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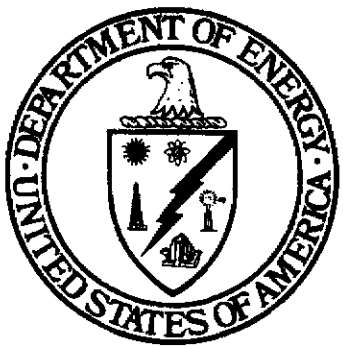
ENVIRONMENTAL MONITORING PLAN

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

JANUARY 2003 **REV. 10**



U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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Environmental Safety and Health Manager — Date: 1/6/03

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Project Director — Date: 1-7-03

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Weldon Spring Site Remedial Action Project

Environmental Monitoring Plan

Revision 10

January 2003

Prepared by

MK-FERGUSON COMPANY
and
JACOBS ENGINEERING GROUP
7295 Highway 94 South
St. Charles, Missouri 63304

for the

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

ABSTRACT

This plan is prepared to detail the environmental monitoring requirements for the Weldon Spring Site Remedial Action Project in accordance with Department of Energy Order 5400.1 and to ensure monitoring is sufficient to protect the environment and water users downstream of the Weldon Spring Site Remedial Action Project. The plan has been revised and reissued annually. Revision 10 of this document is the result of the re-evaluation of groundwater, National Pollutant Discharge Elimination System (NPDES), and surface water programs based on impacts from site remediation activities and past monitoring results. This plan addresses routine environmental monitoring only, and is not intended to present details of monitoring conducted under other plans for specific programs such as groundwater operable unit studies or LCRS water monitoring. Long-term monitoring and maintenance details can be found in the *Long-Term Stewardship Plan for the Weldon Spring Site.*

The Weldon Spring Site Remedial Action Project monitoring program is designed to monitor contaminants and their movement, as a result of completion of the remediation. It will also further characterize remaining contaminated matrices (i.e., groundwater) in order to model their behavior under specific conditions, and measure the effectiveness of completed remedial actions. Site specific criteria considered in planning the pathway analyses early in the project were: physical, chemical, and biological characteristics of the radiological and chemical contaminants; spatial distribution; concentrations; depth to groundwater; geology of the area; climatic conditions; how the area is used by the public and wildlife; and the proximity of contaminated sites to potential receptors.

This plan specifies the environmental monitoring program elements. Surface waters migrating off site will be sampled at downstream locations to ensure that uranium levels remain at or near background. Point discharges of storm water will be sampled in accordance with the NPDES permits issued to the Weldon Spring Site Remedial Action Project until the MDNR determines that the outfalls can be removed from the permits. The results will be reported to the Missouri Department of Natural Resources as required by the permits. Groundwater will be sampled at locations of known or potential impact to monitor the effects of remedial actions on groundwater quality and to monitor contaminant levels for comparison to water quality standards. Groundwater that surfaces at nearby springs will also be sampled to provide a complete assessment of the state of the groundwater system. Perimeter and critical receptor air monitoring was discontinued on December 31, 2000, because of the elimination of the potential sources of radiological airborne emissions. Meteorological monitoring was discontinued in March 2002 because the regulatory requirements are no longer applicable to this site.

SUMMARY OF CHANGES

Revision 10 of the *Environmental Monitoring Plan* is the result of the re-evaluation of groundwater, surface water and National Pollutant Discharge Elimination System (NPDES) monitoring programs based on changes in site remediation activities and past monitoring results at the site.

Several significant changes in site operations took place during the year 2002, including completion of backfilling, final grading, seeding and mulching of the quarry; completion of the Hamburg Trail; and return of the borrow areas to the Missouri Department of Conservation. As these types of major activities occurred, environmental monitoring needs were reevaluated, and appropriate changes were made to the *Environmental Monitoring Plan.*

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1. INTRODUCTION

The Weldon Spring Site Remedial Action Project (WSSRAP), at a site approximately 48 km (30 miles) west of St. Louis, in St. Charles County, Missouri has been completed as scoped to date. The project involved environmental remediation and restoration of the following: a 166-acre inactive uranium feed materials plant (normally referred to as the chemical plant), a 51-acre raffinate pit area, a 9-acre limestone quarry (located 4 mi from the chemical plant), and associated vicinity properties. Within the scope of remediation was cleanup of both radiological and chemical contaminants resulting from previous operations that included trinitrotoluene and dinitrotoluene production (1941-1945), and uranium metals production (1956-1966).

Remediation of the Weldon Spring site was conducted under the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) and as part of the U.S. Department of Energy (DOE) Environmental Restoration and Waste Management Program. The major goals of the WSSRAP were to eliminate potential hazards to the public and the environment, and to the extent practicable, make surplus real property available for other uses. An environmental documentation approach was developed that satisfied the requirements of both the CERCLA, as amended by the *Superfund Amendments and Reauthorization Act* (SARA), and the *National Environmental Policy Act* (NEPA). The results of this process were the *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry* (Ref. 1), the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 2) on ultimate disposal of the Weldon Spring site wastes, the *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri* (Ref. 3), and the *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (Ref. 4).

Because the WSSRAP was a remedial action project, the overall goal was different from that of the operating and/or production facilities for which DOE Order 5400.1, *General Environmental Protection Program*, was developed. The WSSRAP has prepared this *Environmental Monitoring Plan* (EMP) to meet the requirements for DOE environmental monitoring programs as specified in DOE Orders 5400.1 and 5400.5 and the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (Ref. 5), hereafter referred to as the *Regulatory Guide*.

The *Environmental Monitoring Plan* (Ref. 6) is reviewed annually and reissued at least every 3 years in accordance with DOE Order 5400.1; however, the EMP has been revised and reissued annually at the WSSRAP. If, during the monitoring year, significant deviations or alterations to this plan are necessary, approval by the DOE will be obtained. Any deviations or alterations are summarized and documented in the annual site environmental report for the year of occurrence.

1.1 Purpose

DOE Order 5400.1 requires the preparation of an environmental monitoring plan to define the effluent monitoring and environmental surveillance required to demonstrate compliance with applicable Federal, State, and local environmental protection laws and regulations, executive orders, and internal DOE policies.

The purpose of this plan is to detail the environmental monitoring requirements at the Weldon Spring site. Environmental monitoring is performed to document and quantify potential public exposure, to protect public health and safety and the environment, and to demonstrate compliance with applicable legal and regulatory requirements. The monitoring program also verifies adherence to DOE environmental protection policies and supports possible future remedial planning.

1.2 Scope

This plan describes the effluent monitoring and environmental surveillance activities that will be performed at the Weldon Spring site for 2003. These activities include monitoring of effluent, surface water and groundwater. The plan also describes applicable monitoring requirements, analytical methods used, and quality assurance measures. Details and rationale regarding sampling frequencies and analytical parameters are provided.

1.3 Site History

In April 1941, the Department of the Army acquired a total of 6,974 ha (17,232 acres) of land, and contracted with the Atlas Powder Company to operate 20 trinitrotoluene (TNT) and dinitrotoluene (DNT) explosives production lines. The plant was in operation from November 1941 through January 1944 and parts of 1945 and 1946 as part of the facility known as the Weldon Spring Ordnance Works. Four of the production lines were located on what is now the chemical plant/raffinate pits area and the remaining 16 production lines were distributed across an adjacent property that is now referred to as the U.S. Army Reserve and National Guard Training Area. By 1949, all but approximately 809 ha (2,000 acres) of this land had been transferred to the State of Missouri (August A. Busch Memorial Conservation Area and Weldon Spring Conservation Area) and the University of Missouri (agricultural land). Except for several small parcels transferred to St. Charles County, the remaining property became the Army training area.

Through a Memorandum of Understanding between the Secretary of the Army and the General Manager for the Atomic Energy Commission (AEC), 83 ha (205 acres) of the former ordnance works were transferred in May 1955 to the AEC for the construction of the Weldon Spring Uranium Feed Material Plant. Considerable explosives decontamination was performed

by Atlas Powder and the Army prior to construction of the feed materials plant. Until 1966, the feed materials plant was operated as an integrated facility for the conversion of processed uranium ore concentrates to pure uranium trioxide, intermediate compounds, and uranium metal. A small amount of thorium was also processed. Wastewater generated during these operations was settled in four raffinate pits on the site and the supernatant was discharged off site.

In 1958, the AEC acquired title to the Weldon Spring Quarry from the Department of the Army. The quarry is located approximately 5.6 km (3.5 mi) south of the feed materials plant. The Army had used it earlier for disposal of wastes from the manufacture of TNT and DNT, and for disposal of TNT-contaminated rubble during operation of the ordnance works. Prior to 1942, the quarry was mined for limestone aggregate used in construction of the ordnance works. The AEC used the quarry from 1963 to 1969 as a disposal area for uranium residues and a small amount of thorium residue. Disposed material included uranium-contaminated and radium-contaminated building rubble and soils from the demolition of a uranium ore processing facility in St. Louis. Other radioactive materials in the quarry included drummed wastes, uncontained wastes, and contaminated process equipment.

The Weldon Spring Uranium Feed Material Plant was shut down in 1966, and in 1967 the AEC returned the facility to the Department of the Army for a proposed defoliant production plant to be known as the Weldon Spring Chemical Plant. The Army started removing equipment and decontaminating several buildings in 1968, but the defoliant project was canceled in 1969 before any process equipment was installed. The Army retained responsibility for the land and facilities at the chemical plant, but the 20.6 ha (51-acre) tract encompassing the raffinate pits was transferred back to the AEC. From 1969 to 1981, the status of the Weldon Spring site did not change. The site was placed in caretaker status from 1981 through 1985, when custody of the chemical plant and quarry were transferred from the Department of the Army to the DOE . In 1985, the DOE proposed designating control and decontamination of the chemical plant, raffinate pits, and quarry as a major project.

A Project Management Contractor (PMC) for the WSSRAP was selected in February 1986. In July 1986, a DOE project office was established on site, and the PMC, MK-Ferguson Company (with Jacobs Engineering Group, Inc. as an integrated subcontractor), assumed control of the site on October 1, 1986. The quarry was placed on the Environmental Protection Agency National Priorities List (NPL) in July 1987. The DOE redesignated the site as a Major Acquisition System in May 1988. The chemical plant and raffinate pits were added to the NPL in March 1989.

The *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry* (Ref. 1) was signed in September 1990. This operable unit (OU) was designed to implement the early removal of the quarry bulk wastes without risk-based cleanup criteria being established. Strategies that supported the accelerated removal of this source of contamination

included limited characterization prior to remediation, a focused RI/FS, performing a limited Baseline Risk "*Evaluation*" to support the action, removal of wastes utilizing the observational approach, visual and some instrument scans to determine when an area was clean, and stockpiling the wastes in an environmentally safe storage facility until final disposition could be determined. The bulk waste from the quarry was stored (before placement in the disposal cell) at the temporary storage area (TSA), located at the chemical plant site. The quarry bulk waste excavation was completed on October 27, 1995.

Remedial investigations were conducted at the chemical plant/raffinate pits area in 1988 and 1989 under the CERCLA RI/FS process. These investigations included characterization of the groundwater; on-site soil contamination; contaminated sediments in off-site surface drainages, lakes, surface water, and springs; and chemical and radiological contaminants in the raffinate wastes. The results of each of these investigations have been published in the report, *Remedial Investigation for the Chemical Plant Area of the Weldon Spring Site* (Ref. 7). The *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 2), issued in September 1993, marks the selection of the final remediation and disposal method for the chemical plant and bulk wastes for the quarry.

The *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site* (Ref. 3) was signed in September 1998. The Quarry Residual Operable Unit (QROU) addresses residual conditions at the quarry; residual contamination at the quarry proper, the Femme Osage Slough, and nearby creeks; and contaminated groundwater located north of the Femme Osage Slough. Potential impacts to the St. Charles County well field, located downgradient of the quarry area, were also addressed as part of the evaluation for this operable unit. The selected remedy for the QROU is long-term monitoring to verify that conditions at the quarry area and the St. Charles County well field remain protective of human health and the environment. Institutional controls on groundwater usage in the vicinity of the quarry proper will also be implemented to prevent groundwater usage inconsistent with recreational use, which could adversely affect contaminant migration. In conjunction with this action, additional field testing was performed to evaluate the need for, and effectiveness of, removal of uranium from the groundwater north of the slough. Included in this field testing was the installation of a pilot-scale interceptor trench that was operated until April 26, 2002.

The *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (Ref. 4) was signed by the U.S. Environmental Protection Agency (EPA) and the DOE on September 29, 2000. The interim remedial action provided for active remediation of the TCE-contaminated groundwater near the raffinate pits via in situ chemical oxidation (ICO). The DOE issued the *Interim Record of Decision* in response to public comment letters that expressed concern over the proposal not to actively treat all the groundwater contaminants of concern. Independently from the *Interim Record of Decision,* the DOE conducted further field studies to re-examine the effectiveness and

practicability of further active remediation. The results of this study and the completed pilot scale ICO treatment will be incorporated in a final proposal addressing all contaminants in groundwater at the chemical plant.

Fourteen interim response actions were developed and approved at the WSSRAP. Interim response actions are activities that did not change the ultimate disposal method, but mitigated or eliminated conditions which posed immediate or potential threats to worker safety, public health, or the environment. Some of the interim actions taken were removal of exposed friable asbestos, overhead piping, polychlorinated biphenyl (PCB) electrical equipment, power poles and wires; demolition of all buildings; isolation and capping of Ash Pond; capping of some other highly contaminated areas; consolidation of containerized chemicals; and removal of building foundations and contaminated soils to storage areas.

Activities that occurred at the Weldon Spring Site during 2002 were as follows:

- Final operation of the RBIX followed by decommissioning and final disposal.
- Removal of Quarry Water Treatment Plant effluent ponds and backfill, grading, seeding, and mulching of the entire quarry area.
- Return of Site Borrow Area control to MDOC.
- Transfer of LCRS leachate to MSD for treatment.

2. OBJECTIVES AND RATIONALE

The goal of the Weldon Spring Site Remedial Action Project (WSSRAP) was to protect and enhance the environment while protecting the public during remedial activities. The action consisted of safely disposing of hazardous and radiological wastes that resulted from the operation of the Weldon Spring Uranium Feed Materials Plant and the Weldon Spring Ordnance Works. Within the overall project mission, the environmental protection program focussed on monitoring the operational activities of the project. Now that the site, quarry, and vicinity properties have been remediated, groundwater monitoring is the focus of the environmental protection program.

The WSSRAP objectives for the 2003 environmental protection program are as follows:

- Assess compliance with applicable environmental quality standards and public exposure limits.
- Measure background levels and site-specific contaminant levels.
- Measure the effectiveness of effluent treatment or disposition.
- Assess environmental trends from past site-released contaminants.

This *Environmental Monitoring Plan* describes the rationale and design criteria for the monitoring program; designates the extent and frequency of monitoring and measurements; and outlines procedures for laboratory analyses, quality assurance, program implementation, and preparation and disposition of related reports.

Concurrence from the U.S. Department of Energy will be obtained for deviations from this plan. Examples include, but are not limited to, long-term reductions of sampling frequency, elimination of sampling locations, elimination of analyzed parameters, use of less stringent analytical methods, and addition of sampling locations. On a case-by-case basis, short-term, limited, informational or emergency sampling may be conducted under this plan without prior DOE concurrence in order to investigate or follow up on areas of suspected environmental concern.

The WSSRAP environmental protection program is separated into two distinct functions: (1) effluent monitoring, and (2) environmental surveillance. Effluent monitoring assesses the quantities of substances in migration pathways at the site perimeter or in pathways subject to compliance with permit levels and requirements (e.g., the National Pollution Discharge Elimination System [NPDES]). The environmental surveillance program generally reviews environmental media within or outside the site boundary for the presence and concentration of

site-related contaminants to detect and/or track the migration of those contaminants (e.g., surface water monitoring). Surveillance data are used to assess the presence and magnitude of any radiological or toxicological exposures to members of the public, or to assess the effects, if any, on the local environment.

The Weldon Spring site had maintained a relatively stable configuration of its waste materials from cessation of plant operation in the late 1960s and decontamination of some process buildings in the early 1970s until the beginning of remedial activities. It is believed that this stability allowed the site to achieve a rough equilibrium regarding the migration of contaminants from the site. With the start of remediation at the chemical plant and quarry, the nature of the waste units and their physical positions and chemical states were subject to disturbance. The monitoring program was designed to address pathways and constituents in a changing waste setting (through completion of the project) and to further characterize the waste units in order to model their behavior under specific conditions. Since completion of remediation, emphasis has been placed on evaluating the effectiveness of remediation and compliance with effluent limits and continued monitoring of groundwater.

The Department of Energy has defined generic performance criteria that their operations offices must use in developing their programs. The WSSRAP environmental protection program incorporated these criteria into its monitoring program. The objective of the WSSRAP environmental monitoring program was to generate data needed to demonstrate regulatory compliance and to assess the effect of contaminants on the public and environment. Therefore, a program was developed to assess environmental pathways. The program defined a scheme of minimum data points to be collected to evaluate whether environmental conditions were changing, and whether site-related contaminants or activities were affecting public health or the environment. When additional density or data points were required to verify trends or to more closely evaluate environmental conditions, additional samples were collected that were not defined in the plan. Those samples were collected to serve the objectives of the environmental monitoring program at the Weldon Spring site and were consistent with the guidelines of the U.S. Department of Energy (DOE) 5400 Orders. Samples will continue to be collected under this plan to demonstrate the effectiveness of remediation, to monitor operations of the disposal cell and to monitor the groundwater environment. The following section describes the pathway analysis performed by the WSSRAP at the beginning of the project to arrive at the initial monitoring program. The program has been reduced as remediation has progressed to completion.

2.1 Pathway Analysis

To evaluate the potential effect of activities at the Weldon Spring site on human or ecological receptors, it was necessary to conduct a pathway analysis early in the project. Exposure pathways were identified considering the source, mechanisms of release, type and location of contaminants at the site, the probable environmental fate (persistence, partitioning, transport, and intermedia transfer) of these contaminants, and the location and activities of potentially exposed receptors. Table 2-1 identifies the matrix of factors considered in the exposure pathway screening process. The primary objective of the pathway analysis was to identify complete pathways and give reasonable assumptions about future conditions. An exposure pathway was considered complete if a link could be shown between one or more contaminant sources, through one or more environmental transport processes, to an exposure point where human or ecological receptors were present. Identification of potentially complete pathways was a qualitative judgement. Procedures used were intended to be conservative. Identification of a complete pathway did not necessarily indicate that adverse effects could occur; it indicated that the effort to monitor releases was worthwhile from the standpoint of protecting human health and the environment.

Table 2-1 Potential Exposure Route Matrix

COMPONENT OF EXPOSURE ASSESSMENT	FACTORS TO BE CONSIDERED	
Affected Environmental Media	Air Groundwater Surface Water Sediment Surface Soil Subsurface Soil Aquatic Biota Terrestrial Biota	
Contaminant Transport Pathway	Airborne transport Groundwater migration Surface water runoff Sediment transport Infiltration Percolation Surface soil erosion Transport of aquatic biota Terrestrial biota migration	
Current and future receptors	Human	On-site workers, off-site workers and students, off-site residential, recreational.
	Ecological	On-site aquatic, off-site aquatic, on-site terrestrial, off-site terrestrial.
	Environmental	Physiochemical conditions of environmental media.

Table 2-1 Potential Exposure Route Matrix (Continued)

COMPONENT OF EXPOSURE ASSESSMENT	FACTORS TO BE CONSIDERED	
Routes of exposure by medium	Air	Inhalation, immersion
	Groundwater	Ingestion, dermal contact
	Surface water	Ingestion, dermal contact
	Sediment	Ingestion, dermal contact
	Surface Soil	Ingestion, dermal contact
	Subsurface soil	Ingestion, dermal contact
	Biota	Ingestion, dermal contact
	Cross Media Transfers	

2.2 Monitoring Program Rationale

The results of the critical pathway analyses (radionuclide and media) for the WSSRAP included both the Weldon Spring Quarry and the Weldon Spring Chemical Plant, and are presented in Table 2-2. These results were based on data developed during various characterization and monitoring studies, and from site specific criteria, site specific assumptions, and the matrix of potential exposure routes. These analyses were conducted at the beginning of the project before remedial actions were taken.

Table 2-2 Exposure Scenarios Evaluated for Monitoring

RECEPTOR	EXPOSURE SCENARIO	PATHWAY SELECTED FOR MONITORING	RATIONALE
Off-site Residents	Ingestion of small game animals in contact with contaminant source areas.	No	Ingestion of small game animals by residents is assumed low due to large buffer zone of wildlife area.
	Ingestion of groundwater from well downgradient from site sources.*	Yes	Potential use of groundwater as a source for drinking water by residents.*
	Inhalation of particulates dispersed through wind erosion and remedial actions.	Yes	Potential inhalation of airborne particulates by nearby residents.
	Inhalation of radon and thoron gas emitted from radium contaminated soils and other waste materials	Yes	Potential inhalation of radon and thoron gas by nearby residents

Table 2-2 Exposure Scenarios Evaluated for Monitoring (Continued)

RECEPTOR	EXPOSURE SCENARIO	PATHWAY SELECTED FOR MONITORING	RATIONALE
	Dermal contact with airborne and deposited particulates	No	Dermal contact with radiologically contaminated particulates is not considered a substantial exposure mechanism.
	Ingestion of surface water and/or sediment.	Yes	Potential for ingestion due to recreational activity in off-site downstream waters.
Wildlife Area Visitors	Inhalation of particulates dispersed through wind erosion and remedial action.	Yes	Potential inhalation of airborne particulates by wildlife area visitors.
	Inhalation of radon and thoron gas emitted from radium contaminated soils and other waste materials	Yes	Potential inhalation of radon and thoron gas by nearby residents
	Ingestion of game and fish inhabiting wildlife area.	Yes	Potential ingestion of game and fish inhabiting wildlife area collected during hunting and fishing seasons.
	Ingestion of spring and surface water and contact with sediments while swimming or wading.	Yes	Potential exposure through ingestion of, or contact with, surface water in wildlife areas.
	Dermal contact with airborne and deposited particulates.	No	Dermal contact with radiologically contaminated particulates is not considered a substantial exposure mechanism.
Terrestrial Biota (on site)	Ingestion of surface water, sediments, or vegetation, or inhalation of air particulates.	No	Previous studies have indicated no substantial uptake or risk.
Terrestrial Biota (off site)	Ingestion of surface water, sediments, or vegetation, or inhalation of air particulates.	Yes	Potential human consumption of agricultural products/terrestrial food stuffs.
Aquatic Biota (on site)	Uptake of surface water and contact with sediments.	No	Previous studies have indicated no substantial uptake or risk.
	Ingestion of invertebrates and vegetation.	No	Previous studies have indicated no substantial uptake or risk.
Aquatic Biota (off site)	Uptake of surface water and contact with sediments.	Yes	Potential human consumption of game fish in contact with surface water and sediments.
	Ingestion of invertebrates and vegetation.	Yes	Potential human consumption of game fish which ingest invertebrates and vegetation.

* The present exposure scenario for groundwater at the chemical plant and the quarry is recreational; therefore, no access to or use of groundwater as a drinking water source is expected. Groundwater is monitored due to resurgence at springs and the close proximity of the St. Charles County well field.

Site specific criteria considered in pathway analyses included physical, chemical, and biological characteristics of the radionuclides and chemical contaminants detected, spatial distribution, concentration, depth to groundwater, geology of the area, climatic conditions, how the area is used by the public and wildlife, and the proximity of contaminated sites to potential receptors.

Site specific assumptions were as follows:

- Off-site residents have limited access to the contaminant source areas.
- Access of off-site large game animals to contaminant source areas was limited by perimeter fencing.
- Prolonged or year round use of on-site water bodies by waterfowl was limited.
- Frequency and duration of wildlife area visits per individual was low (Ref. 8).
- Average annual consumption of radiological contaminated game animals and fish per individual was low in comparison with total per capita game and fish consumption.

The monitoring programs described in the following subsections have been updated to reflect the successful completion of remedial actions and the resulting elimination of most of the critical pathways described in Table 2-2, and evaluation of analytical samples collected during 2002.

2.2.1 Surface Water

Surface water was influenced by two general mechanisms before remediation was completed. First, storm water that flowed from the site may have carried site-source contaminants. Also, small quantities of water migrated from the site on a regular basis due to activities such as dust control activities and discharge of water retained in excavations. Water from water treatment plants at the site and quarry was discharged directly to the Missouri River and did not contact contaminants. Any future treated water discharges will also be directly to the Missouri River. Second, any contaminants remaining in sediment on site and in stream channels could have been resuspended.

All areas of the chemical plant site and quarry have been remediated, and the chemical plant site has been confirmed. Surface water migrating from the site is subsequently sampled along drainage ways to track its behavior until the uranium concentrations are indiscernible from background levels. Surface waters at the quarry are monitored to determine the effects of groundwater migration from the quarry area to the Femme Osage Slough.

2.2.2 Groundwater

The hydrology and hydrogeology of the Weldon Spring site have been extensively studied, and separate regimes have been identified for the chemical plant and the quarry based on spatial separation and differing geology.

The present conceptual model of the hydrogeologic regime at the former chemical plant and the raffinate pits area incorporates diffuse flow through the fractured limestone with a strong influence of discrete groundwater movement through solution enlarged fractures, conduits, and zones of strongly weathered limestone. Monitoring wells are used to monitor the quality of the groundwater and trends which may occur over time due to past and present site related activities. Converging conduits and structural bedrock lows allow for discrete flow, which then emerges at springs. Appropriate monitoring of the emerging springs addresses the primary mechanism of groundwater movement from the site.

The present conceptual model of the hydrogeologic regime for the quarry incorporates fracture flow through bedrock and diffuse flow through alluvium. Groundwater movement in the limestone units in the quarry is predominately controlled by the interconnected fractures and bedding planes. Groundwater movement in the alluvium is dependent on the composition and grain size distribution of the sediments. Slower and more restricted movement is associated with clays and fine grained deposits occurring primarily north of the Femme Osage Slough. Greater velocities and volumes occur in the coarse sand, gravel, and cobbles present in the Missouri alluvium, which is south of the slough. Monitoring wells are used to monitor the groundwater quality and contaminant trends in bedrock and alluvium north of the slough and the groundwater quality in the river alluvium south of the slough.

2.2.3 Air and Atmospheric Migration

Historically, airborne releases and atmospheric migration of radioactive contaminants resulted from disturbance of waste materials in both the quarry and chemical plant areas. An intensive program of air monitoring was conducted during the remedial action to assess airborne concentrations of radionuclides in the work zones and at various perimeter and off-site locations. This program included radon monitoring (alpha track and electret), external gamma radiation monitoring (TLDs), radioactive particulate monitoring (both low and high volume), and ambient dust monitoring. With completion of the remediation of contaminated materials and final disposition of these materials in the permanent disposal cell, the potential for airborne release of radionuclides was eliminated, and monitoring for radioactive airborne contaminants ceased. Ambient dust monitoring was eliminated with the completion of grading and road and trail construction during 2002.

A meteorological station was operated at this site beginning in 1994, in accordance with the Regulatory Guide, to characterize atmospheric dispersion conditions and assess the consequences of potential radiological releases. During 2001, site meteorological data was collected for informational purposes only, because the potential for radiological airborne release was eliminated. Because of the completion of remedial activities, there is no longer a need for detailed, site-specific meteorological data. Thus, the station was dismantled during the spring of 2002. Meteorological data will now be obtained from the National Weather Service as needed.

2.2.4 Soil and Sediment

Soil and sediment at the Weldon Spring site were found to be radiologically and chemically contaminated from past plant operations. One of the primary objectives of the WSSRAP was to excavate and properly dispose of this material in order to eliminate the risk of public exposure. At the end of 2000, this goal was met when the last load of contaminated soil was placed in the on-site disposal cell. Soil confirmation was completed at the chemical plant in early 2001.

2.2.5 Biological Media

Biological uptake of contaminants in fish was monitored at surrounding wildlife areas beginning in 1987. Radionuclides in aquatic ecosystems were monitored in the past to assess environmental conditions by using benthic invertebrates as indicators of water quality. Results of this monitoring showed that the dose to aquatic organisms was consistently less than the protective guideline of 1 rad/day, therefore, no further biological sampling has been scheduled.

3. ENVIRONMENTAL SURVEILLANCE

The environmental surveillance program for the Weldon Spring Site Remedial Action Project (WSSRAP) is based on a pathway analysis for possible exposure routes and receptors in accordance with Department of Energy Order 5400.1 and 5400.5, the *Regulatory Guide* (Ref. 5), and the status of remediation of the site. The pathway analysis is described in Section 2.1. Exposure routes requiring surveillance in 2003 are surface water and groundwater.

The environmental surveillance program for each medium is based on the applicable regulations, the hazard potential of radiological and chemical contaminants, the amount and concentration of contaminants, and the impacts on the environment. During the year 2003, monitoring requirements may be further reduced as the effectiveness of remediation is demonstrated. Sampling locations, frequency, and analyses required to determine the ambient environmental levels for each medium are summarized in the following sections.

3.1 Surface Water Surveillance Program

Surface water samples will continue to be collected from locations that are known to be, or have been affected by elevated concentrations of contaminants from either the former chemical plant and raffinate pits area or the quarry. Because of the differing topography and hydrologic conditions at the chemical plant and the quarry, surface water sampling programs for each of these areas are described separately. The WSSRAP has incorporated spring monitoring under the groundwater monitoring program, consistent with the draft U.S. Environmental Protection Agency guidance for groundwater monitoring in karst terrains. The data on contaminants in spring water will be more directly correlated to levels in groundwater by using conventional groundwater, instead of surface water, monitoring techniques.

3.1.1 Surface Water Evaluation

A surveillance program, which includes monitoring potentially impacted surface water, has been established to determine the distribution of radiochemical and chemical contaminants that have migrated from the Weldon Spring site in the past. Monitoring results are also used to measure the effectiveness of site remedial activities. The environmental surveillance program for surface water will be conducted in accordance with the requirements of Department of Energy Orders 5400.1, 5400.5, and the *Regulatory Guide* (Ref. 5).

3.1.2 Surface Water Monitoring Program at the Former Weldon Spring Chemical Plant and Raffinate Pits Areas

In the past, surface water runoff from the former chemical plant and raffinate pit areas transported both dissolved and suspended contaminants from waste materials distributed about the site. Remediation of these areas was completed in 2000. Five monitoring locations (Figure 3-1) have been chosen to provide data necessary to monitor the impact of contaminants that, in the past, migrated to downgradient lakes and streams and to gauge the effectiveness of remediation. The locations of the monitoring points and the purpose for monitoring are described in the following sections.

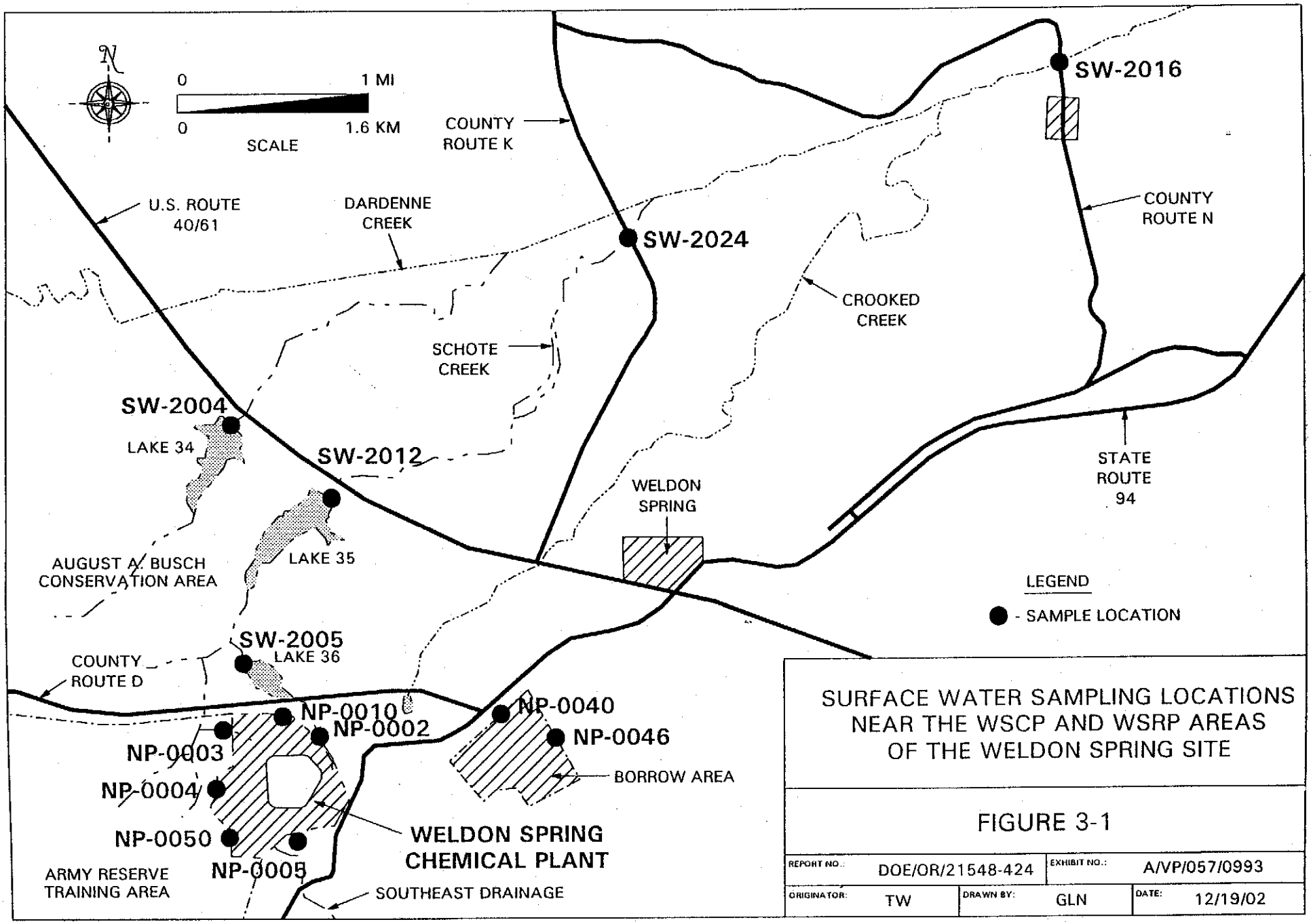
3.1.2.1 Rationale

The U.S. Department of Energy, in cooperation with the Missouri Department of Natural Resources - Division of Geology and Land Survey and the United States Geological Survey, established a detailed profile of the complex hydrogeologic system that influences the flow of surface water from the site. The chemical plant/raffinate pits area is located on the Missouri-Mississippi River surface water drainage divide. The topography is gently undulating and generally slopes northward to the Mississippi River. Streams do not cross the property, but incipient drainageways convey surface water runoff to off-site streams. In the following discussion reference is made to landmarks at the site even though they have been remediated and no longer exist.

Part of the surface drainage from the raffinate pit area discharges, via Outfall NP-0004, to an intermittent stream in the Army Reserve Training Area west of the site. As part of the completed remediation, the raffinate pits were dewatered, remediated, backfilled, and graded. The Ash Pond area discharges through Outfall NP-0003 to the same watershed as Outfall NP-0004. The Ash Pond area was also remediated, backfilled, and graded. Several much smaller stream bodies that receive flow from the raffinate pit area, also discharge to this watershed. Discharges from these locations combine near St. Charles County Route D and flow northward into Lake 35 in the August A. Busch Conservation Area, then to Schote Creek, which in turn enters Dardenne Creek and finally discharges into the Mississippi River.

A second surface drainage system ultimately reaching the Mississippi River drains the northeastern area of the site. The watershed, which contained Frog Pond, discharges at Outfall NP-0002. Drainage from this watershed flows to Lake 36 in the August A. Busch Conservation Area. Lake 36 in turn discharges into Lake 35, which discharges into Schote Creek.

A third watershed directs storm water runoff from the south portion of the site in a southeastly direction to the Missouri River by way of the Southeast Drainage. The discharge location is outfall NP-0005.



SURFACE WATER SAMPLING LOCATIONS NEAR THE WSCP AND WSRP AREAS OF THE WELDON SPRING SITE

FIGURE 3-1

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/057/0993		
ORIGINATOR:	TW	DRAWN BY:	GLN	DATE:	12/19/02

3.1.2.2 Monitoring Locations

All drainage features monitored by the surface water surveillance program at the Weldon Spring Chemical Plant and raffinate pits area are situated on the north (Mississippi River) side of the drainage divide. The routine monitoring locations are numbered SW-2004, SW-2005, SW-2012, SW-2016, and SW-2024 (Figure 3-1). Sampling Location SW-2016, at the intersection of Dardenne Creek and County Highway N, monitors any contribution of site derived contaminants to Schote and Dardenne Creeks. Location SW-2024, Schote Creek at Route K, monitors Schote Creek at a location just before it enters Dardenne Creek. Locations SW-2004, SW-2005, and SW-2012 monitor the three lakes in the August A. Busch Memorial Conservation Area that lie within the watersheds immediately downstream of the chemical plant site.

3.1.2.3 Monitoring Schedule

All surface water locations retained in the monitoring program for 2003 will be monitored for uranium according to the schedule in Table 3-1. Sample frequency has been reduced from quarterly to semiannually because uranium levels have declined to near background. If uranium levels trend higher, uranium analyses at NPDES outfalls will be evaluated to help determine a cause. If the outfalls have been removed from NPDES permit MO-0107701 as planned, informational monitoring for uranium may be conducted. The uranium concentration that constitutes an elevated level is location specific and will be determined on a case-by-case basis based on historical data and best professional judgment for that location. Data generated from surface water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values as shown in the procedure to determine if the concentrations are "above normal." "Above normal" values are reported to the U.S. Department of Energy (DOE) and other agencies in a timely manner as outlined in Procedure ES&H 1.1.7.

Table 3-1 Weldon Spring Chemical Plant Surface Water Monitoring Program

LOCATION	PARAMETER	FREQUENCY
SW-2004	Total Uranium	S
SW-2005	Total Uranium	S
SW-2012	Total Uranium	S
SW-2016	Total Uranium	S
SW-2024	Total Uranium	S

S Semiannual

3.1.3 Surface Water Monitoring Program for the Weldon Spring Quarry

Four surface water monitoring locations near the quarry will be routinely sampled during 2002. Continued monitoring will allow trends to be identified in addition to maintaining a surveillance of total uranium in water bodies near the quarry.

3.1.3.1 Rationale

The quarry is located on the northern bluff of the Missouri River valley. During 2002, the quarry pond and quarry proper were backfilled and graded to provide for overland flow of surface water to the adjacent Femme Osage Creek, which flows directly to the Missouri River. The slough will continue to be routinely monitored because it has been affected by contaminated groundwater migrating from the quarry. Because bulk waste has been removed from the quarry, monitoring also demonstrates the effect of bulk waste removal on surface water quality.

3.1.3.2 Monitoring Locations

Four sampling locations, SW-1003, SW-1004, SW-1005, and SW-1010 (Figure 3-2), are distributed along the Femme Osage Slough, adjacent to, the quarry. These locations within the slough were chosen to provide representative data for areas that are potentially impacted by the quarry contamination. These locations will be sampled semi-annually.

3.1.3.4 Monitoring Schedule

The monitoring schedule for sampling locations in the Femme Osage Slough is given in Table 3-2. Surface water locations will be monitored semiannually.

Table 3-2 Weldon Spring Quarry Surface Water Monitoring Analytical Program

LOCATION	PARAMETER	FREQUENCY
SW-1003	Total uranium	S
SW-1004	Total uranium	S
SW-1005	Total uranium	S
SW-1010	Total uranium	S

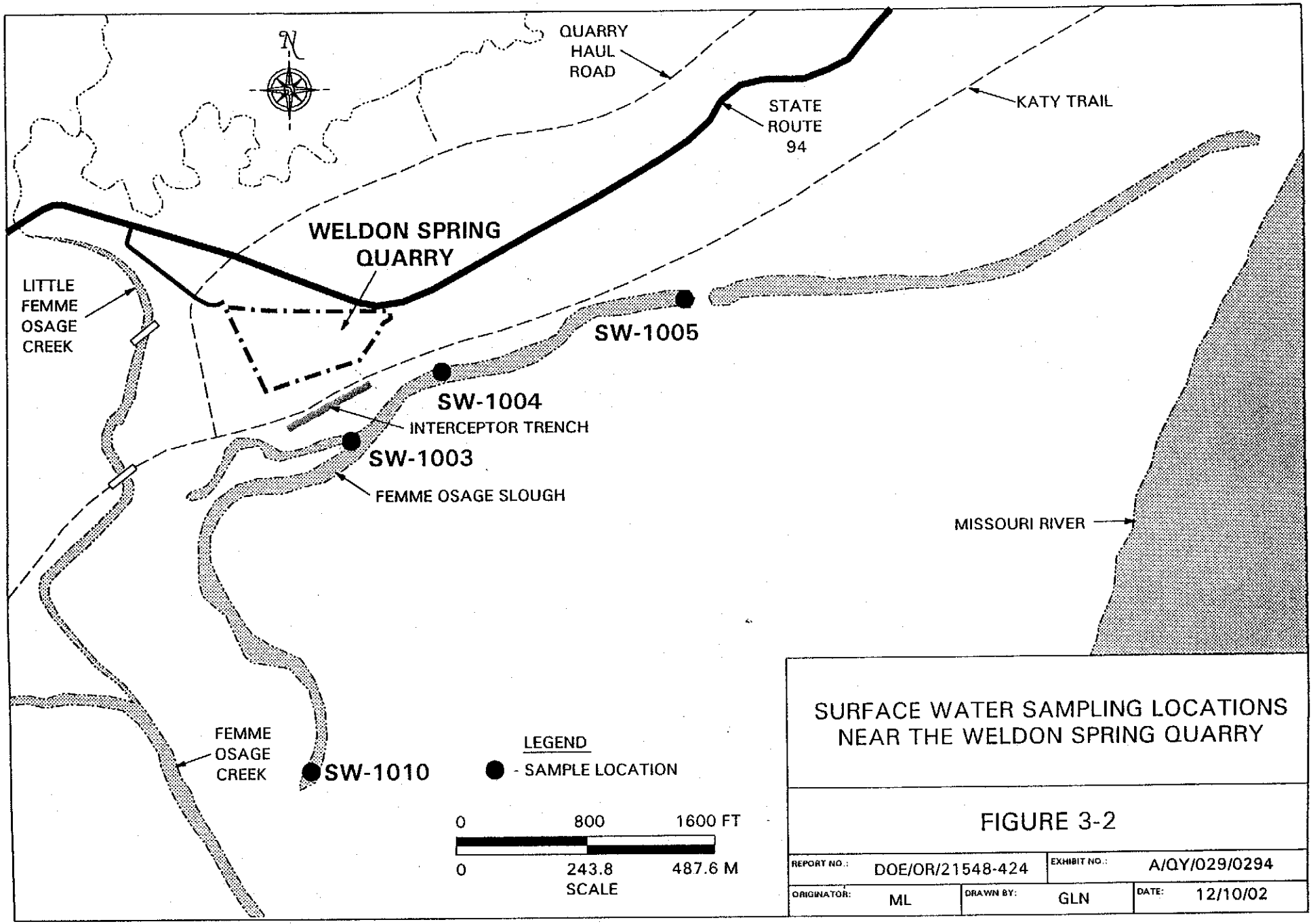
S Semiannual

Data generated from this surface water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values to determine if the concentrations are "above normal." "Above normal" values are reported to the DOE and other agencies as outlined in Procedure ES&H 1.1.7.

3.2 Groundwater Surveillance Program

Groundwater samples will be collected from locations at the former chemical plant and quarry areas where groundwater is known to be affected or has the potential to be affected by contaminants. Due to the differing hydrology and hydrogeology of the two areas, these groundwater monitoring programs are discussed separately in sections 3.2.2 and 3.2.3.

Groundwater beneath the permanent disposal cell is monitored to comply with the intent of 40 CFR 246, Subpart F, and 10 CSR 25-7.264(2)(F). A separate monitoring program has been established for the disposal cell network. This program is discussed in Section 3.2.4.



SURFACE WATER SAMPLING LOCATIONS
NEAR THE WELDON SPRING QUARRY

FIGURE 3-2

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/QY/029/0294		
ORIGINATOR:	ML	DRAWN BY:	GLN	DATE:	12/10/02

3.2.1 Groundwater Evaluation

Groundwater within and around the former chemical plant and quarry has been radiologically and chemically characterized through sampling and analysis. Surveillance programs have been established to monitor the radiological and chemical conditions of potentially affected groundwater. The groundwater surveillance programs were developed based on applicable regulations, historical quantities and concentrations of contaminants in overlying soil or effluents, and public interest. The environmental surveillance programs for groundwater will be conducted in accordance with the requirements of the Department of Energy Orders 5400.1, 5400.5, and the *Regulatory Guide* (Ref. 5).

Above-normal and outlier values will be addressed by implementation of Procedure ES&H 1.1.7, *Environmental Data Review and Above Normal Reporting*. Possible responses include validation of the reported value and resampling of the monitoring location. Unless a value is disqualified as resulting from non-natural causes (laboratory errors, etc.) it will be included in the annual average for the parameter.

3.2.1.1 Groundwater Characterization

Potential exposure pathways were determined based on the sampling of groundwater within, and near, the chemical plant and the quarry. Chemical and radiological characterization of the groundwater and aquifer characterization were provided through the implementation of work plans, sampling plans, and aquifer characterization plans. These plans were approved by the Department of Energy and the U.S. Environmental Protection Agency, and included environmental monitoring, selection of sampling locations, procedures, equipment, frequency and analyses required, minimum detection limits, and levels of quality assurance/quality control. Evaluation of the characterization data and potential exposure pathways provided the basis for the groundwater environmental surveillance program described in this monitoring plan.

In addition to the chemical/radiochemical characterization, changes in the static groundwater level are monitored either manually or with dedicated transducers. Manual readings are taken quarterly at the chemical plant, monthly at the quarry, and during sampling events. When considered necessary, dedicated electronic pressure transducers are installed in certain wells to document the natural water level fluctuations on a more frequent basis.

Quality control samples (including duplicate, matrix spike, equipment blank, and water blank samples) are not included in this schedule, but are collected in accordance with the *Sample Management Guide* (Ref. 10). Sampling frequency, collection methods, and sample handling protocols for quality control samples are discussed in Section 6, Quality Assurance.

3.2.1.2 Parameter Categories

The following radiological and chemical parameter categories will be monitored in groundwater at selected quarry and chemical plant locations:

- Total Uranium: Uranium is a primary contaminant due to the disposal of uranium contaminated materials and process waste at the quarry and uranium refining and raffinate storage at the former chemical plant and raffinate pits.

- Nitroaromatic Compounds: Nitroaromatic compounds are primary contaminants at both the quarry and the chemical plant from previous production of trinitrotoluene (TNT) and dinitrotoluene (DNT) at the Weldon Spring Ordnance Works and the disposal of TNT/DNT contaminated materials at the quarry. Groundwater at both sites will be monitored for 1,3,5-Trinitrobenzene (TNB); 1,3-Dinitrobenzene (DNB); 2,4,6-TNT; 2,4-DNT; 2,6-DNT; and nitrobenzene (NB). Select wells at the chemical plant will be monitored for the following breakdown products: 2-Am-4,6-DNT; 4-Am-2,6-DNT; 2-nitrotoluene (NT); 3-NT; and 4-NT.

- Nitrate: Nitrate is a primary contaminant because of its presence as a residual product during the uranium purification process at the chemical plant and in the production of nitroaromatics at the ordnance works.

- Sulfate and Iron: Sulfate and iron are selected as monitoring parameters because they are indicators of geochemical conditions at the quarry. Geochemical conditions are monitored because they are important attenuation mechanisms for uranium.

- Volatile Organic Compounds (VOCs): VOCs have been detected in groundwater at localized areas of the chemical plant, specifically in the vicinity of the former Raffinate Pits 3 and 4, and near the northwest perimeter of the site. The identified VOCs are chlorinated hydrocarbons (primarily TCE). The source was most likely degreasing agents/solvents discarded in Raffinate Pit 4.

The parameters listed above are monitored to assess the nature and extent of contaminants in the groundwater system, the potential for exposure to the public and the environment, and the effectiveness of remediation activities (e.g., source removal) at the site.

3.2.1.3 Groundwater Estimated Release Quantities and Public Doses

One objective of the groundwater monitoring program at both the chemical plant and the quarry is to collect sufficient data to estimate the approximate quantity of radionuclides released along a given migration route. This information can be used to calculate doses to hypothetical groundwater users, if necessary. The St. Charles County well field, which is a major source of drinking water, is located less than 1.6 km (1 mi) southeast of the quarry. At present, no wells within a 1.6 km (1 mi) radius of the chemical plant site are actively used as a drinking water supply.

3.2.2 Groundwater Monitoring Program for the Weldon Spring Quarry

DOE has monitored groundwater at the Weldon Spring quarry since 1987 as required under DOE Order 5400.1 and the Regulatory Guide (DOE 1991). Until October 1, 2002, DOE the monitoring in accordance with the Weldon Spring site *Environmental Monitoring Plan* (Ref. 6). After that date, monitoring requirements will be conducted in accordance with the *Remedial Design/Remedial Action Plan for the Quarry Residuals Operable Unit* (Ref. 20) as specified in the *Long-Term Stewardship Plan for the Weldon Spring Site* (Ref. 18).

3.2.2.1 Geology and Hydrogeology

The geology of the quarry area is generally separated into upland overburden, Missouri River alluvium, and bedrock. The Missouri River alluvium and bedrock units are saturated, and it is within these units that the groundwater is monitored. General descriptions of each unit follow.

The unconsolidated upland material overlying bedrock consists of up to 9.2 m (30 ft) of silty clay soil and loess deposits. A residual soil is present in some areas between the silty clay and the bedrock; however, the upland soils near the quarry are generally not saturated.

The sediments comprising the alluvium along the Missouri River vary from clays, silts, and sands, to gravels, cobbles, and boulders. The maximum alluvium thickness near the quarry is approximately 31 m (100 ft). The alluvium is laterally discontinuous and is truncated at the erosional contact with Paleozoic bedrock bluffs. The alluvium thickness increases dramatically with distance from the bluffs. Silts and clays with minor amounts of sand are the primary sediments between the bluffs and the Femme Osage Slough. The thick, water-producing sands and gravels of the alluvial aquifer between the Femme Osage Slough and the Missouri River give way to fine-grained organically rich overbank deposits beneath the slough. The potentiometric surface of the alluvial aquifer fluctuates in response to pumping of the St. Charles County production wells and the stage of the Missouri River. The Missouri River is the primary recharge source for the alluvial aquifer.

Bedrock at the Weldon Spring Quarry consists of three distinct Ordovician formations. They are, in descending order, the Kimmswick Limestone, the limestone and shale of the Decorah Group, and the Plattin Limestone. The Kimmswick Limestone is a coarsely crystalline limestone with numerous near vertical solution-enlarged joints. The Decorah Group consists of interbedded limestone and green shale; it is approximately 9.2 m (30 ft) thick, and is horizontally fractured. The Plattin Limestone is a thinly bedded limestone about 31 m to 38 m (100 ft to 125 ft) thick.

3.2.2.2 Rationale

DOE eliminated the source of groundwater contamination under the response actions approved for the Quarry Bulk Waste OU and Quarry Residuals OU by removing contaminated soil, debris, and surface water from the quarry. Monitoring activities at the quarry are described in the selected remedy for the Quarry Residuals OU (Ref. 3). That remedy prescribed long-term monitoring to confirm that natural processes are effective in attenuating groundwater contaminants before they reach the St. Charles County well field.

The quarry monitoring program has two primary objectives:

- Monitor uranium concentrations in groundwater south of the slough to verify that the groundwater is not impacted; and

- 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.

Constituents of concern in the quarry groundwater are uranium and 2,4-DNT.

Groundwater north of the slough contains elevated 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 pCi/L to 16 pCi/L (Ref. 16). 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 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 chemical reduction zone or adsorption onto aquifer materials. Therefore, when groundwater north of the slough attains these levels, the potential to degrade potable water in the St. Charles County well field should be negligible. If groundwater south of the slough exceeds a trigger level of 20 pCi/L, DOE will evaluate risk and take appropriate action.

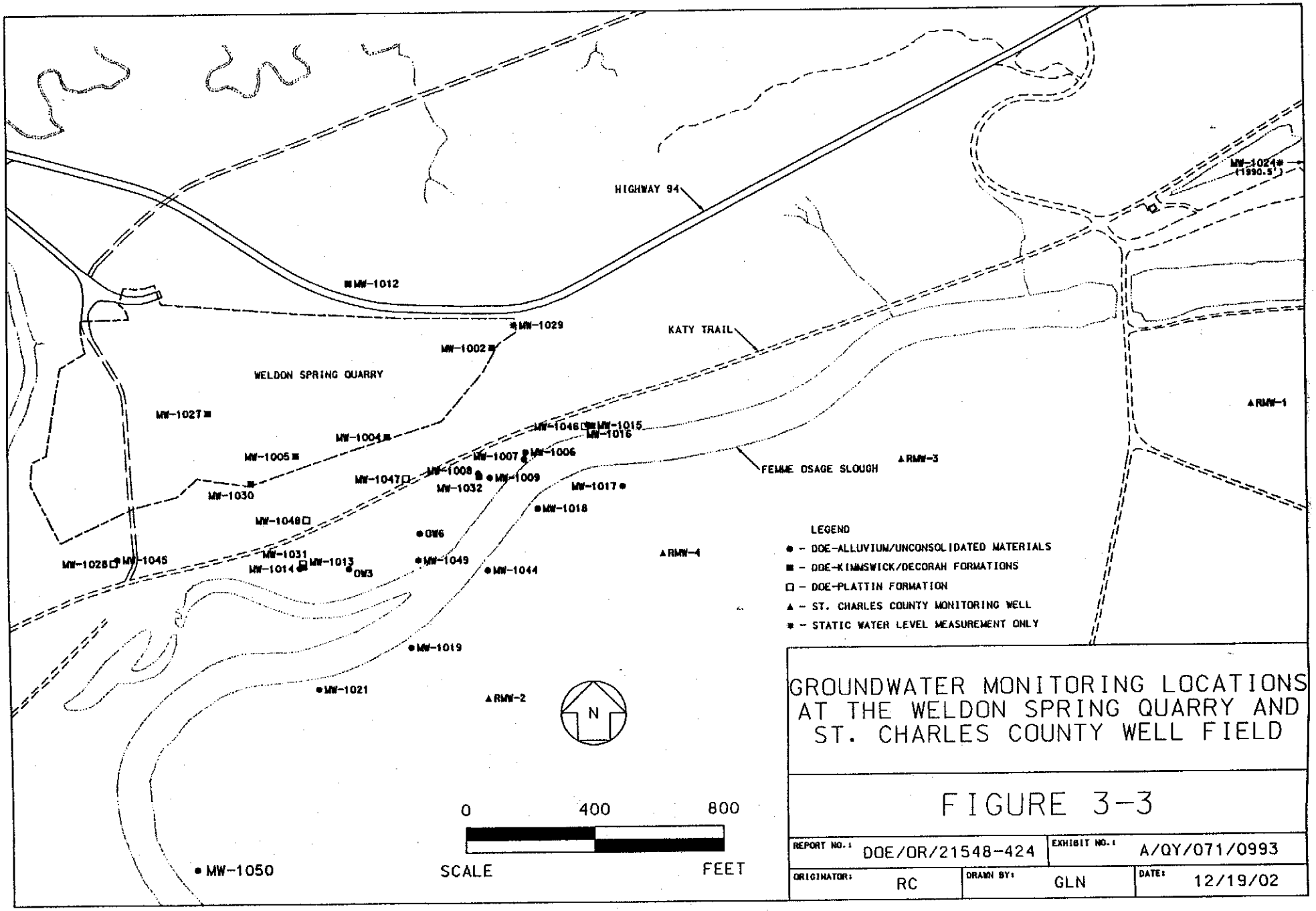
North of the slough, 2,4-DNT has been detected at three locations in concentrations exceeding the Missouri regulatory limit of 0.11 µg/L. Concentrations have generally decreased since completion of bulk waste removal activities from the quarry.

3.2.2.3 Monitoring Locations

Thirty-four groundwater wells in the quarry and surrounding area (which includes the St. Charles County Municipal well field) have been selected for long-term monitoring. Locations of the wells are shown in Figure 3-3.

Currently, 20 wells, including 16 Department of Energy monitoring wells and four county monitoring wells, are screened within the alluvial material located between the quarry and the Missouri River (Figure 3-3). Eight wells, MW-1006 through MW-1009, MW-1014, MW-1016, MW-1045, MW-1049, MW-1051 and MW-1052 are located between the quarry and the slough to monitor contaminant migration south of the quarry within the alluvium. Monitoring wells MW-1017 through MW-1019, MW-1021, MW-1044, and MW-1050 are located south of the slough within the alluvium and are monitored to allow detection of contaminant migration south of the slough. St. Charles County monitoring wells RMW-1 through RMW-4 are monitored to provide an early warning of contaminant migration toward the county production well field, if this should occur.

Currently, another 14 Department of Energy monitoring wells are screened within either the Kimmswick-Decorah or Plattin Formations to monitor contaminants near the quarry within the bedrock (Figure 3-3). Monitoring wells MW-1002, MW-1004, MW-1005, MW-1012, MW-1013, MW-1015, MW-1027, MW-1030, and MW-1032, were installed to monitor contaminants within the Kimmswick-Decorah Formations surrounding the quarry. Monitoring wells MW-1028, MW-1031, MW-1046, MW-1047, and MW-1048 are located south of the quarry within the Plattin Limestone to determine if vertical contaminant migration through the fracture system has occurred.



GROUNDWATER MONITORING LOCATIONS AT THE WELDON SPRING QUARRY AND ST. CHARLES COUNTY WELL FIELD

FIGURE 3-3

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/QY/071/0993		
ORIGINATOR:	RC	DRAWN BY:	GLN	DATE:	12/19/02

3.2.2.4 Monitoring Schedule

The quarry groundwater monitor well network consists of wells arrayed in four "lines" between the quarry and the St. Charles County well field (Table 3-3). 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 toward the well field. The fourth line consists of monitor wells installed by St. Charles County, which are completed in the same portion of the aquifer from which the municipal 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.

Monitoring frequencies are 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 (Ref. 20).

Parameters to be monitored include uranium and six nitroaromatic compounds (including 2,4-DNT). These are the most soluble constituents that leached from the bulk wastes in the quarry into shallow ground prior to waste removal. The uranium in groundwater is affected by the oxidation potential (Eh). Geochemical parameters to be measured include pH, Eh, sulfate, and iron oxidation state. Table 3-4 summarizes the 2003 groundwater monitoring schedule for quarry.

Table 3-3 Quarry Groundwater Monitoring Network

Monitoring Location Group	Sample Locations
Line 1	1002, 1004, 1005, 1027, 1030
Line 2	1006, 1007, 1008, 1009, 1013, 1014, 1015, 1016, 1028, 1029, 1031, 1032, 1045, 1046, 1047, 1048, 1049, 1051, 1052
Line 3	1017, 1018, 1019, 1021, 1044, 1050
Line 4	RMW-1, RMW-2, RMW-3, RMW-4

Table 3-4 Weldon Spring Quarry Groundwater Monitoring Program Summary

LOCATION	TOTAL URANIUM	NITROAROMATIC COMPOUNDS (a)	SULFATE	IRON (b)
MW-1002	Q	Q	Q	Q
MW-1004	Q	Q	Q	Q
MW-1005	Q	Q	Q	Q
MW-1006	Q	Q	Q	Q
MW-1007	Q	Q	Q	Q
MW-1008	Q	Q	Q	Q
MW-1009	Q	Q	Q	Q
MW-1012	Q	Q	Q	Q
MW-1013	Q	Q	Q	Q
MW-1014	Q	Q	Q	Q
MW-1015	Q	Q	Q	Q
MW-1016	Q	Q	Q	Q
MW-1017	S	S	S	S
MW-1018	Q	Q	Q	Q
MW-1019	S	S	S	S
MW-1021	S	S	S	S
MW-1027	Q	Q	Q	Q
MW-1028	S	S	S	S
MW-1030	Q	Q	Q	Q
MW-1031	Q	Q	Q	Q
MW-1032	Q	Q	Q	Q
MW-1044	S	S	S	S
MW-1045	Q	Q	Q	Q
MW-1046	Q	Q	Q	Q
MW-1047	Q	Q	Q	Q
MW-1048	Q	Q	Q	Q
MW-1049	Q	Q	Q	Q
MW-1050	S	S	S	S
MW-1051	Q	Q	Q	Q
MW-1052	Q	Q	Q	Q
MW-RMW1	A	A	A	A
MW-RMW2	A	A	A	A
MW-RMW3	A	A	A	A
MW-RMW4	A	A	A	A

(a) Nitroaromatic Compounds: 1,3,5-TNB; 1,3-DNB; 2,4,6-TNT; 2,4-DNT; 2,6-DNT; nitrobenzene
(b) Iron: Total; Fe^{2+}; Fe^{3+}
Q Quarterly
S Semiannual
A Annual

3.2.3 Groundwater Monitoring Program for the Weldon Spring Chemical Plant and Raffinate Pits

Groundwater monitoring was required by DOE 5400.1 and the *Regulatory Guide* (Ref. 5) to document pre-operational conditions, monitor the effects of Department of Energy operations on groundwater quality, and to demonstrate compliance with applicable Federal and State laws

and regulations. Groundwater monitoring has been conducted at the chemical plant site since the first quarter of 1987. Data from 1987 through 1990 were used to characterize water quality in the chemical plant and raffinate pits areas prior to remediation (Ref. 9). As the site has developed, the program has been adjusted to accommodate changes in laws and regulations, specific project needs, and the requirements of the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) and the *National Environmental Policy Act* (NEPA).

3.2.3.1 Geology and Hydrogeology

Geology at the chemical plant, raffinate pits, and vicinity properties is divided into two major units based on gross lithologic characterization: (1) the unconsolidated glacial and residual soils, and (2) the underlying limestone bedrock. The unconsolidated material consists of topsoil, loess, glacially derived sediments, and residuum. In general, the glacial soils are silty clays with minor amounts of gravel. The unconsolidated materials, which are present at depths ranging from 6 m to 15 m (20 ft to 50 ft), are not saturated and thus are not monitored. Saturated conditions are first encountered in the Burlington-Keokuk Limestone, the uppermost bedrock unit. The Burlington-Keokuk Limestone is composed of two different lithologic zones: a shallow weathered zone and an underlying unweathered zone.

The weathered zone is typically a grayish-orange to yellowish-gray, argillaceous limestone containing up to 60% chert, which occurs as discrete nodules or interbedded lenses. The weathered limestone is a low-yield, semiconfined, heterogeneous, anisotropic aquifer that is fractured and susceptible to natural solution processes. Within the confines of the chemical plant, the uppermost aquifer generally exhibits diffuse flow properties; however, discrete flow zones occur in saturated, highly weathered bedrock lows (paleochannels).

The unweathered portion of the Burlington-Keokuk Limestone is thinly to massively bedded, gray to light gray, finely to coarsely crystalline, stylolitic, and fossiliferous. Fracture densities and weathering are significantly lower in the unweathered zone as compared to the weathered zone, therefore reducing the potential for downward migration of contaminated groundwater.

The chemical plant site straddles a topographic high; therefore, site soils are well drained with minimal accumulation of organic material. These conditions foster oxidizing conditions in the unconsolidated materials and upper bedrock units beneath the chemical plant. Redox conditions are an important control on the mobility and stability of many potential contaminants.

3.2.3.2 Rationale

Groundwater flow and contaminant transport mechanisms at the chemical plant differ from those at the quarry because of differences in the geologic environments of these two

locations. At the chemical plant, the shallow aquifer generally exhibits diffuse flow properties that are overlain by zones of fracture or conduit flow. To accommodate these two flow mechanisms, the groundwater surveillance program includes analyses of water from monitoring wells which typically sample the diffuse component of flow, and from springs which represent the resurgence point for conduit flow paths.

The groundwater monitoring program at the chemical plant is designed to provide the necessary data to accomplish the following objectives, outlined in Department of Energy Order 5400.1, Chapter IV, Section 3 and Section 5, Part b:

- Ensure protection of public health and the environment. Included in this objective are (1) determining whether contaminants are present at levels exceeding drinking water maximum contaminant levels (MCLs) or assumed background concentrations, and (2) monitoring concentration levels of contaminants which exceed these criteria.

- Provide a baseline for studying long-term and short-term effects of source removal, as part of CERCLA activities. Baseline data are required to provide adequate information for future comparisons.

- Perform spatial and temporal groundwater quality trend analyses.

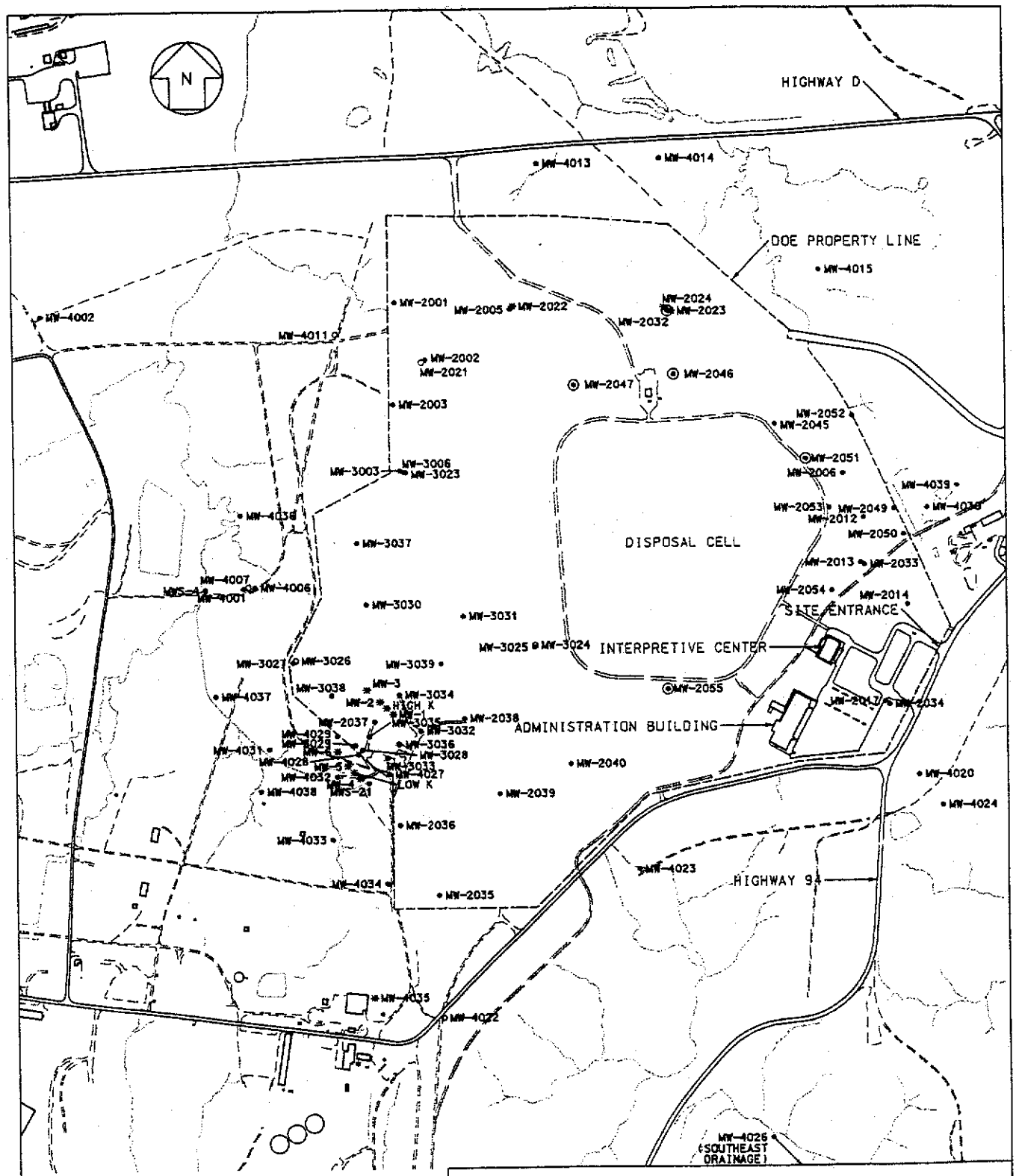
3.2.3.3 Monitoring Locations

Sixty-nine groundwater wells in the chemical plant and raffinate pit areas have been selected for routine monitoring during 2003. Of the 69 wells, 62 are completed in the upper, weathered portion of the shallow aquifer, and seven are completed in the deeper, unweathered portion of the aquifer. Locations of the wells are shown in Figure 3-4. (This figure also shows the locations of the five wells comprising the waste storage facility monitoring program, which is discussed in Section 3.2.4). Samples collected from the 69 chemical plant wells will provide data to assess the nature and extent of groundwater contaminants that may pose a risk to human health and the environment.

3.2.3.4 Monitoring Schedule

The 2003 groundwater monitoring schedule for the chemical plant and raffinate pits area is summarized in Table 3-4. In general, the parameters to be monitored at each well correspond with the contaminants remediated from the overlying waste ponds and nearby soils. Monitoring wells in the vicinity of the former raffinate pits will be sampled for uranium, nitrate, nitroaromatic compounds, and volatile organic compounds (TCE, PCE, and 1,2-DCE). Wells in the former Frog Pond area will be monitored for nitroaromatics and uranium, and wells in the former Ash Pond area will be monitored for uranium, nitrate, and nitroaromatics.

The schedule in Table 3-4 presents the sampling frequency and types of analyses to be performed during 2003. This schedule is based on evaluation of the historical as well as most recent analytical data. At the Chemical Plant area, significant additional groundwater monitoring has occurred during 2001 and 2002 associated with numerous field studies and contaminant investigations. These efforts have greatly enhanced the existing data set for the contaminants of concern. Samples will also be collected and analyzed quarterly at wells for which upward trends in concentrations of a particular contaminant have been identified, recent changes in conditions have occurred (i.e., ICO pilot scale, Frog Pond area, etc.), or areas of highest contamination. The frequency of sampling will be reduced to semiannually in wells where contaminants trends are typically stationary or wells surrounding areas of changing conditions or areas of highest contamination. In cases where recent data show no detectable levels of a contaminant, sampling for that contaminant will be either discontinued or reduced to annually if there is reason to monitor for future impact. Some off-site locations will no longer be monitored for nitroaromatic compounds associated with adjacent Army site sources.



LEGEND

- • – WEATHERED ZONE
- ○ – UNWEATHERED ZONE
- ⊙ – DISPOSAL CELL MONITORING WELL
- ✳ – STATIC WATER LEVEL MEASUREMENT ONLY

0 800 1600

SCALE FEET

CHEMICAL PLANT AREA MONITORING WELL NETWORK

FIGURE 3-4

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/CP/087/0993		
ORIGINATOR:	RC	DRAWN BY:	GLN	DATE:	12/19/02

Table 3-5 Weldon Spring Chemical Plant Monitoring Program Summary

LOCATION	PARAMETERS			
	TOTAL URANIUM	NITROAROMATICS[a]	NITRATE	VOAs[b]
MW-2001	A	A	S	NS
MW-2002	A	A	S	NS
MW-2003	S	A	S	NS
MW-2005	A	A	S	NS
MW-2006	NS	Q*	NS	NS
MW-2012	NS	Q*	NS	NS
MW-2013	NS	Q*	NS	A
MW-2014	NS	Q*	NS	NS
MW-2017	S	NS	NS	NS
MW-2021	A	A	A	NS
MW-2033	NS	Q*	NS	NS
MW-2034	S	NS	NS	NS
MW-2035	A	A	A	NS
MW-2036	A	A	A	A
MW-2037	A	S	S	Q
MW-2038	S	S	S	S
MW-2039	S	A	S	A
MW-2040	S	A	S	NS
MW-2045	NS	Q*	NS	NS
MW-2049	NS	Q*	NS	NS
MW-2050	NS	Q*	NS	NS
MW-2052	NS	Q*	NS	NS
MW-2053	NS	Q*	NS	NS
MW-2054	NS	Q*	NS	NS
MW-3003	Q	S	S	S
MW-3006	S	S	S	A
MW-3023	Q	S	S	S
MW-3024	Q	A	S	S
MW-3025	S	A	S	S
MW-3026	A	A	S	A
MW-3027	A	A	S	A
MW-3028	A	S	S	Q
MW-3029	A	Q	S	Q
MW-3030	Q	Q	S	S
MW-3031	S	A	S	A
MW-3032	A	A	S	S
MW-3034	S	Q	S	Q
MW-3035	A	S	S	Q
MW-3036	A	Q	S	S
MW-3037	S	A	S	A
MW-3038	A	Q	S	A
MW-3039	S	Q	S	Q
MW-4001	S	S	S	S
MW-4002	A	NS	A	NS
MW-4006	A	S	S	A
MW-4007	S	S	S	S
MW-4011	A	NS	S	NS

Table 3-5 Weldon Spring Chemical Plant Monitoring Program Summary (Continued)

LOCATION	PARAMETERS			
	TOTAL URANIUM	NITROAROMATICS[a]	NITRATE	VOAs[b]
MW-4013	A	S	S	NS
MW-4014	A	S	S	NS
MW-4015	NS	Q*	NS	NS
MW-4020	S	NS	NS	NS
MW-4022	A	NS	NS	NS
MW-4023	S	NS	NS	NS
MW-4024	S	NS	NS	NS
MW-4026	A	A	A	NS
MW-4027	A	A	S	S
MW-4028	A	S	S	Q
MW-4029	A	Q	S	Q
MW-4030	NS	Q*	NS	NS
MW-4031	A	A	S	S
MW-4032	A	S	S	Q
MW-4033	A	A	S	A
MW-4034	A	NS	A	NS
MW-4036	Q	S	S	S
MW-4037	A	NS	S	S
MW-4038	A	NS	S	S
MW-4039	NS	Q*	NS	NS
MW-S004	A	NS	S	A
MW-S021	A	S	S	Q

(a) Nitroaromatic Compounds: 1,3,5-TNB; 1,3-DNB; 2,4,6-TNT; 2,4-DNT; 2,6-DNT and Nitrobenzene.
(b) VOAs: Volatile organic analyses for 1,2-DCE; PCE; TCE.
A Annually.
Q Quarterly.
S Semiannually.
NS Not sampled.
* **Includes nitroaromatic breakdown products (see Section 3.2.1.2).**

3.2.4 Groundwater Monitoring for the Disposal Cell

Groundwater monitoring wells were installed around the permanent disposal cell in late 1996 to meet the substantive requirements of 40 CFR 264, Subpart F and 10 CSR 25-7.264 (2)(f). The well locations are shown in Figure 3-4. The *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan* (Ref. 11) describes the procedure used to review detection monitoring data and the strategy for the long-term monitoring program. The schedule for disposal cell detection monitoring, which indicates semiannual sampling, is shown in Table 3-6. (Burgermeister Spring is also considered to be part of the cell monitoring network, although its sampling schedule is presented in the next section.) Leachate (LW-DC10) will be collected at the same frequency and parameters as those wells identified in Table 3-6.

Monitoring well MW-2051, which was installed in 2001 as a possible replacement well for MW-2045, will be used instead of MW-2045. Monitoring well MW-2051 exhibits higher hydraulic conductivities and will better monitor the shallow groundwater system than MW-2045.

The original upgradient well MW-2048 was damaged beyond repair in 2001. A new well, MW-2055, was installed approximately 20 feet upgradient of MW-2048. Data review of the two wells indicated comparable water quality.

Table 3-6 Disposal Cell Detection Monitoring Program Summary

MONITORING LOCATIONS	PARAMETERS						
	TOTAL URANIUM	RADIO CHEMICAL (a)	ANIONS(b)	METALS(c)	NITROARO-MATICS(d)	INDICATOR PARA-METERS(e)	OTHER(f)
MW-2032	S	S	S	S	S	S	S
MW-2046	S	S	S	S	S	S	S
MW-2047	S	S	S	S	S	S	S
MW-2051	S	S	S	S	S	S	S
MW-2055	S	S	S	S	S	S	S

(a) Radiochemical: Ra-226, Ra-228, Th-228, Th-230, and Th-232.
(b) Anions: Nitrate, sulfate, chloride, and fluoride.
(c) Metals: As, Ba, Cr, Co, Fe, Mn, Pb, Ni, Se, V, Zn.
(d) Nitroaromatic compounds: 1,3,5-TNB; 1,3-DNB; 2,4,6-TNT; 2,4-DNT; 2,6-DNT.
(e) Indicator Parameters: Chemical Oxygen Demand, Total Dissolved Solids, Total Organic Carbon, Total Organic Halogen.
(f) Other: PCBs and PAHs.
S Semiannual.

3.2.5 Groundwater Monitoring at Springs

The groundwater flow system in the chemical plant area includes both diffuse and discrete flow components; therefore, a complete groundwater monitoring program must include sampling both at conventional groundwater monitoring wells near the contaminant sources and at springs where groundwater emerges. Springs in the vicinity of the site have been monitored since 1987, beginning with the Department of Energy and Project Management Contractor broad-based Phase I spring and seep characterization, which involved 30 springs and seep features within a 3.2 km (2-mi) radius of the site. The springs and seeps were inventoried and sampled at varying flow rates. The springs impacted by the site were identified, and a program of regular monitoring was established for those springs. Through that program and additional studies conducted by the Department of Energy, the Missouri Division of Geology and Land Survey, and the U.S. Geological Survey, the flow characteristics of the springs and their recharge basins were determined.

3.2.5.1 Monitoring Locations

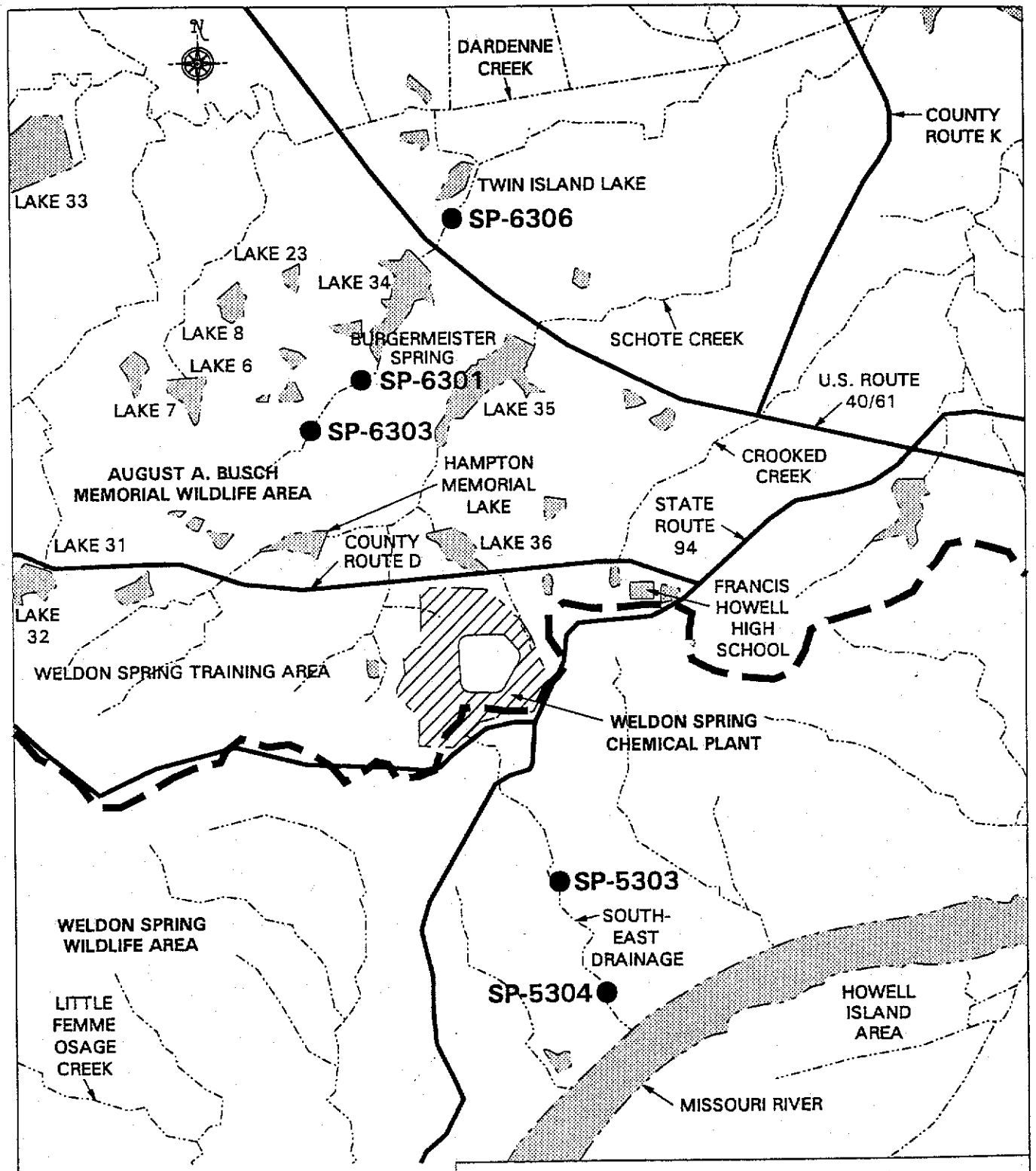
Five springs will be sampled during 2003 to monitor the effects of site remediation and to provide data for estimating doses (if required) to possible recreational users of the nearby areas. The locations of these springs (SP-5303, SP-5304, SP-6301, SP-6303, and SP-6306) are shown in Figure 3-5. Two of the five springs are located in Valley 5300, the Southeast Drainage, which was used during operation of the Weldon Spring Uranium Feed Materials Plant as a drainage for contaminated decant water from the raffinate pits. The other three springs are located in Valley 6300, the Burgermeister Spring branch.

Burgermeister Spring, SP-6301, is a perennial spring that is considered to be the primary local discharge point for contaminated groundwater originating from the site. It exhibits a recognizable contribution from uranium and nitrate contaminated groundwater from the site throughout the year, during both high and low flow periods. For that reason, it is an important monitoring location for identifying impacts from groundwater contamination at the site, and has allowed the project to document improvements in groundwater conditions as remedial actions at the site have been completed. Although the Weldon Spring site is not located in the Valley 6300 watershed, surface waters discharge to this drainage by losing streams that travel along solution-enlarged karst conduits. Groundwater studies have indicated that groundwater from the northern and western portions of the chemical plant emerges at springs in the Burgermeister Spring branch.

3.2.5.2 Monitoring Schedule

The monitoring schedule for the springs is presented in Table 3-6. Springs SP-5303, SP-5304, SP-6301 (Burgermeister), and SP-6303 will be monitored for uranium, nitroaromatic compounds, VOCs, and nitrate. Spring SP-6306 will be monitored for uranium and nitrate. Samples will be collected quarterly during base flow conditions, which is the stage of spring discharge when the water is least influenced by active surface water runoff. To ensure that the base flow samples monitor only the groundwater component of flow, samples will be collected no sooner than 1 week following the conclusion of a precipitation event of sufficient intensity to cause surface water runoff. Sampling during base flow will also keep agitation of the sample to a minimum, which is necessary for obtaining accurate VOC results.

Burgermeister Spring (SP-6301) is an important component of the cell groundwater detection monitoring network. As such, it is subject to requirements set forth in 10 CSR 25-7.264(2)(F) and will be monitored for additional parameters, in accordance with the *Weldon Spring Disposal Cell Groundwater Monitoring Plan* (Ref. 11). Burgermeister Spring will be monitored semiannually at base flow for the parameters that are listed in Table 3-5.



SPRINGS IN THE VICINITY OF THE WELDON SPRING CHEMICAL PLANT AREA

FIGURE 3-5

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/059/0993		
ORIGINATOR:	ML	DRAWN BY:	GLN	DATE:	10/10/02

The five springs will also be sampled semiannually at high flow, which is induced by precipitation events. Discharge during high flow is dominated by surface water runoff. These samples will be analyzed for uranium nitrate and nitroaromatic compounds.

Table 3-7 Spring Monitoring Program (Base Flow/High Flow)

LOCATION	TOTAL URANIUM	NITRO-AROMATICS	VOLATILE ORGANICS[a]	NITRATE	ADDITIONAL CELL DETECTION PARAMETERS[b]
SP-5303	Q/S	Q/S	Q/NS	Q/S	NS
SP-5304	Q/S	Q/S	Q/NS	Q/S	NS
SP-6301	Q/S	Q/S	Q/NS	Q/S	S/NS
SP-6303	Q/S	Q/S	Q/NS	Q/S	NS
SP-6306	Q/S	NS	NS	Q/S	NS

Q Quarterly.
S Semiannually.
NS Not sampled.
(a) Volatile organic analyses for 1,2-DCE; PCE; TCE.
(b) Ra-226, Ra-228, Th-228, Th-230, Th-232, Nitrate, Sulfate, Chloride, Fluoride, As, Ba, Cr, Co, Fe, Mn, Pb, Ni, Se, V, Zn Chemical Oxygen Demand, Total Dissolved Solids, Total Organic Carbon, Total Organic Halogen, PCBs, PAHs (see Table 3-6).

3.2.6 Static Water Levels

Monitoring wells which are not sampled under the environmental monitoring program still require static water levels to be collected. Table 3-8 identifies those wells that currently require annual static water measurements. Refer to Figures 3-3 and 3-4 for locations of these monitoring wells.

Table 3-8 Monitoring Well Locations Requiring Annual Static Water Levels

Chemical Plant Area		Quarry Area
MW-1	MW-2022	OW-1
MW-2	MW-2023	OW-2
MW-3	MW-2024	OW-4
MW-4	MW-4035	OW-5
MW-5	MW-LOW L	MW-1024
MW-6	MW-HIGH K	MW-1029

4. EFFLUENT MONITORING

The Weldon Spring Site Remedial Action Project (WSSRAP) had established two distinct monitoring programs which it characterized as "effluent monitoring." These included waterborne and airborne effluents that could migrate beyond the site perimeters. The airborne effluents program was terminated because no sources remained. The waterborne program is described in the following sections. For the purposes of the environmental monitoring program, groundwater migrating from the site is included under the surveillance program and is not considered an effluent.

4.1 National Pollutant Discharge Elimination System Program - Waterborne Effluent

As a Federal facility, the WSSRAP is subject to, and complies with, Executive Order 12088, which requires all Federal facilities to comply with applicable pollution control standards. Further, U.S. Department of Energy Order 5400.1 states that the Department of Energy is "to conduct the Department's operations in compliance with the letter and spirit of applicable environmental statutes, regulations and standards." In this light, and because the WSSRAP contains point sources for waterborne pollutants, the project operates under Federal *Clean Water Act* requirements and Missouri Clean Water Commission laws and regulations. The Missouri Department of Natural Resources has issued National Pollutant Discharge Elimination System (NPDES) permits to the Department of Energy for the discharge of treated water, storm water and other waters. Because soil remediation has been successfully completed, requests have been, or will be, made to terminate all permits and eliminate all outfalls except outfall NP-0007 of permit MO-0107701 (treated water from the chemical plant site).

4.1.1 Goal

In addition to verifying compliance with NPDES permitted effluent limitations, the goal of the NPDES effluent monitoring program was to characterize the water releases from the WSSRAP. The Project Management Contractor used this information to develop strategies to minimize the discharge of waterborne contaminants from the site in accordance with the WSSRAP policy that all surface water will be closely monitored and treated, as necessary, to meet Federal and State requirements. Existing or potential water sources at the chemical plant and quarry areas are listed in Table 4-1. Estimates of the quantity of water from the sources are described in rates or total volume, depending on the source. The current treatment is also provided for each source. Since Revision 9 of the *Environmental Monitoring Plan* (EMP) (Ref. 6), the quarry sump has been backfilled and worker showers have been removed.

Table 4-1 Existing or Potential Water Sources

SOURCE	CATEGORY[a]	QUANTITY
SITE		
LCRS Sump	RAD	400 gpd
Sanitary Sewage Treatment Plant	SAN	4,000 gpd
Laboratory	RAD	<10 gpd
Storm Water Discharges (200 acres)	STR	195,000,000 gpy[b]
QUARRY		
Storm Water Discharges (14 acres)	STR	13,650,000 gpy[b]

(a) Category is based on the primary treatment method required and the existing natural uranium concentration.
(b) Based on average annual precipitation
RAD Complex treatment; Uranium - greater than 600 pCi/l
SAN Biological treatment
STR Sediment treatment; Uranium - less than 600 pCi/l and all other permitted parameters in compliance.

The remedial action goal was to clean up the site with no increase in contaminant discharge or degradation of the off-site streams during the active project. Therefore, the remedial action program included source identification and periodic sampling and analyses which enabled the Project Management Contractor to identify treatment requirements. The program used studies to identify, analyze, and evaluate appropriate measures for control of runoff, erosion, sediment, and contamination sources. From these studies, procedures and plans were developed for appropriate control and maintenance measures. Control measures for storm water are used to minimize erosion and remove sediment to a level commensurate with the "best practical technology."

4.1.2 NPDES Permits

The Department of Energy currently holds five active NPDES permits for the discharge of various waters from the chemical plant, quarry, and Borrow Areas. Requests have been submitted to MDNR to terminate three of the permits. When vegetation has stabilized soils at the site and quarry a request will be made to terminate the quarry permit (MO-0108987) and to remove storm water outfalls from the site permit (MO-0107701). A request will also be made to remove the sewage treatment plant outfall when St. Charles County assumes control of the sewage treatment plant.

4.1.2.1 NPDES Permit MO-0107701

Permit MO-0107701 applies to various discharges from the chemical plant. This permit was originally issued to the Department of Energy on July 29, 1988, for discharge of surface water runoff through five outfalls (NP-0001 through NP-0005). A sixth outfall (NP-0006) was added on November 4, 1988, for discharge from the sewage treatment plant at the administration

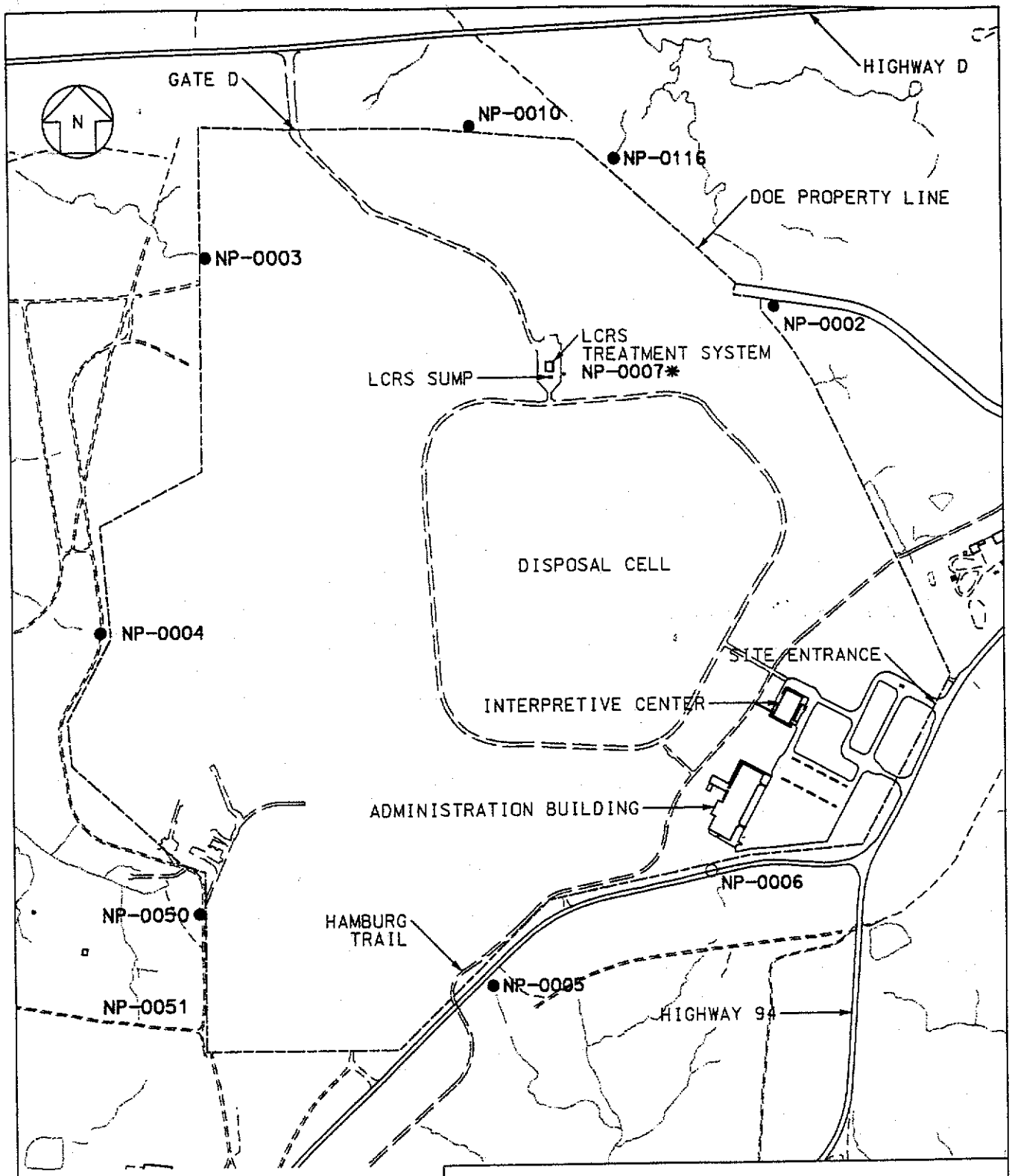
building. A seventh outfall (NP-0007) was added on October 1, 1990, for the discharge of treated effluent from the site water treatment plant.

When the permit was reissued on March 4, 1994, storm water Outfall NP-0010 was added to monitor the construction material storage area, and Outfall NP-0004 was deleted. The permit was revised several times. The first revision on August 4, 1995, resulted in the deletion of Outfall NP-0001 and the addition of parameter limits for management of storm water which accumulated in the chipped wood storage area (CWSA) basin. The second revision on January 17, 1997, increased the limits for selected parameters for Outfall NP-0007. The revised limits are shown in Table 4-3 and became effective the second quarter of 1997. The third revision, on May 22, 1998, added storm water Outfall NP-0004.

An application to renew the permit was submitted during September 1998. The permit was renewed on July 14, 2000. The renewed permit includes Outfall 009 (NP-0050, NP0051), the TSA outfall. Aluminum was added as a parameter for the site water treatment plant, and the provision for the chipped wood storage area was removed. The permit was also modified to reflect one treatment plant, the Retention Basin Ion Exchange Unit or the Train 3 system.

The LCRS treatment system is the only remaining treatment system and is not currently in operation. Leachate water from the cell and well purge water are hauled to the Metropolitan St. Louis Sewer District Bissell Point Treatment Plant for disposal. Should leachate be treated on-site and discharged, the monitoring and reporting for outfall NP-0007 will take place in accordance with the permit.

Figure 4-1 shows the locations of NPDES outfalls at the chemical plant and Tables 4-2 through 4-4 show monitoring requirements for each outfall. This permit requires that sampling results be submitted to the Missouri Department of Natural Resources each calendar quarter in a discharge monitoring report. The report is due by the 28th day of the month following the reporting period. Reporting for the storm water outfalls and the sewage treatment outfall will continue until the outfalls are removed from the permit.



* THE LCRS TREATMENT SYSTEMS DISCHARGE TO THE MISSOURI RIVER, VIA THE EFFLUENT PIPELINE AT NP-0007 (SEE FIGURE 4-2)

LEGEND

● – SAMPLE LOCATION

0 600 1200

SCALE FEET

SURFACE WATER AND NPDES MONITORING LOCATIONS AT THE WELDON SPRING CHEMICAL PLANT 1/1/2003

FIGURE 4-1

REPORT NO.: DOE/OR/21548-424	EXHIBIT NO.: A/CP/086/0993	
ORIGINATOR: TW	DRAWN BY: GLN	DATE: 12/19/02

Table 4-2 NPDES Permits MO-0107701 and MO-0108987 Monitoring Requirements – Sanitary and Storm Water Outfalls

PARAMETERS	UNITS	PERMITTED LIMIT	FREQUENCY
Storm Water Outfalls NP-0002, NP-0003, NP-0004, NP-0005, NP-0010, NP-0051, and NP-1005*			
Flow	Gpd	Monitor	Once/month
Settleable Solids	ml/l/hr	1.0	Once/month
Total Suspended Solids	mg/l	Monitor(a)	Once/month
Nitrate + Nitrite as N**	mg/l	Monitor	Once/month
Uranium, total	mg/l	Monitor(b)	Once/month
Gross Alpha/Beta	pCi/l	Monitor	Once/month
PH	SU	6-9	Once/month
Sewage Treatment Plant Outfall NP-0006			
Flow	Gpd	Monitor	Once/month
Biochemical Oxygen Demand	mg/l	30/45(c)	Once/quarter
Total Suspended Solids	mg/l	30/45(c)	Once/quarter
PH	SU	6-9	Once/quarter
Fecal Coliform	Colonies/100 ml	400/1,000(d)	Once/quarter
Total Residual Chlorine	mg/l	1.0	Once/quarter

* NP-1005 is the only quarry storm water outfall under permit MO-0108987
** Site outfalls only.
(a) Limit is 50 mg/l if erosion control is not designed for 1 in 10 year, 24-hour storm.
(b) Must notify MDNR if uranium levels exceed 2.0 mg/l.
(c) Monthly average/ weekly average
(d) Monthly average/daily maximum.

Table 4-3 NPDES Permit MO-0108987 and MO-0107701 Monitoring Requirements – Quarry Water Treatment Plant and LCRS Treatment System

PARAMETER	PERMIT LIMIT	FREQUENCY	SAMPLE TYPE
Site NP-0007			
Flow	Monitor, gpd	Once/week*	24-hr total
Chemical Oxygen Demand	90/60 mg/l(a)	Once/week*	Grab
Total Suspended Solids	50/30 mg/l(a)	Once/week*	Grab
PH	6-9 standard units	Once/week*	Grab
Aluminum, Total	7.5 mg/l	Once/week*	Grab
Arsenic, Total	0.20 mg/l	Once/week*	Grab
Chromium, Total	0.40 mg/l	Once/week*	Grab
Lead, Total	0.20 mg/l	Once/week*	Grab
Manganese, Total	0.50 mg/l	Once/week*	Grab
Mercury, Total	0.005 mg/l	Once/week*	Grab
Selenium, Total	0.05 mg/l	Once/week*	Grab
Cyanide, Amenable	0. 05 mg/l	Once/week*	Grab
2,4-DNT	1.1 µg/l	Once/week*	Grab
Fluoride, Total	12.0 mg/l	Once/week*	Grab
Nitrate + Nitrite as N:	100 mg/l	Once/week*	Grab

Table 4-3 NPDES Permit MO-0108987 and MO-0107701 Monitoring Requirements – Quarry Water Treatment Plant and LCRS Treatment System (Continued)

PARAMETER	PERMIT LIMIT	FREQUENCY	SAMPLE TYPE
Site NP-0007 (Continued...)			
Sulfate as SO_4	1000 mg/l	Once/week*	Grab
Chloride	Monitor mg/l	once/week*	Grab
Gross Alpha	Monitor, pCi/l	once/week*	Grab
Gross Beta	Monitor, pCi/l	once/week*	Grab
Uranium, Total	Monitor, pCi/l	once/week*	Grab
Ra-226	Monitor, pCi/l	once/month	Grab
Ra-228	Monitor, pCi/l	once/month	Grab
Th-230	Monitor, pCi/l	once/month	Grab
Th-232	Monitor, pCi/l	once/month	Grab
Priority Pollutants(b)	Monitor, mg/l	once/year	Grab
Whole Effluent Toxicity(c)	(d)	once/quarter	Grab
Quarry NP-1001			
In-Stream River Sediment SD-4090 and SD-4091 (Sampling locations shown on Figure 4-2)(e)			
Uranium, Total	Monitor, pCi/g	once/year	Grab

(a) Daily maximum/monthly average.
(b) Complete priority pollutant list shown on Table 4-4.
(c) Requires upstream receiving water control sample to be collected from Missouri River at location SW-1011.
(d) No statistical difference in mortality observed in the effluent test concentration and the upstream receiving water control at a 95% confidence level.
(e) Condition of NPDES permit MO-0108987.
* Equates to once/batch or once/week for continuous discharge.

Table 4-4 NPDES Permit MO-0107701 Monitoring Requirements – Priority Pollutant List (Site NP-0007)

Acenaphthylene	1,3-dichloropropylene
Acenaphthene	4-chlorophenyl phenyl ether
Acrolein	4-bromophenyl phenyl ether
Acrylonitrile	Bis (2-chloroisopropyl) ether
Benzene	Bis (2-chloroethoxy) methane
Benzedrine	Methylene chloride (dichloromethane)
Carbon Tetrachloride (tetrachloromethane)	Methyl chloride (chloromethane)
Chlorobenzene	Methyl bromide (bromomethane)
1,2,4-trichlorobenzene	Bromoform (tribromomethane)
Hexachlorobenzene	Dichlorobromomethane
1,2-dichloroethane	Chlorodibromomethane
1,1,1-trichloroethane	Hexachlorobutadiene
Hexachloroethane	Hexachlorocyclopentadiene
1,1-dichloroethane	Isophorone
1,1,2-trichloroethane	Naphthalene
1,1,2,2-tetrachloroethane	Nitrobenzene

Table 4-4 NPDES Permit MO-0107701 Monitoring Requirements - Priority Pollutant List (Site NP-0007) (Continued)

Chloroethane	2-nitrophenol
Bis (2-chloroethyl) ether	4-nitrophenol
2-chloroethylvinyl ether	2,4-dinitrophenol
N-nitrosodi-n-propylamine	4,6-dinitro-o-cresol
Pentachlorophenol	N-nitrosodimethylamine
Phenol	N-nitrosodiphenylamine
Bis (2-ethylhexyl) phthalate	Phenanthrene
Butyl benzyl phthalate	dibenzo(a,h)anthracene
Di-n-butyl phthalate	Indeno (1,2,3-cd) pyrene
Di-n-octyl phthalate	Pyrene
Diethyl phthalate	Tetrachloroethylene
Dimethyl phthalate	Toluene
Benzo(a)anthracene	Trichloroethylene
Benzo(a)pyrene	Vinyl chloride (chloroethylene)
3,4-benzofluoranthene (benzo(b)fluoranthene)	Aldrin
Benzo(k)fluoranthene	Dieldrin
Chrysene	Chlordane
Anthracene	4,4'-DDT
benzo(ghi)perylene	4,4'-DDE
Fluorene	4,4'-DDD
2-chloronaphthalene	Alpha-endosulfan
2,4,6-trichlorophenol	Beta-endosulfan
p-chloro-m-cresol	Endosulfan sulfate
Chloroform (trichloromethane)	Endrin
2-chlorophenol	Endrin aldehyde
1,2-dichlorobenzene	Heptachlor
1,3-dichlorobenzene	Heptachlor epoxide
1,4-dichlorobenzene	Alpha-BHC
3,3'-dichlorobenzidine	Beta-BHC
1,1-dichloroethylene	Gamma-BHC
1,2-trans-dichloroethylene	Delta-BHC
2,4-dichlorophenol	PCB-1242 (Arochlor 1242)
1,2-dichloropropane (1,3-dichloroprpane)	PCB-1254 (Arochlor 1254)
2,4-dimethylphenol	PCB-1221 (Arochlor 1221)
2,4-dinitrotoluene	PCB-1232 (Arochlor 1232)
1,2-diphenylyhdrazine	PCB-1248 (Arochlor 1248)
Ethylbenzene	PCB-1016 (Arochlor 1016)
Fluoranthene	Toxaphene
Antimony	Arsenic
Beryllium	Cadmium
Chromium	Copper
Lead	Mercury
Nickel	Selenium
Silver	Thallium
Zinc	Cyanide, Total
Phenols, Total	

Data generated from this NPDES water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values to determine if the concentrations are "above normal." "Above normal" values are reported to DOE and other agencies in a timely manner as outlined in Procedure ES&H 1.1.7.

4.1.2.2 NPDES Permit MO-0108987

Permit MO-0108987 applies to storm water discharged from the quarry site and treated water discharged from water treatment plant at the quarry. The location of the quarry water treatment outfall (NP-1001) and the storm water outfall (NP-1005) are shown on Figure 4-2. This permit was originally issued to the Department of Energy on May 5, 1989 for discharge of treated water from the quarry water treatment plant. The permit had an expiration date of May 5, 1994, but remained in effect until it was reissued on June 10, 1994. The quarry water treatment plant treated water from several sources: (1) quarry pond, (2) storm water, (3) groundwater, and (4) some water transported from the chemical plant site. The permit was reissued on July 17, 1998 with the addition of Outfall 002 (Outfall NP-1005). Outfall 002 is for the discharge of storm water from the quarry restoration. Table 4-2 shows permit limits and monitoring requirements for the storm water outfall at the quarry. Because remediation has been completed at the quarry there is no longer a source of contaminated water and the treatment system was removed from the quarry. Also, the outfall line to the Missouri River was plugged. A request will be submitted to MDNR to terminate permit MO-0108987 when the storm water outfall consistently meets compliance limits. The only other remaining requirement will be to monitor river sediment upstream and downstream of the quarry water treatment plant outfall on an annual basis. If the permit is still in effect this monitoring will be completed even though there will be no treatment plant discharge. Parameters pertaining only to treated water effluent are not listed in Table 4-3.

An application was submitted to add storm water from backfilling and final grading of the quarry, add a waste stream to the quarry water treatment plant, and change the manganese limit to reflect the same limit as in permit MO-0107701. The added waste stream was groundwater that was pumped from an interceptor trench (Figure 4-2) located between the quarry and the Femme Osage Slough. The permit was reissued on April 21, 2000, with a manganese limit of 0.5 mg/l and an added storm water outfall.

This permit requires that sampling results be submitted to the Missouri Department of Natural Resources each calendar quarter in a discharge monitoring report. The report is due by the 28th day of the month following the reporting period. A report will be submitted for all outfalls until the permit is terminated.

Data generated from this NPDES water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values to

determine if the concentrations are "above normal." "Above normal" values are reported to DOE and other agencies in a timely manner as outlined in Procedure ES&H 1.1.7.

4.1.2.3 NPDES Permit MO-R100B69

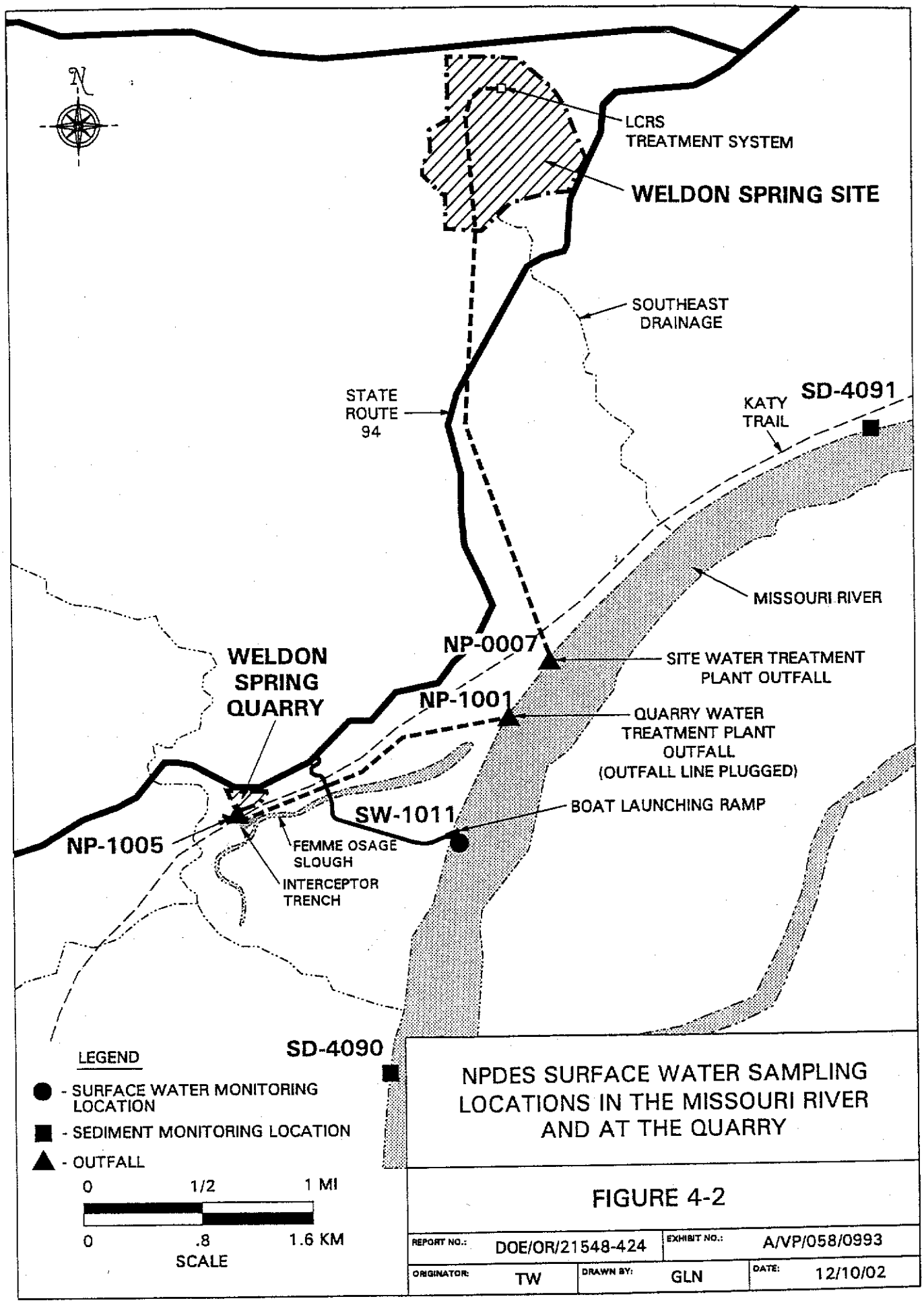
Permit MO-R100B69 was issued on September 1, 1994, and reissued on May 29, 1998. The permit applies to storm water which flows from the Borrow Area. This permit does not specify parameters or frequency of monitoring. The permit was reissued on May 3, 2002. A request was submitted on September 13, 2002, to terminate the permit because the borrow area, haul road, and Hamburg Trail are stabilized with vegetation and control of the area has been returned to the Missouri Department of Conservation.

4.1.2.4 NPDES Permit MO-G670203

Permit MO-G670203 was issued on December 5, 1997, and applies to hydrostatic test water generated at the chemical plant site/raffinate pit area. Hydrostatic test water was generated during maintenance and repairs at the water treatment plants and other areas of the site. The permit required that each discharge be grab sampled during the first 60 minutes of the discharge for Total Suspended Solids, Total Petroleum Hydrocarbons, and pH. Total flow was also recorded. A discharge monitoring report must be submitted to the State on at least an annual basis with reports due by October 28 for the previous October 1 to September 30 period. A request to terminate this permit was submitted to MDNR on November 4, 2002, because hydrostatic testing has been completed.

4.1.2.5 NPDES Permit MO-R104031

Permit MO-R104031 was issued on July 28, 2000. This permit applies to storm water flowing from the quarry borrow area. This permit does not specify outfalls or frequency of monitoring; however, it does specify that total settleable solids shall not exceed a maximum of 2.5 ml/l/hr and total suspended solids shall not exceed a maximum of 45 mg/l. The permit was reissued on May 3, 2002. Because the area has been stabilized and returned to control of the Missouri Department of Conservation a request to terminate the permit was submitted to MDNR on July 18, 2002.



NPDES SURFACE WATER SAMPLING LOCATIONS IN THE MISSOURI RIVER AND AT THE QUARRY

FIGURE 4-2

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/058/0993		
ORIGINATOR:	TW	DRAWN BY:	GLN	DATE:	12/10/02

4.1.3 Additional Storm Water Requirements Needs

Monitoring of other water bodies is required for a complete program. These water bodies are detailed below.

4.1.3.1 Current Erosion and Sediment Control Requirements

Permits for both the site and quarry do not normally place limitations on total suspended solids for storm water runoff; however, if runoff from material storage and construction areas is not treated by facilities or structures that are designed, constructed, and operated to treat the volume of water associated with a 10-year, 24-hour rainfall event, a 50 mg/l limit is placed on total suspended solids at the outfalls. This condition also requires a limit of 6.0 to 9.0 for pH, but a pH limit is imposed at the outfall under all conditions. Additionally, limits for settleable solids are 1.0 ml/l/hour at the storm water outfalls. The *WSSRAP Chemical Plant Surface Water and Erosion Control Report* (Ref. 12) and Procedure ENG-21, *Erosion Prevention and Sediment Control Survey*, require that erosion control measures be designed and maintained to control erosion for a 1 in 10 year, 24-hour storm. In addition, the Storm Water Pollution Prevention Plan (Ref. 22) specifies erosion and storm water pollution control at both borrow areas.

Before the site was remediated, most storm water at the chemical plant site was managed in a network of retention basins (such as the material storage area, chipped wood storage area, etc.) and sedimentation basins (such as Sedimentation Basin 1 and the site water treatment plant sedimentation basin). With completion of remediation and final grading, all basins were removed. Periodic off-site stream inspections may be conducted to assess the effectiveness of on-site erosion controls. Total suspended solids, settleable solids, and pH measurements from the permitted outfalls are reported to the Missouri Department of Natural Resources in the regular *Discharge Monitoring Report*.

4.1.3.2 Vicinity Properties

All Vicinity Properties have been remediated as scoped. Monitoring for future vicinity property remediations, if any, will be determined on a case-by-case basis.

4.1.3.3 Retained Storm Water Monitoring

Storm water that is retained in excavations, trenches, tanks, barrels, secondary containment, etc. is managed in accordance with the *Surface Water Management Plan* (Ref. 13) and the surface water management procedure (ES&H 9.1.2). These documents require that Project Management Contractor (PMC) personnel determine, using site characterization data and process knowledge, whether or not the retained storm water is to be sampled, and if sampled, for which parameters. The procedure also specifies criteria to be used to determine if the retained

storm water may be released to the surface or must be treated before release. Cases of retained storm water have been greatly reduced because remediation is complete.

4.1.3.4 Emergency Monitoring

In the event of accidental releases or spills, samples will be collected just downstream of the release or spill and at the affected outfalls from the site. Parameters will be selected based on the nature of the event.

4.2 Airborne Monitoring Program

The radiological airborne monitoring programs at the Weldon Spring site were discontinued because the potential for public exposure to radiological airborne emissions from the WSSRAP has been eliminated. PM-10 monitoring to measure levels of non-radioactive particulate emissions resulting from resuspension of disturbed dust during general construction operations was discontinued after final site grading were completed.

5. ENVIRONMENTAL MONITORING PROGRAM ADMINISTRATION

5.1 Introduction

The preceding chapters provided the rationale for collecting environmental samples at the Weldon Spring Site Remedial Action Project (WSSRAP) and discussed the groundwater, surface water, and National Pollutant Discharge Elimination System (NPDES) programs. This section describes the requirements for off-site laboratories, data review (accuracy and precision), comparison of recent data to past data (statistical analyses), reporting, records, and peripheral requirements.

5.2 Laboratory Programs

Laboratories performing analyses for environmental monitoring plan samples primarily use U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) analytical methods. For certain analyses (such as radiochemical and wet chemistry) the laboratories use EPA 600 (drinking water), EPA 900 (radiochemical analysis of drinking water), or a method that is reviewed and approved by the Project Management Contractor prior to analysis of a sample. Contracted laboratories have each submitted a site-specific quality assurance project plan to the WSSRAP and have submitted controlled copies of their standard operating procedures. The quality assurance project plan and standard operating procedures are reviewed and approved by the contractor prior to sample shipment to the laboratory. Any changes to the standard analytical protocols or methodologies are documented in the contract laboratory's controlled standard operating procedures. All laboratories currently being used by the WSSRAP have had assessments of their facilities to make sure they have the capability and facilities to perform work according to the specifications in their contracts. Quality assurance assessments are performed to inspect the laboratory facilities and operations, to verify that the laboratories are performing analyses as specified in their contracts, and to check that WSSRAP data documentation and records are being properly maintained.

Site-specific quality assurance project plans from laboratories define standard practices aimed at ensuring that the laboratories are performing high quality work. Each plan is prepared in accordance with the appropriate requirements of *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (Ref. 14). The laboratories demonstrate compliance with additional quality assurance/quality control requirements as specified in their contracts which include sample preparation and analytical methods; calibration of instrumentation; periodic inspections, maintenance, and servicing; statistical procedures to optimize precision and accuracy; corrective action programs; participation in the external Environmental Protection Agency Performance Audit Program; maintenance and storage of WSSRAP records; hardcopy and electronic formatting; and notification of nonconforming issues.

The laboratories' standard operating procedures provide detailed information about internal policy on standard analytical protocol for methods. These standard operating procedures provide step-by-step instructions for performing analytical work and for calculating, reducing, and recording pertinent information about analyses.

The accuracy of chemical and radiological analyses of samples are monitored by the routine use of control samples. This is a requirement of many published protocols (i.e., those of the Environmental Protection Agency) and is good laboratory practice. Results of quality control sample analyses are summarized in the annual report.

5.3 Data Analysis and Statistical Treatment

Proper data analysis and statistical treatment practices are essential to obtain quality results from the effluent monitoring and environmental surveillance programs required by U.S. Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide* (Ref. 5). Therefore, it is necessary to develop a plan to:

- Determine contaminant concentrations at each sampling location for each sampling period, and evaluate the accuracy and precision of those concentrations.

- Compare the contaminant concentrations at each sampling location to previous concentration estimates and evaluate changes or inconsistencies in contaminant levels.

- Compare contaminant concentrations at sampling locations to the established regulatory or administrative limits or standards for those contaminants and/or background concentrations.

The WSSRAP has taken steps to establish appropriate investigation levels for groundwater, surface water, and site effluents to achieve consistent review of environmental data and initiation of appropriate and timely action when necessary. The criteria applied by the WSSRAP to define the investigation levels for all environmental monitoring data are described in several Environmental Safety and Health Department procedures. The procedures listed below direct the WSSRAP staff in the evaluation of environmental monitoring data. These evaluations include assessing data quality and determining whether a given datum exceeds specific action levels. Administrative procedures that must be followed when action levels are exceeded are also defined. The procedures governing data review are:

ES&H 1.1.7 - *Environmental Data Review and Above Normal Reporting*

ES&H 4.9.1 - *Environmental Monitoring Data Verification*

ES&H 4.9.2 – *Environmental Monitoring Data Validation*

These procedures are intended to address Department of Energy guidance criteria for determining investigation levels for environmental monitoring programs.

The statistical techniques used to evaluate and analyze the data are designed to accommodate environmental data sets. Such data sets typically include skewed distributions of time series data, variable analytical results, missing data, and data that are below analytical detection limits.

5.3.1 Summary of Data Analysis and Statistical Treatment Requirements

The following subsections summarize the procedures for data analysis and statistical treatment of the surveillance and effluent data. Upon receipt from the Verification/Validation Group all new environmental data are evaluated against the corresponding historical data and regulatory levels by the data user according to Procedure ES&H 1.1.7. After these data have been reviewed and verified in accordance with Procedure ES&H 4.9.1, they are entered into the WSSRAP environmental database.

5.3.2 Variability of Environmental and Effluent Data

Data precision and accuracy are measures of the variability of analytical results. Precision is a measure of how much individual measurements agree with each other. Accuracy is a measure of how much individual measurements agree with the true value. Careful design and execution of the monitoring and laboratory programs can substantially increase the quality of environmental and effluent monitoring data by improving precision and accuracy.

5.3.2.1 Sources of Variability

Variability of data may arise from six sources: sample collection errors, analytical errors, statistical counting variations, data recording errors, and temporal and spatial variability between environmental samples. Efforts will be taken to minimize variability due to sampling, analytical, and recording errors; however, variability due to statistical counting variations and environmental factors (temporal and spatial) cannot be controlled.

5.3.2.2 Estimating Accuracy and Precision

The validation process will assess the accuracy and precision of 10% of the validatable data points according to the WSSRAP data validation procedure (ES&H 4.9.2). The annual site report will summarize the completeness, accuracy, and precision of the data obtained from off-site laboratories. Appendix A lists precision and accuracy requirements for laboratory analyses.

5.3.3 Review of New Environmental Data and Testing for Outliers

Review of new environmental data requires comparison with historical trends and/or action-level criteria. Data review is accomplished using a set of elementary statistical parameters that are easy for the reviewer to calculate and are included in the data management system software. The statistical procedures, which are described in ES&H 1.1.7, are intended to provide a consistent, simple method to screen analytical data for outliers that require further investigation and/or qualification and to detect data that exceed the action-level criteria (as defined in Procedure ES&H 1.1.7). These procedures are not recommended for other applications, such as evaluating a datum for compliance with a regulatory level or setting a confidence level about the mean.

5.3.3.1 Data Below the Limit of Detection

Data below the limit of detection are included in all statistical calculations conducted for the purposes of data review except in special cases of high detection limits. A high detection limit is a limit that exceeds the mean of the detected values or exceeds two times the mean of previous detection limits for data sets that include only nondetects. One half the detection limit (DL/2) is normally substituted for nondetects in statistical calculations supporting data review. Uncensored data, when available, may be used directly in these statistical calculations provided the uncensored value is greater than or equal to zero. Because negative concentrations are not possible in nature, all negative values will be identified as non-detect and may be included in the statistical calculation after this conversion.

5.3.3.2 Elements of Good Practice

The review of data is documented in accordance with Procedure ES&H 4.9.1, which constitutes a formal record that becomes part of the data verification package.

The electronic data management system facilitates tracking and documenting data quality. Outliers (observations that do not conform to the pattern established by other observations) that have been identified during the data review may be identified and tracked in the Data Reviewer Qualifier field. Verification and validation qualifiers are displayed in their own fields. An extended comments field is available to add additional comments on the quality of a datum. Field sheets, data and tracking information are also stored in the system and may be retrieved by the reviewer to assist in evaluating data.

5.3.4 Treatment of Significant Figures

Calculations performed using the analytical data received from the laboratory will follow the accepted rules for significant figures. Results of calculations will not contain more significant figures than the least precise value used in the calculation.

5.3.5 Parent-Decay Product Relationships

The delays associated with the time between sample collection and sample analysis are insignificant compared to the half-lives of most radionuclides (with the exception of radon and thoron gas and their associated decay products) routinely monitored at the Weldon Spring site. Therefore, it is not necessary to take into account parent-decay times when assessing the majority of parent-decay product relationships.

5.4 Documentation Requirements

The WSSRAP recognizes numerous Department of Energy (DOE) orders, notices, and directives in addition to Federal, State, and local regulations. Since the Weldon Spring site is a remedial action project, rather than an operating facility, the distinction between applicable and nonapplicable guidelines must be determined when interpreting these regulations. The project must comply with appropriate regulations, write and distribute reports in a timely manner, and maintain records properly. The following DOE Orders describe required activities at the site: 225.1A, 231.1, 232.1A, 5400.1, and 5400.5. These Orders are discussed in the following paragraphs.

DOE Order 225.1A, *Accident Investigations*, outlines requirements and procedures for investigating occurrences which may impact environmental protection, safety, and health. Occurrences are categorized into three levels (emergencies, unusual occurrences, and off-normal occurrences). In addition, DOE Order 231.1, *Environmental Safety and Health Reporting*, requires that an annual report of any exposures of DOE or Project Management Contractor employees, nonemployee radiation workers, and visitors be sent to the Radiation Exposure Information Reporting System (REIRS).

DOE Order 232.1A provides guidance and definitions regarding what to report, when to report, who should report, and how reports are categorized. The Order also defines the responsibilities of those involved in the reporting process. The Order requires timely identification, categorization, response, notification, investigation, and reporting of abnormal conditions and events in accordance with DOE Manual 232.1-1A. This manual outlines the reporting process and provides definitions of terminology specific to occurrence reporting.

The *Manual for Categorization of Reportable Occurrences* (Ref. 17) and Procedure RC-5, *Occurrence Reporting* are site specific and are used to classify occurrences.

DOE Order 5400.1, *General Environmental Protection Program*, requires that all Department of Energy facilities comply with all applicable Federal, State, and local environmental protection laws and regulations. Both environmental occurrences and routine monitoring reporting are covered. Environmental occurrences will be reported as stated in DOE 232.1A in accordance with WSSRAP procedures.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, states that DOE facilities will adopt specific standards and requirements that will not allow undue risk from radiation to affect the public or the environment. The WSSRAP has formulated its environmental protection program to meet the requirements of this order and the *Regulatory Guide* (Ref. 5).

5.5 Reports

The following are summaries of reports generated at the WSSRAP to satisfy Federal, State, and/or local environmental protection laws and regulations, Executive Orders, internal Department of Energy policies, or agreements with other agencies.

5.5.1 Annual Site Environmental Report

An annual report will be prepared to summarize and document the results of the EMP. The annual report is the vehicle for documenting the results of the monitoring program at the WSSRAP. The report provides the public and concerned regulatory agencies with summary level discussions regarding the routine environmental monitoring program. It explains how the WSSRAP effluent monitoring program meets the requirements of the NPDES program and compares the measured contaminant levels in several environmental media to applicable Federal and State standards and Department of Energy requirements. When additional characterization and monitoring activities are conducted that are not defined within the scope of the *Environmental Monitoring Plan,* they will be summarized in the annual report.

5.5.2 NPDES Discharge Monitoring Reports

Permits issued under the National Pollutant Discharge Elimination System and provisions of the *Clean Water Act* also require record keeping and reporting. Record keeping requirements are stated in the NPDES permits issued by the Missouri Department of Natural Resources (MDNR). Discharge monitoring reports are submitted as required in the permits and include information on sample collection, flow, and laboratory results. Also included in the reports are noncompliance events. If there is a noncompliance with a daily maximum limitation, the MDNR must receive a written report within 5 days. Any noncompliance that may endanger health or the

environment requires that oral notification be made to the MDNR within 24 hours, followed by a written report within 5 days.

5.5.3 Compliance Reports

Under the *Federal Facility Agreement*, the Department of Energy must submit status reports on activities and technical documents to the Environmental Protection Agency for their review and approval. These include, but are not limited to, the sampling plans and unplanned sampling activity notifications. Each of these activities has specific reporting requirements and time constraints, which are detailed in the *Federal Facility Agreement Implementation Plan* (Ref. 19).

5.6 Records

Department of Energy Order 5400.1 requires that all environmental surveillance and effluent monitoring records, computer programs, raw data, and procedures be retained. These records must be protected against damage or loss. The WSSRAP *Sample Management Guide* (Ref. 10) governs sampling plan preparation, data verification and validation, database administration, and data archiving.

The *Sample Management Guide* specifies a tracking system for sampling activities. Field log books and/or field sampling forms are filled out at sample collection. A Chain-of-Custody Form is completed and accompanies the sample until it is properly disposed of or returned to the WSSRAP. The Chain-of-Custody Form is sent along with the sample to authorize testing by an off-site laboratory.

Environmental data and documentation from sampling, analysis, and quality review programs are maintained in hard copy records, i.e., in written, typed, or printed forms; and electronic records, i.e., computerized records of environmental data.

6. QUALITY ASSURANCE

Quality assurance for environmental monitoring activities at the Weldon Spring site is divided into two separate categories. The first is programmatic or overall project quality assurance, and relates to the incorporation and documentation of the quality of all site activities. This approach is discussed in Section 7.1. The second category is specific to the environmental monitoring activities presented in this plan and is discussed in Section 7.2.

6.1 Programmatic Quality Assurance

The Weldon Spring Site Remedial Action Project (WSSRAP) is obligated to comply with Department of Energy Order 414.1A (Quality Assurance) and 10 CFR 830.120 (Quality Assurance). These requirements were developed to ensure that work performed at facilities handling, processing, or utilizing radioactive materials is of documented quality. To satisfy this obligation, the Project Management Contractor has prepared a project specific *Project Management Contractor Quality Assurance Program* (Ref. 21) which details DOE Order 414.1A and 10 CFR 830.120 (Quality Assurance) requirements which support, control, or guide the environmental monitoring program. This plan has been reviewed by the U.S. Department of Energy and has been reviewed and approved by PMC management and the Project Quality Manager. These requirements include: project organization, a quality assurance program, a document control system, the identification and control of items, inspections, the control of measuring and test equipment, handling, storage, and shipping of quality-affecting items, a program for implementing and verifying corrective action, a program for maintaining quality assurance records, and a routine assessment program.

The WSSRAP also has prepared an *Environmental Quality Assurance Project Plan* (Ref. 15) to meet the intent of *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations,* (Ref. 14). This document supports the *Project Management Contractor Quality Assurance Program* (Ref. 21) and is specific to environmental monitoring and characterization.

6.2 Environmental Monitoring Program Quality Assurance

The quality of the environmental monitoring program is maintained and documented through a number of measures described in the following subsections. The measures include: the use of standard operating procedures; the collection, analysis, and evaluation of quality control samples and performance evaluation samples; the use of standardized analytical methods; data management activities (data verification) and data quality evaluations (data validation); maintaining quality assurance records; performing independent assessments; and evaluating analytical laboratories, sample collection activities, and programmatic procedures. Each of these items will be discussed in the following subsections.

6.2.1 Standard Operating Procedures

Standard operating procedures have been developed for routine activities associated with environmental monitoring at the Weldon Spring site. These procedures have been developed from U.S. Environmental Protection Agency and Department of Energy guidance and from standard industry practices and are site specific. Procedures are prepared, reviewed, and approved by cognizant department managers, the Project Quality Manager, and project management. Controlled copies of procedures are maintained in accordance with the document control requirements of Department of Energy Order 414.1A and 10 CFR 830.120.

6.2.2 Quality Control Samples

Numerous quality control samples are collected in support of environmental monitoring activities. Quality control samples were developed in accordance with the *Sample Management Guide* (Ref. 10). These include: duplicate samples, replicate samples, blank samples, and equipment blank samples. Samples are also provided to the laboratory for internal laboratory quality control evaluations specific to sample media (matrix spikes, matrix spike duplicate and matrix duplicate samples). Table 7-1 presents a summary of the various quality control samples that will be collected to support environmental monitoring activities.

Table 6-1 Field Quality Control Sample Summary

QC SAMPLE TYPE	FREQUENCY	PURPOSE
Matrix Spike/Matrix Spike Duplicate or Matrix Duplicate	1 per 20	Assess matrix and possible intralaboratory variability
Field Replicate	1 per month	Assess matrix, intralaboratory, and field operations Variability
Equipment Blank (non-dedicated Equipment only)	1 per 20	Assess effectiveness of decontamination
Distilled Water Blank	1 per year	Assess quality of distilled water
Trip Blank	1 pair per cooler containing VOA samples	Assess potential VOA cross-contamination during Shipping

6.2.3 Analytical Methods

Standardized analytical methods, procedures, and protocols that are used to analyze samples collected for the environmental monitoring plan are contained in Appendix A. These standardized analytical methods, procedures, and protocols will be used whenever possible, or variations will be approved prior to analysis. Variations to methods, procedures, or protocols are documented in the controlled standard operating procedures received from contracted laboratories or by revisions to the WSSRAP standard operating procedures. Variations of contracted laboratories' standard operating procedures are approved and controlled. Appendix A

also has a summary of the accuracy and precision requirements, taken from the *Sample Management Guide* (Ref. 10).

6.2.4 Data Management Activities and Data Quality Evaluations

Overall environmental data management activities for the Weldon Spring site are detailed in the *Sample Management Guide* (Ref. 10). The *Sample Management Guide* provides guidance for the development of sampling plans, describes data management activities, and general data quality requirements. These general guidelines and data quality requirement goals have been adopted for this monitoring program. The primary activities associated with data management and data quality for this *Environmental Monitoring Plan* (EMP) are data verification, data review, database management, and data validation. These programs ensure the quality of data generated by on-site and off-site analyses of samples collected under the EMP.

Data verification is the WSSRAP process of reviewing the sampling documentation and analytical data to ensure that adequate documentation is maintained and that all results are reported in compliance with established reporting requirements. All data generated by off site analytical laboratories for the *Environmental Monitoring Plan* are verified. The verification process consists of reviewing data for transcription errors, reviewing sampling documentation and chain-of-custody documentation, and comparing actual holding times to the method specified holding times. These activities are documented according to Procedure ES&H 4.9.1. Upon completion of the verification process, the data are reviewed by the data requestor for comparability with historical results and for statistical and compliance evaluations.

Following completion of data verification, data are merged into the appropriate database and are available for general use. All databases are backed up regularly. To maintain the integrity of the computer files, access to edit the database is restricted.

Data validation is an independent formal review of laboratory records performed by WSSRAP personnel to assess the quality of the reported data. Actual laboratory records are reviewed by data validation personnel to determine whether the analytical instruments were within calibration, to ensure the analytical procedures were followed, to ensure quality control samples were within their respective acceptance limits, and to ensure that adequate documentation is available to support the validity of the data. Data validation is performed on approximately 10% of all the validatable data. The 10% are selected by the validation group. Validation activities provide the WSSRAP with qualified data and evaluate completeness of analytical data from the individual laboratories. All validated data receive a database qualifier that provides information for data users to evaluate the useability of the data. These activities are performed and documented in accordance with Procedure ES&H 4.9.2.

6.2.5 Quality Assurance Records

Records generated as a result of environmental monitoring are maintained as quality assurance records. Field sampling forms, analytical data, equipment calibration records, and verification and validation documentation records are all considered quality assurance records and are maintained in accordance with the requirements of site procedures.

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DEPARTMENT OF ENERGY ORDERS

151.1	*Comprehensive Emergency Management System*
225.1A	*Accident Investigations*
231.1	*Environmental Safety and Health Reporting*
232.1A	*Occurrence Reporting and Processing of Operations Information*
360.1	*Training*
414.1A	*Quality Assurance*
5400.1	*General Environmental Protection Program*
5400.5	*Radiation Protection of the Public and the Environment*
5400.13	*Sealed Radioactivity Source Accountability*
5480.19	*Conduct of Operations Requirements for DOE Facilities*
5480.23	*Nuclear Safety Analysis Reports*
5480.30	*Nuclear Reactor Safety Design Criteria*
5500.6B	*Shutdown of Departmental Operations Upon Failure by Congress to Enact Appropriations*
5500.11	*Power Marketing Administration Emergency Management Program*
5632.7A	*Protective Force Program*

FEDERAL AND STATE REGULATIONS

40 CFR 141	*National Primary Drinking Water Regulations*
40 CFR 246	*Source Separation for Materials Recovery Guidelines*
40 CFR 264	*Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*
10 CSR 20-6.010	*NPDES Construction and Operating Permits*
10 CSR 20-7.015	*Effluent Regulations*

10 CSR 20-7.031 *Water Quality Standards*

PROCEDURES

CM&O 15	*Task-specific Safety Assessments*
ECDI-29	*Site Generated Waste Management*
ENG-21	*Erosion Prevention and Sediment Control Survey*
ES&H 1.1.7	*Environmental Data Review and Above Normal Reporting*
ES&H 4.1.1	*Environmental Numbering System*
ES&H 4.1.2	*Chain of Custody*
ES&H 4.1.3	*Sampling Equipment Decontamination*
ES&H 4.3.1	*Surface Water Sampling*
ES&H 4.4.1	*Groundwater Sampling*
ES&H 4.4.2	*Groundwater Level Monitoring and Well Integrity Inspections*
ES&H 4.5.7	*Measurement of Settleable Solids*
ES&H 4.9.1	*Environmental Monitoring Data Verification*
ES&H 4.9.2	*Environmental Monitoring Data Validation*
ES&H 9.1.2	*Surface Water Management*
PS-4	*Records Inventory and Disposition Schedule*
PS-6	*Procedure Preparation Requirements*
RC-5	*Occurrence Reporting*

APPENDIX A
Data Quality Requirements

A-1 Data Quality Requirements for the WSSRAP-Precision and Accuracy Guidelines for Routine Monitoring and Characterization

CATEGORY	ANALYTICAL PARAMETER	PRECISION (WATER)	ACCURACY (WATER)[a]	COMMENTS[b]
Field Measurements	pH	20	NA	ES&H SOP 4.5.1
	Temperature	20	NA	ES&H SOP 4.5.1
	Conductivity	20	NA	ES&H SOP 4.5.2
	Specific Ions	20	NA	ES&H SOP 4.5.5
	Dissolved Oxygen	20	NA	ES&H SOP 4.5.6
	Organic Vapors	20	NA	ES&H SOP 3.1.1
	Settleable Solids	20	NA	ES&H SOP 4.5.7
Off-site Radiological Measurements	Nat. Uranium	20	20	EPA 908.0
	Ra-226, -228	20	20	EPA 903.1
	Th-228, 230, 232	20	20	EERF 00/07
	Gross Alpha	40	40	EPA 900.0
	Gross Beta	40	40	EPA 900.0
Nitroaromatic Compounds	TNT	20	20	USATHAMA
	2,4-DNT	20	20	USATHAMA
	2,6-DNT	20	20	USATHAMA
	1,3,5-TNB	20	20	USATHAMA
	1,3-DNB	20	20	USATHAMA
	Nitrobenzene	20	20	USATHAMA
Miscellaneous	TSS	20	20	EPA 160.1
	TDS	20	20	EPA160.2
	TOC	20	20	EPA 415.1
	Li	20	20	EPA 200.7
	Mo	20	20	EPA 200.7
	Sr	20	20	EPA 200.7
	TOX	20	20	EPA 450.0
	NO3	20	20	EPA 300.0/353.1
	SO4	20	20	EPA 300.0/375.1
	Cl	20	20	EPA 300.0/325.1
	F	20	20	EPA 300.0/340.1
	NO2	20	20	EPA 354.1
CLP-VOA	TCL[c]	As required by CLP		EPA CLP
CLP-Semi VOA	TCL	As required by CLP		EPA CLP
CLP-Pest/PCB	TCL	As required by CLP		EPA CLP
CLP-Metals	Al	As required by CLP		EPA CLP-ICP
	As	As required by CLP		EPA CLP-ICP
	Be	As required by CLP		EPA CLP-ICP
	Cd	As required by CLP		EPA CLP-ICP
	Cr (Total)	As required by CLP		EPA CLP-ICP
	Cu	As required by CLP		EPA CLP-ICP
	Pb	As required by CLP		EPA CLP-AA
	Hg	As required by CLP		EPA CLP-CV
	Ni	As required by CLP		EPA CLP-ICP
	Na	As required by CLP		EPA CLP-ICP
	Zn	As required by CLP		EPA CLP-ICP

A-1 Data Quality Requirements for the WSSRAP-Precision and Accuracy Guidelines for Routine Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	PRECISION (WATER)	ACCURACY (WATER)[a]	COMMENTS[b]
CLP-Metals (Continued)	Ba	As required by CLP		EPA CLP-ICP
	Ag	As required by CLP		EPA CLP-ICP
	Fe	As required by CLP		EPA CLP-ICP
	K	As required by CLP		EPA CLP-ICP
	Mn	As required by CLP		EPA CLP-ICP
	Mg	As required by CLP		EPA CLP-ICP
	Se	As required by CLP		EPA CLP-AA
	V	As required by CLP		EPA CLP-ICP
	Tl	As required by CLP		EPA CLP-AA
	Sb	As required by CLP		EPA CLP-ICP
	Ca	As required by CLP		EPA CLP-ICP
	Co	As required by CLP		EPA CLP-ICP

NA Not Applicable.

(a) Accuracy criteria reflects the maximum ± deviation from 100% recovery. Precision criteria reflects the maximum relative percent difference between duplicate values.

(b) Generic DQRs apply to media and/or analytical methods not listed in this table. Specific DQRs may be developed as a part of future sampling and analysis plans. Methods noted are only one example of several acceptable methods.

(c) Toxic Compound List.