DOE–LM/GJ1158–2006

Weldon Spring Site
Third Five-Year Review

September 2006

U.S. Department of Energy

Office of Legacy Management

Work Performed Under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy Office of Legacy Management.

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Acronyms

AEC	Atomic Energy Commission
ARAR	applicable or relevant and appropriate requirement
Bq/L	becquerel per liter
BTLs	baseline tolerance limits
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
cm/sec	centimeters per second
CMSA	construction material staging area
COC	contaminants of concern
COD	chemical oxygen demand
CPOU	Chemical Plant Operable Unit
CSS	chemical stabilization/solidification
DA	Department of the Army
DNB	dinitrobenzene
DNT	dinitrotoluene
DOE	U.S. Department of Energy
DOE−LM	U.S. Department of Energy Office of Legacy Management
DOJ	Department of Justice
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Difference
FFA	Federal Facility Agreement
FIMS	Facilities Information Management System
ft	feet
ft/d	feet per day
ft/mi	feet per mile
FY	fiscal year
gpa	gallons per acre
gpd	gallons per day
gpm	gallons per month
GPS	global positioning system
GWOU	Groundwater Operable Unit
ha	hectare(s)
HDPE	high-density polyethylene
HEAST	Health Effects Summary Tables
ICs	institutional controls
ICO	in situ chemical oxidation
IRA	Interim Response Action
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
K	Conductivity
kg	kilogram(s)
kg/yr	kilograms per year
km	kilometer
lb	pound(s)
lbs/yr	pounds per year

LCRS	Leachate Collection and Removal System
LIDAR	Light Detection and Ranging
LTS&M	Long-Term Surveillance and Maintenance
m	meter(s)
mCi	millicuries
MCL	maximum contaminant level
MEI	maximally exposed individual
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
mg	milligram(s)
mg/L	milligram(s) per liter
m/km	meters per kilometer
MoDOT	Missouri Department of Transportation
MNA	monitored natural attenuation
MOU	Memorandum of Understanding
mrem	millirem
MSD	Metropolitan St. Louis Sewer District
msl	mean sea level
MW	Monitoring Well
MWQS	Missouri Water Quality Standard
µg	microgram(s)
µg/L	microgram(s) per liter
$\mu g/m^3$	microgram(s) per cubic meter
NB	nitrobenzene
NCP	National Contingency Plan
ND	Non-Detect
NPL	National Priorities List
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NS	Not Sampled
NT	nitrotoluene
O&M	Operation and Maintenance
ORP	oxygen-reduction potential
OU	Operable Unit
PAHs	Polyaromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	perchloroethene
pCi	picocurie(s)
pCi/L	picocurie(s) per liter
PMP	Probable Maximum Precipitation
PNNL	Pacific Northwest National Laboratory
QA	quality assurance
QBWOU	Quarry Bulk Waste Operable Unit
QROU	Quarry Residuals Operable Unit
QWTP	Quarry Water Treatment Unit Plant
RAGS	Risk Assessment Guidance for Superfund
RAM	real-time aerosol monitor

RAO	Remedial Action Objective
RAR	relevant and appropriate
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximally exposed
ROD	Record of Decision
ROW	rights-of-way
SE	Southeast
SP	Spring
STEL	short-term exposure limit
SWTP	Site Water Treatment Plant
TCE	trichloroethylene
TDS	Total Dissolved Solids
TEDE	total effective dose equivalent
TNB	trinitrobenzene
TNT	trinitrotoluene
TOC	total organic carbon
TSA	Temporary Storage Area
U-234	uranium-234
U-238	uranium-238
UMTRA	Uranium Mill Tailings Remedial Action
USGS	U.S. Geological Survey
UUUE	unlimited use and unrestricted exposure
VOC	volatile organic compounds
WSCC	Weldon Spring Citizens Commission
WSSRAP	Weldon Spring Site Remedial Action Project

End of current text

Executive Summary

The Weldon Spring Site, also known as the Weldon Spring Site Remedial Action Project, has been remediated by the Department of Energy in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986. The Weldon Spring Site includes the Chemical Plant Area and the Quarry. Remediation of the Weldon Spring Site was administratively divided into four Operable Units: the Chemical Plant Operable Unit (CPOU), the Groundwater Operable Unit (GWOU), the Quarry Bulk Waste Operable Unit (QBWOU), and the Quarry Residuals Operable Unit (QROU).

The CERCLA Five-Year Review is required by statute. Section 121(c) of CERCLA requires that remedial actions resulting in any hazardous substances, pollutants, or contaminants remaining at a site above levels that allow for unlimited use and unrestricted exposure be reviewed every 5 years to ensure protection of human health and the environment.

This is the third Five-Year Review conducted for the Weldon Spring Site. Since the last Five-Year Review, remedial activities at the Chemical Plant and the Quarry have been completed with the exception of long-term groundwater monitoring at both locations. The GWOU Record of Decision (ROD) (DOE 2004a) was finalized in January 2004 and was signed by the U.S. Environmental Protection Agency (EPA) in February 2004. The GW OU ROD selected the remedy of monitored natural attenuation (MNA) with institutional controls (ICs) to limit groundwater use during the period of remediation. The site has reached construction completion, which was documented in the Preliminary Closeout Report issued by EPA on August 22, 2005. Since the site has reached physical completion, the long-term surveillance and maintenance (LTS&M) activities have become the main focus of the project. The finalization of the LTS&M Plan (DOE 2005a) in July 2005, progress on the establishment of ICs, conducting annual surveillance inspections, and establishing the interpretive center and Howell Prairie have been major activities for the project.

The remedy for the completed activities for the CPOU and QBWOU are protective of human health and the environment, with ICs to restrict certain land use. The remedy for the GWOU is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals through MNA, with ICs. The remedy for the QROU is expected to be protective through long term monitoring with ICs. In the interim exposure pathways that could result in unacceptable risks are being controlled and ICs are in the process of being put into place to prevent the groundwater from being used in the restricted areas.

Five-Year Review Summary Form

SITE IDENTIFICATION	
Site name *(from WasteLAN)*: Weldon Spring Quarry/Plant/Pits (USDOE/Army)	
EPA ID *(from WasteLAN)*: MO3210090004	
Region: 7 **State: MO**	**City/County: St. Charles/St. Charles**
SITE STATUS	
NPL status: ■ Final ☐ Deleted ☐ Other (specify)	
Remediation status (choose all that apply): ☐ Under Construction ■ Operating ☐ Complete	
Multiple OUs? ■ YES ☐ NO	**Construction completion date:** 08 / 22 / 2005
Has site been put into reuse? ■ YES ☐ NO	
REVIEW STATUS	
Lead agency: ☐ EPA ☐ State ☐ Tribe ■ Other Federal Agency _DOE_____________________	
Author name: Thomas Pauling	
Author title: Project Manager	**Author affiliation: Department of Energy**
Review period:** 9 / 01 / 2005 to 09 / 29 / 2006	
Date(s) of site inspection: 11 / 7-8/ 2005	
Type of review: ■ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion	
Review number: ☐ 1 (first) ☐ 2 (second) ■ 3 (third) ☐ Other (specify) __________	
Triggering action: ☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____ ☐ Construction Completion ■ Previous Five-Year Review Report ☐ Other (specify)	
Triggering action date *(from WasteLAN)*: 09/26 / 2001	
Due date *(five years after triggering action date)*: 09 / 26 / 2006	

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form (continued)

Issues:

Erosion issues have been identified on the Chemical Plant Property

Small depression and bulges have been identified on the Disposal Cell

Erosion Issued were identified at the Hwy 94 and Hwy D culverts

Recommendations and Follow-up Actions:

Have repaired erosion areas identified in past inspections. Will continue to inspect for erosion and repair as needed.

These types of areas on the disposal cell are not unexpected for a disposal cell of this type and are not a cause for concern. DOE will continue to monitor the area.

Notified MoDOT of the culvert issues. MoDOT repaired the areas in the Fall 2005. DOE will continue to monitor the areas during the annual inspection

Protectiveness Statement(s):

The remedy for the completed activities for the Chemical Plant and Quarry Bulk Waste OUs are protective of human health and the environment. The remedy for the Groundwater and Quarry Residuals OUs are expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim exposure pathways that could result in unacceptable risks are being controlled and institutional controls are in the process of being put into place to prevent the groundwater from being used in the restricted areas.

Long-Term Protectiveness:

The remedies have all been selected and implemented with long-term protectiveness in mind. The long-term protectiveness of the Weldon Spring Site will be verified by the requirements for monitoring and surveillance included in the LTS&M Plan.

Other Comments:

There are no other comments to make at this time.

End of current text

1.0 Introduction

The purpose of the Five-Year Review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Department of Energy is preparing this Five-Year Review report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The EPA interpreted this requirement further in the NCP; Title 40, *Code of Federal Regulations* (CFR) §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less than every five years after the initiation of the selected remedial action.*

The U.S. Department of Energy (DOE) with the assistance of the DOE Long-Term Surveillance and Maintenance (LTS&M) contractor conducted the Five-Year Review of the remedies implemented at the Weldon Spring Site in St. Charles, Missouri. The review covers the years 2001 through 2005. This review was conducted for the entire site, which includes four operable units, from September 2005 through September 2006. This report documents the results of the review.

This is the third Five-Year Review for the Weldon Spring Site. The triggering action for this statutory review is the date of the second Five-Year Review, as shown in the U.S. Environmental Protection Agency's (EPA's) WasteLAN database: September 26, 2001. The Five-Year Review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

End of current text

2.0 Site Chronology

Table 2–1. Site Chronology

Event	Date
Army Ordinance begins operations	1941
Army begins burning waste and dumping rubble	1942
Army Ordnance Works ends operations	1945
Majority of Ordnance Works property transferred to State of Missouri	1949
Army stops Quarry activity	1949
Chemical Plant site transferred to Atomic Energy Commission (AEC)	1955
Uranium Feed Materials Plant operations begin	1958
AEC acquires Quarry title	1958
AEC begins waste disposal in Quarry	1963
Uranium Feed Materials Plant operations end	1966
Chemical Plant site transferred to Army	1967
AEC stops waste disposal at Quarry	1967
Army starts waste disposal at Quarry	1968
Army begins decontaminating buildings and removing equipment at Chemical Plant	1968
Army stops waste disposal in Quarry	1969
Army transfers raffinate pits to AEC	1971
DOE designates Weldon Spring Site Remedial Action Project as a Major Project	1985
Federal Facility Agreement (FFA) signed between EPA and DOE	1986
The Prime Management Contractor (PMC) is selected	2/1986
DOE and PMC establish site office	7/1986
PMC assumes site control	10/1986
Quarry is placed on the National Priorities List (NPL)	7/1987
Weldon Spring Site Remedial Action Project (WSSRAP) designated as a Major Systems Acquisition	5/1988
Chemical Plant and the raffinate pits added to the NPL	3/1989
Remedial Investigation for the Quarry Bulk Waste complete	12/1989
Feasibility Study for the Quarry Bulk Waste complete	2/1990
ROD for Management of the Bulk Waste at the Weldon Spring Quarry Complete	9/1990
Quarry bulk waste excavation support begins	6/1991
FFA amended	
Building Dismantlement begins	3/1992
Remedial Investigation/Feasibility Study for Chemical Plant complete	11/1992
First Batch of Water Discharged from Quarry Water Treatment Plant	1/1993
Quarry Bulk Waste Excavation Begins	5/1993
First Batch of Water Discharged from Site Water Treatment Plant	5/1993
ROD for Remedial Action at the Chemical Plant Area of the Weldon Spring Site complete	9/1993
Remedial Design Work Plan for the Chemical Plant Complete	1/1994
Chemical Stabilization/Solidification (CSS) Pilot Plant Testing	1995
Building Dismantlement is completed	1/1995
Remedial Action Work Plan for the Chemical Plant Complete	11/1995
Quarry Bulk Waste Excavation Complete	12/1995
Remedial Action Report for the Quarry Bulk Waste Complete	3/1997
Remedial Investigation for GWOU Complete	7/1997
Remedial Investigation for QROU Complete	2/1998
Feasibility Study for QROU Complete	3/1998

Table 2–1 (continued). Site Chronology

Event	Date
First Load of Waste Placed in Disposal Cell	3/5/1998
CSS Plant begins operation	7/1998
ROD for QROU Complete	9/1998
CSS Plant Completed Operations	11/13/1998
Feasibility Study for GWOU Complete	12/1998
Supplemental Feasibility Study for GWOU Complete	6/1999
Remedial Design/Remedial Action Work Plan for the QROU Complete	1/2000
Demolition of Site Water Treatment Plant Completed	7/6/2000
Interim ROD for GWOU Complete	9/2000
Confirmation of Chemical Plant Soil Completed	3/2001
Demolition of Quarry Water Treatment Plan Completed	5/2001
Completion of Placement of Waste in the Disposal Cell	6/3/2001
Last Rock Placed on the Disposal Cell	10/23/2001
150 Acres around Cell Prepared for Planting of Howell Prairie	Spring 2002
Interceptor Trench Field Study Complete	4/26/2002
Ribbon-Cutting and Opening of Interpretive Center	8/5/2002
Site Transferred to DOE LTS&M Program	10/1/2002
Second Planting for the Howell Prairie	1/2003
Performance Evaluation Report for Interceptor Trench Field Study Complete	5/8/2003
First Annual LTS&M Inspection	10/28-29/2003
Remedial Action Report for CPOU Complete	1/30/2004
Remedial Action Report for QROU Complete	1/30/2004
ROD for Groundwater Complete	2/20/2004
Inspection Report Issued	2/25/2004
Annual Public Meeting	3/25/2004
Groundwater Remedial Action Inspection Complete	7/20/2004
Remedial Design/Remedial Action Work Plan for GWOU Complete	7/29/2004
Second Annual LTS&M Inspection	11/17-18/2004
Inspection Report Issued	1/2005
Explanation of Significant Differences for Institutional Controls (ICs) Complete	2/2005
Interim Remedial Action Report for Groundwater Complete	3/2005
Annual Public Meeting	4/6/2005
Final LTS&M Plan Issued	7/2005
Preliminary Closeout Report Issued by EPA	8/22/2005
Third Annual (Five-Year) LTS&M Inspection	11/7-8/2005

3.0 Background

3.1 Site Description

The Weldon Spring Site is located in St. Charles County, Missouri, about 30 miles (48 kilometers [km]) west of St. Louis (Figure 3−1). The site comprises two geographically distinct DOE-owned properties: the Weldon Spring Chemical Plant and Raffinate Pit Sites and the Weldon Spring Quarry. The Chemical Plant is located about 2 miles (2.3 km) southwest of the junction of Missouri State Route 94 and U.S. Highway 40/61. The Quarry is about 4 miles southwest of the Chemical Plant. Both sites are accessible from Missouri State Route 94.

During the early 1940s, the Department of the Army (DA) acquired 17,232 acres (6,974 hectares [ha]) of private land in St. Charles County for 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 3−2. Current land use of the former ordnance works area includes the DOE Weldon Spring Chemical Plant and Weldon Spring Quarry, the U.S. Army Reserve Weldon Spring Training Area, Missouri Department of Conservation (MDC) and Missouri Department of Natural Resources (MDNR)-Division of State Parks managed lands, the Francis Howell High School, a Missouri Department of Transportation (MoDOT) maintenance facility, the St. Charles County water-treatment facility and law enforcement training center, the village of Weldon Spring Heights, and a University of Missouri research park.

The Chemical Plant and Quarry areas total 228.16 acres (92.33 ha). The Chemical Plant property is located on 219.50 acres (88.83 ha); and the Quarry occupies 8.66 acres (3.50 ha).

3.2 Site History

3.2.1 Operations History

In 1941, the U.S. Government acquired 17,232 acres (6,974 ha) of rural land in St. Charles County to establish the Weldon Spring Ordnance Works. In the process, the towns of Hamburg, Howell, and Toonerville and 576 citizens of the area were displaced (DA undated). From 1941 to 1945, the DA 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, and some off-site springs.

Following a considerable amount of explosives decontamination of the facility by the Army and the Atlas Powder Company, 205 acres (83.0 ha) of the former ordnance works property were transferred to the U.S. Atomic Energy Commission (AEC) in 1956 for construction of the Weldon Spring Uranium Feed Materials Plant, now referred to as the Weldon Spring Chemical Plant. An additional 14.88 acres (6.02 ha) 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 plant property. Uranium processing operations resulted in radiological contamination of the same locations previously contaminated by former Army operations.

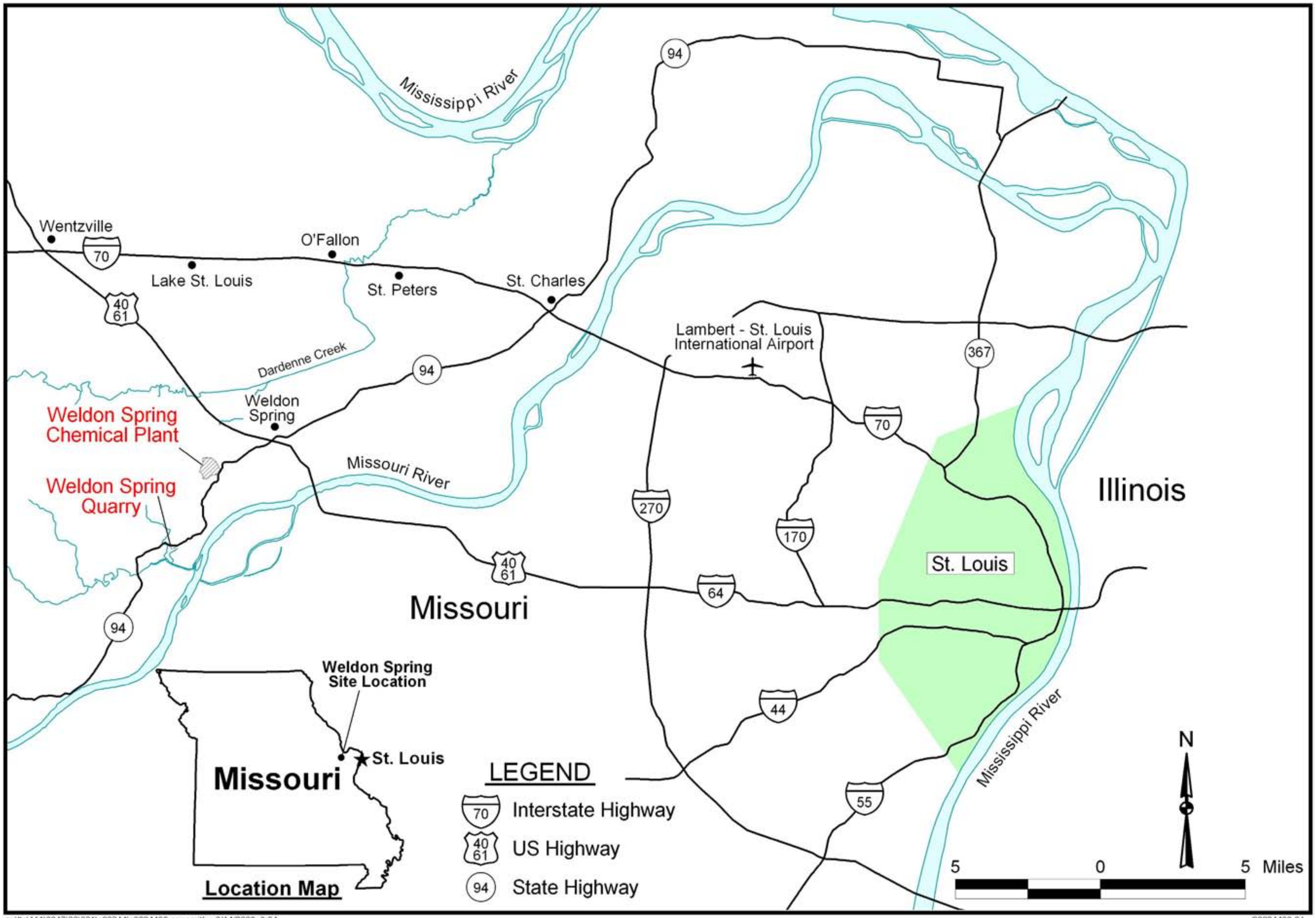

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Figure 3–1. Location of the Weldon Spring, Missouri, Site

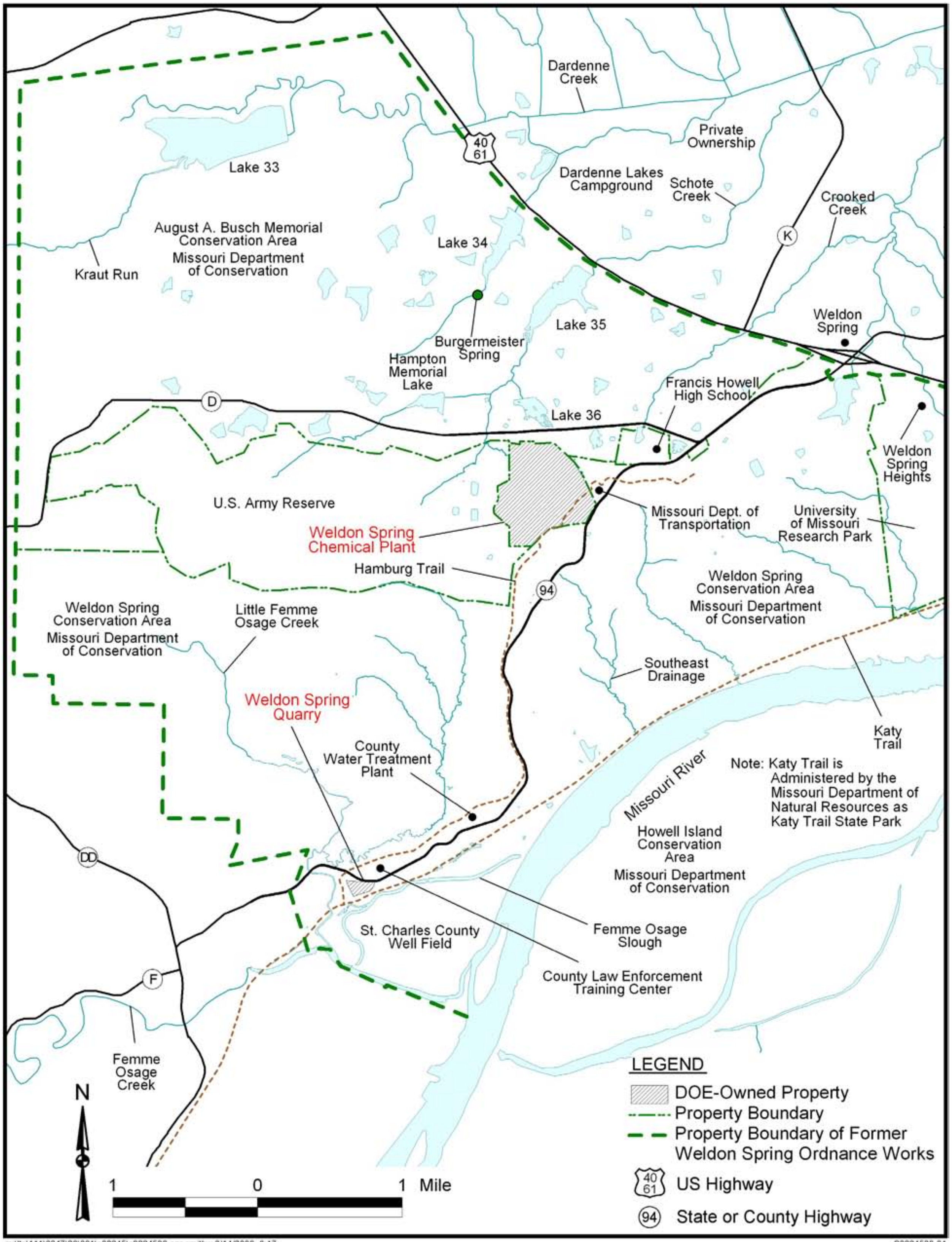

Figure 3–2. Vicinity Map of the Weldon Spring, Missouri, Site

The Weldon Spring Quarry was mined for limestone aggregate used in construction of the ordnance works. The Army also used the Quarry for burning wastes from explosives manufacturing and disposal of TNT-contaminated rubble during operation of the ordnance works. These activities resulted in nitroaromatic contamination of the soil and groundwater at the Quarry.

In 1960, the Army transferred the Quarry to AEC, who used it from 1963 to 1969 as a disposal area for uranium and thorium residues from the Chemical Plant (both drummed and uncontained) and for disposal of contaminated building rubble, process equipment, and soils from demolition of a uranium processing facility in St. Louis. Radiological contamination occurred in the same locations as the nitroaromatic contamination.

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 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 process equipment was installed, and the Army transferred 50.65 acres (20.50 ha) of land encompassing the raffinate pits back to AEC while retaining the Chemical Plant. AEC, and subsequently DOE, managed the site, including the Army-owned Chemical Plant, under caretaker status from 1968 through 1985. Caretaker activities included site security oversight, fence maintenance, grass cutting, and other incidental maintenance. In 1984, the Army repaired several of the buildings at the Chemical Plant, decontaminated some of the floors, walls, and ceilings, and isolated some equipment. In 1985, the Army transferred full custody of the Chemical Plant to DOE, at which time DOE designated control and decontamination of the Chemical Plant, raffinate pits, and Quarry as a major project.

3.3 Remedial Action History

EPA placed the Quarry and Chemical Plant areas on the National Priorities List (NPL) on July 30, 1987, and March 30, 1989, respectively. Initial remedial activities at the Chemical Plant, a series of Interim Response Actions (IRAs) authorized through the use of Engineering Evaluation/Cost Analysis (EE/CA) reports, 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 off site in surface water.
- Detailed characterization of on-site debris, separation of radiological and nonradiological debris, and transport of materials to designated staging areas for interim storage.
- Dismantling of 44 Chemical Plant buildings under four separate IRAs.
- Treatment of contaminated water at the Chemical Plant and the Quarry.

A Federal Facility Agreement (FFA) was signed by EPA and DOE in 1986, and it was amended in 1992. The main purpose of the FFA is to establish a procedural framework and schedule for developing, implementing and monitoring appropriate response actions at the Site in accordance with CERCLA. An FFA Quarterly Report is issued to EPA and MDNR each quarter which documents compliance with the FFA and reports on activities at the site.

A new FFA between EPA, DOE, and MDNR was recently signed by all parties with the final signature by EPA on March 31, 2006. The purpose of the new FFA is to focus more on long-term site management activities.

Remediation of the Weldon Spring Site was administratively divided into the four Operable Units: the Quarry Bulk Waste Operable Unit (QBWOU), Quarry Residuals Operable Unit (QROU), Chemical Plant Operable Unit (CPOU), and Groundwater Operable Unit (GWOU). The Southeast Drainage was remediated as a separate action through an EE/CA report (DOE 1996). The selected remedies are described in the following sections.

3.3.1 Chemical Plant Operable Unit

In the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE1993), DOE established the remedy for controlling contaminant sources at the Chemical Plant (except groundwater) and disposing of contaminated materials in an on-site disposal cell.

The selected remedy included:

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

The remedy included remediation of 17 off-site vicinity properties affected by 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 2004b) was finalized in January 2004.

3.3.2 Quarry Bulk Waste Operable Unit

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

The selected remedy included:

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

3.3.3 Quarry Residuals Operable Unit

The QROU remedy was described in the *Record of Decision for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1998a). 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 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 implementing a well field contingency plan.
- Confirming the model assumptions regarding extraction of contaminated groundwater and establishing controls to protect naturally occurring attenuation processes.
- Restoring the Quarry and establishing ICs.

The *Quarry Residual Operable Unit Remedial Action Report* (DOE 2003a) was finalized in January 2004.

3.3.4 Groundwater Operable Unit

DOE implemented an interim ROD to investigate the practicability of remediating trichloroethylene (TCE) contamination in Chemical Plant groundwater, using in situ chemical oxidation (ICO) (DOE 2000a). The DOE issued a final ROD in January 2004, which was signed by EPA in February 2004. The Groundwater OU ROD selected a remedy of monitored natural attenuation (MNA) with ICs to limit groundwater use during the period of remediation. MNA involves the collection of monitoring data to verify the effectiveness of naturally occurring processes to reduce contaminant concentrations over time. The ROD establishes remedial goals and performance standards for MNA.

3.3.5 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 1996) 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. The excavated materials would be stored temporarily at an on-site storage area until final disposal in the disposal cell. Soil removal was in two phases: 1997-1998 and again in 1999. Post-remediation soil sampling was conducted. More details are included in the *Southeast Drainage Closeout Report Vicinity Properties DA-4 and MDC-7* (DOE 1999a).

3.4 Final Site Conditions

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

- An on-site disposal cell contains approximately 1.48 million cubic yards of contaminated material.
- Residual groundwater contamination remains in the shallow aquifer beneath the Chemical Plant, at the Quarry, and at some surrounding areas.
- Several springs near the Chemical Plant discharge contaminated groundwater.
- Residual soil and sediment contamination remain in the Southeast Drainage.
- Contamination remains at two culvert locations along Missouri State Route 94 and Highway D.
- Residual soil contamination remains at inaccessible locations within the Quarry.

Residual contamination is addressed in the *Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site* (LTS&M Plan) (DOE 2005a), which includes ICs established to maintain protectiveness of contaminants not contained in the disposal cell. Under current land use conditions, the remaining contamination does not pose unacceptable risks to public health and the environment.

3.5 Geology and Hydrogeology

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 units underlying the Weldon Spring Chemical Plant are the Mississippian Burlington and Keokuk Limestone. Overlying the bedrock are unlithified units consisting of fill, topsoil, loess, glacial till, and limestone residuum of thicknesses ranging from a few feet (ft) to several tens of ft.

There are three bedrock aquifers underlying St. Charles County. The shallow aquifer consists of Mississippian Limestones, and the middle aquifer consists of the 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 mid-Ordovician bedrock of the Quarry area includes, in descending order, the Kimmswick Limestone, the Decorah Formation, and the Plattin Limestone. These formations are predominantly limestone and dolomite. Near the Quarry, the carbonate rocks dip to the northeast at a gradient of 11 meters per kilometer (m/km) to 15 m/km (58 feet per mile [ft/mi] to 79 ft/mi) (DOE 1990a). Massive quaternary deposits of Missouri River alluvium cover the bedrock to the south and east of the Quarry.

3.6 Surface Water System and Use

The Chemical Plant and raffinate pits areas are on the Missouri/Mississippi River surface drainage divide. Elevations on the site range from approximately 185 meters (m) (608 ft) above mean sea level (msl) near the northern edge of the site to 203 m (665 ft) above msl near the southern edge. (The 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 Drainageway, based on the site's nomenclature) that flows to the Missouri River.

The northern and western portions of the Chemical Plant site drain to tributaries of the Busch Lakes and Schote Creek, which in turn enter Dardenne Creek, which ultimately drains to the Mississippi River. The manmade lakes in the August A. Busch Memorial Conservation Area are used for public fishing and boating. No swimming is allowed in the conservation area, although some may occur. No water from the lakes or creeks is used for irrigation or for public drinking water supplies.

Before remediation of the Chemical Plant and raffinate pits area 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. Frog Pond and Ash Pond were flow-through ponds that were monitored prior to being remediated and confirmed clean. Throughout the project, retention basins and sedimentation basins were constructed and used to manage potentially contaminated surface water. During 2001, the four sedimentation basins that remained were remediated, and the entire site was brought to final grade and seeded with temporary vegetation. Final seeding was conducted during 2002.

The Weldon Spring Quarry is situated on a bluff of the Missouri River valley about 1.6 km (1 mi) northwest of the Missouri River at approximately River Mile 49. Because of the topography of the area, no direct surface water entered or exited the Quarry before it was remediated. A 0.2-acre (0.07-ha) 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 removal of some sediment from the sump area, was completed during 1995. The Quarry was backfilled, graded, and seeded during 2002.

The Femme Osage Slough, located approximately 213 meters (700 ft) south of the Quarry, is a 2.4-km (1.5-mi) section of the original Femme Osage Creek and Little Femme Osage Creek. The University of Missouri dammed portions of the creeks between 1960 and 1963 during construction of a levee system around the University experimental farms (DOE 1990b). The slough is essentially land-locked and is currently used for recreational fishing. The slough is not used for drinking water or irrigation.

3.7 Ecology

The Weldon Spring Site is surrounded primarily by State Conservation Areas that include the 2,828 ha (6,988 acre) Busch Conservation Area to the north, the 2,977 ha (7,356 acre) Weldon Spring Conservation Area to the east and south, and the Howell Island Conservation Area, an island in the Missouri River which covers 1,031 ha (2,548 acres) (Figure 3−2).

The wildlife areas are managed for multiple uses including timber, fish and wildlife habitat, and recreation. Fishing comprises 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 1992a). The Busch and Weldon Spring Conservation Areas are open year-round, and the number of annual visits to both areas totals about 1,200,000.

3.8 Land Use and Demography

The population of St. Charles County was estimated by the census in 2004 to be about 320,000. This has been a 12.98 percent increase from the 2000 census and about a 30 percent increase over the past 10 years. The three largest communities in St. Charles County are O'Fallon (pop: 67,009), St. Charles (pop: 61,411), and St. Peters (pop: 53,907) (Figure 3−1). The two communities closest to the site are Weldon Spring and Weldon Spring Heights, about 3.2 km (2 mi) to the northeast. The combined population of these two communities is about 5,000. No private residences exist between Weldon Spring Heights and the site. Urban areas occupy about 6 percent of county land, and non-urban areas occupy 90 percent; the remaining 4 percent is dedicated to transportation and water uses.

Francis Howell High School is about 1 km (0.6 mi) northeast of the site along Missouri State Route 94 (Figure 3−2). The school employs approximately 150 faculty and staff, and about 1,760 students attend school there. In addition, approximately 50 full-time employees work at the high school annex, and about 50 bus drivers park their school buses in the adjacent parking lot.

The MoDOT Weldon Spring Maintenance facility, located adjacent to the north side of the Chemical Plant, employs about 10 workers. The Army Reserve Training Area is to the west of the Chemical Plant and in the past was periodically visited by DA trainees and law enforcement personnel. Presently there are about 40 full time personnel working on military equipment at the site. During 2005, the training site had 18,000 man-days of usage by all branches of the military and law enforcement. About 741 acres (300 ha) of land east and southeast of the high school is owned by the University of Missouri. The northern third of this land is being developed into a high-technology research park. The conservation areas adjacent to the Chemical Plant are operated by MDC and employ about 50 people.

End of current text

4.0 Remedial Actions

4.1 Chemical Plant Operable Unit

4.1.1 Chemical Plant Operable Unit Remedy Selection

In September 1993, DOE finalized the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1993) for managing contaminated materials (except groundwater) at the Chemical Plant. The CPOU addressed the various sources of contamination in the Chemical Plant including soils, sludge, sediment, and materials placed in short-term storage as a result of previous response actions. The remedial action included in the Chemical Plant ROD was the major component of site cleanup and addressed comprehensive disposal options for the project. The primary focus was the contaminated material in the Chemical Plant, including that generated as a result of previous response actions, but it also addressed disposal of materials generated by the other Operable Units (OUs) in order to facilitate a disposal decision that would integrate all the OUs. The three key components of the remedy were:

- Remove the contaminated materials.
- Treat the wastes as appropriate by CSS.
- Dispose of the wastes in an engineered disposal facility constructed on site.

The remedy included remediation of 17 off-site vicinity properties affected by Chemical Plant operations. The vicinity properties were remediated in accordance with Chemical Plant ROD cleanup criteria.

4.1.2 Chemical Plant Operable Unit Remedy Implementation

The majority of the activities and components of the Chemical Plant remedial action were discussed in the previous Five-Year Review (DOE 2001a). The cell was close to completion at the time of the report, which was dated August 2001. The cell cover was completed in October 2001. The components of the remedy that have been ongoing since the time of the last review are the Leachate Collection and Removal System (LCRS), leachate monitoring, disposal cell groundwater monitoring, and long-term maintenance and surveillance activities, such as inspections, monitoring and maintenance, and ICs.

4.1.2.1 Disposal Cell Leachate Collection and Removal System

The disposal cell is located on the northeastern portion of the Chemical Plant property, and the outer perimeter protection system encompasses an area of approximately 41 acres (16.6 ha). The five-sided cell has 4:1 side slopes over the clean-fill dike, and cover slopes of approximately 13:1 over the waste. The maximum width of the cell footprint, including the rock-covered apron, is approximately 1,500 ft (457 meters), and the maximum height above grade is approximately 91 ft (28 meters). The cell contains approximately 1.48 million cubic yards (1.13 million cubic meters) of contaminated waste, with a total activity of 6,570 curies. The waste column has a maximum thickness of 63 ft (19 meters), and the waste footprint, including the lower interior dike slopes, is approximately 24 acres (9.7 ha).

Six primary systems were incorporated into the cell design: the cover, the waste, a surrounding clean-fill dike, a geochemical barrier, a basal liner system, and a LCRS.

The cell cover system is approximately 8.5 ft (2.6 meters) thick; the upper 3.5 ft (1.1 meters) of the top slope consists of limestone riprap with an average diameter of 8 inches (20 centimeters); the riprap is 2 ft thick on the side slopes. The riprap layer protects the cover from erosion and restricts penetration of the cover by plant roots and burrowing animals. This riprap layer overlies a sequence of aggregate bedding and drainage layers. Beneath these layers is a high-density polyethylene (HDPE) liner with an attached layer of bentonite. The principal radon/infiltration barrier consists of a 3-ft (0.9-meter)-thick layer of compacted low-permeability clayey soil beneath the HDPE liner.

Three drainage bays were created at the cell bottom sloping toward two low points on the north side of the cell floor to facilitate leachate flow. The west bay includes a monolith of debris cemented with grout containing raffinate sludges.

The cell bottom liner incorporates two HDPE layers separated by a synthetic drainage layer consisting of geotextile and geonet. The upper HDPE liner system is covered with drainage aggregate and a layer of peat mixed with low-radioactivity soil that will adsorb some leachate contaminants. The lower HDPE liner system was placed on a bentonite mat-covered 3-ft (0.9-meter)-thick layer of compacted clay. The mat and clay layer provide an additional low-permeability liner and geochemical barrier that will adsorb uranium and other constituents in leachate that potentially could leak through the HDPE liner system. The cell foundation complies with a siting requirement included in the Missouri regulations for the equivalent of a 30-ft thickness of clay with a permeability of 10^{-7} centimeters per second under the contained waste.

Specific performance and design criteria for the cell include:

- Seismic resistance: sustain a Maximum Credible Earthquake defined as:
  - −Peak Ground Acceleration = 0.26 g (gravitation constant)
  - −Period of the Design Ground Motion = 0.3 second
  - −Duration of the Design Ground Motion = 24 to 30 seconds
  - −Horizontal Seismic Acceleration Coefficient (long term) = 0.17
  - −Horizontal Seismic Acceleration Coefficient (short term) = 0.13
- Sustain a Probable Maximum Precipitation (PMP) event defined as 38.4 inches in 24 hours.

Leachate from the cell is collected in a primary collection system under the cell consisting of 4-inch (10-centimeter)-diameter perforated HDPE pipes placed in the drainage material on top of the primary liner. The pipes convey leachate by gravity to a sump located north of the disposal cell. The sump consists of a 200-ft (61-meter)-long, 42-inch (107-centimeter)-diameter HDPE pipe for storage and a 60-inch (152-centimeter)-diameter HDPE manhole for access. A zone of drain gravel in an annulus enclosed by an 80-mil (2-millimeter)-thick HDPE geomembrane liner was placed around the leachate piping between the cell liner and the sump and also around the sump itself to provide secondary containment. Within the cell, the primary collection pipes are configured to overflow into the drain gravel if they become clogged or if water levels exceed 12 inches (30 centimeters), to be conveyed inside the annulus to the secondary containment around the sump. A monitor well was installed adjacent to the sump manhole to detect leakage from the sump or overflow of the primary collection pipes into the secondary containment system. Primary collection system pipes converge at the sump.

A secondary collection system consists of an HDPE geonet placed between layers of geotextile (high-tensile strength filter fabric), which is placed between the primary and secondary bottom liners. This system collects leakage through the primary liner. Fluids flow through the secondary collection system to two gravel-filled sumps, one for each basin, located along the north edge of the cell. The fluids are then conveyed by HDPE pipe through the gravel-filled annulus to the HDPE sump north of the cell. Flows in secondary collection system pipes can be monitored individually at the sump.

Instrumentation sensors installed in the LCRS sump will be used to monitor the combined (primary and secondary) leachate volume. The east and west secondary leachate collection system flow is discretely monitored prior to being combined with the primary leachate through a system of volumetrically calibrated containers. These containers are equipped with level switches and dump valves. The container fills with secondary leachate to a predetermined level, and a valve is actuated that dumps the contents. The number of dumps is recorded electronically and displayed at the LCRS monitoring cabinet. The flow rates will be calculated from these data. The LCRS monitoring cabinet is installed in the LCRS Support Building and displays the combined sump level and the discrete secondary collection system number of dumps. The operational capacity of the combined sump is approximately 11,200 gallons, and the sump secondary containment is approximately the same.

Leachate level and flow rates have been monitored and recorded weekly to date. As a reliable database is generated, DOE may modify the sump level monitoring frequency in accordance with regulations in 40 CFR 264.303(c) which requires only monthly and then quarterly flow recording. Flow rates are reported in units of gallons per day (gpd) and compared to the action leakage rate of 100 gallons per acre (gpa) per day established for the leachate collection system.

The leachate flow rates for 2001 through 2005 are shown in Figure 4−1. The average discharge from the primary leachate collection system has gone from 325 gpd in 2001 to 155 gpd in 2005. The combined leachate from the secondary leachate collection system averaged approximately 22 gpd for 2001 to 13.6 gpd in 2005. The average leak rate for the secondary leachate collection system for 2001 was approximately 0.96 gpa per day. The average leak rate is 2005 was approximately 0.56 gpa per day. This continues to be much less than 1 percent of the action leakage rate (100 gpa per day). This is a result of superior design and construction, as well as operational controls that optimized the moisture content of the compacted soil waste.

The leachate was sampled at least quarterly since generation for an extensive list of chemical and radiological constituents. Beginning in calendar year 2003, the leachate began to be sampled semiannually in accordance with the *Disposal Cell Groundwater Monitoring Plan* (DOE 2004c).

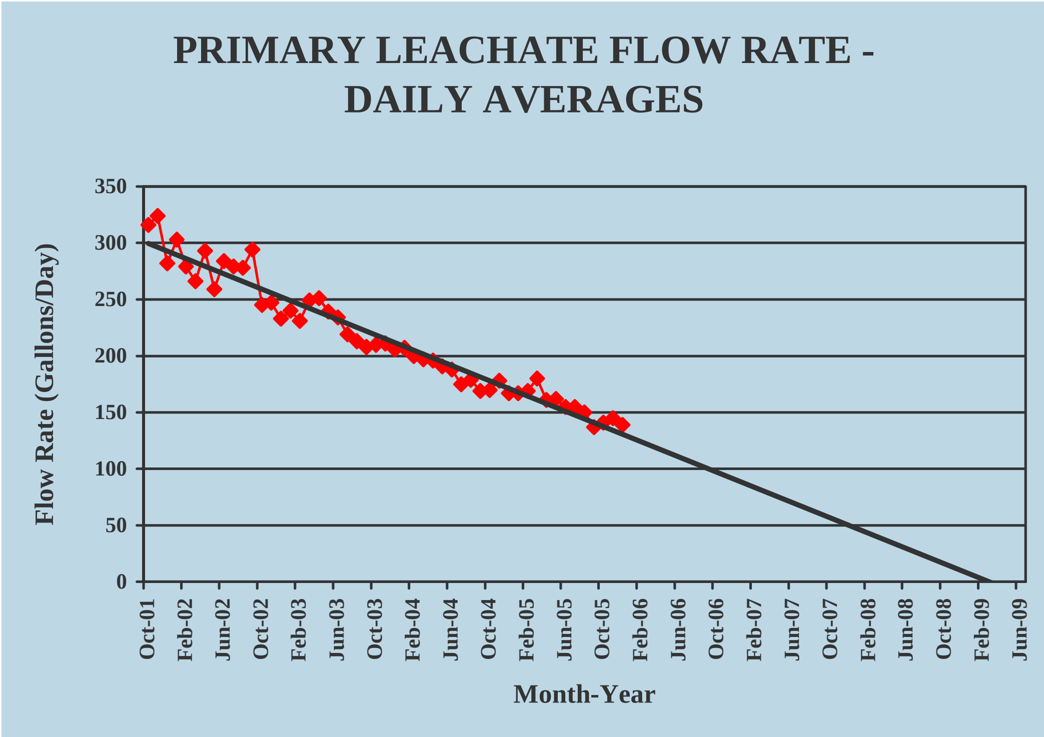

Figure 4–1. Primary Leachate Trends

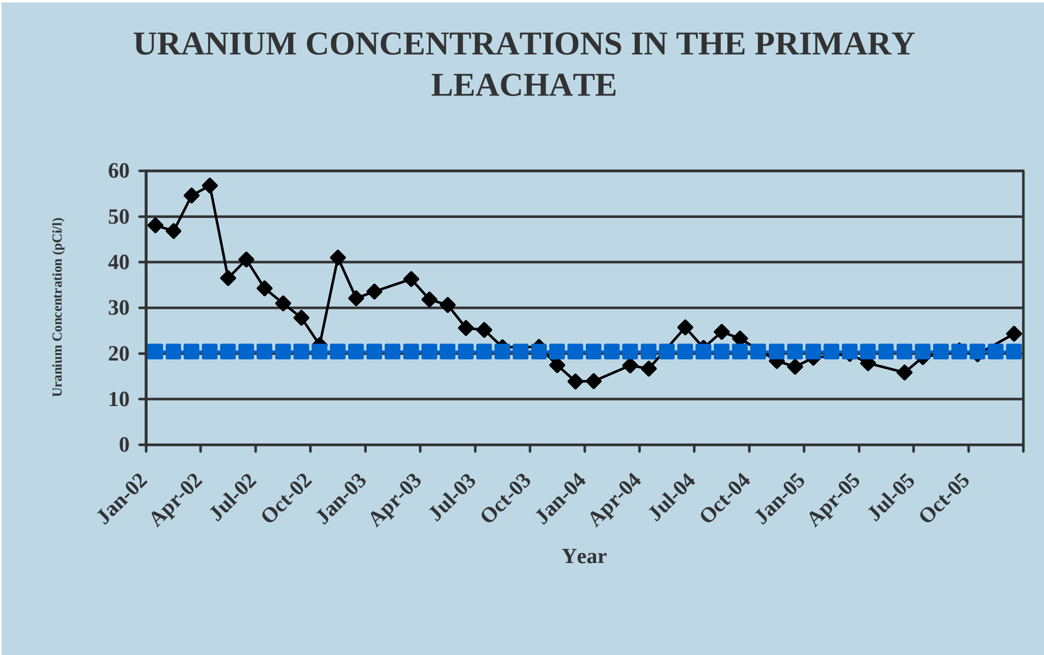

Figure 4–2. Leachate Concentration Trends

The leachate is sampled for the same list of parameters as the disposal cell monitoring wells. The list of analytes is shown in Table 4−1.

Table 4–1. Leachate Analytical Data

	April 2002	June 2003	December 2003	June 2004	December 2004	June 2005	December 2005
Chloride (mg/L)*		35.7	33.8	35.1	33.8	35.9	35.1
Fluoride (mg/L)	0.28	ND	0.26	0.28	0.30	0.25	0.23
Nitrate-N (mg/L)	ND	0.512	0.062	0.27	0.07	0.0027	0.408
Sulfate (mg/L)		50.1	31.4	36.6	31.6	33.3	32.8
Arsenic (mg/L)	ND	0.0015	0.0034	0.0029	0.0024	0.0045	0.0027
Barium (mg/L)	0.554	0.784	1.03	0.859	0.785	1.020	0.743
Chromium (mg/L)	ND	ND	ND	ND	ND	ND	ND
Cobalt (mg/L)	0.0119	0.0082	0.0071	.0055	0.0041	0.0051	0.0023
Iron (mg/L)	5.680	6.14	14.2	2.82	6.62	4.20	1.67
Lead (mg/L)	ND	0.00099	ND	ND	ND	ND	ND
Manganese (mg/L)	3.69	2.07	1.63	1.15	0.814	0.949	0.433
Nickel (mg/L)	.0069	0.0055	0.0090	0.0097	0.0086	0.0084	0.0073
Selenium (mg/L)	ND	0.0057	0.0025	0.0023	0.0032	ND	0.0027
Thallium (mg/L)	ND		0.0014	0.0072	ND	ND	0.0013
COD (mg/L)	26	20	44	31.0	33.0	31.0	38.0
TDS (mg/L)	827	823	747	767	665	749	633
TOC (mg/L)	9.2	11.1	9.4	10.2	9.9	10.37	12.3
1,3,5-TNB (µg/L)	ND	ND	ND	ND	ND	ND	ND
1,3-DNB (µg/L)	ND	ND	ND	ND	ND	ND	ND
2,4,6-TNT (µg/L)	ND	ND	ND	ND	ND	ND	ND
2,4-DNT (µg/L)	ND	ND	ND	ND	ND	ND	ND
2,6-DNT (µg/L)	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene (µg/L)	ND	ND	ND	ND	ND	ND	ND
Radium-226 (pCi/L)	NS	0.42	0.60	0.44	0.58	0.36	0.37
Radium-228 (pCi/L)	NS	ND	ND	ND	ND	0.74	ND
Thorium-228 (pCi/L)	NS	ND	ND	ND	ND	ND	ND
Thorium-230 (pCi/L)	NS	0.144	ND	0.34	0.26	0.43	0.19
Thorium-232 (pCi/L)	NS	ND	ND	ND	ND	ND	ND
Uranium (pCi/L)	NS	25.5	13.8	25.6	17.0	15.8	24.2
PCBs/PAHs (µg/L)	ND	ND	ND	ND	ND	ND	ND

*mg/L=milligrams per liter
ND = Non-detect.

A summary of analytical results for leachate samples collected between 2002 and 2005 is provided in Table 4−1. As needed, the leachate is pumped from the sump and transported to the Metropolitan St. Louis Sewer District (MSD) for treatment in their Bissell Point wastewater treatment facility. A sample of leachate is collected and analyzed in accordance with MSD requirements for each hauling event. DOE has an allocation of 0.15 millicuries (mCi) per year of radioactivity and 25,000 gallons per month (gpm). Leachate uranium activity during 2002 typically was 50 picocuries (pCi/L), which is equivalent to an annual radioactivity of approximately 0.02 mCi. The uranium data has shown a continued downward trend to average 20 pCi/L in 2005. The average uranium concentrations from 2002 through 2005 are shown in Figure 4−2.

DOE received notification in April 2004 that the leachate must meet the radiological drinking water standard of 30 micrograms per liter (µg/L) (20 pCi/L) prior to acceptance. The disposal cell leachate 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 treatment and found to be significantly below the 30-µg/L limits for uranium. DOE requested and received approval to raise the allocation of 15,000 gpm to 25,000 gpm. The disposal cell is not generating any additional leachate, but the increased volume limit provides added operational flexibility related to the pretreatment options and hauling.

4.1.2.2 Disposal Cell Groundwater Monitoring

DOE established a groundwater detection-monitoring network (Figure 4−1) around the cell to monitor cell performance, as required under 40 CFR 264 Subpart F and 10 CSR 25–7.264(2)(F). The network originally consisted of five wells and Burgermeister Spring. All wells are completed in the weathered portion of the Burlington-Keokuk Limestone. In 2001, monitor well MW-2048 was damaged and replaced with MW-2055. Also, MW-2051 was installed to replace MW-2045, where anomalous, elevated metal concentrations were attributed to poor hydraulic performance. Burgermeister Spring (SP-6301) is a perennial downgradient point of emergence for groundwater from the Chemical Plant area.

Disposal cell detection monitoring is summarized in Table 4−2.

Table 4–2. Detection Monitoring Program for the Disposal Cell at the Weldon Spring, Missouri, Site

Sample Locations	Hydrologic Relationship	Sampling Frequency	Analytes (all locations)[a]
MW-2032	Downgradient	Semiannual	Total uranium, radium-226, radium-228, thorium-228, thorium-230, thorium-232, nitrate (as N), sulfate, chloride, fluoride, arsenic, barium, chromium, cobalt, iron, lead, manganese, nickel, selenium, thallium 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, chemical oxygen demand, total dissolved solids, total organic carbon, polychlorinated biphenyl, polycyclic aromatic hydrocarbon, field parameters (pH, temperature, and conductivity [K]).
MW-2046	Downgradient		
MW-2047	Downgradient		
MW-2051	Downgradient		
MW-2055	Upgradient		
SP-6301	Downgradient		

[a]DNB = dinitrobenzene; DNT = dinitrotoluene; TNB = trinitrobenzene; TNT = trinitrotoluene

Specific procedures for evaluation of monitoring results and required responses are presented in the *Disposal Cell Groundwater Monitoring Plan* (DOE 2004c) and are summarized below:

Under the detection monitoring program, signature parameter (barium, iron, manganese, and uranium) data from each monitoring event are compared to baseline tolerance limits (BTLs) to trace general changes in groundwater quality and determine whether statistically significant evidence of contamination due to cell leakage exists. Tolerance limits for signature parameters have been calculated using the dataset from 1997 through 2002, using 95 Percent confidence and 95 percent coverage, based on the assumption that the data are normally distributed. In the case of the newer wells (MW-2051 and MW-2055), the available data used is fairly small; however, the tolerance limits for these wells are representative of groundwater conditions at these locations.

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. Data are compared to the three most recent years of data to determine if statistically significant increases or trends in concentrations are present. Data are considered statistically significant if it is greater than the arithmetic mean plus three times the standard deviation for each location.

Wells with data showing statistically significant increases or decreases are resampled to confirm the exceedance. If the results of the resampling confirm the exceedance, historical leachate analytical data and volumes are evaluated to assess the integrity of the disposal cell. If the leachate data do not indicate that the exceedance could be the result of leakage from the cell, an assessment of the analytical data and review of site-wide monitoring data is performed. If the exceeding parameter is a contaminant of concern (COC) for the GWOU, this information is evaluated under the monitoring program for that OU.

Results of the December 2004 sampling indicated that the BTLs for iron and manganese were exceeded in MW-2032. Resampling in February 2005 confirmed the elevated values. This well was found to be inundated with organic debris as a result of invasion by ants. As a first step, the well has been purged of this debris and will be resampled to determine to what extent this problem may have contributed to the elevated levels. A demonstration report, *Weldon Spring Site Cell Groundwater Monitoring Demonstration Report for the December 2004 Sampling Event* (DOE 2005b), was prepared as outlined in the *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan* (DOE 2004c). This plan was issued in May 2005. The conclusion from the report stated:

Concentration exceedances for the signature constituents iron and manganese at well MW-2032 in December 2004 were caused by biodegradation of natural organic material in the vicinity of the well. Information supporting this conclusion included (1) conversion from fully oxidizing conditions in the well during June 2004 to chemically reducing conditions during the December sampling event. The chemically reducing conditions were indicated by negative oxygen-reduction potential (ORP) values. Most measurements of ORP in groundwater at the site are positive and indicative of oxidizing conditions, and (2) field observations of decaying ants on the pump installed in this well. As part of the biodegradation process, manganese- and iron-reducing bacteria in the local subsurface likely converted solid forms of these metals into dissolved forms, thus increasing their concentrations in groundwater. Evidence for continued biodegradation in

MW-2032 was observed during re-sampling in February, as chemically reducing conditions were present and iron and manganese concentrations remained relatively high.

The non-signature parameters sulfate, total organic carbon (TOC) and chemical oxygen demand (COD), and nickel were observed in MW-2032 during December 2004 at concentrations that were considered statistically significant increases above background levels. Subsequent re-sampling for these analytes in February 2005 indicated that the concentrations of the first three had decreased to levels in line with those occurring in June 2004 and under baseline conditions. Consequently, the elevated levels of sulfate, TOC, and COD at MW-2032 during late 2004 were unlikely to have been caused by disposal cell leachate. The concentration of the metal nickel during the re-sampling was noticeably lower than observed in December 2004 but remained higher than the June 2004 level. This behavior was attributed to the continuing biodegradation at the well and associated dissolution of solid-phase iron and metals, dissolved concentrations of nickel in MW-2032 appeared to remain high, but were expected to decrease to more normal values once the biodegradation ends.

Assessment of statistically significant increases in the concentration of nitrate at disposal cell monitoring well MW-2046 and chromium at MW-2051 in December 2004 showed that neither was related to the disposal cell. Both of these constituents occur in cell leachate at such low levels that a loss of either from the cell would be inconsequential. The elevated level of chromium at MW-2051 in December 2004 was probably caused by dissolution of stainless steel materials comprising the well screen.

The recommendations from the report included the following:

1. On a bi-monthly basis, redevelop the well using purging techniques.
2. Monitor ORP levels bi-monthly, before and after the purging. This will indicate if the chemistry in the groundwater is chemically reducing or oxidizing.
3. Develop means of preventing ant movement into the well.
4. Attempt to kill ants near the well by applying an insecticide at the ground surface.
5. If elevated levels of iron and manganese and reducing conditions at the well persist into October 2005, propose adding amendments to the well that are capable of either minimizing or eliminated bacterial metabolism in and near the well. If amendments are applied, use the least toxic forms initially (e.g., minimal levels of chlorine), and stronger chemical treatments only if less aggressive tactics are unsuccessful. If amendments are applied, increase monitoring of surface water at Burgermeister Spring for impacts.
6. Summarize progress in solving the problem in quarterly FFA reports

4.1.3 Chemical Plant Operable Unit System Operation and Maintenance

The project transferred LTS&M responsibility for the Weldon Spring Site from the DOE-Oak Ridge Office to the DOE LTS&M Program on October 1, 2002, and then to the Office of Legacy Management in December 2003. The following is a discussion of the LTS&M activities which have been ongoing at the site:

4.1.3.1 Long-Term Surveillance and Maintenance Plan

The LTS&M Plan implements long-term components of remedies selected for the Weldon Spring Site.

The following is a chronology of events regarding the development of the LTS&M Plan:

On June 27, 2002, DOE conducted an educational Workshop on LTS&M for the Weldon Spring Site.

The first draft of the *Long-Term Stewardship Plan for the Weldon Spring, Missouri, Site*, was issued on August 9, 2002.

Three work sessions were held to discuss the LTS&M issues. These were as follows:

October 23, 2002: Communication and Public Perception

December 5, 2002: Land Use and Institutional Controls and Homeland Security

February 5, 2003: Monitoring and Maintenance

The second draft, *Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site,* was issued on May 30, 2003. This plan reflected changes based upon written comments received on the first draft, input during the focus sessions, and any new information that had become available since the last draft.

The third draft of the LTS&M Plan was issued on March 12, 2004. This plan reflected updates regarding ICs, the *Disposal Cell Groundwater Monitoring Plan* (DOE 2004c), and the GWOU.

The LTS&M Plan was resubmitted to EPA and the State in August 2004 as a Draft-Final in accordance with the FFA. In response to EPA comments, DOE issued the *Institutional Controls Evaluation (ICE) Report: Summary of Supporting Information for the Identification and Evaluation of Institutional Controls for the Weldon Spring Site* (DOE 2004d) and a revised LTS&M Appendix E: Institutional Controls Plan on October 1, 2004. Due to issues regarding ICs, EPA issued a letter to DOE on November 2, 2004, which invoked the FFA dispute resolution process for the LTS&M Plan.

On November 23, 2004, EPA issued a letter to DOE, which agreed on several steps toward resolution and extended the Dispute Resolution Committee period of time to consider the dispute until December 22, 2004.

On December 1, 2004, DOE issued a letter to EPA, which responded to three issues contained in the November 2, 2004, dispute letter.

On December 9, 2004, EPA issued a letter to DOE, which provided DOE an initial response to their December 1 letter and provided an update on the work the EPA agreed to provide.

On December 22, 2004, DOE, as agreed, issued to EPA a Draft-Final Explanation of Significant Difference (ESD) to complete the decision making for the remedial actions as well as the Southeast Drainage removal action. The objective of the ESD is to clarify the objectives and performance standards for the ICs at the site and to set the requirements for the further development of the ICs.

The *Explanation of Significant Differences, Weldon Spring Site*, (DOE 2005c) was finalized on February 20, 2005. The second Draft-Final LTS&M Plan was reissued on March 11, 2005. EPA and DOE worked diligently to resolve the dispute, but the dispute was elevated to the Senior Executive Committee on May 27, 2005. A 30-day extension of the dispute resolution period was granted during this time. EPA provided DOE with specific text changes to the LTS&M Plan during June 2005. These changes were incorporated and the Final LTS&M Plan was issued during July 2005.

4.1.3.2 Interpretive Center/Howell Prairie

The Weldon Spring Site 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 site history, remedial action activities, and final conditions. The 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 this 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 and the manufacturing wastes.
- The events and community efforts to cleanup the Site and the people that made it happen.
- The multi-faceted phases of the Weldon Spring Site Remedial Action Project.

Attendance at the Interpretive Center has seen a steady upward trend since opening in August 2002. Walk-in attendance (general public) has risen as the community continues to gain awareness about the Center. Local school involvement (primary, secondary and college) has risen sharply as the Centers educational programs have been developed and promoted.

Interpretive Center marketing and communication efforts have allowed contact with many St. Charles and St. Louis County schools and community groups to ensure awareness of Center educational programs. These efforts have led to an overall increase in attendance. Attendance for calendar year 2005 totaled 15,405, which represents a 431 percent increase over the 2004 attendance of 3,573. Attendance is shown in Table 4−3.

Table 4–3. 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
													21,550

The 150 acres surrounding the disposal cell has been planted with over 80 species of native prairie grasses and wildflowers. Plants such as Prairie Blazing Star, Little Bluestem, and Wild Bergamot will once again dominate this area, which was a large native prairie prior to European settlement. Howell Prairie is one of the largest planting of its kind in the St. Louis metropolitan area.

Maintenance activities for the prairie that last few years are listed as follows:

2003: An extensive overseeding operation of approximately 300 pounds (lbs) of prairie grass and forb seed was performed in January 2003. Periodic mowing was performed throughout the year in order to limit weed establishment. Herbicide was applied in selective locations to limit encroachment of invasive exotic weed species from surrounding properties. Hand weeding was performed throughout the prairie area. A comprehensive erosion control effort was completed that consisted of compacting composted material in erosion channels and then overseeding with annual cereal grains.

2004: An extensive overseeding operation of approximately 450 lbs of prairie grass and forb seed was performed in January 2004. Periodic mowing was performed throughout the year in order to limit weed establishment. Herbicide was applied in select locations to limit encroachment of invasive exotic weed species from surrounding properties. Manual weeding also was performed throughout the prairie area.

2005: In order to track the effectiveness of future invasive weed eradication efforts, infested areas were mapped early in the growing season. Areas of infestation were field-located and electronically superimposed onto an aerial photograph of the site. Later in the growing season, spot-spraying individual invasive weed plants with herbicide was performed as part of an on-going efforts to reduce numbers and control encroachment of this species throughout the prairie area. The map of infested areas was utilized during this spot-spraying effort in order to streamline fieldwork. Mowing of selected areas was also performed in order to establish firebreaks in anticipation of a potential prescribed burn in Spring 2006.

In October 2004, the Weldon Spring Site hosted the first annual "Howell Prairie Walk and Talk" open to the general public. Prairie establishment experts from the Howell Prairie Council gave walking tours through the prairie area and were available to answer questions from attendees. A presentation about the Weldon Spring Site was given to the more than 70 attendees.

A garden that consists entirely of plants native to the state of Missouri was designed and planted during 2004. The Native Plant Educational Garden contains extensive planting of species from

Howell Prairie as well as other perennials, shrubs and trees. Walking paths, benches, and markers to identify the various plants are located through the 8-acre garden.

The Howell Prairie, Native Plant Educational Garden, and Interpretive Center were designed to serve as ICs. These areas will attract visitors to the Weldon Spring Site, thus ensuring long-term community education about the remediation project and enhancing the overall educational mission of the site.

4.1.3.3 Inspections

The first annual LTS&M inspection took place at the Weldon Spring Site on October 28–29, 2003. The inspection was conducted in accordance with the draft LTS&M Plan (May 30, 2003), and associated inspection checklist. Representatives from EPA and MDNR participated in the inspection. A representative from MDC participated in portions of the inspection.

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

The IC areas were inspected to ensure that pending restrictions such as excavating soil, groundwater withdrawal, and residential use were not being violated. Each area was inspected and no indications of violations of future restrictions were observed.

The disposal cell was inspected by walking ten transects over the cell and around the cell perimeter at the grade break and the base. No unusual settlement or other unusual observations were noted. Five areas of the cell were marked for annual observations of rock degradation. The LCRS was also inspected and found to be in good condition. Sixty-five of 120 groundwater-monitoring wells were inspected and found to be in generally good condition. A few of the wells needed to be labeled with the proper identification numbers and/or repainted. Other site features including prairie, site markers and roads were also inspected.

During the 2003 inspection, erosion areas were identified on the north and northwest sides of the disposal cell. These areas had been recently repaired with soil and mulch at the time of the 2003 inspection. During the spring of 2004, these areas were greatly affected by one or more heavy rainfalls and the repairs were washed out resulting in very large erosion gullies. Also during the 2003 inspection, an area of erosion was identified at the outfall NP-0050 on the southwest side of the property. Runoff from the Chemical Plant property had flowed under the fence onto the Army property and had eroded out a gravel road used to travel around the Army property. Both of the areas were repaired during July 2004.

Details of the inspection can be found in the *2003 Annual Inspection Report for the Weldon Spring Site St. Charles, Missouri* (DOE 2004e).

The first annual public meeting required by the LTS&M Plan was held on March 25, 2004. This meeting was held to discuss the 2003 inspection. Also discussed were changes to the LTS&M Plan, a summary of environmental data and the interpretive center/prairie.

The second annual LTS&M inspection took place at the Weldon Spring Site on November 17 and 18, 2004. Representatives from EPA and MDNR participated in the inspection.

Representatives from the Weldon Spring Citizen's Commission and MDC participated in portions of the inspection.

The main areas inspected at the site were areas where future ICs will be established, the Quarry, the disposal cell, LCRS, and monitoring wells.

The IC areas were inspected to ensure that pending restrictions such as excavating soil, groundwater withdrawal, and residential use were not being violated. Each area was inspected and no indications of violations of future restrictions were observed.

The disposal cell was inspected by walking ten transects over the cell and around the cell perimeter at the grade break and the base. Some small depression areas on the cell top and a minor surface disturbance on the side slope were noted for further observation. These areas were located and mapped by global positioning system (GPS) survey equipment in December so that they could be closely monitored. Five areas of the cell which had been marked and located by GPS survey equipment during the 2003 annual inspection were located and observed for any signs of rock degradation. The LCRS also was inspected and found to be in good condition. Fifty-seven of 119 groundwater wells were inspected and found to be in generally good condition. One well in the Southeast Drainage had been repainted and the number had not been reapplied, although the brass monument with the well number, which is on every well, was clearly visible. Other site features including the prairie, site markers and roads also were inspected. Areas of erosion were identified on the Chemical Plant property, north of the disposal cell. One of the erosion areas was located slightly inside the buffer zone area and threatened to wash out a buffer zone survey pin. The erosion areas were repaired on June 6-8, 2005. Details of the inspection can be found in the *2004 Annual Inspection Report for the Weldon Spring Site St. Charles, Missouri* (DOE 2005d).

The second annual public meeting required by the LTS&M Plan was held on April 6, 2005. This meeting was held to discuss the 2004 inspection. Also discussed were changes to the LTS&M Plan, a summary of environmental data and the interpretive center/prairie.

The 2005 inspection is discussed in Section 6.5 as the Five-Year Review inspection.

4.1.3.4 Other Monitoring and Maintenance Activities

Other monitoring and maintenance activities for the CPOU include disposal cell monitoring and the collection and monitoring of the leachate, which are both discussed previously in this section. The LCRS Operating Plan is included as Appendix I to the LTS&M Plan. The LCRS/Train 3 Treatment Contingency Plan is included as Appendix J to the LTS&M Plan.

4.1.3.5 Operation and Maintenance Costs

The fiscal year (FY) 2004 LTS&M costs for the Weldon Spring Site were budgeted at $1,449,928. The actual costs were $1,441,383.

The FY 2005 LTS&M costs for the Weldon Spring Site were budgeted at $1,309,754. The actual costs were $1,245,935.

4.2 Groundwater Operable Unit

4.2.1 Groundwater Operable Unit Remedy Selection

Contaminated groundwater remains beneath the Chemical Plant, primarily in the western and southwestern portions of the site and beneath portions of adjacent Army property. Contaminants include uranium, TCE, nitrate, and nitroaromatic compounds. Nitroaromatic compounds also occur in groundwater in the east and northeast portions of the site. Contamination in groundwater is generally confined to the shallow, weathered portion of the Burlington-Keokuk Limestone. Some contamination occurs in the unweathered portion of the Burlington-Keokuk beneath the former raffinate pits. Groundwater from the Chemical Plant also discharges to springs in the August A. Busch Memorial Area.

4.2.1.1 Groundwater Operable Unit In Situ Chemical Oxidation Testing

The *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (IROD) (DOE 2000a) which was approved on September 29, 2000, authorized treatment of TCE in groundwater utilizing ICO methods. Bench-scale testing was conducted in Spring 2001 to evaluate the effectiveness of several different oxidants in destroying TCE in groundwater samples collected from this area of the site. Tests by four different subcontractors demonstrated that, under laboratory conditions, oxidation chemistry was able to destroy TCE without significantly affecting the concentrations of other contaminants.

Following the successful bench-scale testing, technical specifications were prepared for field implementation of a pilot-scale treatment system. One subcontract was awarded in December 2001 to evaluate the effectiveness of ICO under actual field conditions and to assess the feasibility of implementing ICO on a full-scale basis. The pilot-scale injection was performed in April and May 2002 at two specified locations within the area of TCE impact: one location with relatively high hydraulic conductivity (K) (i.e., $K \approx 10^{-3}$ centimeters per second [cm/sec]) and one location with relatively low hydraulic conductivity (i.e., $K \approx 10^{-4}$) cm/sec). These locations were designated the "High K" and "Low K" injection points.

Design, installation, and operation of the ICO pilot-scale system were performed by a specialty subcontractor. Approximately 15,000 gallons of 0.1 percent sodium permanganate solution were introduced to the aquifer during the first injection. Groundwater sampling 10 days after the injection indicated that a second treatment was necessary to achieve the 5-µg/L remediation goal specified in the IROD (DOE 2000a). Thus, a second injection, consisting of approximately 25,000 gallons of additional permanganate solution, was performed.

Groundwater monitoring was conducted before, during and after the pilot-scale treatment as described in *Groundwater Sampling Plan for In-situ Chemical Oxidation Pilot-Scale Testing*. It was determined based on extensive monitoring that the ICO did not perform adequately under field conditions; therefore, the remediation of TCE was reevaluated with the remaining COC. Additional information regarding the results of this study can be found in the *Completion Report for the Groundwater Sampling Performed in Support of the Pilot Phase ICO Project* (DOE 2004h).

4.2.1.2 Groundwater Operable Unit Pump-and-Treat Field Test

A field test was performed in the southwest portion of the Chemical Plant to compare the effectiveness of several scenarios proposed for pump-and-treat remediation of contaminated groundwater. The test was conducted in accordance with *Additional Groundwater Pump and Treat Studies in Support of the Feasibility Study for the Groundwater Operable Unit* (Ref).

The objective of the field test was to determine whether enhancement by artificial recharge or use of angled extraction wells could significantly improve contaminant removal rates compared to those achievable by a conventional pump-and-treat system. The test was designed to include six operational stages of 20 days each, followed by a 90-day recovery period. During each stage, physical and analytical parameters of the groundwater were monitored to accomplish the following objectives: 1) establish a hydraulic capture zone, 2) determine the response of the aquifer, and 3) quantify the mass of contaminants removed.

The six planned stages of the study were as follows:

- Stage 1: Determine the sustainable yield of the shallow aquifer by establishing the maximum pumping rate sustainable at a vertical well (MW-3028).
- Stage 2: Extract water at the sustainable yield from a vertical well (MW-3028).
- Stage 3: Extract water from a vertical well (MW-3028) while introducing an artificial recharge of 5 gpm at two upgradient locations (MW-2037 and MW-3032).
- Stage 4: Extract water from a vertical well (MW-3028) while introducing an artificial recharge of 10 gpm at two upgradient locations (MW-2037 and MW-3032).
- Stage 5: Extract water from an angled well (MW-3033) while introducing an artificial recharge of 5 gpm at two upgradient locations (MW-2037 and MW-3032).
- Stage 6: Extract water from an angled well (MW-3033) while introducing an artificial recharge of 10 gpm at two upgradient locations (MW-2037 and MW-3032).

Stages 1 through 5 of the study were performed from March 2001 through August 2001. Stage 6 was omitted from the study due to the low sustainable yield in the angled well. The recovery monitoring period started on August 13, 2001, and was concluded on November 12, 2001.

The mass of contaminants removed from the aquifer was determined from the measured contaminant concentrations and groundwater volumes extracted each day. A summary of the mass of contaminants removed during the test is presented in Table 4−4.

Table 4–4. Mass of Contaminants Removed During Pump & Treat Study

Stage	Nitrate (kilograms [kg])	TCE (grams [g])	2,4-DNT (g)	Uranium (g)
2	219	228	0.14	1.1
3	216	309	0.08	1.2
4	280	269	0.14	1.3
5	37	42	0.02	0.6

Results of the field studied conducted in 2001 indicated that the modifications to conventional pump and treat that were implemented did not increase the mass of contaminants removed as compared with a conventional vertical well system with no artificial recharge. Consequently, the amount of water extracted from the area due to artificial recharge (injection of potable water) would not reduce the remediation time frames for TCE, nitrate, uranium, or nitroaromatic compounds. Another modification, the use of an angled well, likewise failed to produce results comparable to the vertical extraction well. These results reflect the difficulty involved in siting productive wells in the complex geology of the site.

The hydrogeologic data obtained from these studies were consistent with data collected during a previous study performed in 1998. The results from these field studies support the conceptual model, which is that the sustainable yields are low, and localized dewatering would likely occur. Recharge of the aquifer is very slow, as indicated by the long recovery time of the monitor wells after the study.

The distribution of the contaminants did not change as a result of the field studies, with the exception of significant dilution in the vicinity of the injection wells. The majority of the wells returned to baseline concentrations or were showing increasing trends at the end of the monitoring period, which could be attributed to several mechanisms. One mechanism may be the transport of upgradient contaminated groundwater into the study area because of the low hydraulic gradient across the Chemical Plant. Another mechanism may be the diffusion of contaminants from poorly connected or dead-end fractures and solution features into the more transmissive portions of the aquifer (i.e., paleochannels). Either scenario would indicate that most of the contaminated groundwater removed was from the interconnected secondary porosity features (likely paleochannels). This would indicate that extracting the water from the more transmissive portions of the shallow aquifer would effectively remediate the groundwater within the paleochannel, and that desorption and/or slower groundwater movement from the lower conductivity portions of the aquifer would control the remediation time frames.

Complete analytical results of the field tests are presented in the *Completion Report for the Additional Groundwater Field Studies in Support of the Groundwater Operable Unit* (DOE 2002c).

4.2.2 Groundwater Operable Unit Remedy Implementation

The *Record of Decision for the Final Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (GWOU ROD) (DOE 2004a) was signed by EPA on February 20, 2004. The final GWOU ROD (DOE 2004a) 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 (DOE 2004a) 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 2004f). This network has since been modified as presented in the *Interim Remedial Action Report for the Groundwater Operable Unit of the Weldon Spring Site* (DOE 2005e) and is described below.

COCs for groundwater and springs at the Chemical Plant area are TCE, nitrate, uranium, and nitroaromatic compounds. The set of COCs measured for each of the monitoring locations presented in Table 4−6 depends on the proximity of the particular well or spring to the contaminant plumes.

The objectives specified in the GWOU ROD (DOE 2004a) for the MNA monitoring network are:

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

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

- Baseline conditions (Objective 1) have remained unchanged.
- Performance monitoring locations (Objective 2) indicate that concentrations within the area of impact are decreasing as expected.
- Detection monitoring locations (Objectives 3, 4, and 5) indicate when a trigger has been exceeded.

The guidance documents *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tanks Sites* (EPA 1999) and the *Technical Guidance for the Long-Term Monitoring of Natural Attenuation Remedies at Department of Energy Sites* (DOE 1999b) were used during the development of this monitoring program.

The monitoring network consists of 50 wells, four springs, and one surface water location. The locations and the objectives they satisfy are summarized in Table 4−5 and are depicted on Figure 4−3.

Table 4–5. Monitoring Locations Retained for MNA Monitoring for the GWOU

Objective 1	Objective 2	Objective 3	Objective 4	Objective 5	Objective 6
MW-2017 MW-2035 MW-4022 MW-4023	MW-2012 MW-2014 MW-2038 MW-2040 MW-2046 MW-2050 MW-2052 MW-2053 MW-2054 MW-3003 MW-3024 MW-3030 MW-3034 MW-3039 MW-3040 MW-4013[a] MW-4029 MW-4031 MW-4036[a] MW-4040	MW-2032 MW-2051 MW-3031 MW-3037 MW-4013 MW-4014 MW-4015 MW-4026 MW-4036 MW-4039 MW-4041 MWS-1 MWS-4	MW-2021 MW-2022 MW-2023 MW-2056 MW-3006 MW-4007 MWD-2	SP-5303 SP-5304 SP-6301 SP-6303 SW-2007[b]	MW-2005 MW-2055 MW-3025 MW-3038 MW-4001 MW-4011 MW-4020 MW-4037

[a]Location is also an Objective 3 location.
[b]Location is on Dardenne Creek immediately upstream of Highway 40/61, approximately 2.1 miles north of the Site.

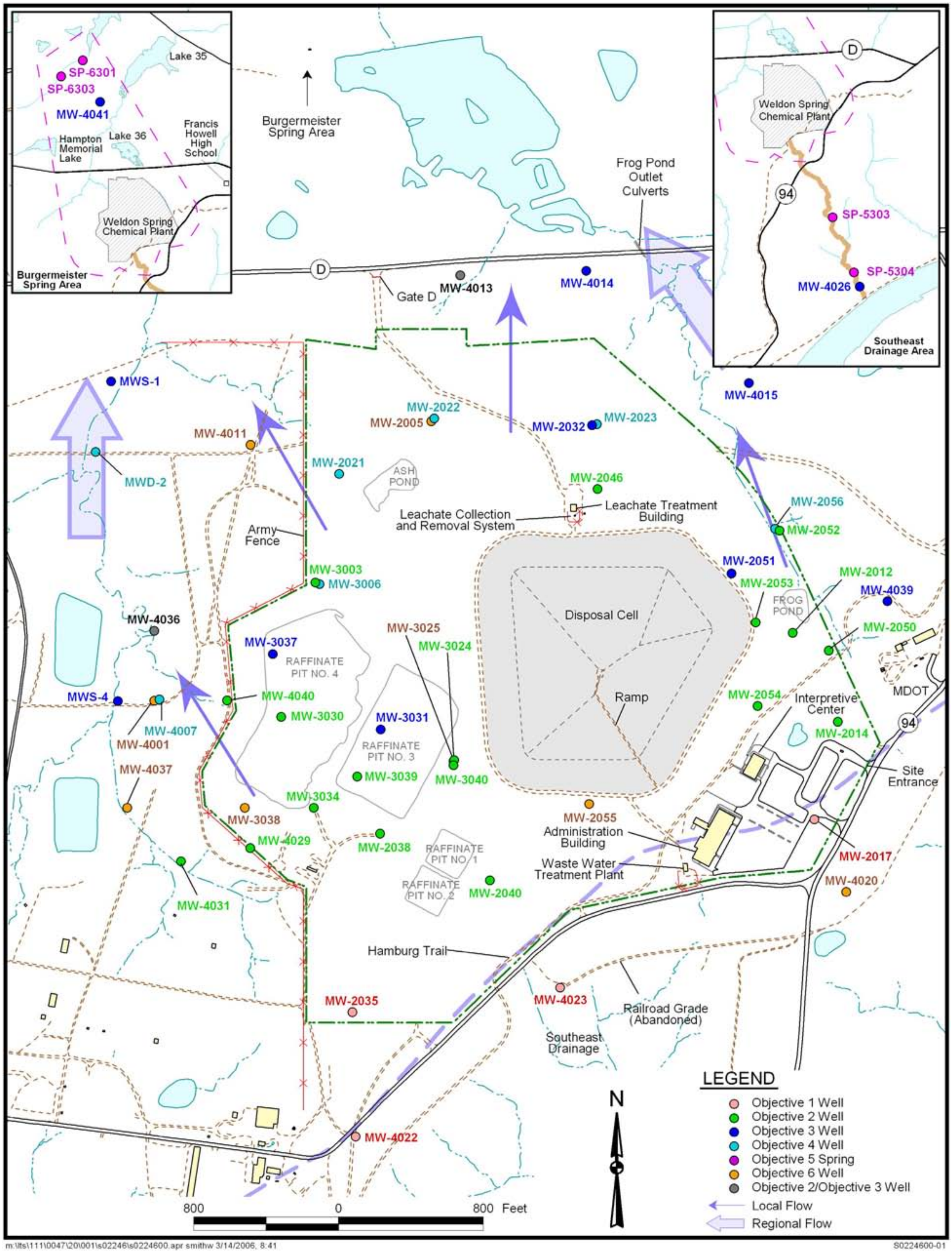

Figure 4–3. MNA Groundwater Monitoring Locations

4.2.3 Groundwater Operable Unit System Operation and Maintenance

The long-term monitoring and maintenance activities discussed in the CPOU section also apply to the GWOU. This includes the LTS&M Plan (DOE 2005a), inspections and ICs. Other maintenance activities include maintenance of the wells, which are inspected during each sampling event and maintained regularly.

4.3 Quarry Bulk Waste Operable Unit

4.3.1 Quarry Bulk Waste Operable Unit Remedy Selection

Remedial activities under the QBWOU were performed under the *Record of Decision for Management of Bulk Wastes at the Weldon Spring Quarry* (DOE 1990a). The QBWOU ROD (DOE 1990a) was signed by EPA on September 28, 1990, and by DOE on March 7, 1991. The primary activities established were to:

- Excavate and remove bulk waste (i.e., structural debris, drummed and unconfirmed waste, process equipment, sludge, and soil).
- Transport the waste along a dedicated haul road to the Temporary Storage Area (TSA), which was located within the boundary of the CPOU.
- Stage bulk wastes at the TSA for ultimate disposal in the on-site disposal cell.

4.3.2 Quarry Bulk Waste Operable Unit Remedy Implementation

Removal of the bulk waste was performed in a multi-tiered process similar to the one used at the Chemical Plant. In the first tier, the Quarry water treatment plant, which was designed to treat contaminated water from the Quarry sump, was constructed. In the second tier, the basic infrastructure, including decontamination facilities, a haul road, and the utilities needed to excavate and transport the waste from the Quarry to the Chemical Plant, was built. In the final tier, the waste was excavated.

The waste was removed with conventional equipment and excavation techniques, placed in covered trucks, and hauled via the haul road to the TSA at the Chemical Plant. The waste was retained in the temporary facility until it could be placed in the disposal cell. From May 1993 to October 1995, approximately 144,000 cubic yards (110,000 cubic meters) of soil and waste material were removed from the Quarry, transported to the Chemical Plant area, and placed in the TSA. All of the wastes were directly placed or treated and placed in the disposal cell by March 1999.

4.3.3 Quarry Bulk Waste Operable Unit System Operation and Maintenance

The QROU addresses residual contamination and long-term monitoring and maintenance for the Quarry.

Table 4–6. Monitoring Parameters for MNA Locations

Location	Sampling Frequency[a]	Monitoring Parameters							
		TCE	Nitrate (as N)	Uranium	1,3-DNB	2,4,6-TNT	2,4-DNT	2,6-DNT	NB
MW-2012	S				✔	✔	✔	✔	✔
MW-2014	S						✔	✔	
MW-2017	S				✔	✔	✔	✔	✔
MW-2021	S		✔						
MW-2022	Q		✔		✔	✔			
MW-2023	Q				✔	✔	✔	✔	✔
MW-2032	S				✔	✔	✔	✔	✔
MW-2035	S	✔	✔	✔			✔		
MW-2038	S		✔				✔		
MW-2040	S		✔			✔			
MW-2046	S					✔			
MW-2050	S						✔	✔	
MW-2051	S				✔	✔	✔	✔	✔
MW-2052	S						✔	✔	
MW-2053	S					✔	✔	✔	
MW-2054	S						✔	✔	
MW-2056	Q				✔	✔	✔	✔	✔
MW-3003	S		✔	✔					
MW-3006	S	✔	✔	✔			✔		
MW-3024	S			✔					
MW-3030	S	✔		✔			✔		
MW-3031	S	✔		✔					
MW-3034	S	✔	✔				✔		
MW-3037	S	✔		✔			✔		
MW-3039	S						✔		
MW-3040	Q	✔	✔	✔					
MW-4007	S	✔	✔						
MW-4013	S		✔				✔	✔	✔
MW-4014	S		✔		✔	✔	✔	✔	✔
MW-4015	S						✔	✔	✔
MW-4022	S		✔	✔					
MW-4023	S		✔	✔					
MW-4026	S			✔					
MW-4029	S	✔	✔						
MW-4031	S		✔						
MW-4036	S	✔	✔	✔			✔		
MW-4039	S				✔	✔	✔	✔	✔
MW-4040	Q	✔	✔	✔			✔		
MW-4041	Q	✔	✔	✔	✔	✔	✔	✔	✔
MWS-1	Q	✔	✔	✔			✔		
MWS-4	Q	✔	✔	✔					
MWD-2	Q		✔	✔					
SP-5303	S			✔					
SP-5304	S			✔					
SP-6301	S	✔	✔	✔	✔	✔	✔	✔	✔
SP-6303	S	✔	✔	✔	✔	✔	✔	✔	✔
SW-2007	Q			✔					

[a]Monitoring frequencies may be decreased to annual or biennial on the basis of trends in at least the first 2 years of data.
S = semiannual
Q = quarterly

4.4 Quarry Residuals Operable Unit

4.4.1 Quarry Residuals Operable Unit Remedy Selection

The QROU remedy was described in the *Record of Decision for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1998a). 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 selected remedy included:

- Long-term monitoring and 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 implementing a well field contingency plan.
- Confirming the model assumptions regarding extraction of contaminated groundwater and establishing controls to protect naturally occurring attenuation processes.
- Restoring the Quarry and establishing ICs.

4.4.2 Quarry Residuals Operable Unit Remedy Implementation

4.4.2.1 Long-Term Groundwater Monitoring

Long-term groundwater monitoring for the QROU consists of two separate programs. The first program details the monitoring of uranium and 2,4-DNT south of the slough to ensure that levels remain protective of human health and the environment. The second program consists of monitoring groundwater contaminant levels within the area north of the slough until they attain a predetermined target level indicating negligible potential to affect groundwater south of the slough.

Groundwater monitoring is necessary to continue to ensure that uranium-contaminated groundwater has a negligible potential to affect the St. Charles County well field. Under current conditions, groundwater north of the slough poses no imminent risk to human health from water obtained from 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 Water Quality Standard (MWQS). Upon attainment of these target levels, it will be determined that the goal for the monitoring program has been met, and the long-term monitoring activities for this OU will be concluded. Following attainment of the long-term monitoring target levels in groundwater north of the slough, an assessment of the residual risks based on actual groundwater concentrations will be performed to determine the need for future ICs.

The groundwater monitoring strategy consists of a stepped approach. The wells have been separated into four lines that provide specific information:

- 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, MW-1030) are sampled to establish trends in contaminant concentrations within the areas of higher impact.
- The second line of wells monitors the area of impact within the alluvial materials and shallow bedrock north of the slough. These wells (MW-1006, MW-1007, MW-1008, MW-1009, MW-1012, 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, MW-1052) are also sampled to establish trends in contaminant concentrations within the areas of higher impact and to monitor the oxidizing and reducing environments that are present within this area.
- The third line of wells monitors the alluvial material directly south of the slough. These wells (MW-1017, MW-1018, MW-1019, MW-1021, MW-1044, 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 well field. These wells (RMW-1, RMW-2, RMW-3, RMW-4) are sampled to monitor the groundwater quality of the productive portions of the alluvial aquifer and to determine the occurrence of uranium outside the range of natural variation.

The frequency of sampling for each location is based on the distance of the well from the source or migration pathway. Monitoring wells on the Quarry rim are sampled quarterly for total uranium. The quarterly sampling helps establish the trend in concentrations at these locations and monitors the effects of Quarry dewatering and bulk waste removal activities on the groundwater system. All Quarry locations are sampled at least annually for uranium, nitroaromatic compounds, and sulfate.

Until October 2005, St. Charles County has its own well-field monitoring program that was initiated in 1989 as a result of cooperative efforts between DOE, St. Charles County, and MDNR. This program is funded by a DOE grant. The program for 2004 consisted of annual, quarterly, and monthly sampling events of operating production wells, the RMW-series wells, and raw and treated water from the water plant. Results of this monitoring program can be obtained through the Division of Environmental Services for St. Charles County.

The sale of the St. Charles County Water Treatment Plant from St. Charles County to Public Water Supply District #2 was finalized on September 29, 2005. This property also includes the county well field and related infrastructure. The monitoring responsibilities for the county well field have been transferred from the County to the Public Water Supply District #2.

4.4.2.2 Quarry Interceptor Trench Field Studies

The selected remedy in the QROU ROD (DOE 1998a) outlined the performance of two field studies to support the decision for long-term monitoring of groundwater and reliance on natural conditions to limit potential migration of uranium south of the slough. These field studies consisted of the installation and operation of an interceptor trench and hydrologic/geochemical sampling within the area of uranium impact to verify the effectiveness of uranium removal by groundwater extraction methods and support the conceptual fate and transport model for the Quarry.

The interceptor trench was constructed to support the action in the QROU ROD (DOE 1998a). This field study was performed southeast of the Quarry to quantify the mass of uranium that could be removed from the alluvial aquifer by groundwater extraction. The trench was constructed to represent a cross-section of alluvial material and was optimally located to extract groundwater from the areas with high uranium concentrations. The trench was approximately 550 ft (168 meters) in length, and water produced from the trench was routed underground to the Quarry water treatment plant. The system was evaluated and monitored for 2 years (April 27, 2000, to April 26, 2002) to confirm model predictions. A total 1,666,234 gallons (6,307,382 liters) of water was pumped from the interceptor trench. Samples were collected daily from the operating pumps to determine the mass of uranium removed.

The objective of the interceptor trench field study was to confirm model predictions of the effectiveness of groundwater extraction systems to remove uranium from the shallow aquifer on the basis of field data. If the performance of the trench was not more effective than modeled (i.e., less than 10 percent of the mass of uranium removed within the 2-year testing period), further evaluation of groundwater treatment would not be necessary. If the performance of the trench exceeded the modeled values (greater than 10 percent of the mass of uranium removed within the 2-year testing period), the effectiveness and benefit of groundwater extraction would be reevaluated.

The efficiency of the interceptor trench system was defined as the ratio of the cumulative mass of uranium removed to the initial mass present within the capture zone of the trench. By the end of the 2-year study period, the interceptor trench had removed 14 kilograms (kg) of uranium. A summary of the production from each pump is detailed in Table 4−7. This accounted for 1.5 percent of the mass available to the interceptor trench. The predicted percent of removal for the 2-year operation was 10 percent. The percent removed was significantly below the predicted performance of the trench, which indicates that the modeled predictions were optimistic and that further evaluation of groundwater treatment was not warranted. A summary of the field study is provided in the *Evaluation of the Performance of the Interceptor Trench Field Study* (DOE 2003b).

Table 4–7. Pump Production

Sump	Production (gallons)	Days of Operation	Total Mass of Uranium Removed (grams)
3004	257	3	2
3104	108,712	47	1,400
3204	158,277	59	1,635
3304	1,398,988	559	10,974
Total	1,666,234	567	14,011

4.4.2.3 Hydrological and Geochemical Field Studies

The conceptual model for the Quarry is that sorption of uranium onto the aquifer matrix and organic material and precipitation of dissolved uranium from groundwater are responsible for the notable decrease of uranium concentrations (from 3,000 pCi/L to less than 1 pCi/L) over a short distance (100 to 300 ft, or 30 to 91 meters) north of the slough. The sharp decrease in uranium levels indicates that dispersion and dilution, which typically generate more diffuse boundaries, are not the primary processes attenuating the uranium in groundwater.

Several investigations were performed in the area north of the slough to evaluate uranium attenuation mechanisms. Oxidation state and redox-sensitive parameter data defined the oxidizing and reducing zones of the alluvial aquifer and the boundary between them. Distribution coefficients were estimated from depth-discrete sampling data to determine the sorption/desorption capacity of the aquifer matrix (both alluvial and bedrock). The distribution of uranium in soil across the reducing front was quantified where uranium was concentrated in a narrow band beneath the oxidized/reduced contact.

The results of the investigations provided a better understanding of the natural geochemistry of the alluvial aquifer north of the slough. The area contains a naturally occurring oxidation/reduction front, which acts as a barrier to the migration of dissolved uranium by inducing its precipitation. The physical and chemical parameters measured in groundwater samples were successfully correlated with the physical properties of the aquifer material and support the conceptual fate and transport model presented in the *Remedial Investigation for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1998b). Specific details are presented in the C*ompletion Report for the Geochemical Characterization Performed in Support of the QROU Field Studies* (DOE 2002).

4.4.2.4 Quarry Reclamation

Reclamation of the Quarry included backfilling the Quarry proper, demolition of the Quarry treatment plant, removal of the Quarry interceptor trench system, and dismantlement of facilities used during bulk waste removal. Backfilling of the Quarry was designed to reduce physical hazards associated with an open Quarry, eliminate the ponding of water, and reduce infiltration of precipitation water into the groundwater system.

In 2000, DOE completed characterization of contamination remaining at the northeast slope and several other locations in the Quarry proper. Soil was excavated from three locations within the Quarry proper (1,574 cubic yards, or 1,203 cubic meters) during 2000 and placed in the permanent disposal cell at the Chemical Plant. Cleanup criteria for the Quarry proper soil were taken from the Chemical Plant ROD (DOE 1993), as specified in the QROU ROD (DOE 1998a). Based on previous characterization activities, only radioactive contaminants of concern were targeted.

Backfill for the Quarry was acquired from an off-site borrow area, consisting of approximately 17 acres (6.9 ha) of land on the MDC property. Approximately 76,400 cubic yards (58,400 cubic meters) of soil was excavated and transported to the Quarry for use as backfill. Uncontaminated soils from within the Quarry and the Quarry staging area were also used as backfill materials for the Quarry.

Fill material was placed and compacted to design elevations within the Quarry proper. During backfilling of the Quarry, selected wall and floor fractures were sealed to prevent infiltration of water and reduce the likelihood of later subsidence of the backfill. Upon completion of backfill activities, final grading and seeding were performed. Reclamation of the Quarry was completed on September 6, 2002.

4.4.3 Quarry Residuals Operable Unit System Operation and Maintenance

The long-term monitoring and maintenance activities discussed in the CPOU section also apply to the QROU. This includes the LTS&M Plan (DOE 2005a), inspections, and ICs. Other maintenance activities include maintenance of the wells, which are inspected during each sampling event and maintained regularly.

4.5 Southeast Drainage

4.5.1 Southeast Drainage Remedy Selection

Cleanup for the Southeast Drainage was addressed as a removal 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 1996) evaluated options for addressing contaminated soils and sediments in the Southeast Drainage. The EE/CA recommended that sediment in accessible areas of the drainage should be removed. The excavated materials would be stored temporarily at an on-site storage area until final disposal in the disposal cell.

4.5.2 Southeast Drainage Remedy Implementation

The Southeast Drainage is a natural drainage area with intermittent flow that traverses both the Army property and the Weldon Spring Conservation Area from the Chemical Plant site to the Missouri River (Figure 3−2). Both the Army and AEC used the drainage to discharge water from sanitary and process sewers to the Missouri River. Also, contaminated liquids in the raffinate pits were decanted to the plant process sewer and subsequently discharged to the Southeast Drainage; overflow from the raffinate pits continued to discharge into the drainage after plant operations ceased. As a result, sediments and soils in the Southeast Drainage were contaminated. Radioactive contaminants of concern were uranium-238, radium-226, thorium-232, and thorium-230. Spring water in the Southeast Drainage (Springs SP-5303 and SP-5304) was contaminated with uranium and low concentrations of nitroaromatic compounds from the contaminated sediment.

Soil removal was in two phases: 1997−98 and again in 1999. A total of 1,931 cubic yards (1,476 cubic meters) was excavated in the first phase, and about 22.5 cubic yards (17.2 cubic meters) was excavated in the second phase.

Post-remediation soil sampling was conducted at Southeast Drainage locations after the soil was excavated. The purpose of this sampling was to determine the remaining concentrations of radionuclides within the soil and sediment and to calculate the risk reduction achieved from soil removal. Sampling was conducted in accordance with the *Post-Remediation Sampling Plan for the Southeast Drainage* (DOE 1997c). All post-remediation data results were used by Argonne National Laboratory to calculate risk reduction achieved by the removal action.

Complete details of the remediation as well as the post-cleanup risk assessment of the Southeast Drainage are in the *Southeast Drainage Closeout Report Vicinity Properties DA−4 and MDC−7* (DOE 1999a).

4.5.3 Southeast Drainage System Operation and Maintenance

The long-term monitoring and maintenance activities discussed in Section 4.1 (CPOU) also apply to the Southeast Drainage. This includes the LTS&M Plan, inspections, and ICs.

4.6 Post-ROD Changes

CERCLA contains provisions for addressing changes to a remedy that occur after the ROD is signed. The following are the changes to RODs which have occurred since the previous Five-Year Review was issued.

4.6.1 Post-ROD Change #22

Post-ROD Change #22 was classified as a non-significant change to the ROD and was dated February 12, 2002. EPA and MDNR were notified of this non-significant change. The description of the change was to ship the incidental quantities of potentially radioactive waste, which have been generated since cell closure, to an off-site disposal facility.

Following this change to the ROD, during 2002, remaining site debris, soil and stabilized sediment from Quarry effluent pond #2 was shipped to Envirosafe in Grandview, Idaho, and 24 drums of stabilized ion exchange resin and small amounts of debris were shipped to Envirocare in Clive, Utah.

4.6.2 Explanation of Significant Difference

An ESD (DOE 2005c) issued in February 2005 applied to three RODs—CPOU ROD, QROU ROD, and the GWOU ROD. The ESD also presented changes to the response action for the Southeast Drainage as part of the change to the CPOU ROD. The ESD documented significant differences to the selected remedies in the three RODs. In the RODs and EE/CA, DOE and EPA made assumptions as to the anticipated future land and other natural resources potentially impacted by contamination released at the site and selected response actions that are protective for those uses. However, the RODs and EE/CA in some cases did not specify particular use restrictions necessary for those actions to remain protective over the long term. At the time the ESD was issued, the actual land and natural resource uses had been consistent with the assumptions made in the RODs, and DOE and EPA believed that the selected remedies remained protective. However, to assure land and resource uses remained consistent with these assumptions over the long term, ICs based upon specific use restrictions are necessary. The purpose of the ESD was to identify the specific use restrictions necessary for all site areas affected by these response actions. The specific ICs needed to implement these use restrictions were then identified, evaluated, and adopted pursuant to the LTS&M Plan (DOE 2005a) and are further discussed in Sections 7.1.5, 7.2.5, and 7.3.5.

End of current text

5.0 Progress Since Last Review

Since the last Five-Year Review, remedial activities at the Chemical Plant and the Quarry have been completed with the exception of long-term groundwater monitoring at both locations. The GWOU ROD (DOE 2004a) was finalized in January 2004 and was signed by EPA in February 2004. The GWOU ROD selected the remedy of MNA with ICs to limit groundwater use during the period of remediation. Since the site has reached physical completion, the LTS&M activities have become the main focus of the project. The finalization of the LTS&M Plan (DOE 2005a) in July 2005, progress on the establishment of ICs, conducting annual surveillance inspections, and establishing the interpretive center and Howell Prairie have been major activities for the project.

At the time of the last Five-Year Review report (DOE 2001a) the remedies for the Chemical Plant and Quarry residuals were not complete, and the remedy for the GWOU had not been selected. The protectiveness statements in the last Five-Year Review stated that the remedies are expected to be protective of human health and the environment upon completion. The Protectiveness Section in the last Five-Year Review also provided discussion about the need and plans for long-term maintenance and surveillance of the site and ICs. The progress in attaining these objectives is detailed in Sections 6, 7, and 8 of this document.

End of current text

6.0 Five-Year Review Process

6.1 Administrative Components of the Five-Year Review Process

The Five-Year Review process for the Weldon Spring Site began in October 2005 and continued through September 2006. The Five-Year Review process included notifying regulatory agencies, the community, and other interested parties of the start of the Five-Year Review, reviewing relevant documents and data, conducting site inspections, conducting site interviews, and developing/reviewing this third Five-Year Review Report. Each of these elements is discussed below.

The EPA and MDNR were formally notified that the Five-Year Review process had begun in a letter dated October 4, 2005, which notified them of the annual LTS&M inspection that was to take place on November 7 and 8, 2005. The letter also stated that the annual inspection would also serve as the Five-Year Review inspection, in preparation for the CERCLA Five-Year Review report due in 2006. During the annual inspection, the Five-Year Review was discussed with all participants, including: Tom Pauling, DOE; Terri Uhlmeyer, SM Stoller, Corp.; Dan Wall, EPA-Region 7; Steve Lang, MDNR; and Nancy Dickenson, WSCC Technical Consultant. Other contributors to the development of the Five-Year Review included Dave Peterson, SM Stoller, Corp.and Mary Picel, Argonne National Lab.

6.2 Community Notification and Involvement

Activities to involve the community in the Five-Year Review were initiated in October 2005, when the DOE informed the Weldon Spring Citizens Commission that the Five-Year Review process was taking place, the purpose of the Five-Year Review and provided them with a list of questions for them to complete regarding their opinions about the site. The questions were generated from the EPA Comprehensive Five-Year Review Guidance and were designed by EPA to solicit input from various interested parties, including the public, regarding the effectiveness and protectiveness of the CERCLA remedies.

On March 8, 2006, the DOE sent out its 2005 Annual Inspection Report (DOE 2006) to its distribution list, which includes many members of the public. The cover letter included a notification to the public that the CERCLA Five-Year Review is underway for the Weldon Spring Site and stated that the review evaluates the effectiveness and protectiveness of the remedies that have been implemented at the site. The letter also stated that the 2005 annual inspection was expanded to support the Five-Year Review process and that DOE encourages public involvement by providing the opportunity to review the annual inspection report and by providing input to the Five-Year Review. The letter also included an attachment of the questions submitted to the WSCC as discussed above and noted that they are available on the Weldon Spring location website for direct online response.

On April 5 and April 9, 2006, the DOE published a newspaper notice informing the public of the annual Weldon Spring Site public meeting which was being held on April 11, 2006, to discuss the 2005 Annual Inspection Report. The notice also included the above notification information that was included in the inspection report cover letter regarding the Five-Year Review.

During the public meeting held at the Weldon Spring Site Interpretive Center on April 11, 2006, in addition to discussing the 2005 Five-Year Review inspection, the DOE discussed the fact that the CERCLA Five-Year Review was underway for the site and discussed the purpose of the Five-Year Review. The questionnaire which was distributed and posted on the website was discussed. The DOE also informed the public that the draft Five-Year Review Report would be distributed to the regulators and the stakeholders for review and comment.

The responses to the questions submitted to the WSCC are attached in Appendix A. Although, the questions were mailed to an extensive distribution list and posted as a survey on the Weldon Spring Site website only one response was received and this was a response mailed in by Barry McFarland of the 89th Readiness Reserve who is a contractor for the Army regarding ICs and other issues. This response is also included in Appendix A. The response received was handwritten, but has been retyped for this report.

This minimal community response and minimal attendance of the general public at the annual public meetings demonstrates to DOE that the public is not concerned with the status of the project. The DOE has strived to communicate with and educate the public during the entire history of the project beginning in the mid 1980s and still strives to keep the public informed of issues and status of the site. A very large success has been the number of people reached by the Interpretive Center, as measured by walk-in visitors, school groups, science clubs, garden clubs, and outreach groups. As discussed in Section 4.1.3.2, the Interpretive Center reached over 15,000 individuals during 2005. This is 15,000 individuals that received education and information, during 2005, regarding the cleanup that occurred at the Weldon Spring Site and what remains at the site. The impact and success of the interpretive center in educating the public, the availability of information for the public at the monthly Weldon Spring Citizens Commission (WSCC) meetings, and the availability of information on the Weldon Spring Site website (which includes all relevant documents, fact sheets, current information and environmental monitoring data), along with the notice of availability of documents to the extensive distribution list, results in a strong public participation program for the Weldon Spring Site. The DOE plans to reevaluate its current format of annual public meetings, which in 2005 resulted in the attendance of four individuals from the general public, and will rely more on the Interpretive Center public outreach, the website, and the WSCC meetings to inform the public of issues and results of annual inspections and environmental monitoring results. This change will be formally proposed in the next revision of the LTS&M Plan.

The draft Five-Year Review was submitted to the EPA and MDNR on June 16, 2006, for a 60-day review. A notice that the draft document was available on the site website was sent to the distribution list. The notice also stated that the public could provide comment on the document and stated that a hard copy would be sent upon request.

The DOE received comments from the EPA, MDNR and the WSCC. Responses to these comments were prepared and transmitted to the individual agencies or groups. Some changes were made to the document in response to the comments.

6.3 Document Review

The following sections list the documents assessed as part of this Five-Year Review. The documents are categorized into the following:

6.3.1 Basis for Response Actions

The documents listed in Table 6−1 identify the background and goals of the remedies and any changes in laws and regulations that may affect the response action. These documents also provide background information on the remedial actions, basis for action, cleanup levels, applicable or relevant and appropriate requirements (ARARs), and address community concerns and preferences.

Table 6–1. Documents Supporting Basis for Response Actions at the Site

Document	Purpose	Use For Review
ROD for the Management of the Bulk Wastes at the Weldon Spring Quarry, September 1990	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns Cleanup Levels ARARs
ROD for Remedial Action at the Chemical Plant Area of the Weldon Spring Site, September 1993	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns Cleanup Levels ARARs
Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri, August 1996	Record removal action decision	Remediation Goals Background Basis for Action Community Concerns Cleanup Levels ARARs
ROD for the Remedial Action for the Quarry Residuals OU at the Weldon Spring Site, Weldon Spring, Missouri, September 1998	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns Cleanup Levels ARARs
Interim ROD for Remedial Action for the GWOU at the Chemical Plant Area of the Weldon Spring Site, September 2000	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns Cleanup Levels ARARs
ROD for the Final Remedial Action for the GWOU at the Chemical Plant Area of the Weldon Spring Site, February 2004	Record selected remedial decision	Remediation Goals Background Basis for Action Community Concerns Cleanup Levels ARARs
Explanation of Significant Differences, Weldon Spring Site, February 2005	Records significant changes from the original remedy	Remediation Goals

6.3.2 Implementation of the Response

The documents listed in Table 6−2 furnish information about design assumptions, design plans or modifications and documentation of the response at the site.

Table 6–2. Documents Supporting Implementation of the Response at the Site

Document	Purpose	Use For Review
Southeast Drainage Closeout Report Vicinity Properties DA4 and MD7, September 1999	Documents removal action completion.	History Chronology Whether Cleanup levels were met
Remedial Design/Remedial Action Work Plan for the QROU, January 2000	Documents planned remedial design and activities	Background Remediation Goals Remedial Activities
Completion Report for Radon Flux Monitoring of the WSSRAP Disposal Facility, January 2001	Documents results of monitoring	Monitoring Results
Chemical Plant Operable Unit Remedial Action Report, January 2004	Documents that construction activities are complete	History Chronology Effectiveness of Remedial Action
Quarry Residuals Operable Unit Remedial Action Report, January 2004	Documents that construction activities are complete	History Chronology Effectiveness of Remedial Action
Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the GWOU at the Weldon Spring Site, July 2004	Documents planned remedial design and activities	Background Remediation Goals Remedial Activities

6.3.3 Operation and Maintenance

O&M documents describe the ongoing measures at a site to ensue the remedy remains protective. They provide the structure for O&M at the site and confirm that O&M is proceeding as planned.

Table 6–3. Documents Supporting Operations and Maintenance at the Site

Document	Purpose	Use For Review
LTS&M Plan for the U.S. Department of Energy, Weldon Spring, Missouri, Site, July 2005	Contains technical information necessary to operate and maintain remedy	History O&M Requirements
Weldon Spring Site Disposal Cell Groundwater Monitoring Plan, March 2004	Contains technical information necessary to operate and maintain the remedy	History O&M Requirements

6.3.4 Remedy Performance

Monitoring data, progress reports, and performance evaluation reports listed in Table 6−4 provide information that can be used to determine whether the remedial actions continue to operate and function as designed and has achieved, or is expected to achieve, cleanup levels.

Table 6–4. Documents Supporting Remedy Performance at the Site

Document	Purpose	Use for Review
FFA Quarterly Reports, 2001−2006	Summarize remedial activities and compliance with FFA	Site Status
Data Validation Reports, 2001–2006	Summarize environmental data	Monitoring Results
Leachate Collection and Removal System Summary Reports, 2003−2006	Summarize Leachate Data and LCRS Status	Leachate Data and LCRS Status
Weldon Spring Site Remedial Action Project Second Five-Year Review, August 2001	Records status and protectiveness of remedies	History Update Status
Weldon Spring Site Environmental Report for Calendar Year 2001, July 2002	Summarize activities and monitoring data annually	Site Status Monitoring Results
Weldon Spring Site Environmental Report for Calendar Year 2002, July 2003	Summarize activities and monitoring data annually	Site Status Monitoring Results
2003 Annual Inspection Report for the Weldon Spring Site, St. Charles, Missouri, February 2004	Document results of annual inspection of LTSM activities and IC status	Status of LTSM activities and IC status
Weldon Spring Site Environmental Report for Calendar Year 2003, July 2004	Summarize activities and monitoring data annually	Site Status Monitoring Results
2004 Annual Inspection Report for the Weldon Spring, Missouri, Site, January 2005	Document results of annual inspection of LTSM activities and IC status	Status of LTSM activities and IC status
Weldon Spring Site Environmental Report for Calendar Year 2004, July 2005	Summarize activities and monitoring data annually	Site Status Monitoring Results
Weldon Spring Site Cell Groundwater Monitoring Demonstration Report for the December 2004 Sampling Event, May 2005	Document sampling results and explanation for exceedances. Includes plan of action	Site Status Monitoring Results Required Actions
2005 Annual Inspection Report for the Weldon Spring, Missouri, Site, February 2006	Document results of annual and five-year inspection of LTSM activities and IC status	Support Five-Year review Status of LTSM activities and IC status

6.3.5 Legal Documentation

The legal documentation listed in Table 6−5 includes information pertinent to the site that specified responsibilities for conducting remedial action, implementing institutional and access controls, and O&M activities.

Table 6–5. Documents Supporting Legal Standards Regarding Remedial Action at the Site

Document	Purpose	Use For Review
Federal Facility Agreement	Commitments/agreement regarding implementation and operation of the remedies, conduct of studies, and responsibilities of other agencies	Site Status Required Actions Roles of Different Agencies
Institutional Control Documentation	Access agreements Easements and Restrictions	Status and requirements of ICs

6.4 Data Review

Historical water quality and water level data for existing wells can be found on the U.S. Department of Energy Office of Legacy Management website: www.gjo.gov/LM/. Photographs, maps, and physical features can also be viewed on this website.

6.4.1 2001 Environmental Monitoring

Detailed environmental monitoring information for 2001 can be found in the *Weldon Spring Site Environmental Report for Calendar Year 2001* (DOE 2002b).

6.4.1.1 Air Monitoring

Throughout the remediation of contaminated soils and materials, the potential for airborne releases and atmospheric migration of radioactive contaminants was closely monitored by measuring concentrations of radon, gamma exposure, airborne radioactive particulates, airborne asbestos, and fine particulate matter at various site perimeter and off-site locations. With the final disposition of contaminated materials in the permanent disposal cell, the potential for airborne release of radionuclides has been eliminated. Thus, the environmental air-monitoring program for 2001 consisted only of ambient dust monitoring (PM-10 monitoring). PM-10 consists of airborne particulate matter (PM) with an aerodynamic equivalent diameter of less than 10 µm. It is often referred to as respirable dust because it is the fraction of total suspended particulate matter than can be entrained by the lungs upon inhalation, thus causing a potential health concern.

PM-10 monitoring was conducted weekly during the construction season (i.e., April to October) at both the Chemical Plant and Borrow Area perimeters. In addition, monthly measurements were made along the haul road between the borrow area and the disposal cell, at the Quarry and the Quarry Borrow Area.

Data loggers attached to the real-time aerosol monitors (RAMs) recorded ambient PM-10 concentrations once per second. Hourly minimum, maximum, and average, as well as 15-minute short-term exposure limit (STEL) values were calculated and reported for each monitoring period. The resulting 24-hour average concentrations were all below the site action level of 150 micrograms per cubic meter (µg/m^3)$^.$ The highest average concentrations of PM-10 recorded at any location during 2001 were 50 µg/m^3.

6.4.1.2 Radiation Dose Analysis

Radiation dose analysis evaluates the potential effects of surface and groundwater discharges of radiological contaminants from the Weldon Spring Site. Taking into account all applicable exposure pathways, the total effective dose equivalent to a maximally exposed individual (MEI) during 2001 was from consumption of water at Burgermeister Spring and was 0.24 millirem (mrem) (2.4E-3 mSv). This estimate is well below the DOE guideline of 100 mrem (1 mSv). By comparison, the annual total effective dose equivalent in the United States due to naturally occurring sources of radioactivity is approximately 300 mrem (3 mSv).

The collective population effective dose equivalent was estimated to be 0.10-person rem (1.03E-3 person-Sv) for users of the Busch Memorial Conservation Area.

6.4.1.3 NPDES Monitoring

During 2001, five active National Pollution Discharge Elimination System (NPDES) operating permits covered discharges from the Site Water Treatment Plant (SWTP) (MO-0107701), Quarry Water Treatment Plant (QWTP) (MO-0108987), storm water discharges from the Borrow Area (MO-R10B69), hydrostatic test water from the site (MO-G670203), and Quarry Borrow Area storm water (MO-R104031). A map of the NPDES outfalls associated with these permits is shown in Figure 6−1.

Treatment plants at both the site and Quarry were in operation during 2001. Five batches were discharged from the Quarry plant and four batches were discharged from the site plant. A batch discharge is treated water that is stored, sampled, and then discharged after compliance is demonstrated. All parameters monitored in treatment plant effluent were in compliance with NPDES permit limits and conditions

The mass of uranium migrating off site in storm water and treated effluent, 3.34 kilograms per year (kg/yr) (7.35 pounds per year [lbs/yr]), was a 37.9 percent reduction from the 2000 mass of 5.38 kg/yr (11.84 lbs/yr) and a 99.2 percent reduction from the 1987 mass of 442 kg.

6.4.1.4 Surface Water

Chemical Plant Surface Water

The Chemical Plant area is located on the Missouri/Mississippi River surface drainage divide. The topography is gently undulating and generally slopes northward to the Mississippi River and, more steeply, southward to the Missouri River. Streams do not run through the property, but because the site is elevated above surrounding areas, drainageways originate on the property and convey storm water off site. Surface drainage from the western portion of the site, which included Ash Pond, the south and north dump area, the temporary storage area, and raffinate pits, drains to tributaries of Busch Lake 35 and then to Schote Creek, which in turn enters Dardenne Creek, ultimately draining to the Mississippi River (Figure 6−1). In this watershed during 1999, Ash Pond, Raffinate Pits 3 and 4, the chipped wood storage area, and the south end of the temporary storage area were completely remediated and confirmed clean. The remainder of this watershed was remediated and confirmed clean during 2000. Final grading was completed during 2001 and the area received temporary seeding.

Surface water drainage from the northeast section of the Chemical Plant, which included the administration building and the subcontractor parking lots, the construction material staging area (CMSA), and part of the disposal cell, discharges to Dardenne Creek from Schote Creek after first flowing through Busch Lakes 36 and 35 (Figure 6−1).

In accordance with the surface water monitoring program for 2001, Schote Creek, Dardenne Creek, and Busch Lakes 34, 35, and 36 were sampled quarterly, for total uranium. This monitoring was conducted to measure the effects of surface water discharges from the site on the quality of downstream surface water. Annual average uranium concentrations for five locations are shown in Table 6−6, along with the 2000 concentrations and the historic high for each location for comparison.

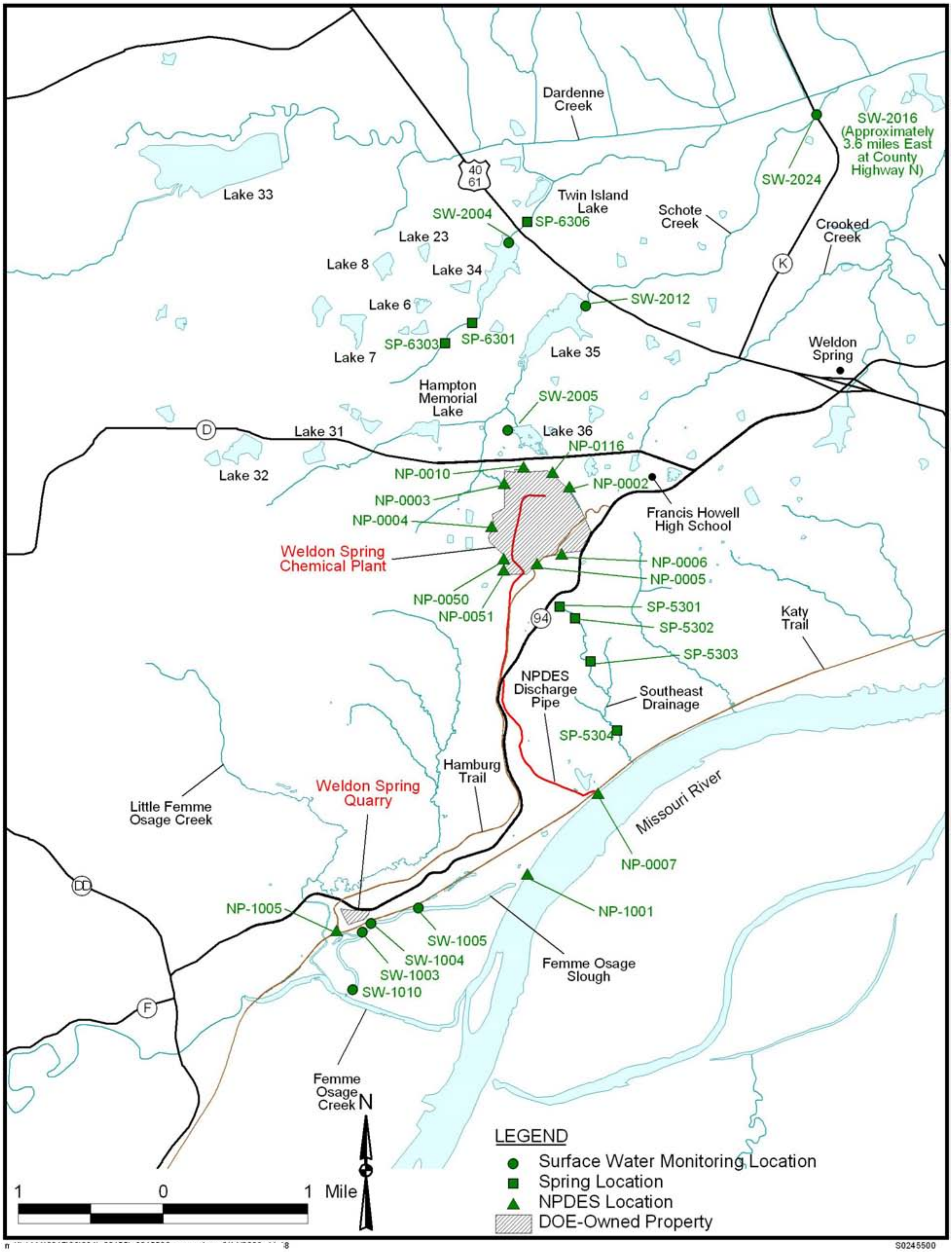

Figure 6–1. NPDESOutfalls

Table 6–6. 2001 Annual Averages for Total Uranium (pCi/L) Concentrations at Weldon Spring Chemical Plant Area Surface Water Locations

Location	Average	Maximum	Minimum	Historic High
SW-2004 (Lake 34)	6.9(6.3)	8.2(11.5)	5.8(<0.7)	39(1989)
SW-2005 (Lake 36)	3.3(5.2)	4.1(8.0)	2.6(3.3)	53.7(1996)
SW-2012 (Lake 35)	3.6(4.3)	4.7(7.5)	1.6(<0.7)	326(1991)[a]
SW-2016 (Dardenne)	0.7(1.4)	1.2(3.1)	0.1(<0.7)	7.8(1994)
SW-2024 (Schote)	1.2(1.1)	1.7(1.9)	0.6(0.9)	5.3(1999)
SW-2007 (Background)	1.2	8.2	0.1	8.2(1990)

[a]This historic high is considered an outlier
Note 1: 2000 results are given in parentheses.
Note 2: Four samples were collected from each location during the year.

Quarry Surface Water

Surface water bodies in the Quarry area are the Femme Osage Slough, Little Femme Osage Creek and the Femme Osage Creek (Figure 6−2). These water bodies do not receive direct runoff from the Quarry, but are sampled to monitor potential changes due to movement of contaminated groundwater from the fractured bedrock of the Quarry through fine-grained alluvial materials.

During 2001, six locations (Figure 6−2) within the Femme Osage Slough were monitored quarterly for total uranium and the annual averages are summarized in Table 6−7. The 2000 results are given in parenthesis.

Table 6–7. 2001 Annual Averages for Total Uranium at Quarry Surface Water Locations

Location	Average	Maximum	Minimum	Historic High
SW-1003	15.9(22.6)	25.5(23.3)	10.1(21.9)	252(1989)
SW-1004	15.1(19.9)	24.6(21.8)	8.3(17.9)	362(1991)
SW-1005	11.5(15.0)	21.0(18.3)	5.2(11.6)	116(1991)
SW-1007	6.8(15.2)	11.5(19.8)	2.5(10.5)	69(1992)
SW-1009	6.8(15.7)	12.1(20.4)	2.1(11.0)	28.6(1991)
SW-1010	15.0(19.6)	27.5(23.4)	6.6(15.8)	156(1991)

2000 results are given in parentheses

6.4.1.5 Groundwater Monitoring

Chemical Plant Groundwater

Since remediation activities began in 1987, more than 100 monitoring locations have been used for groundwater observations and sampling. Each year, wells are installed and/or abandoned as necessary to support the changing needs of the project. During 2001, 23 new wells were installed, and one damaged well was abandoned. A total of 68 wells and four springs were sampled to monitor the groundwater impacts of historical Chemical Plant operations, recent remedial activities, and ongoing field studies.

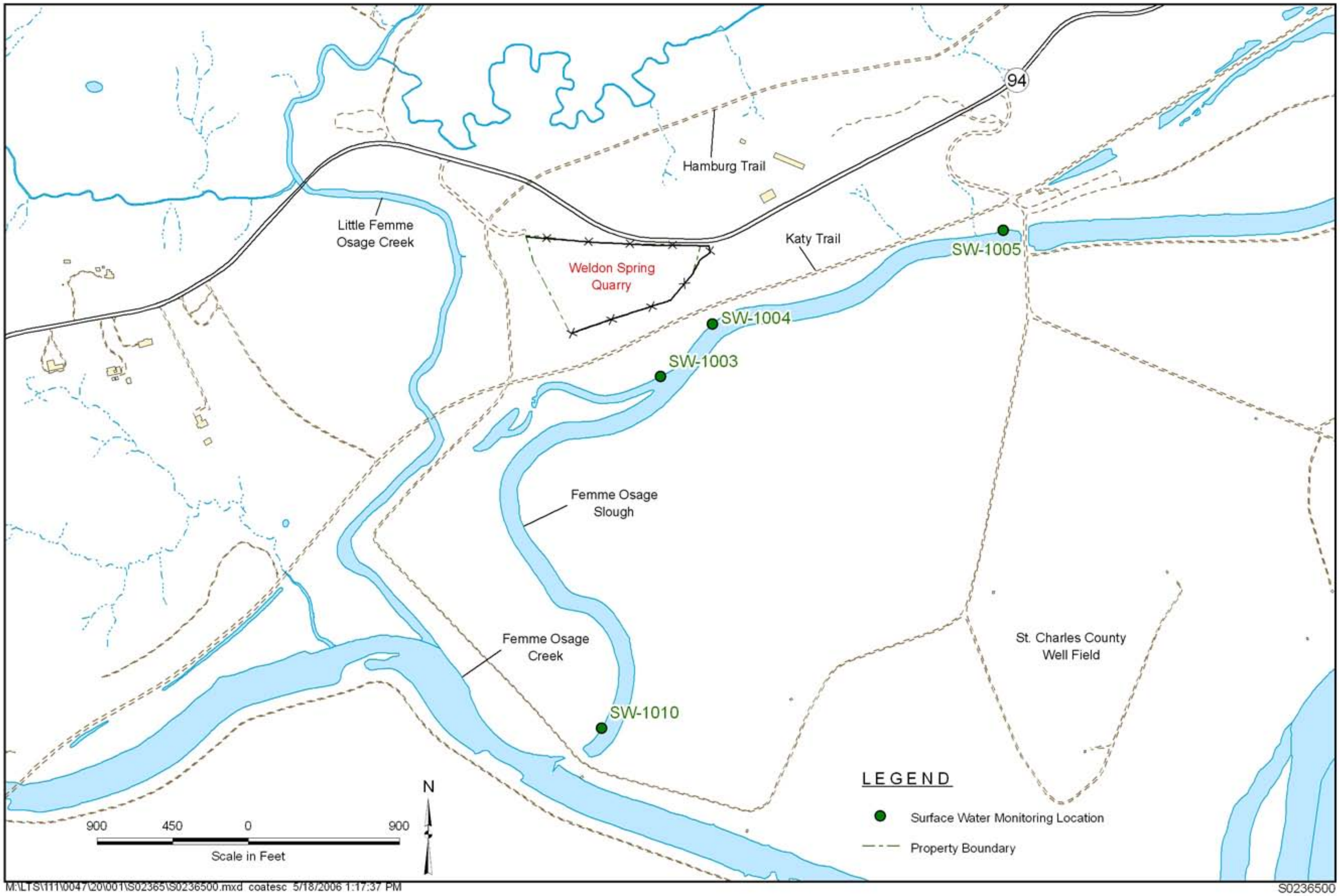

Figure 6–2. Surface Water Monitoring Locations at the Quarry Area

The 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. The Chemical Plant and raffinate pit area lithologies consist of two major geologic units; unconsolidated surficial material and carbonate bedrock. The unconsolidated surficial materials are clay-rich, mostly glacially derived units, which are generally unsaturated. Thicknesses of the unconsolidated materials range from 6.1 meters to 15.3 meters (20 ft to 50 ft) (DOE 1992a).

The site is on a groundwater divide from which groundwater flows north toward Dardenne Creek and then ultimately to the Mississippi River, or south to the Missouri River. Regional groundwater flow for St. Charles County is toward the east. Localized flow is controlled largely by topographic highs and streams and drainages. Groundwater movement is generally by diffuse flow with localized zones of discrete fracture-controlled flow.

Potential groundwater impacts are assessed by monitoring groundwater from the monitoring well network at the site. The aquifer of concern beneath the Chemical Plant, raffinate pits, and vicinity properties is the shallow bedrock aquifer comprised of Mississippian-age Burlington-Keokuk Limestone (the uppermost bedrock unit). The Burlington-Keokuk Limestone is composed of two different lithologic zones, a shallow weathered zone underlain by an unweathered zone. The weathered portion of this formation is highly fractured and exhibits solution voids and enlarged fractures. These features may also be found on a limited scale in the unweathered zone. 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. Localized aquifer properties are controlled by fracture spacing, solution voids, and preglacial weathering, including structural troughs along the bedrock-overburden interface.

All monitoring wells are completed in the Burlington-Keokuk Limestone. Some wells that are screened in the unweathered zone of the Burlington-Keokuk Limestone are used to assess the vertical migration of contaminants. Most of the wells are completed in the weathered zone of the bedrock where groundwater has the greatest potential to be contaminated. Where possible, monitoring wells within the boundaries of the Chemical Plant area are located near historical contaminant sources and preferential flow pathways (paleochannels) to assess migration in the groundwater system.

Springs, a common feature in carbonate terrains, are present in the vicinity of the site. Four springs are monitored routinely. These springs (SP-5303, SP-5304, SP-6301 and SP-6303) have been historically influenced by Chemical Plant discharge water and/or groundwater that contained one or more of the contaminants of concern. Spring 6306 is monitored occasionally, as a result of public comments, and has been demonstrated to be unimpacted by site contaminants.

The presence of elevated total uranium and nitrate levels at Burgermeister Spring (SP-6301), which is 1.9 km (1.2 mile) north of the site, indicates that discrete flow paths are present in the vicinity of the site. Groundwater tracer tests performed in 1995 (DOE 1997) indicated that a discrete and rapid subsurface hydraulic connection exists between the northern portion of the Chemical Plant and Burgermeister Spring.

The 2001 groundwater-monitoring program at the former Chemical Plant focused on monitoring of known contaminants and determining any groundwater impacts which may have resulted from remedial action (e.g., soil excavation and sludge removal) at the site. Total uranium, nitroaromatic compounds, volatile organic compounds (VOCs), and nitrate were monitored at selected locations throughout the Chemical Plant area. In 2001, the monitoring was conducted in accordance with the Environmental Monitoring Plan (DOE 2003d).

Prior to construction of the Chemical Plant, the site was part of a DA Ordnance Works complex for production of the nitroaromatic compounds trinitrotoluene (TNT) and DNT. The first four nitroaromatic production lines were located within the boundaries of the former Chemical Plant and raffinate pits area. Wastes generated from the initial operation of these early production lines were disposed of in open earthen pits which released contaminated seepage to groundwater. One such pit, Lagoon 1, was located along the northeast boundary of the Chemical Plant. Wastewater containing nitroaromatic compounds was transported through wooden pipe networks. Discrete locations at the Chemical Plant known to be impacted by nitroaromatics were sampled and analyzed for these compounds in 2001.

Monitoring wells in the vicinity of the Frog Pond, which began demonstrating elevated concentrations of nitroaromatics compounds in 1999, were sampled bimonthly in 2001. In addition, four new wells were installed at the end of 2001 to further define the extent of nitroaromatic contamination in this area.

Groundwater in the vicinity of the former raffinate pits has been impacted with elevated nitroaromatic compounds, nitrate, and uranium concentrations. The pits contained ore-refining wastes from uranium ore concentrates that were digested with nitric acid during the original Chemical Plant operations. Some of the waste generated and disposed of as raffinate also contained isotopes of thorium and radium. During 2001, groundwater samples from selected locations near the raffinate pits were analyzed for nitrate, total uranium, and nitroaromatic compounds. Thorium and radium were not monitored since previous data did not indicate above-background levels of these parameters.

TCE was detected in groundwater southeast of Raffinate Pit 4 during 1996. VOC monitoring was conducted quarterly at selected wells during 2001 to evaluate potential trends in the area of TCE impact, assess the mobility of the contaminant, and evaluate the effect of remediation activities on VOC contamination levels. In addition, 13 new monitoring wells were installed in this area in 2001 to further define the extent of contamination. Four additional wells were installed to support the pump and treat field studies.

Groundwater in the vicinity of the former Ash Pond had been impacted with elevated nitrate, as well as some uranium and nitroaromatic compounds. Since remedial activities may have mobilized more of these contaminants into the groundwater, wells in this area were monitored quarterly or semiannually for nitrate, uranium, and nitroaromatics.

Sulfate was monitored at many of the Chemical Plant wells to determine whether a correlation existed between sulfate and uranium concentrations. This potential correlation, which has been observed due the geochemistry downgradient from the Quarry, was not observed at the Chemical Plant during 2001 and was not pursued during 2002.

Analytical data for contaminants monitored during 2001 (e.g., uranium, nitrate, sulfate, VOCs, and nitroaromatics) were summarized and compared with background levels and water quality standards in the following paragraphs. Average annual concentrations are compared to background levels established during the GWOU remedial investigation (DOE 1997).

Uranium. Total uranium, which was measured at all active monitoring wells, continued to be present in the groundwater near the former raffinate pits. In 2001, groundwater from 38 monitoring well locations exceeded the average background level of 0.93 pCi/L established during the GWOU remedial investigation (DOE 1997). Only two wells exceeded the groundwater standard of 30 pCi/L (40 CFR 192).

Nitrate and Sulfate. In 2001, nitrate was measured at 54 monitoring wells in the Chemical Plant area. Nitrate levels exceeded the Missouri drinking water primary maximum contaminant level (MCL) of 10 milligrams per liter (mg/L) at 36 of those locations.

Sulfate was measured at 47 monitoring wells in the Chemical Plant area. Average sulfate concentrations exceeded the background level (12 mg/L), established during the GWOU remedial investigation (DOE 1997), at 42 locations. Three wells indicated sulfate concentrations above the Missouri drinking water secondary MCL (250 mg/L).

Nitroaromatic Compounds. Nitroaromatic compounds, which are not naturally occurring, were detected in 42 monitoring wells. New historic highs were reported during 2001 at several wells in the vicinity of Frog Pond, most notably at MW-2012. Levels of nitroaromatics had been increasing at this well since 1997, most likely as a result of remedial activities in this area. Additional wells were installed in the vicinity of Frog Pond in 2000 and 2001 to further define the extent of contamination in this area; however, MW-2012 continued to demonstrate the highest concentrations of nitroaromatic compounds during 2001.

The Missouri drinking water quality standard for 2,4-DNT of 0.11 µg/L was equaled or exceeded in 14 locations at the Chemical Plant.

Volatile Organic Compounds. VOC monitoring continued through 2001 to monitor the extent of contamination and changes in concentration that may have resulted from remedial activities and groundwater field studies. Twenty-four wells demonstrated detectable levels of at least one VOC. Eighteen of these wells exceeded the MWQS of 5 µg/L for TCE.

Chemical Plant Springs

Burgermeister Spring (SP-6301) is a perennial spring that represents a localized emergence of groundwater impacted by a recognizable contribution of contaminants from the Chemical Plant throughout the year. The highest contaminant concentrations occur during base flow stages. During high flow conditions, surface water recharge along the stream segments mixes with contaminated groundwater from the site, and the concentrations are effectively lowered. This spring (SP-6301) was monitored during both high and base stages during 2001.

Annual average concentrations for nitrate, sulfate, uranium, and nitroaromatic compounds are presented in Table 6−8. Compared to concentrations reported for Burgermeister Spring in 2000, these concentrations were in the same general range, with uranium being slightly lower during base flow and slightly higher during high flow. Of the nitroaromatic compounds analyzed only

2,6-DNT was reported above detection limits. No VOCs were reported above detection limits at this spring.

Table 6–8. 2001 Monitoring Data for Burgermeister Spring

Parameter	High Flow			Low (Base) Flow		
	Min.	Max.	Avg.	Min.	Max.	Avg.
Nitrate (mg/L)	2.6	6.6	4.6	1.7	48.5	16.2
Sulfate (mg/L)	27.6	36.6	32.1	24.6	28.6	26.2
U-total (pCi/L)	16.0	32.1	24.1	8.8	55.2	34.7
2,6-DNT (µg/L)	<0.06	0.11	0.07	<0.06	0.14	0.09

Three other springs, which are located in Valley 5300 (SP-5303 and SP-5304) and Valley 6300 (SP-6303), were monitored during 2001 to assess the potential for off-site migration of contaminants. These locations were sampled during base flow for VOCs, uranium, and nitroaromatic compounds, and at high flow for uranium and nitroaromatic compounds. Annual average concentrations of parameters for which detection limits were exceeded are presented in Table 6−9. No VOCs were reported above detection limits at any of the springs.

Table 6–9. 2001 Annual Average Monitoring Data for Springs.

Parameter	High Flow			Low (Base) Flow		
	SP-5303	SP-5304	SP-6303	SP-5303	SP-5304	SP-6303
U-total (pCi/L)	17.79	66.35	1.17	71.85	85.25	1.89
1,3,5-TNB (µg/L)	27.6	36.6	32.1	24.6	28.6	26.2
U-total (pCi/L)	16.0	32.1	24.1	8.8	55.2	34.7
2,6-DNT (µg/L)	<0.06	0.11	0.07	<0.06	0.14	0.09

Quarry Groundwater

The geology of the Quarry is separated into three units: upland overburden, Missouri River alluvium, and bedrock. The unconsolidated upland material overlying bedrock consists of up to 9.2 m (30 ft) of silty clay soil and loess deposits and is not saturated (DOE 1989). Three Ordovician-age formations comprise the bedrock: the Kimmswick Limestone, the limestone and shale of the Decorah Group, and the Plattin Limestone. The alluvium along the Missouri River consists of clays, silts, sands, and gravels above the bedrock. The alluvium thickness increases with distance from the bluff towards the river where the maximum thickness is approximately 31 meter (100 ft). The alluvium is truncated at the erosional contact with the Ordovician bedrock bluff (Kimmswick, Decorah, and Plattin formations), which also composes the rim wall of the Quarry. The bedrock unit underlying the alluvial materials north of the Femme Osage Slough is the Decorah Group. Primary sediments between the bluff and the Femme Osage Slough are intermixed and interlayered clays, silts, and sands. Organic materials are intermixed throughout the sediments.

The uppermost groundwater flow systems at the Quarry are composed of alluvial and bedrock aquifers. The alluvial aquifer is predominantly controlled by recharge from the Missouri River, and the bedrock aquifer is chiefly recharged by precipitation and overland runoff.

At the Quarry, (during 2001) 15 monitoring wells were screened within either the Kimmswick-Decorah (upper unit) or Plattin Formations (lower unit) to monitor contaminants near the Quarry within the bedrock. Ten of the 15 monitoring wells were installed to monitor contaminants within the Kimmswick-Decorah Formations comprising and surrounding the Quarry. The remaining five monitoring wells are located south of the Quarry within the Plattin Limestone to assess vertical contaminant migration.

There are 15 monitoring wells completed into the alluvium near the Quarry and the Missouri River. Those north of the Femme Osage Slough monitor contaminant migration south of the Quarry, while those south of the slough monitor for possible migration of contaminants toward the well field.

The St. Charles County monitoring wells, the RMW series wells, were designed to provide an early warning of contaminant migration toward the county production well field. The county production wells were monitored to verify the quality of the municipal well field water supply.

Eight groundwater monitoring wells located in the Darst Bottom area approximately 1.6 km (1 mile) southwest of the St. Charles County well field were utilized to study the upgradient characteristics of the Missouri River alluvium in the vicinity of the Quarry. These wells provided a reference for background values in the well field area and have been sampled by both the U.S. Geological Survey (USGS) (1992) and DOE (1994). These wells have since been abandoned. A summary of background values used at the Quarry is provided in Table 6−10.

Table 6–10. Average Background Values (pCi/L) for Quarry Monitoring Locations

Parameter	Alluvium[a]	Kimmsick/Decorah[b]	Plattin[c]
Total Uranium (pCi/L)	2.77	3.41	12.30
Ra-226 (pCi/L)	0.61	0.41	3.01
Ra-228 (pCi/L)	2.15	1.06	2.95
Th-228 (pCi/L)	0.33	0.33	4.25
Th-230 (pCi/L)	1.59	0.61	11.20
Th-232 (pCi/L)	0.28	0.38	3.02
Gross Alpha (pCi/L)	4.32	15.80	NA
Gross Beta (pCi/L)	6.82	19.30	NA
Nitroaromatics (µg/L)	NA	NA	NA
Arsenic (µg/L)	5.15	1.48	10.90
Barium (µg/L)	463.00	147.00	109.00
Sulfate (µg/L)	44.20	95.90	165.00

[a]Darst Bottom Wells (USGS and DOE)
[b]MW-1034 and MW-1043 (DOE)
[c]MW-1042 (DOE)
NA = Not Analyzed

Two separate programs were employed in 2001 to monitor groundwater near the Quarry. The first program involved sampling the DOE wells in the Quarry area to continue monitoring the effects of the Quarry dewatering and bulk waste removal on groundwater quality. These activities began in mid-1993 and were completed in late 1995.

The frequency of sampling for each location was based on the distance of the well from the source or migration pathway. Monitoring wells on the Quarry rim were sampled quarterly for total uranium, due to the changes in concentrations over time, to establish the trend in concentrations at these locations, and to monitor the effects of Quarry dewatering and bulk waste removal activities on the groundwater system. All Quarry locations were sampled at least annually for radiochemical parameters, nitroaromatic compounds, and sulfate. The second program monitored the St. Charles County well field and the associated water treatment plant. Active production wells, the St. Charles County RMW-series monitoring wells and untreated and treated water from the County public drinking water treatment plant were sampled quarterly or semiannually for selected parameters. This portion of the monitoring program was developed by representatives of DOE, EPA, several State regulatory agencies, and St. Charles County.

Radiochemical Parameters. During 2001, groundwater monitoring wells at the Quarry were sampled for the following radiochemical parameters: total uranium, Ra-226, Ra-228, and isotopic thorium.

The uranium values continued to indicate in 2001 that the highest levels occur in the bedrock downgradient from the Quarry and in the alluvial material north of the Femme Osage Slough. No locations south of the Femme Osage Slough exceeded background.

The groundwater standard of 30 pCi/L (40 CR 192) was exceeded at 11 locations. The highest was in MW-1008 at 2,077 pCi/L. All of these monitoring wells are located north of the Femme Osage Slough and have no direct impact on the drinking water sources in the Missouri River alluvium. The standard, while used as a reference level, is not applicable to groundwater north of the slough because this area is not considered a usable groundwater source. Background was exceeded at 17 locations.

Nitroaromatic Compounds. In 2001, samples from Quarry monitoring wells were analyzed for nitroaromatic compounds. The monitoring wells, which have historically been impacted with nitroaromatics, are situated in the alluvial materials or bedrock downgradient of the Quarry and north of the Femme Osage Slough. Results were similar to those reported in 2000. No detectable concentrations were observed south of the Femme Osage Slough. The 2,4-DNT average concentration for location MW-1027 remained above the Missouri drinking water standard of 0.11 µg/L during 2001.

Sulfate. Groundwater analyses in 2001 continued to indicate elevated sulfate levels in the monitoring wells in the bedrock of the Quarry rim and in the alluvial materials north of the Femme Osage Slough. One location MW-1005 had an annual average which exceeded the secondary MCL of 250 mg/L in 2001. Overall, only nine monitoring wells had averages above background, which is just slightly lower than the 11 monitoring wells from 2000.

St. Charles County Well Field

Radiochemical Parameters. The St. Charles County production wells, the RMW-series monitoring wells, pretreated (MW-RAWW) and treated water (MW-FINW) from the St. Charles County water treatment plant and DOE well MW-1024, were sampled semiannually during 2001 for the radiochemical parameters Ra-226, Ra-228, and isotopic thorium. Gross alpha, gross beta, and total uranium were analyzed quarterly. The annual averages for total uranium in the well field remain at background. No production well exceeded the groundwater standard of 30 pCi/L as established in 40 CFR 192.

The annual averages for these locations are within the statistical variation of background ranges for groundwater in the Missouri River alluvium. The Missouri Drinking Water Standard of 15 pCi/L for gross alpha was not exceeded at any of the production wells. The St. Charles County treatment plant finished waters were in compliance with the gross alpha level of 10 pCi/L as established in 40 CFR 141 and endorsed in DOE Order 5400.5. The Missouri Drinking Water Standard of 5 pCi/L for combined Ra-226 and Ra-228 was not exceeded at any of the St. Charles County production well locations.

Nitroaromatic Compounds. The St. Charles County production wells and the RMW-series monitoring wells were sampled quarterly for six nitroaromatic compounds. No detectable concentrations were observed at any of these locations.

Metals. Arsenic and barium were monitored during 2001 at the St. Charles County well field. The primary MCL for arsenic (50 µg/L) was exceeded only at one location (RMW-2). The MCL for barium (2,000 µg/L) was not exceeded at any location. None of the values for either metal exceeded their respective MCLS in samples from the public water supply wells or from the St. Charles County water treatment plant. The 2001 results were similar to those reported for 2000, and within historical ranges of those reported since monitoring began.

6.4.2 2002 Environmental Monitoring

Detailed environmental monitoring results for 2002 can be found in the *Weldon Spring Site Environmental Report for Calendar Year 2002* (DOE 2003c).

6.4.2.1 Air Monitoring

The environmental air-monitoring program for 2001 consisted only of ambient dust monitoring. With the completion of most site activities, no ambient dust monitoring was conducted during 2002.

6.4.2.2 Radiation Dose Analysis

The estimated total effective dose equivalent (TEDE) to the hypothetical MEI during 2002 due to consumption of water from Spring 5303, which is located in the SE Drainage, was 0.16 mrem. This is based on a maximum uranium concentration in water samples taken from SP-5303 during 2002 that was 145 pCi/L. The dose for a collective population during 2002 was reported to be similar to that calculated and presented in the 2001 Site Environmental Report (DOE 2002b) where the collective dose was reported to be 0.10 person-rem.

6.4.2.3 NPDES Monitoring

During 2002, the same five permits from 2001 remained in effect. Four batches were discharged from the QWTP. The SWTP was no longer in operation. One of the discharges for 2002 was a batch discharge and three were continuous discharges. A batch discharge is treated water that is stored, sampled, and then discharged after compliance is demonstrated. A continuous discharge is treated water that is sampled and discharged prior to receipt of the analytical results. Continuous discharges were used after the final effluent pond had been remediated. All parameters monitored in treatment plant effluent were in compliance with NPDES permit limits and conditions. The mass of uranium migrating off site in storm water and treated effluent, 2.39 kg/yr (5.26 lbs/yr), was a 30.2 percent reduction from the 2001 mass of 3.34 kg/yr (7.35 lbs/yr) and a 99 percent reduction from the 1987 mass of 442 kg.

6.4.2.4 Surface Water

Chemical Plant Surface Water

In accordance with the 2002 surface water monitoring program, Schote Creek, Dardenne Creek, and Busch Lakes 34, 35, and 36 were sampled quarterly for total uranium. This was the same monitoring as in 2001. Annual average annual concentrations for the five locations are shown in Table 6−11 along with the recent 3-year high for each location for comparison.

Table 6–11. 2002 Annual Averages for Total Uranium (pCi/L) Concentrations at Weldon Spring Chemical Plant Area Surface Water Locations

Location	Average	Maximum	Minimum	Recent 3-Year High
SW-2004 (Lake 34)	4.3	6.7	2.6	11.5
SW-2005 (Lake 36)	3.1	4.1	2.5	8.0
SW-2012 (Lake 35)	2.4	4.5	1.0	7.5
SW-2016 (Dardenne)	0.9	1.4	0.3	3.1
SW-2024 (Schote)	1.9	2.8	0.8	2.8
SW-2007 (Background)	1.2	8.2	0.1	--

Quarry Surface Water

During 2002, six locations within the Femme Osage Slough were monitored quarterly for total uranium and the annual averages are summarized in Table 6−12.

Table 6–12. 2002 Annual Averages for Total Uranium (pCi/L) at Weldon Spring Quarry Surface Water Locations

Location	Average	Maximum	Minimum	Recent 3-Year High
SW-1003	14.8	17.7	11.3	25.5
SW-1004	16.4	17.4	14.4	24.6
SW-1005	11.1	12.1	10.2	21.0
SW-1007	7.2	9.3	6.3	19.8
SW-1009	6.3	8.6	4.9	20.4
SW-1010	15.0	19.3	12.3	27.5

6.4.2.5 Groundwater Monitoring

Chemical Plant Groundwater

The 2002 groundwater-monitoring program was similar to the 2001 monitoring program at the former Chemical Plant and focused on monitoring of known contaminants and determining any groundwater impacts which may have resulted from remedial action (e.g., soil excavation and sludge removal) at the site. Total uranium, nitroaromatic compounds, VOCs, and nitrate were monitored at selected locations throughout the Chemical Plant area. In 2002, the monitoring was conducted in accordance with the Environmental Monitoring Plan (DOE 2003d).

Uranium. Total uranium, which was measured in all active monitoring wells during 2002, continued to be present in the groundwater near the former raffinate pits. In 2002, groundwater from 31 monitoring well locations exceeded the average background level of 0.93 pCi/L established during the GWOU remedial investigation. Only two wells (MW-3024 and MW-3030) exceeded the groundwater standard of 30 µg/L (20 pCi/L) (40 CFR 141).

Nitrate. In 2002, nitrate was monitored at 68 monitoring wells in the Chemical Plant Area. Nitrate levels exceeded the Missouri drinking water primary MCL (10 mg/L) at 36 of those locations.

Nitroaromatic Compounds. Nitroaromatic compounds, which are not naturally occurring, were detected in 47 monitoring wells. New historic highs were reported during 2002 at several wells in the vicinity of Frog Pond, most notably at MW-2012. Levels of nitroaromatics had been increasing at this well since 1997, most likely as a result of remedial activities by DOE and the Army in this area. Additional wells were installed in the vicinity of Frog Pond in 2000 and 2001 to further define the extent of contamination in this area; however, MW-2012 has continued to demonstrate the highest concentrations of nitroaromatic compounds.

The Missouri drinking water quality standard for 2,4-DNT of 0.11 µg/L was equaled or exceeded in 15 locations at the Chemical Plant.

Volatile Organic Compounds. VOC monitoring continued through 2002 to monitor the extent of contamination and changes in concentration that may have resulted from remedial activities and groundwater field studies. Twenty-five wells demonstrated detectable levels of at least one VOC. Seventeen of these wells exceeded the MCL of 5 µg/L for TCE.

Chemical Plant Springs

Burgermeister Spring (SP-6301) was monitored during both high and base stages during 2002. Annual average concentrations for nitrate, uranium, and nitroaromatic compounds are presented in Table 6−13. Compared to concentrations reported for Burgermeister Spring in 2001, these concentrations were in the same general range, with uranium being slightly lower during base flow and slightly higher during high flow. Of the nitroaromatic compounds analyzed, only 2,6-DNT was reported above detection limits. No VOCs were reported above detection limits at this spring.

Table 6–13. 2002 Monitoring Data for Burgermeister Spring

Parameter	High Flow			Low (Base) Flow		
	Min.	Max.	Avg.	Min.	Max.	Avg.
Nitrate (mg/L)	0.94	1.1	1.0	0.97	10.9	5.1
U-total (pCi/L)	8.6	9.7	9.2	11.4	100	51.0
2,6-DNT (µg/L)	<0.1	<0.1	<0.1	<0.1	0.17	0.12

The four other springs, (SP-5303, SP-5304, SP-6303 and 6306), were sampled during base flow for VOCs, uranium, and nitroaromatic compounds, and at high flow for uranium and nitroaromatic compounds, Annual average concentrations of parameters for which detection limits were exceeded are presented in Table 6−14. No VOCs or the nitroaromatic compounds 1,3-DNB or 2,4-DNT were reported above detection limits at any of the springs.

Table 6–14. 2002 Annual Average Monitoring Data for Springs

Parameter	High Flow				Low (Base) Flow			
	SP-5303	SP-5304	SP-6303	SP-6306	SP-5303	SP-5304	SP-6303	SP-6306
U-total (pCi/L)	34.6	29.6	0.97	0.26	82.8	65.2	1.2	0.34
1,3,5-TNB (µg/L)	<0.04	<0.04	0.11	<0.04	0.34	<0.04	0.22	<0.04
2,4,6-TNT (µg/L)	2.0	0.10	0.10	<0.08	42.6	0.10	0.09	<0.08
2,4-DNT (µg/L)	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.06	<0.06
2,6-DNT (µg/L)	<0.10	<0.10	0.17	<0.10	0.17	<0.10	0.30	<0.10

Quarry Groundwater

For the first three quarters of 2002 the monitoring was the same as described for 2001. The monitoring of the Quarry for the fourth quarter was conducted in accordance with the *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit* (DOE 2000b).

Uranium. The uranium values continued to indicate that the highest levels occur in the bedrock downgradient from the Quarry and in the alluvial material north of the Femme Osage Slough. Eighteen locations exceeded background, although no locations south of the Femme Osage Slough exceeded background.

The groundwater standard of 30 µg/L (20 pCi/L) (40 CFR 141) was exceeded at 13 locations. All of these monitoring wells are located north of the Femme Osage Slough and have no direct impact on the drinking water sources in the Missouri River alluvium. Locations exceeding background remained similar to 2001, with only a few exceptions. MW-1009 and MW-1031 no longer had averages greater than background. MW-1051 and MW-1052, which were added to the list as locations having average concentrations exceeding background, were installed as observation wells for the interceptor trench. After the study was completed, these locations were added to the routine long-term monitoring program.

Nitroaromatic Compounds. Results were similar to those reported in 2001. No detectable concentrations were observed south of the Femme Osage Slough. The 2,4-DNT average concentration for each location MW-1027 remained above the Missouri drinking water standard of 0.11 µg/L during 2001.

Sulfate. Groundwater analyses in 2002 continued to indicate elevated sulfate levels in the monitoring wells in the bedrock of the Quarry rim and in the alluvial materials north of the Femme Osage Slough. Overall 12 monitoring wells had averages above background, which is similar to 2001.

Iron. Iron groundwater analyses were added during 2002 to begin preparation for long-term monitoring as detailed in the QROU Remedial Design/Remedial Action (RD/RA) Work Plan (DOE 2000b).

St. Charles County Well field

Uranium. The annual averages for total uranium in the well field remained at background. No production well exceeded the groundwater standard of 30 µg/L (20 pCi/L) as established in 40 CFR 141.66.

Nitroaromatic Compounds. No detectable concentrations were observed at any of these locations.

6.4.3 2003 Environmental Monitoring

Detailed environmental monitoring results for 2003 can be found in the *Weldon Spring Site Environmental Monitoring Report for Calendar Year 2003* (DOE 2004g).

6.4.3.1 Radiation Dose Analysis

The estimated TEDE to the hypothetical MEI during 2003 due to consumption of water from Spring 5303, which is located in the SE Drainage, is 0.1 mrem. This is based on a maximum uranium concentration in water samples taken from SP-5303 during 2003 that was 91.8 pCi/L. The dose for a collective population during 2003 was reported to be similar to that calculated and presented in the 2001 Site Environmental Report (DOE 2002b) where the collective dose was reported to be 0.10-person rem.

6.4.3.2 NPDES Monitoring

During 2003, the QWTP and SWTP were no longer in operation; therefore, there were no treated water discharges from the site in 2003. Also during 2003, vegetation became fully established at both the Chemical Plant and Quarry sites; therefore, stormwater outfalls at both the site and Quarry were removed from the NPDES permits. The following four of the five NPDES permits were terminated in 2003: Quarry water treatment plant (MO-0108987), storm water discharges from the Borrow Area (MO-R10B69), hydrostatic test water from the site (MO-G670203), and Quarry Borrow Area storm water (MO-R104031). The permit remaining in effect, MO-0107701, no longer covered the SWTP effluents. This permit was revised by MDNR on October 3, 2003, to eliminate the storm water outfalls at the Chemical Plant site and was reduced to only including the sanitary treatment system and the SWTP discharge line. The SWTP discharge line will only be used if the site ever operates Train 3 at the LCRS as a contingency to current leachate disposal methods.

The mass of uranium migrating off site in storm water, 2.29 kg/yr (5.04 lbs/yr), was a 37.9 percent reduction from the 2002 mass of 2.39 kg/yr (5.26 lbs/yr) and a 99.5 percent reduction from the 1987 mass of 442 kg.

6.4.3.3 Surface Water

Chemical Plant Surface Water

In accordance with the 2003 surface water monitoring program, Schote Creek, Dardenne Creek, and Busch Lakes 34, 35, and 36 were sampled semiannually for total uranium. Semiannual uranium concentrations for the five locations are shown in Table 6−15 along with the recent 3-year high for each location for comparison.

Table 6–15. 2003 Results for Total Uranium (pCi/L) Concentrations at Weldon Spring Chemical Plant Area Surface Water Locations

Location	1st Semiannual	2nd Semiannual	Average	Recent 3-Year High
SW-2004 (Lake 34)	6.9	5.3	6.1	11.5
SW-2005 (Lake 36)	3.9	2.5	3.2	8.0
SW-2012 (Lake 35)	3.7	1.7	2.7	7.5
SW-2016 (Dardenne)	0.4	1.4	0.9	3.1
SW-2024 (Schote)	0.5	1.0	0.8	2.8
SW-2007 (Background)	N/A	N/A	1.2	--

Quarry Surface Water

Surface water bodies in the Quarry area are the Femme Osage Slough, Little Femme Osage Creek, and the Femme Osage Creek (Figure 6−2). These water bodies do not receive direct runoff from the Quarry, but are sampled to monitor potential changes due to movement of contaminated groundwater from the fractured bedrock of the Quarry through fine-grained alluvial materials.

During 2003, four locations within the Femme Osage Slough were monitored semiannually for total uranium and the results are presented in Table 6−16.

Table 6–16. 2003 Results for Total Uranium (pCi/L) at Weldon Spring Quarry Surface Water Locations

Location	1st Semiannual	2nd Semiannual	Average	Recent 3-Year High
SW-1003	11.9	13.2	12.6	25.5
SW-1004	12.5	12.6	12.6	24.6
SW-1005	8.8	6.8	7.8	21.0
SW-1010	9.4	16.5	13.0	27.5

6.4.3.4 Groundwater Monitoring

Chemical Plant Groundwater

The 2003 groundwater monitoring program was similar to the 2002 monitoring program at the former Chemical Plant and focused on monitoring of known contaminants and determining any groundwater impacts or improvements which may have resulted from remedial action (e.g., soil excavation and sludge removal) at the site. Total uranium, nitroaromatic compounds, VOCs, and nitrate were monitored at selected locations throughout the Chemical Plant area. In 2003, the monitoring was conducted in accordance with the Environmental Monitoring Plan (DOE 2003d).

<u>Uranium.</u> Total uranium, which was measured at 60 monitoring wells, continued to be present in the groundwater near the former raffinate pits. In 2003, groundwater from 36 monitoring well locations exceeded the average background level of 0.93 pCi/L established during the GWOU remedial investigation. Only two wells exceeded the groundwater standard of 30 µg/L (20 pCi/L) (40 CFR 141).

<u>Nitrate.</u> In 2003, nitrate was monitored at 54 monitoring wells in the Chemical Plant area. Average nitrate concentrations exceeded the Missouri drinking water primary MCL (10 mg/L) at 38 of those locations.

<u>Nitroaromatic Compounds.</u> Nitroaromatic compounds, which are not naturally occurring, were detected in 48 monitoring wells. New historic highs were reported during 2003 at several wells in the vicinity of Frog Pond, most notably at MW-2012. Levels of nitroaromatics had been increasing at this well since 1997, most likely as a result of remedial activities by DOE and the Army in this area. Additional wells were installed in the vicinity of Frog Pond in 2000 and 2001 to further define the extent of contamination in this area; however, MW-2012 continued to demonstrate the highest concentrations of nitroaromatic compounds. The MWQS for 2,4-DNT of 0.11 µg/L was equaled or exceeded at 25 locations at the Chemical Plant and the MWQS for 1,3-DNB of 1.0 µg/L was exceeded at one location. The risk-based concentration of 2.8 µg/L for 2,4,6-TNT was exceeded at three locations and the risk based concentration of 1.3 µg/L for 2,6-DNT was exceeded at ten locations. The MWQS for nitrobenzene of 17 µg/L was not exceeded at any location.

Fourteen monitoring locations in the Frog Pond area were also selected to monitor for the following breakdown products: 2-AM-4,6-DNT; 4-AM-2,6-DNT, 2-NT; 3-NT; and 4-NT. The breakdown product data was evaluated to try to determine whether the contaminants were originating from the area of Production Line #1 or from the area of Army Lagoon #1. Nitroaromatic contaminants at Army Lagoon #1 would have different breakdown products associated with that source than Production Line #1 due to the photodegradation processes. Wells downgradient from both of these previously remediated areas showed contamination consistent with both, although the higher concentrations at MW-2012 continued to point toward the area of Production Line #1 as the primary contributor to groundwater contamination.

<u>Volatile Organic Compounds.</u> VOC monitoring continued through 2003 to monitor the extent of contamination and changes in concentration that may have resulted from remedial activities and groundwater field studies. Nineteen wells demonstrated detectable levels of at least one VOC. Eighteen of the wells exceeded the MCL of 5 µg/L for TCE.

Chemical Plant Springs

Burgermeister Spring (SP-6301) was monitored during both high and base stages during 2003. Annual average concentrations for nitrate, uranium, and nitroaromatic compounds are presented in Table 6−17. Compared to concentrations reported for Burgermeister Spring in 2002, these concentrations were in the same general range, with uranium being slightly lower during base flow and slightly higher during high flow. Of the nitroaromatic compounds analyzed, only 2,4-DNT and 2,6-DNT were reported above detection limits. No VOCs were reported above detection limits at this spring.

Table 6–17. 2003 Monitoring Data for Burgermeister Spring

Parameter	High Flow			Low (Base) Flow		
	Min.	Max.	Avg.	Min.	Max.	Avg.
Nitrate (mg/L)	0.83	1.03	0.93	2.15	8.64	4.29
U-total (pCi/L)	10.06	10.06	10.06	17.9	62.5	37
2,4-DNT (µg/L)	<0.06	<0.06	N/A	<0.06	0.08	0.04
2,6-DNT (µg/L)	<0.13	<0.13	N/A	<0.13	0.16	0.10

The four other springs (SP-5303, SP-5304, SP-6303 and 6306) were sampled during base flow for VOCs, uranium, and nitroaromatic compounds, and at high flow for uranium and nitroaromatic compounds, Annual average concentrations of parameters for which detection limits were exceeded are presented in Table 6−18. No VOCs or the nitroaromatic compounds 1,3-DNB or 2,4-DNT were reported above detection limits at any of the springs.

Table 6–18. 2003 Annual Average Monitoring Data for Springs

Parameter	High Flow				Low (Base) Flow			
	SP-5303	SP-5304	SP-6303	SP-6306	SP-5303	SP-5304	SP-6303	SP-6306
Nitrate (mg/L)	0.31	0.91	2.59	0.04	0.33	0.54	2.51	0.01
U-total (pCi/L)	45.9	30.4	1.02	1.17	72.9	69.1	1.2	0.3
1,3,5-TNB (µg/L)	<0.08	<0.08	<0.08	NS	0.24	<0.08	<0.08	NS
1,3-DNB (µg/L)	<0.05	<0.05	<0.05	NS	0.04	<0.05	<0.05	NS
2,4,6-TNT (µg/L)	5.9	0.08	<0.08	NS	75.3	0.11	<0.08	NS
2,4-DNT (µg/L)	<0.06	<0.06	<0.06	NS	<0.06	0.05	0.04	NS
2,6-DNT (µg/L)	<0.13	<0.13	0.16	NS	0.38	<0.13	<0.13	NS

NS: Not Sampled

Quarry Groundwater

During 2003, the monitoring at the Quarry was conducted in accordance with the QROU RD/RA Work Plan (DOE 2000b).

<u>Uranium.</u> The uranium values continue to indicate that the highest levels occur in the bedrock downgradient from the Quarry and in the alluvial north of the Femme Osage Slough. Sixteen locations exceeded background. No locations south of the Femme Osage Slough exceeded

background. The groundwater standard of 30 µg/L was exceeded at thirteen locations. All of these monitoring wells are located north of the Femme Osage Slough and have no direct impact on the drinking water sources in the Missouri River alluvium. Locations exceeding background remained the same as those reported in 2002.

The attainment objective for the long-term monitoring for the groundwater north of the slough is that the 90th percentile of the data within a monitoring year is below the target level of 300 pCi/L for uranium. (DOE 2000b). Based on the 2003 data, the 90th percentile of the uranium data was 1,110 pCi/L. This is a slight decrease from 2002, when the 90th percentile of the uranium data was 1,144 pCi/L.

Nitroaromatic Compounds. No detectable concentrations were observed south of the Femme Osage Slough. The 2,4-DNT average concentration for location MW-1027 remained above the MWQS of 0.11 µg/L during 2003.

The attainment objective for the long-term monitoring for the 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 for 2,4-DNT and that all wells exhibit stable downward trends (DOE 2000b). Based on the 2003 data, the 90th percentile of the data is 0.03 µg/L; however an upward trend has been observed in MW-1032.

Sulfate. Groundwater analyses in 2003 continued to indicate elevated sulfate levels in the monitoring wells in the bedrock of the Quarry rim and in the alluvial materials north of the Femme Osage Slough. Sulfate was monitored as an indicator of the geochemistry of the groundwater. Higher sulfate concentrations generally coincide with elevated uranium levels since both are in dissolved form in an oxidizing environment. Overall, 11 monitoring wells had averages above background, which is similar to 2002.

Iron. Iron is also monitored as an indicator of the geochemistry of the groundwater. Higher iron concentrations generally occur in a reducing environment and do not coincide with elevated uranium levels, which generally occur in an oxidizing environment. Results are similar to those reported during 2002, and continue to confirm that a geochemical reducing zone is inhibiting migration of uranium contaminated groundwater.

St. Charles County Well Field

Uranium. The RMW-series monitoring wells were analyzed annually for total uranium. The results for total uranium remain at background.

Nitroaromatic Compounds. The RMW-series monitoring wells were sampled annually for six nitroaromatic compounds. No detectable concentrations were observed at these locations.

Sulfate and Iron. The RMW-series wells were sampled annually for sulfate and iron.

6.4.4 2004 Environmental Monitoring

Detailed environmental monitoring results for 2004 can be found in the *Weldon Spring Site Environmental Monitoring Report for Calendar Year 2004* (DOE 2005f).

6.4.4.1 Radiation Dose Analysis

For 2004, the potential exposure in terms of dose to an individual who consumes spring water contaminated with uranium was calculated. This calculation represents that exposure for the reasonable maximally exposed (RME) individual since data from the spring with the highest uranium concentration is used (i.e., for Spring 5304 which is located in the SE Drainage with a reported uranium concentration of 70 pCi/L for 2004). The estimated TEDE to this RME is about 0.2 mrem. This dose estimate is the same as that reported for calendar year 2003 with the contribution from U-234 incorporated. That is, 0.1 mrem would be added to the 0.1 mrem dose estimate reported for 2003, resulting in a dose estimate of 0.2 mrem.

6.4.4.2 NPDES Monitoring

MDNR revised the one remaining permit (MO-0107701) on March 5, 2004, to remove the sanitary wastewater treatment plant and transferred it to Lindenwood University under State Operating Permit No. MO0129917. This permit now only covers the SWTP discharge line.

MDNR issued a hydrostatic water permit (MO-G67A009) to the Weldon Spring Site in August 2004. This permit allowed discharge of potable water that was used to hydrostatically test the system designed to pre-treat leachate. Approximately 4,000 gallons were discharged on September 21, 2004. Samples were collected as required by the permit and all analytical results were in compliance with permitted limits.

6.4.4.3 Surface Water

Chemical Plant Surface Water

During 2004, Schote Creek, Dardenne Creek, and Busch Lakes 34, 35, and 36 were sampled semi-annually for total uranium. This monitoring was conducted to measure the effects of remediation and surface water discharges from the site on the quality of downstream surface water.

The results for the Chemical Plant surface water sampling are presented in Table 6−19 along with the recent 3-year high for each location for comparison. Uranium levels at Busch Lake 34 continue to be elevated compared to the remainder of the locations, however, uranium levels at the Busch Lake outlets have shown an overall decline since remediation started. 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 then the total watershed area.

Table 6–19. 2004 Results for Total Uranium (pCi/L) Concentrations at Weldon Spring Chemical Plant Area Surface Water Locations

Location	1st Semiannual	2nd Semiannual	Average	Recent 3-Year High
SW-2004 (Lake 34)	5.3	7.0	6.2	8.1
SW-2005 (Lake 36)	2.9	1.9	2.4	4.1
SW-2012 (Lake 35)	1.2	2.2	1.7	4.7
SW-2016 (Dardenne)	0.8	1.1	0.9	1.4
SW-2024 (Schote)	0.8	1.1	0.9	1.4

Quarry Surface Water

The same four locations within the Femme Osage Slough sampled in 2003 were sampled in 2004. The locations were monitored semiannually for uranium and the results are summarized in Table 6−20. The higher uranium levels observed in the slough during the first semi-annual period were collected when the elevation of the water table was high. The increase in water levels apparently causes increases in concentrations either because of enhanced leaching of uranium residual in the vadose zone or increased uranium mobility under oxidizing conditions. The levels decreased during the second semiannual sampling.

Table 6–20. 2004 Results for Total Uranium (pCi/L) at Weldon Spring Quarry Surface Water Locations

Location	1st Semiannual	2nd Semiannual	Average	Recent 3-Year High
SW-1003	33.1	20.9	27.0	25.5
SW-1004	36.4	21.5	29.0	24.6
SW-1005	7.0	15.8	11.4	21.0
SW-1010	24.8	20.4	22.6	27.5

6.4.4.4 Groundwater Monitoring

Chemical Plant Groundwater

Starting in July 2004, the monitoring at the Chemical Plant was changed to implement the selected remedy of MNA. A sampling program was developed in *the Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit* (DOE 2004f). A summary of monitoring locations and parameters are found in Section 4.2.2 of this report. This implementation of the new monitoring program resulted in a more focused monitoring strategy and a reduction of monitoring locations and parameters.

Uranium. Total uranium, which was measured at 58 monitoring wells during 2004, continues to be present in the groundwater near the former raffinate pits. In 2004, groundwater from 33 monitoring well locations exceeded the average background level of 0.93 pCi/L (0.03 becquerel per liter [Bq/L]) established during the GWOU remedial investigation (DOE 1997). Four wells exceeded the drinking water standard of 30 µg/L (20 pCi/L) (40 CFR 141). Two of the wells that exceeded the uranium standard (MW-3024 and MW-3030) also exceeded the standard in 2003. The other two locations where the standard was exceeded (MW-3040 and MW-4040) are new wells installed in support of the MNA remedy for the GWOU. Wells MW-2021, MW-2036, and MW-4002 were previously analyzed for uranium analysis.

Nitrate. In 2004, nitrate (as N) was monitored at 54 monitoring wells in the Chemical Plant area as part of the MNA program. The areas of highest impact continue to be present in the Raffinate Pit and Ash Pond Areas. Average nitrate concentrations exceeded the MCL of 10 mg/L (40 CFR 141) at 37 of those locations.

Nitroaromatic Compounds. Nitroaromatic compounds, which are not naturally occurring, were monitored in 64 locations across the Chemical Plant area. At least one compound was detected in 44 of these monitoring wells. The areas of highest impact occur near Frog Pond and the Raffinate Pits. New historic highs were reported during 2004 at several wells in the vicinity of

Frog Pond. Levels of nitroaromatic compounds have increased in this area since 1997, most likely as a result of soil remediation by the DOE and Army in this area. The MWQS for 2,4-DNT of 0.11 µg/L was equaled or exceeded at 20 locations and the MWQS for 1,3-DNB of 1.0 µg/L was exceeded at one location. The risk-based concentration of 2.8 µg/L for 2,4,6-TNT was exceeded at two locations and the risk-based concentration of 1.3 µg/L for 2,6-DNT was exceeded at nine locations. The MWQS for nitrobenzene of 17 µg/L was not exceeded at any location.

Fourteen monitoring locations in the Frog Pond area were also selected to monitor for the following breakdown products of nitroaromatics: 2-AM-4,6-DNT; 4-AM-2,6-DNT; 2-NT; 3-NT; and 4-NT. The breakdown product data were evaluated to try to determine whether the contaminants were originating from the area of Production Line #1 or from the area of Army Lagoon #1. Nitroaromatic contaminants at Army Lagoon #1 should differ from those associated with Production Line #1 due to photodegradation processes at the Lagoon. Wells downgradient from both of these previously remediated areas showed contamination consistent with nitroaromatic breakdown, although the higher concentrations at MW-2012 continue to point toward the area of Production Line #1 as the primary contributor to groundwater contamination. The monitoring of breakdown products will not be continued in 2005 as the investigation regarding source areas in this part of the site was completed in 2004. It was concluded that two source areas contributed to the contamination in this area. A more complete discussion can be found in the Completion Report for the Frog Pond Groundwater Investigation (DOE 2004h).

Volatile Organic Compounds. VOC monitoring continued through 2004 to monitor the extent of contamination and changes in concentration that may have resulted from remedial activities and groundwater field studies performed in the area of TCE impact. Twenty-one wells demonstrated detectable levels of at least one VOC. Eighteen of these wells exceeded the MCL of 5 µg/L for TCE.

Chemical Plant Springs

Burgermeister Spring (SP-6301) was monitored during 2004 as a part of the MNA program. Average measured concentrations during 2004 at Burgermeister Spring for nitroaromatic compounds, nitrate, TCE, and uranium are presented in Table 6−21. These results are similar to those observed during 2003. With the exception of 2,4-DNT, the levels of nitroaromatic chemicals at the spring were consistently below their corresponding detection limits. TCE was not detected during the year and nitrate was measured at levels below its standard. Uranium occurred at relatively low concentrations.

Table 6–21. 2004 Monitoring Data for Burgermeister Spring

Parameter	Average	Maximum
1,3,5-Trinitrobenzene (µg/L)	<0.08	<0.08
1,3-DNB (µg/L)	<0.07	<0.07
2,4,6-Trinitrotoluene (µg/L)	<0.08	<0.08
2,4-DNT (µg/L)	0.04	0.09
2,6-DNT (µg/L)	<0.13	<0.13
Nitrate as Nitrogen (mg/L)	2.05	3.49
Trichloroethylene (µg/L)	<0.13	<0.13
Uranium (pCi/L)	24.18	38.9

Three of the four other springs which have been previously monitored are now also monitored in accordance with the MNA program and the LTS&M Plan. Spring 6306 was also monitored during 2004. Results from the sampling of additional springs are shown in Table 6−22. TCE was reported at concentrations less than its detection limit.

Table 6–22. 2004 Annual Average Monitoring Data for Springs

Parameter	SP-5303	SP-5304	SP-6303	SP-6306
1,3,5-Trinitrobenzene (µg/L)	0.20	<0.08	0.11	NA
1,3-DNB (µg/L)	<0.05	<0.05	<0.07	NA
2,4,6-Trinitrotoluene (µg/L)	22.67	0.06	<0.08	NA
2,4-DNT (µg/L)	0.04	<0.06	0.04	NA
2,6-DNT (µg/L)	0.22	<0.13	0.17	NA
Nitrate as Nitrogen (mg/L)	0.20	0.49	2.37	0.04
Trichloroethylene (µg/L)	<1.0	<1.0	<1.0	NA
Uranium (pCi/L)	39.90	53.48	1.09	1.98

< All samples less than the highest detection limit.
NA = Parameter not analyzed at this location

Quarry Groundwater

During 2004, the monitoring at the Quarry was conducted in accordance with the LTS&M Plan as discussed in Section 4.4.2.1.

Uranium. The uranium values continue to indicate that the highest levels occur in the bedrock and alluvial materials between the Quarry rim and the Femme Osage Slough. Fourteen locations north of the slough exceed applicable maximum background concentrations for uranium.

The attainment objective for the long-term monitoring for the groundwater north of the slough is that the 90th percentile of the data within a monitoring year is below the target level of 300 pCi/L for uranium (DOE 2000b). Ten wells north of the slough exceeded the target level of 300 pCi/L in 2004. Based on the 2004 data, the 90th percentile of the data is 1,289 pCi/L. This is a slight increase from 2003, when the 90th percentile of the uranium data was 1,110 pCi/L.

Nitroaromatic Compounds. In 2004, samples from Quarry monitoring wells were analyzed for the six primary nitroaromatic compounds. The monitoring wells, which have historically been impacted with nitroaromatic compounds, are situated in the alluvial materials or bedrock downgradient of the Quarry and north of the Femme Osage Slough. Results were similar to those reported in 2003.

The 2,4-DNT average concentrations for location MW-1027 remained above the MWQS of 0.11 µg/L during 2004. Location MW-1006 had three reported concentrations that exceeded 0.11 µg/L; although the average concentration is less than 0.11 µg/L. Background comparisons are not discussed since nitroaromatic compounds are not naturally occurring compounds.

The attainment objective for the long-term monitoring of 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 for 2,4-DNT and that all wells exhibit stable or downward trends (DOE 2000b). Based on the 2004 data, the 90th percentile of the data is 0.03 µg/L; however, an upward trend has been observed in MW-1027.

Sulfate. Sulfate levels in 2004 in the monitoring wells in the bedrock of the Quarry rim and in the alluvial materials north of the Femme Osage Slough were similar in magnitude to those observed in 2003. Sulfate is monitored as an indicator of the geochemistry of the groundwater, as higher sulfate concentrations are generally observed in an oxidizing environment. Oxidizing conditions in 2003 and 2004 could also cause the relatively elevated uranium concentrations observed in this area.

Iron. Iron is also monitored as an indicator of the geochemistry of the groundwater. Iron concentrations generally increase in a reducing environment. These results are similar to those reported during 2003, and continue to confirm the presence of a geochemical reducing zone along the northern margin of the slough, which is inhibiting migration of uranium-contaminated groundwater.

Missouri River Alluvium Monitoring

Uranium. The 10 monitoring wells located south of the slough were analyzed for uranium to verify that the levels remained within the range of natural variation. One location, RMW-2, exceeded the average background value for the Missouri River alluvium. However, the reported value is well within the range used to calculate the average background and does not indicate impact from the groundwater north of the slough. None of the locations exceeded the drinking water standard of 20 pCi/L (30 µg/L).

Nitroaromatic Compounds. The RMW series of monitoring wells were sampled for the six primary nitroaromatic compounds. No detectable concentrations were observed at these locations.

Sulfate and Iron. The monitoring wells south of the slough were sampled for sulfate and iron to evaluate the geochemistry of the Missouri River alluvial aquifer. The data indicated that a strongly reducing environment is prevalent in the groundwater immediately south of the slough, as exhibited by the high iron concentrations and low sulfate concentrations. The RMW-series wells indicate a slightly less reducing environment when compared to the wells immediately south of the slough. This is likely the influence of the Missouri River on the groundwater quality in this portion of the alluvial aquifer.

6.4.5 2005 Environmental Monitoring

Detailed environmental monitoring information from 2005 can be found in the *Weldon Spring Site Environmental Monitoring Plan for Calendar Year 2005* (DOE 2006b).

6.4.5.1 Radiation Dose Analysis

For 2005, the potential exposure in terms of dose to an individual who consumes spring water contaminated with uranium was calculated. This calculation represents that exposure for the RME individual since data from the spring with the highest uranium concentration is used (i.e., for Spring 5304 which is located in the SE Drainage with a reported uranium concentration of 122 pCi/L for 2005). The estimated TEDE to this RME is about 0.27 mrem.

6.4.5.2 NPDES Monitoring

The Weldon Spring Site had one NPDES permit (MO-0107701) during 2005. The permit only covers the former SWTP discharge line. The SWTP discharge line will only be used if the site ever operates Train 3 at the LCRS as a contingency to current disposal methods. This permit's expiration date was in July 2005. DOE submitted a renewal application to MDNR in January 2005, but has not received a renewed permit to date. The site currently operates under the existing permit until MDNR issues a renewed permit.

6.4.5.3 Surface Water

Chemical Plant Surface Water

During 2005, Schote Creek, Dardenne Creek, and Busch Lakes 34, 35, and 36 were sampled annually for total uranium. This monitoring was conducted to measure the effects of remediation and surface water discharges from the Site on the quality of downstream surface water.

The results for the Chemical Plant surface water sampling are presented in Table 6−23 along with the recent 3-year high for each location for comparison. Uranium levels at the off-site surface water locations for 2005 were similar to 2004 averages. The uranium levels at Busch Lake 34 continue to be elevated compared to the remainder of the locations; however, uranium levels at the Busch Lake outlets have shown an overall decline since remediation started.

Table 6–23. 2005 Results for Total Uranium (pCi/L) Concentrations at Weldon Spring Chemical Plant Area Surface Water Locations

Location	Uranium	Recent 3-Year High[a]
SW-2004 (Lake 34)	3.7	6.97
SW-2005 (Lake 36)	2.5	4.1
SW-2012 (Lake 35)	.81	4.5
SW-2016 (Dardenne)	0.95	1.36
SW-2024 (Schote)	1.0	2.77

[a]2002–2004

In 2005, the location SW-2007 was sampled quarterly for uranium in accordance with the MNA program as a background location. This location is located on Dardenne Creek immediately upstream of Highway 40/61, approximately 2.1 miles north of the Site. The results are shown in Table 6−24.

Table 6–24. 2005 Results for Total Uranium (pCi/L) Concentrations at Weldon Spring Chemical Plant Area Surface Water Background Location: SW-1007

Date	Uranium
02/07/2005	0.35
05/19/2005	0.81
08/11/2005	0.88
11/21/2005	0.81
SW-2024 (Schote)	2.1

6.4.5.4 Quarry Surface Water

The same four locations within the Femme Osage Slough were monitored to determine the impact of groundwater migration from the Quarry. These locations, were monitored semiannually for uranium. The samples are located from the upper section of the Femme Osage Slough. This section of the slough is known to receive groundwater contribution from the area of uranium impact. The 2005 semi-annual uranium concentrations for the Quarry surface water locations are summarized in Table 6−25. The 2005 levels were similar to the 2004 concentrations.

Table 6–25. 2005 Results for Total Uranium (pCi/L) at Weldon Spring Quarry Surface Water Locations

Location	1st Semi-annual	2nd Semi-annual	Average	Recent 3-Year High *
SW-1003	32.3	21.6	27.0	33.1
SW-1004	32.4	20.5	26.5	36.4
SW-1005	25.6	16.5	21.1	12.1
SW-1010	24.6	24.9	24.8	24.8

* 2002–2004

6.4.5.5 Groundwater Monitoring

Chemical Plant Groundwater

Uranium. Total uranium, which was measured at 17 monitoring wells during 2005, continued to be present in the groundwater near the former raffinate pits. In 2005, groundwater from 12 monitoring well locations exceeded the average background level of 0.93 pCi/L (0.03 Bq/L) established during the GWOU remedial investigation (DOE 1997). Four wells exceeded the drinking-water standard of 30 µg/L (20 pCi/L) (40 CFR 141).

Nitrate. In 2005, nitrate (as N) was monitored at 22 monitoring wells in the Chemical Plant area as part of the MNA program. The areas of highest impact continued to be in the Raffinate Pit and Ash Pond Areas. Average nitrate concentrations exceeded the MCL of 10 mg/L (40 CFR 141) at 12 of those locations.

Nitroaromatic Compounds. Nitroaromatic compounds, which are not naturally occurring, were monitored in 30 locations across the Chemical Plant area. The areas of highest impact occurred near Frog Pond and the Raffinate Pits. Levels of nitroaromatic compounds have increased in this area since 1997, most likely as a result of soil remediation by DOE and DA in this area. The

MWQS for 2,4-DNT of 0.11 µg/L was equaled or exceeded at seven locations and the MWQS for 1,3-DNB of 1.0 µg/L was exceeded at one location. The risk-based concentration of 2.8 µg/L for 2,4,6-TNT was exceeded at one location and the risk-based concentration of 1.3 µg/L for 2,6-DNT was exceeded at four locations. The MWQS for nitrobenzene of 17 µg/L was not exceeded at any location.

TCE. TCE monitoring was conducted under the GWOU MNA monitoring program to monitor the extent of contamination and changes in concentration that may have resulted from remedial activities and groundwater field studies performed in the area of TCE impact. Four wells demonstrated detectable levels of TCE. Three of these wells exceeded the MCL of 5 µg/L for TCE.

Chemical Plant Springs

Average measured concentrations during 2005 at Burgermeister Spring and Spring 6303 for nitroaromatic compounds, nitrate, TCE, and uranium, which were analyzed as part of the MNA program, are presented in Table 6−26. These results are similar to those observed during 2004. With the exception of 2,4-DNT, the levels of nitroaroamatic chemicals at the spring were consistently below their corresponding detection limits. TCE was detected during the year at SP-6303 but not at Burgermeiste Spring and nitrate in both springs was measured at levels below its MCL. Though uranium occurred at relatively low levels in both springs in 2005, the average and maximum uranium concentrations at Burgermeister Spring were noticeably higher than the equivalent concentration measured during 2004. This latter observation was likely attributed to the relatively low rainfall that was recorded for the area in 2005, which meant that less water was available for dilution.

Table 6–26. 2005 Monitoring Data for Burgermeister Spring (Spring 6301) and Spring 6303

	Spring 6301		Spring 6303	
Parameter	**Average**	**Maximum**	**Average**	**Maximum**
1,3-Dinitrobenzene (µg/L)	ND	ND	ND	ND
2,4,6-Trinitrotoluene (µg/L)	ND	ND	0.151	0.27
2,4-Dinitrotoluene (µg/L)	ND	ND	ND	0.083
2,6-Dinitrotoluene (µg/L)	0.08	0.11	ND	ND
Nitrobenzene	ND	ND	ND	ND
Nitrate as Nitrogen (mg/L)	5.07	7.19	8.37	11.6
Trichloroethene (µg/L)	ND	ND	0.605	0.73
Uranium (pCi/L)	57.25	58.8	2.25	3.1

The additional three springs, SP-5303, SP-5304, SP-6306, were sampled in 2005 as part of the MNA program for uranium only. Results from the sampling of additional springs are shown in Table 6−27. The uranium is lower in SP-6303 compared to 2004, but significantly higher in SP-5303 and SP-5304. This could also be attributed to the dry conditions during 2004.

Table 6–27. 2005 Uranium Monitoring Data for Springs 5303, 5304, and 6306

	SP-5303		SP-5304		SP-6306	
Parameter	**Average**	**Maximum**	**Average**	**Maximum**	**Average**	**Maximum**
Uranium (pCi/L)	91.35	92.7	100	122	0.23	0.30

Quarry Groundwater

During 2005, the monitoring at the Quarry was conducted in accordance with the LTS&M Plan as discussed in Section 4.4.2.1.

Uranium. The uranium values continue to indicate that the highest levels occur in the bedrock and alluvial materials between the Quarry rim and the Femme Osage Slough. Eighteen locations north of the slough exceed applicable maximum background concentrations for uranium.

The attainment objective for the long-term monitoring for the groundwater north of the slough is a 90th percentile of the data within a monitoring year below the target level of 300 pCi/L for uranium (DOE 2000b). Eleven wells north of the slough exceeded the target level of 300 pCi/L in 2005. Based on the 2005 data, the 90th percentile of the data is 1,223 pCi/L. This is a slight decrease from 2004, when the 90th percentile of the uranium data was 1,289 pCi/L**.**

Nitroaromatic Compounds. In 2005, samples from Quarry monitoring wells were analyzed for the six primary nitroaromatic compounds. Results were similar to those reported in 2004.

The 2,4-DNT average concentration for location MW-1027 remained above the MWQS of 0.11 µg/L during 2005. Location MW-1006 also had an average concentration that exceeded 0.11 µg/L. MW-1032 had detectable concentrations in 2004, but did not have detectable concentrations in 2005.

Attainment objective for 2,4-DNT north of the slough is that the 90th percentile associated with measured concentrations of this compound within a monitoring year is below the target level of 0.11 µg/L and that all wells exhibit stable or downward trends (DOE 2000b). During 2005, the 90th percentile associated with 2,4-DNT concentrations in quarry well was 0.068 µg/L; however, an upward trend was observed in MW-1027.

Sulfate. Sulfate levels in 2005 in the monitoring wells in the bedrock of the Quarry rim and in the alluvial materials north of the Femme Osage Slough were similar in magnitude to those observed in 2004.

Iron. Iron is also monitored as an indicator of the geochemistry of the groundwater. Iron concentrations generally increase in a reducing environment. These results continued to confirm the presence of a geochemical reducing zone along the northern margin of the slough, which is inhibiting migration of uranium-contaminated groundwater.

Missouri River Alluvium Monitoring

Uranium. The 10 monitoring wells located south of the slough were analyzed for uranium to verify that the levels remain within the range of natural variation. One location, RMW-2, exceeds the average background value for the Missouri River alluvium. However, the reported value is well within the range used to calculate the average background and does not indicate impact from the groundwater north of the slough. None of the locations exceed the drinking-water standard of 20 pCi/L (30 µg/L).

Nitroaromatic Compounds. The RMW-series monitoring wells were sampled for the six primary nitroaromatic compounds. No detectable concentrations were observed at these locations.

Sulfate and Iron. The monitoring wells south of the slough were sampled for sulfate and iron to evaluate the geochemistry of the Missouri River alluvial aquifer. The data indicate that a strongly reducing environment is prevalent in the groundwater immediately south of the slough, as exhibited by the high iron concentrations and low sulfate concentrations. The RMW-series wells indicate a slightly less reducing environment when compared to the wells immediately south of the slough. This is likely the influence of the Missouri River on the groundwater quality in this portion of the alluvial aquifer.

6.4.6 Trend Analysis

Statistical tests designed to detect temporal trends in contaminant of concern (COC) concentrations at the Chemical Plant were performed using historical and current data from several monitoring wells and springs. Trending was assessed for total uranium, nitrate, TCE, and nitroaromatic compounds.

The computer program TREND, developed at Pacific Northwest Laboratory, was used to perform the trend analyses; the method employed was the nonparametric Mann-Kendall test. The analyses indicate the potential presence of statistically significant downward or upward trends in concentration at a given location. TREND results serve as approximate indicators of changes in plume behavior, and are not intended as predictors of future concentrations. However, program results might be used to indicate areas that should be more closely monitored in the future.

In past years a FORTRAN version of TREND was used to identify potential upward or downward trends at the Chemical Plant. Analysis of 2005 data was performed with a version of the program that has been included in the software package Visual Sample Plan (VSP). This package is developed and maintained by Pacific Northwest National Laboratory (PNNL). It was originally developed in the early 1990s as a tool for designing sampling plans. In subsequent years, a variety of features have been added to accommodate more complex sampling designs and some statistical analysis tools. Recently the nonparametric Mann-Kendall trend analysis was incorporated in the software. This tool facilitates much easier and quicker trend analysis for multiple analytes at multiple wells.

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 log-normal distribution). The nonparametric method is valid for scenarios where there are a high number of non-detect data points. Data reported as trace concentrations or less than the detection limit can be used by assigning them a common value that is smaller than the smallest measured value in the data set (i.e., one-half the specified detection limit). This approach is valid because only the relative magnitudes of the data, rather than their measured values, are used in the method. A possible consequence of this approach is that the test can produce biased results if a large fraction of data within a given time series are non-detect and detection limits change between sampling events. To avoid this potential problem with Chemical Plant data, the Mann Kendall test was only applied to data series in which a half or more of the data consisted of detected concentrations.

The trend analyses were performed for all data collected between 2001 and 2005 at select locations at the Chemical Plant and Quarry. To maintain sufficient power of the statistical tests, the analyses were limited to data sets with three or more data points. If fewer than three detected concentrations were present in a given time series for a contaminant, the data set was not analyzed. One-half the specified detection limit (on the date of analysis) was used in place of all concentrations reported at below the detection limit.

The two-tailed version of the Mann-Kendall test was employed to detect either an upward or downward trend for each data set. As part of this approach, a test statistic, Z, was calculated. A positive value of Z indicated that the data were skewed in an upward direction, and a negative value of Z indicated that the data were skewed in a downward direction. The alpha value (or error limit) used to identify a significant trend was 0.05. In the two-tailed test at the 0.05 alpha level of significance, the null hypothesis of "no trend" was rejected if the absolute value of the Z statistic was greater than Z_1-$\alpha/_2$, where Z_1-$\alpha/_2$ was obtained from a cumulative normal distribution table. In other words, the absolute value of the TREND output statistic, Z was compared to the table $Z_{.975}$ value of 1.96. If the absolute value of the Z output statistic was greater than 1.96, then a significant trend was reported.

A non-parametric estimate of the slope, which is calculated independently of the trend, was estimated for each data set The slope was estimated using a nonparametric procedure included in the TREND program. A 95 percent (1-α) two-sided confidence interval about the true slope was obtained with the nonparametric technique. The direction and magnitude of the slope, along with the upper and lower 95 percent confidence limit estimates, are included in the test results presented in the following section.

6.4.6.1 Chemical Plant Trend Results

The trend analyses indicated that most contaminants at wells used to monitor MNA did not show signs of either upward or downward trends during the past 5 years. This is seen in the test results for uranium in Chemical Plant groundwater (Table 6−28), which show uranium levels in MW-3003 and MW-3031 as possibly trending downward, but no trends are apparent in the remaining seven wells included in the analyses.

Of 13 wells included in the nitrate trending analysis (Table 6−29), downward trends were identified at three locations (MW-3034, MW-3040, and MWS-4) and upward trends were indicated at two wells (MW-3003 and MWS-1). A nitrate concentration measured in a sample from MW-3003 during 2005 represented a 5-year high for this constituent and well. Similarly, nitrate was detected in MWS-1 during 2005 at a record high level.

Table 6–28. Chemical Plant Groundwater Uranium Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-3003	27	Down	-0.00235	-0.00343	-0.00121
MW-3024	17	None	-0.00763	-0.01821	0.00458
MW-3030	32	None	-0.00048	-0.00232	0.00133
MW-3031	22	Down	-0.00038	-0.00118	-0.00012
MW-3037	7	None	-0.00014	-0.00059	0.00057
MW-3040	8	None	-7.072e-5	-0.03146	0.03290
MW-4036	10	None	-0.00218	-0.01884	0.00073
MW-4040	8	None	0.05590	-0.05096	0.15901
MWS-4	11	None	6.1592e-6	-0.00016	5.4527e-5

Table 6–29. Chemical Plant Groundwater Nitrate Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-2038	44	None	-3.77939	-54.6859	60.6883
MW-2040	14	None	-7.92862	-34.8707	6.33729
MW-3003	28	Up	25.4812	6.74905	45.1303
MW-3034	42	Down	-77.0239	-189.492	-13.3494
MW-3040	8	Down	-34.8454	-162.722	-13.7714
MW-4013	7	None	6.23676	-58.5459	96.9297
MW-4014	7	None	0.61543	-2.01144	8.01859
MW-4029	44	None	24.5382	-8.54433	66.192
MW-4031	30	None	-12.3578	-36.8127	13.309
MW-4036	7	None	-7.47087	-12.0392	5.93997
MW-4040	8	None	22.392	-26.7753	75.5277
MWS-1	7	Up	1.57013	0.43507	2.76144
MWS-4	13	Down	-1.01882	-1.37816	0.36058

Trending analyses for nitroaromatic chemicals in groundwater were limited in number because large proportions of the concentrations reported for these compounds during the past 5 years at Objective 2 and 3 wells tended to be below detection limits. For the nitroaromatic constituents and wells at which trending could be assessed, test results indicated either no trend or upward trends (Tables 6−30, 6−31, 6−32, and 6−33). None of the wells had a sufficient number of nitrobenzene detections to warrant trending analysis for this compound. However, a sufficient quantity of detections were available for 1,3 dinitrobenzene at two wells such that trending analyses could be conducted for this nitroaromatic compound (Table 6−33).

Table 6–30. Chemical Plant Groundwater 2,4-DNT Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-2012	23	None	94.5334	-11.6125	303.22
MW-2014	20	Up	0.02048	0.0	0.03783
MW-2038	44	None	0.00780	-0.01305	0.04508
MW-2050	22	Up	9.49566	5.20763	14.5311
MW-2052	16	None	-0.01187	-0.03730	0.00036
MW-2054	16	None	-0.06521	-1.90822	1.52521
MW-3030	32	Up	0.12442	0.05877	0.19649
MW-3034	45	None	-0.00609	-0.05771	0.03274
MW-3039	13	None	-0.14535	-0.41088	0.14049
MW-4015	14	None	0.00872	-0.01116	0.03438

Table 6–31. Chemical Plant Groundwater 2,6-DNT Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-2012	23	None	84.5034	-17.2681	226.993
MW-2014	20	Up	0.05513	0.00549	0.14141
MW-2050	22	Up	8.52233	6.79835	9.67937
MW-2051	13	None	0.04964	-0.02978	0.23463
MW-2052	16	None	-0.02516	-0.11991	0.01767
MW-2053	16	None	0.15981	-0.69876	1.15511
MW-2054	16	None	2.09444	-2.19894	12.8011
MW-3030	32	Up	0.08999	0.05280	0.12820
MW-4013	7	None	-0.11372	-0.37051	0.01377
MW-4015	14	None	0.04799	-0.06644	0.19078

Table 6–32. Chemical Plant Groundwater 2,4,6-TNT Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-2012	23	None	0.0	-35.2002	36.6839
MW-2046	11	None	-0.3865	-1.46442	0.21135
MW-2051	13	None	0.00324	-0.02301	0.07123
MW-2053	16	None	-0.21305	-2.30355	1.39823

Table 6–33. Chemical Plant Groundwater 1,3-DNB Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-2012	23	None	0.23431	-0.21627	0.71852
MW-2050	22	None	.03708	0.0	0.10555

Of some interest is the observation that both 2,4-DNT and 2,6-DNT exhibited upward trends in wells MW-2014, MW-2050, and MW-3030 (Tables 6−30 and 6−31). The first two of these wells are located in the vicinity of Frog Pond, and the latter is located within the historical footprint of the former Raffinate Pit 4. 2,4-DNT was not detected at MW-2014 during 2005 and the average 2005 concentration of 2,6-DNT at this well was quite low (0.48 µg/L) despite the fact that upward trends were indicated for this location. In contrast, the average concentrations of 2,4-DNT and 2,6-DNT at MW-2050 during 2005 were relatively high. As discussed in previous annual reports, this latter observation might be due to rebound from remedial actions that took place in the Frog Pond area. The average concentrations of 2,4-DNT and 2,6-DNT at MW-3030 (in the former Raffinate Pits area) were significantly less than those observed at MW-2050.

MW-3030 was also the site of a detected upward trend for TCE during the past 5 years (Table 6−34). The average concentration of TCE in this well during 2005 was 455 µg/L, which was significantly larger than the MCL for TCE (5 µg/L). Groundwater in the vicinity of MW-3030 may have been affected by rebounds in TCE concentration as a result of previous attempts at remediation in the Raffinate Pits area.

Table 6–34. Chemical Plant Groundwater TCE Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-3030	30	Up	76.0922	58.0986	100.66
MW-3034	40	None	-52.2382	-125.83	12.2989
MW-4029	46	None	-14.0478	-52.1775	7.80077

Testing for temporal trends during the past 5 years for uranium concentrations at springs monitored under the Chemical Plant MNA program (Table 6−35) was possible for SP-5303 and SP-5304 in the Southeast Drainage and Burgermeister Spring (SP-6301) located to the north of the site. Test results for all three of these locations indicated no trend.

Table 6–35. Chemical Plant Springs Uranium Trend Analysis

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
SP-5303	21	None	0.00953	-0.00939	0.02481
SP-5304	38	None	-0.00452	-0.01732	0.00608
SP-6301	43	None	0.00077	-0.00612	0.00772

6.4.6.2 Quarry Trend Analysis

Testing for temporal trends was performed on Quarry groundwater monitoring well concentration data for total uranium and 2,4-DNT collected between 2001 and 2005. These analyses were performed using the previously described program TREND as incorporated in the Visual Sample Plan software package. As in the case of the Chemical Plant, the method employed was the nonparametric Mann-Kendall test.

Results of the trending analyses for uranium are reported for each of Lines 1 through 4 of the observation wells used to monitor groundwater chemistry at the Quarry. The results for the wells located in the immediate vicinity of the Quarry (Table 6−36) show that downward trends were exhibited in MW-1004, MW-1005 and MW-1030. Decreases in uranium at these locations are likely the result of bulk waste removal from and restoration activities at the Quarry. Remedial activities at the Quarry are expected to prevent infiltration of precipitation and storm water into the residually contaminated fracture system in the area. Downward trends were also reported in 2003 and 2004 for the three monitoring wells mentioned above.

Table 6–36. Quarry Groundwater Uranium Trend Analysis for Line 1 Monitoring Wells

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-1002	19	None	0.00013	-0.00013	0.00043
MW-1004	19	Down	-0.16873	-0.32268	-0.08837
MW-1005	19	Down	-0.28046	-0.36810	-0.18681
MW-1027	19	None	-0.00583	-0.05439	0.05726
MW-1030	19	Down	-0.00251	-0.00439	-0.00105

At the Line 2 monitoring well network, downward trends were exhibited for uranium (Table 6−37) in MW-1031, MW-1045, MW-1046, and MW-1048. These observations appear to correlate with the previously mentioned downward trends associated with wells at the Quarry proper, which could indicate that the gradual effects of quarry remediation are now being observed at wells located closer to Femme Osage Slough. Downward trends were also reported for the MW-1045 and MW-1046 locations in 2003 and 2004. In contrast to such evidence for decreasing uranium concentrations, upward trends in uranium were identified at MW-1013, MW-1014, MW-1016, MW-1047 and MW-1052 in the Line 2 network (Table 6−37). These wells are located in the area of highest uranium impact in the Quarry area. Upward trends were also reported for MW-1013, MW-1014, MW-1016, and MW-1052 in 2004.

Table 6–37. Quarry Groundwater Uranium Trend Analysis for Line 2 Monitoring Wells

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-1006	19	None	0.13973	-0.01873	0.25100
MW-1007	19	None	-0.00392	-0.00817	0.00049
MW-1008	21	None	-0.19594	-0.54857	0.16893
MW-1009	22	None	-0.00025	-0.00122	0.00012
MW-1013	22	Up	0.05081	0.01283	0.11518
MW-1014	22	Up	0.31411	0.20708	0.41413
MW-1015	19	None	-0.00326	-0.02928	0.01449
MW-1016	19	Up	0.01438	0.00413	0.02265
MW-1028	10	None	-0.00010	-0.00056	0.00041
MW-1031	22	Down	-0.00203	-0.00410	-0.00048
MW-1032	22	None	-0.03058	-0.08970	0.03992
MW-1045	18	Down	-0.00095	-0.00191	-0.00012
MW-1046	19	Down	-0.00124	-0.00177	-0.00061
MW-1047	22	Up	8.18386e-5	0.0	0.00017
MW-1048	22	Down	-0.01226	-0.02518	-0.00034
MW-1051	20	None	0.10944	-0.04075	0.28177
MW-1052	20	Up	0.11182	0.00192	0.44033

None of the six wells comprising Line 3 had a sufficient number of detected uranium concentrations to warrant trend analysis. This result is expected given that chemically reducing conditions in the vicinity of Line 3 tend to remove uranium from solution in ground water.

Data were available to perform trend testing for uranium in three of the Line 4 monitoring wells (RMW-1, RMW-2, and RMW-4). Two of these wells showed no trend and one exhibited an upward trend. Despite this latter result, dissolved uranium in the Missouri River alluvium does not appear to be problematic given that its concentrations in the RMW series of wells are low and within background levels.

Table 6–38. Quarry Groundwater Uranium Trend Analysis for Line 4 Monitoring Wells

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
RMW-1	11	None	0.00032	-0.00012	0.00056
RMW-2	11	Up	0.00146	0.00039	0.00314
RMW-4	11	None	-0.00023	-0.00047	0.00032

Trend analysis for 2,4-DNT at the Quarry was limited to well MW-1027 in the Line 1 network where an upward trend was identified. Trend tests were not possible for the remaining Quarry wells because analyses of samples collected from them during the past 5 years typically result in non-detects. The resulting apparent preponderance of low concentrations for 2,4-DNT north of the slough suggests that levels of this constituent have been been decreasing in recent times in response to Quarry remediation. Simultaneously, the reducing conditions associated with wells located in the immediate vicinity of and south of the slough are likely to enhance the biodegradation of this nitroaromatic compound.

Table 6–39. Quarry Groundwater 2,4-DNT Trend Analysis for Line 1 Monitoring Wells

Location	No. of Samples	Trend	Slope	Lower Confid. Interval	Upper Confid. Interval
MW-1027	20	Up	2.79433	1.86228	4.07392

The upward trend in 2,4-DNT levels at MW-1027 conforms with a similar finding regarding this well and constituent in the 2004 annual report. This observation may be related to increases in groundwater elevation detected in the area north of the slough prior to 2005. Although water levels in this area during the past 5 years have fallen within historical ranges, locally measured heads have shown a slight to moderate increase in comparison to even earlier years, presumably in response to recharge from precipitation. Such recharge of oxygenated water could potentially cause residual 2,4-DNT to avoid biologically mediated degradation, just as it can lead to apparently increasing uranium concentrations.

6.5 Site Inspection

The Weldon Spring Site, located in St. Charles, Missouri, was inspected November 7–8, 2005. The inspection was conducted in accordance with the *LTS&M Plan for the Weldon Spring, Missouri, Site* (July 2005a), and the associated inspection checklist. Representatives from EPA and MDNR participated in the inspection. Representatives from the WSCC and MDC participated in portions of the inspection. This inspection also served as the Five-Year Review inspection to support the Site's CERCLA Five-Year Review Report, which is required to be issued in 2006.

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

The IC areas were inspected to ensure that pending restrictions such as excavating soil, groundwater withdrawal, residential use, etc., were not being violated. Each area was inspected and no indications of violations of future restrictions were observed.

An aerial survey of the disposal cell was flown in September 2005. This survey is required by the LTS&M Plan (DOE 2005a) and checklist to be conducted every 5 years in conjunction with the Five-Year Review inspection. The previous aerial survey was conducted in 2003 in conjunction with the first annual LTS&M inspection. The survey results were discussed during the inspection and are discussed in more detail in Section 6.5.2.

The disposal cell was inspected by walking ten transects over the cell and around the cell perimeter at the grade break and the base. Hand-held GPS equipment was used to navigate the ten transects. Five areas of the cell which had been marked and located by GPS survey equipment during the 2003 annual inspection were located and observed for any signs of rock degradation. The LCRS also was inspected and found to be in good condition. Each of the 119 groundwater-monitoring wells were inspected and found to be in generally good condition. Some of the wells were inspected in the weeks prior to and after the scheduled 2-day inspection. Other site features including the prairie, site markers, and roads also were inspected.

The purposes of the annual inspection were 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.

As preparation for the Five-Year Review, the LTS&M requires that DOE contact MDNR to determine if well registrations were issued for the groundwater restricted area. The Wellhead Section of MDNR was contacted and in response to this request they emailed a list of the well registrations that were issued for the groundwater restricted area. There were no new wells installed in this area with the exception of groundwater monitoring wells installed by DOE or the DA.

At the time of the inspection seven personnel from S.M. Stoller Corporation were employed full-time at the Site. Also employed at the Site were 11 part-time contractor and subcontractor employees.

This report presents the results of the DOE annual inspection of the Weldon Spring Site. The following personnel from S.M. Stoller were the lead inspectors during the inspection:

Dick Johnson – Grand Junction, Colorado
Terri Uhlmeyer – Weldon Spring, Utah, Site

Dick Johnson was one of the lead inspectors for the IC areas and for the disposal cell inspection. He has been supporting long-term management activities for DOE low-level radioactive disposal sites for 5 years. Dick currently is serving as DOE contractor Site Lead for ten disposal sites located in six states. He inspects at least 15 sites annually and prepares the inspection reports for many of those inspections. He also prepares an annual compliance report, currently addressing five disposal sites, to comply with NRC general license requirements. Dick has 9 years of experience working as a hydrogeologist and performing civil engineering design and construction inspection for an engineering and architectural consulting firm. During the past 16 years his responsibilities have included radiological characterization, engineering design, remediation, demolition, disposal, verification, long-term site management, and compliance documentation for various CERCLA, Uranium Mill Tailings Radiation Control Act (UMTRCA), and Decontamination and Decommissioning projects for DOE contractors. Dick Johnson has a B.S. degree in geology and an M.S. degree in geomorphology, and is a Certified Professional Geologist.

Terri Uhlmeyer was one of the Lead Inspectors for the IC areas and for the disposal cell inspection. She also coordinated the inspection and preparation of this report. Terri worked for the EPA for 4 years as a Resource Conservation and Recovery Act (RCRA) inspector and compliance officer, and conducted numerous inspections during that time and attended several inspection training courses. She has worked at the Weldon Spring Site for 15 years, and served as the Regulatory Compliance Manager for 11 years and was in charge of inspections at the Site. She has also been involved in the CERCLA documentation, waste management, and safety aspects of the project and has prepared many reports and plans for the site. Terri Uhlmeyer has a B.S. degree in Petroleum Engineering.

The following support personnel from Stoller participated in the inspection:

Randy Thompson – Weldon Spring Site

The following personnel observed the inspection and provided oversight:

Tom Pauling – DOE
Dan Wall – EPA, Region VII
Shawn Muenks – MDNR
Steve Lang - MDNR
John Vogel – MDC
Nancy Dickens – Consultant to WSCC
Tom Nelson – WSCC member
Mike Duvall – St. Charles County

The inspection was conducted in accordance with the *LTS&M Plan for the Weldon Spring, Missouri, Site* (DOE 2005a), and dated July 2005.

The inspection base maps, which include the location of the photographs, are included as Figure 6−3 and Figure 6−4. The inspection photos are included in Appendix B.

6.5.1 Institutional Controls

During the inspection, the pending IC areas were inspected in accordance with the current information in the LTS&M Plan. Figure 6−5 and Figure 6−6 are the institutional control location maps from the 2005 Annual Inspection Report. As a result of a corrective action from the 2004 annual inspection, hand-held GPS units were used to navigate to various IC boundary markers. The GPS units were also used to navigate to several other areas of the inspection, including disposal cell transects and rock degradation test plots.

The IC areas are listed below as they are stated in the inspection checklist:

Land and Shallow Groundwater Use Within the Site Proper Boundary (Outside Disposal Cell Buffer Zone)

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 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 no indications of excavations into soil or bedrock or groundwater withdrawal or use were observed. MDC use and maintenance of the Hamburg Trail across DOE property is pending final agreement. Lindenwood University has been granted use of the Administration Building and its use is consistent with the agreement. Current land use remains consistent with the planned ICs.

Land and Shallow Groundwater Use at DOE Site Proper Disposal Cell and Buffer Zone

Inspect for indications of excavations into soils and bedrock and for residential use of the shallow groundwater within the buffer zone. Inspect to ensure that the land use continues to be in compliance with the terms of the restrictions within the notation.

Inspection Results: This area was inspected and no indications of excavations into soils and bedrock and no residential use of the shallow groundwater within the buffer zone were observed. Current land use remains consistent with planned ICs. The monument locations are shown in Figure 6−5.

During the inspection two survey monuments (WS28 and WS32) and two survey pins (WS27P and WS34P) were located.

Approximately one week after the official inspection a depression area was noted in the prairie approximately 150 ft from the disposal cell on the north side (Photo 1). The depression is shown in Figure 6−7. It was determined this was an area of past trenching and is most likely settlement caused by inadequate compaction of the soil at the completion of trenching. The area will be evaluated to determine the best course of action to address the area.

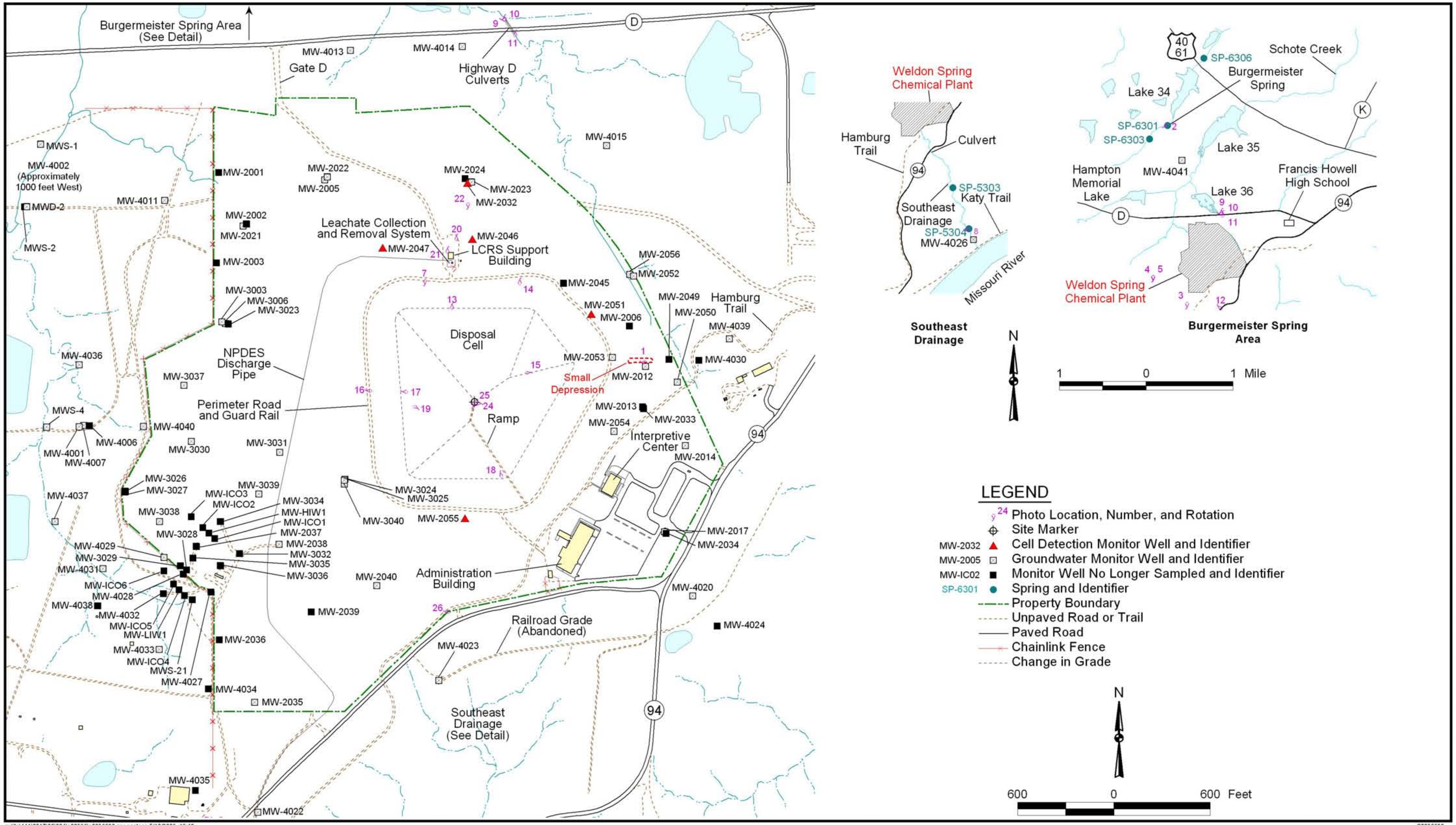

Figure 6–3. 2005 Inspection Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site

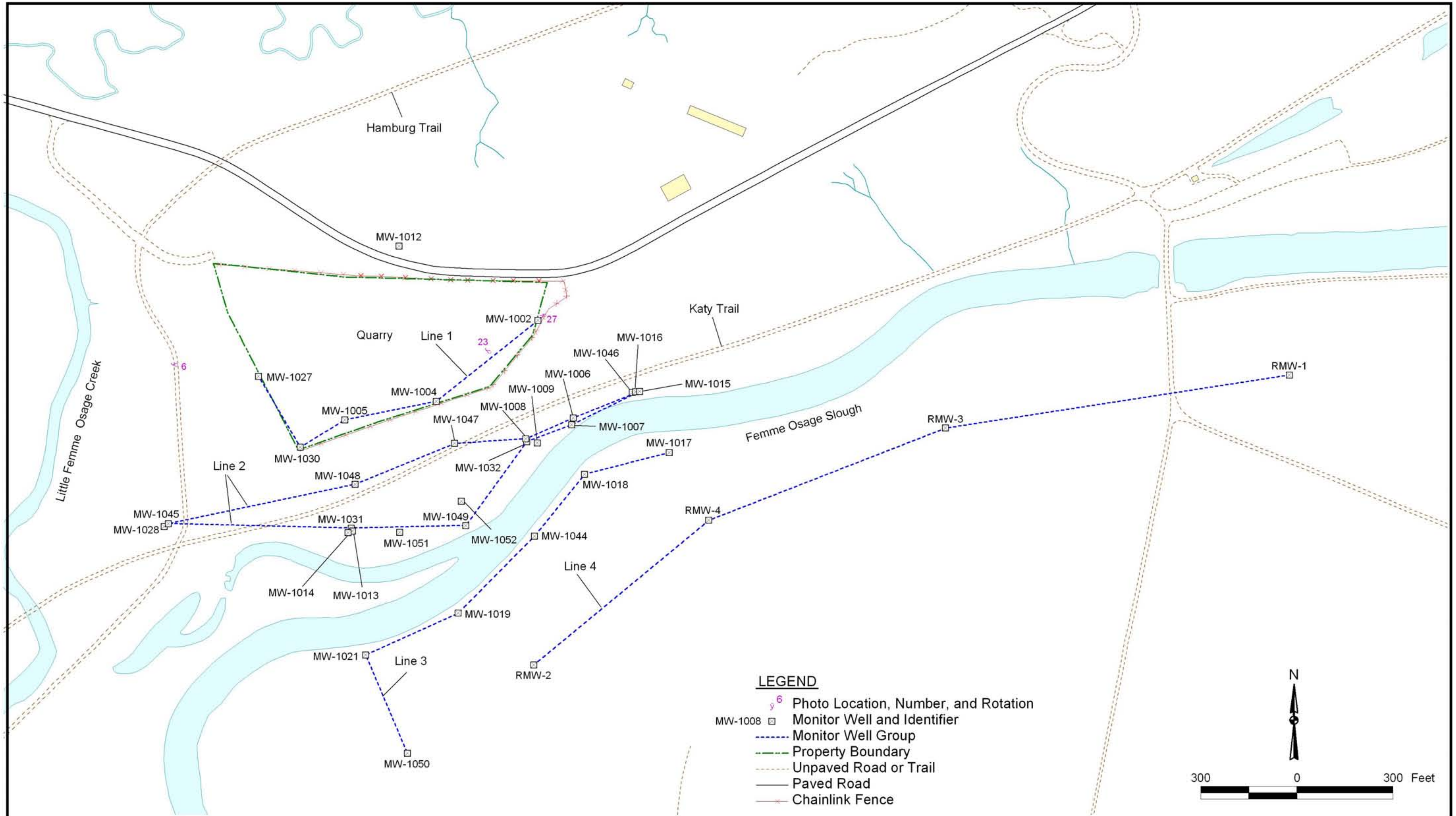

Figure 6–4. Inspection Map for the Quarry Area of the Weldon Spring, Missouri, Site

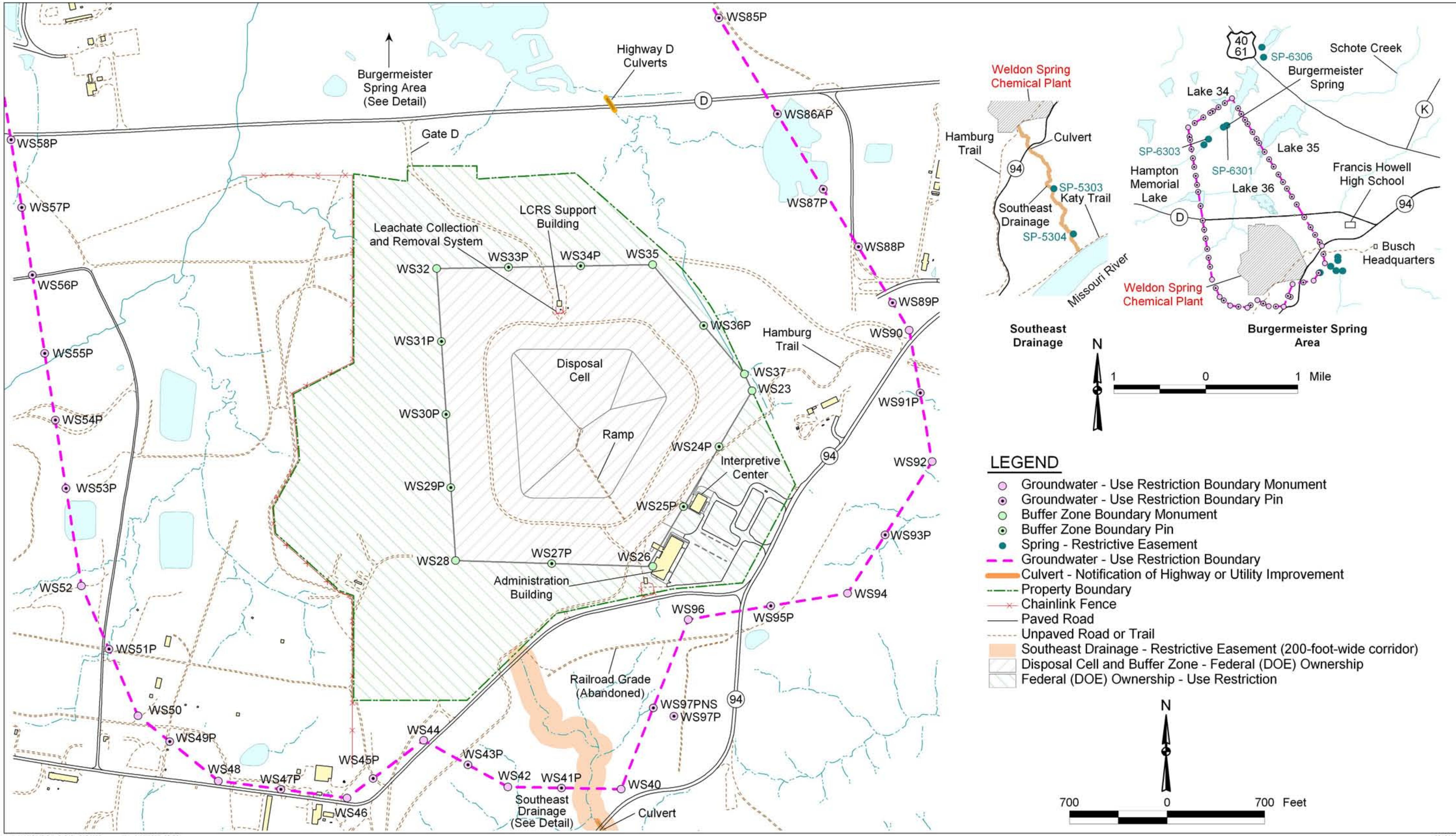

Figure 6–5. Institutional Controls Location Map for the Chemical Plant Area

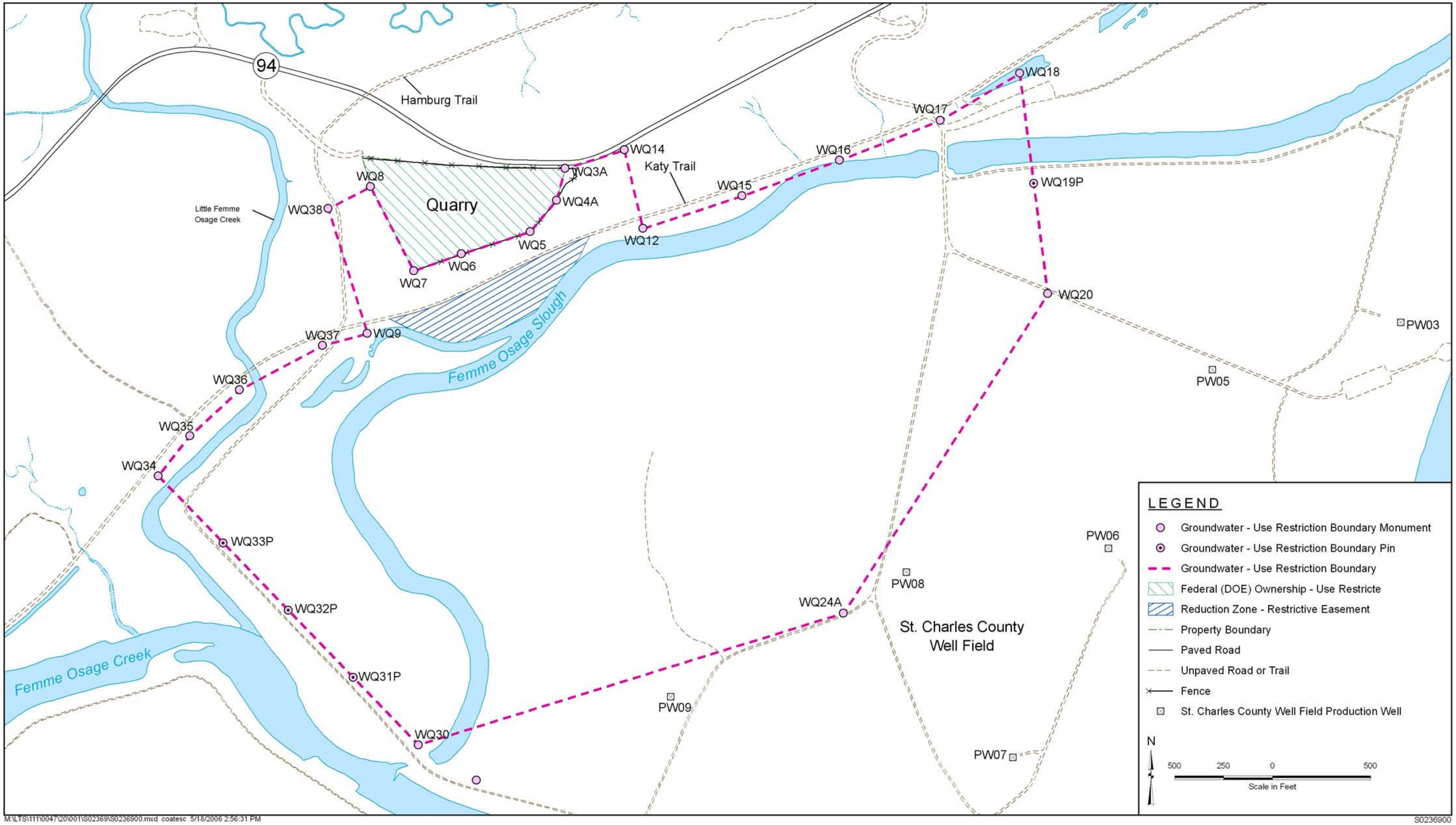

Figure 6–6. Institutional Controls Location Map for the Quarry Area

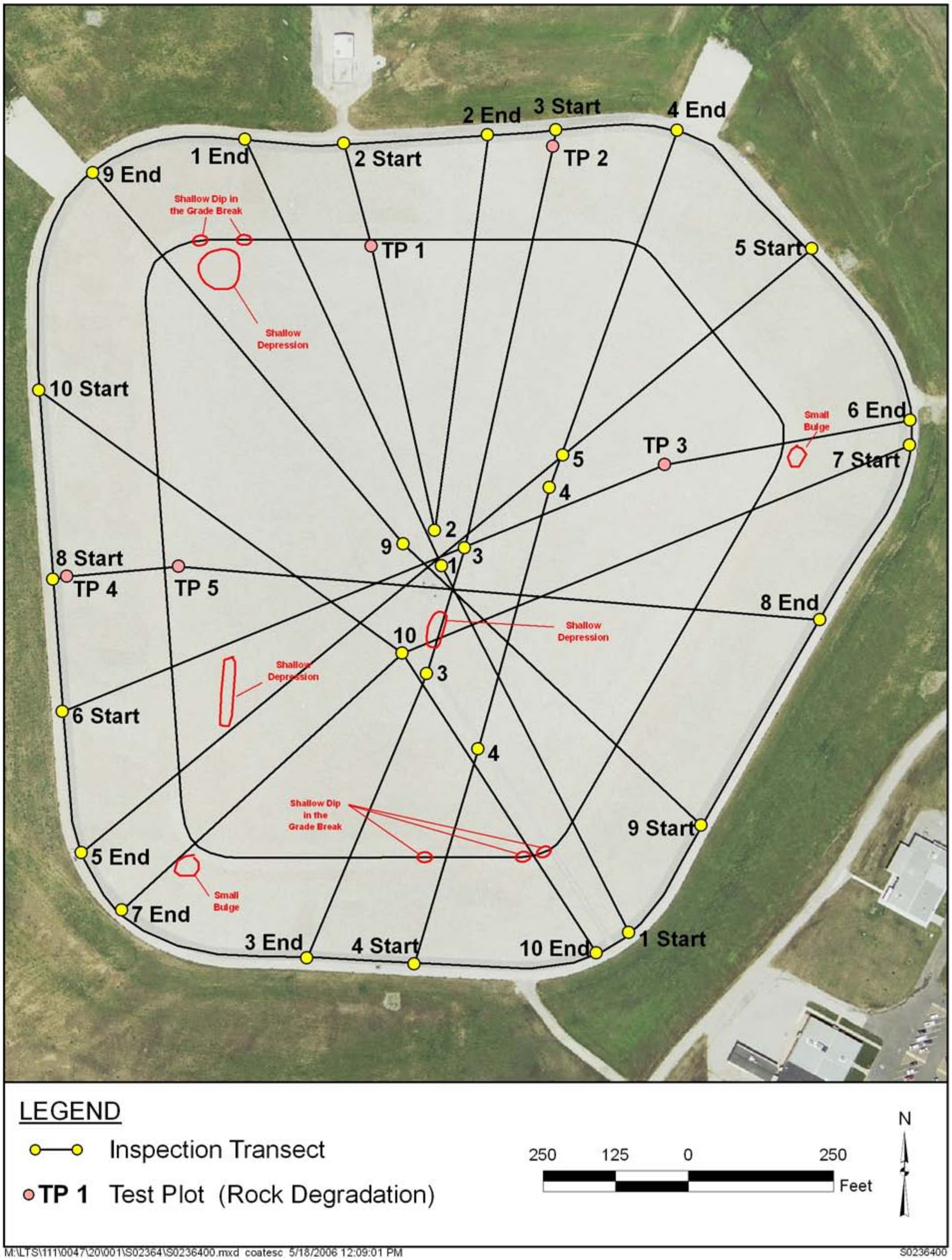

Figure 6–7. Disposal Cell inspection Transects and Rock Test Plot Locations at the Weldon Spring, Missouri, Site

(Photo 4). This was also noted during the 2004 inspection. During the 2005 inspection, dirt was replaced around the monument (Photo 5). On the MDC property, WS73 (monument) and WS72P (pin) were located. The Chemical Plant groundwater restriction area boundary monuments are shown in Figure 6−5. It was also observed that six wells on the Army property did not have the DOE 24-hour contact label that the site had recently begun applying to the wells at the request of the WSCC.

Land and Shallow Groundwater Use on the DOE Quarry Property

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

Inspection Results: The Quarry Property was inspected and no indications of excavation into soil or bedrock or groundwater withdrawal or use were observed. Also, no party has been granted use of portions of the Quarry area. Quarry backfill continues to provide positive drainage from the Quarry to the Little Femme Osage Creek and vegetative cover remains well established (Photo 6). There was some erosion occurring along some of the high walls of the Quarry. This is not a concern at this time, but will be continue to be observed in the future. Current land use remains consistent with planned ICs.

Groundwater (Quarry)

Groundwater use is restricted in certain 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.

Inspection Results: The groundwater restricted area was inspected and no evidence of groundwater withdrawal or use in the area was observed. The Quarry groundwater restriction area boundary survey monuments are shown in Figure 6−6. The following monuments were located during the inspection: WQ3, WQ4, WQ5, WQ6, WQ7, WQ9, WQ10, WQ12, and WQ24.

Land Use in 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 and bedrock 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 and bedrock were observed. As required by the final 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 (Photo 7). These labels were observed during the inspection and some recommendation to improve the labels were noted. Land use remains consistent with planned ICs.

Southeast Drainage

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

Inspection Results: The inspectors walked down the entire Southeast Drainage and no indications of residential use or construction or any other activity that would indicate non-recreational use of the area were observed. The springs also were inspected and no indications of residential, commercial, or agricultural use of the springs were observed (Photo 8). Current land use remains consistent with planned ICs. Boundary monument WS39 at the lower end of the SE Drainage was located.

Highway D Culvert

Check for signs of disturbance of the affected region where the Frog Pond outlet culverts pass beneath Highway D and in the utility rights-of-way in the affected area.

Inspection Results: The Highway D culverts were inspected (Photo 9). During the 2003 and 2004 annual inspection, erosion was observed on top of the area where the outlet side of the culvert passes beneath the ditch between Highway D and the north end of the culvert, exposing the culverts. MoDOT had been notified of this condition and been sent a copy of the inspection reports. Prior to the 2005 inspection, MoDOT had been in contact with the site and stated that they were going to address the culvert. They later contacted the site and stated that they had placed gravel on the culvert. It was noted during this inspection that gravel had been placed on top of the area covering the exposed culverts (Photo 10). This effort appears to have stabilized the areas so as to minimize additional erosion. Concrete had also been placed on the outside and middle of the culverts on the inlet side (Photo 11).

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.

Inspection Results: The State Route 94 culvert was inspected. During the 2003 and 2004 inspections the upstream end of the culvert was substantially blocked with debris. MoDOT had also been notified of this condition. During the 2005 inspection it was noted that the area had been cleared of debris (Photo 12).

Pipeline from LCRS to Missouri River

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

Inspection Results: The pipeline area was inspected. GPS surveying equipment was used to establish the locations of the manholes and cleanouts. It was noted that there were no on-site disturbances of the pipeline and there were no apparent disturbances in the area of the pipeline or manholes in the off-site areas.

6.5.2 Disposal Cell

An aerial survey was conducted of the disposal cell for the 2005 inspection and 2006 Five-Year Review Report. The LTS&M Plan (DOE 2005a) and inspection checklist require this aerial survey to be conducted in conjunction with the Five-Year Review inspection. The survey is required to be conducted with a vertical resolution not less precise than 0.5 ft and map and survey data to be produced with the cell surface represented by 1-ft contour intervals. The aerial survey was flown in early September and the maps were produced in October. The contractor (Stoller) prepared maps from data provided and compared 2005 contours with 2003 contours and found numerous discrepancies between the contours showing what would be several large depressions and bulging areas in comparison between the two aerial surveys. The contractor requested that the aerial survey subcontractor re-evaluate the data for both years. The data was evaluated and it was determined that the 2003 baseline data was not correct. A letter of explanation was provided from the subcontractor. The data was corrected and a map was produced which showed a possible slight depression on the southwest side. Appendix C includes the maps of the as-built survey points and the corrected 2003 and 2005 aerial survey maps.

The disposal cell was inspected in accordance with the LTS&M Plan and the annual inspection checklist. The cell was divided into ten transects (Figure 6−7). The inspectors divided into two groups and walked five transects each; one group also walked along the grade break at the top of the side slopes and along the cell perimeter. The inspectors looked for depressions, shifts of cell plane vertices, and other indications of settlement. Other items for inspection were vegetation, wet areas, apron drains, guardrail, and the stairs. A GPS unit was used during the 2003 inspection to map five areas chosen for rock degradation review. The inspectors took photographs of these and compared them to photographs from the previous inspections of the same areas and observed no rock degradation. These areas from the 2003, 2004, and 2005 inspections are shown in Photos 13a through 17c.

A few small shallow depressions on the cell cover and along the grade break were noted during the inspection. It appeared that the depressions ranged up to approximately 2 or 3 inches deep. The majority of these areas had been identified during the previous inspection(s). A few additional areas were noted on the northeast and southwest corners of the cell (Photo 18). The area identified as a depression by the aerial survey was located by GPS and it was observed that a slight depression exists in this area (Photo 19). These slight depressions are not unexpected for a disposal cell of this type and are not a cause for concern. They will continue to be monitored.

The small area of surface disturbance that was noted at the base of the side slope near the northwest corner of the cell during the 2004 inspection was re-evaluated and determined to not exist. This area of disturbance was initially identified by the presence of different-colored side slope rocks present on top of the toe apron. Upon further inspection, it was apparent that a small area of the side slope had not slipped to rotate the rocks.

The disposal cell was evaluated by a subcontractor engineering firm on September 27, 2005. The individual who performed the evaluation is a professional engineer with disposal cell and rock performance expertise. The engineer determined that the rocks on the toe apron were not a result of side slope slippage. The reasons given were:

- Rocks in question have a 6 inches to 8 inches nominal diameter and to move them on top of adjacent rocks would require at least 6 inches to 8 inches of movement.
- No longitudinal slip lines are present above the rocks in question.
- No head scarp could be located above the dislodged rocks.
- Many different colored rocks are present on the side slope probably due to different origins in the source Quarry and do not indicate movement.

In accordance with the checklist the inspectors also checked 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.

6.5.3 Leachate Collection and Removal System

Operations of the LCRS were discussed with site personnel and the system was inspected (Photo 20). The fences and doors were locked and in good condition. The system was functioning as designed. The LCRS data and documentation were reviewed during the document review period of the inspection and the following information was checked and verified that it was available: sampling data, LCRS flow rates, action leakage rate information, “burrito” system flow rates, and leachate data.

DOE continues to exercise its pretreatment contingency process equipment by pretreating the leachate through a system of cartridge filters and ion exchange media that is selected for uranium (Photo 21). The leachate is sampled and continues to be well below the limit for uranium. The leachate will continue to be managed in this manner until the leachate is consistently below the 20 pCi/L level for uranium.

6.5.4 Erosion

6.5.4.1 Chemical Plant Area

During the 2004 inspection, erosion areas were identified on the north and northwest sides of the disposal cell. These areas were repaired during June 6−8, 2005. A total of 32 rock boxes were constructed to prevent erosion from continuing. These rock boxes were filled with 2-inch rock and topped with 3−6 inch rock to ensure the rock would stay in place during high precipitation events. An additional 17 loads (approximately 255 tons) of 3- to 6-inch rock was delivered and placed in the ditches/swales. The filled ditches provide well-drained channels for water to flow freely and no additional erosion should occur (Photo 22). A discussion of the repairs was held during the inspection and a few of the areas were inspected and found to be in good condition.

6.5.4.2 Quarry Area

Erosion areas were observed along some of the high walls of the Quarry during the inspection (Photos 23). These areas will continue to be monitored in the future.

6.5.5 General Site Conditions

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

6.5.5.1 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.

6.5.5.2 Vandalism

Minor vandalism has occurred at the top of the disposal cell and includes scratching on the face of the plaques and moving of rocks (Photo 24). The St. Charles County Sheriff's representative was notified of this during the annual contact interview (Appendix D) and he stated that he would notify his officers and they would conduct extra patrols and would require anybody that is there after dark to leave the premises. Also, it is planned to place larger signs at the base of the cell which state that the disposal cell viewing platform is closed at night. The vandalism will continue to be monitored. A historical marker (#10) was also found to be vandalized in July 2005. Two pictures from the marker had been cut out. The marker was replaced. The markers will continue to be routinely inspected.

6.5.5.3 Personal Injury Risks

No personal injury risks were observed.

6.5.5.4 Site Markers

The Site markers consist of four information plaques on top of the cell, historical markers, and other information markers.

The four information plaques on top of the cell were in generally in good condition. The faces of the bronze plaques have been scratched, and a repair kit was purchased to repair the scratches. The pedestal on the south side of the viewing platform was eroded under the southeast corner. (Photo 25). The historical markers were inspected prior to the inspection on October 27, 2005, and found to be in good condition. Photos were taken of each marker. Marker #3 is shown in Photo 26.

The plan also states that signs are posted on the LCRS fence to inform the public that trespassing is forbidden and that persons may call the DOE 24-hour security telephone number (970-248-6070 or 877-695-5322) for information. During the 2005 inspection, it was noted that these signs were posted on the LCRS fence.

The LTS&M Plan (DOE 2005a) also states that, "Inspectors will verify that the phone numbers remain displayed at the Chemical Plant and Quarry sites and are listed in local phone directories."

The phone numbers were displayed at the Chemical Plant and Quarry sites, but were not found to be all of the local phone directories. It was determined that the relevant phone directory companies would be contacted to correct this.

6.5.6 Monitoring Wells

Monitoring wells in the Disposal Cell Monitoring Well Network, Chemical Plant Monitoring Well Network, and Quarry Monitoring Well Network were inspected (Photo 27). The inspection checklist required all the disposal cell wells to be inspected and greater than 10 percent of the Chemical Plant and Quarry wells to be inspected. Each of the 119 groundwater monitoring wells was inspected as a function of the Five-Year Review inspection. Some of the wells were inspected in the weeks prior to and after the inspection. Each well was photographed and recorded. The checklist required the wells to be inspected to ensure they are properly secured and locked, in good condition, and to check if they need maintenance and have the proper ID number on the well. All of the wells met these requirements. It should be noted that each well is at least inspected quarterly during the year when static water levels are recorded. The wells are inspected and maintained at least quarterly during the year when static water levels are recorded. The wells are listed below for identification purposes.

6.5.6.1 Disposal Cell Monitoring Well Network

Each well in the disposal cell network was inspected and is listed below:

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

6.5.6.2 Chemical Plant Area Monitoring Well Network

The inspection checklist requires at least 10 percent of the wells be inspected from the Chemical Plant monitoring well network. The monitoring well network consists of 87 monitoring wells. Only forty-seven wells are monitored for the groundwater remedy of MNA. The remaining wells are monitored quarterly for static water levels only. The wells were all inspected and are listed below:

MW-2001, 2002, 2003, 2005, 2006, 2012, 2013, 2014, 2017, 2021, 2022, 2023, 2024, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2045, 2046, 2047, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 3003, 3006, 3023, 3024, 3025, 3026, 3027, 3028, 3029, 3030, 3031, 3032, 3034, 3035, 3036, 3038, 3039, 3040, 4001, 4002, 4006, 4007, 4011, 4013, 4014, 4015, 4020, 4022, 4023, 4024, 4026, 4027, 4028, 4029, 4030, 4031, 4032, 4033, 4034, 4035, 4036, 4037, 4038, 4039, 4040, 4041, ICO1, ICO2, ICO3, ICO4, ICO5, ICO6, H1W1, LIWI .

6.5.6.3 Quarry Monitoring Well Network

The inspection checklist requires greater than 10 percent of the wells in the Quarry monitoring well network to be inspected. The monitoring well network consists of 29 wells. The wells were all inspected and are listed below:

MW-1002, 1004, 1005, 1006, 1007, 1008, 1009, 1012, 1013, 1014, 1015, 1016, 1017, 1018, 1019, 1021, 1027, 1028, 1029, 1030, 1031, 1032, 1044, 1045, 1046, 1047, 1048, 1049, 1051, 1052, 1053.

Wells RMW-1, RMW-2, RMW-3, and RMW-4, which were formerly owned by St. Charles County and are now owned by Public Water Supply District #2, were also inspected.

6.5.7 On-Site Document and Record Verification

The following on-site documents and records were verified:

- Surveillance and Maintenance Plan: (LTS&M Plan for the Weldon Spring, Missouri, Site, July 2005)
- As-built drawings: (disposal cell)
- Maintenance log
- Contingency Plan/Emergency Response Plan: (Weldon Spring Site Project Safety Plan, April 2004)
- NPDES permit(s): (#MO-0107701, revised March 5, 2004). It was discussed that the expiration date for this permit was July 13, 2005. DOE had sent in an application to MDNR for a renewed permit on January 2005, but has not received a renewed permit to date. The site currently operates under the existing permit until MDNR issues a renewed permit.
- MSD agreement and records
- Ground water monitoring records
- Leachate records
- Interpretive Center sign-in logs
- Telecons and interview records

6.5.8 Contacts

Several stakeholders were notified prior to the inspection in accordance with the checklist. These included:

- St. Charles County Sheriff
- Cottleville Fire District
- Francis Howell High School
- Francis Howell School District
- Simplex-Grinnel Alarm System
- Weldon Spring Citizens Commission
- St. Charles County
- Public Water Supply District #2
- Middendorf-Kriedell Library

The IC contacts were also contacted in regards to the inspection and to maintain annual contact with the representatives in regards to ICs. In the future, when the ICs are established, this annual contact will be used to verify cognizance of the ICs and the requirements and/or restrictions with each representative. The representatives contacted are listed below.

- John Vogel – MDC
- Joel Porath – MDC
- Cynthia Green – MDC
- Jennifer Frazier – MDNR – Parks
- Roy Stevenson – DA
- Barry McFarland – DA
- Tom Ryan –MoDOT

The St. Charles Planning and Zoning Department was also contacted and 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 was verified to be filed and present at the St. Charles Recorder of Deeds office by checking the county website at www.saintcharlescounty.org.

The Stoller Project 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 from the EPA *Comprehensive Five-Year Review Guidance.* The forms for each of these contacts and interviews are attached as Appendix D.

6.5.9 Findings and Recommendations

Table 6–40. Findings and Recommendations

Finding	Corrective Action	Target Date
The boundary monument WS-46 was broken off.	Coordinate repair of the monument.	June 2006
Six wells on the Army property did not have the contact label applied.	Apply contact labels to wells.	March 2006
Additional signs need to be placed around the Site that state that the viewing platform at the top of the disposal cell is closed at night.	Purchase and install signs.	May 2006
A few additional small depressions were observed on the disposal cell.	Use the GPS equipment to locate the areas. Continue to monitor these areas.	May 2006
The pedestal on the south side of the viewing platform was eroded under the SE corner.	Repair the erosion.	June 2006
The telephone number for the Site was not located in all local phone directories and some in some directories the telephone number was hard to locate.	Contact telephone directories and ensure the telephone number is listed correctly.	May 2006

End of current text

7.0 Technical Assessment

7.1 Chemical Plant Operable Unit

Question A: Is the remedy functioning as intended by the decision documents?

Answer A: Yes, the remedy is functioning as intended by the decision documents.

7.1.1 Remedial Action Performance

The review of documents and environmental monitoring data and the results of the annual and Five-Year Review inspections indicate that the remedy for the CPOU, which consisted of controlling contaminant sources at the Chemical Plant and disposing of contaminated materials in an engineered on-site disposal facility is functioning as intended. The disposal cell has remained stable and in good condition and based on annual inspections and groundwater and leachate monitoring is performing as intended.

7.1.2 System Operation and Maintenance

DOE has finalized the LTS&M Plan, which includes system operation and O&M information for LTS&M. DOE also performs annual inspections on LTS&M activities, environmental monitoring, and ICs and have found these activities to be functioning as intended, thus far.

7.1.3 Opportunities for Optimization

Several opportunities for optimization have been reviewed for performing different aspects of the annual inspection. To monitor elevation change in the disposal cell cover, aerial LIDAR (Light Detection and Ranging) was a new technology explored as an alternative to traditional topographic mapping from aerial photography. Airborne LIDAR is a technology that determines location and elevation of an object or surface using laser pulses in conjunction with the aircraft's onboard GPS. It was determined that for 1 ft contour mapping, LIDAR points would be insufficient without supplementing the data with photogrammetric breaklines. Also, from a cost-effectiveness perspective, LIDAR is more suited to large areas (6−8 square miles), or where penetration of dense vegetation is required. Therefore, the conventional traditional topographic mapping from aerial photography was continued to be utilized for aerial survey during the 2005 inspection.

Also, the use of hand-held GPS units have been introduced into the inspections as discussed in Section 6.5. The GPS units have enhanced the inspections by assisting in locating certain important inspection points, such as the disposal cell transects, rock photodegradation test plots and survey monuments and pins.

7.1.4 Early Indicators of Potential Issues

There are no early indicators of potential issues that could affect the protectiveness of the remedy.

7.1.5 Implementation of Institutional Controls and Other Measures

The information in this section is extracted from Section 3 of the LTS&M Plan (DOE 2005a).

This section summarizes information pertinent to the implementation of ICs to meet objectives of the use restrictions described in the ESD issued in February 2005 (DOE 2005c). The ESD clarified use restrictions necessary for the remedial actions specified in the CPOU, GWOU, and QROU RODs to remain protective over the long-term.

7.1.5.1 Use Restrictions

The ESD prepared for the Weldon Spring Site presents use restrictions for specific areas. The areas are on either Federal or state owned properties. No privately owned property is affected by the use restrictions. The following describes the use restrictions for the Chemical Plant property:

Disposal Cell and Buffer Area

The use restrictions listed below must be met throughout the disposal cell area, including its surrounding 300-ft buffer zone. This area is under federal DOE jurisdictional control. The use restrictions listed below shall be maintained until the remaining hazardous substances are at levels allowing for unlimited use and unrestricted exposure (UUUE). Due to the extremely long-lived nature of the radioactive constituents in the disposal cell, these restrictions are expected to be necessary for essentially as long as the disposal cell remains in place. The objectives of the controls or restrictions are as follows:

1. Prevent activities on the disposal cell, such as the use of recreational vehicles that could compromise the integrity of the cell cover (e.g., result in the removal or disturbance of the riprap).
2. Prevent activities in the buffer zone such as drilling, boring, or digging that could disturb the vegetation, disrupt the grading pattern, or cause erosion.
3. Retain access to the buffer area for continued maintenance, monitoring, and routine inspections of the cell and buffer area.
4. Prevent construction of any type of residential dwelling or facility for human occupancy on the disposal cell and buffer area, other than facilities to be occupied for activities associated with performing environmental investigation and/or restoration and expansion of the existing Interpretive Center.
5. Maintain the integrity of any current or future remedies or monitoring systems.

Southeast Drainage Soil or Sediment

The use restrictions listed below must be met at the approximately 37-acre area covering the 200-ft corridor along the length of the Southeast Drainage. The restricted area is located on property that is owned by state entities. These restrictions will need to be maintained until the remaining hazardous substances are at levels allowing for UUUE, which is anticipated to be a period of decades or longer.

1. Prevent the development and use of the Southeast Drainage property for residential housing, schools, childcare facilities and playgrounds.

7.1.5.2 Types of Institutional Controls

Specific IC mechanisms have been identified to implement the use restrictions presented for each area. The ICs generally fall into one of the four categories identified by EPA guidance (EPA 2000). Multiple mechanisms are being used to provide “layering” for additional durability.

The EPA IC categories are as follows.

1. Proprietary controls, such as easements and covenants, are based in real property law and generally create legal property interests.
2. Governmental controls are generally implemented and enforced by state or local governments and can include zoning restrictions, well drilling regulations, building permits, ordinances, or similar mechanisms that restrict land or resource use.
3. Enforcement and permit tools with ICs components, such as CERCLA FFAs, CERCLA Unilateral Administrative Orders, and Administrative Orders on Consent, can be used to enforce or restrict site activities, as can RCRA permits and orders.
4. Informational devices such as state registries, deed notices, information centers, markers, and advisories provide information that a site contains residual or capped contamination.

7.1.5.3 Summary of Institutional Controls Currently in Place

The following ICs are in place for the Weldon Spring Site:

1. DOE has exclusive jurisdictional control over the Chemical Plant and the Quarry. Federal ownership provides inherent authority for DOE to control land use based on its legislative jurisdiction and take action against unapproved uses, but also entails statutory and regulatory obligations. Numerous requirements are placed on federal agencies that manage land to ensure the protection of human health and the environment. Per DOE Order 430.1B Real Property Asset Management, DOE is required to provide an inventory of the specific ICs implemented to restrict use of the property in DOE’s Facilities Information Management System (FIMS). The maintenance of a real property asset inventory system is designed to communicate the presence of land use restrictions to current federal management personnel and to assure this information is readily available to possible future users of the land. As part of the protocol for maintaining this database, FIMS data must be (a) maintained as complete and current throughout the life cycle of real property assets, including real property related ICs; and (b) archived after disposal of real property assets with those necessary for long-term maintenance and surveillance identified, reviewed, and retained accordingly.

   CERCLA Section 120(h) (3) requires for property transfers to be accompanied by a covenant warranting that “all remedial action necessary to protect human health and the environment with respect to any such substance remaining on the property has been taken before the date of transfer” and that “any additional remedial action found to be necessary after the date of transfer shall be conducted by the United States.” Upon transfer, the deed or other agreement governing the transfer must contain clauses that indicate the following information: (a) necessary restrictions on the use of the property to ensure protection of human health and the environment (e.g., maintenance of ICs); and (b) restrictions on the use necessary to ensure the required remedial investigations, response actions (e.g., monitoring, implementation of ICs), and oversight activities (e.g., LTS&M activities) will not be disrupted.

2. DOE has committed to perpetual care of the disposal cell and buffer zone as specified in the Chemical Plant ROD, which is enforceable under the FFA.

3. A notation has been entered on the ownership record filed at the St. Charles County Recorder’s Office (deed notice). The notation explains the restrictions on groundwater use and residential development of the Chemical Plant and Quarry areas. The notice acts as an informational device in the event ownership is transferred at some point in the future.

4. The Interpretive Center serves as a community information resource, which depicts the history of the area and details the progression of the cleanup process. Information is available on the construction of the engineered disposal cell and the residual groundwater contamination.

5. Placement of historical markers along the Hamburg Trail and information plaques accessible at the top of the engineered disposal cell. The historical markers depict significant events and locations along the trail related to the displacement of the population during the early 1940s to accommodate the federal government's World War II efforts. The markers also note significant events at their respective locations related to DOE cleanup efforts and encourages the reader to learn more by visiting the DOE Interpretive Center. Similarly, the plaques at the top of the disposal cell contain information regarding the surroundings and the history of St. Charles, as well as information regarding the cleanup and waste materials buried within the disposal cell. See Appendix N for a sample historical marker and disposal cell plaque.

6. Missouri regulates the construction of wells pursuant to 10 CSR Chapter 3 Well Construction Code, Section 3.010(1)(A)4 of which states that "a well shall be constructed so as to maintain existing natural protection against pollution of water-bearing formations and to exclude all known sources of contamination from the well including sources of contamination from adjacent property." 10 CSR 3.030(2) says, "Minimum Protective Depths of Well Casing. All wells shall be watertight to such depths as may be necessary to exclude contaminants. A well shall be constructed so as to seal off formations that are likely to pose a threat to the aquifer or human health." Well Construction Code 10 CSR 3.090(1)(A) says, "All persons engaged in drilling domestic wells in Area 1, a limestone or dolomite area shall set no less than 80 ft of casing, extending not less than 30 ft into bedrock. Example: if 60 ft of residual (weathered rock) material is encountered in drilling before bedrock, then 90 ft of casing must be set." These regulations combine to have the effect of preventing the construction of wells that would allow for consumption of contaminated groundwater by preventing the well from drawing water from groundwater from a depth less than 80 ft which includes the surficial contaminated zone.

7. DOE has real estate licenses with MDC that allow access for the purpose of monitoring and maintaining groundwater wells, drilling and plugging wells, usage of the effluent water pipeline, and a physical entrance at the north gate.

8. The existing Southeast Drainage easement on MDC property providing DOE rights to use the drainage for overland discharge of sewerage; this easement does not directly prohibit development of the Southeast Drainage, but providing notice in the title records that the property is subject to overland sewage flow may help deter residential development in this area until a more effective IC can be put in place.

9. DOE has real estate licenses with MDNR that allow access along portions of the Katy Trail for the purpose of monitoring and maintaining groundwater wells, drilling and plugging wells, usage of the effluent water pipeline, and sampling access along portions of the Katy Trail.

10. Memorandum of Understanding (MOU) with DA regarding cooperation with DOE remedy implementation. The MOU gives DOE permission to access Army property for the purpose of implementing remedial actions, which includes monitoring and maintaining groundwater wells, and drilling and plugging wells.

11. The use restrictions and the ICs identified in the LTS&M Plan are enforceable under the FFA.

Copies of existing IC agreements are included in Appendix E of the LTS&M Plan.

7.1.5.4 Implementation of Additional Institutional Controls

In addition to ICs that are already in place as discussed above, DOE will implement the ICs identified in the subsections below. These ICs were identified based on research findings and positions developed by EPA and DOE (EPA 2005a,b; DOE 2005c,d). These are: (1) easements with state entities; (2) an updated MOU with the Army; and (3) special area designation under the Missouri Well Drillers' Act. It is possible that some overlap may occur in the implementation of groundwater use restrictions by the Army and DOE on federal and state owned properties. To the extent practical, DOE will coordinate with the Army to make sure that the actions undertaken are compatible and avoid unnecessary duplications.

If the DOE is unable to secure one or more of the easements on property owned by the state of Missouri or by an agency of the state of Missouri by negotiation, using the DOE's standard real property acquisition procedures, DOE may submit an alternative plan for review and approval. The plan will outline the alternative approach DOE proposes to use to achieve an equivalent level of control as would have been provided by the easement. The plan shall describe the alternative ICs, the procedures necessary to implement the alternative ICs, the level of control the alternative ICs would provide in meeting the relevant IC objectives, and a schedule for implementing the alternative ICs. If EPA does not approve the alternative plan, EPA may direct DOE to initiate and pursue condemnation to acquire the easement.

Easements

DOE plans to negotiate easements with surrounding affected state agency landowners for implementing the use restrictions required on state properties. An easement is a real property interest that conveys certain rights from the grantor (fee simple land owner) to the grantee. In the case of the Weldon Spring Site, DOE will seek easements for the purpose of restricting use of the contaminated groundwater and the hydraulic buffer zone, and also to restrict land use in the Southeast Drainage and at the Quarry reduction zone. See discussion above for a full description of the restrictions. The easements will also assure DOE access to monitoring locations for sampling and maintenance and, where applicable, provide that DOE is notified of use inconsistent with the terms of the easements. When put into effect, these easements will supersede and replace the current real estate licenses described above.

DOE possesses delegated acquisition authority to acquire real property interests, including easements to implement ICs, through the authority of the Atomic Energy Act of 1954 and the Energy Organizational Act of 1974, combined with Congressional appropriation authority. For the Weldon Spring Site, budget authorization for establishing ICs is part of the authorization for the remedial action under CERCLA. In addition, congressional authorization is not needed for less than "fee simple" acquisitions, which will be the case for the Weldon Spring Site.

DOE will acquire easements in accordance with DOE policy and procedures. The completed easements would be appropriate for recordation with St. Charles County and effective in the state of Missouri.

DOE has completed the following activities towards acquiring the easements:

1. Obtained legal descriptions and surveyed the affected properties: The legal descriptions of the properties affected by the use restrictions are presented in Appendix D of the LTS&M Report.
2. Conducted a title search for the affected properties: DOE conducted a title search (Investors Title Search Company 2004) to identify "less than fee simple" owners within the wider area originally comprising the Weldon Spring Ordnance Works to investigate real property interests, easements, or rights-of-way (ROWs) in these areas.
3. Obtained preliminary title commitment: A follow-on title search was conducted (Investors Title Search Company March 2005) to provide sufficient ownership information to proceed with negotiations. The information obtained from these title searches are summarized in the LTS&M Plan. All of the "less than fee simple" ownership in the properties identified for use restrictions are expected to be unaffected by the restrictions, that is utility ROW would not be impaired by the implementation of DOE's use restrictions. Conversely, DOE has examined the existing ROWs and concluded that none of these interfere with or invalidate any of the use restrictions, including any of the prospective easements.

Memorandum of Understanding for the Army Property

Use restrictions have been identified for a portion of the Army Training as part of DOE's GWOU remedy. An existing MOU is currently in effect that commits the Army to support the remedial actions implemented by DOE. DOE will seek to modify or update this MOU to specify the use restrictions identified above. The new or revised MOU will be specific with respect to the necessary groundwater use restrictions for property under Army control. The MOU will also allow DOE access to the property for the purposes of collecting groundwater samples from both DOE and Army wells, drilling or plugging wells as needed, conducting remedial actions (if necessary), and inspecting for consequential land or resource use changes.

The Army also will be pursuing appropriate IC mechanisms as part of the CERCLA groundwater remedy they have implemented for their area. The MOU will also address other coordination issues relative to the Army ICs, as needed and as compatible with the Army IC implementation schedule.

Special Area Designation Under the State Well Drillers' Act

DOE will request further well drilling restrictions to be imposed in the groundwater restriction areas by petitioning for a rule change under 10 CSR 23-3.100 Sensitive Areas. This regulation provides that sensitive areas be "designated on the basis of either naturally occurring problems caused by unique groundwater chemistry or because they are located in a fragile groundwater environment which is experiencing rapid population growth or urbanization." Large "sensitive" areas have been designated based upon common features. "Special" areas, which present unique or additional constraints, are designated on a case-by-case basis. Currently, three areas of the state have been designated as special areas, with unique requirements governing the drilling of wells in these areas. Special Area 3, within and south of the City of New Haven, was designated by an emergency rulemaking with the intention of following up with a permanent rule change. Since this area was designated based upon migration of contaminated groundwater from a Superfund site, it offers the best guidance for the types of restrictions DOE would expect to be imposed for the Weldon Spring Site. The regulation describes the contaminants and the aerial extent of contamination, including a map, and then requires a driller to consult with MDNR to gain "specific guidance on well drilling protocol and construction specifications on a case-by-case basis. The division must provide approval for all new wells prior to construction."

The LTS&M Plan states that DOE will prepare a package of information derived from the LTS&M Plan and submit it to MDNR Geological Survey and Resource Assessment Division. This package will provide the basic information and other supporting rationale needed for inclusion in the regulation.

7.1.5.5 Schedule for Implementing Additional Institutional Controls

The time frame for implementation of the additional ICs, which is listed in the LTS&M Plan, is listed below along with the status of achieving each of the ICs. The effective date of the LTS&M Plan was July 2005.

1. Special Area Designation Under the State Well Drillers' Act—DOE will submit a package that proposes special area designation to the MDNR within 4 months of the effective date of the LTS&M Plan. This period of time will allow for consultation with MDNR and EPA on the proper form and content for the package, which should facilitate approval of the request.

   Status: DOE and its contractor traveled to Kansas City, Missouri and met with the U.S. Army Corps of Engineers and the 89th Readiness Reserves (Army) on September 15, 2005, to coordinate a request for special area designation for the overlapping contaminated groundwater areas from both sites. Both parties had collaborated on a combined presentation for the Missouri Well Installation Board at their regularly scheduled meeting on November 4, 2005, at Springfield, Missouri.

   DOE and its contractor participated in a meeting with the Army and MDNR on October 18, 2005, at Rolla, Missouri, to discuss the presentation for the Missouri Well Installation Board.

   DOE and the Army made their presentation to the Missouri Well Installation Board at their regularly scheduled meeting of November 4, 2005. The presentation consisted of the history and background for the two sites and a request for a Special Area Designation for the groundwater restricted areas.

An informational meeting was held on December 13, 2005, at the Weldon Spring Site by MDNR to present information to the public regarding the Special Use Area Designation for DOE and Army sites and to receive feedback from stakeholders and the general public.

On February 20, 2006, DOE and the Army attended the regularly scheduled meeting of the Missouri Well Installation Board in Lake Ozark, Missouri, answering specific questions from the Board. The Board decided on certain elements of the proposal, including the size and shape of the Special Area and the method of imposing the restriction via advance consultation between the drillers and MDNR. The Board thus decided to proceed with rulemaking process, but did not vote on the action at this meeting. Instead, they directed MDNR staff to prepare a revised draft rule based on the meeting discussions and to present it for a vote at their next meeting.

On May 19, 2006, DOE and the Army attended the regularly scheduled meeting of the Board at the Weldon Spring Site. The location had been selected by the Board to facilitate participation from the local community, as well as to provide an opportunity for Board members to gain knowledge of the Weldon Spring Site and visit the proposed restriction areas. The Board voted at this meeting and passed the draft regulation as prepared by MDNR staff.

Since May, MDNR staff have been proceeding with the internal procedures required to publish the draft rulemaking in the State Register. This process involves several internal and legislative briefings. Based on the rulemaking schedule provided by MDNR, it is anticipated that this rulemaking, and thus the institutional control provided therein, will be finalized in mid to late 2007.

2. MOU with the Army—DOE will submit a draft updated (or revised) MOU to the Army for review and comment within 6 months of the effective date of the LTS&M Plan. This time will allow for coordination with the Army's own IC implementation plans for the adjacent Weldon Spring Ordnance Works Superfund site.

   <u>Status</u>: DOE also met with Army representatives on September 15 to discuss the updated MOU. DOE delivered a draft of the new MOU to the Army in January 2006, and copied MDNR and EPA. Minor changes were suggested by MDNR and were made by DOE. In February 2006 the Army point of contact within the U.S. Army Corps of Engineers was reassigned to new duties. Since that time, the new Army project manager has also departed on temporary active duty to Afghanistan, leaving the project temporarily reassigned again. Since the new MOU contains both "access" and "restrictive use" provisions, it must be approved by both the land owner, the 89th Regional Readiness Command, and the U.S. Army Corps of Engineers as the remedial action controlling agency. The draft MOU has been awaiting legal review, but DOE expects that once it is given adequate attention, any specific issues or concerns could be addressed within a few months time. The hurdle to overcome is not the access, but rather the restriction on groundwater use, and whether the Army will be comfortable with the language, as well as the means to assure this restriction remains in place over the long term. Although we are not able to control the schedule priorities of other agencies, we are hopeful that the MOU can be finalized before the end of 2006. Until it is, the existing MOU, together with the existing land use on the Army

property, provide a measure of control that is sufficient for current needs to monitor groundwater and prevent groundwater use.

3. Easements—DOE will submit proposed easements to the state agencies within 8 months of the effective date of the LTS&M Plan. The timeline for submitting the proposed easements is dependent on DOE's completion of the following activities toward acquiring the easements: (1) obtain title opinion from either the Department of Justice (DOJ) or another federal entity with delegated authority from DOJ which validates that the title work is thorough and accurate; (2) prepare the appraisals that will be included in the package. DOE is currently working on the appraisals for the affected properties which will reflect the extent to which the properties are devalued as a result of the restrictions being imposed; (3) prepare the easements and associated documentation for implementation including warranty deeds from state property owners; and (4) obtain title insurance on state-owned properties; a "Title Insurance Policy" will be obtained through an independent provider. This title insurance serves the purpose of providing a guarantee that due diligence has been done in identifying the property owners and that all parties that may have right of way or other rights to the property have been identified. This will ensure that agreements are being established with the appropriate parties.

   Status: DOE issued initial letters, dated October 12, 2005, to the surrounding state agency property owners in order to reinitiate discussions regarding the proposed easements. DOE through its realty section and its interagency agreement with the U.S. Army Corps of Engineers (Omaha Office) sent a draft easement and offer letter to the Missouri Department of Conservation (MDC) in May 2006. Negotiations are ongoing with MDC, but the identification of several text changes has led to delays in DOE providing offer letters and draft easements to the Missouri Department of Transportation (MoDOT) and the Missouri Department of Natural Resources-Divison of Parks (MDNR-Parks) for the other two much smaller areas impacted by the residual contamination in the groundwater. DOE expects to issue the MoDOT and MDNR-Parks offers prior to end of September 2006. It is expected that both MDC and MoDOT will have to present these easements to their governing Commissions for approval, so that negotiations and finalization of the easements may not occur until the middle of 2007 or later.

   At the completion of all easements, DOE will record them with the St. Charles County Recorder of Deeds. At the completion of all easements and the new MOU, DOE will revise the LTS&M Plan Appendix E to include copies of these agreements.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

Answer: Yes, the exposure assumptions, toxicity data, clean-up levels, and remedial objectives used at the time of the remedy are still valid.

The following is excerpted from the ESD (DOE 2005c), which is discussed in Section 4.6.2 and was issued in February 2005:

> The 1993 CPOU ROD specifies that "perpetual care be taken of the committed land within the disposal cell footprint because waste would retain its toxicity for thousands of years." It stipulates that the cell cover be inspected and that the groundwater be monitored. This ROD also specified that "following completion of the site cleanup

activities, an assessment of the residual risks based on actual site conditions will be performed to determine the need for any future land use restrictions. This assessment would consider the presence of the on-site disposal cell, the buffer zone, the adjacent Army site, and any other relevant factors necessary to ensure that appropriate measure are taken to protect human health and the environment for the long term.

As part of the remedy selected for the CPOU, soil contamination was cleaned up by removing to depth and disposing of contaminated soils in the on-site disposal cell. Soil cleanup goals were established in the CPOU ROD that were intended to be as low as reasonably achievable given the design limitations pertaining to safe field excavation techniques and field survey capabilities. Recreational use was considered to be the reasonably anticipated future land use. A standard conservative recreational visitor scenario as defined in the CPOU Baseline Risk Assessment was considered to be representative of recreational use. The exposure assumptions used were consistent with those recommended for a recreational scenario in EPA Risk Assessment Guidance for Superfund (RAGS). Risk calculations based on the soil cleanup goals showed cumulative risk to the recreational visitor was within the acceptable risk range. Recognizing that the actual post cleanup condition might be different that what was anticipated by the cleanup goals, the ROD specified that a post-remediation risk assessment would be performed following cleanup and that a final decision on the need for any future land use restrictions would be based on the actual residual condition.

The soil excavations were conservatively designed to remove contamination to depth to achieve the established cleanup goals or better. The post-remediation risk assessment used post cleanup confirmation data to evaluate the cumulative risk posed by exposure to soil from all contaminants. The assessment is believed to overestimate risks because it did not take into consideration the backfilling and reworking of the soils following excavation. The assessment confirmed that the potential risks to recreational visitors are within the acceptable risk range.

The post-remediation risk assessment also evaluated the risk to a suburban resident. A standard conservative suburban residential scenario as defined in the CPOU Baseline Risk Assessment was used. Following recommendations in EPA guidance (RAGS, Exposure Factors Handbook), the exposure assumptions (e.g., contact rate, exposure frequency and duration variables) used as input to this estimate were based on statistical data representing the 95th or if not available, the 90th percentile value for these variables. This approach provides risk estimates for RME to a resident receptor. The calculated risk to the suburban resident was generally greater than 1×10^{-4} but less than 1×10^{-3} and therefore slightly exceeds the acceptable risk range. However, the risk to the suburban resident from exposure to naturally occurring background concentrations of radionuclides in soils is 5.3×10^{-4} or essentially the same risk posed by residual concentrations in the remediated areas. In other words, there is no significant incremental increase in risk from exposure to the remediated areas for a suburban resident. For purposes of this site and this ESD, the standard conservative suburban residential scenario is considered representative of UUUE, the EPA policy threshold for determining whether ICs are appropriate.

These calculated risks are cumulative of all contaminants; however, the risks are primarily due to the radionuclides associated with the uranium ores. The CPOU ROD considered the standards for residual Rs-226 found in 40 CFR 192, Subpart B to be relevant and appropriate (RAR) to the cleanup of these radionuclides. The ROD was issued in 1993 prior to the issuance of EPA Directive 9200.4-25, Use of Soil Cleanup Criteria 40 CFR 192 as Remediation Goals for

CERCLA Sites. A review of the expectations set forth by EPA in this guidance confirms 1) these standards would be considered RAR were the decision to be made today, i.e., the contamination and its distribution was consistent with the outlined expectations; and 2) the actual residual concentrations for radium and thorium combined are much less than the concentrations identified in the guidance as meeting the health-based standard.

For the above reasons, DOE concludes there is no need to restrict land use in the Chemical Plant Area on the basis of exposure to soils. This assessment applies to land use only.

Section 1.5 *Current Regulatory Requirements* of the LTS&M discusses the ARARs which apply to the post-remediation aspect of the project, which consist of RCRA post-closure disposal cell monitoring requirements, including the RCRA groundwater protection standard (40 CFR 264, Subpart F) and additional post-closure requirements included in 40 CFR 264 Subpart N including action leakage rate, leachate and removal requirements, and requirements to maintain the integrity of the final cover. None of these standards have been revised.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Answer C: No other information has come to light that could call into question the protectiveness of the remedy.

7.2 Groundwater Operable Unit

Question A: **Is the remedy functioning as intended by the decision documents?**

Answer A: Yes, the remedy is functioning as intended by the decision documents

7.2.1 Remedial Action Performance

DOE is preparing a report that documents the status of the MNA remedy for ground water at the Chemical Plant as of 2006. Monitoring in support of MNA formally began in July 2004 and has continued through 2006 with the intent of updating the database that was used to select this remedy for the CPOU. A primary purpose of the report is to establish current baseline measures of contaminant levels that can be compared to future contaminant concentrations to evaluate the progress of MNA over the next several decades. Data from new wells installed at the site in spring 2004 and preexisting monitor wells are being used to determine whether the initial concentrations of ground water contaminants identified during a 2003 evaluation of MNA processes at the site (DOE 2005f) have since changed.

The new MNA report looks at a variety of factors that have bearing on the progress of natural attenuation in Chemical Plant groundwater and the methods that can be used to gauge such progress. Included with the report are temporal plots of contaminant concentration at all of the wells in the MNA monitoring program that can be visually examined for obvious trends, if any, that are indicative of either attenuation, increases, or relative stability of contaminant mass comprising individual plumes underlying specific areas of the Plant.

Current baseline measures of contaminant levels and plume distributions are being developed using three different computational approaches. First, statistical trending analyses are applied to the temporal concentration plots for individual wells so that defensible arguments can be made for establishing new baseline concentration values. Under this approach, the determination of a new baseline concentration depends on the type of trend, if any, that is observed. Second, the arithmetic means of measured concentrations in individual wells are computed to represent lumped-measures of baseline concentration in explicit contaminant plumes. This step involves some assessment of concentration behavior during the past few years at each of the wells used to assess plume extent. Third, in recognition of the fact that some monitor wells are situated in areas of very high concentration and others tend to be located near plume fringes, an area-weighting scheme is being used to develop spatially averaged measures of baseline concentration. This last approach can be reliably applied only to plumes that are defined by concentration measurements in several wells.

In addition to offering suggestions for using the new baseline values to assess MNA progress in future years, the new MNA report includes trigger levels for each of the contaminants of concern as grouped by MNA monitoring objective (Objectives 1 through 5). Because these trigger levels are largely based on data collected since July 2004, they differ slightly from comparable levels presented in the LTS&M Plan for the site (DOE 2005a).

Few up- or down-trends have been observed at individual monitor wells during the past three years for the suite of contaminants that are tracked at the Weldon Spring Chemical Plant. This result and inspection of temporal plots of COC concentration at individual wells suggests that constituent levels during this time period either (1) show a tendency to remain relatively constant between sampling events or (2) fluctuate considerably between successive events or from year to year. Those wells and contaminants falling into the first category appear to be reflective of locales where the freshwater recharge necessary for driving MNA is minimal, and more years of monitoring will be needed to document gradual flushing of contaminants. In contrast, the sites experiencing temporal fluctuations in constituent levels are probably more strongly affected by recharge events, with wet spells likely causing enhanced leaching of contaminants for finite periods and subsequent dry conditions leading to lower concentrations at specific monitor wells. Additional monitoring in these latter wells is expected to identify when episodic recharge no longer causes concentration increases.

7.2.2 System Operation and Maintenance

DOE has finalized the LTS&M Plan, which includes system operation and O&M information for LTS&M. DOE also performs annual inspections on LTS&M activities, environmental monitoring, and ICs and have found these activities to be functioning as intended, thus far.

7.2.3 Opportunities for Optimization

A review of remediation technologies relevant to the existing contamination at the GWOU was performed as part of the 5-year review process. This review was conducted to determine whether new technologies better than that (i.e., more effective) currently implemented have been introduced since the publication of the Feasibility Study (FS) Report (DOE 1998c) and the issuance of the ROD for the GWOU (DOE 2004a). The technology review consisted of a current literature search and evaluation of the latest information from the Federal Remediation

Technologies Roundtable, the Environmental Security Technology Certification Program, Hazardous Waste Clean-Up Information, and the Groundwater Remediation Technologies Analysis Center. These programs are summarized in Table 7−1. At this time, no new viable remediation technologies have become available for addressing TCE, nitrate, nitroaromatic compounds, and uranium present in groundwater at the Chemical Plant area. Thus, the selected remedy of MNA with ICs as implemented is still the optimum remedy for the GWOU.

Table 7–1. Remediation Technology Programs Reviewed

Program	Agency Sponsor(s)	Web Site	Comments
Federal Remediation Technologies Roundtable (FRTR)	U.S. Department of Defense U.S. Environmental Protection Agency U.S. Department of Energy U.S. Department of the Interior National Aeronautics and Space Administration	www.frtr.gov	Covers in situ and ex situ technologies for all contaminant types in soil and groundwater.
Environmental Security Technology Certification Program (ESTCP)	U.S. Department of Defense	www.estcp.org	Focuses on in-situ and ex-situ remediation technologies for organic compounds and explosives including TCE and nitroaromatic compounds in soil and groundwater.
Hazardous Waste Clean-Up Information (CLU-IN) Web Site	U.S. Environmental Protection Agency	www.clu-in.org	A public service of EPA's Technology Innovation Program under the Office of Superfund Remediation and Technology Innovation. Contains information on in situ and ex situ treatment technologies for inorganic and organic contaminants in soil and groundwater.
Groundwater Remediation Technologies Analysis Center (GWRTAC)	U.S. Environmental Protection Agency U.S. Department of Energy U.S. Department of Defense	www.gwrtac.org	Contains information on in situ and ex situ treatment technologies for inorganic and organic contaminants in groundwater.

7.2.4 Early Indicators of Potential Issues:

There are no early indicators of potential issues.

7.2.5 Implementation of Institutional Controls and Other Measures:

The following are the use restriction listed in the LTS&M Plan for the GWOU. The ICs that are in place and planned for the Weldon Spring Site are discussed under the CPOU section above. The ICs that specifically apply to the GWOU are the Missouri Well Installation Special Area designation rulemaking, the easements with MDC, MoDOT and MDNR-Parks, and the new MOU with the Army.

Chemical Plant Area Groundwater and Springs

The use restrictions listed below must be met in the entire area of approximately 1,140 acres shown on Figure 6−5, where groundwater use needs to be restricted until concentrations of the COCs meet drinking water or risk-based standards that allow for UUUE. The period of time necessary for contaminants to attenuate to these levels has been estimated at approximately 100 years. The size of the restricted area includes a 1,000-ft buffer area that accounts for the groundwater gradient and flow conditions at the site. The restricted area includes properties under federal jurisdictional control (DOE and the Army) as well as properties owned by state entities.

The objectives of the controls or restrictions are as follows:

1. Prevent the use of the contaminated shallow groundwater and spring water for drinking water purposes. The contaminated shallow groundwater occurs in the weathered and unweathered portions of the upper limestone unit (Burlington-Keokuk). The contaminated groundwater and spring water system occurs within the limits of the hydraulic buffer zone identified on Figure 6−5. The springs are identified on the error as SP-6301, SP-6303, SP-5303, and SP-5304. This restriction will need to be maintained over a period of decades or longer.
2. Limit the use of all groundwater within the outlined restricted area to investigative monitoring only. The boundary of the restricted area extends beyond the area of contamination and is intended to provide a buffer against potential hydraulic influences on the area of contamination by preventing such things as pumping wells being located in the proximity of the contaminated area. This restriction includes the shallow groundwater system and also extends vertically to all groundwater systems that underlie the contaminated groundwater. This restriction will need to be maintained over a period of decades or longer.
3. Retain access to the area for continued monitoring and maintenance of groundwater wells and springs.
4. Maintain the integrity of any current or future remedies or monitoring systems.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid.

A review of assumptions incorporated into the risk assessments documented in the Remedial Investigation/Feasibility Study (RI/FS)-ROD for the GWOU was also performed. The review included the following risk assessment aspects: risk assessment methodology, exposure scenarios, exposure assessment input parameters, and toxicity values.

No changes to the risk assessment methodology recommended by EPA for CERCLA sites have occurred since the publication of the GWOU documentation. Exposure scenarios and exposure assessment input parameters are also still valid as land uses assumed in the risk assessment documents are still representative of current and expected future land uses. In addition, ICs have been identified and are currently being implemented to ensure that current land uses are maintained (see Sections 7.1.5 and 7.2.5 for additional discussion on ICs being implemented).

The EPA toxicity values used to characterize risks for the constituents of concern for the GWOU (TCE, uranium, nitrate, 2,4-DNT, 2,6-DNT, 2,4,6-TNT, 1,3-DNB, and NB) were also reviewed. All values except for TCE and uranium have remained unchanged since the Baseline Risk Assessment was issued. The toxicity value (slope factor for carcinogenicity) for TCE has since been withdrawn from EPA's Integrated Risk Information System (IRIS) database until further EPA evaluations are completed. Based on this withdrawal, no new definitive risk calculations for TCE would be possible based on the EPA protocol that CERCLA risk assessments follow the RAGS methodology and derived toxicity values from the IRIS database. The uranium slope factors for radionuclide toxicity were revised by EPA and are about a two-fold increase from that used in the Baseline Risk Assessment. The decision presented in the ROD accounted for both TCE and uranium as constituents of concern with MCLs for both used as the remedial action objectives. Therefore, the change in toxicity values does not affect the remedial action or the remedial design that is being implemented. Table 7−2 is a compilation of the toxicity values used in the preparation of the RI/FS-ROD and their current status.

Table 7–2. Review of Toxicity Values Used In Risk Assessments for the GWOU and QROU

Constituents of Concern[a]	Toxicity Values In BRA	IRIS Database Accessed March 2006	Status of Toxicity Value
Uranium(chemical) Uranium (radiological)b U-234 U-235+D U-238+D	0.003 mg/kg-d 4.4E-11/pCi 4.5E-11/pCi 6.2E-11/pCi	0.003 mg/kg-d 7.1E-11/pCi 7.2E-11/pCi 8.7E-11/pCi	Unchanged Revised (increased) Revised (increased) Revised (increased)
Nitrate	1.6 mg/kg-d	1.6 mg/kg-d	Unchanged
Trichloroethylene	0.011 $[(mg/kg\text{-}d)^{-1}]$	Not available	Withdrawn
2,4-DNT	0.002 mg/kg-d 0.68 $[(mg/kg\text{-}d)^{-1}]$	0.002 mg/kg-d 0.68 $[(mg/kg\text{-}d)^{-1}]$	Unchanged Unchanged
2,6-DNT	0.001 mg/kg-d 0.68 $[(mg/kg\text{-}d)^{-1}]$	0.001 mg/kg-d 0.68 $[(mg/kg\text{-}d)^{-1}]$	Unchanged Unchanged
2,4,6-trinitrotoluene	0.0005 mg/kg-d 0.03 $[(mg/kg\text{-}d)^{-1}]$	0.0005 mg/kg-d 0.03 $[(mg/kg\text{-}d)^{-1}]$	Unchanged Unchanged
1,3-DNB	0.0001 mg/kg-d	0.0001 mg/kg-d	Unchanged
Nitrobenzene	0.0005 mg/kg-d	0.0005 mg/kg-d	Unchanged

[a]1,3,5-trinitrobenzene (1,3,5-TNB) was included in the RI/FS evaluations but was deleted from the list of constituents of concern presented in the GWOU ROD because the site concentrations were no longer of concern when evaluated against the revised reference dose for this compound. The EPA revised the reference dose for 1,3,5-TNB from 0.00005 to 0.03 (i.e., determined to be a thousand-fold less toxic).

The following slope factors for the ingestion pathway for uranium were used in the Baseline Risk Assessment to evaluate its radiological effects: uranium-234, 4.4E-11/pCi; uranium-235 +D, 4.5E-11/pCi; and uranium-238+D, 6.2E-11/pCi. The "+D" designation indicates that the risks from associated short-lived decay products (i.e., with radioactive half-lives less than or equal to 6 months) are also included. These values were taken from EPA's Health Effects Summary Tables (HEAST) of 1995. Since then an update on radionuclide toxicity values was posted by EPA in April of 2001. This update of the HEAST for radionuclides incorporates all new values, based on Federal Guidance Report No. 13, which was developed by EPA's Office of Radiation and Indoor Air. Federal Guidance Report No. 13 incorporates state-of-the-art models and methods that take into account age- and gender-dependence of radionuclide intake, metabolism, dosimetry, radiogenic cancer risk, and competing risks. Major differences between the risk coefficients of Federal Guidance Report No. 13, as incorporated into the current radionuclide slope factors, and the preceding generation of radionuclide slope factors (published in the November 1995 HEAST) include the following:

- Consideration of revised dosimetric models, including a revised lung model and age-dependent biokinetic models and GI-absorption factors for internal dose estimates and revised external dose coefficients for external dose estimates.
- Consideration of age- and gender-dependent inhalation and ingestion rates.
- Incorporation of updated vital statistics and baseline cancer mortality data.
- Specification of separate values for ingestion of water, food products, and soil, based on the different *age-dependent intake rate functions for these materials, instead of the single ingestion value for each radionuclide presented previously.*

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Answer C: No other information has come to light that could call into question the protectiveness of the remedy.

7.3 Quarry Residuals Operable Unit

Question A: Is the remedy functioning as intended by the decision documents?

Answer A: Yes, the remedy is functioning as intended by the decision documents.

7.3.1 Remedial Action Performance

In accordance with the QROU ROD (DOE1998a), long-term monitoring was the selected remedial action and consisted of the following components to be implemented

- Long-term monitoring and 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 implementing a well field contingency plan.
- Confirming the model assumptions regarding extraction of contaminated groundwater and establishing controls to protect naturally occurring attenuation processes.
- Restoring the Quarry.
- Establishing ICs.

Each of the above components is discussed below:

Long-term monitoring of the groundwater north of the Femme Osage slough is discussed in Section 4.4.2.1 and is monitored by the first two lines of monitoring wells. Groundwater monitoring is prudent to ensure uranium-contaminated groundwater has a negligible potential to impact the well field. Under the current conditions, the groundwater north of the slough poses no imminent risk to human health from water obtained from the former St. Charles County well field. A target level of 300 pCi/L for uranium was established in the RD/RA Work Plan (DOE 2000b) to represent significant reduction in the contaminant levels north of the slough. The target level for 2,4-DNT in groundwater north of the slough has been set at 0.11 µg/L, the MQWS. Upon attainment of these target levels, it will be determined that the goal for the monitoring program has been met and the long-term monitoring activities for this operable unit be concluded. Following attainment of the long-term monitoring target levels in groundwater north of the slough, an assessment of the residual risks based on actual groundwater concentrations will be performed to determine the need for future ICs. The data discussed in Section 6 in the data review data trending sections demonstrate that the majority of the wells are trending down or remaining stationary. The wells are monitored regularly in accordance with the OROU RD/RA Workplan and LTS&M Plan.

Long-term monitoring to protect the quality of the public water supply in the Missouri River alluvium is discussed in Section 4.4.2.1. Currently, uranium levels in monitoring wells south of the slough and at the production wells in the former St. Charles County well field have been, and remain, within background ranges. Nitroaromatic compounds have not been detected in groundwater south of the slough. The vulnerability of the St. Charles County well field from contaminated groundwater originating from the Quarry has been the focus of several studies (DOE 1998b and LWC 1986). It was determined from these studies that recharge from the area of impact accounts for less than 1 percent of the total flow through the well field, therefore, if natural attenuation of uranium were to cease after attainment of the 300 pCi/L target concentration, the increase in uranium in the well field would be 3 pCi/L. A target level of 30 pCi/L for uranium and 0.11 µg/L for 2,4-DNT was established in the RD/RA Workplan (DOE 2000b) to identify any significant change in the alluvial aquifer. If groundwater south of the slough were ever to meet or exceed these contamination levels, actions outlined in the LTS&M Plan would be evaluated. The uranium target level was revised to 20 pCi/L during the previous Five-Year Review to reflect the new MCL at the recommendation of EPA. Data from south of the slough will continue to be evaluated and trended to establish that uranium and 2,4-DNT levels are not increasing.

A well field contingency plan was developed and is included as Appendix L to the LTS&M Plan (DOE 2005a).

The Quarry interceptor trench field study is discussed in Section 4.4.2.2 and below. The study confirmed the model assumptions regarding extraction of contaminated groundwater.

As part of the selected remedy for the QROU, an interceptor trench about 550-ft long was installed in alluvial material southeast of the Quarry. This trench was designed to confirm model predictions of the effectiveness of groundwater extraction systems to remove uranium from the shallow aquifer on the basis of field data. The trench was operated and monitored for two years (April 27, 2000, to April 26, 2002). At the end of the two-year period, approximately 14.0 kg of uranium were removed from groundwater that entered the trench. This mass of uranium represented about 1.5 percent of the uranium present in the capture zone of the trench. Uranium concentrations in nearby monitor wells showed no significant decrease.

Using parameters from the FS (DOE 1998d), groundwater in the alluvial aquifer in the vicinity of the interceptor trench is assumed to travel at 0.21 feet per day(ft/d). For a 2-year period, water from a distance of 153 ft would reach the trench. The transport of uranium toward the trench, however, would be retarded because of adsorption along the flow path. For an effective porosity of 0.27, a density of 1.2 g/mL, and a distribution coefficient (Kd) of 5 mL/g, the velocity of the uranium toward the trench would be reduced by a factor of 23.2 to about 0.01 ft/d, implying a travel distance of about 7 ft in 2 years. Uranium concentrations in monitor wells located beyond this distance would not be expected to show any significant decrease.

Assuming that the uranium content in the soil would decrease linearly with time, it would take about 133 years to remove all of the uranium in the capture zone of the trench. Because the reduction of uranium concentration is not linear in time (the greatest decreases would occur early in time, and then decrease), the cleanup period would be expected to be much longer than the 133 years predicted using a simple linear assumption. If the interceptor trench model discussed in the FS (DOE 1998d) were used instead of a simple linear model to predict cleanup times based on the actual trench performance, cleanup times would exceed the 240 to 350 years predicted by the model.

The hydrological and geochemical field studies were conducted to attain a better understanding of the natural geochemistry of the alluvial aquifer north of the slough and are discussed in Section 4.4.2.3. ICs have been established to prevent disturbance of the reduction zone in this area.

The restoration of the Quarry was completed and is discussed in Section 4.4.2.4. The establishment of ICs is discussed in Section 7.3.5.

7.3.2 System Operation and Maintenance

DOE has finalized the LTS&M Plan, which includes system operation and O&M information for LTS&M. DOE also performs annual inspections on LTS&M activities, environmental monitoring, and ICs and have found these activities to be functioning as intended, thus far.

7.3.3 Opportunities for Optimization

An evaluation of sampling frequency optimization and potential well abandonment was conducted for the QROU groundwater monitoring system. This type of remedy optimization evaluation is recommended by the CERCLA Five-Year Review Guidance (EPA 2001). The evaluation was based on well logs, contaminants of concern and other chemical data results from the past 10 to 15 years, the hydrochemistry study of the Quarry area (DOE 2002a) and the annual environmental reports for 2003 (DOE 2004g), 2004 (DOE 2005f), and 2005 (DOE 2006b).

Part one of the evaluation was limited to uranium and was conducted for each of the four lines of monitoring wells:

Line 1 (MW-1002, MW-1004, MW-1005, MW-1027, MW-1030): There is not obvious spatial redundancy for these wells, therefore it is recommended to continue to monitor all of these wells. However, obvious temporal redundancy of the chemical data collected at these wells suggest that the monitoring frequency be reduced from quarterly to semi-annually.

Line 2: The majority of the groundwater monitoring wells in this line are located in clusters:

- MW-1006, MW-1007
- MW-1008, MW-1009, MW-1032
- MW-1013, MW-1014, MW-1031
- MW-1015, MW-1016, MW-1046
- MW-1028, MW-1045

The information drawn from these well clusters do not appear to be spatially redundant: (i.e., each vertical interval sampled by a well within a cluster provides information that is distinct from the other and is valuable in evaluating the attenuation effects provided by the reduction zone and the slough. The vertical intervals either differ with respect to the formation monitored (i.e., alluvium versus Kimmswick/Decorah Limestone versus Plattin Limestone) or with respect to oxidizing versus reducing portions of the alluvium (e.g., at the MW-1006/MW-1007 and the MW-1008/MW-1009/MW-1032 clusters). Since uranium concentrations remain relatively high within some of these vertical intervals, it is prudent to keep monitoring them.

However, the data from these clusters are temporally redundant. As a consequence, with the exception of well MW-1028, which is already limited to sampling on a twice-yearly basis, it is recommended that the sampling frequency be reduced from quarterly to semi-annually.

The other wells in Line 2 (MW-1047, MW-1048, MW-1049, MW-1051, and MW-1052) also appear to reflect conditions that vary spatially (either vertically or horizontally) and therefore should continue to be monitored. However, temporal redundancy at these wells also support changing the sampling frequency from quarterly to semi-annually.

Line 3 (MW-1017, MW-1018, MW-1019, MW-1021, MW-1044, MW-1050): With the exception of MW-1050, these wells provide data that are not spatially redundant. Therefore, it is recommended to continue sampling these wells. Given the location of MW-1050 (to the south of well MW-1021) and its concentration results, concentrations in samples taken from this well appear to be spatially redundant as well as temporally redundant. It is recommended that this well be abandoned.

Regarding sampling frequency, these wells are currently sampled semi-annually and it is recommended that this frequency be maintained.

Line 4 (RMW-1, RMW-2, RMW-3, RMW-4): These wells continue to provide clear semi-annual evidence of uranium attenuation to a degree that is fully protective of drinking water. Given the sentinel nature of these wells (i.e., their location just upgradient of the municipal water supply wells), semiannual sampling should continue.

Part two of this evaluation is regarding nitroaromatic sampling at the quarry groundwater monitoring wells. No concentrations of nitroaromatics have been detected south of the slough in Lines 3 or 4. A limited number of wells have shown detections in Lines 1 and 2. The attainment objective for the long-term monitoring for the 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 for DNT. The QROU RD/RA Workplan also states that the data from each well will be trended to establish that the 2,4-DNT concentrations in the groundwater north of the slough are decreasing (DOE 2000b). As discussed in Sections 6.4.3.4.3, 6.4.4.4.3, and 6.4.5.4.3, the 90th percentile of the data for 2003, 2004 and 2005, have been .03 µg/l, .03 µg/l, and .068, respectively. The only wells that showed concentrations above the detection limit in 2005 were MW-1004, MW-1006, and MW-1027. MW-1027 is the only well, which shows an upward trend.

It is recommended, based upon the above information, that the wells at the quarry no longer be sampled for nitroaromatics with the exception of MW-1004, MW-1006, and MW-1027. Following the collection of the 2006 data, these three wells will be trended again and it is recommended that any well with a stable or downward trend not be sampled for nitroaromatics in 2007. Any well with an upward trend will continue to be sampled semiannually until the trend is stable or downward.

7.3.4 Early Indicators of Potential Issues

There are no early indicators of potential issues.

7.3.5 Implementation of Institutional Controls and Other Measures

The following are the use restriction listed in the LTS&M Plan (DOE 2005a) for the QROU. The ICs that are in place and planned for the Weldon Spring Site are discussed under the CPOU section above. The ICs that specifically apply to the QROU are the Missouri Well Installation Special Area designation rulemaking and the easements with MDC and MDNR-Parks.

The use restrictions listed below must be met at the specific areas shown in Figure 6−3. The use restrictions must be maintained until the remaining hazardous substances are at levels allowing for UUUE.

1. Prevent the development and use of the Quarry for residential housing, schools, childcare facilities and playgrounds. Prevent drilling, boring, digging, or other activities in the Quarry proper that disturb the vegetation, disrupt the grade, expose the Quarry walls, or cause erosion of the clean fill that was used to restore the Quarry. This restriction should be maintained for the long-term. The 9-acre Quarry is under DOE jurisdictional control.
2. Prevent the use of the contaminated shallow groundwater for drinking water purposes. The contaminated shallow groundwater underlies the Quarry and extends to the marginal alluvium north of the slough as indicated in Figure 6−6. This restriction will need to be maintained over a period of decades or longer.
3. Limit the use of all groundwater within the outlined restricted area shown on Figure 6−6 to investigative monitoring only. The boundary of the restricted area extends beyond the area of contamination and is intended to provide a buffer against potential hydraulic influences on the area of contamination by preventing such things as pumping wells being located in the proximity of the contaminated area. This restriction includes the shallow groundwater system and also extends vertically to all groundwater systems that underlie the contaminated groundwater. This restriction will need to be maintained over a period of decades or longer, until uranium concentrations in Quarry groundwater north of the slough are at 300 pCi/L or lower. With the exception of the 9-acre Quarry, this restricted area is owned by state entities. This area covers approximately 202 acres.

4. Prevent drilling, boring, digging, construction, earth moving or other activities in the location identified as the Quarry natural reduction zone area that could result in disturbing the soils at this location or exposing subsurface soils (i.e., soils deeper than [about] 5 ft below the surface). The soil in this area at a depth of 5 ft or greater contains geochemical properties that allow reduction processes to naturally occur, resulting in the precipitation of uranium from Quarry groundwater north of the Femme Osage Slough and thereby minimizing uranium migration to the well field. The restrictions must be maintained over a period of decades or longer, until uranium concentrations in Quarry groundwater north of the slough are 300 pCi/L or lower. This area is located on property owned by a state entity and is approximately 4.7 acres in size.
5. Retain access to the area for continued monitoring and maintenance of groundwater wells.
6. Maintain the integrity of any current or future remedies or monitoring systems.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

Answer B: Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid.

A review of assumptions incorporated into the risk assessments documented in the RI/FS-ROD for the QROU was also performed. The review included the following risk assessment aspects: risk assessment methodology, exposure scenarios, exposure assessment input parameters, and toxicity values.

No changes to the risk assessment methodology recommended by EPA for CERCLA sites have occurred since the publication of the QROU documentation. Exposure scenarios and exposure assessment input parameters are also still valid as land uses assumed for the risk assessments are still representative of current and expected future land use (i.e., recreational visitor scenario). In addition, as for the GWOU, ICs are also being implemented to ensure that current land uses remain unchanged. The toxicity values for the QROU constituents of concern (primarily uranium and 2,4-DNT) have also remained unchanged since the publication of the QROU RI/FS documentation (see Table 7−2 above for a listing of the toxicity values used and their current status).

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Answer C: No other information has come to light that could call into question the protectiveness of the remedy.

End of current text

8.0 Issues

Table 8–1. Primary Issues Identified During the Annual Inspections

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Erosion areas have been identified on the Chemical Plant Property	N	N
Small depressions and bulges have been identified on the Disposal Cell	N	N
Erosion issues were identified at the Hwy 94 and Hwy D culverts	N	N

End of current text

9.0 Recommendations and Follow-Up Actions

Table 9–1. Recommendations and Follow-Up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness	
					Current	Futures
Erosion areas have been identified on the Chemical Plant Property	Have repaired erosion areas identified in past inspections. Will continue to inspect for erosion and repair as needed.	DOE	EPA	N/A	N	N
Small depressions and bulges have been identified on the Disposal Cell	These types of areas are not unexpected for a disposal cell of this type and are not a cause for concern. DOE will continue to monitor the area.	DOE	EPA	N/A	N	N
Erosion issues were identified at the Hwy 94 and Hwy D culverts	Notified MoDOT of the issues. MoDOT repaired the areas in Fall 2005. DOE will continue to monitor the areas during the annual inspections.	MDoT	N/A	N/A	N	N

End of current text

10.0 Protectiveness Statements

10.1 Chemical Plant Operable Unit

The remedy that has been implemented at the CPOU is protective of human health and the environment. Contaminant sources are contained in an on-site disposal facility at the Chemical Plant. The environmental monitoring data and annual inspections continue to verify that the disposal cell is functioning as intended.

The remedy that has been implemented at the Southeast Drainage is protective of human health and the environment. The remedy consisted of removal of contaminated soils and sediment to levels that are protective under the current land use. The drainage has recovered from the removal activities and is stable. Institutional controls will be used to maintain appropriate land and resource use and ensure that the remedy remains protective over the long-term.

10.2 Groundwater Operable Unit

The remedy for the GWOU is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals, through MNA, which is expected to require approximately 100 years to achieve. In the interim exposure pathways that could result in unacceptable risks are being controlled and ICs are in the process of being put into place to prevent the groundwater from being used in the restricted area.

10.3 Quarry Bulk Waste Operable Unit

The remedy for the QBWOU is protective of human health and the environment. The action consisted of excavating the bulk wastes from the quarry and placing them in controlled temporary storage pending final placement in the on-site disposal cell at the Chemical Plant. Excavating the wastes from the quarry eliminated the potential for direct contact with the waste material and removed the source of ongoing contaminant migration to groundwater.

10.4 Quarry Residuals Operable Unit

The remedy for the QROU is protective of human health and the environmentunder current uses . The remedy consists of long term groundwater monitoring and ICs to maintain appropriate land and resource use and ensure that the remedy remains protective over the long-term.

End of current text

11.0 Next Review

This is the third statutory Five-Year Review for this site. The next Five-Year Review will be conducted in the year 2011.

End of current text

12.0 References

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40 CFR 141. U.S. Environmental Protection Agency, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, July 1, 2005.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*, July 1, 2005.

40 CFR 264. U.S. Environmental Protection Agency, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, July 1, 2005.

10 CSR 20-7.031. *Missouri Code of State Regulations*, Title 10, "Department of Natural Resources," Division 20, "Clean Water Commission," Chapter 7.031, "Water Quality Standards."

10 CSR 25-7.264. *Missouri Code of State Regulations*, Title 10, "Department of Natural Resources," Division 25, "Hazardous Waste Management Commission," Chapter 7.264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities."

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Appendix A

Community Involvement Questionnaire Responses

Weldon Spring Citizens Commission Responses to Five-Year Review QuestionsRegarding the Weldon Spring Site

1. What is your overall impression of the Weldon Spring Site cleanup project? (General sentiment.)

a) DOE with help from EPA, MDNR, and stakeholders turned a wasteland into a community resource. Contaminants are still here (disposal cell and residual contamination) but DOE has developed a good plan to monitor. With the vigilance of agencies, Weldon Spring Citizens Commission, and stakeholders, the LTM should provide an effective system.

b) Well-planned and -executed project. The legacy phase seems to remain an important aspect to DOE & EPA.

c) Weldon Spring had a major problem in 1980. Today, that site has been made as safe as practical at this time. I am glad to see the project in its maintenance state. The Interpretive Center will help keep the project in mind and be protective of the site as long as it remains in the public sight.

c) What happened to waste during “caretaker” Status? I wish it had been cleaned up right away not twenty something years later. Raffinate pit overflow was pumped right into the river before the Clean Water Act came about.

2. What effects have the completion of the site cleanup project had on the surrounding community?

a) The entire area is now a cultural, educational, and ecological resource that has enhanced the community.

b) The Interpretive Center and outreach to the community done by Yvonne and staff has had a positive impact. The community is seeming to take a positive interest in the project.

c) The newest community, Weldon Spring Heights, is pleased that the site is now safe. I think the greater community is not well aware of it.

c) The concern over radiation related illness: The MO Dep’t. Of Health and Senior Services Division of Community Health in its April 2005 “Analysis of Leukemia Incidence (1996-2000) and Mortality (1994-2002) Data in St. Charles County, and Weldon Spring and its Surrounding Areas” recommends that “the Cancer Inquiry Program should continue to monitor the cancer incidence and mortality rates in Weldon Spring and its surrounding areas.” This is because it was a Uranium Feed Materials Plant, not Purina Farms.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

a) Our concerns are fearful for the future because of what remains (disposal cell, residual contamination) and due to the historic public resentment and distrust of DOE practices prior to about 1985. DOE has a huge public relations problem that needs to be slowly and methodically dealt with.

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

a) Yes – the Commission meetings do a good job of keeping the issues on the forefront and discussing solutions with the staff. The Commission's newsletter is a good information source to the community.

b) We are well informed and try to keep the community informed. Many other people not associated with the site may choose to not know about the Weldon Spring cleanup site.

c) Yes, but the Baseline Risk Assessment should be updated for Fluoride (not just groundwater quality descriptor [in NPDES for 007 outfall] like WSOW says) when the National Academy of Sciences sends its recommendations to EPA in the coming months. It should include reference doses for Spinal Stenosis, especially for children.

5. Do you feel well informed about the site's ongoing activities?

Yes we do.

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

a) We feel that there should remain employees at the site to prepare and coordinate appropriate documents and activities as opposed to performing this duty long distance. This provides a level of assurance and comfort to the community and the Commission.

b) Keep the Interpretive Center and the prairie prominent to the community.

c) Keep chipping away at your "bad press". Be honest at all times and don't ever try to hedge or dodge an issue. Keep the success of the Interpretive Center, prairie and gardens in the forefront.

7. Any other comments?

a) Always keep the public informed, not only with press releases, but by also using the Weldon Spring Citizens Commission meetings and newsletters

b) I am new to the Commission and have been very pleased with the Commission's level of involvement and the staff's willingness to respond to the Commission's needs.

c) 1. Make sure PWSD#2 continues monitoring sentinel wells for sign of migration.

2. Make sure people understand what protection of human health and the environment means (difference between health-based and risk-based).

3. There are still hot spots, make sure people don't go there.

Weldon Spring Site Five-Year Review Survey

The U.S. Department of Energy encourages public involvement by providing input to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five-Year review. Please answer the following questions regarding the effectiveness and protectiveness of the CERCLA remedies at the Weldon Spring Site. Please complete and return this survey by April 30, 2006 to:

Weldon Spring Survey
U.S. Department of Energy Office of Legacy Management
2597 B-3/4 Road
Grand Junction, CO 81503

1. What is your overall impression of the Weldon Spring Site cleanup project? (General sentiment.)

The project is progressing well.

2. What effects have the completion of the site cleanup project had on the surrounding community?

It seems like some of the rumors about people "glowing" have died down. More comfort seen at the public meetings I have attended.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

No.

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

Well informed. I get all the inspection reports and have read the LTSMP.

5. Do you feel well informed about the site's ongoing activities?

Yes.

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

Good job. Hope to keep working and communicating with the DOE on ICs in the future.

7. Any other comments?

No

Barry McFarland
89th RRC

End of current text

Appendix B

Inspection Photos


Photo 1. Depression area in the prairie east of the disposal cell.


Photo 2. Burgermeister Spring


Photo 3. Groundwater restriction boundary WS-46. Monument has been broken off.

Photo 4. Groundwater restriction boundary monument WS-52. Has been dug around sides.

Photo 5. Groundwater restriction boundary monument WS-52. Dirt was replaced around monument.


Photo 6. The Quarry viewed from the Hamburg Trail. Note the successful revegetation and numerous tree samplings

Photo 7. A “No Excavation” warning sign at the leachate sump area.


Photo 8. Spring SP-5304 in the Southeast Drainage.


Photo 9. Outlet end of Highway D Culverts.

Photo 10. Gravel repair to Highway D Culverts.

Photo 11. Inlet side of Highway D Culverts. Concrete had been placed on outside and in the middle of culverts.

Photo 12. Highway 94 culvert inlet in the Southeast Drainage.


Photo 13a. Rock Test Plot #1, 2003


Photo 13b. Rock Test Plot #1, 2004


Photo 13c. Rock Test Plot #1, 2005

Photo 14a. Rock Test Plot #2, 2003

Photo 14b. Rock Test Plot #2, 2004

Photo 14c. Rock Test Plot #2, 2005


Photo 15a. Rock Test Plot #3, 2003


Photo 15b. Rock Test Plot #3, 2004


Photo 15c. Rock Test Plot #3, 2005


Photo 16a. Rock Test Plot #4, 2003


Photo 16b. Rock Test Plot #4, 2004


Photo 16c. Rock Test Plot #4, 2005


Photo 17a. Rock Test Plot #5, 2003


Photo 17b. Rock Test Plot #5, 2004


Photo 17c. Rock Test Plot #5, 2005

Photo 18. View from top looking SW towards admin bldg. Slight bulge.

Photo 19. Slight depression area shown on aerial survey on southwest side looking northwest.

Photo 20. Outside Train 3 LCRS Building.


Photo 21. Ion Exchange system for leachate treatment.


Photo 22. Erosion control repairs.


Photo 23. Walls of Quarry Proper.

Photo 24. Rocks disturbed on top of cell.

Photo 25. The platform and markers on top of the disposal cell.

Photo 26. Historical Marker #3.

Photo 27. Monitoring well MW-1002 on the Quarry rim.

End of current text

Appendix C

Aerial Surveys

As-Built Compared to 2003

Change in Feet

- -3.0' to -1.5'
- -1.5' to -1.0'
- -1.0' to -0.5'
- -0.5' to 0.5'
- 0.5' to 1.0'
- 1.0' to 1.5'
- 1.5' to 3.0'

Possible Disturbance Area

As-Built Contours
- 10' Interval
- 2' Interval

2003 Contours
- 10' Interval
- 2' Interval

N

1:3,000

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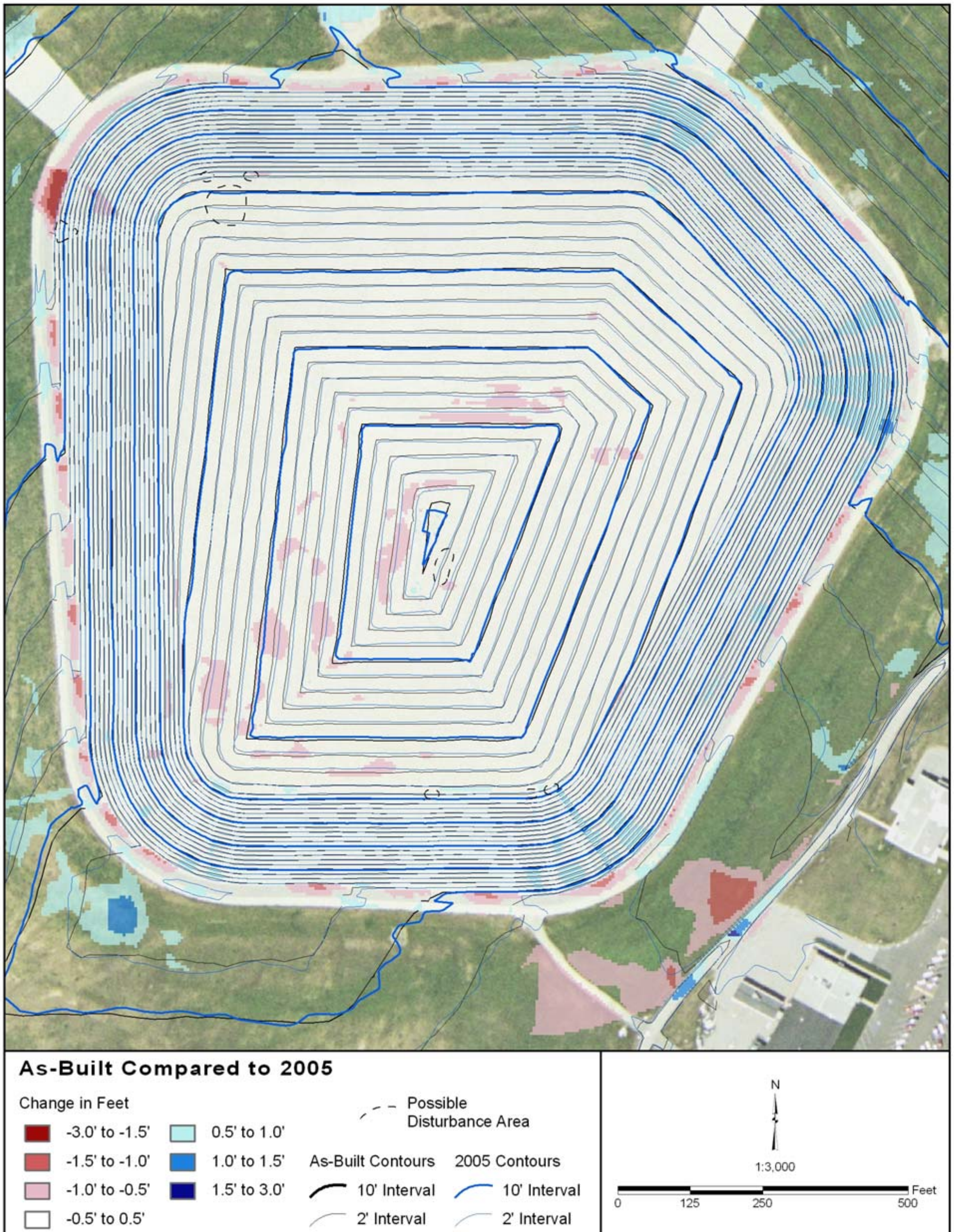

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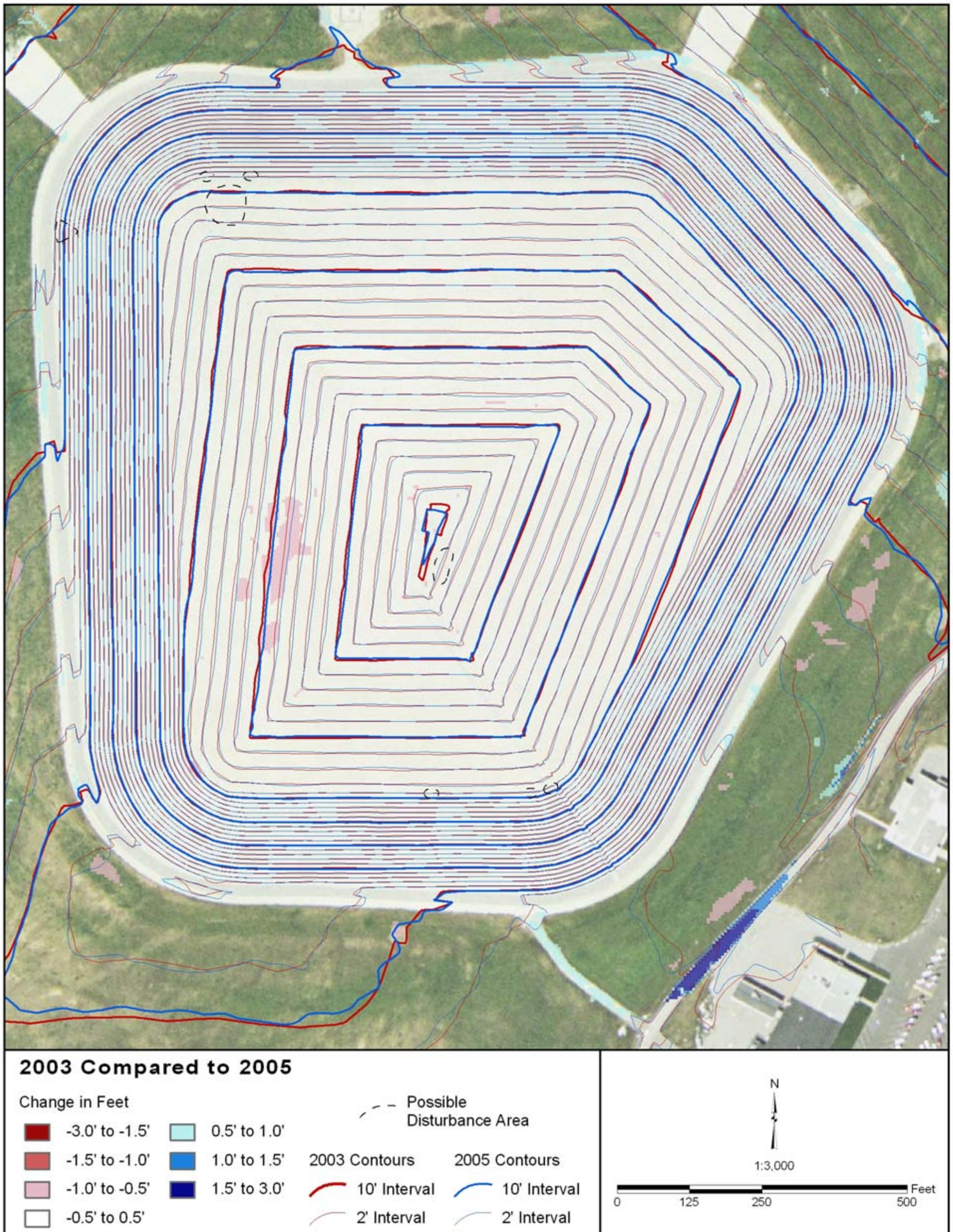

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Appendix D

Interview Forms

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.:**	
Subject: Annual Inspection	**Time: 11:30 am**	**Date: 11/2/05**
Type: __ Telephone _x_ Visit ___ Other **Location of Visit: Interpretive Center**	____ Incoming _ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: S.M. Stoller, Corp.**
Individual Contacted:		
Name: Yvonne Deyo	**Title: Project Manager**	**Organization: S.M. Stoller, Corp.**

Telephone No: 636-300-0012 **Fax No:** **E-Mail Address:**	**Street Address: 7295 Hwy. 94 South** **City, State, Zip: St. Charles, MO 63304**

Summary Of Conversation

I interviewed Yvonne Deyo, the S.M. Stoller Project Manager at the Weldon Spring Site. The interviewing of the Project 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?** Trespassing is not an issue due to the site being completely publicly accessible. Public use of the site continues to rise and minor littering occurs at various locations including at the top of the disposal cell. Minor moving of the rocks on top of the disposal cell also occurs. Defacing of the bronze plaques at the top of the cell has occurred, although this damage is easily repairable.
5. **What is the current on-site presence? Describe staff and activities.** There are 7 full-time contractor employees and 11 part-time contractor and subcontractor employees. Activities include long-term surveillance and maintenance operations, project management, data evaluation, operation of interpretive center, preparation of site-related regulatory documents, support in development of institutional controls, and general administrative support. Also providing support on other DOE projects, such as Mound and Fernald.
6. **Any suggestions or comments regarding annual inspection?** None

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 10:00**	**Date: 10/25/05**
Type: x Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming x Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Helene Diller	**Title: Administrative Asst.**	**Organization: WSCC**

Telephone No: 636-300-0037 **Fax No:** **E-Mail Address:**	**Street Address: 7295 Hwy. 94 South** **City, State, Zip: St. Charles, MO 63304**

Summary Of Conversation

I contacted Helene Diller, the administrative assistant for the Weldon Spring Citizens Commission, to officially notify her of the annual inspection to take place on November 7 and 8, 2005. Helene and the commission had been notified informally of the dates approximately 30 days ago, and by copy of the 30-day notice letter that was sent to the EPA and MDNR. Helene informed me that the WSCC consultant, Nancy Dickens, and a few members of the commission would be participating in the inspection. I also told Helene that I would be sending the WSCC interview questions to be answered for the 5-year review.

INTERVIEW RECORD

Site Name: Weldon Spring Site		**EPA ID No.: MO6210022830**	
Subject: Annual Inspection		**Time: 1:15**	**Date: 10/24/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**		____ Incoming _x_ Outgoing	

Contact Made By:

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

Individual Contacted:

Name: Joel Porath	**Title: Wildlife Regional Supv.**	**Organization: August A. Busch Memorial Conservation Area, Missouri Department of Conservation**

Telephone No: 636-441-4554 **Fax No:** **E-Mail Address:**	**Street Address: 2360 Hwy D** **City, State, Zip: St. Charles, MO 63304**

Summary Of Conversation

I contacted Joel Porath and notified him of the Weldon Spring Site's LTS&M annual inspection on November 7 and 8, 2005. I also told him that this would serve as our 5-year review inspection and DOE would be issuing a 5-year review report next year. I discussed the pending institutional controls that DOE is working on with the MDC, such as the planned easement and the Special Use Area designation. I also told him that we had been keeping John Vogel informed of the inspection and that he would be participating in portions of the inspection.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 3:00**	**Date: 10/21/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Mike Duvall	**Title: Director, Env. Services**	**Organization: St. Charles County**
Telephone No: 636-949-7583 **Fax No:** **E-Mail Address:**	**Street Address: 201 North Second Street, Suite 537** **City, State, Zip: St. Charles, MO 63301**	

Summary Of Conversation

I contacted Mike Duvall, Director of Environmental Services for St. Charles County to notify him of the annual inspection that was going to take place on November 7 and 8, 2005. He had previously been notified of this date by copy of the letter that went to EPA and MNDR. Mr. Duvall stated that he planned to participate in the inspection. I asked him if he had any concerns or issues about the site and he stated that in his opinion it was one of the most well conducted and communicated projects in the bi-state area. We discussed the sale of the water treatment plan and well field to Public Water Supply District #2. He said the two parties were working on a strategy for transitioning the QA/QC monitoring of the well field, etc. He said that he and the County still want to stay heavily involved as a stakeholder at the site.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 11:15**	**Date: 10/20/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Pam Sloan	**Title: Principal**	**Organization: Francis Howell High School**

Telephone No: 636-851-4700 ext. 4840 **Fax No:** **E-Mail Address:**	**Street Address: 7001 Hwy 94 South** **City, State, Zip: St. Charles, MO 63304**

Summary Of Conversation

I contacted Pam Sloan, Principal of Francis Howell High School, and explained that DOE would be conducting an annual Long-Term Surveillance and Maintenance inspection each year and as part of the inspection we would be contacting certain stakeholders, such as the Francis Howell High School to maintain contact with them and to determine if they had any concerns or issues about the site. I informed Ms. Sloan that our inspection this year would be on November 7 and 8, 2005 and this would also serve as our 5-year review inspection and DOE would be issuing a 5-year review report in September. I asked if she had any issues and concerns about the site and she stated that she did not. I discussed our educational programs with Ms. Sloan and told her we had many field trips and tours from schools at the site. I told her I would email her a copy of our educational program flyers. I gave her my phone number and told her to call me with any concerns or questions she might have.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 2:00 pm**	**Date: 11/03/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:

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

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 asked Mr. Anthony if there were any planning and zoning activities currently in the one-quarter mile surrounding the chemical plant and quarry properties. Mr. Anthony verified that there were not any such activities in this area at this time. I also asked Mr. Anthony if he would like to be added to our distribution list. He said that he would. I told him that I would send him a copy of our final Long-Term Surveillance and Maintenance Plan, which was issued in July. I told him that it included information on our institutional controls and planned restricted areas.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 1:00 pm**	**Date: 11/03/05**
Type: __ Telephone _x_ Visit ___ Other **Location of Visit:** Weldon Spring Site	____ Incoming _ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Randy Thompson	**Title: Data Manager**	**Organization: SM Stoller, Corp.**
Telephone No: 636-926-7040 **Fax No: 636-447-0803** **E-Mail Address: randy.thompson@gjo.doe.gov**	**Street Address: Weldon Spring Site** **City, State, Zip:**	

Summary Of Conversation

I interviewed Randy Thompson, Data Manager at the Weldon Spring Site. The interviewing of the data manager is a requirement included in the Annual Inspection Checklist.

1. **What is the current status of data validation/reporting?** Data validation and review has been completed for data through August 2005. The completion of data validation reports has been issued through March 2005 data. The April through June 2005 report is in final review and will be issued soon.
2. **How is the data reported?** After qualification flags are applied, the data is put on the website the next day. We are now preparing quarterly data validation reports and the yearly data is summarized in the annual environmental 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?** The data reviewed and validated are completed through July 2005 and are available online. August 2005 data will be available on the website within the next week or so. Yes, we are meeting our 90-day commitment.
4. **Are there any trends that show contaminants increasing or decreasing?** Some wells are trending up and some are trending down. The quarterly data validation reports discuss trends and a more thorough trend analysis is performed and documented in the annual environmental report.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 10:00**	**Date: 10/20/05**
Type: x Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming x Outgoing	

Contact Made By:

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

Individual Contacted:

Name: Roy Stevenson	**Title: Facility Manager**	**Organization: Army**

Telephone No: 636-329-1200 **Fax No:** **E-Mail Address:**	**Street Address: 7301 Hwy. 94 South** **City, State, Zip: St. Charles, MO 63304**

Summary Of Conversation

I contacted Roy Stevenson of the 89th Regional Readiness Command at the Weldon Spring Army site and notified him that DOE would be conducting the annual LTS&M inspection at the Weldon Spring Site on November 7 and 8. I also told him this would serve as our 5-year review inspection. I told him we would be driving around on the Army site and inspecting our wells and survey monuments and pins. He said we should check in at the gate and he would be there that day. I asked if there was anything going on at the Army during that time and he said there would be a group at the range and we would not be able to go in that area. I discussed the pending institutional controls that DOE is working on with the Corps, such as the revised Memorandum of Understanding (MOU) and the Special Use Area designation. We discussed the fact that the area had been turned over from Ft. Leonard Wood to the 89th Regional Readiness Command. I also asked him if the Army planned to do any road construction or changes or any other construction in the area. He said there would be road repairs, but no road construction and that the only construction would be on the range.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.:MO6210022830**	
Subject: Annual Inspection	**Time: 10:00**	**Date: 10/21/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Emily	**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 Emily. 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: 2:30**	**Date: 10/17/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:

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

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 November 7-8, 2005. I told him it was also our 5-year review inspection and cleanup sites are required to do 5-year reviews and we would be issuing a 5-year review report in September. I had talked to Captain Hudson last year 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 and did not know of any calls or issues regarding the site. I informed him that we have had visitors to the top of the cell at night and have found beer cans, etc. He said he would inform his officers and they would do extra patrols and would require anybody there to leave. He asked if we had signs stating that it was closed at night and I replied that we didn't at this time, but we do plan to get some posted soon. He thought that would be a good idea. I asked him if he felt he was being kept adequately informed about the site and he stated that he was. (He is on our distribution list). He told me that we could contact him if we had any problems and he would respond. I informed him that some of our emergency numbers had changed and I would be faxing him a new list. I faxed him the list that afternoon.

INTERVIEW RECORD

Site Name: Weldon Spring Site		**EPA ID No.: MO6210022830**	
Subject: Annual Inspection		**Time: 3:30 pm**	**Date: 10/19/05**
Type: _X_ Telephone ___ Visit ___ Other **Location of Visit: Weldon Spring Site**		__ Incoming _x_ Outgoing	
Contact Made By:			
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**	
Individual Contacted:			
Name: John Vogel	**Title: Area Manager**	**Organization: August A. Busch Memorial Conservation Area, Missouri Dept. of Conservation**	
Telephone No: 636-441-4554 **Fax No:** **E-Mail Address:**		**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 November 7 and 8, 2005. He had previously been notified of this date by copy of the letter that went to EPA and MNDR. He said bow hunting would be over by then and deer rifle hunting would not begin until November 14. He said he would like to participate in the inspection of the Southeast Drainage area again this year and I told him I would get him a copy of the agenda soon. I discussed the status of our pending institutional controls with MDC. I asked John if he knew of any land or groundwater use in the planned groundwater restriction area that had taken place that would affect the future institutional controls in that area and he stated that there had not been any of this activity. We discussed physical access to the springs and culverts for the inspection and he said it should not be a problem. I asked him if he had any concerns at this time and he said he would just like the twin culverts at Hwy. D to be repaired. I informed him of MDOT's progress on this to date.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 9:15**	**Date: 11/2/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:

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

Individual Contacted:

Name: Anna Sylvan	**Title: Documents Manager**	**Organization: Middendorf-Kredell Library**

Telephone No: 636-978-7926 **Fax No:** **E-Mail Address:**	**Street Address: 2750 Hwy. K** **City, State, Zip: O'Fallon MO 63366**

Summary Of Conversation

I contacted Anna Sylvan, Documents Manager for the Middendorf-Kredell Library in O'Fallon, Missouri. Ms. Sylvan manages the records and documents that the project issues for public review at the library. I informed Ms. Sylvan that DOE would be conducting the Long-Term Surveillance and Maintenance annual inspection at the Weldon Spring Site on November 7-8, 2005. I further explained to her that DOE would be conducting this inspection every year and were using the opportunity this year to call her and determine if she has any concerns or issues with the records management. Ms. Sylvan stated that it has been a very harmonious relationship with DOE and the records and she has not had any problems. I set up an appointment to meet with her later that morning. I met with her at approximately 10:30 and viewed the records area. The records were all arranged orderly on shelves. Ms. Sylvan also had contact information for the site posted.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 2:00**	**Date: 10/24/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Barry McFarland	**Title: Regional Environmental Program Coordinator**	**Organization: Army**

Telephone No: 316-681-1759 ext. 1419 **Fax No:** **E-Mail Address:**	**Street Address: 3130 George Washington Blvd.** **City, State, Zip: Wichita, KS 67219-1598**

Summary Of Conversation

I contacted Barry McFarland of the 89th Regional Readiness Command for the Army and notified him that DOE would be conducting the Weldon Spring Site annual LTS&M inspection on November 7 and 8, 2005. I also told him this would serve as the 5-year review inspection. I explained to him that this was more of a courtesy notification and we would be conducting this inspection every year and would use this call in the future to keep in contact with the 89th and to find out if they have any concerns or issues and to check on the status of institutional controls. I told him that I had contacted Roy Stevenson at the Weldon Spring Army Site and we would contact him when we arrived at the Army site. I discussed the pending institutional controls that DOE is working on with the Corps, such as the revised Memorandum of Understanding (MOU) and the Special Use Area designation.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 10:30**	**Date: 10/25/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Cynthia Green	**Title: Realty Specialist**	**Organization: Missouri Department of Conservation**

Telephone No: 314-751-4115 **Fax No:** **E-Mail Address:**	**Street Address: PO Box 180** **City, State, Zip: Jefferson City, MO 65102**

Summary Of Conversation

I contacted Cynthia Green and notified her of the Weldon Spring Site's LTS&M annual inspection on November 7 and 8, 2005. I reminded her that we would be contacting all of the DOE institutional control contacts each year to discuss the ICs and inquire if there are any concerns or issues. I also told her that this would serve as the 5-year review inspection and DOE would be issuing a 5-year review report next year. I discussed the pending institutional controls that DOE is working on with the MDC, such as the planned easement and the Special Use Area designation. I also told her that I had contacted John Vogel and Joel Porath about the inspection and that John would be participating in portions of the inspection

INTERVIEW RECORD

Site Name: Weldon Spring Site		**EPA ID No.: MO6210022830**
Subject: Annual Inspection	**Time: 9:15**	**Date: 10/27/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**		____ Incoming _x_ Outgoing
Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Jennifer Frazier	**Title: Real Estate Manager**	**Organization: MDNR-Parks**
Telephone No: 573-751-7987 **Fax No:** **E-Mail Address:**	**Street Address: PO Box 176** **City, State, Zip: Jefferson City, MO 65102**	

Summary Of Conversation

I contacted Jennifer Frazier, MDNR-Parks and notified her of the LTS&M annual inspection at the Weldon Spring site on November 7 and 8, 2005. . I reminded her that we would be contacting all of the DOE institutional control contacts each year to discuss the ICs and inquire if there are any concerns or issues. Jennifer stated that as far as negotiation of ICs is concerned that Parks still has the concerns that they had previously addressed in correspondence with DOE, including worker safety, etc. We discussed a possible meeting of the two parties or the possibility of a representative attending the inspection. I told Ms. Frazier that I would send her a copy of an agenda for the inspection.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 2:45**	**Date: 10/24/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

	Contact Made By:	
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
	Individual Contacted:	
Name: Mark Bailey	**Title: Assistant Fire Chief**	**Organization: Cottleville Fire Dept**

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

Summary Of Conversation

I contacted Mark Bailey of the Cottleville Fire Department and informed him that DOE would be conducting the Long-Term Surveillance and Maintenance annual inspection at the Weldon Spring Site on November 7-8, 2005. Since this was the first time I have spoken to Mark, as the site's former contact had left the Cottleville Dept., I explained to him that this was more of a courtesy notification. I told him that DOE would be conducting this inspection every year and would use this call in the future to keep in contact with the Cottleville Fire Department and to find out if they have any concerns or issues. He asked about the status of the site and I discussed our current status including the status of the cleanup, number of employees, number of buildings, educational activities and field trips and informed him that Lindenwood University has taken over the building. He said he would be interested in a tour and I told him to call anytime. I also told him we had an updated emergency contact list and I would fax it to him. I faxed it to him that afternoon.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**
Subject: Annual Inspection	**Time: 9:15** / **Date: 10/28/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing

Contact Made By:

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

Individual Contacted:

Name: Rick Pavia	**Title: Project Manager**	**Organization: Francis Howell School District**
Telephone No: 636-926-8611 **Fax No:** **E-Mail Address:**	**Street Address: 7055 Hwy 94 South** **City, State, Zip: St. Charles, MO 63304**	

Summary Of Conversation

Rick Pavia contacted me in response to a message I had left for Pat Houlahan of the Francis Howell School District. Mr. Pavia stated that he would now be the contact for the district. I explained that DOE would be conducting an annual Long-Term Surveillance and Maintenance inspection at the Weldon Spring Site each year and as part of the inspection we would be contacting certain stakeholders, such as the school district to maintain contact with them and to determine if they had any concerns or issues about the site. I informed Mr. Pavia that this year's inspection would be November 7 and 8, 2005. I discussed our educational programs with Mr. Pavia and told him we had many field trips and tours from schools at the site. I told him I would email him a copy of our educational program flyers. I gave him my phone number and told him to call me with any concerns or questions he might have.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 3:40**	**Date: 10/21/05**
Type: x Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming x Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Tim Geraghty	**Title: Manager of Engineering and Operations**	**Organization: Public Water Supply District #2**

Telephone No: 636-561-3737 **Fax No:** **E-Mail Address:**	**Street Address: PO Box 370** **City, State, Zip: O'Fallon, MO 63366**

Summary Of Conversation

I contacted Tim Geraghty of Public Water Supply District #2, and explained that DOE would be conducting an annual Long-Term Surveillance and Maintenance inspection each year at the Weldon Spring Site and as part of the inspection we would be contacting certain stakeholders to maintain contact with them and to determine if they had any concerns or issues about the site. I informed Mr. Geraghty that the inspection this year would be on November 7 and 8, 2005 and this would also serve as the site's 5-year review inspection and DOE would be issuing a 5-year review report in September. I asked Mr. Geraghty if he had any issues or concerns about the site and he stated that he did not and they would not hesitate to call us if they did. We briefly discussed the recent sale of the water treatment plant and well field from St. Charles County to PWS#2 and I told Mr. Geraghty to call us with any questions or issues and gave him my phone number.

INTERVIEW RECORD

Site Name: Weldon Spring Site	**EPA ID No.: MO6210022830**	
Subject: Annual Inspection	**Time: 1:00**	**Date: 10/25/05**
Type: _x_ Telephone ___ Visit ___ Other **Location of Visit:**	____ Incoming _x_ Outgoing	

Contact Made By:		
Name: Terri Uhlmeyer	**Title: Compliance Manager**	**Organization: SM Stoller, Corp.**
Individual Contacted:		
Name: Tom Ryan	**Title: Assistant District Engineer**	**Organization: Missouri Department of Transportation**
Telephone No: 314-340-4203 **Fax No:** **E-Mail Address:**	**Street Address: 1590 Woodlake Dr.** **City, State, Zip: Chesterfield, Mo 63017**	

Summary Of Conversation

I contacted Tom Ryan of the Missouri Department of Transportation, and explained that DOE would be conducting an annual Long-Term Surveillance and Maintenance inspection each year and as part of the inspection we would be contacting certain stakeholders to maintain contact with them and to determine if they had any concerns or issues about the site. I informed Mr. Ryan that our inspection this year would be on November 7 and 8 and this would also serve as our 5-year review inspection and DOE would be issuing a 5-year review report in September. I also reminded him that an annual inspection report would be issued approximately in January and a public meeting would be held in the Spring. We discussed the status of the repair to the Hwy D culverts.

End of current text