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ENVIRONMENTAL MONITORING PLAN FOR CALENDAR YEAR 1993

Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

JUNE 1993

REV. 1

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Weldon Spring Site Remedial Action Project

Environmental Monitoring Plan for Calendar Year 1993

Revision 1

June 1993

Prepared by

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for the

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ABSTRACT

Environmental monitoring programs have been formulated annually since the inception of the Weldon Spring Site Remedial Action Project (WSSRAP) to ensure the health and safety of the public, protection of the environment, and compliance with all applicable Federal, State, and local environmental laws and regulations. These plans have evolved over time as characterization activities have defined the extent and magnitude of contamination and as construction and remediation activities have warranted.

This Environmental Monitoring Plan for Calendar Year 1993 satisfies the requirements of the U.S. Department of Energy (DOE) Orders 5400.1 and 5400.5 and the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991). These orders specified the requirements which must be documented in an environmental monitoring plan for each DOE facility with the potential for contributing to environmental pollution.

The scope of this plan includes the schedule and analyses for effluent monitoring and environmental surveillance activities that will be performed during the 1993 environmental monitoring year (calendar year). These activities include the monitoring of surface water, groundwater, effluent waters, radon, gamma radiation, air particulate, biological, and meteorological conditions.

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1 INTRODUCTION

The Weldon Spring site (WSS) is located near Weldon Spring, Missouri, 48 km (30 mi) west of St. Louis, Missouri. The WSS consists of an inactive uranium production facility including raffinate pits, a chemical plant, an abandoned limestone quarry, and associated vicinity properties. These areas contain chemically and radiologically contaminated materials originating from previous operations at the site.

Remediation of the WSS is being 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 program is known as the Weldon Spring Site Remedial Action Project (WSSRAP). The major goals of the WSSRAP are to eliminate potential hazards to the public and the environment, and make surplus real property available for other uses, to the extent possible. An environmental documentation approach has been developed that satisfies the requirements of both the CERCLA, as amended by the *Superfund Amendments and Reauthorization Act* (SARA) and the *National Environmental Policy Act* (NEPA). The result of this process will be a Record of Decision (ROD) regarding ultimate disposal of the WSS wastes.

DOE Order 5400.1, *General Environmental Protection Program* requires the preparation of an Environmental Protection Program Implementation Plan at all DOE sites. The Weldon Spring site *Environmental Protection Program Implementation Plan* (EPPIP) (MKF and JEG 1992a) details the methods by which the WSSRAP will comply with this order. Because the WSSRAP is a remedial action project, the overall goal is different from the standard operating and/or production facilities for which DOE Order 5400.1 was developed. Therefore, the WSSRAP EPPIP meets the intent of DOE Order 5400.1, while being tailored to the unique aspects of a remedial action project. 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 *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), hereafter referred to as the *Regulatory Guide*.

1.1 Purpose

DOE Order 5400.1 requires the preparation of an EMP 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 EMP is to detail the environmental monitoring requirements at the WSS. Environmental monitoring is performed at the WSS to ensure that any potential public exposure is documented and quantified, to ensure that the public's health and safety and the environment are protected, and to demonstrate compliance with applicable legal and regulatory requirements. The monitoring program also confirms adherence to DOE environmental protection policies, and supports remedial planning.

1.2 Scope

This plan describes the effluent monitoring and environmental surveillance activities that will be performed at the WSS during calendar year 1993. These activities include monitoring of surface water, groundwater, radon, gamma exposure, air particulate, sediment, and meteorological conditions. The plan also describes applicable monitoring requirements, analytical methods used, and quality assurance measures. Details and rationale regarding sampling frequencies and analytic parameters are provided. Also presented are summaries of additional programs implemented to satisfy the requirements of DOE Order 5400.1, Order 5400.5, and the *Regulatory Guide*. An evaluation of compliance or noncompliance with each regulatory guide criteria statement has been included in Appendix A of this document. Where criteria statements were applicable to the WSSRAP, recognition of satisfying the criteria was included in the text and in Appendix A; where criteria statements were not applicable, justification is included only in Appendix A.

1.3 Site History

In April 1941, the Department of the Army (DA) acquired 6,974 ha (17,232 acres) of land where the Atlas Powder Company operated four of its 20 trinitrotoluene (TNT) and dinitrotoluene (DNT) explosives production lines from November 1941 through January 1944 as part of the facility known as the Weldon Spring Ordnance Works (WSOW). The remaining

16 production lines were distributed across an adjacent property which is now referred to as the U.S. Army Reserve and National Guard Training Area (WSTA). By 1949, all but approximately 809 ha (2,000 acres) had been transferred to the State of Missouri (August A. Busch Memorial Wildlife Area and Weldon Spring Wildlife Area) and the University of Missouri (agricultural land). Except for several small parcels transferred to St. Charles County, the remaining property became the WSTA.

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 WSOW were transferred in May 1955 to the AEC for the construction of the Weldon Spring Uranium Feed Material Plant (WSUFMP). Considerable explosives decontamination was performed by Atlas Powder and the DA prior to WSUFMP construction. Until 1966, the WSUFMP 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. Wastes generated during these operations were stored in four raffinate pits on the site property.

In 1958 the AEC acquired title to the Weldon Spring Quarry (WSQ) from the DA. The quarry is located approximately 5.6 km (3.5 mi) south of the WSUFMP. The WSQ had been used earlier by the DA for the disposal of wastes from the manufacture of TNT and DNT, and for the disposal of TNT-contaminated rubble during the operation of the WSOW. Prior to 1942, the WSQ was mined for limestone aggregate during construction of the WSOW. The AEC used the WSQ from 1963 to 1969 as a disposal area for uranium residues and a small amount of thorium residue, but most of the material disposed of there consisted of uranium and radium-contaminated building rubble and soils from the demolition of a uranium ore processing facility in St. Louis. Other radioactive materials include drummed wastes, uncontained wastes, and contaminated process equipment.

The WSUFMP was shut down in 1966, and in 1967 the AEC returned the facility to the DA for use as a defoliant production plant to be known as the Weldon Spring Chemical Plant (WSCP). The Army started removing equipment and decontaminating several buildings in 1968. The defoliant project was canceled in 1969, before any process equipment was installed. The

DA retained the responsibility for the land and the facilities at the WSCP, but the 20.6 ha (51-acre) tract encompassing the Weldon Spring raffinate pits (WSRP) was transferred back to the AEC. From 1969 to 1981, no activities took place regarding the status of the WSS. The WSS was placed in caretaker status from 1981 through 1985, when custody of the WSCP and WSQ were transferred from the DA to the DOE. In 1985, the DOE proposed designating the control and decontamination of the WSCP, WSRP, and WSQ as a major project.

2 OBJECTIVES AND RATIONALE

The goal of the Weldon Spring Site Remedial Action Project (WSSRAP) is to protect and enhance the environment while ensuring the protection of the public. This will be accomplished by safely disposing of hazardous and radiological wastes that resulted from operation of the Weldon Spring Uranium Feed Materials Plant (WSUFMP) and the U.S. Army's Weldon Spring Ordnance Works (WSOW). Within the overall project mission, the environmental protection program focuses on the operational activities of the project.

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

- To assess compliance with all applicable environmental quality standards and public exposure limits.
- To determine the background levels and site specific compound levels.
- To determine the effectiveness of effluent treatment and controls.
- To determine the validity and effectiveness of exposure models.
- To determine the long term buildup and prediction of environmental trends from site-released contaminants.
- To detect and quantify unplanned releases.

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

In the event deviation from the EMP were to occur, either by the determinations of the Prime Management Contractor (PMC) or by circumstances outside the control of the PMC, concurrence will be obtained from the U. S. Department of Energy (DOE) and the appropriate Federal, State, and local agencies. Examples include the reduction of sampling frequency, elimination of sampling locations, elimination of analyzed parameters, or a change in analytical methods if less stringent.

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 a migration pathway from the site at its perimeter, or in a pathway subject to compliance with applicable regulations (e.g., National Emissions Standards for Hazardous Air Pollutants [NESHAPs]) or permit levels and requirements (e.g., 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 contaminants to detect and/or track the migration of those contaminants. Surveillance data are used to assess the presence and magnitude of any radiological or toxicological exposures by members of the public, or to assess the effects, if any, on the local environment.

The Weldon Spring site (WSS) has maintained a relatively stable configuration of its waste products since cessation of the plant operation and decontamination of some process buildings in the early 1970s. It is believed that this stability has allowed the site to achieve a rough equilibrium regarding the migration of contaminants from the site. Since the WSS is presently under active remediation, the nature of the waste units and their physical position and chemical state are subject to disturbance. The monitoring program for 1993 has been designed to address the pathways and constituents reflective of a changing waste setting and to further characterize the waste units in order to model their behavior under specific conditions.

The U.S. Department of Energy (DOE) has defined generic performance criteria that the DOE operations offices must use in developing their programs. The environmental protection program has incorporated these criteria into the WSSRAP monitoring program. The objective of the WSSRAP environmental monitoring program is to generate all data necessary to ensure regulatory compliance and assess the public and environmental impact from site contaminants. Therefore, a program must be developed that assesses all viable environmental pathways. The program in this Environmental Monitoring Plan (EMP) defines a minimum scheme of data points to be collected in order to evaluate whether environmental conditions are changing, and whether site-related contaminants or activities are impacting public health or the environment. Where additional data points or density is required to verify trends or more closely evaluate environmental conditions, additional samples may be collected that are not defined in the plan.

Those samples will be collected to serve the objectives of the Environmental Monitoring Program at the Weldon Spring site and will be consistent with the guidelines of the DOE 5400 Orders. The following section describes the pathway analysis performed by the WSSRAP to arrive at the monitoring program.

2.1 Pathway Analysis

To evaluate the potential impact on human or ecological receptors of activities at the WSS, it is necessary to conduct a pathway analysis. Exposure pathways are identified considering the source, release mechanisms, type and location of contaminants at the site and 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 is to identify complete pathways and give reasonable assumptions about future conditions. An exposure pathway is considered complete if a linkage can be shown between one or more contaminant sources, through one or more environmental transport processes, to an exposure point where human or ecological receptors are present. Identification of potentially complete pathways is a qualitative judgement. Procedures used are intended to be conservative. The identification of a complete pathway does not necessarily indicate that adverse effects will occur; it indicates that the effort to monitor releases is worthwhile from the standpoint of protecting human health and the environment.

2.2 Monitoring Program Rationale

The critical pathway analyses (radionuclide and media) conducted for the WSSRAP included both the Weldon Spring Quarry (WSQ) and the Weldon Spring Chemical Plant/Weldon Spring raffinate pits (WSCP/WSRP) and are presented in Table 2-2. These analyses were based on data developed during various characterization studies (e.g., Phase I and II soils study, groundwater study, etc.), and from site specific criteria, site specific assumptions, and the matrix of potential exposure routes.

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; area use by public and wildlife; and the proximity of contaminated sites to potential receptors.

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
Release Mechanism of Medium	Air - Volatilization, fugitive dust. Groundwater - Groundwater flow, discharge to surface water. Surface water - Surface runoff overland flow, groundwater recharge, partitioning with sediment, volatilization. Sediment - Surface runoff overland flow, leaching, partitioning with surface water, release to biota surface disturbance. Surface soil - Fugitive dust transport/depository, surface runoff overland flow, leaching, surface disturbance. Subsurface soil - Leaching. Aquatic biota - direct contact, ingestion. Terrestrial biota - direct contact, ingestion.
Contaminant Transport Pathway	Airborne transport Groundwater migration Surface water flow Sediment Transport Infiltration Surface soil erosion Transport of aquatic biota Terrestrial biota migration
Contaminant Fate and Transport	Physical - Volatilization Sorption, surface complexation. Chemical - Photolysis oxidation/reduction. Hydrolysis. Dissolution/precipitation. Ion exchange, chemical portioning. Aqueous complexation. Chemical degradation. Hydration. Biological - Bioaccumulation. Biomagnification. Biotransformation. Biodegradation.
Current and future receptors	Human - On-site workers. Off-site residential, recreational, commercial, industrial. Ecological - On-site aquatic, terrestrial biota Off-site aquatic, terrestrial biota

TABLE 2-1 Potential Exposure Route Matrix (Continued)

Component of Exposure Assessment	Factors to be Considered	
Exposure routes by medium	Air	- Indoor/outdoor vapor phase inhalation, immersion Indoor/outdoor particulate inhalation
	Groundwater	- Ingestion Dermal contact
	Surface water	- Ingestion Dermal contact
	Sediment	- Ingestion Dermal contact
	Surface Soil	- Ingestion Dermal contact Immersion
	Subsurface soil	- Indoor/outdoor vapor phase Inhalation.
	Biota	- Ingestion Inhalation Dermal contact Immersion
	Cross Media Transfers	

TABLE 2-2 Exposure Pathways Selected for Evaluation

Population Potentially Exposed	Exposure Route, Medium, Exposure Point	Pathway Selected for Evaluation	Reason for Selection
Off-site Residents	Ingestion of small game animals in contact with contaminant source areas.	No	Ingestion of small game animals by residents is assumed as low due to large buffer zone of wildlife area.
	Ingestion of groundwater from local wells downgradient from WSQ.	Yes	Use of groundwater as a source for drinking water by residents.
	Inhalation of particulates dispersed through wind erosion and remedial action.	Yes	Inhalation of airborne particulates by nearby residents.
	Dermal contact with airborne and deposited particulates	No	Dermal contact with radionuclides is not considered an important uptake mechanism.
	Ingestion of food crops adjacent to area.	Yes	Potential use by local residents of food crops grown adjacent to site.
	Ingestion of surface water and/or sediments.	No	Potential for ingestion is low since recreational activity in impacted waters is prohibited.
Wildlife Area Visitors	Inhalation of particulates dispersed through wind erosion and remedial action.	Yes	Inhalation of airborne particulates by wildlife area visitors.
	Ingestion of game and fish inhabiting wildlife area.	Yes	Ingestion of game and fish inhabiting wildlife area collected during hunting/fishing season.
	Ingestion of surface water and contact with sediments while swimming or wading.	No	Exposure potential through ingestion of surface water/contact with sediments in surface waters in Busch Wildlife and Weldon Spring Wildlife Area for visitors is low since these activities are prohibited.
	Dermal contact with airborne and deposited particulates.	No	Dermal contact with radionuclides is not considered a significant uptake mechanism.
Terrestrial Biota (on site)	Ingestion of surface water and/or sediments at WSQ.	No	Use of surface water as drinking water and ingestion sediment by biota.
	Ingestion of surface water and/or sediments at WSCP/WSRP.	Yes	Ingestion of raffinate pit surface water and sediment by biota.
	Ingestion of vegetation and soils.	No	Dose from vegetation as food source and incidental ingestion of soils is low.

TABLE 2-2 Exposure Pathways Selected for Evaluation (Continued)

Population Potentially Exposed	Exposure Route, Medium, Exposure Point	Pathway Selected for Evaluation	Reason for Selection
	Inhalation of airborne particulates dispersed through wind erosion and remedial action.	No	Inhalation route for biota is not considered to significantly contribute to overall dose.
Terrestrial Biota (off site)	Ingestion of surface water and sediments.	Yes	Use of area surface water as a source for drinking water and incidental ingestion of soils.
	Ingestion of vegetation, and soils in WSQ area.	Yes	Use of vegetation and crops as food source and incidental ingestion of soils by biota inhabiting the wildlife area.
	Ingestion of vegetation and soils in WSCP/WSRP area.	No	Contaminant levels in vegetation is low and incidental ingestion of soils by biota inhabiting wildlife areas is low.
	Inhalation of airborne particulates due to wind erosion and soil disturbance.	No	Inhalation route for biota is not considered to significantly contribute to overall dose.
Aquatic Biota (off site and on-site - WSCP/WSRP)	Uptake of surface water and contact with sediments.	Yes	Uptake by biota inhabiting surface water in wildlife area.
	Ingestion of invertebrates and vegetation.	Yes	Ingestion of invertebrates and vegetation by game species.
Aquatic Biota (on-site WSQ)	Uptake of surface water and contact with sediments.	No	Limited access to quarry ponds.
	Ingestion of invertebrates and vegetation.	No	Limited access to quarry ponds.

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 is limited by perimeter fencing; prolonged or year round use of on-site water bodies by waterfowl is limited; frequency and duration of wildlife area visits per individual is low (MDOC 1991); and consumption of game animals and fish per individual averaged over a year is low.

The monitoring programs described in the following subsections were designed with specific knowledge of the active pathways and the pathway analyses performed. Each media-specific monitoring and analysis program follows a general rationale.

2.2.1 Surface Water

Surface water is influenced by three general mechanisms:

- Surface water impacted by water that flows from the site and carries with it site-source contaminants. Small quantities of water migrate from the site on a regular basis due to human influenced activities, such as the discharge of treated effluent from the administration building.

- Surface water impacted by contaminants resuspended from sediments on-site and in stream channels.

- Surface water impacted by the discharge of contaminated groundwater to surface water receptors from springs in the area.

Each feature receiving surface water is sampled and contaminant levels are measured. The migrating surface waters are subsequently sampled along their course to track their behavior until the concentrations are diluted, or otherwise rendered indiscernible, from background levels.

2.2.2 Groundwater

The hydrology and hydrogeology of the WSS have been extensively studied and separate regimes have been identified for the WSCP/WSRP and the WSQ based on differing geology. The present conceptual model of the hydrogeologic regime at the WSCP/WSRP incorporates the activity of diffuse flow through the fractured limestone, and the influence of discrete groundwater movement through solution enlarged fractures and conduits. Monitoring wells are used to monitor the influence of site contaminants on the groundwater. Converging conduits transport diffuse flow to discrete flow, and then to the springs previously mentioned. Proper monitoring of the resurging water at those springs satisfies the need to monitor other mechanisms of groundwater movement. The present conceptual model of the hydrogeologic regime for the WSQ incorporates the fractured flow described for the WSCP/WSRP and flow through the porous media of the Missouri River alluvium.

2.2.3 Air and Atmospheric Migration

Air pathway and atmospheric migration of contaminants and radiation constitute a broad set of exposure pathways. Characterization studies conducted over the past four years have determined that the only significant sources for airborne contamination from the WSS-related wastes lie within the boundaries of the WSCP/WSRP and the WSQ areas. As remedial activities begin to disturb source areas, the potential for increased airborne emissions will increase. More intensive work-area monitoring will maintain knowledge of real-time airborne emission levels.

Airborne particulates, radionuclides, and atmospheric radiation released from the WSS source areas must pass the facility boundaries before migrating to uncontrolled or public access areas. Site perimeter monitoring will be utilized to detect and monitor the migration of radioactivity detectable at the facility boundaries. Finally, specific locations around the WSS where there is concentrated human activity are considered "critical receptor" locations and will receive focussed attention.

2.2.4 Soil and Sediment

Soils and sediments on and around the WSS have been, and in some locations continue to be, receiving contaminants from the WSS. The soil is generally in a stable condition and, although it might act as a long term source for groundwater and surface water contamination, soil in itself does not pose a dynamic contaminant front that would require routine monitoring. Soils and associated contamination that are disturbed during remedial activities may be mobilized by surface water runoff or dispersed in the air and migrate from the site. Therefore, the surface water monitoring program will monitor levels of suspended and settleable solids to assess the quantities of materials leaving the site; the air monitoring program, combined with air modeling when appropriate, will assess potential impact to off-site receptors.

For the purposes of this plan, sediments are those solid materials that are mobilized by surface water flow and accumulate to some discernable depth in and along the stream channels and lake basins. Sediments have been characterized during the remedial investigations performed at the WSS and WSQ. That characterization, along with the determinations made during subsequent, routine biological and surface water sampling will meet the environmental monitoring data needs of the project for 1993.

2.2.5 Biological Media

Biological factors, such as the animal and plant vectors in a biouptake chain, will be sampled to assemble and provide surveillance of the environmental and potential human pathways. Biouptake sampling of fish at surrounding wildlife areas has been conducted since 1987. Game animals are sampled when specimens become available, but dose estimates are calculated based upon surface water and soil concentrations. Agricultural products are monitored as part of the characterization of foodstuffs and to established natural levels of radionuclides. Monitoring of radionuclides in aquatic ecosystems is conducted to assess environmental conditions.

3 ENVIRONMENTAL SURVEILLANCE

The environmental surveillance program for the Weldon Spring site (WSS) for 1993 is based on the pathway analysis for possible exposure routes and receptors and is in accordance with DOE Order 5400.1 and 5400.5 and the *Regulatory Guide*. Exposure routes requiring surveillance are air, surface water, groundwater, and biological media. Radiological concentrations obtained for each of these media are used to estimate public dose and to provide compliance data for all applicable environmental regulations.

The environmental surveillance program for each media is based on the applicable regulations, the hazard potential of the contaminants, the amount and concentration of the contaminants, and the impacts to the environment. Sampling locations, frequency, and analyses required to determine the ambient environmental levels for each media are summarized in the following sections.

3.1 Surface Water Surveillance Program

Surface water samples will be collected from locations known to be, or potentially impacted, by the Weldon Spring Chemical Plant/Weldon Spring raffinate pits (WSCP/WSRP) area or the Weldon Spring Quarry (WSQ). Because of the differing topography and hydrologic conditions at the WSCP/WSRP and the WSQ, surface water sampling programs for each of the areas at the WSS are described separately. In previous *Environmental Monitoring Plans* (EMP) for the Weldon Spring Site Remedial Action Project (WSSRAP), the monitoring of springs was included as part of the surface water monitoring program. As of the 1992 EMP, the WSSRAP has incorporated a spring monitoring under the groundwater monitoring program, consistent with the draft U.S. Environmental Protection Agency (EPA) guidance for groundwater monitoring in karst terrains. The data on contaminants in spring water will be more directly correlated to levels in the groundwater near the site, as measured using conventional monitoring well techniques.

3.1.1 Surface Water Evaluation

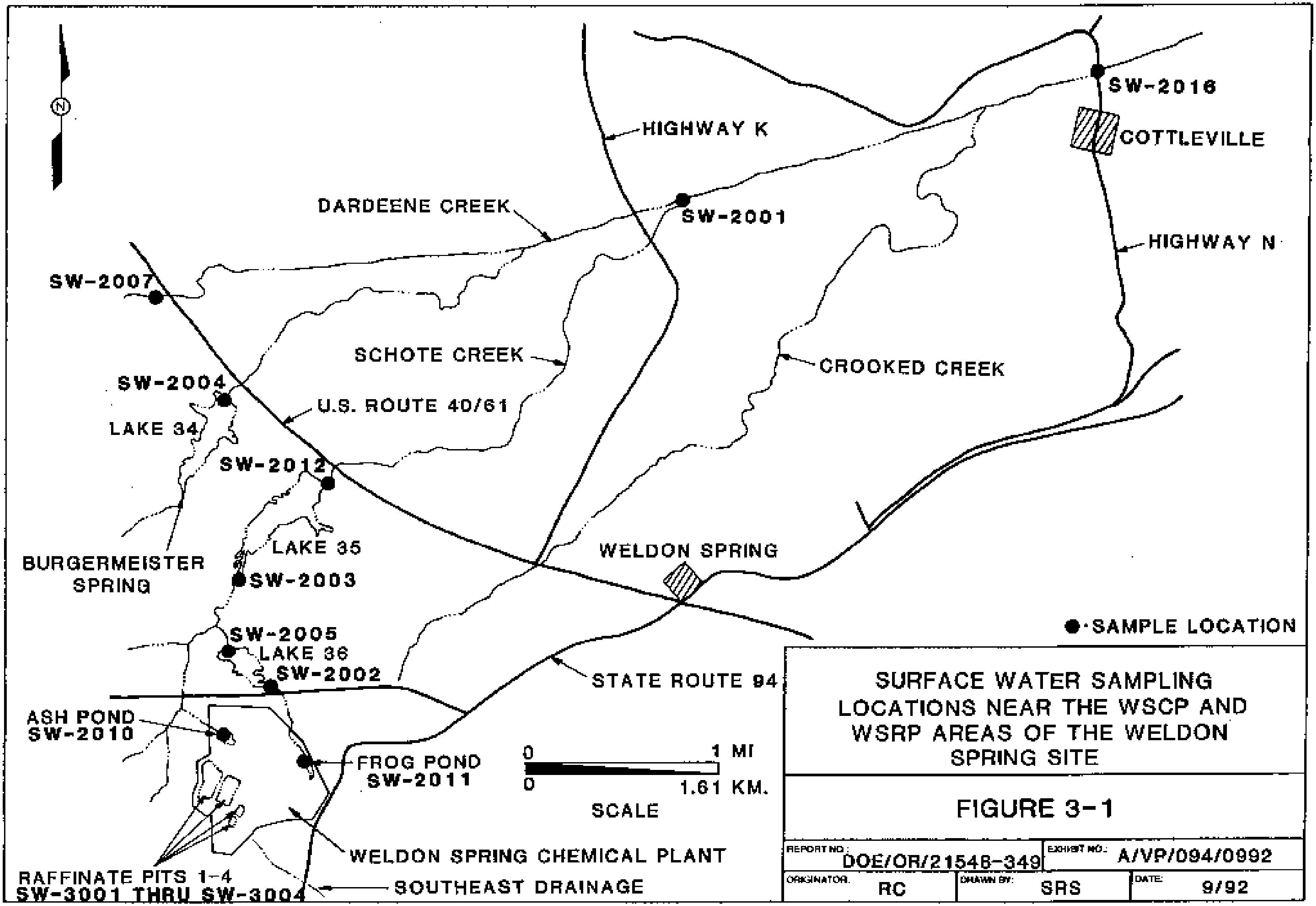
Surface water bodies in and around the WSCP/WSRP and WSQ have been radiologically and chemically characterized through sampling and analyses. A surveillance program that includes monitoring potentially impacted surface water has been established to monitor radiological and chemical conditions. The extent of the surface water environmental surveillance program is based upon applicable regulations, hazard potential and concentration of effluents, public interest, and the nature of potential or actual impacts on surface water. The environmental surveillance program for surface water will be conducted in accordance with the requirements of DOE Orders 5400.1, 5400.5, and the *Regulatory Guide*.

3.1.2 Surface Water Monitoring Program at the WSCP/WSRP

The WSCP/WSRP area is located on the Missouri-Mississippi River surface-drainage divide. The topography of the WSCP/WSRP is gently undulating and generally slopes northward to the Mississippi River. Streams do not cross the properties, but incipient drainageways convey surface water runoff to off-site streams. Most surface drainage from the WSCP area discharges either via an intermittent stream in the Army Reserve Training Area (WSTA) to the west or into Ash Pond on the WSCP property as shown in Figure 3-1. Discharges from these locations combine near St. Charles County Road D and flow northward into Schote Creek, which in turn enters Dardenne Creek, which discharges into the Mississippi River. An additional surface drainage system ultimately reaching the Mississippi River drains the northeastern WSCP area through Frog Pond. A storm water sewer system that drains land surfaces from most of the plant area also discharges into Frog Pond. The Frog Pond drainage enters Lake 36 in the August A. Busch Wildlife Area (ABWA). Lake 36 in turn discharges into Lake 35 which ultimately discharges into Schote Creek.

Runoff from the southern portion of the WSCP property flows southeast to the Missouri River. Included in this runoff is water from the WSCP sanitary and process sewer system, which merges prior to discharge from the WSCP. Although the sanitary sewer system was taken out of service in 1986, it still receives storm water due to infiltration of the sewer line.

Surface water draining from the WSCP/WSRP area transports both dissolved and suspended contaminants from waste materials distributed about the site. Monitoring locations have been chosen to provide data necessary to track the fate and concentration of contaminants delivered to downgradient streams and water features. The location of the monitoring points and the purpose for monitoring are described in detail in the following sections. The U.S. Department of Energy (DOE), in cooperation with the Missouri Department of Natural Resources -Division of Geology and Land Survey and the United States Geological Survey, has



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

FIGURE 3-1

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established a detailed profile of the complex hydrogeologic system that influences the flow of surface water from the site.

3.1.2.1 Surface Water Monitoring Locations at the WSCP/WSRP. All features monitored under the surface water surveillance program are situated on the north (Mississippi River) side of the drainage divide. Those waters requiring contaminant monitoring to the south of this divide are monitored under either the effluent monitoring or groundwater monitoring programs. The routine monitoring locations are numbered from SW-2001 through SW-2007, SW-2009 through SW-1012, and SW-2016. Locations SW-2008 and SW-2009 (Burgermeister Spring and Overflow Spring) have been added to the groundwater surveillance program and have been given different location identifiers. Location SW-2016 was added in 1992.

As illustrated in Figure 3-1, the sampling points are located down-gradient of the on-site contaminated water sources. The program monitors contaminant levels in the lakes and streams that pass through public and private lands so that the DOE can assess the potential risk to down-gradient receptors. The program also documents the effects of dilution, degradation, and other natural processes in diminishing contaminant levels downstream from the site.

Location SW-2007 is positioned on Dardenne Creek upstream of any tributaries that receive contaminated runoff or groundwater discharge from the WSCP/WSRP. This location serves as a background station by establishing contaminant levels in Dardenne Creek, before the creek is influenced by the WSCP/WSRP. Location SW-2001, at the confluence of Schote and Dardenne creeks, and location SW-2016, downstream of SW-2001 at the intersection of Dardenne Creek and County Highway N, monitor the contribution of site-derived contaminants from Schote and Dardenne creeks. Locations SW-2002 through SW-2005 and SW-2012 monitor the three lakes on the ABWA, which lay within the basin receiving runoff from the WSCP/WSRP. Location SW-2012 is positioned at the spillway of Lake 35. Because of substantial leakage from the base of Lake 35, discharge to the spillway is generally absent except during heavy precipitation events; therefore, discharge at SW-2012 is somewhat episodic. To begin to deliver more regular data, Lake 35, Location 2012 will be designated as the water's edge closest to the spillway during times of no discharge, and samples are to be collected each quarter. Monitoring points SW-2010 and SW-2011 are located within the boundary of the WSCP/WSRP area at Ash Pond and Frog Pond, respectively.

Surface water location SW-2017, the material staging area (MSA) pond, has been added to this year's environmental monitoring schedule in order to determine the contaminant levels which are discharged off site from materials at the staging area. This impoundment, which collects stormwater which falls on the MSA, is pumped periodically into the Ash Pond diversion channel, which ultimately discharges into Busch Lake 35.

The four raffinate pits located at the WSCP/WSRP were used as solids-settling ponds during plant operation to collect waste products from uranium purification, and to allow the discharge of relatively solid-free decant water. The pits vary in size; Raffinate Pits 1 and 2 are approximately 0.4 ha (1 acre) in size and contain approximately 3.7 m (12 ft) of sludge material; Raffinate Pit 3 is approximately 3.6 ha (9 acre) in area and contains 3.7 m to 4.3 m (12 ft to 14 ft) of sludge material; and Raffinate Pit 4 is approximately 5.3 ha (13 acre) in area, but contains only a minor amount of sludge, along with some scrap steel and drummed wastes from the decommissioning of the plant. The use of the overflow system for the pits was discontinued long ago, and no direct runoff from the pits is presently possible. The WSSRAP samples these raffinate waters to monitor notable changes in the quality of the water. Location identifiers SW-3001 through SW-3004 are assigned to Raffinate Pits 1 through 4, respectively.

3.1.2.2 WSCP/WSRP Surface Water Monitoring Schedule. Surface water features at the WSCP/WSRP area will be monitored according to the schedule listed on Table 3-1. Samples will be collected for radionuclides on an annual basis and for total uranium on a quarterly basis, except for the raffinate pits, which will be sampled semi-annually. Nitrates and sulfate, which are high in the raffinate pits, will be monitored on a semi-annual basis. These soluble anions provide an additional check on the impact of the site on local surface waters. In addition, the following parameters will be measured during each sampling event: pH, conductivity, and temperature. Two samples will be collected for radon on a quarterly basis from each of the raffinate pits. One sample will be collected 0.3 m (1 ft) from the sludge surface and the other sample will be collected 0.3 m (1 ft) below the water surface away from the sides. These samples will be obtained to determine anticipated radon levels which will be encountered during future remediation activities at the WSCP/WSRP.

The MSA pond, SW-2017, will also be sampled on a quarterly basis for total uranium. In addition, the pond will be sampled quarterly for the Hazardous Substance List Metals, total

TABLE 3-1 Monitoring Parameters for Surface Water at the WSCP/WSRP

Location	Q1	Q2	Q3	Q4
SW-2001	U	I,U	R	I,U
SW-2002	U	I,U	R	I,U
SW-2003	U	I,U	R	I,U
SW-2004	U	I,U	R	I,U
SW-2005	U	I,U	R	I,U
SW-2007	U	I,U	R	I,U
SW-2010	U	I,U	R	I,U
SW-2011	U	I,U	R	I,U
SW-2012	U	I,U	R	I,U
SW-2016	U	I,U	R	I,U
SW-2017	M,P,T,C	M,P,T,C	M,P,T,C	M,P,T,C
SW-3001	U,I,Rn	Rn	R,I,Rn	Rn
SW-3002	U,I,Rn	Rn	R,I,Rn	Rn
SW-3003	U,I,Rn	Rn	R,I,Rn	Rn
SW-3004	U,I,Rn	Rn	R,I,Rn	Rn

U Uranium, total
I Inorganic anions (nitrate and sulfate)
R Uranium, Ra-226, Ra-228, Th-228, Th-230, Th-232, gross alpha, and gross beta
Rn Radon
M HSL Metals (As, Ba, Cd, Pb, Cr, Hg, Se, Ag, Mg)
P Polychlorinated Biphenyls
T Total Petroleum Hydrocarbons
C Total Organic Carbon

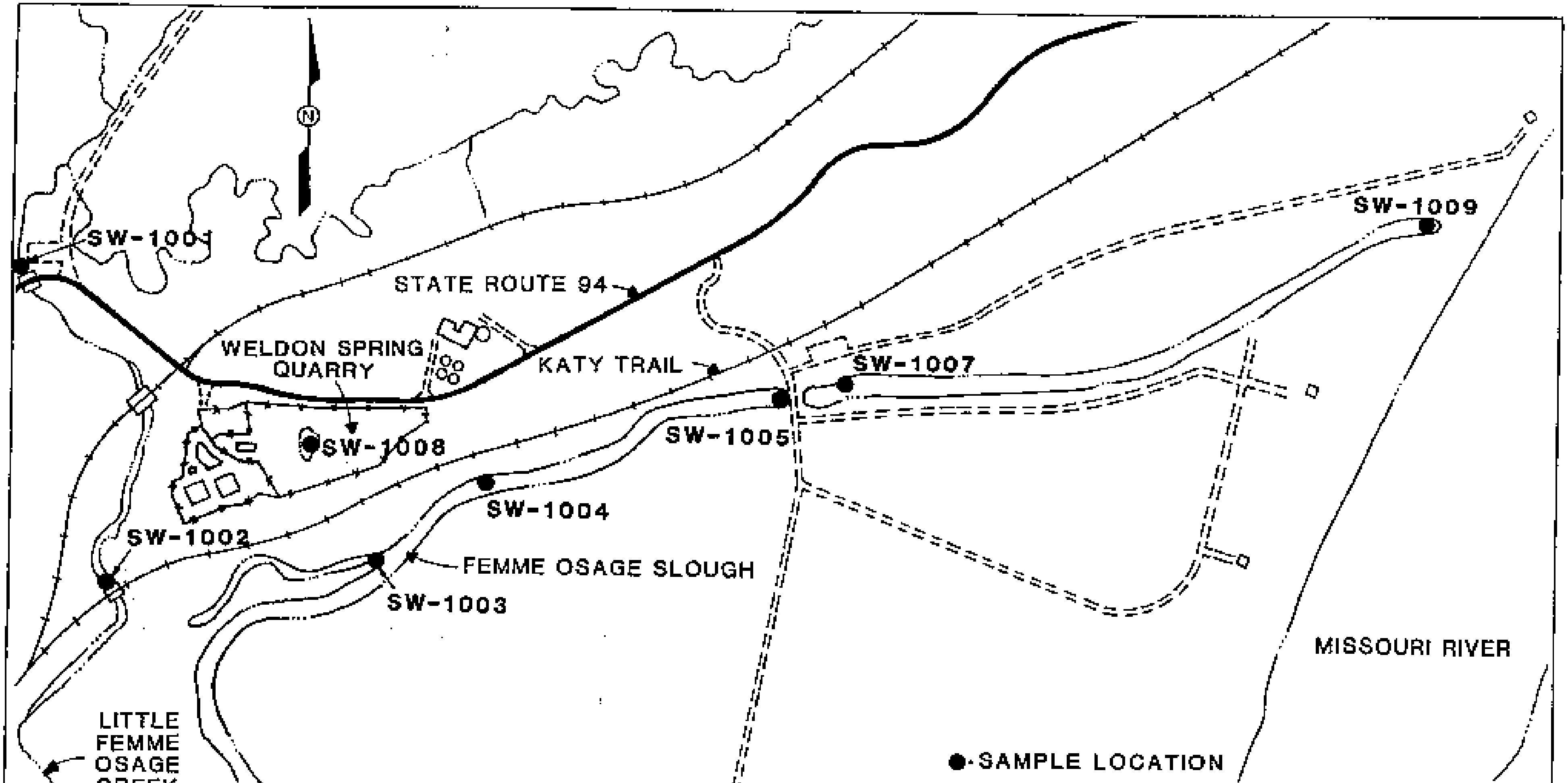
petroleum hydrocarbons, polychlorinated biphenyls, and total organic carbon. If any of these parameters indicates an upward trend in concentration, the monitoring frequency may be increased.

3.1.3 Surface Water Monitoring Program for the WSQ

The 13 surface water monitoring locations within or near the WSQ have been chosen for routine monitoring to investigate and document whether surface waters near the quarry might pose a risk to human health or the environment.

3.1.3.1 Rationale. The WSQ is located on the northern bluff of the Missouri River valley. Surface water within the quarry consists of the quarry pond, which acts as a sump and intercepts groundwater. There is no direct surface water runoff from the quarry; however, the movement of contaminated groundwater from the quarry through the fine-grained alluvium to the Femme Osage Slough has resulted in elevated uranium levels in the slough water. The quarry pond and the slough are directly impacted by the contamination within the quarry; therefore, they are routinely monitored. Also, samples from the Missouri River, the Femme Osage Creek, and the Little Femme Osage Creek are collected routinely to provide control data for comparison with data from those locations directly impacted by contamination from the quarry.

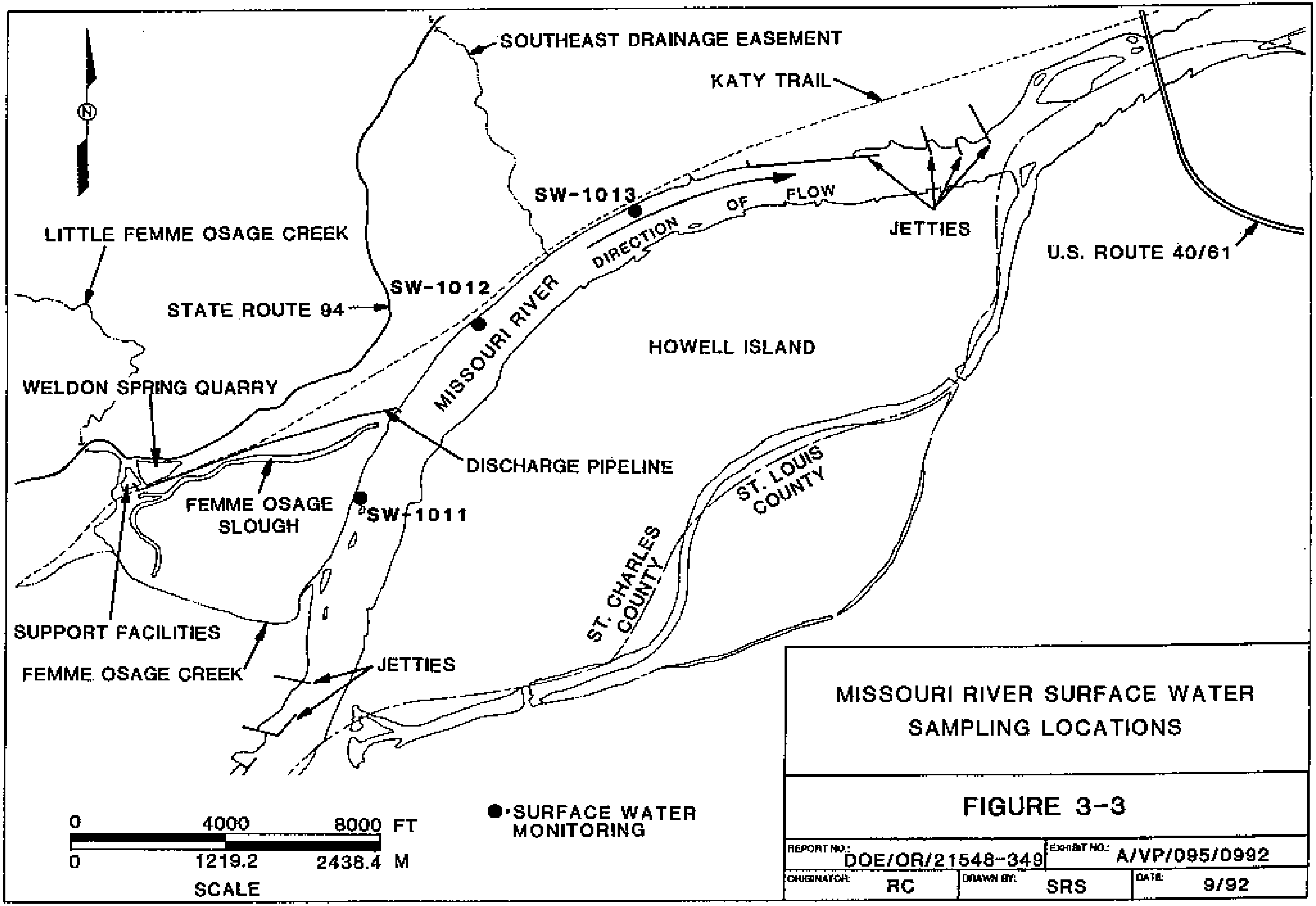
3.1.3.2 Monitoring Locations. Monitoring locations SW-1001, SW-1002, and SW-1014 (see Figure 3-2) monitor the Little Femme Osage Creek at points upstream and down stream of the WSQ. Six sampling locations, SW-1003 through SW-1005, SW-1007, SW-1009, and SW-1010, are distributed along the Femme Osage Slough west of, adjacent to, and east of the WSQ. These locations within the slough were chosen to provide the most representative data of potentially impacted areas from the quarry contamination. Location SW-1008, which monitors the ponded water within the WSQ, gives a rough determination of the concentrations of the various contaminants in the ponded surface water which may migrate to groundwater. Locations SW-1011, SW-1012, and SW-1013 (see Figure 3-3) provide baseline water quality data from the Missouri River. Location SW-1011 is the Missouri River location furthest upstream and is above any potential influences from WSS contamination.



SURFACE WATER SAMPLING LOCATIONS NEAR THE WELDON SPRING QUARRY

FIGURE 3-2

REPORT NO.: DOE/OR/21548-349		EXHIBIT NO.: A/QY/082/0992
ORIGINATOR: RC	DRAWN BY: SRS	DATE: 9/92



MISSOURI RIVER SURFACE WATER SAMPLING LOCATIONS			
FIGURE 3-3			
REPORT NO.: DOE/OR/21548-349		EXHIBIT NO.: A/VP/095/0992	
ORIGINATOR: RC	DRAWN BY: SRS	DATE: 9/92	

TABLE 3-2 WSQ Surface Water Monitoring Analytical Program for 1993

	1993 EMP					
	JAN/ FEB	MAR/ APR	MAY/ JUNE	JULY/ AUG	SEPT/ OCT	NOV/ DEC
WELDON SPRING QUARRY AREA						
SW-1001	U,M	R,N,I	U	U	U	U
SW-1002	U,M	R,N,I	U	U	U	U
SW-1003	U,M	R,N,I	U	U	U	U
SW-1004	U,M	R,N,I	U	U	U	U
SW-1005	U,M	R,N,I	U	U	U	U
SW-1007	U,M	R,N,I	U	U	U	U
SW-1008	R,I,N,M	R,N,I	R,N,I	R,N,I	R,N,I	R,N,I
SW-1009	U,M	R,N,I	U	U	U	U
SW-1010	U,M	R,N,I	U	U	U	U
SW-1011	U,M	R,N,I	U	U	U	U
SW-1012	U,M	R,N,I	U	U	U	U
SW-1013	U,M	R,N,I	U	U	U	U
SW-1014	U,M	R,N,I	U	U	U	U

R = Uranium, Ra-226, Ra-228, Th-228, Th-230, Th-232, gross alpha, and gross beta
U = Uranium, total
I = Nitrate, sulfate
N = Nitroaromatic compounds
M = Arsenic, barium

3.1.3.3 Monitoring Schedule. All surface water bodies near the WSQ that are used as baseline, or are potentially affected by the WSQ, including the Femme Osage Slough, Femme Osage Creek, Little Femme Osage Creek, the Missouri River, and the quarry pond, will be sampled as shown in Table 3-2.

All locations will be monitored bimonthly for total uranium due to the fluxuations in concentrations as a result of slough levels, and the potential impact of contaminants in the surface waters on groundwater south of the slough. This will allow any trends to be identified, in addition to maintaining a surveillance of uranium in surface water bodies near the WSQ. Additionally, all locations will be monitored at least annually for arsenic, barium, nitrate, sulfate, nitroaromatic compounds, and other radiological parameters, including Th-228, Th-230, Th-232, Ra-226, Ra-228, gross alpha, and gross beta to provide baseline data and early detection of these parameters within surface water bodies near the WSQ due to their potential to impact groundwater near the WSQ. The quarry pond is monitored bimonthly for all parameters listed above, with the exception of arsenic and barium, to maintain surveillance of the contaminants within the quarry.

3.2 Groundwater Surveillance Program

Groundwater samples will be collected from locations known to be impacted, or potentially impacted, by the WSCP/WSRP area or the WSQ area. Due to the differing hydrology and hydrogeology of the two areas, groundwater monitoring programs will be discussed separately.

3.2.1 Groundwater Evaluation

Groundwater within and around the WSCP/WSRP and WSQ has been radiologically and chemically characterized through sampling and analyses. A surveillance program that includes monitoring potentially impacted groundwater has been established to monitor radiological and chemical conditions. The extent of the groundwater environmental surveillance program has been determined based upon applicable regulations, hazard potential of effluents, quantities and concentrations of effluents, public interest, and the potential or actual impacts on groundwater. The environmental surveillance program for ground water will be conducted in accordance with the requirements of the DOE Orders 5400.1, 5400.5, and the *Regulatory Guide*.

3.2.1.1 Groundwater Characterization. Potential exposure pathways were determined by the sampling of groundwater within, and near, the WSCP/WSRP and the WSQ. Chemical and radiological characterization of the groundwater within or near the WSCP/WSRP and WSQ was provided through the implementation of work plans, sampling plans, and other characterization plans. These plans were approved by the DOE and the U.S. Environmental Protection Agency (EPA), and include environmental monitoring, sampling locations, procedures, equipment, frequency and analysis required, minimum detection limits, and levels of quality assurance/quality control. Evaluation of the characterization data and potential exposure pathways has provided the basis for the groundwater environmental surveillance program described in this EMP.

In addition to the chemical/radiochemical characterization, changes in the static groundwater level (SWL) are monitored either manually or with dedicated transducers. Manual readings are taken during sampling events and monthly during the well inspection. Dedicated transducers are installed in specific wells to document fluctuations in SWL on a daily basis for more focused investigations as outlined in Section 3.2.2.3.

3.2.1.2 Parameter Categories. The following radiological and chemical parameter categories will be monitored in groundwater at the WSQ and the WSCP/WSRP/VP due to similar contaminant constituents present at both areas:

- Total Uranium (U): Uranium is a contaminant of concern at both the WSQ and the WSCP/WSRP due to both the purification process of uranium and raffinate storage at the WSCP/WSRP and the disposal of uranium contaminated materials and process wastes at the WSQ. Uranium is monitored to assess the potential for exposure to the public and the environment and to assess migration in the groundwater system and contamination levels in the aquifer.

- Radiological Parameters (R): The radiological parameters consisting of gross alpha, gross beta, Th-228, Th-230, Th-232, Ra-226, and Ra-228 are monitored at both the WSQ and WSCP/WSRP due to their presence in uranium residue disposed at the WSS. These parameters are monitored to assess the potential for exposure to the public and the environment and to assess migration in the groundwater system and contamination levels in the aquifer.

- Nitroaromatic Compounds (N): Nitroaromatic compounds are contaminants of concern at both the WSQ and the WSCP/WSRP due to the previous production of trinitrotoluene (TNT) and dinitrotoluene (DNT) at the WSCP/WSRP area and the disposal of TNT/DNT contaminated materials at the WSQ. Groundwater at both the WSQ and the WSCP/WSRP will be monitored for 1,3,5-TNB; 1,3-DNB; 2,4,6-TNT; 2,4-DNT; and 2,6-DNT in addition to 4-amino-2,6-DNT and 2-amino-4,6-DNT to monitor the degradation and migration of nitroaromatic compounds at the WSS.

- Sulfate-Nitrate-Alkalinity (I): Both nitrate and sulfate are contaminants of concern due to their presence as residual products during the uranium purification process at the WSCP/WSRP and in the production of nitroaromatics at the Weldon Spring Ordnance Works (WSOW). Both nitrate and sulfate levels are elevated in the raffinate pits and at some groundwater locations at the WSCP/WSRP. Elevated sulfate levels were observed in monitoring wells adjacent to the WSQ and in the alluvium north of the

Femme Osage Slough. Monitoring of nitrate has been discontinued at the WSQ because no notable groundwater contamination by nitrate has occurred. Nitrate and sulfate provide potentially important constraints on the areal extent of contaminated plumes at the WSS because they generally behave as conserved elements in the groundwater system (i.e., they are not strongly impacted by sorption, precipitation, or degradation reactions). Alkalinity is monitored to verify whether conditions exist to sustain the elevated levels of contaminants.

- Parameters of Concern (PC): These are a unique group of compounds (listed in Table 3-3) that have been identified as potential contaminants in the groundwater beneath the WSCP/WSRP/VP area in the *Remedial Investigation for the Chemical Plant Area of the Weldon Spring Site* (MKF and JEG 1992b). Groundwater at the WSCP/WSRP was last analyzed for many of these compounds prior to 1990. In order to provide a current assessment of contaminant levels in groundwater, the "parameters of concern" compounds that have not been analyzed since 1990 will be measured once in 1993. Those that are found to exceed MCLs (or other applicable standards), and are not part of the present monitoring program, will be added. Seasonal effects will not be considered during this sampling because previous statistical analyses have demonstrated that contaminant concentrations are not sensitive to this factor (MKF and JEG 1992b).

- Geochemical Characterization (G): This group of parameters includes an extensive list of anions and cations that are not routinely monitored at the WSSRAP. Performing these analyses in addition to those described above will provide a relatively complete characterization of groundwater at the WSS. Characterization data are required for modeling geochemical transport and provide insight into the quality of the groundwater and the migration of contaminants. Six analyses (1 yr of quarterly data and 1 yr of semiannual data) to establish the expected range of variation at each location, to screen data for unreasonable values, and to provide a statistical basis for comparing current conditions with post-remedial or post-construction conditions. After completion of these analyses, the need for additional geochemical sampling will be evaluated on an individual basis.

Other specific sampling categories will be performed at the WSQ and WSCP/WSRP. These categories will be discussed in their respective sections.

TABLE 3-3 WSCP/WSRP/VP Parameters of Concern

Parameter	Mo. GW Std ($\mu g/l$)[a]
Al	NS[c]
Sb	14
As	50
Be	100
Cd	10
Cr	50
Co	1,000
Cu	1,000
Pb	50
Li	NS[c]
Mn	50
Hg	2
Mo	NS[c]
Ni	200
Se	10
Ag	50
Tl	2
U	20 (13.6 pCi/l)[b]
V	NS[c]
Zn	5,000
NO_3 (asN)	10,000
2,4-DNT	0.11

(a) Missouri Quality Standard for Groundwater 1991 10 CSR 20-7

(b) Proposed EPA Drinking Water Standard conversion to pCi/l based on site-specific uranium isotopic composition

(c) No Standard

3.2.1.3 Groundwater Estimated Release Quantities and Public Doses. It is the objective of the groundwater monitoring program at both the WSCP/WSRP and WSQ to collect sufficient data to estimate the approximate quantity of radionuclides released along that migration route. The radionuclide release information will be used to calculate the public dose to hypothetical groundwater users. At present, no wells are actively pumped as water supplies within a 1.6 km (1 mi) radius of the WSCP/WSRP site. Wells outside that area have been sampled in the past and have shown no evidence of radionuclide contamination from the WSSRAP. Those private wells will continue to be routinely sampled and analyzed by the Missouri Department of Health (MDOH) as part of an independent program by that agency. The results are also made available for review by the WSSRAP staff.

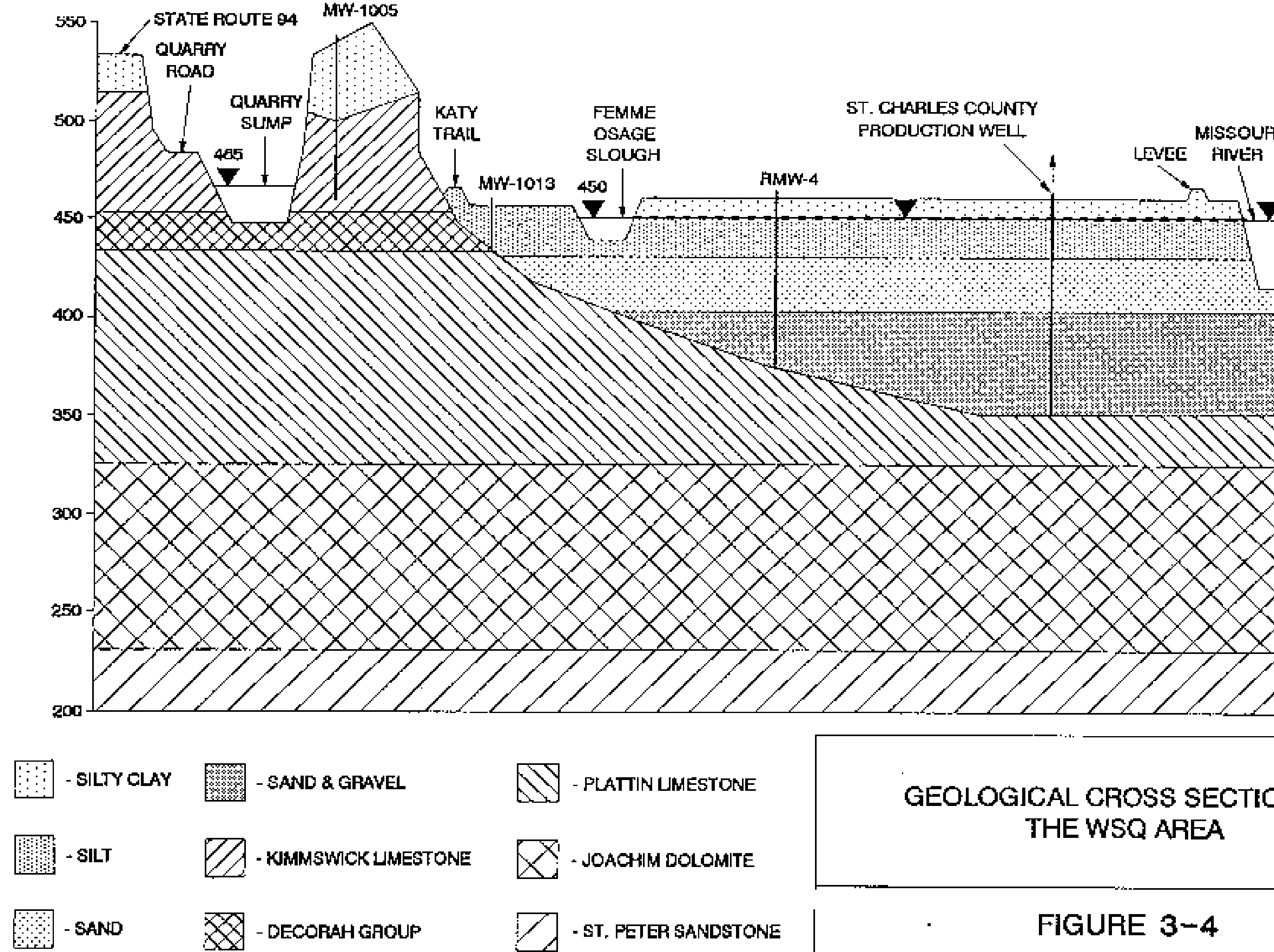
Presently, eight drinking water production wells are located within a 1.6 km (1 mi) radius of the WSQ. The data collected from the WSQ and county well field region will allow a determination to be made on whether the WSQ presents an increased incremental risk to users of that water. No measurable increases in uranium or chemical contaminant levels above background have been seen at the well field to date.

3.2.2 Groundwater Monitoring Program for the WSQ

Forty-eight groundwater wells, including 36 DOE monitoring wells, four St. Charles County monitoring wells, and eight municipal wells owned by St. Charles County have been chosen for routine monitoring to investigate and document the possibility that groundwater near the WSQ may be impacted by materials in the quarry.

3.2.2.1 Geology and Hydrogeology. The geology of the WSQ area is generally separated into upland overburden, Missouri River alluvium, and bedrock. The Missouri River alluvium and bedrock units produce groundwater, and it is within these units that the groundwater is monitored. A general description of each unit follows, and Figure 3-4 displays a generalized cross section of the quarry geology.

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 WSQ are generally not saturated and are not monitored.



-MODIFIED AFTER BGA, 1986

NOT TO SCALE

✱ NOTE: VIEW LOOKING WEST

GEOLOGICAL CROSS SECTION OF THE WSQ AREA

FIGURE 3–4

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ORIGINATOR: RC	DRAWN BY: GLN		DATE: 6/9/93

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 WSQ is approximately 31 m (100 ft). The alluvium is truncated at the erosional contact with Paleozoic bedrock bluffs along the Katy Trail. The alluvium thickness increases dramatically with distance from the bluff. Silts and clays with minor amounts of sand are the primary sediments between the bluff and the Femme Osage Slough. The thick, water-producing sands and gravels of the alluvial aquifer give way to fine-grained organically rich overbank deposits beneath the Femme Osage 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. This indicates that the Missouri River is the primary recharge source for the alluvial aquifer.

Bedrock at the WSQ consists of three distinct Ordovician formations. In descending order, they are 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. Chemical and radiological wastes at the WSQ are of particular concern because of their proximity to the St. Charles County well field located approximately 0.8 km (0.5 mi) to the south. Well field protection is a sensitive issue for the public, the DOE, and other regulatory agencies. The DOE has issued a number of orders providing direction on the assessment of exposure to the public, including directions for protection from radiation and other chemical species where applicable. The 1993 groundwater monitoring program at the WSQ has been designed to provide the necessary data to accomplish the following objectives:

- Ensure the protection of public health and the environment. This objective includes determining whether present contaminant levels exceed State or Federal drinking water standards, DOE derived concentration guidelines, or assumed background levels at the WSQ and the St. Charles County well field, and monitoring concentration levels of contaminants which exceed these criteria.

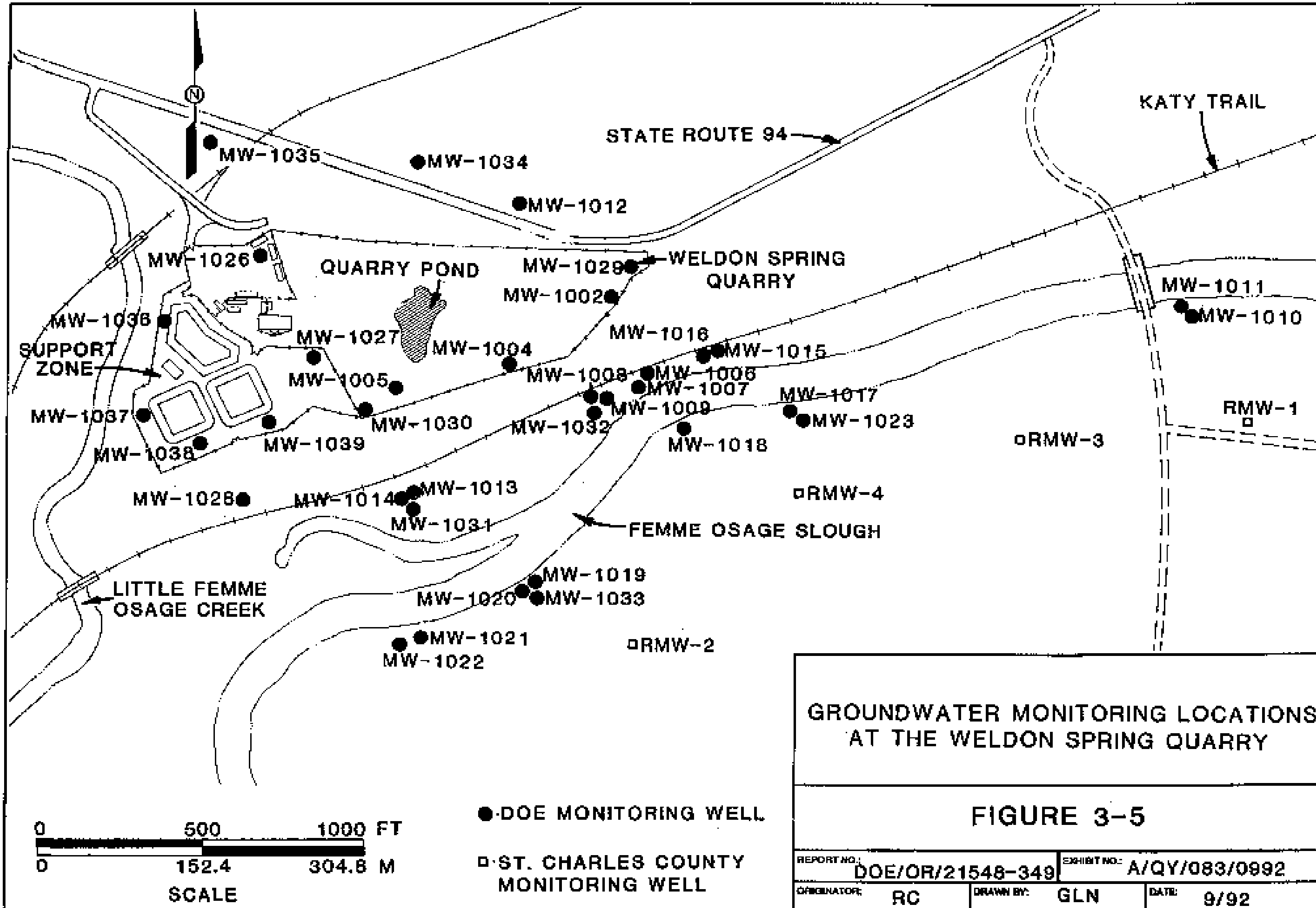
- Provide information on the effects of quarry de-watering and bulk waste removal.

- Perform spatial and temporal trend analyses.

- Develop baseline geochemical information for the determination on the interaction of the groundwater with contaminants and the surrounding environment. This characterization will facilitate the determination of contaminant transport and possible oxidation/reduction of contaminants across the Femme Osage Slough, and possible changes in the oxidation or reduction state of the groundwater due to remediation activities in the WSQ.

3.2.2.3 Monitoring Locations. Currently there are 33 wells, including eight municipal production wells, four county-owned monitoring wells, and 21 DOE monitoring wells which are screened within the alluvial material located between the quarry and the Missouri River (see Figures 3-5 and 3-6). Five of the wells, MW-1035 through MW-1039 are located west of the quarry to monitor the immediate area surrounding the quarry water treatment plant equalization basin and effluent ponds. Six wells, MW-1006 through MW-1009, MW-1014, and M-1016 are located between the quarry and the slough to monitor contaminant migration south of the quarry within the alluvium. The monitoring wells MW-1010, MW-1011, and MW-1017 through MW-1024 are located south of the slough within the alluvium and are monitored to enable detection of contaminants south of the slough. St. Charles County monitoring wells RMW-1 through RMW-4 are monitored to ensure that the quarry contaminants are not migrating toward the municipal well field, and to enable an early warning of contaminant migration toward the county production well field, if this should occur. The eight county municipal wells, PW-2 through PW-9, are also monitored to ensure that the quarry contaminants are not affecting the quality of the municipal well field water supply.

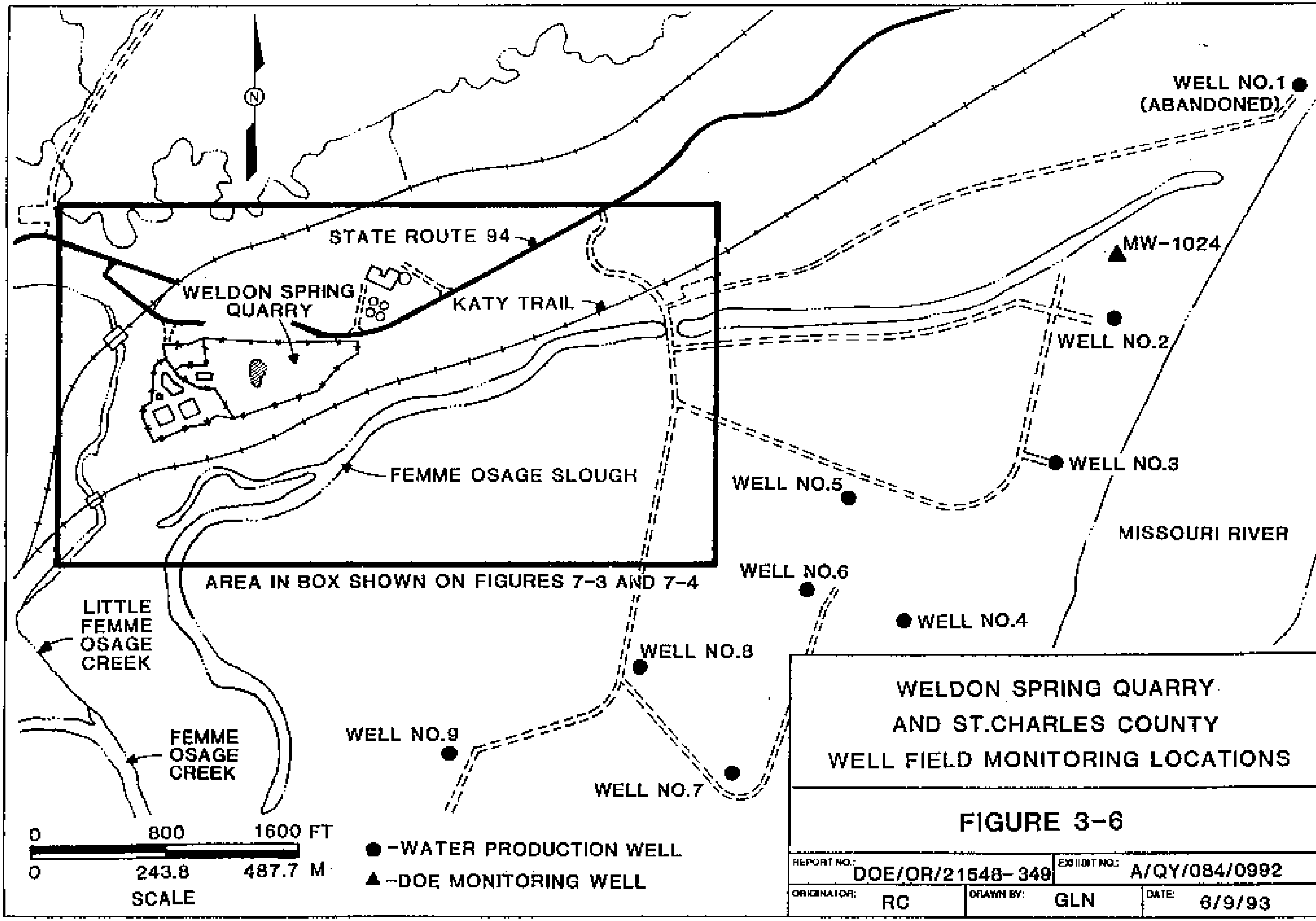
Currently, there are 15 DOE monitoring wells which are screened within either the Kimmswick-Decorah or Plattin Formations to monitor contaminants near the quarry within the bedrock. Monitoring wells MW-1002, MW-1004, MW-1005, MW-1012, MW-1013, MW-1015, MW-1026, MW-1027, MW-1029, MW-1030, MW-1032, and MW-1034 were installed to monitor contaminants within the Kimmswick-Decorah Formations surrounding the quarry. It should be noted that MW-1012 and MW-1034 are north and upgradient of the quarry and have been designated as background wells. Monitoring wells MW-1028, MW-1031, and MW-1033 are located south of the quarry within the Plattin Limestone to determine whether vertical contaminant migration through the fracture system has occurred.



GROUNDWATER MONITORING LOCATIONS AT THE WELDON SPRING QUARRY

FIGURE 3-5

REPORT NO.: DOE/OR/21548-349		EXHIBIT NO.: A/QY/083/0992
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 9/92



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

FIGURE 3-6

REPORT NO.: DOE/OR/21548-349		EXHIBIT NO.: A/QY/084/0992
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 6/9/93

For the bedrock comprising the WSQ and the alluvial materials south and west of the quarry, monitoring wells MW-1034 (bedrock) and MW-1035 (alluvium) have been determined to be upgradient for the determination of groundwater quality in these materials at the WSQ. In 1992, eight groundwater monitoring wells were installed in the Darst Bottom area located approximately 1.6 KM (1 mi) southwest of the St. Charles County Well Field. These wells were installed by the U.S. Geological Survey (USGS) to determine the upgradient characteristics of the Missouri River Alluivium in the vicinity of the WSQ. Analyses of the groundwater from those wells have been used by the WSSRAP as background values for the well field area. Subsequent analyses by the USGS are provided to WSSRAP for this purpose.

Three dedicated transducers with electronic recording capacity are currently monitoring downgradient bedrock wells south and west of the quarry. These wells include MW-1004, MW-1005, and MW-1027. In addition, the static water level (SWL) of the quarry pond is incorporated in this network. Readings are taken every 24 hr to ensure correlation to the dewatering activities and significant precipitation events. In addition, one transducer is to be installed in MW-1040 adjacent to the equalization basin. This transducer will alert the plant operators in the unlikely event that the SWL will rise above the base of the leachate collection system following significant precipitation and/or flooding events.

3.2.2.4 Monitoring Schedule. Three separate groundwater monitoring programs have been developed for the WSQ. These programs have been developed to monitor specific areas at the WSQ and surrounding areas according to the levels of contaminant impact, public concern, and regulatory guidelines. The three monitoring programs are as follows:

- The WSQ and DOE monitoring wells north and south of the Femme Osage Slough.
- The St. Charles County well field and water treatment plant.
- The quarry water treatment plant.

The first program addresses the sampling of the DOE wells monitoring the WSQ area and is summarized in Table 3-4. This program was developed to monitor contaminant migration and the effects of quarry dewatering and bulk waste removal, which is scheduled to begin in the spring of 1993. This program consists of the bimonthly or quarterly sampling of certain monitoring wells for total uranium and chemical parameters, the monthly sampling of several monitoring wells for specific parameters, and the annual sampling of all monitoring wells for

TABLE 3-4 WSQ Groundwater Monitoring Program Summary for 1993

	Total Uranium	Radiological Parameters	Nitroaromatics	Sulfate	Geochemical
MW-1002	M	A	M	M	Q
MW-1004	M	A	M	M	-
MW-1005	M	A	M	M	Q
MW-1006	B	A	B	B	-
MW-1007	B	A	B	B	-
MW-1008	B	A	B	B	-
MW-1009	B	A	B	B	-
MW-1010	Q	A	Q	Q	-
MW-1011	Q	A	Q	Q	-
MW-1012	B	A	B	B	-
MW-1013	B	A	B	B	Q
MW-1014	B	A	B	B	Q
MW-1015	B	A	B	B	-
MW-1016	B	A	B	B	-
MW-1017	B	A	Q	Q	-
MW-1018	B	A	Q	Q	Q
MW-1019	B	A	Q	Q	Q
MW-1020	B	A	Q	Q	-
MW-1021	B	A	Q	Q	Q
MW-1022	B	A	Q	Q	Q
MW-1023	B	A	Q	Q	-
MW-1024	Q	Q*	Q	Q	-
MW-1026	B	A	B	B	-
MW-1027	M	A	M	M	-
MW-1028	B	A	B	B	Q
MW-1029	B	A	B	B	-
MW-1030	M	A	M	M	-
MW-1031	B	A	B	B	Q
MW-1032	B	A	B	B	Q

TABLE 3-4 WSQ Groundwater Monitoring Program Summary for 1993 (Continued)

	Total Uranium	Radiological Parameters	Nitroaromatics	Sulfate	Geochemical
MW-1033	B	A	Q	Q	Q
MW-1034	B	A	B	B	Q

* Gross α only quarterly
A Annually
B Bimonthly
M Monthly
Q Quarterly
Radiological Gross alpha, gross beta, Th-228, Th-230, Th-232, Ra-226 and Ra-228
Geochemical Br, Cl, Al, As, Ba, Ca, Cr, Fe, F, K, Li, Mg, Mn, Na, Ni, P, Pb, Sr, NO_2, NO_3, SiO_2, TOC, Ag, Be, Cd, Co, Cu, Hg, Mo, Sb, Se, V, Zn, Tl, Fe^{2+}, S^{2-}, TSS, TDS

radiological parameters. The monitoring wells adjacent to the WSQ, north of the Femme Osage Slough, and monitoring wells MW-1010 and MW-1011 located south of the slough are to be sampled bimonthly. All remaining DOE monitoring wells located south of the Femme Osage Slough are to be sampled quarterly. The monthly sampling of certain monitoring wells is due to increased levels of specific parameters over time and has been developed to better establish the trend in concentrations at these locations. The monthly sampling is to be performed for 4 mo; if during that time no increasing trend is determined, bimonthly sampling will be initiated for those wells.

The second program monitors the St. Charles County well field and the associated water treatment plant. Active production wells and the St. Charles County RMW-series monitoring wells are to be sampled quarterly and annually for selected parameters. Table 3-5 presents the analytical parameters and sampling frequency of these wells. This portion of the monitoring program has been developed by representatives of the DOE, the Missouri Department of Natural Resources (MDNR), the EPA, and St. Charles County. This program is presently under negotiation and may be revised for this calendar year. Any deviation from this program will be summarized in the annual site environmental report (ASER).

The well field monitoring program includes sampling both untreated and treated water from the St. Charles County water treatment plant. Gross alpha analysis will be performed on

TABLE 3-5 St. Charles County Well Field Sampling Program Summary for 1993

Monitoring Locations	Parameters											
	Total Uranium	Radiological	Nitroaromatics	Metals			Anions		Organic, VOA, BNA	PCBs Pesticides	Geochemical	Gross α
				As	Ba	Hg, Pb, Cd	Nitrate	Sulfate				
MW-1024	Q	A	Q	Q	Q	-	Q	Q	A	A	-	Q
RMW-1	Q	A	Q	Q	Q	-	Q	Q	A	A	Q	Q
RMW-2	Q	A	Q	Q	Q	-	Q	Q	A	A	Q	Q
RMW-3	Q	A	Q	Q	Q	-	Q	Q	A	A	-	Q
RMW-4	Q	A	Q	Q	Q	-	Q	Q	A	A	-	Q
PW-2	Q	A	Q	Q	Q	A	A	A	A	A	Q	Q
PW-3	Q	A	Q	Q	Q	A	A	A	A	A	-	Q
PW-4	Q	A	Q	Q	Q	A	A	A	A	A	-	Q
PW-5	Q	A	Q	Q	Q	A	A	A	A	A	-	Q
PW-6	Q	A	Q	Q	Q	A	A	A	A	A	-	Q
PW-7	Q	A	Q	Q	Q	A	A	A	A	A	-	Q
PW-8	Q	A	Q	Q	Q	A	A	A	A	A	-	Q
PW-9	Q	A	Q	Q	Q	A	A	A	A	A	Q	Q
Raw water	Q	A	Q	Q	Q	A	A	A	A	A	-	Q
Treated water	Q	A	Q	Q	Q	A	A	A	A	A	-	Q

A — Annual
M — Monthly
Radiological — Gross beta, Th-228, Th-230, Th-232, Ra-226, and Ra-228
B — Bimonthly
Q — Quarterly
Geochemical — Refer to Table 3-4

TABLE 3-6 Weldon Spring Quarry Water Treatment Plant Monitoring Program Summary for 1993

Monitoring Locations	Parameters							
	Total Uranium	Radiological	Anions	Metals	Nitroaromatics	PCBs	PAH	Pesticides
MW-1035	Q	A	Q	A	Q	A	A	A
MW-1036	Q	A	Q	A	Q	A	A	A
MW-1037	Q	A	Q	A	Q	A	A	A
MW-1038	Q	A	Q	A	Q	A	A	A
MW-1039	Q	A	Q	A	Q	A	A	A

A Annually
Radiological U-234, U-238, Th-230, Th-232, Ra-226, Ra-228
Metals As, Ba, Cd, Pb, Cr, Hg, Se, Ag, Mg
PAH polynuclear aromatics
Pesticides Endrin; lindane; methoxychlor; toxaphene; 2,4-D; 2,4,5-TP silvex

Q Quarterly
Anions Nitrate and sulfate
PCBs polychlorinated biphenyls

a quarterly basis. This portion of the monitoring program satisfies the portion of the *Regulatory Guide* and DOE Order 5400.5 requiring the monitoring of affected or potentially affected public drinking water supplies as defined in 40 CFR Part 141.26. The quarterly gross alpha values will be averaged and presented in the ASER. All above-normal or outlier quarterly values will be responded to by implementation of procedure ES&H 1.1.7, *Reporting Above Normal Values from Environmental Monitoring Networks*. Responses include validation of the reported value and resampling of the monitoring location. All values not disqualified as being non-natural will be included in the annual average.

The third program monitors the equalization basin and two effluent ponds at the quarry water treatment plant. Monitoring wells MW-1035 through MW-1039 will be sampled quarterly and annually for selected parameters which are outlined in Table 3-6. The monitoring programs have been developed to meet the requirements of 40 CFR 264, Subpart F and 10 CSR 25.7, Subpart F which require the monitoring of contaminants of concern in the groundwater beneath storage facilities. The contaminants of concern were derived from the *Engineering Evaluation/Cost Analysis for the Proposed Management of Contaminated Water in the Weldon Spring Quarry* (MacDonell et al 1989) and the *Baseline Risk Evaluation for Exposure to Bulk Waste at the Weldon Spring Quarry, Weldon Spring, Missouri* (Haroun et al 1990).

Quality control samples (including duplicate, matrix spike, field blank, equipment blank, and water blank samples) are not included in this schedule, but are collected in compliance with procedure ES&H 4.1.4s. Sampling frequency, collection methods, and sample handling protocols for quality control samples are discussed in Section 7, Quality Assurance.

3.2.3 Groundwater Monitoring Program for the WSCP/WSRP

Groundwater monitoring is required by DOE 5400.1 and the *Regulatory Guide* to determine and document the effects of DOE operations on groundwater quality and to demonstrate compliance with applicable Federal and State laws and regulations. Groundwater monitoring has been conducted at the WSCP/WSRP/VP since the first quarter of 1987. The program has been adjusted yearly to accommodate to changes in laws and regulations, specific project needs, and *Comprehensive Environmental Response, Compensation and Liability Act-National Environmental Policy Act* (CERCLA-NEPA) requirements. In late 1992, monitoring wells were installed around the site water treatment plant equalization basin and the temporary storage area (TSA) to evaluate their impact on the groundwater.

Seventy groundwater wells have been chosen for routine monitoring to investigate and document the possibility that groundwater near the WSCP/WSRP may pose a risk to human health and the environment.

3.2.3.1 Geology and Hydrogeology. Geology at the WSCP/WSRP/VP may be divided into two major units based on gross lithologic characterization: the unconsolidated glacial and residual soils and the underlying bedrock. The unconsolidated material consists of topsoil loess, glacially derived sediments, and residuum. On average, the glacial soils are silty clays withminor amounts of gravel. The unconsolidated materials, which are present at depths ranging from 6 m to 15 m (20 ft to 50 ft), are usually not saturated and thus are not monitored.

Saturated conditions are generally first encountered at various lithologic zones in the Burlington-Keokuk Limestone, the underlying bedrock unit. The Burlington-Keokuk Limestone is composed of two different lithologic zones: a shallow weathered zone underlain by an unweathered or competent 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, semi-confined, heterogeneous, anisotropic aquifer that is fractured and susceptible to natural solution processes. Within the confines of the WSCP/WSRP/VP, the aquifer generally exhibits diffuse flow properties; however, discrete flow zones may be present in saturated, highly weathered bedrock and in saturated residuum filling paleochannels.

The unweathered or competent portion of the Burlington-Keokuk Limestone is thinly to massively bedded, gray to light gray, finely to coarsely crystalline, styolitic and fossiliferous. Fracture densities are significantly lower in the competent zone than in the weathered zone.

In contrast to the WSQ, which is located near a poorly drained, swampy area, the WSCP/WSRP/VP site straddles a topographic high. Thus site soils are well drained and there has been minimal build up of organic material. These conditions foster relatively oxidizing conditions in the unconsolidated materials and upper bedrock units beneath the WSCP/WSRP/VP in comparison to potentially reducing conditions present in the WSQ environs. Redox conditions are an important control on the mobility and stability of many species that are potential contaminants at these two locations.

3.2.3.2 Rationale. Groundwater flow and contaminant transport mechanisms at the WSCP/WSRP/VP differ from those at the WSQ because of differences in the geologic environments of these two locations. Site geologic conditions are briefly described in the following section. At the WSCP/WSRP/VP, the aquifer generally exhibits diffuse flow properties that are overlain by zones of fracture or conduit flow. To accommodate these two flow mechanisms, the WSCP/WSRP/VP 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 discrete or conduit flow paths.

The 1993 groundwater monitoring program at the WSCP/WSRP/VP is designed to provide the necessary data to accomplish the following objectives:

- Ensure protection of public health and the environment. Included in this objective are (1) evaluating whether contaminants of concern, as determined in the draft remedial investigation for the site, are present at levels exceeding maximum contaminant levels (MCLs) or assumed background concentrations which are being determined by the USGS at uncontaminated wells located in the immediate vicinity of the WSCP/WSRP, and (2) monitoring concentration levels of contaminants which exceed these criteria.

- Develop a baseline for studying long-term and short-term effects of source removal, which is to be conducted as part of CERCLA-NEPA activities slated to begin in 1994. At least one year of baseline data taken quarterly will be required to provide adequate information for future comparisons. Wells that were not previously monitored on a quarterly basis will be monitored quarterly in 1993.

- Develop a baseline for studying the effects of the settling ponds associated with the wastewater treatment plant and on-site construction activities.

- Perform spatial and temporal trend analyses.

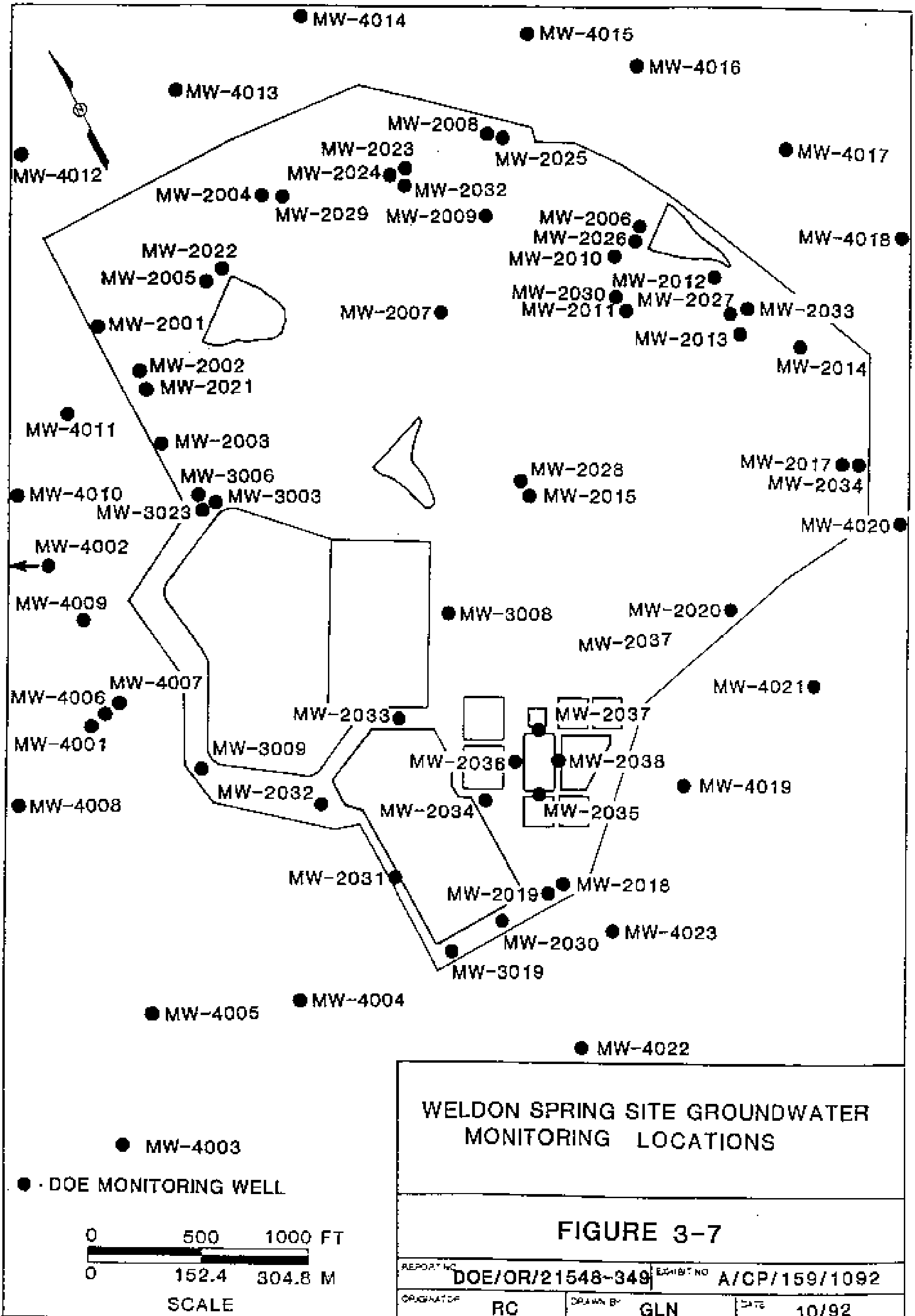
- Provide information to support planning for the Groundwater Separate Operable Unit, which is slated to begin in fiscal 1993. This effort requires chemical characterization of the WSCP/WSRP/VP groundwater to support contaminant migration modelling and to evaluate potential indicator parameters that may be used to predict contaminant migration.

3.2.3.3 WSCP/WSRP Groundwater Monitoring Locations. For calendar year 1993, 70 DOE monitoring wells will be utilized for the environmental surveillance program (see Figure 3-7). Sixty-three of these wells monitor the upper portion of the formation and seven monitor the deeper portions of the bedrock aquifer near potential source areas and in areas of known groundwater contamination. Nine of these groundwater monitoring wells were installed in late 1992 to monitor the groundwater associated with the equalization basin at the site watertreatment plant and the TSA. Monitoring at these locations and depths will detect changes in the horizontal and vertical components of contaminant migration. Background locations are monitored by the USGS and the data made available to the WSSRAP.

3.2.3.4 Monitoring Schedule. The WSCP/WSRP/VP monitoring wells will be placed on a quarterly or semiannual sampling schedule for nitroaromatics, ions, and uranium. Locations will be sampled semiannually except where the following conditions apply: (1) fewer than six samples have been analyzed during the period 1990 through 1992; (2) the average uranium concentration exceeds 13.6 pCi/l (the proposed drinking water standard in groundwater); (3) 2,4-DNT or 2,6-DNT exceeds 0.11μg/l (the ambient water quality standard for 2,4-DNT); or other nitroaromatic compounds exceed 10 times their respective detection limits. For locations failing Condition 1, all categories will be sampled quarterly; for those failing Conditions 2 or 3, only uranium or the nitroaromatic compounds, respectively, need be sampled quarterly. If a semi-annual well fails Conditions 2 or 3 during the first sampling event, it will be moved to quarterly sampling for the remainder of the year. Outliers will not be considered in these calculations. The definition of an outlier from WSSRAP data is being developed for the next revision of the *Environmental Data Analysis Plan* (EDAP).

As a precaution, wells near the raffinate pits and chemical plant buildings will be sampled annually for a suite of radionuclides that are present in the raffinate pit sludge. Although these analyses have been assigned to the first monitoring period, they may be moved to other periods, if necessary. The parameters of concern are to be monitored annually. Most of these parameters are encompassed in the geochemical suite, and are thus included in the sampling event designated G* (refer to Tables 3-7 and 3-8).

In 1992, geochemical parameters were measured on a quarterly basis for the 4000 wells (locations adjacent to the site) and key 2000 and 3000 wells (locations within the site). These wells will be moved to a semi-annual schedule for geochemical parameters with the exception



WELDON SPRING SITE GROUNDWATER MONITORING LOCATIONS

FIGURE 3-7

REPORT NO	DOE/OR/21548-349	EXHIBIT NO	A/CP/159/1092		
ORIGINATOR	RC	DRAWN BY	GLN	DATE	10/92

TABLE 3-7 WSCP/WSRP/VP Semi-Annual Groundwater Monitoring Analytical Program for 1993

Monitoring Location	S1	S2
MW-3006	N,I,G*,R	N,U,G,I
MW-4003	N,U,I,G*	N,U,G,I
MW-4004	N,U,I,G*	N,U,G,I
MW-4007	N,I,G*,R	N,U,G,I
MW-4008	N,U,I,G*,R	N,U,G,I
MW-4009	N,U,I,G*	N,U,G,I
MW-4010	N,I,G*,R	N,U,G,I
MW-4011	N,I,G*,R	N,U,G,I
MW-4012	N,U,I,G*	N,U,G,I
MW-4014	N,U,I,G*	N,U,G,I
MW-4015	N,U,I,G*	N,U,G,I
MW-4016	N,U,I,G*	N,U,G,I
MW-4017	N,U,I,G*	N,U,G,I
MW-4018	N,U,I,G*	N,U,G,I
MW-4019	N,U,I,G*	N,U,G,I
MW-4023	N,U,I,G*	N,U,G,I

N Nitroaromatics
U Uranium, total
G Geochemical parameters - Br, Cl, NO2, Al, As, Ba, Ca, Cr, Fe, K, Li, Mg, Mn, Na, Ni, P, Pb, Si, Sr, DOM
G* Geochemical parameters - including Ag, Be, Cd, Co, Cu, Hg, Mo, Sb, Se, V, Zn
R Radionuclides - total uranium, Ra-226, Ra-228, Th-228, Th-230, Th-232, gross alpha, and gross beta
I Inorganic anions

TABLE 3-8 WSCP/WSRP Quarterly Groundwater Monitoring Analytical Program for 1993

Monitoring Location	1993 EMP Samples			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
MW-2001	N,I,G*,R	N,U,I	N,U,G,I	N,U,I
MW-2002	N,I,G*,R	N,U,I	N,U,G,I	N,U,I
MW-2003	N,I,G*,R	N,U,I	N,U,G,I	N,U,I
MW-2004	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2005	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2006	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2007	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2008	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2009	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2010	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2011	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2012	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2013	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2014	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2015	N,I,G*,R	U,G,I	N,U,G,I	U,G,I
MW-2017	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2018	N,I,G*R	U,G,I	N,U,G,I	U,G,I
MW-2019	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2020	N,I,G*R	U,G,I	N,U,G,I	U,G,I
MW-2021	N,I,G*R	U,G,I	N,U,G,I	U,G,I
MW-2022	N,I,G*,R	U,G,I	N,U,G,I	U,G,I
MW-2023	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2024	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2025	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2026	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2027	N,U,I,G*	U,G,I	N,U,G,I	U,G,I
MW-2028	N,I,G*,R	U,G,I	N,U,G,I	U,G,I
MW-2029	N,U,I,G*	U,G,I	N,U,G,I	U,G,I

TABLE 3-8 WSCP/WSRP Quarterly Groundwater Monitoring Analytical Program for 1993 (Continued)

Monitoring Location	1993 EMP Samples			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
MW-2030	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2032	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2033	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-2034	N,U,I,G*	N,U,G,I	N,U,G,I	N,U,G,I
MW-3003	N,I,G*,R	U	N,U,G,I	U
MW-3008	N,I,G*,R	N,U	N,U,G,I	N,U
MW-3009	N,I,G*,R	N,U	N,U,G,I	N,U
MW-3019	N,I,G*,R	U,G,I	N,U,G,I	U,G,I
MW-3023	N,I,G*,R	N,U,G,I	N,U,G,I	N,U,G,I
MW-4001	N,I,G*,R	N	N,U,G,I	N
MW-4002	N,I,G*,R	N	N,U,G,I	N
MW-4005	N,U,I,G*	U	N,U,G,I	U
MW-4006	N,I,G*,R	N	N,U,G,I	N
MW-4013	N,U,I,G*	N	N,U,G,I	N
MW-4020	N,U,I,G*	U	N,U,G,I	U
MW-4021	N,U,I,G*	U	N,U,G,I	U
MW-4022	N,U,I,G*	U,G,I	N,U,G,I	U,G,I

N Nitroaromatics
U Uranium, total
G Geochemical parameters - Br, Cl, NO2, Al, As, Ba, Ca, Cr, Fe, K, Li, Mg, Mn, Na, Ni, P, Pb, Si, Sr, DOM
G* Geochemical parameters - including Ag, Be, Cd, Co, Cu, Hg, Mo, Sb, Se, V, Zn
R Radionuclides - total uranium, Ra-226, Ra-228, Th-228, Th-230, Th-232, gross alpha, and gross beta
I Inorganic anions

of the bailed wells (MW-2030, MW-2032, MW-2033, MW-2034, and MW-2023) and MW-4022. These locations, and those that were not monitored for geochemical parameters in 1992, will be monitored quarterly for these parameters in 1993. The specific wells, analytical constituents, and schedule for the quarterly and semi-annual sampling event are listed in Tables 3-7 and 3-8, respectively.

Monitoring wells MW-2035 through MW-2043, which surround the site water treatment plant equalization basin and the TSA will be monitored in order to comply with the requirements of 40 CFR 264, Subpart F and 10 CSR 25.7, Subpart F which requires the monitoring of contaminants of concern in the groundwaters beneath storage facilities. These monitoring wells will be sampled quarterly and annually for the selected parameters outlined in Table 3-9.

Quality control samples (including duplicate, matrix spike, field blank, equipment blank, and water blank samples) are not listed here, but will be collected in compliance with procedure ES&H 4.1.4s. Sampling frequency, collection methods, and sample handling protocols are discussed in Section 7, Quality Assurance.

3.2.4 Groundwater Monitoring at Springs

The groundwater flow system beneath the WSCP/WSRP/VP comprises both diffuse flow and discrete flow components; therefore, a complete groundwater monitoring program must include sampling at conventional groundwater monitoring wells near the contaminant sources, and sampling at springs to detect the transition from diffuse flow to the discrete flow. Springs in the vicinity of the site have been monitored since 1987, beginning with the DOE and Project Management Contractor (PMC) 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 set of springs impacted by the site was determined and a program of regular monitoring established for those springs. Through that program and the additional studies conducted by the DOE, PMC, and the Missouri and U.S. Geological Surveys, the flow characteristics of the springs and their recharge basins were determined.

As a result of the Phase I characterization, 11 springs (nine perennial and two wet weather) that are potentially impacted by site-related contaminants, were identified for routine

TABLE 3-9 SWTP and TSA Monitoring Program Summary for 1993

Monitoring Location	Parameters								
	Total Uranium	Radiological	Anions	Metals	Nitroaromatics	PCBs	PAH	Pesticides	Geochemical
MW-2035	Q	A	Q	A	Q	A	A	A	A
MW-2036	Q	A	Q	A	Q	A	A	A	A
MW-2037	Q	A	Q	A	Q	A	A	A	A
MW-2038	Q	A	Q	A	Q	A	A	A	A
MW-2039	Q	A	Q	A	Q	A	A	A	A
MW-2040	Q	A	Q	A	Q	A	A	A	A
MW-2041	Q	A	Q	A	Q	A	A	A	A
MW-2042	Q	A	Q	A	Q	A	A	A	A
MW-2043	Q	A	Q	A	Q	A	A	A	A

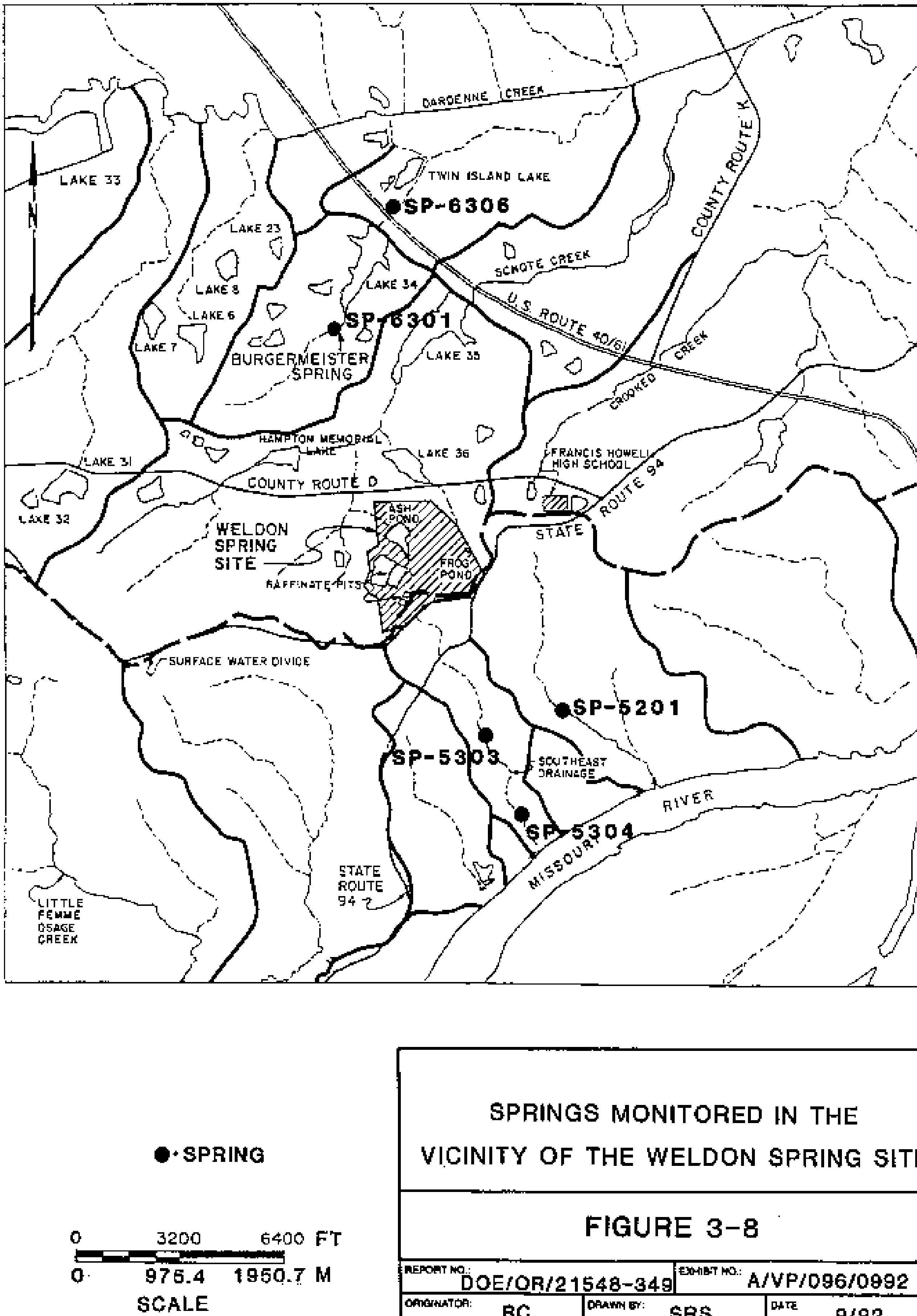
A Annually
Q Quarterly
Radiological U-234, U-238, Th-230, Th-232, Ra-226, Ra-228
Anions Nitrate and sulfate
Metals As, Ba, Cd, Cr, Pb, Hg, Se, Ag, Mg
PCBs polychlorinated biphenyls
PAH polynuclear aromatics (SW846 Method 8100)
Geochemical Br, Cl, Al, As, Ba, Ca, Cr, Fe, F, K, Li, Mg, Mn, Na, Ni, P, Pb, Sr, NO_2, NO_3, SiO_2, TOC, Ag, Be, Cd, Co, Cu, Hg, Mo, Sb, Se, V, Zn, Tl, Fe^{2+}, S^{2-}, TSS, TDS
Pesticides Endrin; lindane; methoxychlor; toxaphene; 2,4-D; 2,4,5-TP Silvex

monitoring. In 1992, the results of this monitoring program were evaluated, and six locations were eliminated from the program because they were minimally impacted by the WSCP/WSRP/VP or duplicated other monitoring locations (MKF and JEG 1992c). The remaining five springs were scheduled for more intense monitoring to provide the DOE with valuable environmental health and safety data. Figure 3-8 identifies the springs that will be routinely monitored for site-related contaminants.

3.2.4.1 Monitoring Locations. Two of the five springs are located in Valley 5300 (the Southeast Drainage), one is located in adjacent Valley 5200, and the remaining two are located in Valley 6300 (the Burgermeister Spring branch). The Southeast Drainage was used during operation of the Weldon Spring Uranium Feed Material Plant (WSUFMP) as a discharge route for contaminated decant water from the sludge settling ponds. As a result, the sediment in this drainage-way became contaminated by various substances, including radionuclides. Uranium is present in the water discharged from the natural springs along this drainage. It is unclear, however, whether contamination of the Southeast Drainage springs reflects discharge of groundwater that was contaminated by sources upstream of the drainage or by the sediments within the drainage.

The Burgermeister Spring branch receives site-contaminated ground and surface water. Although the WSS is not located in Valley 6300, it is connected to this drainage way by losing streams that travel along subterranean conduits and emerge at springs in the Burgermeister Spring branch. The most prominent location is Burgermeister Spring (SP-6301), a perennial spring that discharges site-contaminated water during high and low flow periods. High flow is dominated by a surface water component, whereas low flow is dominated by a groundwater component. Spring 6306, located downstream of Busch Lake 34 and downstream of Burgermeister Spring, also contains uranium. Considerable evidence suggests that Lake 34, which has elevated uranium concentrations, is a plausible source for the uranium in Spring 6306. However, there is also evidence of a possible connection to Busch Lake 35, which is located in the same drainage as the WSS and also has elevated uranium levels.

3.2.4.2 Monitoring Program. The monitoring program for 1993 will follow that for 1992, and will again emphasize the flowrate from the springs at the time of sampling as a critical sampling parameter. Table 3-10 summarizes the frequency and sample parameters for the springs to be monitored. Low flow is defined as seasonal baseflow, or the stage of spring



SPRINGS MONITORED IN THE VICINITY OF THE WELDON SPRING SITE

FIGURE 3-8

REPORT NO.: DOE/OR/21548-349	EXHIBIT NO.: A/VP/096/0992		
ORIGINATOR: RC	DRAWN BY: SRS	DATE 9/92	

TABLE 3-10 Spring Monitoring Program for 1993

	SCHEDULE			
LOCATION	Q1*	Q2**	Q3*	Q4*
SP-6301	L	H,L	L	H,L
SP-6306	L	H,L	L	H,L
SP-5303	L	L	L	L
SP-5304	L	L	L	L
SP-5201	L	L	L	L

* All samples analyzed for uranium, nitrate, sulfate, and geochemical constituents.
** Samples analyzed for full radiation (U, Th and Ra isotopes), nitrate, sulfate, and nitroaromatics.
L Low flow
H High flow

discharge when not influenced by active surface water runoff from local land surfaces. Low flow samples are intended to monitor the undiluted groundwater component of flow. To meet this criterion, low flow samples will be collected no sooner than one week following the conclusion of a precipitation event of sufficient intensity to cause surface runoff to occur. To provide a direct comparison with groundwater collected from monitoring wells, low flow samples will be filtered in the same manner (0.45 μm filter) as monitoring well samples.

In contrast to low flow, high flow is induced by precipitation events. During high flow, discharge is dominated by surface run off; thus high flow samples will be treated like surface water samples and will not be filtered.

All springs will be monitored at low flow. This is especially critical for springs in the Southeast Drainage (SP-5303 and SP-5304) because the contribution from surface discharge to the spring flow may yield unrepresentative samples, due to the presence of contaminated sediments in this drainage.

Spring 6301 (Burgermeister Spring) is a critical point of resurgence for groundwater contaminated by the WSS wastes. It is impacted by surface runoff from the site during high flow and by contaminated groundwater from beneath the site during low flow. Thus geochemical samples will be collected at low-flow on a quarterly basis to provide a basis for comparison with site groundwater. Characterization of SP-6301 at both high and low flow stages throughout the site cleanup should provide a valuable measure of environmental conditions.

3.3 External Radiation Exposure Environmental Surveillance Monitoring

The external radiation exposure environmental surveillance program at the WSS was designed to monitor potential external exposure points at the WSCP/WSRP, WSQ perimeters, vicinity properties, and at off-site locations where the highest potential for an exposure to a member of the general public to gamma radiation exists. Gamma radiation is emitted by nearly all the radionuclides of the U-238 and Th-232 decay series and these radionuclides are found in above-background concentrations on the WSS.

In addition, the environment contains naturally occurring radioactive substances which emit gamma radiation. Terrestrial radiation sources are natural radioactive elements in the environment (soil and water). Cosmic radiation is high-energy radiation that originates in outer space and filters through the atmosphere reaching the earth's surface. Together, these two sources account for natural background gamma radiation. Terrestrial and cosmic radiation levels depend largely on the soil composition and elevation above sea level, respectively.

3.3.1 Weldon Spring Site Monitoring Locations

The locations chosen as external monitoring stations were based on the characteristics of the WSS. External gamma exposure to a member of the public as a result of fugitive dust emissions from the WSS is an unrealistic exposure pathway. This is based on the primary radioactive contaminant, uranium, and the three air monitoring programs that have been extablished to ensure airborne concentrations at the side perimeters are maintained at near background levels. Any airborne emission from the WSS will be intermittent and have low concentrations of radionuclides. Thus, this pathway would not result in a measurable external exposure to a member of the general public. In addition, there are no high energy accelerators, industrial x-ray, or large isotopic radiation sources present at the WSS. The only potential for external exposure to a member of the general public results from contaminated soils located at the WSCP/WSRP, WSQ, and vicinity properties.

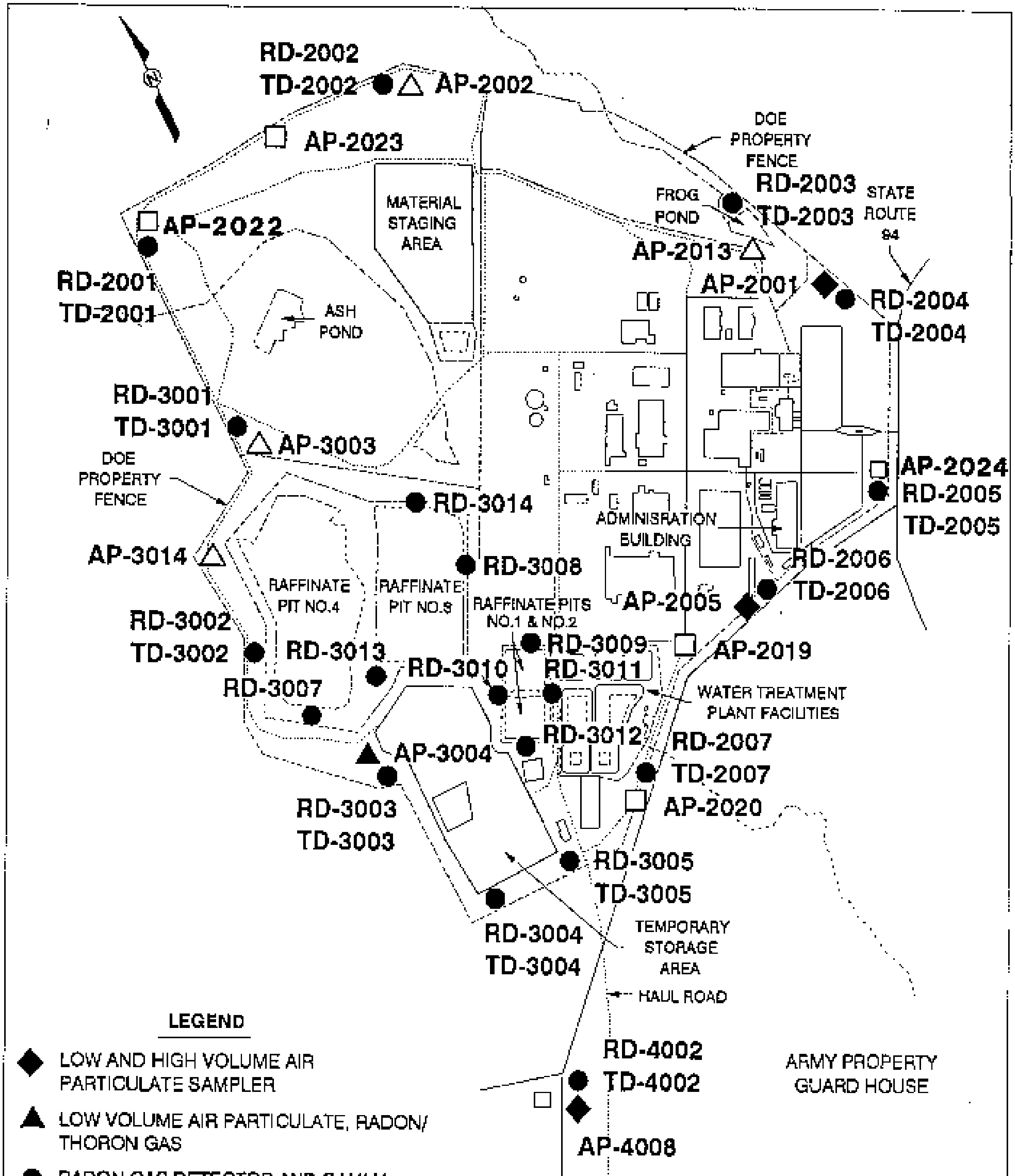
Exposure from gamma radiation at the WSS will be monitored at 20 locations using spherical environmental thermoluminescent dosimeters (TLD)s. Twelve monitoring stations will be located around the perimeter fence of the WSCP/WSRP (Figure 3-9). Eight monitoring stations will be located along the WSQ perimeter fence (Figure 3-10). The 12 monitoring stations at the WSCP/WSRP are spaced at intervals ranging from approximately 122 m to 610 m (400 ft to 2,000 ft) around the site perimeter. The eight monitoring stations at the WSQ will be spaced at intervals of 76 m to 190 m (250 ft to 650 ft).

Spacing of the monitoring stations around the perimeters of the WSCP/WSRP and WSQ is based on the relative potential for external exposures. The perimeter of the WSQ, which has the shortest distances between monitoring stations, is the most accessible to a member of the general public. In addition, the contaminated materials within the WSQ at some points are less than 46 m (150 ft) from the perimeter. The intervals between monitoring stations at the WSCP/WSRP near the TSA and SWTP are similar to those at the WSQ. Material presently at the WSQ will begin to be moved to the TSA during 1993. In some places the TSA perimeter is less than 31 m (100 ft) from the WSCP/WSRP perimeter. The intervals between monitoring stations along the remainder of the WSCP/WSRP perimeter are larger because the potential for external exposure to a member of the general public is less significant.

3.3.2 Off-Site Monitoring Locations

Eight off-site monitoring stations (Figures 3-9 through 3-11), as well as two of the perimeter monitoring stations, will be used to assess gamma radiation exposure rates at locations near the WSCP/WSRP where members of the general public abide or reside. The monitoring stations at the Francis Howell High School and the Busch Wildlife headquarters were chosen because they have the largest populations near the WSCP/WSRP. The State of Missouri Highway Department, TD-2004; the Army Reserve guard house, TD-4002; and the WSSRAP administration building, TD-2005; are the closest locations to the WSCP/WSRP where a member of the general public abides or resides.

The monitoring station near the residence, TD-4007 (Figure 3-10), was chosen because the individuals who reside there have an assumed continuous exposure time, the longest of any of the WSS nearby receptors. The location at the Femme Osage Slough vicinity property, TD-4008, was chosen because it is located near the Katy Trail, which has the largest population group that visits the WSS vicinity, and it is used by individuals who fish from the Femme Osage Slough.



LEGEND

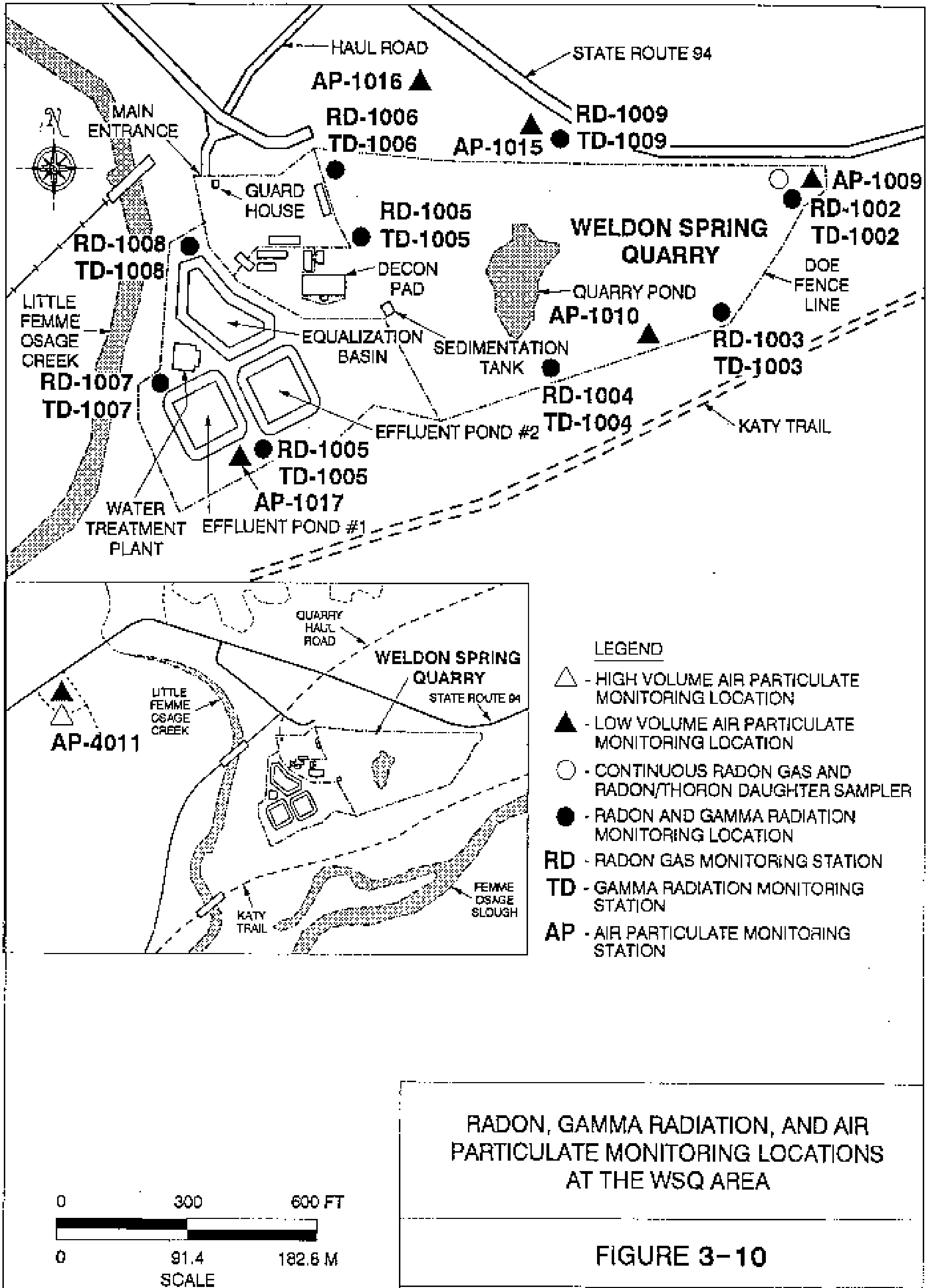
- ◆ LOW AND HIGH VOLUME AIR PARTICULATE SAMPLER
- ▲ LOW VOLUME AIR PARTICULATE, RADON/ THORON GAS
- ● RADON GAS DETECTOR AND GAMMA RADIATION DETECTOR STATION
- △ LOW VOLUME PERMANENT AIR PARTICULATE SAMPLER
- □ LOW VOLUME PORTABLE AIR PARTICULATE SAMPLER

0 500 1000 FT
0 152.4 304.8 M
SCALE

RADON-222, TLD, AND AIR PARTICULATE MONITORING LOCATIONS AT THE WSCP/WSRP AREA

FIGURE 3-9

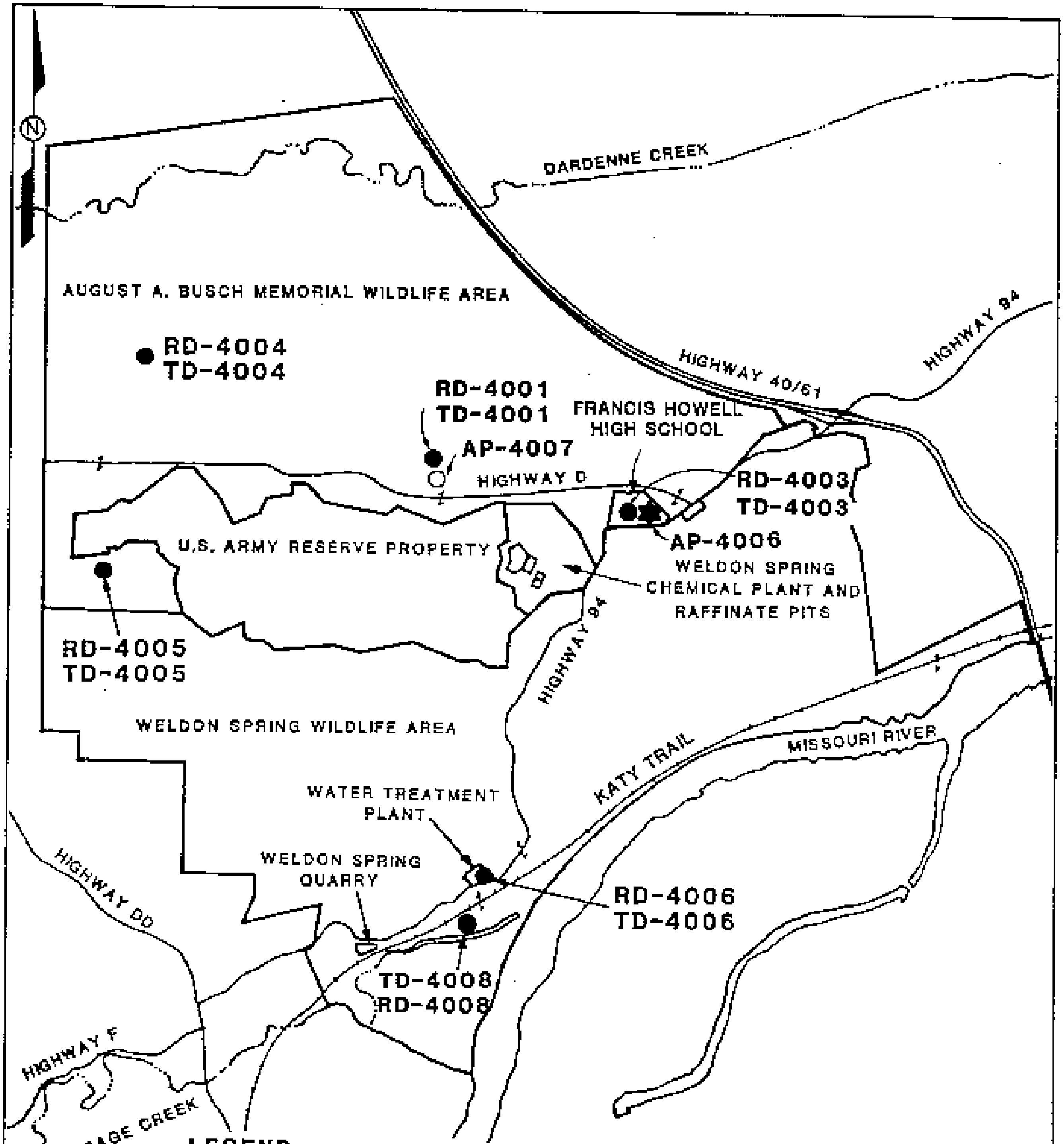
REPORT NO.: DOE/OR/21548-349	EXHIBIT NO.: A/CP/027/0393	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 6/9/93



RADON, GAMMA RADIATION, AND AIR PARTICULATE MONITORING LOCATIONS AT THE WSQ AREA

FIGURE 3-10

REPORT NO.: DOE/OR/21548-349	EXHIBIT NO.: A/QY/029/0393		
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 6/9/93	



LEGEND

● RADON GAS AND GAMMA RADIATION DETECTOR STATIONS

✶ LOW AND HIGH VOLUME AIR PARTICULATE SAMPLERS AND RADON/THORON GAS SAMPLER

○ LOW AND HIGH VOLUME AIR PARTICULATE, RADON/THORON GAS, AND RADON/THORON DAUGHTER SAMPLERS

0 5000 10000 FEET

0 1524 3048 METERS

SCALE

OFF-SITE RADON AND GAMMA MONITORING LOCATIONS

FIGURE 3-11

REPORT NO.: DOE/OR/21548-349		EXHIBIT NO.: A/VP/098/1092	
ORIGINATOR: RC	DRAWN BY: SRS	DATE 5/24/93	

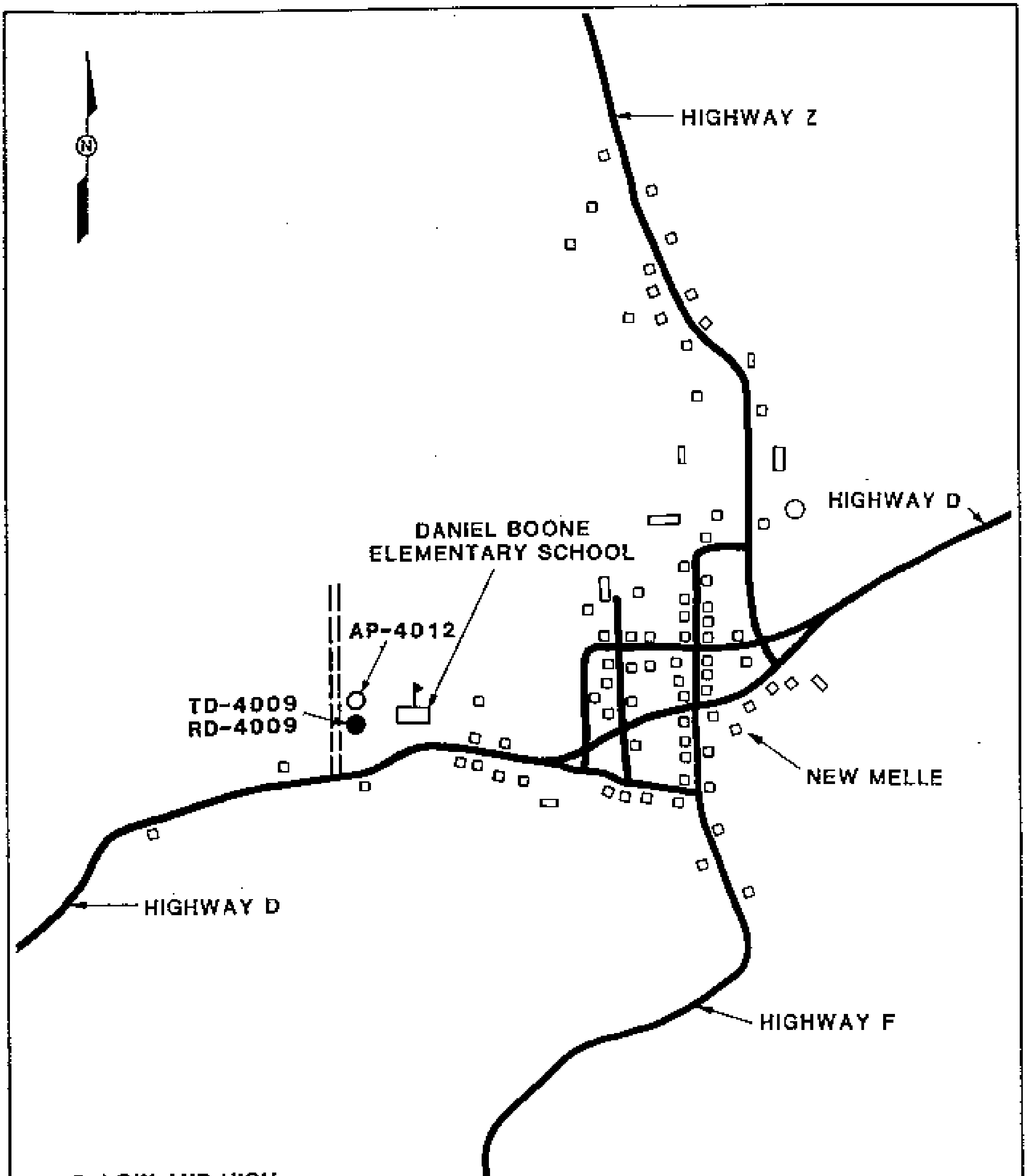
Five monitoring stations are used to measure background gamma radiation exposure rates (Figures 3-11 and 3-12). The monitoring locations are TD-4001, TD-4004, TD-4005, TD-4006, and TD-4009. In 1989, background gamma radiation exposure rates were measured in each of the three distinct geological regions in the vicinity of the WSS. The three distinct regions are the dissected glacial till deposits, the alluvial deposition of the Missouri River, and the Salem Plateau. Statistical analysis of the data from the background measurements indicated that at the 95% confidence level there was no reason to suspect a difference in the gamma exposure rates between the three geological regions. Since there was no reason to suspect a difference between the gamma exposure rates in the three geological regions, an average of the results of the five background locations will give a better approximation of the background gamma radiation exposure rate.

3.3.3 Background Monitoring Locations

Four of the background monitoring stations are within 6.4 km (4 mi) of the WSCP/WSRP or WSQ. The fifth background station, TD-4009, is approximately 12.9 km (8 mi) from the WSCP/WSRP and 11.3 km (7 mi) from the WSQ (Figure 3-12). The *Regulatory Guide* suggests that background stations should be located at a minimum of 9.7 km to 14.5 km (6 mi to 9 mi) from a site. Although three of the background stations are not located at the distances suggested in the *Regulatory Guide*, they are at appropriate distances with respect to the WSS. As mentioned, the WSS; will not render external radiation exposures as a result of any airborne emissions. There are no high energy accelerators, industrial X-ray, or large isotopic radiation sources at the WSS; thus the distances that the four background stations are from the WSCP/WSRP, WSQ, and vicinity properties are more than sufficient to attenuate the gamma radiation from on-site contaminated soils.

3.3.4 Radiological Measurements

Measurements with a pressurized ion chamber (PIC) as suggested in the *Regulatory Guide* will not be made at monitoring stations used in previous years. Because the TLDs integrate gamma exposure for 13 wk, the TLDs actually provide a better assessment to determine if any natural occurring anomalies are present at the location than would a short term PIC measurement. Results of previous TLD measurements are consistent with yearly background gamma exposures made by the PMC and other DOE contractors around the WSS. The



○ LOW AND HIGH VOLUME AIR PARTICULATE, RADON/THORON GAS, AND RADON/THORON DAUGHTER SAMPLERS

● RADON GAS DETECTOR AND GAMMA RADIATION DETECTOR STATION

0 .25 MI
SCALE
0 .40 KM

BACKGROUND AIR MONITORING STATION

FIGURE 3-12

REPORT NO.: DOE/OR/21548-349			EXHIBIT NO.: A/VP/110/1192		
ORIGINATOR: RC	DRAWN BY: GLN		DATE: 5/24/93		

monitoring stations at the WSQ, located in the controlled area, are positioned near contaminated soils and material. The above background results are due to the proximity of the monitoring stations to the contaminated soils. Because previous TLD measurements are consistent with background exposure rates performed by the PMC, and others and are within the expected range for this altitude, it is concluded that there are no naturally occurring anomalies present. Thus, PIC measurements are not necessary.

The quality control measures that will be implemented for environmental TLDs include spiked and duplicate detectors. At least two duplicate TLDs will be deployed, one at the WSQ and one at the WSCP/WSRP. The TLDs are exchanged and retrieved in accordance with the appropriate standard operating procedures (SOPs) and field sheets will be used to document placement, retrieval, and any unusual occurrences. Chain-of-Custody Forms will also be filled out as specified in the appropriate WSSRAP SOP. The data received from the vendor will be reviewed and any anomalies identified and investigated. In addition, performance testing, deployment, and storage of TLDs will be done according to ANSI-N545-1975. The environmental TLD used for monitoring ambient gamma radiation exposures is composed of two carbon doped aluminum oxide (Al_2O_3:C) chips in an opaque black polypropylene plastic holder. The holder is contained in a tamper resistant heavy duty vinyl pouch with slots to permit attachment. One chip in the holder has no filtration associated with it. The second chip is filtered by a layer of plastic and lead. The TLDs will be collected and read on a quarterly basis.

3.4 Biological Monitoring Program

Biological monitoring requirements are designated in DOE Orders 5400.1, 5400.5, and the *Regulatory Guide* and programs are developed to protect the health of the public and the quality of the environment. DOE Order 5400.1 designates that samples of air, water, soil, foodstuffs, biota and other environmental media be collected for assessment of environmental conditions. Environmental monitoring focuses on effluent monitoring to detect, characterize, and report unplanned releases. In order to detect changes in ecological conditions, studies are developed to determine baseline conditions in the environment, such as lakes and streams. Remedial activities are in process for the WSQ and interim actions are being conducted at the WSCP where contaminants may be released to the environment. Work practices are incorporated into remedial actions to avoid releases and monitoring studies also evaluate the effectiveness of these practices. Some low, controlled releases to off-site locations currently occur and are the basis for the remedial actions at the WSS.

The DOE Orders also designate that environmental monitoring shall be conducted "to monitor the effects, if any, of DOE activities on the environment, to identify and quantify new or existing environmental quality problems, and to characterize and define trends in physical, chemical and biological conditions." As part of the CERCLA process for the remediation of the site, ecological risk assessments are prepared which, to a great degree, meet the monitoring goals under DOE Order 5400.1. Ecological risk assessment is a relatively new process under CERCLA guidance. As a result, some data gaps exist for the ecological assessment in the *Weldon Spring Chemical Plant Baseline Risk Assessment* (ANL 1992). In order to complete the assessment for the WSCP, specific activities are included in the Environmental Monitoring Program. This approach is supported by the DOE Order 5400.1 requirement to show "compliance with applicable environmental laws and regulations" including those designated by Federal and State authority.

3.4.1 Past studies

Characterization studies conducted prior to 1990 examined the level and extent of contaminants in the environment. These studies involved sampling of surface waters, soils, and sediments. Primary exposure routes for biota, were examined, although studies were not designed to assess ecological conditions. The main purpose of these studies was to examine the contaminants in relation to their potential for human exposure.

Nevertheless, some information can be applied to the DOE monitoring requirements and the CERCLA ecological assessment process. In 1987, the first biouptake study was conducted by measuring concentrations of metals, PCB's, and radionuclides in fish. No fish were found in the WSCP raffinate pits or in the WSQ pond; however, sunfish were found in Frog Pond. No polychlorinated biphenyls (PCBs) were found in fish from off-site locations, but detectable concentrations of metals were found in some fish samples taken from these locations. Small game mammals were sampled in 1988 and no radionuclides were detected in these samples. Waterfowl were sampled from Raffinate Pit 4 during 1990. Results showed detectable levels of radionuclides in organ, bone, and flesh samples. One white-tailed deer was sampled in 1991 due to an accidental death and radionuclides were detected in some bone, organ, and flesh samples.

In 1992, more emphasis was placed on characterizing ecological conditions on site and at vicinity properties receiving effluent from the WSS. The aquatic biological investigation characterized the physical properties of lakes and streams in the area and in biological organisms found within the aquatic habitats. Data from electrofishing surveys and stocking practices were compiled to define fish populations in vicinity lakes and to examine their influences on other organisms within the lakes. Population surveys for deer located within the WSCP/WSRP area were conducted to determine whether overcrowding, habitat loss, or contaminated resources are affecting deer populations on site.

3.4.2 Monitoring Rationale

A biological monitoring program comprising of various aquatic and terrestrial studies will be conducted in 1993 to meet monitoring requirements. The studies will focus primarily on vicinity properties that currently receive effluent from the WSS, and whose biotic systems have not been fully characterized. Secondly, information will be gathered to complete the baseline risk assessment for the WSCP. Other ecological activities, not specifically designated here, will include the protection and relocation of species, as necessary, when interim activities, such as the site water treatment plant, begin.

Radiological parameters analyzed in 1993 studies will include total uranium in fish, invertebrates, vegetation, soils, and surface waters. Isotopic raduium and thorium will be analyzed in agricultural products if air monitoring determines that sampling is required. Chemical parameters will include those parameters analyzed for contaminant levels (i.e., silver, mercury, selenium, lead, and arsenic) and those parameters analyzed to describe ecological conditions (i.e., pH, alkalinity, and dissolved oxygen).

The 1993 ecological monitoring program will emphasize the additional characterization of aquatic systems on site and at off-site locations. The monitoring may be streamlined based upon 1992 sampling results, which are still unavailable. Terrestrial sampling will be limited to gathering data needed to complete the ecological risk assessment for the WSCP area.

3.4.3 Aquatic Monitoring

Eleven locations will be included in the monitoring of aquatic habitats. At the WSQ, the Femme Osage Slough located south of the quarry pond will be routinely monitored. Vicinity property locations include lower reaches of the Little Femme Osage Creek, the Missouri River near the WSQ water treatment plant outfall, Lakes 34, 35, and 36, and Burgermeister Spring at the August A. Busch Wildlife Area (ABWA). Schote Creek, located on the ABWA will also be monitored as will two locations, an upper and lower spring, in the Southeast Drainage. Other lakes and creeks will be monitored as part of the background sampling program. Dardenne Creek, north of the Lake 33 dam, will be sampled to compare conditions in Schote Creek. An upper reach of the Little Femme Osage Creek will be sampled and compared to the creek sampling location near the quarry. A background spring, located in the Weldon Spring Wildlife Area (WSWA), will be used to compare conditions at Burgermeister Spring.

3.4.3.1 Fish Sampling. Fish are monitored at off-site locations primarily to ensure public health and safety. The sampling for 1993 will be greatly reduced in relation to the previous two sampling years. Review of the fish data indicates that flesh samples from Busch Lakes 35 and 36 are accumulating radionuclides that are found at levels significantly different than background. The concentrations found are extremely low and the calculated total estimated dose is less than 1.0 mrem/year. No significant difference was found between species of fish, although the current data set is small. As a result, fish monitoring will be limited to sampling the flesh of game species from Busch Lakes 34, 35, and 36 and the Femme Osage Slough. Busch Lake 33 will be used as a background location. In addition, only fish within 20% of the legal length limit will be sampled or in the case of species with no designated limit, only individuals greater than 17.5 cm (7 in.) will be taken.

Sampling of fish will be conducted in conjunction with the Missouri Department of Conservation (MDOC) fisheries program. Adult fish will be collected using the electrofishing technique in which fish are stunned with a low electrical current, dip-netted from the water and placed in holding tanks prior to data collection. All fish collected during the electrofishing event will be identified, measured (total length), and recorded for analysis of fish populations. In addition, a gross examination of each fish will be made to determine the incidence of external disease, parasites, or physical abnormalities.

Specific game species; bass, sunfish, crappie, and catfish will be collected for radiological analysis of uranium. Results of the radiological analyses will be used to calculate the effective dose equivalent to humans based upon consumption of fish.

3.4.3.2 Invertebrates. Benthic invertebrates and zooplankton are routinely used as indicators of water and ecological quality in lakes and streams. In the DOE Order 5400.1, this status is recognized with specific designation for monitoring benthics and organisms in the water column. Additional characterization and monitoring data is required to make conclusive statements concerning the ecological conditions of the impacted lakes and streams; therefore, the 1993 sampling will vary only slightly from 1992. Significant modifications were made to the initial investigation conducted in 1991. Results of 1992 and 1993 sampling will provide the information required to assess the environmental quality of these habitats.

Eleven locations have been sampled in the past, and these locations have been selected for the 1993 year, with the exception of Frog Pond, and background Lakes 26 and 33. Frog Pond, located at the WSCP, will not be sampled because invertebrate data has been collected for the past two years; the exposure potential to other biota is extremely low from consumption of contaminated invertebrates; no public fishing is conducted on-site; and the pond will be remediated as part of the WSCP/WSRP clean-up. In addition, Frog Pond is not ecologically comparable to the off-site lakes that received contaminated water, and additional data from Frog Pond is not appropriate for use in comparing to off-site lakes.

Busch Lakes 34, 35, and 36 and the Femme Osage Slough will be sampled for benthic invertebrates and zooplankton. Creeks and drainages, including the Little Femme Osage Creek, Burgermeister Spring, and the Southeast Drainage will be sampled for benthic invertebrates. Busch Lake 33 will be sampled for background data for lakes, and the upper Little Femme Osage Creek and Upper Dardenne Creek will be sampled as background streams. A background spring has been selected in the WSWA for comparison to Burgermeister Spring.

Benthic samples will be taken twice annually in June and August. Zooplankton samples will be collected monthly from June through September and again in December. Benthic samples will consist of a single composite sample taken from four locations within each lake using a dredge type sampler. Zooplankton will be sampled using a single composite of samples taken from each of four locations using a vertical tow with a plankton net. Vertical tows will be taken, starting at the bottom of the lake and towing to the surface at a constant speed.

Streams and drainages will be sampled at each of three sites; the riffle zone, the immediate upstream pool, and the immediate downstream pool. Riffle samples will be taken with a Surber sampler and will be composited from three Surber samples. The pool sites will be composited into a single sample from which three Ekman dredge grabs will be taken at each of the upstream and downstream pools. A separate qualitative sample will be taken at each stream and drainage location in order to collect a representative community of benthic invertebrates. The qualitative sample will be taken by examining various stream features and collecting all observed species. An example includes *Gerris sp.*, which skim on the surface of the water, or caddisfly cases found on the lower surface of rocks in a dry creek bed which may not be collected in a dredge sampler. All invertebrates collected will be identified to species and enumerated to determine population densities and diversities.

Biomass samples of benthic invertebrates will also be collected and retained for analysis of total uranium. One biomass sample will be collected from the four locations in each lake and composited for one biomass sample. Prior to analysis of radionuclides in benthic invertebrates, the sample will be sorted into sub-samples by family or genus, or composited based on total mass of sample collected.

A variety of hydrological data will be collected to assist in the interpretation of the biological data. Temperature, dissolved oxygen, conductivity, pH, water clarity (Secchi disc), total suspended solids, total phosphorus and alkalinity will be measured. A measure of the productivity of the lakes and streams will be taken by analyzing water samples for chlorophyll a. Water samples will also be analyzed for uranium, barium, and arsenic. Sediment samples will be taken and analyzed for total uranium and selected toxicity metals including arsenic, barium, cadmium, lead, mercury, selenium, silver, and zinc.

3.4.3.3 Missouri River Vegetation. Aquatic and terrestrial vegetation along the Missouri River will be sampled and analyzed for total uranium concentrations. This action is required under the agreement made to the EPA to conduct preoperational and operational monitoring at the location of the Weldon Spring Quarry water treatment plant (QWTP) discharge structure. In the past two years, a downstream location was selected and algae (aquatic vegetation) and terrestrial vegetation along the Missouri River were collected, at a minimum, once annually. The samples were analyzed for total uranium.

Currently, the QWTP is scheduled to begin the discharge of treated water in late 1992. Once discharge begins, sampling will be conducted twice (late spring and early fall) at two locations along the Missouri River. One location will be upstream of the discharge structure and the second will be downstream of the structure. The vegetation will be collected and analyzed for total uranium and gross alpha and compared to preoperational data that has been collected.

3.4.3.4 Other Aquatic Studies. Radiological and metal contaminated surface water and suspended soils are currently released from the WSCP to the Southeast Drainage during storm events. Since the Southeast Drainage flows directly into the Missouri River, aquatic species could be exposed to contaminants in the river. In particular, three species from the Missouri River that have been reported within 4.8 km (3 mi) of the confluence are listed on the Federal threatened and endangered species list. One, the pallid sturgeon *scaphirhyachus albus* is a Federally endangered species and two are Federal C2 candidate species; the *macrohybopsis meeki*, sicklefin chub, and the *macrohybopsis gelida*, sturgeon chub.

In response to data gaps present in the *Baseline Assessment For the Chemical Plant Area of the Weldon Spring Site* (ANL 1992), surface water and sediments will be sampled in the Missouri River at the Southeast Drainage. Four locations will be sampled on two separate occasions; one during high river stage (spring) and the second during a low river stage (summer). All sampling events will occur within 24 hr of a storm event. Sampling locations will include one sample taken in the Southeast Drainage approximately 2 m (6.6 ft) from the confluence of the Missouri River. Three locations will be selected in the Missouri River at locations of approximately 10 m (33 ft), 100 m (330 ft), and 200 m (660 ft) downstream of the confluence. Samples will be taken in the main channel of the river, since endangered species primarily use this area of the river (Pflieger 1975). Surface water samples will be taken 2 m (6.6 ft) below the surface of the water. Sediment samples will be a composite of three dredge-type grabs. All samples will be analyzed for total uranium, lead, mercury, silver, and zinc. These parameters were found at levels in the Southeast Drainage that could potentially affect ecological receptors.

3.4.4 Terrestrial Habitats

The terrestrial community of the WSS area is diverse. The WSCP/WSRP and WSQ are primarily old field or maintained grass habitats with remnant upland and slope forests. Much of the land immediately surrounding and adjacent to the WSS is state-owned wildlife area (ANL 1990a). Habitats within these areas include old field, cultivated farmlands, and upland, slope and bottomland forests. The terrestrial community supports a wide variety of fauna including avian and mammal species. White-tailed deer, gray squirrels, and cottontail rabbits have been sighted within the chemical plant boundaries. Opossum, fox, and coyote roam within the WSWA and ABWA areas. Many birds are summer residents in the area or are spring/fall migratory species and utilize the field and forest habitats. Eastern screech and barred owls have been sighted along upland forests south of the chemical plant and great horned owls have been sighted at the Ash Pond.

The 1992 monitoring year included extensive efforts to characterize terrestrial fauna and habitats in the WSCP as part of the requirements for assessment of exposure and impact to biota. These activities have been completed with few additional requirements. Therefore, the terrestrial monitoring studies will focus on sampling agricultural products, as required by DOE Order 5400.1, and continue to survey deer populations at the WSCP/WSRP for completion of the ecological assessment.

3.4.4.1 Fauna. White-tailed deer are the largest common mammal in Missouri and are frequently sighted within the WSCP/WSRP area. Since June of 1991, population surveys have been conducted to document the size and composition of the deer population and to record their use of specific areas on site. The data collected are used to calculate dose to deer from the resting and foraging at the WSCP/WSRP, and to humans from the consumption of on-site deer. While no hunting is allowed at WSS, deer are able to move on and off site by either jumping the perimeter fences or by moving through off-site drainageways.

Observational spotlight surveys will be conducted at least four times during the year for large mammals. Site-specific locations, activities, and numbers will be documented. Observations will include visual sightings, and detection of tracks, scats, or nests and will be recorded for each sampling location.

In addition to gathering information to estimate doses, measured dose may be obtained by sampling deer on site. Since a limited number of deer exist on site and conclusive statements can only be made with a large number of samples, no deer will be sampled unless an individual becomes available due to accidental death. Background samples from hunter donations were available for analysis in 1992, and additional samples of tissue may be collected, if available, in 1993. Samples will be analyzed for isotopic thorium, Ra-226 and Ra-228, and total uranium. Tissue samples will also be analyzed for arsenic, cadmium, copper, lead, mercury, thallium, and zinc. These metals were selected based upon contaminate levels in soils, sediments, and surface waters on site, and their potential for adverse ecological effects (ANL 1992).

3.4.4.2 Foodstuffs. Monitoring for foodstuffs within a 16 km (10 mi) radius is required by the DOE *Regulatory Guide*. Foodstuffs include such products as meat, eggs, milk, and grains. The foodstuffs program at WSS is designed as a tiered sampling program. The primary products grown in the WSS area are crops, and emphasis is placed on monitoring these products. Agricultural sampling results will determine whether additional foodstuff products will be sampled.

Agricultural lands surrounding the Weldon Spring site comprise approximately 20% of the terrestrial habitat. The ABWA and WSWA contain approximately 890 ha (2,200 acres) of agricultural lands and are leased to sharecroppers for farming. Besides State-owned property, there are private farms within the immediate area. Agricultural products grown in the area include corn, soybeans, sunflowers, and milo. These products are grown primarily for cattle and wildlife feed.

The extent of terrestrial foodstuff sampling under DOE Order 5400.5 is based upon the projected dose to off-site populations from an air to crop to man pathway. The WSS has a projected dose of <0.1 mrem/year to members of the public from this pathway. Therefore, a surveillance level will be established for agricultural monitoring. These results will be published in subsequent site environmental reports until resampling is performed.

Preliminary data from 1991 sampling indicate low levels of radionuclides (>1.0 pCi/g) in agricultural products. Air monitoring results show no detectable particulate emissions. Contaminated surface waters in the surrounding areas are not used to irrigate the agricultural fields. As a result of these conditions, monitoring for the 1993 calendar year will be reduced to a surveillance level. Sampling will only be conducted if air monitoring results indicate above background concentrations of radionuclides.

If sampling is required, samples will be taken from within the 16 km (10 mi) radius area. Samples equal to 1% of the total number of acres planted within the study area will be selected based upon the type of crops currently planted. A minimum of four samples from each field will be collected. Consideration will be given to distance from contamination source when collecting samples. Grain samples may include corn, milo, or soybeans. For corn, two additional samples will be taken including a whole cob and a stalk sample. Samples will be analyzed for isotopic thorium, isotopic radium, and total uranium concentrations.

3.4.5 Data Reporting

All information gathered from ecological surveys and monitoring activities will be used to determine ecological conditions at the WSS. Survey data will be summarized to indicate population densities, species presence, usage patterns, and species diversities.

Data collected for biouptake studies will be used to determine exposures for human and animal populations. Dose calculations for humans will be based upon the ingestion of contaminated biota and will be performed as discussed in Section 6.2. Contaminants found in detectable concentrations in fauna, water, or sediments will be compared to data gathered from designated background locations. Statistical tests will be used to determine whether biota utilizing contaminated resources have significantly higher levels of contaminant concentrations than background biota at a 90% confidence level. The student's T-test or the Mann-Whitney U-test will be used based upon whether the distribution of data populations can be assumed to be normal. Preliminary tests of variance and normality will be determined by using the W-test and the F-test. For the W-test, data reported as nondetects or less than the detection limit (DL) will be quantified as DL/2, according to EPA guidance (EPA 1989a).

3.4.6 Collection Permits

The taking of specific fauna for scientific study is authorized by permits from the MDOC and the U.S. Fish and Wildlife Service. Applications for permits, as required by sampling plans and State and Federal regulations, will be submitted prior to sample collection. Compliance with all applicable State and local laws will also be followed in all sample collection events.

3.4.7 Natural Resource Trusteeship

At the WSSRAP, the DOE is the primary Federal Natural Resource Trustee for the response actions being carried out under CERCLA. Other agencies that may act as co-trustees are the U.S. Department of Interior (U.S. Fish and Wildlife Service) and the State of Missouri. The DOE has notified the agencies of their status as co-trustees and of releases of CERCLA hazardous substances. The DOE would also coordinate with the co-trustees on requests for further information regarding the potential damage to natural resources. The biological monitoring program outlined here provides information on existing ecological conditions, that may serve as the preassessment screen for a natural resource damage assessment.

4 EFFLUENT MONITORING

The Weldon Spring Site Remedial Action Project (WSSRAP) has established two distinct monitoring programs which it characterizes as "effluent monitoring." These include airborne and waterborne effluents that might exit the site perimeters. These programs are described in detail in the following sections.

4.1 National Pollution Discharge Elimination System Program

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 (DOE) Order 5400.1 states that the DOE 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 since 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 (MDNR) has issued National Pollutant Discharge Elimination System (NPDES) permits to the DOE for the discharge of storm and other waters.

4.1.1 Goal

In addition to verifying compliance with NPDES permitted effluent limitations, the goal of the NPDES effluent monitoring program is to characterize the water releases from the WSSRAP. The Project Management Contractor (PMC) will use this information to develop ways to minimize the discharge of waterborne contaminants from the site in accordance with WSSRAP policy that all surface water be closely monitored and treated, as necessary, to meet Federal and State requirements. Table 4-1 presents the known sources of water on the site.

The remedial action goal is to clean up the site with no increase in contaminant discharge or degradation of the off-site streams. Therefore, the WSSRAP remedial action program consists of source identification and periodic sampling and analyses which enable the PMC to determine treatment requirements. The program uses studies to identify, analyze, and evaluate appropriate measures for control of runoff, erosion, sediment, and contamination sources. From

TABLE 4-1 Existing or Potential Water Sources

Source	Category[a]	Quantity
SITE		
Raffinate Pits No. 1[b]	RAD	1.3×10^6 gal
2[b]	RAD	1.3×10^6 gal
3[b]	RAD	7.7×10^6 gal
4[b]	RAD	32.9×10^6 gal
Frog Pond[b]	STR	500,000 gal maximum
Ash Pond[b]	STR/RAD	1,800,000 gal maximum
Decontamination Pad[c]	RAD	8.3 gpm
TSA (10 ac)[b]	RAD	9,800,000 gpy[e]
MSA (9 ac)[b]	STR/RAD	8,800,000 gpy[e]
Sanitary Sewage Treatment Plant	SAN	4,000 gpd
Laboratory	TBD[d]	---
Sumps and Tanks[b]	TBD[d]	---
Storm Water Discharges (200 ac)	STR	195,000,000 gpy[e]
Worker Toilets	SAN	---
Worker Showers[c]	TBD[d]	1.7 gpm
Decontamination Facilities[c]	RAD	---
Ash Pond Diversion Pond[b]	STR	---
Retention Basins[b]	STR	---
QUARRY		
Quarry Sump[b]	RAD	3,000,000 gal
Quarry Storm Water (9 ac)	RAD	8,800,000 gpy[e]
Quarry Washdown[c]	RAD	2.5 gpm
Decontamination Pad[c]	RAD	2.0 gpm
Worker Toilets	SAN	---
Worker Showers[c]	TBD[d]	0.6 gpm

TABLE 4-1 Existing or Potential Water Sources (Continued)

Source	Category[a]	Quantity
VICINITY PROPERTIES		
Femme Osage Slough	STR	---
Busch Lake No. 34	STR	---
Busch Lake No. 35	STR	---
Busch Lake No. 36	STR	---

(a) Category is based on the primary treatment method required and the existing natural uranium concentration.
(b) Part of storm water
(c) While operating
(d) Case-by-case basis
(e) Based on average annual precipitation

SAN Biological Treatment; Uranium - background to 30 pCi/l
STR Sediment Treatment; Uranium - less than DCG, 600 pCi/l
RAD Complex Treatment; Uranium - greater than DCG, 600 pCi/l
TBD To Be Determined

these studies, procedures and plans are developed for appropriate control and maintenance measures. Control measures for stormwater are used to minimize erosion and remove sediment to a level commensurate with the "best available technology."

4.1.2 NPDES Effluent Evaluation

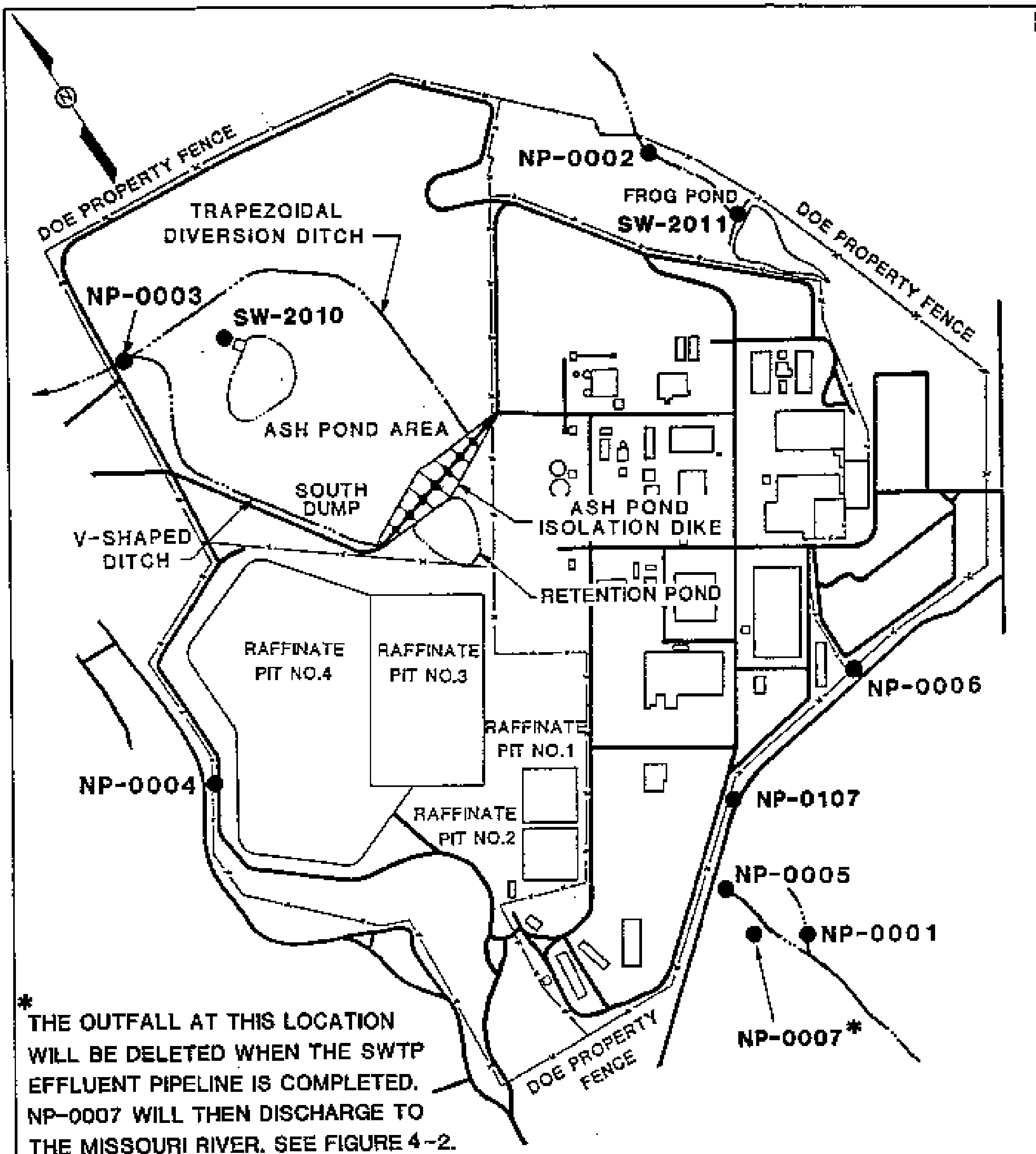
Required effluent monitoring at the Weldon Spring Chemical Plant (WSCP) includes effluent from five storm water outfalls, one treated sanitary sewer outfall from the administration building treatment plant, one hydrostatic test water outfall, and one site water treatment plant (SWTP) outfall. The SWTP is designed to treat the various contaminated waters at the chemical plant. Required effluent monitoring at the WSQ includes one quarry water treatment plant (QWTP) effluent outfall and one hydrostatic test water outfall. The QWTP will treat contaminated water from several sources: (1) quarry pond, (2) storm water, and (3) equipment decontamination operations. All of these discharges are monitored in accordance with NPDES permits issued for the Weldon Spring site (WSS) by the MDNR.

Storm water permit applications were submitted to the MDNR October 1, 1992; however, the MDNR may require additional storm water outfalls for effluent monitoring during 1993. The MDNR will evaluate the applications and modify existing NPDES permits if additional storm water outfalls are required.

Existing or potential water sources for Weldon Spring Chemical Plant/Weldon Spring raffinate pits (WSCP/WSRP) permitted outfalls 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 category is also provided for the source. Certain waters, however, are not clearly defined and will require monitoring on a case-by-case basis for final treatment determination.

4.1.2.1 NPDES Permits. Four permits have been issued by the MDNR for discharges from the WSSRAP. Permit MO-0107701, for the chemical plant, contains seven outfalls (NP-0001, NP-0002, NP-0003, NP-0004, NP-0005, NP-0006, and NP-0007) and MO-0108987 for the quarry contains one outfall (NP-1001). *Quarterly Discharge Monitoring Reports* (DMRs) are required as compliance deliverables for these outfalls. Permit MO-G680001 for the QWTP and Permit MO-G680002 for the SWTP each include one outfall that requires a DMR as a compliance deliverable within 30 days of each discharge event. These two outfalls are for hydrostatic test water. The annual site environmental report (ASER) and the *Quarterly Environmental Data Summaries* (QEDS) also summarize the data from these outfalls. Discharge data are also reported to EG&G Idaho Nuclear Engineering Laboratories (INEL) and to DOE's Oak Ridge - Environmental Protection Division (OR-EPD) as detailed in the *Effluent Information System* (EIS) and *Onsite Discharge Information System (ODIS) Users Manual* (EG&G 1977).

NPDES permit MO-0107701 was issued to the DOE on July 29, 1988, for the discharge of surface water runoff through five outfalls from the chemical plant. 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 SWTP which will be used to treat contaminated water during remedial activities at the WSCP. Operation of the treatment facility associated with outfall NP-0007 will include storage of the treated effluent (for additional treatment if necessary) until testing confirms all effluent standards have been met. Figure 4-1 shows the location of the permitted outfalls from the chemical plant.



*THE OUTFALL AT THIS LOCATION WILL BE DELETED WHEN THE SWTP EFFLUENT PIPELINE IS COMPLETED. NP-0007 WILL THEN DISCHARGE TO THE MISSOURI RIVER. SEE FIGURE 4-2.

● -SAMPLE LOCATION

SCALE 0 500 1000 FT
0 152.4 304.8 M

NPDES SURFACE WATER SAMPLING LOCATIONS AT THE WSCP/RP

FIGURE 4-1

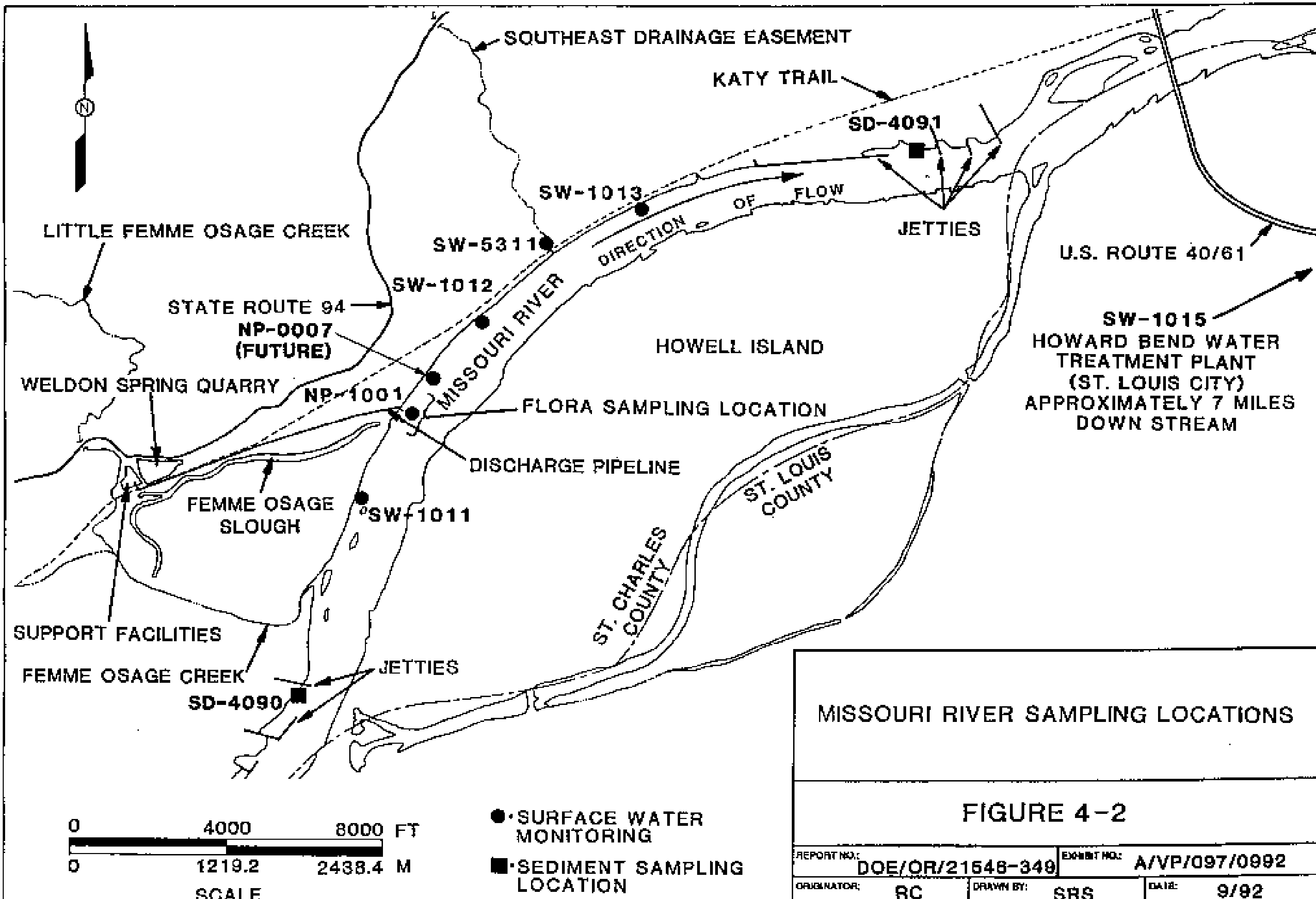
REPORT NO: DOE/OR/21548-349		EXHIBIT NO.: A/CP/152/0992	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 9/92	

NPDES permit MO-0108987 was issued to the DOE on May 5, 1989, for the discharge of treated effluent from the QWTP which will be used to treat contaminated water during remedial activities at the quarry. Operation of this treatment plant will include storage of treated effluent (for additional treatment if necessary), until testing confirms all effluent standards have been met. Figure 4-2 shows the permitted outfall (NP-1001) for the quarry.

NPDES permit MO-G680001 was issued to the DOE on December 19, 1991, for the discharge of water used to conduct hydrostatic tests on the QWTP, basins, and associated equipment. The water will be pumped from the basins to Little Femme Osage Creek. NPDES permit MO-G680002 was issued to the DOE on April 17, 1992, for the discharge of water used to conduct hydrostatic tests on the SWTP, basins, and associated equipment. The water will be pumped from the basins to storm water outfall NP-0005.

4.1.2.2 NPDES Permitted Parameters. Monitoring parameters for the storm water outfalls NP-0001 through NP-0005 include: flow, settleable solids, total suspended solids (TSS), nitrate as total nitrogen (N), uranium, lithium, gross alpha, and pH. The parameters for the discharge for the administration building sanitary sewage treatment plant (NP-0006) include: flow, total suspended solids (TSS), pH, biochemical oxygen demand (BOD), and fecal coliform (Table 4-2). Permitted parameters for outfall NP-0007 of the SWTP and NP-1001 of the QWTP are shown on Table 4-3. The treated water is to be analyzed for these parameters, and compliance demonstrated, before a batch of treated effluent is discharged to the Missouri River. The treated water from the SWTP will be monitored at two locations; in the effluent basins prior to discharge to the Southeast Drainageway (NP-0007), and in the drainageway prior to discharge to the river (SW-5311) to assess reintroduction of contaminants from the drainageway. Plans are being made to construct an effluent pipeline directly to the Missouri River. The MDNR modified NPDES Permit No. 0107701 on September 4, 1992, will allow effluent from the SWTP to be discharged to either the Southeast Drainage (5300) or directly to the Missouri River by way of a pipeline.

In addition to the batch parameters for NP-0007 and NP-1001, other parameters are periodically monitored. Monitoring for 110 priority pollutants (Table 4-4) is required for these discharges once per year. The priority pollutants are organic compounds that are included in the following major categories: volatile organic compounds, semi-volatile organic compounds, pesticides, and polychlorinated biphenyls (PCBs). During the public comment period, xylene



MISSOURI RIVER SAMPLING LOCATIONS

FIGURE 4-2

REPORT NO.: DOE/OR/21548-349		EXHIBIT NO.: A/VP/097/0992	
ORIGINATOR: RC	DRAWN BY: SRS		DATE: 9/92

TABLE 4-2 NPDES Permit Monitoring Requirements - Sanitary and Storm Water Sources

Parameters	Units	Permitted Limit	Frequency
Site NP-0002, NP-0003, AND NP-0005 (see Table 4-6 also)			
Flow	GPD	Monitor	once/month
Settleable Solids	ml/l/hr	1.0[c]	once/month
Total Suspended Solids (TSS)	mg/l	Monitor[d]	once/month
Nitrate as N	mg/l	Monitor	once/month
Lithium	mg/l	Monitor	once/month
Uranium	mg/l	Monitor	once/month
Gross Alpha	pCi/l	Monitor	once/month
pH	SU	6-9[c]	once/month
Site NP-0001 and NP-0004			
Flow	GPD	Monitor	once/quarter
Settleable Solids	ml/l/hr	1.0[c]	once/quarter
Total Suspended Solids (TSS)	mg/l	Monitor[d]	once/quarter
Nitrate	mg/l	Monitor	once/quarter
Lithium	mg/l	Monitor	once/quarter
Uranium	mg/l	Monitor	once/quarter
Gross Alpha	pCi/l	Monitor	once/quarter
pH	SU	6-9	once/quarter
Site NP-0006			
Flow	GPD	Monitor	once/month
Biochemical Oxygen Demand (BOD)	mg/l	10/15[a]	once/quarter
Total Suspended Solids (TSS)	mg/l	15/20[a]	once/quarter
pH	SU	6-9	once/quarter
Fecal Coliform	Colonies/100 ml	400/1,000[b]	once/quarter

(a) Monthly average/weekly average
(b) Monthly average/daily maximum
(c) Limits apply after date of Record of Decision, "monitoring only" requirements apply until that date.
(d) Limit is 50 mg/l if erosion control is not designed for 1 in 10 year, 24 hr storm.

TABLE 4-3 NPDES Permit Monitoring Requirements - QWTP and SWTP

Parameter	Permit Limit	Frequency	Sample Type
Site NP-0007 (and SW-5311 if applicable) and Quarry NP-1001			
Flow	Monitor, gpd	once/batch	24-hr total
Biochemical Oxygen Demand	Monitor, mg/l	once/batch	grab
Chemical Oxygen Demand	90/60 mg/l[a]	once/batch	grab
Total Suspended Solids	50/30 mg/l[a]	once/batch	grab
pH	6-9 standard units	once/batch	grab
Arsenic, Total	0.10 mg/l	once/batch	grab
Barium, Total	1.50 mg/l	once/batch	grab
Cadmium, Total	0.02 mg/l	once/batch	grab
Chromium, Total	0.10 mg/l	once/batch	grab
Copper, Total	1.0 mg/l	once/batch	grab
Iron, Total	0.6 mg/l	once/batch	grab
Lead, Total	0.1 mg/l	once/batch	grab
Manganese, Total	0.1 mg/l	once/batch	grab
Mercury, Total	0.004 mg/l	once/batch	grab
Selenium, Total	0.02 mg/l	once/batch	grab
Silver, Total	0.10 mg/l	once/batch	grab
Zinc, Total	5.0 mg/l	once/batch	grab
Cyanide, Total	0.0075 mg/l	once/batch	grab
Asbestos	Monitor, fibers/l	once/batch	grab
2,4-DNT	0.22 μg/l	once/batch	grab
Fluoride, Total	4.0 mg/l	once/batch	grab
Nitrate as N: Site	20 mg/l	once/batch	grab
Quarry	Monitor, mg/l	once/batch	grab
Sulfate as SO_4	500 mg/l	once/batch	grab
Chloride	Monitor, mg/l	once/batch	grab
Gross Alpha	Monitor, pCi/l	once/batch	grab
Gross Beta	Monitor, pCi/l	once/batch	grab
Uranium, Total	Monitor, pCi/l[b]	once/batch	grab

TABLE 4-3 NPDES Permit Monitoring Requirements - OWTP and SWTP (Continued)

Parameter	Permit Limit	Frequency	Sample Type
Ra-226	Monitor, pCi/l	once/batch	grab
Ra-228	Monitor, pCi/l	once/batch	grab
Th-230	Monitor, pCi/l	once/batch	grab
Th-232	Monitor, pCi/l	once/batch	grab
Priority Pollutants	Monitor, mg/l	one batch/year	grab
Whole Effluent Toxicity	10% Mortality	once/quarter	grab
Polonium 210: Quarry	Monitor	twice/year	grab
Actinium 227: Quarry	Monitor	twice/year	grab
Radon: Quarry	Monitor	twice/year	grab
In Stream Water SW-1011, SW-1012, SW-1013, SW-1015[c]			
Gross Alpha	Monitor, pCi/l	once/batch release	grab
Gross Beta	Monitor, pCi/l	once/batch release	grab
Uranium, Total	Monitor, pCi/l	once/batch release	grab
Ra-226	Monitor, pCi/l	once/batch release	grab
Ra-228	Monitor, pCi/l	once/batch release	grab
Th-230	Monitor, pCi/l	once/batch release	grab
Th-232	Monitor, pCi/l	once/batch release	grab
In Stream River Sediment SD-4090 and SD-4091			
Uranium, Total	Monitor	twice/year	grab
Terrestrial and Aquatic Flora Upstream and Downstream of OWTP Outfall			
Uranium, Total	Monitor	twice/year	grab

(a) Daily maximum/monthly average.
(b) Water will not be discharged if greater than 100 pCi/l.
(c) A sample of finished water shall also be collected from the Howard Bend Water Treatment Plant (SW-HBTW) each time a sample is collected at SW-1015.

TABLE 4-4 NPDES Permit Monitoring Requirements - Priority Pollutant List Quarry NP-1001 and Site NP-0007

Acenaphthene	4-chlorophenyl phenyl ether
Acrolein	4-bromophenyl phenyl ether
Acrylonitrile	Bis (2-chloroisopropyl) ether
Benzene	Bis (2-chloroithexy) methane
Benzidine	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
Chloroethane	2-nitrophenol
Bis (2-chloroethyl) ether	4-nitrophenol
2-chloroethyl vinyl 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	1,2,5,6-dibenzanthracene (dibenzo(a,h)anthracene)
Di-n-butyl phthalate	Indeno (1,2,3-cd) pyrene (2,3-o-phenylene pyrene)
Di-n-octyl phthalate	Pyrene
Diethyl phthalate	Tetrachloroethylene
Dimethyl phthalate	Toluene
1,2-benzanthracene (benzo(a)anthracene)	Trichloroethylene
Benzo(a)pyrene (3,4-benzopyrene)	Vinyl Chloride (chloroethylene)

TABLE 4-4 NPDES Permit Monitoring Requirements Priority Pollutant List Quarry NP-1001 and Site NP-0007 (Continued)

3,4-benzofluoranthene (benzo(b)fluoranthene)	Aldrin
11,12-benzofluoranthene (benzo(k)fluoranthene)	Dieldrin
Chrysene	Chlordane (technical mixture and metabolites)
Anthracene	4,4-DDT
1,12-benzoperylene (benzo(ghi)perylene)	4,4-DDE (p,p-DDX)
Fluorene	4,4-DDD (p,p-TDE)
2-chloronaphthalene	Alpha-endosulfan
2,4,6-trichlorophenol	Beta-endosulfan
Parachlorometa cresol	Endosulfan sulfate
Chloroform (trichloromethane)	Endrin
2-chlorophenol	Endrin aldehyde
1,2-dichlorobenzene	Heptachlor
1,3-dichlorobenzene	Heptachlor epoxide (BHC hexachlorocyclohexane)
1,4-dichorobenzene	Alpha-BHC
3,3-dichlorobenzidine	Beta-BHC
1,1-dichloroethylene	Gamma-BHC
1,2-trans-dichloroethylene	Delta-BHC (PCB polychlorinated biphenyls)
2,4-dichlorophenol	PCB-1242 (Arochlor 1242)
1,2-dichloropropane (1,3-dichloropropane)	PCB-1254 (Arochlor 1254)
2,4-dimethylphenol	PCB-1221 (Arochlor 1221)
2,4-dinitrotoluene	PCB 1232 (Arochlor 1232)
2,6-dinitrotoluene	PCB-1248 (Arochlor 1248)
1,2-diphenylhydrazine	PCB-1260 (Arochlor 1260)
Ethylbenzene	PCB-1016 (Arochlor 1016)
Fluoranthene	Toxaphene
Xylene[a]	2,4,6-trinitrotoluene[a]

(a) QY NP-1001 only

and trinitrotoluene (TNT) were added to the list of 110 priority pollutants for the QWTP. Priority pollutants for the SWTP will be monitored at the same locations as the other parameters.

Additional monitoring associated with these discharges includes in-stream monitoring to be conducted during or after discharge of each batch of treated effluent into the Missouri River. Four in-stream monitoring locations in the Missouri River are to be monitored for the following radiological parameters (expressed as activity): gross alpha, gross beta, uranium, Ra-226, Ra-228, Th-230, and Th-232. These radiochemical species constitute the primary radiological concern to potential downstream users. If the site discharges appear to increase measured levels of radiochemicals in the river water above background, as determined from preoperational testing and upstream testing at Location SW-1011, gross gamma emitters will be analyzed to evaluate incremental contribution toward proposed gamma and photon maximum contaminant levels (MCLs).

Additional periodic monitoring is required for other parameters such as whole effluent toxicity (WET) screens, supplemental monitoring of additional radionuclides, analysis of river sediment for uranium, and analysis of terrestrial and aquatic flora for uranium (Table 4-3). In order to encourage good erosion control practices, the special condition sections of both NPDES permits place limitations on total suspended solids and pH for runoff from material storage or construction areas that do not have treatment designed for a 1 in 10 year, 24 hour storm. These parameters are monitored at the storm water outfalls.

The parameters required for the water treatment plant equipment and basin hydrostatic testing listed in permits MO-G680001 and MO-G680002 include flow, oil and grease, and total suspended solids (Table 4-5). Only potable and/or uncontaminated storm water is used for leakage testing.

4.1.3 Description of Effluent Monitoring Program

The monitoring program is best presented in tabular form. Tables 4-2 through 4-5 summarize the permit requirements for the four permits and all 10 outfalls. The two hydrostatic test water NPDES permits represent two outfalls. The remaining eight outfalls are the QWTP outfall, the SWTP outfall, the sanitary sewage treatment plant outfall, and five stormwater outfalls. Additional outfalls may be added after the storm water permit applications are submitted if the MDNR modifies the permits.

TABLE 4-5 NPDES Permit MO-G680001 and MO-G680002, Monitoring Requirement - Quarry Water Treatment Plant and Site Water Treatment Plant Equipment Testing

Parameter	Permit Limit	Frequency	Sample Type
Flow	Monitor-Total Gal.	Once/event	24-hr total
Oil and grease	15 mg/l	once/event	grab
Total suspended solids	50 mg/l	once/event	grab

4.1.3.1 Routine Monitoring Requirements. As the tables indicate, the outfalls are sampled at various frequencies. The storm water outfalls are sampled on a once per month or once per quarter basis as they discharge. The treated water effluent ponds at the SWTP and QWTP are to be sampled for each treated batch and the effluent held until compliance with the permit standards is demonstrated. The hydrostatic test water discharges are sampled within the first 60 min of each discharge. The sewage treatment discharge is sampled once per quarter.

Several parameters in the tables show monitoring only, and no effluent standard is applied. Site personnel have established goals for these parameters, especially those associated with the radiological parameters.

The administration building sewage treatment plant outfall, NP-0006, involves treatment of sanitary waste with no radioactive contamination. The permit requirements are typical of a domestic treatment facility with discharge to a losing stream. The requirements are considered a high level of treatment i.e., monthly averages of 10 mg/l for biochemical oxygen demand (BOD) and 15 mg/l for total suspended solids (TSS). Other nonradioactive sanitary wastewater generated on the site would be expected to meet these requirements.

The storm water outfall permit requirements have been established to monitor the storm water discharges and ensure the MDNR that the waters are rain-induced, and not seepage from one of the more contaminated sources. Storm water also includes water pumped from the material storage area (MSA) pond, excavation trenches, and pits. The uranium contamination levels in storm water are highly variable, but are considered to be below the correction level because the annual average concentration is historically less than the DOE's derived concentration guideline (DCG) of 600 pCi/l for natural uranium. The primary contaminant encountered in the surface water is sediment derived from erosion occurring during overland or channel flow. This process has been occurring for years, but has been minimized by natural vegetation that established itself after the facility ceased operation. The only imposed effluent limits dealing with controlling erosion and sediment during remedial activities are: settleable solids levels must be 1 ml/l/hr or less after the Record of Decision (ROD) and TSS (if no erosion control) must be 50 mg/l or less. Storm water discharge levels for uranium have been monitored over a significant time and vary considerably. The established goal for uranium concentration in rain-induced discharges is not to exceed historic levels, which have averaged below the DCG. New or additional contaminant controls must not allow discharges to exceed the DCG of 600 pCi/l natural uranium established by DOE Order 5400.5.

The contaminated water in the quarry sump, raffinate pits, and potentially in other miscellaneous waters, requires treatment to the high levels shown in Table 4-3. The high levels of treatment imposed by the permit are due to the desire by the State to meet standards associated with potential contamination of groundwater. Although the DOE goal for uranium is to discharge less than the DCG (600 pCi/l), the treatment required to remove nonradioactive contamination also removes uranium and allows for a significantly lower uranium level for these discharges. The lower level is based on the as-low-as-reasonably-achievable (ALARA) concept that showed that treatment to a level of 30 pCi/l, not to exceed 100 pCi/l, is cost effective.

Flow is measured continuously at outfalls NP-0002, NP-0003, NP-0005, NP-0007, NP-1001, and for the two permitted hydrostatic water discharges. The hydrostatic test water total flows are measured by pumping rates or tank or basin volumes. The outfall flows are measured by flow recorders with an accuracy of at least ±10%. The meters will be calibrated before use and recalibrated annually and after actions that could affect calibration.

4.1.3.2 Emergency Monitoring Requirements. In the event that contaminated water is accidentally released before treatment, or in the event of spills, effluent monitoring will be conducted. Parameters will be determined on a case-by-case basis.

4.1.3.3 Intermittent Monitoring Requirements. In response to regulatory and public concerns, the DOE has agreed to additional monitoring associated with the SWTP and QWTP discharges. Concern over a negative effect on the Missouri River has led to additional Missouri River water monitoring that will be conducted during discharge of each batch of treated effluent. In-stream Missouri River monitoring locations are shown on Figure 4-2 and include SW-1011, a location upstream of the QWTP outfall that is unaffected by the discharge; SW-1012 between the QWTP outfall and the Southeast Drainage; between the SWTP and QWTP outfalls; SW-1013 downstream of both outfalls; and SW-1015, at the water intake for the St. Louis City Howard Bend Water Treatment Plant at River Mile 37. Radiological parameters (expressed as activity per liter) are required for in-stream monitoring and include: gross alpha, gross beta, uranium, Ra-226, Ra-228, Th-230, and Th-232. These monitoring requirements are tabulated in Table 4-3.

A pipeline to transport discharge of SWTP effluent directly to the Missouri River is in the planning stages. The Southeast Drainage, which would receive the site effluent at its upper end, is a vicinity property and contains some areas of contaminated sediment. In the event that the Southeast Drainage is used as the discharge path for the SWTP, the outfall parameters for the SWTP effluent will also be analyzed just before the effluent enters the river (SW-5311) to determine the contamination added by resuspended sediment.

River sediment will be collected semiannually from the two locations shown on Figure 4-2 and analyzed for total uranium. Terrestrial and aquatic flora samples will be taken from the river and levee areas upstream and downstream of the discharge point for the QWTP and analyzed for total uranium (see Table 4-3).

Whole Effluent Toxicity (WET) screens are required for the treatment plant effluents on a quarterly basis. Representative samples will be obtained from effluent ponds and used to perform the toxicity analysis as described in the special conditions of the NPDES permit (see Table 4-3).

Po-210, Ac-227, and radon will be monitored semiannually for the QWTP effluent. Preoperational monitoring for these parameters has been performed on the quarry sump water (see Table 4-3).

4.1.3.4 Upstream Source Identification Needs. Sources of contamination are present upstream of the three main storm water discharges. These main discharges are the weir downstream of Frog Pond (NP-0002), the weir downstream of Ash Pond (NP-0003), and the Southeast Drainage weir (NP-0005). Drainage facilities above each of these outfalls have an influence on the character of the discharges that is not fully understood. The variability of these discharges can best be determined by a concerted effort to monitor the upstream facilities. This understanding will be more important as new regulations are implemented and as more construction takes place on the site.

Three upstream locations have been identified for monthly water monitoring. This monitoring will take place at the same time the monthly NPDES sample is collected so that a direct comparison can be made. The discharge directly from Frog Pond (SW-2011) will be sampled in conjunction with NP-0002; the discharge directly from Ash Pond (SW-2010) will be sampled in conjunction with NP-0003; and the discharge from NP-0107 will be sampled in conjunction with NP-0005 (Table 4-6). These locations are shown in Figure 4-1. Sample parameters, with the exception of settleable solids, will be the same as at the NPDES outfalls. If there is no flow from SW-2010, SW-2011, or NP-0107 during NPDES sampling, no sample will be collected for that month. Frog Pond and Ash Pond will be sampled quarterly directly from the water body (Table 3-1) as a part of the surface water monitoring program.

TABLE 4-6 Upstream Monitoring in Conjunction with NPDES Monitoring at NP-0002, NP-0003, and NP-0005

Parameters	Units	Frequency
Upstream Sampling Locations SW-2010, SW-2011, NP-0107		
Flow[a]	GPD	Once per month during collection of NPDES samples
Total Suspended Solids	mg/l	Once per month during collection of NPDES samples
Nitrate as N	mg/l	Once per month during collection of NPDES samples
Lithium	mg/l	Once per month during collection of NPDES samples
Uranium	mg/l	Once per month during collection of NPDES samples
Gross Alpha	pCi/l	Once per month during collection of NPDES samples
pH	SU	Once per month during collection of NPDES samples

(a) Samples are to be water collected from the discharges from Ash Pond (SW-2010), Frog Pond (SW-2011) and the pipe at NP-0107.

4.1.4 Additional Monitoring

4.1.4.1 Outfall Upstream Sources. The sources of runoff through the storm water outfalls are a variety of storm control systems including storm sewers, drainage channels, and retention basins. Monitoring of these upstream facilities is not required by the permit, but since they are sources for contamination of the outfalls, they will be monitored. Monitoring is often needed to fully understand the waste characteristics at the permitted outfall. Also, explanations of violations of permit limits are required by the MDNR when the sampling results vary significantly from the norm, and upstream water analysis data are often needed for these explanations. With this in mind, additional samples will be taken in these upstream facilities and may be taken in other areas on a case-by-case basis.

4.1.5 Preoperational Needs

DOE Order 5400.1 requires preoperational monitoring of processes which have the potential for environmental impact. Preoperational monitoring will be performed in or near the Missouri River since this is the receiving stream for discharge from the water treatment plants. The water treatment plants should be operational before January 1, 1993. Preoperational monitoring will be completed by then, and the data will be used to evaluate the effect of discharge from the QWTP and SWTP on the Missouri River.

4.1.5.1 Additional River Data. A major source of river data is the monitoring program Union Electric has for the Callaway Power Generation facility. Raw water data from the St. Louis City Howard Bend Water Plant and its neighbor, the St. Louis County Water Company Central Water Plant will also be reviewed. These water plants represent the nearest downstream public water supply intakes from the Missouri River.

4.1.6 Storm Water Requirements and Needs

4.1.6.1 Current Erosion and Sediment Control Requirements. Permits for both the site and quarry place limitations on total suspended solids and pH levels for runoff from material storage and construction areas if this runoff is not treated in a facility that is designed, constructed, and operated to treat the volume of water associated with a 10-yr, 24-hr rainfall event. The total suspended solids must not exceed 50 mg/l, and the pH must remain in the range of 6.0 to 9.0 standard units at the outfalls. Additionally, after the ROD, limits for settleable solids will be 1.0 ml/l/hr and pH will be 6.0 to 9.0 for the storm water outfalls.

In order to evaluate the effectiveness of erosion control measures, the DOE/PMC will periodically collect surface water samples adjacent to construction or material storage areas for analysis of pH and total suspended solids. Total suspended solids and pH measurements from the permitted outfalls are reported to MDNR in the regular discharge monitoring report.

4.1.6.2 NPDES Permit Renewal Application Data. The NPDES permit, MO-0107701, for the WSCP expires on July 28, 1993. Characterization data must be collected for the application to reissue the permit. The data and application must be submitted to MDNR at least 180 days before the expiration date, approximately January 28, 1993. These data will have been collected before the end of calendar year 1992. A sampling plan has been developed for collection of storm water samples and sample parameters required for the SWTP outfall are prescribed in the permit application.

4.2 Airborne Effluent and Environmental Surveillance Program

This section documents the rationale and requirements of the programs that will be implemented to monitor airborne emissions from the WSSRAP and to evaluate the impacts of those emissions on the public and the environment. The WSSRAP has two diffuse sources of airborne radiological emissions; the WSCP/WSRP and the WSQ. Emissions from these sources and the estimated exposures are predicted to be low. The emissions monitoring program is tailored to be commensurate with the low potential for exposure and to meet the requirements of DOE Orders 5400.1 and 5400.5 and the *Regulatory Guide*.

4.2.1 Source Assessment

As required by DOE guidance, an assessment of the two diffuse sources was conducted. The assessment included documenting the different radionuclides that could potentially be released from the sources and their concentrations. The DOE guidance also requires that an assessment be conducted on these sources under normal operating conditions with the loss of emissions controls. The loss of emissions controls at the WSSRAP would require the affected remediation activities to halt. Loss of emission controls used at the WSSRAP, such as water spray, cleaning of surfaces, high efficiency particulate air (HEPA) filtration, could not go unnoticed, and as a result, the loss of emission controls would result in no emissions. In addition, the assessment addressed the factors that could potentially contribute to the suspension of contaminants. The assessment provided a basis for the airborne emissions monitoring program and ensured that the design would provide timely, representative, and adequately sensitive monitoring results.

4.2.1.1 Point Source Assessment. In addition to the diffuse sources at the WSCP/WSRP and WSQ, there are several potential point sources at the WSSRAP. These include the exhaust vents of the portable ventilation systems used during building demolition, and the SWTP and QWTP filter press ventilation system exhaust vents.

4.2.1.2 Weldon Spring Quarry Diffuse Source Assessment. The WSQ diffuse source is a 3.6 ha (9-acre) limestone quarry located approximately 6.4 km (4 mi) south-southwest of the WSCP/WSRP area. The WSQ is essentially in a closed basin; surface water within the rim flows to the quarry floor and into a pond which covers approximately 0.2 ha (0.5 ac). The WSQ was used as a disposal area for dinitrotoluene (DNT) and trinitrotoluene (TNT) process wastes, uranium, radium, and thorium residues and the associated daughter products from on-site and off-site processing of uranium and thorium, and building rubble and soils from the demolition of a uranium processing facility in St. Louis. Airborne emissions from the quarry result from the wind blown resuspension of radioactive particulates from quarry soils and resuspension of radioactive particulates due to remediation activities at the WSQ, such as the operation of heavy equipment and the excavation of soils. In addition, there are also airborne releases of Rn-220 (thoron gas) and Rn-222 (radon gas) from the WSQ due to the decay of Ra-224, Ra-226, and daughters of Th-232 and U-238.

Characterization of the WSQ soils has been completed in support of the WSQ RI/FS. The radiological contaminants in the WSQ are uranium and thorium and their respective daughters. Concentrations range from 3.0 pCi/g to 1600 pCi/g U-238, <1.0 pCi/g to 2780 pCi/g Ra-226, 0.7 pCi/g to 36 pCi/g Th-232, <1.0 pCi/g to 2200 pCi/g Ra-228, and <1.0 pCi/g to 6800 pCi/g Th-230. A study is being conducted to determine the lung solubility class of WSQ bulk wastes. Until the lung solubility classes have been determined, the most restrictive solubility classes will be assumed for uranium and thorium in the bulk wastes. In addition, particle size analysis will be initiated to determine expected particle sizes during remediation activities.

Statistical evaluation of the results from effluent monitoring at the WSQ during 1992 indicated no evidence that the results from any of the perimeter air particulate samplers were greater than background. Statistical analysis also indicated that six of the eight radon track etch detectors were greater than background. The calculated effective dose equivalent to a hypothetical maximally exposed individual from the airborne emissions from the WSQ was 1.9 mrem (MKF and JEG 1993a). The 1.9 mrem dose calculated for the hypothetical individual from the airborne inhalation pathway was exclusively due to radon emissions. Conservative assumptions were used to calculate the hypothetical effective dose equivalent. It was assumed that the radon daughter equilibrium ratio at Highway 94, where the individual walked twice daily, was 50% and that the concentration of radon at Highway 94 was the same as the concentration measured within the WSQ controlled area.

Excavation of soils and placement of contaminated materials from remediation of the WSQ water treatment plant area are believed to be responsible for the above background air particulate monitoring results. These activities are similar to the activities that have occurred during 1992. However, in March of 1993, a major remediation project involving the removal and controlled temporary storage of 181,300 m^3 (140,000 cu yd) of contaminated bulk wastes will begin. The bulk wastes to be excavated from the WSQ will have significantly higher concentrations of radiological contaminants. Engineering controls will be used during bulk waste removal to restrict the release of airborne particulates from the WSQ during excavation of soils and bulk waste removal. The *Feasibility Study for Management of the Bulk Waste at the Weldon Spring Quarry* (ANL 1990b) provides public dose estimates resulting from WSQ bulk waste removal. The dose estimate from airborne radioactive particulates for a hypothetical individual who walked along Highway 94 twice a day, during the 1.25 years that will be required to remove the bulk waste, was 1.3 mrem. The dose estimate calculated for a nearby resident with an assumed 100% occupancy time during the 1.25 years was 0.18 mrem.

Radon concentrations measured at the WSQ have historically been above background because the radium concentrations in WSQ wastes are greater than background concentrations and because the WSQ is a large depression in the terrain with side walls ranging from 3 m to 15 m (10 ft to 50 ft) high which allows for build-up of radon concentrations within the WSQ. Above background radium concentrations, in conjunction with stable meteorological conditions, which tend to trap emanating radon within the quarry, result in the measured above background concentrations at the WSQ perimeter. The *Feasibility Study For Management of the Bulk Wastes at the Weldon Spring Quarry* (ANL 1990b) evaluated the potential emissions of radon during the excavation of the bulk waste. The results of the study indicate that a dose of 1.0 mrem would be received by the hypothetical individual who walked along Highway 94 twice a day for 1.25 years. Although the dose estimate in the Feasibility Study is lower than the calculated dose to the hypothetical maximally exposed individual from airborne emissions during 1990, it is based on more realistic assumptions. A daughter equilibrium ratio of 10% was assumed based on measured radon and radon daughter concentrations taken during 1989 (Haroun et al 1990), and the concentration at Highway 94 was calculated using the computer model MILDOSE (Strenge and Bander 1981) which was modified to more accurately assess airborne concentrations resulting from releases from large areas (Yuan et al 1989). The radon dose calculated for a nearby resident in the Feasibility Study was 2.3 mrem.

4.2.1.3 WSCP/WSRP Diffuse Source Assessment. The WSCP/WSRP diffuse source encompasses 87 ha (217 acres) on which 29 buildings and four raffinate pits are located. Airborne emissions from the WSCP/WSRP result from the windblown resuspension of radioactive particulates from site soils and chemical plant buildings, and resuspension of radioactive particulates from site operations such as building demolition and soil excavation. In addition, there are airborne emissions from the WSCP/WSRP due to the transformation of Ra-224 and Ra-226 (daughters of Th-232 and U-238), into Rn-220 (thoron gas) and Rn-222 (radon gas).

Characterization of the WSCP/WSRP buildings and soils have been completed in support of the site RI/FS. Radiological contaminants in the WSCP buildings are uranium, thorium, and the respective daughters. Concentrations in bulk samples collected from the WSCP buildings range from background levels to 20,000 pCi/g U-238, 190 pCi/g Ra-226, 5,400 pCi/g Ra-228, and 540 pCi/g Th-230. As at the WSQ, particle analysis will be conducted during remediation activities and a lung solubility study is being conducted using materials from the WSCP/WSRP. Bulk samples from process buildings and the raffinate pits have been collected. Until the lung solubility classes have been determined, the most restrictive solubility classes will be assumed for thorium and uranium.

The site soils characterization also indicates that the contaminants in the soils are uranium and thorium and their associated daughters. Most of the 87 ha (217 acres) of the WSCP/WSRP have above background concentrations of uranium (>1 pCi/g). Concentrations range from 0.3 pCi/g to 2,259 pCi/g U-238, 0.6 pCi/g to 452 pCi/g Ra-228, and 0.3 pCi/g to 123 pCi/g Th-230.

In the past several years statistical evaluation of the results from effluent monitoring and environmental surveillance monitoring at the WSCP/WSRP has indicated that there is no reason to suspect, at the 95% confidence level, that the results were greater than background (i.e., no above background exposure to the public from WSCP/WSRP operations has occurred). Activities that will be performed during 1993 are similar to those that were performed in previous years, such as excavation of low level radiologically contaminated soils and building demolition. Although building demolition during 1993 includes buildings that have significantly higher concentrations of contaminants than those that have been demolished previously, additional engineering controls and action levels will be used to control emissions. Engineering controls to be used during building demolition work include: cleaning or removing loose contamination (i.e., dust or dirt) from the internal and external surfaces of the building and equipment; water to control emissions at the source; and in some cases HEPA filtration of the building interior air during work activities prior to demolition of the building exterior.

Action levels have been established for airborne radioactive particulate concentration levels inside the building and total dust concentrations outside the buildings. These action levels have been established to control emissions to levels that are ALARA, and are discussed in detail in Section 4.2.2.1.

As mentioned in the WSQ source assessment, the bulk waste from the WSQ is expected to begin being placed at the temporary storage area (TSA) during March of 1993. Engineering controls such as the use of water to control airborne particulate emissions will also be used at the TSA. Radon gas emissions at the TSA due to the higher radium concentrations in the bulk waste will be minimized through the use of an attenuating cover material. In the *Feasibility Study for Management of the Bulk Waste at the Weldon Spring Quarry* (ANL 1990b), a dose estimate for airborne emissions from the bulk waste at the TSA was calculated. In the study, a dose estimate was calculated for a worker in an on-site office building and a student at Francis Howell High School. The calculated dose to the office worker was 0.08 mrem from radon, and 0.84 mrem from radioactive particulates for a total of 0.92 mrem. The calculated dose for the student was 0.05 mrem from radon, and 0.05 mrem from radioactive airborne particulates for a total of 0.1 mrem.

Portable ventilation systems will be used during building demolition activities. These systems will be primarily used for asbestos removal operations but in some cases will be used primarily to remove airborne radiological contaminants. However, even during asbestos removal operations the systems will also provide, as a secondary benefit, removal of radiological contaminants. Although these systems are essentially point sources, due to the number, temporary nature, and mobility of these systems, during building demolition they will be treated as fugitive dust sources rather than point sources.

The SWTP will be used to treat contaminated water from the raffinate pits and the QWTP will be used to treat WSQ sump water. Filter press operation at each of the plants is a source of potential emissions. The filter presses are isolated in rooms that are ventilated through HEPA filters. Based on engineering calculations and the use of the CAP-88 PC model results, it can be shown that the exhaust vents from either the QWTP or SWTP filter press room ventilation systems will produce a dose greater than 0.1 mrem.

As a result of the point sources assessment the *Regulatory Guide* specifies that only confirmatory measurements will be required for these point sources. The confirmatory monitoring will be done in accordance with 40 CFR 61 and will have EPA Region VII approval. These monitoring requirements will be outlined in the 1993 NESHAPs Plan.

4.2.2 Airborne Monitoring Programs

To effectively monitor the two WSSRAP diffuse sources that have been described, three air monitoring programs will be utilized; site specific monitoring, perimeter monitoring, and critical receptor monitoring. These three programs are designed to meet the requirements for airborne effluent monitoring and environmental surveillance as specified in the *Regulatory Guide* and DOE Orders 5400.1 and 5400.5.

The location, equipment, sampling time, minimum detection levels, accuracy, and investigation levels will be discussed in the site specific, site perimeter, and critical receptor monitoring program sections. In addition, sample heights, proximity to obstructions, and linear flow rate will also be discussed in the individual monitoring program sections.

4.2.2.1 Site Specific Monitoring Program. As mentioned in the WSCP/WSRP source assessment, the large diffuse source is made up of a number of smaller diffuse sources that include wind blown resuspension of radioactive particulates from contaminated soils and buildings, and resuspension of radioactive particulates due to site remediation activities such as building demolition and excavation of soils. Although there is some potential for resuspension of radioactive particulates due to natural meteorological occurrences, it is small compared to the potential for site remediation activities to resuspend radioactive air particulates. In order to assess the contribution of site remediation activities to the total airborne emissions from the WSCP/WSRP, site specific monitoring will be utilized. Site specific monitoring will also be used at the WSQ to supplement data from the WSQ perimeter monitors. Site specific monitoring will use mobile air particulate samplers and total dust monitors to measure the airborne radioactive particulate and dust concentrations near specific potential sources of airborne emissions.

Site specific monitoring, in addition to providing data concerning the contribution of specific activities to the total airborne inventory, will provide faster feed back concerning the effectiveness of engineering controls and data concerning dispersion patterns. Filters from site-specific air particulate monitors will be collected on a daily basis as compared to weekly for the perimeter samplers, which means data can be obtained as much as six days sooner. In addition, the total dust monitors will provide instantaneous airborne dust concentrations.

During demolition of a building within the WSCP/WSRP area, for example, mobile air particulate samplers will be used to monitor airborne emissions from the specific activity. Samplers will be placed at the work zone perimeters. The number of samplers used will be commensurate with the potential for above background emissions. In addition, a group of site specific samplers may be used to monitor separate work activities that are in relatively close proximity to one another. This will facilitate more efficient use of site specific samplers and maintain air monitoring coverage for all the activities. Total dust measurements will also be taken within the work zones to measure total dust concentrations.

When possible, the air particulate samplers will be placed in areas that are free from obstructions or conditions that could effect the air sampling results. The air particulate samplers are usually placed two times the distance from one obstruction or structure as the obstruction or structure is high (i.e., an air sampler would be placed 3 m [10 ft] from a 1.5 m [5 ft] tall tree). In addition, the samplers will be placed, if possible, in areas that do not have turbulent air conditions, such as nearby busy roads, or active equipment. Total dust monitors will be used, as needed, to make instantaneous checks of total airborne dust concentrations during work activities to ensure that engineering controls and good work practices are effective.

Site specific air particulate and total dust monitoring will be utilized during remediation activities at the WSQ. Monitors will be placed just outside the work areas based on the current meteorological conditions. Site specific monitoring will be used to assess airborne emissions from specific activities and areas within the WSQ.

Equipment that will be used for site specific air particulate sampling includes a portable air particulate sampler with a filter holder and a vacuum pump, a mass flow meter, filter, portable power supply, and air sampler stand. Equipment used for site specific total dust measurements includes a total dust monitor and data logger.

The portable air samplers that will be used for site specific air particulate sampling are low volume carbon vaned oil-less vacuum pumps. The low volume pumps are generally operated at approximately 40 l/min. The linear flow rate for the low volume air samplers, volume sampled per unit time, divided by the filter area, is 23 m/min. The total dust monitors that will be used are self-contained aerosol monitors whose sensing principle is based on the detection of scattered electromagnetic radiation in the near infrared range.

A mass flow meter, which is calibrated in a National Institute for Standards and Testing (NIST) traceable wind tunnel, will be used to set the flow rates of the portable air monitors at the beginning of each sampling period. The mass flow meter electronically compensates for temperature and pressure to read in standard liters per minute (sl/min, a liter of air at 0°C and barometric pressure of 76 cm Hg). The mass flow meter will also be used to check flow rates at the end of the sampling period. If the flow rate change is more than ± 20% from the starting flow rate to the ending flow rate, the data will be flagged and the change in flow rate noted when the data are reported. Prior to each use, the total dust monitor will be calibrated using a two-step calibration sequence. First, the instrument will be zeroed and then calibrated against a NIST traceable reference standard.

The portable sampler pumps will not be leak-tested because the flow rate is determined by placing a mass flow meter in the line between the filter assembly and the pump. Pump leakage will not affect the flow reading, which is made on the air passing through the filter to the pump. In addition, the Effluent Monitoring Regulatory Guide and EPA Methods 5 and 17 for measurement of airborne particulates specify that the filter head assemblies need only to be designed and inspected to minimize leakage around the filter.

The filters that will be used for low-volume samplers are a mixed cellulose esters membrane. These filters have a pore size of 0.8 μm and are 47 mm (1.85 in.) in diameter. The manufacturer states that the filter media retains 99.98% of dioclylphalate particles with an aerodynamic mean diameter of 0.3 μm at 32 l/min across a 100 cm^2 (15.2 in.) in surface area. The samplers will be placed on portable stands at a height of approximately 0.8 m (2.5 ft) off the ground. The air samplers will be placed at 0.8 m (2.5 ft) rather than 1.5 m (5 ft), as specified by the U.S. Environmental Protection Agency (EPA), due to the weight of the pumps and the safety problems that would be brought about by placing the pumps 1.5 m (5 ft) off the ground. The 1.5 m (5 ft) height would require personnel to lift the pumps, which are relatively heavy and will be moved frequently, above their heads. In addition, the stands would have a high center of gravity, making the stands susceptible to tipping in strong winds.

Because there is presently no electrical service in the controlled area of the WSCP/WSRP where the portable air samplers will generally be used, portable generators will be used to power the air samplers.

The minimum detectable concentration (MDC) that will typically be achieved during site specific monitoring is approximately 5.0E-14 μCi/ml. Because work activities may not always have a duration long enough to collect a large sample volume, a sample MDC may be higher than the typical MDC of 5.0E-14 μCi/ml. Whenever possible, a large sample volume will be collected in order to reduce the MDC.

At one sigma, the total typical uncertainty associated with a site specific air particulate sample at a concentration of 2.4E-14 μCi/ml is 8.3E-15 μCi/ml. The total sample uncertainty is dependent on the uncertainty associated with a number of sources, which include the volume sampled, detector calibration, uncertainties with efficiency and background count rate, and sample count rate.

After samples are collected, the filters will be stored for a minimum of 72 hr before they are counted to allow for decay of the short-lived radon and thoron decay products. The activity of the samples will then be counted on an alpha-scintillation detector or a gas-flow proportional counter. Counting times for the alpha scintillation detector and the gas flow proportional counter will generally be 60 min. Counting times may be longer in order to achieve a lower MDC.

The quality control (QC) procedures that will be implemented as part of the site- specific monitoring program include the calibration of instruments, source and background counts, recounts of samples, review of documentation, and use of standard operating procedures (SOPs). The QC procedures are intended to ensure the accuracy and validity of the data.

Calibration will be required for the alpha-scintillation and gas-flow proportional detectors, and the mass flow meter. The alpha-scintillation detector will be calibrated a minimum of every six months using NIST traceable radioactive sources in accordance with the applicable SOPs. The gas-flow proportional counter will be calibrated when repairs are made to the detector or if daily checking of the detector indicates that the instrument requires recalibration. This will be performed in accordance with applicable SOPs. The mass flow meter will be calibrated on an annual basis by the manufacturer in a NIST traceable wind tunnel. The portable airborne particulate samplers will be leak tested on an annual basis to ensure that the measured volume of air is passing through the sample collection filter. The total dust monitors will be calibrated prior to each use with a NIST traceable reference scatter.

Daily source and background counts will be made on the alpha-scintillation and gas-flow proportional detectors in accordance with the applicable SOPs. The daily source and background count results are compared to the calibration results. If daily checks are within three standard deviations when compared to results obtained during calibration, or within control limits as generated by the gas flow proportional software package, the instruments will be put into service. Instruments failing the daily background and/or source check will be taken out of service as described in the applicable WSSRAP standard operating procedure.

At least one in 20 air particulate samples will be recounted and the results compared to the initial count results. The precision between the two sample counts will be determined and the results kept on file.

A review by an individual other than the sampler of the sample documentation and calculations will be required as part of the QC procedure. The reviewer will be responsible for ensuring that the documentation is complete and the calculations correct.

4.2.2.2 Site Perimeter Monitoring. A perimeter monitoring program will be used to monitor airborne emissions from the two large diffuse sources, the WSCP/WSRP and the WSQ, which encompass soils with above background radionuclide concentrations. The program will require the use of 17 air particulate samplers, 20 radon track etch detectors, two continuous radon/thoron samplers, and one radon/thoron daughter sampler at permanent locations. In addition, four portable air particulate samplers will be deployed depending on the current work activity at six possible monitoring locations. The monitors will be used in conjunction with site specific monitoring to estimate the total airborne emissions that leave the two diffuse sources. The use of air monitors at the WSCP/WSRP and WSQ perimeter, in conjunction with site specific monitoring, is the most effective way to monitor airborne emissions from the WSS. The sources described in the WSCP/WSRP and WSQ source assessment are essentially ground sources. Sources such as stacks or vents that release radioactive material at a significant distance from the ground have the highest measured concentrations at ground level some distance from the source. This occurs because it takes time for the material to reach the ground, and as the material falls, it is driven from the source by the wind. Ground sources, however, have the highest concentration measured at the ground level at points closest to the source. As a result, the highest concentrations that leave the WSCP/WSRP and WSQ are at the perimeters.

There will be seven permanent and six temporary perimeter radioactive air particulate monitoring stations at the WSCP/WSRP (Figure 3-9). The WSCP/WSRP perimeter monitors are generally equally spaced along the perimeter fence with distances ranging from approximately 76 m to 610 m (250 ft to 2,000 ft). Because the potential for airborne emissions from the WSCP/WSRP is low, any airborne emissions that do occur will be intermittent and have low concentrations. The use of 13 perimeter monitors is commensurate with the potential for an exposure to a member of the general public.

There will be five permanent perimeter radioactive particulate monitoring stations at the WSQ (Figure 3-10). The WSQ perimeter monitors are generally evenly spaced around the perimeter of the area with distances ranging from approximately 137 m to 305 m (450 ft to 1000 ft).

There will be 13 radon monitoring stations at the WSCP/WSRP perimeter (Figure 3-9) placed approximately 122 m to 610 m (400 ft to 2000 ft) from one another. Due to the characteristics of the WSCP/WSRP diffuse radon source, the density of radon monitoring stations around the perimeter will be commensurate with the potential for causing an exposure from radon to a member of the general public. Remediation of the WSCP/WSRP is not expected to increase radon emissions, but some increase may occur during the transfer of bulk waste from the WSQ to the TSA, which is located within this area. Because the waste that will be transferred from the WSQ to the TSA has higher concentrations than the WSCP/WSRP soils, there is higher potential for radon emissions from the TSA than from WSCP/WSRP. As a result, the distances between radon monitoring stations along the WSCP/WSRP perimeter near the TSA will be less than typical WSCP/WSRP perimeter station separation.

Nine radon monitoring stations will be placed around the perimeters of the raffinate pits to determine anticipated radon levels which will be encountered during future remediation activities. Four monitors will be placed around Raffinate Pits 1 and 2 and 5 monitors around Raffinate Pits 3 and 4 (Figure 3-9). These monitors will be placed approximately 153 m to 367 m (500 ft to 1200 ft) apart.

An effective dose equivalent of 0.08 mrem was calculated at the nearest WSCP/WSRP critical receptor with the highest potential for an exposure to a member of the general public as a result of radon emission from TSA operation (ANL 1990b). Therefore, the 12 radon monitoring stations at the WSCP/WSRP perimeter will be sufficient to monitor potential radon emissions.

There will be eight radon monitoring stations on the WSQ perimeter (Figure 3-10). The radon monitoring stations at the WSQ are approximately 76 m to 198 m (250 ft to 650 ft) apart. The distance between monitoring stations at the WSQ is less than at the WSCP/WSRP because of the higher radium concentration at the WSQ, and because the WSQ is a large depression in the terrain with side walls ranging from 3 m to 15 m (10 ft to 50 ft) high. This, in conjunction with stable meteorological conditions, tends to trap emanating radon within the WSQ and raises the concentrations along the WSQ perimeter. As a result there is higher potential for radon emissions from the WSQ than from the WSCP/WSRP, and thus the distance between stations at the WSQ is smaller.

An effective dose equivalent of 1.0 mrem was calculated at the nearest WSQ critical receptor with the highest potential for an exposure to a member of the general public as a result of radon emissions from bulk waste removal (ANL 1990b). Therefore, eight radon monitoring stations at the WSQ perimeter will be sufficient to monitor potential radon emissions.

The number of radioactive air particulate and radon monitoring stations at the WSCP/WSRP and WSQ is in proportion to the potential for emissions from the sources. In addition, the use of site specific monitoring will allow monitors to be placed such that the density of monitors will be increased during activities with higher potential for airborne emissions.

Equipment for the site perimeter monitoring program includes low volume air particulate samplers, continuous radon-gas and radon-daughter monitors, a mass flow meter, scintillation detectors, a gas-flow proportional detector, filters, and radon track etch detectors.

The low volume permanent and temporary air particulate samplers at the WSCP/WSRP and WSQ site perimeter locations are self adjusting carbon vaned or twin-diaphragm, oil-less air pumps. Each of the permanent samplers will be mounted in a weather-protective housing with a 110 volt outlet and a thermostat-controlled cooling fan. Each of the temporary samplers will be mounted on a wheeled platform inside a protective housing. The permanent and temporary samplers will have hour meters, to document the operational period and regulators to maintain a constant flow.

The continuous radon gas and radon daughter monitors (Figures 3-9 and 3-11) are portable, fully automated instruments capable of continuously monitoring for radon, and radon and thoron daughters. The radon detectors contain a 12.7 cm (5 in.) diameter tube that is optically coupled to a 3 liter (0.78 gal) Lucas Cell coated with silver activated zinc sulphide to detect radon gas. The working level monitor uses a silicon barrier diode detector to detect radon and thoron daughters that are deposited on a membrane filter with a 0.45 μm pore size. The continuous radon and working level monitors have internal data storage capabilities. The data will be retrieved on a weekly basis from the sampler locations by downloading the data from the samplers to a portable computer. The sensitivities of the continuous radon and radon daughter monitors are 0.1 pCi/l and 1.0 mWL. The manufacturer stated accuracy for the continuous radon and radon daughter monitors is within $\pm 10\%$ of the measured concentration.

A mass flow meter is used to set and measure the flow rate of the low volume air particulate samplers. The low volume air particulate samplers will be run continuously at a flow rate of approximately 40 l/min (1.4 cu ft/min) with weekly filter replacement. Prior to changing the filter each week, the flow rate is measured with the mass flow meter which electronically corrects for pressure and temperature to read in standard liters per minute. After the filter is changed the flow rate will be adjusted on an as-needed basis to 40 l/min (1.4 cu ft/min). The starting flow rate of 40 l/min is then averaged with the ending flow rate, and the average flow rate used to calculate the total volume of air sampled. If the flow rate changes by more than

20% during the sampling period, the monitor will be evaluated to determine if service is required. The data will be flagged and the change in flow rate noted when the data is reported. The linear flow rate for the perimeter low volume air particulate samplers is 18 m/min (57.5 ft/min) at 40 l/min (1.4 cu ft/min). The site perimeter airborne particulate samplers will not be leak tested. Leak testing is not necessary because the flow rate is determined by placing a mass flow meter in line between the filter assembly and the pump. Pump leakage will not affect the flow reading, which is made only on the air passing through the filter to the pump.

The filters used to monitor the site perimeter are the same mixed cellulose ester filters used for site-specific monitoring. The filters are 47 mm (1.85 in.) in diameter, have a pore size of 0.8 μm and retain 99.98% of dioclyphalate particles with an aerodynamic mean diameter of 0.3 μm.

The perimeter air particulate samplers will be placed at approximately 1.5 m (5 ft) above the ground. The radon track etch detectors and the continuous radon and radon daughter monitors will be placed above the ground approximately 2 m (6.25 ft) and 1 m (3.2 ft), respectively. With the exception of the WSQ perimeter monitors, samplers, detectors, and monitors will be placed away from unusual localized effects or other conditions (e.g., in proximity to a large building, vehicular traffic, or trees) that could result in artificially high or low concentrations. Several of the WSQ perimeter monitoring stations are close to trees. Because the trees serve as a natural barrier to airborne emissions, the trees will not be removed from the areas near the monitoring locations. In addition, due to the limited space available along the ridge at the southeastern perimeter of the WSQ, the stations cannot be moved without being near the trees.

The radon detectors that will be deployed are track etch detectors that have a minimum sensitivity of 0.2 pCi/l. The vendor stated uncertainty, at one sigma, for the radon tract etch detectors is $\pm$25% of the measured concentration. Data from 1990 indicated the average uncertainty, at one sigma, was $\pm$17%, with an average concentration of approximately 4.5 pCi/l, which includes background. The detectors will be placed in pairs at each of the locations, and will be exchanged on a quarterly basis.

The air particulate filters will be counted to determine the gross alpha concentrations using an alpha scintillation detector or a gas flow proportional detector. The counting times for samples will in general be 60 min for the alpha scintillation detector and gas-flow proportional detector.

Each sample will be collected for a period long enough to ensure that a gross alpha MDC of 1E-15 μCi/ml can be obtained. Because naturally occurring Po-210 and Pb-210 exist in the atmosphere at concentrations on the order of 2.5E-15 μCi/ml, obtaining a MDC less than 1E-15 μCi/ml is of little value due to the interference from Po-210 and Pb-210. In addition, the Derived Concentration Guideline (DCG) of Th-232, Class W (most restrictive DCG for contaminants at WSSRAP) is 7.0E-15 μCi/ml. With a background of 2.0E-15 μCi/ml and a gross alpha activity of 1.0E-15 μCi/ml, the composite activity of 3.0E-15 μCi/ml is still less than the Th-232 DCG. The MDC is dependent on sample volume (sample time multiplied by the flow rate), the efficiency and background count rate of the instrument used to measure the activity on the filter, and the sample and background count times.

At one sigma, the total typical uncertainty associated with a site perimeter air particulate sample at a gross alpha concentration of 8.7E-16 μCi/ml is 3.0E-16 μCi/ml. The total sample uncertainty is dependent on the uncertainty associated with the volume sampled, detector calibration uncertainties with the determination of detector efficiency, and detector background count rate, as well as the uncertainty associated with the sample count rate. Uncertainty may vary because different detectors are used, and due to variations in the other sources of uncertainty; however, 1E-16 μCi/ml represents a typical uncertainty achieved with a sample having a gross alpha concentration of 1E-15 μCi/ml.

The investigation level that will be established for the perimeter air monitoring program is based on a one tail hypothesis test which compares the data collected at the background station with the data from a particular monitoring station. The test uses data collected from the previous 52 weeks to determine if a particular monitoring station's data is different than background, at the 95% confidence level.

Because the radon track etch detectors are collected on a quarterly basis, there are only four data points per year per location; therefore, the radon track etch detectors are compared to the background stations results only on an annual basis. Each location's monitoring results are compared to results from the background stations. If the results from a location are found to be statistically greater than the results from the background stations, an investigation will be conducted to determine the source of the above background concentrations, with the exception of the quarry monitoring stations, which are historically greater than background because of the radiologically contaminated material that was placed in the quarry.

The quality assurance/quality control (QA/QC) procedures for the low volume air particulate samplers are the same as those described for site specific monitoring. The QA/QC procedures that will be implemented for the continuous radon gas and radon daughter monitors include calibration and SOPs. The continuous radon gas and radon daughter monitor will be calibrated annually at the Technical Measurement Center at Grand Junction, Colorado. The continuous radon gas and radon daughter monitors will be operated in accordance with the applicable SOPs.

The QA/QC procedures that will be employed for the perimeter radon track etch detectors include duplicates, spikes, chain-of-custody and laboratory authorization forms, field sheets, and review of vendor data. The pair of radon track etch detectors placed at each location will serve as duplicates. Three spikes, track etch detectors exposed to a known source, will be returned to the vendor for analysis on an annual basis. In addition, field sheets will be used during deployment and recovery of the radon track etch detectors to document detector locations and any unusual occurrences. Chain-of-custody and laboratory authorization forms will be filled out in accordance with the applicable SOP in order to track the radon track etch detectors. Finally, the data received from the vendor will be reviewed for any anomalies.

4.2.2.3 Critical Receptor Monitoring. The most accurate method of dose calculation at nearby receptor points is through the use of actual concentration measurements at these locations. Measurements from nearby receptor points or critical receptors will be an important element in determining the emissions from the WSCP/WSRP and the WSQ when used in connection with site-specific monitoring data and the perimeter air monitoring data. Critical receptors are defined as those locations at which individuals abide or reside where the highest potential off-site concentrations of radionuclides other than radon are likely to occur during remediation of the WSS. The sites that were selected as critical receptors are located within 1 km (0.6 mi) of the WSS where members of the public may spend at least 8 hr/d for a significant fraction of the year. Monitoring of the critical receptors will be done in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) plan which has been approved by the U.S. Environmental Protection Agency (EPA) Region VII.

Critical receptor locations AP-2001, AP-4006, AP-4008, and AP-2005 (Figures 3-9 and 3-11) are strategically located to measure radioactive airborne emissions for the WSCP/WSRP at points where maximally exposed individuals reside or abide. Station AP-2001 is at the common boundary of the WSCP and Missouri Highway Department Maintenance Facility. Station AP-4008 is located at the U.S. Army Reserve and National Guard Training Area (WSTA). Station AP-2005 is located between the WSCP and the WSSRAP administration building. Station AP-4011 (Figure 3-10) is located 50 m (165 ft) from the nearest residence 0.2 km (0.12 mi) west of the WSQ. Station AP-4012 (Figure 3-12) is located approximately 12.9 km (8 mi) from the WSCP/WSRP and 11.3 km (7 mi) from the WSQ to monitor the Daniel Boone Elementary School and establish background.

Other facilities (i.e., the St. Charles County Water Treatment Plant and the Weldon Spring Height subdivision) are located near the WSS, however, because of the greater distance, and because previous monitoring data from closer critical receptor locations indicates with 95% confidence that there has been no above-background radioactive airborne concentrations, these facilities are not considered critical receptors.

The critical receptor monitoring program will utilize high volume air samplers, low volume air samplers, and radon track etch detectors at all locations. A continuous radon monitor will also be used at critical receptor location AP-2005 and at background station AP-4012. The high volume samplers have heavy duty, turbine-type blowers and feature an electronic controller that automatically adjusts the speed of the sampler to correct for variations in line voltage, temperature, pressure, and filter loading. The low volume air samplers are the same samplers described in site perimeter air sampling. They have dual diaphragm air pumps at all locations with the exception of the critical receptor nearest the WSQ (Figure 3-10) that utilizes the carbon vaned air pump. The continuous radon and radon daughter monitors are the radon track etch detectors as described in the site perimeter air monitoring program.

Mass flow meters will be used as described in the perimeter monitoring program for the low volume air samplers. A mass flow meter will also be used to measure and set the flow rates of the high-volume air samplers. The low volume and high volume air particulate samplers will be run continuously at 40 l/min and 950 l/min respectively. The linear flow rates for the low volume and high volume air particulate samplers are 48 m/min and 23 m/min respectively. Flow rates for both low volume air samplers and high volume air samplers will be checked at the end of each week and then readjusted to the desired flow rate after the new filter is installed.

The start and finish flow rates will be averaged, and the average flow rate used to calculate the total volume sampled. If the flow rate changes by more than 20% during the sampling period, the monitor will be evaluated to determine if service is required. The data will be flagged and used for qualitative purposes only.

The filters used for the low volume air samplers are the same filters used for site specific monitoring, and are 99.98% efficient in retaining 0.3 μm dioctyl phthalate (DOP) particulates at a flow rate of 32 l/min across 100 cm^2. The high volume air samplers use 203 mm by 254 mm (8 in by 10 in) glass fiber filters that have a mean DOP efficiency of 99.99% for particulate diameters of 0.3 to 0.4 μm.

The low volume air particulate samplers and continuous radon and radon daughter monitors will be placed at the same height specified in the perimeter monitoring section. The high volume air particulate samplers have a sample height of approximately 2 m (6.6 ft). In addition, the monitoring receptor stations will not be located in proximity to unusual localized effects or other conditions (e.g., in proximity to a large building, vehicular traffic or trees) that could result in artificially high or low concentrations.

On a quarterly basis, each of the 13 weekly filters from high volume air particulate samplers at critical receptors and at the background station will be composited by location. The composite sample will then be dissolved and divided into three aliquots. The 18 composite samples (three aliquot from six sampler locations) will be analyzed for isotopic thorium, isotopic uranium, Ra-228, and Ra-226.

The filters from the low-volume air samplers will be collected on a weekly basis and analyzed for gross alpha concentrations using the same procedure described in the perimeter air monitoring program. The data stored in the continuous radon-gas and radon-daughter monitors will be collected weekly as described in the perimeter air monitoring program.

The investigation level for the critical receptor monitoring locations will be concentrations determined to be greater than background concentrations. The monitoring results from each location will be compared to the background station results using a statistical test. If a station is found to be statistically different than background, an investigation will be conducted to determine the validity and/or source of this difference.

The quality control procedures for the low volume air samplers and the continuous radon-gas and radon-daughter monitors will be the same as those described in the perimeter air monitoring program. The quality control program for the high volume air samplers will include spikes, duplicates, and blanks.

The high volume air particulate samplers will be operated in accordance with the applicable SOP. The SOP also specifies how filters are to be handled before, during, and after collection.

With each group of high volume sampler filters sent for radiochemical analysis, two filters will be spiked with known activities of Th-230, and two filters will be spiked with known activities of natural uranium (U-238, U-235 and U-234 in natural activity ratios). Since each filter composite collected at critical receptor locations is split into thirds, these thirds will serve as duplicates.

Field blanks will be collected each week when filters are exchanged. A field blank is an unused filter that is taken with the technician in the field. In addition, an unused filter will be collected directly from the filter package. The two sets of blanks will also be composited and analyzed radiochemically. Results from the blank composite will be used to identify field or laboratory contamination of filters.

In addition to the system of spikes, duplicates, and blanks, the radioanalytical analyses will be evaluated for internal consistency. At the WSS, U-238 and U-234 are in secular equilibrium. Uranium concentrations on air filters should also be in equilibrium. When radioanalytical results are provided, the degree of equilibrium will be evaluated. In most cases, Th-228 and Ra-228 are also in equilibrium. Equality between these radionuclides will also be evaluated.

4.3 Asbestos Monitoring

During 1993, site perimeter air monitoring for asbestos will be routinely performed only when asbestos removal is taking place. Perimeter asbestos monitoring locations at the WSCP/WSRP and at the WSQ are the same as those used for radioactive air particulate monitoring (Figures 3-9 and 3-10). At least two perimeter asbestos monitoring stations at the WSQ and WSCP/WSRP will be used: one upwind and the other downwind from the asbestos removal activities. A determination of which monitoring stations to use will be based on current meteorological conditions when asbestos removal begins. During asbestos removal activities at the WSCP/WSRP, an asbestos monitor will be placed at the Francis Howell High School in the same location as the radioactive air particulate monitoring station. Finally, asbestos monitoring will be performed inside and adjacent to asbestos removal work areas during removal activities.

When asbestos removal activities are being performed at the WSS, daily asbestos monitoring will be performed in the immediate work area. Samples from the perimeter asbestos monitoring stations and from the Francis Howell High School monitoring station will be collected on a weekly basis. Samples from monitoring stations inside and adjacent to asbestos removal work areas will be collected on a daily basis. Sample results from the Francis Howell High School monitoring station and the perimeter monitoring stations will be reported in the ASER. If elevated levels are detected at any of these monitoring locations, the results from the adjacent and immediate work areas will be reviewed in relation to the elevated levels and pertinent data will be included in the ASER.

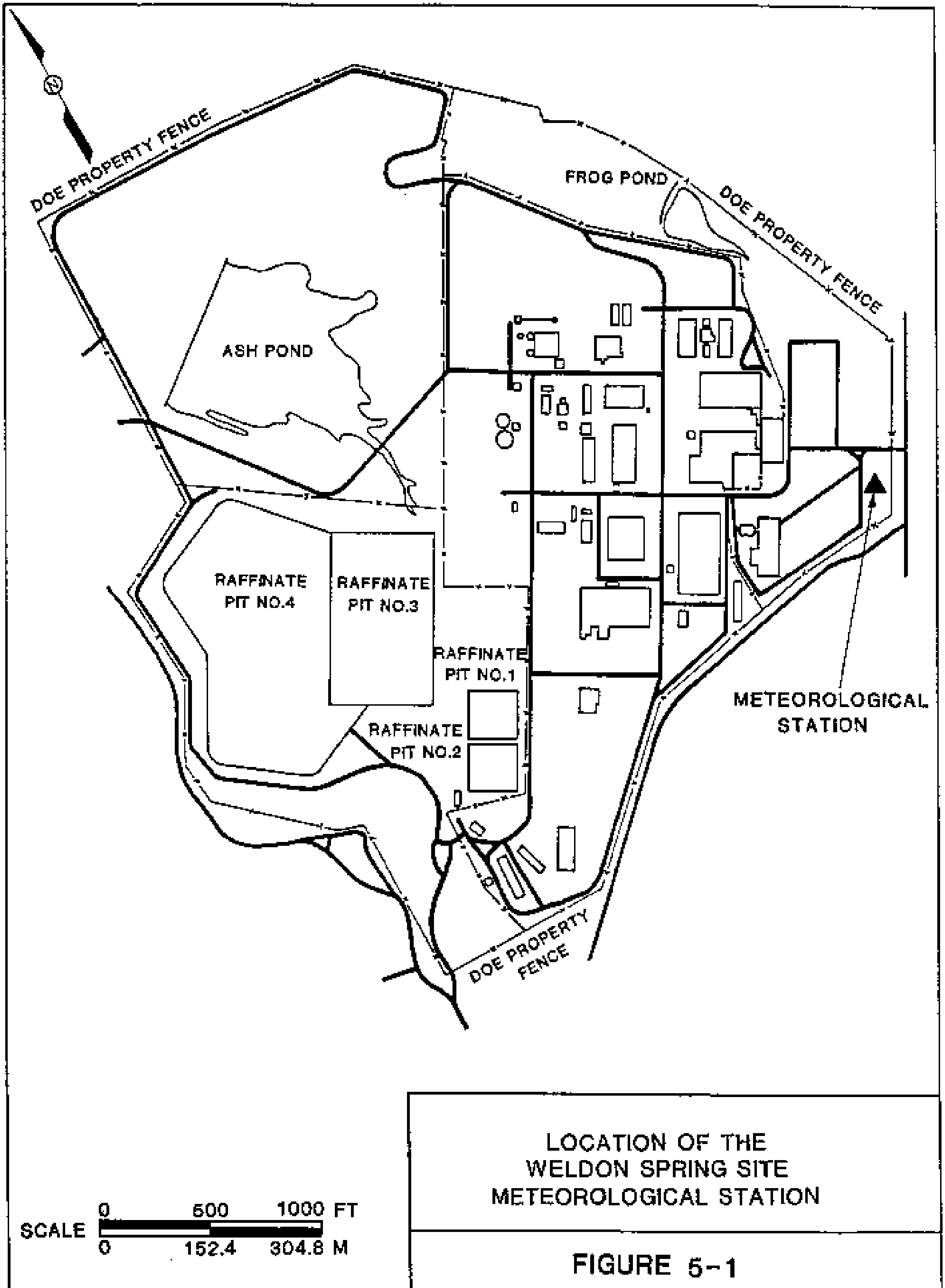
5 METEOROLOGICAL MONITORING PROGRAM

This section describes the meteorological parameters measured, meteorological instrumentation, and computer programs and models that support the environmental surveillance and emergency response activities at the Weldon Spring Site Remedial Action Project (WSSRAP). Calculation of radiological dose to the general public is based upon measurements from critical receptor locations (Section 4.2.2.3). The use of actual concentration measurements at these locations yields more accurate dose calculations than those based upon modeling of downwind dispersion. The sources for off-site airborne releases at the site are diffuse sources from waste areas and site remedial activities. No point source (stack-type) releases operate at the site.

The WSSRAP has two sources of potential airborne radiological emissions: the Weldon Spring Chemical Plant and Weldon Spring raffinate pits (WSCP/WSRP), and the Weldon Spring quarry (WSQ). The location of the meteorological station is on the eastern edge of the WSCP/WSRP area and is more than 122 m (400 ft) from the nearest building (Figure 5-1). An assessment of the two diffuse sources was conducted as required by the *Regulatory Guide* and is summarized in Section 4.2.1. The assessment included documenting different radionuclides that could potentially be released from the sources and their concentrations.

The WSSRAP meteorological station samples and records wind speed and direction, horizontal wind fluctuation, ambient air temperature, barometric pressure, and precipitation intensity and accumulation. The station microprocessor performs signal computations and stores data electronically. Provisions also exist to record data on a back-up chart recorder which is located near the base of the station tower.

The meteorological station consists of a tower, an instrumentation enclosure, and a rain gage. The wind speed and direction sensors are mounted 10 m (33 ft) above ground level on a retractable, tilt down tower. Sensors at greater heights are unnecessary since potential releases of airborne emissions are at or near ground level. The wind aspirated temperature sensor and barometric pressure transducer are mounted 2 m (6.6 ft) above ground level at the enclosure. Horizontal wind fluctuation is computed by the station microprocessor.



LOCATION OF THE
WELDON SPRING SITE
METEOROLOGICAL STATION

FIGURE 5-1

REPORT NO.:	DOE/OR/21548-349	EXHIBIT NO.:	A/CP/153/0892		
ORIGINATOR:	RC	DRAWN BY:	GLN	DATE:	9/92

These parameters are collected and stored every 60 sec. The 1 min recordings are averaged once per hour and the hourly data are downloaded daily to a remote computer. These data are reviewed daily and archived digitally.

The meteorology information is used to support many WSSRAP environmental monitoring program functions such as:

- Station data enable dispersion and diffusion modeling to supplement critical receptor monitoring in the event of an airborne release.

- Ecological studies require rainfall, temperature, and wind speed data to determine water level fluctuation in lakes and wetland areas, foliar vegetation absorption analysis, and in agricultural data reviews.

- The Environmental Protection Group utilizes precipitation data to correlate aquifer level fluctuations in the Femme Osage Slough and the WSQ. This aids in the determination of the cause of fluctuating uranium concentrations in the area.

- Hydrological analyses utilize precipitation measurements to correlate surface and groundwater level fluctuations and to assess seasonal influences on contaminant concentration trends.

- Meteorological data are used to help prepare the annual site environmental report (ASER), study off-site effluent discharges, and to determine site watershed runoff coefficients for the Environmental Impact Statement/On-Site Discharge Information System (EIS/ODIS) report.

- Station data were also used in the application for the National Pollutant Discharge Elimination System (NPDES) storm water permit.

Furthermore, the real-time data read out of meteorological variables aid site personnel in observing and analyzing the dispersion of potentially released airborne materials during and after an incident.

In the event that it is determined that modeling of the air pathways is necessary, the WSSRAP will use either the computer program CAP-88 (a modified version of AIRDOS-EPA) or ISCST2 (Industrial Source Complex Short Term Dispersion Model, Version 2). Both models employ steady-state Gaussian equations to model the dispersion plume generated from an emission into the air.

Inspection and maintenance of the meteorological station, daily review of meteorological data, and semiannual calibration of the meteorological station are documented in accordance with procedure ES&H 4.8.3.

6 ENVIRONMENTAL MONITORING PROGRAM ADMINISTRATION

This section describes the activities that will constitute much of the structure and substance of the environmental monitoring program at the Weldon Spring Site Remedial Action Project (WSSRAP). Aspects of data management and presentation are discussed along with regulatory compliance and the performance of dose assessments. In addition, the performance of special studies that are outside the scope of this document, emergency preparedness, and changes in the scope of investigations are also addressed.

6.1 Data Analysis and Statistical Treatment

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

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

- Comparing the contaminant concentrations at each sampling location to previous concentration estimates at that point and to identifying changes or inconsistencies in contaminant levels.

- Comparing the contaminant concentrations at each sampling location to the established limits for those contaminants.

- Comparing contaminant concentrations at single sampling locations or groups of locations to those at control (i.e., background) or other points and evaluating the reliability of those comparisons.

The WSSRAP has taken steps to establish investigation levels, for groundwater, surface water, and site effluents to ensure that environmental data are reviewed in a consistent manner and to ensure appropriate and timely action is initiated when, and if, criteria are exceeded. The criteria applied by the WSSRAP to define the investigation levels for all environmental monitoring data (except asbestos) are described in several environmental, safety, and health

(ES&H) procedures. Procedures have been written to direct the WSSRAP staff in the evaluation of monitoring data. These evaluations will determine whether data collected during routine environmental monitoring programs exceed specific action levels, and will reference an administrative procedure to define the general actions to be taken for exceedance of any criteria. These procedures include:

ES&H 1.1.7 - *Reporting Above Normal Values from Environmental Monitoring Networks*

ES&H 4.6.4 - *Constant Flow Low Volume Air Sampler Operation and Air Sample Filter Handling*

ES&H 4.6.6 - *Constant Flow High Volume Air Sampler Operation and Air Sample Filter Handling*

ES&H 4.6.7 - *RGA-40 Radon Gas Monitor: Operation and Data Handling*

ES&H 4.9.3 - *Surface Water and Groundwater Data Review Procedure*

These procedures are intended to effectively address the DOE guidance criteria for determining investigation levels for environmental monitoring programs.

The statistical techniques used to evaluate and analyze the data will be designed with consideration for the characteristics of effluent and environmental data. These characteristics may include skewed distributions of time series data, high variability analytical results, large amounts of missing data, and data that are below analytical detection limits.

6.1.1 Summary of Data Analysis and Statistical Treatment Requirements

The following sections summarize the methods of data analysis and statistical treatment of the effluent and environmental data. Immediately upon receipt from the laboratory, all new groundwater, surface water, and National Pollutant Discharge Elimination System (NPDES) data will be evaluated against the corresponding historical statistics and entered into the WSSRAP environmental database once it has been verified in accordance with standard operating procedure ES&H 4.9.1. Apparent outliers will be qualified and excluded from use only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. Air monitoring data obtained from off-site laboratories, as required by the National Emissions Standards for Hazardous Air Pollutants (NESHAP), will be verified in accordance with procedure ES&H 4.9.1. Air monitoring data obtained from the WSSRAP on-site laboratory shall be handled in accordance with procedure ES&H 2.6.7.

Selected data will be summarized using a range, variance, standard deviation, standard error, median, mean, and confidence interval about the mean. The confidence level of the data will be estimated by using blank and spike samples, and comparing the results of these analyses to the known concentrations. The precision of the data will be determined by comparison to replicate samples.

6.1.2 Variability of Effluent and Environmental Data

The variability of effluent and environmental data will determine the degree of precision and accuracy that can be achieved with the results. Careful design and execution of the monitoring and laboratory programs can substantially improve the quality of effluent and environmental monitoring data and associated data results.

6.1.2.1 Sources of Variability. Variability of data may arise from six sources; sampling errors, analytical errors, statistical counting variations, data recording errors, and temporal, and spatial variability between environmental samples. Variability due to sampling, analytical, and recording errors can be minimized. However, variability due to the environment factors (temporal and spacial) cannot be controlled and must be checked through statistical summaries.

6.1.2.2 Estimating Accuracy and Precision. The validation process will assess the accuracy and precision of groundwater, surface water, and NPDES data sets according to the WSSRAP data validation procedure (ES&H 4.9.2). NESHAPs air monitoring is performed in accordance with 40 CFR 61, which outlines specific parameters to ensure the accuracy and precision of each data set. Data will also be validated in accordance with procedure ES&H 4.9.2, if required. The accuracy and precision of data obtained from the WSSRAP on-site laboratory is determined in accordance with procedure ES&H 2.6.7. The annual site environmental report (ASER) will summarize completeness, accuracy, and precision.

6.1.3 Summarization of Data and Testing For Outliers

To adequately analyze environmental data, the distribution of these data must be statistically summarized and outliers, which may distort these analyses, must be identified. Statistical summarization is performed for trending and other analyses of historic data and for review of new data. The objectives of data review differ from those of rigorous trend analysis. Whereas trend analysis requires careful definition and handling of data distributions, data review requires a conservative, easily used evaluation of new data to address the following questions: (1) Is the value a new maximum or minimum value? (2) Does the value constitute a high level for a contaminant of concern at a sensitive location? (3) Does this value confirm or discount a recently recorded high or low value? (4) Is the extreme value due to analytical factors? The following subsections describe statistical methods used to summarize historical data when applicable (summarization will not be required for all data).

6.1.3.1 Distribution Analysis. Most common statistical tests rely on the assumption that the data being tested follows a normal distribution. This may not be the case for environmental data, which commonly follows a log-normal distribution. Therefore, all data sets containing 10 or more samples will be tested for distribution type and, if necessary, the appropriate transformation will be made prior to calculation of summary statistics. Alternatively, nonparametric hypothesis testing will be used. For the purposes of meeting the objectives of data review, a Gaussian distribution will be assumed and summary statistics will be calculated on a trimmed data set. Moving averages will be used to accomodate data with time-dependent trends.

6.1.3.2 Measures of Central Tendency. For normally distributed or transformed data with only a small number of extreme or less-than-detectable values, the arithmetic mean is the appropriate estimator of central tendency. When the data set contains large numbers of extreme values or concentrations below the analytical detection limits, the median, which is less sensitive to extreme values than the mean, will be used to summarize the data. Trimmed means or minimum variance unbiased estimators may also be used in these cases and for the purpose of data review.

6.1.3.3 Measures of Dispersion. Dispersion in normally distributed or transformed data, without large numbers of outliers and less-than-detectable values, will be represented as a variance, standard deviation, standard error, or confidence interval. If a large number of extreme values are contained within a data set or is not normally distributed or cannot be transformed to a normal distribution, the interquartile range and the median absolute deviation will be reported.

6.1.3.4 Less-Than-Detectable Values. When uncensored data are available for the monitoring information, these values will be utilized in all statistical calculations in order to minimize bias in the parameter estimates. When reporting the data in cases where intakes and/or doses are assigned, scientific, professional judgement shall be used in providing conclusions about the data. This is especially true when the data contains a large percentage of values at, near, or below the detection level, because the use of such data sets may lead to physically impossible results (Appendix D). In addition, the number of values that do actually fall below the reported lower limit of detection (LLD) shall be noted.

When uncensored data are not available, the number of less-than-detectable values will be documented. In the case of a small percentage of less-than-detectable values in the data set, the approach recommended by the U.S. Environmental Protection Agency (EPA) for replacing the less-than-detectable value with half of the analytic detection level (DL) and including these values in all statistical manipulations will be utilized. Problems with this approach and varying DLs should be addressed on a case-by-case basis (EPA 1989b). However, in the case of data sets with a larger percentage of less-than-detectable values, special statistical treatments such as rank dependent or proportion type hypothesis testing or other non-parametric techniques provided by Gilbert and Kinnison (1981) will be used to generate conclusions concerning the reported data.

6.1.3.5 Testing for Outliers. For the purpose of outlier testing, those data sets will be screened in accordance with the guidance set forth in the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (EPA 1989c) and ASTM Volume 14.02. Outlier analysis will not be performed on data sets of less than 4 points. For data sets with large time gaps, outlier analysis will not be performed until no fewer than 3 new data points are available. For the purposes of data review, outliers will be ranked relative to the trimmed mean at the 95% and 99% confidence intervals. All outliers exceeding the 99% confidence interval will require investigation; investigation of those within the 95% and 99% interval will be at the reviewer's discretion.

6.1.3.6 Elements of Good Practice. Data review procedures are being developed to aid in interpreting the effluent monitoring data and to improve the quality of results by helping to detect erroneous measurements. Comments on the quality of the samples taken will be entered into the data base with the sample contaminant concentration measurements. In addition to the data collected during the regular sampling program, field logs describing events that might affect contaminant concentrations will be reviewed and incorporated, as appropriate.

6.1.4 Treatment of Significant Figures

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

6.1.5 Parent-Decay Product Relationships

The delays associated with sample collection to sample analysis are insignificant compared to the half-lives of the radionuclide present and routinely monitored at the Weldon Spring site (WSS). Therefore, it is not necessary to take into account decay times when calculating parent-decay product relationships.

6.1.6 Comparisons to Regulatory or Administrative Control Standards and Control Data

One reason for obtaining reliable estimates of contaminant concentrations at the monitoring stations is to compare the values to regulatory or administrative control standards or values at control stations to determine whether action must be taken to reduce the contaminant levels in the effluents.

6.1.6.1 Single Concentration Measurements. Statistical tests are not appropriate for comparisons of single values, such as when a single radionuclide concentration measurement is compared to its regulatory limit. Single values can have a large associated uncertainty, and they are not necessarily an accurate representation of how well the facility is complying with the limit. Statistical summaries of groups of related samples will be used when possible. If single concentration measurements cannot be grouped, statistical tolerance limits will be used.

6.1.6.2 Groups of Measurements. Concentration estimates from groups of sampling locations will be compared using standard analysis of variance techniques when the data meet the underlying assumptions of those tests. Standard nonparametric statistical comparison techniques will be used when the assumptions of the parametric tests are not met by the data. Caution will be used when comparing groups of readings from single points over time, because of the likely strong autocorrelation in the time series of data.

6.2 Dose Calculations

This section is intended to provide a description of models, computer programs, input data, and data sources that will be used to assess accurate and realistic radiation doses to the population and to a hypothetical maximally exposed individual that could result from remediation activities at the WSSRAP. Environmental monitoring data will be used either as direct input data in dose calculations or, where appropriate, will serve as data input in exposure and dose models.

The results of the dose calculations will be reported in the ASER. The methodology used to calculate the exposure point concentration and estimate dose will also be documented in the ASER.

6.2.1 Surface Water and Groundwater Dose Calculations

The radiological dose assessment from groundwater and surface water will be accomplished by using data gathered from groundwater and surface water effluents monitoring and environmental surveillance monitoring programs. Site-specific monitoring data representing surface water and groundwater radionuclide concentrations will be used as input in the dose assessment calculation. This data will allow a more accurate assessment of doses to a maximally exposed individual and the population surrounding the WSS.

The exposure and dose assessment estimate will be conducted for both the general off-site population and a maximally exposed receptor. Intake variables for a given pathway will be selected to reflect a reasonable, realistic exposure mode.

The results from the surface water and groundwater effluent monitoring and environmental surveillance programs will be evaluated in the site environmental report for the potential to contribute a radiological dose to a member of the general public. If measured concentrations in surface water and groundwater effluent from the WSS exceed natural background concentrations with 95% confidence, an exposure scenario will be developed to assess the dose. Realistic ingestion rates and times will be assigned for a maximally exposed individual. A standard dose conversion factor will be assumed and referenced for the calculations.

6.2.2 Airborne Radiological Dose Calculations

The radiological dose assessment from airborne emissions will be conducted using environmental data as well as computer models. Exposures for critical receptors and hypothetical maximally exposed individuals will be determined through monitoring data. For sources where perimeter monitors indicate exceedance of background with 95% confidence, population dose estimates will be made by computer modeling. This would constitute a change over previous monitoring years when computer modeling was not utilized. The new site specific monitoring program, in conjunction with existing perimeter monitoring data, will be used to obtain a more reliable source term. This will allow computer modeling to be used if necessary.

The computer models that will be considered for use in this dose assessment include AIRDOS PC, LTSAMP, and COMPLY. COMPLY and LTSAMP are computer models that have the capability to assess radiological dose from airborne emissions at distances less than 300 m (990 ft). COMPLY is an EPA computer model designed mainly to model emissions from stacks or vents rather than large diffuse sources. LTSAMP is a computer model developed at the Uranium Mill Tailings Remedial Action (UMTRA) project to calculate doses from large diffuse sources.

Because of the diverse nature of the sources at the WSSRAP, any one of these programs, or all three, may be used to assess doses due to airborne emissions from the two WSSRAP sources. The use of LTSAMP would also be dependent on gaining approval from DOE Headquarters.

Those pathways that are complete and could realistically contribute to the dose to a member of the general public will be assessed and documented in the annual site environmental report. Justification for elimination of any pathways will also be provided in the annual site environmental report. Scenarios that reflect realistic but conservative assumptions will be developed for those pathways that could contribute to the dose to a member of the general public. Realistic occupancy times will be assumed for potentially exposed individuals. Standard breathing rates and dose conversion factors from the *Federal Guidance Report No. 11* (Eckerman et al 1988) will be used in the calculations.

6.3 Records and Reports

The WSSRAP recognizes numerous DOE orders, notices, and directives in addition to Federal, State, and local regulations. Since the WSS 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, and ensure that reports are written and distributed in a timely manner and that records are properly maintained.

6.3.1 Subject Orders

The following DOE Orders govern activities at the WSS: Order 5000.3A, Order 5400.1, Order 5400.5, Order 5284.1B and Order 5484.1. These orders are described below in the following paragraphs.

DOE Order 5000.3A, *Occurrence Reporting and Processing of Operations Information*, is a system of reporting those occurrences listed in 5400.1, 5400.5, and 5484.1. Occurrences are categorized into nine groups such as environmental, personnel radiation protection, and are divided into three categories in order of decreasing severity: emergencies, unusual occurrences, and off-normal occurrences.

DOE Order 5400.1, *General Environmental Protection Program*, requires that all DOE facilities comply with those Federal, State, and local environmental protection laws that are applicable. Both environmental occurrences and routine monitoring reporting are covered. WSSRAP has prepared an *Environmental Protection Program Implementation Plan* (EPPIP) (MKF and JEG 1992a) to meet the specific requirements of DOE Order 5400.1. Environmental occurrences will be reported as stated in DOE 5484.1 and DOE 5000.3 in accordance with WSSRAP procedures. Reports prepared by the WSSRAP include the *Environmental Monitoring Plan* (EMP), ASER, *Groundwater Protection Program Management Plan* (MKF and JEG 1992c), *Groundwater Monitoring Plan*, *Radioactive Effluent Information System and On-site Discharge Data Reports*, the *Quarterly Environmental Data Summaries* (QEDS), and the *Environmental Protection Program Implementation Plan* (MKF and JEG 1992a).

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

DOE Order 5482.1B, *Environment, Safety, and Health Appraisal Program*, establishes a review and appraisal program for the Environmental, Safety and Health (ES&H) programs at the WSSRAP. There are six levels of appraisals and audits: management appraisals, technical safety appraisals, functional appraisals, internal appraisals, environmental surveys, and environmental audits. Each appraisal and audit requires a quarterly status report, or a report as otherwise directed, to report on corrective actions.

DOE Order 5484.1, *Environmental Protection, Safety, and Health Protection Information Reporting Requirements*, outlines requirements and procedures for investigating occurrences which may impact environmental protection, safety, and health. Occurrences are categorized into three levels - A, B, and C. In addition, the Annual Radiation Exposure Information Reporting System (REIRS) requires an annual report of any exposures obtained by DOE or Project Management Contractor (PMC) employees, nonemployee radiation workers, and visitors.

6.3.2 Records

DOE Order 5400.1 requires that all environmental surveillance and effluent monitoring records, computer programs, raw data, and procedures be maintained. These records must be protected against damage or loss. The WSSRAP maintains an *Environmental Data Administration Plan* (EDAP) (MKF and JEG 1992d) which governs sampling plan preparation, data verification and validation, database administration, and data archiving.

The EDAP provides a tracking system for sampling activities. Field log books and field data forms are filled out at sample collection. A Chain-of-Custody (COC) Form is completed and accompanies the sample until it is properly disposed of or returned to the WSSRAP. A laboratory authorization form is sent along with the sample, COC, and the shipping order form to authorize testing by an off-site laboratory. The sample information, such as identification number, date, and parameters is then entered into the Environmental Sample Tracking (EST) System. EST tracks the samples, calculates costs, invoice payments, and budget reports. Upon receipt of data from a laboratory, it is reviewed through a verification process. The verification process reviews data delivery, sample preservation and identification, chain of custody, holding times, and data review to ensure compliance with the laboratories *Quality Assurance Project Plan* (QAPjP) and standard operating procedures.

Data are accessed by the DOE and the PMC using a computerized data management program developed on site, the Generic Universal Report Utility (GURU). The database allows data to be selected and sorted based on identification number and parameter. Records are protected from alteration by the user.

Other computer programs used are: the Safety, Health, And Radiation Protection (SHARP) program, the Site Wide Audit Tracking System (SWATS), and the Waste Inventory Tracking System (WITS).

All environmental data and documentation from sampling, analysis, and quality review programs are maintained in hard copy records; i.e., documents and data in written, typed, or printed forms; and electronic records, i.e., computerized records of environmental data. Original documents are transferred to Project Quality and stored as quality assurance records in a fireproof vault. Copies are kept in the ES&H files. Work data files and electronic data records are maintained by the Data Administration sections and archived annually.

6.3.2.1 Environmental Monitoring Plan. The EMP details environmental and effluent sampling. The EMP is required to be reviewed annually and reissued at least every three years. The ASER presents data results and interprets these results, highlighting any unusual data. The ASER is produced annually (see Section 6.3.1.1). The *Groundwater Protection Program Management Plan* (MKF and JEG 1992c) structures the groundwater program into a consistent program which facilitates periodic review. This plan is reviewed and updated annually. The *Groundwater Protection Program Monitoring Plan* is taken directly from the EMP, with the focus on the groundwater monitoring program. The *Radioactive Effluent Information System and On-site Discharge Data Report* is an annual report which consists of a letter and DOE form F 5821.1 which covers any releases from the site. The EPPIP, as mentioned above, outlines DOE Order 5400.1 as it applies to WSSRAP. This plan is updated annually and should be referred to for a complete and thorough listing of applicable regulations.

6.3.2.2 Annual Site Environmental Report. The ASER presents the findings of the Environmental Monitoring Program conducted at the WSS in each monitoring year. The report presents summary environmental data, discusses compliance with environmental standards, and highlights significant programs and efforts undertaken at the WSS. Annual environmental monitoring reports have been prepared for this site (or portions thereof) since 1981.

The ASER is the DOE's vehicle for documenting the results of its extensive 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 radionuclide NESHAPs regulations and compares the measured contaminant levels to applicable standards and DOE requirements. Further, the report indicates whether changes are occurring in contaminant distribution or contaminant source conditions on and around the site--changes which might equate to variations in potential exposure scenarios to the public or environmental receptors.

Environmental monitoring is the WSSRAP's most effective means by which to assess the impacts from the site. The data and evaluations contained in the report provide the summary of that monitoring for each monitoring year. The ASER reports results of the contaminant level measurements and compares the environmental levels of radioactivity and chemical contaminants released from the site with applicable standards.

In addition to the routine environmental monitoring conducted in each monitoring year, a number of related activities and special studies are performed. These activities and studies are directly applicable to the assessment of the overall impact of site operations on the environment. These activities are described in the ASER, and the results from special studies or non-annual sampling shall be summarized in the ASER and subsequent ASERs if the information is of public or environmental concern. Reference to the next sampling event shall be made applicable. These include Oak Ridge National Laboratories (ORNL) research on site, Federal Facility Agreement (FFA) driven activities, and activities not scoped in this *Environmental Monitoring Plan* (EMP).

The report contains trend analyses and figures for groundwater wells, definitions of selected terms used in the report, a discussion of the environmental guidelines that apply to the monitoring program, and presents dose assessment calculations.

6.3.2.3 Quarterly Environmental Data Summary. Though not required by a DOE Order, the QEDS, are produced to aid in communicating site environmental data to the public and participating regulatory agencies. The QEDS summarizes environmental data, highlights any significant findings, and offers tentative interpretations. The QEDS allow preliminary data to be reviewed by interested individuals and organizations on a more frequent basis.

6.3.2.4 Discharge Monitoring Reports. Permits issued under the NPDES and provisions of the *Clean Water Act* also require recordkeeping and reporting. Recordkeeping requirements are stated in the NPDES permits issued by Missouri Department of Natural Resources (MDNR). Discharge Monitoring Reports (DMRs) are issued on a quarterly basis to MDNR and include information on sample collection, flow, and laboratory results. If there is a noncompliance event, MDNR must receive an oral response within 24 hr followed by a written response within five days. Written reports may also need to be filed with the DMRs.

6.3.2.5 Performance Indicator Quarterly Reports. The DOE Performance Indicator Program (PI) is a requirement of SEN-29-91 that calls for the production of a quarterly report. This program allows trending and analyzing operational data which will improve the DOE and contractor line management control of operations. The report contains a management summary, a PI summary, trends and analysis, and quantitative data.

6.3.2.6 Compliance Reports. Under the *Federal Facility Agreement* (FFA), the DOE must submit status reports of activities and technical documents to the EPA for their review and approval. These include, but are not limited to, the ASER, EMP, QEDS, sampling plans, and unplanned sampling activity notifications. Each of these reports has its own reporting requirements and time constraints which are detailed in the *Draft Federal Facility Agreement Implementation Plan* (MKF and JEG 1992e).

Other reports covering environmental issues are produced by the Compliance Department. The *Quarterly Compliance Report* is required by the DOE. This report covers issues of noncompliance for the quarter along with corrective actions. Also, the *Annual Report on Environmental Permits* is issued annually to the DOE. this report is required by DOE Order 5400.2 and covers all environmental permits issued to the site.

6.3.3 Records

DOE Order 5400.1 requires that all environmental surveillance and effluent monitoring records, computer programs, raw data, and procedures be maintained. These records must be protected against damage or loss. The WSSRAP maintains an *Environmental Data Administration Plan* (EDAP) (MKF and JEG 1992d) which governs sampling plan preparation, data verification and validation, database administration, and data archiving.

The EDAP provides a tracking system for sampling activities. Field log books and field data forms are filled out at sample collection. A Chain-of-Custody (COC) Form is completed and accompanies the sample until it is properly disposed of or returned to the WSSRAP. A laboratory authorization form is sent along with the sample, COC, and the shipping order form to authorize testing by an off-site laboratory. The sample information, such as identification number, date, and parameters is then entered into the Environmental Sample Tracking (EST) System. EST tracks the samples, calculates costs, invoice payments, and budget reports. Upon receipt of data from a laboratory, it is reviewed through a verification process. The verification process reviews data delivery, sample preservation and identification, chain of custody, holding times, and data review to ensure compliance with the laboratories *Quality Assurance Project Plant* (QAPjP) and standard operating procedures.

Data are accessed by the DOE and the PMC using a computerized data management program developed on site, the Generic Universal Report Utility (GURU). The database allows data to be selected and sorted based on identification number and parameter. Records are protected from alteration by the user.

Other computer programs used are: the Safety, Health, and Radiation Protection (SHARP) program, the Site Wide Audit Tracking System (SWATS), and the Waste Inventory Tracking System (WITS).

All environmental data and documentation from sampling, analysis, and quality review programs are maintained in hard copy records; i.e., documents and data in written, typed, or printed forms; and electronic records, i.e., computerized records of environmental data. Original documents are transferred to Project Quality and stored as quality assurance records in a fireproof vault. Copies are kept in the ES&H files. Work data files and electronic data records are maintained by the Data Administration sections and archived annually.

6.4 Environmental Activities Varying from EMP Scope

When additional characterization and monitoring activities are conducted that are not defined within the scope of the EMP, a judgement will be made by the Environmental Protection Group Manager as to the relevance of each of those activities to the overall environmental reporting requirements. An example of an activity which might be reported in the ASER is a soil or water characterization effort that exceeds the scope of those previously performed in the area. Conversely, an example of activities that may not warrant ASER reporting are what are termed "engineering characterization" efforts performed in support of various construction activities at the site. An exception to this is the ecological characterization required by the National Environmental Policy Act (NEPA) that would provide information to assess impact to the ecosystem.

During the 1993 monitoring year, it may be determined necessary to alter the scope of the monitoring program. In such case, the changes in monitoring parameters schedule, frequency, and/or location will be authorized by the Environmental Protection Group Manager with notification given to the ES&H Department Manager. All variances from the program scope will be documented with a memorandum to project management and will be reported in the ASER.

6.5 Emergency Preparedness

The WSSRAP maintains on site the management and staffing structure necessary to respond to environmental and medical emergencies. Plans and procedures are in place that detail the response and reporting program, implementation criteria, and routine environmental response and safety drills. The specific plans which address these measures include: the *Emergency Response Manual* (MKF and JEG 1993b) and the *Emergency Preparedness Plan* (MKF and JEG 1993c). These plans encompass environmental emergencies, spills, fire, medical and natural disasters.

6.6 Laboratory Programs

Laboratories that are performing analysis for the EMP are mainly using Contract Laboratory Program (CLP) methodologies. For certain analyses (such as radiochemical and wet chemistry) the laboratories are using EPA 600 (drinking water), EPA 900 (radiochemical analysis of drinking water) or a method that is reviewed and approved by the PMC prior to analysis of a sample. Contracted laboratories have submitted a site-specific *Quality Assurance Project Plan* (QAPjP) to the WSSRAP and have submitted controlled copies of their standard operating procedures (SOPs). The QAPjP and SOPs are reviewed and approved by the PMC prior to sample shipment to a laboratory. Any changes to the standard analytical protocols or methodology are documented in their controlled SOPs. All of the current laboratories being used by WSSRAP have had a preliminary assessment of their facilities to make sure that they have the capability and facilities to perform work according to the specifications in their contract. Quality Assurance audits are performed to inspect the laboratory facilities and operations, to ensure 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 QAPjP from laboratories consist of standard practices that ensure that the laboratory is performing high quality work. Each QAPjP prepared for WSSRAP is in accordance with the current *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA 1980). The laboratories demonstrate compliance with additional QA/QC requirements as specified in their contracts which includes: sample preparation and analytical methods; calibration of instrumentation; periodic inspection, maintenance and servicing; statistical procedures to control precision and accuracy; corrective action programs; participation in external EPA Performance Audit Program; maintenance and storage of WSSRAP records; hardcopy and electronic formatting; and notification of nonconforming issues.

The laboratories SOPs consist of detailed information about internal policy on standard analytical protocol on methods. These SOPs instruct the analyst on how to exactly perform the analytical work and how to calculate, reduce, and record pertinent information about analysis.

Accuracy of all chemical and radiological analyses of water media samples will be monitored by the routine use of control samples. This is a requirement of many published protocols (i.e., EPA) and is good laboratory practice. A quarterly *Quality Assurance Summary Report* will be prepared to determine the accuracy and precision of water media samples and to determine if the frequency of collection of QC samples is being maintained. This information will be summarized in the ASER.

Detailed information on the PMC laboratory evaluations program can be found in Section 10.2, Environmental Monitoring Program Quality Assurance, the WSSRAP *Environmental Data Administration Plan* (EDAP) (MKF and JEG 1992d), and various ES&H Department procedures. These programs give information about sample collection, data administration and management programs necessary to make the overall WSSRAP laboratory program accurate and reliable to the data users.

7 QUALITY ASSURANCE

Quality assurance (QA) for environmental monitoring activities at the Weldon Spring site (WSS) is divided into two separate categories. The first, programmatic or overall project QA, 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.

7.1 Programmatic Quality Assurance

The Weldon Spring Site Remedial Action Project (WSSRAP) is obligated to comply with DOE Order 5700.6C and 10 criteria of American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance Program-1 (NQA-1-1989). 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, Morrison Knudsen Corporation has prepared a corporate *NQA-1 Quality Assurance Manual* (MKC 1991) which addresses's the requirements of NQA-1. This corporate plan is consistent with the 18-element format of NQA-1. In addition to this corporate plan, the Project Management Contractor (PMC) has prepared a project specific *Project Management Contractor Quality Assurance Program* (MKF and JEG 1992f) which details how the various aspects of NQA-1 and MK-Ferguson's Quality Assurance Program, as described in the corporate QA manual, will be implemented at the WSS. This QAP has been reviewed and approved by project management, the Project Quality Manager, and the U.S. Department of Energy (DOE) Project Manager.

The QAP details numerous ASME NQA-1 requirements which support, control, or guide the environmental monitoring program. These requirements include: documented project organization, a documented 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 audit program. QA procedures detail implementation of these requirements. Specific procedures include: SQP-1, *Site Wide Audit Tracking System*, SQP-2, *Quality Assurance Surveillance* SQP-7a, *Quality Assurance Records*, SQP-14a, *Nonconformance and Corrective Action*, and SQP-18a, *Independent Assessments*.

The WSSRAP also has prepared an *Environmental Quality Assurance Project Plan* (EQAPjP) (MKF and JEG 1992g) to meet the intent of EPA QAMS 005/80. This document supports the project QAP and is specific to environmental monitoring and characterization. The QAP and EQAPjP were revised to meet the requirements of DOE Order 5700.6C in 1992. Root cause analysis and lessons learned are addressed in QA SOPs which were completed in 1992.

7.2 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 self assessments; and auditing and evaluating analytical laboratories, sample collection activities, and programmatic procedures. Each of these items will be discussed in the following subsections.

7.2.1 Standard Operating Procedures

Standard operating procedures (SOPs) 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 (EPA) and DOE guidance and from standard industry practices and are specific to the WSS. Procedures at the WSS 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 ASME NQA-1. Procedures are reviewed at least annually and revised as appropriate.

Personnel undergo training specific to their responsibilities, varying from procedure review, through classroom training, and "hands on" training under the supervision of a qualified individual. This training is tracked through the use of a training matrix. Each manager prepares a unique subset of procedures for each individual from a list of all site procedures. Training records are maintained by the Productivity Improvement Coordinator. As procedures are revised, the matrices are updated and personnel are retrained.

SOPs applicable to environmental monitoring activities at the WSSRAP are listed in Table 7-1. These procedures cover all activities from groundwater sampling through chain-of-custody samples and provide detailed instructions to monitoring personnel.

7.2.2 Quality Control Samples

Numerous QC samples are collected in support of environmental monitoring activities. QC samples are collected in accordance with procedure ES&H 4.1.4. These include: duplicate samples, replicate samples, blank samples, and rinsate samples. Samples are also provided to the laboratory for internal laboratory quality control evaluations specific to sample media (matrix spikes and matrix spike duplicate/matrix duplicate samples). Table 7-2 presents a summary of the various quality control samples that will be collected to support environmental monitoring activities.

QC samples will be collected for each defined matrix. The matrices associated with the EMP samples are the Weldon Spring quarry (WSQ) groundwater, the St. Charles well field groundwater, the WSQ surface water, the Weldon Spring Chemical Plant (WSCP) groundwater, and the WSCP surface water. QC samples are also collected for National Pollutant Discharge Elimination System (NPDES) samples and airborne radiological monitoring programs.

Quarterly Quality Assurance Summary Reports will be prepared to summarize QC data and evaluate the performance of the WSSRAP data collection and analysis program. The *Quarterly Quality Assurance Summary* will also determine the precision and accuracy by matrix to determine the variability of the analyses.

Contracted laboratories will be required to submit for review all applicable performance evaluation samples from external programs, such as the EPA Environmental Monitoring Systems Laboratory (EMSL) and DOE environmental measurements laboratory (EML) programs. Evaluation of performance evaluation samples will be made by the PMC during laboratory audits to determine if quality control is being met by the contracted laboratories.

7.2.3 Analytical Methods

Standardized analytical methods, procedures, and protocols that are used to analyze samples collected for the EMP are contained in Appendix B. These standardized analytical

TABLE 7-1 Procedures Applicable to Environmental Monitoring Activities

Procedure Number	Procedure Title
ES&H 1.1.7	Reporting Above Normal Values from Environmental Monitoring Networks
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 4.1.4	Quality Control Samples for Aqueous and Solid Matrices
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 4.4.5	Soil/Sediment Sampling
ES&H 4.5.1	Ph and Temperature Measurements in Water
ES&H 4.5.2	Specific Conductance Measurement in Water
ES&H 4.5.7	Measurement of Settleable Solids
ES&H 4.5.8	Water Sampling Filtering
ES&H 4.6.1	Area TLD Deployment for Environmental Sampling
ES&H 4.6.2	Radon Concentrations Measurement in Ambient Air
ES&H 4.6.4	Constant Flow Air Sampler Operation and Sample Filter Handling
ES&H 4.6.6	Constant Flow High Volume Air Sampler Operation and Sample Filter Handling
ES&H 4.9.1	Environmental Monitoring Data Verification
ES&H 4.9.2	Environmental Monitoring Data Validation
CM&O-15	Task-specific Safety Assessments
RC-30	Monitoring Well Waste Management

TABLE 7-2 Field Quality Control Sample Summary

QC Sample Type	Frequency	Purpose
Matrix Spike/Matrix Spike Duplicate or Matrix Duplicate	*1 per 20 or 1 per 14 days	Assess matrix and possible intralaboratory variability
Blind Duplicate/Secondary Duplicate	1 per 20	Assess matrix intralaboratory and interlaboratory variability.
Replicate	*1 per 20	Assess matrix and intralaboratory variability
Equipment Blank (non-dedicated equipment only)	1 per 20	Assess effectiveness of decontamination
Distilled Water Blank **	1 per month	Assess quality of distilled water
Trip Blank	1 per day when analyzing for VOAs	Assess potential cross-contamination during shipping
Field Blank**	1 per month	Assess impact of ambient conditions on samples

* Whichever is of higher frequency.
** Collected together on the same day.

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 SOPs received from contracted laboratories or by revisions to the WSS SOPs. Variations of contracted laboratories' SOPs are approved and controlled by the Project Quality Department. Appendix B also has a summary of the required detection limits, as well as accuracy and precision requirements and is taken from the *Environmental Data Administration Plan* (EDAP) (MKF and JEG 1992d).

7.2.4 Data Management Activities and Data Quality Evaluations

Overall environmental data management activities for the Weldon Spring site are detailed in the EDAP (MKF and JEG 1992d). The EDAP provides guidance for the development of sampling plans, describes data management activities, and details general data quality requirements. These general data quality goals have been adopted for this monitoring program. The primary activities associated with this environmental monitoring program include data verification, database management, and data validation. These programs document the quality of data generated by on-site and off-site analyses of samples.

Data verification is the WSSRAP's 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 that are generated by analytical laboratories and are part of the EMP are verified. The verification process consists of reviewing accounting aspects, reviewing sampling documentation and chain-of-custody documentation, comparing actual holding times to method specified holding times, and a review of the data for comparability with historical results. All of these activities are documented according to procedure ES&H 4.9.1.

Following completion of data verification, data are merged into the site 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 data base 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 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 data generated. Approximately 5% of these data are randomly selected by the laboratory coordinator. An additional 5% are selected for validation based on the data review. Validation activities provide the WSSRAP with qualified data. 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.

7.2.5 Quality Assurance Records

Records generated as a result of environmental monitoring are maintained as QA records. Field Sampling Forms, analytical data, equipment calibration records, and verification and validation documentation records are all considered quality assurance records and are maintained by the Project Quality Department in accordance with the requirements of SQP-7a. This provides both security and protection to these critical records.

7.2.6 Self Assessments

Consistent with DOE Order 5482.16, the WSSRAP has developed a formal self-assessment program. This program is detailed in WSSRAP procedure MGT-1. Implementation of this procedure requires that all departments perform a self assessment at least annually. Self assessments are scheduled and tracked by the Project Quality Department and are performed by a team led by the manager of the department being assessed. A report that summarizes the areas evaluated and the assessment results is prepared following each self assessment. Findings and proposed corrective actions are tracked according to the Site Wide Audit Tracking System (SWATS) (SQP-1a).

7.2.7 Audits

Three aspects of the WSSRAP are audited to evaluate the quality-related activities of the Environmental Monitoring Program. These include analytical laboratories, sample collection activities, and programmatic procedures.

Analytical laboratories performing analyses for the WSS are audited annually. These audits are directed by a lead auditor from the Project Quality Department, with support provided by a select team of site personnel who have with knowledge of analytical methods and procedures. These audits focus on compliance with the specifications of the contract, the project-specific *Quality Assurance Project Plan* (QAPjP) prepared by the laboratories prior to performing sample analysis, and with laboratory-specific procedures and policies. An audit report is generated and corrective actions tracked by the Project Quality Department.

The Project Quality Department routinely audits site operations, including environmental monitoring activities. These audits evaluate compliance with project-specific procedures. As with all other audits, an audit report is generated and corrective actions are tracked by the Project Quality Department. The Project Quality Department also reviews and approves all new and revised SOPs to ensure that SOPs comply with quality related activities.

The Weldon Spring site is also routinely audited by numerous external entities including DOE - Headquarters and DOE - Oak Ridge. These audits assess compliance with applicable regulations, DOE orders guidance, site plans, and procedures. Formal reports and corrective actions are tracked using the Site Wide Audit Tracking System (SWATS).

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DOE ORDERS

5400.1 *General Environmental Protection Program*

5400.5 *Radiation Protection of the Public and the Environment*

5400.3A *Occurrence Reporting and Processing of Operations Information*

5482.1B *Environment, Safety, and Health Appraisal Program*

5484.1 *Environmental Protection, Safety, and Health Protection Information Reporting Requirements*

PROCEDURES

ES&H 1.1.7a *Reporting Above Normal Values from Environmental Monitoring Networks*

ES&H 2.6.4 *Ludlum Model 2000 Scaler and Model 43-10 Detector: Gross Alpha Measurement Operation and Calibration*

ES&H 2.6.7s *Calibration and Operation of the HT-1000 Low Background Gas Flow Proportional Counter*

ES&H 4.1.1a *Environmental Numbering System*

ES&H 4.1.2s *Chain of Custody*

ES&H 4.1.3s *Sampling Equipment Decontamination*

ES&H 4.1.4s *Packaging and Shipping Requirements for Non-regulated Samples*

ES&H 4.3.1s *Surface Water Sampling*

ES&H 4.4.1s *Groundwater Sampling*

ES&H 4.4.2s *Groundwater Level Monitoring and Well Integrity Inspections*

ES&H 4.4.5s *Soil/Sediment Sampling*

ES&H 4.5.1s *pH and Temperature Measurements in Water*

ES&H 4.5.2s *Specific Conductance Measurement in Water*

ES&H 4.5.7s *Measurement of Settleable Solids*

ES&H 4.5.8s *Water Sampling Filtering*

ES&H 4.6.1s *Area TLD Deployment for Environmental Sampling*

ES&H 4.6.2s *Radon Concentrations Measurement in Ambient Air*

ES&H 4.6.4s *Constant Flow Air Sampler Operation and Sample Filter Handling*

ES&H 4.6.6s *Constant Flow High Volume Air Sampler Operation and Sample Filter Handling*

ES&H 4.8.3s *The WSSRAP Meteorological Monitoring Station*

ES&H 4.9.1a *Environmental Monitoring Data Verification*

ES&H 4.9.2a *Environmental Monitoring Data Validation*

CM&O-15a	*Task-specific Safety Assessments*
RC-30s	*Monitoring Well Waste Management*

APPENDIX A
Environmental Monitoring Plan Guidance Requirements

1.0 INTRODUCTION

1.1 As required in the Environmental Monitoring Requirements section of DOE 5400.1, all DOE sites should* develop and maintain documentation concerning their environmental protection programs in the form of environmental monitoring plans.

The WSSRAP has prepared this *Environmental Monitoring Plan* (EMP) to meet the requirements for U.S. Department of Energy (DOE) environmental monitoring programs as specified in DOE Orders 5400.1 and 5400.5 and the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*.

1.2 These required plans should* clearly describe how the minimum requirements in this document are to be met and how compliance will be ensured.

This *Environmental Monitoring Plan* defines the effluent monitoring and environmental surveillance required to comply with applicable Federal, State, and local environmental protection laws and regulations, Executive Orders, and internal DOE policies. The EMP is made available to the State and Federal regulatory agencies.

1.3 In meeting the minimum requirements, each site should* also consider the guidance provided in this document as "should" statements and document the specific procedural criteria that are adopted.

An evaluation of the applicability or nonapplicability of should* guidance provided in the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* has been included in the *Environmental Monitoring Plan for Calendar Year 1993* in accordance with the above-referenced guide. Other recommendations have been evaluated and included in this document where applicable.

2.0 LIQUID EFFLUENT MONITORING

2.1 All liquid effluent streams from DOE facilities should* be evaluated and their potential for release of radionuclides assessed.

Section 2.2 and 2.2.1. All liquid effluent streams have been and/or will be assessed. The effluent streams are monitored under the provisions of the Weldon Spring Site Remedial Action Project (WSSRAP) National Pollutant Discharge Elimination System

(NPDES) permits. The effluent streams include five storm water outfalls, two water treatment plant discharges, two hydrostatic test water discharge points, and one sanitary wastewater treatment plant discharge.

2.2 The results of this assessment provide the basis for the facility's Effluent Monitoring Program (DOE 5400.5), which should* be documented in the site Environmental Monitoring Plan (as described in DOE 5400.1)

Section 4. The results of the assessments provide the basis for the EMP as noted in section 4 of the EMP. The NPDES permits provide the basic monitoring program which has been expanded to form the complete effluent monitoring program.

2.3 Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination should* be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.

Section 4.1. The WSSRAP is not an operating facility. Storm water discharges average below the derived concentration guideline (DCG) for uranium. Discharges that have a potential for radioactive contamination (site and quarry water treatment plants) will be sampled and analyzed before discharge is allowed. If the water does not meet the NPDES limits, it will be retreated and retested.

2.4 Facility operators should* provide monitoring of liquid waste streams adequate to 1) demonstrate compliance with the applicable requirements of DOE 5400.5, Chapter II, paragraphs 1a, 1d, 2a, and 3, 2) quantify radionuclides released from each discharge point, and 3) alert affected process supervisors of upsets in processes and emission controls.

Section 4.1. No process water is discharged from the WSSRAP; however, storm water, construction water, treated water, etc. is monitored to satisfactorily demonstrate compliance with DOE Order 5400.5 Chapter II, paragraphs 1a, 1d, 2a, and 3, and quantify radionuclides. The water treatment plants discharge to holding ponds will be batch tested and released only if compliance is met.

2.5 When continuous monitoring or continuous sampling is provided, the overall accuracy of the results should* be determined (±% accuracy and the % confidence level) and documented in the Environmental Monitoring Plan.

Section 4.1.3.1. The only continuous monitoring that occurs is for flow monitoring at NPDES outfalls NP-0002, NP-0003, NP-0005, NP-0007, and NP-1001 and the two hydrostatic test water permitted discharges.

2.6 **In addition, provisions for monitoring of liquid effluents during an emergency should* be considered when determining routine liquid effluent monitoring program needs.**

Section 4.1.3.2. Emergency monitoring of liquid effluents is performed in the event that contaminated water is accidentally released before treatment or in the event of spills.

2.7 **In addition, the selection or modification of a liquid effluent monitoring system should* be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.**

Section 2.2. The rationale for the liquid effluent monitoring program includes a characterization of the sources, pollutants, sample collection systems, treatment systems, and final release points. The NPDES permits also partially prescribe the parameters to be monitored.

2.8 **For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a pre-operational assessment should* be made and documented in the Environmental Monitoring Plan to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.**

Section 4.1 and Table 4.1. The WSSRAP is not an operating facility; therefore, there are no process effluents. There have been, however, assessments made to determine storm water and treated water flows and characteristics.

2.9 **The performance of the effluent monitoring systems should* be sufficient for determining whether effluent releases of radioactive material are within the Derived Concentration Guides (DCGs) specified in DOE 5400.5 and to comply with the reporting requirements of Chapter II, paragraph 7, of that Order.**

Section 4.1 and 7. The effluent monitoring systems are sufficient to determine if the effluent releases are within the DCGs described in DOE Order 5400.5.

2.10 The required detection levels of the analysis and monitoring systems should* be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.

Section 7.2.3 and Appendix B. Required detection levels are adequate for NPDES monitoring and to demonstrate compliance with all regulatory requirements.

2.11 Sampling systems should* be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.

Section 4.1. Sampling of liquid effluents are performed in accordance with WSSRAP standard operating procedures (SOPs) in order to provide representative samples, to predict trends, record releases, and to quantify releases.

2.12 Continuous monitoring and sampling systems should* be calibrated before use and recalibrated any time they are subject to maintenance, modification or system changes that may affect equipment calibration.

Section 4.1.3.1. The only continuous monitoring systems for effluents are the flow meters at NP-0002, NP-0003, and NP-0005 and the flow meters to be used in the future at the site and quarry water treatment plants.

2.13 In addition, they should* be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.

Section 4.1.3.1. The flow meters will be recalibrated at least annually and will be routinely checked in accordance with WSSRAP SOPs.

2.14 Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) should* be considered when locating sampling and monitoring systems to avoid conditions that will influence the operation of the system.

Flow meters and automatic water samplers are the only sampling and monitoring systems and are designed for use under the existing conditions at the WSSRAP.

2.15 Off-line liquid transporting lines should* be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.

This statement does not apply. The only off-site liquid transporting lines will be from the site and quarry water treatment plants. These lines will transport treated water that is sampled before entering the lines to ensure its composition.

2.16 If continuous monitoring/sampling and recording of the effluent quantity (stream flow) is not feasible for a specific effluent stream, the extenuating circumstances should* be documented in the Environmental Monitoring Plan.

This statement does not apply. Two storm water outfalls do not have continuous flow monitoring. Outfall NP-0004 is normally dry and is a very shallow swale. Outfall NP-0001 is an abandoned process sewer that collects surface water via infiltration. The flows are very low and normally non-existent making it impractical to use continuous monitoring.

2.17 Sampling/monitoring lines and components should* be designed to be compatible with the chemical and biological nature of the liquid effluent.

Section 4. The liquid effluent is water, which is compatible with sampling/monitoring lines and components.

2.18 The output signal instrumentation, monitoring system recorders, and alarms should* be in a location that is continuously occupied by operations or security personnel.

This statement does not apply. There are no industrial processes. When the site and quarry water treatment plants begin operation, they will be manned 24 hours a day; however, there will not be a continuous release of treated water. Water will only be released in batches after it is tested and found to be under permitted limits.

2.19 To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems are required, they should* have alarms set to provide timely warnings.

This statement does not apply. There is continuous monitoring of effluent related to public exposure since the WSSRAP is not an operating facility.

2.20 As they apply to the monitoring/sampling of liquid effluents, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. All sampling and monitoring activities are performed in accordance with the general quality assurance program provisions.

3.0 AIRBORNE EFFLUENT MONITORING

3.1 All airborne emissions from DOE-controlled facilities [(a)] should* be evaluated and their potential for release of radionuclides assessed.

Section 4.2.1. The WSSRAP has two diffused sources of airborne radiological emissions: the Weldon Spring Chemical Plant Weldon Spring raffinate pits (WSCP/WSRP) and the Weldon Spring quarry (WSQ). An assessment of the two diffused sources was conducted and included documenting the different radionuclides that could potentially be released and their concentrations. The assessment also addressed the factors that could potentially contribute to the suspension of contaminants.

3.2 The potential for emissions should* include consideration of the loss of emission controls while otherwise operating normally.

Section 4.2.1. Normal operations, consisting of remediation activities, will result in limited emissions due to the disturbance of soils and materials. Engineering controls, including water spraying, leaning of surfaces prior to movement, and high efficiency particulate air (HEPA) filtration, have been incorporated into the remediation activities in order to prevent uncontrolled emissions.

3.3 The results of this evaluation also provide the basis for the site's effluent monitoring program (as discussed in DOE 5400.5), which should* be documented in the site Environmental Monitoring Plan (as discussed in DOE 5400.1).

Section 4.2.1. The airborne emissions assessment provided a basis for the airborne emissions monitoring program and ensures that the design of the plan would provide timely, representative, and adequately sensitive monitoring results in accordance with DOE Orders 5400.1 and 5400.5 and the *Regulatory Guide*.

3.4 Airborne emissions from DOE-controlled facilities that have the potential for causing doses exceeding 0.1 mrem (effective dose equivalent) to a member of the public under realistic exposure conditions from emissions in a year should* be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.

Section 4.2. Although the estimated exposures form the WSCP/WSRP and the WSQ are predicted to be low, the emissions monitoring program is tailored for the low potential for exposure and in accordance with DOE Orders 5400.1 and 5400.5 and the *Regulatory Guide*.

3.5 The criteria listed in Table 3-1 should* be used to establish the airborne emission monitoring program for DOE-controlled sites.

Section 4.2. The WSSRAP airborne emissions monitoring plan has taken into account the criteria for monitoring the emissions with respect to the calculated maximum dose from emissions in a year to members of the public.

3.6 For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a pre-operational assessment should* be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of airborne emissions to be expected from the facility, and to establish the associated airborne emission monitoring needs of the facility.

Section 4.2.1. Engineering controls will be employed to minimize levels to those which are as low as reasonably achievable (ALARA) and a particle size analysis is to be performed annually to determine the expected particle size comprising the effluents.

3.7 The performance of the airborne emissions monitoring system should* be sufficient for determining whether the releases of radioactive materials are within the limits or requirements specified in DOE 5400.5.

Section 4.2.2. The airborne emissions monitoring system is divided into three sections: site specific monitoring, site perimeter monitoring, and critical receptor monitoring at both the WSCP/WSRP and the WSQ. This three staged approach is designed to monitor the smaller sources in order to discern each sources contribution to the total amount of airborne emissions from either the WSCP/WSRP or the WSQ. This approach will allow for quicker remedial action in the event elevated emissions are indicated at a specific work area, and in order to remain in compliance with the limits or requirements specified in DOE Order 5400.5.

3.8 Sampling and monitoring systems should* be calibrated before use and recalibrated any time they are subject to maintenance or modification that may affect equipment calibration.

Section 4.2.2.1, 4.2.2.2, and 4.2.2.3. Sampling systems are calibrated in accordance with WSSRAP SOPs and manufacturers specifications.

3.9 Sampling and monitoring systems should* be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.

Section 4.2.2.1, 4.2.2.2, and 4.2.2.3. Monitoring systems are calibrated as stated in item 3.8, above.

3.10 Provisions for monitoring of airborne emissions during accident situations should* be considered when determining routine airborne emission monitoring program needs.

Section 4.2.2.1. Three air monitoring programs are utilized at the WSSRAP to monitor site specific areas, perimeter areas, and critical receptors. Site specific monitoring , in addition to providing data concerning the contributions of specific activities to the total airborne inventory, will provide faster feed back concerning the effectiveness of engineering controls and data concerning dispersion patterns. Filters from site-specific monitors will be collected on a daily basis as compared to weekly for the perimeter samplers in order to assess the possibility of accidental release of airborne contaminants. Site-specific monitoring will be utilized during remediation activities at the WSQ. Monitors will be placed immediately outside the work areas based on current meteorological conditions to assess airborne emissions from specific activities and areas within the WSQ.

3.11 Diffuse sources should* be identified and assessed for their potential to contribute to public dose and should* be considered in designing the site effluent monitoring and environmental surveillance program.

Section 4.2.1. Two diffuse sources have been identified at the WSSRAP: the WSCP/WSRP and the WSQ. To effectively monitor these two diffuse sources, three air monitoring programs will be utilized to monitor the site-specific areas, the perimeter areas, and the critical receptors. These areas were used to determine the locations, equipment, sampling time, minimum detection levels, accuracy, and investigation levels for each program. These programs are designed to meet the requirements of DOE Orders 5400.1 and 5400.5 and the *Regulatory Guide*.

3.12 Diffuse sources that may contribute a significant fraction (e.g., 10%) of the dose to members of the public resulting from site operations should* be identified, assessed, documented, and verified annually.

Section 4.2.1. Two diffuse sources, the WSCP/WSRP and the WSQ, are monitored under the airborne effluent and environmental surveillance program due to their potential to contribute a significant fraction of the dose to members of the public. These sources are evaluated annually in the *Environmental Monitoring Plan* which is revised annually for the WSSRAP.

3.13 Airborne emission sampling and monitoring systems should* demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.

Section 4.2.2. The employment of site specific monitoring will ensure that response to elevated airborne emission will be timely, representative, and adequately sensitive.

3.14 However, where a significant potential (greater than once per year) exists for approaching or exceeding a large fraction of the emission standard (e.g., 20%), continuous monitoring should* be required.

Section 4.2.2. Although it is not expected that airborne emissions will exceed the emission standard, continuous monitoring is performed at the site perimeter and at the critical receptor locations. Continuous monitoring is performed during work hours at site specific locations.

3.15 Design of systems such that replacement of sorbent and filter should* not disturb the geometry between the collector and detectors.

Radioiodine monitors which require the replacement of sorbent and filter are not employed at the WSSRAP. The WSSRAP utilizes portable air samplers, mass flow meters, gas-flow proportional detectors, and alpha-scintillation detectors.

3.16 To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems (as required by the criteria in Table 3-1) are required, they should* have alarms set to provide timely warnings.

Continuous monitors are not utilized at the WSSRAP for the monitoring of airborne effluent. Receptor samplers at critical receptor locations are used to assess the airborne effluents at these locations.

3.17 As they apply to the monitoring of airborne emissions, the general quality assurance program provisions discussed in Chapter 10 should* be followed.

Quality control (QC) procedures which are implemented as part of the airborne effluent and environmental monitoring program include calibration of instruments, source and background counts, recounts of samples, review of documentation, and use of documented SOPs. Additional quality assurance/quality control (QA/QC) procedures which are employed in this program include duplicated, spikes, chain-of-custody and laboratory authorization forms, field sheets, and review of vendor data all in accordance with WSSRAP SOPs.

4.0 METEOROLOGICAL MONITORING

4.1 Each DOE site (facility)[a] should* establish a meteorological monitoring program that is appropriate to the activities at the site, the topographical characteristics of the site, and the distance to critical receptors.

Section 5. The WSQ is located approximately 4 km (2.4 mi) south-southwest of the WSCP/WSRP area. The WSQ is located 200 m (650 ft) above Mean Sea Level (MSL) and the WSCP/WSRP is located 153 m (500 ft) above MSL. It has been determined that the WSQ and the WSCP/WSRP meteorological conditions do not differ significantly and do not require separate meteorological monitoring stations. The meteorological monitoring station is located at eastern edge of the WSCP/WSRP and is more than 122 m (400 ft) from the nearest building.

4.2 The scope of the program should* be based on an evaluation of the regulatory requirements, meteorological data needed for impact assessments, environmental surveillance activities, and emergency response.

Section 5. The meteorological information is used to support many WSSRAP environmental surveillance programs functions such as dispersion and diffusion modeling, ecological studies, hydrological analyses, and emergency response actions.

4.3 The site's meteorological program should* be documented in a meteorological monitoring section of the Environmental Monitoring Plan (DOE 5400.1).

Section 5. The Meteorological Program, consisting of parameters measured, instrumentation, and computer programs and models, is reviewed annually and documented in the EMP.

4.4 For data from an off-site source to be acceptable, the data should* be representative of conditions at the DOE facility and provide statistically valid data consistent with on site monitoring requirements.

The meteorological data utilized at the WSSRAP is obtained from an on-site meteorological monitoring station.

4.5 Specific meteorological information requirements for each facility should* be based on the magnitude of potential source terms, the nature of potential releases from the facility, possible pathways to the atmosphere, distances from release points to critical receptors, and the proximity of other DOE facilities.

Section 2. The exposure pathway analysis was performed by initially determining the potential exposure routes and the factors to be considered and then using site specific factors, determining those routes which will be evaluated in the environmental surveillance program. The meteorological measurements and frequencies were determined based on these criteria.

4.6 Meteorological information requirements for facilities should* be sufficient to support environmental monitoring and surveillance programs.

Section 5. Meteorological information requirements take into account the information required to support the environmental monitoring and surveillance programs as outlined in Item 4.3.

4.7 The meteorological monitoring program for each DOE site should* provide the data for use in atmospheric transport and diffusion computations that are appropriate for the site and application.

Section 5. Meteorological monitoring station data provides information pertinent to dispersion and diffusion modeling to supplement critical receptor monitoring in the event of an airborne release. The computer programs CAP-88 and ISCST2, employed with information from the monitoring station, are plume dispersion models designed to provide a schematic view of dispersion at the WSSRAP.

4.8 Before any model is deemed appropriate for a specific application, the assumptions upon which the model is based should* be evaluated and the evaluation results documented.

Section 5. The WSSRAP will use the programs CAP-88 or ISCST2 if necessary. These models are based on the assumptions of steady-state Gaussian principles.

4.9 Meteorological programs for sites where on site meteorological measurements are not required should* include a description of climatology in the vicinity of the site and should* provide ready access to representative meteorological data.

Meteorological measurements are required for activities performed at the WSSRAP.

4.10 Potential release modes, distances from release points to receptors, and meteorological conditions should* be considered in assessments for DOE facilities required to take on-site measurements.

Section 2 and 5. An exposure pathway analysis was performed by initially determining the potential exposure routes and the factors to be considered and then using site-specific factors to determine those routes which will be evaluated in the environmental surveillance program. Meteorological conditions, such as prevailing wind direction and speed, are taken into account in the determination of on-site measurements required.

4.11 Meteorological measurements should* be made in locations that, to the extent practicable, provide data representative of the atmospheric conditions into which material will be released and transported.

Section 5. The meteorological monitoring station is located at the Weldon Spring site (WSS) and, therefore, provides adequate information regarding the media into which material may be released and transported at both the WSCP/WSRP and the WSQ.

4.12 The instruments used in the monitoring program should* be capable of continuous operation in the expected range of atmospheric conditions at the facility.

Section 5. Measurements for wind speed and direction, horizontal wind fluctuation, ambient air temperature, barometric pressure, and precipitation intensity and accumulation are collected and stored every 60 sec. The 1-min recordings are averaged once per hour and the data downloaded daily to a remote computer. Real-time data can also be obtained to aid site personnel observing and analyzing the dispersion of potentially released airborne material during and after an incident.

4.13 Wind measurements should* be made at a sufficient number of heights to adequately characterize the wind at potential release heights.

The wind speed and direction sensors are mounted 10 m (33 ft) above ground level. Sensors at greater heights are unnecessary since potential releases of airborne emissions are at, or near, ground level.

4.14 The meteorological monitoring program should* provide for routine inspection of the data and scheduled maintenance and calibration of the meteorological instrumentation and data-acquisition system at a minimum, based on the calibration frequency recommendations of the manufacturers.

Section 5. Inspection and maintenance of the meteorological monitoring station, daily review of meteorological data, and semi-annual calibration of the instrumentation are documented and performed in accordance with ES&H Procedure 4.8.3.

4.15 Inspections, maintenance, and calibrations should* be conducted in accordance with written procedures, and logs of the inspections, maintenance, and calibrations should* be kept and maintained as permanent records.

Section 5. Inspection and maintenance of the meteorological monitoring station, daily review of meteorological data, and semi-annual calibration of the instrumentation are documented and performed in accordance with Procedure ES&H 4.8.3.

4.16 The instrument system should* provide data recovery of at least 90% on an annual basis for wind direction, wind speed, those parameters necessary to classify atmospheric stability, and other meteorological elements required for dose assessment.

Section 5. The instrument system is expected to provide 90% data recovery on an annual basis based on inspection and maintenance of equipment in accordance with Procedure ES&H 4.8.3.

4.17 The topographic setting of a facility and the distances from the facility to points of public access should* be considered when evaluating the need for supplementary instrumentation.

Supplementary instrumentation is not necessary due to the determination by a certified meteorologist that the WSCP/WSRP and the WSQ do not have differing meteorological conditions.

4.18 If meteorological measurements at a single location cannot adequately represent atmospheric conditions for transport and diffusion computations, supplementary measurements should* be made.

Supplementary instrumentation is not necessary due to the determination by a certified meteorologist that the WSCP/WSRP and the WSQ do not have differing meteorological conditions.

4.19 A site-wide meteorological monitoring program should* be established at each multifacility site to provide a comprehensive database that can be used for all facilities located within the site.

The WSSRAP is not a multifacility site and the meteorological condition for the WSCP/WSRP and the WSQ have been determined to be similar.

4.20 As they apply to meteorological monitoring, the general quality assurance program provisions described in Chapter 10 should* be followed.

Section 5. Inspection and maintenance of the meteorological monitoring station, daily review of meteorological data, and semi-annual calibration of the instrumentation are documented and performed in accordance with ES&H Procedure 4.8.3.

5.0 ENVIRONMENTAL SURVEILLANCE

5.1 An evaluation should* be conducted and used as the basis for establishing an environmental surveillance program for all DOE-controlled sites.

Section 2. The WSSRAP Environmental Monitoring Program has been established and modified yearly as a result of the evaluation of environmental conditions, pathway analyses, and Federal, State, and local laws and environmental protection regulations, Executive Orders, and internal DOE policies.

5.2 The results of this evaluation should* be documented in the site Environmental Monitoring Plan (as required by DOE 5400.1).

Sections 3 and 7. This *Environmental Monitoring Plan* summarizes the environmental surveillance sampling or measurement locations for both the WSCP/WSRP and the WSQ sites and the minimum required analyses or measurement frequencies for these locations in order to adequately ensure the protection of the public and the environment. These locations are sampled or measured in accordance with documented SOPs which incorporate U.S. Environmental Protection Agency (EPA) and DOE guidance and standard industry practices. The minimum detection level and accuracy of the analyses or measurements are in accordance with Federal, State, and local laws and environmental protection regulations, Executive Orders, and internal DOE policies. The quality of the Environmental Monitoring Program is maintained and documented by SOPs, quality control samples, performance audit samples, standardized analytical methods, data management, data quality evaluations, quality assurance records, self assessments, laboratory audits, and quality audits. If above normal or anomalous data values are suspected after review of data, written SOPs regarding actions and reporting are employed.

5.3 The environmental surveillance program for DOE-controlled sites should* be conducted in accordance with the requirements of DOE 5400.1 and DOE 5400.5.

Section 3. The environmental surveillance program has been prepared to meet the requirements for DOE environment monitoring programs as specified in DOE Orders 5400.1 and 5400.5 and the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, as well as applicable Federal, State, and local laws and environmental protection regulations.

5.4 The criteria for environmental surveillance programs (listed in Table 5-1) should* be used for establishing the environmental surveillance program for DOE-controlled sites.

Section 3. Criteria listed in Table 5-1 of the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* were used in the establishment of the environmental surveillance program and are further discussed in items 5.6 through 5.10.

5.5 Any additional site-specific criteria should* be documented in the site Environmental Monitoring Plan.

Additional site specific criteria which effect or alter the criteria listed in Table 5-1 are documented in the *Environmental Monitoring Plan* and discussed in items 5.6 through 5.10.

5.6 When feasible, all environmental media that, as determined by site-specific radiation exposure pathway analysis, might lead to a measurable annual dose of site origin at the site boundary should* be routinely sampled and analyzed (for the critical radionuclides to dose) and routine measurements of penetrating radiation should* be performed at those sites that, as determined by site-specific exposure pathway analysis, might result in an annual dose of site origin at the site boundary, if the total exceeds a) 5 mrem effective dose equivalent; or b) 100 person-rem collective effective dose equivalent within a radius of 80 km of a central point in the site.

Sections 3 and 4.2. Measurements are made as determined by the site specific pathway analysis within the site boundaries, at the site boundaries, and at points outside the site boundaries as outlined in the previously mentioned Sections.

5.7 Environmental surveillance measurements may be performed periodically, but should* be performed at least every five years, to confirm the low dose levels, if the projected annual effective dose equivalent of site origin is $\leq$0.1 mrem.

Sections 3 and 4.2. Environmental surveillance is performed on a regular basis as specified in the previously mentioned sections.

5.8 Actual measurements on two media for each critical radionuclide/pathway combination, one of which might be the effluent stream, should* be performed as part of the site routine effluent monitoring and environmental surveillance program.

Measurements on two media for each critical radionuclide/pathway combination are not necessary due to extensive characterization of the media and historic monitoring. The *Environmental Monitoring Plan* has been designed to take into account the radionuclide/pathway combinations requiring environmental surveillance.

5.9 Use of data should* be based on statistically significant differences between the point of measurement and background (or control) data.

Background sampling or measurement locations have been established for all pathway media at both the WSCP/WSRP and the WSQ. In an agreement with the U.S. Geological Survey (USGS), the DOE has established background for the Missouri River Alluvium by the sampling of seven temporary wells installed by the USGS. These wells are to be sampled during 1992 and then abandoned by the USGS; therefore, routine sampling is not possible. Background locations for both the Little Femme Osage Creek and the Missouri River are monitored routinely. Background for groundwater at the WSCP/WSRP is based on the results of an ongoing sampling program by the Missouri Department of Health (MDOH). Private drinking water wells in the vicinity of the WSCP/WSRP are routinely monitored by that department and the results provided to the WSSRAP, therefore, these locations are not routinely monitored as background locations. Several lakes in the Busch Wildlife Area and Dardenne Creek are sampled routinely as background locations for surface waters near the WSCP/WSRP. The Draft Remedial Investigation (RI) for the WSS has established statistical background levels for chemical constituents at the WSS. Five background air monitors are monitored routinely to establish background levels for the WSCP/WSRP and the WSQ. These monitors are located within 6 m to 13 m (4 mi to 8 mi) from the WSS.

5.10 Provisions should* be made, as appropriate, for the detection and quantification of unplanned releases of radionuclides to the environment.

Source measurement and control of all contained surface water is performed at the WSS to prevent the release of radionuclide to the groundwater and surface waters. Monthly storm water sampling is performed to monitor the transport and release of radionuclides at the WSS. Perimeter air monitoring is performed routinely, as well as work place monitoring, to determine releases of radionuclides at the WSS.

Section 4.2.2.1. Three air monitoring programs are utilized at the WSSRAP to monitor site specific areas, perimeter areas, and critical receptors. Site specific monitoring, in addition to providing data concerning the contributions of specific activities to the total airborne inventory, will provide faster feedback concerning the effectiveness of engineering controls and data concerning dispersion patterns. Filters from site-specific monitors will be collected on a daily basis as compared to weekly for the perimeter samplers, in order to assess the possibility of accidental release of airborne contaminants. Site-specific monitoring will be utilized during remediation activities at the WSQ. Monitors will be placed immediately outside the work areas based on current meteorological conditions to assess airborne emissions from specific activities and areas within the WSQ.

5.11 The need for environmental sampling and analysis should* be evaluated, by exposure pathway analysis, for each site radionuclide effluent or emission (liquid or airborne).

Section 2. The exposure pathway analysis for the WSSRAP was performed to evaluate the impact on human or ecological receptors due to radiological effluent or emissions from the WSSRAP. Sampling or measurement locations were determined based on this exposure pathway analysis in order to ensure the protection of the public and the environment.

5.12 This analysis with appropriate data, references, and site-specific assumptions, along with site-specific criteria for selection of samples, measurements, instrumentation, equipment, and sampling or measurement locations should* be documented in the site Environmental Monitoring Plan.

Section 2. The exposure pathway analysis was performed by initially determining the potential exposure routes and the factors to be considered and then using site specific factors, determining those routes which will be evaluated in the environmental surveillance program. The selection samples, measurements, and locations were determined based on the selected exposure routes.

5.13 A critical pathway analysis (radionuclide/ media) should* be performed, documented, and referenced in the annual Site Environmental Report.

The critical pathway analysis is revised annually for inclusion in both the EMP and the annual site environmental report.

5.14 If the projected dose equivalent from inhalation of particulates exceeds the criteria of Table 5-1, particle-size analysis of the emission should* be conducted at least annually.

Sections 4.2.1.1 and 4.1.1.2. Particle size analysis will be performed on an annual basis on specific sources which have higher potential for airborne emissions.

5.15 For all new or modified facilities coming on-line, a pre-operational assessment should* be made and documented in the site Environmental Monitoring plan to

determine the types and quantities of effluents to be expected from the facility and to establish the associated environmental surveillance program.

Section 3. An additional water treatment plant is expected to be operational in CY 1993. Additional monitoring of these facilities prior to operation will be performed based on a pre-operational assessment as to the types and quantities of effluents from the facility and establish pre-operational characteristics of the groundwater, surface water, and ambient air at the WSS.

Section 4.2.1. Engineering controls will be employed to minimize levels to those which are ALARA and a particle size analysis is to be performed annually to determine the expected particle size comprising the effluents.

5.16 Calibration of dosimeters and exposure-rate instruments should* be based on traceability to National Institute for Standards and Testing (NIST) standards.

Sections 4.2 and 3.3.4. Calibration of monitoring systems requiring known value sources is performed using NIST traceable radioactive sources or by the manufacturer utilizing NIST traceable wind tunnels.

5.17 Gross radioactivity analyses should* be used only as trend indicators, unless documented supporting analyses provide a reliable relationship to specific radionuclide concentrations or doses.

Section 4.2.3.3. The WSSRAP has done extensive characterization of the WSCP/WSRP and the WSQ to provide reliable relationships between radionuclides. In addition, the WSSRAP continues to perform radionuclide specific analysis such as the critical receptor monitoring program.

5.18 The overall accuracy ($\pm$% accuracy) should* be estimated, and the approximate Environmental Detection Limit at a specified % confidence level for environmental measurements for beta-gammas, alphas, and neutrons should* be determined and the two levels documented in the site Environmental Monitoring Plan.

Sections 4.2.2.1 and 4.2.2.2. The overall accuracy and the approximate Environmental Detection Limit for the environmental measurements are documented in the previously mentioned Sections.

5.19 Sample preservation methods should* be consistent with the analytical procedures used.

Section 6. Preservation of environmental samples is performed in accordance with EPA methodology for the analyses of specific parameters.

5.20 All environmental surveillance techniques should* be designed to take a representative sample or measurement of the important radiation exposure pathway media.

Sections 3, 4, and 7. The environmental sampling techniques employed at the WSS are performed in accordance with documented SOPs in order to obtain representative samples of the media.

5.21 Sampling or measurement frequencies for each significant radionuclide or environmental medium combination (e.g., those that contribute 10% or more to off site dose greater than 0.1 mrem EDE from emissions in a year) should* take into account the half-life of the radionuclides to be measured and should* be documented in the site Environmental Monitoring Plan.

The radionuclides that exist at the WSSRAP which contribute 10% or more to off-site dose all have lengthy half-lives and would have no significance on the sampling frequency.

5.22 "Background" or "control" location measurements should* be made for every significant radionuclide and pathway combination (e.g., those that contribute 10% or more to off site dose greater than 0.1 mrem EDE from emissions in a year) for which environmental measurements are used in the dose calculations.

Section 3. Background sampling and measurement locations have been designated for both the WSCP/WSRP and the WSQ sites for all exposure media routes.

5.23 An annual review of the radionuclide composition of effluents or emissions should* be made and compared with those used to establish the site Environmental Monitoring Plan.

Section 3 and 4. The radionuclide composition of exposure media at the WSCP/WSRP and the WSQ sites are determined annually for evaluation of additional environmental surveillance.

5.24 Any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, should* be documented in an approved revised site Environmental Monitoring Plan.

The WSSRAP *Environmental Monitoring Plan* is revised annually due to the complexity and evolution of the remedial work being performed. A revised *Environmental Monitoring Plan,* taking into account deviations from routine requirements, is unnecessary due to the annual revisions. All variances from the program scope are documented with a memorandum to project management and reported in the annual Site Environmental Report.

5.25 The air sampling rate should* not vary by more than $\pm$20% and total air flow or total running time should* be indicated; air sampling systems should* be leak-tested, flow-calibrated, and tested and inspected on a routine basis at a minimum, using the calibration frequency recommendations of the equipment manufacturers.

Section 4.2.2.1, 4.2.2.2, and 4.2.2.3. Sampling systems are calibrated in accordance with WSSRAP SOPs and manufacturers' specifications. Alpha-scintillation detectors are calibrated a minimum of every 6 mo using NIST traceable radioactive sources. The gas-flow proportional counter is calibrated when repairs are made to the detector or there has been a potential for drift in the readings in the equipment. The mass flow meter will be calibrated on an annual basis by the manufacturer in a NIST traceable wind tunnel. If the flow rate in the field changes more than 20% during the sampling period, the monitor will be evaluated to determine if service is required.

5.26 State and local game officials should* be consulted when selecting appropriate protected species to sample.

The ecological monitoring program is designed in close consultation with local conservation and protection agencies. Preliminary activities for the 1993 annual monitoring relate to sampling of game species within the surrounding wildlife areas. State and Federal collection permits are obtained as necessary for sampling and all sampling programs are reviewed with appropriate agencies prior to work. No sampling of protected species; i.e. Federally or State listed endangered or threatened species is planned for 1993. Monitoring activities for protected species are limited to visual observations and identification for purposes of documenting occurrence of species within the WSS area.

5.27 DOE Operations Offices and contractor staff should* ensure that groundwater monitoring plans are consistent with State and regional EPA groundwater monitoring requirements under RCRA and CERCLA, to avoid unnecessary duplication.

Section 1. The WSSRAP has prepared the Environmental Monitoring Plan to meet the requirements for DOE environmental monitoring programs as specified in DOE Orders 5400.1 and 5400.5, the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, and applicable Federal, State, and local laws and environmental protection regulations. Copies of the EMP are made available to the State and Federal regulatory agencies.

5.28 DOE Operations Offices and contractor staff should* consult with State and regional EPA personnel as needed to ensure that the requirements are incorporated into the Radiological Monitoring Plan.

Section 1. All applicable Federal, State, and local laws and environmental protection regulations regarding radiological parameters are incorporated into the environmental surveillance programs for the WSS. Copies of the EMP are provided to the State and Federal regulatory agencies.

5.29 Any changes in the site-specific or generic factors should* be noted in the plan and the retired or replaced values preserved for historical purposes.

Section 2. The site-specific factors effecting the environmental surveillance program are evaluated, revised, and documented annually in the Environmental Monitoring Plan.

5.30 When neutron monitoring is required, the method of measurement should* be based on the anticipated flux and energy spectrum.

No significant neutron sources are present at the WSSRAP.

5.31 The sample exchange frequency for non-particulate sampling should be determined on a site-specific basis and should* be documented in the environmental surveillance files.

Sections 4.2.2.1, 4.2.2.2, and 4.2.2.3. The sampling frequency for non particulate sampling is documented in the applicable SOPs and in the previously mentioned Sections.

5.32 Liquid milk samples should be refrigerated or otherwise preserved prior to analysis; however, the analytical procedure to be used should* be considered when choosing a sample preservation method.

The 1993 environmental program does not include sampling of milk products; therefore, no sample preservation methods have been selected. Agricultural products such as corn and milo are primary foodstuffs grains within the 16 km (10 mi) monitoring area and are sampled. The foodstuffs monitoring program is designed as a tiered sampling program.

As part of the *1992 Environmental Monitoring Plan*, foodstuff resources are being reviewed and a determination will be made on additional sampling requirements. Dairy farms are few in the area and currently three have been identified in the 16 km (10 mi) border. Air monitoring data indicate no particulate emissions that would require dairy product monitoring.

5.33 As they apply to environmental surveillance activities, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. All environmental surveillance activities are performed in accordance with the DOE and site quality assurance program provisions.

6.0 LABORATORY PROCEDURES

6.1 Laboratory procedures and practices should* be documented in the site Environmental Monitoring Plan (in compliance with DOE 5400.1.

Section 6. All laboratories performing analysis for the Environmental Monitoring Program have procedures and practices documented in their specific Quality Assurance Project Plan (QAPjP). At this time, WSSRAP has over seven laboratories analyzing samples collected as part of the Environmental Monitoring Program. In addition, WSSRAP has submitted for proposal a new laboratory specification that will replace and add new laboratories for environmental monitoring. Due to the large amount of information required form these laboratories, it would be impractical to document all of the procedures and practices in the *Environmental Monitoring Plan*.

6.2 Each monitoring and surveillance organization should* have a sample identification system that provides positive identification of samples and aliquots of samples throughout the analytical process.

Sections 3.0, 6.3, and 7.2. WSSRAP has sample identification system that uniquely identifies samples for collection to data submittal to database usage (procedure ES&H 4.1.1). Laboratories under contract to WSSRAP generally have internal sample tracking and identification systems, but sample identification is reported back to the WSSRAP using the WSSRAP identification number.

6.3 The system should* incorporate a method for tracking all pertinent information obtained in the sampling process.

Sections 6.3 and 7.2. WSSRAP has the Environmental Sample Tracking (EST) system that is used to track environmental samples from collection to receipt to invoice approval for each laboratory under contract. WSSRAP has the Generic Universal Retrieval Utility (GURU) system that is used to maintain the environmental data received from the laboratories. GURU is utilized to comply, compare, and perform statistics on routine samples that are part of the Environmental Monitoring Program.

6.4 To prevent incorrect analysis results caused by the spread of contamination among samples, each laboratory should* establish and adhere to written procedures to minimize the possibility of cross-contamination between samples.

This is not summarized in the *Environmental Monitoring Plan*; however, laboratories under contract to WSSRAP all have SOPs that discuss the identification and prevention of cross-contamination between samples. In addition, the WSSRAP Verification Group and the data reviewers request validation for data that is suspected to be in error or cross-contaminated.

6.5 High-activity samples should* be kept separate from low-activity samples.

This is not summarized in the Environmental Monitoring Plan (EMP), but laboratories under contract to WSSRAP have a Nuclear Regulatory Commission (NRC) license or similar State license. These laboratories screen samples received from the WSSRAP to determine if they can accept the samples. According to requirements in their NRC license, they can only accept samples under a specific activity. Most laboratories have controlled areas that process samples above a certain activity. Generally, most environmental samples collected from the WSSRAP are low activity.

6.6 In addition, the integrity of samples should* be maintained; that is, the degradation of samples should* be minimized by using proper preservation and handling practices that are compatible with the analytical methods used.

Section 7. WSSRAP SOPs (ES&H 4.3.1 and 4.4.1) outline the proper preservation and sample handling practices. These SOPs explain what parameters are compatible with similar parameters.

6.7 To provide that the analyses performed are consistent and of the highest quality, specific analytical methods should* be identified, documented, and used to identify and quantify all radionuclides in the facility inventory or effluent that contribute 10% or more to the public dose or environmental contamination associated with the site.

Section 7.2 and Appendix B. A variety of WSSRAP and subcontractor procedures, plans, and programs are utilized to ensure that analytical methods are of the highest quality. The analytical methods are identified and documented in the above-referenced sections.

6.8 Standard analytical methods should* be used for radionuclide analyses (when available), and any modification of a standard method(s) should* be documented.

Sections 6.3 and 7.2. Some radionuclide analyses do have modifications to the standard method. All changes to standard methods are reviewed and approved by the Project Management Contractor (PMC) prior to analyses.

6.9 In addition, methods, requirements, and necessary documentation should* be specified in any analytical contracts established with outside laboratories.

Sections 6.3 and 7.2. The specifications of the contracts with the laboratories do include the requirements for documentation, methods, and other requirements regarding quality assurance. Laboratories are audited annually to ensure their compliance with these issues.

6.10 All sites that release or could release gamma-emitting radionuclides should* have the capability (either in-house or outside) of having samples analyzed by gamma-ray spectroscopy systems.

This is not summarized in the *Environmental Monitoring Plan*, but the WSSRAP has the capability of analyzing gamma emitting radionuclides using gamma-ray spectroscopy and also has the capability of analyzing for alpha/beta emitting radionuclides using a gas-flow proportional counter and an alpha spectroscopy system.

6.11 Counting equipment should* be calibrated using, at a minimum, the calibration frequency recommendations of the manufacturers so that accurate results are obtained.

Section 4.2. All counting equipment is calibrated using the calibration frequency recommended by the manufacturer and in accordance with Procedure ES&H 2.6.4, *Ludlum Model Scaler and Model 43-10 Detector: Gross Alpha Measurement Operation and Calibration.*

6.12 In addition, check sources should* be counted periodically on all counters to verify that the counters are giving correct results.

This is not summarized in the *Environmental Monitoring Plan*, but check sources are periodically counted to verify that the counters are giving correct results in accordance with Procedure ES&H 2.6.7, *Calibration and Operation of the WT-1000 Low Background Gas Flow Proportional Counter.*

6.13 Samples that are sent off site for analysis or for laboratory intercomparison should* be monitored for contamination and radiation levels and packaged in a manner that meets applicable transportation regulations and requirements.

This is not summarized in the *Environmental Monitoring Plan*, but all samples that are sent off site for analysis are monitored for contamination and radiation levels in a manner that meets applicable transportation regulations and requirements. This is accomplished by the Site Shipping Officer, who is also responsible for properly packaging the shipments in accordance with Procedure RC-17s, *Off-site Transportation of Hazardous Materials.*

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT

7.1 The statistical techniques used to support the concentration estimates, to determine their corresponding measures of reliability, and to compare radionuclide data between stations and times should* be designed with consideration of the characteristics of effluent and environmental data.

Section 6.1. Environmental data are statistically summarized using known and proven methods to determine the distribution, central tendency, dispersion, and outliers of the data. The statistical techniques take into account the characteristics of skewed distribution of time series data, high variability analytical results, missing data, and results below the analytical detection limits. All new data are evaluated against the corresponding historical statistics. Apparent outliers are only excluded from use after investigation confirms that an error has been made during sample collection, preparation, measurement, or analysis process.

7.2 Documented and approved sampling, sample-handling, analysis, and data management techniques should* be used to reduce variability of the results as much as possible.

Section 6.1. SOPs have been developed for environmental monitoring activities specific to the WSS. These SOPs have been developed from USEPA and DOE guidance and standard industry practices. Personnel undergo training specific to their responsibilities varying from procedure review through classroom training and "hands on" training under the supervision of a qualified individual.

7.3 The level of confidence in the data due to the radiological analyses should* be estimated by analyzing blanks and spiked pseudosamples and by comparing the resulting concentration estimates to the known concentrations in those samples.

Section 6.1. Numerous QC samples are collected in support of environmental monitoring activities including blank samples, matrix spikes, and matrix duplicates. The confidence level of the data is estimated by comparing the results of the QC samples with known concentrations.

7.4 The precision of radionuclide analytical results should* be reported as a range, a variance, a standard deviation, a standard error, and/or a confidence interval.

Section 6.1. The environmental monitoring data is statistically summarized by the determination of the range, variance, and standard deviation of the data values at each sampling location.

7.5 Data should* be examined and entered into the appropriate databases promptly after analysis.

Section 6.1. Immediately upon receipt from the laboratory, all new data are verified and entered into the WSSRAP database (Section 7.2).

7.6 When selecting the data to be considered, outliers should* be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process.

Section 6.1. Apparent outliers are qualified and excluded from use only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. Procedures are employed to aid in the interpretation of the data and to improve the quality of the results from the program by helping to detect erroneous measurements.

7.7 As each data point is collected, it should* be compared to previous data, because such comparison can help identify unusual measurements that require investigation or further statistical evaluation.

Section 6.1. All new data is evaluated against corresponding historical statistics to aid in the identification of unusual data values which may require further investigation or evaluation in accordance with WSSRAP SOPs.

7.8 As they apply to data analysis and statistical treatment activities, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. Overall data management activities for the WSSRAP are detailed in the *Environmental Data Administration Plan* (EDAP) (MKF and JEG 1992d). The EDAP provides guidance for the development of sampling plans, describes data management activities, and details general data quality requirements. These general data quality goals have been adopted for this Environmental Monitoring Plan (EMP). The primary activities associated with this *Environmental Monitoring Plan* (EMP) include data verification, database management, and data validation. These programs document the quality of data generated by on-site and off-site analyses of samples.

8.0 DOSE CALCULATIONS

8.1 Except where mandated otherwise (e.g., compliance with 40 CFR Part 61), the assessment models selected for all environmental dose assessments should* appropriate characterize the physical and environmental situation encountered.

Section 6.2. Assessment models selected for environmental dose estimates at the WSSRAP are intended to assess accurate and realistic radiation doses to the population and to a hypothetical maximally exposed individual that could result from remediation activities. Environmental monitoring data are used either as direct input data in dose calculations or where appropriate, serves as data input in exposure and dose models.

8.2 The information used in dose assessments should* be as accurate and realistic as possible.

Section 6.2. Radiological dose assessments for selected environmental media employ data from the effluent monitoring and environmental surveillance programs in order to ensure that the data are accurate and realistic.

8.3 Complete documentation of assessments of the radiation dose resulting from the operation of DOE-controlled facilities should* be provided in a manner that supports the annual site Environmental Monitoring Report, Environmental Monitoring Plan, or other application, and show the 1) models used, 2) computer programs used, and 3) input data and data source assumptions made.

Section 6.2. The annual site environmental report includes documentation of the models, computer programs, input data, and data sources used in the assessment of radiation doses.

8.4 Default values used in model applications should* be documented and evaluated to determine appropriateness to the specific modeling situation.

Section 6.2. Model default values will be evaluated to determine the appropriateness of the values as they apply to the modelling situation. The use of default values will be documented with the results of any dose modeling.

8.5 When performing human foodchain assessments, a complete set of human exposure pathways should* be considered, consistent with current methods (IAEA 1982; Moore et.al. 1979; NCRP Report No. 76; NUREG/CR-3332).

Section 3.4.4.2 and 6.2. The foodstuffs sampling program provides data to determine the projected dose to off-site persons from an air to crop to man exposure route. A projected dose of <0.1 mrem/yr dose to a member of the public has been determined.

8.6 Surface water and groundwater modeling should* be conducted as necessary to conform with the applicable requirements of the state government and the regional office of the EPA.

Section 3. The WSSRAP has received no specific requirements to perform groundwater or surface water modeling from the State or regional regulators. Pursuant to CERCLA and RCRA guidance, the WSSRAP has and continues to conduct a variety of groundwater contaminant transport modeling efforts.

8.7 The general quality assurance program provisions of Chapter 10 should* be followed as they apply to performing calculations that assess dose impacts.

Section 6.2. All general quality assurance program provisions are followed as they apply to performing calculations that assess dose impacts.

9.0 RECORDS AND REPORTS

9.1 Accordingly, DOE officials and DOE management and operating contractors should* identify and comply with the relevant requirements.

Section 6. Activities at the WSS are performed in accordance with DOE Orders 5000.3A, 5400.1, 5400.5, 5284.1b. and 5484.1; National Pollution Discharge Elimination System permits issued by the Missouri Department of Natural Resources; and the Federal Facilities Agreement, as well as other applicable Federal, State, and local laws and environmental protection regulations.

9.2 Timely notification of occurrences and information involving DOE and its contractors should* be made to the appropriate DOE officials and to other responsible authorities.

Section 6. Reporting of all occurrences listed in DOE Orders 5400.1, 5400.5, and 5484.1 is performed in accordance with DOE Order 5000.3A.

9.3 Auditable records relating to environmental surveillance and effluent monitoring should* be maintained.

Section 6. The WSSRAP maintains an *Environmental Data Administration Plan* (MKF and JEG 1992d) which governs sampling plan preparation, data verification and validation, database administration, and data archiving. All environmental data from sampling, analysis, and quality review programs are maintained in hard copy and electronic copy. All original documentation is transferred to the Project Quality Department and stored in a controlled area in a fireproof safe.

9.4 Calculations, computer programs, or other data handling should* be recorded or referenced.

Section 6. Computer programs and data management systems utilized at the WSS are the Environmental Sample Tracking (EST) system, the Generic Universal Report Utility (GURU) program, the Safety, Health, And Radiation Protection (SHARP) program, the Site Wide Audit Tracking System (SWATS), and the Waste Inventory Tracking System (WITS).

9.5 As they apply to reporting and recordkeeping activities, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. Standard operating procedures are maintained and documented to ensure the quality of the environmental monitoring program and those activities which influence the program.

10.0 QUALITY ASSURANCE

10.1 In addition to these plans, the Environmental Monitoring Plan should* contain a section on QA and should* cover the monitoring activities at each site, consistent with applicable elements of the 18-element format in ANSI/ASME NQA-1.

Section 7. The quality assurance section of the *Environmental Monitoring Plan* (EMP) outlines the requirements for the activities at the WSSRAP, which is obligated to comply with the requirements of ANSI/ASME NQA-1 as outlined in DOE Order 5700.6C. A Quality Assurance Program is maintained for the WSS, which addresses the requirements of NQA-1. Also, a project specific Quality Assurance Project Plan (QAPjP) describing how various aspects of NQA-1 and the Quality Assurance Program will be implemented at the WSS.

10.2 Periodic audits should* be performed to verify compliance with operational and QC procedures.

Section 7. Audits are performed periodically to evaluate quality related activities in the environmental monitoring program. Analytical laboratories performing analyses for the WSS are audited annually by WSS personnel from the Project Quality Department and other related departments. The Project Quality Department routinely audits site operations associated with environmental monitoring activities. The WSS is also routinely audited by external entities, including DOE-Headquarters and DOE-Oak Ridge.

10.3 The following requirements from ANSI/ASME NQA-1 should* be followed: Planned and scheduled audits should* be performed to verify compliance with all aspects of the quality assurance program and to determine its effectiveness. These audits should* be performed independently in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited (i.e., supervisors cannot audit their own facilities). Audit

results should* be documented and reported to and reviewed by responsible management. Follow-up action should* be taken where indicated.

Section 7. The Project Quality Department routinely audits environmental monitoring activities to evaluate compliance with project-specific procedure. Audit reports are generated and corrective actions are monitored by the Project Quality Department.

10.4 The elements of a QA program plan should* be derived from the 18 criteria in ANSI/ASME NQA-1 and those stipulated in 10 CFR Part 50.

The WSSRAP complies with the requirements of ANSI/ASME NQA-1 in accordance with DOE Order 5700.6c. The WSSRAP is not a nuclear production or utilization facility and, therefore, the Quality Assurance program is not derived from the criteria stipulated in 10 CFR Part 50 which pertains to these types of facilities.

10.5 Radiation measurement, including portable instruments, environmental dosimeters, in situ monitoring equipment, and laboratory instruments, should* be calibrated with standards traceable to NIST calibration standards (NCRP 1978; National Bureau of Standards Special Publication 609).

Section 7. Calibration of all radiation measurements is performed in accordance with documented procedures, industrial practices, and DOE Orders which have standards traceable to NIST calibration standards.

APPENDIX B
Data Quality Requirements

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization

Category	Analytical Parameter	Analytical Method (b)	MDL soil μg/g (b)	Precision (a) (soil)	Accuracy (a) (soil)	MDL (b) μg/l	Precision (a) (water)	Accuracy (a) (water)	Comments
Radiation Screening	Gross Alpha	2.6.4 *	NA	NA	NA	NA	NA	NA	ES&H SOP
	Gross Beta/Gamma	2.6.3 *	NA	NA	NA	NA	NA	NA	ES&H SOP
Field Measurements	pH	4.5.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Temperature	4.5.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Conductivity	4.5.2 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Specific Ions	4.5.5 *	NA	NA	NA	NA	20	NA	ES&H SOP.
	Organic Vapors	3.1.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Settableable Solids	4.5.7 *	NA	NA	NA	0.1	20	NA	ES&H SOP
Onsite Radiological Measurements	Th-230, Th-232	UNC	2 pCi/g	50	50	NA	NA	NA	
	U-238, U-235,	901.1	1 pCi/g	50	30	NA	NA	NA	
	Ra-226, Ra-228	901.1	1 pCi/g	50	20	NA	NA	NA	
	TH-230, TH-232	UNC	2 pCi/g	50	20	NA	NA	NA	
Offsite Radiological Measurements	Natural Uranium	EPA 908.0	1 pCi/g	50	30	1 pCi/l	20	20	
	Ra-226, -228	EPA 903.1	1 pCi/g	50	30	1 pCi/l	20	20	
	Th-230, -233	EERF 00/07	1 pCi/g	50	30	1 pCi/l	20	20	

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

Category	Analytical Parameter	Analytical Method (b)	MDL soil µg/g (b)	Precision (a) (soil)	Accuracy (a) (soil)	MDL (b) µg/l	Precision (a) (water)	Accuracy (a) (water)	Comments
	Gross Alpha	EPA 900.0	3 pCi/g	50	30	3 pCi/l	40	40	
	Gross Beta	EPA 900.0	3 pCi/g	50	30	8 pCi/l	40	40	
Nitroaromatic Compounds	TNT	USATHAMA	e	e	e	0.03 d	f	f	
	2,4-DNT	USATHAMA	e	e	e	0.03 d	f	f	
	2,6-DNT	USATHAMA	e	e	e	0.01 d	f	f	
	1,3,5-TNB	USATHAMA	e	e	e	0.03 d	f	f	
	1,3-DNB	USATHAMA	e	e	e	0.09 d	f	f	
	Nitrobenzene	USATHAMA	e	e	e	0.03 d	f	f	
Miscellaneous	TSS	EPA 160.2	NA	NA	NA	2	20	20	
	TDS	EPA 160.2	NA	NA	NA		20	20	
	TOC	EPA 415.1				0.1	20	20	
	Lithium	EPA 200.7	5	50	50	50	20	20	
	MO	EPA 200.7	4	50	50	4	20	20	
	ZR	EPA 200.7	20	50	50	20	20	20	
Miscellaneous (Continued)	CR+3	EPA 200.7		50	50	10	20	20	
	CR+6	Colorimetric		50	50	5	20	20	
	TOX	EPA 450.0	5	50	50		20	20	

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

Category	Analytical Parameter	Analytical Method (b)	MDL soil μg/g (b)	Precision (a) (soil)	Accuracy (a) (soil)	MDL (b) μg/l	Precision (a) (water)	Accuracy (a) (water)	Comments
	NO3	300.0/353.1	0.5	50	50	0.25/0.1c*	20	20	mg/l
	SO4	300.0/375.1,.2	5	50	50	1.0/1.0c*	20	20	mg/l
	CL	300.0/325.1,.3	1.5	50	50	0.25/0.2c*	20	20	mg/l
	FL	300.0/340.1,.2,.3	1.25	50	50	0.25/0.6c*	20	20	mg/l
	NO2	354.1,.2	0.5	50	50		20	20	mg/l
	% Moisture	ASTM	NA	50	NA	NA	NA	NA	
	pH (soil)	EPA 160.2	NA	50	NA	NA	NA	NA	
	Asbestos-PCM/TEM	3.1.4	NA	NA	NA	NA	NA	NA	ES&H SOP
CLP-VOA		CLP	CRDL	As required by CLP		CRDL	As required by CLP		
CLP-Semivoa - BNA		CLP	CRDL	As required by CLP		CRDL	As required by CLP		
CLP-Pest/PCB		CLP	CRDL	As required by CLP		CRDL	As required by CLP		
CLP-Metals	AL	CLP-ICP	20	As required by CLP		200	As required by CLP		
	AS	CLP-ICP	1	As required by CLP		10	As required by CLP		
	BE	CLP-ICP	0.5	As required by CLP		5	As required by CLP		

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

Category	Analytical Parameter	Analytical Method (b)	MDL soil µg/g (b)	Precision (a) (soil)	Accuracy (a) (soil)	MDL (b) µg/l	Precision (a) (water)	Accuracy (a) (water)	Comments
	CD	CLP-ICP	0.5	As required by CLP		5	As required by CLP		
	CR	CLP-ICP	1	As required by CLP		10	As required by CLP		
	CU	CLP-ICP	2.5	As required by CLP		25	As required by CLP		
	PB	CLP-AA	0.5	As required by CLP		5	As required by CLP		
	HG	CLP-CV	0.1	As required by CLP		0.2	As required by CLP		
	NI	CLP-ICP	4	As required by CLP		40	As required by CLP		
	NA	CLP-ICP	500	As required by CLP		5000	As required by CLP		
	ZN	CLP-ICP	2	As required by CLP		20	As required by CLP		
	BA	CLP-ICP	20	As required by CLP		200	As required by CLP		
	AG	CLP-ICP	1	As required by CLP		10	As required by CLP		
	FE	CLP-ICP	10	As required by CLP		10	As required by CLP		
	K	CLP-ICP	500	As required by CLP		5000	As required by CLP		
	MN	CLP-ICP	1.5	As required by CLP		15	As required by CLP		
	MG	CLP-ICP	500	As required by CLP		5000	As required by CLP		
CLP-Metals (Continued)	SE	CLP-AA	0.5	As required by CLP		5	As required by CLP		
	VA	CLP-ICP	5	As required by CLP		50	As required by CLP		
	TL	CLP-AA	1	As required by CLP		10	As required by CLP		

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

Category	Analytical Parameter	Analytical Method (b)	MDL soil µg/g (b)	Precision (a) (soil)	Accuracy (a) (soil)	MDL (b) µg/l	Precision (a) (water)	Accuracy (a) (water)	Comments
	SB	CLP-ICP	6	As required by CLP		60	As required by CLP		
	CA	CLP-ICP	500	As required by CLP		5000	As required by CLP		
	CO	CLP-ICP	5	As required by CLP		50	As required by CLP		
Other parameters not listed		TBD	TBD	50	50	TBD	20	20	See Note

* See comment section
TBD To Be Determined
NA Not Applicable
Accuracy = Percent Bias = Percent Recovery - 100
(a) Accuracy and precision data are listed as percent and presented from EPA DQR guidance document - specific precision and accuracy to be negotiated with the laboratory
(b) Detection limits and methods from existing contract - new detection limits and/or methods to be established with new laboratory
(c) JTC methods and detection limits
(d) Army Environmental Hygiene Agency (AEHA) detection limits
(e) To be negotiated with the laboratory
(f) To be provided by AEHA
NOTE: 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

TABLE B-2 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Airborne Monitoring

Category	Analytical Parameter	Analytical Method	MDL	Precision	Accuracy	Comments
Radon Track Etch	Radon	N/A	0.1 pCi/l	N/A	N/A	---
Continuous Radon	Radon	4.6.7	0.1 pCi/l	N/A	N/A	ES&H SOP
Continuous Radon Daughter	Radon Daughter	4.6.8	1.0 mWL	N/A	N/A	ES&H SOP
Low Volume Airborne Particulate	Airborne Particulate (Gross Alpha)	2.4.3*	2.5E-15	N/A	N/A	ES&H SOP
TLD	External Gamma	N/A	1 μrem/hr	N/A	N/A	ANSI N 565 1978

N/A Not Applicable
* See Comments Section
mWL milli Working Levels

APPENDIX C

Document Hierarchy for the Environmental Montioring Plan
for Calendar Year 1993

APPENDIX D

Telecon From L. Hopkins to File Regarding the Use of Uncensored Data Sets, Dated June 1, 1992