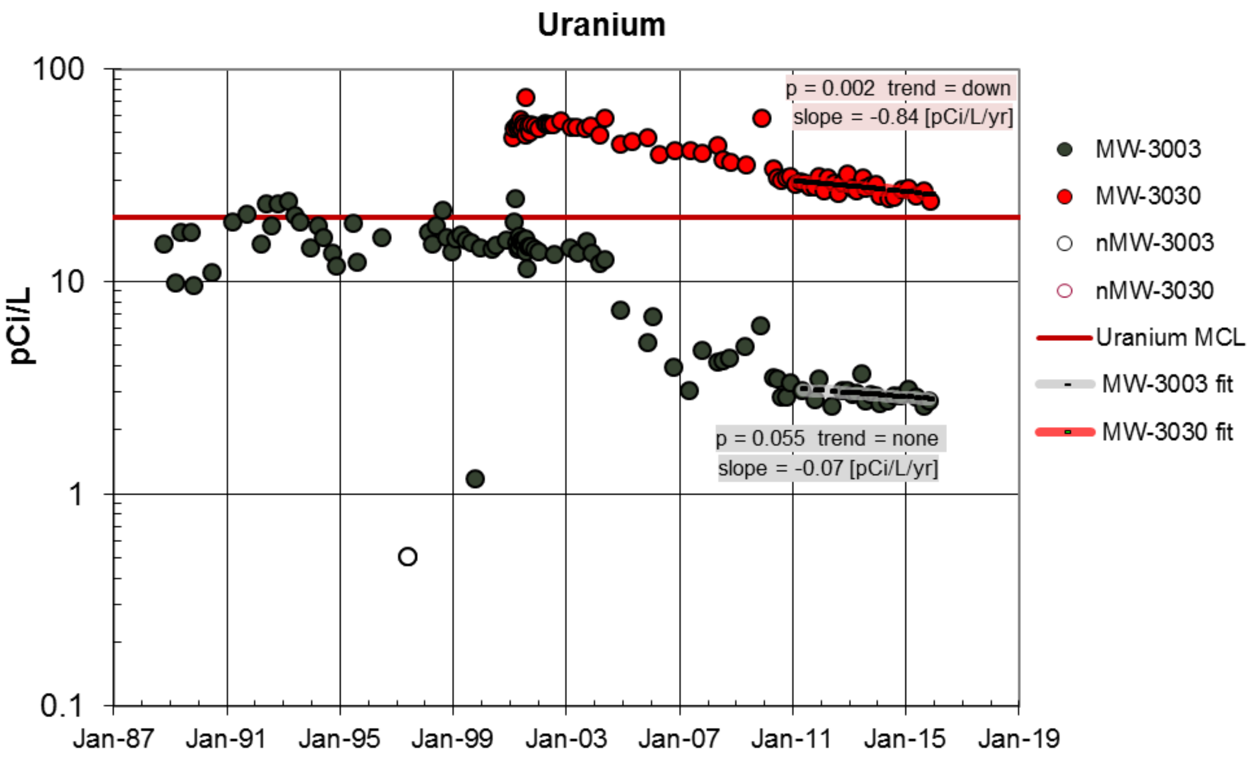


Figure 20. Uranium Concentrations in Performance Monitoring Wells—Weathered Unit

Uranium impact is greatest in the wells that are screened in the unweathered unit beneath and immediately downgradient of the former raffinate pits (Figure 19). 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 results in wells MW-4040, MW-3040, and MW-3024 were consistently above the Objective 2 100 pCi/L trigger level during the previous 5 years and are currently trending upward. Well MW-3026, which had not been sampled since 2004 due to low concentrations and a downward trend, was added to the uranium monitoring network in 2014 because of its proximity to former Raffinate Pit 4. The results since 2014 have been consistently higher (around 50 pCi/L) than samples collected 10 years earlier (Figure 21). They also appear to be increasing, although there are too few samples to indicate a statistically significant up trend. Data from well MW-4042 (screened deeper in the unweathered unit at the same location as high-concentration well MW-4040) indicate that significant uranium has not migrated into the deeper part of the unweathered unit.

The anomalously high values in late 2009 for each of the wells above the 100 pCi/L trigger level were lab qualified as estimated. The anomalously high result of the February 2014 sample collected from MW-4040 was not lab qualified as estimated. In response, MW-4040 was resampled; that result and later sample results were in line with historical results.

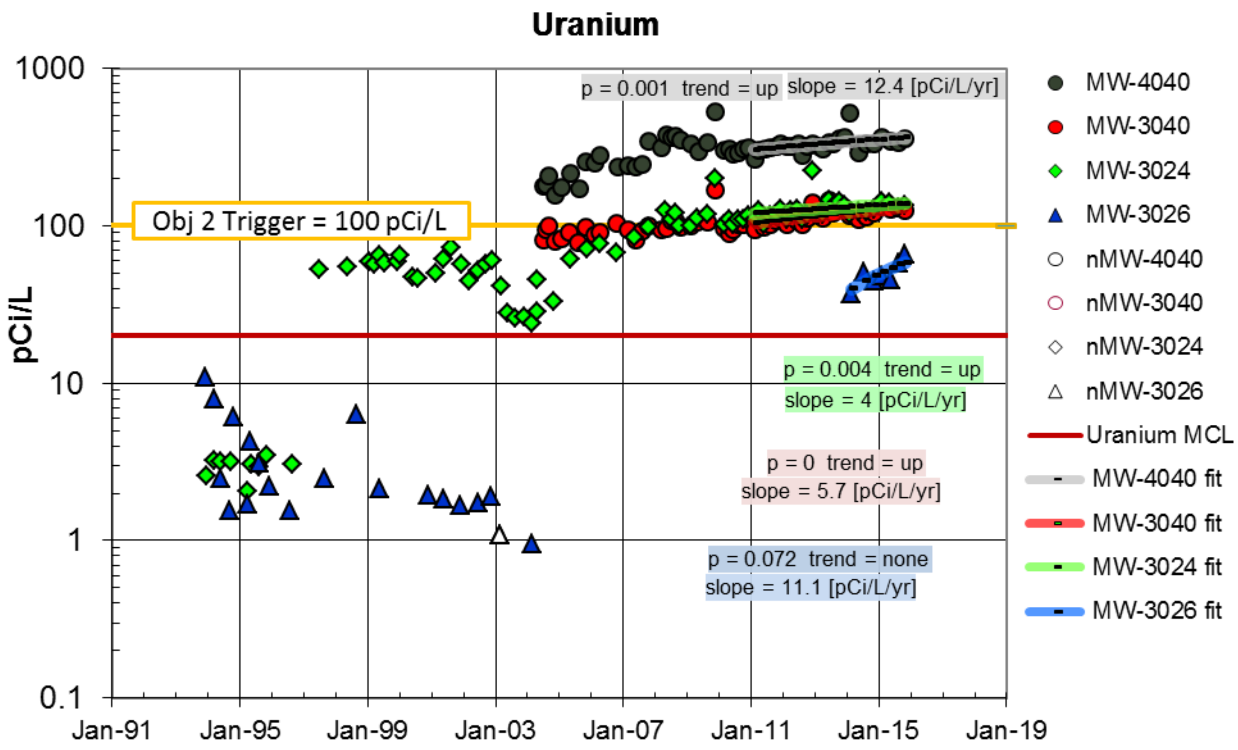
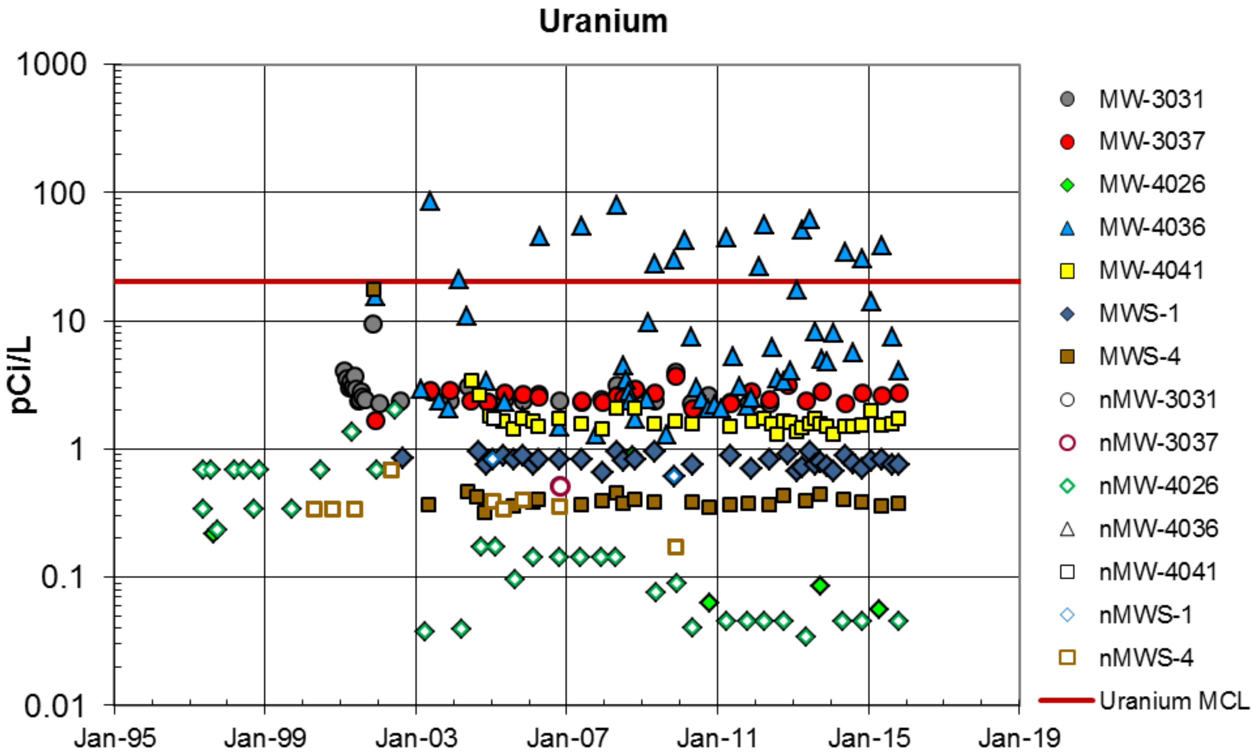


Figure 21. Uranium Concentrations in Performance Monitoring Wells—Unweathered Unit

Uranium GWOU Detection Monitoring Results

Uranium detection monitoring locations are listed in Table 9. Uranium levels have been at or below typical background levels for all weathered unit detection monitoring wells except MW-4036 (Figure 22). None of the weathered unit wells have a discernable trend. Uranium levels in MW-4036 vary seasonally, ranging from 2 to 62 pCi/L from 2011 through 2015.

Uranium levels have been at or below typical background levels for all unweathered unit detection monitoring wells except MW-4043 (Figure 23). Well MW-4043 averaged 77 pCi/L over the previous 5 years but has been trending downward, with the most recent result at 59 pCi/L. It is adjacent to weathered unit well MW-4036. Uranium levels in MW-3006 are on a recent up trend but are still below 1 pCi/L.



Note: MW-3031 decommissioned July 13, 2013

Figure 22. Uranium Levels in Detection Monitoring Wells—Weathered Unit

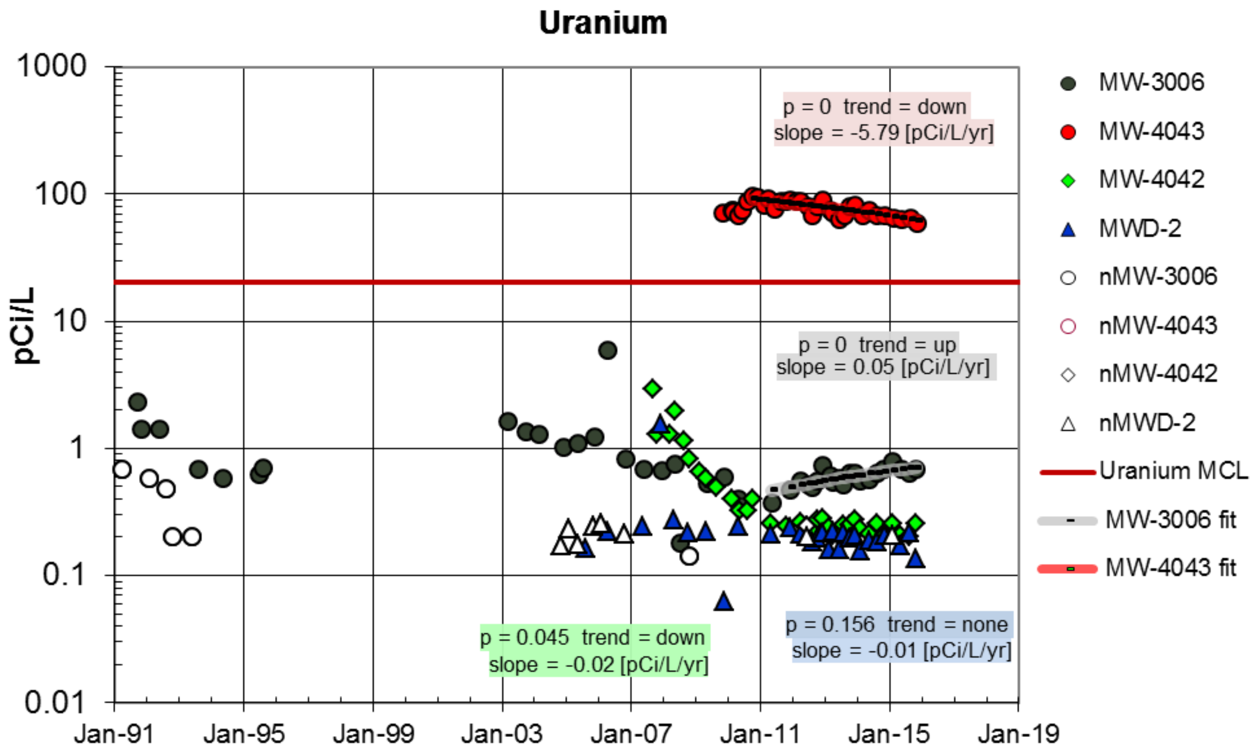


Figure 23. Uranium Levels in Detection Monitoring Wells—Unweathered Unit

Table 9. Uranium GWOU Detection Monitoring Locations

Locations	Detection Monitoring Areas
Weathered Unit	
MW-3031	Fringe
MW-3037	Fringe
MW-4026	Southeast Drainage (alluvium)
MW-4036	Downgradient
MW-4041	Downgradient
MWS-1	Downgradient
MWS-4	Downgradient
Unweathered Unit	
MW-3006	Fringe
MW-4042	Downgradient
MWD-2	Downgradient
Springs and Surface Water	
SP-5303	Southeast Drainage
SP-5304	Southeast Drainage
SP-6301	Burgermeister Spring Branch
SP-6303	Burgermeister Spring Branch
SW-2007	Dardenne Creek

The variable uranium levels in MW-4036 were part of a special study that was initiated in 2008. A new well, MW-4043 was installed in 2009 adjacent to MW-4036 and screened in the unweathered unit. The location is in the western preferential flow zone (paleochannel) that extends north-northwest from Raffinate Pit 4.

Uranium concentrations in MW-4036 vary nearly 2 orders of magnitude, ranging from above those in upgradient impacted area well MW-3030 to near background levels (about 2 pCi/L) during the year (Figure 24). The variation in this well is a response to seasonal effects that cause water levels in the unweathered unit to rise more than those in the overlying weathered unit, creating a seasonal upward vertical gradient, typically most pronounced in the winter and spring. Concentrations in weathered unit well MW-4036 can approach those in unweathered unit well MW-4043 when there is an upward gradient. When there is no upward gradient, concentrations in MW-4036 decline to near-background levels. These data indicate that uranium is migrating horizontally from the impacted area in the unweathered unit within the paleochannel.

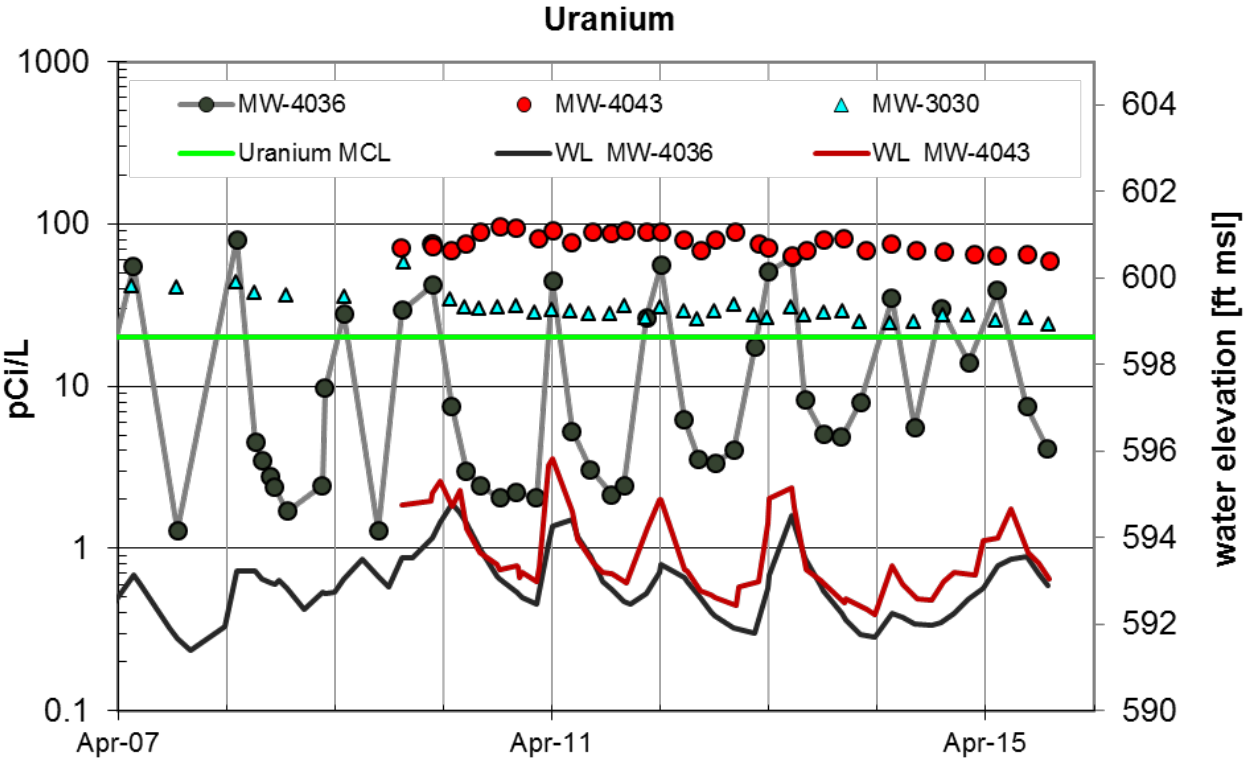


Figure 24. Seasonally Variable Uranium Concentrations in MW-4036

Well MW-4042 is a deep unweathered unit well adjacent to MW-4040, the high uranium concentration well in the upper part of the unweathered unit. It confirms that uranium has not migrated downward to the deeper part of the unweathered unit. The initial slightly higher concentrations in MW-4042 that dissipated over the next few years (Figure 24) were likely introduced during well installation as the well was drilled through the higher-concentration upper part of the unweathered unit.

In general, the distribution of uranium has expanded along the western side of the Raffinate Pits area, as indicated by the variable uranium values reported in MW-4036 and the elevated uranium levels measured in MW-4043. The presence of uranium in a downgradient spring SP-6201, at an average value of 19.4 pCi/L, also supports the conclusion of downgradient migration of uranium. Downgradient migration is expected, as the attenuation mechanisms for uranium are dilution and dispersion, which lead to some downgradient migration. Triggers for Objective 3–near wells were set to take into account the migration of contaminants in the paleochannels. Uranium impact is contained within the paleochannel located within the upper portion of the shallow aquifer (weathered and unweathered units of the Burlington-Keokuk Limestone).

Uranium concentrations at surface water locations north of the former Chemical Plant have not significantly changed from the previous 5-year period (Figure 25). Concentrations in Dardenne Creek have been low since monitoring resumed at location SW-2007 in 2001. Concentrations at spring SP-6303 had been declining on a long-term trend and were at background levels from 2010 until it was last sampled on April 4, 2013. It has been dry since. Uranium concentrations at Burgermeister Spring (SP-6301) continue to vary (by about an order of magnitude) but remain within historical ranges and well below the trigger level of 150 pCi/L (Figure 25).

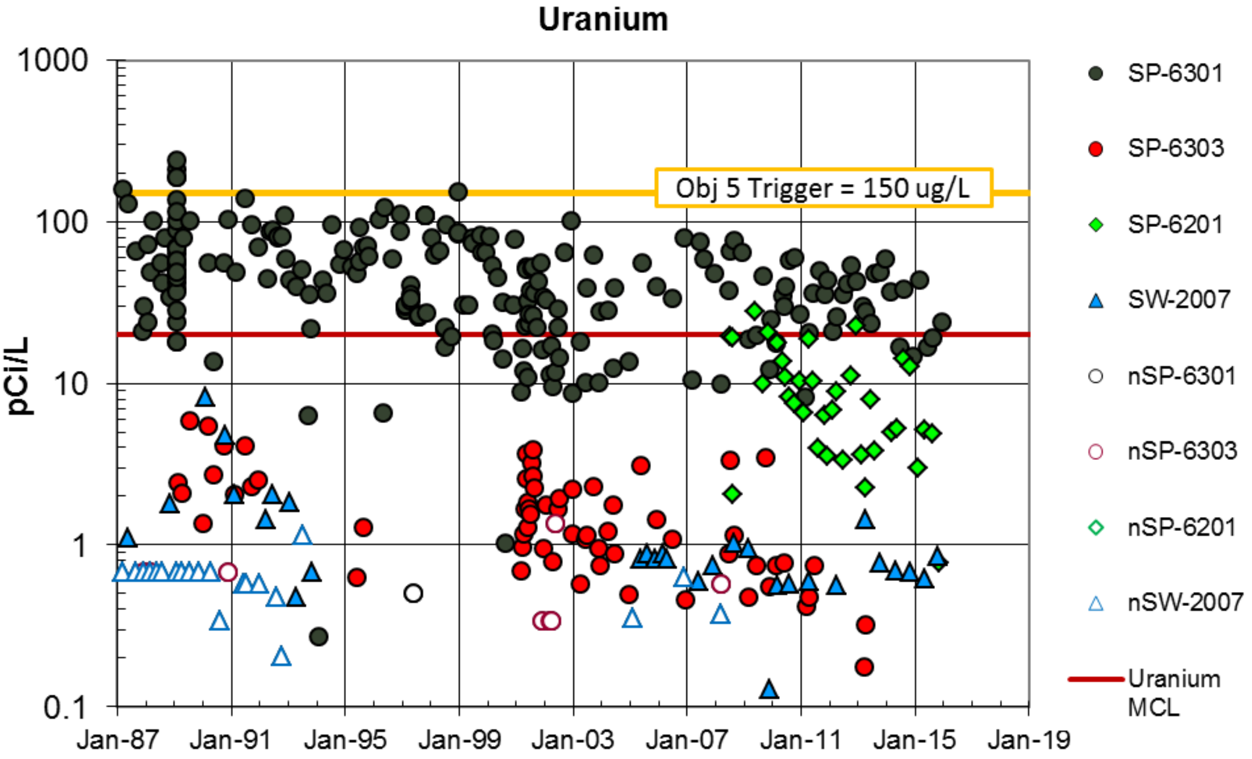


Figure 25. Uranium Levels in Surface Locations North of the former Chemical Plant

The uranium levels in Burgermeister Spring and SP-6303 are not correlated and indicate that the source contribution to SP-6303 is less than the contribution to Burgermeister Spring. The variability of uranium concentrations at Burgermeister Spring appear to be inversely related to the variability that occurs at MW-4036 (Figure 26). As water elevations increase in response to increased rainfall, uranium concentrations at Burgermeister Spring decrease, likely due to increased dilution. Groundwater travel times from the site to Burgermeister Spring are on the order of 2 to 9 days, as determined from dye tracing (DOE 1997a).

Trending of Burgermeister Spring uranium results over 5-year intervals has been problematic due to the variability of results. The period from 2009 through 2014 gives an uptrend. The period from 2010 through 2015 gives no trend. The indicated trend for a 5-year period can be controlled by just a few data points that are influenced by the weather. A longer time frame provides a more reliable trend that can be projected forward (Figure 27). The chart provides linear regression fits, Mann-Kendall trends, and slopes for three time periods. Extrapolating the “order of magnitude every 60 years” line (labeled “OM 60 yrs” on Figure 27 and Figure 28) suggests that the highest uranium concentrations seen at Burgermeister Spring could be below the 20 pCi/L MCL in 30 to 40 years (Figure 28).

Uranium impact in the Southeast Drainage is the result of historical discharges to this drainage during plant operation that resulted in contaminated soil and sediment within the drainage. The source of uranium impact in the two springs (SP-5303 and SP-5304) 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 29), and uranium behaves similarly in both springs. Uranium levels in both springs exceed the MCL but are less than the trigger level of 150 pCi/L. Uranium concentrations in MW-4026, a monitoring well downgradient of the two springs, were very low or below detection limits (Figure 29).

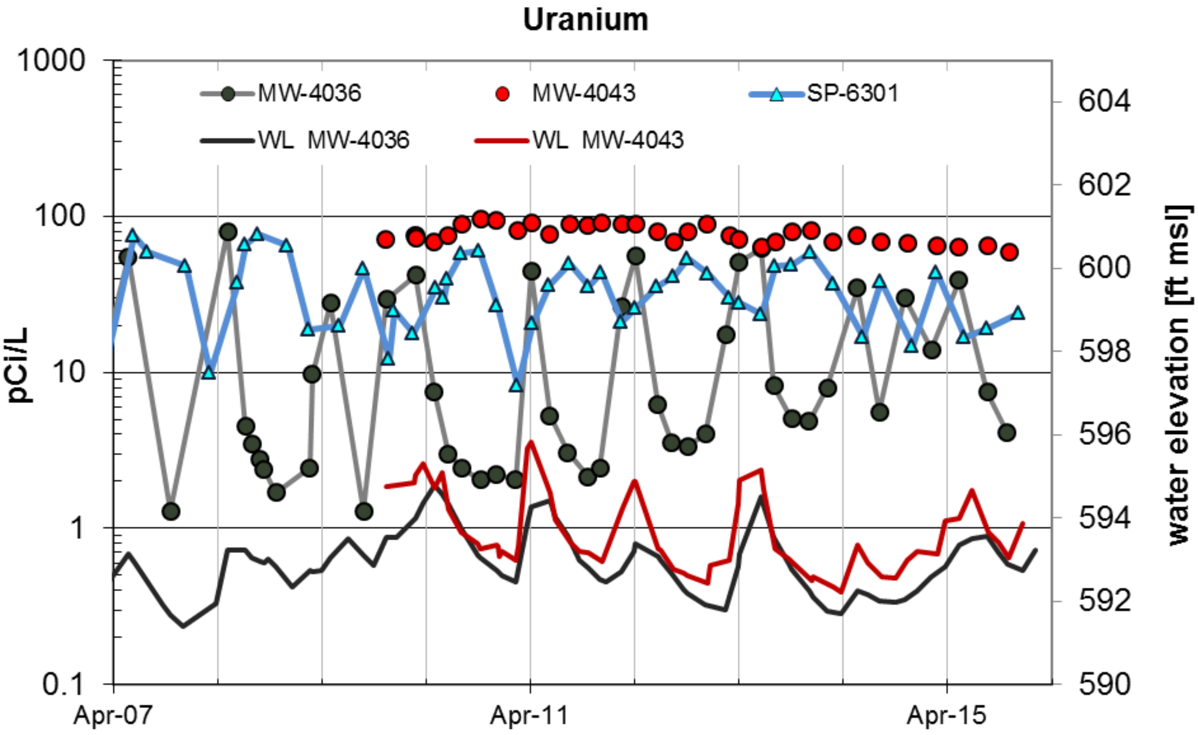


Figure 26. Variable Uranium Levels at Burgermeister Spring (SP-6301)

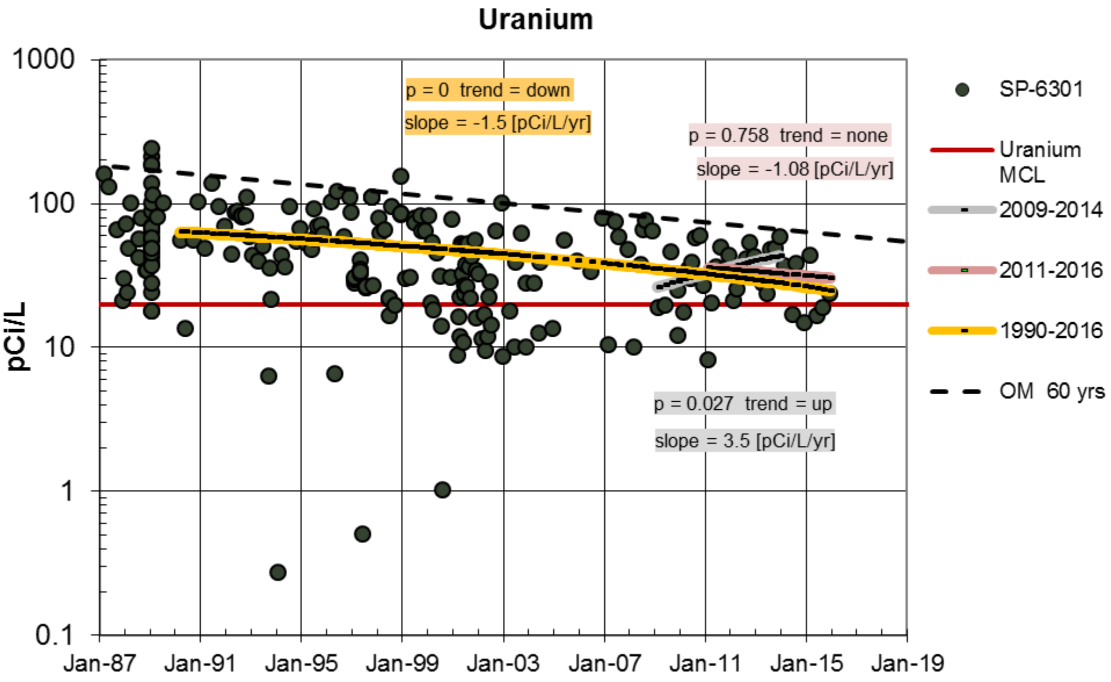


Figure 27. Trending of Uranium Levels at Burgermeister Spring (SP-6301)

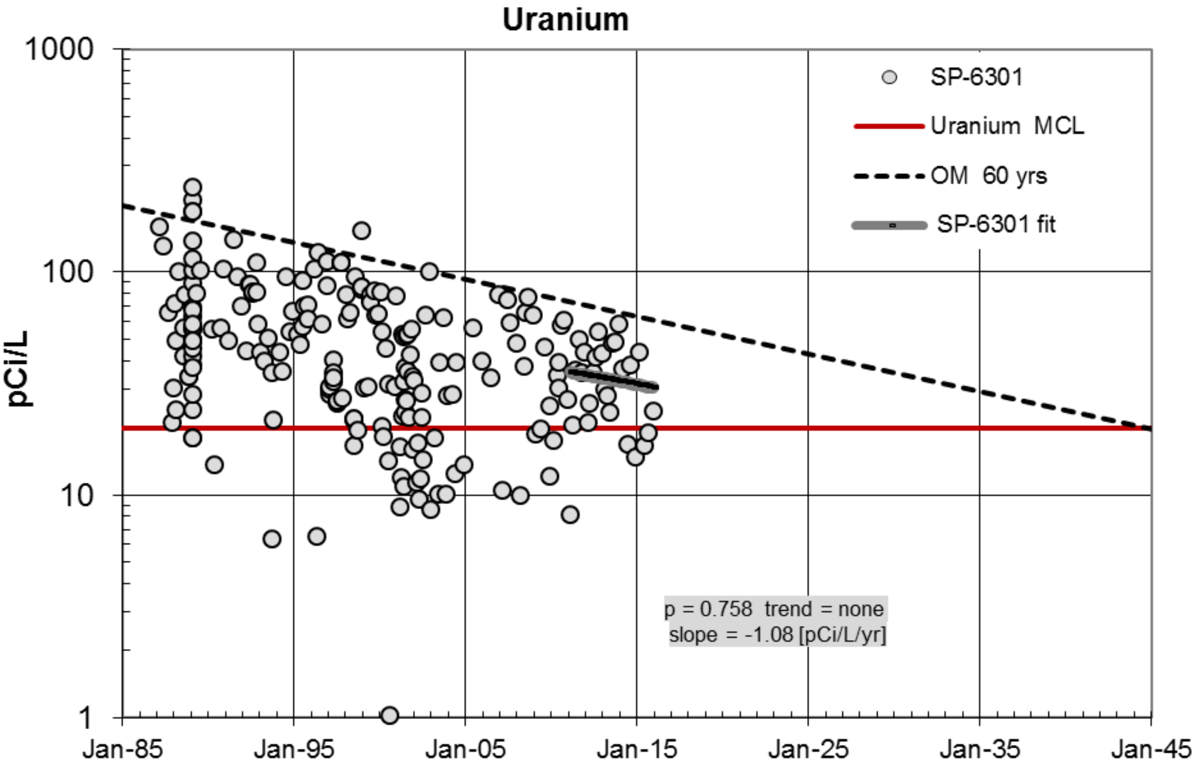


Figure 28. Long-term Projection of Uranium Levels in Spring SP-6301 (Uranium at or Below MCL)—Burgermeister Spring

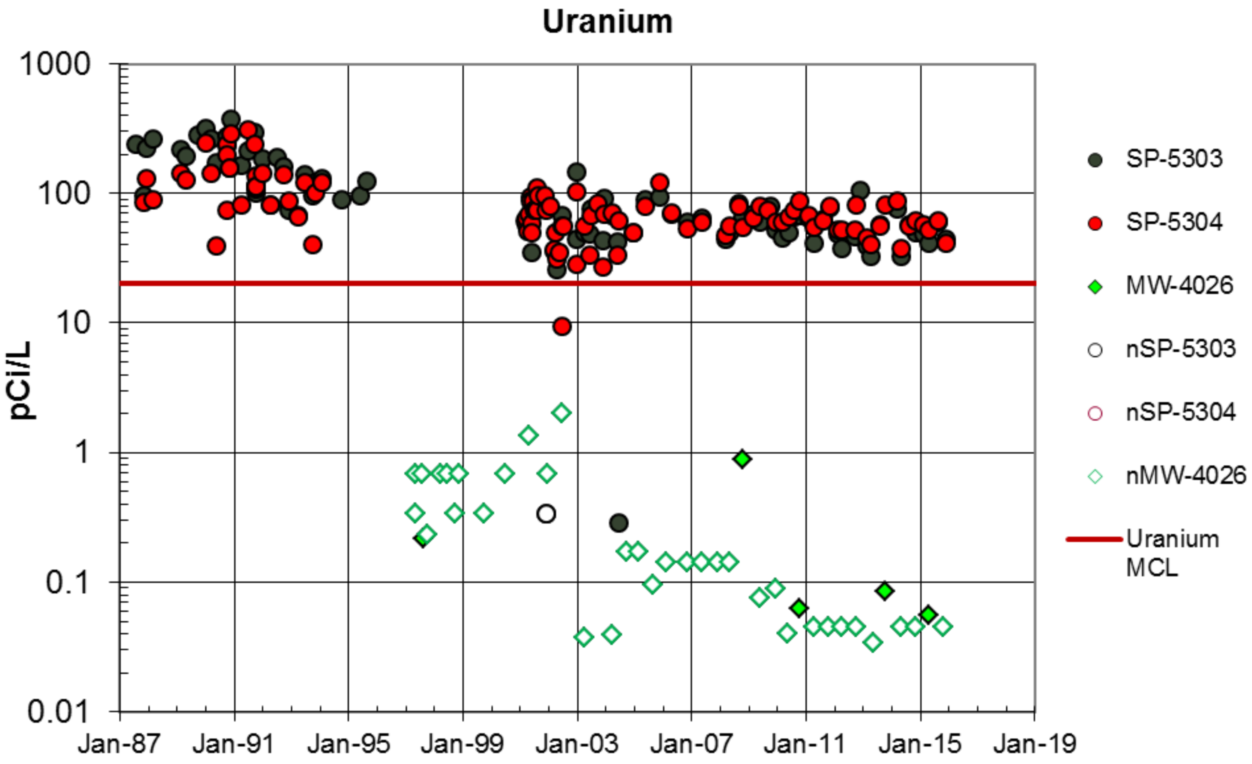


Figure 29. Uranium Levels in Southeast Drainage Springs and MW-4026

Analysis of the data from 2011 through 2015 indicated no statistically significant trends for these two springs. However, the historical data set indicates that uranium levels at SP-5303 and SP-5304 have been decreasing over the long-term (Figure 30).

While uranium levels in the Raffinate Pits area have changed since the implementation of the MNA remedy for uranium, overall, the remedy remains protective. 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. Uranium levels are decreasing in the weathered unit due to dilution and dispersion.

The removal of the raffinate pits has decreased infiltration and recharge, thereby reducing the dilution and flushing of unweathered unit groundwater. Increased uranium levels are the result of residual uranium from contaminated materials that were forced deeper into the bedrock by the high hydraulic head historically present when the raffinate pits were full. The reduced infiltration and the relatively low permeability of the unweathered unit will slow the flushing of impacted groundwater from this unit.

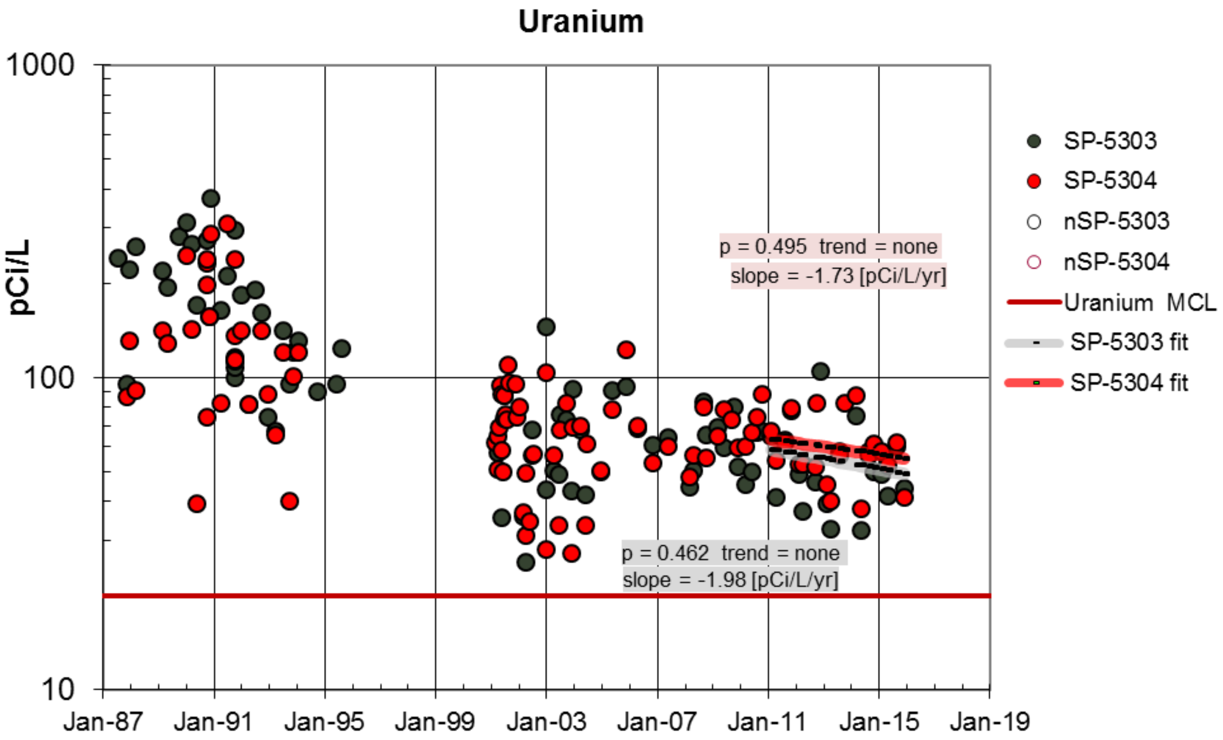


Figure 30. Trending of Uranium in Southeast Drainage Springs

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) and could attain the MCL in the next 10 years if decreases continue at the current rate. However, in areas where upward vertical gradients occur seasonally, the lower part of the weathered unit will receive contribution from the upper part of the unweathered unit from below. Uranium levels in impacted areas within the less-permeable unweathered unit are increasing due to reduced infiltration to offset desorption of uranium from residual materials that were introduced into this zone by higher hydraulic heads in the former raffinate pits. Recharge that does enter the system is more likely to move horizontally through the weathered unit than vertically into the unweathered unit due to greater conductivity in the horizontal direction and the lack of a vertical driving force to move the groundwater downward as was previously exerted by water in the raffinate pits.

Unweathered Unit Uranium Monitoring Network

A subset of wells and springs was identified in a special study conducted from February 2012 to February 2014 to monitor the elevated uranium levels in the unweathered unit in the impacted area. This study was in response to the three impacted area wells that continue to exceed the 100 pCi/L trigger value for uranium in impacted areas. The network consists of all 15 wells screened in the unweathered unit, advantageously located weathered unit wells, and 3 downgradient springs (Table 10). Sampling frequencies of the monitoring wells were determined to be adequate to detect any significant changes. The inclusion of historically low-concentration downgradient wells increases the likelihood of detecting potential future migration. Past and future uranium concentrations for unweathered unit wells, weathered unit wells, and surface locations in the unweathered unit uranium monitoring network will document the progression of the MNA remedy.

Table 10. Unweathered Unit Uranium Monitoring Network Locations

Location	Objective	Unit	Average Uranium [b] 2012–2014 Study (pCi/L)	Recommended Frequency (samples per year)
MW-4040	2	Unweathered	338 (14)	4
MW-3026 [a]	2	Unweathered	36.8 (1)	4
MW-3040	2	Unweathered	119 (13)	4
MW-3024	2	Unweathered	132 (13)	4
MW-3003	2	Weathered [c]	2.9 (10)	4
MW-3006	2	Unweathered	0.57 (12)	4
MW-4042	4	Unweathered	0.24 (12)	4
MW-4043	3	Unweathered	76.7 (13)	4
MW-4036 [a]	3	Weathered	19.6 (13)	4
MWS-2	3	Weathered	1.6 (12)	4
MWD-2	3	Unweathered	0.19 (12)	4
MW-4007	3	Unweathered	2.5 (12)	4
MW-4011 [a]	3	Unweathered	0.53 (1)	2
MW-4041	3	Weathered	1.5 (12)	4
MW-2021 [a]	3	Unweathered	0.53 (1)	2
MW-2022 [a]	3	Unweathered	1.0 (1)	2
MW-2023 [a]	3	Unweathered	NS	2
MW-2032 [a]	3	Weathered	2.0 (4)	2
MW-2056 [a]	3	Unweathered	NS	2 (for 2 years then decrease)
MW-4022 [a]	3	Unweathered	NS	1
MW-4013 [a]	3	Weathered	NS	2 (for 2 years then decrease)

Table 10 (continued). Unweathered Unit Uranium Monitoring Network Locations

Location	Objective	Unit	Average Uranium [b] 2012–2014 Study (pCi/L)	Recommended Frequency (samples per year)
MW-4014 [a]	3	Weathered	NS	2 (for 2 years then decrease)
SP-6201	5	Spring	7.5 (10)	4
SP-6301	5	Spring	37.8 (13)	4
SP-6303 [a]	5	Spring	0.25 (2)	4

[a] Wells and spring to be added to the unweathered unit monitoring network.
[b] Number in parentheses is number of samples used to calculate the average.
[c] MW-3003 is screened across the weathered/unweathered unit interface.

Notes:
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.

Abbreviation:
NS = not sampled

Nitrate GWOU Performance Monitoring Results

The highest concentrations of nitrate have been measured in the former Raffinate Pits area (Figure 31). Elevated nitrate concentrations are also present in the former Ash Pond area. Both are historical sources of this contaminant. The higher mobility of nitrate compared to other contaminants at the site has resulted in a larger distribution of this contaminant in the shallow aquifer. Nitrate levels exceed the MCL of 10 mg/L (for nitrate as N) in all of the Objective 2 wells in both the weathered and unweathered units of the Burlington-Keokuk Limestone. Table 11 presents a summary of the nitrate data for the period from 2011 through 2015.

Nitrate concentrations are highest in the weathered unit of the Burlington-Keokuk Limestone in the former Raffinate Pits area. Concentrations in wells MW-2038, MW-3003, MW-4029, MW-3034, and MW-4031 are all currently above 100 mg/L but below the 1350 mg/L trigger value (Figure 32). Concentrations in wells MW-4013, MW-2040, and MW-4036 are below 100 mg/L but above the 10 mg/L MCL (Figure 33).

Recent data indicate that concentrations are decreasing in the higher-concentration weathered unit wells, with statistically significant decreases in MW-4029 and MW-4031. Concentrations are relatively stable in the lower-concentration weathered unit wells with the exception of MW-4036. Nitrate concentrations vary up to an order of magnitude at MW-4036 with no discernable trend. Well MW-4036 is located within the preferential flow path that extends north from Raffinate Pit 4. Its variability is not due to contribution from the unweathered unit, as was the case for uranium, because unweathered unit well MW-4043 has a low and decreasing nitrate concentration (Figure 34). Variability in MW-4036 appears to be more related to dilution, in that concentrations are lower when water levels are high.

Nitrate concentrations in the unweathered unit (Figure 35) exceed the MCL only in the Raffinate Pits area. Nitrate concentrations in well MW-4040 (located near Raffinate Pit 4) have been relatively stable with no observable trend since it was installed. Nitrate in well MW-3040 has had a consistent decreasing trend over the long term and the past 5 years. Nitrate concentrations at this well could reach the 10 mg/L MCL in the next 15 years. Well MW-3024, located adjacent to MW-3040, is screened over the same 10 ft interval plus an additional 10 ft higher (20 ft screened interval, nearer the weathered unit). Nitrate in MW-3024 has a decreasing trend, but at a lower rate that will likely take at least 50 years to reach the 10 mg/L MCL.

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 along the leading edge of the area of impact in the weathered unit. Some locations were expected to show temporary upward trends due to ongoing dispersion; however, concentrations are not expected to exceed historical maximums seen within the areas of highest impact. The higher mobility of nitrate compared to other contaminants at the site has resulted in quicker flushing of this contaminant from the aquifer system.

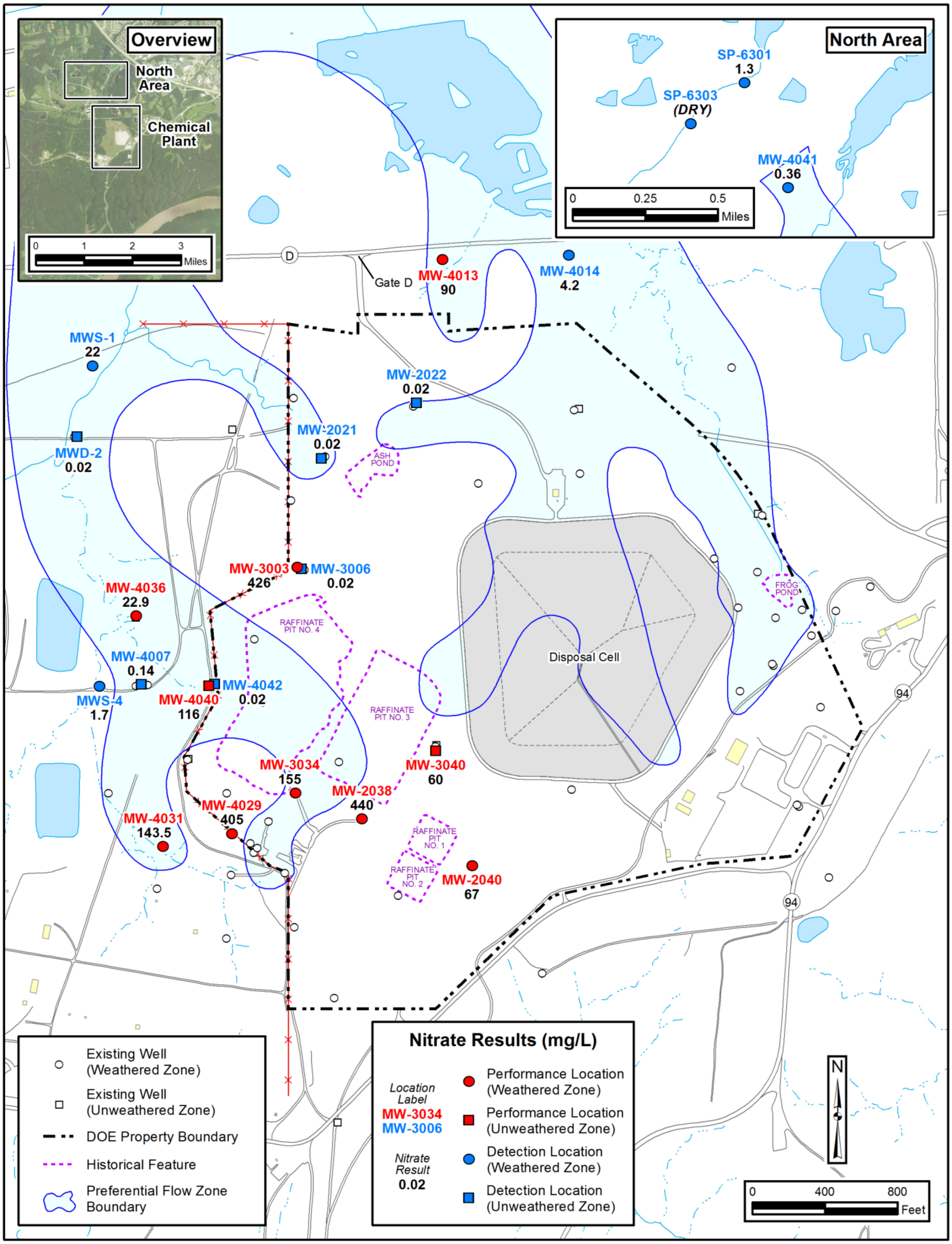


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Figure 31. Nitrate Monitoring Locations with 2015 Average Concentrations

Table 11. Average Nitrate Concentrations in GWOU Performance Monitoring Wells

Location	**Nitrate Concentration (mg/L)**				
	2011	**2012**	**2013**	**2014**	**2015**
Weathered Unit					
MW-2038	485	460	550	450	440
MW-3003	466	449	372	457	426
MW-4029	449	440	400	410	405
MW-3034	195	184	173	165	155
MW-4031	191	160	160	149	144
MW-4013	96	76	108	85	90
MW-2040	89	82	87	86	67
MW-4036	33	45	31	18.3	23
Unweathered Unit					
MW-3040	116	89	78	65	60
MW-4040	119	113	107	120	116

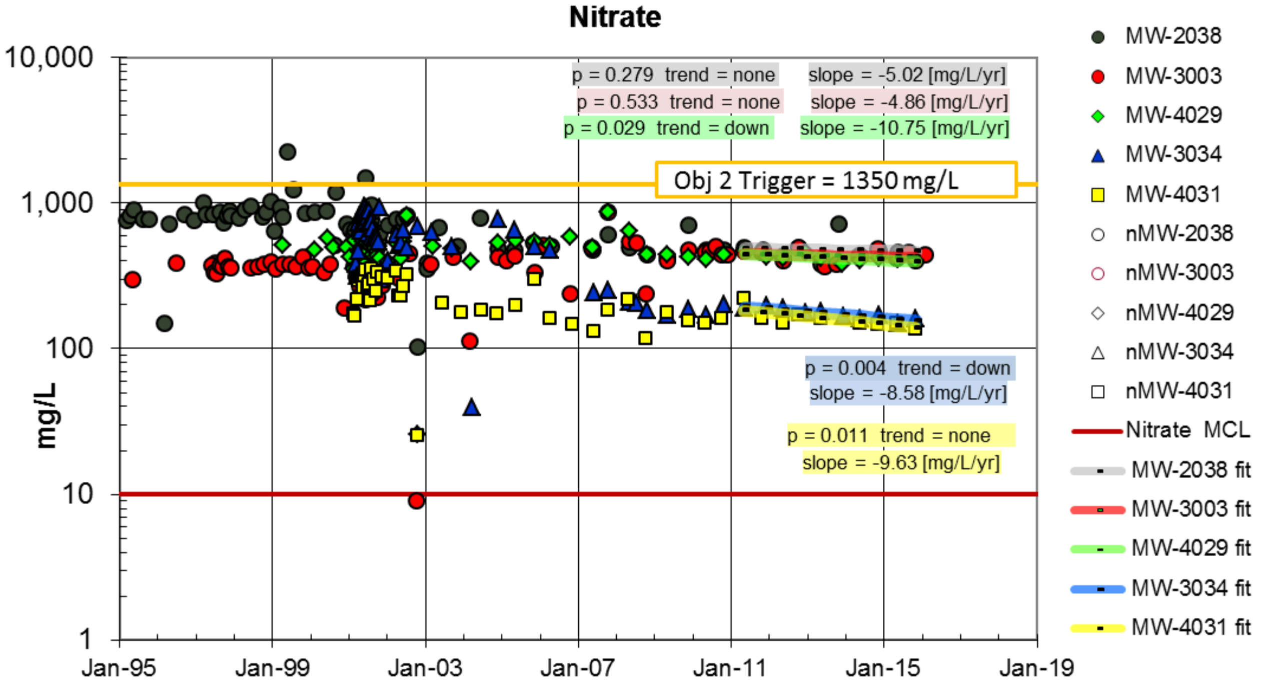

Figure 32. Nitrate Concentrations in Performance Monitoring Wells—Weathered Unit (Higher-Concentration Wells)

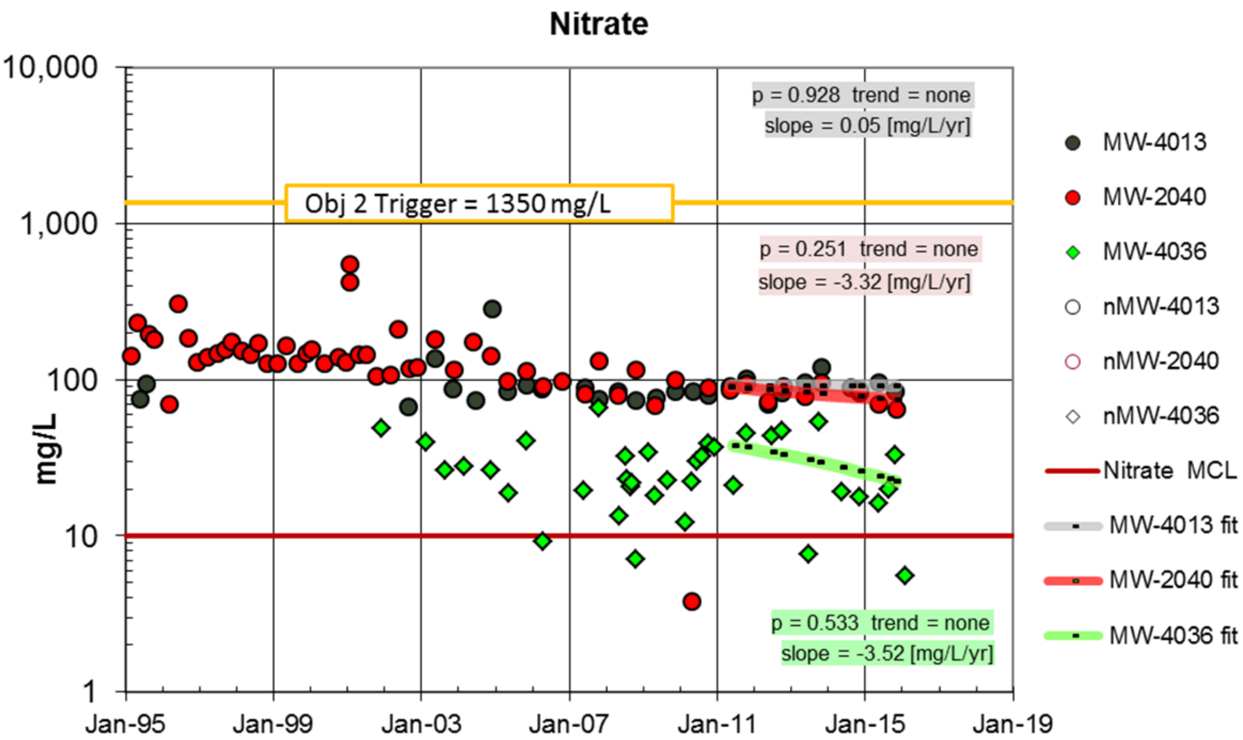

Figure 33. Nitrate Concentrations in Performance Monitoring Wells—Weathered Unit (Lower-Concentration Wells)

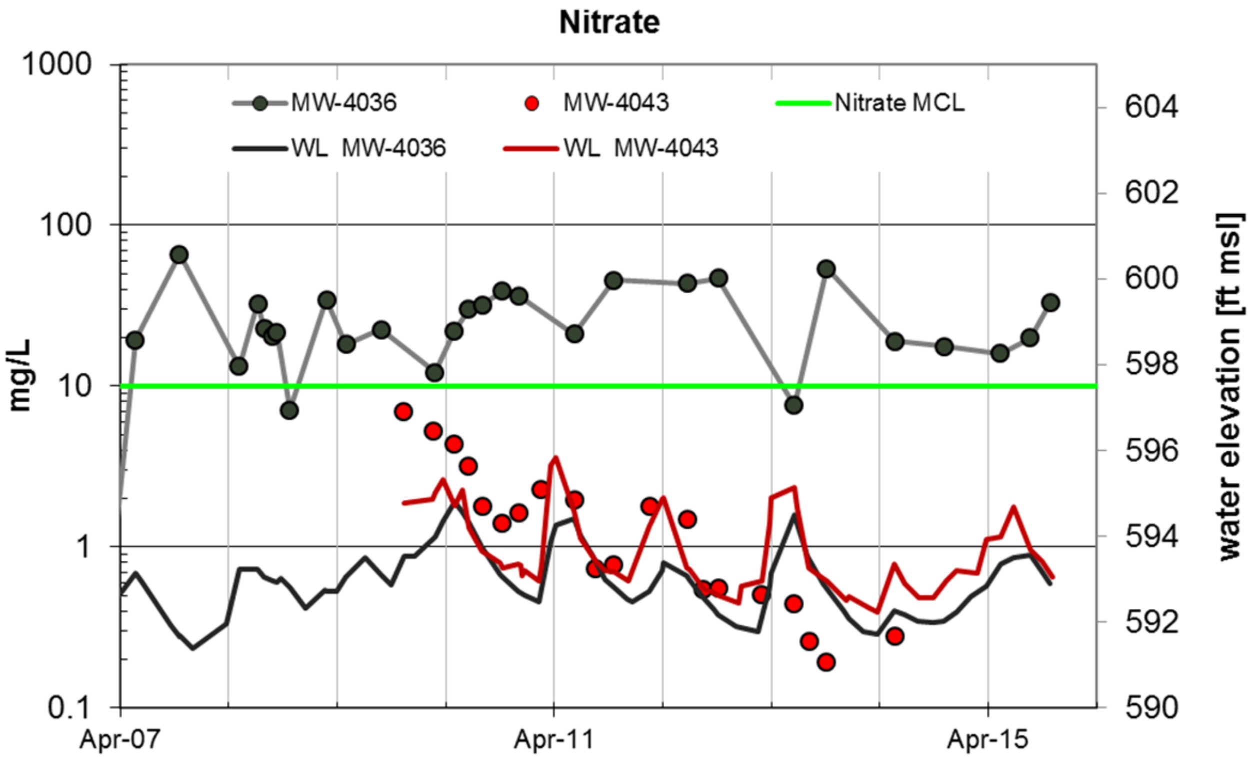

Figure 34. Variable Nitrate Concentrations in MW-4036

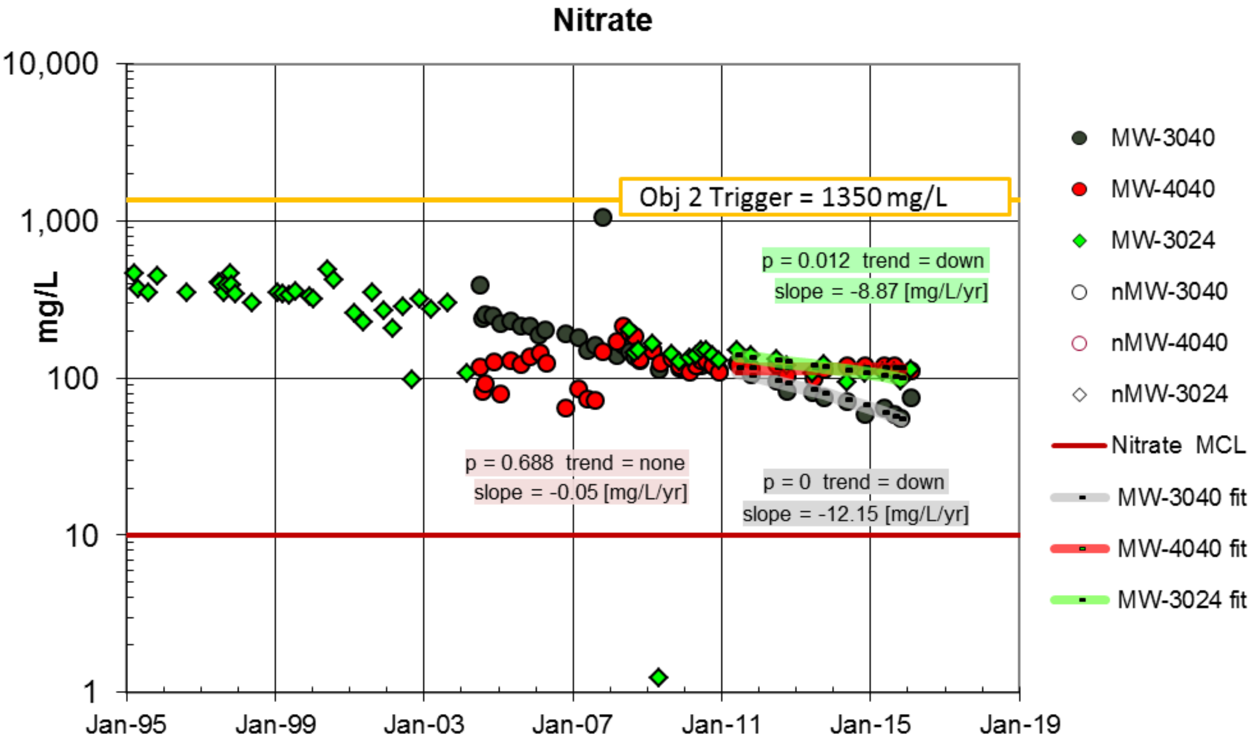

Figure 35. Nitrate Concentrations in Performance Monitoring Wells—Unweathered Unit

Nitrate GWOU Detection Monitoring Results

Results at nitrate detection monitoring locations (Table 12) indicate that nitrate migration from the area of impact is behaving as expected. Migration has been restricted to the weathered unit with only well MWS-1 exceeding the 10 mg/L MCL (Figure 36). Average concentrations of nitrate in well MWS-1 have exceeded the MCL since 2005 and have been steadily increasing. Trending of data since 2004 (there are an insufficient number of samples in the last 5 years for trending) indicate a persistent, long-term uptrend. For comparison, uranium levels have remained steady at MWS-1, typically less than 1 pCi/L. Nitrate levels at far downgradient well MW-4041 have a slight increasing trend over the last 10 years, but concentrations at this well are so low, always less than 1 mg/L, that the rate of increase is currently of no concern. Nitrate is below detection in unweathered unit detection monitoring wells except for low-level detections in MW-4007 and MW-4042 (Figure 37).

Table 12. Nitrate Detection Monitoring Locations for the GWOU

Location	Detection Monitoring Areas
Weathered Unit	
MW-4014	Fringe
MW-4041	Downgradient
MWS-1	Downgradient
MWS-4	Downgradient
Unweathered Unit	
MW-2021	Vertical Extent
MW-2022	Vertical Extent
MW-3006	Fringe
MW-4007	Downgradient
MW-4042	Downgradient
MWD-2	Downgradient
Springs and Surface Water	
SP-6301	Burgermeister Spring
SP-6303	Burgermeister Spring Branch

The nitrate concentrations in Burgermeister Spring ranged from 0.4 to 5.4 mg/L from 2011 through 2015—less than the MCL of 10 mg/L. All nitrate concentrations in Burgermeister Spring have been less than the MCL since 2003 (Figure 38). Spring SP-6303 has been dry since 2013, although when this location was flowing, nitrate concentrations typically tracked those of Burgermeister Spring.

Trend analysis of Burgermeister Spring (SP-6301) results indicates that nitrate concentrations are continuing to decrease (Figure 38). Analysis of the data collected from 2011 through 2015 indicated no statistically significant trend (because concentrations vary by about an order of magnitude), though visual inspection of data since 1987 indicates a long-term down trend.

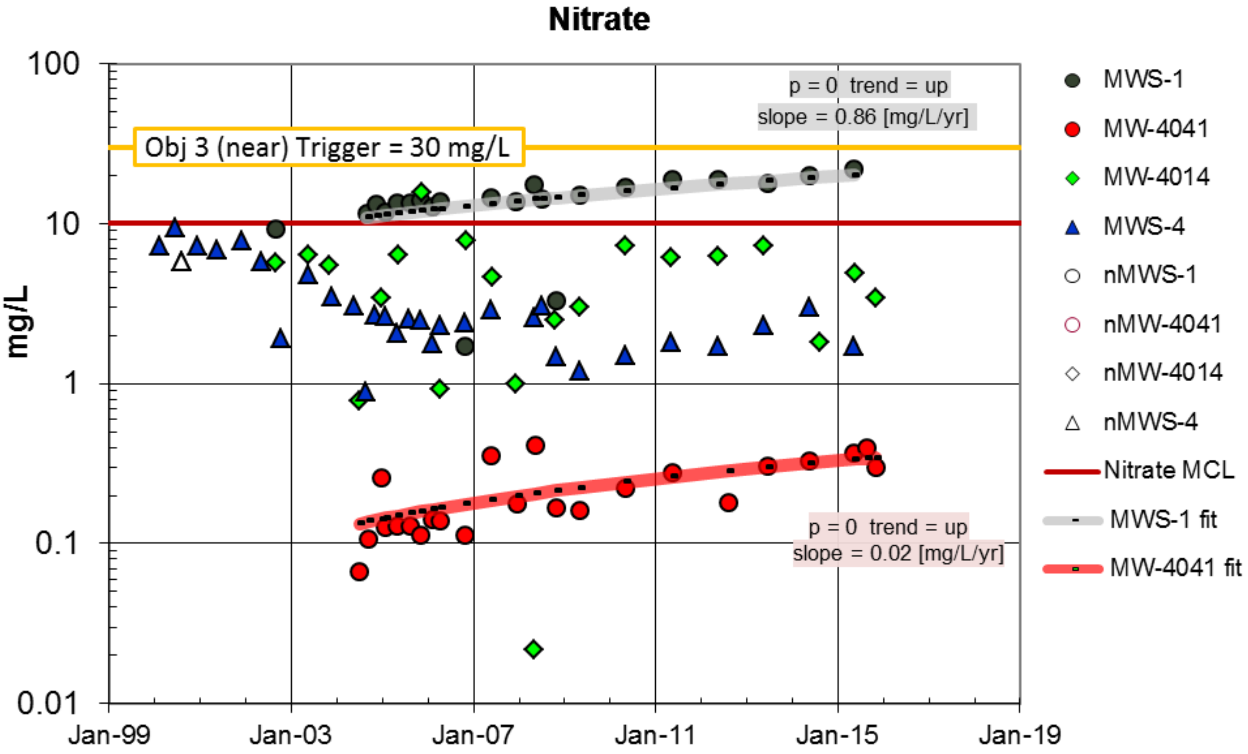

Figure 36. Nitrate Concentrations in Detection Monitoring Wells—Weathered Unit

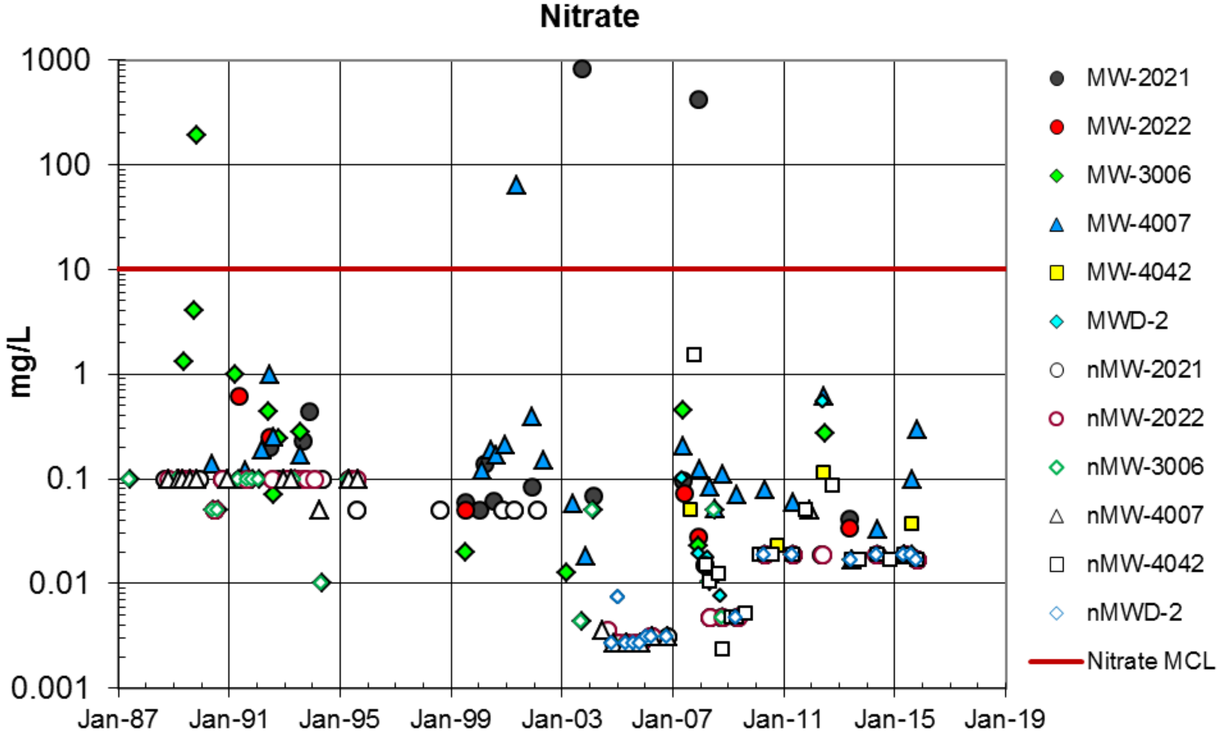

Figure 37. Nitrate Concentrations in Detection Monitoring Wells—Unweathered Unit

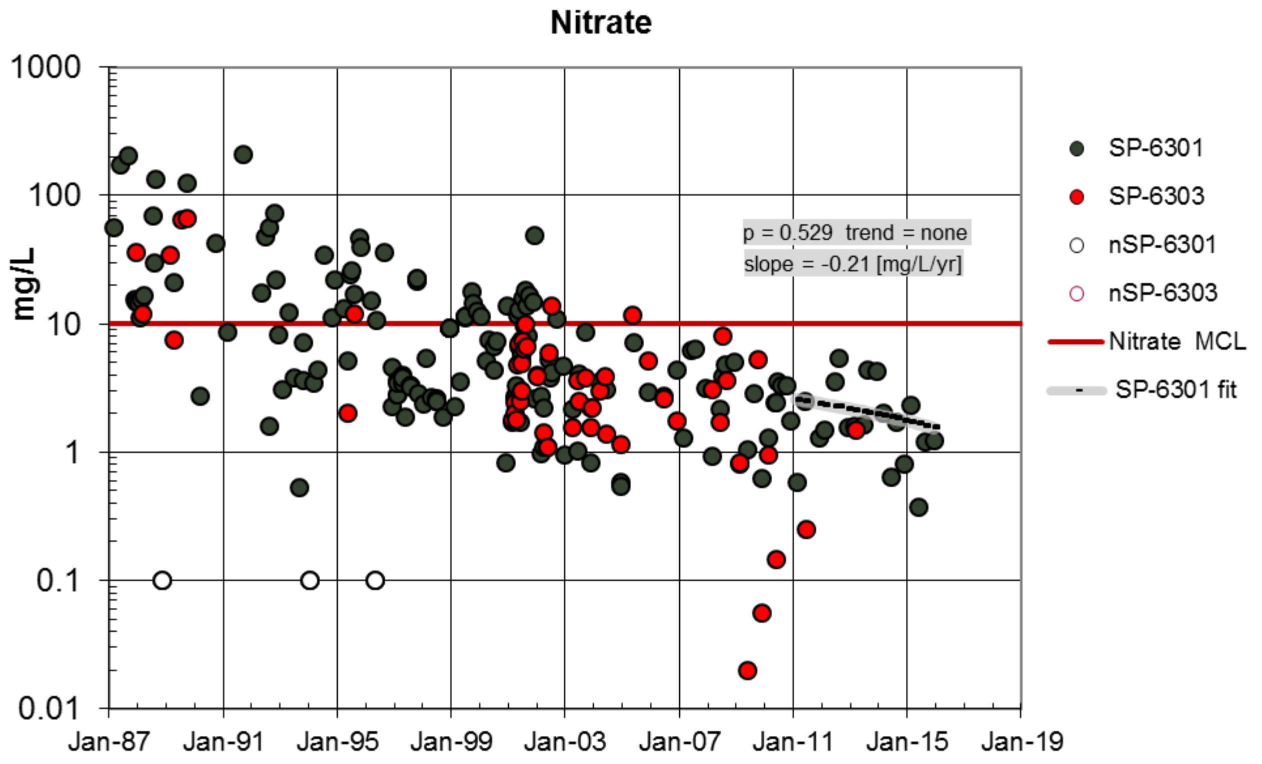

Figure 38. Nitrate Concentrations in Burgermeister Spring and SP-6303 (SP-6303 has been dry since April 2013)

Trichloroethene (TCE) GWOU Performance Monitoring Results

TCE contamination in the shallow groundwater is located in the vicinity of former Raffinate Pit 4, where drums containing TCE are suspected to have been discarded. TCE impact is detected only in the weathered unit of the Burlington-Keokuk Limestone. Table 13 presents a summary of the TCE data for the period from 2011 through 2015, and Figure 39 shows well locations with 2015 TCE average concentrations.

Table 13. Average TCE Concentrations in GWOU Performance Monitoring Wells

Location	**TCE Concentration (μg/L)**				
	2011	**2012**	**2013**	**2014**	**2015**
MW-3030	249	199	214	185	185
MW-3034	153	134	118	105	320
MW-4029	320	284	291	315	315

TCE impact is highest in MW-4029, along a preferential flow pathway in the area. The TCE concentrations in MW-3030 and MW-3034 have varied over time (Figure 40); however, some changes are a result of rebound from field studies performed in 2001 and 2002. Data from recent years indicate decreases in TCE concentrations in these three wells.

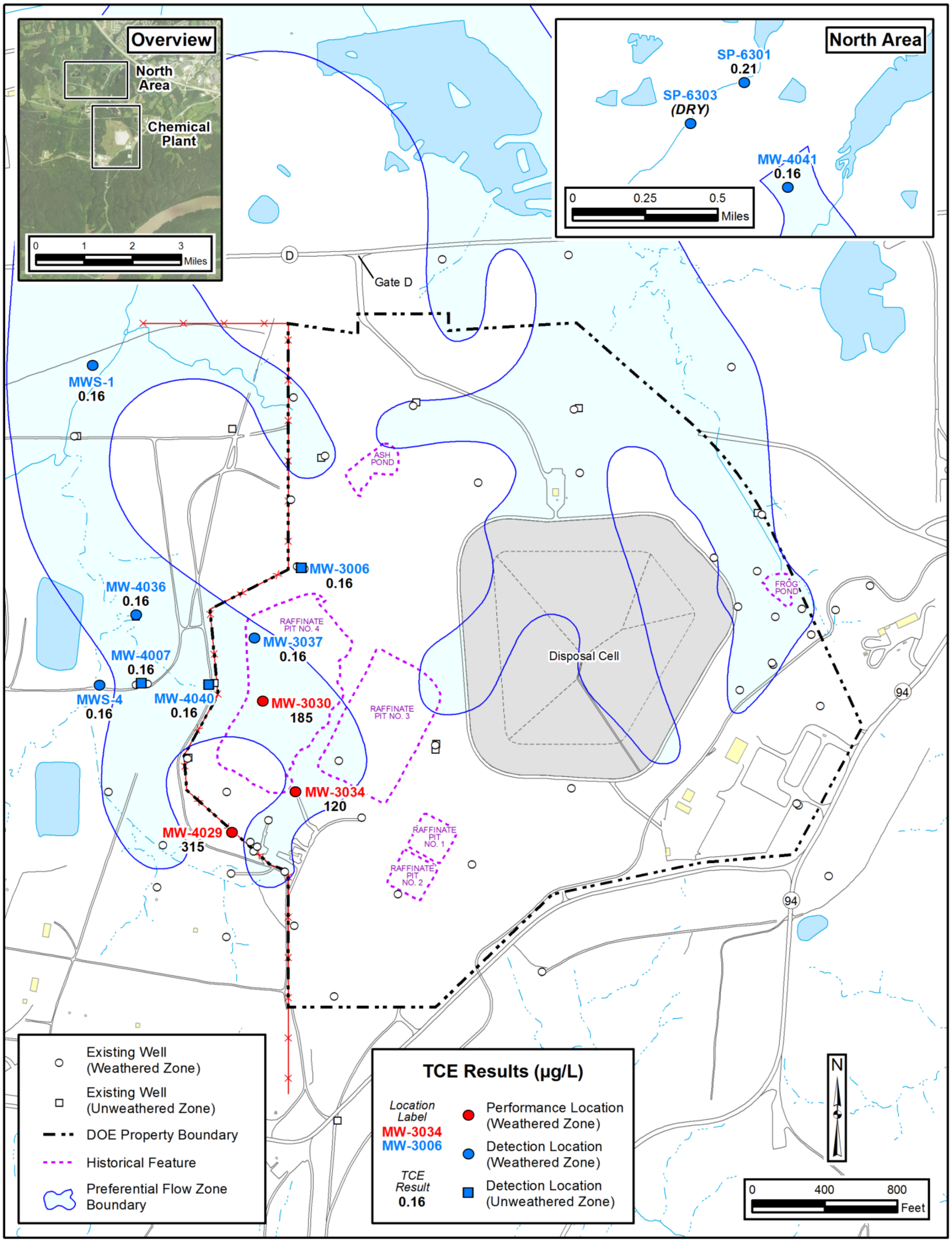

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Figure 39. TCE Monitoring Locations with 2015 Average Concentrations

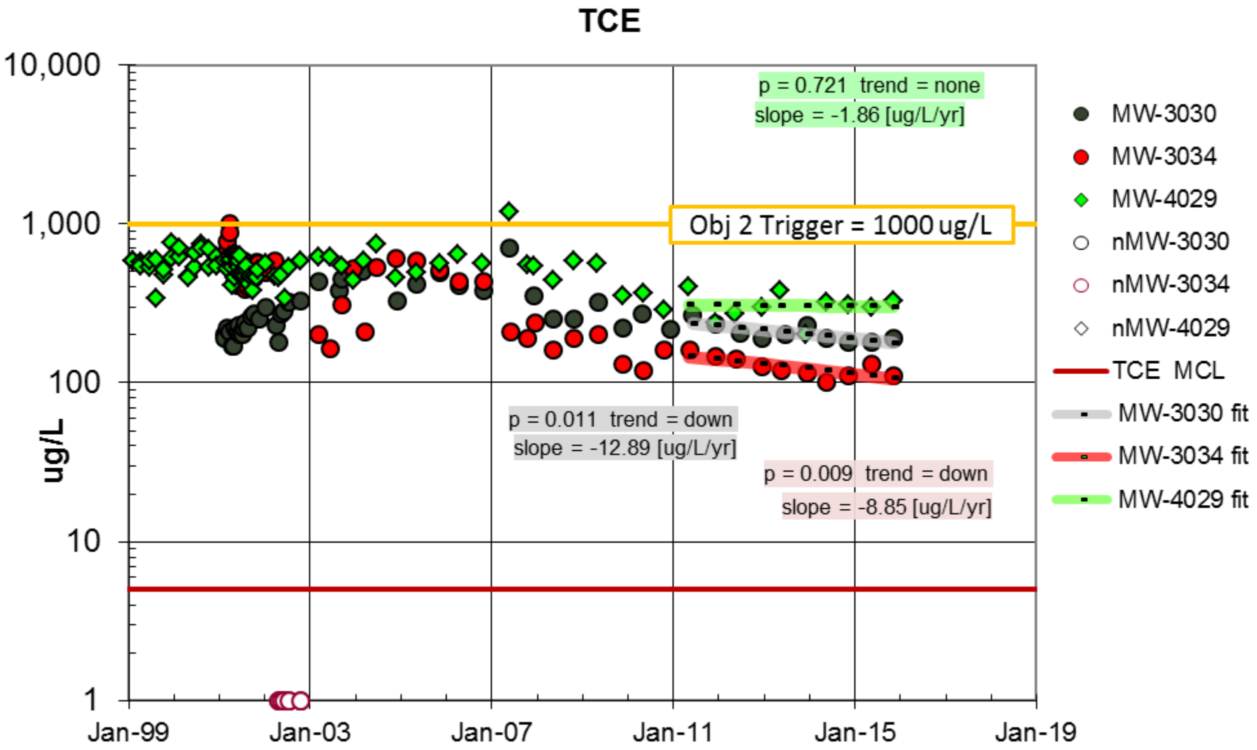


Figure 40. TCE Concentrations in Performance Monitoring Wells

Concentrations of TCE in all of the Objective 2 wells continue to exceed the 5 µg/L cleanup standard.

Results of the trend analysis indicate that TCE concentrations in groundwater are decreasing. Down trends were calculated for MW-3030 and MW-3034 using data from 2011 through 2015. TCE concentrations are trending down for all three wells using a longer data set.

Low levels of the TCE degradation product *cis*-1,2-dichloroethene (DCE) was measured in the three Objective 2 wells with concentrations significantly less than the 70 µg/L MCL (Figure 41). Results of *trans*-1,2-DCE were all less than 1 µg/L and either reported as estimated or nondetect values in the three Objective 2 wells. No reportable concentrations of vinyl chloride were detected in any of the Objective 2 wells. The geochemistry of the groundwater at the former Chemical Plant is oxidizing; therefore, reductive dechlorination of TCE is limited. Dilution and dispersion are the primary attenuation mechanisms for TCE in groundwater.

Overall, TCE impact is confined to a discrete area of the Chemical Plant site and is limited to the weathered unit of the Burlington-Keokuk Limestone. TCE concentrations in the weathered unit are slowly decreasing in the area of impact.

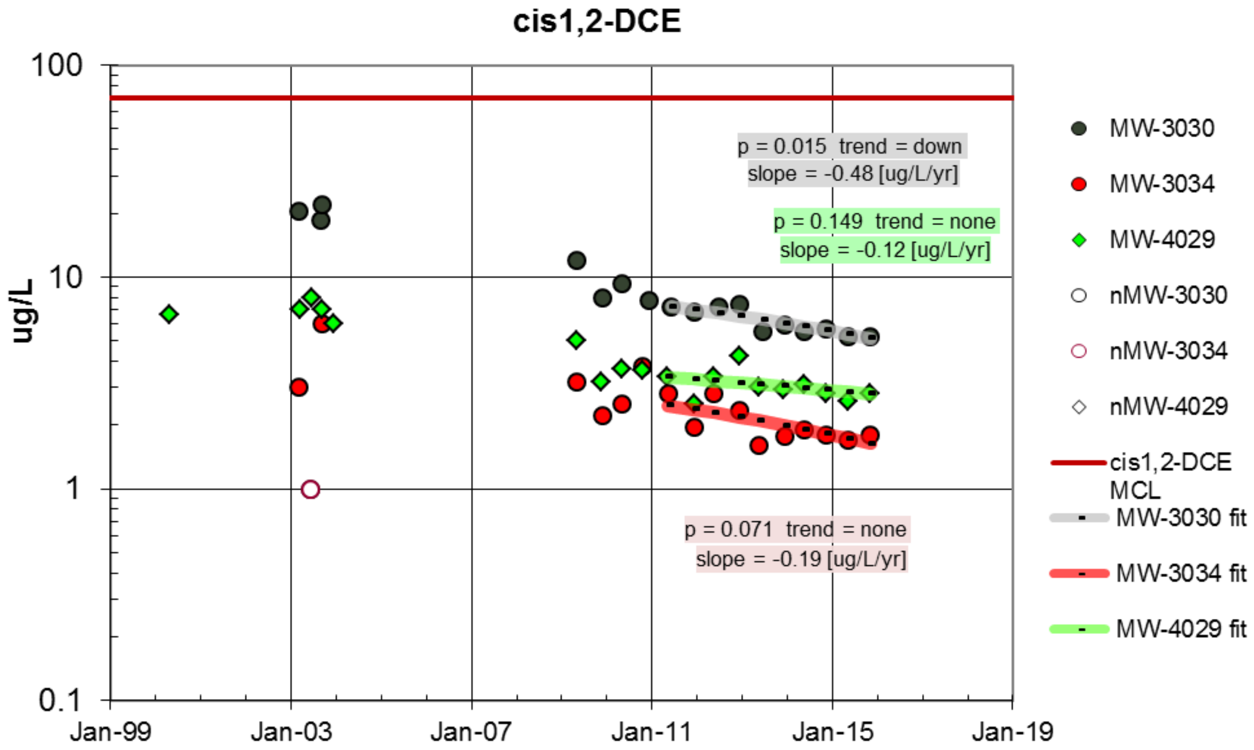
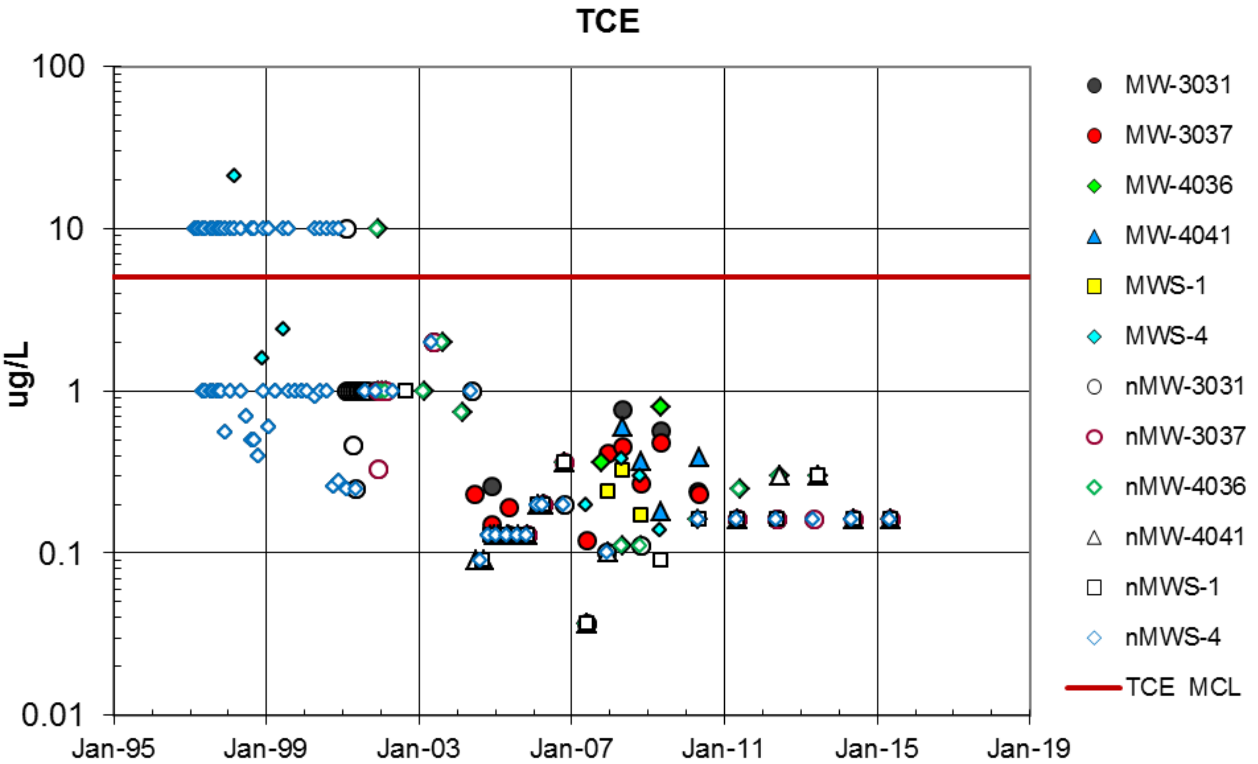


Figure 41. cis-1,2-DCE Concentrations in Performance Monitoring Wells

Trichloroethene GWOU Detection Monitoring Results

No detections or estimated values of TCE were reported in the detection monitoring wells (weathered unit, Figure 42; unweathered unit, Figure 43) or at Burgermeister Spring from 2011 through 2015. One estimated value of 0.71 µg/L was reported for the June 2011 sample from SP-6303, which has been dry since mid-2013. The data from the past 5 years indicate that the area of TCE impact has not expanded, either laterally or vertically. No reportable concentrations of the degradation products *cis*-1,2-DCE, *trans*-1,2-DCE, or vinyl chloride were detected at any of the detection monitoring locations.



Note: MW-3031 was decommissioned July 13, 2013

Figure 42. TCE Concentrations in Detection Monitoring Wells—Weathered Unit

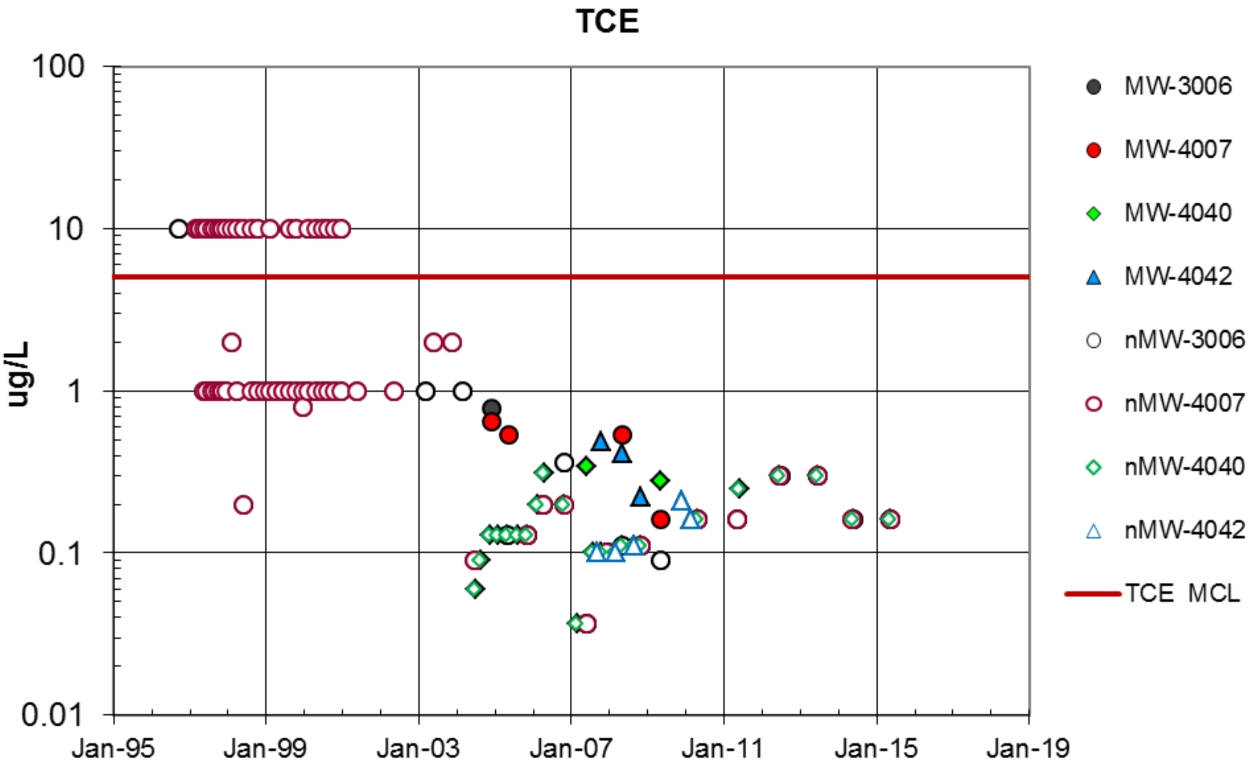


Figure 43. TCE Concentrations in Detection Monitoring Wells—Unweathered Unit

Nitroaromatic Compounds GWOU Performance Monitoring Results

Former Frog Pond Area

The former Frog Pond area is the most significant area of nitroaromatic compound impact for groundwater at the site and is limited to the weathered unit of the Burlington-Keokuk Limestone. Groundwater in this area has historically had concentrations above the cleanup standards for 1,3-DNT; 2,4,6-TNT; 2,4-DNT; 2,6-DNT; and NB. Concentrations of nitroaromatic compounds increased in this area starting in 1997. More recent data from several performance monitoring wells indicate that concentrations of some compounds have decreased to below cleanup standards.

The distribution of nitroaromatic compounds suggests that the primary source area is Production Line 1, most notably the wash house (T-13) and the wastewater settling tank (T-16) (Figure 18). Some contribution to the nitroaromatic contamination originates from 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 topography. The impact of nitroaromatic compounds in the former Frog Pond area is isolated to the Burlington-Keokuk Limestone weathered unit.

Nitroaromatic compound concentrations, primarily the DNTs, have continued to be variable in the former Frog Pond area. Starting in 1997, increases in concentrations were reported, and concentrations increased dramatically during and after the completion of soil excavation in this area and 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 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 nitroaromatic compounds in several wells in this area decreased substantially in 2004.

Since 2007, DNT concentrations in MW-2012 have varied by 2 to 3 orders of magnitude. The suspected cause was the infiltration of surface water runoff into the groundwater system through a subsidence feature that formed near MW-2012. The continued influence of surface water infiltration is indicated by the fluctuation of groundwater elevations in several Objective 2 wells near the preferential flow pathway in the area (Figure 44). Large fluctuations in groundwater elevations occurred historically when Frog Pond and surface water drainage features were present. In recent years, groundwater elevations and seasonal variability have generally increased in wells along the preferential pathway, most notably in MW-2012 and MW-2052. This increase is likely attributed to surface water contribution in a natural drainage channel that is beginning to establish in this area.

The “MCL” line on the data charts for 1,3-DNB and 2,4-DNT are ROD cleanup standards based on Missouri Water Quality Standards. The “MCL” line on the data charts for 2,6-DNT and 2,4,6-TNT are risk-based ROD cleanup standards. Table 8.1 of 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) provides the basis for the cleanup standards.

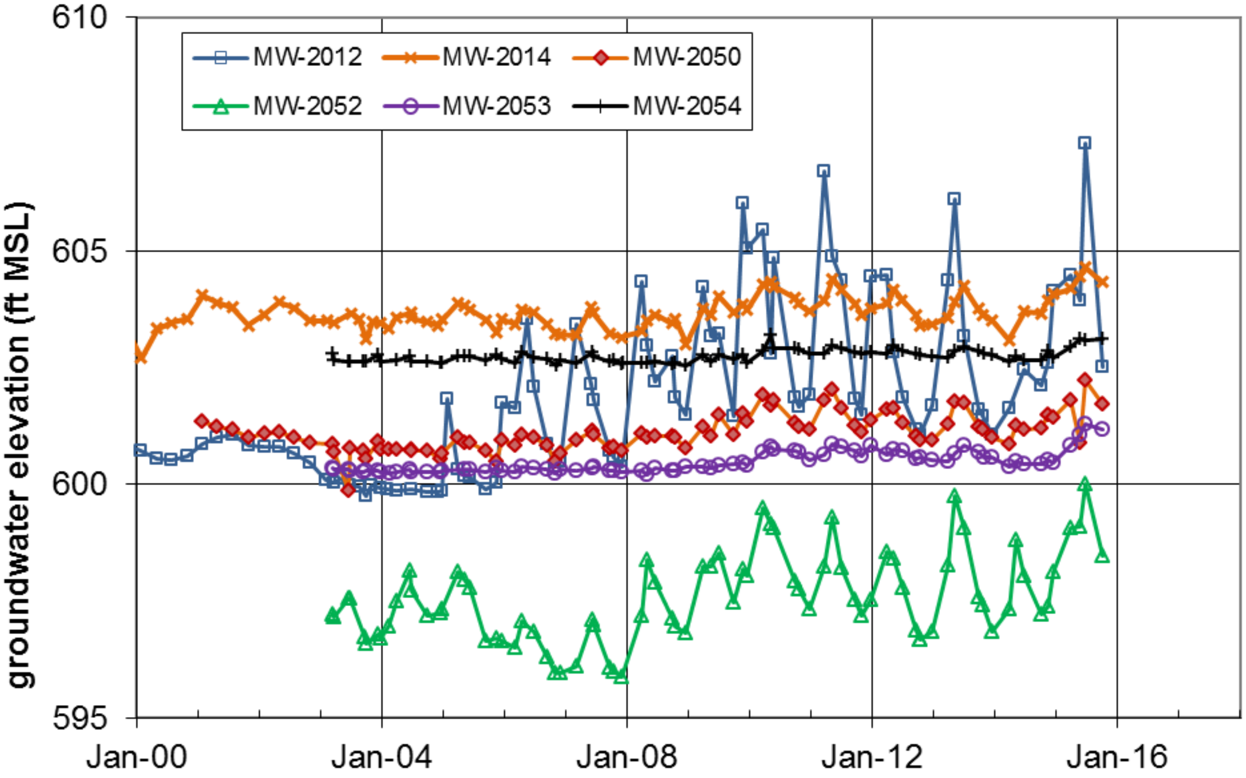


Figure 44. Groundwater Elevations in Frog Pond Area Monitoring Wells

1,3-DNB

Performance monitoring concentrations of 1,3-DNB in well MW-2012 were above the 1 µg/L cleanup standard from late 2001 to early 2006 but have remained below that level since then (Figure 45). Decreases in 1,3-DNB are expected, as this nitroaromatic compound is a photodegradation product of 2,4-DNT. Increases in concentration 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. Concentrations of 1,3-DNB in wells MW-2050, MW-2052, and MW-2053 that have not been above the 1,3-DNB MCL but are impacted by 2,4-DNT are included on Figure 45 to illustrate the decline in 1,3-DNB concentrations in MW-2012 since 2003. Considering that 1,3-DNB has been below the cleanup standard for more than 10 years at both performance and detection monitoring locations, future annual reports will confirm that levels remain low but will not include details about the data.

Detection monitoring location (Table 14) results for 1,3-DNB show that no downgradient migration of impacted groundwater has occurred from the area of known impact within the weathered unit (Figure 46). Fringe location MW-2051 has low concentrations of 1,3-DNB, and these concentrations are consistent with historical data. The data from the unweathered unit wells (Figure 47) indicate that the impacted groundwater in the overlying weathered unit has not moved downward. The concentrations reported in SP-6303 are negligible and are consistent with historical data. None of the concentrations reported exceeded the triggers levels set for the Objective 3 or 4 wells or the Objective 5 springs.

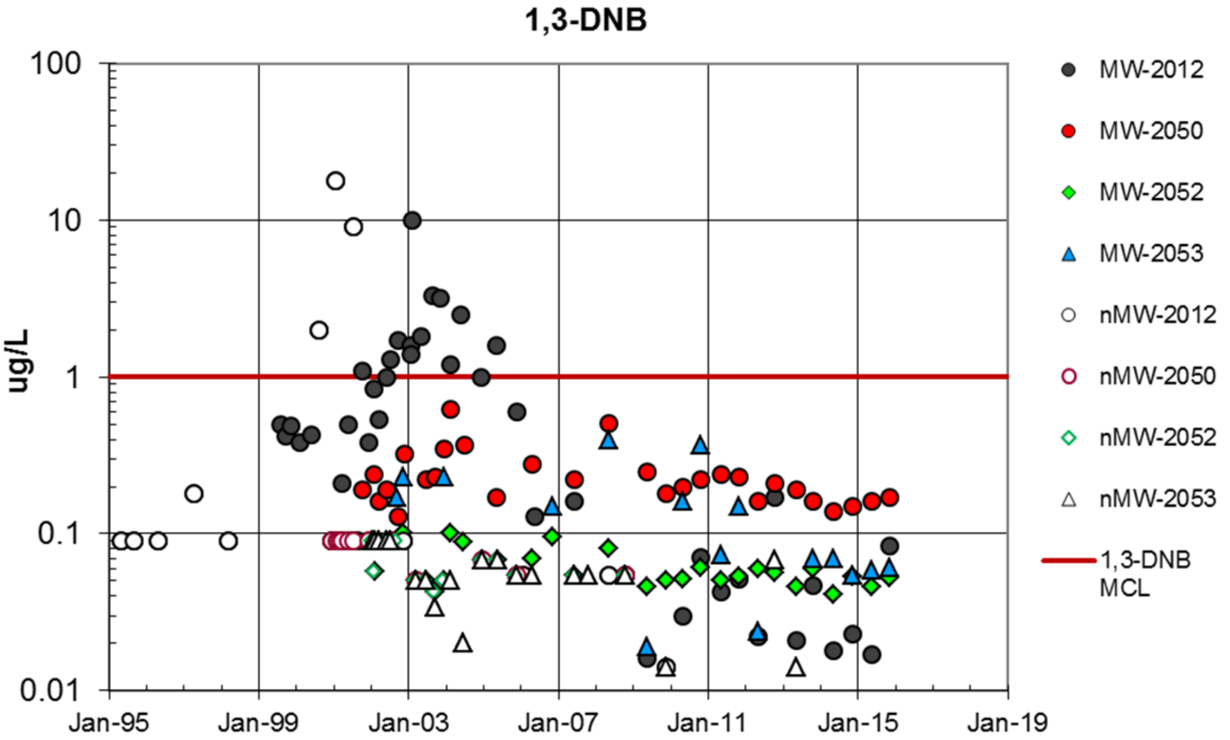


Figure 45. 1,3-DNB Concentrations in Performance Monitoring Well MW-2012

Table 14. 1,3-DNB Detection Monitoring Locations for GWOU Detection Monitoring Locations

Locations	Detection Monitoring Areas
Weathered Unit	
MW-2032	Fringe
MW-2051	Fringe
MW-4014	Downgradient
MW-4039	Fringe
MW-4041	Downgradient—Far
Unweathered Unit	
MW-2022	Vertical Extent
MW-2023	Vertical Extent
MW-2056	Vertical Extent
Springs	
SP-6301	Burgermeister Spring
SP-6303	Burgermeister Spring Branch

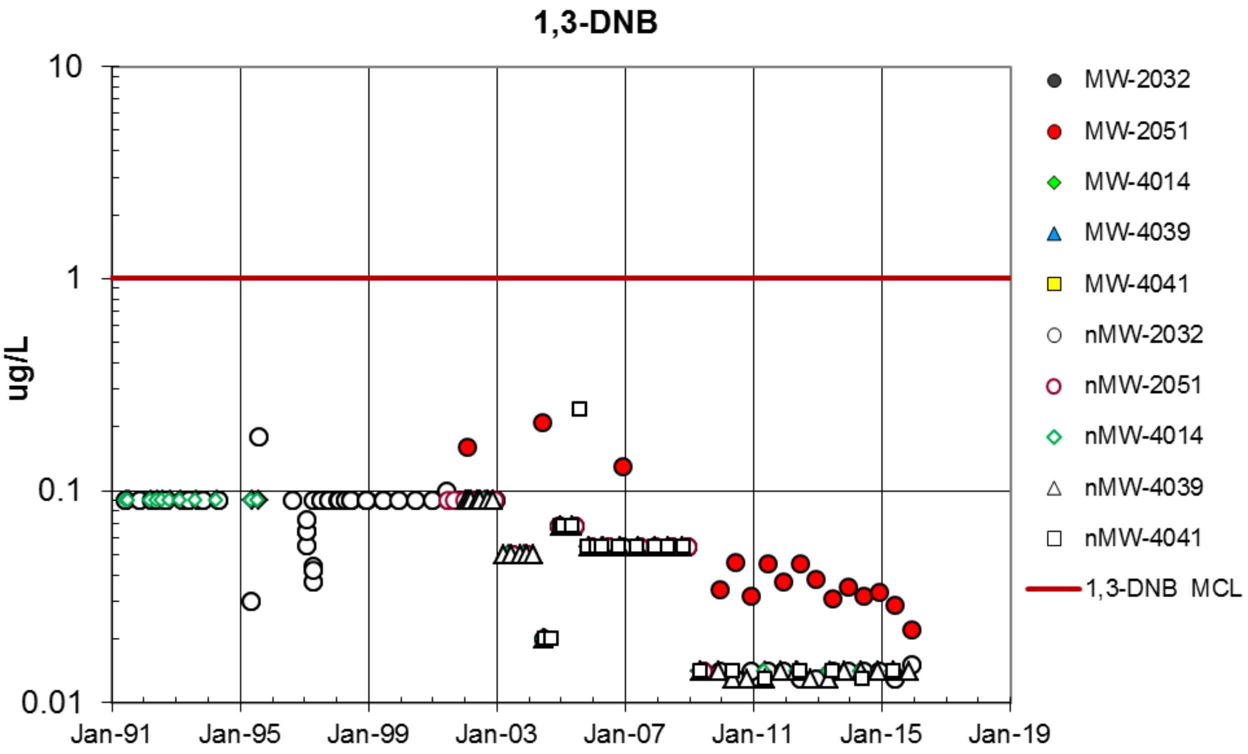


Figure 46. 1,3-DNB Concentrations in Detection Monitoring Wells—Weathered Unit

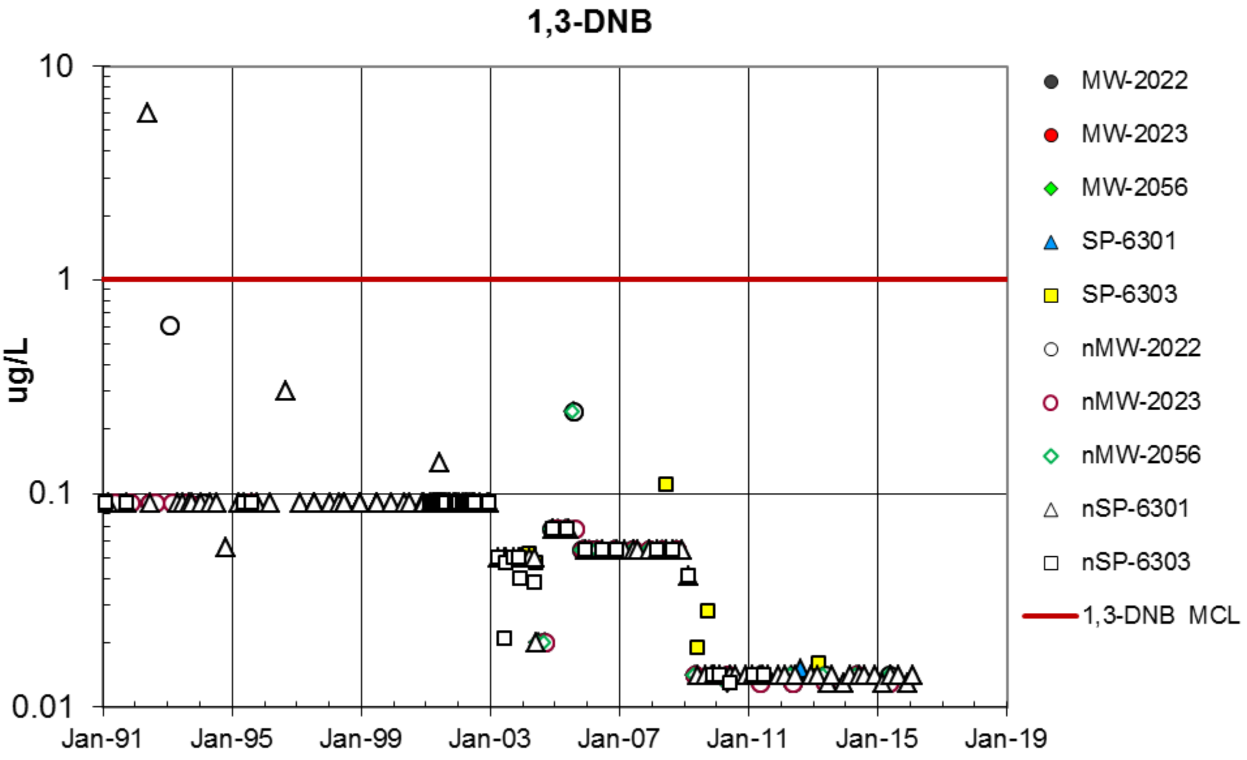


Figure 47. 1,3-DNB Concentrations in Detection Monitoring Wells—Unweathered Unit and Springs

Nitrobenzene (NB)

The nitroaromatic compound NB was not detected during the previous 5 years except for a single estimated value of 0.044 µg/L reported at well MW-2052 in the October 15, 2012, sample. The cleanup standard for NB is 17 µg/L.

NB has not been detected (without validation qualifiers) in any of the Objective 3, 4, or 5 detection monitoring locations since the MNA program began in 2004.

2,4,6-TNT Performance Monitoring Results

All 2,4,6-TNT concentrations reported at monitoring locations (Figure 48) from 2011 through 2015 were below the cleanup standard of 2.8 µg/L (Table 15). Concentrations of TNT have generally been decreasing in the Frog Pond area (Figure 49) since 2003. Well MW-2046 monitors a discrete area of TNT impact in the north-central portion of the site. Trend analysis of 2,4,6-TNT data collected from 2011 through 2015 indicates that concentrations are continuing to decrease in all of the Objective 2 wells, even though no statistically significant trends were calculated for the last 5 years' data.

Table 15. Average 2,4,6-TNT Concentrations in GWOU Performance Monitoring Wells

Location	2,4,6-TNT Concentration (µg/L)				
	2011	2012	2013	2014	2015
MW-2012	0.94	1.4	0.58	0.50	1.6
MW-2046	0.65	0.56	0.65	0.52	0.43
MW-2053	1.0	1.6	0.61	1.1	0.91

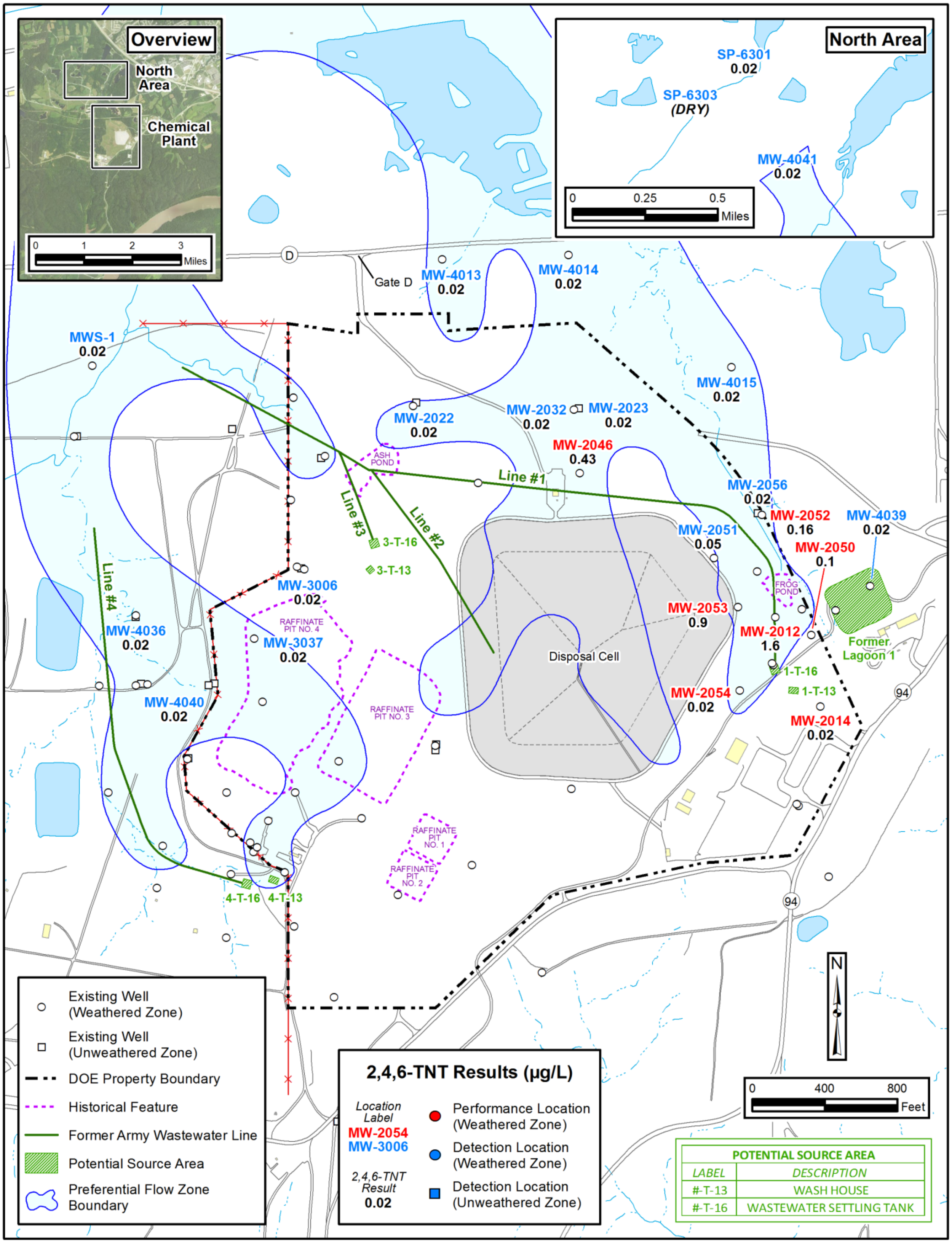


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Figure 48. 2,4,6-TNT Monitoring Locations with 2015 Average Concentrations

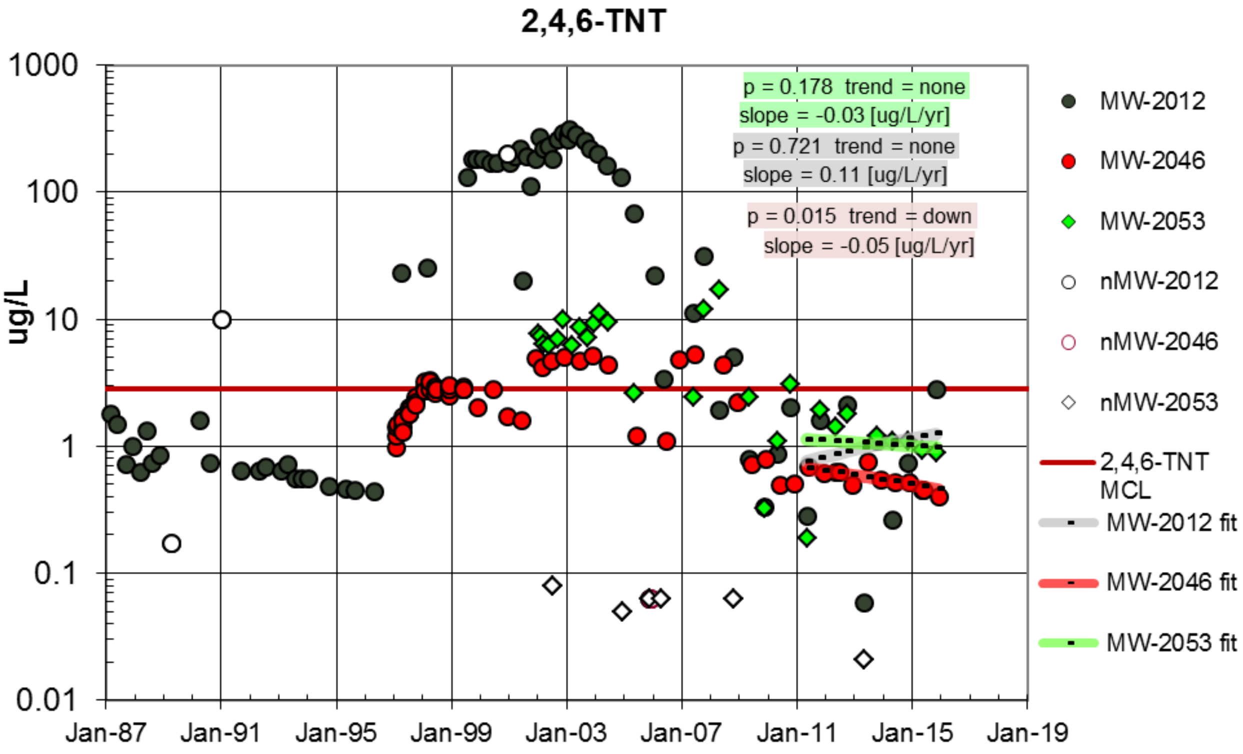

Figure 49. 2,4,6-TNT Concentrations in Performance Monitoring Wells

2,4,6-TNT Detection Monitoring Results

The 2,4,6-TNT concentrations reported in weathered unit detection monitoring wells (Table 16) indicate that impacted water has not migrated downgradient beyond the area of known impact. All weathered unit wells except MW-2051 have 2,4,6-TNT concentrations at or below the detection limit (Figure 50); these concentrations are consistent with historical data. No reportable concentrations of 2,4,6-TNT were detected in the wells in the unweathered unit (Figure 51).

The concentrations reported in Burgermeister Spring and SP-6303 are negligible and are consistent with historical data. A low-level, estimated concentration was detected at SP-6303 in 2013, which has been dry since that sample was collected (Figure 51). None of the concentrations reported exceeded the trigger levels set for the Objective 3 or 4 wells or the Objective 5 springs.

Table 16. 2,4,6-TNT GWOU Detection Monitoring Locations

Locations	**2,4,6-TNT** **Detection Monitoring Areas**
Weathered Unit	
MW-2032	Fringe
MW-2051	Fringe
MW-4014	Downgradient
MW-4039	Fringe
MW-4041	Downgradient—Far
Unweathered Unit	
MW-2022	Vertical Extent
MW-2023	Vertical Extent
MW-2056	Vertical Extent
Springs	
SP-6301	Burgermeister Spring
SP-6303	Burgermeister Spring Branch

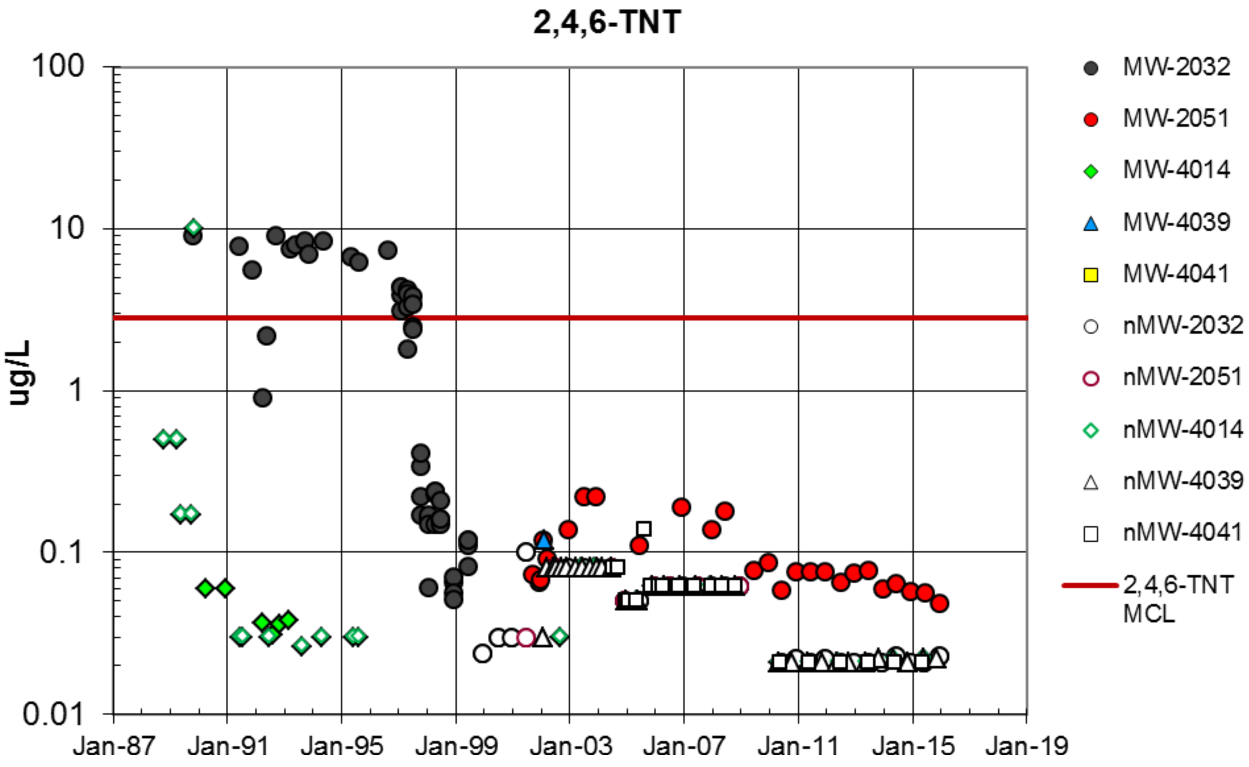

Figure 50. 2,4,6-TNT Concentrations in Weathered Unit Detection Monitoring Wells

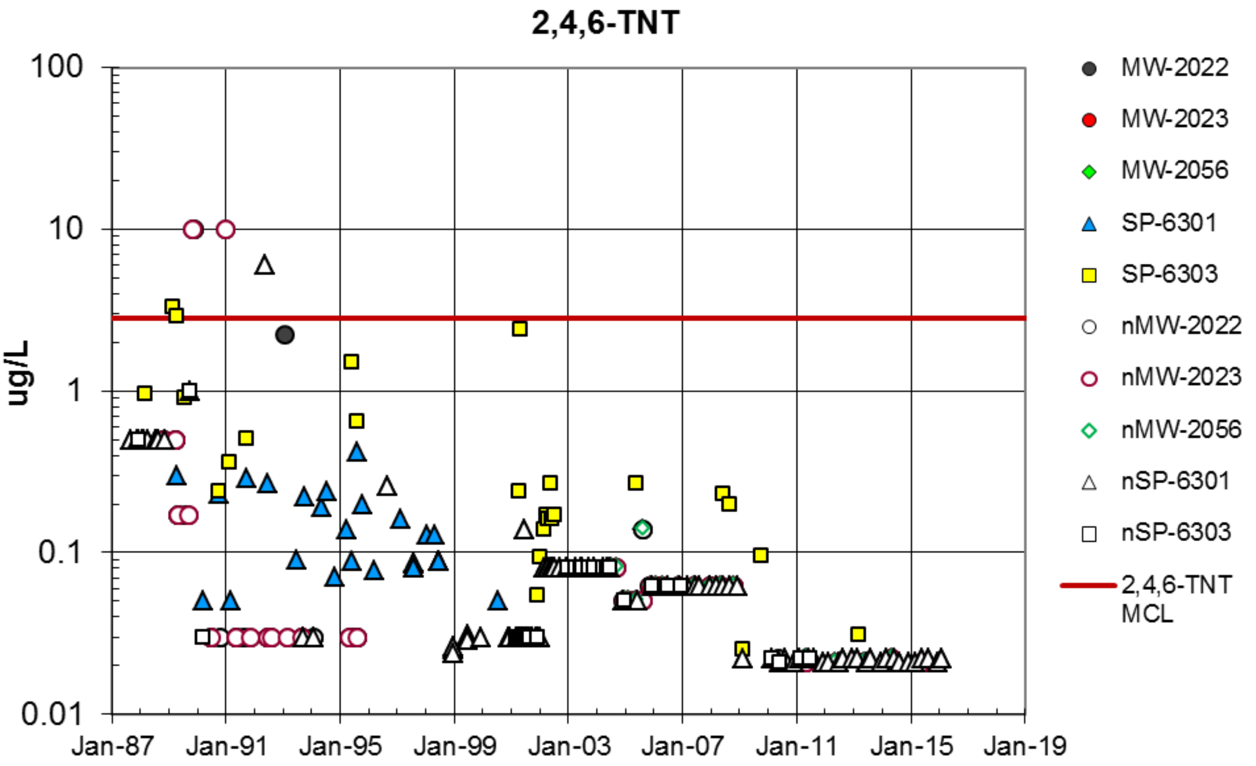

Figure 51. 2,4,6-TNT Concentrations in Unweathered Unit Detection Monitoring Wells and Springs

2,4-DNT and 2,6-DNT Performance Monitoring

The nitroaromatic compounds 2,4-DNT and 2,6-DNT are the most persistent in groundwater at the site. Figure 52 shows the locations of the performance and detection monitoring wells. Data from the last few years indicate that concentrations of DNT have varied in most of the Objective 2 wells (Table 17 and Table 18). The variability can be attributed to the introduction of surface water into the groundwater system. 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.

Table 17. Average 2,4-DNT Concentrations in Performance Monitoring Wells in the Frog Pond Area

Location	2,4-DNT Concentration (µg/L)				
	2011	2012	2013	2014	2015
MW-2012	3.3	38.7	2.99	0.12	20
MW-2050	20.5	12.5	5.4	2.5	5.4
MW-2053	5.5	0.14 (U)	0.39	0.41	0.019 (U)
MW-2014	0.12	0.12	0.14	0.12	0.12
MW-2052	0.06	0.07	0.06	0.05	0.06
MW-2054	0.08	0.08	0.09	0.10	0.09

(U) = analyte not detected above reporting limit for any samples during the year (2 samples per year)

Table 18. Average 2,6-DNT Concentrations in Performance Monitoring Wells in the Frog Pond Area

Location	2,6-DNT Concentration (µg/L)				
	2011	2012	2013	2014	2015
MW-2012	18.5	51.9	17.6	4.4	37
MW-2050	29.5	28.5	29	22.5	20
MW-2053	52	20.5	3.5	4.7	6.5
MW-2014	0.35	0.37	0.36	0.35	0.48
MW-2052	0.15	0.21	0.14	0.09	0.13
MW-2054	0.20	0.21	0.21	0.26	0.24

Wells with higher 2,4-DNT and 2,6-DNT concentrations in the former Frog Pond area downgradient of the TNT-production buildings and Army Lagoon 1 are generally the most variable (Figure 53 and Figure 54), and lower-concentration wells are more stable (Figure 55 and Figure 56). During previous years, the highest concentrations of these two compounds were reported in MW-2012; however, concentrations of DNT and the other nitroaromatic compounds have decreased substantially at this location. The highly variable concentrations in MW-2012 are typically related to water elevations; higher concentrations occur at times when water levels are low (Figure 57). Well MW-2050 is the most stable higher-concentration well and may be the last to decrease to the cleanup standards.

Concentrations of 2,4-DNT in lower-concentration wells MW-2014, MW-2052, and MW-2054 were less than or near the cleanup standard of 0.11 µg/L. Only MW-2014 had a concentration slightly above the cleanup standard. Concentrations of 2,6-DNT in the lower-concentration wells were below the cleanup standard of 1.3 µg/L for all samples collected from 2011 through 2015.

The calculated trends of MW-2012 and MW-2053 are meaningless because the concentrations are highly variable, though concentrations in both wells are showing lower highs and lower lows through time. Although results need to be more stable to estimate time until reaching cleanup standards, the high variability appears to favor significantly lower concentrations. The last 5 years of data from the most stable higher-concentration well, MW-2050, do indicate a statistically significant down trend for both 2,4-DNT and 2,6-DNT. The lower-concentration wells are relatively stable with long-term decreasing concentrations of 2,4-DNT and 2,6-DNT.

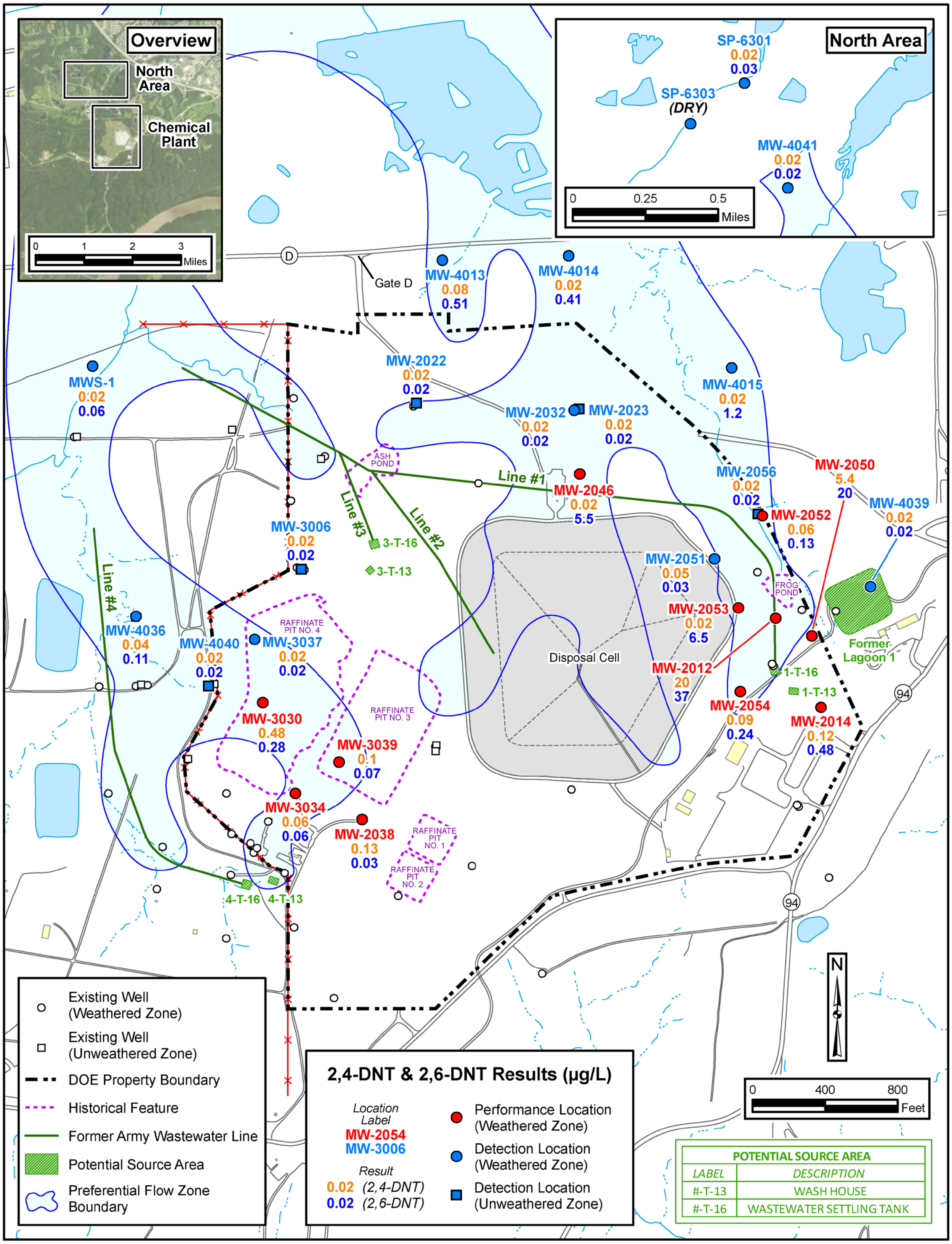

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Figure 52. 2,4-DNT and 2,6-DNT Monitoring Locations with 2015 Average Concentrations

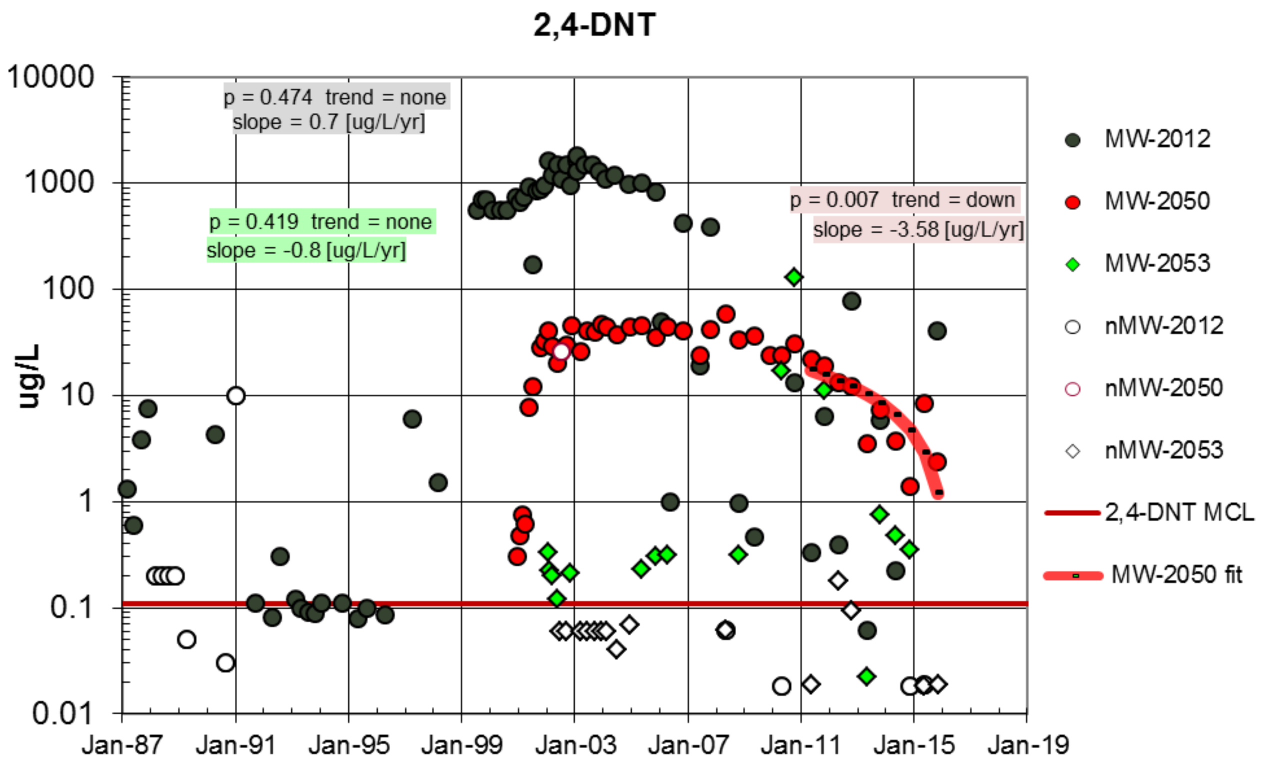

Figure 53. 2,4-DNT in Higher-Concentration Performance Monitoring Wells

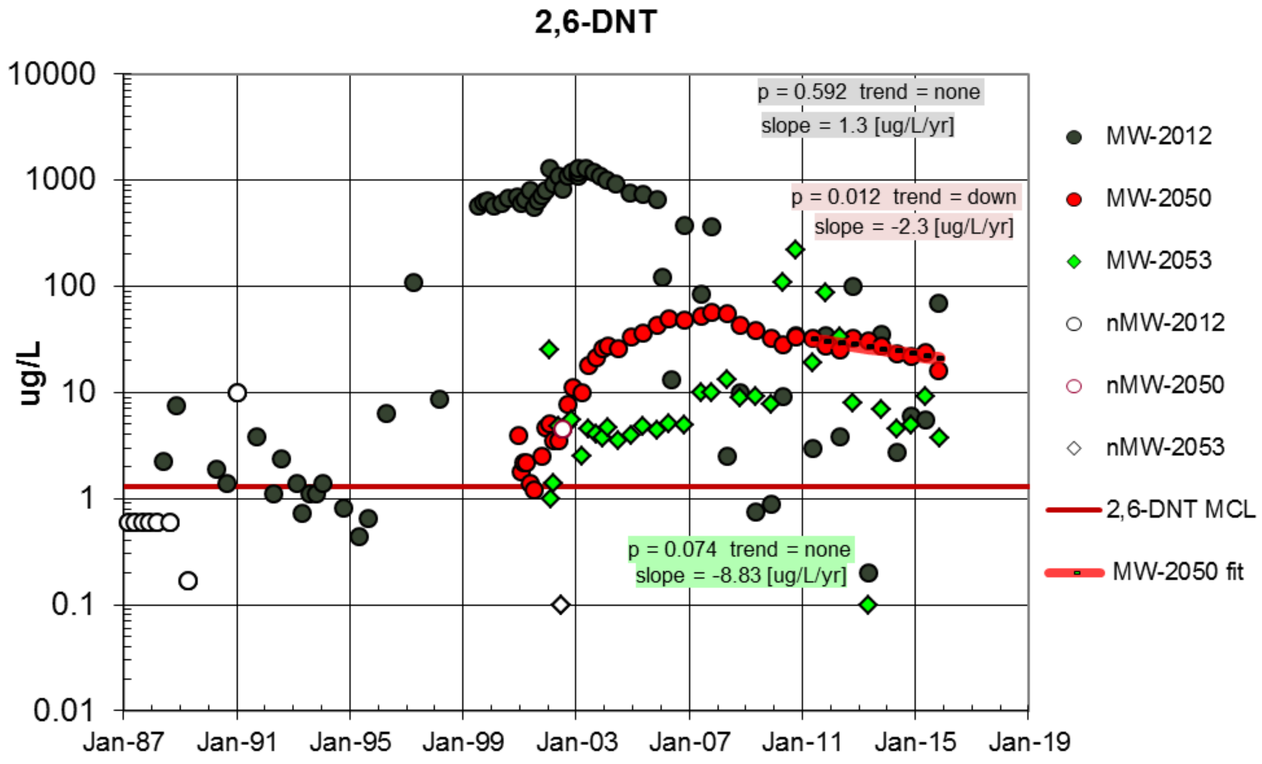

Figure 54. 2,6-DNT in Higher-Concentration Performance Monitoring Wells

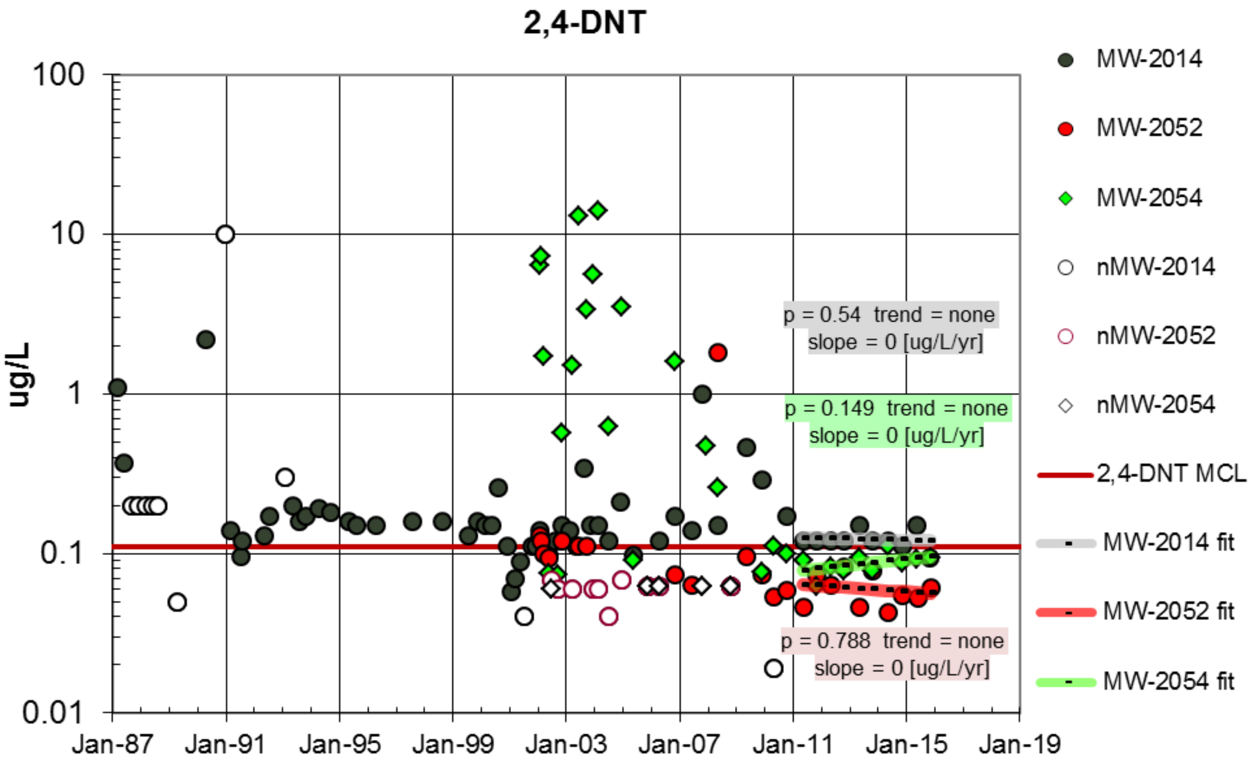

Figure 55. 2,4-DNT in Lower-Concentration Performance Monitoring Wells

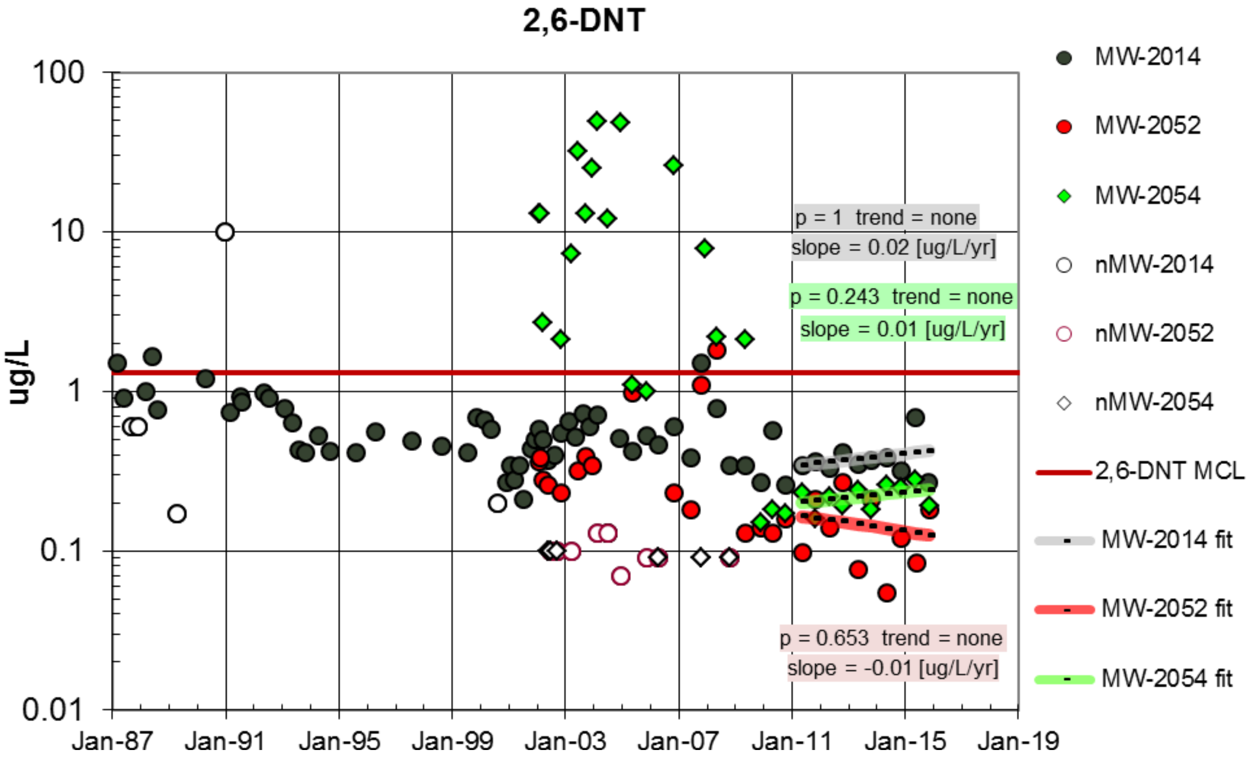

Figure 56. 2,6-DNT in Lower-Concentration Performance Monitoring Wells

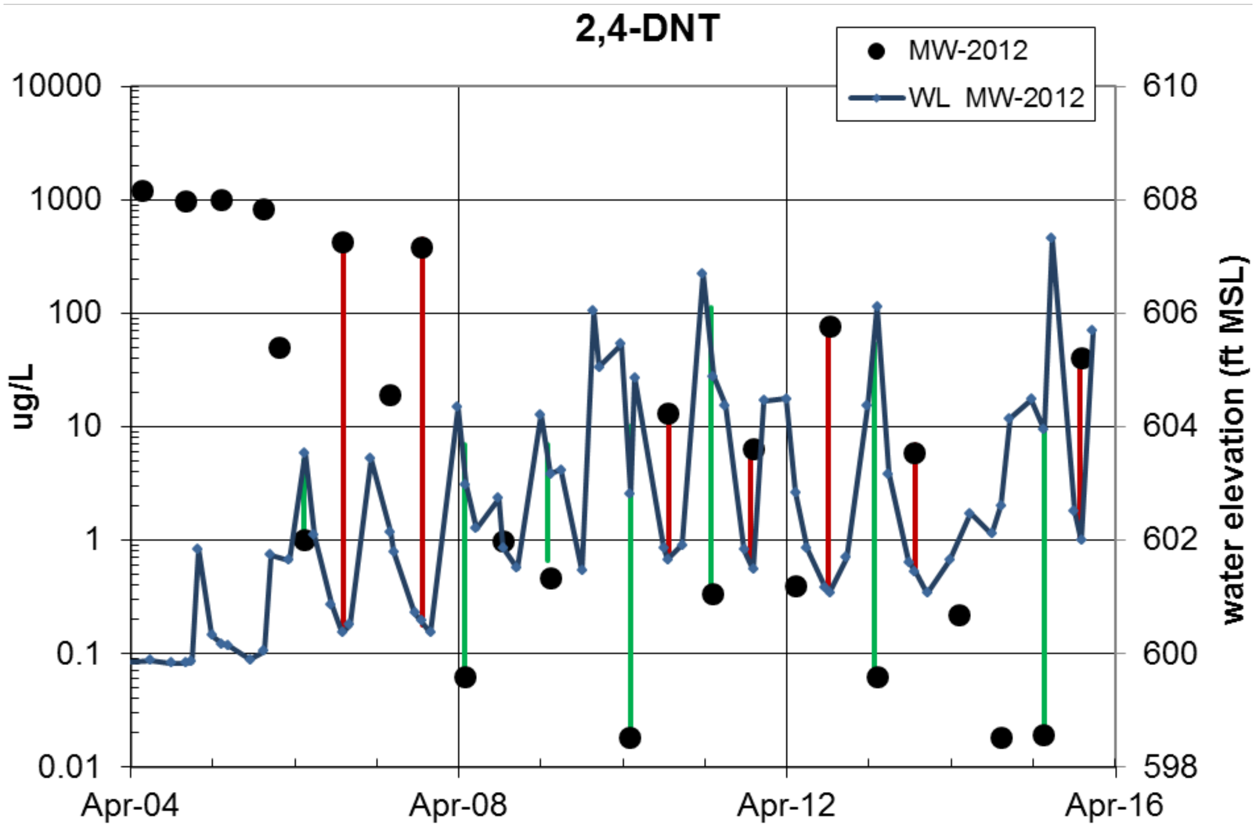

Figure 57. Variable 2,4-DNT Concentrations in MW-2012

2,4-DNT and 2,6-DNT Detection Monitoring

Results from detection monitoring locations (Table 19) for the area of 2,4-DNT impact in the Frog Pond area indicate that some migration from this area continues (Figure 58). Results from 2011, 2012, and 2013 from MW-4015 are above the 0.11 µg/L cleanup standard for 2,4-DNT, but only the 2011 result was not qualified as estimated. None of the concentrations reported exceeded the 0.55 µg/L trigger level set for downgradient Objective 3 wells. The data from the unweathered unit wells (Figure 59) indicate that the impacted groundwater in the overlying weathered unit has not moved downward. The concentrations reported in Burgermeister Spring and SP-6303 are negligible and are consistent with historical data. The 2013 detection in SP-6303 was lab qualified as estimated. None of the concentrations reported exceeded the trigger levels set for the Objective 5 springs. Concentrations in these downgradient wells have decreased slightly during the review period.

Table 19. 2,4-DNT and 2,6-DNT GWOU Detection Monitoring Locations—Frog Pond Area

Location	Detection Monitoring Area
Weathered Unit	
MW-2032	Fringe
MW-2051	Fringe
MW-4013	Downgradient
MW-4014	Downgradient
MW-4015	Downgradient
MW-4039	Fringe
MW-4041	Downgradient—Far
Unweathered Unit	
MW-2023	Vertical Extent
MW-2056	Vertical Extent
Springs	
SP-6301	Burgermeister Spring
SP-6303	Burgermeister Spring Branch

Concentrations of 2,6-DNT show persistent detections in weathered unit wells MW-4013, MW-4014, and MW-4015 (Figure 60). Concentrations of 2,6-DNT in these wells are stable, though they may be trending up in MW-4014, which has the lowest concentrations of the three wells. Results remain below the 1.3 µg/L cleanup standard for the three wells. Concentrations of 2,6-DNT in the other weathered unit wells are at the detection limit. No reportable concentrations of 2,6-DNT were detected in the wells in the unweathered unit (Figure 61).

There were 14 low-level detections of 2,6-DNT reported at Burgermeister Spring (SP-6301) in the previous 5 years, though only 3 were not qualified as estimated. Within the perspective of historical data, concentrations are decreasing at Burgermeister Spring. A 0.31 µg/L detection (below the 1.3 µg/L cleanup standard) was reported at SP-6303 in 2013. This spring has been dry since mid-2013.

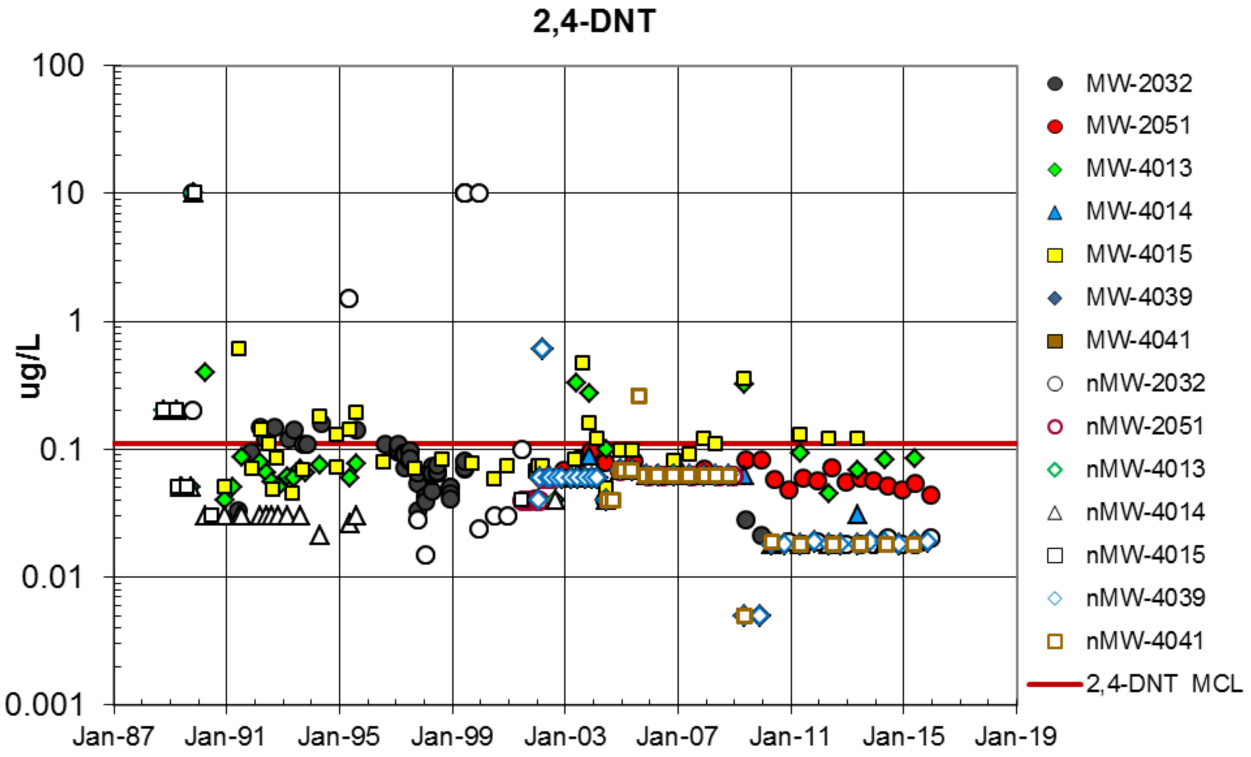

Figure 58. 2,4-DNT in Weathered Unit Detection Monitoring Wells

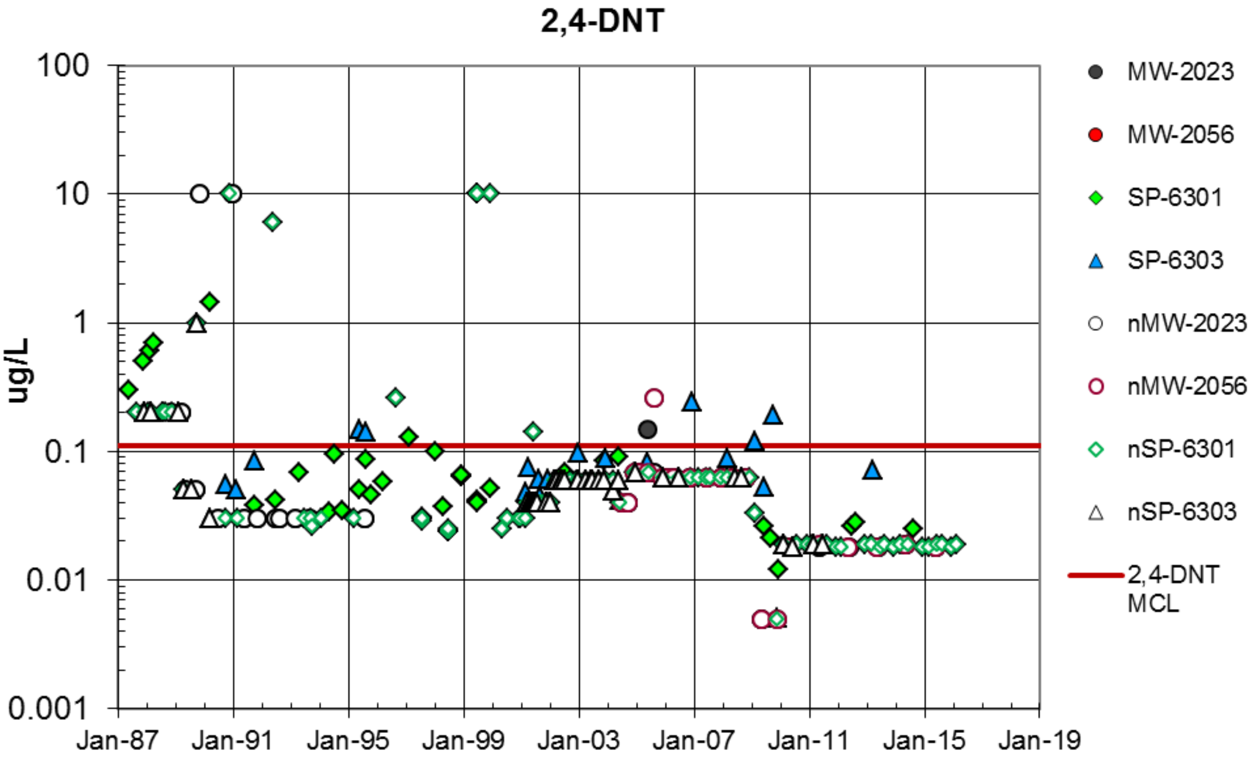

Figure 59. 2,4-DNT in Unweathered Unit Detection Monitoring Wells and Springs

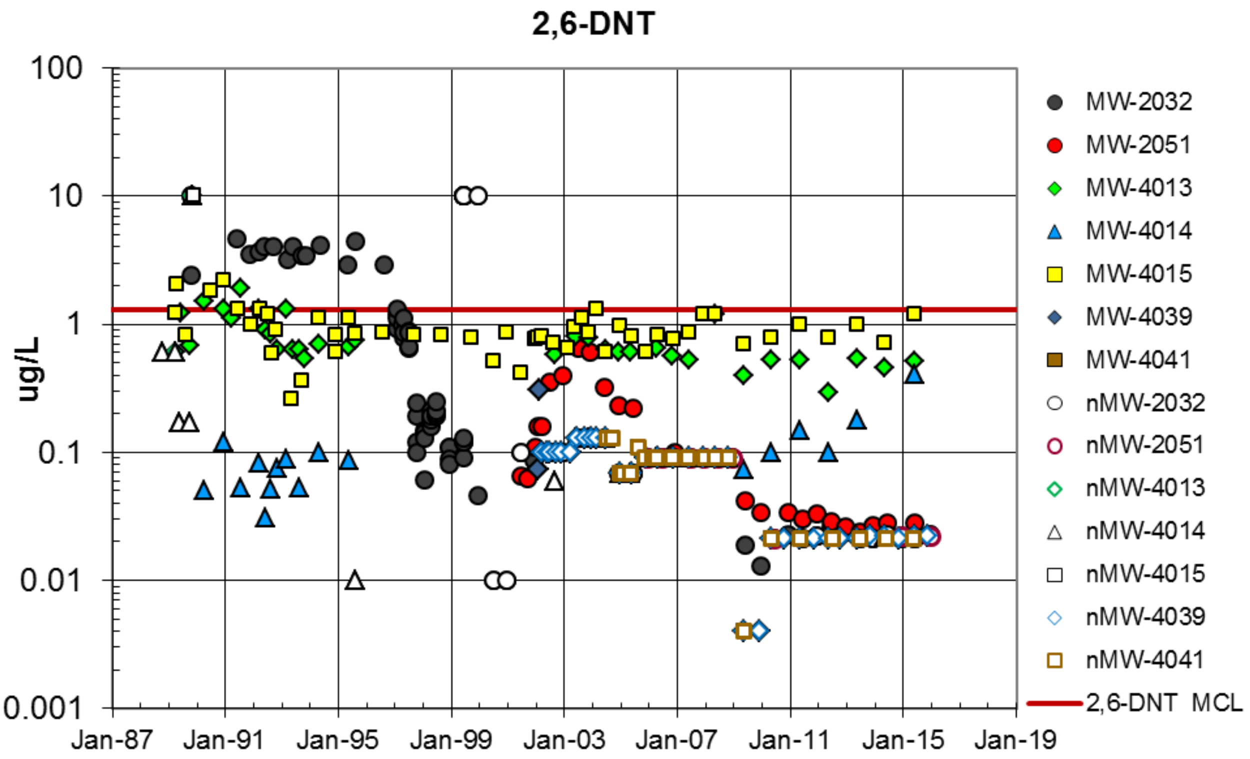

Figure 60. 2,6-DNT in Weathered Unit Detection Monitoring Wells

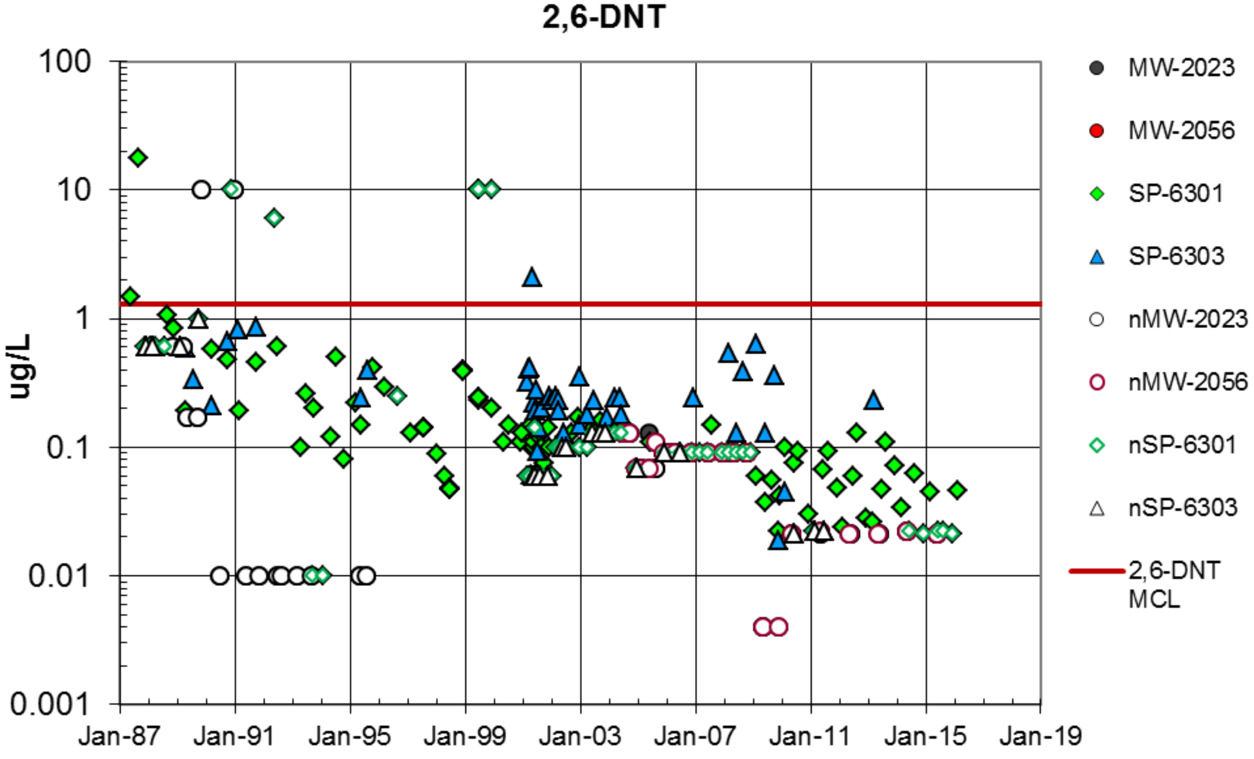

Figure 61. 2,6-DNT in Unweathered Unit Detection Monitoring Wells and Springs

Overall, the impact of nitroaromatic compounds in 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 are variable with generally decreasing concentrations. Most locations exhibit long-term decreasing trends. Concentrations of 1,3-DNB, NB, and 2,4,6-TNT are currently below the cleanup standard for all monitoring locations.

Nitroaromatic Compounds—Former Raffinate Pits Area

The other area of nitroaromatic compound impact at the Chemical Plant site is in the former Raffinate Pits area where portions of TNT-production lines 3 and 4 were located. Groundwater in this area is impacted by 2,4-DNT in concentrations that exceed the cleanup standard of 0.11 µg/L. The impact of nitroaromatic compounds is limited to the weathered unit of the Burlington-Keokuk Limestone. Table 20 presents a summary of the 2,4-DNT data from the former Raffinate Pits area for the period of 2011 through 2015.

Table 20. 2,4-DNT Data from GWOU Performance Monitoring Wells in the Raffinate Pits Area

Location	**2,4-DNT Concentration (µg/L)**				
	2011	**2012**	**2013**	**2014**	**2015**
MW-2038	0.13	0.15	0.12	0.13	0.13
MW-3030	0.63	0.57	0.60	0.64	0.48
MW-3034	0.07	0.06	0.06	0.06	0.06
MW-3039	0.19	0.16	0.15	0.15	0.10

The highest 2,4-DNT concentrations in the former Raffinate Pits area continue to be observed in well MW-3030 (Figure 62). Concentrations in wells MW-2038, MW-3030, MW-3034, and MW-3039 have been consistently decreasing except for a temporary rebound in MW-3030 during 2009. The 2,4-DNT concentrations in MW-3034 have been less than or equal to the cleanup standard of 0.11 µg/L since 2009. For the first time since 2,4-DNT monitoring began at well MW-3039, sample results in 2015 were below the cleanup standard.

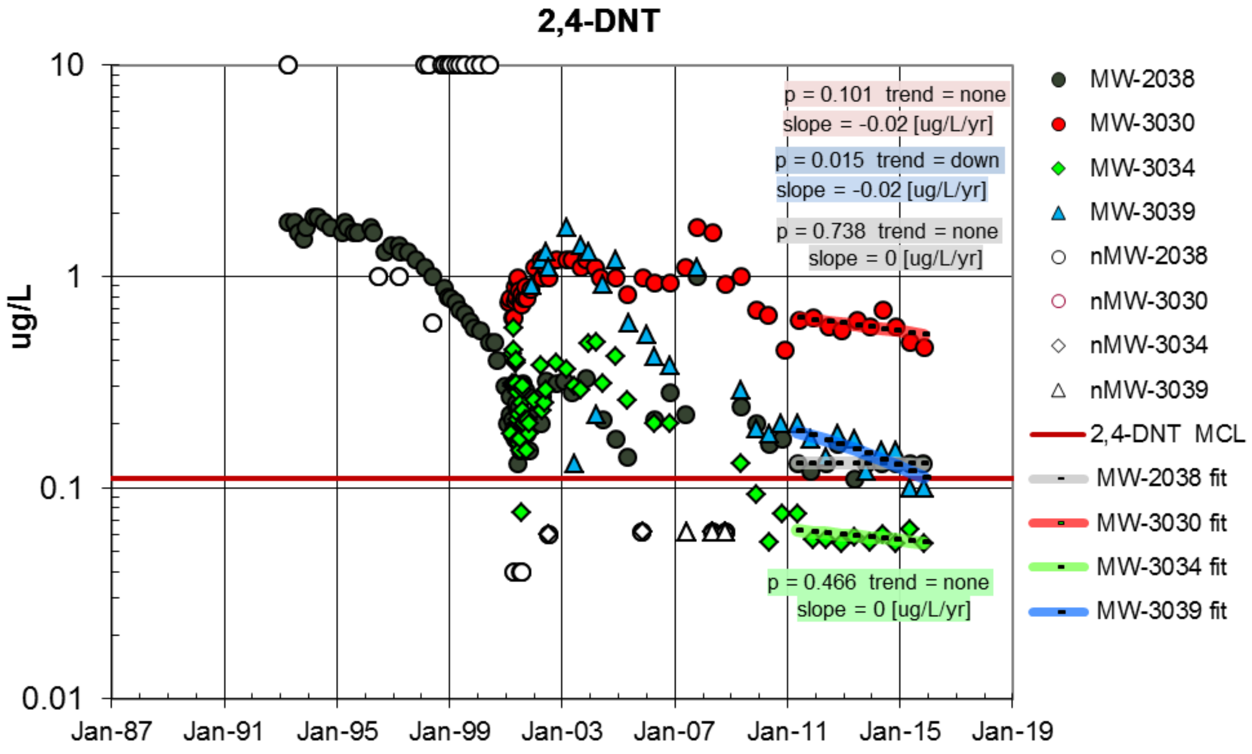

Figure 62. 2,4-DNT Concentrations in Performance Monitoring Wells in the Former Raffinate Pits Area

Trend analysis based on the data from 2011 through 2015 indicates that 2,4-DNT concentrations in the former Raffinate Pits area are decreasing. A statistically downward trend was calculated for well MW-3039, which in 2015 decreased to below the cleanup standard. Concentrations in wells MW-2038 and MW-3030 continued their long-term decline despite no statistically significant trend for the last 5 years. Concentrations in well MW-3034 are stable at low levels below the cleanup standard. If long-term trends continue, concentrations of 2,4-DNT at MW-2038 could drop below the 0.11 µg/L cleanup standard in the next 5 years. The higher concentrations at well MW-3030 will probably take another 20 to 30 years to reach the cleanup standard.

Results from detection monitoring locations (Table 21) for the area of 2,4-DNT impact in the Raffinate Pits area show that minimal migration from this area has occurred. The source of 2,4-DNT detected in wells MW-4036 and MW-3037 may be the Chemical Plant site, the Army property, or both. These results are questionable in that the replicate analysis of the one-time concentration above the 0.11 µg/L cleanup standard in MW-3037 (Figure 63) was not within control limits, and the detections in MW-4036 were qualified as estimated. All sample results from the unweathered unit wells since the early 1990s are below detection limits and verify that the impacted groundwater in the overlying weathered unit has not migrated downward.

Table 21. 2,4-DNT and 2,6-DNT GWOU Detection Monitoring Locations—Raffinate Pits Area

Locations	Detection Monitoring Areas
Weathered Unit	
MW-3037	Fringe
MW-4036	Downgradient
MWS-1	Downgradient
Unweathered Unit	
MW-3006	Vertical Extent
MW-4040	Vertical Extent

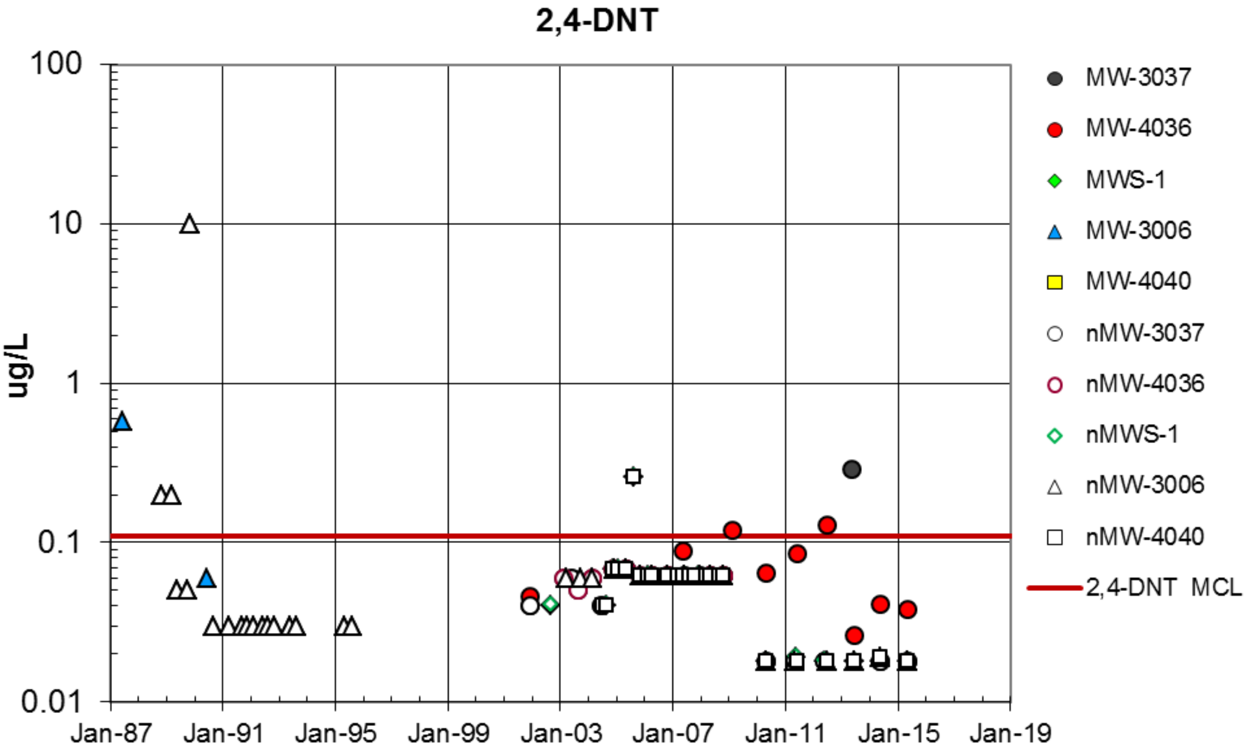

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Figure 63. 2,4-DNT in Raffinate Pits Area Detection Monitoring Wells—Weathered Unit

5.2.2 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 2015 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 22 presents the results for the Chemical Plant surface water sampling along with the previous 5-year high. Figure 64 presents the historical results since 1987 along with results from SW-2007 (upstream location on Dardenne Creek) for comparison. The uranium levels at Busch Lake 34 continue to be higher than the other 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 generally consistent with data from previous years. Uranium concentrations in Dardenne Creek that are not influenced by Chemical Plant runoff are typically less than 1 pCi/L (SW-2007 location upstream of the confluence of Chemical Plant drainages with Dardenne Creek).

Table 22. Total Uranium at Weldon Spring Chemical Plant Area Surface Water Locations

Location	Uranium (2015) (pCi/L)	Previous 5-Year High[a]
SW-2004 (Busch Lake 34)	4.9 (Apr 30, 2015)	6.4 (2014)
SW-2005 (Busch Lake 36)	4.0 (Apr 29, 2015)	3.2 (2011)
SW-2012 (Busch Lake 35)	0.84 (Apr 30, 2015)	1.4 (2012)
SW-2016 (Dardenne Creek)	1.0 (Apr 30, 2015)	1.4 (2013)
SW-2024 (Schote Creek)	1.3 (Apr 30, 2015)	3.0 (2013)

[a] 2010–2014

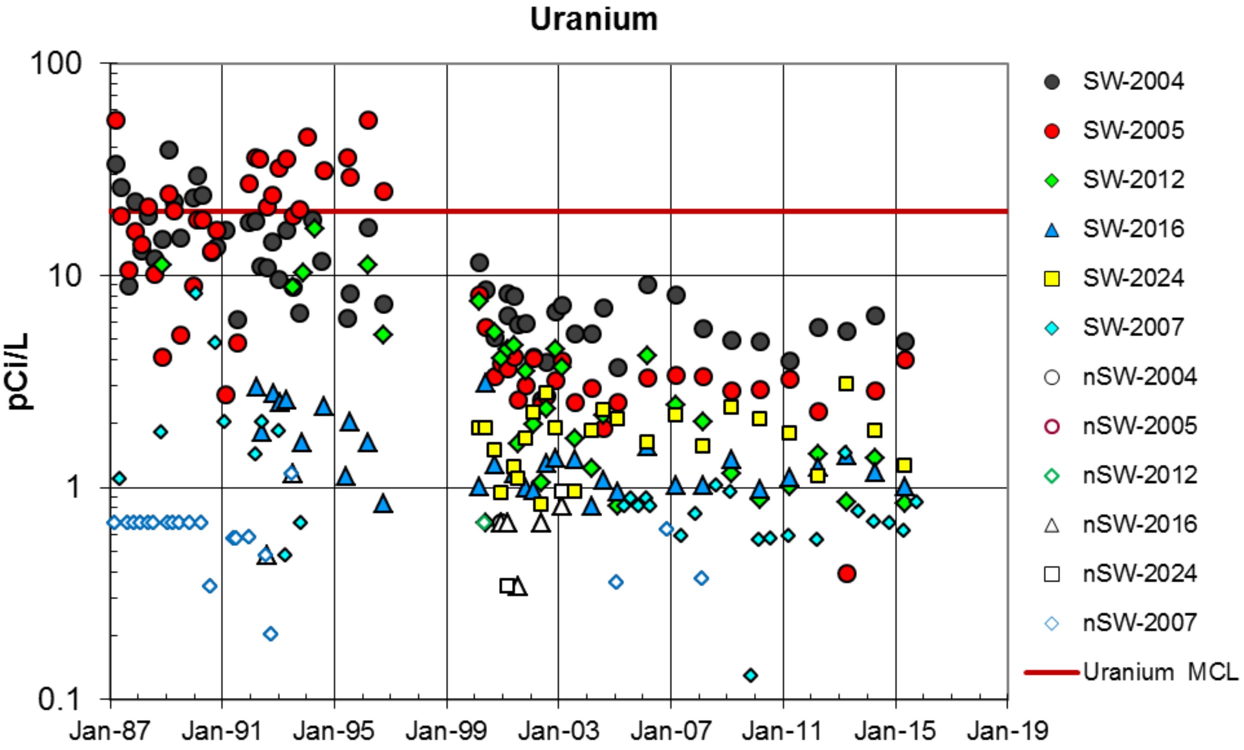

Figure 64. Total Uranium at Weldon Spring Chemical Plant Area Surface Water Locations

5.2.3 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 the disposal cell leachate. Semiannual detection monitoring began in mid-1998, after cell construction and waste placement activities had begun.

Under the monitoring program for the disposal cell, the monitoring wells, spring, and leachate are sampled semiannually (in June and December). Samples from the wells and spring are analyzed for the analytes listed in Table 23. Leachate was analyzed for the analytes listed in Table 24. Sampling was performed as specified in Appendix K of the LTS&M Plan (DOE 2008a). The present modified program is a result of a review of the leachate and groundwater data. Appendix K of the LTS&M Plan describes the rationale for modifying the program.

The performance of the disposal cell is gauged on the concentrations of signature parameters in the groundwater. Signature parameters are those constituents present in the leachate at concentrations that are at least 1 order of magnitude greater than in the underlying groundwater. Initially, barium, iron, manganese, and uranium were identified as signature parameters for the leachate. In 2008, the list was reduced to include only barium and uranium. Under the monitoring program, signature parameter 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 at the 95 percent confidence limits using the data set from 1997 through 2002.

Table 23. Disposal Cell Detection Monitoring—Groundwater and Spring Analyte List

Radiological	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

Abbreviations:
DNB = dinitrobenzene
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
TNB = trinitrobenzene
TNT = trinitrotoluene

Table 24. Disposal Cell Detection Monitoring—Leachate Analyte List

Radiological	Inorganic Ions	Metals	Nitroaromatic Compounds	Other	General Indicator Parameters
Radium-226 Radium-228 Thorium-228 Thorium-230 Thorium-232	Chloride Fluoride Nitrate 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

Abbreviations:
COD = chemical oxygen demand
DNB = dinitrobenzene
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
TDS = total dissolved solids
TNB = trinitrobenzene
TNT = trinitrotoluene
TOC = total organic carbon

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 3 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 a statistically significant increase are resampled to confirm the exceedance. If the resampling results 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 OU.

5.2.3.1 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:

$$v = \left(\frac{K}{n}\right)\left(\frac{\mathrm{dh}}{\mathrm{dl}}\right)$$

$$v = \left(\frac{20\ \mathrm{ft/day}}{0.10}\right)\left(\frac{607\ \mathrm{ft} - 583\ \mathrm{ft}}{2100\ \mathrm{ft}}\right) = 2.29\ \mathrm{ft/day}$$

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 2005a). 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 (average of 607.0 ft above mean sea level for the previous 5 years) and MW-2032 (average of 583.0 ft above mean sea level for the previous 5 years), 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 2015 was 2.29 ft/day, which is the same (within 5%) as the average flow rate calculated since 2005.

5.2.3.2 Disposal Cell Monitoring Results—Signature Parameters

The monitoring results for the signature parameters collected from 2011 through 2015 are presented in Table 25 and are shown on Figure 65 and Figure 66 along with applicable BTLs. The results were less than the applicable BTLs, which indicates that there is no statistical evidence of leakage into the groundwater beneath the disposal cell. The general groundwater quality in the detection monitoring wells and Burgermeister spring (SP-6301) during this period was consistent with historical data. Leachate concentrations are shown on charts for comparison.

Section 5.3, "Leachate Collection and Removal System Data," presents the monitoring results for the disposal cell leachate. The LCRS is sampled semiannually, and the data are compared to 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. These three constituents have shown a general decline.

Table 25. Signature Parameter Results and Associated BTLs at Disposal Cell Monitoring Locations

Parameter	Location	BTL	Results									
			June 2011	Dec 2011	June 2012	Dec 2012	June 2013	Dec 2013	June 2014	Dec 2014	June 2015	Dec 2015
Barium (µg/L)	MW-2032	337	148	182	194	190	152	167	125	165	125	148
	MW-2046	277	215	198	200	148	158	198	161	171	151	156
	MW-2047	471	397	338	350	365	376	339	366	368	351	367
	MW-2051	285	250	238	262	268	279	260	262	292	259	279
	MW-2055	98	19	17	18	19	20	20	20	19	18	18
	SP-6301	180	131	115	123	114	116	135	111	101	86	113
Uranium (pCi/L)	MW-2032	6.4	2.4	2.3	2.0	2.0	2.2	2.0	3.9	3.6	4.8	3.0
	MW-2046	1.8	1.1	1.2	1.2	1.1	1.2	1.3	1.2	1.1	1.3	1.2
	MW-2047	2.7	1.1	1.2	1.2	1.2	1.2	1.3	1.2	1.0	1.3	1.1
	MW-2051	4.5	1.2	1.3	1.2	1.1	1.5	1.3	1.3	1.1	1.3	1.1
	MW-2055	7.5	1.9	1.9	1.8	1.7	1.7	1.8	2.0	1.5	1.9	1.9
	SP-6301	159	36	44	35	43	24	58	17	15	17	24

BTL = baseline tolerance limit

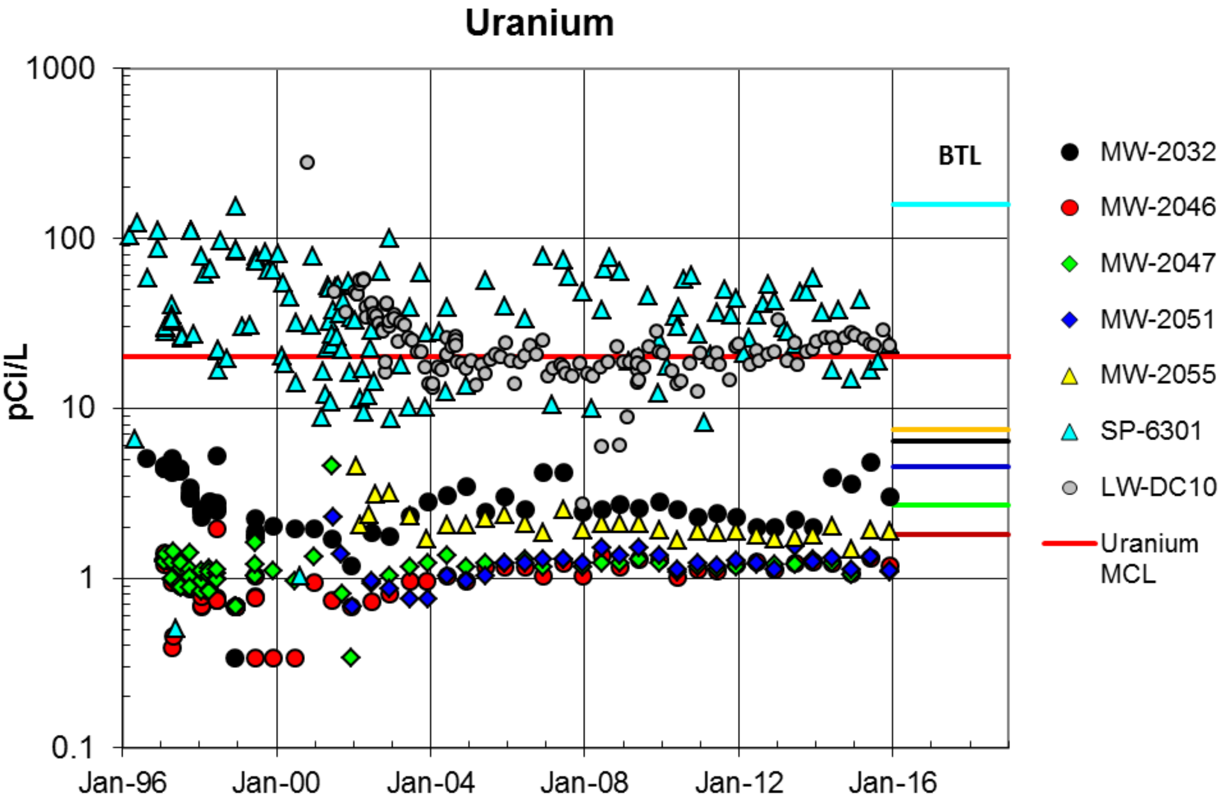

Figure 65. Uranium Concentrations—Disposal Cell Monitoring Wells with BTLs

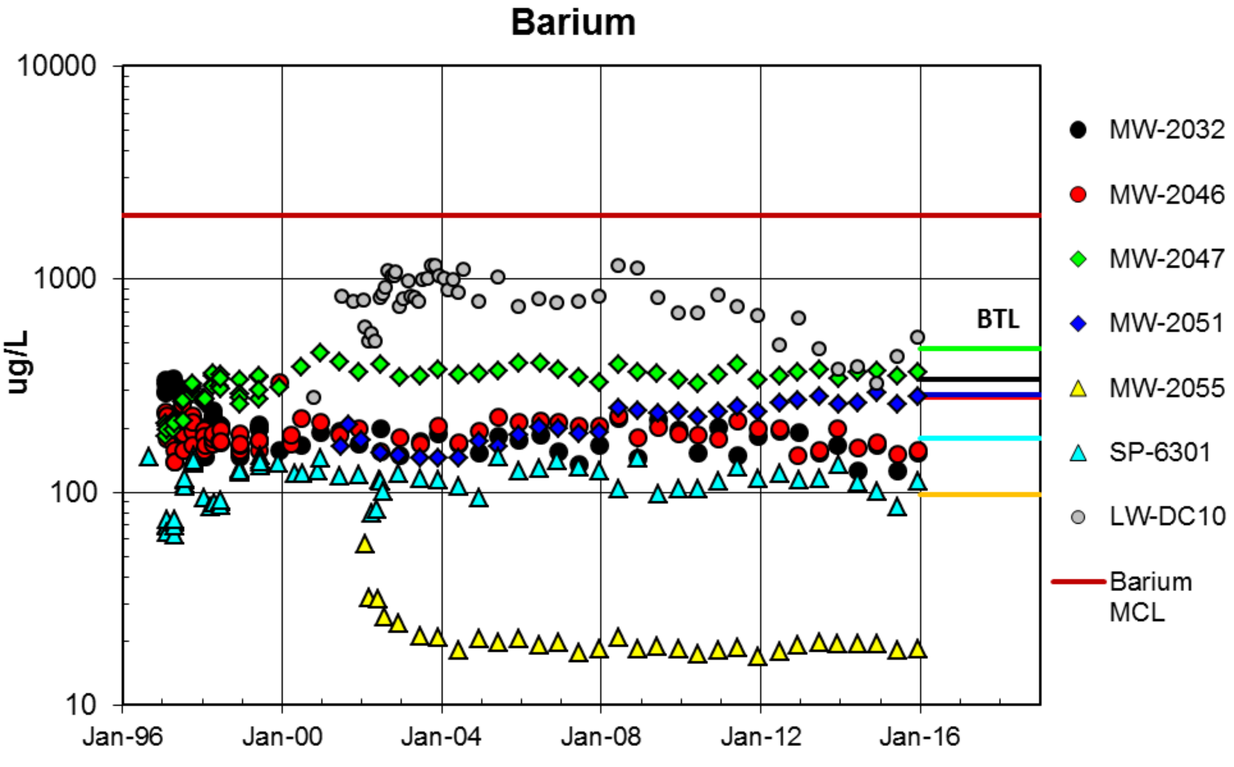

Figure 66. Barium Concentrations—Disposal Cell Monitoring Wells with BTLs

5.2.4 Quarry Groundwater

The removal of waste from the Quarry was completed in 1995. 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).

5.2.4.1 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 Group, 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. These units 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 26 provides a summary of the uranium background values (DOE 1998).

Table 26. 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.

Abbreviation:
UCL_{95} = 95th percentile upper confidence limit on the mean concentration

5.2.4.2 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 (Table 27 and Figure 67). 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 No. 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 occurrences of uranium outside the range of natural variation.

Table 27. Monitoring Line Categories for Wells at the Quarry

Background	Line 1	Line 2	Line 3	Line 4
MW-1012	MW-1004	MW-1032	MW-1017 (A)	RMW-1 (A)
	MW-1005	MW-1013	MW-1018 (A)	RMW-2 (A)
	MW-1027	MW-1048	MW-1019 (A)	RMW-3 (A)
	MW-1030	MW-1015	MW-1021 (A)	RMW-4 (A)
	MW-1002	MW-1031	MW-1044 (A)	
		MW-1028	MW-1050 (A)	
		MW-1046		
		MW-1047		
		MW-1008 (A)		
		MW-1051 (A)		
		MW-1014 (A)		
		MW-1006 (A)		
		MW-1052 (A)		
		MW-1007 (A)		
		MW-1016 (A)		
		MW-1009 (A)		
		MW-1045 (A)		
		MW-1049 (A)		

A =alluvial wells

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 Line 1 wells (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 2015, 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 2011 and 2015. Results for the trend 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.

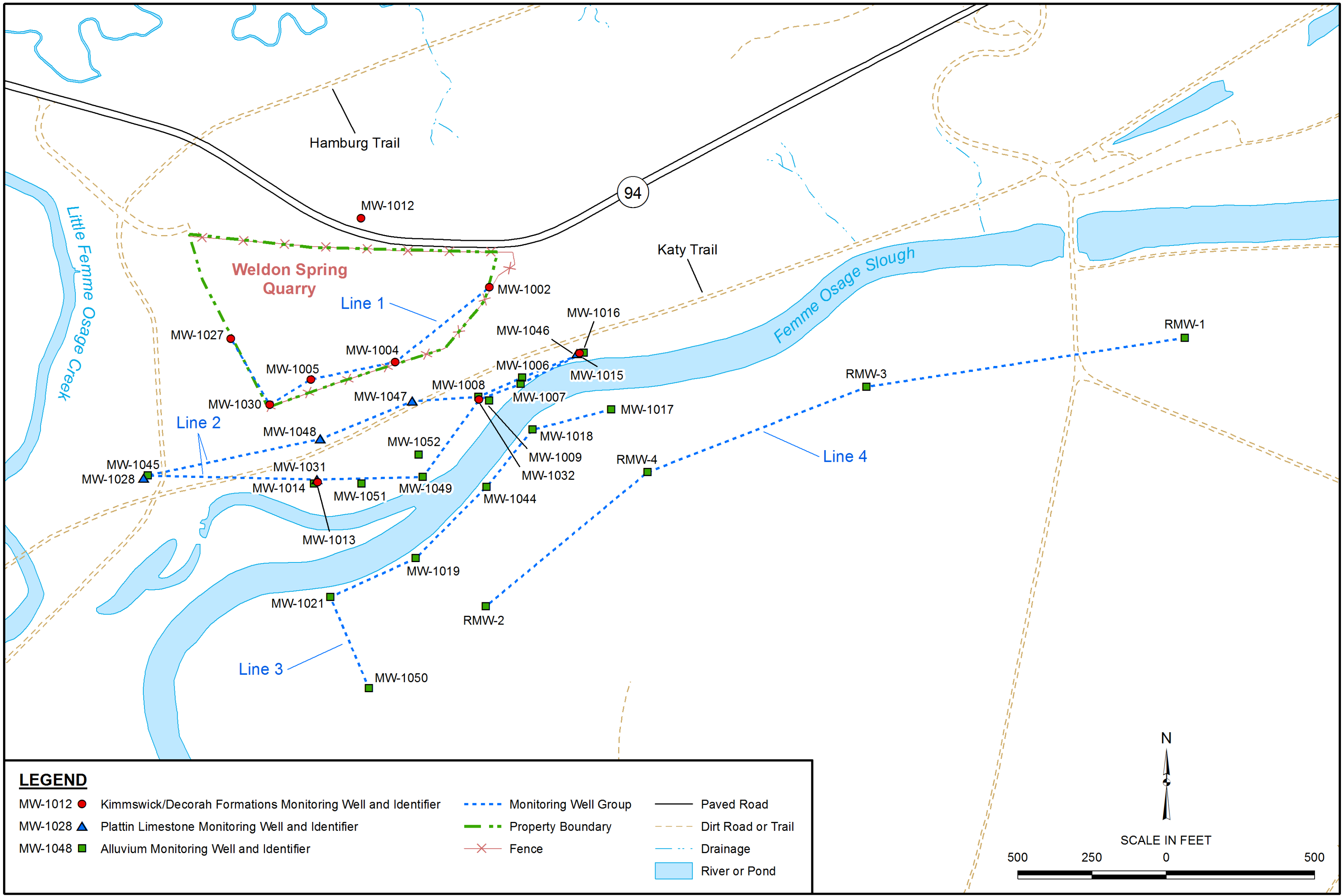

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Figure 67. Groundwater Monitoring Well Locations at the Quarry Area of the Weldon Spring, Missouri, Site

5.2.4.3 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 have remained relatively unchanged from previous years despite varying overall groundwater elevations.

Groundwater elevations in the quarry area fluctuate significantly (Figure 68), 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 elevations are typically highest in the spring and lowest in the fall. Groundwater elevations in 2015 were an exception due to drought conditions from 2014 extending into the first half of 2015 before abating in the second half of the year (Figure 69 and Figure 70).

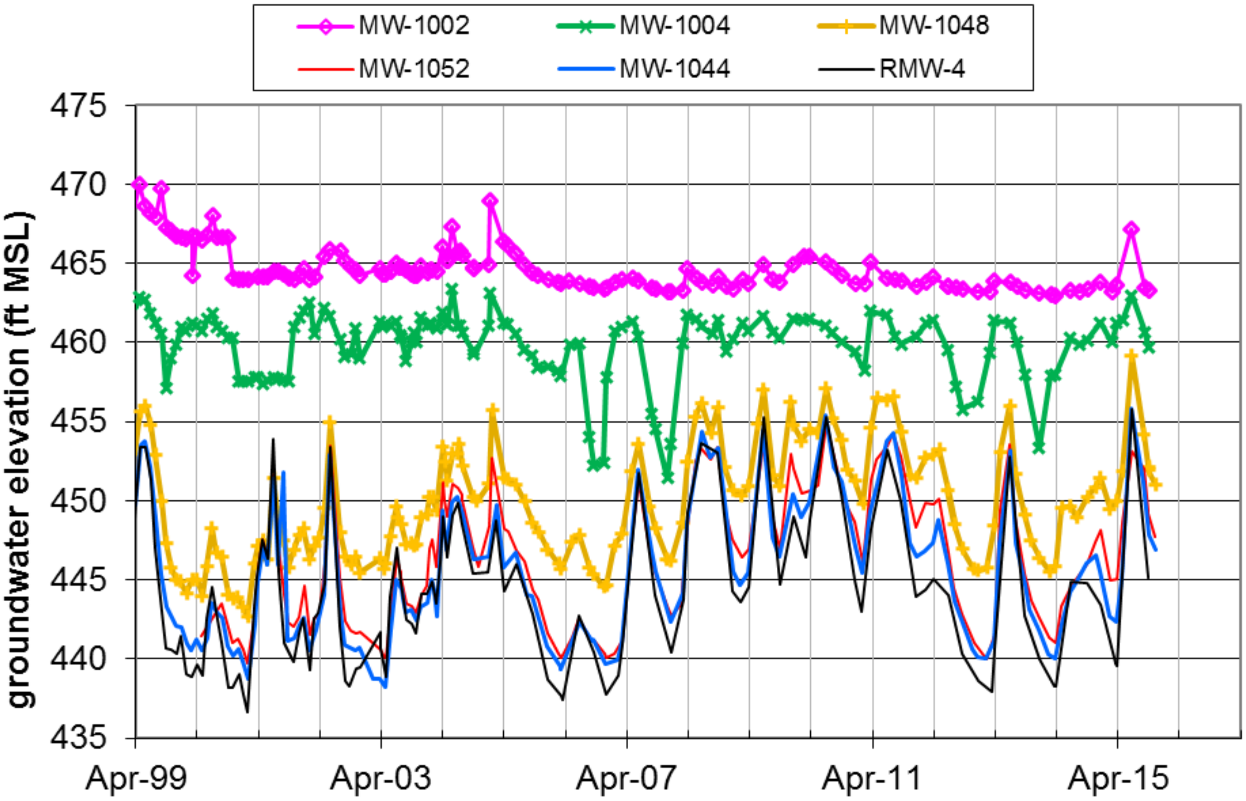

Figure 68. Groundwater Elevations in the Quarry Area(lines with no symbols are alluvial aquifer wells)

5.2.4.4 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 the Decorah Group that constitute the Quarry. Uranium migration in groundwater north of the slough is limited by naturally reducing conditions. Under reducing conditions, uranium migration is slowed by chemical processes that favor uranium adsorption onto aquifer materials and precipitation of stable uranium minerals. Figure 71 shows the average uranium concentrations in 2015.

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.

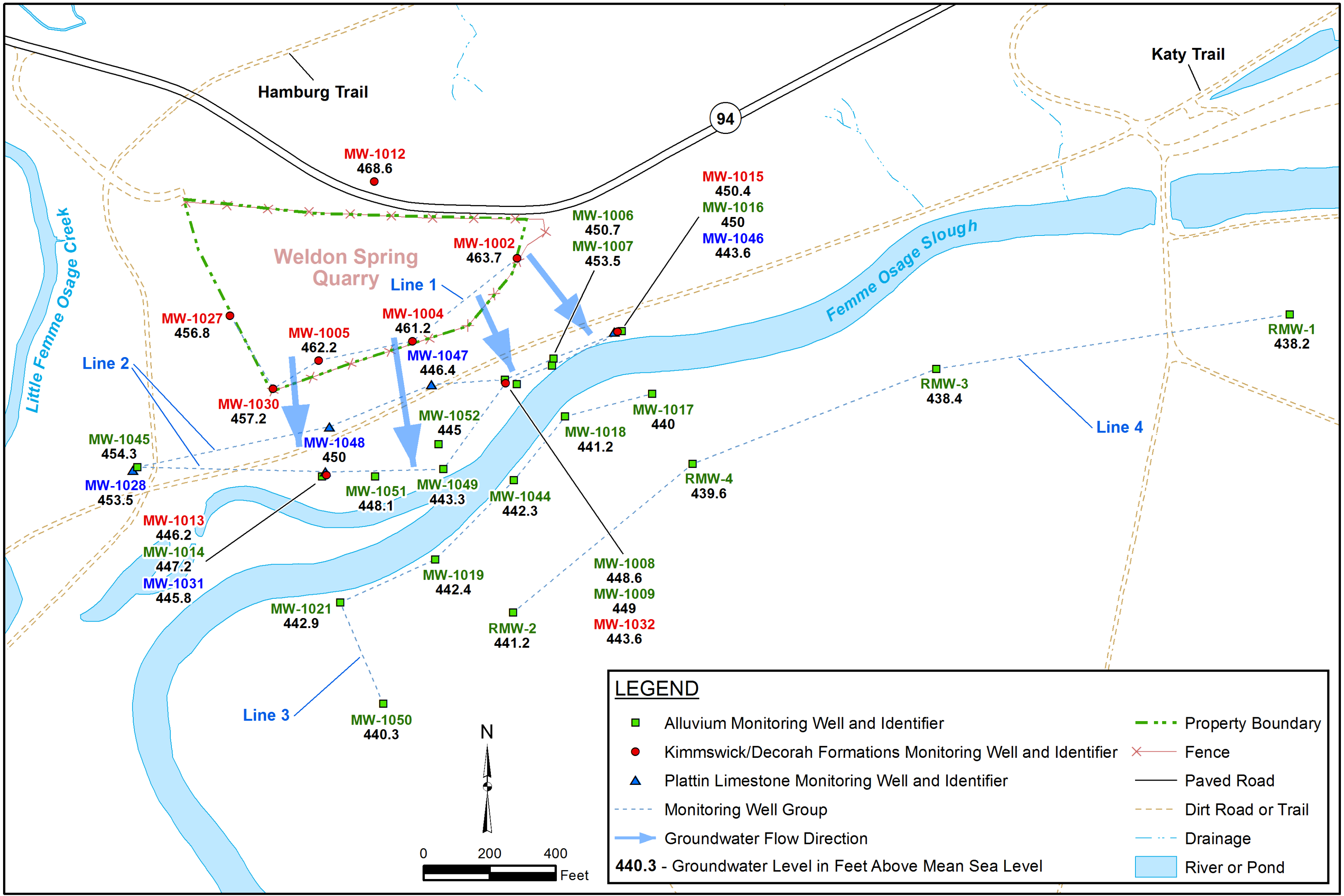

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Figure 69. Groundwater Elevations at the Weldon Spring Quarry (March 23, 2015)

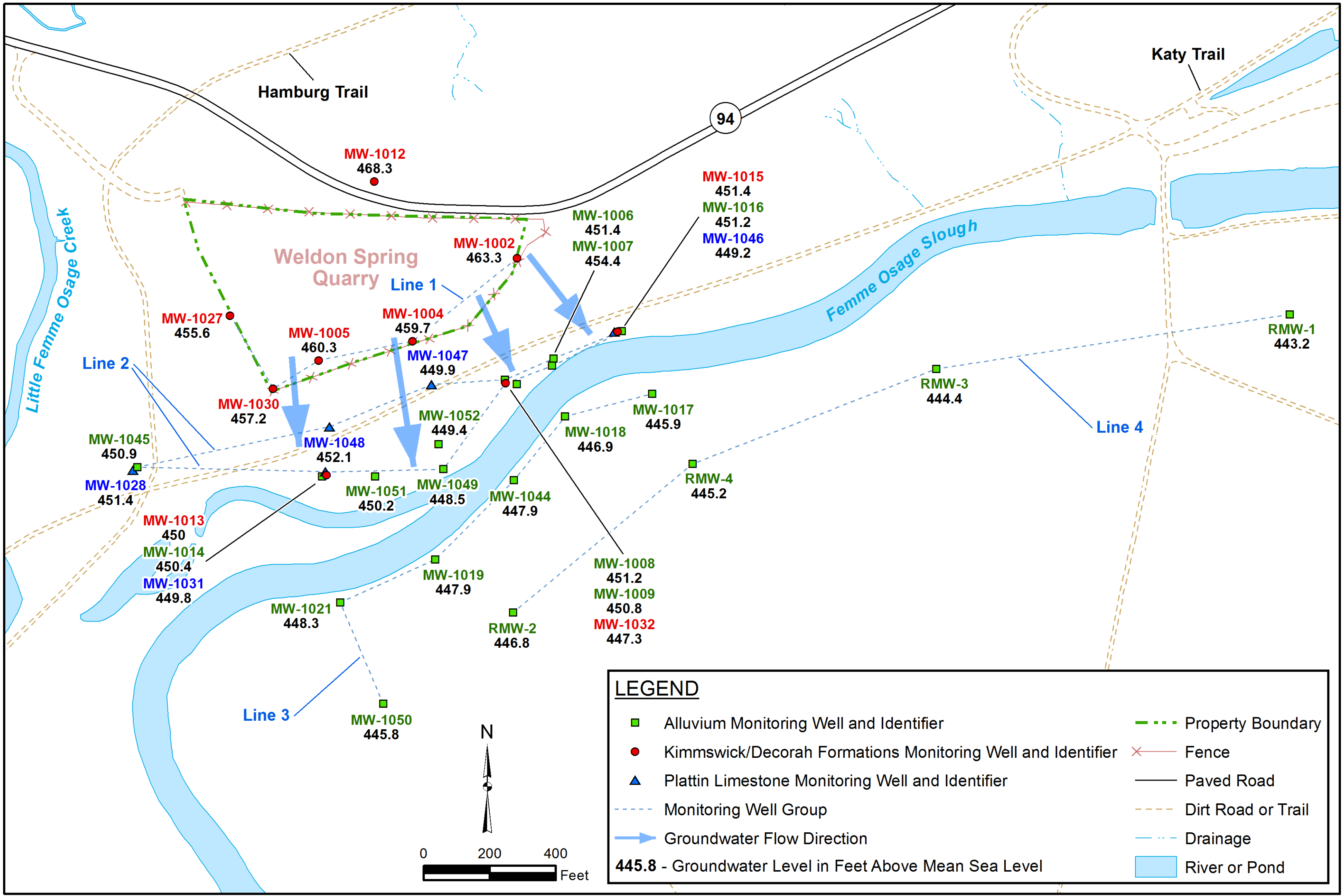

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Figure 70. Groundwater Elevations at the Weldon Spring Quarry (September 28 to 30, 2015)

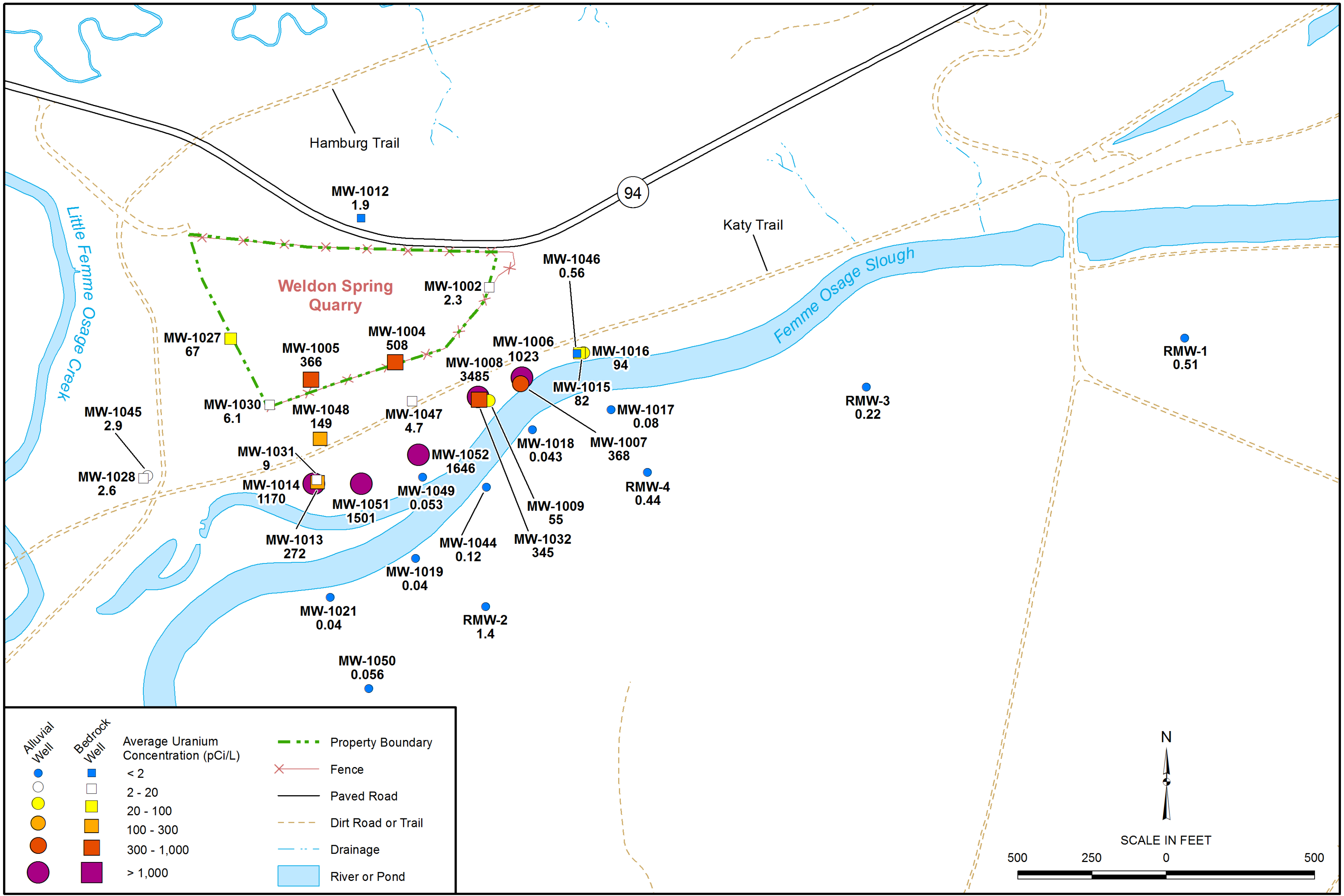

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Figure 71. 2015 Average Uranium Concentration in Quarry Area Wells

5.2.4.5 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 Results Line 1 Wells

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.

Levels of uranium in the Line 1 wells along the Quarry rim continue to be high. Table 28 summarizes the annual averages for total uranium from 2011 through 2015 (wells listed from higher to lower uranium concentrations). Figure 72 shows wells with higher uranium values. Uranium levels in MW-1004 and MW-1005 exceeded the target level of 300 pCi/L. Figure 73 shows wells with lower uranium values. Uranium levels in the Line 1 wells have shown a general decrease except for MW-1030, which stopped decreasing in 2007 at a level below the 20 pCi/L uranium cleanup standard. Since 2006, the annual average levels of uranium in MW-1002, MW-1027, and MW-1030 have been less than the 300 pCi/L target level established for groundwater north of the Femme Osage Slough. Uranium levels in MW-1002 and MW-1030 have consistently been less than the MCL of 20 pCi/L since 2001.

Table 28. Average Total Uranium in the QROU Line 1 Wells

Location	Line	Geologic Unit	Average Uranium (pCi/L)				
			2011	2012	2013	2014	2015
MW-1004	1	Kimmswick-Decorah	**544**	**513**	**513**	**479**	**508**
MW-1005	1	Kimmswick-Decorah	**442**	**697**	**391**	**405**	**366**
MW-1027	1	Kimmswick-Decorah	112	88	104	82	67
MW-1030	1	Kimmswick-Decorah	6.9	2.7	7.0	7.4	6.1
MW-1002	1	Kimmswick-Decorah	2.8	2.8	2.5	2.4	2.3
MW-1012	1[b]	Kimmswick-Decorah	2.1	2.3	2.4	2.1	1.9

Notes:
Concentrations in **bold** exceed the target level of 300 pCi/L.
MW-2012 is an upgradient location.

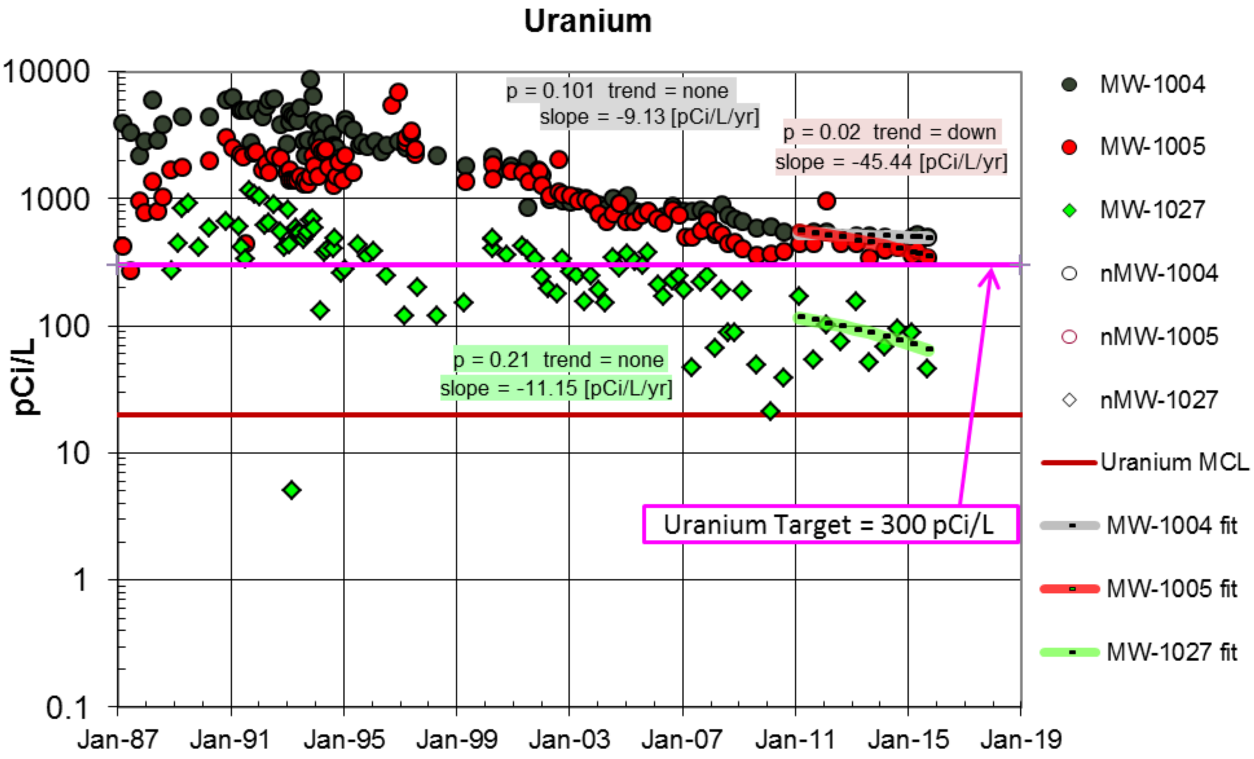

Figure 72. Uranium in Line 1 Monitoring Wells—Higher Concentrations

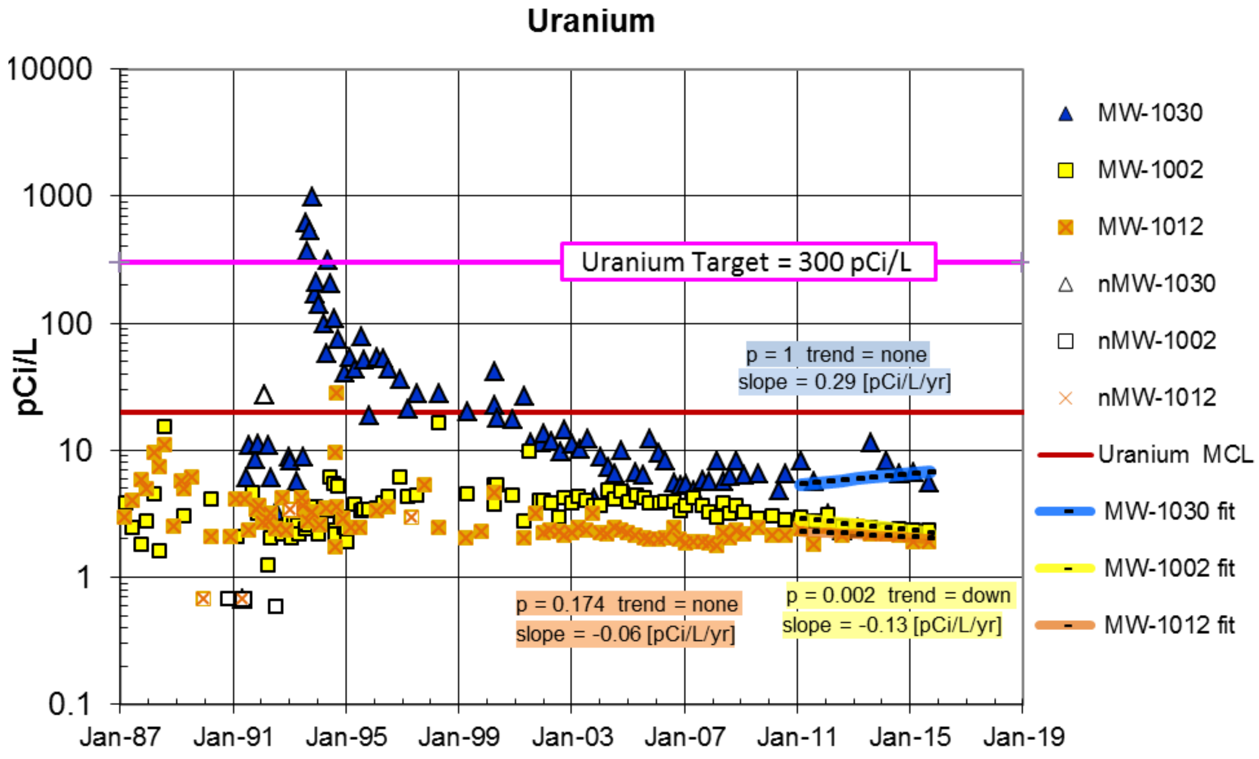

Figure 73. Uranium in Line 1 Monitoring Wells—Lower Concentrations

The results of trend analysis for the Line 1 wells (on Figure 72 and Figure 73) indicate that uranium concentrations in recent years have been decreasing in most of the wells, as indicated by negative slopes. Statistically downward trends have been calculated for MW-1002 and MW-1005. If the current decreases in uranium continue in these wells, it is estimated that the target level of 300 pCi/L could be reached in 5 to 10 years, though the decline in MW-1004 uranium levels has slowed over the last 5 years.

Uranium Results Line 2 Bedrock Wells

Bedrock wells located between the Quarry rim and Femme Osage Slough continue to have elevated uranium levels. The annual averages for uranium from 2011 through 2015 are summarized in Table 29. In the 2011 through 2015 time period, only MW-1032 had concentrations that exceeded the target level of 300 pCi/L. Wells with higher concentrations (Figure 74) have generally been decreasing since 2000. If concentrations in MW-1032 continue to decline at their historical rate, they will be below the 300 pCi/L target level by 2020. The higher-uranium-concentration wells are all screened in the shallower Kimmswick-Decorah (well depths 25 to 35 ft) except for MW-1048, which is screened in the deeper Plattin Formation. It is directly south and downgradient of the Quarry.

All of the lower-uranium-concentration wells are screened in the Plattin Formation (well depths 47 to 55 ft), and all are below the 20 pCi/L uranium MCL (Figure 75). Uranium concentrations in MW-1047 began to be erratic in 2013, rising suddenly then dropping off, with one result above the 20 pCi/L MCL. It is south and directly downgradient of the Quarry (as is higher-concentration well MW-1048), so it would not be unexpected for it to occasionally have higher concentrations. The down trend for MW-1046 is beginning to stabilize as it has reached background levels. MW-1028 has had an uptrend for the last 5 years of data but is still at low levels that are below historical averages.

Uranium levels in the Line 2 bedrock wells have generally decreased since 2000 (Figure 74). The highest levels of uranium are in MW-1032, which is beneath the area of highest uranium impact in the overlying alluvium. It is expected that the average uranium concentrations in all Line 2 bedrock wells will be less than the target level of 300 pCi/L in the next 5 years.

Table 29. Average Total Uranium in QROU Line 2 Bedrock Wells

Location	Line	Geologic Unit	Average Uranium (pCi/L)				
			2011	2012	2013	2014	2015
MW-1032	2	Kimmswick-Decorah	**546**	**462**	**388**	**364**	**345**
MW-1013	2	Kimmswick-Decorah	204	265	222	191	272
MW-1048	2	Plattin	162	182	177	134	149
MW-1015	2	Kimmswick-Decorah	125	109	94	102	82
MW-1031	2	Plattin	10	10	11	9.6	9.0
MW-1028	2	Plattin	1.7	2.2	2.0	2.3	2.6
MW-1046	2	Plattin	1.2	1.0	0.8	0.6	0.6
MW-1047	2	Plattin	0.7	0.7	1.5	14	4.7

Concentrations in **bold** exceed the target level of 300 pCi/L

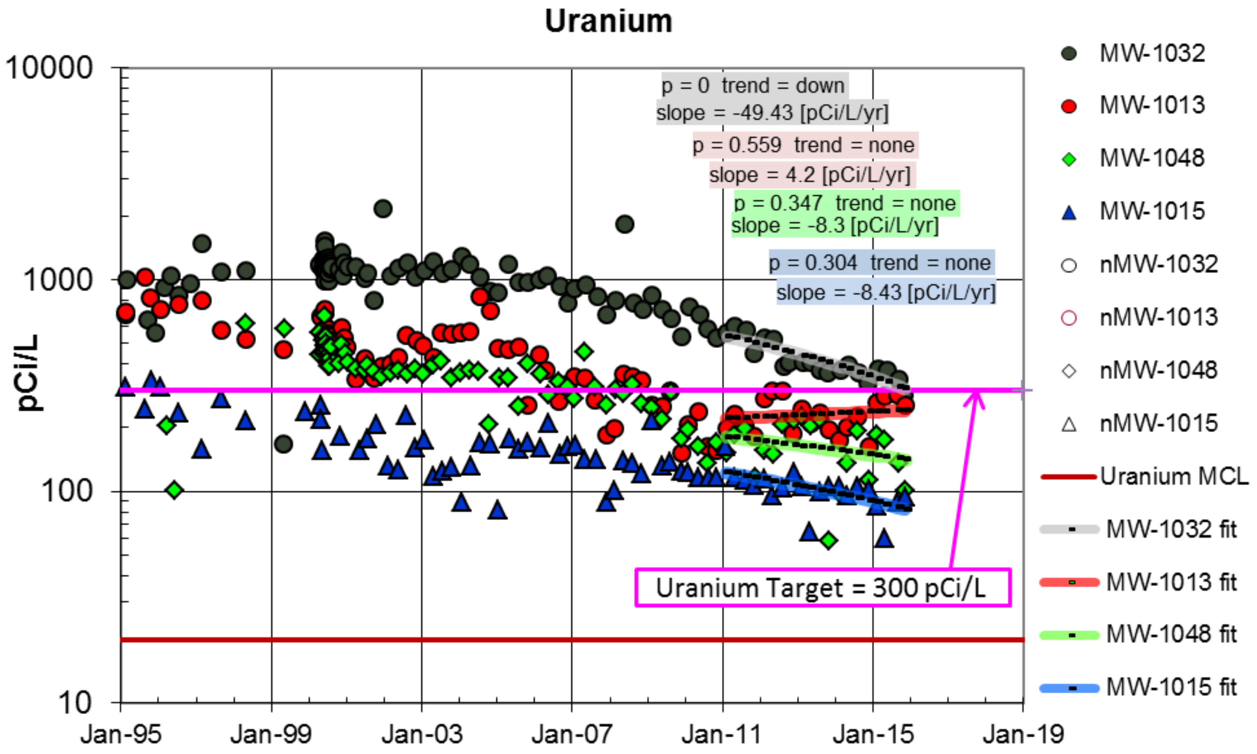

Figure 74. Uranium in Line 2 Bedrock Wells—Higher Concentrations

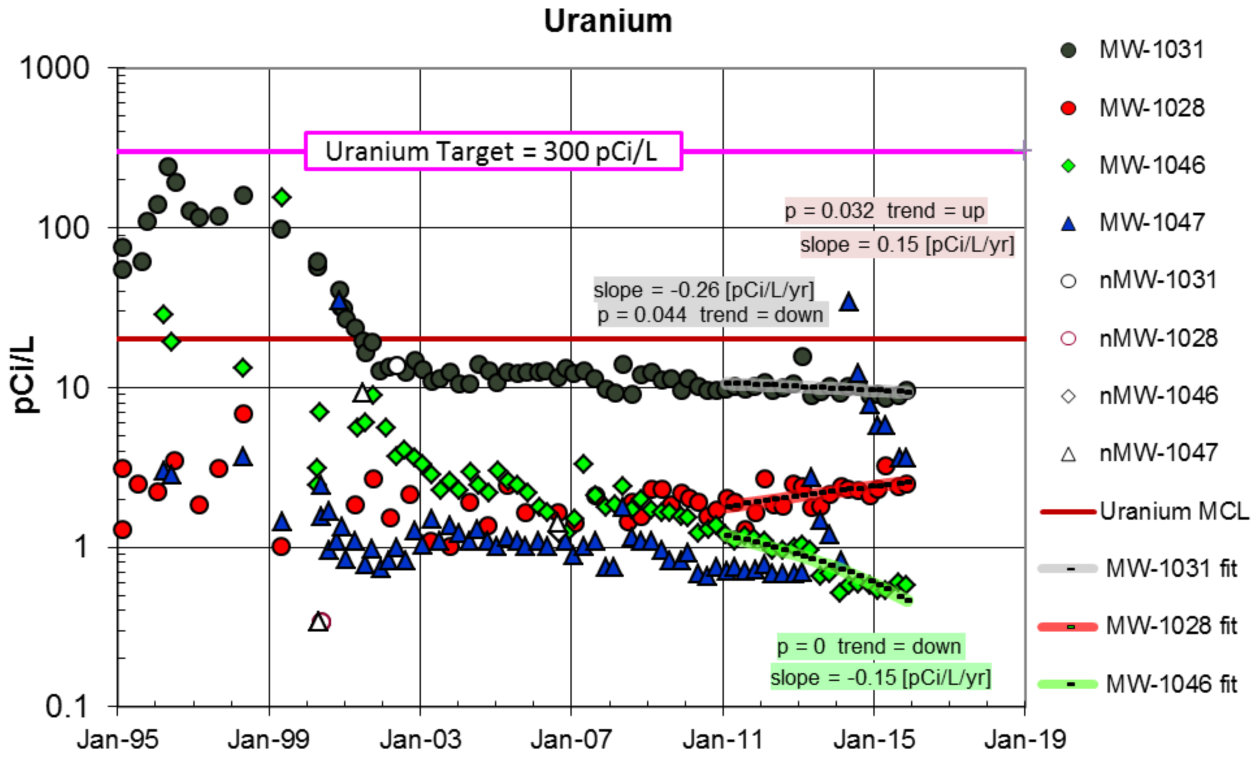

Figure 75. Uranium in Line 2 Bedrock Wells—Lower Concentrations

Statistically significant downward trends were identified in three of the eight bedrock wells. Concentrations in well MW-1032 will soon reach the 300 pCi/L uranium target. The down trends for wells MW-1031 and MW-1046, and the slight up trend for well MW-1028 are inconsequential in that their uranium concentrations are far below the uranium MCL. Uranium in well MW-1047 (also below the MCL) is of more interest because of two recent sharp increases followed by subsequent declines. Visual inspection of the total data set for Line 2 bedrock wells suggests that the higher-uranium-concentration wells are all in a long-term downward trend. The lower-uranium-concentration wells are all below the uranium MCL.

Uranium Results Line 2 Alluvial Wells

The highest levels of uranium in groundwater are in the alluvial aquifer between the Quarry rim and Femme Osage Slough. The annual averages for uranium in the alluvial wells from 2011 through 2015 are summarized in Table 30. Uranium concentrations in the wells above the 300 pCi/L target level (Figure 76) have been relatively stable for over 25 years with no long-term increasing or decreasing trends, though concentrations vary by an order of magnitude. The highly variable uranium concentrations in wells MW-1051 and MW-1052 typically (though not always) are lower when water levels are low (Figure 77). The extreme variability in 2000 was related to multiple samples being collected during testing after their April 2000 installation.

Uranium concentrations in wells below the 300 pCi/L target level (Figure 78) have also been relatively stable over the past 25 years, in that a concentration from today would fit within the historical range of the past 25 years, though most vary over an order of magnitude. Concentrations in well MW-1007 vary over 3 orders of magnitude (Figure 78) and occasionally exceed the target level. Concentrations in MW-1007 do not appear to be correlated with water levels, though it is only 10 ft deep and adjacent to the slough. Uranium results in well MW-1049 have mostly been below the uranium detection limit for more than the past 10 years. It is 15 ft deeper (total depth is 37 ft) than any of the other alluvial wells.

Table 30. Average Total Uranium in QROU Line 2 Alluvial Wells

Location	Line	Geologic Unit	Average Uranium (pCi/L)				
			2011	2012	2013	2014	2015
MW-1008	2	Alluvium	**2139**	**1360**	**1950**	**2457**	**3485**
MW-1051	2	Alluvium	**857**	**736**	**1049**	**962**	**1501**
MW-1014	2	Alluvium	**1095**	**1037**	**957**	**634**	**1170**
MW-1006	2	Alluvium	**876**	**935**	**1071**	**1179**	**1023**
MW-1052	2	Alluvium	**759**	**989**	**1306**	177	**1646**
MW-1007	2	Alluvium	26	6.7	50	**473**	**368**
MW-1016	2	Alluvium	131	109	103	86	94
MW-1009	2	Alluvium	1.1	0.9	5.4	5.0	55
MW-1045	2	Alluvium	1.4	3.8	2.2	3.6	2.9
MW-1049	2	Alluvium	NA	NA	NA	NA	NA

Notes:
Concentrations in **bold** exceed the target level of 300 pCi/L.
NA = most or all results were below detection or qualified as estimated.

The alluvial wells are screened primarily in the oxidized portion of the groundwater system, where changes in groundwater elevations have typically affected the uranium levels measured in the wells. Geochemical data from these wells support the presence of dissolved uranium in the groundwater. The geochemistry of the groundwater in this area exhibits high oxidation-reduction potential (ORP) values, high sulfate concentrations, and low dissolved iron concentrations, indicators of an oxidizing environment.

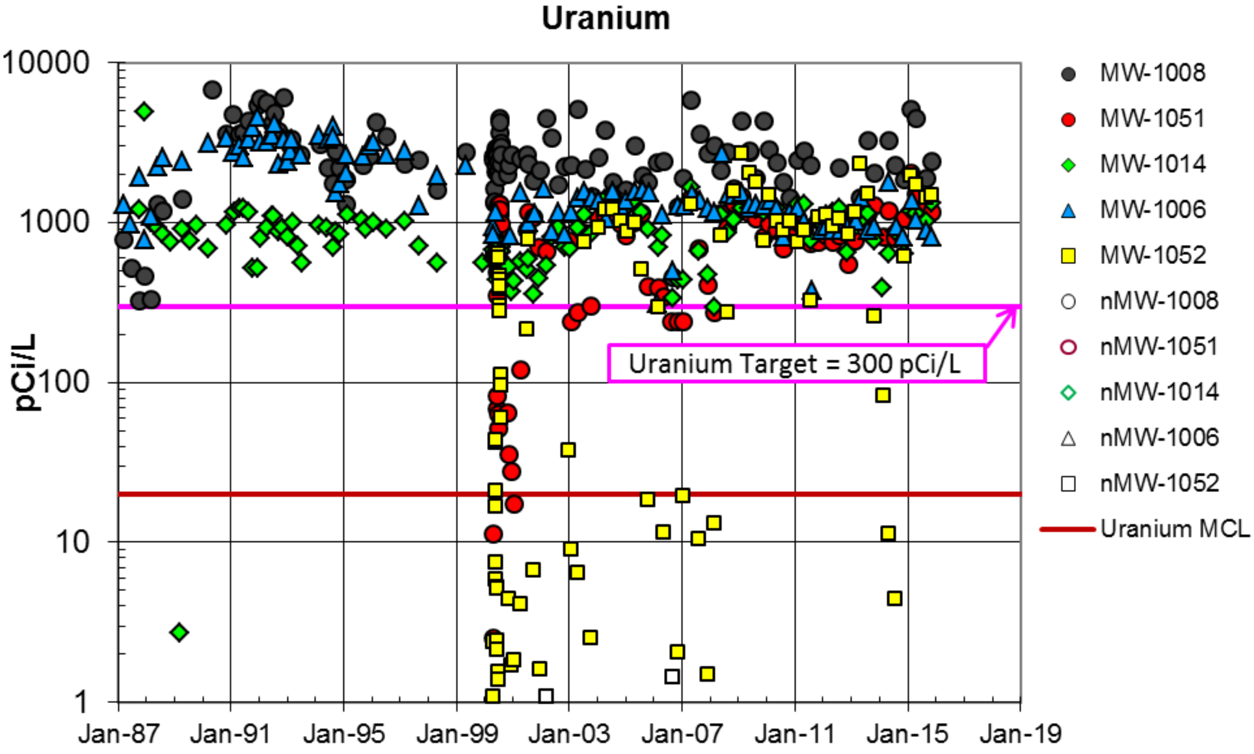

Figure 76. Uranium in Line 2 Alluvial Wells—Higher Concentrations

A visual inspection of the data from Line 2 alluvial wells indicates long-term stable uranium concentrations accompanied by significant variability. Any attempts to quantify uranium trends in these wells over a 5-year period would be unproductive.

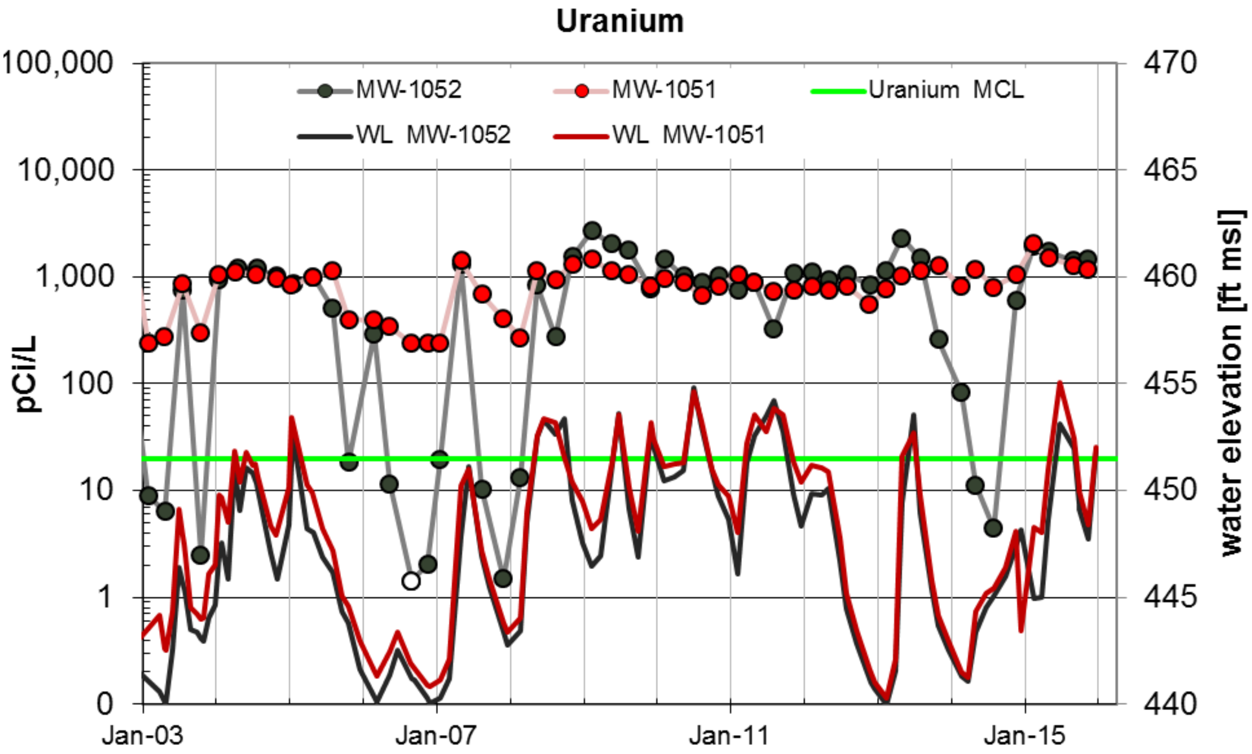

Figure 77. Variable Uranium Concentrations in MW-1052 and MW-1051

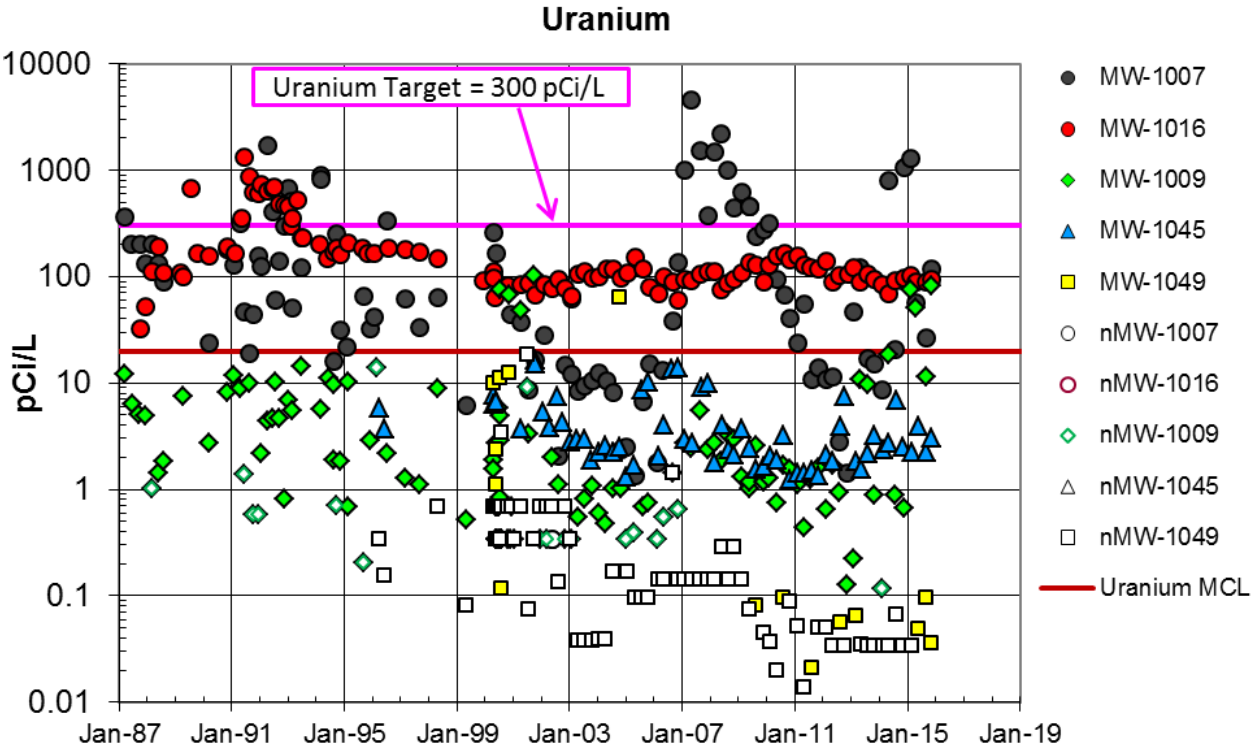

Figure 78. Uranium in Line 2 Alluvial Wells—Lower Concentrations

Uranium Attainment Objective

The attainment objective for the long-term monitoring of uranium in groundwater north of the slough is that the 90th percentile of the data within a monitoring year is below the 300 pCi/L target level (DOE 2000b). The average uranium levels in eight wells north of the slough exceeded the target level in 2015 (one bedrock well and seven alluvial wells). The 90th percentile associated with the data from the Line 1 and 2 wells was 1,470 pCi/L. This value is higher than those determined for 2010 through 2014, which had been decreasing since 2009 (Figure 79). Looking at the 90th percentile for Lines 1 and 2 separately indicates that the increased metric was the result of changes in uranium levels in the Line 2 wells, primarily the uranium levels measured in the Line 2 alluvial wells. Concentration levels in these wells have historically varied about an order of magnitude or more (Figure 76 and Figure 78). The changes in the Line 2 bedrock wells, whose 90th percentile dropped below the 300 pCi/L target in 2015, are similar to those seen in the Line 1 wells. In general, uranium levels in Line 1 and the Line 2 bedrock wells have decreased, whereas the levels in the Line 2 alluvium are within the historical range.

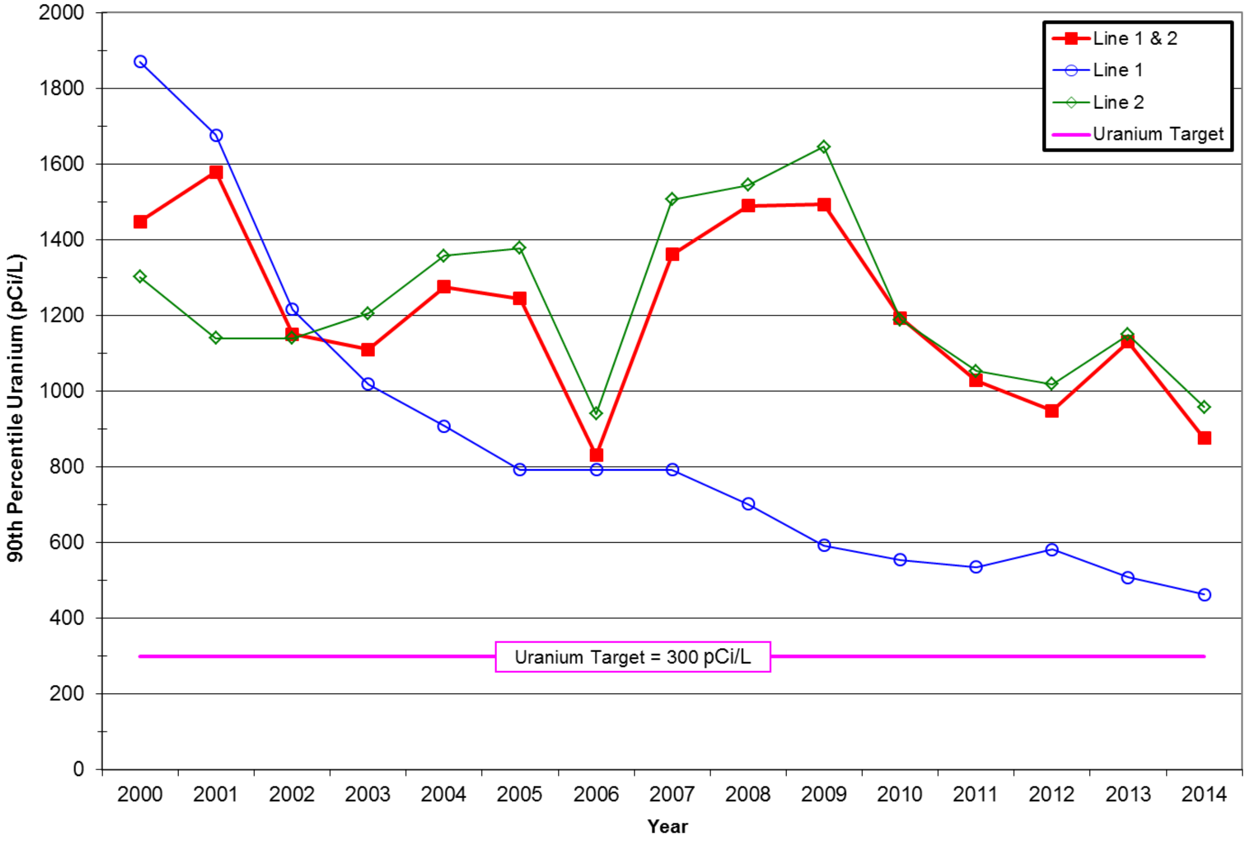

Figure 79. 90th Percentile of Uranium in Line 1 and 2 Wells

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 have 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 within historical ranges. Sample results from monitoring in wells screened in the reducing portion of the area north of the slough indicate that uranium levels continue to remain low.

Nitroaromatic Compounds

Samples from eight monitoring wells were analyzed for the nitroaromatic compound 2,4-DNT. Two of these monitoring wells, MW-1027 and MW-1006, have historically had 2,4-DNT concentrations above the 0.11 µg/L cleanup standard, though the levels are generally declining and were below 0.11 µg/L during 2015 (Figure 80). Levels in these wells are variable, and occasional results above the cleanup standard over the next 5 to 10 years would not be unexpected. The only other detections during the previous 5 years were at MW-1004 and were qualified as estimated. The remaining wells monitor upgradient and downgradient water quality along the Quarry rim or between the Quarry and Femme Osage Slough. Historical results of 2,4-DNT (Figure 81) and 2,6-DNT (Figure 82) of all eight selected monitoring wells document the success of the bulk waste removal from the Quarry.

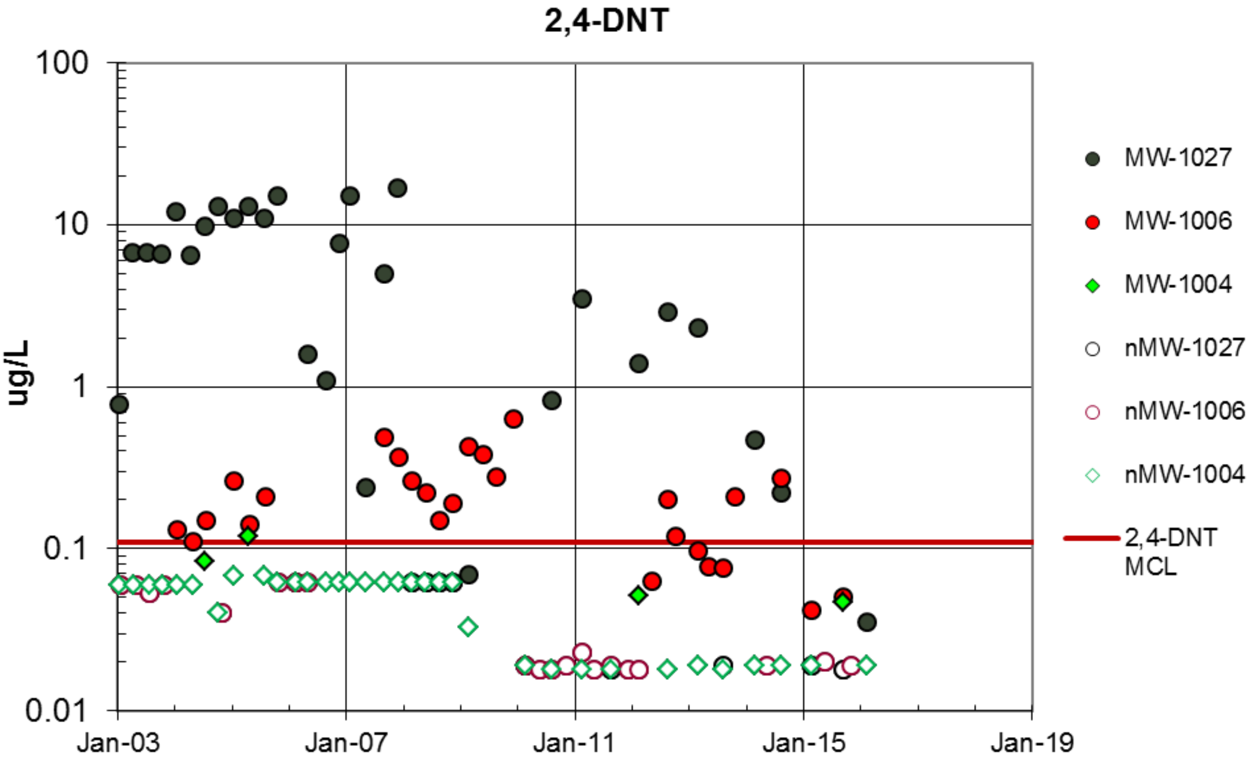

Figure 80. 2,4-DNT in MW-1027, MW-1006, and MW-1004

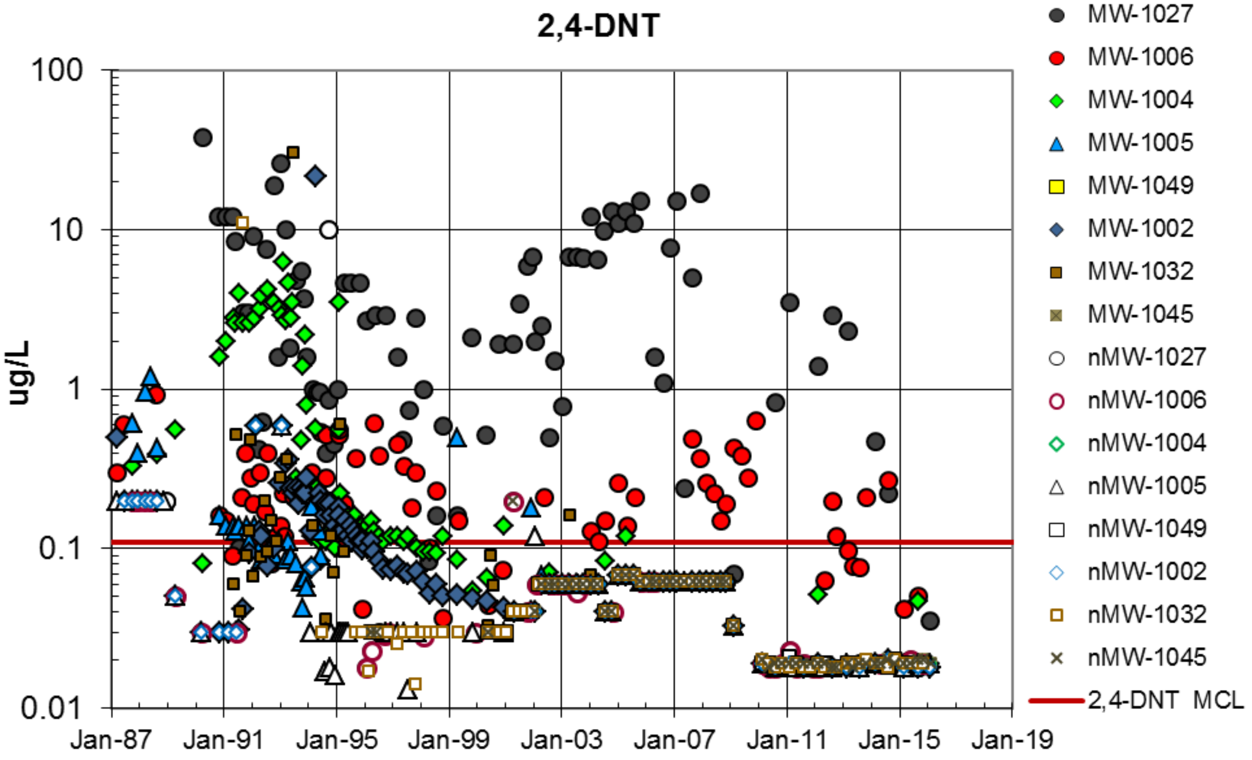

Figure 81. Historical 2,4-DNT Results for the Eight Selected Monitoring Wells

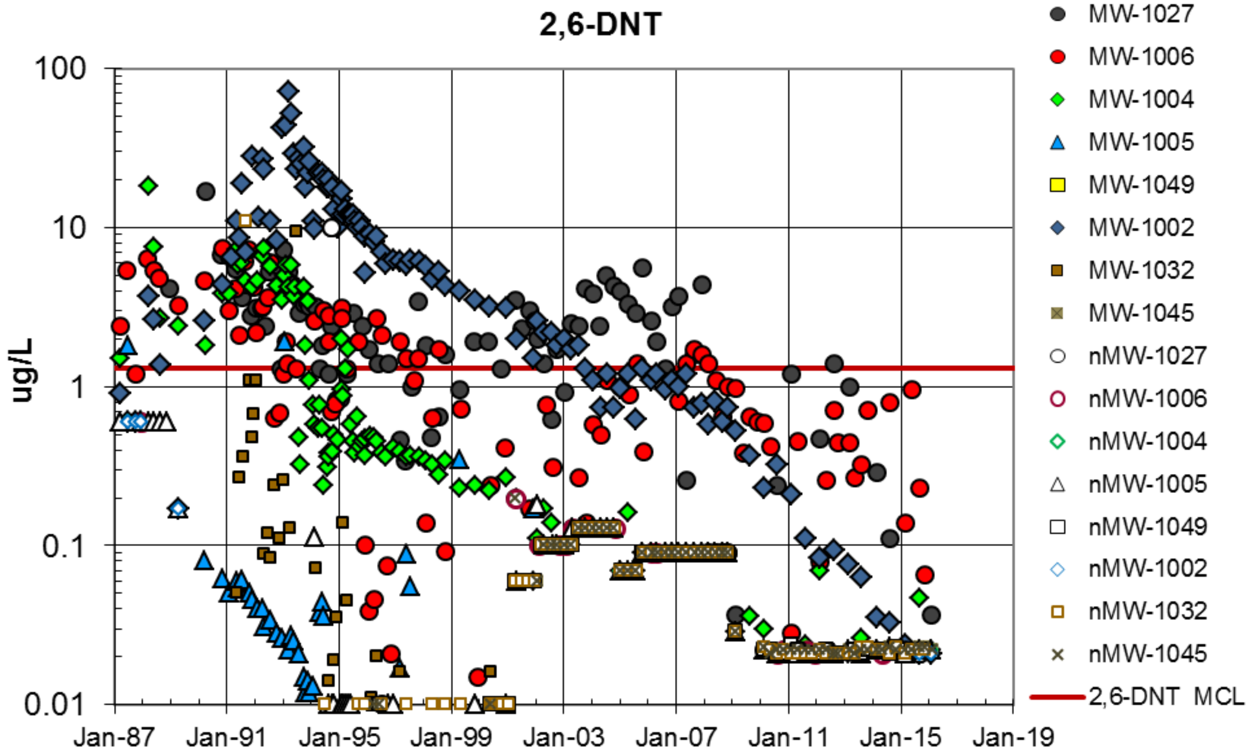

Figure 82. Historical 2,6-DNT Results for the Eight Selected Monitoring Wells

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 selected for continued long-term monitoring were used to calculate this metric. The 90th percentile associated with the data from the eight wells was below the objective in 3 of the 5 most recent years. These values continue to be at the low end of the historical range (Figure 83). Present concentrations in groundwater pose little potential impact to groundwater in the Missouri River alluvium.

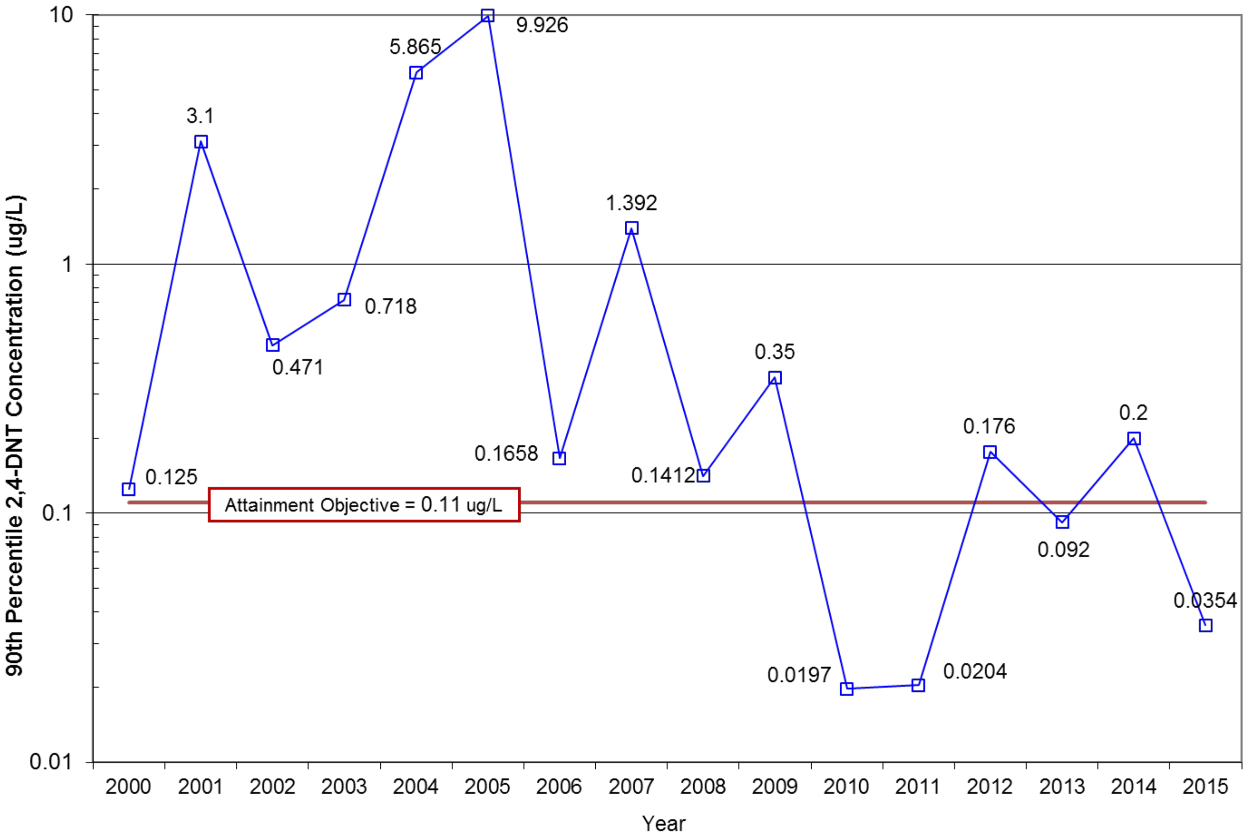

Figure 83. 90th Percentile of 2,4-DNT in Long-Term Monitoring Wells

Geochemical Parameters

The geochemistry of the shallow aquifer is monitored to verify the presence of the reduction zone and to confirm that the reduction zone is capable of the ongoing attenuation of uranium in groundwater. Groundwater is analyzed for sulfate, dissolved iron, ferrous iron, and Eh (a measure of the oxidation-reduction state of groundwater constituents). Sulfate is monitored as an indicator of oxidation-reduction conditions in the groundwater in the vicinity of the Quarry. Higher sulfate concentrations are generally observed in an oxidizing environment. Sulfate concentrations generally track uranium concentrations in wells with variable uranium concentrations (high sulfate, high uranium and low sulfate, low uranium). Iron (total dissolved and ferrous) is also monitored as an indicator of oxidation-reduction conditions in the groundwater. Iron concentrations typically increase in a reducing environment. These results generally correlate with observed uranium concentrations upgradient and downgradient of the reduction zone, as uranium is typically more mobile in an oxidizing environment and precipitates in a reducing environment. Table 31 presents the 2015 geochemical parameter averages for Line 1 and Line 2 monitoring location. Figure 84 through Figure 88 present the historical sulfate values. Figure 89 shows the association of uranium and sulfate in well MW-1007. Figure 90 through Figure 93 present the historical dissolved iron values.

Table 31. Geochemical Parameter Data at the Weldon Spring Quarry in 2015

Location	Line	Geologic Unit	Average Values			
			Sulfate (mg/L)	Dissolved Iron (µg/L)	Ferrous Iron (µg/L)	ORP[a] (mV)
MW-1004	1	Kimmswick-Decorah	93	134	115	49
MW-1005	1	Kimmswick-Decorah	81	950	370	48
MW-1027	1	Kimmswick-Decorah	55	35	25	43
MW-1030	1	Kimmswick-Decorah	42	1,050	605	25
MW-1002	1	Kimmswick-Decorah	75	ND	10	49
MW-1012 [b]	1	Kimmswick-Decorah	35	ND	20	73
MW-1032	2	Kimmswick-Decorah	101	92	80	70
MW-1013	2	Kimmswick-Decorah	62	3,805	938	−32
MW-1048	2	Plattin	49	1,548	1,163	−63
MW-1015	2	Kimmswick-Decorah	81	35	60	26
MW-1031	2	Kimmswick-Decorah	28	28	15	60
MW-1028	2	Plattin	24	32	20	88
MW-1046	2	Plattin	36	288	275	−13
MW-1047	2	Plattin	80	28	8	25
MW-1008	2	Alluvium	94	ND	10	45
MW-1051	2	Alluvium	151	213	90	41
MW-1014	2	Alluvium	125	38	38	64
MW-1006	2	Alluvium	96	1,123	625	48
MW-1052	2	Alluvium	53	3,758	795	−34
MW-1007	2	Alluvium	40	48,275	4,570	−120
MW-1016	2	Alluvium	66	ND	10	46
MW-1009	2	Alluvium	27	27,800	6,613	−100
MW-1045	2	Alluvium	23	47	30	56
MW-1049	2	Alluvium	ND	47,750	8,180	−136

[a] Convert oxidation-reduction potential to Eh by adding 200 mV to the ORP value.
[b] MW-1012 is upgradient
mV = millivolts; ND= all samples below detection

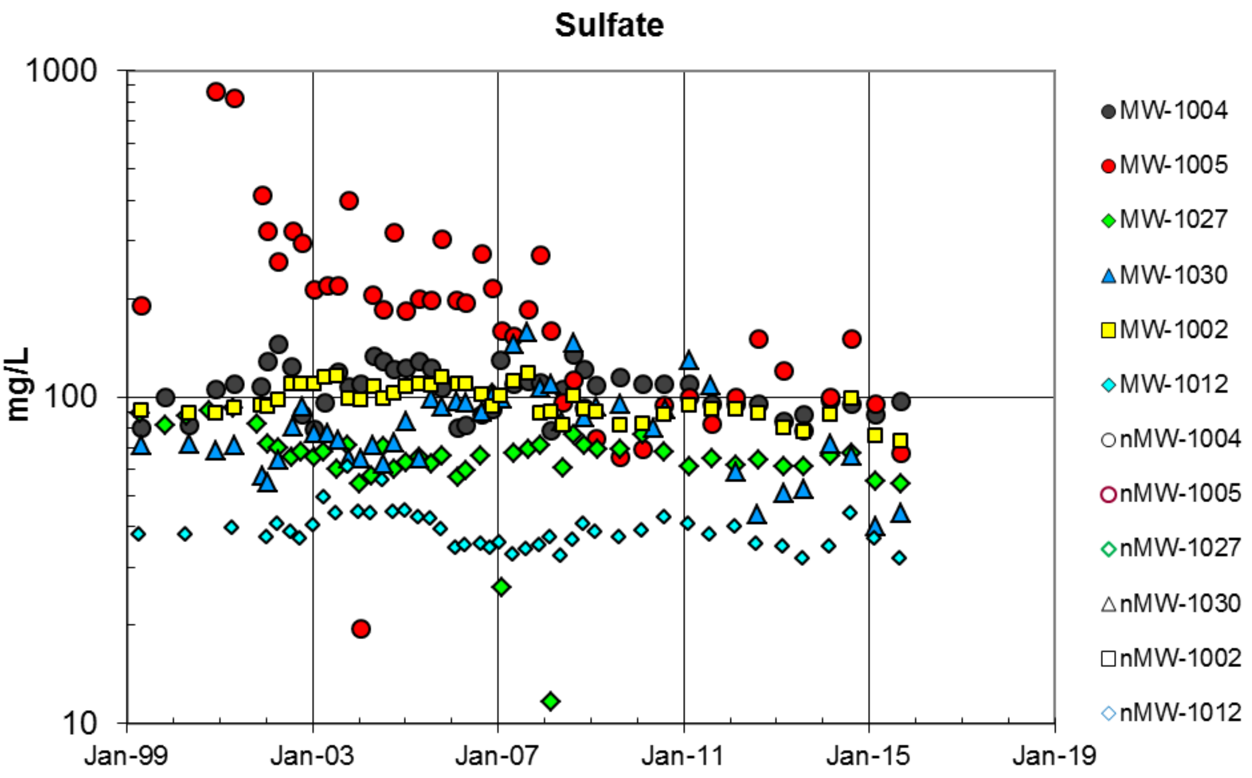

Figure 84. Sulfate in Line 1 Wells (Bedrock), MW-1012 is Upgradient

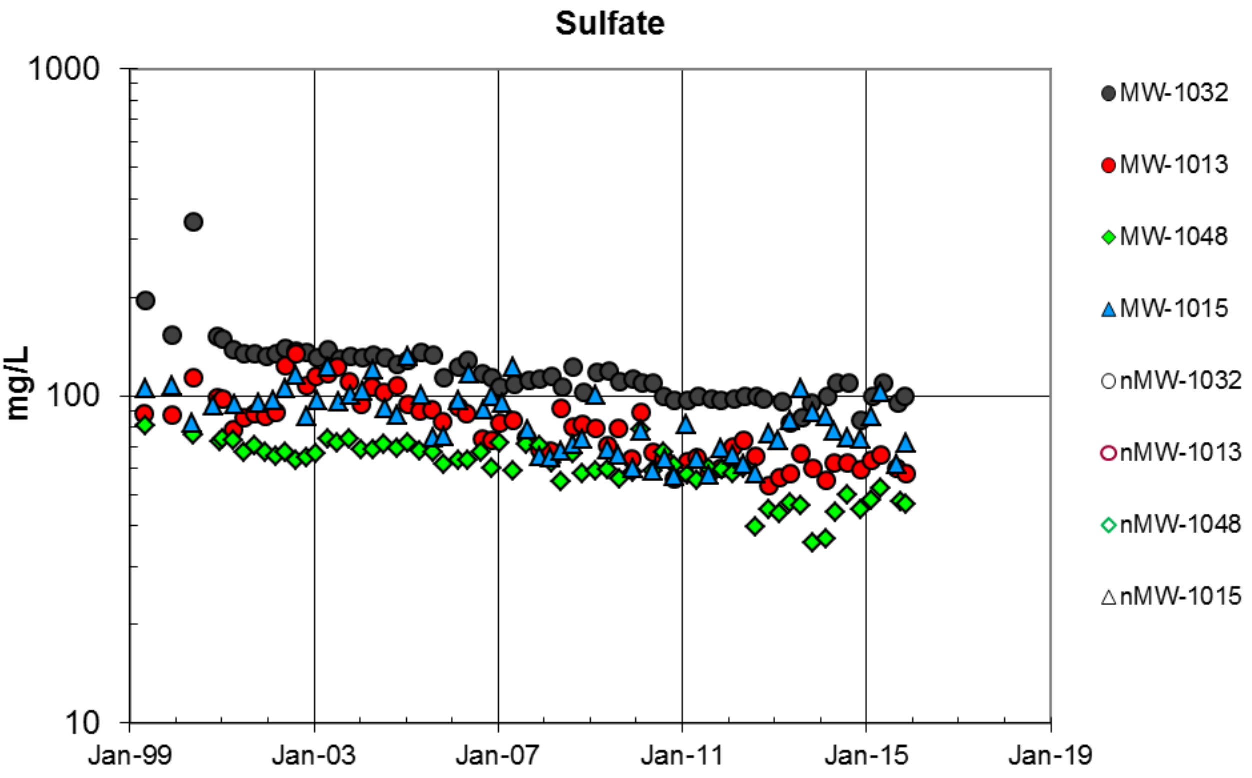

Figure 85. Sulfate in Line 2 Bedrock Wells—Higher-Uranium-Concentration Wells

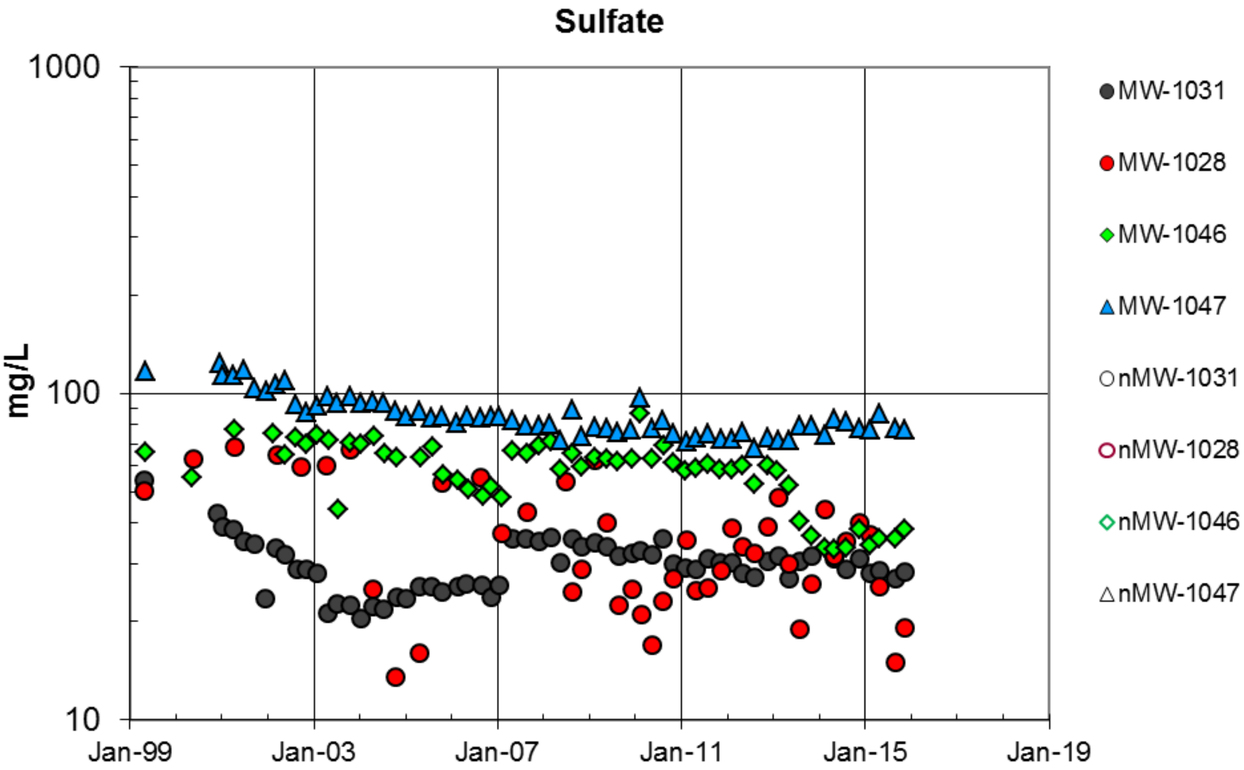

Figure 86. Sulfate in Line 2 Bedrock Wells—Lower-Uranium-Concentration Wells

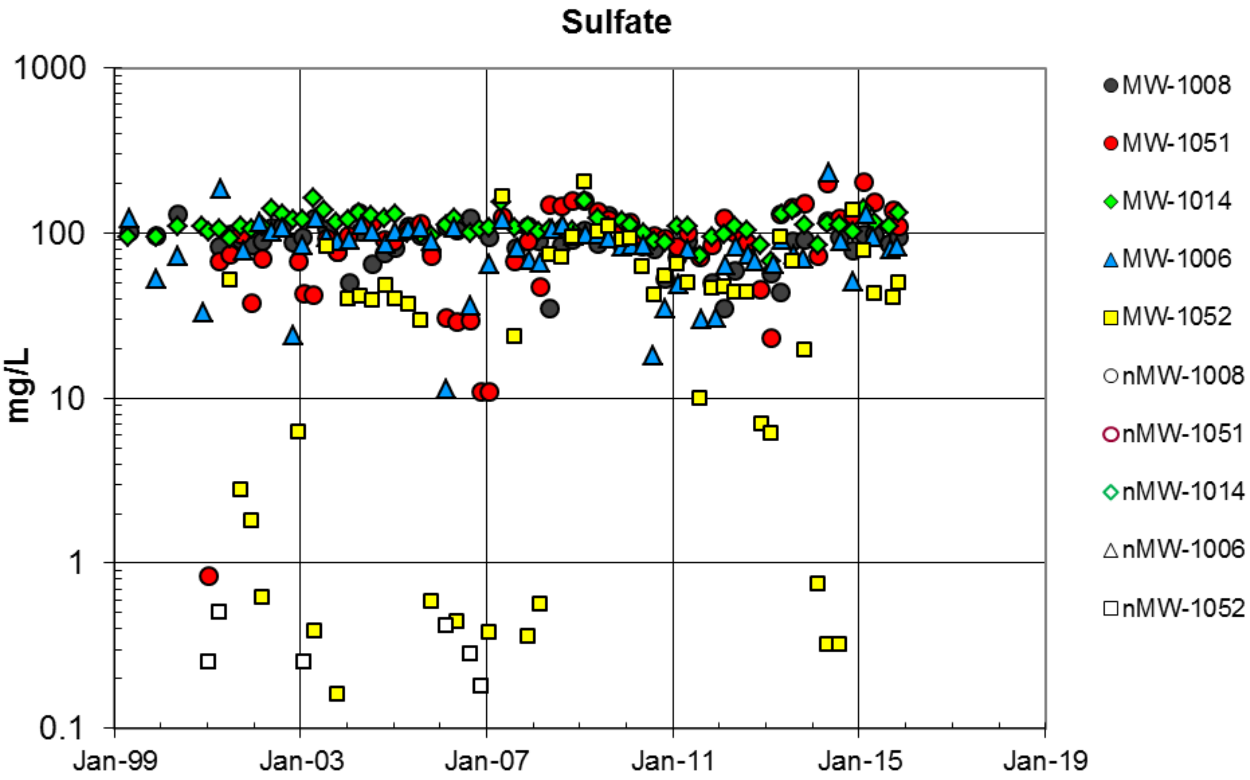

Figure 87. Sulfate in Line 2 Alluvial Wells—Higher-Uranium-Concentration Wells

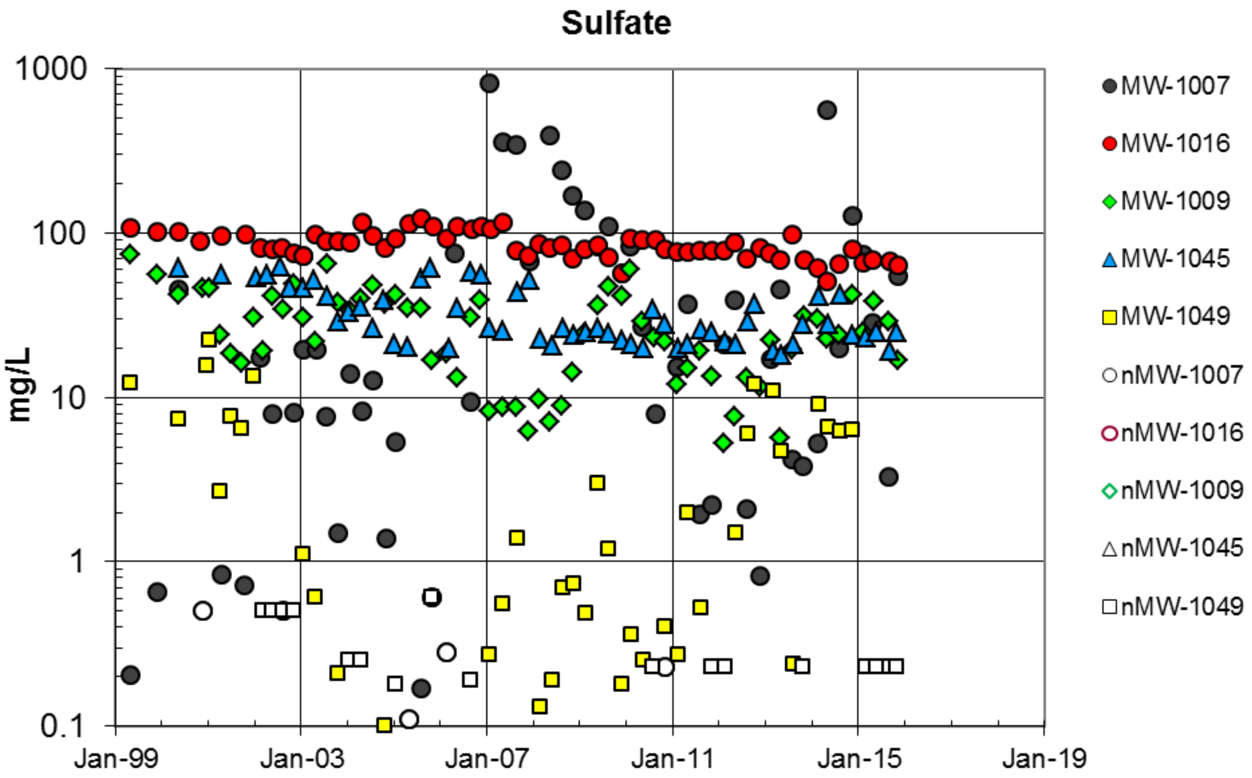

Figure 88. Sulfate in Line 2 Alluvial Wells—Lower-Uranium-Concentration Wells

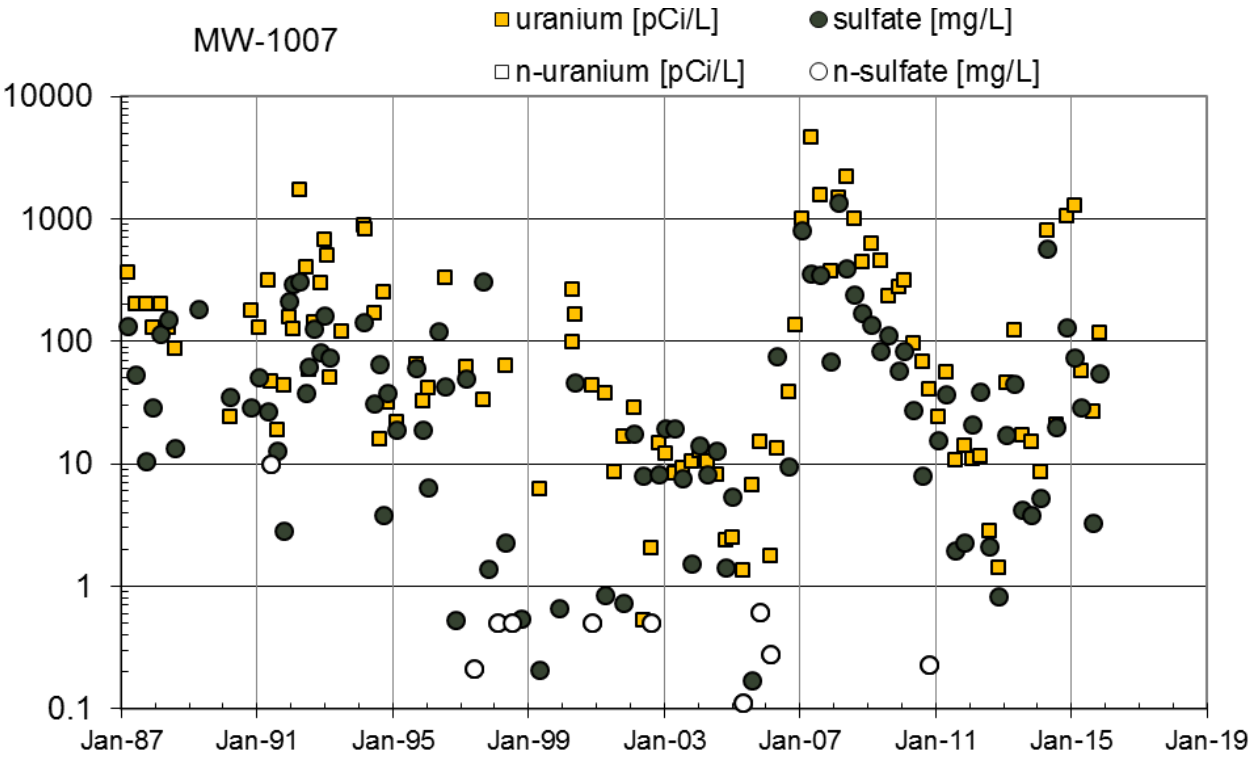

Figure 89. Sulfate and Uranium Variability in MW-1007

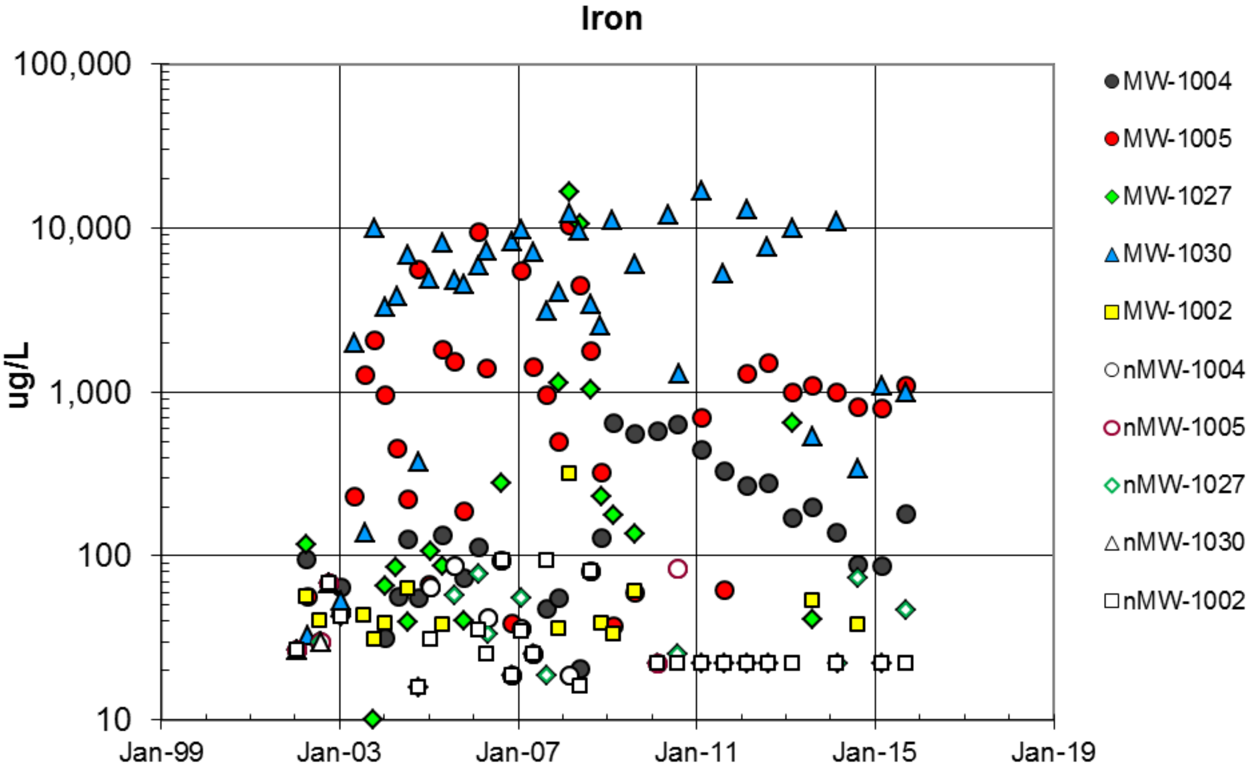

Figure 90. Dissolved Iron in Line 1 Bedrock Wells

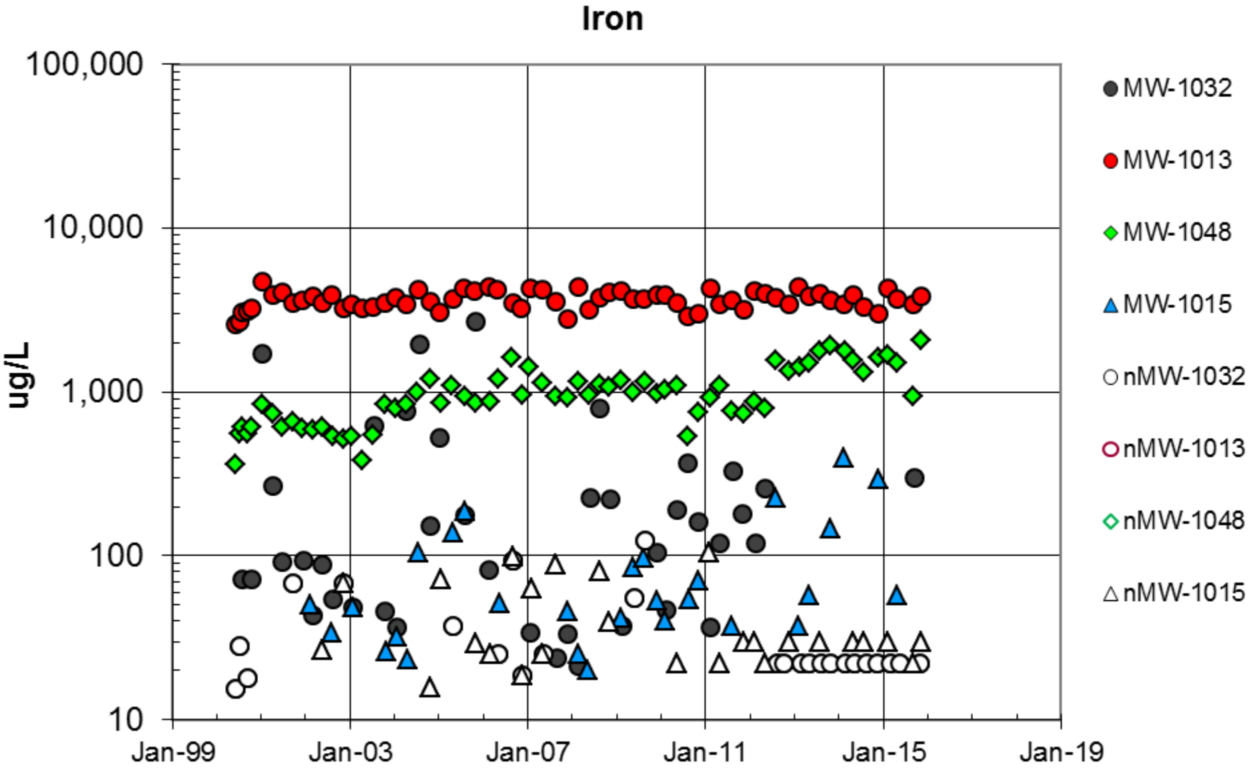

Figure 91. Dissolved Iron in Line 2 Bedrock Wells—Higher-Uranium-Concentration Wells

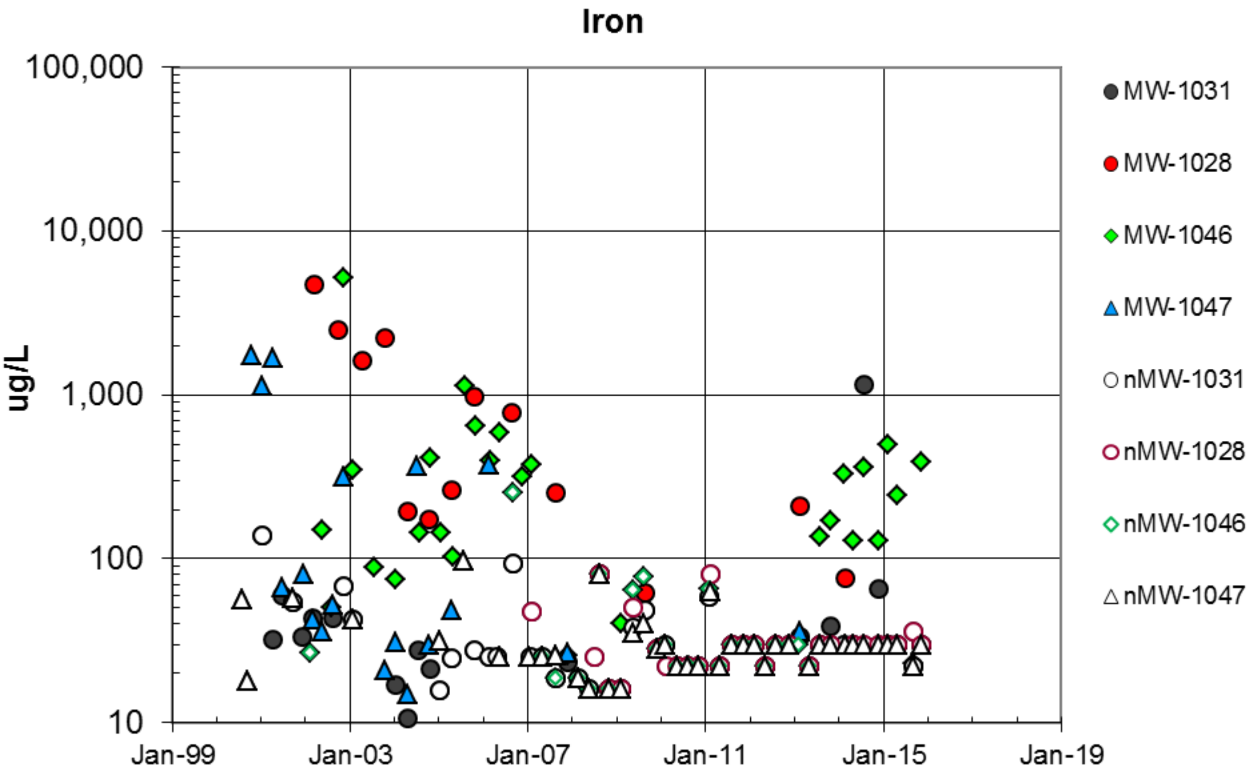

Figure 92. Dissolved Iron in Line 2 Bedrock Wells—Lower-Uranium-Concentration Wells

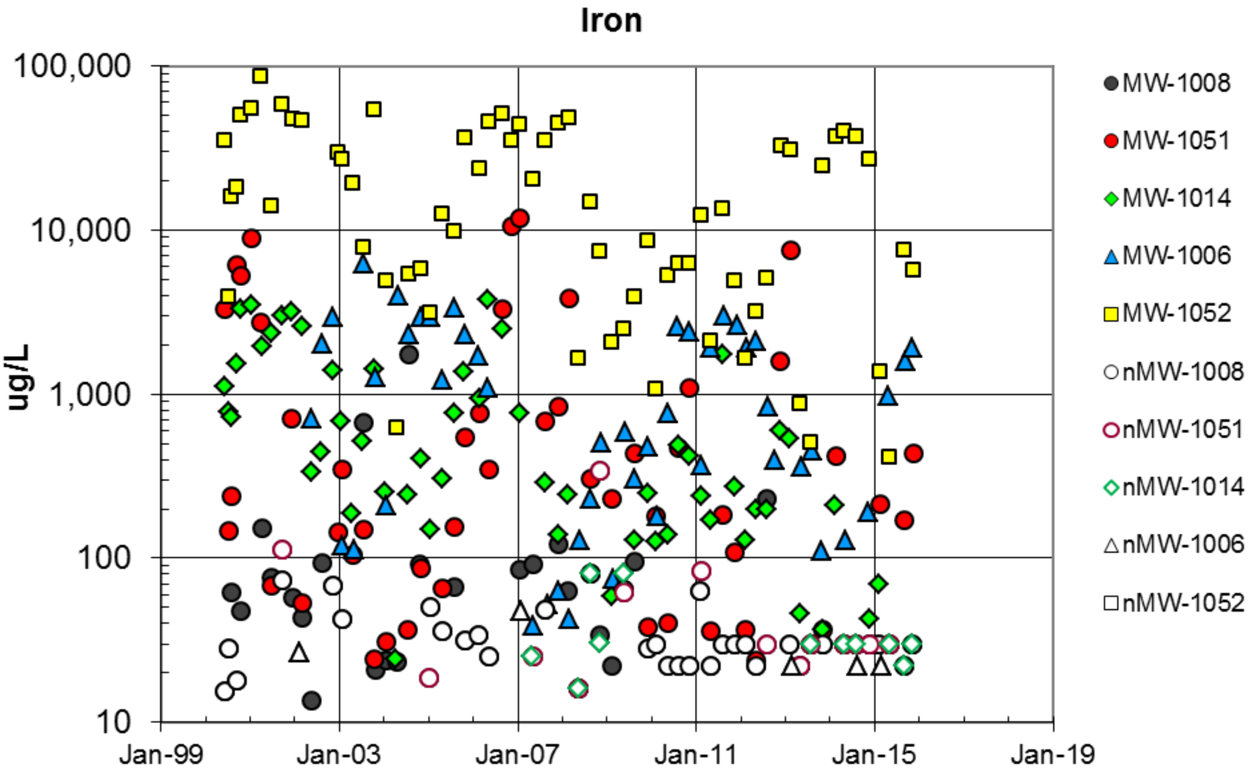

Figure 93. Dissolved Iron in Line 2 Alluvial Wells—Higher-Uranium-Concentration Wells

A review of the 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 in 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 reduction area was consistent during the review period, and the attenuation of uranium in this area continues.

5.2.4.6 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 verify 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) are sampled to verify that uranium levels remain within the range of natural variation in Missouri River alluvium. Figure 71 shows the well locations along with the 2015 average uranium values. The results indicate that the average uranium levels were less than the statistical background value in the alluvium (Table 26). All of the locations south of the slough have uranium levels that are well below the drinking water standard of 20 pCi/L. Uranium in samples from most Line 3 wells is consistently either not detected or at estimated levels below the reporting limit (Figure 94), and Line 4 wells continued their long-term downtrend over the past 5 years (Figure 95).

Geochemical Parameters

The monitoring wells south of the slough were sampled for sulfate, dissolved iron, and ORP to assess oxidation-reduction conditions in the Missouri River alluvium downgradient of the area of uranium impact. Table 32 shows the sampling results. Historical sulfate results are shown on Figure 96 (Line 3 wells) and Figure 97 (Line 4 wells). Historical dissolved iron results are shown on Figure 98 (Line 3 wells) and Figure 99 (Line 4 wells).

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 uranium migration if it were to pass beyond the reduction zone north of the slough. Data from the review period were consistent for all locations except MW-1044, where increased sulfate concentrations were reported beginning in late 2008 and have continued through 2015. High iron concentrations and low Eh values indicate that a reducing environment is still prevalent in this area. Uranium levels remain low at this location and at the remainder of the locations along the southern edge of the Femme Osage Slough.

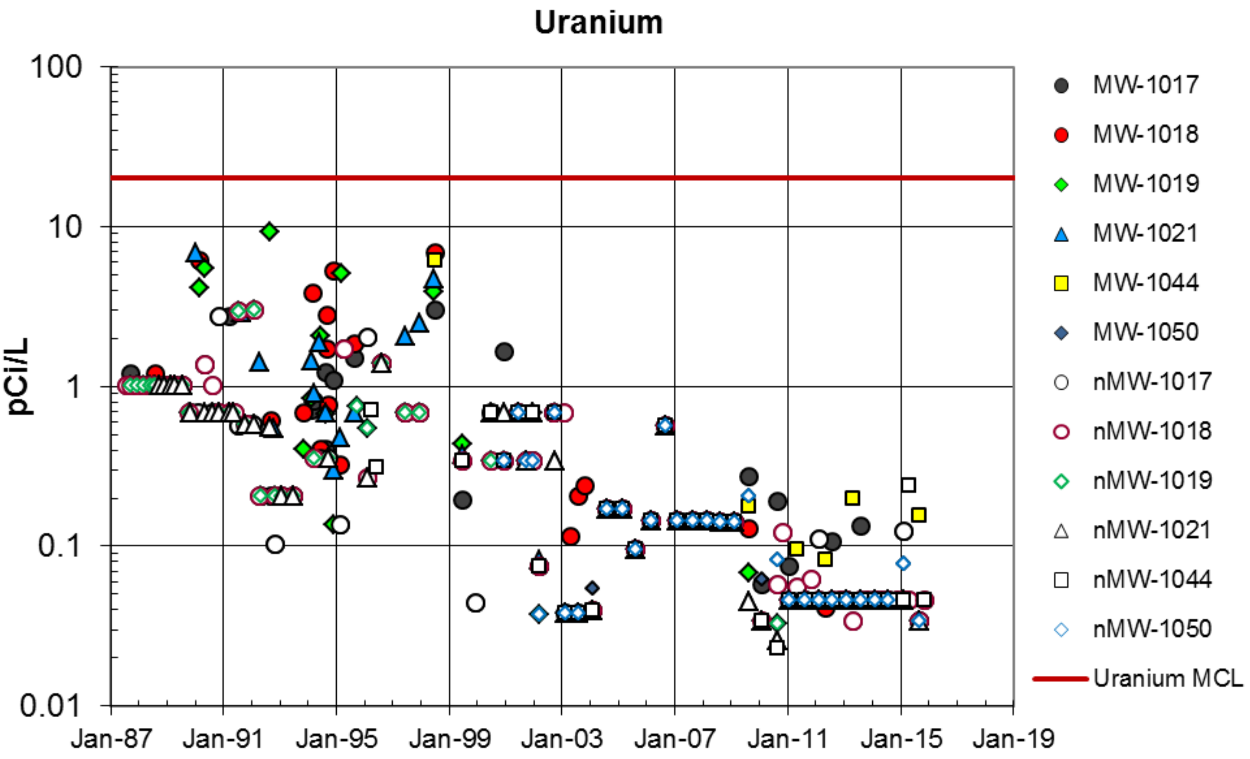

Figure 94. Uranium in Line 3 Monitoring Wells

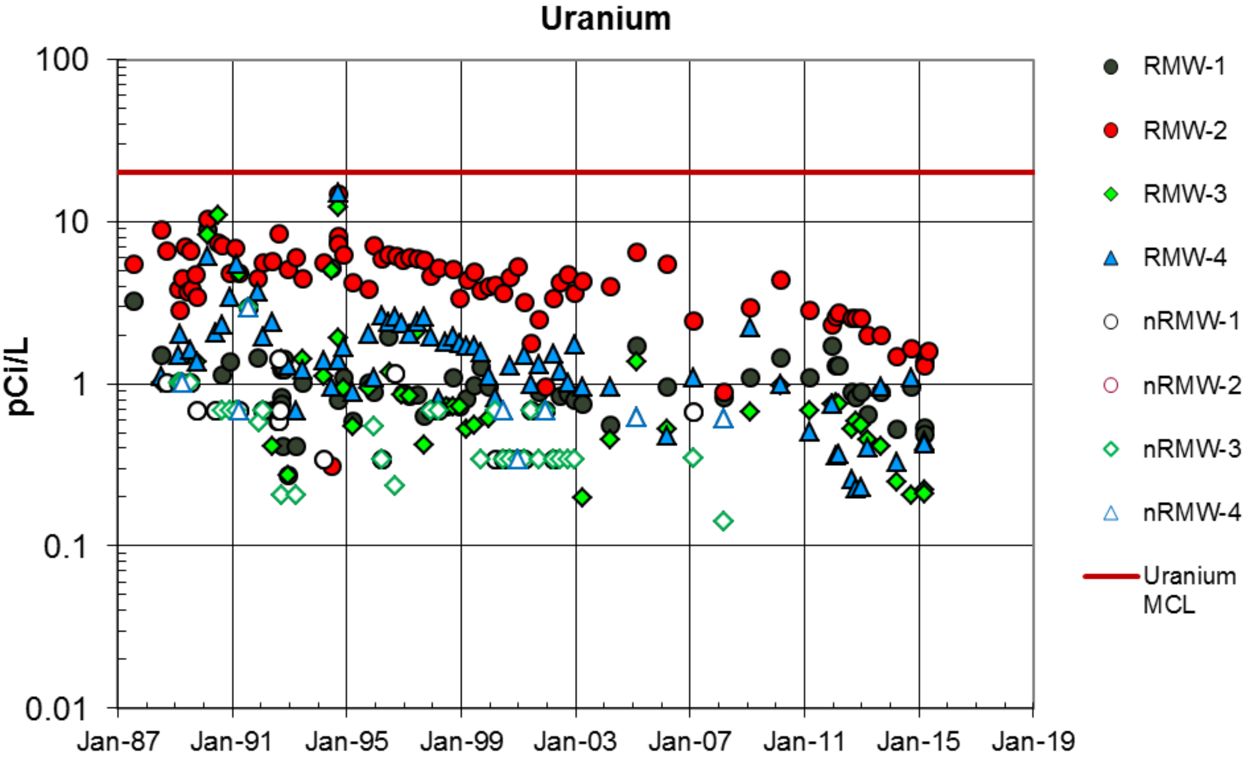

Figure 95. Uranium in Line 4 Monitoring Wells

Table 32. 2015 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	0.90	24,000	640	−147
MW-1018	14	40,600	775	−150
MW-1019	0.46	13,850	1,145	−131
MW-1021	0.64	17,500	1,630	−132
MW-1044	133	21,850	4,130	−163
MW-1050	0.61	17,450	5,355	−138
RMW-1	18	8,320	440	−79
RMW-2	22	13,200	1,100	−119
RMW-3	16	15,400	1,300	−134
RMW-4	69	16,900	810	−130

[a] Convert oxidation-reduction potential to Eh by adding 200 millivolts to the oxidation-reduction value.
mV = millivolts

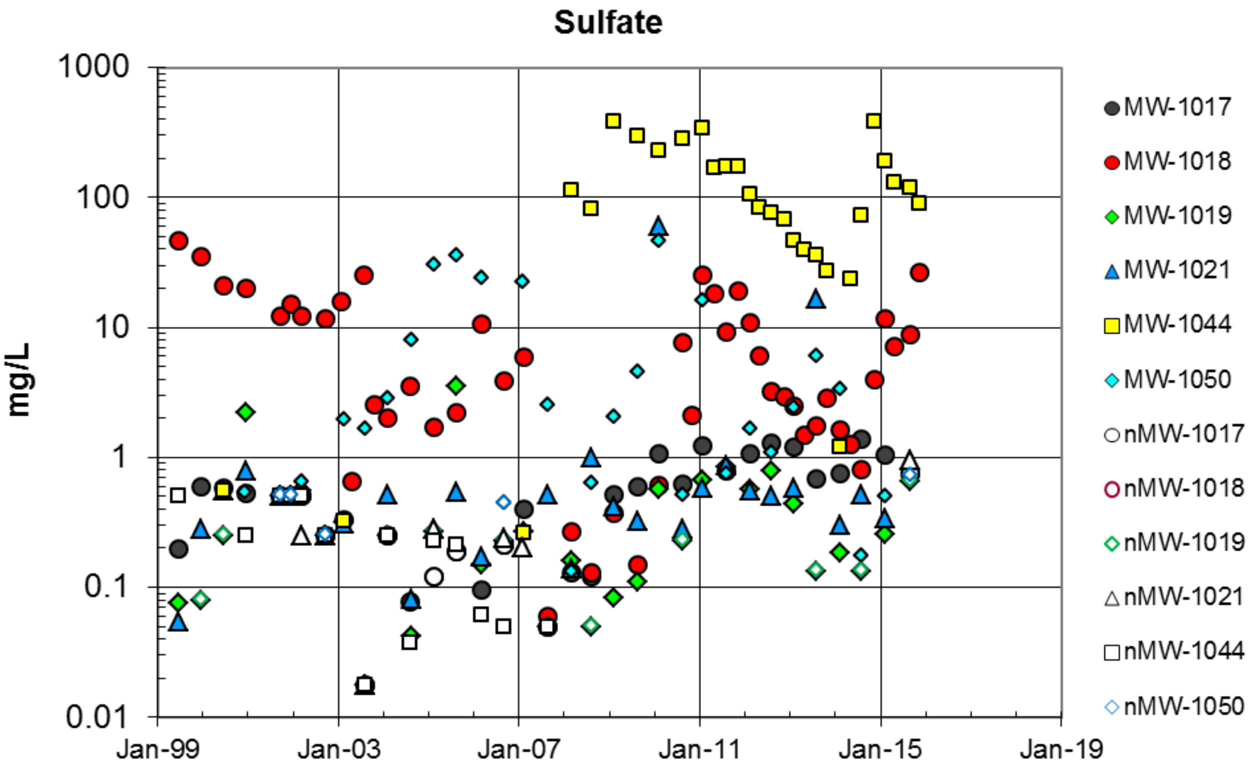

Figure 96. Sulfate in Line 3 Wells

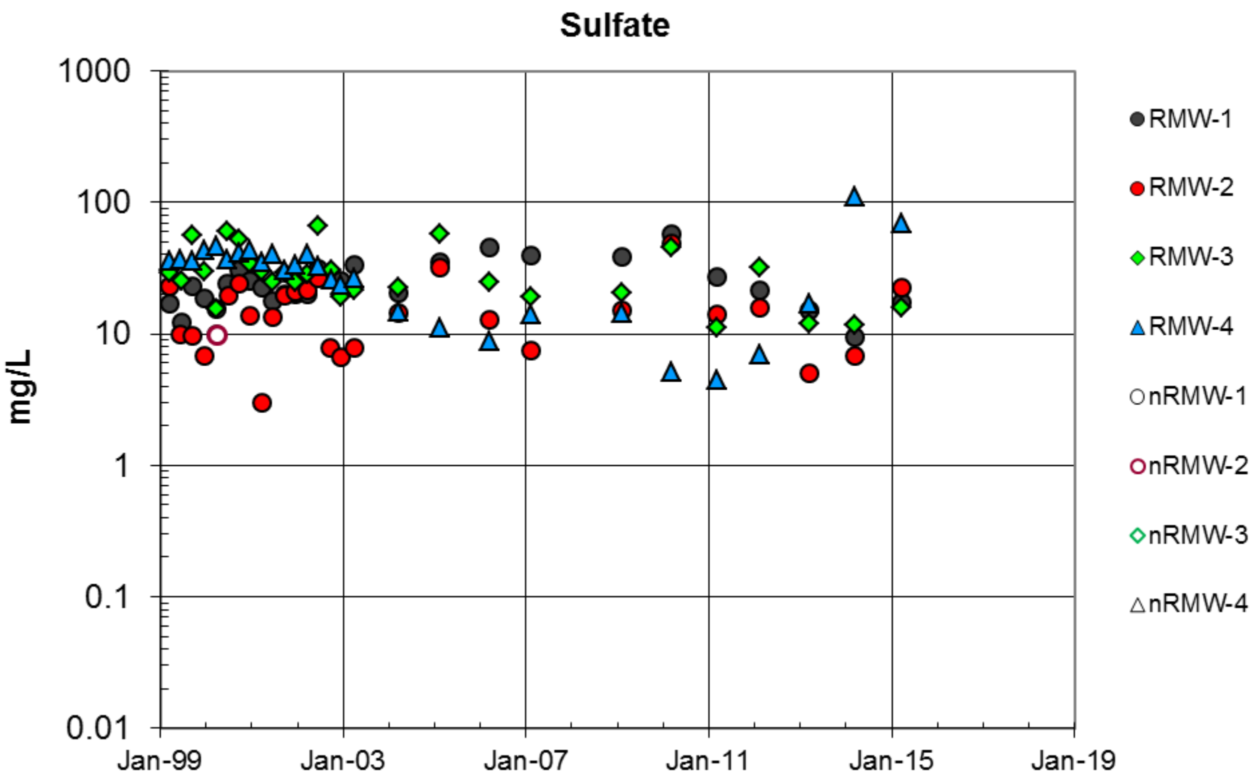

Figure 97. Sulfate in Line 4 Wells

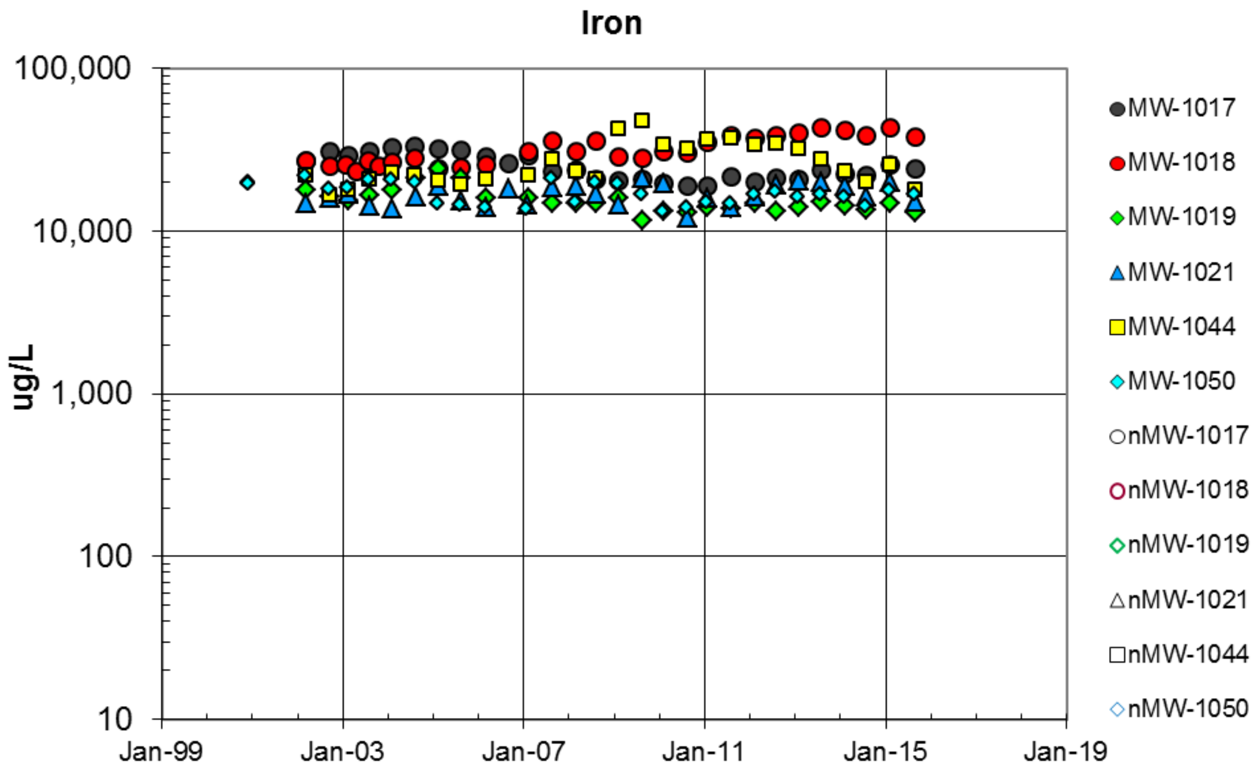

Figure 98. Dissolved Iron in Line 3 Wells

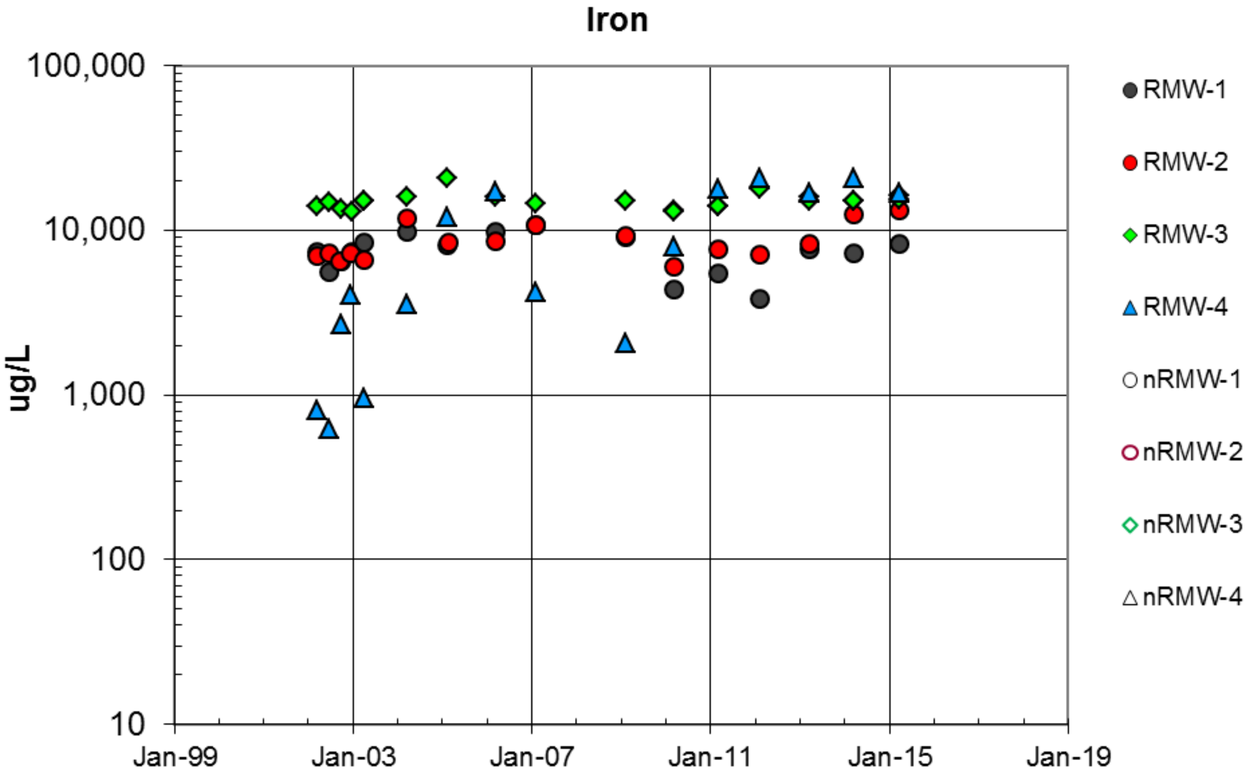

Figure 99. Dissolved Iron in Line 4 Wells

5.2.5 Quarry Surface Water

Four locations within Femme Osage Slough (Figure 100) were sampled quarterly in 2015 to assess the water quality in the slough and the potential impact from groundwater north of the slough (Table 33). 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.

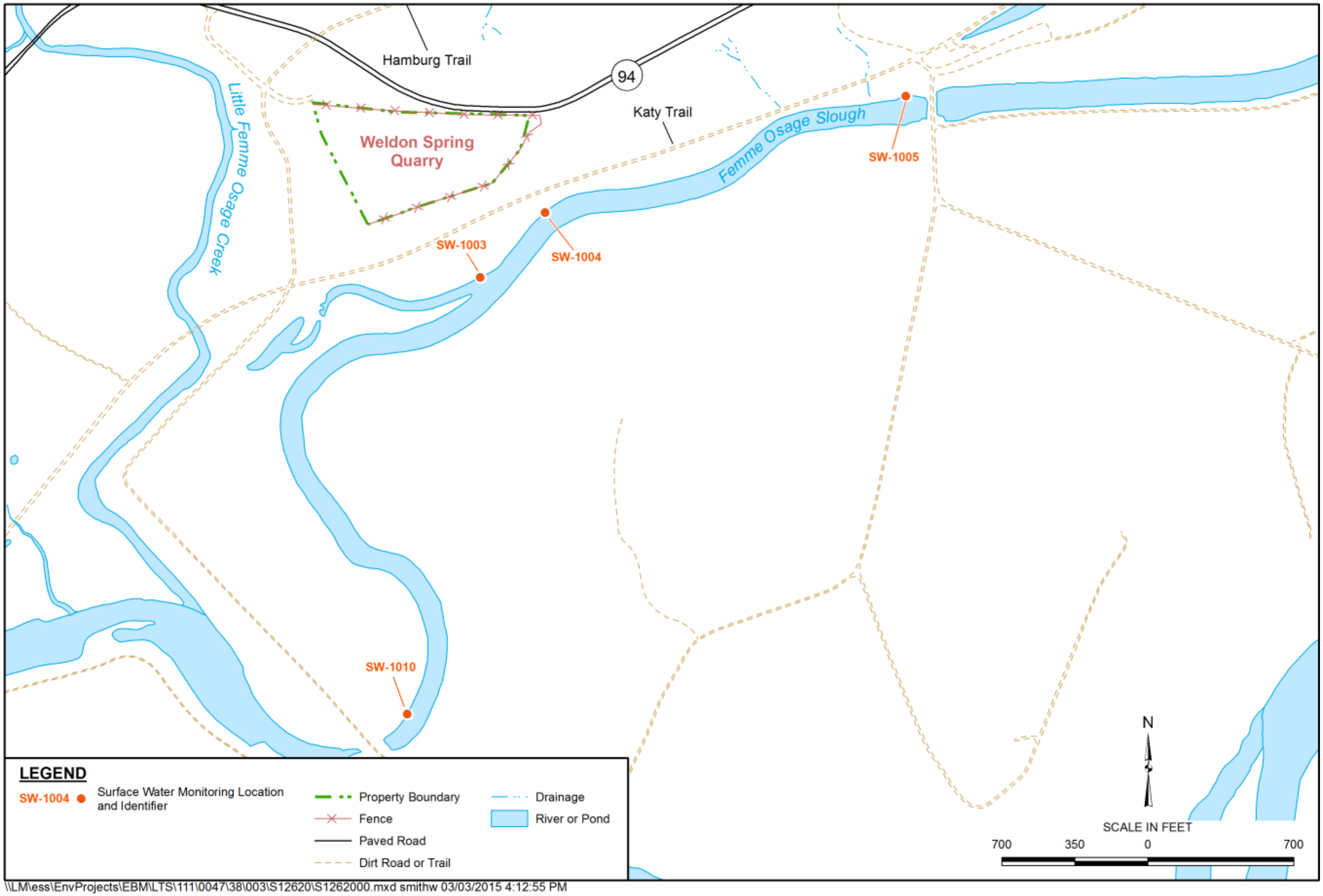

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Figure 100. Surface Water Monitoring Locations at the Quarry Area of the Weldon Spring, Missouri, Site

Table 33. 2015 Total Uranium in the Femme Osage Slough near the Quarry

Location	Uranium (pCi/L)			
	Q1	**Q2**	**Q3**	**Q4**
SW-1003	124 Feb 9, 2015	58 April 20, 2015	4.4 Aug 17, 2015	22 Nov 9, 2015
SW-1004	45 Feb 9, 2015	156 April 20, 2015	4.8 Aug 17, 2015	19 Nov 9, 2015
SW-1005	16 Feb 9, 2015	18 April 20, 2015	4.0 Aug 17, 2015	8.3 Nov 9, 2015
SW-1010	8.2 Feb 9, 2015	9.7 April 20, 2015	4.4 Aug 17, 2015	14 Nov 9, 2015

Abbreviations:
Q1, Q2, Q3, Q4 = quarterly sampling periods

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 was completely dry 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 101) have been elevated since this water body has been partially or completely dry starting in late 2006. Similar conditions were present in the early 1990s. Average uranium values decreased from 2009 through 2012 but showed a slight increase in 2014 to early 2015 (Figure 101). In mid-2015 the drought ended with persistent rainfall that resulted in the slough filling to the point that several adjacent wells were flooded. The flooding of low-lying wells reoccurred in late 2015 and early 2016 due to heavy rainfall. At one point, 11 inches fell on the site over a 3-day period (December 26 to December 28). This caused a lowering of uranium levels during the second half of 2015 due to dilution.

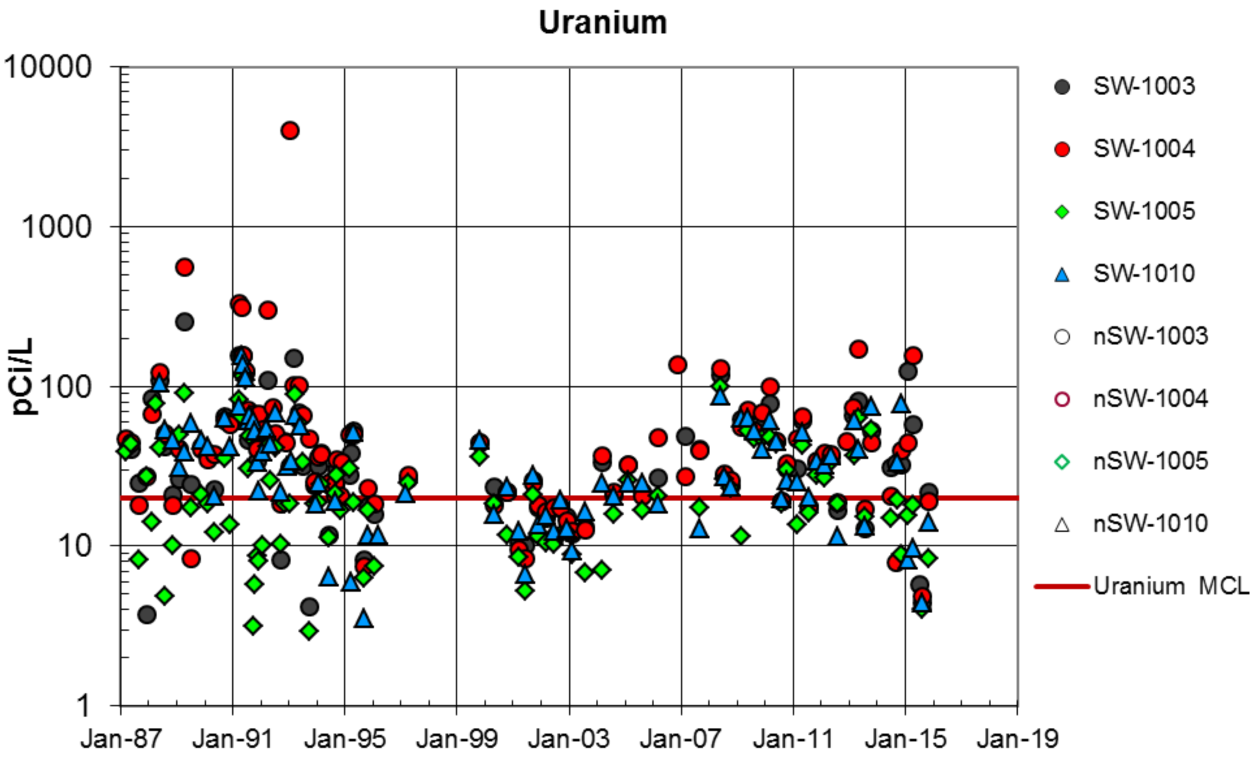

Figure 101. Uranium Levels in the Femme Osage Slough

5.3 Leachate Collection and Removal System Data

The LCRS collects leachate from the disposal cell. Leachate sampling continued in 2015 in accordance with the "Disposal Cell Groundwater Monitoring Plan" in Appendix K of the LTS&M Plan (DOE 2008a).

During 2015, the leachate was pumped from the sump on a quarterly basis (January, April, July, and October) and pretreated. The pretreated leachate was transported to MSD and discharged into the headworks at their Bissell Point wastewater treatment facility in April and October. A sample of pretreated 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 (raw) leachate during 2015 averaged 25.32 pCi/L. The uranium concentrations have increased since 2010, when levels were near 16 pCi/L.

Figure 102 shows the uranium concentrations in untreated (raw) leachate for the past 10 years.

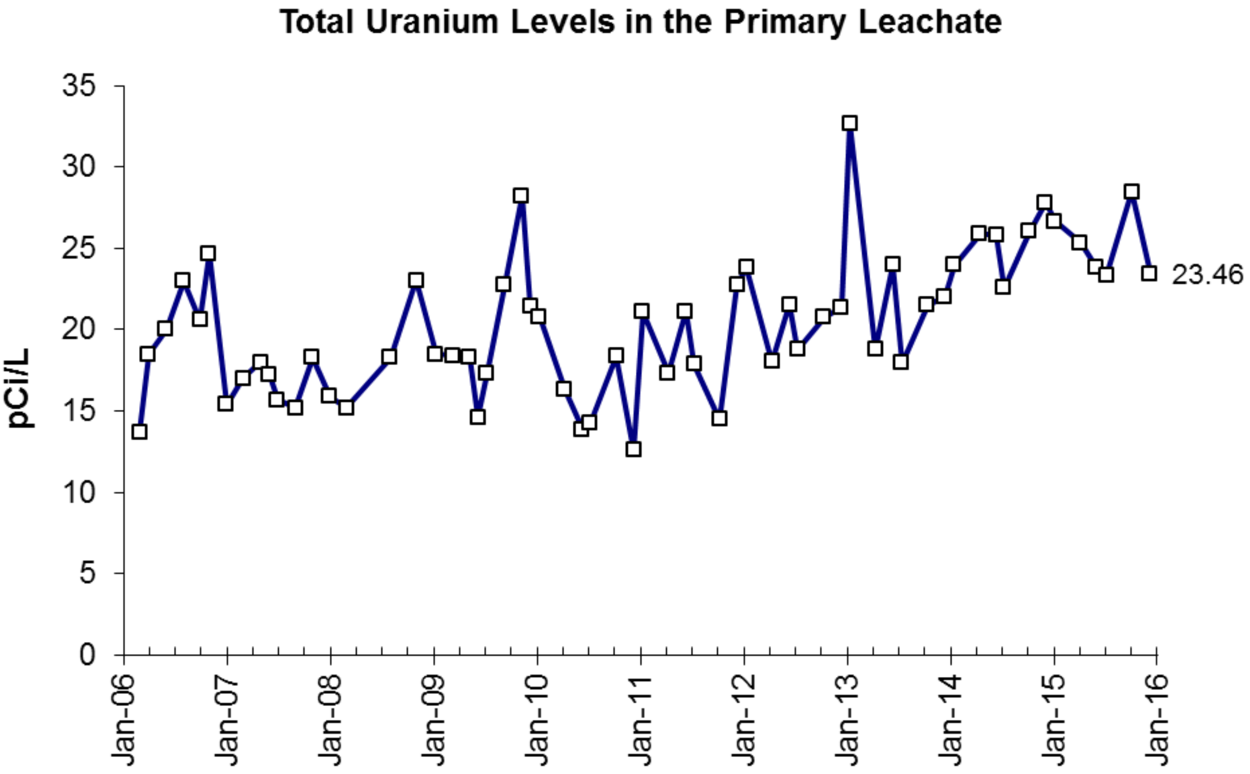

Figure 102. Actual Uranium Concentrations in the Primary Leachate

Every 2 weeks the LCRS facility is inspected, and the secondary containment 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 2014 and 2015, discharge from the primary leachate collection system generated approximately 69 gallons per day and 63 gallons per day, respectively. Figure 103 shows the daily averages for the primary leachate flow rates. The combined leachate flow rate from the secondary leachate collection system averaged approximately 9.8 gallons per day in 2014 and 9.4 gallons per day in 2015. On a per-acre basis, the average leakage rate for the secondary leachate collection system in 2014 and 2015 was approximately 0.41 and 0.39 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.

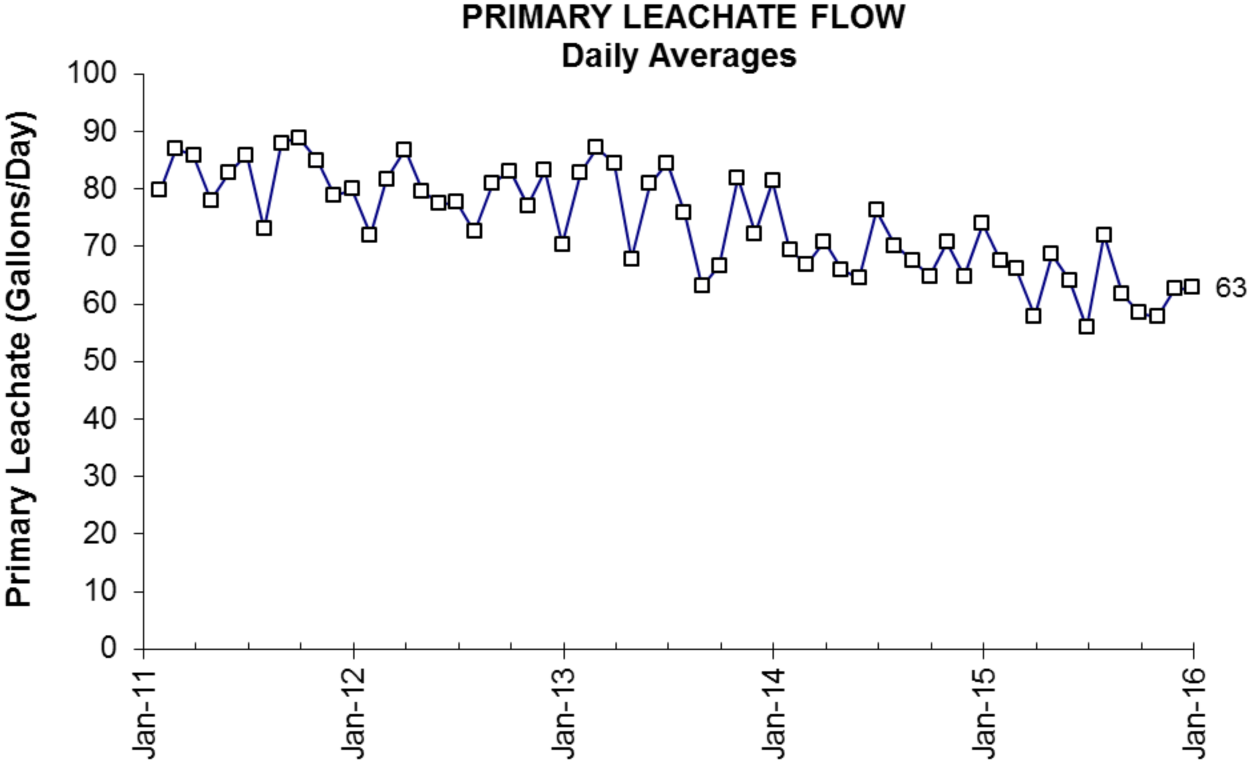

Figure 103. Daily Averages of the Primary Leachate Flow

5.4 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.

5.5 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 2015. The total effective dose (TED) has been calculated for 2015 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, TED is expressed as the potential dose to an individual who consumes spring water contaminated with uranium. Because this calculation uses data from the spring with the highest uranium concentration (SP-5304 in the Southeast Drainage, where the highest 2015 uranium concentration was 61.9 pCi/L), the calculated dose represents the reasonable dose for the maximally exposed individual. The estimated TED to this maximally exposed individual is about 0.067 mrem. This result is compared to DOE limits established in DOE Order 458.1 to demonstrate compliance with regulatory requirements.

5.5.1 Pathway Analysis and Exposure Scenario

Under current site conditions, the only potential exposure pathway to consider is that of a recreational visitor to the Weldon Spring Conservation Area 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 area and the Quarry area is not a pathway of concern, as no drinking water wells are located near the contaminated groundwater, and there is no access to the contaminated groundwater at the Quarry area. Concentrations of uranium in the production wells near the Quarry are comparable to background concentrations.

Inhalation of airborne particulates, inhalation of radon gas, and exposure to external gamma radiation 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 2015.

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).

5.5.2 Total Effective Dose Estimates

The TED estimate for the exposure scenario was calculated using 2015 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 2015.

Exposure scenario assumptions 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 2015 was at SP-5304 in the Southeast Drainage (61.9 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 DCF U-234 + 0.023DCF U-235 + 0.48 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) × volume of water ingested (L) × DCF uranium-total (mrem/pCi).

TED (total uranium) = 61.9 pCi/L × 4 L × (2.69×10^{-4} mrem/pCi) = 0.067 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 2015 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 100 percent of the all data in 2015 (including field data).
- Appendix H provides the Data Review and Validation Reports that were generated during 2015.

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/POL/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 34 describes the quality control samples collected at the Weldon Spring site.

Table 34. 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 2015. 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 2015, 53 field duplicates were collected from 486 field locations sampled (10.9 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 35 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 35. Summary of Calculated RPDs for 2015

Parameter	Number of Samples	Average RPD
Uranium	32	5.9
Sulfate	16	1.3
Nitrate (as Nitrogen)	11	6.7
Iron	7	3.2
Manganese	4	8.8
Barium	3	5.3
Fluoride	3	5.1
Total Organic Carbon	3	1.1
Chloride	2	1.0
Chemical Oxygen Demand	2	13.4
Copper	2	13.0
Total Dissolved Solids	2	2.5
Nitroaromatics	2	18.9
Volatile Organics	2	3.7
Selenium	1	3.7
Zinc	1	7.8

The results in Table 35 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 H).

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 2015, six 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. There were no surface water samples collected in 2015 using a stainless-steel bucket. All surface water samples were collected by directly placing the surface water into a sample container.

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 H 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 36 identifies the number of quarterly and total data points that were validated in 2015 and indicates the percentage of those selected that were complete. Data points in this table include all sample types (including field parameters).

Table 36. Validation Summary for Calendar Year 2015

Calendar Quarter	No. of Data Points Validated	No. of Validated Data Points Rejected	Completeness [a]
Quarter 1	644	0	100
Quarter 2	1,540	0	100
Quarter 3	639	0	100
Quarter 4	1149	0	100
2015 Total	3972	0	100

[a] Completeness is a measure of acceptable data. The value is determined by the following equation:

$$\text{Completeness} = \frac{(\#\ \text{validated} - \#\ \text{rejected})}{\#\ \text{validated}}$$

Notes:
Reflects all validatable data for the calendar year.

Table 37 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 2015, 100 percent of data validation was completed. Data points in this table include samples of groundwater, leachate, surface water, and spring water.

Table 37. Validation Qualifier Summary for Calendar Year 2015

Number of Data Points									
	Field	**Anions**	**Metals**	**Misc.**	**Nitro-aromatics**	**Radio-chemical**	**Semi-volatiles**	**Volatiles**	**Total**
Accepted	1349	252	674	408	552	189	368	180	3972
Rejected	0	0	0	0	0	0	0	0	0
Not Validatable	0	0	0	0	0	0	0	0	0
Total	1349	252	674	408	552	189	368	180	3972
Percentages									
Accepted	100%	100%	100%	100%	100%	100%	100%	100%	100%
Rejected	0%	0%	0%	0%	0%	0%	0%	0%	0%
Not Validatable	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Appendix H provides 2015 Data Review and Validation Reports for the Weldon Spring site, which detail the data qualifiers applied to individual data points.

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Appendix A

2015 Inspection Report Agenda

2015 WELDON SPRING SITE ANNUAL INSPECTION
AGENDA

Tuesday, December 1, 2015

8:30 – 9:00 am

Review agenda, inspection teams, and review of safety related work issues. Review findings/corrective actions from last year's inspection. Inspectors/observers will divide into 2 separate groups. Team 1 (Team Leader - Terri Uhlmeyer) will cover the Chemical Plant Area and surrounding properties. 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 Institutional Control area and note any land disturbance
- Disposal Cell buffer zone
- Monitoring wells on DOE Chemical Plant property
- Inspect erosion areas in prairie

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

- Southeast Drainage from Hamburg Trail to Missouri River, including springs 5303 & 5304
- Highway 94 culvert

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 6301)
- Spring 6303
- MW-4041 on MDC property

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 Supply District #2 well field area

4:00 – 4:30 pm

- Summarize observations and prepare for next day

2015 WELDON SPRING ANNUAL INSPECTION
AGENDA (continued)

Wednesday, December 2, 2015

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

Discussion of Leachate Collection and Removal System (LCRS) data and Erosion Monitoring Data

1:00– 2:00 pm

Inspection of LCRS (No confined space entry planned)

2:00 – 4:00 pm

Document and paperwork review

4:00 – 5:00 pm

Discussion of any 2015 inspection findings or observations

Appendix B

Sign-in Sheet

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LTS&M ANNUAL INSPECTION
WELDON SPRING SITE
December 1, 2015

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Appendix C

2015 Inspection Checklist

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:**
Location: St. Charles, MO	**EPA ID: MO6210022830**
Agencies accompanying DOE for portions of the annual inspection: ☑ EPA, Region 7 ☑ MDNR ☑ Other (list): MDC (SE Drainage)	**Weather:** 40s Sunny

Remedy Includes:
- Disposal Cell
- Institutional controls
- Monitored Natural Attenuation
- Long Term Monitoring
- Other

Inspectors Terri Uhlmeyer (Navarro) Randy Thompson (Navarro)

Participants Ken Starr (DOE)
Hoai Tran (EPA)
Patrick Anderson (MDNR)
Dan Carey (MDNR)
Chris Papinsick (Navarro)
Dave Parker (Navarro)
Rex Hodges (Navarro)
Yvonne Deyo (Navarro)
Kevin McCarthy (Navarro)
Darrell Landers (Navarro)
Tim Zirbes (Navarro)
Raenhard Wesselschmidt (MDC)

II. INTERVIEWS (Check all that apply)

1. **Local Site Manager** Yvonne Deyo (Name) Site Manager (Title) 4/23/15 (Date)
   Interviewed ☑ at site ☑ at office ☐ by phone Phone no. 636-300-2612
   Problems, suggestions; ☑ Report attached

2. **Environmental Data Manager** Randy Thompson (Name) Operations Manager (Title) 11/23/15 (Date)
   Interviewed ☑ at site ☑ at office ☐ by phone Phone no. 636-300-2640
   Check to ensure that environmental data is reviewed and trended.
   Problems, suggestions; ☑ Report attached

3. **Other Staff (as applicable)** N/A (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: 11/24/15
Email: N/A **Phone No.** 636-949-7325
Problems; suggestions; ☑ Report attached

Agency: Cottleville Fire Department **Contact Name:** Mark Boehle, Assistant Fire Chief
Date Contacted: 11/30/15
Email: maboehle@cottlevillefpd.org **Phone No.** 636-447-6655, ext. 8703
Problems; suggestions; ☑ Report attached

Agency: SimplexGrinnel (LCRS and Interpretive Center Alarm Company)
Contact Nicole (Name) (Title) 11/5/15 (Date) 888-746-7539 (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: 12/1/15
Email: Robert.Gaugh@fhsdschools.org **Phone No.** ~~636-851-47~~00 314-220-2746
Problems; suggestions; ☑ Report attached New contact: Jeremy Boettler

Agency: St. Charles County **Contact Name:** Ryan Tilley, Environmental Public Health Manager
Date Contacted: 11/5/15
Email: rtilley@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. Inspected noted wells on the property. Inspected erosion areas. Maintenance on all wells looked good. Erosion is improving by vegetation filling in.

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 on Army property and wells and springs on Conservation property. No evidence of spring or groundwater use.

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. Inspected wells on property.

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 excavation. "No Dig" labels were present on the 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. Inspected springs. No evidence of spring use.

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 in leaves.

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 on Aug. 26, 2015. There was no evidence of disturbances. The report is attached as an Appendix.

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: 11/6/15

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: Audrey Beres, Policy Coordinator
Address: P.O. Box 180, Jefferson City, MO 65102
Institutional Control and Real Estate Licenses to Verify: See No. 1

Date Contacted: 11/16/15

Email: audrey.beres@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~~ Danny Lyskowski
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: 12/8/15

Email: ~~mary.bryan~~ Danny.Lyskowski@dnr.mo.gov Phone No. 573-751-~~7987~~ 7634

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: 11/10/15

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: 11/5/15

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: 11/30/15

Email: stowe.johnson@modot.mo.gov Phone No.: 573-522-5562

Problems; suggestions; ☑ Report attached

7. **Agency:** Missouri Department of Transportation
Contact Name: Jim Wright, 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: 11/6/15

Email: James.Wright@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: 11/20/15

Email: ctajkows@sccmo.org Phone No. 636-949-7305

Problems; suggestions; ☑ Report attached

9. **Agency:** U.S. Dept. of Army
Contact Name: John Downing, Materials Handler
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: 11/20/15

Email: john.downingjr@usar.army.mil Phone No. 314-402-1836

Problems; suggestions; ☑ Report attached

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: 11/16/15

Problems; suggestions; ☐ Report attached

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: 11/24/15

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

4. **Site Markers (Four Information Plaques on Top of Cell, Historical Markers, and Other Information Markers)**

☐ Location shown on site map   Legible and Secure ☑ Yes   ☐ No

In Good Condition ☑ Yes   ☐ No

Remarks____

5. **Guard Rail Around Cell** ☑ Location shown on site map   Secure ☑ Yes   ☐ No

Remarks____

6. **Stairs to Top of Cell** ☑ Location shown on site map

Stairs in good condition ☑ Yes   ☐ No   Handrail stable and in good condition ☑ Yes   ☐ No

Remarks Handrail painted this year

7. **Other Site Conditions:**

Remarks____

VII. EROSION

1. **Chemical Plant Areas** ☑ Location shown on site map   Erosion evident ☑ Yes   ☐ No

Depth__________

Remarks Erosion shown on Figure

2. **Quarry Area** ☐ Location shown on site map   Erosion evident ☐ Yes   ☑ No

Depth__________

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.
Conducted aerial LiDAR survey in December 2014. Plan
to conduct every 2 years to replace transect walk.

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 plot photos were compared
to previous years photos. The rocks had not degraded or
changed.

3. **Vegetative Growth** Weeds or Plants on Cell ☐ Yes ☑ No

Remarks

4. **Wet Areas/ Water Damage**

Wet areas ☐ Yes ☑ No ☐ Location shown on site map Areal extent________

Ponding ☐ Yes ☑ No ☐ Location shown on site map Areal extent________

Seeps ☐ Yes ☑ No ☐ Location shown on site map Areal extent________

Remarks________

5. **Toe/Apron Drains** Proper drainage ☑ Yes ☐ No Silting ☐ Yes ☑ No

Erosion ☐ Yes ☑ No

Remarks________

6. **Slope Instability** ☐ Location shown on site map Evidence of slope instability ☐ Yes ☑ No

Remarks________

7. **Leachate Collection and Removal System** ☑ Fence/Gates/Locks in good condition

☑ Functioning ☑ Routinely sampled ☑ Good condition ☑ No Trespassing sign posted

☑ Correct Phone Numbers Posted

Data Issues ☐ Yes ☑ No Flow Rate Issues ☐ Yes ☑ No

Remarks________

8. **Condition of 300 Ft. Buffer Zone** Erosion ☑ Yes ☐ No

Remarks Shown on erosion figure. No issue of affecting the disposal cell.

9. **Condition of Prairie** Erosion ☑ Yes ☐ No

Remarks The prairie condition is good. No areas of runaway erosion.

IX. GROUNDWATER MONITORING

1. **Disposal Cell Monitoring Well Network**

☑ Properly secured/locked ☑ Good condition

☑ Properly maintained ☑ Correct ID on each well

Remarks MW-2032, 2046, 2047, 2051, 2055

100% of Disposal cell wells inspected.

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

☑ Properly secured/locked ☑ Correct ID on each well
☑ Good condition ☑ Properly maintained

List wells checked by number (> 10% of wells) MW- 2035, 2036, 2037, 2038, 2039, 3026, 3027, 3028, 3029, 3030, 3034, 3037, 3038, 3039, 4001, 4006, 4007, 4026, 4027, 4029, 4031, 4032, 4040, 4041, 4043

Remarks

3. **Quarry Monitoring Well Network**

☑ Properly secured/locked ☑ Correct ID on each well
☑ Good condition ☑ Properly Maintained

List wells checked by number (> 10% of wells) MW- 1006, 1008, 1009, 1012, 1014, 1017, 1018, 1044, 1052, RMW-4

Remarks

X. OVERALL OBSERVATIONS

Implementation of the Remedies

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

Nothing to note, 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.

Use of LiDAR to replace walking of transects.

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Appendix D

Inspection of Discharge Pipeline Manholes and Final Outfall Structure from the Weldon Spring, Missouri, Site to the Missouri River Outlet: Conducted August 26, 2015

Inspection of Discharge Pipeline Manholes and Final Outfall Structure from the Weldon Spring, Missouri, Site to Missouri River Outlet: Conducted August 26, 2015

This inspection report summarizes the visual inspection of the four manhole access points, a crossing of the pipeline at a small creek, and the final discharge outfall structure on the Missouri River at the Weldon Spring, Missouri, Site. The inspection was performed on August 26, 2015 and participants included the Department of Energy-Legacy Management Site Manager for the Weldon Spring, Missouri, Site, three Legacy Management Services employees and a representative of the Missouri Department of Natural Resources. The manholes and outfall structure are part of the pipeline that begins at the facility for the Weldon Spring Leachate Collection and Removal System and terminates at a discharge outfall structure located on the Missouri River. The pipeline is regulated under a National Pollutant Discharge Elimination System (NPDES) permit with the State of Missouri. The permit number is MO-0107701 and expires June 30, 2016. The location of the pipeline and manholes is shown in Figure 1.

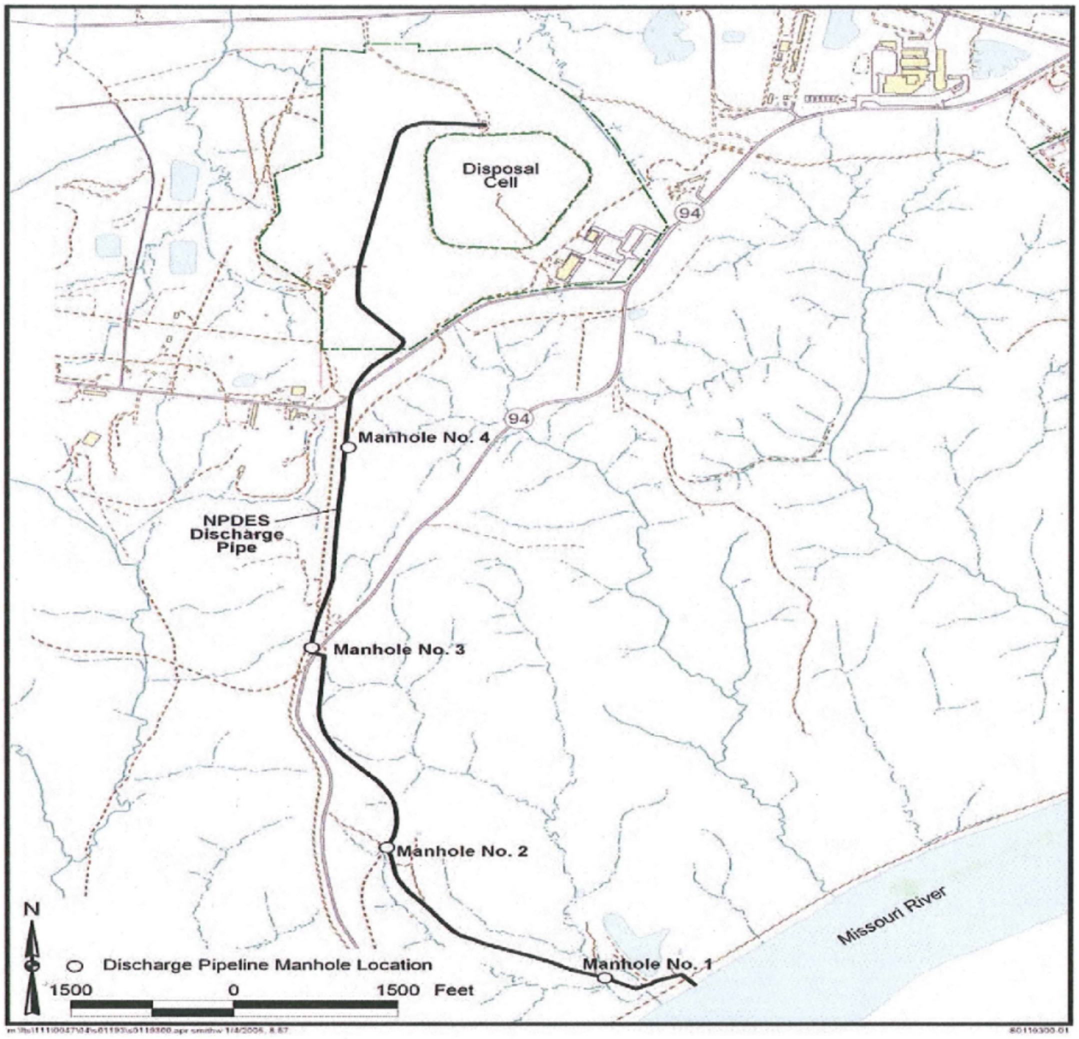


Figure 1. Location of Manholes and Outfall Structure at the Weldon Spring Site

Inspection of Manholes 1 Through 4

On August 26, 2015, the four manhole access points were located and inspected. The inspection began at Manhole 3 and 4 near the Hamburg trail and then continued to Manholes 1 and 2 located on Missouri Department of Conservation property. The inspection did not include opening of the manholes. Several cleanout structures were also observed during the inspection. The areas around each manhole were cleared of any vegetation and debris and photographs were taken at each location. The photographs of each manhole are presented below.

Each of the manhole locations were found to be in good condition with only minor vegetation or debris located at each manhole. The access trail and easement for the pipeline east of Highway 94 was mowed in July 2015 and cleared of the heavy vegetation along the trail to Manholes 1 and 2. Based on the clearing of the trail there was minimal vegetation maintenance required during the inspection. Manholes 3 and 4 are both located along the Hamburg Trail and vegetation is maintained on a frequent basis along this trail.

Approximately 100 yards east of Manhole 1 (downstream), a very large cottonwood tree had fallen in 2014 and continues to block the trail near the small bridge. However, the inspection team was able to navigate around the tree and continued with the pipeline outfall inspection without having to access the Katy Trail.

Manhole 1: Closest to Missouri River

Manhole 2: Near Old Railroad Line

Manhole 3: Near Highway 94

Manhole 4: Mound Near Hamburg Trail

Inspection of Discharge Outfall at the Missouri River and Creek Crossing

Approximately 100 yards east of Manhole 1 is a small abandoned bridge where the buried, concrete encased pipeline passes under the creek directly southeast of the bridge. The bridge has been inaccessible to vehicles for many years and is in poor condition. The pipeline is encased in concrete along the portion of the pipeline that crosses a small creek near the bridge to prevent damage from debris flowing in the creek. Though there was water flowing over the top of the pipeline encasement, no damage was observed anywhere along the encasement.

Pipeline crossing under small creek

The inspection of the pipeline discharge outfall and structure was performed on August 26, 2015. The structure was observed to be in good condition, as shown in the photo below. Some mud, debris, and rocks were observed inside and outside of the structure, but overall there was no damage or clogging of the pipeline observed at the outfall.

Discharge Outfall Structure at Missouri River

The sign placed near the discharge outfall structure has bullet penetrations. This damage occurred many years ago. The sign is in a direction where it can be viewed from the Missouri River and was not easily seen from the Katy Trail due to heavy growth of vegetation around the sign. It could not be determined if any additional damage occurred in the past year.

Appendix E

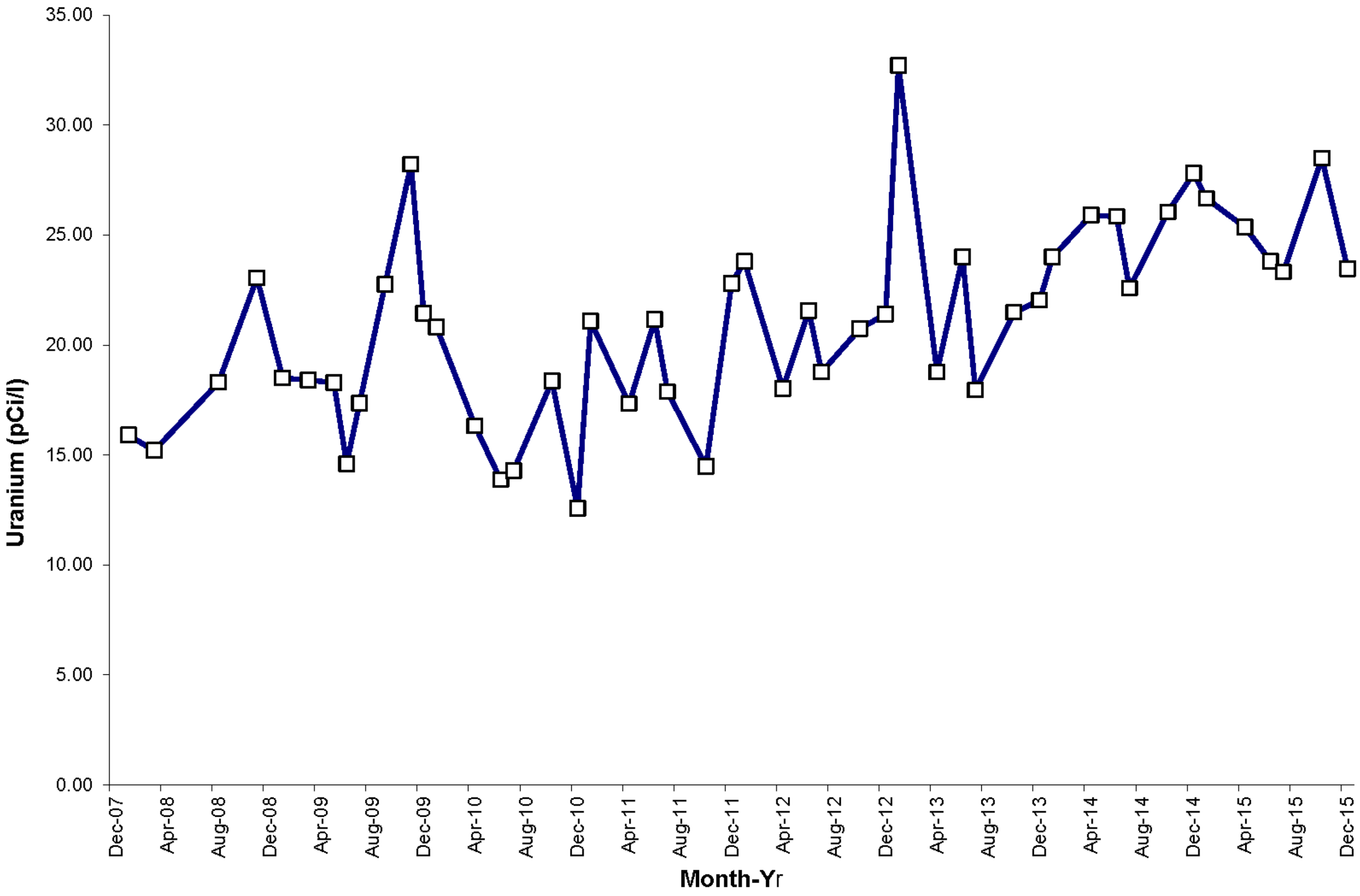
Leachate Production Rates, Uranium Levels, and Flow Rates

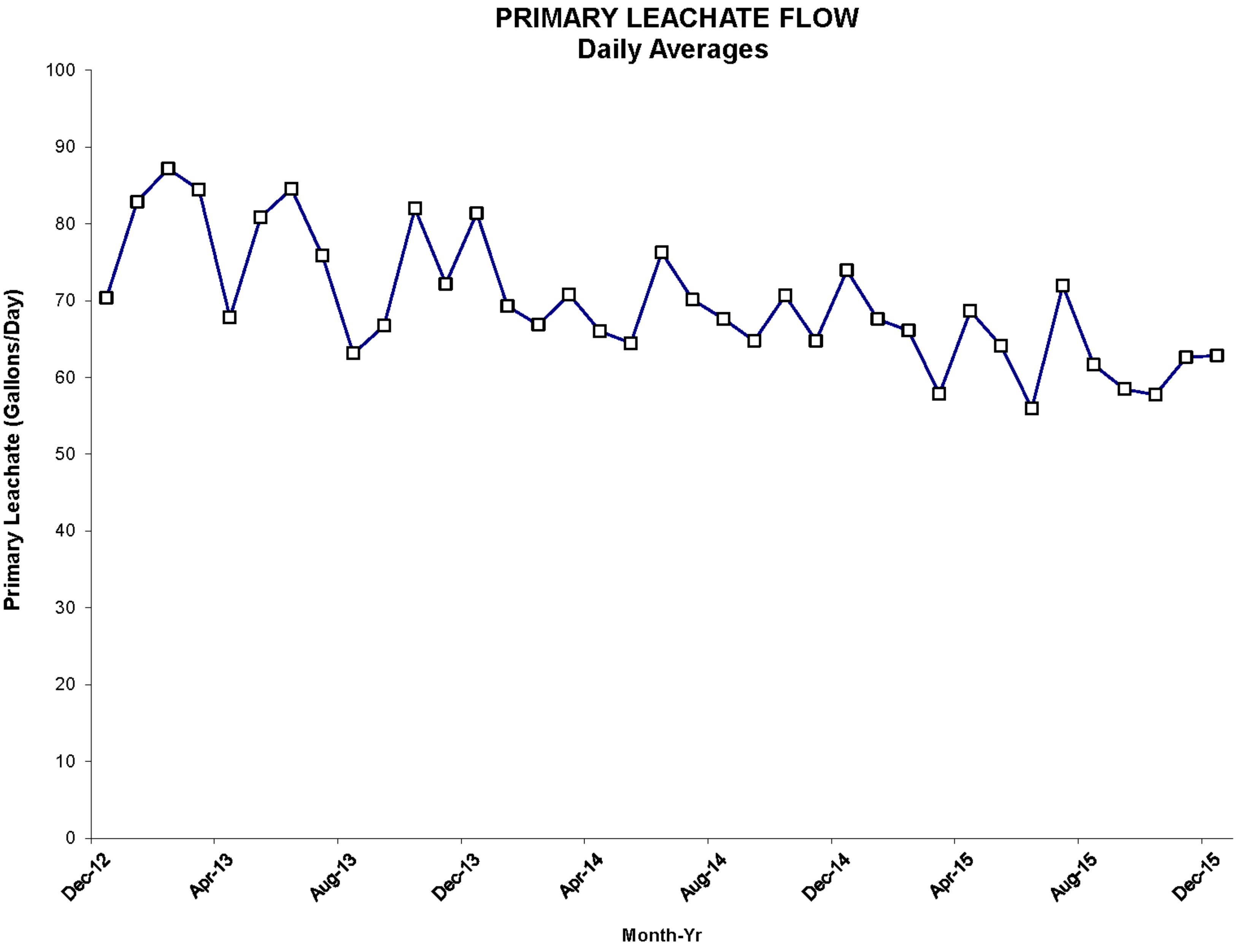
Attachment 1: LCRS Flow Data Spreadsheet

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) (a)	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)
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
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
Jan-14	31	8271	2748	7940	215	0.0	46	8.0	2148	69	1.5	0.3	6.9	78	0.36
Feb-14	28	2748	4838	0	163	0.0	48	6.5	1873	67	1.7	0.2	5.8	75	0.32
Mar-14	31	4838	7249	0	170	0.0	39	6.6	2195	71	1.3	0.2	5.5	78	0.29
Apr-14	30	7249	2634	6836	192	0.0	43	5.7	1980	66	1.4	0.2	6.4	74	0.33
May-14	31	2634	4959	0	237	36.3	46	6.6	1999	64	1.5	0.2	7.6	74	0.39
Jun-14	30	4959	7577	0	282	0.0	42	5.9	2288	76	1.4	0.2	9.4	87	0.46
Jul-14	31	7577	2095	7981	278	0.0	40	6.1	2174	70	1.3	0.2	9.0	81	0.44
Aug-14	31	2095	4552	0	314	0.0	42	4.4	2097	68	1.3	0.1	10.1	79	0.48
Sep-14	30	4552	6884	0	310	29.1	43	6.4	1944	*65*	1.4	0.2	10.3	77	0.50
Oct-14	31	6884	2412	7018	309	0.0	42	4.4	2191	71	1.3	0.1	10.0	82	0.48
Nov-14	30	2412	4647	0	249	0.0	36	5.9	1944	65	1.2	0.2	8.3	75	0.40
Dec-14	31	4647	7252	0	270	0.0	37	4.4	2293	74	1.2	0.1	8.7	84	0.42
Jan-15	31	7252	2537	7107	223	22.7	44	6.1	2096	68	1.4	0.2	7.2	76	0.37
Feb-15	28	2537	4606	0	174	0.0	38	6.0	1851	66	1.4	0.2	6.2	74	0.32
Mar-15	31	4606	6633	0	194	0.0	33	7.5	1793	58	1.1	0.2	6.2	65	0.31
Apr-15	30	6633	2237	6699	195	0.0	42	5.9	2060	69	1.4	0.2	6.5	77	0.34
May-15	31	2237	4540	0	224	42.0	44	4.4	1988	64	1.4	0.1	7.2	73	0.37
Jun-15	30	4540	6546	0	282	0.0	40	5.6	1679	56	1.3	0.2	9.4	67	0.45
Jul-15	31	6546	2267	6872	320	0	37	4.4	2231	72	1.2	0.1	10.3	84	0.49
Aug-15	31	2267	4524	0	302	0	38	5.2	1912	62	1.2	0.2	9.7	73	0.46
Sep-15	30	4524	6533	0	217	0	34	3.2	1755	59	1.1	0.1	7.2	67	0.35
Oct-15	31	6533	2333	6360	318	9.9	36	6.1	1790	58	1.2	0.2	10.3	69	0.48
Nov-15	30	2333	4544	0	249	42.1	37	4.7	1879	63	1.2	0.2	8.3	72	0.40
Dec-15	31	4544	6773	0	235	0	39	6.3	1949	63	1.2	0.2	7.6	72	0.38

(a) - June through November of 2012, West secondary counter was out of service.

Total Uranium Levels in the Primary Leachate




PRIMARY LEACHATE FLOW
Daily Averages
Primary Leachate (Gallons/Day)
100
90
80
70
60
50
40
30
20
10
0
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Month-Yr

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Appendix F

2015 Inspection Report Interviews and Contacts

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 9:00 AM**	**Date: 11/23/2015**
Type: ___ Telephone _x_ Visit ___ Other **Location of Visit: Administration Building**	__ Incoming __ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Yvonne Deyo	**Title: Site Manager**	**Organization: Navarro**

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

I interviewed Yvonne Deyo, the Navarro 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.

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. However, nighttime access of the disposal cell viewing platform and other undesirable behaviors have been substantially reduced due a private security firm's seasonal patrol coverage of the site during evening hours. Protective well caps have been installed on monitoring wells to prevent vandalism. No site-related vandalism has been noted this year.
5. **What is the current on-site presence? Describe staff and activities.** There are 13 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 of site IT and telephone issues, landscape management and general administrative support. On-site staff also provide support to other DOE sites such as Mound, Fernald, and Pinellas and to other LMS programmatic areas. Environmental sampling personnel support sampling activities at other sites in the Legacy Management system. The LMS contractor continues to support operation and maintenance of the DOE-owned and leased on-site facilities.
6. **Are there any issues associated with the site at this time?** None concerning site protectiveness to the environment or the public.
7. **Any suggestions or comments regarding annual inspection?** The inspection continues to provide a useful mechanism to have regulators on-site to evaluate site protectiveness to the environment and the public.

INTERVIEW RECORD

Site Name: Weldon Spring Site		**EPA ID No.: MO6210022830**
Subject: Annual Inspection	**Time: 2:00 pm**	**Date: 11/20/15**

Type: _x_ Telephone ___ Visit ___ Email
Location of Visit: NA

__ Incoming _x_ Outgoing

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: John Downing	**Title: Materials Handler**	**Organization: Army**

Telephone
Cell No: 314-402-1836
E-Mail Address:

Street Address: 7301 Hwy. 94 South
City, State, Zip: St. Charles, MO 63304

Summary Of Conversation

I contacted John Downing at the Weldon Spring Army site by telephone on November 20, 2015, and notified him that DOE would be conducting the annual LTS&M inspection at the Weldon Spring Site on December 1 and 2, and that we would be on Army property on the morning of the 1st. I told him we would be driving around on the Army site and inspecting our wells. We discussed access to the Army property and how to contact him the morning of the inspection so that he is aware of who is on-site.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 1:00 pm**	**Date: 11/23/15**
Type: ___ Telephone _x_ Visit ___ Other **Location of Visit:** Weldon Spring Site	__ Incoming __ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Randy Thompson	**Title: Site/Operation Manager**	**Organization: Navarro**

Telephone No: 636-300-2640 **Fax No: 636-300-2626** **E-Mail Address: Randy.Thompson@lm.doe.gov**	**Street Address: Weldon Spring Site** **City, State, Zip:**

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 sample data through September 2015. The data validation and review is being worked for samples collected during October 2015. Data for the November/December sampling are still in the analysis/reporting phase at 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 September 2015 and are available online. The October through December 2015 data have 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: 11:28am**	**Date: 11/30/15**
Type: ___ Telephone ___ Visit x Email **Location of Visit: NA**	__ Incoming x Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Mark Boehle	**Title: Assistant Fire Chief**	**Organization: Cottleville Fire Dept**

Telephone No: 636-447-6655 ext. 8703 **Fax No:** **E-Mail Address: maboehle@cottlevillefpd.org**	**Street Address: PO Box 385** **City, State, Zip: Cottleville, MO 63338**

Summary Of Conversation

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

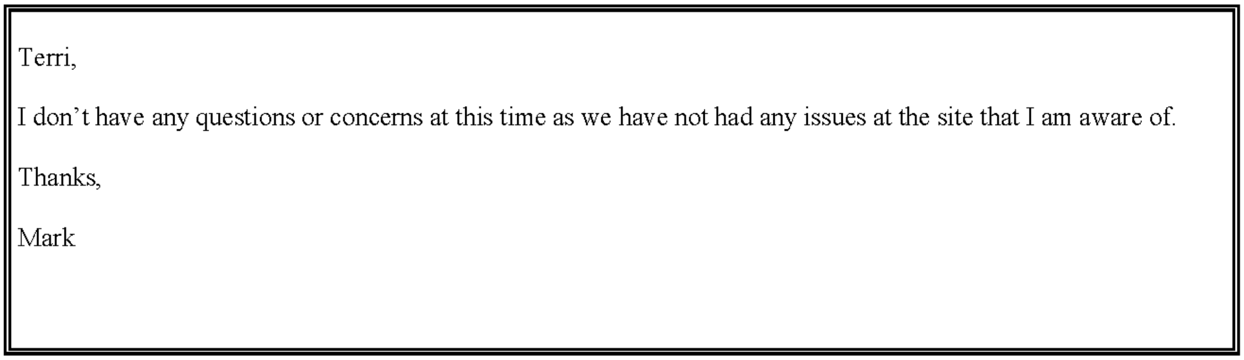
Mark, I am contacting you regarding the upcoming Department of Energy – Weldon Spring Site annual long-term surveillance and maintenance inspection, which is scheduled for December 1-2, 2015. As part of the inspection we contact stakeholders to maintain contact with them and to determine if they have any concerns or issues about the site. There have been no major changes to the site at this time. There are still plans to build a new building, but DOE is still in the early planning stages. Please respond and let me know us know if you have any questions, issues or concerns.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
5. Do you feel well-informed about the site's activities and progress?
6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
7. Any other general comments?

Mark responded:



Terri,

I don’t have any questions or concerns at this time as we have not had any issues at the site that I am aware of.

Thanks,

Mark

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 10:15 am**	**Date: 11/24/15**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Wayne Anthony	**Title:**	**Organization: St. Charles Planning and Zoning Department**

Telephone No: 636-949-7900 x7221 **Fax No:** **E-Mail Address:**	**Street Address:** **City, State, Zip:**

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 December 1 and 2, 2015 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 stated that he did not know of any activities in the area. I informed Mr. Anthony of preliminary plans for a new building at the site. Mr. Anthony also let me know that he would probably be retiring in the spring and his possible replacement would be Robert Meyers with the extension 7225.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 10:06 am**	**Date: 11/5/15**
Type: ___ Telephone ___ Visit _x_ Email **Location of Visit: NA**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Ryan Tilley	**Title: Director, Division of Environmental Health and Protection**	**Organization: St. Charles County**

Telephone No: 636-949-7406 **Fax No:** **E-Mail Address: RTilley@sccmo.org**	**Street Address: 201 North Second Street, Suite 537** **City, State, Zip: St. Charles, MO 63301**

Summary Of Conversation

I contacted Ryan Tilley, Director, Division of Environmental Health and Protection for St. Charles County by email. The email stated the following:

Ryan, I am contacting you regarding the upcoming Department of Energy – Weldon Spring Site annual long-term surveillance and maintenance inspection, which is scheduled for December 1 and 2, 2015. You were copied on the notification letter with the agenda which was dated October 28, 2015. 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.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
5. Do you feel well-informed about the site's activities and progress?
6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
7. Any other general comments?

Ryan responded that he had no questions or concerns.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.:MO6210022830**	
Subject: Annual Inspection	**Time: 10:30 am**	**Date: 11/5/15**

Type: _x_ Telephone ___ Visit ___ Other
Location of Visit:

__ Incoming _x_ Outgoing

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Nicole	**Title:**	**Organization: Simplex/Grinnell**

Telephone No: 888-746-7539
Fax No:
E-Mail Address:

Street Address:
City, State, Zip:

Summary Of Conversation

I contacted Simplex/Grinnell, the alarm company for the project, and talked to Nicole. 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.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 10:30 am**	**Date: 11/24/15**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit: NA**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Jim Hudson	**Title: Captain**	**Organization: St. Charles County Sheriff Office**

Telephone No: 636-949-7325 **Fax No: 636-949-7525** **E-Mail Address:**	**Street Address:** **City, State, Zip:**

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 December 1 and 2, 2015. I had talked to Captain Hudson the last eleven 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.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 9:54 am**	**Date: 12/1/15**
Type: ___ Telephone ___ Visit _x_ Email **Location of Visit: NA**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Dave Wedlock/Jeremy Boettler	**Title: Principal/Director of Facilities and Operation**	**Organization: Francis Howell High School**

Telephone No: 636-851-4080 /314-220-2746 **Fax No:** **E-Mail Address: dave.wedlock@fhsdsschools.org /jeremy.boettler@fhsdsschools.org**	**Street Address: 7001 Hwy 94 South** **City, State, Zip: St. Charles, MO 63304**

Summary Of Conversation

Dr. Wedlock, I am contacting you regarding the upcoming Department of Energy – Weldon Spring Site annual long-term surveillance and maintenance inspection, which is scheduled for December 1 and 2, 2015. 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. If there is another individual on your staff that you would like to contact, please let me know.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
5. Do you feel well-informed about the site's activities and progress?
6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
7. Any other general comments?

Dr. Wedlock responded that Jeremy Boettler, the Director of Facilities and Operations was the new contact. I copied Mr. Boettler on the email and stated the following:

Jeremy, Just to let you know the Department of Energy contacts its stakeholders at the time of the annual inspection of the site to determine if they have any questions or concerns. The annual inspection this year is December 1-2, 2015.

Please respond and let me know if you have any questions, issues or concerns.

Mr. Boettler responded that they did not have any questions or issues.

INTERVIEW RECORD

Site Name: Weldon Spring Site		**EPA ID No.: MO6210022830**
Subject: Annual Inspection	**Time: 8:52 am**	**Date: 11/16/15**
Type: ___ Telephone ___ Visit _x_ Email **Location of Visit: NA**		__ Incoming _x_ Outgoing

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Audrey Beres	**Title: Policy Coordinator**	**Organization: Missouri Department of Conservation**
Telephone No: 573-522-4115 x3346 **Fax No:** **E-Mail Address:**		**Address: P.O. Box 180** **City, State, Zip: Jefferson City, Mo 65102**

Summary Of Conversation

I contacted Audrey Beres of the Missouri Department of Conservation (MDC) by email.

Audrey, I am contacting you to notify you of the Department of Energy Weldon Spring Site annual inspection which will take place on December 1 and 2, 2015. 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 13th 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 (and is currently being revised) 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 or someone from his staff usually participates in the walk down the southeast drainage. Please respond to this email or call me to let me know if you have any questions, concerns or issues. Thanks.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so,

please give details.

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.

5. Do you feel well-informed about the site's activities and progress?

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

7. Any other general comments?

Audrey responded that she did not have any questions or concerns.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 11:21 am**	**Date: 11/20/15**
Type: ___ Telephone ___ Visit _x_ Email **Location of Visit: NA**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Craig Tajkowski	**Title: County Engineer**	**Organization: St. Charles County**

Telephone No: 636-949-7305 **Fax No:** **E-Mail Address: ctajkows@sccmo.org**	**Address: 201 N. 2nd St, Ste. 429** **City, State, Zip: St. Charles, Mo 63301**

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 December 1 and 2, 2015. 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 13th 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.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Craig's responses are included below:

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)? I do not have enough knowledge or experience with the site to have an impression.
2. What effects have the site operations had on the surrounding community? Unknown

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details. No

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details. No

5. Do you feel well-informed about the site's activities and progress? Information seems available, but I have had no personal or professional need to closely track that information.

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation? No

7. Any other general comments? None

I included a link to the Weldon Spring Site website in my response.

INTERVIEW RECORD

Site Name: Weldon Spring Site		**EPA ID No.: MO6210022830**
Subject: Annual Inspection	**Time: 4:07 pm**	**Date: 11/6/15**
Type: ___ Telephone ___ Visit _X_ Email **Location of Visit: Weldon Spring Site**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

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 **Fax No:** **E-Mail Address: John.Vogel@mdc.mo.gov**	**Street Address: 2360 Hwy D** **City, State, Zip: St. Charles, MO 63304**

Summary Of Conversation

I contacted John Vogel, to notify him of the annual inspection that was going to take place on December 1-2, 2015. The email stated:

John, I am contacting you regarding the upcoming Department of Energy – Weldon Spring Site annual long-term surveillance and maintenance inspection, which is scheduled for December 1 and 2, 2015. You were copied on the notification letter with the agenda which was dated October 28, 2015. 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. We also touch base about the institutional control areas to ensure that landowners remain aware of the institutional controls on their properties. As you know we have the current easement with MDC. I also wanted to check about any hunting seasons at that time. Please respond and let me know if you or a representative will attend the inspection or if you have any questions, issues or concerns. Thanks!

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016.

John responded:

Hi Terri-

I believe that Raenhard Wesselschmidt will be attending the Southeast Drainage inspection this year. During the inspection, squirrel season will be open on the area, but that has been the case during past inspections and we have not had any conflicts, so I don't expect any this year. My answers to the questions are below:

Thanks,
John

His response to the questions are below:

1. **What is your overall impression of the project (general sentiment)?**
   I think the project was a quality project to clean up the surrounding area and ensure long-term protection of the natural resources.
2. **What effects have the site operations had on the surrounding community?**
   Site operations have had a positive impact on the surrounding community. The interpretive programs offered at the site are a benefit to the community. In addition, many community members use the site as an access point to the local trail systems.
3. **Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.**
   I am not aware of any community concerns regarding the site or its operation/administration. From time to time, our office does receive questions regarding the safety of recreating on the area due to radioactivity concerns, but I think the Weldon Spring Interpretive Center does a good job of addressing those concerns.
4. **Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.**
   I am not aware of any events or incidents at the site.
5. **Do you feel well-informed about the site's activities and progress?**
   I do feel well-informed about the site's activities. Regular e-mail correspondence, conversations with site employees, and mailings are appreciated.
6. **Do you have any comments, suggestions, or recommendations regarding the site's management or operation?**
   I would like to pose the question of whether or not the annual inspection of the Southeast Drainage is really needed. It is my understanding that the purpose of the inspection is to confirm no residential structures have been built within 200-feet of the drainage. Speaking on behalf of the property owner, the Missouri Department of Conservation, I am comfortable in saying our agency would know if a residential structure was to be built in the area. Our agency has no plans to construct any residential structures in the drainage, nor would we allow anyone else to construct a residential structure. I don't really see the need to invest the time each year during the annual inspection to do the Southeast Drainage walk. I would think the time could be better spent on other portions of the annual inspection. Department of Conservation staff are still willing to participate in this portion of the annual inspection as long as we continue to do it.
7. Any other general comments?
   Thank you for continuing to communicate with the Department of Conservation.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 8:24 am**	**Date: 11/10/15**
Type: ___ Telephone ___ Visit _x_ Email **Location of Visit: NA**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Quinn Kellner	**Title: Natural Resource Manager** **Jones-Confluence State Park**	**Organization: MDNR-Parks**

Telephone No: 636-899-1135 **Fax No:** **E-Mail Address: Quinn.kellner@dnr.mo.gov**	**Street Address: PO Box 67** **City, State, Zip: West Alton, MO 63386**

Summary Of Conversation

I contacted Quinn Kellner, MDNR-Parks and emailed him about the LTS&M annual inspection at the Weldon Spring site on December 1 and 2, 2015. He had been previously notified by copy of the regulator 30-day notification letter and a copy of the agenda. The email stated:

Quinn, 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 December 1-2, 2015. You were copied on the notification letter with the agenda which was dated October 28, 2015. 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.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below is a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Quinn's response to the questions are below:

1. What is your overall impression of the project (general sentiment)? That the remediation is very well monitored and documented thoroughly. A significant effort is made to fully inform the public and stakeholders about the status of the site.
2. What effects have the site operations had on the surrounding community? Other than the need for access to sampling sites on land that I manage, I have had limited experience with project operations. I did participate in one annual inspection.
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details. Not aware of any concerns.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details. No events to report.

5. Do you feel well-informed about the site's activities and progress? Yes.

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation? None.

7. Any other general comments?

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 2:10 pm**	**Date: 11/30/15**
Type: _x_ Telephone ___ Visit _x_ Email **Location of Visit: NA**	_ξ_ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Stowe Johnson	**Title: Sr. Environmental Specialist**	**Organization: Missouri Department of Transportation**

Telephone No: 573-522-5562 **Fax No:** **E-Mail Address: Stowe.Johnson@modot.mo.gov**	**Address: P.O. Box 270** **City, State, Zip: Jefferson City, Mo 65102**

Summary Of Conversation

I contacted Stowe Johnson of the Missouri Department of Transportation by email and emailed the following information to him:

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 (LTS&M) inspection at the Site. 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 December 1 and 2, 2015.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
5. Do you feel well-informed about the site's activities and progress?
6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
7. Any other general comments?

Regarding our history and relationship with MoDOT, the culvert on Highway D was removed by DOE as the

shoulders were widened, 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, therefore we will be contacting them regarding the easement. I would appreciate it if you could respond to this email and let me know if there are any issues or concerns.
Thanks!

Stowe contacted me by telephone on November 30, 2015, and informed me that MoDOT did not have any concerns or issues. We discussed the culvert and I let him know that if we saw any issues during the inspection that we would contact him.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 8:17 am**	**Date: 11/6/15**
Type: ___ Telephone ___ Visit _x_ Email **Location of Visit: NA**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Tom Evers/James Wright	**Title: St. Charles County Area Engineer**	**Organization: Missouri Department of Transportation**

Telephone No: 636-240-5277 **Fax No:** **E-Mail Address: Thomas.Evers@modot.mo.gov/James.Wright@modot.mo.gov**	**Address: 6780 Old Hwy. N** **City, State, Zip: St. Charles, Mo 63304**

Summary Of Conversation

I contacted Tom Evers of the Missouri Department of Transportation by email and emailed the following information to him:

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 (LTS&M) inspection at the Site. 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 December 1 and 2, 2015.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
5. Do you feel well-informed about the site's activities and progress?
6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
7. Any other general comments?

Regarding our history and relationship with MoDOT, the culvert on Highway D was removed by DOE as the shoulders were widened, 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, therefore we will be contacting them regarding the easement. I would appreciate it if you could respond to this email and let me know if there are any issues or concerns.
Thanks!

Tom responded that his position with MoDOT had changed and he is no longer the Area Manager for St. Charles County. He copied James Wright the person replacing him on the email.

INTERVIEW RECORD

Site Name: Weldon Spring Site

EPA ID No.: MO6210022830

Subject: Annual Inspection

Time: 12:50 pm **Date: 11/5/15**

Type: ___ Telephone ___ Visit _x_ Email
Location of Visit: NA

__ Incoming _x_ Outgoing

Contact Made By:

Name: Terri Uhlmeyer | **Title: Compliance Manager** | **Organization: Navarro**

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

I contacted Tom Blair of the Missouri Department of Transportation by email and emailed the following information to him:

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 (LTS&M) inspection at the Site. 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 December 1 and 2, 2015.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
5. Do you feel well-informed about the site's activities and progress?
6. Do you have any comments, suggestions, or recommendations regarding the site's management or

operation?

7. Any other general comments?

Regarding our history and relationship with MoDOT, the culvert on Highway D was removed by DOE as the shoulders were widened, 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, therefore we will be contacting them regarding the easement. I would appreciate it if you could respond to this email and let me know if there are any issues or concerns.

Thanks!

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Five Year Review	**Time: 2:00 pm**	**Date: 1/6/16**
Type: _ Telephone ___ Visit ___ Email **Location of Visit: N/A**	__ Incoming _x_ Outgoing	

Contact Made By:

Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: Navarro**

Individual Contacted:

Name: Patrick Anderson	**Title:**	**Organization: Remediation and Radiological Assessment Unit, Federal Facilities Section, Missouri Department of Natural Resources**
Telephone No: 573-751-3087 **Fax No:** **E-Mail Address: patrick.anderson@dnr.mo.gov**	**Street Address:**	

Summary Of Conversation

I contacted Patrick Anderson from the Missouri Department of Natural Resources by email regarding the Five-Year Review. Patrick works in the Federal Facilities Section.

Patrick, I am contacting you regarding the upcoming Department of Energy – Weldon Spring Site annual long-term surveillance and maintenance inspection, which is scheduled for December 1-2, 2015. You were copied on the notification letter with the agenda which was dated October 28, 2015. 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.

Also, this inspection will serve as the Weldon Spring Site Fifth Five-Year Review inspection. The purpose of a Five-Year Review is to ensure that the remedy that was implemented to clean up the site continues to protect human health and the environment. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that clean-up actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a Five-Year Review. Community involvement is an integral part of the Five-Year Review process and DOE is soliciting your input or suggestions regarding the Weldon Spring Site and its cleanup. Below are a list of questions provided by Environmental Protection Agency (EPA) guidance for the Five-Year Review that we are requesting that you respond to. The Five-Year Review Report is scheduled to be completed by September 2016. Thanks!

Five-Year Review Questions

1. What is your overall impression of the project (general sentiment)?
2. What effects have the site operations had on the surrounding community?
3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
5. Do you feel well-informed about the site's activities and progress?
6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
7. Any other general comments?

Patrick's responses are below:

1. What is your overall impression of the project (general sentiment)?
-Overall, this project is running well. There are good lines of communication between the stakeholders. However, more frequent interaction between site management and state and federal agencies would allow for the completion of any outstanding issues.

2. What effects have the site operations had on the surrounding community?
-In general, current site operations have had a positive effect on the community. It provides unique educational opportunities to local schools and meeting locations for various clubs and interest groups.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
-As interest in other radiologically contaminated sites in the St. Louis area has increased in the past few years, interest in the Weldon Spring site has also increased. However, no specific community concerns have been raised.

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency response from local authorities? If so, please give details.
-Awareness of vandalism and other activities comes from the open lines of communication between the stakeholders and their use. It is our understanding the majority of issues of vandalism and trespassing at the site stem from juveniles moving around the topmost layer of rocks, leaving behind litter at the top of the disposal cell, or rendering a monitoring well useless. It has been noted by the site managers that an increased use of the interpretive center after hours and use of a private security patrol has increased the level of security, thereby having the effect of also decreasing the episodes of vandalism and trespassing after hours.

5. Do you feel well-informed about the site's activities and progress?
-Yes

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
-Please continue to keep all communication lines open. Communication has been very helpful in understanding and preventing problems. A quarterly conference call between site management and state and federal regulatory agencies may also be helpful to discuss any issues that arise or require additional discussion.

7. Any other general comments?
-None at this time.

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Appendix G

Trend Calculation Example

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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 (2011 through 2015 for the Five-Year Review and the 2015 Annual Report). The trend analysis is conducted using the Mann-Kendall test described in Helsel and Hirsch (2002). The Mann-Kendall test for trends was implemented in a Microsoft Excel subroutine. This simplifies the comparison of trend results with the data used for trending. The Mann-Kendall results were checked using the Mann-Kendall test that is implemented in the Visual Sampling Plan (VSP) software (VSP 2013; Gilbert 1987; Hirsch et al. 1982). The data included in the trending calculations is indicated by a linear regression line fit to that data. The method used to calculate the line was derived from equations in Isaaks and Srivastava, 1989.

The chart below (Figure G-1) shows nitrate concentrations at spring SP-6301. Trends were calculated for two time periods, 2009 through 2013 and 2011 through 2015 (indicated by a linear regression fit for each on the chart) to illustrate the variability of trending results. The uptrend calculated from the 2009-2013 data barely passes the $p<0.05$ test for statistical significance. The 2011-2015 data is too variable (low plus/minus score, Table G-1, S(+-)) to have a statistically significant trend even using the less rigorous (more likely to conclude there is a trend) “1 – tail” test. Table G-1 provides additional data and calculations used in the Mann-Kendall test. On visual inspection of the data, it seems obvious that the long-term trend is down.

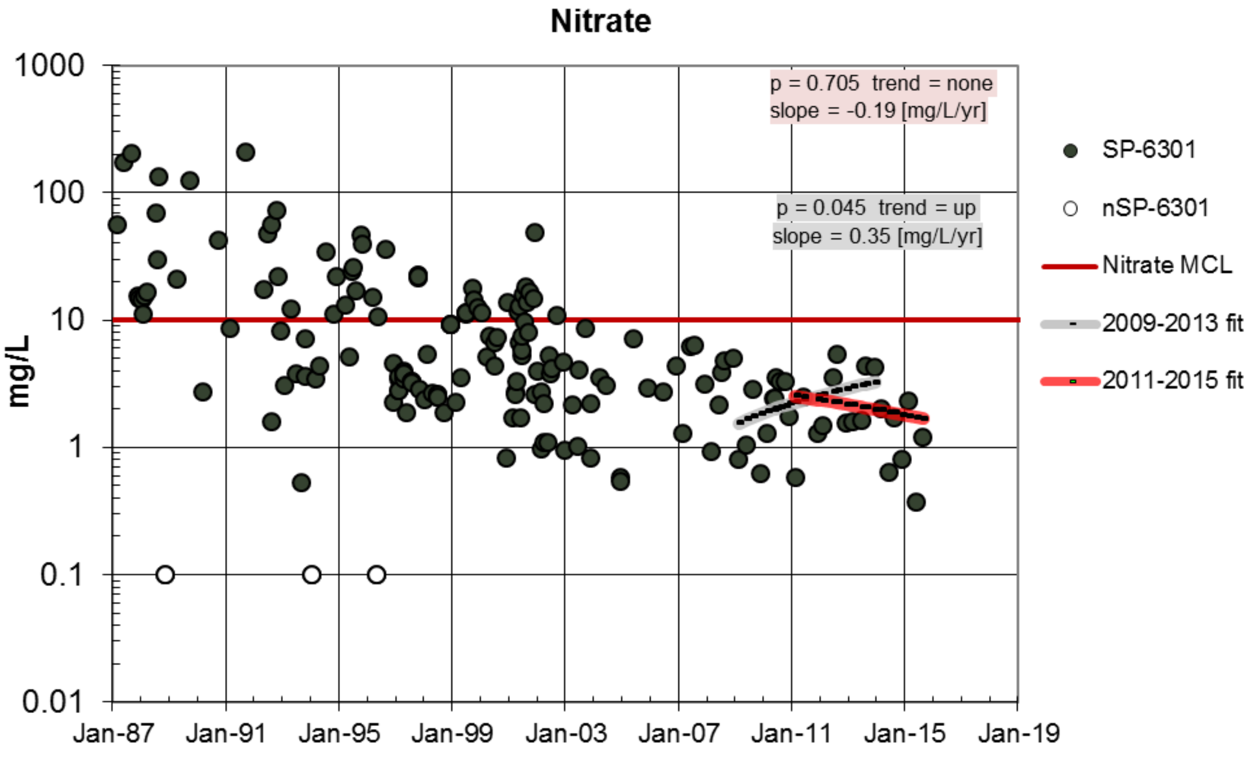


Figure G-1. Nitrate Concentrations with Trending Results for SP-6301

Table G-1. Nitrate Concentrations with Trending Results for SP-6301

well	analyte	units	begin	end	nSamples	avg (mg/L)	stdev	nPairs	S (+−)
SP-6301	Nitrate	mg/L	1/1/2009	1/1/2014	22	2.34	1.33	231	72
SP-6301	Nitrate	mg/L	1/1/2011	1/1/2016	18	2.07	1.44	153	−11

well	Kendalls τ	Z	p (2 tail)	Trend	slope ($mg\ L^{-1}\ yr^{-1}$)	p (1 tail)	Trend	ties
SP-6301	0.312	2.00	**0.045**	**up**	0.35	0.023	up	1
SP-6301	−0.072	0.38	**0.705**	**none**	−0.19	0.352	none	0

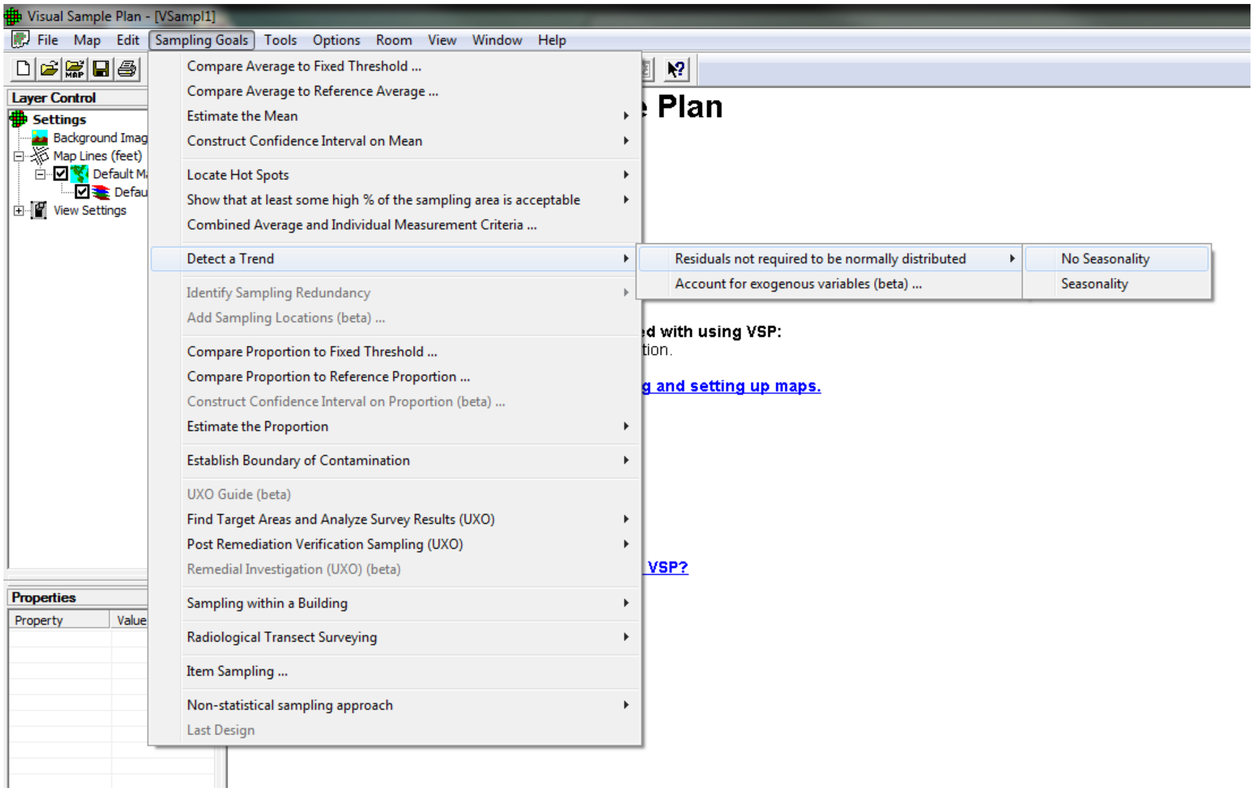
mg/L = milligrams per liter
$mg\ L^{-1}\ yr^{-1}$ = milligrams per liter per year
nSamples = number of sample results used in the Mann-Kendall calculation
avg = average
stdev = standard deviation
nPairs = number of pairs of results compared for either plus (second result greater than first result), minus (second result less than first result) score, or ties (first and second result equal)
S (+−) = total of plus/minus scores

Kendalls τ = S divided by nPairs
Z = z score, a statistical measurement of a scores relationship to the mean in a group of scores
P value = a tool for deciding whether to reject the null hypothesis (no trend), a normalized z-score

Trend Calculation Example Using VSP:

1) Install and open VSP (VSP can be downloaded at http://vsp.pnnl.gov/)

Under **Sampling Goals**, select **Detect a Trend**, then select **No Seasonality**.

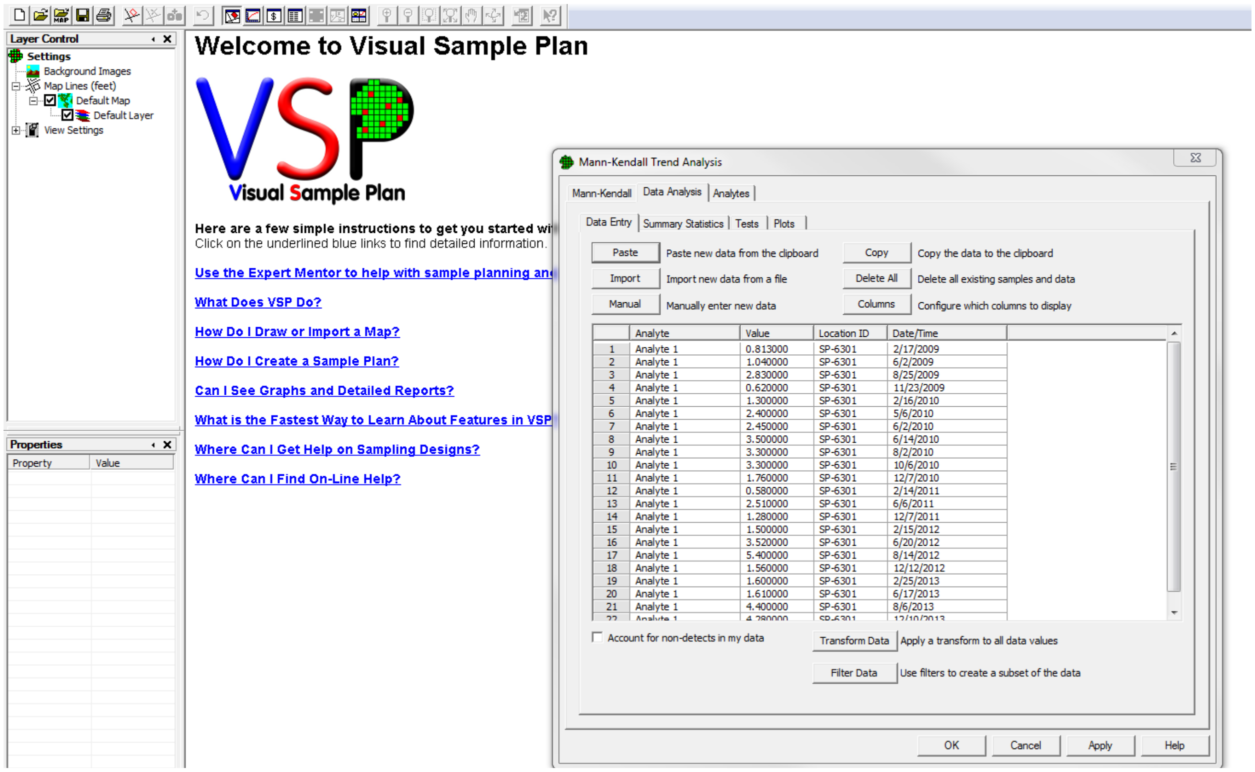


2) Enter data.

Data used for trend calculations is available on the GEMS (Geospatial Environmental Mapping System) system at [http://gems-int.lm.doe.gov] in the Groundwater Quality by Location report.

The example provided 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 (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



	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

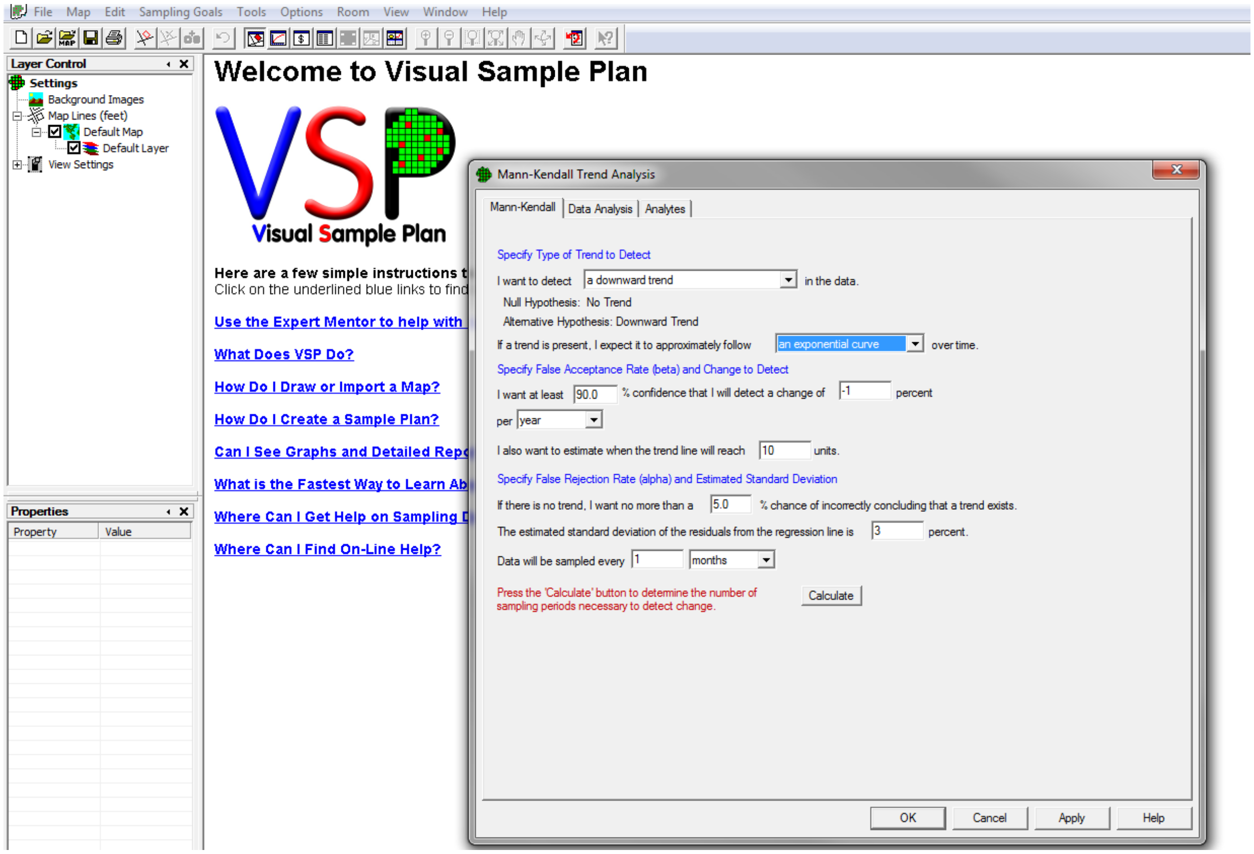
<u>3) Set the parameters under the **Mann-Kendall** tab.</u>

a) The “I want to detect” box allows selecting a downward or upward trend (1-tail test), or either trend (2-tail test).

b) You can calculate an exponential or linear equation to fit the data.

c) Selecting less than 5% chance of an incorrect trend sets the p value at 0.05.

d) Click **Calculate**.



Welcome to Visual Sample Plan

Here are a few simple instructions t
Click on the underlined blue links to find

Use the Expert Mentor to help with

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 Repo

What is the Fastest Way to Learn Ab

Where Can I Get Help on Sampling D

Where Can I Find On-Line Help?

Mann-Kendall Trend Analysis

Specify Type of Trend to Detect

I want to detect a downward trend in the data.

Null Hypothesis: No Trend

Alternative Hypothesis: Downward Trend

If a trend is present, I expect it to approximately follow an exponential curve over time.

Specify False Acceptance Rate (beta) and Change to Detect

I want at least 90.0 % confidence that I will detect a change of -1 percent per year

I also want to estimate when the trend line will reach 10 units.

Specify False Rejection Rate (alpha) and Estimated Standard Deviation

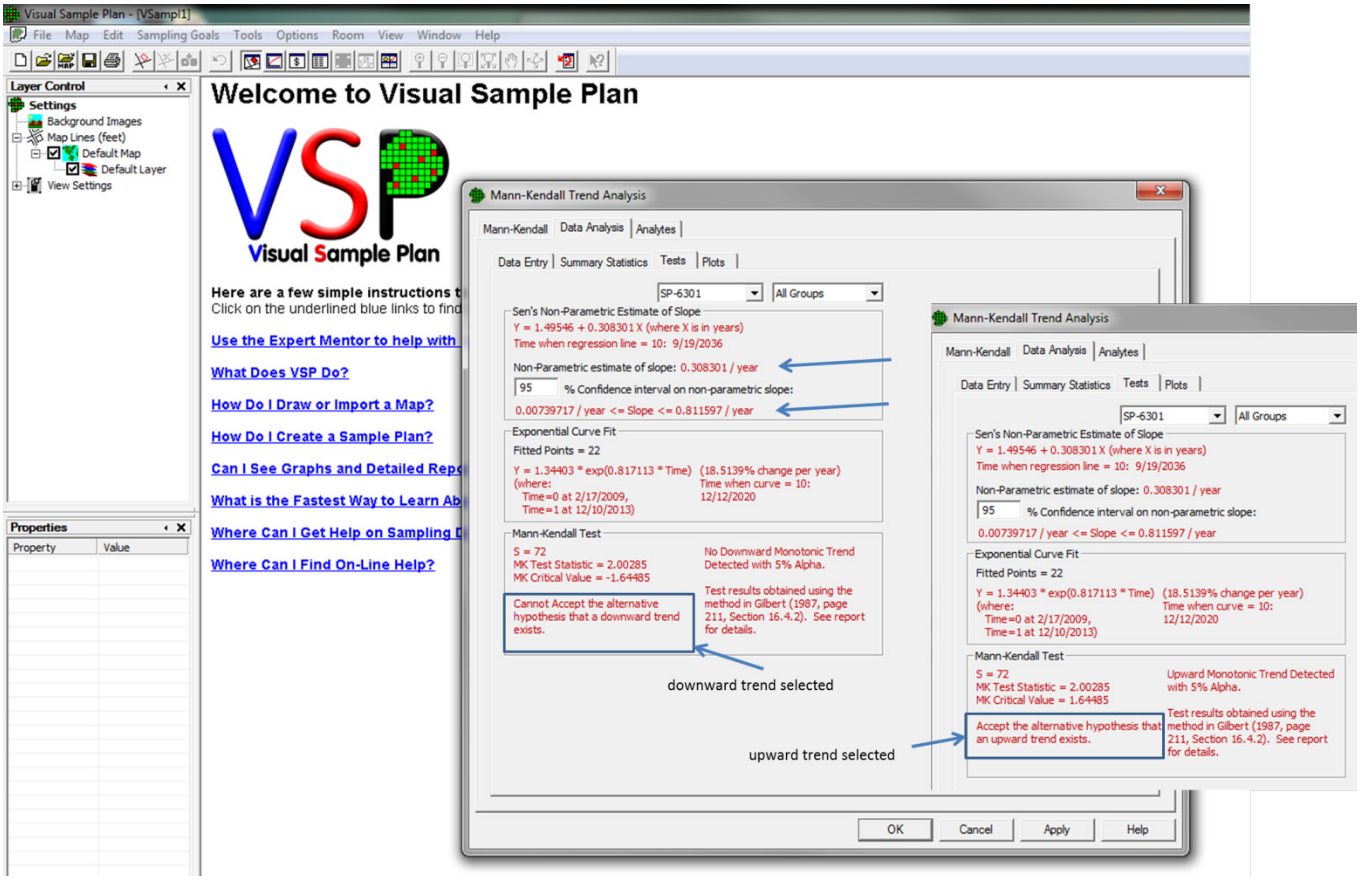
If there is no trend, I want no more than a 5.0 % chance of incorrectly concluding that a trend exists.

The estimated standard deviation of the residuals from the regression line is 3 percent.

Data will be sampled every 1 months

Press the 'Calculate' button to determine the number of sampling periods necessary to detect change.

4) Results are under the **Data Analysis**, **Tests** tab.
Results are shown on the figure.



SP-6301 | All Groups

Sen's Non-Parametric Estimate of Slope
Y = 1.49546 + 0.308301 X (where X is in years)
Time when regression line = 10: 9/19/2036
Non-Parametric estimate of slope: 0.308301 / year
95 % Confidence interval on non-parametric slope:
0.00739717 / year <= Slope <= 0.811597 / year

Exponential Curve Fit
Fitted Points = 22
Y = 1.34403 * exp(0.817113 * Time) (18.5139% change per year)
(where:
Time=0 at 2/17/2009,
Time=1 at 12/10/2013)
Time when curve = 10:
12/12/2020

Mann-Kendall Test
S = 72
MK Test Statistic = 2.00285
MK Critical Value = -1.64485
No Downward Monotonic Trend Detected with 5% Alpha.
Cannot Accept the alternative hypothesis that a downward trend exists.
Test results obtained using the method in Gilbert (1987, page 211, Section 16.4.2). See report for details.

downward trend selected

SP-6301 | All Groups

Sen's Non-Parametric Estimate of Slope
Y = 1.49546 + 0.308301 X (where X is in years)
Time when regression line = 10: 9/19/2036
Non-Parametric estimate of slope: 0.308301 / year
95 % Confidence interval on non-parametric slope:
0.00739717 / year <= Slope <= 0.811597 / year

Exponential Curve Fit
Fitted Points = 22
Y = 1.34403 * exp(0.817113 * Time) (18.5139% change per year)
(where:
Time=0 at 2/17/2009,
Time=1 at 12/10/2013)
Time when curve = 10:
12/12/2020

Mann-Kendall Test
S = 72
MK Test Statistic = 2.00285
MK Critical Value = 1.64485
Upward Monotonic Trend Detected with 5% Alpha.
Accept the alternative hypothesis that an upward trend exists.
Test results obtained using the method in Gilbert (1987, page 211, Section 16.4.2). See report for details.

upward trend selected

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Appendix H

Data Review and Validation Reports for the Weldon Spring Site

U.S. DEPARTMENT OF ENERGY | Legacy Management

Data Review and Validation Report

General Information

Report Number (RIN): 15016705
Sample Event: January 6, 2015
Site(s): Weldon Spring LTS&M
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 364396
Analysis: Metals
Validator: Alison Kuhlman
Review Date: January 22, 2015

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
Uranium	LMM-02	SW-846 3005A	SW-846 6020

Data Qualifier Summary

None of the analytical results required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received three water samples on January 7, 2015, 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 at ambient temperature and in iced coolers at 1.8°C and 1.0°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) 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 SW-846 6020, Uranium

Calibrations were performed on January 17, 2015, 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 MDL.

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.

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. The serial dilution data met the acceptance criteria.

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 22, 2015. 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 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 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.

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.

There were no outliers identified and the data for this RIN are acceptable as qualified.

Report Prepared By: Alison Kuhlman Alison E. Kuhlman 2015.02.05 10:29:13 -07'00'

Alison Kuhlman
Data Validator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15016705 **Lab Code:** GEN **Validator:** Alison Kuhlman **Validation Date:** 1/22/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☐ General Chem ☐ Rad ☐ Organics

# of Samples: 3 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15016705 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 1/22/2015

Duplicate: LW-DC90 **Sample:** LW-DC10

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	39.2			1.00	40.5			1.00	3.26		ug/L

Page 1 of 1

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15016705
Lab Code: GEN
Date Due: 1/21/2015
Matrix: Water
Site Code: WEL01
Date Completed: 1/21/2015

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	01/17/2015			OK	OK	OK	99.5	96.6		2.0	95.7	1.1	98.5

Data Review and Validation Report

General Information

Report Number (RIN): 15127568
Sample Event: December 30, 2015 and January 6, 2016
Site(s): Weldon Spring LTS&M
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 388895
Analysis: Metals and Wet Chemistry
Validator: Samantha Tigar
Review Date: February 8, 2016

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
Uranium	LMM-02	SW-846 3005A	SW-846 6020

Data Qualifier Summary

None of the analytical results required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received four water samples on January 8, 2016, accompanied by a Chain of Custody (COC) form. The receiving documentation included a listing of the shipping air waybill number. 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 shipments were received intact with the temperature inside the iced cooler of 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 metal 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 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 January 15, 2016, using six calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute value 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 SW-846 6020, Uranium

Calibrations were performed on January 14, 2016, 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 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 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 five times the blank concentration.

Inductively Coupled Plasma Interference Check Sample 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.

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 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. 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.

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 February 5, 2016. 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

Daily calibration checks were performed as required with acceptable results.

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 SP-6301. The duplicate results met the criteria, demonstrating acceptable overall 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. 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 potential outliers identified, and the data for this RIN are acceptable as qualified.

Samantha Tigar

Samantha M. Tigar
2016.02.09
08:22:58 -07'00'

Report Prepared By: ____
Samantha Tigar
Data Validator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15127568 **Lab Code:** GEN **Validator:** Samantha Tigar **Validation Date:** 2/8/2016

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☐ Rad ☐ Organics

# of Samples: 4 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15127568 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 2/8/2016

Duplicate: SP-6311 **Sample:** SP-6301

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
NO2+NO3 as N	0.587			1.00	0.576			1.00	1.89		mg/L
Uranium	5.14			1.00	5.32			1.00	3.44		ug/L

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15127568 **Lab Code:** GEN **Date Due:** 2/5/2016

Matrix: Water **Site Code:** WEL01 **Date Completed:** 2/5/2016

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
NO2+NO3 as N	01/15/2016	0.000	1.0000	OK	OK	OK	107.00	96.3		0.68	

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15127568　**Lab Code:** GEN　**Date Due:** 2/5/2016

Matrix: Water　**Site Code:** WEL01　**Date Completed:** 2/5/2016

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Uranium	ICP/MS	01/14/2016			OK	OK	OK	102.0	105.0		3.4	98.4	3.6	126.5

Data Review and Validation Report

General Information

Report Number (RIN):	15117512
Sample Event:	December 7–9, 2015
Site(s):	Weldon Spring
Laboratory:	TestAmerica, Denver, Colorado
Work Order No.:	280-77814-1
Analysis:	Organics
Validator:	Stephen Donivan
Review Date:	January 15, 2016

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
280-77814-3	MW-2033	2,4-Dinitrotoluene	J	Peak resolution
280-77814-4	MW-2046	2,6-Dinitrotoluene	J	Peak resolution
280-77814-5	MW-2047	2,4-Dinitrotoluene	J	Peak resolution

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received nine water samples on December 10, 2015, 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 of 0.1 °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 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 17, 2015, 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.

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.

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 nitroaromatics surrogate recoveries were within the acceptance ranges.

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 4 times the spike concentration. All matrix spike recoveries were within the acceptance range.

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 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.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics 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 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 December 23, 2015. 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 potential outliers identified and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2005

Laboratory: TestAmerica Denver
RIN: 15117512
Report Date: 01/15/2016

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-2046	N001	12/07/2015	1,3,5-Trinitrobenzene	1.10			3.60		FQ	1.20		FQ	21	0	NA
WEL01	MW-2051	N001	12/08/2015	2,4,6-Trinitrotoluene	0.0490	J		0.190		FQJ	0.0560	J	F	24	4	NA
WEL01	MW-2051	N001	12/08/2015	2,4-Dinitrotoluene	0.0440	J		0.130	P X	FJ	0.0480	J	F	24	5	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.

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-2033, MW-2046, MW-2047, and MW-2055 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 SP-6301. There were no analytes detected in the sample or duplicate.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Stephen Donivan

Stephen E. Donivan
2016.01.15 10:49:26
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Report Prepared By: ____
Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15117512 **Lab Code:** STD **Validator:** Stephen Donivan **Validation Date:** 01/15/2016

Project: Weldon Spring LTS&M **Analysis Type:** ☐ Metals ☐ General Chem ☐ Rad ☑ Organics

# of Samples: 9 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15117512 **Lab Code:** STD **Project:** Weldon Spring LTS&M **Validation Date:** 01/15/2016

Duplicate: SP-6331 **Sample:** SP-6301

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
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	J		1	0.021	U		1			ug/L
Nitrobenzene	0.032	U		1	0.032	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 15117512 **Project:** Weldon Spring LTS&M **Lab Code:** STD **Validation Date:** 01/15/2016

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): 15117509
Sample Event: November 23 and December 7–9, 2015
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 387213
Analysis: Metals, Organics, Radiochemistry, and Wet Chemistry
Validator: Stephen Donivan
Review Date: February 9, 2016

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
Metals: As, Ba, Co, Cr, Fe, Mn, Ni, Pb, Se, Tl, U	LMM-02	SW-846 3005A	SW-846 6020
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, TDS	WCH-A-033	SM 2540C	SM 2540C
PAH Compounds	LMS-02	SW-846 3510C	SW-846 8310
PCBs	PEP-A-006	SW-846 3535A	SW-846 8082
Volatiles (VOAs)	LMV-06	SW-846 8260B	SW-846 8260B
Anions: Cl, F, SO4	MIS-A-045	EPA 300.0	EPA 300.0
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Total Organic Carbon, TOC	WCH-B-025	SM 5310D	SM 5310D

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
387213002	MW-2051	Radium-228	J	Less than the Determination Limit
387213003	LW-DC10	Manganese	J	Field duplicate result
387213003	LW-DC10	NO3/NO2-N	J	Field duplicate result
387213003	LW-DC10	Radium-226	J	Less than the Determination Limit
387213003	LW-DC10	Radium-228	U	Less than the Decision Level Concentration
387213003	LW-DC10	Thallium	U	Less than 5 times the calibration blank
387213006	MW-2047	Radium-226	J	Less than the Determination Limit
387213006	MW-2047	Radium-228	J	Less than the Determination Limit
387213008	MW-2046	Thallium	U	Less than 5 times the calibration blank
387213009	LW-DC10 Duplicate	Manganese	J	Field duplicate result
387213009	LW-DC10 Duplicate	NO3/NO2-N	J	Field duplicate result
387213009	LW-DC10 Duplicate	Radium-226	J	Less than the Determination Limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 14 water samples on December 10, 2015 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

One of the six sample coolers was missing from the original sample shipment, the missing cooler was received the following day. The sample shipments were received with the temperatures inside the iced cooler of 2.3 °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 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 November 9, 2015. 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 15, 2015, 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 five calibration standards on December14, 2015. 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 2540C, 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 four calibration standards on October 9, 2015, 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 December 14, 2015, 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 5, 2015. 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.

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 November 16, 2015, using eight 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.

Method SW-846 8310, PAH Compounds
The initial calibration for PAHs was performed using eight calibration standards on December 8, 2015. 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 April 6, 2015. The daily calibration checks performed on December 29, 2015 met the acceptance criteria.

Radium-228
Plateau voltage determinations and detector efficiency calibrations were performed more than one year previous to the sample analysis and verified on November 2, 2015. Daily instrument checks performed on December 28, 2015 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 nitrate/nitrite-N spike recovery was above the laboratory acceptance range but within the validation acceptance range, not rquiring qualification.

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 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 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 7, 2016. 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.

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-2033, and MW-2055 were further qualified with a “Q” flag in the database indicating the data are considered qualitative because these are Category II or III wells.

Trip Blank

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 target compounds detected in this 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 SP-6301. 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. The manganese and nitrate/nitrite-N duplicate results for location LW-DC10 did not meet the acceptance criteria. The associated sample and duplicate 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.

There were no laboratory results were identified as potential outliers. And the data from this event are acceptable as qualified.

Stephen Donivan

Stephen E. Donivan
2016.02.10
08:30:10 -07'00'

Report Prepared By: ____
Stephen Donivan
Laboratory Coordinator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2006

Laboratory: GEL Laboratories

RIN: 15117509

Report Date: 02/08/2016

					Current	*Qualifiers*		**Historical Maximum**	*Qualifiers*		**Historical Minimum**	*Qualifiers*		**Number of Data Points**		**Statistical Outlier**
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	LW-DC10	N004	12/08/2015	Iron	0.0562	B		21.2			0.0878	B		29	0	No
WEL01	LW-DC10	N003	12/08/2015	Iron	0.0345	B		21.2			0.0878	B		29	0	No
WEL01	MW-2047	N003	12/07/2015	Nitrate + Nitrite as Nitrogen	105			89.8		FQ	77.0		FQ	5	0	No
WEL01	MW-2047	N003	12/07/2015	Thorium-230	-0.0812	U		0.705	U	FQ	0.150	J	FQJ	19	13	No
WEL01	MW-2051	N003	12/08/2015	Nickel	0.00323	B		0.00928	B	F	0.00420	B	F	21	3	NA
WEL01	MW-2051	N003	12/08/2015	Radium-226	2.04			1.60		JF	0.180	J	F	21	8	No
WEL01	MW-2051	N003	12/08/2015	Uranium	0.00162			0.00230	B	FJ	0.00165		F	21	1	No
WEL01	MW-2055	N003	12/09/2015	Arsenic	0.00388	B		0.00283	B	FQ	0.00052	U	FQ	19	18	NA
WEL01	MW-2055	N003	12/09/2015	Cobalt	0.0001	U		0.00500	U	FQ	0.000199	B	FQ	19	6	NA
WEL01	MW-2055	N003	12/09/2015	Manganese	0.001	U		0.0169	E	FQ	0.00122	BE	FQ	19	3	No
WEL01	SP-6301	N003	12/08/2015	Cobalt	0.0001	U		0.00500	U		0.000136	B		24	10	NA
WEL01	SP-6301	N003	12/08/2015	Nickel	0.00113	B		0.0245	E		0.00134	B		24	7	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: 15117509 **Lab Code:** GEN **Validator:** Stephen Donivan **Validation Date:** 02/08/2016

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☑ Rad ☑ Organics

# of Samples: 14 **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	There was 1 trip/equipment blank evaluated.
☑ Field Duplicates	There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15117509 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 02/08/2016

Duplicate: LW-DD10 **Sample:** LW-DC10

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
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	3.47	B		1.00	3.51	B		1.00			ug/L
Barium	533			1.00	473			1.00	11.93		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	28.2			1.00	30.9			1.00			mg/L
Chloride	45.9			10.00	46.0			10.00	0.22		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	0.428	B		1.00	0.417	B		1.00			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	0.239	J		1.00	0.264	J		1.00	9.94		mg/L
Indeno(1,2,3-cd)pyrene	0.016	U		1.00	0.016	U		1.00			ug/L
Iron	34.5	B		1.00	56.2	B		1.00			ug/L
Lead	0.500	U		1.00	0.500	U		1.00			ug/L
Manganese	357			1.00	287			1.00	21.74		ug/L
Naphthalene	0.150	U		1.00	0.150	U		1.00			ug/L
Nickel	4.72	B		1.00	4.21	B		1.00	11.42		ug/L
NO2+NO3 as N	2.69			5.00	3.34			5.00	21.56		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	0.734		0.379	1.00	1.12		0.448	1.00		1.3	pCi/L
Radium-228	0.654		0.432	1.00	0.413	U	0.367	1.00		0.8	pCi/L
Selenium	1.91	B		1.00	1.50	U		1.00			ug/L
Sulfate	90.9			10.00	95.5			10.00	4.94		mg/L
Thallium	0.631	B		1.00	0.450	U		1.00			ug/L

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15117509 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 02/08/2016

Duplicate: LW-DD10 **Sample:** LW-DC10

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Thorium-228	0.0926	U	0.258	1.00	0.0902	U	0.352	1.00		0	pCi/L
Thorium-230	-0.135	U	0.299	1.00	0.308	U	0.473	1.00		1.6	pCi/L
Thorium-232	0.0464	U	0.204	1.00	0.0549	U	0.236	1.00		0.1	pCi/L
Total Dissolved Solids	809			1.00	779			1.00	3.78		mg/L
Total Organic Carbon	11.1			1.00	10.9			1.00	1.82		mg/L
Uranium	34.5			1.00	37.3			1.00	7.80		ug/L

Duplicate: SP-6381 **Sample:** SP-6301

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
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
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
Vinyl Chloride	0.300	U		1.00	0.300	U		1.00			ug/L

SAMPLE MANAGEMENT SYSTEM

Non-Compliance Report: Method Blanks

RIN: 15117509 **Lab Code:** GEN

Project: Weldon Spring LTS&M

Validation Date: 02/08/2016

Method Blank	Date Analyzed	Method	Analyte	Result	Flag(s)	MDL
1203451767	12/11/2015	EPA 8260B	Tetrachloroethene	0.34	J	0.30
1203459573	12/31/2015	EPA 3535A/8082	Aroclor 1260	0.04	J	0.03

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15117509 **Lab Code:** GEN **Date Due:** 01/07/2016

Matrix: Water **Site Code:** WEL01 **Date Completed:** 01/07/2016

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	12/15/2015			OK	OK	OK	104.0	102.0			100.0		100.0
Barium	ICP/MS	12/14/2015			OK	OK	OK	102.0	107.0		2.0	105.0	3.7	97.0
Chromium	ICP/MS	12/14/2015			OK	OK	OK	103.0	98.1			96.0		101.0
Cobalt	ICP/MS	12/14/2015			OK	OK	OK	101.0	96.5			91.0		100.0
Iron	ICP/MS	12/14/2015			OK	OK	OK	99.8	96.3			94.0		106.0
Lead	ICP/MS	12/14/2015			OK	OK	OK	103.0	97.7			107.0		105.0
Manganese	ICP/MS	12/14/2015			OK	OK	OK	101.0	102.0		1.0	107.0	1.8	105.0
Nickel	ICP/MS	12/14/2015			OK	OK	OK	106.0	94.5		0.0	92.0		101.0
Selenium	ICP/MS	12/15/2015			OK	OK	OK	104.0	102.0			102.0		114.0
Thallium	ICP/MS	12/14/2015			OK	OK	OK	101.0	94.7			100.0		84.0
Uranium	ICP/MS	12/14/2015			OK	OK	OK	101.0	101.0		0.0	107.0	0.3	103.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15117509 **Lab Code:** GEN **Date Due:** 01/07/2016

Matrix: Water **Site Code:** WEL01 **Date Completed:** 01/07/2016

Analyte	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB	Blank					
Chemical Oxygen Demand	12/14/2015	0.000	0.9996	OK	OK	OK	102.00	105.0		9.00	
Chloride	12/11/2015	0.000	0.9996	OK	OK	OK	97.10				
Chloride	12/14/2015							104.0		0	
Fluoride	12/11/2015	0.000	0.9993	OK	OK	OK	99.20	94.3		3.00	
NO2+NO3 as N	12/15/2015	0.000	0.9999	OK	OK	OK	99.80	112.0		0	
NO2+NO3 as N	12/15/2015							109.0		5.00	
Sulfate	12/11/2015	0.000	0.9996	OK	OK	OK	100.00				
Sulfate	12/14/2015							103.0		0	
Total Dissolved Solids	12/14/2015					OK	100.00			0	
Total Organic Carbon	12/18/2015	0.000	0.9996	OK	OK	OK	97.50	86.4		2.00	

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15117509 **Lab Code:** GEN **Date Due:** 01/07/2016

Matrix: Water **Site Code:** WEL01 **Date Completed:** 01/07/2016

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
LW-DC10	Radium-226	12/29/2015						0.50
Blank	Radium-226	12/29/2015	0.1920	U				
LW-DC10	Radium-226	12/29/2015					89.7	
Blank_Spike	Radium-226	12/29/2015				86.70		
LW-DC10	Radium-228	12/28/2015			79.0			
LW-DD10	Radium-228	12/28/2015			84.0			
MW-2032	Radium-228	12/28/2015			90.0			
MW-2046	Radium-228	12/28/2015			86.0			
MW-2047	Radium-228	12/28/2015			70.0			
MW-2051	Radium-228	12/28/2015			86.0			
MW-2055	Radium-228	12/28/2015			98.0			
SP-6301	Radium-228	12/28/2015			91.0			
LW-DC10	Radium-228	12/28/2015			75.0			2.76
Blank_Spike	Radium-228	12/28/2015			90.0	86.30		
Blank	Radium-228	12/28/2015	0.1140	U	104.0			
LW-DC10	Thorium-228	12/28/2015			77.0			
LW-DD10	Thorium-228	12/28/2015			68.0			
MW-2032	Thorium-228	12/28/2015			79.0			
MW-2046	Thorium-228	12/28/2015			69.0			
MW-2047	Thorium-228	12/28/2015			78.0			
MW-2051	Thorium-228	12/28/2015			88.0			
MW-2055	Thorium-228	12/28/2015			86.0			
SP-6301	Thorium-228	12/28/2015			75.0			
LW-DC10	Thorium-228	12/28/2015			76.0			0.42
Blank	Thorium-228	12/28/2015	-0.0300	U	85.0			
LW-DC10	Thorium-230	12/28/2015						0.87
Blank_Spike	Thorium-230	12/28/2015				97.20		
Blank	Thorium-230	12/28/2015	0.1710	U				
LW-DC10	Thorium-232	12/28/2015						0.55
Blank	Thorium-232	12/28/2015	0.0270	U				

U.S. DEPARTMENT OF ENERGY | Legacy Management

Data Review and Validation Report

General Information

Report Number (RIN):	15117481
Sample Event:	November 9 - 10, 2015
Site(s):	Weldon Spring LTS&M
Laboratory:	GEL Laboratories, Charleston, South Carolina
Work Order No.:	385704 and 385711
Analysis:	Metals and Wet Chemistry
Validator:	Samantha Tigar
Review Date:	December 23, 2015

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

None of the analytical results required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 37 water samples on November 17, 2015, accompanied by Chain of Custody (COC) forms. The COC forms were 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 forms were 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 at 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 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

Calibrations were performed on November 9, 2015, using five 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 PQL and all results were within the acceptance range.

Method SW-846 6010B, Iron

Calibrations were performed on November 24, 2015, 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. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium
Calibrations were performed on December 3 and 10, 2015, 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 four times the spike or when the sample is prepared from diluted samples. The spike recoveries met the acceptance 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 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 December 15, 2015. 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.

Sampling Protocol

Sampling at all monitoring wells met the Category I or II 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 groundwater sample results for wells MW-1008, MW-1009, MW-1028, MW-1031, MW-1046, MW-1047, MW-1051, and MW-1052 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 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. Duplicate samples were collected from locations MW-1015 and SW-1004. The duplicate results met the criteria, demonstrating acceptable overall 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. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

Two potentially anomalous results were identified. Review of these data did not identify any laboratory errors and the data from this event are acceptable as qualified.

Samantha Tigar

Samantha M. Tigar
2016.01.13 08:48:04
-07'00'

Report Prepared By: ______________________________

Samantha Tigar
Data Validator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2001

Laboratory:

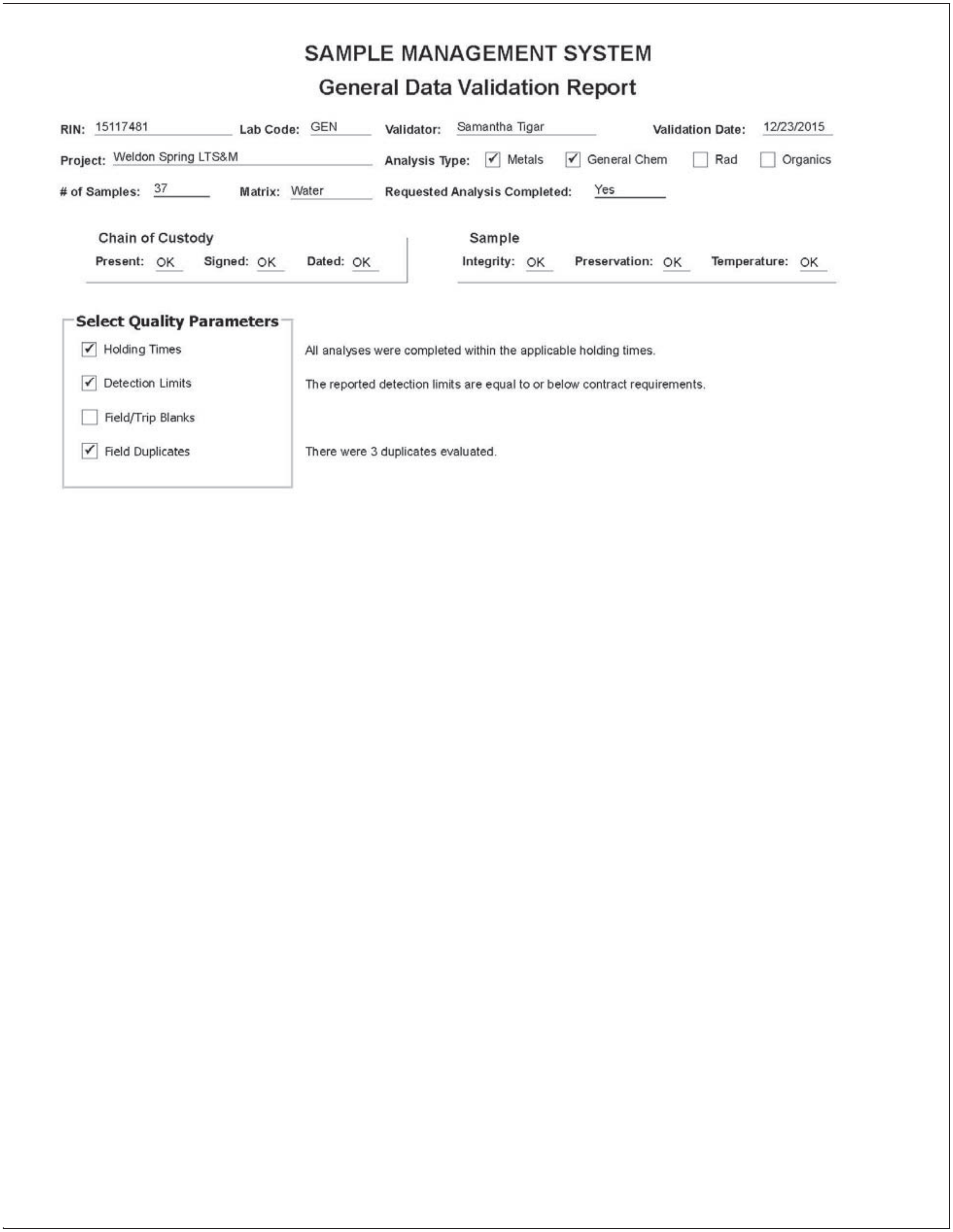
RIN: 15117481

Report Date: 12/23/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL02	MW-1007	0001	11/09/2015	Iron	74.8			70.0		F	18.0		F	50	0	Yes
WEL02	MW-1018	N001	11/10/2015	Sulfate	26.8			25.5		F	0.0600	B	FJ	41	0	Yes
WEL02	MW-1048	0001	11/10/2015	Iron	2.06			1.91		F	0.383		F	58	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: 15117481 **Lab Code:** GEN **Validator:** Samantha Tigar **Validation Date:** 12/23/2015

Project: Weldon Spring LTS&M **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	All analyses were completed within the applicable holding times.
☑ Detection Limits	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15117481 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 12/23/2015

Duplicate: MW-1115 **Sample:** MW-1015

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Iron	30.0	U		1.00	30.0	U		1.00			ug/L
Sulfate	71.8			20.00	70.1			20.00	2.40		mg/L
Uranium	139			5.00	147			5.00	5.59		ug/L

Duplicate: SW-1104 **Sample:** SW-1004

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Sulfate	30.0			20.00	30.2			20.00	0.66		mg/L
Uranium	28.1			1.00	28.9			1.00	2.81		ug/L

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15117481 **Lab Code:** GEN **Date Due:** 12/15/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 12/15/2015

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Iron	ICP/ES	11/24/2015	0.0000	1.0000	OK	OK	OK	103.0	105.0			94.7		101.7
Uranium	ICP/MS	12/03/2015			OK	OK	OK	99.9	99.5		0.9	100.0	3.1	120.5
Uranium	ICP/MS	12/10/2015			OK	OK	OK	106.0	114.0		1.7	100.0	1.8	104.5

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15117481 **Lab Code:** GEN **Date Due:** 12/15/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 12/15/2015

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Sulfate	11/17/2015	0.000	1.0000	OK	OK	OK	98.10	101.0		0.03	
Sulfate	11/17/2015	0.000	1.0000	OK	OK	OK	95.80	99.0		0.29	
Sulfate	11/18/2015							96.9		0.91	

Data Review and Validation Report

General Information

Report Number (RIN):	15107455
Sample Event:	November 2-4, 2015
Site(s):	Weldon Spring
Laboratory:	TestAmerica, Denver, Colorado
Work Order No.:	280-76434-1
Analysis:	Metals, Organics, and Wet Chemistry
Validator:	Gretchen Baer
Review Date:	January 22, 2016

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
280-76434-2	MW-1006	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-8	MW-1049	Uranium	U	Less than 5 times the calibration blank
280-76434-11	MW-2012	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-11	MW-2012	2,6-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-12	MW-2014	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-13	MW-2038	2,6-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-15	MW-2050	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-16	MW-2052	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-18	MW-2054	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-76434-20	MW-3034	2,4-Dinitrotoluene	J	Chromatographic peak resolution

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 26 water samples on November 5, 2015, 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 0.9 °C, 2.0 °C, and 3.4 °C, which complies with requirements. The sample submitted for MW-1045 for nitroaromatics analysis was received partially frozen. This condition did not impact the requested analysis and no qualification is required. 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.

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 November 11, 2015. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method EPA 353.2, Nitrate + Nitrite as N
Calibrations were performed on November 10, 2015, using eight calibration standards. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method SW-846 6010B, Iron
Calibrations were performed on November 19, 2015, 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 PQL. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium
Calibrations were performed on November 11, 2015, 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 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 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 October 21 and November 4, 2015, using seven 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. A target compounds 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 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 November 27, 2015, 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.

Metals and Wet Chemistry
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.

Organics
The method blank results were below the MDL for all target compounds.

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.

Nitroaromatics and Volatile Organics 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 one exception. A surrogate recovery for the trip blank was slightly above the acceptance limit. All associated sample results were below detection limits, so no further data qualification is necessary.

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 4 times the spike. The spike recoveries met the acceptance 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 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.

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 December 11, 2015. 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 potential outliers identified and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2008

Laboratory: TestAmerica Denver
RIN: 15107455
Report Date: 1/22/2016

					Current	*Qualifiers*		**Historical Maximum**	*Qualifiers*		**Historical Minimum**	*Qualifiers*		**Number of Data Points**		**Statistical Outlier**
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-2050	N001	11/02/2015	2,6-Dinitrotoluene	16.0			55.0		F	22.0		FQ	15	0	No
WEL01	MW-3030	N001	11/03/2015	trans-1,2-Dichloroethene	0.360	J		0.870	J	F	0.430	J	F	13	0	No
WEL01	MW-3030	N001	11/03/2015	Uranium	0.0350			0.0857	NE	FJ	0.0360		F	38	0	NA
WEL01	MW-3039	N001	11/04/2015	2,6-Dinitrotoluene	0.0710	J		0.120	*	FJ	0.0730	J	F	15	2	No
WEL01	MW-4029	N001	11/03/2015	trans-1,2-Dichloroethene	0.250	J		0.450	J	F	0.270	J	F	17	5	No
WEL01	MW-4029	N002	11/03/2015	trans-1,2-Dichloroethene	0.240	J		0.450	J	F	0.270	J	F	17	5	No
WEL01	MW-4043	N001	11/03/2015	Uranium	0.0870			0.140		QF	0.0930	E	FQ	38	0	NA
WEL02	MW-1032	N001	11/02/2015	Uranium	0.420			2.69		FQ	0.480		FQ	31	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.

Sampling Protocol

Sample results for all monitoring wells were qualified with an “F” flag, indicating the wells were purged and sampled using the low-flow method.

At all monitoring well locations, purging and sampling met the Category I criteria, with the following exceptions: wells MW-1032, MW-2014, MW-2040, MW-2050, MW-4039, and MW-4043 were classified as Category II because they produced water at a rate less than the minimum low-flow purging rate. The sample results for these wells were qualified with a “Q” flag (qualitative), indicating the samples were not collected under the optimal conditions of the Category I stability criteria. The pre-sampling purge criteria were met for all wells, with the exception of the water level at MW-1045 (which was identified as Category I). The water level drop slightly exceeded acceptance criteria while being purged at a rate of 100 milliters per minute. The results for this well are also qualified with a “Q” flag.

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 locations MW-1006 and MW-4029. 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.

Trip Blank

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 target compounds detected in this blank.

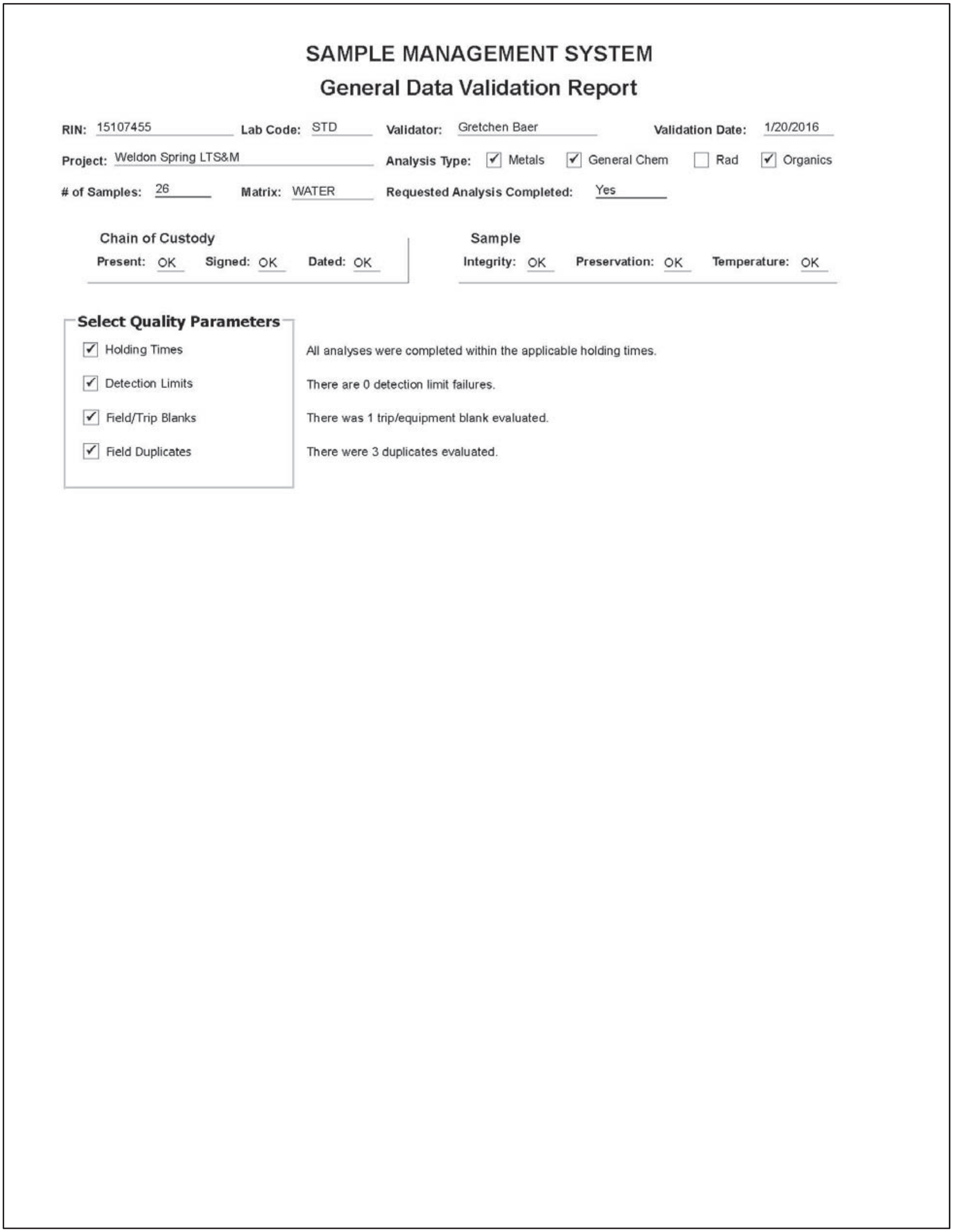
Field Measurements

Daily calibration checks were performed as required with acceptable results.

Gretchen Baer
2016.01.22 11:39:50 -07'00'

Report Prepared By: ______________________________

Gretchen Baer
Data Validator



SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15107455 **Lab Code:** STD **Validator:** Gretchen Baer **Validation Date:** 1/20/2016

Project: Weldon Spring LTS&M **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	All analyses were completed within the applicable holding times.
☑ Detection Limits	There are 0 detection limit failures.
☑ Field/Trip Blanks	There was 1 trip/equipment blank evaluated.
☑ Field Duplicates	There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15107455 **Lab Code:** STD **Project:** Weldon Spring LTS&M **Validation Date:** 1/20/2016

Duplicate: MW-1106 **Sample:** MW-1006

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
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	J		1	0.019	U		1			ug/L
2,6-Dinitrotoluene	0.065	J		1	0.042	J		1			ug/L
Iron	1900			1	1800			1	5.41		ug/L
Nitrobenzene	0.033	U		1	0.033	U		1			ug/L
Sulfate	82			1	83			1	1.21		mg/L
Uranium	1200			1	1200			1	0		ug/L

Duplicate: MW-4129 **Sample:** MW-4029

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
1,2-Dichloroethane	0.13	U		1	0.13	U		1			ug/L
cis-1,2-Dichloroethene	2.8			1	2.6			1	7.41		ug/L
Nitrate+Nitrite as N	400			100	390			50	2.53		mg/L
Tetrachloroethene	0.40	J		1	0.41	J		1			ug/L
trans-1,2-Dichloroethene	0.25	J		1	0.24	J		1			ug/L
Trichloroethene	330			1	330			1	0		ug/L
Vinyl Chloride	0.10	U		1	0.10	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 15107455 **Project:** Weldon Spring LTS&M **Lab Code:** STD **Validation Date:** 1/20/2016

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: 15107455 **Lab Code:** STD

Project: Weldon Spring LTS&M

Validation Date: 1/20/2016

Ticket	Location	Lab Sample ID	Method	Dilution	Surrogate	Recovery	Lower Limit	Upper Limit
NLW 909	MW-4229	280-76434-26	8260B	1	Dibromofluoromethane	121.0	77.0	120.0

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15107455　**Lab Code:** STD　**Date Due:** 12/3/2015

Matrix: Water　**Site Code:** WEL01　**Date Completed:** 12/4/2015

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	11/19/2015	0.0000	1.0000	OK	OK	OK	101.0	97.0	101.0	1.0	92.0	8.6	79.0
Uranium	ICP/MS	11/12/2015	0.0000	1.0000	OK	OK	OK	94.0			3.0	98.0	2.4	87.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15107455 **Lab Code:** STD **Date Due:** 12/3/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 12/4/2015

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	11/10/2015	-0.010	1.0000	OK	OK	OK	105	91	96	3	
Sulfate	11/16/2015	0.048	0.9970	OK	OK	OK	96				
Sulfate	11/17/2015					OK	101				
Sulfate	11/18/2015							102	104	0	

Data Review and Validation Report

General Information

Report Number (RIN): 15107444
Sample Event: October 22 - 29, 2015
Site(s): Weldon Spring LTS&M
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 384455
Analysis: Metals and Wet Chemistry
Validator: Samantha Tigar
Review Date: December 14, 2015

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
Uranium	LMM-02	SW-846 3005A	SW-846 6020

Data Qualifier Summary

None of the analytical results required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 28 water samples on October 30, 2015, accompanied by a Chain of Custody (COC) form. The receiving documentation included a listing of the shipping air waybill number. 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 shipments were received intact with the temperature inside the iced cooler of 1.1 °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 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 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 November 12, 2105, using six calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute value 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 SW-846 6020, Uranium
Calibrations were performed on November 12 and 13, 2015, 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 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 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 five times the blank concentration.

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.

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 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 PQL should be less than 20 percent. 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 serial dilutions were performed on samples with concentrations less than 50 times the MDL, no data were evaluated.

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 1, 2015. 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.

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 MWD-2, MWS-1, MWS-2, MW-2021, MW-2022, MW-2023, MW-2056, MW-3003, MW-3006, MW-3024, MW-3026, MW-3037, MW-3040, MW-4007, MW-4011, and MW-4040 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 MWS-4 and MW-4036. The duplicate results met the criteria, demonstrating acceptable overall 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. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

A potential outlier was identified at location SP-6201 for Nitrate + Nitrite as N. The location had a historic low for uranium which supports a high Nitrate + Nitrite as N result. Also, when compared to a similar location (SP-6301), the result falls into the overarching data cluster. This data point is a probable representation of a true extreme value.

Samantha Tigar

Samantha M. Tigar
2015.12.29
09:21:06 -07'00'

Report Prepared By: ____
Samantha Tigar
Data Validator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2010

Laboratory: GEL Laboratories
RIN: 15107444
Report Date: 12/15/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-3026	N001	10/26/2015	Uranium	0.0973			0.0870		FQ	0.0544	E	FQJ	10	0	No
WEL01	MW-3040	N001	10/28/2015	Nitrate + Nitrite as Nitrogen	55.9			130		FQ	59.0		FQ	17	0	No
WEL01	MW-4031	N001	10/28/2015	Nitrate + Nitrite as Nitrogen	137			220		F	148		F	11	0	NA
WEL01	MWD-2	N001	10/27/2015	Uranium	0.000202			0.00036		F	0.000228		FQ	24	2	No
WEL01	SP-6201	N001	10/28/2015	Nitrate + Nitrite as Nitrogen	8.41			0.750			0.01000	U		11	3	Yes
WEL01	SP-6201	N001	10/28/2015	Uranium	0.00113			0.0335			0.00333			30	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: 15107444 **Lab Code:** GEN **Validator:** Samantha Tigar **Validation Date:** 12/14/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☐ Rad ☐ Organics

# of Samples: 28 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15107444 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 12/14/2015

Duplicate: MW-4136 **Sample:** MW-4036

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
NO2+NO3 as N	32.8			100.00	32.8			50.00	0		mg/L
Uranium	6.03			1.00	6.27			1.00	3.90		ug/L

Duplicate: MWX-4 **Sample:** MWS-4

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	0.548			1.00	0.544			1.00	N/A		ug/L

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15107444 **Lab Code:** GEN **Date Due:** 11/27/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 12/1/2015

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	11/12/2015			OK	OK	OK	107.0	106.0			109.0		99.5
Uranium	ICP/MS	11/13/2015			OK	OK	OK	102.0	104.0			107.0		107.5

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15107444 **Lab Code:** GEN **Date Due:** 11/27/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 12/1/2015

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
NO2+NO3 as N	11/12/2015	0.000	1.0000	OK	OK	OK	101.00	99.7			
NO2+NO3 as N	11/12/2015			OK	OK	OK	104.00	102.0			

Data Review and Validation Report

General Information

Report Number (RIN): 15097402
Sample Event: October 6, 2015
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 382721
Analysis: Metals, Organics, Radiochemistry, and Wet Chemistry
Validator: Stephen Donivan
Review Date: January 15, 2016

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 2, Data Verification. 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
Ammonia-N	WCH-A-005	EPA 350.1	EPA 350.1
Anions: Br, F, SO4	MIS-A-045	EPA 300.0	EPA 300.0
Biological Chemical Oxygen Demand	WCH-A-007	SM 5210B	SM 5210B
Chemical Oxygen Demand	WCH-A-010	EPA 410.4	EPA 410.4
Cyanide, Amenable	WCH-A-015	EPA 335.1	EPA 335.1
Gross Alpha/Beta	GPC-A-001	EPA 900.0	EPA 900.0
Metals	LMM-02	SW-846 3005A	SW-846 6020
Metals	LMM-01	SW-846 3005A	SW-846 6010B
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Phenol	WCH-A-027	EPA 420.4	EPA 420.4
Phosphate as P	WCH-A-029	EPA 365.4	EPA 365.4
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 Organic Carbon, TOC	WCH-B-025	SM 5310D	SM 5310D

Analyte	Line Item Code	Prep Method	Analytical Method
Total Suspended Solids, TSS	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
382721002	LW-DC12	Cyanide, Amenable	J	Matrix spike result
382721002	LW-DC12	Cyanide, Total	J	Matrix spike result
382721002	LW-DC12	Gross Alpha	J	Less than the Determination Limit
382721002	LW-DC12	Mercury	J	Matrix spike result
382721002	LW-DC12	Phenol	J	Matrix spike result
382721002	LW-DC12	Radium-226	J	Less than the Determination Limit
382721003	LW-DC12 Duplicate	Cyanide, Amenable	J	Matrix spike result
382721003	LW-DC12 Duplicate	Cyanide, Total	J	Matrix spike result
382721003	LW-DC12 Duplicate	Mercury	J	Matrix spike result
382721003	LW-DC12 Duplicate	Phenol	J	Matrix spike result
382721003	LW-DC12 Duplicate	Radium-226	J	Less than the Determination Limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received three water samples on October 7, 2015 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 temperature inside the iced coolers of 3.1°C and 5.1 °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 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 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 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.

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 ranges with the following exceptions.

The cyanide, mercury, and phenol MS recoveries were below the acceptance range, 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 (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.

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 2, 2015. 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 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-DC12. 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 the acceptance criteria.

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.

There were no laboratory results were identified as potential outliers. And the data from this event are acceptable as qualified.

Stephen Donivan

Stephen E. Donivan
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Report Prepared By: ______________________________
Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15097402 **Lab Code:** GEN **Validator:** Stephen Donivan **Validation Date:** 01/15/2016

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☑ Rad ☑ Organics

# of Samples: 3 **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 was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15097402 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 01/15/2016

Duplicate: LW-DC99 **Sample:** LW-DC12

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
ALPHA	3.78		1.82	1.00	1.35	U	1.59	1.00		2.0	pCi/L
Aluminum	68.0	U		1.00	68.0	U		1.00			ug/L
Antimony	1.00	U		1.00	1.00	U		1.00			ug/L
Arsenic	2.64	B		1.00	2.59	B		1.00			ug/L
Barium	249			1.00	253			1.00	1.59		ug/L
Beryllium	1.00	U		1.00	1.00	U		1.00			ug/L
BETA	8.04		1.80	1.00	8.18		1.87	1.00		0.1	pCi/L
BOD, 5 DAY	1.00	Ud		1.00	1.42	J		1.00			mg/L
Boron	44.3	B		1.00	42.8	B		1.00			ug/L
Bromide	2.86			1.00	2.87			1.00	0.35		mg/L
Cadmium	0.110	U		1.00	0.110	U		1.00			ug/L
Chemical Oxygen Demand	16.5	J		1.00	6.67	U		1.00			mg/L
Chromium	2.00	U		1.00	2.00	U		1.00			ug/L
Cobalt	0.317	B		1.00	0.252	B		1.00			ug/L
Copper	8.95			1.00	9.43			1.00	5.22		ug/L
Cyanide	0.00167	U		1.00	0.00167	U		1.00			mg/L
Cyanide, Amenable to Chlorination	1.67	U		1.00	1.67	U		1.00			ug/L
Cyanide, Chlorinated	1.67	U		1.00	1.67	U		1.00			ug/L
Fluoride	0.437	J		1.00	0.442	J		1.00	1.14		mg/L
Iron	33.0	U		1.00	33.0	U		1.00			ug/L
Lead	0.985	B		1.00	0.978	B		1.00			ug/L
Magnesium	50400			1.00	50100			1.00	0.60		ug/L
Manganese	127			1.00	122			1.00	4.02		ug/L
Mercury	0.067	UN		1.00	0.067	UN		1.00			ug/L
Molybdenum	2.82	B		1.00	2.78	B		1.00	1.43		ug/L
NH3 as N	0.212			1.00	0.152			1.00	NA		mg/L
Nickel	3.4	B		1.00	3.37	B		1.00	0.89		ug/L
NO2+NO3 as N	3.22			10.00	3.31			10.00	2.76		mg/L
Phosphorus, Total as P	0.017	U		1.00	0.017	U		1.00			mg/L
Radium-226	0.684		0.322	1.00	0.581		0.313	1.00		0.4	pCi/L
Radium-228	0.0154	U	0.283	1.00	0.378	U	0.348	1.00		1.6	pCi/L
Selenium	4.19	B		1.00	4.35	B		1.00			ug/L
Silver	0.200	U		1.00	0.200	U		1.00			ug/L
Sulfate	89.1			10.00	89.6			10.00	0.56		mg/L
Thallium	0.450	U		1.00	0.450	U		1.00			ug/L
Thorium-228	-0.000494	U	0.173	1.00	-0.11	U	0.250	1.00		0.7	pCi/L
Thorium-230	0.145	U	0.206	1.00	0.260	U	0.379	1.00		0.5	pCi/L
Thorium-232	-0.0811	U	0.0926	1.00	-0.0224	U	0.159	1.00		0.6	pCi/L
Tin	7.37	B		1.00	8.51	B		1.00			ug/L
Titanium	1.00	U		1.00	1.00	U		1.00			ug/L

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15097402 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 01/15/2016

Duplicate: LW-DC99 **Sample:** LW-DC12

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Total Organic Carbon	8.34			1.00	8.40			1.00	0.72		mg/L
Total Phenol	0.00175	U		1.00	0.00246	J		1.00			mg/L
Total Suspended Solids	0.570	U		1.00	0.570	U		1.00			mg/L
Uranium	8.13			1.00	8.01			1.00	1.49		ug/L
Zinc	18			1.00	16.7			1.00			ug/L

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15097402 **Lab Code:** GEN **Date Due:** 11/04/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 11/03/2015

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								
Aluminum	ICP/ES	10/09/2015			OK	OK	OK	102.0	102.0			105.0		103.0
Antimony	ICP/MS	10/19/2015			OK	OK	OK	112.0	111.0			100.0		102.0
Arsenic	ICP/MS	10/19/2015			OK	OK	OK	115.0	114.0			102.0		100.0
Barium	ICP/MS	10/15/2015			OK	OK	OK	101.0	104.0		0.0	99.0	5.2	102.0
Beryllium	ICP/ES	10/09/2015			OK	OK	OK	101.0	100.0			95.0		102.0
Boron	ICP/ES	10/09/2015			OK	OK	OK	103.0	106.0			109.0		107.0
Cadmium	ICP/MS	10/15/2015			OK	OK	OK	100.0	97.8			93.0		104.0
Chromium	ICP/MS	10/19/2015			OK	OK	OK	110.0	106.0			101.0		101.0
Cobalt	ICP/MS	10/19/2015			OK	OK	OK	109.0	103.0			98.0		99.0
Copper	ICP/MS	10/19/2015			OK	OK	OK	109.0	102.0		2.0	95.0	1.6	99.0
Iron	ICP/MS	10/19/2015			OK	OK	OK	95.0	96.1			102.0		99.0
Lead	ICP/MS	10/15/2015			OK	OK	OK	101.0	96.4			99.0		103.0
Magnesium	ICP/ES	10/09/2015			OK	OK	OK	103.0	114.0		0.0	101.0	2.6	100.0
Manganese	ICP/MS	10/19/2015			OK	OK	OK	99.6	95.9		0.0	107.0	3.7	98.0
Mercury	CVAA	10/21/2015			OK	OK	OK	105.0	35.9					106.0
Mercury	CVAA	10/21/2015							34.8					
Molybdenum	ICP/MS	10/19/2015			OK	OK	OK	113.0	116.0		3.0	106.0	2.1	99.0
Nickel	ICP/MS	10/19/2015			OK	OK	OK	107.0	100.0		4.0	95.0		103.0

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15097402 **Lab Code:** GEN **Date Due:** 11/04/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 11/03/2015

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	10/15/2015			OK	OK	OK	99.1	98.5			98.0		113.0
Silver	ICP/MS	10/15/2015			OK	OK	OK	103.0	98.2			92.0		103.0
Thallium	ICP/MS	10/15/2015			OK	OK	OK	95.7	93.8			90.0		92.0
Tin	ICP/ES	10/09/2015			OK	OK	OK	100.0	96.8			92.0		97.0
Titanium	ICP/ES	10/09/2015			OK	OK	OK	101.0	101.0			100.0		100.0
Uranium	ICP/MS	10/16/2015			OK	OK	OK	109.0	106.0		0.0	102.0	0.9	111.0
Zinc	ICP/MS	10/15/2015			OK	OK	OK	97.9	92.7		1.0	115.0		99.0

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15097402 **Lab Code:** GEN **Date Due:** 11/04/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 11/03/2015

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
Blank	ALPHA	10/29/2015	-0.5580	U				
Blank_Spike	ALPHA	10/29/2015				108.00		
LW-DC12	ALPHA	10/31/2015						0.20
LW-DC12	ALPHA	10/31/2015					110.0	
Blank_Spike	BETA	10/29/2015				119.00		
Blank	BETA	10/29/2015	0.6590	U				
LW-DC12	BETA	10/31/2015						0.23
LW-DC12	BETA	10/31/2015					119.0	
LW-DC12	Radium-226	10/27/2015						0.85
Blank	Radium-226	10/27/2015	0.3750	U				
LW-DC12	Radium-226	10/27/2015					105.0	
Blank_Spike	Radium-226	10/27/2015				80.40		
LW-DC12	Radium-228	11/02/2015			68.0			
LW-DC99	Radium-228	11/02/2015			75.0			
LW-DC12	Radium-228	11/02/2015			88.0			0.13
Blank_Spike	Radium-228	11/02/2015			94.0	110.00		
Blank	Radium-228	11/02/2015	0.1770	U	93.0			
LW-DC12	Thorium-228	10/26/2015			62.0			
LW-DC12	Thorium-228	10/26/2015			77.0			0
Blank	Thorium-228	10/26/2015	0.0590	U	72.0			
LW-DC99	Thorium-228	10/29/2015			76.0			
LW-DC12	Thorium-230	10/26/2015						1.50
Blank	Thorium-230	10/26/2015	0.0510	U				
LW-DC12	Thorium-232	10/26/2015						1.55
Blank_Spike	Thorium-232	10/26/2015				105.00		
Blank	Thorium-232	10/26/2015	-0.0040	U				

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15097402
Lab Code: GEN
Date Due: 11/04/2015

Matrix: Water
Site Code: WEL01
Date Completed: 11/03/2015

Analyte	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB	Blank					
BOD, 5 DAY	10/07/2015					OK	102.00				
Bromide	10/10/2015					OK	103.00	98.7		0	
Chemical Oxygen Demand	10/09/2015					OK	102.00	110.0			
Cyanide	10/13/2015					OK	110.00	4.2			
Cyanide, Chlorinated	10/13/2015					OK	-0.15				
Fluoride	10/10/2015					OK	92.60	93.3		2.00	
NH3 as N	10/09/2015					OK	103.00	104.0		38.00	
NO2+NO3 as N	10/14/2015					OK	102.00	105.0		1.00	
NO2+NO3 as N	10/14/2015							102.0		1.00	
Phosphorus, Total as P	10/13/2015					OK	95.20	98.5			
Phosphorus, Total as P	10/13/2015							102.0			
Sulfate	10/10/2015					OK	94.10				
Sulfate	10/12/2015							103.0		0	
Total Organic Carbon	10/24/2015					OK	96.50				
Total Phenol	10/12/2015					OK	101.00	15.1	18.8	22.00	
Total Suspended Solids	10/12/2015					OK	102.00				

Data Review and Validation Report

General Information

Report Number (RIN):	15097400
Sample Event:	September 30, 2015
Site(s):	Weldon Spring LTS&M
Laboratory:	GEL Laboratories, Charleston, South Carolina
Work Order No.:	382731
Analysis:	Wet Chemistry
Validator:	Stephen Donivan
Review Date:	November 3, 2015

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
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0

Data Qualifier Summary

None of the analytical results required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received four water samples on October 6, 2015, accompanied by Chain of Custody (COC) forms. The COC forms were 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 forms were 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 at 2.3 °C and in another cooler at ambient temperature, 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 September 24, 2015, 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 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.

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 or when the sample is prepared from diluted samples. The spike recoveries met the acceptance 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 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.

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 November 2, 2015. 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 for this RIN are acceptable as qualified.

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 well MW-1052 were further qualified with a “Q” flag in the database indicating the data are considered qualitative because this was a Category II well.

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 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. A duplicate sample was collected from location MW-1048. The duplicate results met the criteria, demonstrating acceptable overall precision.

Stephen Donivan

Stephen E.
Donivan
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Report Prepared By: ______________________________

Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15097400 **Lab Code:** GEN **Validator:** Stephen Donivan **Validation Date:** 11/03/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☐ Metals ☑ General Chem ☐ Rad ☐ Organics

# of Samples: 4 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15097400 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 11/03/2015

Duplicate: MW-1148 **Sample:** MW-1048

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
Sulfate	47.4			20.00	46.9			20.00	1.06		mg/L

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15097400 **Lab Code:** GEN **Date Due:** 11/03/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 11/03/2015

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Sulfate	10/09/2015	0.000	0.9997	OK	OK	OK	99.80	98.4		0	

Data Review and Validation Report

General Information

Report Number (RIN): 15087315
Sample Event: August 27-September 9, 2015
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order Nos.: 280-74144-1, 280-74144-2, 280-74144-3
Analysis: Metals, Organics, and Wet Chemistry
Validator: Gretchen Baer
Review Date: November 5, 2015

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, with the following exception. Samples MW-1048 (NJS 756), MW-1051 (NJS 758), and MW-1052 (NJS 759) were not analyzed for sulfate due to a laboratory error during sample preparation. These locations were re-sampled on September 30, 2015, and the samples were submitted to GEL Laboratories for sulfate analysis under RIN 15097400.

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
280-74144-3	MW-1004	Iron	J	Reporting limit verification > 130%
280-74144-4	MW-1004	1,3,5-Trinitrobenzene	J	Chromatographic peak resolution
280-74144-4	MW-1004	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-74144-8	MW-1006	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-74144-10	MW-1007	Sulfate	J	Field duplicate RPD > 20%
280-74144-10	MW-1007	Uranium	J	Field duplicate RPD > 20%; serial dilution result
280-74144-19	MW-1014	Iron	U	Less than 5 times the method blank
280-74144-23	MW-1016	Iron	U	Less than 5 times the method blank
280-74144-26	MW-1017	Sulfate	U	Less than 5 times the calibration blank
280-74144-30	MW-1019	Sulfate	U	Less than 5 times the calibration blank
280-74144-32	MW-1021	Sulfate	U	Less than 5 times the calibration blank
280-74144-33	MW-1027	Iron	U	Less than 5 times the method blank
280-74144-35	MW-1028	Iron	U	Less than 5 times the method blank
280-74144-41	MW-1032	Iron	J	Reporting limit verification > 130%
280-74144-45	MW-1045	Iron	J	Reporting limit verification > 130%
280-74144-47	MW-1046	Iron	J	Reporting limit verification > 130%
280-74144-55	MW-1050	Sulfate	U	Less than 5 times the calibration blank
280-74144-58	MW-1051	Iron	J	Reporting limit verification > 130%
280-74144-61	MW-1004 Duplicate	Iron	J	Reporting limit verification > 130%
280-74144-62	MW-1004 Duplicate	1,3,5-Trinitrobenzene	J	Chromatographic peak resolution
280-74144-62	MW-1004 Duplicate	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-74144-64	MW-1007 Duplicate	Sulfate	J	Field duplicate RPD > 20%
280-74144-64	MW-1007 Duplicate	Uranium	J	Field duplicate RPD > 20%; serial dilution result
280-74144-66	MW-1015 Duplicate	Iron	J	Reporting limit verification > 130%

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 66 water samples on September 11, 2015, 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 temperatures inside the iced coolers between 1.9 °C and 2.2 °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. 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 EPA 300.0, Sulfate

Calibrations were performed using six calibration standards on September 2, 2015. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method SW-846 6010B, Iron

Calibrations were performed on September 24 and 26, 2015, 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 PQL. A check result was above the acceptance range. Affected results less than 5 times the PQL and above the MDL are qualified with a “J” flag (estimated).

Method SW-846 6020, Uranium

Calibrations were performed on September 17 and 28, 2015, 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 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 8321, Nitroaromatics
Initial calibrations for nitroaromatics were performed on September 18, 2015, for instrument "LCMS4" 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.

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 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.

Organics
The method blank results were below the MDL for all target compounds.

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.

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 nitroaromatics surrogate recoveries were within the acceptance ranges.

The recovery of the internal standards added to the samples is monitored to measure instrument performance. The recovery of internal standard one from some 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 spike recoveries met the acceptance 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 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. The dilution performed for uranium at MW-1007 did not meet the acceptance criteria. 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 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 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 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.

The laboratory committed a preservation error that caused sulfate analysis to be cancelled for three samples. The laboratory notified the laboratory coordinator in an email dated September 28, 2015, but it did not address this error in the data package (Report Number: 280-74144-3). The Initial Calibration Summary Report for an ion chromatography calibration performed on September 23, 2015, was not included in the data package; the results for calibration verification samples provide evidence of an acceptable calibration.

Electronic Data Deliverable (EDD) File

The EDD files arrived on September 30, 2015. 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.

No laboratory results from this sampling event were identified as potential outliers. 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. Many pH measurements were below historical ranges and were identified as potential outliers. All pH measurements for this sampling event were qualified with a “J” flag (estimated) for calibration parameters out of acceptance range. The data for this RIN are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2004
Laboratory: TestAmerica Denver
RIN: 15087315
Report Date: 11/5/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL02	MW-1002	N001	09/08/2015	2,6-Dinitrotoluene	0.0210	U	F	1.40		F	0.0240	J	F	44	1	NA
WEL02	MW-1002	N001	09/08/2015	Sulfate	73.0		F	118		F	76.0		F	45	0	No
WEL02	MW-1044	0001	08/27/2015	Iron	18.0		F	47.3	N	F	19.2	N	F	24	0	No

Data Validation Outliers Report - Field Parameters Only

Comparison: All historical Data Beginning 1/1/2004
Laboratory: Field Measurements
RIN: 15087315
Report Date: 11/5/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL02	MW-1002	N001	09/08/2015	pH	6.31		JF	7.08		FQ	6.32		F	32	0	No
WEL02	MW-1004	N001	09/08/2015	pH	6.30		JF	7.09		F	6.38		F	33	0	No
WEL02	MW-1007	N001	08/31/2015	Field Ferrous Iron	0		JF	37.8			1.02		F	43	0	NA
WEL02	MW-1013	N001	08/31/2015	pH	6.38		JF	7.11		F	6.47		F	46	0	No
WEL02	MW-1014	N001	08/31/2015	pH	6.30		JF	7.02		F	6.46		F	46	0	No
WEL02	MW-1017	N001	08/27/2015	Field Ferrous Iron	0.510		F	21.0		F	0.770		F	23	0	No
WEL02	MW-1017	N001	08/27/2015	pH	6.21		JF	7.31		F	6.60		F	23	0	Yes
WEL02	MW-1018	N001	08/27/2015	pH	6.14		JF	7.13		F	6.47		F	33	0	Yes

Data Validation Outliers Report - Field Parameters Only

Comparison: All historical Data Beginning 1/1/2004

Laboratory: Field Measurements
RIN: 15087315
Report Date: 11/5/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL02	MW-1019	N001	08/27/2015	pH	6.22		JF	7.24		F	6.61		F	23	0	Yes
WEL02	MW-1021	N001	08/27/2015	pH	6.05		JF	7.27		F	6.58		F	23	0	Yes
WEL02	MW-1027	N001	09/08/2015	Turbidity	0.310		FQ	467		FQ	0.420		F	32	0	NA
WEL02	MW-1031	N001	09/01/2015	pH	6.51		JFQ	7.26		FQ	6.52		FQ	46	0	No
WEL02	MW-1032	N001	09/09/2015	Dissolved Oxygen	1.36		FQ	26.1			1.37		FQ	45	0	NA
WEL02	MW-1044	N001	08/27/2015	pH	6.35		JF	7.33		F	6.67		F	32	0	Yes
WEL02	MW-1045	N001	09/09/2015	pH	6.36		JF	7.21		F	6.41		F	45	0	NA
WEL02	MW-1047	N001	09/02/2015	pH	6.88		JFQ	7.90		FQ	6.93		FQ	46	0	No
WEL02	MW-1050	N001	08/27/2015	pH	6.14		JF	7.27		F	6.51		F	23	0	Yes
WEL02	MW-1051	N001	09/01/2015	pH	6.34		JF	7.04		FQ	6.41		FQ	46	0	No
WEL02	MW-1052	N001	09/01/2015	Dissolved Oxygen	4.75		FQ	4.74		FQ	0.680		FQ	46	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 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 Category II wells MW-1005, MW-1008, MW-1009, MW-1012, MW-1027, MW-1028, MW-1030, MW-1031, MW-1032, MW-1046, MW-1047, and MW-1052 were further qualified with a “Q” flag in the database indicating the data are considered qualitative because of the well performance.

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-1004, MW-1007, and MW-1015. The relative percent difference (RPD) 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 with the exception of the sulfate and uranium RPDs at location MW-1007, which were above the acceptance range. There were no analytical errors identified during the review of the data. The field ferrous iron duplicate also had poor agreement at this location, with results of 0.00 mg/L and 1.24 mg/L. The field ferrous iron, sulfate, and uranium results for this location are qualified with a “J” flag as estimated values.

Field Measurements

Daily calibration checks were performed as required with acceptable results. (An operational check for dissolved oxygen charge was outside the acceptance limit but the sampler commented that maintenance was performed. No data qualification is necessary.)

The pH field measurement values are qualified with a “J” flag (estimated) because of calibration values outside acceptance limits.

The field ferrous iron measurement value for location MW-1007 is qualified with a “J” flag (estimated) because of poor agreement with the duplicate measurement.

Gretchen K Baer

Gretchen Baer
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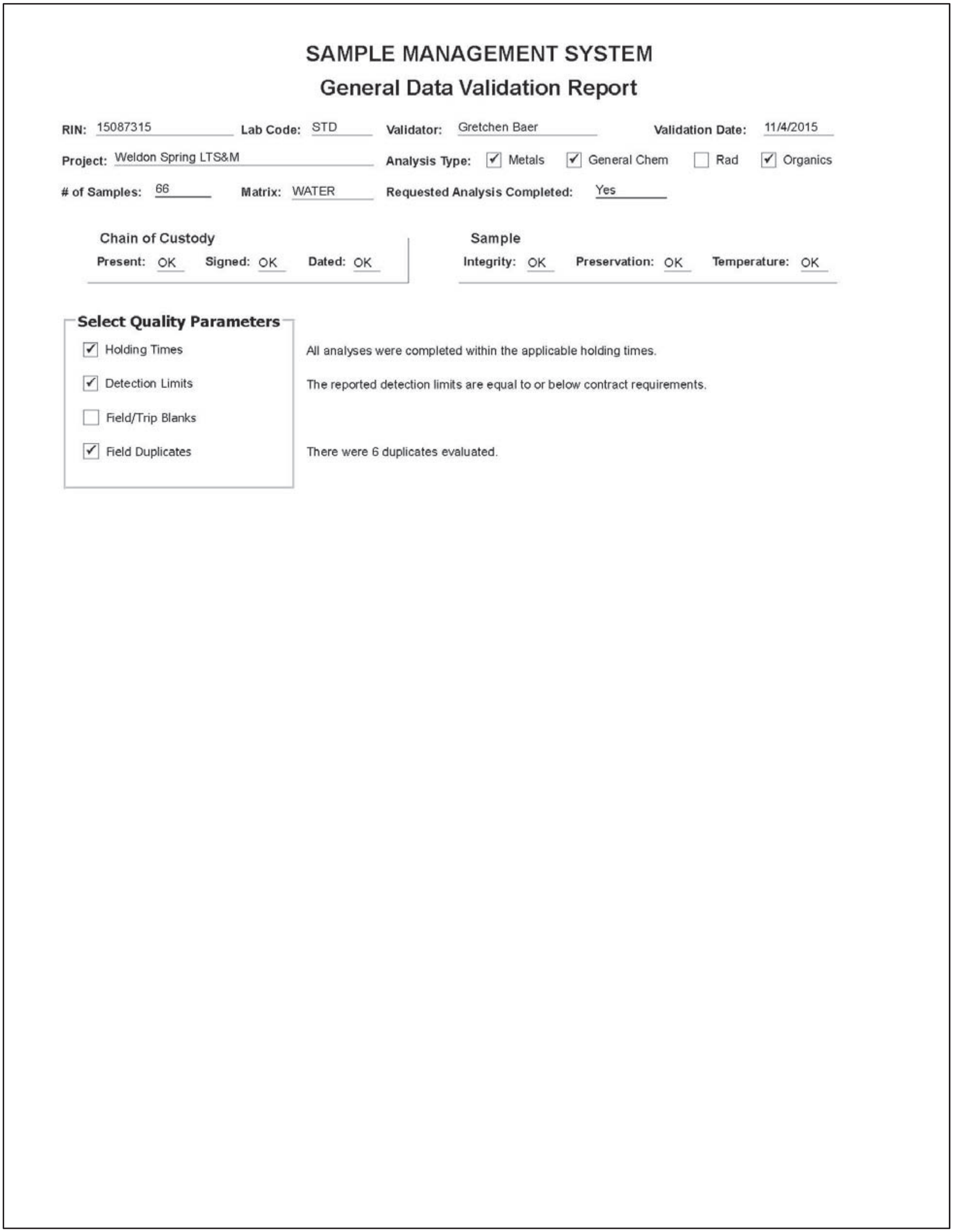
Report Prepared By: ______________________________
Gretchen Baer
Data Validator



SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15087315 **Lab Code:** STD **Validator:** Gretchen Baer **Validation Date:** 11/4/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☐ Rad ☑ Organics

# of Samples: 66 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There were 6 duplicates evaluated.

Page 1 of 1

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15087315 **Lab Code:** STD **Project:** Weldon Spring LTS&M **Validation Date:** 11/4/2015

Duplicate: MW-1104 **Sample:** MW-1004

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
1,3,5-Trinitrobenzene	0.019	J		1	0.024	J		1			ug/L
1,3-Dinitrobenzene	0.014	U		1	0.013	U		1			ug/L
2,4,6-Trinitrotoluene	0.022	U		1	0.021	U		1			ug/L
2,4-Dinitrotoluene	0.047	J		1	0.061	J		1			ug/L
2,6-Dinitrotoluene	0.047	J		1	0.066	J		1			ug/L
Iron	180	B		1	180			1	0		ug/L
Nitrobenzene	0.033	U		1	0.032	U		1			ug/L
Sulfate	97			1	94			1	3.14		mg/L
Uranium	730			1	730			1	0		ug/L

Duplicate: MW-1107 **Sample:** MW-1007

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
Iron	44000	B		1	47000			1	6.59		ug/L
Sulfate	3.3	J		1	16			1	131.61		mg/L
Uranium	39	B		1	29			1	29.41		ug/L

Duplicate: MW-1115 **Sample:** MW-1015

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
Iron	22	U		1	33	J		1			ug/L
Sulfate	62			1	62			1	0		mg/L
Uranium	130			1	120			1	8.00		ug/L

SAMPLE MANAGEMENT SYSTEM

Organics Data Validation Summary

RIN: 15087315 **Project:** Weldon Spring LTS&M **Lab Code:** STD **Validation Date:** 11/4/2015

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: 15087315
Lab Code: STD
Date Due: 10/9/2015
Matrix: Water
Site Code: WEL01
Date Completed: 10/1/2015

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	09/24/2015			OK	OK	OK	103.0	91.0	88.0	3.0	94.0	0.2	136.0
Iron	ICP/ES	09/24/2015			OK	OK	OK	103.0			9.0	95.0		113.0
Iron	ICP/ES	09/24/2015			OK	OK	OK	91.0						
Iron	ICP/ES	09/26/2015			OK	OK	OK	92.0	95.0	94.0	1.0			
Iron	ICP/ES	09/26/2015			OK	OK	OK	92.0						
Uranium	ICP/MS	09/18/2015			OK	OK	OK	103.0			2.0	90.0	4.7	102.0
Uranium	ICP/MS	09/18/2015			OK	OK	OK	103.0	109.0	107.0	1.0	93.0	12.0	102.0
Uranium	ICP/MS	09/18/2015			OK	OK	OK	103.0	100.0	112.0	3.0	90.0	0.9	
Uranium	ICP/MS	09/18/2015			OK	OK	OK	100.0				102.0		
Uranium	ICP/MS	09/18/2015			OK	OK	OK	100.0				98.0		
Uranium	ICP/MS	09/28/2015			OK	OK	OK	102.0						

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15087315

Lab Code: STD

Date Due: 10/9/2015

Matrix: Water

Site Code: WEL01

Date Completed: 10/1/2015

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Sulfate	09/02/2015	0.051	0.9990								
Sulfate	09/23/2015			OK	OK	OK	100				
Sulfate	09/24/2015			OK	OK	OK	94				
Sulfate	09/25/2015			OK	OK	OK	95	111	113	0	
Sulfate	09/25/2015							92	92	1	
Sulfate	09/25/2015							101	107	2	
Sulfate	09/25/2015							96	95	1	

U.S. DEPARTMENT OF ENERGY | Legacy Management

Data Review and Validation Report

General Information

Report Number (RIN): 15087291
Sample Event: August 17–20, 2015
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-73387-1
Analysis: Metals, Organics, and Wet Chemistry
Validator: Stephen Donivan
Review Date: November 3, 2015

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
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3010A	SW-846 6020
Volatiles (VOA)	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
280-73387-4	MW-3026	Nitrate+Nitrite as N	J	MS recovery

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 27 water samples on August 21, 2015, 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 1.4 °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 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 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 September 8, 2015. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method EPA 353.2, Nitrate + Nitrite as N
Calibrations were performed on August 28, 2015, using six calibration standards. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method SW-846 6020, Uranium
Calibrations were performed on August 26–27, 2015, 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 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 8260B, Volatiles
The volatile compounds requested were 1,2-dichloroethane, cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. Initial calibrations were performed August 14 and 21, 2015, using seven 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. 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 September 2, 2015, 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.

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 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.

Organics
The method blank results were below the MDL for all target compounds with the exception of methylene chloride. Methylene chloride was not detected in any of the associated samples.

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.

Organics 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 exception of the matrix spike sample discussed below.

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 4 times the spike concentration.

The VOA MS/MSD performed on sample SP-6301 exhibited surrogate recoveries outside acceptance limits. In addition, the MS/MSD relative percent difference limits were exceeded due to an analyst error. The spike amounts were adjusted for the error and were in control. Method precision and accuracy have been verified by the acceptable laboratory control sample analysis data and data qualification was not required.

The nitrate+nitrite as N MS/MSD results for sample MW-3026 did not meet the acceptance criteria. The nitrate+nitrite as N result for this sample is qualified “J” 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 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 revised EDD file arrived on November 24, 2015. 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 potential outliers identified and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2004

Laboratory: TestAmerica Denver
RIN: 15087291
Report Date: 11/03/2015

					Current	*Qualifiers*		Historical Maximum	*Qualifiers*		Historical Minimum	*Qualifiers*		Number of Data Points		Statistical Outlier
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-3026	N002	08/18/2015	Uranium	0.0870			0.0776		FQ	0.00140		F	9	0	NA
WEL01	MW-3026	N001	08/18/2015	Uranium	0.0850	B		0.0776		FQ	0.00140		F	9	0	NA
WEL01	MW-4041	N001	08/20/2015	Nitrate + Nitrite as Nitrogen	0.400	*		0.370		F	0.113		F	10	0	No
WEL01	SP-6301	N001	08/20/2015	Uranium	0.00560			0.118			0.0120			69	0	No
WEL02	SW-1003	N001	08/17/2015	Uranium	0.00650			0.182			0.0191			41	0	No
WEL02	SW-1004	N002	08/17/2015	Uranium	0.00710			0.250	B		0.0116			42	0	No
WEL02	SW-1004	N001	08/17/2015	Uranium	0.00710			0.250	B		0.0116			42	0	No
WEL02	SW-1005	N001	08/17/2015	Uranium	0.00590			0.147			0.0104			36	0	No
WEL02	SW-1010	N001	08/17/2015	Sulfate	13.0			510			14.6			16	0	NA
WEL02	SW-1010	N001	08/17/2015	Uranium	0.00650			0.128			0.0120			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.

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 Category II wells were further qualified with a “Q” flag in the database indicating the data are considered qualitative because of the well performance.

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 SW-1004 and SP-6301. The relative percent difference (RPD) 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 with the exception of the uranium RPD at location SP-6301, which was above the acceptance range. An analytical error was identified during the review of the data. The error was corrected and revised deliverables were received 11-24-2015.

Trip Blank

One blank was prepared and analyzed to document contamination attributable to shipping and field handling procedures. There were no target compounds detected in this blank.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Stephen Donivan

Stephen E. Donivan
2015.11.25 08:13:47
-07'00'

Report Prepared By: ______________________________
Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15087291 **Lab Code:** STD **Validator:** Stephen Donivan **Validation Date:** 11/03/2015

Project: Weldon Spring LTS&M **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	All analyses were completed within the applicable holding times.
☑ Detection Limits	The reported detection limits are equal to or below contract requirements.
☑ Field/Trip Blanks	There was 1 trip/equipment blank evaluated.
☑ Field Duplicates	There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15087291 **Lab Code:** STD **Project:** Weldon Spring LTS&M **Validation Date:** 11/25/2015

Duplicate: SP-6311 **Sample:** SP-6301

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
1,2-Dichloroethane	0.13	UF2		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	0.022	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
cis-1,2-Dichloroethene	0.15	UF2		1	0.15	U		1			ug/L
Nitrate+Nitrite as N	1.2			1	1.1			1	8.70		mg/L
Nitrobenzene	0.033	U		1	0.032	U		1			ug/L
Tetrachloroethene	0.20	UF2		1	0.20	U		1			ug/L
trans-1,2-Dichloroethene	0.15	UF2		1	0.15	U		1			ug/L
Trichloroethene	0.16	UF2		1	0.16	U		1			ug/L
Uranium	28			1	33			1	16.39		ug/L
Vinyl Chloride	0.10	U		1	0.10	U*		1			ug/L

Duplicate: SW-1104 **Sample:** SW-1004

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Sulfate	13			1	13			1	0		mg/L
Uranium	7.1			1	7.1			1	0		ug/L

SAMPLE MANAGEMENT SYSTEM

Non-Compliance Report: Method Blanks

RIN: 15087291 **Lab Code:** STD

Project: Weldon Spring LTS&M

Validation Date: 11/03/2015

Method Blank	Date Analyzed	Method	Analyte	Result	Flag(s)	MDL
MB 280-29260	08/28/2015	8260B	Methylene Chloride	0.66	J	0.32
MB 280-29323	09/02/2015	8260B	Methylene Chloride	0.52	J	0.32

SAMPLE MANAGEMENT SYSTEM

Non-Compliance Report: MS/MSD Performance

RIN: 15087291 **Lab Code:** STD

Project: Weldon Spring LTS&M

Validation Date: 11/03/2015

MS/MSD	Date Analyzed	Method	Analyte	Recovery MS	Recovery MSD	Lower Limit	Upper Limit	MSD RPD	RPD Limit
NJR 798	08/28/2015	8260B	1,1,1-Trichloroethane	129.0	106.0	65.0	135.0	48.00	20.0
NJR 798	08/28/2015	8260B	1,1-Dichloroethane	115.0	97.0	65.0	135.0	52.00	21.0
NJR 798	08/28/2015	8260B	1,1-Dichloroethene	112.0	94.0	65.0	136.0	51.00	20.0
NJR 798	08/28/2015	8260B	1,2-Dichloropropane	108.0	92.0	64.0	135.0	51.00	20.0
NJR 798	08/28/2015	8260B	1,3-Dichlorobenzene	103.0	87.0	65.0	135.0	51.00	20.0
NJR 798	08/28/2015	8260B	Benzene	111.0	95.0	65.0	135.0	52.00	20.0
NJR 798	08/28/2015	8260B	Bromodichloromethane	113.0	98.0	65.0	135.0	54.00	20.0
NJR 798	08/28/2015	8260B	Carbon Tetrachloride	135.0	112.0	65.0	135.0	49.00	21.0
NJR 798	08/28/2015	8260B	Chlorobenzene	107.0	89.0	65.0	135.0	50.00	20.0
NJR 798	08/28/2015	8260B	Chloroform	118.0	100.0	65.0	135.0	51.00	20.0
NJR 798	08/28/2015	8260B	Ethylbenzene	107.0	90.0	65.0	135.0	51.00	20.0
NJR 798	08/28/2015	8260B	Methylene Chloride	99.0	82.0	54.0	141.0	44.00	26.0
NJR 798	08/28/2015	8260B	Tetrachloroethene	115.0	93.0	65.0	135.0	47.00	20.0
NJR 798	08/28/2015	8260B	Toluene	116.0	96.0	65.0	135.0	49.00	20.0
NJR 798	08/28/2015	8260B	trans-1,2-Dichloroethene	119.0	99.0	65.0	135.0	50.00	24.0
NJR 798	08/28/2015	8260B	Trichloroethene	115.0	99.0	65.0	135.0	53.00	20.0

SAMPLE MANAGEMENT SYSTEM

Non-Compliance Report: Surrogate Recovery

RIN: 15087291 **Lab Code:** STD

Project: Weldon Spring LTS&M

Validation Date: 11/03/2015

Ticket	Location	Lab Sample ID	Method	Dilution	Surrogate	Recovery	Lower Limit	Upper Limit
NJR 798 MS			8260B		Dibromofluoromethane	131.0	77.0	120.0
NJR 798 MS			8260B		1,2-Dichloroethane-d4 (Su	136.0	70.0	127.0

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15087291 **Lab Code:** STD **Date Due:** 09/18/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 09/21/2015

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Uranium	ICP/MS	08/26/2015					OK	113.0	117.0	113.0	3.0	99.0	4.4	95.0
Uranium	ICP/MS	08/27/2015					OK	99.0	95.0	108.0	4.0	103.0	2.0	102.0
Uranium	ICP/MS	08/27/2015					OK	97.0	96.0	97.0	0.0	102.0	1.1	102.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15087291 **Lab Code:** STD **Date Due:** 09/18/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 09/21/2015

Analyte	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB	Blank					
Nitrate+Nitrite as N	08/28/2015	0.000	1.0000	OK	OK	OK	104.00	49.0	50.0	1.00	
Nitrate+Nitrite as N	08/28/2015					OK		85.0	88.0	3.00	
Sulfate	09/08/2015	0.000	0.9980	OK	OK	OK	95.00	95.0	96.0	0	

Data Review and Validation Report

General Information

Report Number (RIN): 15077200
Sample Event: July 8 - 9, 2015
Site(s): Weldon Spring LTS&M
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 376924
Analysis: Metals
Validator: Alison Kuhlman
Review Date: August 24, 2015

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
Uranium	LMM-02	SW-846 3005A	SW-846 6020

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. 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
376924002	LW-DC12	Uranium	J	Field duplicate RPD outside acceptance criteria
376924004	LW-DC92	Uranium	J	Field duplicate RPD outside acceptance criteria

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received six water samples on July 10, 2015, 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 at ambient temperature, 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) 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 SW-846 6020, Uranium

Calibrations were performed on July 14 and 17, 2015, 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 MDL.

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.

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. The serial dilution data met the acceptance criteria.

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 23, 2015. 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 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, LW-DC12, and SW-1003. 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, with the exception of the duplicate at SW-1003. The associated sample results are qualified with “J” flags as estimated values.

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.

There were no outliers identified and the data for this RIN are acceptable as qualified.

Report Prepared By: Alison Kuhlman Alison E. Kuhlman
2015.08.24 16:07:37 -06'00'
Alison Kuhlman
Data Validator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15077200 **Lab Code:** GEN **Validator:** Alison Kuhlman **Validation Date:** 8/24/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☐ General Chem ☐ Rad ☐ Organics

# of Samples: 6 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15077200 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 8/24/2015

Duplicate: LW-DC90 **Sample:** LW-DC10

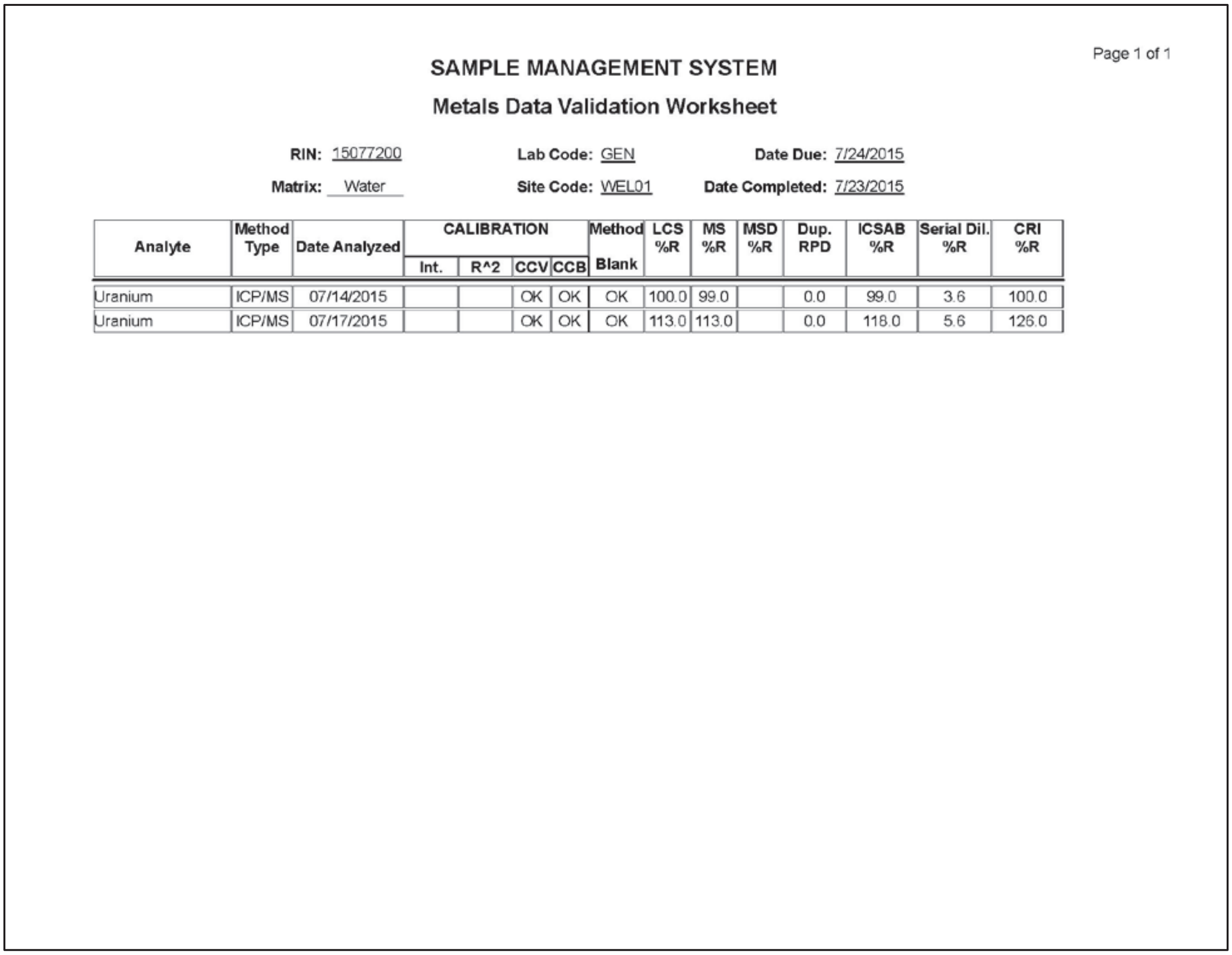
Analyte	Sample Result	Flag	Error	Dilution	Duplicate Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	34.3			1.00	35			1.00	2.02		ug/L

Duplicate: LW-DC92 **Sample:** LW-DC12

Analyte	Sample Result	Flag	Error	Dilution	Duplicate Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	7.11			1.00	7.12			1.00	0.14		ug/L

Duplicate: SW-1103 **Sample:** SW-1003

Analyte	Sample Result	Flag	Error	Dilution	Duplicate Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	8.45			1.00	6.85			1.00	20.92		ug/L



SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15077200 **Lab Code:** GEN **Date Due:** 7/24/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 7/23/2015

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	07/14/2015			OK	OK	OK	100.0	99.0		0.0	99.0	3.6	100.0
Uranium	ICP/MS	07/17/2015			OK	OK	OK	113.0	113.0		0.0	118.0	5.6	126.0

Data Review and Validation Report

General Information

Report Number (RIN): 15057063
Sample Event: June 1–2, 2015
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-70317-1
Analysis: Organics
Validator: Stephen Donivan
Review Date: August 7, 2015

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

None of the analytical results required qualification.

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received eight water samples on June 4, 2015, 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 of 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 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 June 22, 2015, 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.

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.

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 nitroaromatics surrogate recoveries were within the acceptance ranges.

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 4 times the spike concentration. All matrix spike recoveries were within the acceptance range.

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 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.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics 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 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 1, 2015. 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 2,6-dinitrotoluene result for location MW-2046 was identified as a potential outlier. This sample was analyzed three times with increasing dilution factors with comparable results. The data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2005

Laboratory: TestAmerica Denver
RIN: 15057063
Report Date: 08/07/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-2046	N002	06/01/2015	2,6-Dinitrotoluene	9.00			2.40		QF	1.20		FQ	20	0	Yes
WEL01	MW-2051	N002	06/02/2015	2,4,6-Trinitrotoluene	0.0560	J		0.190		FQJ	0.0580	J	F	23	4	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.

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, and MW-2055 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. There were no analytes detected in the sample or duplicate.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Stephen Donivan

Stephen E. Donivan
2015.08.07
08:39:30 -06'00'

Report Prepared By: ______________________________
Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15057063 **Lab Code:** STD **Validator:** Stephen Donivan **Validation Date:** 08/07/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☐ Metals ☐ General Chem ☐ Rad ☑ Organics

# of Samples: 8 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15057063 **Lab Code:** STD **Project:** Weldon Spring LTS&M **Validation Date:** 08/07/2015

Duplicate: LW-DD10 **Sample:** LW-DC10

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
1,3,5-Trinitrobenzene	0.017	U		1	0.016	U		1			ug/L
1,3-Dinitrobenzene	0.014	U		1	0.013	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	0.022	U		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: 15057063 **Project:** Weldon Spring LTS&M **Lab Code:** STD **Validation Date:** 08/07/2015

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):	15057062
Sample Event:	June 1–2, 2015
Site(s):	Weldon Spring
Laboratory:	GEL Laboratories, Charleston, South Carolina
Work Order No.:	374404
Analysis:	Metals, Organics, Radiochemistry, and Wet Chemistry
Validator:	Stephen Donivan
Review Date:	August 13, 2015

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
Metals: As, Ba, , Cr, Cu, Fe, Mn, Ni, Pb, Se, U, Zn	LMM-02	SW-846 3005A	SW-846 6020
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, TDS	WCH-A-033	SM 2540C	SM 2540C
Uranium Isotopes	LMR-02	HASL-300, U-02-RC Mod	HASL-300, U-02-RC Mod
PAH Compounds	LMS-02	SW-846 3510C	SW-846 8310
PCBs	PEP-A-006	SW-846 3535A	SW-846 8082
Volatiles (VOAs)	LMV-06	SW-846 8260B	SW-846 8260B
Anions: Cl, F, SO4	MIS-A-045	EPA 300.0	EPA 300.0
Nitrate + Nitrite as N	WCH-A-022	EPA 353.2	EPA 353.2
Total Organic Carbon, TOC	WCH-B-025	SM 5310D	SM 5310D

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
374404001	MW-2051	Radium-226	J	Less than the Determination Limit
374404001	MW-2051	Thorium-230	U	Less than the Decision Level
374404002	LW-DC10	Barium	J	Field duplicate result
374404002	LW-DC10	Manganese	J	Serial dilution result
374404002	LW-DC10	Radium-226	J	Less than the Determination Limit
374404002	LW-DC10	Radium-228	J	Less than the Determination Limit
374404003	MW-2032	Radium-226	J	Less than the Determination Limit
374404003	MW-2032	Radium-228	J	Less than the Determination Limit
374404003	MW-2032	Uranium-234	J	Method blank result
374404004	SP-6301	Uranium-234	J	Method blank result
374404004	SP-6301	Uranium-235	J	Field duplicate result
374404005	MW-2047	Radium-226	J	Less than the Determination Limit
374404005	MW-2047	Radium-228	J	Less than the Determination Limit
374404006	MW-2055	Radium-226	J	Less than the Determination Limit
374404007	MW-2046	Radium-226	J	Less than the Determination Limit
374404008	LW-DC10 Duplicate	Barium	J	Field duplicate result
374404008	LW-DC10 Duplicate	Manganese	J	Serial dilution result
374404008	LW-DC10 Duplicate	Radium-228	J	Less than the Determination Limit
374404010	SP-6301 Duplicate	Uranium-234	J	Method blank result
374404010	SP-6301 Duplicate	Uranium-235	J	Field duplicate result
374404011	SP-6301	Radium-226	J	Less than the Determination Limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 10 water samples on June 4, 2015 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

One of the six sample coolers was missing from the original sample shipment, the missing cooler was received the following day. The sample shipments were received 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 with the following exception. Sample LW-DC10 was inadvertently logged for TSS instead of TDS. The error was not discovered by the lab until after the holding time had expired. The laboratory was instructed to proceed with the analysis outside of the holding time. The TDS result for this sample is qualified with a “J” flag as an estimated value.

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 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 June 2, 2015. 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 June 9, 2015, 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 June 6 and 10, 2015. 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 2540C, 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 June 6, 2015, 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 June 23–26, 2015, 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 June 15, 2015. 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.

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 VOA9 was performed on May 7, 2015, 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.

Method SW-846 8310, PAH Compounds
The initial calibration for PAHs was performed using eight calibration standards on May 19, 2015. 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 and Uranium 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 April 6, 2015. The daily calibration checks performed on June 16, 2015 met the acceptance criteria.

Radium-228
Plateau voltage determinations and detector efficiency calibrations were performed more than one year previous to the sample analysis and verified on October 8, 2014. Daily instrument checks performed on June 26, 2015 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. With the exception of uranium-234, the radiochemistry method blank results were less than the DLC. The sample uranium-234 results are qualified with a “J” flag as estimated values.

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 with the following exception. The surrogate recoveries from the PCB matrix spike duplicate prepared from sample LW-DC10 and MW-2055 did not meet the acceptance criteria. PCBs were not detected in the associated samples and the results were not further qualified.

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 ranges with the following exceptions.

The mercury MS recoveries were below the acceptance range, the sample mercury 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 (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 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 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 1, 2015. 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.

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, and MW-2055 were further qualified with a "Q" flag in the database indicating the data are considered qualitative because these are Category II wells.

Trip Blank

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 target compounds detected in this 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-DC12 and SP-6301. 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. The barium duplicate result for location LW-DC10 and the uranium-235 duplicate result for location SP-6301 did not meet the acceptance criteria. The associated sample and duplicate 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.

There were no laboratory results were identified as potential outliers. And the data from this event are acceptable as qualified.

Stephen Donivan

Stephen E. Donivan
2015.08.13 11:46:57
-06'00'

Report Prepared By: ______________________________

Stephen Donivan
Laboratory Coordinator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2005

Laboratory: GEL Laboratories
RIN: 15057062
Report Date: 08/13/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-2032	N001	06/01/2015	Uranium	0.00707			0.00620	B	FQ	0.00292		F	22	0	No
WEL01	MW-2047	N001	06/02/2015	Thorium-230	0.705	U		0.651	U	FQ	0.150	J	FQJ	20	13	No
WEL01	MW-2047	N001	06/02/2015	Uranium	0.00191			0.00190	E	FQ	0.00153		FQ	20	1	No
WEL01	MW-2051	N001	06/02/2015	Thorium-230	0.940			0.844	U	F	0.1000	U	F	22	19	No
WEL01	MW-2055	N001	06/02/2015	Selenium	0.0110			0.0153		FQ	0.0119		FQ	21	0	No
WEL01	SP-6301	N001	06/01/2015	Barium	0.0858			0.149			0.0984	E		25	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: 15057062 **Lab Code:** GEN **Validator:** Stephen Donivan **Validation Date:** 08/13/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☑ Rad ☑ Organics

# of Samples: 10 **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	There was 1 trip/equipment blank evaluated.
☑ Field Duplicates	There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15057062 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 08/13/2015

Duplicate: LW-DD10 **Sample:** LW-DC10

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
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	1.70	U		1.00			ug/L
Barium	434			1.00	159			1.00	92.75		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	32.6			1.00	38.9			1.00			mg/L
Chloride	45.4			10.00	46.2			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	0.406	B		1.00	0.443	B		1.00			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	0.211	J		1.00	0.220	J		1.00	4.18		mg/L
Indeno(1,2,3-cd)pyrene	0.016	U		1.00	0.016	U		1.00			ug/L
Iron	146			1.00	146			1.00			ug/L
Lead	0.500	U		1.00	0.500	U		1.00			ug/L
Manganese	335	E		1.00	359	E		1.00	6.92		ug/L
Naphthalene	0.150	U		1.00	0.150	U		1.00			ug/L
Nickel	5.34	B		1.00	5.82	B		1.00	8.60		ug/L
NO2+NO3 as N	3.73			5.00	3.62			5.00	2.99		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	0.561		0.353	1.00	0.0793	U	0.172	1.00		2.4	pCi/L
Radium-228	0.913		0.437	1.00	0.786		0.460	1.00		0.4	pCi/L
Selenium	3.69	B		1.00	3.66	B		1.00			ug/L
Sulfate	87.9			10.00	89.4			10.00	1.69		mg/L
Thallium	0.450	U		1.00	0.450	U		1.00			ug/L

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15057062 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 08/13/2015

Duplicate: LW-DD10 **Sample:** LW-DC10

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Thorium-228	0.223	U	0.365	1.00	0.062	U	0.283	1.00		0.7	pCi/L
Thorium-230	0.148	U	0.420	1.00	-0.0115	U	0.351	1.00		0.6	pCi/L
Thorium-232	0.0514	U	0.222	1.00	0.0902	U	0.270	1.00		0.2	pCi/L
Total Dissolved Solids	816			1.00	826			1.00	1.22		mg/L
Total Organic Carbon	11.6			1.00	11.5			1.00	0.87		mg/L
Uranium	35			1.00	35.9			1.00	2.54		ug/L

Duplicate: SP-6381 **Sample:** SP-6301

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
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
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-233+234	7.32		0.945	1.00	6.81		1.14	1.00	7.22	0.7	pCi/L
Uranium-235/236	0.854		0.150	1.00	0.468		0.165	1.00	58.40	3.4	pCi/L
Uranium-238	7.60		0.980	1.00	6.94		1.16	1.00	9.08	0.9	pCi/L
Vinyl Chloride	0.300	U		1.00	0.300	U		1.00			ug/L

SAMPLE MANAGEMENT SYSTEM

Organics Data Validation Summary

RIN: 15057062 **Project:** Weldon Spring LTS&M **Lab Code:** GEN **Validation Date:** 08/13/2015

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 were 2 surrogate failures.

SAMPLE MANAGEMENT SYSTEM

Non-Compliance Report: Surrogate Recovery

RIN: 15057062 **Lab Code:** GEN

Project: Weldon Spring LTS&M

Validation Date: 08/13/2015

Ticket	Location	Lab Sample ID	Method	Dilution	Surrogate	Recovery	Lower Limit	Upper Limit
NGQ 907	LW-DD10	374404008	EPA 3535A/8082	1.00	4cmx	109.0	33.0	102.0
NGQ 905	MW-2055	374404006	EPA 3535A/8082	1.00	4cmx	103.0	33.0	102.0

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15057062 **Lab Code:** GEN **Date Due:** 07/02/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 07/02/2015

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	06/24/2015			OK	OK	OK	101.0	101.0			99.0		110.0
Barium	ICP/MS	06/23/2015			OK	OK	OK	97.3	125.0		0.0	108.0	8.4	99.0
Chromium	ICP/MS	06/23/2015			OK	OK	OK	100.0	96.9			89.0		103.0
Cobalt	ICP/MS	06/23/2015			OK	OK	OK	101.0	95.4			94.0		105.0
Iron	ICP/MS	06/23/2015			OK	OK	OK	107.0	103.0		5.0	99.0		109.0
Lead	ICP/MS	06/23/2015			OK	OK	OK	102.0	98.0			99.0		104.0
Manganese	ICP/MS	06/23/2015			OK	OK	OK	103.0			3.0	97.0	22.0	106.0
Nickel	ICP/MS	06/23/2015			OK	OK	OK	101.0	93.0		4.0	86.0		102.0
Selenium	ICP/MS	06/23/2015			OK	OK	OK	100.0	100.0			90.0		99.0
Thallium	ICP/MS	06/23/2015			OK	OK	OK	101.0	98.9			102.0		86.0
Uranium	ICP/MS	06/24/2015			OK	OK	OK	108.0	103.0		1.0	111.0	5.3	120.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15057062 **Lab Code:** GEN **Date Due:** 07/02/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 07/02/2015

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	06/06/2015	0.000	0.9980	OK	OK	OK	109.00	109.0		12.00	
Chemical Oxygen Demand	06/10/2015					OK	109.00	106.0		0	
Chloride	06/05/2015	0.000	1.0000	OK	OK	OK	92.80	106.0		0	
Fluoride	06/05/2015	0.000	1.0000	OK	OK	OK	95.10	93.9		0	
NO2+NO3 as N	06/09/2015	0.000	1.0000	OK	OK	OK	96.10	104.0		5.00	
Sulfate	06/05/2015	0.000	1.0000	OK	OK	OK	94.90	104.0		0	
Total Dissolved Solids	06/05/2015					OK	98.60			0	
Total Organic Carbon	06/16/2015					OK	102.00				
Total Organic Carbon	06/17/2015							96.4		1.00	

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15057062 **Lab Code:** GEN **Date Due:** 07/02/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 07/02/2015

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
Blank_Spike	Radium	06/16/2015	0.1650	U				
LW-DC10	Radium-226	06/16/2015						1.23
Blank_Spike	Radium-226	06/16/2015				103.00		
LW-DC10	Radium-226	06/16/2015					104.0	
LW-DC10	Radium-228	06/26/2015			86.0			
LW-DD10	Radium-228	06/26/2015			98.0			
MW-2032	Radium-228	06/26/2015			105.0			
MW-2046	Radium-228	06/26/2015			99.0			
MW-2047	Radium-228	06/26/2015			93.0			
MW-2051	Radium-228	06/26/2015			91.0			
MW-2055	Radium-228	06/26/2015			99.0			
SP-6301	Radium-228	06/26/2015			101.0			
LW-DC10	Radium-228	06/26/2015			89.0			0.98
Blank_Spike	Radium-228	06/26/2015			105.0	99.00		
Blank	Radium-228	06/26/2015	0.0920	U	104.0			
LW-DC10	Thorium-228	06/30/2015			76.0			
LW-DD10	Thorium-228	06/30/2015			76.0			
MW-2032	Thorium-228	06/30/2015			85.0			
MW-2046	Thorium-228	06/30/2015			76.0			
MW-2047	Thorium-228	06/30/2015			85.0			
MW-2051	Thorium-228	06/30/2015			76.0			
MW-2055	Thorium-228	06/30/2015			85.0			
SP-6301	Thorium-228	06/30/2015			76.0			
Blank	Thorium-228	06/30/2015	0.0770	U	84.0			
LW-DC10	Thorium-228	07/01/2015			67.0			1.37
Blank_Spike	Thorium-228	07/01/2015			86.0			
Blank	Thorium-230	06/30/2015	0.6000	U				
LW-DC10	Thorium-230	07/01/2015						0.48
Blank_Spike	Thorium-230	07/01/2015				105.00		
Blank	Thorium-232	06/30/2015	0.0530	U				
LW-DC10	Thorium-232	07/01/2015						0.81
SP-6301	Uranium-233+234	06/27/2015			87.0			

U.S. DEPARTMENT OF ENERGY | Legacy Management

Data Review and Validation Report

General Information

Report Number (RIN): 15057016
Sample Event: May 14-20, 2015
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-69637-1
Analysis: Metals, Organics, and Wet Chemistry
Validator: Gretchen Baer
Review Date: August 7, 2015

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
280-69637-2	MW-2014	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-69637-6	MW-2038	1,3,5-Trinitrobenzene	J	Sample container rinse not performed
280-69637-6	MW-2038	1,3-Dinitrobenzene	J	Sample container rinse not performed
280-69637-6	MW-2038	2,4,6-Trinitrotoluene	J	Sample container rinse not performed
280-69637-6	MW-2038	2,4-Dinitrotoluene	J	Sample container rinse not performed
280-69637-6	MW-2038	2,6-Dinitrotoluene	J	Sample container rinse not performed
280-69637-6	MW-2038	Nitrobenzene	J	Sample container rinse not performed
280-69637-8	MW-2050	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-69637-9	MW-2052	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-69637-11	MW-2054	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-69637-17	MW-4013	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-69637-26	MW-1049	1,3,5-Trinitrobenzene	J	Sample container rinse not performed
280-69637-26	MW-1049	1,3-Dinitrobenzene	J	Sample container rinse not performed
280-69637-26	MW-1049	2,4,6-Trinitrotoluene	J	Sample container rinse not performed
280-69637-26	MW-1049	2,4-Dinitrotoluene	J	Sample container rinse not performed
280-69637-26	MW-1049	2,6-Dinitrotoluene	J	Sample container rinse not performed
280-69637-26	MW-1049	Nitrobenzene	J	Sample container rinse not performed
280-69637-29	MW-1149	Uranium	U	Less than 5 times the calibration blank

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 29 water samples on May 21, 2015, 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 temperatures inside the iced coolers between 3.3 °C and 5.6 °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.

Sample MW-2038 and MW-1049 were received in a 4-liter bottle for nitroaromatics. The laboratory can use only 1 liter for this analysis; consequently, the sample bottle was not rinsed with solvent as required by the method. Associated nitroaromtic results are qualified with a “J” flag as estimated values.

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 EPA 300.0, Sulfate

Calibrations were performed using six calibration standards on May 5, 2015. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method EPA 353.2, Nitrate + Nitrite as N

Calibrations were performed on May 28 and June 4, 2015, using six calibration standards. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method SW-846 6010B, Iron

Calibrations were performed on May 28, 2015, 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 PQL. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on May 28, 2015, 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 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 8321, Nitroaromatics

Initial calibrations for nitroaromatics were performed on May 27, 2015, 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.

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 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.

Organics

The method blank results were below the MDL for all target compounds.

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.

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 nitroaromatics surrogate recoveries were within the acceptance ranges.

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 4 times the spike concentration. The spike recoveries met the acceptance 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 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.

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 percent 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 June 19, 2015. 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 potential outliers identified and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All Historical Data
Laboratory: TestAmerica Denver
RIN: 15057016
Report Date: 8/7/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-4014	N001	05/18/2015	2,6-Dinitrotoluene	0.410		F	0.180	*	F	0.01000	U	J	21	14	NA
WEL01	MW-4015	N001	05/19/2015	1,3,5-Trinitrobenzene	7.40		QF	7.10		FQJ	0.0900		J	25	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.

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-2014, MW-2017, MW-2022, MW-2023, MW-2040, MW-2050, MW-2056, MW-3026, MW-4011, MW-4015, MW-4039, and MW-1032 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. Duplicate samples were collected from locations MW-2038 and MW-1049. 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

Daily calibration checks were performed as required with acceptable results. (The operational check form on May 19, 2015, has two entries inadvertently reversed for the dissolved oxygen calibration. No data qualification is necessary.)

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Report Prepared By: ____

Gretchen Baer
Data Validator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15057016 **Lab Code:** STD **Validator:** Gretchen Baer **Validation Date:** 8/7/2015

Project: Weldon Spring LTS&M **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	All analyses were completed within the applicable holding times.
☑ Detection Limits	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 15057016 **Project:** Weldon Spring LTS&M **Lab Code:** STD **Validation Date:** 8/7/2015

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: 15057016 **Lab Code:** STD **Date Due:** 6/18/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 6/19/2015

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Iron	ICP/ES	05/28/2015			OK	OK	OK	101.0			4.0	92.0	4.3	97.0
Uranium	ICP/MS	05/28/2015			OK	OK	OK	107.0	108.0	108.0	0.0	99.0		100.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15057016
Lab Code: STD
Date Due: 6/18/2015
Matrix: Water
Site Code: WEL01
Date Completed: 6/19/2015

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	05/28/2015	0.000	1.0000	OK	OK	OK	108.00	100.0	97.0	1.00	
Nitrate+Nitrite as N	06/04/2015	0.000	1.0000	OK	OK	OK	104.00				
Sulfate	06/01/2015	0.000	1.0000	OK	OK	OK	101.00	105.0	106.0	1.00	

U.S. DEPARTMENT OF ENERGY | Legacy Management

Data Review and Validation Report

General Information

Report Number (RIN): 15046982
Sample Event: April 30 – May 18, 2015
Site(s): Weldon Spring LTS&M
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 373355, 373357
Analysis: Metals and Radiochemistry
Validator: Stephen Donivan
Review Date: August 4, 2015

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
Uranium	LMM-02	SW-846 3005A	SW-846 6020
Uranium Isotopes	LMR-02	U-02-RC Mod	U-02-RC Mod

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the attached validation worksheets and the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifiers

Sample Number	Location	Analyte	Flag	Reason
373355013	MW-4040	All uranium isotopes	J	Tracer counts <400

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 30 water samples on May 19, 2015, accompanied by Chain of Custody (COC) forms. The COC forms were 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 forms were 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 at ambient temperature 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 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 the *Quality Systems Manual*. 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 uranium; 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 calibration and laboratory spike standards were prepared from independent sources.

Method SW-846 6020, Uranium
Calibrations were performed on June 7, 2015, 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.

Radiochemical Analysis

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 with the following exception. The tracer recovery for MW-4040 was 20 percent. A high concentration of uranium in the samples resulted in low chemical recovery. Because the tracer area counts were less than 400 the results for this location are flagged with a “J” as estimated values. The full width at half maximum (FWHM) was reviewed to evaluate the spectral resolution. All internal standard FWHM values were below 100 kiloelectron volts (keV), demonstrating acceptable resolution. All internal standard peaks were within 50 keV of the expected position. The regions of interest (ROIs) for analyte peaks were reviewed. All ROIs were satisfactory and all manual integrations were performed correctly.

A comparison was made between the uranium isotopic data, converted to mg/L, and the uranium concentration measured by method SW-846 6020. The uranium isotopic concentrations were generally in agreement with the total uranium concentration reported for all samples. The relative percent differences (RPDs) were below 15 percent for all cases except for location MW-4040 with an RPD of approximately 20 percent. There were no errors noted and the results are acceptable.

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.

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 or when the sample is prepared from diluted samples. The spike recoveries met the acceptance criteria for all analytes evaluated. Some spike recoveries of sulfate exceeded the laboratory's acceptance criteria, but were within the ±25 percent data validation 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. 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. The serial dilution data met the serial dilution criteria, with the exception of uranium. The associated sample result has been previously qualified.

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.

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-2023, MW-3040, and MW-4036. 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.

Electronic Data Deliverable (EDD) File

The EDD file arrived on June 17, 2015. 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 not outliers identified and the data for this RIN are acceptable as qualified.

Stephen Donivan

Stephen E. Donivan
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Report Prepared By: ______________________________
Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15046982 **Lab Code:** GEN **Validator:** Stephen Donivan **Validation Date:** 08/04/2015

Project: Weldon Spring LTS&M **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 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15046982 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 08/04/2015

Duplicate: MW-2123 **Sample:** MW-2023

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	2.33			1.00	2.31			1.00	0.86		ug/L
Uranium-233+234	1.35		0.197	1.00	1.11		0.174	1.00	19.51	1.8	pCi/L
Uranium-235/236	0.0567		0.0281	1.00	0.0226	U	0.0247	1.00		1.8	pCi/L
Uranium-238	0.782		0.127	1.00	0.852		0.140	1.00	8.57	0.7	pCi/L

Duplicate: MW-3140 **Sample:** MW-3040

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	188			1.00	189			1.00	0.53		ug/L
Uranium-233+234	51.2		14.1	1.00	47.0		13.3	1.00	8.55	0.4	pCi/L
Uranium-235/236	4.26		1.55	1.00	2.29		1.01	1.00	60.15	2.1	pCi/L
Uranium-238	61.5		16.8	1.00	48.6		13.7	1.00	23.43	1.2	pCi/L

Duplicate: MW-4136 **Sample:** MW-4036

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Uranium	57.3			1.00	68.2			1.00	17.37		ug/L
Uranium-233+234	20.5		4.35	1.00	19.3		2.59	1.00	6.03	0.5	pCi/L
Uranium-235/236	1.47		0.518	1.00	1.05		0.204	1.00	33.33	1.5	pCi/L
Uranium-238	21.2		4.50	1.00	19.9		2.67	1.00	6.33	0.5	pCi/L

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15046982 **Lab Code:** GEN **Date Due:** 06/16/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 06/16/2015

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	06/07/2015	0.0000	1.0000	OK	OK	OK	103.0	103.0		3.0	97.0	1.6	97.0
Uranium	ICP/MS	06/07/2015						98.8	101.0		1.0	100.0	5.1	103.0
Uranium	ICP/MS	06/07/2015							106.0		2.0			104.0

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15046982 **Lab Code:** GEN **Date Due:** 06/16/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 06/16/2015

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
MW-2023	Uranium-233+234	06/11/2015			93.0			
MW-2123	Uranium-233+234	06/11/2015			87.0			
MW-3003	Uranium-233+234	06/11/2015			74.0			
MW-4022	Uranium-233+234	06/11/2015			97.0			
MW-4041	Uranium-233+234	06/11/2015			85.0			
MW-4136	Uranium-233+234	06/11/2015			68.0			
MWS-2	Uranium-233+234	06/11/2015			84.0			
RMW-2	Uranium-233+234	06/11/2015			100.0			
SW-2004	Uranium-233+234	06/11/2015			95.0			
MW-2023	Uranium-233+234	06/11/2015			100.0			1.61
MW-2023	Uranium-233+234	06/11/2015			94.0			
MW-3040	Uranium-233+234	06/11/2015			86.0			
MW-4036	Uranium-233+234	06/11/2015			91.0			
MW-3040	Uranium-233+234	06/12/2015			45.0			
MW-3140	Uranium-233+234	06/12/2015			42.0			
MW-4036	Uranium-233+234	06/12/2015			96.0			
MW-4040	Uranium-233+234	06/12/2015			20.0			
MW-4043	Uranium-233+234	06/12/2015			62.0			
MW-3040	Uranium-233+234	06/12/2015			58.0			0.06
MW-4036	Uranium-233+234	06/12/2015			75.0			1.47
MWS-1	Uranium-233+234	06/13/2015			94.0			
Blank	Uranium-233+234	06/13/2015	0.0190	U	106.0			
Blank	Uranium-235	06/13/2015	0.0136	U				
MW-2023	Uranium-235/236	06/11/2015						0.03
MW-2023	Uranium-235/236	06/11/2015						
MW-3040	Uranium-235/236	06/11/2015						
MW-4036	Uranium-235/236	06/11/2015						
MW-3040	Uranium-235/236	06/12/2015						1.54
MW-4036	Uranium-235/236	06/12/2015						0.44
MW-2023	Uranium-238	06/11/2015						0.29
Blank_Spike	Uranium-238	06/11/2015				104.00		
MW-2023	Uranium-238	06/11/2015					106.0	

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15046982 **Lab Code:** GEN **Date Due:** 06/16/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 06/16/2015

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
MW-3040	Uranium-238	06/11/2015					101.0	
MW-4036	Uranium-238	06/11/2015					87.4	
MW-3040	Uranium-238	06/12/2015						0.47
MW-4036	Uranium-238	06/12/2015						1.55
Blank	Uranium-238	06/13/2015	0.0030	U				

Data Review and Validation Report

General Information

Report Number (RIN): 15046977
Sample Event: May 4-13, 2015
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-69359-1
Analysis: Organics and Wet Chemistry
Validator: Stephen Donivan
Review Date: August 4, 2015

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
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
280-69359-16	MW-4036	2,4-Dinitrotoluene	J	chromatographic resolution
280-69359-16	MW-4036	Nitrate+Nitrite as N	J	Field duplicate precision
280-69359-21	MW-4036 Duplicate	2,4-Dinitrotoluene	J	chromatographic resolution

Sample Number	Location	Analyte(s)	Flag	Reason
280-69359-21	MW-4036 Duplicate	Nitrate+Nitrite as N	J	Field duplicate precision

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 26 water samples on May 14, 2015, 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 3.6 °C and 5.4 °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 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 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 May 20, 2015, using eight calibration standards. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

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 May 14 and 16, 2015, using seven 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 May 27, 2015, 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.

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.

Wet Chemistry
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.

Organics
The method 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 nitroaromatics surrogate recoveries were within the acceptance ranges.

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 4 times the spike concentration. All matrix spike recoveries were within the acceptance range with the following exception. The nitrate+nitrite as

N spike recoveries were above the laboratory acceptance range, but within the validation criteria of 120% , not requiring qualification.

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 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.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for nitroaromatics 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 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 29, 2015. 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 potential outliers identified and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 01/01/2005

Laboratory: TestAmerica Denver
RIN: 15046977
Report Date: 08/04/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-3030	N001	05/11/2015	cis-1,2-Dichloroethene	5.20			12.0		F	5.50		F	12	0	No
WEL01	MW-4036	N002	05/11/2015	2,4-Dinitrotoluene	0.0230	J		0.130		J	0.0260	J	F	16	8	No
WEL01	MW-4041	N001	05/12/2015	Nitrate + Nitrite as Nitrogen	0.370			0.330		F	0.113		F	9	0	No
WEL01	MWS-1	N001	05/11/2015	Nitrate + Nitrite as Nitrogen	22.0			20.0		FQ	1.72		FQ	9	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

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-2021, MW-2035, MW-3003, MW-3006, MW-3024, MW-3037, MW-3040, MW-4007, MW-4022, 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.

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-2021 and MW-4036. The relative percent difference (RPD) 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 with the exception of the nitrate+nitrite as N RPD at location MW-4036, which was above the criteria at 29 percent. There were no analytical errors identified during the review of the data. The nitrate+nitrite as N results for this location are qualified with a “J” flag as estimated values.

Trip Blank

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 target compounds detected in this blank.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Stephen Donivan

Stephen E. Donivan
2015.08.07 08:03:33
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Report Prepared By: ______________________________
Stephen Donivan
Laboratory Coordinator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15046977 **Lab Code:** STD **Validator:** Stephen Donivan **Validation Date:** 08/04/2015

Project: Weldon Spring LTS&M **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	All analyses were completed within the applicable holding times.
☑ Detection Limits	There are 0 detection limit failures.
☑ Field/Trip Blanks	There was 1 trip/equipment blank evaluated.
☑ Field Duplicates	There were 2 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15046977 **Lab Code:** STD **Project:** Weldon Spring LTS&M **Validation Date:** 08/04/2015

Duplicate: MW-2121 **Sample:** MW-2021

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
Nitrate+Nitrite as N	0.019	U		1	0.019	U		1			mg/L

Duplicate: MW-4136 **Sample:** MW-4036

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
1,2-Dichloroethane	0.13	U		1	0.13	U		1			ug/L
1,3,5-Trinitrobenzene	0.19			1	0.14			1	30.30		ug/L
1,3-Dinitrobenzene	0.017	J		1	0.014	J		1			ug/L
2,4,6-Trinitrotoluene	0.021	U		1	0.021	U		1			ug/L
2,4-Dinitrotoluene	0.038	J		1	0.023	J		1			ug/L
2,6-Dinitrotoluene	0.11			1	0.075	J		1			ug/L
cis-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Nitrate+Nitrite as N	16	F1		5	12			5	28.57		mg/L
Nitrobenzene	0.032	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
Vinyl Chloride	0.10	U		1	0.10	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15046977 **Lab Code:** STD **Date Due:** 06/11/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 05/29/2015

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	05/20/2015	0.000	1.0000	OK	OK	OK	103.00	106.0	106.0	0	
Nitrate+Nitrite as N	05/20/2015					OK	102.00	126.0	122.0	2.00	
Nitrate+Nitrite as N	05/20/2015					OK	103.00	103.0	103.0	1.00	

Data Review and Validation Report

General Information

Report Number (RIN):	15046936
Sample Event:	April 20-29, 2015
Site(s):	Weldon Spring LTS&M
Laboratory:	GEL Laboratories, Charleston, South Carolina
Work Order No.:	372094, 372103, 372109
Analysis:	Metals, Wet Chemistry, and Radiochemistry
Validator:	Gretchen Baer
Review Date:	June 17, 2015

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
Sulfate	WCH-A-036	EPA 300.0	EPA 300.0
Uranium	LMM-02	SW-846 3005A	SW-846 6020
Uranium Isotopes	LMR-02	U-02-RC Mod	U-02-RC Mod

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the attached validation worksheets and the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifiers

Sample Number	Location	Analyte	Flag	Reason
372103-007	MW-1044	Uranium	U	Less than 5 times the calibration blank
372094-008	MW-1004	All uranium isotopes	J	Tracer counts <400
372094-009	MW-1005	All uranium isotopes	J	Tracer counts <400

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 48 water samples on April 30, 2015, accompanied by Chain of Custody (COC) forms. The COC forms were 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 forms were 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 at 2 °C and in another cooler at ambient temperature, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses with the exception of the containers ofr SW-2005 and SW-2015. These bottles were received unpreserved and were acidified by the laboratory prior to analysis. No further qualification is necessary. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal 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 the *Quality Systems Manual*. 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 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 calibration and laboratory spike standards were prepared from independent sources.

Method EPA 300.0, Sulfate

Calibrations were performed on April 29, 2015, 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.

Method EPA 353.2, Nitrate + Nitrite as N

Calibrations were performed on May 1, 2015, using five calibration standards. The resulting calibration curve met the correlation coefficient and intercept acceptance criteria. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria.

Method SW-846 6010B, Iron

Calibrations were performed on May 4, 2015, 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.

Method SW-846 6020, Uranium

Calibrations were performed on May 14-15, 2015, 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.

Radiochemical Analysis

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 with two exceptions. The tracer recoveries for MW-1004 and MW-1005 were below 30 percent. A high concentration of uranium in the samples resulted in low chemical recovery. Because the tracer area counts were less than 400 the results for these locations are flagged with a "J" as estimated values. The full width at half maximum (FWHM) was reviewed to evaluate the spectral resolution. All internal standard FWHM values were below 100 kiloelectron volts (keV), demonstrating acceptable resolution. All internal standard peaks were within 50 keV of the expected position. The regions of interest (ROIs) for analyte peaks were reviewed. All ROIs were satisfactory and all manual integrations were performed correctly.

A comparison was made between the uranium isotopic data, converted to mg/L, and the uranium concentration measured by method SW-846 6020. The uranium isotopic concentrations were generally in agreement with the total uranium concentration reported for all samples. The relative percent differences (RPDs) were below 15 percent for all cases except for location MW-1048, with an RPD of approximately 50 percent. There were no errors noted and the results are acceptable.

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.

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 or when the sample is prepared from diluted samples. The spike recoveries met the acceptance criteria for all analytes evaluated. Some spike recoveries of sulfate exceeded the laboratory's acceptance criteria, but were within the ±25 percent data validation 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. 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. The serial dilution data met the serial dilution criteria, with the exception of uranium. The associated sample result has been previously qualified.

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. The analytical report included the MDL (MDC for radiochemistry) and PQL for all analytes and all required supporting documentation.

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 the wells MW-1005, MW-1009, MW-1028, MW-1031, MW-1046, MW-1047, and MW-1052 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. Duplicate samples were collected from locations MW-1015, SP-5304, SW-1003, and SW-2005. 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.

Electronic Data Deliverable (EDD) File

The EDD file arrived on May 28, 2015. 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 uranium result for location MW-1028 was identified as anomalously high. The data associated with this result were further reviewed. There were no errors noted and the data for this RIN are acceptable as qualified.

Gretchen K Baer

Gretchen Baer
2015.06.18 08:43:10 -06'00'

Report Prepared By: ____

Gretchen Baer
Data Validator

Data Validation Outliers Report - No Field Parameters

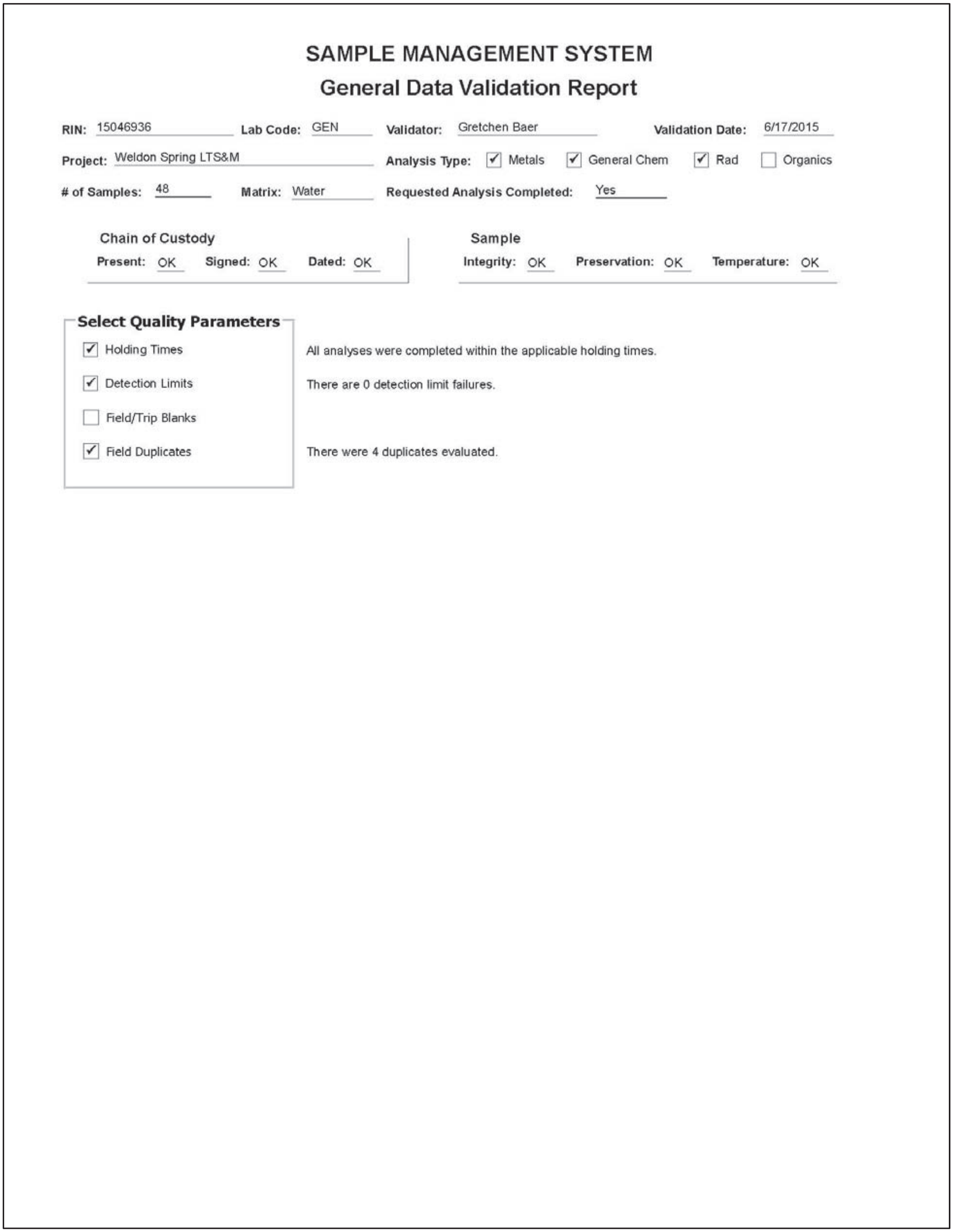
Comparison: All historical Data Beginning 1/1/2005

Laboratory: GEL Laboratories
RIN: 15046936
Report Date: 6/18/2015

					Current	*Qualifiers*		**Historical Maximum**	*Qualifiers*		**Historical Minimum**	*Qualifiers*		**Number of Data Points**		**Statistical Outlier**
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	SW-2005	N002	04/29/2015	Uranium	0.00586			0.00500	E	J	0.000574			10	0	NA
WEL01	SW-2005	N001	04/29/2015	Uranium	0.00592			0.00500	E	J	0.000574			10	0	NA
WEL02	MW-1015	N001	04/23/2015	Uranium	0.0888		F	0.346	N	FJ	0.0950		F	46	0	No
WEL02	MW-1028	N001	04/28/2015	Uranium	0.00473		FQ	0.00391		FQ	0.00188	E	FQ	34	0	Yes
WEL02	MW-1031	N001	04/27/2015	Uranium	0.0126		FQ	0.0230		FQ	0.0130		FQ	42	0	NA
WEL02	MW-1052	0001	04/28/2015	Iron	0.413		FQ	50.6		FQJ	0.506		FQ	41	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: 15046936 **Lab Code:** GEN **Validator:** Gretchen Baer **Validation Date:** 6/17/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☑ Rad ☐ Organics

# of Samples: 48 **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 4 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15046936 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 6/17/2015

Duplicate: MW-1115 **Sample:** MW-1015

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
Sulfate	103			20.00	105			20.00	1.92		mg/L
Uranium	88.8			1.00	97.3			1.00	9.13		ug/L
Uranium-233+234	31.7		4.25	1.00	32.0		4.12	1.00	0.94	0.1	pCi/L
Uranium-235/236	1.74		0.299	1.00	2.07		0.324	1.00	17.32	1.5	pCi/L
Uranium-238	32.5		4.34	1.00	33.0		4.25	1.00	1.53	0.2	pCi/L

Duplicate: SP-5314 **Sample:** SP-5304

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
NO2+NO3 as N	0.205			1.00	0.204			1.00	0.49		mg/L
Uranium	77.1			1.00	77.8			1.00	0.90		ug/L

Duplicate: SW-1103 **Sample:** SW-1003

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
Sulfate	20.4			2.00	20.6			20.00	0.98		mg/L
Uranium	85.2			1.00	85.5			1.00	0.35		ug/L
Uranium-233+234	25.8		3.65	1.00	24.8		3.18	1.00	3.95	0.4	pCi/L
Uranium-235/236	1.31		0.266	1.00	1.48		0.242	1.00	12.19	0.9	pCi/L
Uranium-238	25.2		3.56	1.00	25.3		3.24	1.00	0.40	0	pCi/L

Duplicate: SW-2105 **Sample:** SW-2005

	Sample				Duplicate						
Analyte	**Result**	**Flag**	**Error**	**Dilution**	**Result**	**Flag**	**Error**	**Dilution**	**RPD**	**RER**	**Units**
Uranium	5.92			1.00	5.86			1.00	1.02		ug/L

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15046936 **Lab Code:** GEN **Date Due:** 5/28/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 4/23/2015

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Iron	ICP/ES	05/04/2015	0.0000	0.9998	OK	OK	OK	103.0	100.0			92.0		103.0
Uranium	ICP/MS	05/14/2015			OK	OK	OK	104.0	102.0		2.0	106.0	10.0	111.0
Uranium	ICP/MS	05/14/2015							104.0		1.0	105.0	0.8	100.0
Uranium	ICP/MS	05/15/2015			OK	OK	OK	114.0	103.0		2.0	105.0	1.0	105.0
Uranium	ICP/MS	05/15/2015							99.4		1.0	109.0	1.0	101.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15046936
Lab Code: GEN
Date Due: 5/28/2015

Matrix: Water
Site Code: WEL01
Date Completed: 4/23/2015

Analyte	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB	Blank					
NO2+NO3 as N	05/01/2015	0.000	1.0000	OK	OK	OK	100.00	99.5		0	
Sulfate	04/30/2015	0.040	0.9997	OK	OK	OK	106.00	107.0		1.00	
Sulfate	05/01/2015			OK	OK	OK	107.00	113.0		0	
Sulfate	05/02/2015							113.0		2.00	
Sulfate	05/02/2015							116.0		0	

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15046936 **Lab Code:** GEN **Date Due:** 5/28/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 4/23/2015

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
MW-1004	Uranium-233+234	05/16/2015			15			
MW-1005	Uranium-233+234	05/16/2015			16			
MW-1015	Uranium-233+234	05/16/2015			56			
MW-1048	Uranium-233+234	05/16/2015			39			
MW-1115	Uranium-233+234	05/16/2015			60			
SW-1003	Uranium-233+234	05/16/2015			38			
SW-1103	Uranium-233+234	05/16/2015			69			
MW-1015	Uranium-233+234	05/16/2015			37			0.19
SW-1003	Uranium-233+234	05/16/2015			63			0.36
MW-1015	Uranium-233+234	05/16/2015			81			
SW-1003	Uranium-233+234	05/16/2015			56			
Blank	Uranium-233+234	05/16/2015	0.0289	U	85			
MW-1006	Uranium-233+234	05/20/2015			32			
MW-1051	Uranium-233+234	05/20/2015			31			
MW-1006	Uranium-233+234	05/20/2015			36			0.21
Blank_Spike	Uranium-233+234	05/20/2015			85			
Blank	Uranium-233+234	05/20/2015	0.3440		94			
MW-1006	Uranium-233+234	05/21/2015			36			
Blank	Uranium-235	05/16/2015	0.0163	U	85			
Blank	Uranium-235	05/20/2015	0.0946	U	94			
MW-1015	Uranium-235/236	05/16/2015						0.04
SW-1003	Uranium-235/236	05/16/2015						1.46
MW-1015	Uranium-235/236	05/16/2015						
SW-1003	Uranium-235/236	05/16/2015						
MW-1006	Uranium-235/236	05/20/2015						0.4
MW-1006	Uranium-235/236	05/21/2015						
MW-1015	Uranium-238	05/16/2015						0.09
SW-1003	Uranium-238	05/16/2015						0.32
Blank_Spike	Uranium-238	05/16/2015				98.6		
MW-1015	Uranium-238	05/16/2015					92.2	
SW-1003	Uranium-238	05/16/2015					101	
Blank	Uranium-238	05/16/2015	0.0210	U	85			

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15046936 **Lab Code:** GEN **Date Due:** 5/28/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 4/23/2015

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
MW-1006	Uranium-238	05/20/2015						0.05
Blank_Spike	Uranium-238	05/20/2015				104		
Blank	Uranium-238	05/20/2015	0.1530	U	94			
MW-1006	Uranium-238	05/21/2015						

Data Review and Validation Report

General Information

Report Number (RIN): 15036906
Sample Event: April 6, 2015
Site(s): Weldon Spring
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 370596
Analysis: Metals, Radiochemistry, and Wet Chemistry
Validator: Gretchen Baer
Review Date: June 17, 2015

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/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
Chemical Oxygen Demand	WCH-A-010	EPA 410.4	EPA 410.4
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
Gross Alpha/Beta	GPC-A-001	EPA 900.0	EPA 900.0
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, TSS	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
370596-002	LW-DC12	Gross Alpha	J	Less than the Determination Limit
370596-002	LW-DC12	Mercury	J	Matrix spike recovery
370596-002	LW-DC12	Radium-226	J	Less than the Determination Limit
370596-004	LW-DC12 Duplicate	Gross Alpha	J	Less than the Determination Limit
370596-004	LW-DC12 Duplicate	Mercury	J	Matrix spike recovery
370596-004	LW-DC12 Duplicate	Radium-226	J	Less than the Determination Limit

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received four water samples on April 8, 2015, 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 1 °C, which complies with requirements. All 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 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 the *Quality Systems Manual*. 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 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 410.4, Chemical Oxygen Demand

The initial calibrations were performed using five calibration standards on April 15, 2015. 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 D, Total Suspended Solids

There is no initial or continuing calibration requirement associated with the determination of total suspended solids.

Method SW-846 6020, Metals

Calibrations were performed April 29 – May 1, 2015, 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 7470A, Mercury

Calibration was performed April 10, 2015, using five 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.

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.

Gross Alpha/Beta
Plateau voltage determinations and detector efficiency calibrations were performed more than one year previous to the sample analysis and verified on September 30, 2014. Daily instrument checks performed on April 30, 2015, met the acceptance criteria.

Radium-226
Emanation cell plateau voltage determinations and cell efficiency calibrations were performed within a year previous to sample analysis. The daily calibration checks performed on May 7, 2015, met the acceptance criteria.

Radium-228
Plateau voltage determinations and detector efficiency calibrations were performed more than one year previous to the sample analysis and verified on September 30, 2014. Daily instrument checks performed on April 28, 2015, 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. With the exception of thorium-230, the radiochemistry method blank results were less than the DLC. The associated sample results for thorium-230 were less than the MDC, so no results were qualified.

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 4 times the spike concentration. The spike results met the recovery and precision criteria for all analytes evaluated with the following exception. The mercury spike recoveries for location LW-DC12 were below 30 percent. Mercury spike recoveries are typically very low for this location; therefore, the results are qualified with a “J” flag (estimated).

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.

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 May 7, 2015. 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 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-DC12. 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 K Baer

Gretchen Baer
2015.06.17 12:49:55
-06'00'

Report Prepared By: ______________________________

Gretchen Baer
Data Validator

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2005
Laboratory: GEL Laboratories
RIN: 15036906
Report Date: 6/17/2015

					Current			Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	LW-DC12	N002	04/06/2015	Manganese	0.0150			0.929			0.0169			32	0	No
WEL01	LW-DC12	N001	04/06/2015	Manganese	0.0154			0.929			0.0169			32	0	No
WEL01	LW-DC12	N001	04/06/2015	Uranium	0.00838			0.00759			0.00042	B		70	6	NA
WEL01	LW-DC12	N002	04/06/2015	Uranium	0.00853			0.00759			0.00042	B		70	6	NA
WEL01	LW-DC12	0001	04/06/2015	Uranium	0.00820			0.00759			0.00042	B		70	6	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: 15036906 **Lab Code:** GEN **Validator:** Gretchen Baer **Validation Date:** 6/17/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☐ Rad ☐ Organics

# of Samples: 4 **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 was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15036906 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 6/17/2015

Duplicate: LW-DC99 **Sample:** LW-DC12

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
ALPHA	4.78		2.04	1.00	5.63		2.14	1.00		0.6	pCi/L
Arsenic	2.85	B		1.00	2.39	B		1.00			ug/L
Barium	250			5.00	244			5.00	2.43		ug/L
BETA	8.92		1.89	1.00	10.5		2.25	1.00	16.27	1.1	pCi/L
Chemical Oxygen Demand	23.3			1.00	15.3	J		1.00			mg/L
Chromium	2.00	U		1.00	2.00	U		1.00			ug/L
Copper	6.18			1.00	7.61			1.00	20.74		ug/L
Iron	100			1.00	106			1.00			ug/L
Lead	0.500	U		1.00	0.500	U		1.00			ug/L
Manganese	15.4			1.00	15			1.00	2.63		ug/L
Mercury	0.067	UN		1.00	0.067	UN		1.00			ug/L
Nickel	3.12	B		1.00	3.31	B		1.00	5.91		ug/L
Radium-226	0.932		0.544	1.00	0.917		0.458	1.00		0	pCi/L
Radium-228	-0.226	U	0.406	1.00	0.278	U	0.447	1.00		1.6	pCi/L
Selenium	2.25	B		1.00	1.69	B		1.00			ug/L
Silver	0.200	U		1.00	0.200	U		1.00			ug/L
Thorium-228	0.103	U	0.0973	1.00	-0.0701	U	0.0811	1.00		2.7	pCi/L
Thorium-230	-0.016	U	0.121	1.00	0.0933	U	0.150	1.00		1.1	pCi/L
Thorium-232	0.00697	U	0.0867	1.00	-0.0488	U	0.0803	1.00		0.9	pCi/L
Total Suspended Solids	1.14	U		1.00	1.10	U		1.00			mg/L
Uranium	8.38			1.00	8.53			1.00	1.77		ug/L
Zinc	11.8	B		1.00	16.2			1.00			ug/L

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15036906 **Lab Code:** GEN **Date Due:** 5/6/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 5/7/2015

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	04/10/2015	-0.0200	1.0000	OK	OK	OK	99.5	21.0					
Mercury	CVAA	04/10/2015							22.3					95.0
Arsenic	ICP/MS	05/01/2015			OK	OK	OK	107.0	104.0			94.0		99.0
Barium	ICP/MS	04/30/2015							118.0		1.0	104.0		100.0
Barium	ICP/MS	04/29/2015			OK	OK	OK	103.0				101.0		101.0
Chromium	ICP/MS	04/30/2015							98.9					
Chromium	ICP/MS	04/29/2015			OK	OK	OK	105.0				90.0		106.0
Copper	ICP/MS	04/30/2015							97.1		1.0			
Copper	ICP/MS	04/29/2015			OK	OK	OK	108.0				85.0		104.0
Iron	ICP/MS	04/30/2015							103.0		0.0			
Iron	ICP/MS	04/29/2015			OK	OK	OK	112.0				104.0		112.0
Lead	ICP/MS	04/30/2015							99.6					
Lead	ICP/MS	04/29/2015			OK	OK	OK	103.0				94.0		105.0
Manganese	ICP/MS	04/30/2015							98.3		0.0			
Manganese	ICP/MS	04/29/2015			OK	OK	OK	107.0				94.0		106.0
Nickel	ICP/MS	04/30/2015							95.4		1.0			
Nickel	ICP/MS	04/29/2015			OK	OK	OK	107.0				83.0		106.0

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15036906 **Lab Code:** GEN **Date Due:** 5/6/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 5/7/2015

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Selenium	ICP/MS	04/30/2015							96.0					
Selenium	ICP/MS	04/29/2015			OK	OK	OK	107.0				95.0		102.0
Silver	ICP/MS	04/30/2015							102.0					
Silver	ICP/MS	04/29/2015			OK	OK	OK	107.0				93.0		103.0
Uranium	ICP/MS	04/30/2015							109.0		1.0			
Uranium	ICP/MS	04/29/2015			OK	OK	OK	107.0				101.0	8.0	117.0
Zinc	ICP/MS	04/30/2015							95.1		2.0			
Zinc	ICP/MS	04/29/2015			OK	OK	OK	109.0				89.0		103.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15036906 **Lab Code:** GEN **Date Due:** 5/6/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 5/7/2015

Analyte	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB	Blank					
Chemical Oxygen Demand	04/15/2015	-17.000	0.9980	OK	OK	OK	104.00	106.0		0	
Total Suspended Solids	04/09/2015					OK	102.00				
Total Suspended Solids	04/09/2015						101.00			0	

Page 1 of 1

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 15036906 **Lab Code:** GEN **Date Due:** 5/6/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 5/7/2015

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
Blank	ALPHA	04/30/2015	-0.2210	U				
LW-DC12	ALPHA	04/30/2015					107.0	
LW-DC12	ALPHA	04/30/2015						0.37
Blank_Spike	ALPHA	05/03/2015				108.00		
Blank	Beta	04/30/2015	-0.4970	U				
LW-DC12	BETA	04/30/2015						0.63
LW-DC12	BETA	04/30/2015					115.0	
Blank_Spike	BETA	05/03/2015				117.00		
Blank	Radium-226	05/07/2015	0.1770	U				
Blank_Spike	Radium-226	05/07/2015				121.00		
LW-DC12	Radium-226	05/07/2015					108.0	
LW-DC12	Radium-226	05/07/2015						0.51
LW-DC12	Radium-228	04/28/2015			84.0			
LW-DC99	Radium-228	04/28/2015			90.0			
LW-DC12	Radium-228	04/28/2015			94.0			1.99
Blank_Spike	Radium-228	04/28/2015			91.0	83.30		
Blank	Radium-228	04/28/2015	0.0614	U	86.0			
LW-DC12	Thorium-228	04/14/2015			87.0			
LW-DC99	Thorium-228	04/14/2015			94.0			
LW-DC12	Thorium-228	04/14/2015			87.0			2.14
Blank	Thorium-228	04/14/2015	-0.0012	U	84.0			
LW-DC12	Thorium-230	04/14/2015						2.31
Blank	Thorium-230	04/14/2015	0.5570		84.0			
LW-DC12	Thorium-232	04/14/2015						0.21
Blank_Spike	Thorium-232	04/14/2015				96.30		
Blank	Thorium-232	04/14/2015	0.0075	U	84.0			

Data Review and Validation Report

General Information

Report Number (RIN): 15036845
Sample Event: March 18, 2015
Site(s): Weldon Spring LTS&M
Laboratory: GEL Laboratories, Charleston, South Carolina
Work Order No.: 369145
Analysis: Metals and Wet Chemistry
Validator: Alison Kuhlman
Review Date: May 4, 2015

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

None of the analytical results required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 10 water samples on March 19, 2015, accompanied by Chain of Custody (COC) forms. The COC forms were 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 forms were 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 at 2 °C and in another cooler at ambient temperature, 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 IC8 was performed on March 14, 2015, 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 March 30, 2015, 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 March 31, 2015, 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 or when the sample is prepared from diluted samples. The spike recoveries met the acceptance 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 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. The serial dilution data met the serial dilution criteria, with the exception of uranium. The associated sample result has been previously qualified.

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 April 16, 2015. 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 for this RIN are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2005

Laboratory: GEL Laboratories

RIN: 15036845

Report Date: 5/4/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL02	RMW-2	0001	03/18/2015	Iron	13.2			12.4			6.03			9	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 high-flow method detailed in program directive WEL-2015-01. No further action is required.

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 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. Duplicate samples were collected from location RMW-3. The duplicate results met the criteria, demonstrating acceptable overall precision.

Report Prepared By: Alison Kuhlman Alison E. Kuhlman
2015.05.04 16:05:42 -06'00'

Alison Kuhlman
Data Validator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15036845 **Lab Code:** GEN **Validator:** Alison Kuhlman **Validation Date:** 5/4/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☐ Rad ☐ Organics

# of Samples: 10 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There were 2 duplicates evaluated.

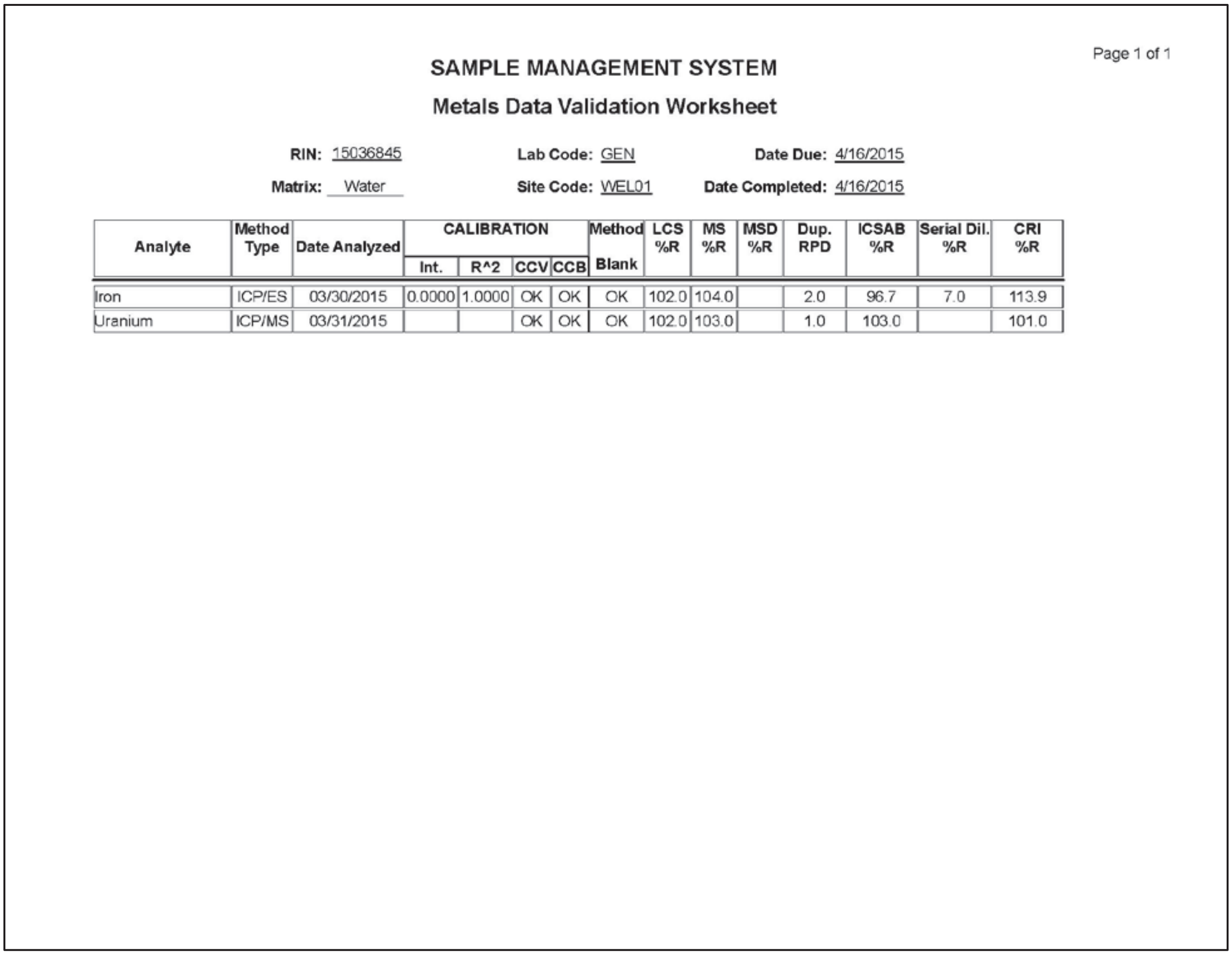
SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15036845 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 5/4/2015

Duplicate: RMW-5 **Sample:** RMW-3

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Iron	15400			1.00	16100			1.00	4.44		ug/L
Sulfate	15.7			1.00	15.5			1.00	1.28		mg/L
Uranium	0.323			1.00	0.322			1.00			ug/L



Page 1 of 1

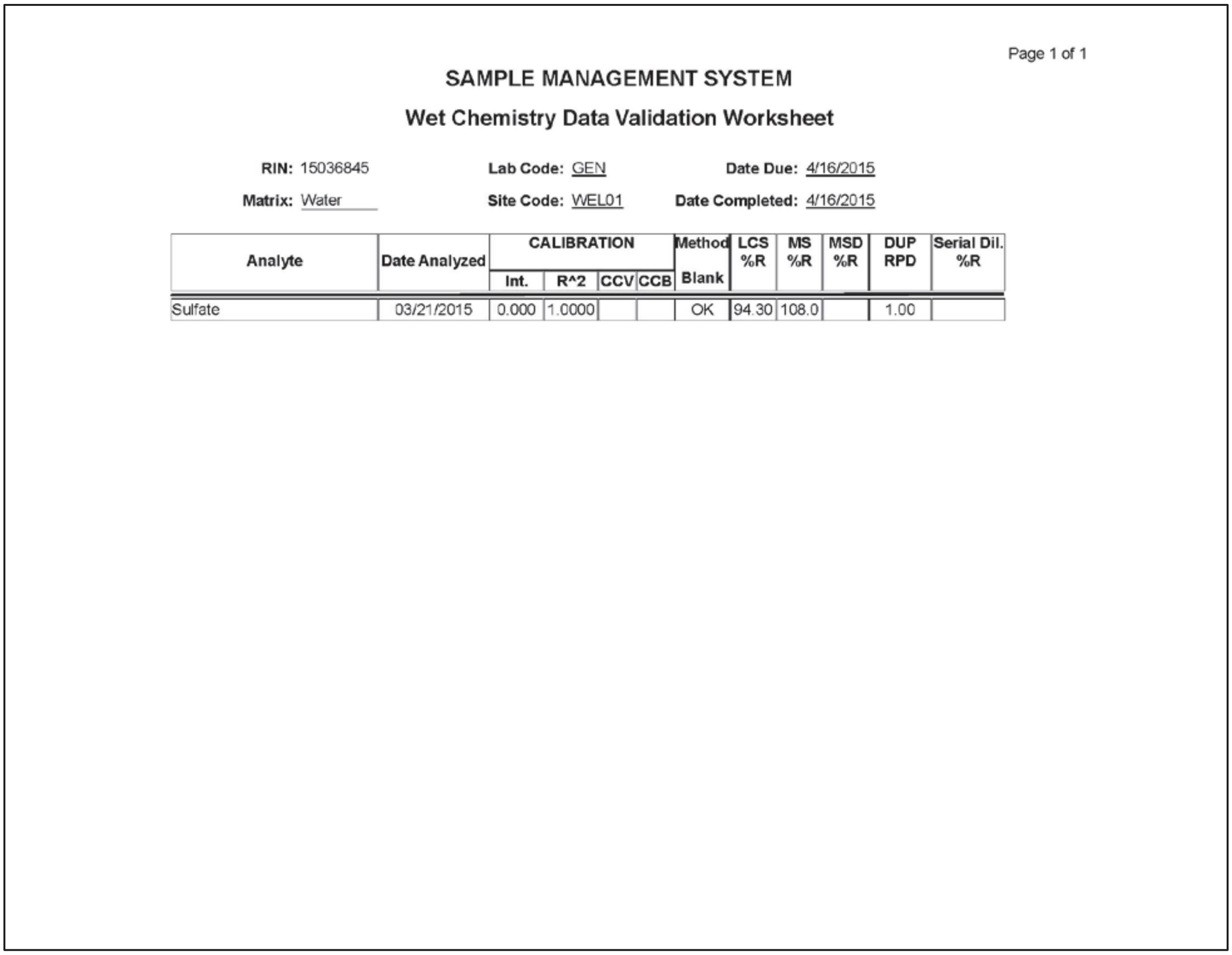
SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15036845 **Lab Code:** GEN **Date Due:** 4/16/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 4/16/2015

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	03/30/2015	0.0000	1.0000	OK	OK	OK	102.0	104.0		2.0	96.7	7.0	113.9
Uranium	ICP/MS	03/31/2015			OK	OK	OK	102.0	103.0		1.0	103.0		101.0



SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15036845

Lab Code: GEN

Date Due: 4/16/2015

Matrix: Water

Site Code: WEL01

Date Completed: 4/16/2015

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Sulfate	03/21/2015	0.000	1.0000			OK	94.30	108.0		1.00	

Data Review and Validation Report

General Information

Report Number (RIN):	15026826
Sample Event:	March 2, 2015
Site(s):	Weldon Spring
Laboratory:	TestAmerica, Denver, Colorado
Work Order No.:	368185
Analysis:	Metals and Wet Chemistry
Validator:	Alison Kuhlman
Review Date:	April 9, 2015

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
Uranium	LMM-02	SW-846 3010A	SW-846 6020

Data Qualifier Summary

None of the analytical results required qualification.

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 2 water samples on March 6, 2015, 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 shipments were received intact with the temperature inside the iced cooler of 2 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses and all samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal 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 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 11, 2105, using five calibration standards. The resulting calibration curve met the correlation coefficient and intercept acceptance criteria. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria.

Method SW-846 6020, Uranium

Calibrations were performed on March 11, 2015, 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 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 (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.

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. A uranium post digestion spike was prepared and analyzed with acceptable results.

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.

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 23, 2015. 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 potential outliers identified and the data from this event are acceptable as qualified.

Sampling Protocol

Sample results for all monitoring wells met the Category II low-flow sampling criteria and were qualified with both a “Q” flag and an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

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-2023. The duplicate results met the criteria, demonstrating acceptable overall precision.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Report Prepared By: Alison Kuhlman

Alison E. Kuhlman
2015.04.10 13:44:51 -06'00'

Alison Kuhlman
Data Validator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15026826 **Lab Code:** GEN **Validator:** Alison Kuhlman **Validation Date:** 4/9/2015

Project: Weldon Spring LTS&M **Analysis Type:** ☑ Metals ☑ General Chem ☐ Rad ☐ Organics

# of Samples: 2 **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	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There was 1 duplicate evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15026826 **Lab Code:** GEN **Project:** Weldon Spring LTS&M **Validation Date:** 4/9/2015

Duplicate: MW-2123 **Sample:** MW-2023

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
NO2+NO3 as N	0.017	U		1.00	0.017	U		1.00			mg/L
Uranium	2.6			1.00	2.61			1.00	0.38		ug/L

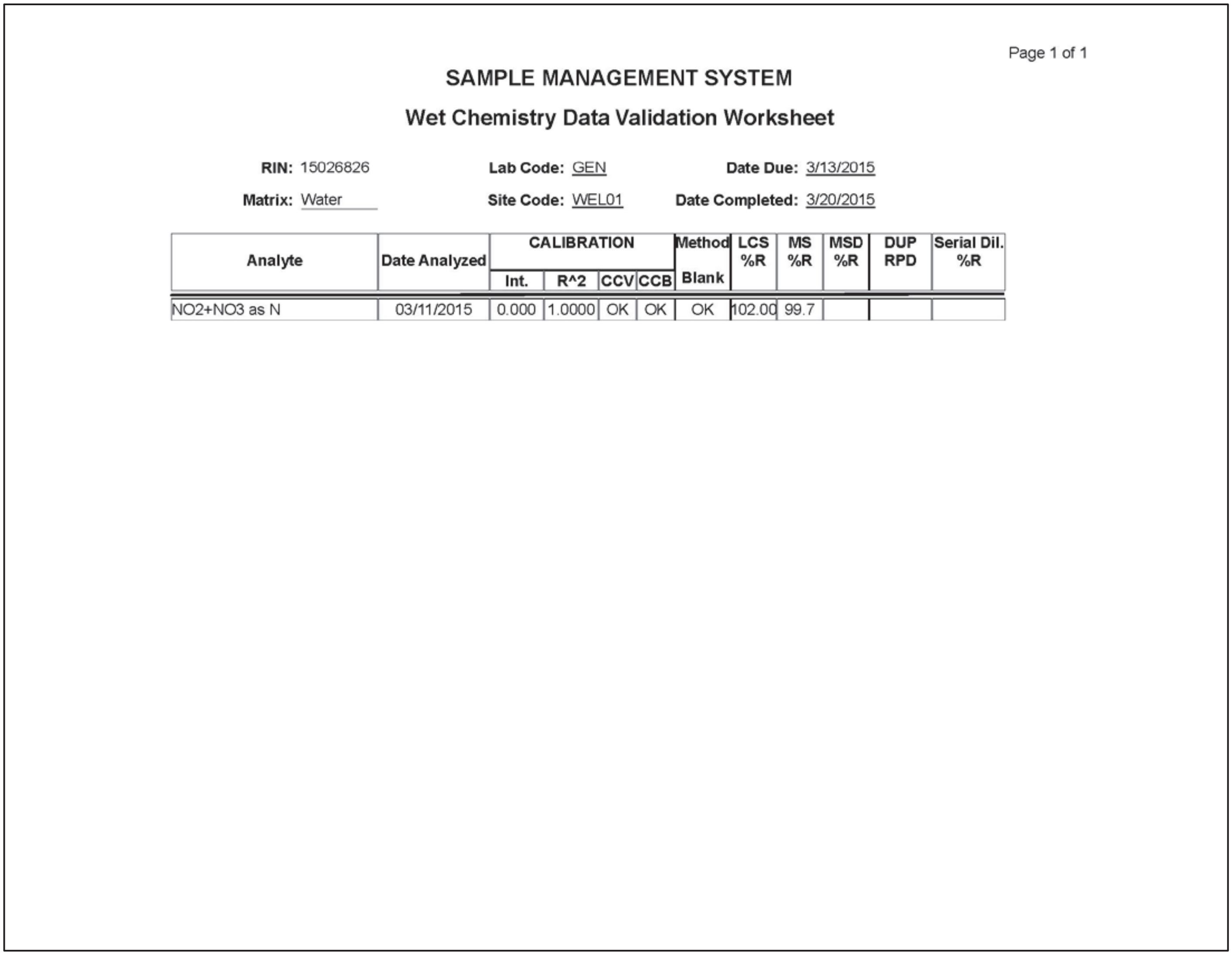
SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 15026826 **Lab Code:** GEN **Date Due:** 3/13/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 3/20/2015

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Uranium	ICP/MS	03/11/2015			OK	OK	OK	104.0	103.0		1.0	103.0	10.0	114.5



Page 1 of 1

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15026826 **Lab Code:** GEN **Date Due:** 3/13/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 3/20/2015

Analyte	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB	Blank					
NO2+NO3 as N	03/11/2015	0.000	1.0000	OK	OK	OK	102.00	99.7			

Data Review and Validation Report

General Information

Report Number (RIN): 15026794
Sample Event: February 23-24, 2015
Site(s): Weldon Spring
Laboratory: TestAmerica, Denver, Colorado
Work Order No.: 280-65798-1
Analysis: Metals, Organics, and Wet Chemistry
Validator: Gretchen Baer
Review Date: May 15, 2015

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
280-65798-8	MW-1006	1,3,5-Trinitrobenzene	J	Chromatographic peak resolution
280-65798-8	MW-1006	2,4-Dinitrotoluene	J	Chromatographic peak resolution
280-65798-24	SP-6301	Uranium	J	MS recovery > upper limit
280-65798-25	SP-6311	Uranium	J	MS recovery > upper limit

Sample Shipping/Receiving

TestAmerica in Denver, Colorado, received 26 water samples on February 26, 2015, 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 1.5 °C and 3.4 °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 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 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 February 16, 2015. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method EPA 353.2, Nitrate + Nitrite as N
Calibrations were performed on March 13, 2015, using six calibration standards. 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. A reporting limit verification check was made to verify the linearity of the calibration curve near the PQL and all results were acceptable.

Method SW-846 6010B, Iron
Calibrations were performed on February 27, 2015, 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 PQL. The reporting limit check result met the acceptance criteria.

Method SW-846 6020, Uranium
Calibrations were performed on February 27, 2015, 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 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 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 7 and 17, 2015, using seven 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 10, 2015, 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. Nitrobenzene and 2,4,6-trinitrotoluene had percent drift values greater than 20 percent. There were no sample results greater than the MDL associated with these calibration verification compounds, so no qualification is necessary.

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 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.

Organics
The method blank results were below the MDL for all target compounds.

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.

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 nitroaromatics surrogate recoveries were within the acceptance ranges.

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 4 times the spike concentration. with the following exception. A spike recovery for uranium was above the acceptance range. Associated results above the MDL are qualified with a "J" flag (estimated).

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 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 March 20, 2015. 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 potential outliers identified and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters

Comparison: All historical Data Beginning 1/1/2008

Laboratory: TestAmerica Denver
RIN: 15026794
Report Date: 5/15/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL02	MW-1002	N001	02/23/2015	2,6-Dinitrotoluene	0.0240	J	F	0.880		F	0.0330	J	F	18	0	No
WEL02	MW-1002	N001	02/23/2015	Sulfate	76.0		F	101		F	78.0		FQ	19	0	No
WEL02	MW-1030	N001	02/23/2015	Sulfate	40.0		FQ	146			43.6		FQ	16	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

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-1005, MW-1012, MW-1027, MW-1030, MW-1032, 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. Duplicate samples were collected from locations MW-1027 and SP-6301. The relative percent difference (RPD) 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 with the exception of the uranium RPD at location MW-1027, which was above the criteria at 42 percent. There were no analytical errors identified during the review of the data. The uranium results for this location are qualified with a “J” flag as estimated values.

Trip Blank

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 target compounds detected in this blank.

Field Measurements

Daily calibration checks were performed as required with acceptable results.

Gretchen K Baer

Gretchen Baer
2015.05.15 14:14:33 -06'00'

Report Prepared By: ____
Gretchen Baer
Data Validator

SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 15026794 **Lab Code:** STD **Validator:** Gretchen Baer **Validation Date:** 5/15/2015

Project: Weldon Spring LTS&M **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	All analyses were completed within the applicable holding times.
☑ Detection Limits	The reported detection limits are equal to or below contract requirements.
☑ Field/Trip Blanks	There was 1 trip/equipment blank evaluated.
☑ Field Duplicates	There were 3 duplicates evaluated.

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 15026794 **Lab Code:** STD **Project:** Weldon Spring LTS&M **Validation Date:** 5/15/2015

Duplicate: MW-1127 **Sample:** MW-1027

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
Iron	22	U		1	28	J		1			ug/L
Sulfate	55			1	56			1	1.80		mg/L
Uranium	130			1	85			1	41.86		ug/L

Duplicate: SP-6311 **Sample:** SP-6301

	Sample				Duplicate						
Analyte	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution	RPD	RER	Units
1,2-Dichloroethane	0.13	U		1	0.13	U		1			ug/L
1,3,5-Trinitrobenzene	0.016	U		1	0.017	U		1			ug/L
1,3-Dinitrobenzene	0.013	U		1	0.014	U		1			ug/L
2,4,6-Trinitrotoluene	0.021	U		1	0.022	U		1			ug/L
2,4-Dinitrotoluene	0.018	U		1	0.019	U		1			ug/L
2,6-Dinitrotoluene	0.045	J		1	0.042	J		1			ug/L
cis-1,2-Dichloroethene	0.15	U		1	0.15	U		1			ug/L
Nitrate+Nitrite as N	2.3			1	2.2	B		1	4.44		mg/L
Nitrobenzene	0.031	U		1	0.033	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	64			1	65			1	1.55		ug/L
Vinyl Chloride	0.10	U		1	0.10	U		1			ug/L

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 15026794 **Project:** Weldon Spring LTS&M **Lab Code:** STD **Validation Date:** 5/15/2015

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: 15026794　**Lab Code:** STD　**Date Due:** 3/26/2015

Matrix: Water　**Site Code:** WEL01　**Date Completed:** 3/20/2015

Analyte	Method Type	Date Analyzed	CALIBRATION				Method	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB	Blank							
Iron	ICP/ES	02/27/2015			OK	OK	OK	99.0	100.0	94.0	7.0	95.0		105.0
Uranium	ICP/MS	02/27/2015			OK	OK	OK	101.0				100.0	1.1	98.0
Uranium	ICP/MS	02/28/2015							98.0	100.0	0.0	108.0		
Uranium	ICP/MS	03/03/2015			OK	OK	OK	106.0	122.0	132.0	4.0	99.0	3.3	104.0

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 15026794 **Lab Code:** STD **Date Due:** 3/26/2015

Matrix: Water **Site Code:** WEL01 **Date Completed:** 3/20/2015

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	03/11/2015	0.034	0.9992	OK	OK	OK	107.00	104.0	104.0	0	
Nitrate+Nitrite as N	03/13/2015					OK	95.00				
Sulfate	02/26/2015			OK	OK	OK	97.00	92.0	100.0	3.00	
Sulfate	02/26/2015									0.20	
Sulfate	02/27/2015							102.0	103.0	0	

U.S. DEPARTMENT OF ENERGY | Legacy Management

Data Review and Validation Report

General Information

Report Number (RIN):	15016756
Sample Event:	February 2 – 12, 2015
Site(s):	Weldon Spring LTS&M
Laboratory:	GEL Laboratories, Charleston, South Carolina
Work Order No.:	367308, 367316, and 367317
Analysis:	Metals and Wet Chemistry
Validator:	Alison Kuhlman
Review Date:	May 4, 2015

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 2. 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
367308028	MW-1017	Uranium	U	Less than 5 times the calibration blank
367308038	MW-1050	Uranium	U	Less than 5 times the calibration blank
367316020	MWD-2	Uranium	U	Less than 5 times the calibration blank

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received 66 water samples on February 18, 2015, accompanied by Chain of Custody (COC) forms. The COC forms were 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 forms were 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 at 2 °C and in another cooler at ambient temperature, 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 IC8 was performed on February 10, 2015, 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 24 and February 26, 2015, 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 March 11 and March 12, 2015, 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 or when the sample is prepared from diluted samples. The spike recoveries met the acceptance 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 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. The serial dilution data met the serial dilution criteria, with the exception of uranium. The associated sample result has been previously qualified.

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 19, 2015. 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 uranium results for locations MW-4007, MW-1009, MW-1051, and SW-1003 were identified as statistical outliers. 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 1/1/2005

Laboratory: GEL Laboratories
RIN: 15016756
Report Date: 5/4/2015

					Current			**Historical Maximum**			**Historical Minimum**			**Number of Data Points**		**Statistical Outlier**
						Qualifiers			*Qualifiers*			*Qualifiers*				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	*Lab*	*Data*	Result	*Lab*	*Data*	Result	*Lab*	*Data*	N	N Below Detect	
WEL01	MW-4007	N001	02/02/2015	Uranium	0.00490			0.00431		FQ	0.00290		FQ	18	0	Yes
WEL02	MW-1009	N001	02/09/2015	Uranium	0.111			0.0271	E	FQ	0.00017	B	UFQ	41	7	Yes
WEL02	MW-1051	N001	02/12/2015	Sulfate	205			199		FQ	10.9		FQ	42	0	No
WEL02	MW-1051	N001	02/12/2015	Uranium	3.01			2.15	N	FQJ	0.354		FQ	42	0	Yes
WEL02	SW-1003	N001	02/09/2015	Uranium	0.182			0.174			0.0191			36	0	Yes
WEL02	SW-1010	N001	02/09/2015	Uranium	0.0120			0.128			0.0168			28	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.

Appendix I

CD of Report