DOE/OR/21548-843
CONTRACT NO. DE-AC05-86OR21548

SAMPLING PLAN FOR THE QROU INTERCEPTOR TRENCH FIELD STUDY

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

OCTOBER 2000 **REV. 2**

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

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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PLAN TITLE: Sampling Plan for the QROU Interceptor Trench Field Study	

APPROVALS

Quarry Residuals Operable Unit Coordinator	9/27/2000 Date
Project Manager – Quarry and Vicinity Properties	27 Sept 00 Date
Data Administration Coordinator	9/29/00 Date
Environmental Safety and Health Manager	10/2/00 Date
Engineering Manager	10-2-2000 Date
Project Quality Manager	10/3/2000 Date
Deputy Project Director	10/3/2000 Date

DOE/OR/21548-843

Weldon Spring Site Remedial Action Project

Sampling Plan for the QROU Interceptor Trench Field Study

Revision 2

October 2000

Prepared by

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

for the

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

ABSTRACT

The Quarry Residuals Operable Unit (QROU) is one of four operable units comprising the Weldon Spring Site Remedial Action Project. The *Record of Decision for the QROU* outlines additional studies, which include the installation and operation of a pilot-scale interceptor trench and further definition of the hydrogeological and geochemical constraints on uranium migration in the fine-grained alluvium north of the Femme Osage Slough. This sampling plan describes the sampling of the discharge water from the interceptor trench and groundwater quality sampling and static water level measurements of nearby monitoring wells. These data will be utilized to assess the performance of the interceptor trench system and will be compared to the predictive model for the removal of uranium from the shallow aquifer.

SUMMARY OF CHANGES

Revision 2 of the *Sampling Plan for the QROU Interceptor Trench Field Study* incorporates the following changes:

- Inclusion of periodic estimations of the mass of uranium in groundwater in the area of impact.
- Deletion of Sample Port IT-3403 (north valve vault) from sampling schedule.
- Modifications in analyses for geochemical parameters and frequencies for sampling.

TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF FIGURES

NUMBER **PAGE**

LIST OF TABLES

NUMBER **PAGE**

1. INTRODUCTION

The *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit* (ROD) (Ref. 1) outlines field studies to be conducted to verify predictive models presented in the *Feasibility Study* (Ref. 2) relating to groundwater remediation. The determination to perform additional field tests was made given the presence of significant levels of uranium in quarry groundwater north of the slough, which is in close proximity to the St. Charles County well field, and the reliance on natural systems to limit potential exposure. An evaluation to determine the effectiveness of uranium removal from the groundwater will be continued into the post-ROD phase of the operable unit. Field data will be collected during a field study using an interceptor trench for the extraction of groundwater. The trench will be sufficiently large to intercept groundwater from a representative cross section of alluvial material and optimally located to extract groundwater in areas with high uranium contamination.

1.1 Purpose

The purpose of this sampling plan is to obtain data that can be used to monitor and evaluate the performance of the trench. Performance will be based on:

- The mass of uranium removed from the area of groundwater impact north of the Femme Osage Slough.
- The initial mass of uranium present in the area of groundwater impact north of the Femme Osage Slough prior to performance of the full study.
- The changes in uranium concentrations within the area of impact due to withdrawal of impacted groundwater.
- The changes in nitroaromatic compound concentrations within the area of impact due to withdrawal of impacted groundwater.
- The changes in geochemical conditions within the area of impact due to sustained groundwater withdrawal.
- The hydraulic capture zone of the interceptor trench in the shallow aquifer.

1.2 Objectives

The objective of the field study is to confirm the predictive model (Ref. 2) for uranium removal from the shallow aquifer using actual field data. Groundwater modeling using analytical methods indicated that an interceptor trench had the potential to reduce the mass of uranium in groundwater north of the slough by only 8% to 10% over a 2-year operating period (Ref. 2).

1.3 Scope

The scope of this plan includes:

- Sampling to estimate the mass of uranium present in the area of groundwater impact north of the slough.
- Sampling of the interceptor trench and nearby monitoring wells to assess the performance of the interceptor trench system.

1.4 Authorizing Document

The authorizing document for this sampling plan is the *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit*.

2. DATA QUALITY OBJECTIVES

During the development of the *Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit* (Ref. 2) remedial alternatives which could reduce the amount of uranium in groundwater that could potentially migrate to the St. Charles county well field were evaluated. The objective of the *Feasibility Study* was to identify any alternative that provided a feasible option for significantly removing or reducing uranium concentrations in the groundwater north of the slough by means of standard engineering approaches. A broad range of in situ and ex situ technologies was considered. From these technologies, three alternatives (Table 2-1) were outlined in the *Feasibility Study* that met the criteria of effectiveness, implementability, and cost, as defined in 40 CFR 300.

Table 2-1 Summary of Preliminary Alternatives for the QROU

Remedial Alternative	Description
Alternative 1: No Action Alternative	Under this alternative, no further action would be taken. This alternative is intended to provide a baseline for comparison with other alternatives being evaluated, as required by CERCLA.
Alternative 2: Monitoring with No Active Remediation	This alternative would involve routine sampling and analysis to monitor for continued contaminant reduction. Contaminant concentrations are expected to decrease due to source removal, natural attenuation, and dilution.
Alternative 6; Groundwater Removal at Selected Areas, On-Site Treatment	This alternative would involve the removal of groundwater where contaminant concentrations are relatively high. Groundwater removal would be performed using an interceptor trench and the water treated prior to discharge.

Projections based on the fate and transport model for uranium in the quarry area groundwater indicate that the potential for adverse impact to the well field is minimal (Ref. 3). Also, evaluations in the *Feasibility Study* indicate that all alternatives, including those with active components, would achieve only a very small and slow reduction in the concentrations of uranium in groundwater at high costs without attaining increased protection.

In recognizing the inherent uncertainties in these types of models and the importance of providing as much additional protection to the well field as possible, the performance of additional field studies was specified in the *Record of Decision* (Ref. 1). This field test, consisting of the operation of a small-scale interceptor trench (similar to Alternative 6), will be conducted to verify predictive models that were presented in the *Feasibility Study* relating to groundwater remediation.

2.1 State the Problem

The performance of a groundwater extraction system (interceptor trench) for remediating uranium-contaminated groundwater was predicted using optimistic assumptions and limited field data. The objective of this field study is to collect data to confirm the predictive model.

2.2 Identify the Decision

This field study will determine:

- The total mass of uranium removed from the area of groundwater impact though the operation of the interceptor trench.
- The mass of uranium extracted over time by the trench.
- The hydraulic capture zone of the interceptor trench.
- The effects of groundwater extraction on the uranium distribution in the area of impact.
- The effects of groundwater extraction on groundwater flow in the area north of the slough.
- The effects of groundwater extraction on the oxidation potential of the aquifer in the area north of the slough.

2.3 Inputs to the Decision

Inputs into the decision include:

- Analytical results for uranium and nitroaromatic compounds from samples obtained from the interceptor trench.
- Volumes of groundwater extracted from the interceptor trench.
- Groundwater level data from nearby monitoring wells.
- Analytical results for uranium and nitroaromatic compounds, as well as geochemical parameters, from nearby monitoring wells.

2.4 Define the Study Area Boundaries

This field study encompasses the area of groundwater impact north of the Femme Osage Slough (Figure 2-1). Sampling will be limited to discharge from the interceptor trench and the monitoring wells outlined in this plan. Sampling will be performed over the operational period of the trench, which could be up to 2 years.

2.5 Develop the Decision Rule

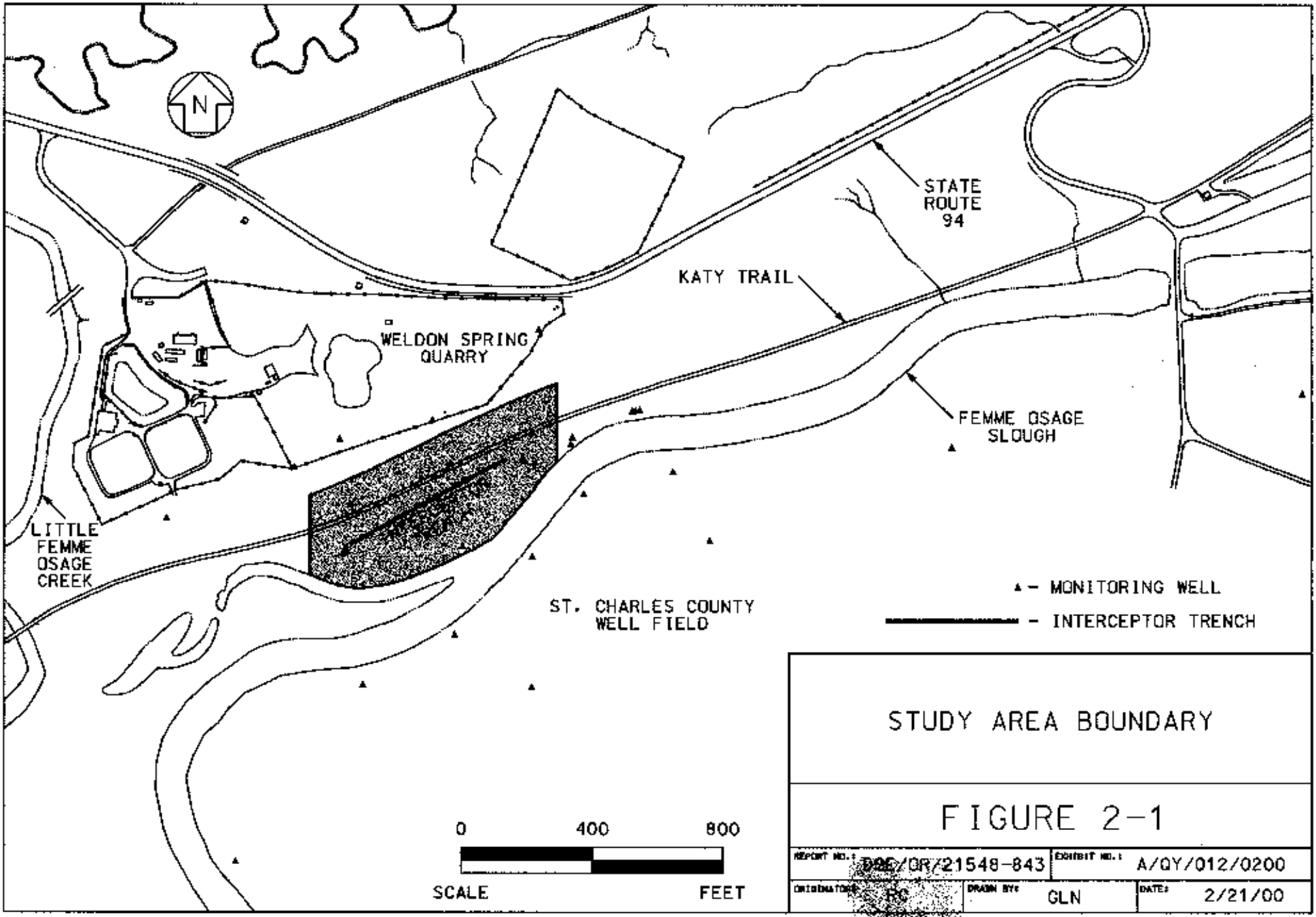
Further evaluation regarding treatment of groundwater in the area will not be necessary if the field data indicate that the performance of the trench is less effective or within the predicted performance goals (10% of the mass of uranium removed within the area of influence of the trench within a 2-year testing period) (Figure 2-2). If the field data indicate that the performance of the trench exceeds the specified goals, the effectiveness or benefit of continued groundwater extraction will be evaluated (Ref. 3).

2.6 Optimize the Design

Data collection will be optimized by:

- Using samples from the trench discharge to determine the mass of uranium extracted by the interceptor trench.

- Utilizing existing groundwater monitoring wells for the measurement of static water levels and groundwater quality data in the vicinity of the trench, in order to minimize the number of additional monitoring wells necessary for this study.



STUDY AREA BOUNDARY

FIGURE 2-1

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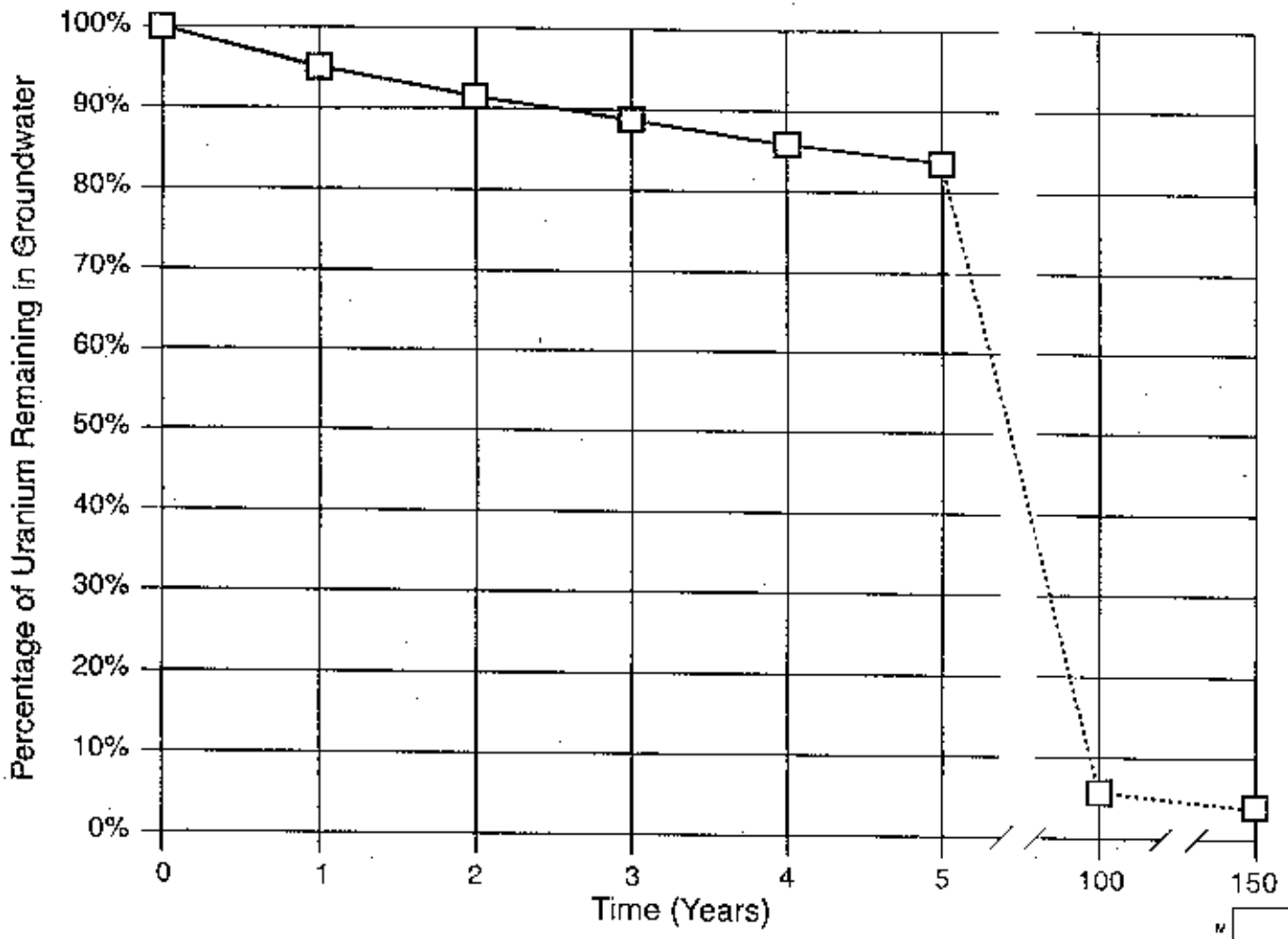


SOURCE: REF. 2

MODELED INTERCEPTOR TRENCH SYSTEM PERFORMANCE CURVE

FIGURE 2-2

REPORT NO.	DOE/OR/21548-843	EXHIBIT NO.			
ORIGINATOR:	RCC	DRAWN BY:	WLD	DATE:	February 2000

3. MONITORING WELL INSTALLATION

This section will focus on the drilling and monitoring well installation activities to be performed to support this field study.

3.1 Monitoring Well Locations

A total of six new monitoring wells is proposed for this field study to supplement the existing monitoring wells in close proximity to the interceptor trench (Figure 3-1). Monitoring wells will be installed in two lines perpendicular to the interceptor trench to obtain data across the study area. The locations of the lines were selected to obtain data from the differing aquifer materials (coarser grained and finer grained) that the trench intersects and to assess the influence of groundwater extraction on uranium removal and groundwater flow in these different material types. The wells will be screened at intervals to simulate the same thickness of the aquifer that the interceptor trench will have influence (Figures 3-2 and 3-3). A summary of the coordinates and estimated well depths and screened intervals is provided in Table 3-1. Final well placement will be determined in the field, based on actual field conditions.

Table 3-1 Summary of Proposed Monitoring Wells

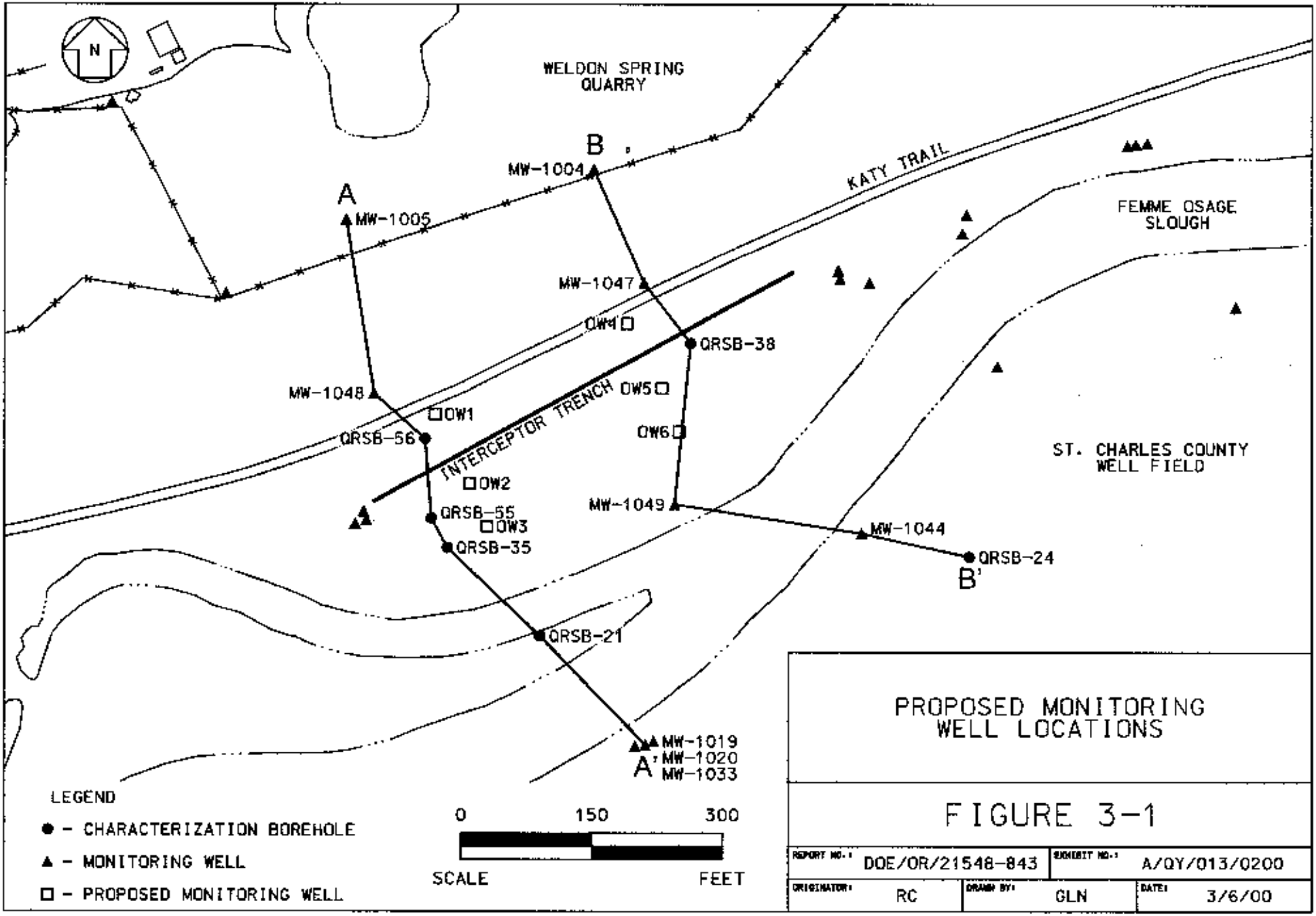
LOCATION	NORTHING	EASTING	ESTIMATED DEPTH (ft)
OW1	1028320	748000	25
OW2	1028240	748040	25
OW3	1028190	748060	20
OW4	1028425	748220	25
OW5	1028350	748260	20
OW6	1028300	748280	20

3.2 Drilling Activities

Drilling activities will be performed as specified in the task description for Work Package 487A, *Well Installation and Abandonment (Task 6)*. The boreholes will be advanced to the depths specified in Table 3-1. The unconsolidated materials and bedrock will be continuously sampled for descriptive and correlative purposes.

3.3 Geologic Descriptions

The alluvial materials and bedrock will be logged in accordance with Procedure ES&H-4.4.7, *Soil, Rock Core, and Rock Chip Borehole Logging*. During description of the materials, emphasis will be placed on identifying the presence of organic, iron or manganese oxides/hydroxides, sand lenses, staining, zones of core loss, or fractures.


N
WELDON SPRING QUARRY
B
MW-1004
A
MW-1005
KATY TRAIL
FEMME OSAGE SLOUGH
MW-1047
OW4
QRSB-38
MW-1048
OW1
QRSB-56
INTERCEPTOR TRENCH
OW5
OW6
ST. CHARLES COUNTY WELL FIELD
OW2
QRSB-55
OW3
QRSB-35
MW-1049
MW-1044
QRSB-24
B'
QRSB-21
MW-1019
A'
MW-1020
MW-1033
LEGEND
● - CHARACTERIZATION BOREHOLE
▲ - MONITORING WELL
□ - PROPOSED MONITORING WELL
0
150
300
SCALE
FEET
PROPOSED MONITORING WELL LOCATIONS
FIGURE 3-1
REPORT NO.: DOE/OR/21548-843
EXHIBIT NO.: A/QY/013/0200
ORIGINATOR: RC
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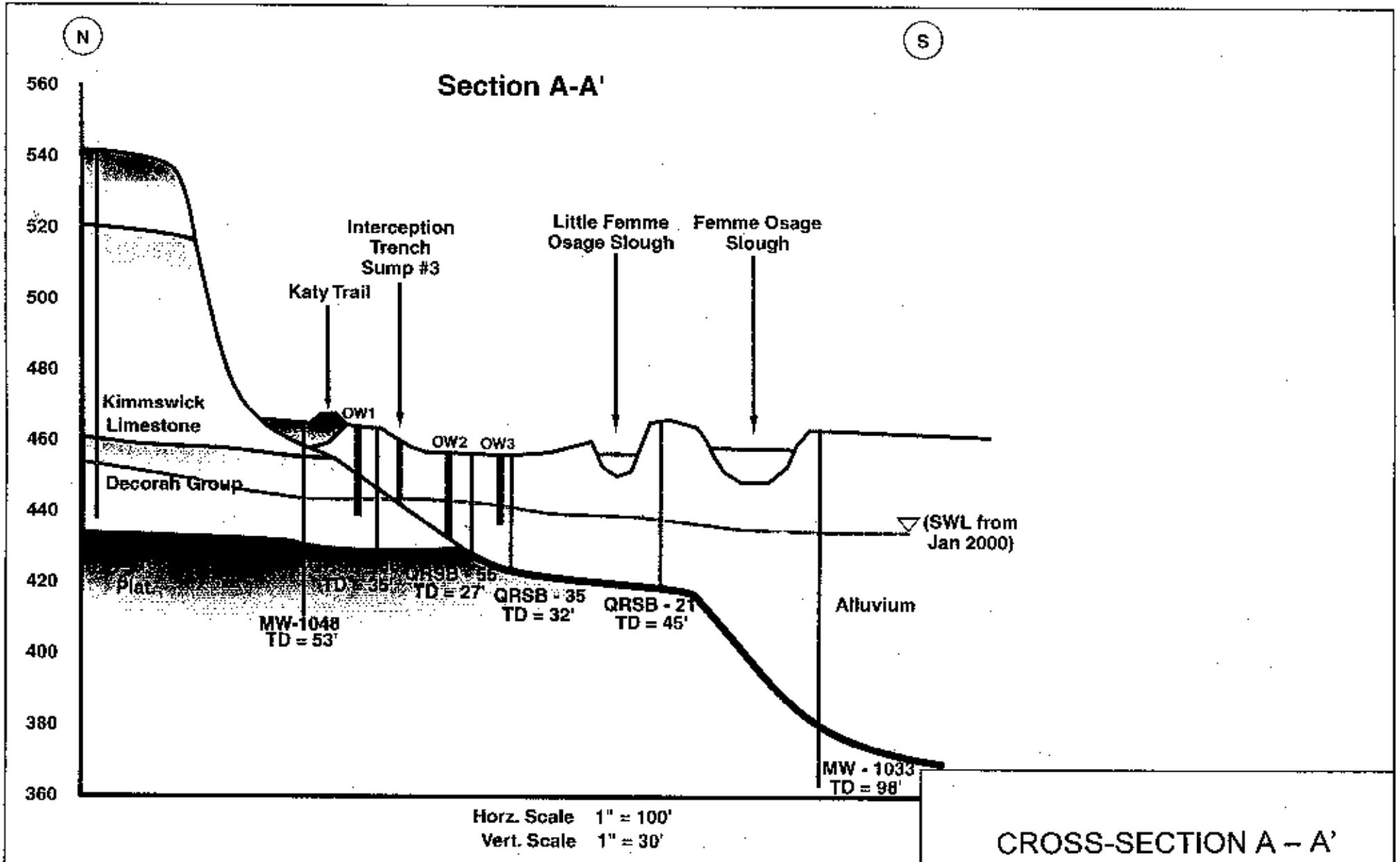
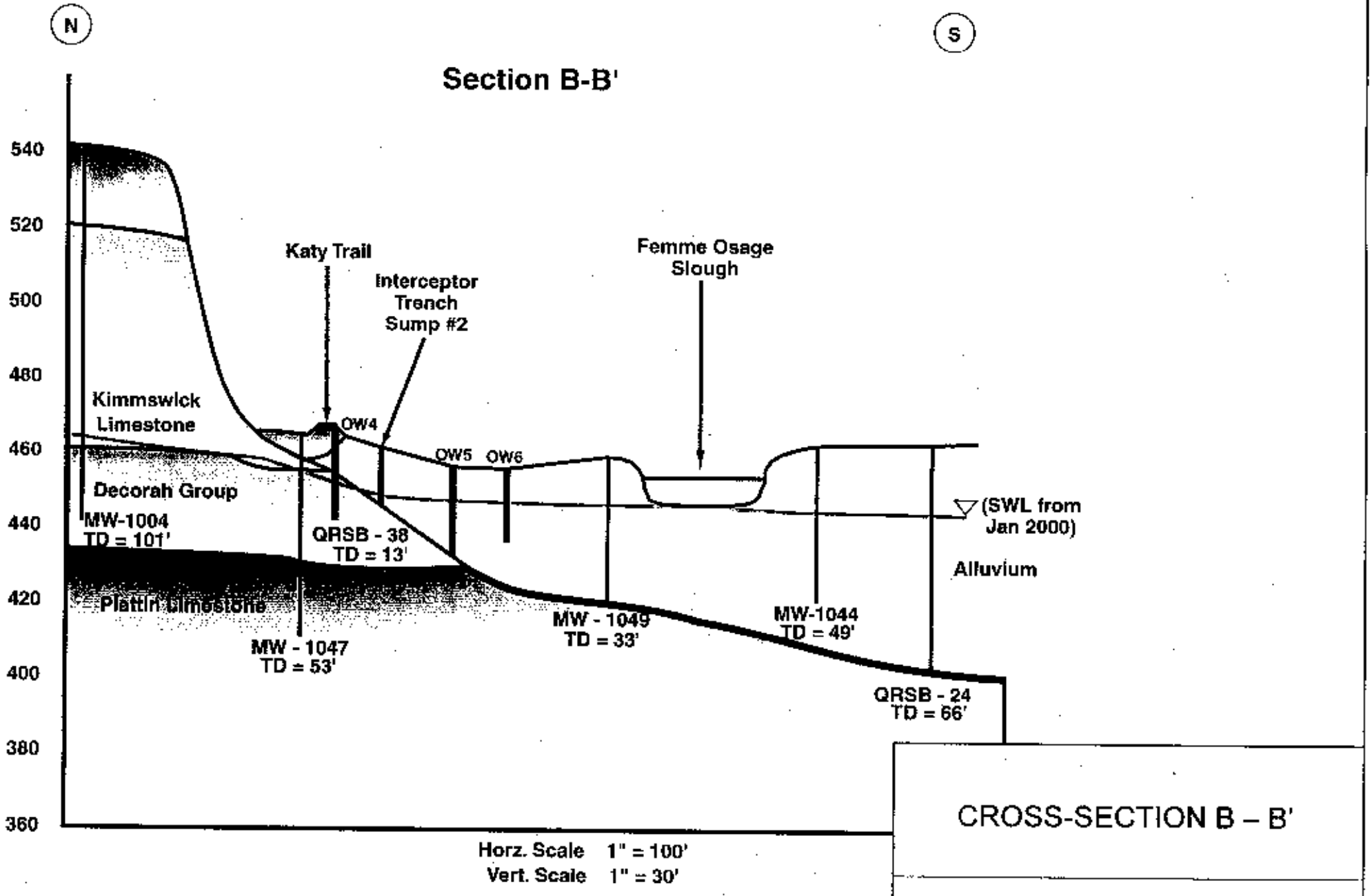
DATE: 3/6/00



CROSS-SECTION A – A'

FIGURE 3-2

REPORT NO.	DOE/OR/21548-843	EXHIBIT NO.			
ORIGINATOR:	RCC	DRAWN BY:	WLD	DATE:	February 2000



CROSS-SECTION B – B'

FIGURE 3-3

REPORT NO.	DOE/OR/21548-843	EXHIBIT NO.	
ORIGINATOR:	RCC	DRAWN BY: WLD	DATE: February 2000

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3.4 Monitoring Well Installation

The new monitoring wells will be constructed of 2-in. diameter Schedule 40 PVC materials. Wells should be constructed as outlined in Table 3-2; however, the field geologist will determine final screen placement at the time of installation based on hydrogeologic considerations, such as fracture density, depth to water, etc. Wells will be installed as specified in the task description and in accordance with the Missouri Well Drillers' Law (10 CSR 23).

Table 3-2 New Monitoring Well Construction Specifics

Location	Total Depth (ft)	Soil Drilling (linear ft)	Rock Coring (linear ft)	Screen Length (ft)	Filter Pack Interval (ft bgs)
OW1	25	15	10	10	8 – 25
OW2	25	25	0	15	5 – 25
OW3	20	20	0	10	5 – 20
OW4	25	10	15	10	8 – 20
OW5	20	20	0	15	5 – 20
OW6	20	20	0	10	5 – 20

bgs – below ground surface

3.5 Monitoring Well Development

Each well will be developed to promote the flow of water into the monitoring well. Development will proceed after a period of at least 24 hours from grout placement. Development will consist of surging water into and out of the formation and removing sediment from the well casing. Development will be performed until the produced water is clear and the pH stabilizes. Adequate development will be determined in the field by the Project Management Contractor (PMC) field geologist.

3.6 Radiological Scanning of Soil Borings

During drilling activities, the soils and rock core will be scanned using a Ludlum 44-9 Geiger-Mueller Detector for the detection of beta and gamma emitters, namely uranium, in accordance with Procedure ES&H 2.4.1, *Calibration and Use of Portable Radiological Survey Instruments*. Any soil portion of the boring that registers counts per minute (cpm) two times greater than the maximum CPM established at a background location will be submitted to the site radiological laboratory for U-238 analysis. Analysis will be performed to identify the disposition of materials during this drilling.

Elevated levels of U-238 greater than background are present in discrete subsurface locations, typically above the bedrock surface. Levels greater than 120 pCi/g have not been identified and therefore, are not expected to occur in this area. This conclusion is based on characterization data presented in the *Remedial Investigation* (Ref. 4) and post-remedial action data obtained in support of remediation of Vicinity Property 9 (Ref. 5). Surface soils exceeding 30 pCi/g were removed during remediation of this area, as outlined in the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 6).

3.7 Investigation Derived Wastes

All waste streams generated during this activity will be managed in accordance with ECDI-29, *Site Generated Waste Management*. Wastes generated during this task include, but are not limited to, soil cuttings, personal protective equipment, and miscellaneous trash, which will be handled by the subcontractor, as specified in the task description for WP-487A. Disposition of these materials will be approved by the PMC prior to transport of materials.

4. SAMPLING ACTIVITIES

This section outlines the sampling and monitoring activities to be performed for this field study. Sampling will be performed prior to initiation of the field study to provide data for estimation of the mass of uranium present in the area of groundwater impact. Activities performed during the field study will include sampling effluent from the interceptor trench, sampling of groundwater from nearby monitoring wells, and measuring groundwater levels.

4.1 Interceptor Trench

Sampling activities will consist of obtaining discharge water from the trench and recording the quantity of water extracted from the trench.

4.1.1 Sampling Locations

Samples will be collected from each of the four sampling ports (3004, 3104, 3204, and 3304) located in the south valve vault (Figure 4-1). A sample port (3403) is located in the north valve vault and will be used in the event the south valve vault is inaccessible.

4.1.2 Parameters

Operational samples will be analyzed for total uranium and nitroaromatic compounds.

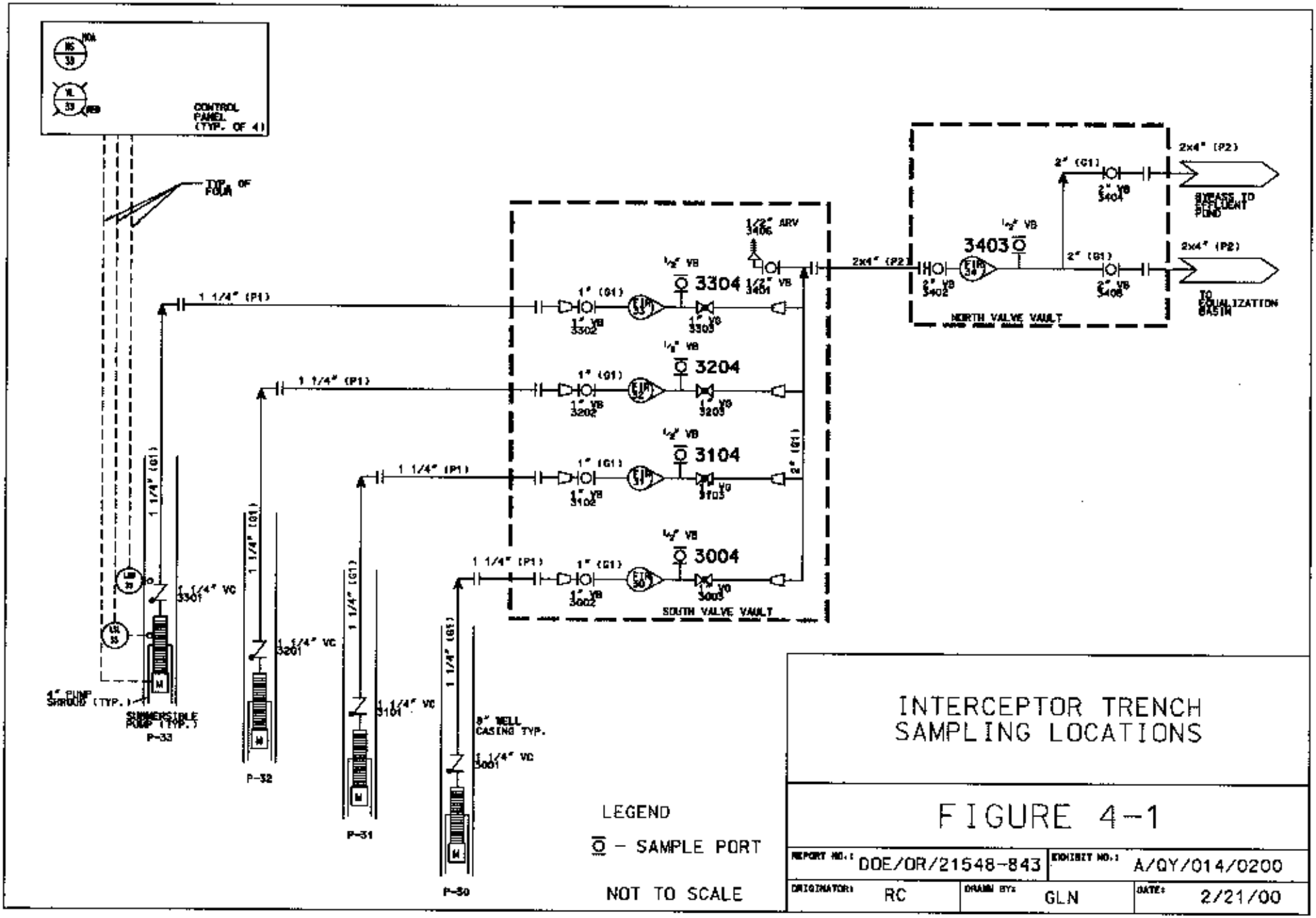
4.1.3 Sampling Frequency

Samples will be collected at the frequencies outlined in Table 4-1. More frequent sampling is outlined for the first 3 months of operation to assess potential impacts to the treatment system. Less frequent samples will be obtained for off-site verification of on-site uranium analysis.

Table 4-1 Interceptor Trench Sampling Frequency

Parameter	Laboratory	Frequency	
Uranium, total[a]	On-site	0 – 3 months	Daily
		> 3 months	Weekly
	Off-site	0 – 3 months	Weekly
		> 3 months	Monthly
Nitroaromatic Compounds	Off-site	0 – 3 months	Weekly
		> 3 months	Monthly

(a) Filtered samples will be collected on a weekly basis for both on-site and off-site analysis during the first 3 months of the field study. Filter size will be 0.45 µm.



INTERCEPTOR TRENCH SAMPLING LOCATIONS

FIGURE 4-1

REPORT NO.:	DOE/OR/21548-843	EXHIBIT NO.:	A/QY/014/0200		
ORIGINATOR:	RC	DRAWN BY:	GLN	DATE:	2/21/00

4.1.4 Sample Identification

All containers will be labeled in accordance with Procedure ES&H 4.1.1, *Numbering System for Environmental Samples and Sampling Locations*. Sample numbers will follow the designation outlined in Table 4-2. Filtered samples will be given the designation "-F" at the end. Sample locations, samples collected, and related data will be recorded on the field sheets at the time of collection.

Table 4-2 Interceptor Trench Sample Identification

Sample Port	Sample ID	Location
3004	IT-3002-date	South Vault
3104	IT-3102-date	South Vault
3204	IT-3202-date	South Vault
3304	IT-3302-date	South Vault
3403	IT-3403-date	North Vault

4.1.5 Sample Collection

Samples will be collected in accordance with the technical operations procedures and safe work plans for the operation of the interceptor trench system and quarry water treatment plant. A sample will not be collected if the flow totalizer indicates the sump did not operate since the last sample was collected.

4.1.6 Sample Containers and Preservation Methods

Table 4-3 summarizes the appropriate containers and preservation methods for each sample.

Table 4-3 Sample Containers and Preservation – Interceptor Trench

Parameter	Laboratory	Container	Preservation
Uranium, total	On-site	10 ml, plastic	None
	Off-site	250 ml, plastic	Nitric acid, pH < 2
Nitroaromatic Compounds	Off-site	1 liter, amber glass	Ice, 4 C

4.1.7 Flow Rate and Extracted Volume Measurements

A flow rate totalizer is located at each sample port to monitor the quantity of water extracted from each sump within the trench and the quantity extracted from the trench as a whole. These quantities, as well as the time of measurement, will be recorded at each sampling event.

4.2 Groundwater Quality

Sampling activities will consist of measuring the static water level in each well, measuring field parameters, and obtaining specified groundwater samples.

4.2.1 Sampling Locations

Groundwater samples will be collected from monitoring wells (1008, 1009, 1013, 1014, 1031, 1032, 1047, 1048, 1049, and OW1 through OW6) located in close proximity to the interceptor trench (Figure 4-2). Samples will be collected to assess the influence of the interceptor trench operation on the groundwater quality of the shallow aquifer.

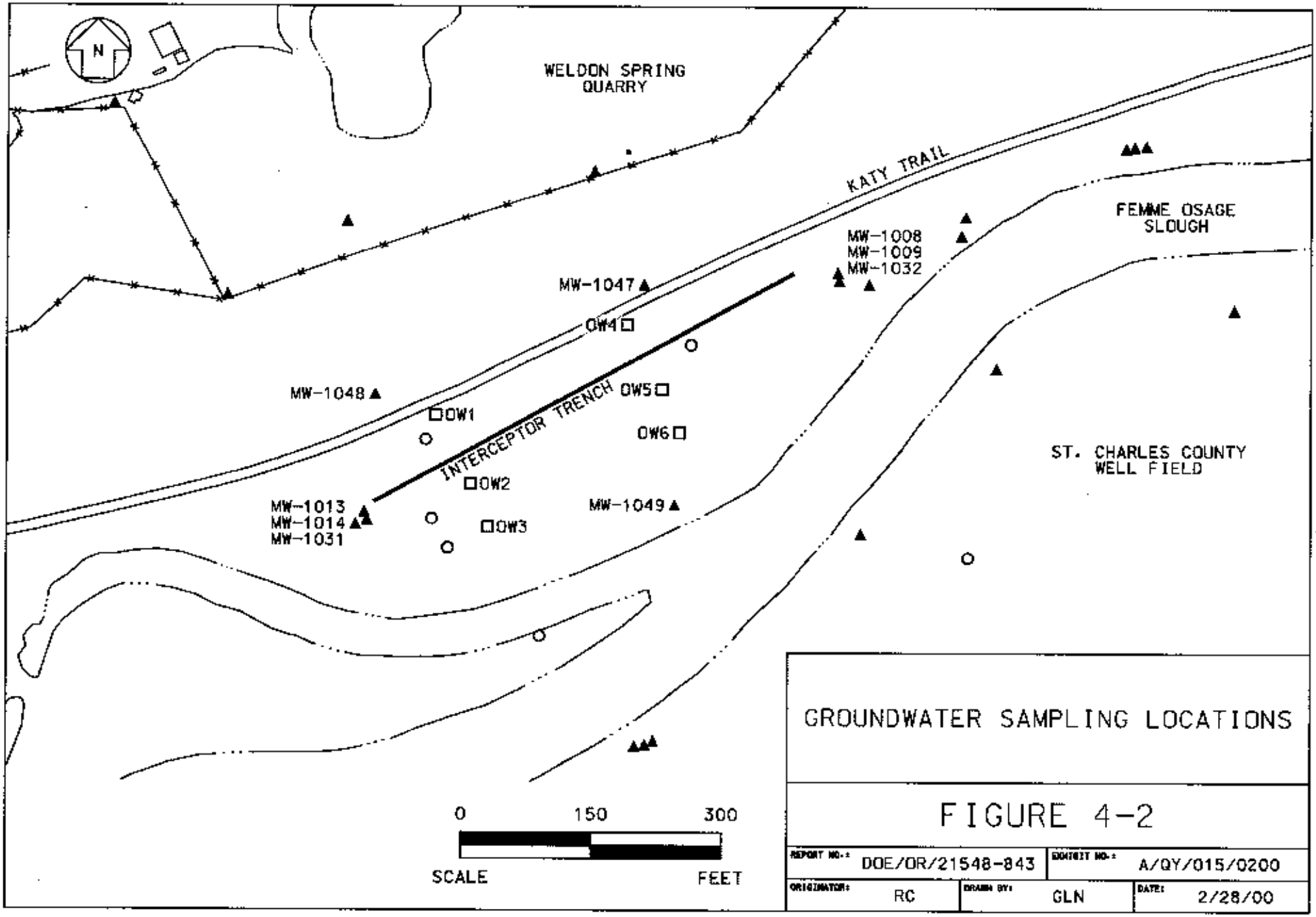
4.2.2 Parameters

Samples collected for the monitoring wells will be analyzed for total uranium, nitroaromatic compounds, geochemical parameters (sulfate/sulfide, ferrous iron, and dissolved iron), and field parameters. Field parameters (pH, Eh, dissolved oxygen, and conductivity) will be measured at each location during each sampling event.

Uranium samples will be analyzed at both the on-site radiological laboratory and at off-site contract laboratories. Off-site analysis will be performed to verify on-site results. Geochemical parameters will be analyzed on-site. The remainder of the parameters will be determined at off-site contract laboratories.

4.2.3 Sampling Frequency

Samples will be collected at the frequency outlined in Table 4-4.



GROUNDWATER SAMPLING LOCATIONS

FIGURE 4-2

REPORT NO.:	DOE/OR/21548-843	EXHIBIT NO.:	A/QY/015/0200		
ORIGINATOR:	RC	DRAWN BY:	GLN	DATE:	2/28/00

Table 4-4 Monitoring Well Sampling Frequency

PARAMETER	SAMPLING FREQUENCY		NOTES
	0 – 3 MONTHS	3 – 24 MONTHS	
Uranium, total – on-site[a][c]	weekly	monthly	a, b, c
Uranium, total – off-site[a]	monthly	quarterly	a
Nitroaromatic Compounds	monthly	quarterly	
Fe^{2+}/Dissolved Fe (total)	monthly	quarterly	
SO_4/H_2S	monthly	quarterly	

(a) Filtered samples will be collected on a weekly basis for both on-site and off-site analysis during the first 3 months of the study.
(b) Location 1047 will be sampled only for off-site analysis due to slow recharge.
(c) OW series wells will be sampled biweekly for on-site uranium analysis.

4.2.4 Sample Identification

All containers will be labeled in accordance with Procedure ES&H 4.1.1, *Numbering System for Environmental Samples and Sampling Locations*. Sample numbers will follow the designation GW-XXXX-date, where XXXX designates the well ID number. Filtered samples will be given the designation "-F" at the end. Sample locations, samples collected, and pertinent related data will be recorded on the field sheets at the time of collection in accordance with Procedure ES&H-4.4.1, *Groundwater Sampling*.

4.2.5 Sample Collection

Samples will be collected in accordance with procedure ES&H 4.4.1, *Groundwater Sampling*. Field parameters, including Eh, pH, conductivity, and temperature, will be measured at each location. Sample filtering will be performed in accordance with Procedure ES&H 4.4.1.

4.2.6 Sample Containers and Preservation Methods

Table 4-5 summarizes the appropriate containers and preservation methods for each sample.

Table 4-5 Sample Containers and Preservation – Monitoring Wells

Parameter	Laboratory	Container	Preservation
Uranium, total	On-site	10 ml, plastic	None
	Off-site	250 ml, plastic	Nitric acid, pH < 2
Nitroaromatic Compounds	Off-site	1 liter, amber glass	Ice, 4 C
Geochemical	On-site	250 ml, glass	None
Iron Dissolved	Off-site	250 ml, plastic	Nitric acid, pH <2 (filtered sample)

4.2.7 Static Water Level Measurements

Static water level measurements will be recorded prior to each sampling event. Measurements will be performed in accordance with procedure ES&H 4.4.2, *Groundwater Level Monitoring and Well Integrity Inspection.*

4.3 Initial Mass Determination

Prior to initiation of this field study, a one-time sampling event will be performed in the area of groundwater impact to estimate the mass of uranium present.

4.3.1 Sampling Locations

Groundwater samples will be collected from monitoring wells MW-1002, MW-1004, MW-1005, MW-1006, MW-1007, MW-1008, MW-1009, MW-1013, MW-1014, MW-1015, MW-1016, MW-1027, MW-1030, MW-1031, MW-1032, MW-1045, MW-1046, MW-1047, MW-1048, and MW-1049, as well as OWI through OW6 (Figure 4-3). Samples will be collected to determine the level of uranium throughout the area of impact prior to starting the field study.

4.3.2 Parameters

Samples collected will be analyzed for total uranium. These samples will be analyzed at both the on-site radiological laboratory and off-site contract laboratories. Filtered and unfiltered samples will also be collected and analyzed.

4.3.3 Sample Identification

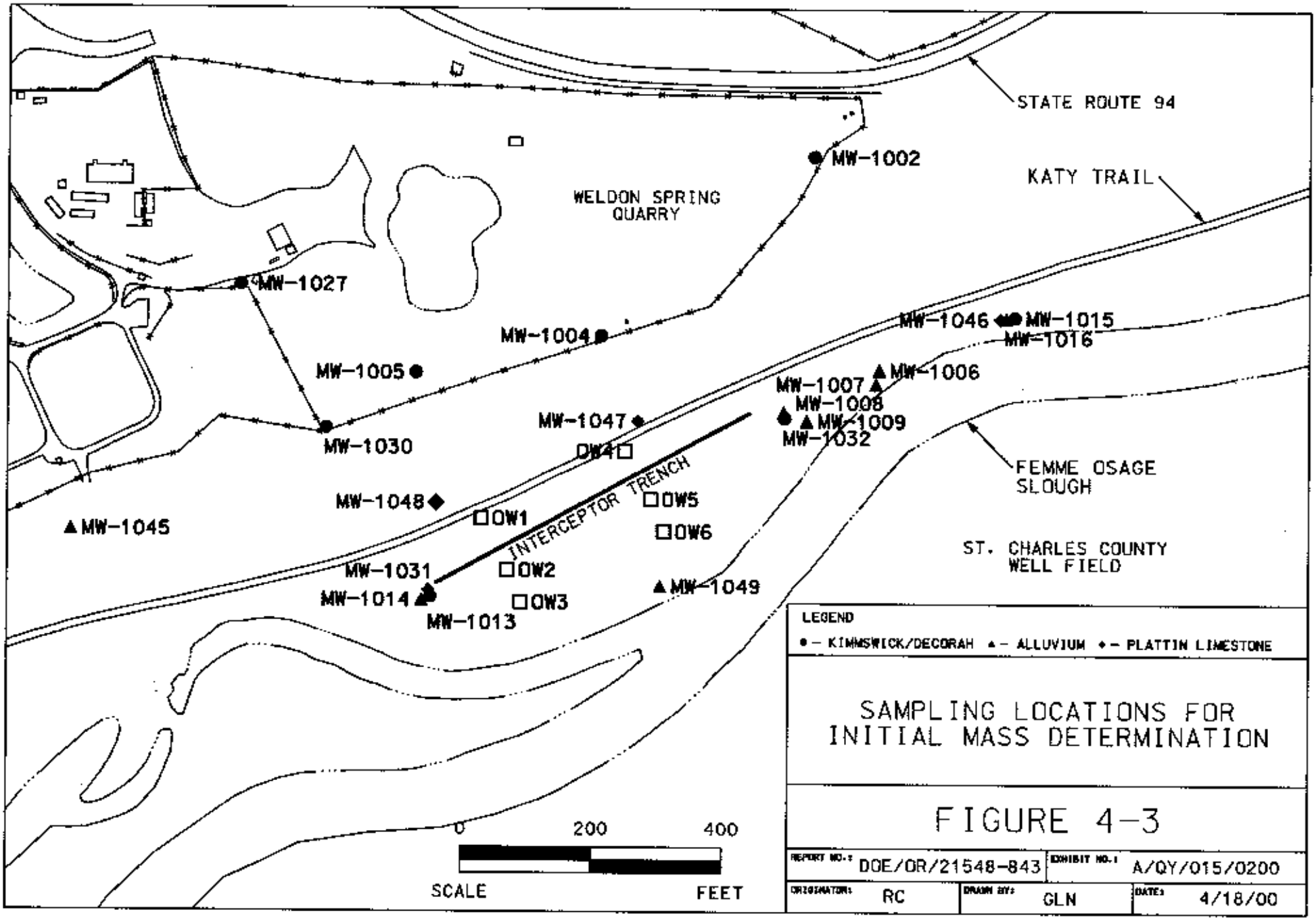
Sample identification will be performed as outlined in Section 4.2.4 of this report. Filtered samples will be given the designation "-F" at the end.

4.3.4 Sample Collection

Sample collection will be performed as outlined in Section 4.2.5 of this report.

4.3.5 Sample Containers and Preservation Methods

The appropriate containers and preservation methods are summarized in Table 4-5.



SAMPLING LOCATIONS FOR INITIAL MASS DETERMINATION

FIGURE 4-3

REPORT NO.: DOE/OR/21548-843	EXHIBIT NO.: A/QY/015/0200	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 4/18/00

4.4 Continuous Monitoring of Groundwater Levels and Field Parameters

Continuous monitoring will be performed with multi-parameter pressure transducers.

4.4.1 Monitoring Locations

Continuous monitoring of groundwater levels and field parameters will be performed in the six new wells (OW1 through OW6) installed for this field study.

4.4.2 Parameters

Parameters to be measured are water level, temperature, dissolved oxygen and Eh.

4.4.3 Operation

Pressure transducer will be calibrated and operated in accordance with the manufacturer's recommendations. The multi-parameters transducers will be programmed to collect measurements at the following frequencies:

	FREQUENCY	
PARAMETER	0-3 MONTHS	3-24 MONTHS
Pressure	6 hrs	12 hrs
Temperature	24 hrs	24 hrs
Dissolved Oxygen	6 hrs	24 hrs
Eh	6 hrs	24 hrs

5. ANALYTICAL METHODS

5.1 Field Methods

Field parameters (temperature, dissolved oxygen, pH, and Eh) will be measured for each groundwater sample as outlined in procedure ES&H 4.4.1, *Groundwater Sampling*.

5.2 Laboratory Methods

Laboratory analytical methods are specified in Table 5-1.

Table 5-1 Summary of Analytical Methods

PARAMETER	LABORATORY	METHOD
Uranium, total	On-site	KPA (ES&H 2.6.5)
	Off-site	KPA
Nitroaromatic Compounds	Off-site	HPLC or GC
Fe^{2+}	On-site	Hach DR2000 Methods 8146 and 8008
SO_4/H_2S	On-site	Hach DR2000 Methods 8051 and 8131
Fe, total	Off-site	CLP/CP (filtered)

5.2.1 On-Site Analyses

Geochemical parameters (Fe^{2+} and SO_4/H_2S) will be analyzed for each groundwater sample according to the procedures specified in the Hach DR2000 instrument manual. Samples should be analyzed within 2 hours of sample collection.

Total uranium analyses performed at the on-site laboratory will be conducted in accordance with procedure ES&H 2.6.5, *Calibration and Operation of the KPA-11 Kinetic Phosphorescence Analyzer*.

5.2.2 Off-Site Analyses

Total uranium, nitroaromatic compounds, and iron will be analyzed by the methods outlined in Table 5-1. Detection limits for uranium should be less than or equal to 1.0 pCi/l. Detection limits for each nitroaromatic compounds should be less than 0.1 µg/l. Iron analysis will be performed on filtered samples. Detection units for iron analysis should be less than 1.0 µg/l.

6. QUALITY CONTROL

The Project Management Contractor (PMC) at the Weldon Spring Site Remedial Action Project (WSSRAP), has developed the *Environmental Quality Assurance Project Plan* (EQAPjP) (Ref. 7) to guide all environmental activities conducted at the WSSRAP in accordance with the U.S. Environmental Protection Agency guidelines. The *Sample Management Guide* (Ref. 8) has been developed following the guidelines listed in the EQAPjP. This guide establishes the approach to sample planning, collection, and data analysis.

6.1 Chain-of-Custody

Chain-of-Custody forms will be completed and placed in the sample coolers in accordance with Procedure ES&H 4.1.2, *Initiation, Generation, and Transfer of Environmental Chain-of-Custody*.

6.2 Analytical Procedures

The on-site laboratory conducting the radiological analysis for this sampling effort uses approved methodologies in accordance with site standard operating procedures (SOPs).

The off-site quantitative laboratories conducting radiological and chemical analysis have submitted controlled copies of their site-specific quality assurance project plans (QAPjP) and SOPs. The plans and SOPs have been reviewed and accepted by the Project Management Contractor (PMC). The Weldon Spring Site Remedial Action Project (WSSRAP) and contract laboratory SOPs comply with the accepted standards and methodologies for performing analytical processes, operations, and activities. The laboratory QAPjPs and SOPs specify quality control requirements to demonstrate the precision, representativeness, and accuracy of the analytical data.

6.3 Quality Control Samples

Quality control samples will be collected to ensure consistent and accurate performance of sample collection and laboratory analysis. Table 6-1 provides a summary list of the quality control samples that will be collected to support this effort.

Table 6-1 Field Quality Control Sample Summary

QC SAMPLE TYPE	FREQUENCY	PURPOSE
Field Replicate (on-site and off-site)	1 per 20 samples	Assess matrix, intralaboratory, and field operations variability
Matrix Spike/Matrix Spike Duplicate or Matrix Duplicate (off-site only)	1 per 20 samples	Assess matrix and possible intralaboratory variability

6.4 Data Evaluation

Data packages received from the off-site contract undergo several processes to evaluate the quality of the data. When data are first received, copies will be distributed to the Verification/Validation Group and data users for review as described in the following sections.

6.4.1 Data Verification

Analytical results received from the laboratory will be reviewed in accordance with Procedure ES&H 4.9.1, *Environmental Monitoring Data Verification.* The following factors will be evaluated to verify if a sample has been properly handled according to WSSRAP protocol:

- Chain of custody
- Holding Times
- Sample preservation requirements
- Sample analysis request form
- Quality control samples
- Laboratory receipt forms

6.4.2 Data Review

The data package will be distributed to the data users for review. The data will be reviewed to identify discrepancies in the field quality control samples, inconsistencies with characterization data, and apparent abnormalities. Deficiencies identified by data users will be reported to the Verification Group. Data users may request validation of any data that appear to be of questionable quality. This review will be done in accordance with Procedure ES&H 1.1.7, *Data Review and Above-Normal Data Reporting.*

6.4.3 Data Validation

Randomly selected laboratory data and data selection by verification personnel or data users will undergo thorough review of the analytical process in accordance with Procedure ES&H 4.9.2, *Environmental Monitoring Data Validation.* The Validation Group will conduct these reviews.

The validation procedure will provide a consistent means for reviewing and evaluating the data resulting from laboratory analyses and will provide a consistent means of documenting the evaluation and reporting the usefulness of the data to data users. This will be accomplished by a thorough review of the analytical data using laboratory records to assess laboratory conformance to quality control criteria, data quality requirements for data quality objectives, and procedural requirements.

7. DATA REPORTING, ANALYSIS, AND EVALUATION

The trench system will be evaluated and monitored for up to 2 years. Data will be collected from the trench and nearby monitoring wells and assessed throughout the operational period.

7.1 Data Reporting

At the completion of the field study, the data from the trench will be summarized in the *Completion Report for the QROU Interceptor Trench Field Study*. This report will detail the sampling activities, analytical results, and quality control issues for this field study. Deviations or modifications to this plan will also be discussed. Modifications may include, but are not limited to, changes in sampling frequencies, changes in sampling methods, or changes in analyses. Quarterly updates regarding the field study will be reported in the *Federal Facilities Agreement* quarterly reports.

7.2 Data Analysis

The initial mass of uranium in the area of groundwater impact will be derived from the results of the samples obtained prior to start-up of the field study (Section 4.3). The concentrations of uranium will be modeled in three dimensions to obtain a plume segregated into regions of isoconcentration. The extent of the uranium impact in groundwater will be delineated to 15 pCi/l (maximum background) for determination of the volume of the plume. A porosity of 0.27 (Ref. 2) will be used for determination of the volume of water in the area of impact. The mass of uranium will be estimated by multiplying the concentration of each isoconcentration region by the volume of water within the same region.

Periodic estimations of the mass of uranium in groundwater will be made in the area of impact. These estimates will be made quarterly to monitor changes in the uranium mass with respect to the operation of the trench.

Static water level measurements obtained during this field study will be used to determine the effects of groundwater withdrawal on the groundwater flow in the shallow aquifer north of the slough. This information will be necessary to estimate the percentage of the plume that is influenced by the operation of the trench. The hydraulic capture zone of the trench will be determined by modeling the groundwater surface using water levels measured in nearby wells. Drawdowns attributable to operation of the trench will be verified using drawdown analysis (graphical and/or analytical) of the water levels in the sumps and wells.

The mass of uranium removed from the trench will be derived from measurements of uranium concentrations and the volumetric discharge rate from the trench over time. The ratio of the mass of uranium removed to the initial total mass present within the area of hydraulic capture will provide an indication of the trench efficiency. A curve of the mass of uranium removed versus time will be constructed.

7.3 Field Study Evaluation

Data presented in the *Completion Report of the QROU Interceptor Trench Field Study* will be compiled to evaluate the effectiveness of an interceptor trench system for the removal of uranium from the shallow aquifer in the area north of the Femme Osage Slough. Data to be presented will include:

- Curve of the mass of uranium removed over time.
- Curves of the volume of groundwater extracted
- Static water level data from nearby monitoring wells.
- Summary of analytical data for uranium and nitroaromatic compounds from the study area.
- Summary of the total mass of uranium removed from the aquifer.
- Summary of the total volume of groundwater extracted from the aquifer.
- Conclusions regarding the performance of the interceptor trench system

8. REFERENCES

1. Argonne National Laboratory. *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri.* DOE/OR/21548-725. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1998.

2. Argonne National Laboratory. *Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri.* DOE/OR/21548-595. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office by the Environmental Assessment Division. St. Charles, MO. March 1998.

3. MK-Ferguson Company and Jacobs Engineering Group. *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit.* Rev. 0. DOE/OR/21548-787. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. January 2000.

4. MK-Ferguson Company and Jacobs Engineering Group. *Remedial Investigation for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring Missouri.* Rev. 2. Final. DOE/OR/21548-587. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. February 1998.

5. MK-Ferguson Company and Jacobs Engineering Group. *Post-Remedial Action Report For Vicinity Property No. 9 (WP-461).* Rev. 0. DOE/OR/21548-685. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 1997.

6. U.S. Department of Energy. *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site.* Rev. 0. DOE/OR/21548-376. Oak Ridge Field Office. St. Charles, MO. September 1993.

7. MK-Ferguson Company and Jacobs Engineering Group. *Environmental Quality Assurance Project Plan.* Rev. 4. DOE/OR/21548-352. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. October 1999.

8. MK-Ferguson Company and Jacobs Engineering Group. *Sample Management Guide.* Rev. 2. DOE/OR/21548-499. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 2000.

PROCEDURES AND DEPARTMENT INSTRUCTIONS

ECDI-29, *Site Generated Waste Management*
ES&H 1.1.7, *Data Review and Above-Normal Data Reporting*
ES&H 2.4.1, *Calibration and Use of Portable Radiological Survey Instruments*

ES&H 2.6.5, *Calibration and Operation of KPA-11 Kinetic Phosphoresce Analyze*
ES&H 4.1.1, *Numbering System for Environmental Samples and Sampling Locations*
ES&H 4.1.2, *Initiation, Generation, and Transfer of Environmental Chain of Custody*
ES&H 4.4.1, *Groundwater Sampling*
ES&H 4.4.2, *Groundwater Level Monitoring and Well Integrity Inspection*
ES&H 4.4.7, *Soil, Rock Core, and Rock Chip Borehole Logging*
ES&H 4.9.1, *Environmental Monitoring Data Verification*
ES&H 4.9.2, *Environmental Monitoring Data Validation*

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MK-Ferguson Company
Weldon Spring Site Remedial Action Project

TRANSMITTAL OF CONTRACT DELIVERABLE

Date: **October 4, 2000** Transmittal No.: **CD-0237-02**

Title of Document: **Sampling Plan For The QROU Ionterceptor Trench Field Study**

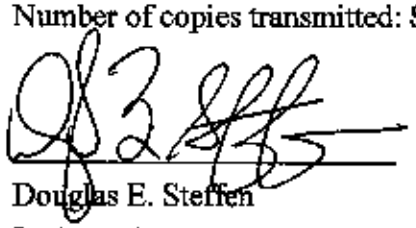
Doc. Num.: **843** Rev. No.: **2** Date of Document: **October 2000**

Purpose of Transmittal: Request for Department of Energy acceptance of contract deliverable.

In compliance with the Project Management Contract, MK-Ferguson Company hereby delivers the attached document to the U.S. Department of Energy, Weldon Spring Site Office. The document has been reviewed and approved by Project Management Contractor management.

The document will be considered accepted unless we receive written notification to the contrary within 30 days of the date of this transmittal.

Number of copies transmitted: **Six**



Douglas E. Steffen
Project Director