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Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site

March 2004

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U.S. Department of Energy

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Acronyms and Abbreviations

AEC	U.S. Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
ARAR	applicable or relevant and appropriate requirement
ANL	Argonne National Laboratory
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 *United States Code* [U.S.C.] 9601, *et seq.*)
CFR	*Code of Federal Regulations*
CSR	*Code of State Regulations*
CSS	chemical stabilization/solidification
D_{50}	median diameter
DA	U.S. Department of the Army
DCE	dichloroethylene
DNB	dinitrobenzene
DNT	dinitrotoluene
DOE	U.S. Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
HDPE	high-density polyethylene
ICO	in-situ chemical oxidation
IRA	Interim Response Action
LCRS	leachate collection and removal system
LM	Office of Legacy Management
LTS&M Plan	Long-Term Surveillance and Maintenance Plan
MCE	Maximum Credible Earthquake
MCL	maximum contaminant level
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MNA	Monitored Natural Attenuation
MoDOT	Missouri Department of Transportation

MSD	Metropolitan St. Louis Sewer District
mg/L	milligram(s) per liter
µg/L	microgram(s) per liter
NEPA	National Environmental Policy Act (42 U.S.C. 4321, *et seq*.)
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
ORAU	Oak Ridge Associated Universities
ORO	Oak Ridge Operations Office, Oak Ridge, Tennessee
OU	operable unit
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene (or perchloroethylene)
pCi/L	picocurie(s) per liter
PMP	probable maximum precipitation
RCRA	Resource Conservation and Recovery Act (42 U.S.C. 6901, *et seq.*)
RD/RA	Remedial Design/Remedial Action
RI	Remedial Investigation
ROD	Record of Decision
TCE	trichloroethylene
TNB	trinitrobenzene
TNT	trinitrotoluene
TSA	temporary storage area
VOC	volatile organic compound
WSCC	Weldon Spring Citizens Commission

See also definitions in Section 3.0, "Glossary"

1.0 Basis and Regulatory Requirements

1.1 Purpose and Scope

This Long-Term Surveillance and Maintenance (LTS&M) Plan explains how the U.S. Department of Energy (DOE) will fulfill its surveillance and maintenance obligation at the DOE Weldon Spring Site located near Weldon Spring, Missouri. Long-term surveillance and maintenance refers to all activities necessary to ensure protection of human health and the environment following completion of cleanup, disposal, or stabilization at a site or portion of a site. As defined by the DOE guidance document, *Long-Term Stewardship Planning Guidance for Closure Sites* (DOE 2002c), These activities include "all engineered and institutional controls designed to contain or to prevent exposure to residual contamination and waste, such as surveillance activities, record-keeping activities, inspections, groundwater monitoring, ongoing pump and treat activities, cap repair, maintenance of entombed buildings or facilities, maintenance of other barriers and contained structures, access control, and posting signs."

The site consists of the former Weldon Spring Chemical Plant (which includes an on-site disposal cell), the former Weldon Spring quarry, and portions of the surrounding area where radiological contamination was transported beyond site boundaries. This LTS&M Plan does not address property included in the Weldon Spring Ordnance Works Department of Army Superfund Site.

Objectives for performing long-term surveillance and maintenance at the site include the following:

- Ensure protectiveness of human health and the environment from residual hazards that remain on site.
- Maintain site records and information so that future custodians can continue to provide effective surveillance and maintenance.
- Assure regulators and stakeholders that DOE's institutional controls have been identified and are accompanied by redundancy and a commitment to provide surveillance and maintenance for the site for as long as required.
- Respond to regulatory and other surveillance and maintenance requirements in a fully compliant manner.
- Provide accountability for the site.
- Provide a plan for emergency response.
- Provide a plan for funding surveillance and maintenance for the site.
- Identify the analysis methods of site oversight to perform trend analysis and identify thresholds at which future actions must be taken.
- Provide a forum for stakeholder and regulator involvement for ensuring enduring protection of the site. (DOE 2002c)

Table 1−1 shows specific surveillance and maintenance objectives applied to the Weldon Spring Site.

Table 1–1. Summary of Surveillance and Maintenance Objectives and Strategies for the Weldon Spring, Missouri, Site

Surveillance and Maintenance Objective	Strategies to Achieve Objective
Control exposure to waste contained in the disposal system and maintain integrity of the system	• Conduct regular inspections • Evaluate observations made by other surveillance and maintenance program workers at the site • Maintain signs and federal ownership • Monitor institutional controls and point of compliance locations • Monitor systems for notification of site concerns by other monitoring agencies, regulators, stakeholders, and the general public
Control exposure to contaminated groundwater	• Inspect institutional controls • Monitor groundwater
Limit or prevent induced migration of contaminated groundwater	• Restrict land use through institutional controls
Provide early warning of potential contamination of St. Charles County water supply	• Conduct regular inspections • Monitor groundwater • Monitor institutional controls
Control exposure to contaminated springs	• Restrict land use through institutional controls • Monitor water quality
Control exposure to residual contaminants in the Southeast Drainage	• Maintain non-residential land use through institutional controls • Monitor water quality
Control exposure to residual contamination of soils and culverts beneath Missouri State Route 94 and Highway D	• Maintain awareness of residual contaminants by maintaining institutional controls • Inspect institutional controls areas
Avoid personal injuries	• Maintain all-terrain vehicle barrier • Inform public of risks • Maintain public access structures in good condition
Prevent loss of knowledge	• Operate and maintain the on-site Interpretive Center • Comply with requirements of mandatory surveillance and maintenance program • Interact with regulators and stakeholders regularly • Record site information in St. Charles County real property records • Comply with National Archives and Records Administration records management requirements • Maintain information signs for the public for this high-visibility disposal site • Maintain local records collection and post annual reports on the Internet

Section 1.0, “Basis and Regulatory Requirements,” describes the purpose and scope of this document, site activities leading up to long-term surveillance and maintenance, legal and regulatory basis, and institutional controls. Section 2.0, “Long-Term Surveillance and Maintenance,” provides information regarding the surveillance and maintenance implementation program for the Weldon Spring Site, including stakeholder roles, public participation, inspections, reports, 5-year reviews, routine site maintenance, environmental

monitoring, institutional control monitoring, emergencies, permits, and record keeping. Section 3.0, "Glossary" includes definitions of relevant terms. The Appendixes are listed below:

- Appendix A—Background Information, Remedial Action Histories, Final Site Conditions
- Appendix B—Risk Assessment Information
- Appendix C—Disposal Cell Contents
- Appendix D—Legal Description of DOE Property
- Appendix E—Institutional Control Documentation
- Appendix F—Official Contact List
- Appendix G—Distribution List
- Appendix H—Annual Inspection Checklist
- Appendix I—Leachate Collection and Removal System Operating Plan
- Appendix J—LCRS/Train 3 Treatment Contingency Plan
- Appendix K—Disposal Cell Groundwater Monitoring Plan
- Appendix L—Well Field Contingency Plan

This LTS&M Plan is in effect upon receipt of concurrence from the U.S. Environmental Protection Agency (EPA) in consultation with the Missouri Department of Natural Resources (MDNR). DOE, as an agent of the federal government, will implement surveillance and maintenance activities for the on-site disposal cell, the quarry, and off-site areas where contaminated groundwater or soil remains.

1.2 Location and Property Ownership

The Weldon Spring Site is located in St. Charles County, Missouri, about 30 miles (48 kilometers) west of St. Louis (Figure 1−1). The site comprises two geographically distinct DOE-owned properties: the Weldon Spring Chemical Plant and Raffinate Pit Sites (Chemical Plant) and the Weldon Spring Quarry (quarry). The Chemical Plant is located about 2 miles (2.3 kilometers) 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. Directions to the site from Lambert-St. Louis International Airport are provided in Table 1−2.

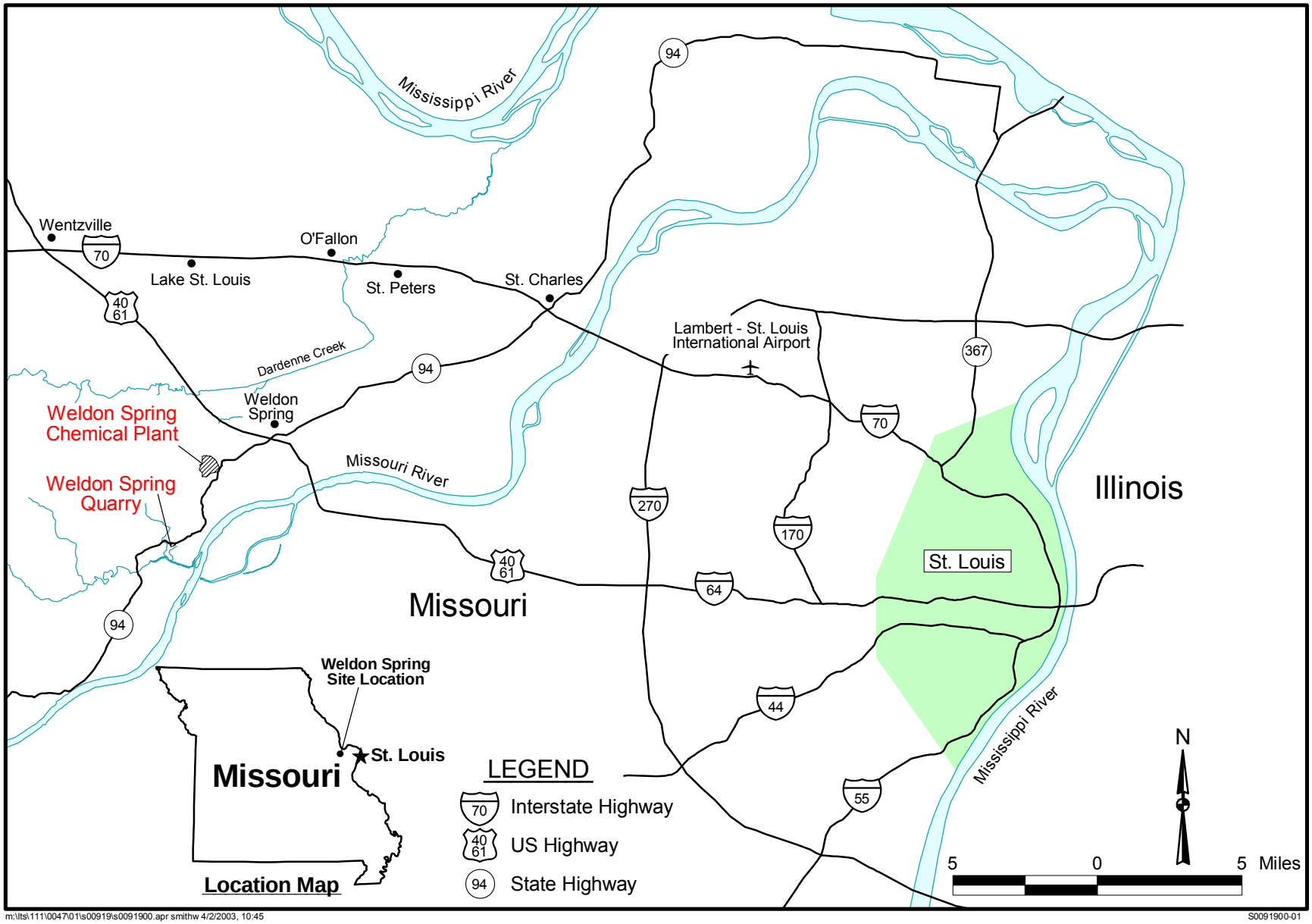

Figure 1–1. Location of the Weldon Spring, Missouri, Site

Table 1–2. Mileage and Directions from the Lambert-St. Louis International Airport to the Weldon Spring, Missouri, Site

Mileage	Route
0.0	At the Airport exit, take the I-70W on-ramp
11.3	On I-70W, take Exit 228 (Missouri State Route 94 and 1st Capital Drive)
11.9	Turn left on 1st Capital Drive and continue on South 1st Capital Drive (becomes Missouri State Route 94)
24.4	On Missouri State Route 94, turn right at the Interpretive Center entrance

During the early 1940s, the Department of the Army (DA) acquired 17,232 acres (6,974 hectares) 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 1−2. 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 Natural Resources-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 hectares). The Chemical Plant property is located on 219.50 acres (88.83 hectares); and the quarry occupies 8.66 acres (3.50 hectares). Legal descriptions of the two parcels are presented in Appendix D. DOE maintains real estate correspondence and instruments at the records repository in Grand Junction, Colorado.

Most of the land consists of two state conservation areas managed by MDC, who employs about 50 people at its facilities (DOE 2002b). The August A. Busch Memorial Conservation Area, located north of the Chemical Plant, includes about 6,987 acres (2,828 hectares) of actively managed grassland and forest. The Weldon Spring Conservation Area comprises about 7,356 acres (2,977 hectares) of primarily forested land located south and east of the Chemical Plant. The quarry in located within this conservation area. Both conservation areas are actively managed for fish and wildlife production and are used annually by more than 1,200,000 visitors for fishing, hunting, and hiking (DOE 2002b).

The Francis Howell High School occupies approximately 61 acres (25 hectares) and is located about 0.6 mile (1.0 kilometer) northeast of the Chemical Plant. The school employs approximately 150 faculty and staff, and about 1,600 students attend school. The MoDOT facility adjacent to the northeast side of the Chemical Plant employs about 10 workers (DOE 2002b).

The two communities closest to the Chemical Plant are Weldon Spring and Weldon Spring Heights, located about 2 miles (3.2 kilometers) to the northeast. The combined population of these two communities is about 5,000 (DOE 2002b). No private residences are located between the Chemical Plant and these two communities; however, two residences owned by MDC are

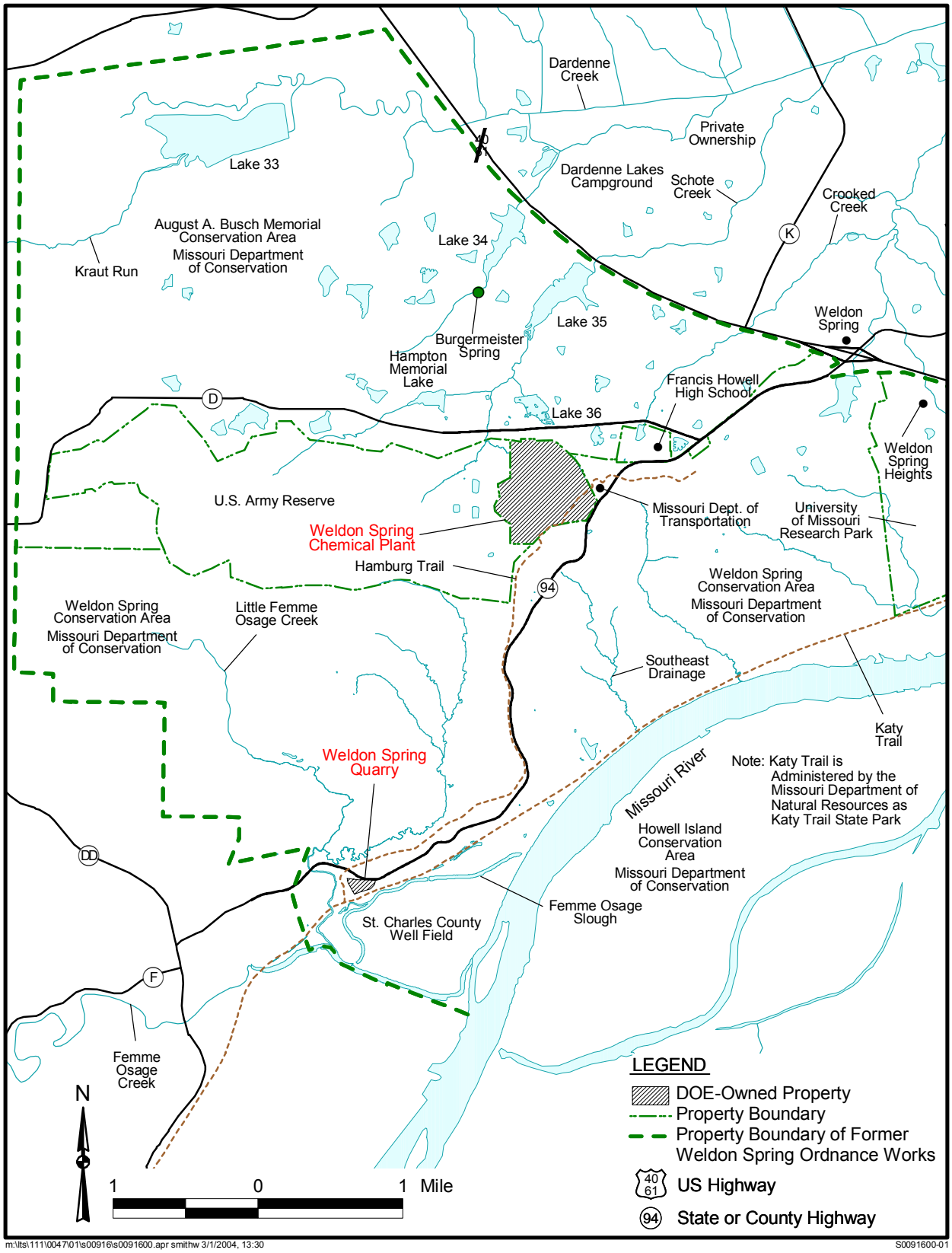

Figure 1–2. Vicinity Map of the Weldon Spring, Missouri, Site

located north of the Chemical Plant site. These two residences are connected to the potable water system for the county. The closest private residence to the quarry is located approximately 1 mile (0.6 kilometer) to the west. Residential and commercial growth is occurring in the communities surrounding the conservation areas, particularly in the city of O'Fallon, an area of growing residential population north of U.S. Highway 40/61.

1.3 Site History

1.3.1 Operations History

In 1941, the U.S. Government acquired 17,232 acres (6,974 hectares) 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 site. 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 hectares) 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 hectares) 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.

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 hectares) 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.

1.3.2 Remedial Action History

EPA placed the quarry and Chemical Plant areas on the National Priorities List (NPL) in 1987 and 1989, respectively. Initial remedial activities at the Chemical Plant site, 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.

Remediation of the Weldon Spring Site was administratively divided into four Operable Units (OUs): Quarry Bulk Waste OU, Quarry Residuals OU, Chemical Plant OU, and Groundwater OU. 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.

1.3.2.1 Chemical Plant OU

In the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE1993), DOE established the remedy for controlling contaminant sources at the Chemical Plant area (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.
- Disposal of wastes removed from the Chemical Plant area and 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 ROD

cleanup criteria. Detailed information regarding the vicinity properties is included in Section A2.1.5, "Vicinity Properties" of Appendix A.

A detailed description of this remediation is in Section A2.1, "Chemical Plant OU."

1.3.2.2 Quarry Bulk Waste OU

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

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.

A detailed description of this remediation is in Section A2.3, "Quarry Bulk Waste OU."

1.3.2.3 Quarry Residuals OU

The Quarry Residuals OU remedy was described in the *Record of Decision for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1998). The Quarry Residuals OU 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 to prevent exposure to contaminated groundwater north of the Femme Osage slough.
- Long-term monitoring and institutional controls 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 property and establishing institutional controls.

A detailed description of this remediation is in Appendix A, Section A2.4, "Quarry Residuals OU."

1.3.2.4 Groundwater OU

DOE implemented an interim ROD to investigate the practicability of remediating trichloroethylene (TCE) contamination in Chemical Plant groundwater, using in situ chemical oxidation (DOE 2000). The DOE issued a final ROD in January 2004 which selected a remedy of monitored natural attenuation (MNA) with institutional controls (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.

1.4 Final Site Conditions

The contents of the disposal cell are listed in Appendix C. Descriptions of remaining residual contamination are provided in Appendix A. 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 area and at the quarry.
- Several springs near the Chemical Plant area discharge residually 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 by components of this LTS&M Plan, which include institutional controls 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. Risk assessments are described in Appendix B.

1.5 Legal and Regulatory Requirements

The federal government holds title to and DOE is responsible for the radioactive and other hazardous materials generated by DOE and predecessor agencies at the Weldon Spring Site.

DOE acquired the radioactive materials under authority of the Atomic Energy Act of 1954 (Public Law 83–703). Most of the radioactive waste materials generated at the Chemical Plant consisted of radionuclides of the natural uranium and thorium-232 decay series derived from processing uranium and thorium ore concentrates. Contaminated materials disposed of or stored at the quarry included process wastes from the Chemical Plant and debris from a decommissioned uranium ore processing facility in St. Louis, Missouri. DOE disposed of the contaminated soils, stabilized sludge, contaminated debris from the Quarry and the demolished Chemical Plant buildings, and

contaminated materials from remediated vicinity properties in a disposal cell located on the Chemical Plant property. Regulated nonradiological hazardous materials that were encountered during remedial action were treated and disposed of in the cell or disposed of at EPA-approved disposal facilities. A comprehensive list of wastes disposed of in the cell is provided in Appendix C.

EPA listed the quarry on the NPL on July 30, 1987, and the listing was expanded to include the Chemical Plant and raffinate pits on March 30, 1989. Consequently, DOE conducted remediation of the Weldon Spring Site in accordance with regulations promulgated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and incorporated values from the National Environmental Policy Act (NEPA) (42 U.S.C. 4321). DOE identified four OUs for which DOE selected remedies and conducted remedial action. Some contamination remains in groundwater and soil at the Weldon Spring Site; these materials are managed by DOE. Post-remediation site conditions and risk status at the Weldon Spring Site are described in Appendixes A and B.

The radiological soil cleanup applicable or relevant and appropriate requirements (ARARs) and DOE orders for the remediation of the Weldon Spring Site include Title 40 *Code of Federal Regulations* Part 192 (40 CFR 192) and DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. These regulations and guidance specify release limits for radium, uranium, and thorium in soil; radon concentration; surface contamination limits in structures; direct gamma exposure rate; and total effective dose. These regulatory and guidance documents are provided on the LTSM Program website at http://www.gjo.doe.gov/programs/ltsm/general/proj_info/index.htm.

ARARs also were identified for site groundwater and surface water. Cell contents are not regulated under the Resource Conservation and Recovery Act (RCRA), but RCRA postclosure disposal cell monitoring and maintenance requirements are ARARs. Chemical contaminants are principally addressed under EPA or State of Missouri regulations. Site surveillance and maintenance ARARs are listed in Table 1–3. DOE orders are not enforceable by other agencies.

1.5.1 Groundwater Standards

Two references used to develop criteria for the environmental groundwater monitoring program are (1) the EPA *Quality Criteria for Water, 1986* (EPA 1986), which is intended to protect public groundwater sources; and (2) the Missouri Drinking Water Standards in Title 10 *Code of State Regulations,* Division 20, Chapter 7 (10 CSR 20–7). The affected groundwater north of the slough is not considered a usable groundwater source; therefore the drinking water standards in 40 CFR 141 are not applicable (DOE 1998). Other Federal and State water quality standards identified as ARARs are listed in Table 1−4.

CERCLA requires that 5-year reviews be performed at sites where residual contamination remains at levels above those that allow unlimited use and unrestricted exposure. Institutional controls have been developed to provide protection until levels decrease to levels that are considered protective.

Table 1–3. ARARs and DOE Orders for Postclosure Surveillance and Maintenance of the Weldon Spring, Missouri, Site

Regulation or DOE Order[a]	Summary	Applicable OU[a]
40 CFR 141	Specifies maximum contaminant levels in groundwater, establishes criteria for designating a water-bearing formation as an aquifer.	Chemical Plant OU Quarry Residuals OU Groundwater OU
40 CFR 192, Subpart D	Specifies performance requirements for radiological disposal facilities. Specifically, radon releases shall not exceed 20 picocuries per square meter per second and the cell must be designed to remain effective for 1,000 years, or at least 200 years.	Chemical Plant OU
40 CFR 264 Subpart F	RCRA groundwater monitoring requirements, which include monitoring backgroundwater quality and groundwater quality passing the point of compliance to allow detection of contaminant migration into the uppermost aquifer.	Chemical Plant OU
40 CFR 264.111	RCRA closure standard for monitoring nonradiological hazardous waste.	Chemical Plant OU
40 CFR 264.117	Specifies that postclosure care must begin upon disposal cell closure and continue for at least 30 years.	Chemical Plant OU
40 CFR 264 Subpart N	Specifies monitoring and maintenance throughout the postclosure period, including maintaining the cell cover, maintaining and monitoring the leachate collection system, maintaining a groundwater monitoring system, and protecting and maintaining surveyed benchmarks.	Chemical Plant OU
10 CSR 20–7.031	Missouri groundwater quality standards.	Quarry Residuals OU Groundwater OU
10 CSR 25–7.264(2)(F)	Missouri regulation for surface water monitoring requirements to detect groundwater contamination.	Chemical Plant OU
DOE Order 450.1	Environmental Protection Program	Chemical Plant OU, Quarry Residuals OU, Groundwater OU
DOE Order 5400.5	Establishes the maximum total effective dose equivalent for exposure of the public to radiation (≤100 mrem/yr above background).	Chemical Plant OU Groundwater OU Quarry Residuals OU

[a]See Appendix A for descriptions of the site OUs.
Key: DNT = dinitrotoluene; µg/L = micrograms per liter; mrem/yr = millirem per year.

Table 1–4. Federal and State Water Quality Standards for the Weldon Spring, Missouri, Site

Constituent	Standard	Citation	Applicable Occurrence
Nitrate (as N)	10 mg/L	40 CFR 141.62	Groundwater OU
Sulfate	250 mg/L	40 CFR 143.3	Groundwater OU
Total Uranium	20 pCi/L	40 CFR 141	Groundwater OU
1,3-DNB	1.0 µg/L	10 CSR 20-7[a]	Groundwater OU
2,4-DNT	0.11 µg/L	10 CSR 20-7[a]	Groundwater OU and Quarry Residuals OU
NB	17 µg/L	10 CSR 10-7[a]	Groundwater OU
TCE	5 µg/L	40 CFR 141.61	Groundwater OU
2,6-DNT	1.3 µg/L	Risk Based[b]	Groundwater OU
2,4,6-TNT	2.8 µg/L	Risk Based[c]	Groundwater OU

[a]Missouri Groundwater Quality Standard.
[b]Risk-based concentration equivalent to 10^{-5} for a resident scenario.
[c]Risk-based concentration equivalent to 10^{-6} for a resident scenario.
Key: DNT = dinitrotoluene; mg/L = milligram(s) per liter; pCi/L = picocurie per liter; µg/L = microgram(s) per liter

1.6 Institutional Controls

Institutional controls at the Weldon Spring Site are grouped into three main categories. The first category is nonengineering measures (primarily legal controls) that serve to limit activities in order to prevent or reduce exposure to hazardous substances. Institutional controls can also be defined as Real Estate agreements that are entered into between landowners for the purpose of maintaining monitoring programs or site integrity. The third type of institutional control involves ongoing education of the public such as through the Weldon Spring Site Interpretive Center.

Institutional controls are applied to prevent inadvertent exposure to contaminated media and residual contaminants as required under site Records of Decision. The Records of Decision are based upon a presumed land use and exposure scenario for risk determination. DOE must ensure that future land use is consistent with the exposure scenarios found to be protective for the selected remedies.

Institutional controls for the Weldon Spring Site are summarized in Table 1−5. Chemical Plant area locations requiring institutional controls are shown on Figure 1–3, and Quarry Area locations are shown on Figure 1–4.

Institutional controls may include restrictions placed on the deeds to the properties, including property currently in federal ownership.

For the Chemical Plant OU, DOE will apply institutional controls to maintain control and integrity of the disposal cell and associated structures and to ensure that the wastes do not cause environmental degradation or pose unacceptable risks to human health. DOE has filed a notation on ownership record to restrict land and shallow groundwater use at the Chemical Plant site and quarry. DOE will establish institutional controls to restrict residential land use and spring water consumption in the Southeast Drainage, nonrecreational consumption of Burgermeister Spring water, and exposure to the contaminated culverts under Highway D and Missouri State Route 94. DOE will ensure preservation of the land use identified in the Groundwater OU remedy so that

exposure pathways to contaminated groundwater remain incomplete, and groundwater use in the region does not cause unanticipated migration of contaminated groundwater.

Table 1–5. Summary of Institutional Controls for the Weldon Spring, Missouri, Site

IC No.	Description	Method of Implementation	Parties to Document	Duration
1	Restrict land and shallow groundwater use at the DOE Chemical Plant site and quarry property	Notation on land records for continuing control of land use through Federal ownership	DOE	Current notation in effect. Indefinite term.
2	Construct and manage an Interpretive Center and Historical Markers which will educate the public on the Weldon Spring Site history. Also establish a prairie and native plant garden.	Continuing control through Federal ownership	DOE	Commensurate with community support.
3	Restrict groundwater use in areas surrounding the former Chemical Plant	Real Estate Restrictive License, Easement, Permit, or notation.	MoDOT to DOE, MDC to DOE, DA to DOE	Until groundwater standards are met. Indefinite term license, easement, or permit. Pending.
4	Prohibit residential use of the Southeast Drainage area (200-foot-wide corridor)	Real Estate Restrictive Easement	MDC to DOE, MDNR to DOE	Indefinite term easement. Pending.
5	Restrict exposure to two residually contaminated culverts and soil under Missouri State Route 94 and Highway D	Real Estate Restrictive License or Easement	MoDOT to DOE, MDC to DOE	Until culverts are replaced. Indefinite term license or easement. Pending.
6	Restrict land use to prevent physical disturbance of the quarry area reduction zone	Real Estate Restrictive Easement	MDC to DOE	Indefinite term easement. Pending.
7	Restrict all groundwater use adjacent to DOE's quarry property in the area of contamination and surrounding buffer zone	Real Estate Restrictive Easement	MDC to DOE, MDNR to DOE	Until groundwater standards are met. Indefinite term easement. Pending.
8	Provides DOE access through DOE's north gate over MDC property	Real Estate License	MDC to DOE	Current license in effect; renewable in 10-year increments.
9	Grants DOE permission to abandon or install and operate groundwater wells and perform water sampling	Real Estate License or Permit	MDC to DOE, DA to DOE, MDNR to DOE	Current licenses in effect; renewable in 10- year increments. Until groundwater standards are met.
10	Grants DOE continuing operation and maintenance of the effluent discharge pipeline that runs from DOE property to the Missouri River or through the Katy Trail	Real Estate License	MDC to DOE, MDNR to DOE, DA to DOE	Current licenses in effect; renewable in 10-year increments.
11	DOE grants MDC responsibility for operational use, maintenance, and repair of the portion of the Hamburg Trail on DOE property	Real Estate Use-Permit	DOE to MDC	Currently in effect. Indefinite term use-permit.
12	DOE permits local entity the use of 30,000 ft^2 of the DOE administration building	Real Estate Use-Permit	DOE to local entity	Currently in effect with Lindenwood University. Indefinite term use-permit.

Key: DA = Department of the Army; IC = institutional control; MDC = Missouri Department of Conservation; MDNR = Missouri Department of Natural Resources; MoDOT = Missouri Department of Transportation

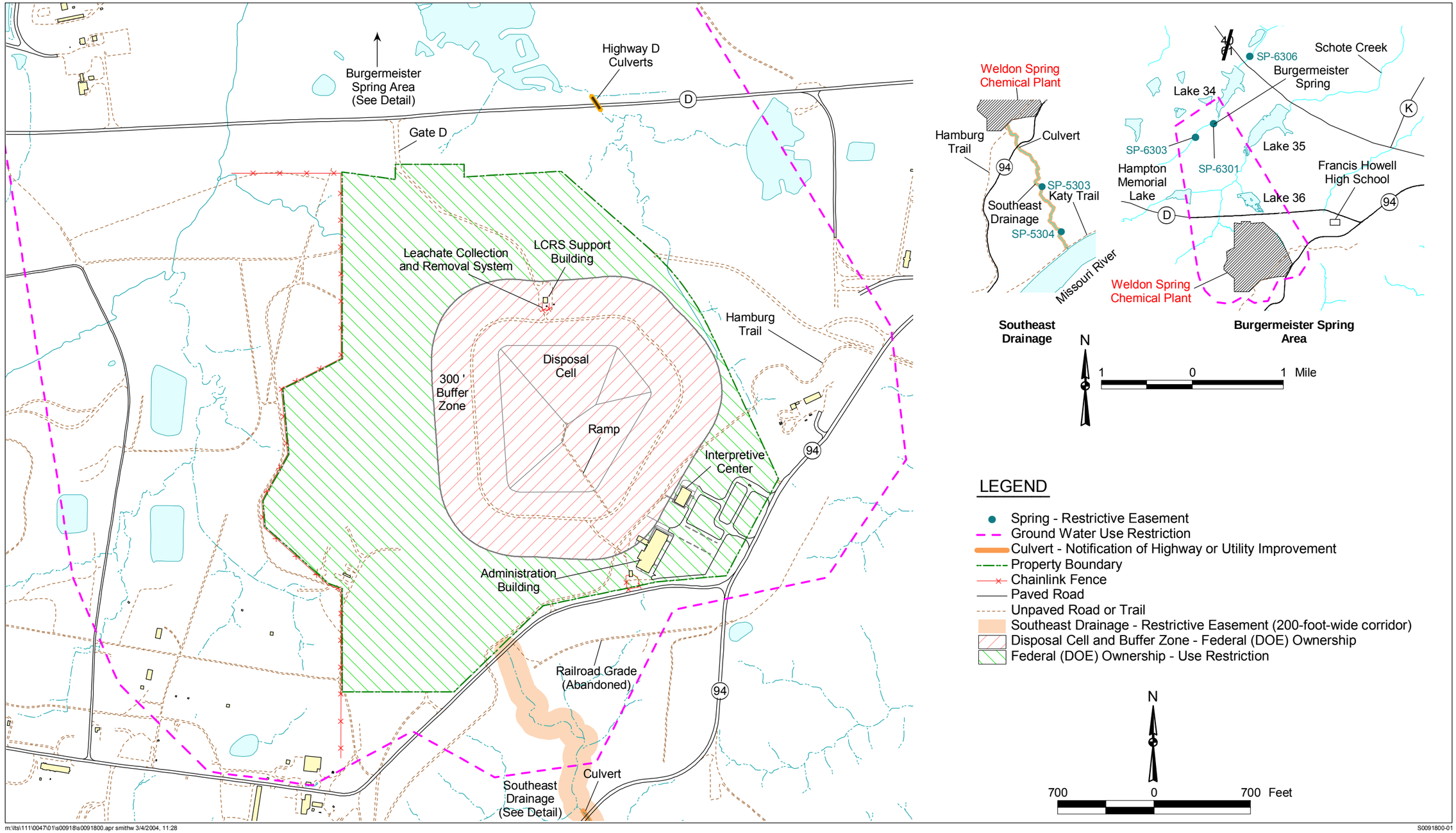

Figure 1–3. Institutional Controls Location Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site

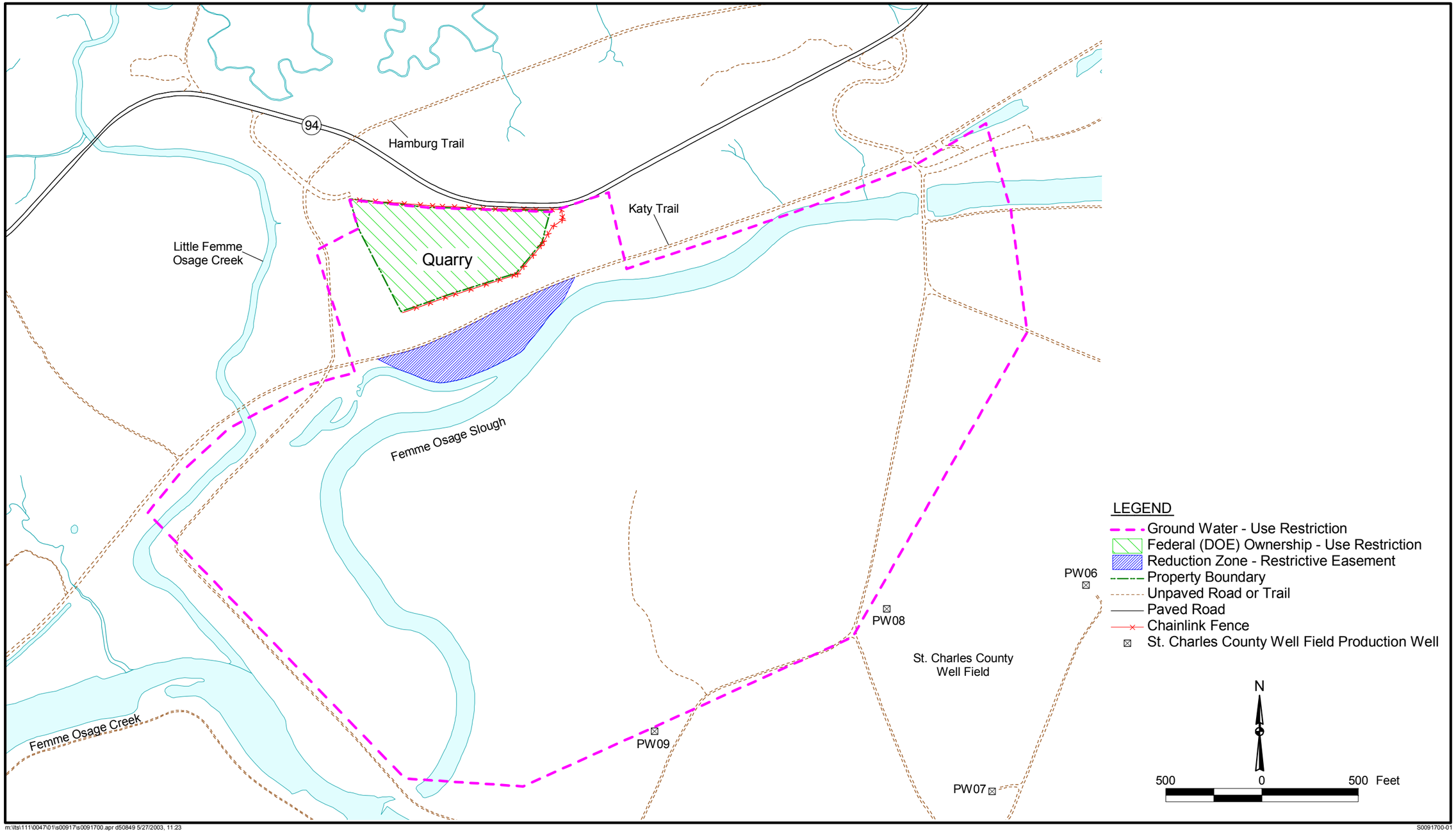

Figure 1–4. Institutional Controls Location Map for the Quarry Area of the Weldon Spring, Missouri, Site

No institutional controls are required by the Quarry Bulk Waste OU remedy because bulk waste removal was not intended to constitute the final remedy for this area. However, long-term groundwater monitoring and institutional controls are required by the Quarry Residuals OU remedy. DOE will establish institutional controls to prohibit use of contaminated groundwater for irrigation, consumption, or as a surface water source. Other uses inconsistent with a recreational user exposure scenario will also be restricted. DOE will also establish institutional controls to prevent disturbance of the uranium reduction zone between the Katy Trail and Femme Osage Slough, and to restrict groundwater use south of Femme Osage Slough that may result in intercepting contaminated groundwater north of the slough.

Restrictive easements and other realty documents will be recorded in the records of St. Charles County under the system mandated by its regulations. These protective controls will remain with the land through any subsequent transfer or conveyance of the property. The institutional controls will identify appropriate authorities to enforce restrictions. These controls are presented in Appendix E. Monitoring these controls to ensure effectiveness is described in Section 2.3.4, "Institutional Controls Inspection."

End of current text

2.0 Long-Term Surveillance and Maintenance

2.1 Surveillance and Maintenance Implementation

This LTS&M Plan implements long-term components of remedies selected for the Weldon Spring Site in the Records of Decision. This plan incorporates by reference requirements for long-term surveillance and maintenance specified in the *Long-Term Surveillance and Maintenance Program Plan* (DOE 1999a). The purpose of long-term surveillance and maintenance is to meet the objectives listed in Section 1.1, "Purpose and Scope."

Remaining potential human health risks have been identified for the Weldon Spring Site (Appendix B), and surveillance and maintenance objectives corresponding to those risks have been developed.

This surveillance and maintenance plan employs established DOE systems and procedures and establishes methods and procedures specific to the Weldon Spring Site to control risk and maintain protectiveness. DOE will maintain protectiveness at the Weldon Spring Site through a combination of federal ownership, maintaining a local presence, conducting regular inspections, conducting environmental sampling and other site operations, monitoring environmental media, institutional controls, and regulatory compliance; and working with stakeholders and regulators to perpetuate site awareness and knowledge of current conditions. These parties constitute the community of stewards at the Weldon Spring Site (Table 2–1).

2.1.1 Role of DOE

The Weldon Spring Site was remediated under CERCLA. Postclosure requirements for implementing the selected remedies are specified in this surveillance and maintenance plan. DOE will conduct surveillance and maintenance activities at the Weldon Spring Site in accordance with this surveillance and maintenance plan to protect human health and the environment and to comply with applicable regulations. DOE is responsible for the radiological and other hazardous substances that remain at the Weldon Spring Site.

Effective January 1989, DOE Headquarters designated the DOE office at Grand Junction, Colorado, as the program office for long-term surveillance and maintenance of all DOE remedial action sites, disposal sites, and other sites, as assigned, that (1) have no ongoing DOE mission and (2) are not part of a larger DOE facility. DOE thereby established a common office for the security, surveillance, monitoring, and maintenance of these sites. The DOE office in Grand Junction established the Long-Term Surveillance and Maintenance Program to carry out this responsibility.

Responsibility for surveillance and maintenance of the Weldon Spring Site was assigned to the Long-Term Surveillance and Maintenance Program, effective October 1, 2002 (DOE 2002a). DOE has since reorganized in this area and has established the Office of Legacy Management (LM), which is separate from the Office of Environmental Management (EM). This was done primarily to provide a separate focus for DOE's long-term commitments and responsibilities at sites without an on-gong long-term mission. Effective October 1, 2003, the Weldon Spring Site, as well as the other long-term care sites, began reporting to LM. Sites are initially provided direction through the Policy and Site Transition Office (LM-40). Once the transition period gives way to the steady state period, the site is directed by the Land and Site Management Office

(LM-50)). LM has personnel in four main locations: Washington D.C.; Grand Junction, Colorado; Morgantown, West Virginia; and Pittsburgh, Pennsylvania. Because of the long-lived nature of the contaminants remaining on site, the federal government will provide surveillance and maintenance services at the Weldon Spring Site in perpetuity. The objective of this plan is to define a program that will ensure continuing protection of the public and the environment and ongoing regulatory compliance.

DOE is responsible for the preparation, revision, and implementation of this LTS&M Plan, which includes procedures for site inspection, monitoring, and maintenance of the site, and for managing remaining contamination. Surveillance and maintenance activities also include complying with reporting requirements and maintaining records pertaining to this site.

Table 2–1. Weldon Spring Site Stewards and Their Functions

Organization	Function
DOE Office of Legacy Management	Formulate policy and provide resources and support. Site surveillance and maintenance program management; conduct inspections, monitoring, and maintenance; maintain public interpretive center and information repository; provide opportunities for public participation; resolve stakeholder issues, ensure compliance with DOE orders and ARARs, provide records management.
EPA Region VII	Lead regulatory agency. Provide regulatory oversight in coordination with MDNR to assess DOE compliance, oversee CERCLA requirements and activities, and implementation of this surveillance and maintenance plan. Review and comment on CERCLA documents, LTS&M Plan changes, annual and five-year review reports.
Missouri Department of Natural Resources	Provide regulatory consultation in coordination with EPA. Review and comment on CERCLA documents, LTS&M Plan changes, annual and five-year review reports. Issue and maintain well permits. Provide access agreement for Katy Trail.
Weldon Spring Citizens Commission	Public representative, surveillance and maintenance planning input, review of LTS&M Plan changes, document review.
St. Charles County (Division of Environmental Services, Register of Deeds, Regional Planning Commission, Water Department)	Local Government representative. Compliance with applicable county regulations; preservation of deeds, easements, parcel maps; zoning and use approvals; institutional controls oversight.
Missouri Department of Health and Senior Services	Public health issues.
Missouri Department of Conservation	Property owner. Access agreements for department-owned property, party to land and groundwater use restrictions.
U.S. Department of the Army	Property owner. Access agreements for Army-owned property, party to land and groundwater use restrictions.
Francis Howell School District	Review reports (due to location of Francis Howell High School).
Missouri Department of Transportation	Right-of-way grantee, responsible for maintenance along Highway D and Missouri State Route 94, possible party to groundwater use restriction due to location of Maintenance Facility.
Underground Utility Owners	Easement grantees. Easements cross through affected area of Highway D and Missouri State Route 94 culverts.
General Public	Public meeting input, review of LTS&M Plan changes, document review.

LTS&M Plan Revision—DOE will revise this plan in response to changed site or oversight conditions. If the change entails modification of the monitoring program and authority to implement the modification is not conferred upon DOE in the LTS&M Plan, DOE will solicit public comment on the proposed changes. EPA, in consultation with MDNR, will concur in changes to the plan. If the change entails administrative changes such as updating contact information, or if the plan confers upon DOE authority to make the change, DOE may revise those portions of the plan and notify regulators and stakeholders of the revision.

2.1.2 Role of Regulators

EPA Region VII, located in Kansas City, Kansas, is the lead agency for Weldon Spring Site activities conducted under CERCLA. EPA will oversee the CERCLA activities, approve site remedies, and concur in their ongoing implementation. EPA will also review and comment on CERCLA documents, LTS&M Plan changes, and Five-Year Review Reports.

MDNR in Jefferson City, Missouri, will provide regulatory consultation in coordination with EPA. MDNR will also review and comment on CERCLA documents, LTS&M Plan changes, and Five-Year Review Report.

Both EPA's and MDNR's role during long-term surveillance and maintenance will be defined in a postclosure agreement under development and anticipated to become effective upon completion of the Groundwater OU decision and documentation. Both agencies will be given the opportunity to participate in the annual site inspection.

2.1.3 Role of Stakeholders

Stakeholders may comment on LTS&M Plan changes, provide review of DOE activities by reviewing documents and attending public meetings, informally monitor the site and site surveillance and maintenance program, and report concerns to DOE or regulators. See Section 2.2, "Public Participation" for more details regarding stakeholder involvement.

2.2 Public Participation

Promoting involvement of the public in the surveillance and maintenance process at the Weldon Spring Site ensures that citizens' concerns are addressed and that relevant public information is provided. Active citizen involvement also promotes understanding of, and encourages informed participation in, the project by the general public. DOE seeks to encourage public participation by providing site information via public contacts, DOE contacts, documents to the public for comment, and public meetings. Decision points requiring public input are shown on Figure 2−1.

2.2.1 Regulator, Stakeholder, and Responder Contacts

The purpose of the contact effort is to ensure that public and key community leaders, including federal, state, and local government officials, are kept informed of site activities and status changes. Contact information is maintained, including

- Legislative and executive branch officials (federal, state, and local).
- U.S. Environmental Protection Agency, Region VII

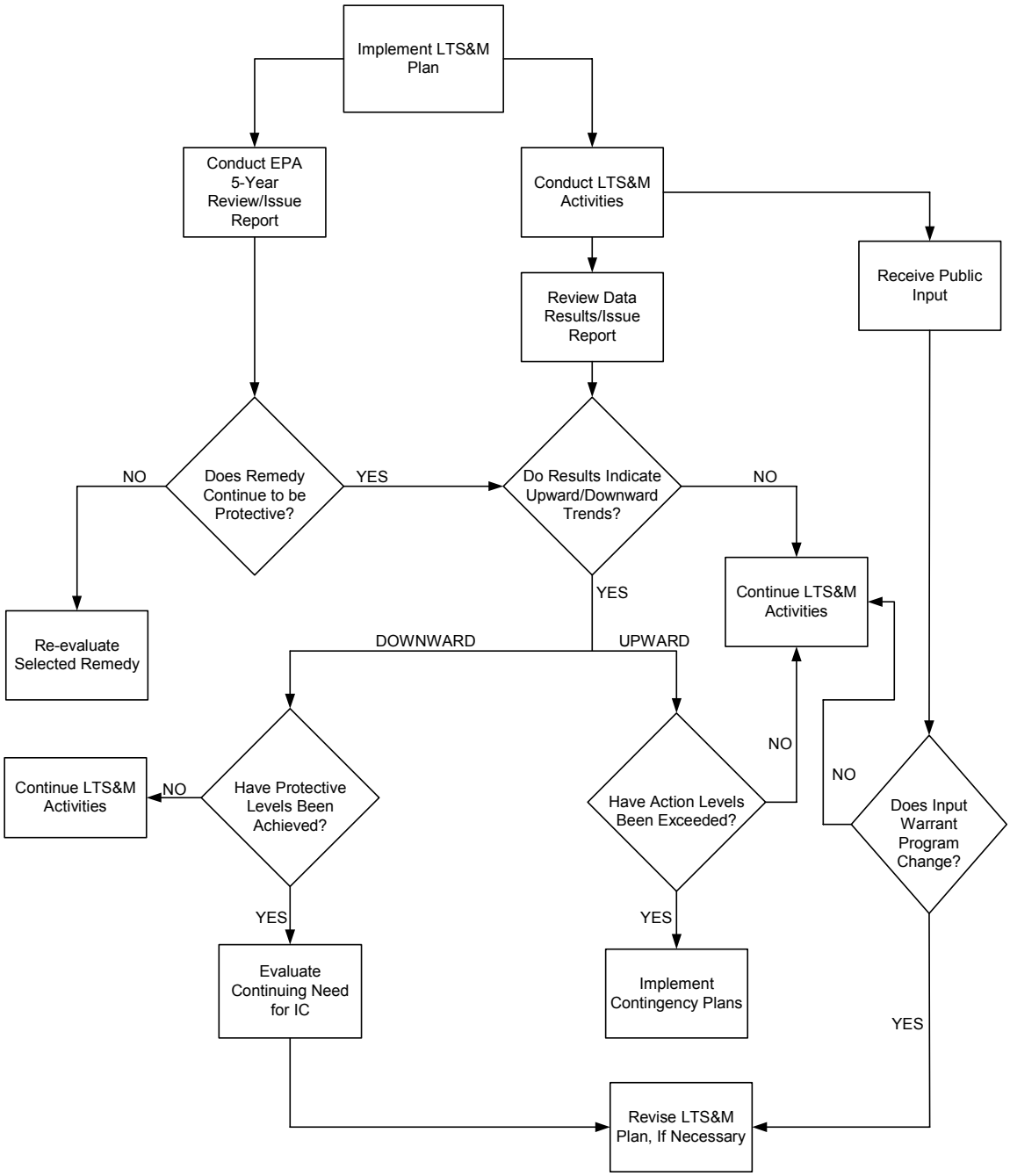

Figure 2–1. Long-Term Surveillance and Maintenance Flow Chart for the Weldon Spring, Missouri, Site

- U.S. Department of the Army.
- State of Missouri (Departments of Natural Resources, Conservation, Health, and Transportation).
- St. Charles County.
- Weldon Spring Citizens Commission.
- Francis Howell School District.
- Interested citizens.
- Media (print and electronic).

The Official Contact List (Appendix F) and the Distribution List (Appendix G) will be maintained for the annual and the 5-year review report, and other site announcements and notifications.

2.2.2 DOE Contacts

Contact information for the DOE staff responsible for implementing the Weldon Spring Site surveillance and maintenance program will be posted at the Interpretive Center. Posting this information should encourage the public to actively participate with DOE in the surveillance and maintenance process by reporting sightings or concerns such as visible changes to the cell cover, erosion, suspicious land use, damaged monitor wells, or vandalism.

The DOE contact list will also serve an informational purpose by providing a mechanism for the public to submit questions or requests for information when there is no continuous on-site DOE presence. The following contact list will be maintained and revised on an annual basis, as necessary, to reflect the most current contact information.

- Pamela Thompson, Site Manager, Weldon Spring Site
  U.S. Department of Energy
  7295 Hwy 94 South, St. Charles, MO 63304
  (636) 441-8978

- Donna Bergman-Tabbert, LM-50, Grand Junction Site
  U.S. Department of Energy
  2597 B 3/4 Road, Grand Junction, CO 81503
  (970) 248-6001

- Sam Marutzky
  S.M. Stoller Corporation
  2597 B ¾ Road, Grand Junction, CO 81503
  (970) 248-6059

- Yvonne Deyo, Interpretive Center Manager, Weldon Spring Site
  S.M. Stoller Corporation
  7295 Hwy 94 South, St. Charles, MO 63304
  (636) 300-0012

- Grand Junction 24-Hour Monitored Security Telephone Numbers
  (877) 695-5322
  (970) 248-6070

- Website
  http://www.gjo.doe.gov/programs/ltsm

2.2.3 Document Review and Public Meetings

Interested stakeholders as discussed in Section 2.2.1, "Regulator, Stakeholder, and Responder Contacts" will be notified of the availability of both annual and each CERCLA 5-year review reports available to the public at the Interpretive Center, the Middendorf-Kredell branch of the St. Charles City-County Library System, and on the LTSM Program website. This notification will ensure that the public is aware of site activities and changes. Comments and/or questions can be directed to the DOE contacts listed in Section 2.2.2, "DOE Contacts."

To ensure a mechanism whereby the public can be briefed on and participate in periodic site reviews, a schedule for a public meeting will be included in the notification letter sent with each annual site inspection report and posted on the website. The annual meeting will include discussions of site surveillance and maintenance activities and observations during the previous year, proposed changes to the LTS&M Plan, and public comments and concerns.

2.2.4 Interpretive Center Operation

DOE will maintain and operate an interpretive center 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 also will provide information about the long-term surveillance and maintenance program for the site, provide access to surveillance and maintenance information, and support community involvement activities. The hours of operation of the Interpretative Center are posted at the site. The current hours of operation are Monday through Friday: 9:00 a.m. to 5:00 p.m., Saturday: 10:00 a.m. to 2:00 p.m., and Sunday: 12:00 p.m. to 4:00 p.m. The Interpretative Center is closed on holidays. These hours are subject to change and current hours will be posted on the website.

DOE will provide staff and funding needed to operate the Interpretive Center. DOE will monitor center usage and public perception of the center's value, and may discontinue center operations after calendar year 2004 or at any time thereafter if, with the concurrence of EPA in consultation with the state, the Interpretive Center does not enhance protectiveness or community acceptance of and participation in surveillance and maintenance activities.

2.3 Routine Site Inspections

2.3.1 Frequency of Inspections

DOE will inspect the Weldon Spring Site annually to confirm that institutional controls remain effective and to determine if maintenance or additional monitoring are needed. Variation to this inspection frequency will be explained in the inspection report. DOE will notify EPA and the MDNR of the inspection at least 30 days before the scheduled inspection date. At the time of the

next 5-year review, (i.e., 2006 inspection), DOE may propose that the inspection frequency be modified.

2.3.2 Inspection Procedure

For the purposes of inspection, the Weldon Spring Site will be divided into specific areas (Table 2−2). Each area will be inspected individually.

Table 2–2. Inspection Areas for the Weldon Spring, Missouri, Site

Area	Description
	Chemical Plant
Disposal Facility and 300-ft Buffer Zone	Disposal cell, apron, and 300-ft buffer area, ramp and platform, guard rail, LCRS, leachate treatment building and appurtenances, access and perimeter roads, cell performance monitor wells, and site markers.
Chemical Plant Site Boundary	Area between the 300-ft buffer zone and the Chemical Plant property boundary, including access roads, survey monuments, information signage, and groundwater monitor wells.
Chemical Plant Outlying Area	Groundwater use restriction area (Figure 1–1), additional area beyond property boundary where development may affect site integrity, selected off-site areas where erosion might eventually threaten the Chemical Plant site, areas overlying contaminated groundwater plumes, culverts at Missouri State Route 94 and Highway D, groundwater monitor wells, Springs 6301, 6303, 6306, 5303, and 5304, and the Southeast Drainage.
	Quarry
Quarry and Quarry Outlying Area	Quarry property, area of groundwater use restrictions (Figure 1–2), area beyond property boundary where development may affect site integrity, survey monuments, and groundwater monitor wells.

Inspectors will physically inspect the cell top and side slopes, side slope toe, cell and site drainage structures, and the LCRS. Inspectors will look for modifying processes or threats to disposal cell integrity such as creep, bulging, differential settlement, erosion, or rock degradation. Inspectors also will look for physical evidence of intrusion and violation of institutional controls. Previous maintenance work will be inspected and maintenance needs will be compiled.

Inspecting the cell cover, clean fill dike cover, and toe apron for settlement or rock degradation will consist of walking 10 random transects across the cell, walking the grade break at the top of the side slopes, and walking along the cell perimeter. Inspectors will look for and map depressions, shifts of cell plane vertices, or other indications of settlement; map concentrations of degraded, split, or weathered pieces of limestone; and estimate a percentage of deteriorated rock exposed within each mapped area. The mapping will address only obvious indications of rock durability concerns. A global positioning system or other method with equivalent accuracy will be used for mapping.

Inspectors will compare results with previous survey results to determine if features are construction artifacts or if additional degradation has occurred. If inspectors identify settlement, or if the percentage of degraded rock appears significant or is noticeably greater than on the remainder of the cover, DOE will determine a course of monitoring and evaluation as described in Table 2−8.

Inspectors will note changes to the area surrounding the Chemical Plant and quarry sites. Significant changes within these areas could include new development or expansion of existing development, erosion, or road building. Near the quarry, inspectors will note evidence of development that may result in changes to the surface grading, groundwater system, disturbance of the reduction zone, and evidence of inappropriate groundwater extraction. At the quarry, inspectors will also look for evidence of settling, ponding water, backfill erosion, and highwall instability.

Within each area, the condition of specific site-surveillance features (Section 2.3.5, "Specific Site-Surveillance Features"), such as site markers and monitor wells, will be inspected for change, deterioration, and functionality.

Some observations will be documented with photographs. Such observations may be evidence of vandalism, changed conditions, or maintenance needs. Inspectors will record photograph information on a Field Photograph Log, which becomes part of the site record maintained at the DOE office at Grand Junction.

Inspectors will verify that the phone numbers remain displayed at the Chemical Plant and quarry sites and are listed in local telephone directories.

2.3.3 Inspection Checklist and Map

Site inspections are guided by checklists that address the performance of each inspection. The initial annual inspection checklist for the Weldon Spring Site and the 5-year inspection checklist for the cell cover are presented in Appendix H. Initial site inspection maps are shown on Figures 2–2 and 2–3. The maps are used to record field notes, photograph locations, and other annotations of inspection findings. The field maps become a part of the permanent site record.

At the conclusion of a site inspection, inspectors will note revisions to the applicable checklist in anticipation of the next site inspection. The checklists are again reviewed and revised as necessary before each inspection. Revisions to the checklists may include inspection instructions addressing new observations, notes about maintenance conducted since the previous inspection, or progressive changes in site conditions.

Concurrently with each annual inspection, inspectors will review the *Comprehensive Five-Year Review Guidance* (EPA 2001).

2.3.4 Institutional Controls Inspection

DOE will conduct a formal annual inspection of the physical locations addressed by institutional controls. DOE also will evaluate whether the institutional controls remain effective in protecting human health and the environment and will take appropriate action if evidence indicates the controls are not effective, in coordination with EPA and MDNR.

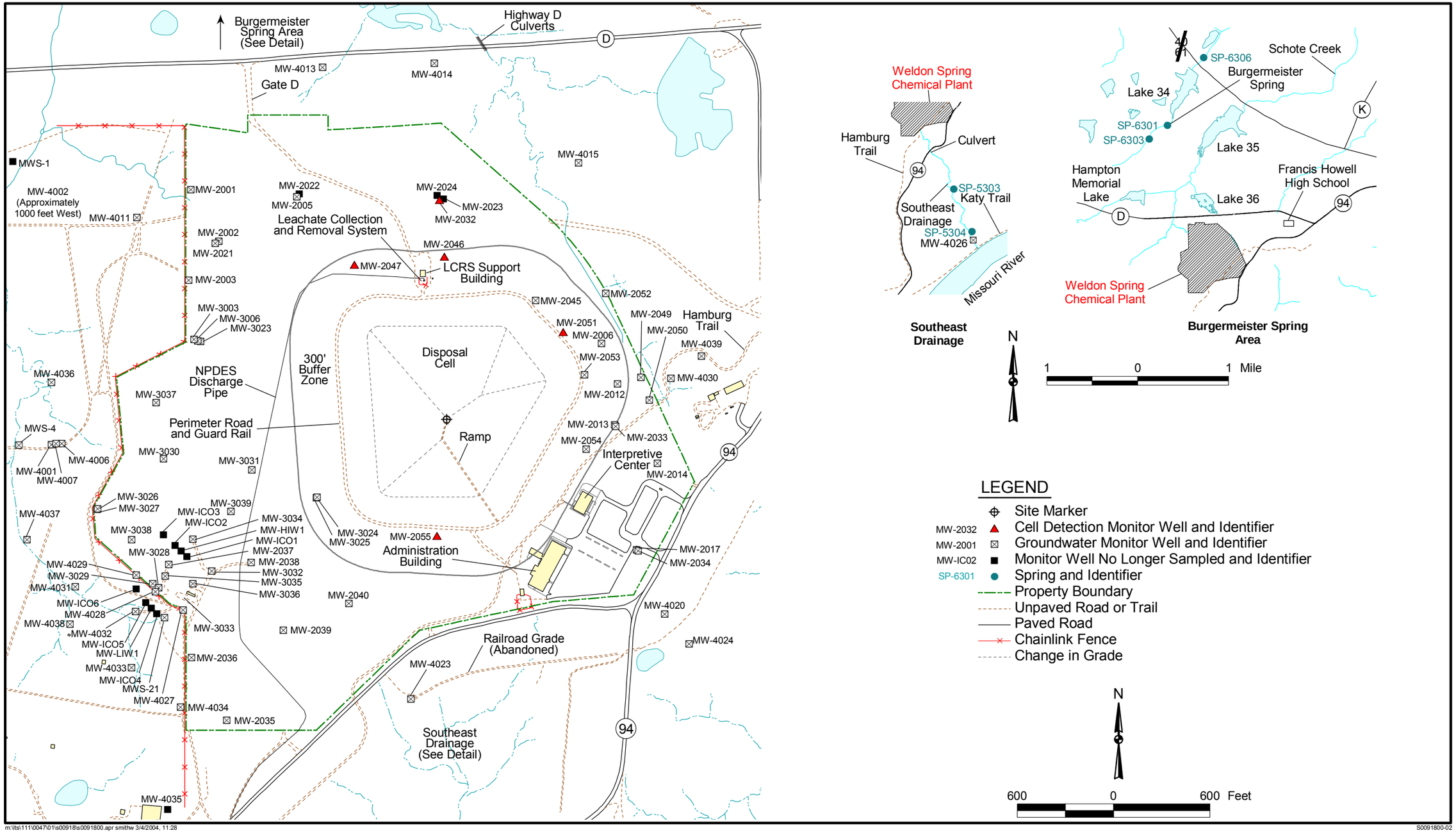

Figure 2–2. Inspection Base Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site

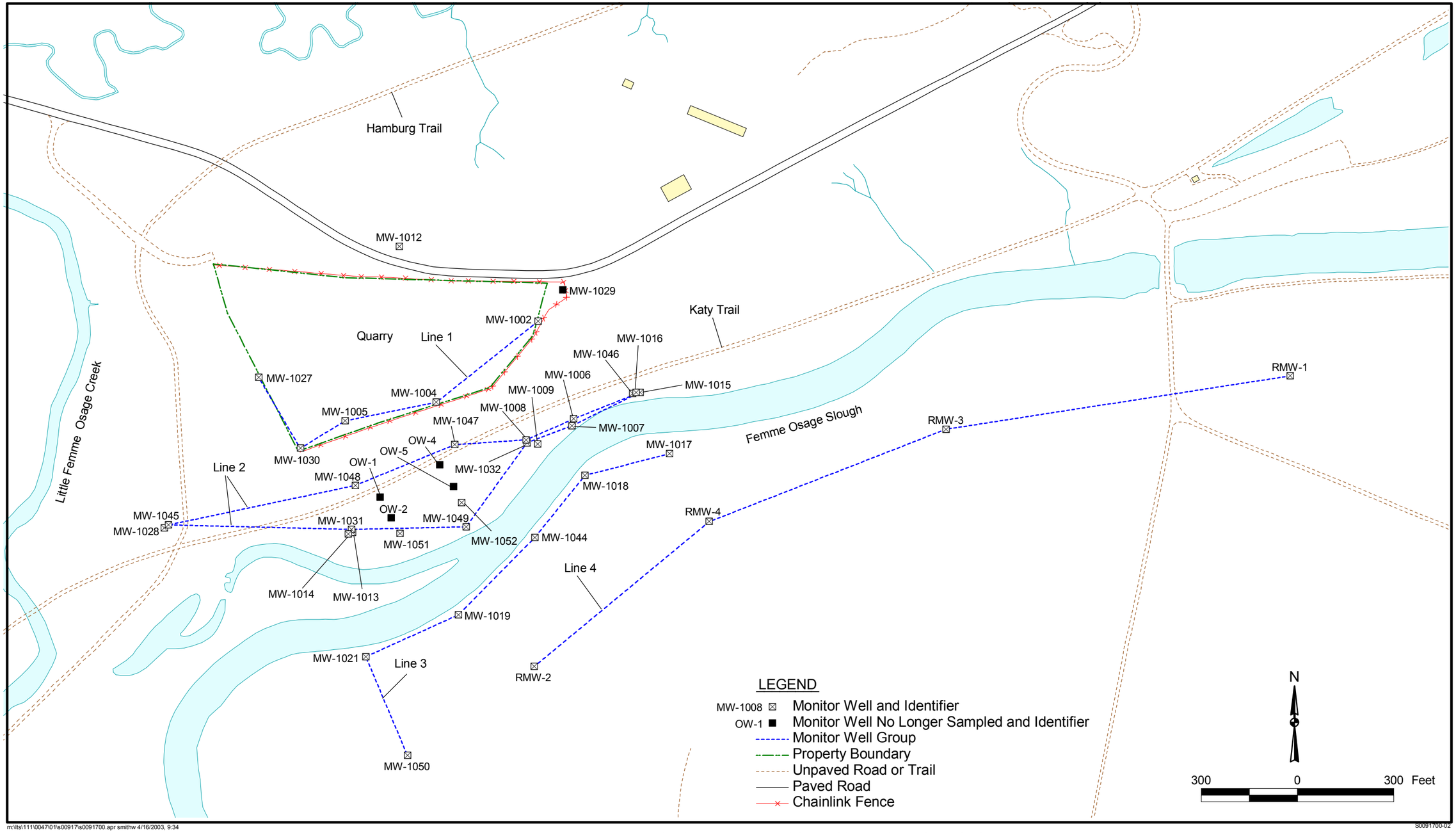

Figure 2–3. Inspection Base Map for the Quarry Area of the Weldon Spring, Missouri, Site

DOE will contact property owners and other grantees of real property interests annually to ensure cognizant representatives remain aware of institutional controls on their property. Institutional control contact information will be maintained in Appendix F of this plan. The contact will consist of a documented phone conversation to confirm agency contact information, followed by a certified letter. Contacts will be documented and submitted to the site record. Similarly, DOE will also check county records to verify that deed restrictions and other institutional control instruments remain in place.

Inspection requirements for specific areas will include the following:

Groundwater and Surface Water—During annual site inspections, inspectors will look for indications of groundwater or surface water withdrawal or use in restricted use areas (see Figure 1–1 and Figure 1–2). Indications may include new wells, well points, pumps set on wells or well points, or new residential or commercial development with no apparent connection to a municipal water supply. Observations will be recorded in the annual report and summarized in the 5-year review report. In preparation for the 5-year review, DOE will contact MDNR to determine if well registrations were issued for the area affected by contaminated groundwater.

Chemical Plant and Quarry—During annual inspections, inspectors will look for indications of excavation into soils and bedrock at the DOE-owned property, or in the geochemical reduction zone south of the quarry (see Figure 1–2). If any party has been granted use of portions of the Chemical Plant site or quarry, inspectors will ensure that such use is in accordance with terms of use agreements and that surface drainage has not been modified.

Highway D and Missouri State Route 94 Culverts—During annual inspections, DOE will look 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. Inspectors will also look for signs of disturbance of the affected region where the Southeast Drainage culvert passes beneath Missouri State Route 94. Also during annual inspections, DOE will contact MDC (the property owner) and the MoDOT (owner of the right-of-way) to ensure these agencies remain aware of the restrictions at these locations.

Southeast Drainage—During the annual inspections, inspectors will look for indications of residential use or construction in the Southeast Drainage, or other activity that would signify residential use of the area. Also during the annual inspection, DOE will ensure that MDC remains aware of land use restrictions imposed in the affected area of the Southeast Drainage.

Institutional Controls Enforcement—Enforcement mechanisms are defined for each institutional control in the institutional control instrument attached in Appendix E. DOE will notify EPA and MDNR if institutional controls have been violated or if enforcement action is necessary. DOE will present the results of institutional controls monitoring and maintenance in the annual report.

2.3.5 Specific Site-Surveillance Features

Specific site-surveillance features at the Weldon Spring Site are shown on Figure 2–2 and Figure 2–3.

2.3.6 Access Controls

Information Signs—A sign is posted at the Interpretive Center and at various historical marker locations in the area providing the LTSM Program 24-hour and local contact phone numbers. 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) or the local DOE representatives (636-300-0012) for information.

Disposal Cell Guard Rail—A guard rail surrounds the cell at the toe of the side slope. The barricade is designed to prevent vehicular access to the cell.

Fencing—A chain-link security fence encloses the LCRS sump to mitigate unauthorized entry. The reconstructed security fence located one foot on the Army's side of the common boundary is owned and maintained by the Army for its security purposes. Historical fencing remains around a portion of the DOE quarry site.

2.3.7 Site Markers

Four permanent site markers are installed on concrete pylons on top of the disposal cell. These include general information about the cell cover. The coordinates and elevation for the north monument benchmark are as follows: North: 1,043,145.709; East: 755,063.602; Elevation 734.2267 ft mean sea level.

2.3.8 Monitor Wells

Chemical Plant Area—The groundwater monitor well network will be defined from existing or new monitor wells located inside or adjacent to the Weldon Spring Site property to reflect long-term surveillance and maintenance requirements specified in the ROD for the Groundwater OU. These wells are completed in the Burlington-Keokuk Limestone. Construction details and lithologic logs for the wells will be archived in the Weldon Spring Site records at the DOE office at Grand Junction.

Quarry Area—The groundwater monitor well network consists of approximately 30 monitor wells located primarily downgradient of the Weldon Spring Site property (Figure 2–3). These wells are completed in the alluvial aquifer or the underlying bedrock units (Kimmswick Limestone, Decorah Group, or Plattin Limestone). Construction details and lithologic logs for the wells are archived in the Weldon Spring Site records at the DOE office at Grand Junction.

2.3.9 Personnel

Typically, two inspectors will perform annual inspections. Inspectors will be experienced engineers or scientists who have the required knowledge, skills, and abilities to evaluate site conditions and recognize potential or actual problems.

Inspectors will be assigned for a given inspection of the Weldon Spring Site on the basis of site conditions and inspector expertise. Areas of expertise include civil, geotechnical, and geological engineering; geology, hydrology, biology, and environmental science (e.g., ecology, soils, or range management). If conditions warrant, more than two inspectors may be assigned to the inspection to evaluate serious or unusual problems and make appropriate recommendations.

2.3.10 Annual Reports

Results of annual site inspections will be reported to EPA and MDNR. DOE will post the final report on the Internet (www.gjo.doe.gov/programs/ltsm/) and submit it to the Weldon Spring Site Interpretive Center, other local information repositories, and stakeholders. In the report, DOE also will address maintenance and surveillance and maintenance monitoring results for the previous 12 months and will include descriptions of the cause and outcome of events that require notification of local, state, or federal officials.

2.4 Follow-up Inspections

Follow-up inspections are unscheduled inspections that are conducted in response to threatening or unusual site conditions.

2.4.1 Criteria

DOE may conduct follow-up inspections if the following occurs:

- A condition is identified during the routine site inspection, or other site visit, that requires personnel with specific expertise to return to the site to evaluate the condition.

- DOE is notified by a citizen, employee, or federal, state, or local agency that conditions at the site are substantially changed. Notification may be made to the DOE office at Grand Junction using the toll-free phone number posted at the Interpretive Center, to on-site personnel, or to local law enforcement agencies.

Once a condition or concern is identified at the site, DOE personnel will evaluate the information and decide whether to respond with a follow-up inspection. At any time, DOE may request the assistance of local authorities to confirm the seriousness of a condition at the site before scheduling a follow-up inspection. DOE will notify EPA and the MDNR of a follow-up inspection upon identifying the need to conduct such an inspection.

Specific conditions that may necessitate a follow-up inspection include intrusion, violation of institutional controls, vandalism, or the need to revisit the site to evaluate, define, or conduct maintenance tasks. Conditions that may require a more immediate follow-up inspection include extreme weather, seismic events, and disclosure of deliberate human activity that threatens the integrity of waste containment. DOE will evaluate risk when scheduling follow-up inspections. Urgency of the follow-up inspection will be in proportion to the seriousness of the condition.

In the event of an incident or activity that threatens or compromises institutional controls or poses a risk of exposure to or release of known contaminants, DOE will follow the procedures in Section 2.9, "Emergencies, Contingency Planning, and Corrective Action."

2.4.2 Personnel

Inspectors assigned to follow-up inspections will be selected on the same basis as for routine site inspections.

2.4.3 Reports of Follow-up Inspections

Results of follow-up inspections will be included in the next annual inspection report. Separate reports will not be prepared unless DOE determines it advisable to notify EPA, MDNR, or another outside agency of a situation at the site that remains uncorrected.

If follow-up inspections are required for more serious reasons, DOE will submit to EPA, MDNR, and St. Charles County a preliminary report of the follow-up inspection within 60 days. These reasons may include situations that could result in a compromise or failure of cell containment or situations that could result in unacceptable risk to the public or the environment. The public will be notified of the availability of the follow-up report via posting on the Internet. Copies of the report will be available to the public upon request.

2.5 5-Year Review

DOE will prepare a CERCLA 5-year review report in accordance with current EPA guidance for 5-year reviews. The purpose of the CERCLA 5-year review is to ensure that the remedies remain protective of human health and the environment. The Weldon Spring Site 5-year review report also will serve as the principle mechanism for monitoring, evaluating, improving, and reporting on all long-term management activities, including operations and maintenance; long-term monitoring; institutional control monitoring and enforcement; community involvement; information system; contingency actions; and post-ROD changes. The 5-year review report will also include the results of the previous five annual inspections and environmental monitoring results.

In the 5-year review report, DOE will present an evaluation of remedy performance and recommendations for modifying the surveillance and maintenance program, implementing corrective action, or revision to the selected remedies (if necessary).

DOE will consult current EPA guidance for 5-year reviews and will add essential elements to the inspection that precedes preparation of the 5-year review report to ensure capture of necessary field observations. Additional evaluation of site monitoring data for the 5-year period will be conducted.

At 5-year intervals, in addition to annual visual inspections, general or differential settlement of the cell cover will be monitored through the use of terrestrial and/or aerial surveys, and rock gradation changes in the cell cover, clean fill dike cover, and toe apron will be visually assessed and evaluated (Appendix H).

In accordance with EPA guidance, DOE will prepare a single 5-year review report that addresses the four OUs of the Weldon Spring Site. The most recent 5-year review was competed in 2001 (DOE 2001b). The next 5-year review report will be released in 2006; therefore, the 2005 inspection will be structured to support the 5-year review.

2.6 Routine Site Maintenance and Operations

Roads and Walkways—Inspectors will evaluate the condition of the access road, perimeter road, and disposal cell ramp and platform for maintenance needs. Needs may include vegetation control, grading, or adding aggregate. MDC will be responsible for maintenance of the Hamburg Trail.

Wells—During the routine site inspection, DOE will inspect the disposal cell wells and >10% of Chemical Plant and quarry monitor wells and arrange for needed maintenance or repairs. Groundwater samplers also will note maintenance needs and ensure the wells are kept secured and in good repair. Monitoring personnel will maintain access to sample locations, which may include maintenance of access routes and vegetation control. Maintenance at off-site locations will be conducted in accordance with access agreements.

LCRS—Modeling results predict that the transient drainage water production rate will decrease steadily over the 10 years following cap completion until it becomes insignificant. On-site personnel will monitor fluid volume in the LCRS sump and arrange for sampling and disposal in accordance with the *Leachate Collection and Removal System Operating Plan* (Appendix I). DOE will decrease on-site monitoring frequency to reflect diminishing transient drainage water production. Ultimately, the system may be monitored from a remote location, with system inspections coinciding with routine site inspections or conducted in response to concerns about remote monitoring information.

The LCRS sump is a confined space, and methane is generated by peat in the liner system. Workers must follow confined space entry procedures before entering the sump, which includes checking the sump atmosphere for oxygen and explosive concentrations of gases.

Interpretive Center, Administration Building, Sanitary Wastewater Treatment System, and Associated Grounds—DOE intends to offer use of these structures and associated landscaped areas to another primary building user. DOE will use office space and the laboratory in the administrative building. The primary building user will assume responsibility for building and grounds maintenance and capital improvements within the region shown on the final agreement. DOE will retain responsibility for maintenance of and capital improvements of the Interpretive Center. DOE and the primary building user will enter into a long-term use permit that specifies provisions for shared occupation. Currently this arrangement has been entered into with Lindenwood University for an indefinite term.

Vegetation—DOE will control vegetation on the disposal cell and in other rock-armored areas to prevent damage to the cell cover and maintain the proper function of drainage structures. Vegetation control may include cutting trees and shrubs and applying herbicides to their stems. The primary building user will maintain vegetation around the administration building and Interpretive Center.

DOE will establish a demonstration prairie on the remainder of the Chemical Plant site. The prairie provides high quality erosion protection and a low maintenance cover. Maintenance activities may include periodic cutting, burning, fertilizing, erosion control, and weed control. Prairie maintenance will be conducted by a subcontractor and supervised by a prairie ecosystem consultant, who will direct maintenance activities on the basis of site conditions. A consortium of conservation groups may manage the prairie.

DOE will also be establishing a native plant educational garden that will surround the Interpretive Center. Maintenance activities may include periodic irrigation, mowing, burning, and weed control. Garden maintenance will be conducted by a subcontractor and volunteer labor. Maintenance activities will be supervised by the Interpretive Center manager. The intent of the garden is to assist in attracting and then educating the public about the Weldon Spring Site. Routine maintenance completed during the previous 12 months will be summarized in the next annual inspection report.

2.7 Environmental Monitoring

The RD/RA work plans for the Weldon Spring Site specify environmental monitoring requirements for specific OUs, which are implemented through this plan. Results will be reported in the annual site environmental report and summarized in the 5-year review report. Environmental data results are available on the Internet (www.gjo.doe.gov/programs/ltsm). In accordance with current laboratory turnaround times and review protocol, the data will be available on the website approximately 60 to 90 days after sampling.

DOE may conduct additional site environmental monitoring that is not required as part of an approved remedy but is required under DOE Order 450.1, *Environmental Protection Program*. DOE will report the results of the additional monitoring in the annual site environmental report.

Separate groundwater monitoring programs have been established for the Chemical Plant and quarry sites because of geographic separation and differences in the hydrogeologic features that influence groundwater flow. Groundwater monitoring locations will include local springs where groundwater emerges from conduit flow paths (DOE 2003).

Groundwater monitoring is being conducted using methods and procedures established for the Weldon Spring Site, in accordance with the Weldon Spring Site *Environmental Monitoring Plan* (DOE 2003). The *Environmental Monitoring Plan* describes procedures, methods, and quality assurance requirements for collecting and reporting groundwater monitoring data.

Monitoring results are compared to EPA and State of Missouri groundwater quality standards that are identified as ARARs in Table 1−3.

2.7.1 Disposal Cell Detection Monitoring

Disposal cell detection monitoring is summarized in Table 2−3. Specific procedures for evaluation of monitoring results and required responses are presented in the "Disposal Cell Groundwater Monitoring Plan" (Appendix K). The disposal cell monitoring requirements are also included in the *Environmental Monitoring Plan* (DOE 2003).

DOE will monitor groundwater upgradient and downgradient of the disposal cell and will also monitor Burgermeister Spring (SP–6301) during low flow as part of the disposal cell monitoring program. Burgermeister Spring is a primary localized resurgence point of groundwater from the Chemical Plant and represents surface water hydraulically connected to the Chemical Plant.

Table 2–3. Detection Monitoring Program for the Disposal Cell at the Weldon Spring, Missouri, Site

Sample Locations	Hydrologic Relationship	Sampling Frequency	Analytes (all locations)
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).
MW–2046	Downgradient		
MW–2047	Downgradient		
MW–2051	Downgradient		
MW–2055	Upgradient		
SP–6301	Downgradient		

Note: DNB = dinitrobenzene; DNT = dinitrotoluene; TNB = trinitrobenzene; TNT = trinitrotoluene

2.7.2 Groundwater OU

Presently, DOE monitors groundwater wells in the Chemical Plant area and several nearby springs in accordance with the Weldon Spring Site *Environmental Monitoring Plan* (DOE 2003). Beginning in July 2004, DOE will perform monitoring activities to support Monitored Natural Attenuation (MNA) in accordance with the requirements 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 2004). The performance goals for the monitoring program are:

- Contaminants will attenuate at a rate sufficient to meet cleanup standards in approximately 100 years.
- Contaminant migration will remain confined to the currently impacted groundwater system.
- Contaminant levels at potential exposure points (springs) will not pose unacceptable risks to receptors.
- Contaminant levels at the springs will decline over time.

The sources of contamination have been removed; therefore, groundwater quality should continue to improve. The overall area of contamination should not become significantly larger than it currently is. The distribution of contaminants is controlled by the structure of the bedrock, which controls the groundwater flow direction in the shallow aquifer beneath the Chemical Plant

area. The areas of highest contamination generally occur along the more weathered, preferential flow pathways, and migration occurs primarily along these linear flow features. The expectation is that the contaminant plumes will continue to disperse along existing flow paths and become more dilute with natural recharge from precipitation and lateral flow. Concentrations in the areas of highest impact will decrease, but because of dispersion, concentrations in some downgradient locations may exhibit temporary increases. These changes in concentrations have already been observed at some locations. Contamination should not go any deeper than it already has. Slight impact has been observed in the unweathered Burlington-Keokuk Limestone at the Chemical Plant area. Groundwater flow has a preferential horizontal component, and vertical movement of groundwater is limited by structural controls of the bedding planes and abundant horizontal fractures found in the upper weathered unit.

Off-site migration occurs laterally through solution-enlarged conduits and bedding planes. No well-defined plumes of high concentrations have been detected north of the site, although site contaminants have been detected in springs in the August A. Busch Conservation Area. The western and northern portions of the site are within the recharge area of the impacted springs: Burgermeister Spring (SP-6301) and SP-6303.

Springs in the Southeast Drainage also indicate impact from site derived contaminants. Historically, contaminated groundwater from Raffinate Pits 1 and 2 flowed into the Southeast Drainage. This drainage was also used as a discharge point for effluent from the Chemical Plant operations. Because this drainage has losing stream segments in its upper reaches, surface water infiltrated the subsurface where a portion of contaminated sediment was deposited in fractures and solution features and acts as a residual source of contamination to spring water.

Groundwater at the Chemical Plant area is contaminated with trichloroethylene (TCE), nitrate, uranium, and nitroaromatic compounds (Figures A−14 through A−19). These constituents will be measured at some or all of the monitoring locations, depending on the well's proximity to each contaminant plume (Table 2−4).

The objectives of the monitoring program 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.

- Objective 2 is to verify that 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.
- Objective 3 is to ensure that lateral migration remains confined to the current area of impact.
- Objective 4 is to monitor locations underlying the impacted groundwater system to confirm that there is no significant vertical migration of contaminants.
- Objective 5 is to monitor contaminant levels at the impacted springs, which are the only potential points of exposure under current land use conditions.

Table 2–4. Monitoring Parameters for MNA Locations

Location	Sampling Frequency[a]	Monitoring Parameters			
		TCE	Nitrate (as N)	Uranium	Nitroaromatic
MW-2003	S				T
MW-2012	S				T
MW-2014	S				T
MW-2017	S				T
MW-2021	S		T		T
MW-2022	Q[b]		T		T
MW-2023	Q[b]				T
MW-2032	S				T
MW-2037	S		T		
MW-2035	S	T	T	T	T
MW-2038	S		T		
MW-2046	S				T
MW-2050	S				T
MW-2051	S				T
MW-2052	S				T
MW-2053	S				T
MW-2054	S				T
MW-2056	Q[b]				T
MW-3003	S		T	T	
MW-3006	S	T	T	T	T
MW-3024	S			T	
MW-3029	S				T
MW-3030	S			T	
MW-3031	S	T		T	T
MW-3034	S	T	T		
MW-3036	S	T	T		T
MW-3037	S	T	T	T	T
MW-3039	S		T		
MW-4007	S	T	T		
MW-4013	S		T		T
MW-4014	S				T
MW-4015	S				T
MW-4022	S		T	T	
MW-4023	S		T	T	
MW-4026	S			T	
MW-4029	S	T	T		T
MW-4036	S	T	T	T	T
MW-4040	Q[b]	T	T	T	T
MW-4041	Q[b]	T	T	T	T
MWS-1	Q[b]	T	T	T	T
MWS-4	Q[b]	T	T	T	T
SP-5303	S			T	
SP-5304	S			T	
SP-6301	S	T	T	T	T
SP-6303	S	T	T	T	T

[a]Monitoring frequencies may be decreased to annual or biennial based on trending of at least the first 2 years of data.
[b]Quarterly frequency will be for the initial 2-year period, decreasing to a less frequent monitoring thereafter.
S − Semiannual
Q − Quarterly

- Objective 6 is to monitor the 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 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:

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

The 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 final monitoring network consists of 51 wells used to evaluate the performance of the MNA alternative and detect unexpected expansion of the contaminant plumes. The locations and the objectives they satisfy are summarized in Table 2−4 and are depicted on Figure 2−4.

2.7.2.1 Performance Monitoring (Objective 2 Locations)

Concentrations of contaminants of concern are expected to decrease to cleanup standards within a reasonable timeframe (i.e., 100 years). Long-term trend analysis will be performed to confirm downward trends in contaminant concentrations over time. Performance will be gauged against long-term trends. It is anticipated that some locations could show temporary upward trends due to the recent source control remediation, ongoing dispersion, analytical variability, or other factors. However, concentrations are not expected to exceed historical maximums.

Trigger levels will be set for the performance monitoring (Objective 2) locations in the event unexpected increases occur within the area of impact (Table 2−5). The first trigger will be a statistically significant increase in contaminant concentrations outside those that have been measured for the previous 12 data points. Concentrations that exceed the mean plus 3 standard deviations for that location will be considered to be a statistically significant increase. A second trigger will be established for each contaminant that will invoke a more vigorous response. Due to the greater concentrations of nitroaromatic compounds in the Frog Pond area (MW-2012, MW-2014, MW-2050, MW-2052, MW-2053, MW-2054, and MW-4015) as compared to the remainder of the site, separate triggers have been established for each area.

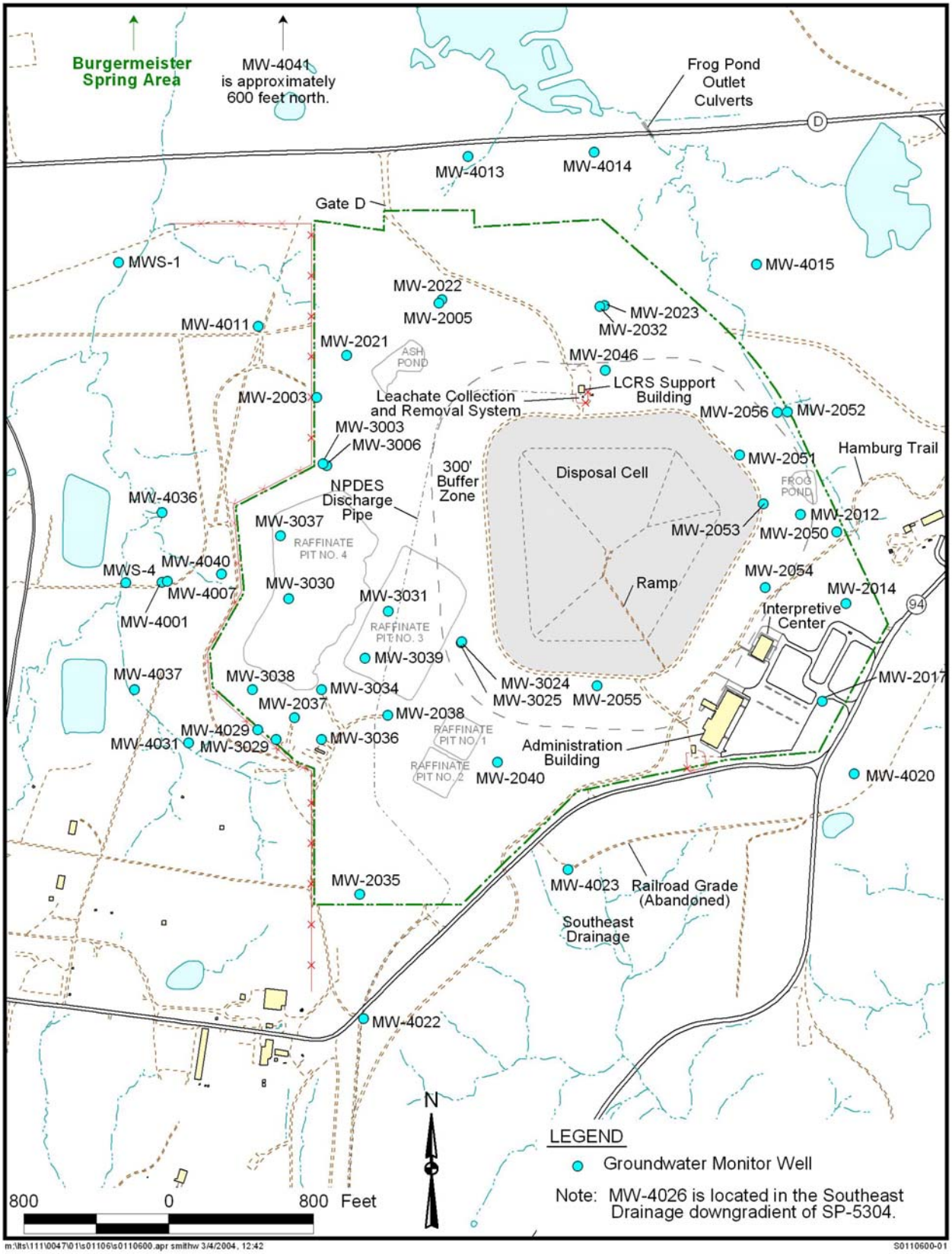

Figure 2–4. MNA Groundwater Monitoring Locations

Table 2–5. Trigger Levels for Performance Monitoring for the GWOU

Contaminant	First Trigger	Second Trigger	
TCE	Statistically significant increase defined as concentration(s) that exceed the mean plus 3 standard deviations for the previous 3 years of data. For locations that are ND, a statistically significant increase is considered to be the respective cleanup standard.	1,000 µg/L	
Nitrate (as N)		1,500 mg/L	
Uranium		300 pCi/L	
1,3-DNB		100 µg/L	FP – 200 µg/L
2,4,6-TNT		100 µg/L l	FP – 500 µg/L
2,4-DNT		100 µg/L	FP – 2,000 µg/L
2,6-DNT		100 µg/L	FP – 2,000 µg/L
Nitrobenzene		50 µg/L	FP – 50 µg/L

FP – Frog Pond Area

2.7.2.2 Detection Monitoring (Objective 3, 4, and 5 Locations)

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. This objective will be met by monitoring various downgradient perimeter locations that are either impacted or minimally impacted. Contamination should not go any deeper than it already has. Slight impact has been observed in the unweathered Burlington-Keokuk Limestone at the Chemical Plant area. Contaminant impacts in these locations are expected to remain minimal or non-existent.

The springs discharge groundwater that includes contaminated groundwater originating from the Chemical Plant site. Current 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 these affected springs should be observed.

Maximum trigger levels will be set for each contaminant for the detection monitoring locations and the springs. These triggers are summarized in Table 2−6.

Table 2–6, Trigger Levels for Detection Monitoring for the GWOU

Contaminant	Objective 3 (Weathered Unit)	Objective 4 (Unweathered Unit)	Objective 5 (Springs)
TCE µg/L	75	10	5
Nitrate (as N) mg/L	500	500	100
Uranium pCi/L	100	100	300
1,3-DNB µg/L	15	0.25	0.25
2,4,6-TNT µg/L	15	0.25	0.25
2,4-DNT µg/L	15	0.25	0.25
Nitrobenzene µg/L	15	0.25	0.25
2,6-DNT µg/L	15	0.25	0.5

2.7.2.3 Upgradient Groundwater Monitoring (Objective 1 Locations)

Groundwater quality will be monitored at upgradient unimpacted locations (Objective 1) in order to maintain a baseline of naturally occurring constituents to determine if downgradient conditions may be showing natural changes rather than contaminant based changes.

2.7.2.4 Hydrologic Monitoring (Objective 6 Locations)

Hydrologic conditions at the site over time will be monitored in all the wells 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. Objective 6 wells are supplemental wells to the groundwater monitoring network to provide sufficient coverage for hydrologic monitoring. Groundwater quality samples will not be collected from Objective 6 wells.

Groundwater elevation maps will be created and evaluated annually to verify that the groundwater flow directions and rates are sufficient to support the attenuation of the contaminants in the predicted timeframes. Also, groundwater flow directions will be evaluated against the institutional control boundary to verify that the restricted use area is adequate.

2.7.2.5 Data Analysis

Trend analysis will be performed at the performance and detection monitoring locations to evaluate if trends are occurring. If sufficient changes are observed in the detection monitoring wells, a reevaluation of appropriateness of the location as a detection monitoring location may be necessary.

A trend method using the nonparametric Mann-Kendall test will be employed (DOE 1999b). This test is based on the relative magnitudes of the data rather than the actual values and does not require distributional assumptions. This nonparametric method is valid for scenarios where there are a high number of non-detect data points. Also, 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 quantitation limit). Also, use of this method will be consistent with previous methods employed at the Weldon Spring Site. Results of the trend analyses will indicate the potential presence of statistically significant trends, as well as their direction and magnitude.

The two-tailed version of the Mann-Kendall test will be employed to detect either an upward or downward trend for each data set. In this approach, a test statistic, A, is calculated based on the mean and variance of the data set. A positive value of Z indicates that the data are skewed in an upward direction, and a negative value of Z indicates that the data are skewed in a downward direction. The error limit (α) used to identify a significant trend will be 0.05. In the two-tailed test where α is 0.05, the null hypothesis of "no trend" is rejected if the absolute value of the Z statistic is greater than $Z_{1-\alpha/2}$, where $Z_{1-\alpha/2}$ is obtained from a cumulative normal distribution table.

The linear slope, which is calculated independently of the trend, will be established for all data sets. The slope is estimated using a nonparametric procedure. A 95% two-sided confidence interval about the true slope is calculated to indicate the variability of the values upon which the line is based.

Groundwater data from the upgradient locations will be compared with previously collected data from each respective location. Trend analysis similar to that employed at the performance

monitoring locations will also be performed to evaluate if trends in naturally occurring constituents are occurring. If sufficient changes are observed in the upgradient monitoring wells, a re-evaluation of detection monitoring limits may be necessary.

2.7.3 Quarry Residuals OU

DOE monitors groundwater wells at the Weldon Spring quarry, and until October 1, 2002, DOE conducted this monitoring in accordance with the Weldon Spring Site *Environmental Monitoring Plan*. After that date, monitoring requirements began to be conducted in accordance with the *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit* (DOE 2000a).

The major source of groundwater contamination was removed under the ROD for the Quarry Bulk Waste OU by removal of contaminated soil, debris, and surface water from the quarry. The Quarry Residuals OU remedy prescribes long-term monitoring to confirm that natural processes are effective in attenuating groundwater contaminants before they reach the St. Charles County well field. The remedy also includes institutional controls to prevent groundwater use or disturbance of a naturally occurring reduction zone. The rationale for the monitoring activities at the quarry are described in the *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit* (DOE 2000a). Contaminants of concern in the quarry groundwater are uranium and 2,4-DNT.

The quarry monitoring program has two primary objectives:

- Monitor uranium concentrations in groundwater south of Femme Osage Slough to verify that the groundwater is not impacted.
- Monitor contaminant concentrations within the area of affected groundwater north of the slough until they attain target concentrations, indicating negligible potential to degrade groundwater south of the slough.

Groundwater north of the slough contains elevated concentrations of uranium. Uranium concentrations south of the slough and in the area of production wells at the St. Charles County well field remain within the observed natural variation within the aquifer, ranging from 0.1 picocurie per liter (pCi/L) to 14.3 pCi/L; an average background is 2.77 pCi/L (See Appendix A). DOE detected a maximum uranium concentration of 2,740 pCi/L north of the slough in 1999 and set an administrative target level of 300 pCi/L (90 percent reduction) as the remediation goal for the groundwater in the plume north of the slough. Uranium is attenuated through either precipitation as the groundwater passes through a geochemical reduction zone or adsorption onto aquifer materials. Modeling indicates that recharge from the area of impact north of the slough accounts for less than 1 percent of the total flow through the St. Charles County well field (DOE 2000a). If, after attaining the target level of 300 pCi/L attenuation were to become ineffective, the increase to the well field would be 3 pCi/L. If concentrations in groundwater south of the slough exceed the maximum contaminant level of 20 pCi/L, DOE will evaluate risk and take appropriate action (see Section 2.9.1.3, “Quarry Residuals OU”).

North of the slough, 2,4-DNT has been detected at one location in concentrations exceeding the Missouri regulatory limit of 0.11 µg/L. Concentrations have generally decreased since

completion of bulk waste removal activities from the quarry contamination. The target level for 2,4-DNT has been set at the Missouri State Water Quality standard.

The quarry groundwater monitor well network consists of wells arrayed in four "lines" between the quarry and the St. Charles County well field (Figure 2−3). The first and second lines are established to monitor the effect of residual quarry contaminants on groundwater quality within the alluvium and shallow bedrock north of Femme Osage Slough. The third line, consisting of wells completed in the alluvial aquifer south of the slough, is monitored to provide early warning of contaminant migration across the reduction zone and toward the well field. The fourth line, which consists of monitor wells installed by St. Charles County, are completed in the same portion of the aquifer from which the municipal water supply wells withdraw water. The purpose of the fourth line wells is to monitor water quality in the alluvial aquifer and monitor for occurrence of uranium at concentrations outside the range of natural variance.

Monitoring frequencies were established to (1) provide adequate warning of contaminant migration, taking into account travel times from known plume locations to critical locations upgradient of the well field; and (2) provide data adequate for valid statistical analysis of groundwater conditions. Aquifer hydraulic characterization results indicate that groundwater travel time from north of the slough to immediately south of the slough is approximately 1 year. Travel time between Lines 3 and 4 is slower because of a lower hydraulic gradient (DOE 2000a).

Parameters to be monitored include uranium and six nitroaromatic compounds (including 2,4-DNT) (Table 2−7). Uranium and 2,4-DNT were identified as contaminants of concern using the CERCLA process. Geochemical parameters will also be measured (pH, Eh [oxidation-reduction potential], sulfate, and iron oxidation state) to monitor the geochemical properties for the reduction zone and confirm that the reduction zone is capable of ongoing attenuation of uranium in groundwater. These results should correlate with observed uranium concentrations upgradient and downgradient of the reduction zone. DOE will establish institutional controls to prevent physical disturbance of the reduction zone.

Table 2–7. Groundwater Monitoring Program for the Quarry at the Weldon Spring, Missouri, Site

Monitoring Location Group	Sample Locations[a]	Sampling Frequency	Analytes (all wells)
Line 1	1002, 1004, 1005, 1027, 1030	Quarterly	Total uranium, 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, NB, pH, Eh, sulfate, total iron, and iron(+2)
Line 2	1006, 1007, 1008, 1009, 1013, 1014, 1015, 1016, 1031, 1032, 1045, 1046, 1047, 1048, 1049	Quarterly	
Line 3	1017, 1018, 1019, 1021, 1044, 1050	Semiannually	
Line 4	RMW-1, RMW-2, RMW-3, RMW-4	Annually	

[a]Sample location identifiers for Lines 1, 2, and 3 have "MW–" prefixes.
Note: DNB = dinitrobenzene; DNT = dinitrotoluene; NB = nitrobenzene; TNB = trinitrobenzene; TNT = trinitrotoluene, Eh = oxidation-reduction potential

North of the slough, data from wells in Lines 1 and 2 will be analyzed to demonstrate that the target concentration for uranium and the regulatory limit for 2,4-DNT are attained. Data analysis will be conducted in accordance with methods described in *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Groundwater* (EPA 1992). Cleanup objectives are met when the uranium target concentration of 300 pCi/L and the 2,4-DNT standard of 0.11 µg/L

are not exceeded at the 90th percentile in a 12-month monitoring period, and trend analysis indicates that contaminant levels are decreasing. If either analyte meets these criteria, monitoring of that analyte can be discontinued.

South of the slough, uranium concentrations will be compared to the EPA maximum contaminant level of 20 pCi/L, and analytical results will be evaluated for the presence of nitroaromatic compounds to verify that groundwater is not affected. If elevated uranium levels are detected, DOE will implement the contingency actions presented in Section 2.9.1.3, "Quarry Residuals OU."

DOE backfilled the quarry and graded the surface to create positive drainage. Therefore, surface water will not accumulate within the quarry. No surface water monitoring is required as part of remedy implementation for the Quarry Residuals OU; however, DOE will monitor surface water at four locations along Femme Osage Slough, as shown on Figure 2–5. During high groundwater levels, this portion of the slough is recharged by groundwater.

2.7.4 Disposal Cell LCRS Monitoring and Operation

The LCRS requires periodic monitoring to ensure the system is functioning as designed and sump capacity is not exceeded. Monitoring will indicate if the secondary leachate collection system is collecting leachate, either as a result of primary liner leakage or from another source. Liquid levels in the secondary sump containment must be monitored. DOE will remove and dispose of leachate at a frequency sufficient to prevent leachate volume from reaching the maximum capacity of the sump. Section 303(c) of 40 CFR 264 requires that after the final cover is installed, the amount of liquids removed from the sump be recorded at least monthly. If the liquid level in the sump stays below the pump operating level for two consecutive months, the amount of liquids in the sump must be recorded at least quarterly. If the liquid level in the sump stays below the pump operating level for two consecutive quarters, the amount of liquids in the sump must be recorded at least semiannually. If at any time during the postclosure care period the pump operating level is exceeded on quarterly or semiannual recording schedules, the recording of amount of liquids must return to monthly until the liquid level again stays below the pump operating level for two consecutive months. "Pump operating level" for the Weldon Spring Site is defined as the maximum amount of liquid in the sump, which equals 11,200 gallons. Leachate production rates, analytical results, and disposal records will be archived with the site surveillance and maintenance records at the DOE office at Grand Junction and summarized in the annual report. Monitoring and operating procedures are specified in Appendix I.

Leachate level and flow rates will be monitored and recorded daily at the outset. 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 will be reported in units of gallons per day and compared to the action leakage rate of 100 gallons/acre/day established for the leachate collection system. See Section 2.9.2.2, "Action Leakage Rate" for more information regarding the action leakage rate.

During 2002, discharge from the primary collection system was less than 300 gallons per day, and combined discharge from the east and west secondary collection system was less than 20 gallons per day. In January 2003 and December 2003 the flow decreased to 240 gallons per acre per day and 207 gallons per acre per day, respectively. The secondary discharge decreased to 16 gallons per acre per day in 2003.

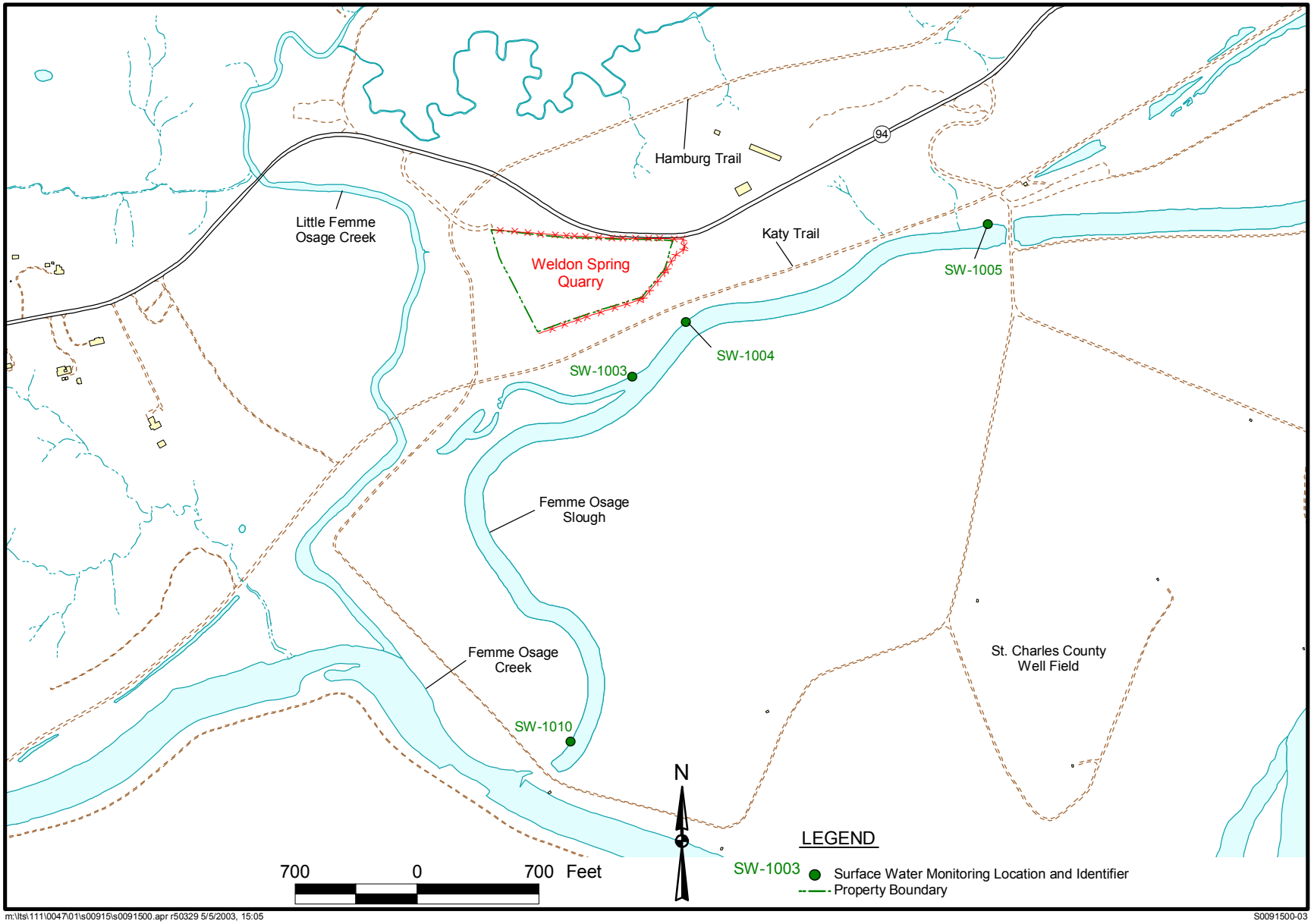

Figure 2–5. Surface Water Monitoring Locations at the Quarry Area of the Weldon Spring, Missouri, Site

2.7.4.1 Leachate Chemistry Monitoring and Disposal

The leachate has been sampled quarterly since generation for an extensive list of chemical and radiological constituents. Beginning in calendar year 2003, the leachate is sampled semiannually in accordance with Appendix K "Disposal Cell Groundwater Monitoring Plan." The list of analytes is included in the plan. 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. An aliquot of leachate is collected for each approximately 3,000 gallons of leachate, composited, and analyzed in accordance with MSD requirements (Appendix I). DOE has an allowance of 0.15 millicuries per year of radioactivity and 15,000 gallons per month. Leachate uranium activity during 2002 typically was 50 pCi/L, which is equivalent to an annual radioactivity of approximately 0.02 millicuries. The 2003 annual average for uranium was 26 pCi/L with the December 2003 value at 14 pCi/L.

2.7.5 Air Monitoring

Because radioactive and asbestos waste handling operations were complete, and waste was encapsulated in the disposal cell, DOE halted air monitoring at the site perimeter and at off-site locations for radon-222, thoron (radon-220), and particulates in 2000. Radon flux measurements collected on the first foot of the 3-foot-thick layer of the radon barrier averaged less than 5 percent of the regulatory limit of 20 pCi per square meter per second (DOE 2001a). Therefore, no postclosure radon monitoring is required.

2.8 Regulatory Compliance Monitoring

At the time of the routine site inspection, DOE will evaluate the degree of compliance with regulations governing surveillance and maintenance activities at the Weldon Spring Site. Those regulations are specified in Section 1.2, "Legal and Regulatory Requirements."

An evaluation of regulatory compliance may be required at other times as well, in response to unusual or nonroutine occurrences. The results of this monitoring will be presented in the annual report. However, if DOE identifies instances of noncompliance that necessitate corrective action, DOE will inform EPA and MDNR of site conditions as soon as they are assessed.

2.9 Emergencies, Contingency Planning, and Corrective Action

Emergency measures are the actions DOE will take in response to "unusual damage or disruption" that threatens or compromises site safety or security, such as exposure or release of cell contents. DOE will contain and manage radioactive or hazardous materials that are the responsibility of DOE in the unlikely event such materials are discovered or released. Certain circumstances may arise during the surveillance and maintenance phase of the Weldon Spring Site that requires implementation of contingency actions. To the extent these actions can be anticipated and planned for (e.g., the quarry well field contingency plan), they have been incorporated into RODs and RD/RA workplans. Unanticipated contingency actions will be subject to CERCLA processes prior to implementation. Certain options under CERCLA, which will be evaluated, include emergency or time-critical actions, IRAs, and changes or amendments to the RODs.

Site inspections, monitoring, and maintenance activities are designed to identify potential problems before they develop into a need for corrective action. However, in the unlikely case that extreme natural events, vandalism, or unanticipated events threaten the integrity and operation of the disposal cell, corrective actions that could include temporary emergency measures will be carried out to mitigate the problem. In addition, DOE will evaluate the factors that caused the problem and ensure that the possibility of recurrence is minimized or avoided.

DOE will notify EPA, MDNR, and St. Charles County as soon as an emergency situation is known to exist. The Missouri Department of Health and Senior Services will be notified, if appropriate. Emergency contact information will be maintained in Appendix F of this plan. DOE also will maintain a listing for local DOE contact phone numbers in the local telephone directories.

As soon as practical after initial emergency response notifications have been made and appropriate measures have been initiated, the following stakeholders will be notified of the situation: Weldon Spring Citizens Commission (WSCC), MoDOT (local), MDOC (local), Francis Howell High School, and Francis Howell School District. A listing of these emergency notification contacts will also be maintained in Appendix F.

DOE will send letters to and request acknowledgement from the St. Charles County Sheriff's Department in St. Charles to notify the DOE office at Grand Junction in the event of unauthorized human intrusion or unusual natural events, and to the U.S. Geological Survey National Earthquake Information Center in Denver to notify the DOE office at Grand Junction in the event of an earthquake in the vicinity of the site. These agencies will contact DOE should an event occur that might affect the control of known contaminants or the condition of site surveillance features at the Weldon Spring Site. In addition, DOE monitors emergency weather notification system announcements.

The public may use the 24-hour security telephone numbers monitored at the DOE office at Grand Junction (970-248-6070 or 877-695-5322), or the telephone number for local site support personnel (636-300-0012) to notify DOE of site concerns.

For the purposes of this plan, corrective action refers to specific occurrences listed below. Minor problems such as filling potholes, repairing drainage structures, and repairing monitoring equipment are completed under normal site maintenance procedures. Occurrences that require corrective action will generally be those that indicate a potential release of contamination from the disposal cell or otherwise threaten the health and safety of the public or the environment.

Occurrences that may require corrective action include

- Concentration limits exceeded or sustained upward trends at monitoring locations.
- Damage to the disposal cell that could potentially allow release of contamination and/or threaten the health and safety of the public or the environment.
- Excessive leachate production in the disposal cell.
- Rapid headward erosion of nearby drainages.

2.9.1 Groundwater Contingency Actions

2.9.1.1 Disposal Cell Groundwater Corrective Action

If it is determined that leakage from the disposal cell has resulted in deterioration of the groundwater at the Chemical Plant, a review of the remedy will be necessary. This is based on the condition that the remedy is not behaving as expected and may no longer be protective of human health and the environment. Modifications or actions would be documented under CERCLA and would be consistent with RCRA 40 CFR 264.100 At this time, a modification of this program would be documented in collaboration with the EPA and MDNR.

2.9.1.2 Groundwater OU

Trigger concentrations have been assigned at appropriate locations as indicators of changed conditions or of potential for impact. Responses will range from data verification and increased monitoring to reevaluation of MNA timeframes.

Upon initial exceedence of a trigger concentration, confirmatory samples will be collected to assure that laboratory error has not occurred. If the confirmatory sample confirms the original data point is correct, sampling frequency will be increased to quarterly to determine if the event represents a sustained upward trend. If this is the case, sampling frequency will be increased at other nearby locations. If other locations are also affected above the baseline conditions, then the increased frequency of sampling will continue to be expanded to other wells in order to gather additional information to determine the cause.

If the second higher concentration (Tables 2−5 and 2−6) is exceeded, additional existing monitoring wells will be included in the sampling program. The MNA timeframes and the adequacy of the institutional controls will also be reevaluated.

The monitoring program has also been developed to recognize any of the following observations that could lead to reconsideration of the remedy:

- A sustained upward trend in contaminant concentrations in groundwater or spring water, indicating that undiscovered sources may be present.
- Trends in contaminant concentrations that are inconsistent with meeting cleanup goals within a reasonable timeframe.
- Significant increases in the areal or vertical extent of contamination, resulting in new impacts to adjacent (both horizontal and vertical) groundwater systems.

Should an alternative to MNA be needed, it will be implemented in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) process for post-ROD changes. If the remedy requires immediate action, a time-critical removal will be conducted. Alternatives other than MNA will be reevaluated and will include in situ chemical oxidation as well as other treatment or containment technologies that may be available in the future.

2.9.1.3 Quarry Residuals OU

Groundwater from the St. Charles County well field located south of Femme Osage Slough is used for residential purposes. Monitoring data indicate that uranium concentrations in this area are within the range of background concentrations for the Missouri River alluvium. Because removal of major sources of contamination has been completed, no significant amounts of additional contaminants should be introduced into the groundwater system. However, because of the presence of uranium in groundwater north of the slough, contingency actions have been considered in the event that uranium concentrations increase or uranium from the quarry is observed in groundwater south of the slough.

During bulk waste removal activities, a well field contingency plan (DOE 1992) was prepared to address concerns about the protection of the well field in the event contaminants were mobilized due to remedial actions. The monitoring and contingency action portions of the contingency plan have been incorporated into this LTS&M Plan. If an alternate source of drinking water is required, engineering design and construction will proceed based on the design criteria that was presented in the contingency plan (Appendix L). The contingency plan also outlined the preliminary planning and preparation that will be necessary to implement the construction of new wells in the existing well field or a partial or full replacement well field.

The quarry groundwater monitor well network consists of wells arrayed in four "lines" between the quarry and the St. Charles County well field. The first and second lines are established to monitor the effect of residual quarry contaminants on groundwater quality within the alluvium and shallow bedrock north of Femme Osage Slough. The third line, consisting of wells completed in the alluvial aquifer south of the slough, is monitored to provide early warning of contaminant migration toward the well field. The fourth line consists of monitor wells completed in the same portion of the aquifer from which the water supply wells withdraw water and whose purpose is to monitor the water quality in the alluvial aquifer and monitor for occurrence of uranium at concentrations outside the range of natural variance.

If a consistently upward trend in uranium or 2,4-DNT concentrations is observed for three consecutive sampling events in the groundwater north or south of the slough, DOE will investigate the contaminant source and transport mechanism. This may include conducting hydrogeologic and geochemical investigations, installing additional monitor wells, or increasing sampling frequency of the monitoring network.

If uranium concentrations in groundwater south of the slough exceed the trigger level of 20 pCi/L, DOE will notify EPA Region VII, MDNR, and St. Charles County as soon as the condition is confirmed. Confirmation may include reanalyzing samples, if possible, or resampling the locations in question and other potentially affected locations and submitting the samples to analytical laboratories for expedited analysis.

If the elevated uranium concentration is valid, DOE will reevaluate the potential for impacts to the well field and the alluvial aquifer. This evaluation may include

- Increasing the frequency of sample collection.

- Performing hydrogeologic and/or contaminant transport investigations to identify migration pathways.
- Installing additional monitor wells.
- Conducting groundwater modeling to predict long-term impacts.
- Conducting a risk evaluation consistent with methods outlined under CERCLA.
- Determining the need for and feasibility of groundwater remediation.
- Installing new production wells in the existing well field, or partial or full replacement of the well field in an alternate location.

2.9.2 Disposal Cell Contingency Actions

2.9.2.1 Leachate Contingency Treatment

Prior to obtaining approval to dispose of leachate in the regional water treatment system, DOE designed a dedicated water treatment plant (referred to as Train 3) to decrease manganese and uranium levels. DOE constructed a treatment building and installed some of the required equipment. The plant was not completed as an automated system, but DOE will modify the equipment to function as a manually operated batch treatment system, if needed. The system will use chemical precipitation to remove manganese and ion exchange resin columns to remove uranium.

Treated leachate will be sampled before discharge. Leachate will be pumped into a dedicated pipeline and discharged to the Missouri River at National Pollutant Discharge Elimination System (NPDES) Outfall 007 in accordance with DOE's NPDES permit. DOE will maintain the NPDES permit for the discharge point (outfall) of the discharge line, for possible future use.

The *LCRS/Train 3 Treatment Contingency Plan* is included as Appendix J (see also the *Leachate Collection and Removal System Operating Plan* in Appendix I).

2.9.2.2 Action Leakage Rate

As outlined in the Notice of Final Rulemaking, *Federal Register* Volume 57, Number 19, dated January 29, 1992, EPA recommends 100 gallons/acre/day for land disposal units meeting the minimum required design specifications. However, the final rule allows the owner/operator to calculate an action leakage rate based on site-specific design of the unit. The calculated action leakage rate should be based on calculations of the maximum flow capacity of the leak detection system so as not to exceed one foot head on the bottom liner. Based on the site specific design, the calculated action leakage rate for the Weldon Spring Site disposal cell is 2,640 gallons/acre/day. For the 26.5-acre waste footprint within the disposal cell, this converts to 69,960 gallons per day. As a more practical number, the DOE agreed to use the recommended 100 gallons/acre/day as the action leakage rate for the disposal cell. The actual combined secondary flow rates recorded at the end of December 2002 were less than1 gallon/acre/day (100 times less than the action leakage rate). The average flow rates for 2003 were approximately 0.6 gallon per acre per day.

In accordance with EPA regulations (40 CFR 264.304), if the action leakage rate is exceeded, DOE will notify EPA and MDNR within 7 days of the determination. A preliminary written assessment of the determination will be submitted within 14 days and will include amount of liquids, likely sources of liquids, and possible location, size, and cause of any leaks, and short-term actions taken and planned. Other actions to be taken will be to:

- Determine any other short-term and longer-term actions to be taken to mitigate or stop any leaks.
- Submit to EPA and MDNR, within 30 days after the original notification, results of the above actions taken and the actions planned. DOE will continue to submit this report monthly to EPA and MDNR as long as the flow rate exceeds the action leakage rate.

To make the above determinations the DOE will

- Assess the source of liquids and amounts of liquids by source.
- Conduct a fingerprint, hazardous constituent, or other analysis of the liquids in the leak detection system to identify the source of liquids, possible location of any leaks, and the hazard and mobility of the liquid.
- Assess the seriousness of any leaks in terms of potential for escaping into the environment.

DOE has considered possible events involving the disposal cell that may require response actions. A summary of event scenarios and corresponding response actions is provided in Table 2−8. Triggers for specific response actions are provided in the inspection checklists in Appendix H. If a trigger is met, DOE will notify authorities in accordance with Section 2.9, "Emergencies, Contingency Planning, and Corrective Action."

2.10 Permit and Agreement Administration

Certain permits and agreements will be required for DOE to carry out its role as steward at the Weldon Spring Site. These instruments are summarized in Table 2−9. DOE will keep these permits current, comply with conditions of the agreements, and terminate the agreements when they are no longer needed. Other agreements that are part of a selected remedy are discussed as institutional controls.

2.11 Budget and Funding

DOE will request adequate funds to maintain the remedies specified in the RODs for the site. DOE will be appropriated funds to conduct long-term surveillance and maintenance at the Weldon Spring Site as part of an annual Congressional appropriation.

Approximate total funding to implement the surveillance and maintenance program described in the LTS&M Plan is estimated in 2005 dollars (Table 2−10). Additional funds are available to complete site restoration and implement the final Groundwater OU ROD. Costs for prairie maintenance and leachate disposal should decrease over the next 10 years. Contingency funds, if needed, will be drawn from Congressionally appropriated funds.

Table 2–8. Potential Disposal Cell Event Scenarios for the Weldon Spring, Missouri, Site

Event Scenario	Response Action
Biointrusion**,** consisting of unwanted, deep-rooted plants invading the cover, or burrowing animals that could compromise proper functioning of the rock cover, drain layer, or radon/infiltration barrier. The riprap rock cover acts as a biointrusion barrier to discourage these occurrences. If the biointrusion accelerates a breakdown of the rock cover, it may not provide sufficient protection against erosion. If the drain layer becomes clogged with plant roots, it may not function properly (drain laterally) and may cause a head buildup with a resulting greater infiltration through the radon/infiltration barrier. Full penetration of the radon/infiltration barrier could result in potential radon emissions or an overall increased infiltration rate through the cover.	Annual maintenance will include spot application of an approved herbicide to kill observed vegetation on all rock-covered surfaces of the cell and the cell perimeter road. Dead vegetation will not require removal. Burrowing animals within the cell footprint will be removed in accordance with an approved method. If penetration of the composite liner (geomembrane) has occurred, the damage to the cover material will be evaluated. If necessary, the liner will be repaired using similar materials and construction practices, provided an assessment of the problem does not indicate a design flaw. If the radon/infiltration barrier has been fully penetrated, the barrier will be repaired. Air monitoring for radon emissions may be used to evaluate the effect of biointrusion on the radon barrier. Monitoring stations will be established on the disposal cell and at the project boundaries. If a repair is made, air-monitoring stations will be added in the work zone. Monitoring will continue through the response action period until it is determined that the potential for radon exposure is controlled. Monitoring frequency for leachate production rate and chemistry may be increased following discovery of the problem.
Degradation of Radon/Infiltration Barrier performance could result from rupture due to differential settlement caused by unexpected deterioration in the waste or cracking from drying of the medium- to high-plasticity clays. The possibility of these scenarios occurring is remote because controlled waste placement limits differential settlement, and the thick layer of rock cover materials over the radon/infiltration barrier reduces the potential for drying. Some desiccation cracking is expected in the radon/infiltration barrier in the bentonite in the geomembrane, but this should be limited to near the surface of the barrier. In addition, the ability of the clayey radon/infiltration barrier to deform plastically allows the disposal cell to accommodate some settlement beyond design-predicted values.	If settlement is observed during an inspection or indicated in evaluation of aerial topographic maps, and the observed settlement might result in ponding or degraded radon/infiltration barrier performance, a professional engineer will perform an analysis to evaluate the potential for reduced performance of the barrier with regard to radon attenuation and resistance to infiltration. If the engineering evaluation indicates that the observed settlement has the potential to degrade performance of the radon barrier, monitoring for radon emissions will begin at the suspected areas, and leachate production rates and monitoring results will be evaluated. An evaluation of these data will determine if repair of the radon/infiltration barrier is necessary.
Erosion of the Rock-Covered Areas may be caused by slope failure, disruption of the riprap rock armor, or concentrated flows leading to headward cutting and gully formation. If allowed to continue, subsequent erosion of the radon/infiltration barrier may occur.	Should the area of erosion-altered riprap cover exceed 30 ft in length and 3 inches deep, and evaluation indicates a threat to containment integrity, DOE will repair the cover by replacing materials. Repairs of smaller erosional features may be deferred; however, monitoring frequency will double. The root cause of the erosion (e.g., storm, snowfall, extreme temperatures, earthquake event, human intervention) will be analyzed, and appropriate measures will be taken to mitigate the mechanism causing the erosion.

Table 2–8 (continued). Potential Disposal Cell Event Scenarios for the Weldon Spring, Missouri, Site

Event Scenario	Response Action
Erosion of the Site Outside the Disposal Cell may occur as rilling or gullying in areas constructed for sheet flow drainage. Rilling is the development of numerous, minute, closely spaced channels resulting from uneven removal of surface soil by streamlets of sufficient discharge and velocity to generate cutting power. If concentrated flows continue, rilling can progress into gullying with associated headward (upstream) cutting. Gullying can occur in areas of concentrated flow such as drainage channels. To prevent this, the final site grading minimizes any concentrated flows and promotes sheet flow. In addition, vegetation and rock armor are used to reduce surface erosion.	Should observed erosional damage threaten cell system integrity or create off-site sediment transport, a repair to the surface will be made. Repairs of smaller erosional features may be deferred; however, monitoring frequency will double. Erosion features oriented toward the disposal cell will require prompt repairs. Methods and materials used in the repair may include regrading, revegetating, erosion mats, rock armor, etc. The cause of the erosion (e.g., storm, snowfall, vegetative growth, human intervention) will be analyzed, and appropriate measures will be taken to mitigate the mechanism causing the erosion.
Rock Cover Deterioration may occur over time as a result of physical and chemical weathering of the limestone cobbles and boulders. Accelerated chemical weathering of the rock can occur if slightly acidic rainwater reacts with the limestone and dissolves the rock. Accelerated physical weathering can occur if the rock has abundant fractures that, after becoming saturated, are exposed to freezing conditions. This causes the water in the fractures to expand and mechanically break the rock apart.	If the percentage of degraded rock appears to increase between two consecutive inspections, DOE may initiate controlled monitoring by point count, photography, gradations, or other method. If controlled monitoring indicates that the median diameter (D_{50}) of the rock may be approaching the threshold levels (see below), DOE will conduct an engineering evaluation to determine if rock degradation has or is expected to reduce erosion protection to less than one half of a 24-hour probable maximum precipitation event. If the gradation for the area is still within initial specifications, the area will continue to be monitored as recommended by a professional engineer. Degraded rock may be replaced under the following conditions: • The D_{50} of the cell cover rock inside the parietal line halfway between the cell apex and the slope break equals 3 inches. • The D_{50} of the remaining cell cover rock inside the slope break line equals 4 inches. • The D_{50} of the rock in the clean fill dike slopes, except the north slope, equals 4 inches. • The D_{50} of the rock in the north clean fill dike slope equals 6 inches. • The D_{50} of the toe apron rock equals 6 inches.

Table 2–8 (continued). Potential Disposal Cell Event Scenarios for the Weldon Spring, Missouri, Site

Event Scenario	Response Action
Abnormal Functioning of the LCRS may be potentially caused by the following factors: • *Cover damage or reduced lateral drainage in the cover drainage layer*. Damage to the cover from biointrusion or settlement is discussed above. Reduced lateral drainage in the cover drainage layer may increase the head above the radon/infiltration barrier and result in increased infiltration through the barrier. • *Clogging and reduced flow capacity in the drain piping system.* In the event of clogging of the LCRS drains, a secondary gravel drainage channel is available to prevent leachate buildup in the waste. • *Increase in the permeability of the supporting liners.* Progressive failure due to deterioration of the liners is accounted for in the normal operation during the long and very long term by designing the cell to function as if no synthetic liner is present. A 3-foot-thick compacted clay liner and at least 20 feet of unsaturated low-permeability soils below the LCRS will severely limit vertical migration of any seepage resulting from failure of the LCRS and will function as a geochemical barrier.	If the leachate collection rate increases significantly in the primary system, an evaluation of the cover (including lateral drainage in the drainage layer similar to biointrusion or settlement scenarios) will be implemented. If clogging of the LCRS piping is suspected, measured steps will be taken to isolate and clean out the affected area. If the action leakage rate is exceeded in the secondary system, actions will be taken in accordance with 40 CFR 264.304. These actions are discussed in Section 2.9.2.2, "Action Leakage Rate."

Table 2–9. Permits and Agreements for the Weldon Spring, Missouri, Site

Type	Party	Description
Approval Authority	MSD	Approval to allow hauling and discharge of the leachate and monitor well purge water to the Metropolitan St. Louis Sewer District.
NPDES Permit (MO-0107701)	MDNR	Allows discharge of treated leachate and well purge water as a contingency.
Federal Facility Agreement (CERCLA-VII-F-0057)	EPA	Enforceable agreement with EPA for completion of remedial action activities and documentation.
Interagency Agreement	DOD OSC	For shipment of low-level radioactive wastes to off-site landfills.
License Agreement	MDNR	Katy Trail Information Center.
Consent Agreement (95-HW-000)	MDNR	Site Treatment Plan for the treatment of Mixed Waste that is stored for longer than one year.
Access Agreement	MDNR	To allow vehicles access on the Katy Trail.
Monitor Well Registrations	MDNR	Required for existing monitor wells.

DOD OSC = Department of Defense Operations Support Command
MDNR = Missouri Department of Natural Resources
MSD = Metropolitan St. Louis Sewer District
NPDES = National Pollutant Discharge Elimination System

Table 2–10. Estimated Annual Funding Requirements for Long-Term Surveillance and Maintenance of the Weldon Spring, Missouri, Site—Base Year Fiscal Year 2005

Item	Estimated cost
Monitoring[a]	
Labor	$292,000
Groundwater & surface water analyses	$156,900
Leachate analysis	$14,900
Operations and Maintenance[a]	
Labor	$24,000
Disposal Cell	$5,000
Erosion control & roads	$26,500
LCRS & leachate disposal	$33,000
Monitor well replacements/repairs	$101,500
Annual Inspection & Meeting (includes labor)	$20,900
Reporting/ Administrative (includes labor)	$39,000
Interpretive Center/Prairie (includes labor)	$160,500
Other Participants[a]	$125,000
Subtotal	$999,200
10% contingency	$99,900
	$1,099,100
Escalation from 2003 to 2005 @ 2.1%/yr	$46,200
Total (2005 dollars)	$1,145,300

[a]These costs are anticipated to decline throughout the surveillance and maintenance period.
Note: LCRS = Leachate Collection and Removal System

2.12 Records and Data Management

Ssite surveillance and maintenance records are maintained at the DOE office at Grand Junction. These records have been selected because they contain critical information needed to ensure the continued management and the follow-on actions and controls (including property management) required to protect public health and the environment and to demonstrate compliance with applicable legal requirements. This surveillance and maintenance record collection does not include information pertaining to employee or public health and safety issues with respect to former site operations.

Access and Retrieval—The records at the DOE office at Grand Junction are available to the site custodian as well as all stakeholders. Key site documents (e.g., closure reports, environmental assessments, fact sheets, RODs, inspections, and long-term surveillance plans) and site mapping/environmental data (e.g., boundaries, structures, and wells) are viewable on the Internet at http://www.gjo.doe.gov/programs/ltsm.

In addition, DOE will maintain local access at the Weldon Spring Site Interpretive Center and at the Middendorf-Kredell branch of the St. Charles City-County Library System to selected site documents.

The local surveillance and maintenance documents available at the Interpretive Center will include the following (only those documents marked with an asterisk will be maintained at the library):

- The Administrative Record (includes documents supporting site remedy selection).
- *The Administrative Record index.
- *RODs for the Chemical Plant OU, Groundwater OU, Quarry Bulk Waste OU, and Quarry Residuals OU.
- Closure reports documenting final site conditions.
- Site atlas (vicinity, topographic, and base maps).
- *The LTS&M Plan (this document).
- DOE real property records, including legal descriptions for DOE-owned property.
- Baseline and aerial photographs.
- Groundwater monitoring reports.
- *Annual reports.
- 5-Year review reports.
- Follow-up or contingency inspection preliminary assessments and reports.
- Site maintenance or repair reports.
- Corrective action plans and reports.

These documents will either be available electronically or as printed material. In either case, DOE will attempt to provide a means for users to obtain a printed copy of the information.

Pre-Surveillance and Maintenance Record Collection—The Regional Records Center is the federal records repository in Kansas City, Missouri, and is the designated archive facility for Weldon Spring records created during the operation and remediation of the site. To facilitate retrieval of records after site operations cease, and because the greatest repository of site knowledge will reside with the site steward, DOE will obtain copies of box and file indices and Records Transmittal and Receipt forms (SF 135) for the site. These indices and SF 135s will be retained with the surveillance and maintenance collection.

In addition, DOE will have custody of site documents residing in the federal records center and will be notified prior to the destruction of any temporary records.

Original real property records are retained and maintained by a federal real property specialist.

Regulatory Requirements—Weldon Spring Site records are maintained in full compliance with DOE requirements:

- 36 CFR Parts 1220–1238, "National Archives and Records Administration"

- Title 44, *United States Code* (U.S.C.), Chapter 29, "Records Management by the Archivist of the United States and by the Administrator of General Services," Chapter 31, "Records Management by Federal Agencies," and Chapter 33, "Disposal of Records."

2.12.1 Site Drawings and Photographs

Weldon Spring Site conditions were documented with as-built drawings and maps. Aerial photographs of the Weldon Spring Site were taken regularly. These drawings and photographs will be maintained in the permanent site record at the DOE office at Grand Junction.

2.12.2 Site Maps

The maps for the Weldon Spring Site Chemical Plant and quarry areas (Figure 2−2 and Figure 2−3) show the locations of the property boundaries, structures, roads inside and near the property boundaries, monitor wells, survey monuments, section, township, range, and principal meridian. Map data are maintained in a geographical information system database.

The site map data will be used to generate maps for site inspections. After each inspection, new inspection maps will be prepared that show the locations of items of interest noted during previous inspections. Each site inspection map will indicate the year of the inspection and inspection purpose.

2.12.3 Site Record Drawings and Maps

Site record drawings and maps represent final site conditions and configurations of the cell, structures, monitor wells, and other site features. These drawings and maps are included in the Remedial Action Reports for each OU, and will be managed in the permanent Weldon Spring Site records file at the DOE office at Grand Junction.

2.12.4 Site Baseline Photographs

Photographs taken during various phases of Weldon Spring Site remediation and a photographic record of final site conditions are maintained in the Weldon Spring Site permanent site file. These photographs provide a visual record to complement the as-built drawings and maps.

Initial site features will be photographed by DOE. This initial set of photographs will serve as site baseline photographs.

2.12.5 Site Inspection Photographs

Photographs will also be taken during subsequent site inspections to document current conditions, especially new or changed conditions, at the site. Comparison of current photographs with the baseline set of photographs will be useful to document steady or changing conditions at the site over time.

2.12.6 Site Aerial Photographs

Aerial photographs of the Weldon Spring Site (in black and white or color) have been taken numerous times during operation and reclamation of the site. The photographs provide a record for monitoring changing conditions (e.g., erosion, vegetation, and land use) over time and are preserved in the permanent site file.

2.13 Quality Assurance

The long-term custody of the Weldon Spring Site and all activities related to the annual surveillance and maintenance of the site will comply with DOE Order 414.1A, *Quality Assurance*, the DOE contractor's *Long-Term Surveillance and Maintenance Program Quality Assurance Program Plan* (DOE 1999c), and the draft *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (ASQC 1994).

Quality assurance requirements will be transmitted through procurement documents to subcontractors when appropriate.

Specific quality assurance requirements and protocols for Weldon Spring Site monitoring operations are contained in the *Environmental Monitoring Plan* (DOE 2003) and the *Groundwater and Surface Water Sampling and Analysis Plan for GJO Projects* (DOE 2002d).

2.14 Health and Safety

Health and safety procedures for LTSM Program activities are consistent with DOE orders, regulations, codes, and standards. LTSM Program activities at the Weldon Spring Site are conducted in accordance with the *Health and Safety Manual* (STO 2) and the Weldon Spring Site Project Safety Plan. Weldon Spring Site contractors and subcontractors must read the plan and sign a Statement of Understanding for the program files.

Immediate health and safety concerns are listed in the Weldon Spring Site Project Safety Plan. Before performing LTSM Program activities, LTSM Program staff and contractors will conduct a site safety briefing, after which attendees must sign an attendance roster.

DOE placed a health advisory at the bottom end of the disposal cell ramp, advising the public that the climb to the top of the cell may exceed their physical abilities.

3.0 Glossary

Alluvium: Sediments generally composed of clay, silt, sand, gravel, or similar unconsolidated material deposited by flowing rivers.

Aquifer: Rock or sediment that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

Background level: 1. The concentration of a substance in an environmental medium (air, water, or soil) that occurs naturally or is not the result of human activities. 2. In exposure assessment the concentration of a substance in a defined control area, during a fixed period of time before, during, or after a data-gathering operation.

Confining unit: A layer of material of low hydraulic conductivity immediately above or below an aquifer that prevents the upward or downward movement of groundwater.

Contamination: Introduction into water, air, and soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use. Also applies to surfaces of objects, buildings, and various household and agricultural use products.

Exposure pathway: The course a contaminant takes from its source to the exposed individual. A complete exposure pathway generally requires four elements: (1) a source and mechanism of release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminant (referred to as the exposure point), and (4) an exposure route (e.g., external gamma irradiation, ingestion, inhalation, dermal absorption). If any of these elements is missing, the exposure pathway is considered incomplete.

Exposure scenario: A series of assumptions based on factors such as land use and human activities at a site. The major assumptions inherent to a scenario aside from land use, are the frequency and duration of exposure to a contaminant. These exposure assumptions are assigned numerical values along with assumptions regarding exposure pathways and estimate of exposure point concentrations to calculate potential intakes of a contaminant by a receptor. Typical exposure scenarios are residential, commercial/industrial, and recreational.

Feasibility Study (FS): 1. Analysis of the practicability of a proposal; e.g., a description and analysis of potential cleanup alternatives for a site such as one on the NPL. The feasibility study usually recommends selection of a cost-effective alternative. It usually starts as soon as the remedial investigation is underway; together, they are commonly referred to as the RI/FS. 2. A small-scale investigation of a problem to ascertain whether a proposed research approach is likely to provide useful data.

Groundwater: The supply of water found beneath the Earth's surface, usually in aquifers, which supply wells and springs.

Headward erosion: Occurs when the upper end of a drainage is cut back (lengthened in the upstream direction) by water as it flows in at its head.

Institutional controls: Controls such as deed restrictions, use restrictions, and permitting requirements that prohibit or limit activities that may result in exposure to contamination. Effective institutional controls must remain in effect for the duration of the hazard, survive a change in property ownership, and be enforceable. Institutional controls also include those which preserve knowledge and facilitate public education regarding hazards at a site in order to enhance protectiveness into the future.

Leachate: Water that collects contaminants as it percolates through wastes, pesticides or fertilizers.

Leaky confining unit: A layer or zone of relatively lower permeability material immediately above or below an aquifer that allows some upward or downward movement of groundwater.

Maximum Credible Earthquake (MCE): A measure of the greatest seismic load that can be expected at a given location. The Weldon Spring disposal cell was designed to withstand a maximum credible earthquake.

Operable Unit (OU): Term for each of a number of separate activities undertaken as part of a Superfund site cleanup.

Probable Maximum Precipitation (PMP): The greatest amount of precipitation for a given duration that is theoretically possible from a storm event at a particular geographical area at a certain time of year. PMP is derived by adjusting the results of depth-area-duration analyses of precipitation in major storms that have occurred or could have occurred in the area of interest for maximum moisture charge and rate of moisture flow. The Weldon Spring disposal cell was designed and built to withstand 38.4 inches of rainfall in 6 hours.

Protectiveness: Maintaining risks to human health and the environment to within approved limits.

Radioactivity: The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nucleus of an unstable atom.

Radon: A colorless, naturally occurring, radioactive, inert gas formed by radioactive decay of radium atoms in soil and rocks.

Radon/infiltration barrier: A layer of compacted low-permeability clayey soil in the disposal cell cover that slows the movement of radon enough for the radon to decay before it escapes, and prevents precipitation water from entering the disposal cell.

Raffinate: A waste product from a refining process.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at NPL sites under CERCLA.

Reduction zone: A subsurface zone with characteristics of a reducing environment, such as gray to black soils, presence of organic materials, and absence of iron oxides. Reducing indicates a chemical condition that will change the solubility of most metals (e.g., uranium is typically precipitated in a reducing environment).

Remedial Action (RA): The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Design (RD): A phase of remedial action that follows the remedial investigation/feasibility study and includes development of engineering drawings and specifications for a site cleanup.

RD/RA Work Plan: A plan implementing the requirements of a ROD consisting of a combination of the remedial design and remedial action phases.

Remedial Investigation (RI): An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site, establish site cleanup criteria, identify preliminary alternatives for remedial action, and support technical and cost analyses of alternatives. The remedial investigation is usually done with the feasibility study. Together they are usually referred to as the RI/FS.

Remediation: Removal of contamination at a site to levels that do not exceed pre-established goals, such as federal or state standards or alternate concentration limits that are protective of human health and the environment.

Risk: A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

Risk assessment: A process for organizing and analyzing information to determine if an environmental chemical might cause harm to exposed persons or the ecosystem. Risk assessments for the Weldon Spring Site conform to the procedures established by EPA. For human health, the EPA risk assessment process analyzes the possibility of cancer and noncancer effects caused by site contamination. EPA considers it acceptable if a person's chances of developing cancer (from site contaminants) are increased by only 1 chance in 1 million to 1 chance in 10,000 in addition to the chances of a person developing cancer from other causes. For noncancer effects, EPA compares the potential intake amount to the toxicitiy of the site contaminant. This ratio is called the hazard quotient; if one or more chemicals are present, the ratios are added to get a hazard index. EPA considers it not acceptable if the hazard quotient or hazard index is greater than 1.

Risk factor: Characteristics (e.g., race, sex, age, obesity) or variables (e.g., smoking, occupational exposure level) associated with increased probability of a toxic effect.

Route of exposure: The avenue by which a chemical comes into contact with an organism, e.g., inhalation, ingestion, dermal contact, injection.

Select soil waste: A silty-clayey soil, with at least 50 percent passing the No. 200 sieve and maximum particle size limited to 6 inches. For construction of the Weldon Spring disposal cell, the material for this layer was selectively retrieved from the available contaminated soils present on site. The material was free of debris that could damage the high-density polyethylene (HDPE) liner.

Stakeholders: Any organization, government entity, or individual who has a stake in or may be affected by an approach to environmental regulation, pollution prevention, energy conservation, and other activities.

Surveillance and Maintenance: All activities necessary to ensure protection of human health and the environment following completion of cleanup, disposal, or stabilization at a site or portion of site. Long-term surveillance and maintenance includes all engineered and institutional controls designed to contain or prevent exposure to residual contamination and waste, such as surveillance activities, record-keeping activities, inspections, groundwater monitoring, ongoing pump and treat activities, cap repair, maintenance of entombed buildings or facilities, maintenance of other barriers and contained structures, access control, and posting signs.

Stratigraphic unit: A stratum or collection of adjacent strata recognized as a unit in the classification of a rock sequence with respect to any of the many properties and attributes that rocks may possess, for purposes such as description, mapping, and correlation. Rocks may be classified stratigraphically on the basis of features such as color, properties (e.g., mineral content, radioactivity, chemical composition), age, and fossil content.

Superfund: The program operated under the legislative authority of CERCLA and the Superfund Amendments and Reauthorization Act of 1986 that funds and carries out EPA solid waste emergency and long-term removal and remedial activities. These activities include establishing the NPL, investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions.

Surface water: All water naturally open to the atmosphere (e.g., rivers, lakes, reservoirs, ponds, streams, impoundments, seas, and estuaries).

Transient drainage: Gravity drainage of water expelled from the pore spaces of soil encapsulated in the disposal cell. Water is introduced into the cell during construction as water added for compaction and dust control, as moisture in waste materials, and from precipitation. The weight of overlying material squeezes water from pore space, which drains out the bottom of the waste material. In the Weldon Spring disposal cell, this water is captured on the bottom liner system and conveyed to the LCRS. “Transient” refers to the fact that the cell cover prevents recharge of water into the cell, and drainage is an artifact of construction that will eventually reach zero flow.

Vicinity property: A discrete and off-site property or structure contaminated with hazardous materials that were derived from a processing site.

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