5-1061.18 1201

Department of Energy

Ohio Field Office
Fernald Area Office
P. O. Box 538705
Cincinnati, Ohio 45253-8705
(513) 648-3155

JAN 15 1998

DOE-0353-98

Mr. James A. Saric, Remedial Project Manager
U.S. Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF THE DRAFT START-UP MONITORING PLAN FOR THE SOUTH FIELD EXTRACTION AND SOUTH PLUME OPTIMIZATION MODULES, AND; REQUEST FOR MODIFICATION OF COMMENCE OPERATIONS DATES ESTABLISHED IN THE REMEDIAL ACTION WORK PLAN FOR AQUIFER RESTORATION AT OPERABLE UNIT 5

This letter transmits the draft Start-Up Monitoring Plan for the South Field Extraction and South Plume Optimization Modules and requests a modification to the schedule in the Operable Unit (OU5) Remedial Action Work Plan (RAWP), June 1997 to commence operations for the South Field Extraction System (SFES), South Plume Optimization System (SPOS), and Re-Injection Demonstration System (IDS) Projects. The enclosed plan outlines a preferred groundwater restoration start-up sequence for each of these three modules or components which is different from that sequence identified in the OU5 RAWP. The preferred start-up strategy presented in the enclosed plan is consistent with the strategy identified in the draft Re-Injection Demonstration Test Plan submitted to you in August 1997.

During the development of the Re-Injection Demonstration Test Plan, it was recognized that the start-up sequence outlined in the OU5 RAWP should be changed to initiate groundwater extraction in the South Field prior to starting re-injection.

The DOE proposes that the OU5 RAWP commence operations dates be modified to start the SFES prior to the IDS. The proposed revised start-up sequence and schedule for these three modules are shown as follows (along with the original RAWP milestone dates):

OPERABLE UNIT 5
REMEDIAL ACTION WORK PLAN SCHEDULE FOR
THE INJECTION DEMONSTRATION, SOUTH PLUME OPTIMIZATION,
AND SOUTH FIELD EXTRACTION SYSTEM PHASE I PROJECTS

ACTIVITY/MODULE	CURRENT RAWP DATE FOR COMMENCEMENT OF OPERATIONS	PROPOSED REVISED DATE FOR COMMENCEMENT OF OPERATIONS
Injection Demonstration	August 1, 1998	September 30, 1998
South Plume Optimization	September 1, 1998	September 1, 1998
South Field Extraction System Phase I	September 30, 1998	August 1, 1998

If you have any questions regarding this transmittal, please contact Robert Janke at (513) 648-3124, or John Kappa at (513) 648-3149.

Sincerely,

Johnny W. Reising
Fernald Remedial Action
Project Manager

FEMP:Kappa

Enclosure: As Stated

cc w/enc:

G. Jablonowski, USEPA-V, 5HRE-8J
R. Beaumier, TPSS/DERR, OEPA-Columbus
T. Schneider, OEPA-Dayton (total of 3 copies of encs.)
M. Davis, ANL
F. Bell, ATSDR
D. S. Ward, HSI GeoTrans
R. Vandegrift, ODOH
F. Barker, Tetra Tech
D. Brettschneider, FDF/52-5
K. Broberg, FDF/52-5
D. Carr, FDF/52-2
T. Hagen, FDF/65-2
J. Harmon, FDF/90
E. Henry, FDF/52-5
W. Hertel, FDF/52-5
J. Hughes, FDF/52-5
M. Jewett, FDF/52-5
AR Coordinator, FDF/78

cc w/o enc:

N. Hallein, EM-42/CLOV
A. Tanner, DOE-FEMP
R. Heck, FDF/2
S. Hinnefeld, FDF/2
EDC, FDF/52-7

1201

START-UP MONITORING PLAN FOR THE SOUTH FIELD EXTRACTION AND SOUTH PLUME OPTIMIZATION MODULES

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

JANUARY 1998

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

53100 & 53300-SU001
REV. B
DRAFT

1201

START-UP MONITORING PLAN FOR THE SOUTH FIELD EXTRACTION AND SOUTH PLUME OPTIMIZATION MODULES

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

JANUARY 1998

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

DRAFT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

This start-up monitoring plan is the controlling document for the start-up of the South Field Extraction (Phase 1) and South Plume Optimization Modules. Figure 1-1 shows the location of the two modules, the location of individual wells within the modules, contingency well RW-8, the AWWT Expansion Facility, and the existing South Plume Module. Start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules will focus on establishing an acceptable treatment flow and maintaining hydraulic capture of the 20 μg/L total uranium plume. This plan will facilitate start-up by:

1) Providing the initial pumping rates (set points) for each individual well within the two modules

2) Providing a preferred sequencing for start-up of the modules and the individual wells within the modules

3) Prescribing a limited but focused sampling program which will be conducted during start-up of the modules to supplement remedy performance monitoring already defined in the IEMP (DOE 1997b) and operational philosophy already defined in the Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment Project (OMMP) (DOE 1997c).

The need for this start-up monitoring plan is identified in Section 3.0 of the IEMP and in Section 1.0 of the OMMP. Following completion of the limited and focused monitoring presented in this plan, long term monitoring to assess achievement of aquifer remedy goals will continue as part of the IEMP. Similarly, operation and maintenance of the modules will continue according to the operational philosophy set forth in the OMMP.

1.1 <u>OBJECTIVES</u>

The objectives of this start up plan are to:

- Determine and establish optimum flow rates for each new extraction well in consideration of Baseline Remedial Strategy Report (BRSR, DOE 1997a) Objectives

- Supplement Remedy Performance Monitoring presented in the Integrated Environmental Monitoring Plan (IEMP, DOE 1997b) during start-up to determine the initial effectiveness of the modules in meeting Baseline Remedial Strategy Objectives

- Establish monitoring to be utilized in determining if off-property contingency well RW-8 (formally known as 3N) is required to achieve remedial objectives.
- Obtain information necessary to begin the long term maintenance and operation of the modules.

1.2 INTEGRATION WITH OTHER KEY DOCUMENTS

This section explains how this start-up plan integrates with other key Aquifer Remediation and Waste Water Project (ARWWP) documents to provide for the start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules. The other key documents include:

- The Operable Unit 5, Record of Decision (ROD) (DOE 1996b)
- The Operable Unit 5 Remedial Design (RD) Work Plan (DOE 1996c)
- The Operable Unit 5 Remedial Action (RA) Work Plan (DOE 1997e)
- The BRSR (DOE 1997a)
- Detailed System Design and Construction Packages
- The OMMP for the Aquifer Restoration and Wastewater Treatment Project (DOE 1997c)
- The IEMP (DOE 1997b)
- Re-Injection Demonstration Test Plan (DOE 1997d).

Figure 1-2 illustrates how the OU5 ROD, RD and RA Work Plans, BRSR, OMMP and IEMP integrate with one-another in relation to the remedial design, detailed design and construction, and operation of the South Field Extraction (Phase 1) and South Plume Optimization Modules. The OU5 ROD establishes the scope of the Aquifer Remedy. The RD Work Plan defines the activities for developing the documentation necessary to implement the Aquifer Remedy. The RA Work Plan provides the implementation strategy and enforceable schedule for initiating the Aquifer Remedy.

Implementation of the aquifer remedy can be divided into three areas: remedial design, detailed system design and construction, and system operation. The BRSR is the controlling document for the remedial design of the aquifer remedy. The BRSR establishes the location of wells, the number of wells, the pumping rates, re-injection rates and establishes the initial target "road-map" for guiding the remedy to completion. Detailed design and construction is documented through detailed system design packages, construction management and control procedures, system operability testing (SOTs), detailed start-up plans, and start-up readiness reviews. Detailed start-up plans for construction differ from this start-up monitoring plan in that detailed start-up plans for construction take the system to the point of being ready for operation. This start-up monitoring plan explains how the system will be started (once it has been turned over from construction to operations personnel) and defines the limited and focused monitoring that will take place, above and beyond the IEMP and OMMP, to begin operation of the systems.

System operation consists of both the physical operation and maintenance of the systems and with how well the system is working to remediate the aquifer, as illustrated in Figure 1-3. The OMMP establishes the operational and maintenance philosophy for the remediation systems. The IEMP identifies a program of groundwater monitoring and sampling that will be used to track achievement of aquifer remedy goals. As Figure 1-3 illustrates, this start-up monitoring plan will supplement both the OMMP and IEMP.

This start-up monitoring plan supplements the OMMP by providing the initial "set point" for each individual extraction well. The set point tells the operator the flow rate at which an extraction well is to be pumped. This plan also provides the operator with the preferred sequencing for start-up of the modules and the individual extraction wells within the modules. This start-up monitoring plan supplements the IEMP with additional monitoring needed to assess initial remedy performance and supplements the OMMP by collecting data to establish baseline maintenance requirements for new extraction wells.

1.3 OTHER CONSIDERATIONS

During the preparation of this plan it was recognized that previous plans and commitments needed to be considered. These considerations are listed below.

- AWWT Expansion Facility
- Integration with the IEMP and OMMP
- Integration with the start-up of the Re-Injection Demonstration Module
- Monitoring to determine the immediate need for a contingency well in the South Plume Optimization Module
- Remediation Design parameters

- Wastewater treatment operations philosophy
- Lessons learned from the operation of the South Plume Extraction System.

These considerations are discussed in each of the following subsections.

AWWT Expansion Facility

Successful completion and operation of the AWWT Expansion Facility is needed prior to the start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules. The AWWT Expansion will provide the needed groundwater treatment capacity for meeting the agreed to 20 ppb discharge limit at the Great Miami River.

Integration with the IEMP and OMMP

The limited and focused sampling outlined in this start-up plan will supplement remedy performance monitoring already defined in the Integrated Environmental Monitoring Plan (IEMP) and operational philosophy already defined in the Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment Project (OMMP). Information learned from carrying out this start-up plan will be incorporated into future revisions of the IEMP and OMMP for the long term operation and monitoring of the aquifer remedy.

Integration with the start-up of the Re-Injection Demonstration Module

Start-up monitoring of the South Field Extraction (Phase-1) Module and the South Plume Optimization Module will be coordinated with the start-up monitoring conducted for the Re-Injection Demonstration Module. The controlling document for the Re-Injection Demonstration is the Re-Injection Demonstration Test Plan (DOE 1997d). Data collected during the Re-Injection Demonstration (i.e., water level and water quality) will be interpreted along with data collected during start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules to answer questions concerning the initial performance of the remedial system in meeting remediation objectives. Preferred sequencing for start-up of the South Field Extraction (Phase-1), South Plume Optimization, and Re-Injection Demonstration Modules is presented in Section 2.0.

Monitoring to determine the need for a contingency well in the South Plume Optimization Module

The South Plume Optimization Module is an off-property module that consists of two extraction wells (Figure 1-1). Resolution of off-property landowner access issues resulted in limiting the South Plume

Optimization Module to two wells with a third well identified as a contingency well (i.e., Well RW-8, which was originally called 3N). Criteria were presented in Section 5.0 of the BRSR for determining the need to install this contingency well.

Monitoring activities presented in Section 3 of this start-up plan were designed with the intent of determining the need for contingency well RW-8. The start-up monitoring presented in this plan will provide information to begin to determine if the contingency well is needed. However, it is recognized that this contingency well (RW-8) and other additional extraction wells may be needed in the future, at a time beyond that covered by this plan. The determination of the need for additional extraction wells, at a time beyond that covered by this start-up monitoring plan, will be made as part of the groundwater remedy performance reporting being conducted in accordance with the IEMP. As noted in Section 1.2 of this plan, the start-up monitoring plans supplement the IEMP and as such may indicate the need for long-term monitoring above and beyond that currently identified in the IEMP. These additional monitoring activities, if determined to be necessary, would be incorporated into the IEMP as part of the annual updates or biennial revisions.

Remediation design parameters

Remediation design parameters for the baseline groundwater remedial strategy are presented in Section 5.0 of the BRSR. Section 5.0 of the BRSR defines the location of extraction wells, the number of extraction wells, the pumping rates, re-injection rates, and treatment flows for the baseline groundwater remedial strategy. Table 5-1 of the BRSR presents the extraction/injection rate schedule for the baseline groundwater remedial strategy. This schedule lists the modeled pumping set points to be adopted as the initial pumping rates for each extraction well in the South Field Extraction (Phase-1) and South Plume Optimization Modules. More detail on the establishment of initial pumping rates is provided in Section 2.0.

Wastewater Treatment Operations Philosophy

Operational philosophy for the treatment of wastewater, which includes groundwater, is presented in Section 5.0 of the OMMP. The primary goals of wastewater treatment operations and maintenance are to: 1) meet effluent discharge requirements, 2) minimize bypassing of untreated groundwater and storm water, and 3) maintain treatment headwork capacities. The objectives for wastewater treatment are presented in Section 2.0 of the OMMP. The priority for water treatment through the wastewater treatment facilities is the water containing the greatest uranium concentrations. This same logic will be followed for treatment routing decisions during start-up and operation of the South Field Extraction (Phase-1) and South Plume Optimization Modules. Details of the start-up sequence and routing strategy are presented in Section 2.0.

<u>Lessons Learned from the Operation of the South Plume Extraction System</u>

The South Plume Extraction System has been pumping groundwater from the Great Miami Aquifer since August 1993. Operational experience gained from the operation of the South Plume Wells will be applied to the South Field Extraction (Phase-1) and South Plume Optimization Wells.

In particular the South Plume Wells have experienced iron fouling of system components, including well screens, control valves, flow meters and check valves. The South Plume wells have been placed on a quarterly preventive maintenance program to address the iron fouling. The preventive maintenance program for the South Plume Wells is presented in the South Plume Performance Monitoring and Maintenance Plan (DOE 1997g). A similar maintenance program for the South Field Extraction (Phase-1) Module will be established, based on the South Plume program and the well maintenance checks identified in Section 3.7. Maintenance activities for the South Plume Optimization Module will be incorporated into the existing South Plume Performance Monitoring and Maintenance Plan.

It is anticipated that maintenance due to iron fouling will be less severe in the South Field Extraction (Phase-1) and South Plume Optimization Wells than it has been in the South Plume Wells. Iron concentrations in the South Field Extraction (Phase-1) and South Plume Optimization areas are lower than iron concentrations in the area of the South Plume Wells. Wells in the South Field Extraction (Phase-1) and South Plume Optimization Modules are designed such that the top of the well screens will remain submerged during pumping (as opposed to the screens in the South Plume Extraction Wells which at times extended above the water table during pumping). This should decrease the potential for iron to precipitate out onto the well screens.

1.4 START-UP PLAN ORGANIZATION

The Start-up Plan for the South Field Extraction (Phase-I) and South Plume Optimization Modules is comprised of the following seven sections.

Section 1.0 INTRODUCTION: This section presents the objectives of the start-up monitoring plan, explains how the plan integrates with other key documents, discusses other considerations, and outlines the rest of the sections in the plan.

Section 2.0 SET POINTS AND SEQUENCING: This section of the plan presents the pumping rates for the individual wells in both modules and the preferred sequence for start-up of the modules and wells within the modules. This section also presents the operational strategy for determining if groundwater pumped from the aquifer will be sent to treatment, or bypassed around treatment.

Section 3.0 MONITORING ACTIVITIES: The scope of start-up monitoring activities are presented in this section. Monitoring activities include: process control sampling, well maintenance monitoring, groundwater quality sampling, water level monitoring, and groundwater flow direction monitoring.

Section 4.0 DATA EVALUATION: This section outlines the data evaluation strategy for the data collected during the re-injection demonstration.

Section 5.0 SCHEDULES, DELIVERABLES, AND REPORTING: Schedules, deliverables, and reporting are discussed in this section.

Section 6.0 MANAGEMENT STRUCTURE AND RESPONSIBILITIES: This section presents an overview of the management structure for the start-up monitoring plan and outlines responsibilities for start-up monitoring activities.

Section 7.0 SUPPORTING ACTIVITIES: This section presents activities which will be conducted to support the plan (i.e., data management, health and safety, quality assurance/quality control, waste disposition, and decontamination).

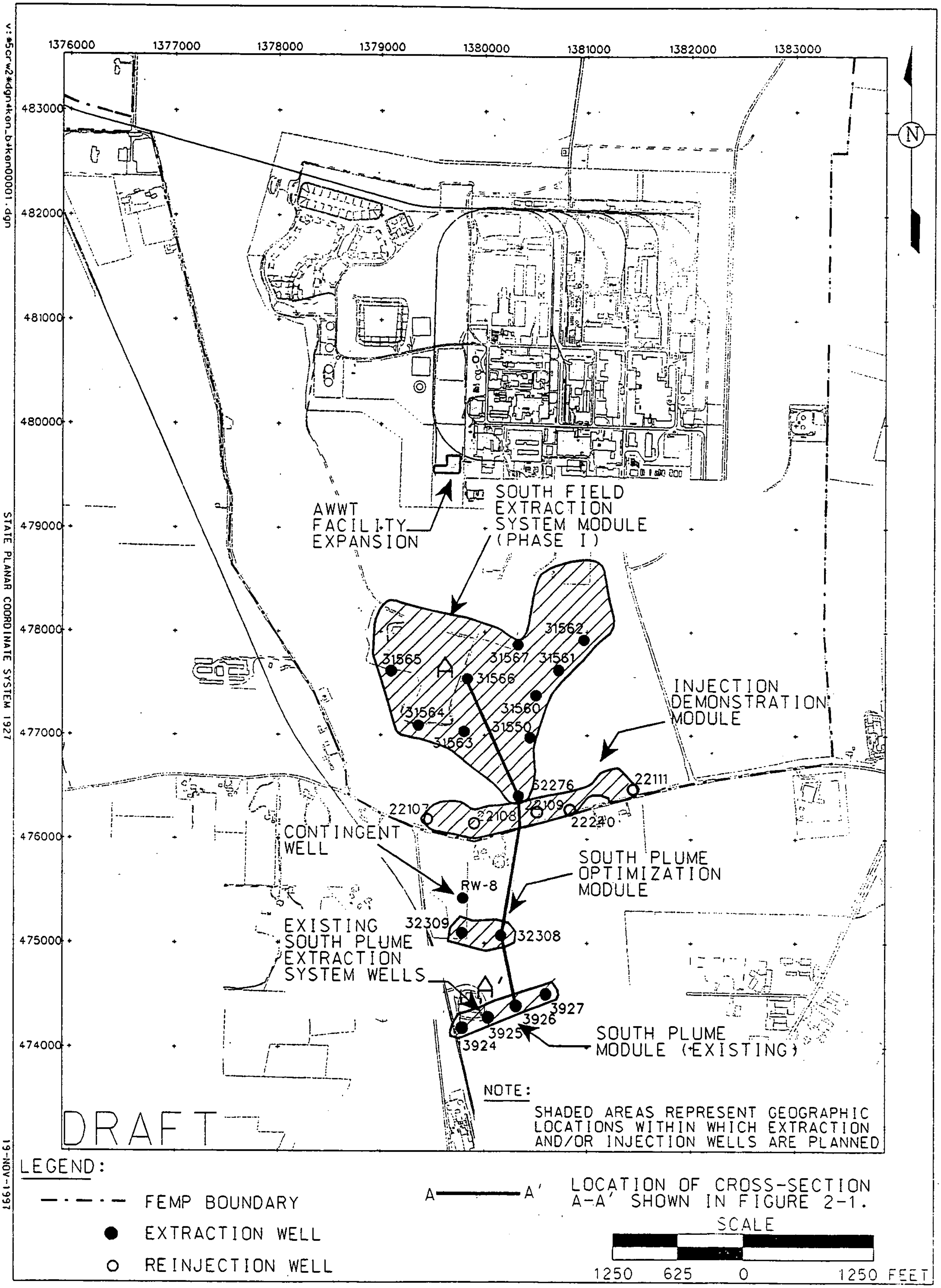


FIGURE 1-1. LOCATION OF AQUIFER RESTORATION MODULES

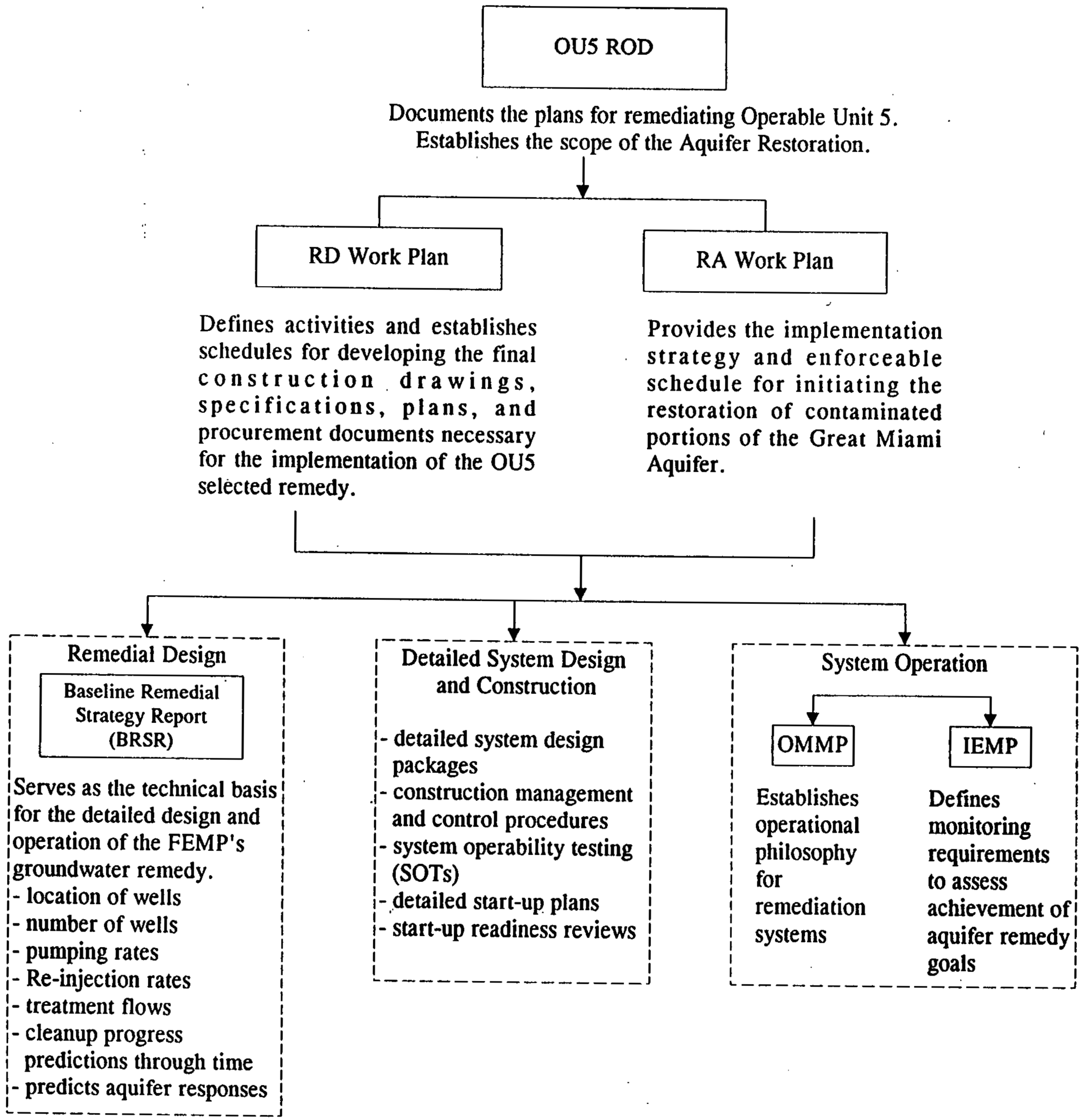


Figure 1-2 DOCUMENT INTEGRATION FOR THE AQUIFER REMEDY

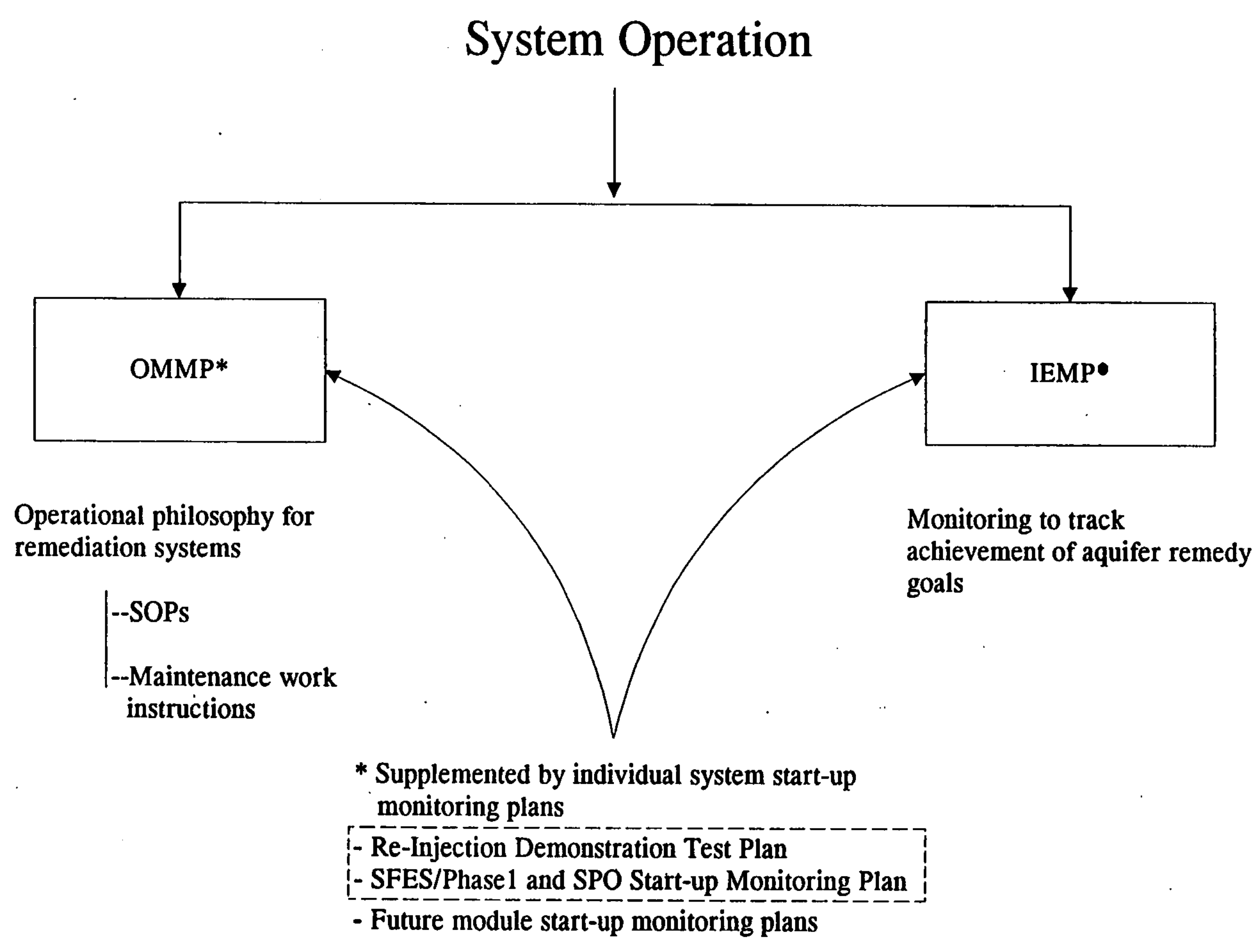


Figure 1-3 System Operation Documentation

2.0 INITIAL PUMPING RATES AND MODULE SEQUENCING

This section defines the initial rates at which individual wells in the South Field Extraction (Phase-1) and South Plume Optimization Modules are to be pumped and presents the preferred sequence for start-up of each module and the individual wells located within each module.

2.1 INITIAL PUMPING RATES (SET-POINTS)

As discussed in Section 1.0, the BRSR is the document that serves as the technical basis for the detailed design of the FEMP groundwater remedy. All start-up pumping rates listed in this plan conform to pumping rates presented in Section 5.0 of the BRSR. Start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules will be coordinated with continued pumping from the South Plume Module and start-up of the Re-Injection Demonstration Module. Sixteen extraction wells and five re-injection wells will be involved in the start-up process. Initial pumping/re-injection rates, "set points", for these 21 wells are presented in Table 2-1 of this start-up plan. With all 21 wells operating, the total system pumping rate will be approximately 3400 gpm, the total system injecting rate will be approximately 1000 gpm; resulting in a net aquifer extraction rate of 2400 gpm.

Should monitoring data collected during start-up indicate that capture of the 20 μg/L total uranium plume is not being maintained, then adjustments to the initial pumping rates given above will need to be implemented. The FEMP groundwater model will be used to help determine how pumping rates should be adjusted to maintain capture of the uranium plume. Adjustment of pumping rates will be constrained by equipment limitations. Actual data will be collected to verify the model predictions. Field data will be used to measure remedy performance, not model predictions.

2.2 PREFERRED START-UP SEQUENCE FOR THE MODULES

The start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules will be coordinated with the continued pumping of the South Plume Module and the start-up of the Re-Injection Demonstration Module.

Figure 1-1 shows the location of each of these modules and the location of the individual wells located within each module. The South Field Extraction (Phase-1) Module is located upgradient of the Re-injection Demonstration Module. The South Plume Optimization Module and the existing South Plume Module are both located downgradient of the Re-injection Demonstration Module.

The start-up sequence outlined below is preferred as it will slow the migration of the plume from the South Field prior to the start of re-injection.

The preferred start-up sequence for the modules is as follows:

1. *Continue operation of South Plume Module at a net extraction rate of 1400 gpm.*

2. *Begin operation of the South Field Extraction (Phase-1) Module first.* No other modules will be started until water levels in the aquifer have stabilized (i.e., drop in water level due to pumping has stopped). Pumping from this module will alter the hydraulic gradient and slow the migration of the uranium plume in the South Field area.

3. *Begin Operation of the South Plume Optimization Module next.* Once again, no other modules will be started until water levels in the aquifer have stabilized (i.e., drop in water level due to pumping has stopped).

4. *Begin re-injection in the Re-Injection Demonstration Module Last.*

It is anticipated that operating the South Field Extraction (Phase-1) wells combined with the South Plume Optimization and Re-Injection Demonstration Wells will create a hydraulic barrier along the southern FEMP property boundary, as shown by the water table elevation profile in Figure 2-1. The water table elevation profile is oriented north to south as identified in Figure 1-1. As Figure 2-1 illustrates, prior to any pumping in this area, the groundwater gradient was to the south at about 0.56 feet of elevation per 1000 feet of lateral distance. When pumping in the South Plume began in 1993, the water table was lowered by approximately 1.5 feet to 3.5 feet by the pumping and the gradient to the south was increased to about 1.1 feet elevation per 1000 feet lateral distance. When more pumping and injection begin in 1998, it is predicted that the water table will be lowered by an additional 1.5 feet to almost 3 feet. In addition, the re-injection wells will create a small mound of water in the re-injection demonstration area (Re-injection Well #22109 on Figure 2-1). This mound, in conjunction with the south field extraction system (Phase-1) wells, is anticipated to cause the hydraulic gradient north of the re-injection wells to reverse and flow northward to create the desired hydraulic barrier along the southern FEMP property boundary.

2.3 START-UP STRATEGY AND PREFERRED SEQUENCING FOR START-UP OF INDIVIDUAL WELLS

The start-up of extraction wells is restrained by treatment capabilities and discharge requirements. Section 5.0 of the OMMP presents a strategy for the treatment of groundwater. The strategy states that treatment of pumped groundwater will be prioritized based on uranium concentration. Flow from the highest uranium concentration producing wells will be routed to treatment until all available treatment capacity is utilized. All remaining well discharges will be bypassed around treatment to the Parshall Flume. The total uranium concentration of mixed flows will be determined using the flow weighted average concentration calculation shown in the following equation.

$$C_{avg} = \frac{\sum_{1}^{n}(F_i C_i)}{\sum_{1}^{n}(F_i)}$$

Where C_{avg} = the flow weighted average concentration
F_i = the rate of flow of component I
C_i = concentration of the flow component F_i

Extraction wells in the South Field Extraction (Phase-1) Module all have the capability to route flow on an individual basis. The existing four South Plume off-property wells and the two new South Plume Optimization Wells do not have the capability to route flow on an individual basis. Combined flow from the South Plume and South Plume Optimization wells can be routed as a group for full treatment, full bypass, or partial bypass/partial treatment.

As noted in Section 5.0 of the OMMP, two treatment systems at the FEMP will be dedicated entirely to the treatment of groundwater during the aquifer remedy, the Advanced Waste Water Treatment (AWWT) Expansion System and the South Plume Interim Treatment (SPIT) System. The AWWT Expansion facility will provide an effective treatment capacity of 1500 gpm and the SPIT facility will provide 175 gpm; a total of 1675 gpm. As outlined in the OMMP, other wastewater treatment systems will intermittently be utilized for groundwater treatment such that at least 2000 gpm groundwater flow is treated on an annual average. Start up of the South Field Extraction (Phase-1) and South Plume Optimization Modules will be based on the dedicated availability of these two modules only for groundwater treatment. Reliance on only these two dedicated treatment systems during start-up will limit the impact that rainstorms and other flows to treatment will have on start-up.

As shown in Table 2-1, pumping from all ten wells in the South Field Extraction (Phase-1) Module will result in an extraction rate of 1500 gpm. Continued pumping from the South Plume Module will provide an additional flow of 1400 gpm. The concentration of uranium in the flow coming from the South Plume Module is currently < 20 μg/L. As explained above, the four existing South Plume wells must be routed as a group for either full treatment, full bypass, or partial bypass/partial treatment. During start-up of the South Field Extraction (Phase-1) Module, flow from South Plume will be routed as a group to full bypass, providing that the flow concentration is still less than 20 μg/L. Note that some of this flow will likely be treated in another site facility that is not fully dedicated to groundwater treatment. This will provide 1675 gallons of effective dedicated groundwater treatment capacity for 1500 gallons of pumped water from the South Field Extraction (Phase-1) system. The extra 175 gpm capacity will buffer any unforseen efficiency problems that might occur during start-up of the wells.

Since enough dedicated groundwater effective treatment capacity is available for all of the groundwater which will be pumped from the South Field Module, start-up of South Field Extraction (Phase-1) wells will be able to proceed fairly rapidly. Table 2-2 prioritizes the South Field Extraction (Phase-1) wells for start-up based on the concentration of uranium measured in the pumped water during development of the wells. The combined South Plume and South Plume optimization concentration is anticipated to be greater than 20 μg/L.

Extraction Well 22 (32276) will be turned on first. Each well will be pumped until flow rates have stabilized (anticipated to be one hour or less) before the next well is turned on. Flow from all ten wells will initially be routed to treatment. Process control sampling data (total uranium concentration at the wellhead) will be used to assess how rapidly flow concentrations are changing. These data will be utilized for treatment routing decisions once the individual well target flow rates are achieved and relatively stable well specific uranium concentrations are observed. Section 3.1 provides additional details on process control sampling.

Once the change in uranium concentration measured in the flow at the wellhead has been established in all wells in the South Field Extraction (Phase-1) Module, an initial flow route for start-up of the South

Plume Optimization Wells will be determined. The uranium concentration of various mixing options will be determined using the flow weighted average concentration calculation presented earlier. Some individual wells within the South Field Extraction (Phase-1) Module (those with the lowest uranium concentrations) will probably be routed to bypass to provide for partial treatment of combined flow from the South Plume and South Plume Optimization Wells, which are routed as a group. At this time, development data from RW-7 is not available. Table 2-2 will be revised with development data from RW-7 prior to start-up to verify the preferred start-up sequencing presented for the South Plume Optimization Module. Based on the current understanding of the total uranium plume though, it is anticipated that groundwater pumped from RW-7 will contain a higher concentration of uranium than groundwater pumped from RW-6. Therefore, pumping will begin in RW-7 first. As discussed above for the South Field Extraction (Phase-1) Wells, RW-7 will be pumped until flow rates have stabilized before pumping begins in RW-6.

The start-up sequence for the South Field Re-Injection Wells is presented in the Re-Injection Demonstration Test Plan (DOE 1997d). In summary, there are five re-injection wells in the Re-Injection Demonstration Module. Re-injection will begin sequentially starting with the western most Well 22107, and proceeding east to 22108, 22109, 22240, and finally 22111, see Figure 1-1. A start-up goal will be to get re-injection, at a rate of 200 gpm per well, going in all five wells as quickly as possible (one day) to achieve the net system re-injection rate of 1000 gpm. Water levels and flow rates in the re-injection wells will be closely monitored for stability for approximately two hours following start-up before a decision will be made to move to the next re-injection well to begin operations there. It is anticipated that injection rates will stabilize quickly. Readiness Review Testing should provide additional information on how quickly the wells will stabilize. As presented earlier, the preferred start-up sequence has re-injection beginning after start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules.

TABLE 2-1

INITIAL PUMPING/INJECTION RATES "SET POINTS" FOR START-UP OF THE SOUTH FIELD EXTRACTION (PHASE-1) AND SOUTH PLUME OPTIMIZATION MODULES

Module	Modeling Well ID	Actual Well ID	Pumping/Injection (+)=Pumping (-)=Injecting[a]	Subtotal
South Field Phase 1	13	31565	200	
South Field Phase 1	14	31564	200	
South Field Phase 1	15	31566	200	
South Field Phase 1	16	31563	200	
South Field Phase 1	17	31567	100	
South Field Phase 1	18	31550	100	
South Field Phase 1	19	31560	100	
South Field Phase 1	20	31561	100	
South Field Phase 1	21	31562	100	
South Field Phase 1	22	32276	200	1500
South Plume	RW-1	3924	300	
South Plume	RW-2	3925	300	
South Plume	RW-3	3926	400	
South Plume	RW-4	3927	400	1400
South Plume Optimization	RW-6	32308	250	
South Plume Optimization	RW-7	32309	250	500
Re-Injection Demo	8	22107	-200	
Re-Injection Demo	9	22108	-200	
Re-Injection Demo	10	22109	-200	
Re-Injection Demo	11	22240	-200	
Re-Injection Demo	12	22111	-200	-1000
Total pumping gpm			3400	
Total injecting gpm			1000	
Net aquifer extraction gpm			2400	

[a]Pumping rates taken from Table 5-1 of the BRSR

TABLE 2-2

TOTAL URANIUM CONCENTRATIONS MEASURED IN EXTRACTION WELLS DURING DEVELOPMENT

Modeling Well ID	Actual Well ID	BRSR Modeled Pumping Rates (gpm)	BRSR Initial Modeled Pumping Concentrations (μg/L)	Total Uranium Concentration During Well Development Pumping (μg/L)	Approximate Pumping Rate During Development	Uranium Concentration Range Measured in Groundwater During Well Installation or from Geoprobe (μg/L)
22	32276	200	239.4	400	400	0.7-490 [c]
19	31560	100	62.7	217	200	0.9-280
21	31562	100	231.4	177	425	0.2-270
18	31550	100	16.9	130 [a]	700	0.3-381
20	31561	100	64.8	49	300	0.6-46
16	31563	200	79.8	30 [b]	600	0.2-30
14	31564	200	11.9	18	400	<0.03-26
13	31565	200	139.2	15	400	1.4-21
17	31567	100	9.6	14 [b]	600	1.9-14
15	31566	200	63.3	4.8	300	<0.4-7.7
RW-6	32308	250	27.8	123	450	2.0-127 [d]
RW-7	32309	250	45.6			1-166 [e]

[a] 130 μg/L measured during a seven day pumping test.
[b] No development data available, highest concentration measured in groundwater during installation used instead.
[c] Geoprobe data from location 12194
[d] Geoprobe data from location 12235
[e] Geoprobe data from location 32338

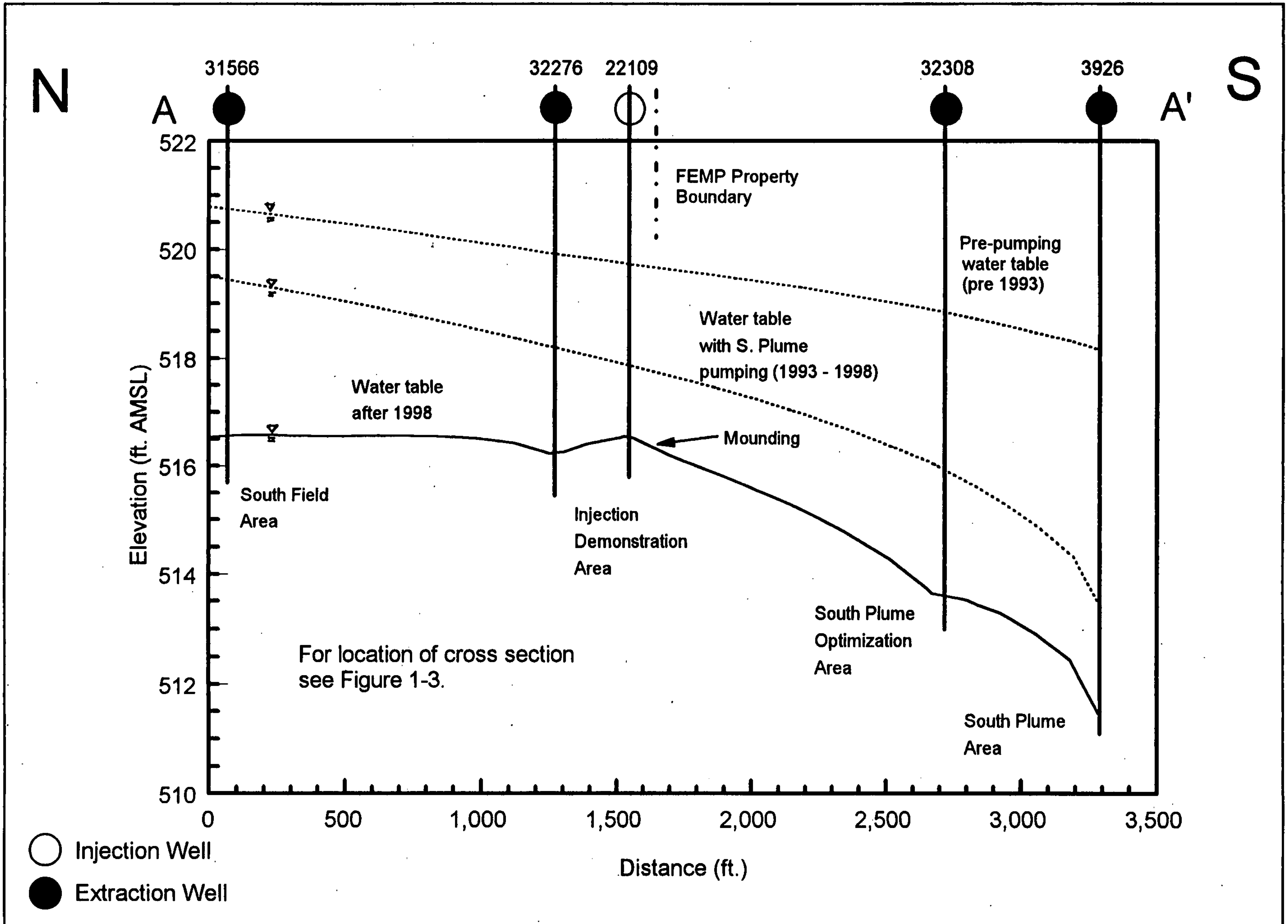


Figure 2-1. Water Table Elevation Profiles

F:\FLWWORKSPOPSP21.PRE

3.0 MONITORING ACTIVITIES

This section of the start-up plan presents a limited program of monitoring activities that will be conducted during start-up to supplement OMMP and IEMP monitoring and sampling activities.

Start-up monitoring activities will include:

- Process Control Sampling for total uranium at each extraction well
- Downhole Camera Surveys of each Extraction Well
- Biological Sampling within each Extraction Well
- Groundwater Sampling for Major Anions and Cations in each Extraction Well
- Groundwater Level Monitoring
- Well Specific Flow Direction Monitoring
- Well maintenance checks.

In addition to these limited and focused start-up monitoring activities, monitoring to assess the performance of the aquifer remedy will be conducted as already outlined in the IEMP. Each of the above listed activities is discussed below.

3.1 PROCESS CONTROL SAMPLING

For the purpose of this Start-up Monitoring Plan, process control sampling refers to the collection of uranium concentration data at each extraction well to support flow routing decisions. This sampling will be utilized to assist in determining whether the flow from a particular well should be routed to treatment or bypassed around the treatment system. Treatment and discharge sampling during start-up are not in the scope of this Start-Up Plan because the activities are already controlled using operational philosophy set forth in the OMMP.

Total uranium samples will be collected from the wellhead of each new extraction well immediately following start-up. The frequency at which additional samples will be collected is dependent upon the anticipated concentration of the pumped water, as defined in Table 2-2. Extraction wells with an anticipated uranium concentration in the pumped water that is $\leq 20\ \mu g/L$ will be sampled as outlined below until the degree of change in the concentration of total uranium has been characterized for each individual well.

- Immediately following Start-up
- Every 6 hours for the first day
- Daily from day 2 until the rate of change of the uranium concentration in the pumped groundwater is defined.

If the anticipated pumping uranium concentration for flow from a particular extraction well is >20 μg/L then the pumped groundwater will be routed to treatment (consistent with the strategy presented in Figure 1-4) and less well head sampling will be required since the treatment flow is already above 20 μg/L total uranium. Therefore the start-up sampling frequency for wells with an anticipated pumping uranium concentration that is > 20 μg/L total uranium will be once every two days until the rate of change of the uranium concentration in the pumped groundwater is defined.

The individual rate of change of the uranium concentration in the pumped groundwater at each new extraction well will be used to define a longer term sampling frequency for each well. Wells whose rate of change are low will be scheduled for less frequent sampling than wells whose rate of change are high.

3.2 DOWNHOLE CAMERA SURVEYS

Downhole camera surveys will be conducted at each new extraction well in the South Field Extraction (Phase-1) and South Plume Modules to provide a baseline for observing changes in the physical condition of the extraction wells over time. Each extraction well will be surveyed with a downhole camera (according to environmental monitoring procedure EQT-08 Down-Hole Camera Operation) just prior to the installation of the pump and at quarterly scheduled maintenance checks, if the pump is pulled. Quarterly maintenance checks are currently conducted for the South Plume Wells. Camera survey information will be used to help establish long term maintenance needs for each new extraction well. Once long term maintenance needs for each new extraction well have been established, the OMMP will be revised accordingly to provide for long term care of the extraction wells.

3.3 BIOLOGICAL SAMPLING

Biological sampling will be conducted in each new extraction well prior to the start of pumping and quarterly throughout the year to correspond with regularly scheduled maintenance checks. Data will be used to help establish long term maintenance needs for each new extraction well. Once long term maintenance needs for each new extraction well have been established, the OMMP will be revised accordingly to provide for long term care of the extraction wells.

Plugging of the well screen, gravel pack, and formation immediately surrounding the extraction well screens can occur due to bacterial growth. Operational experience with the South Plume Extraction Wells indicates that iron precipitation and bacteria are plugging problems. If bacteria are present in the extraction wells then a grab sample collected from the wells should detect the presence of the bacteria. The biological sampling results interpreted along with visual observations made using a down hole camera survey and data collected during short term draw down tests performed during quarterly maintenance checks will be useful in determining if biofouling conditions are developing that could, if untreated, lead to well plugging problems.

Prepared Biological Activity Reaction Test culture methods are the most promising approach for routine biological monitoring purposes (Smith 1995, pg. 85) and will be used to test water samples obtained from each new extraction well. Each sample event will test for iron-related bacteria, slime-forming bacteria, and total aerobic bacteria.

3.4 GROUND WATER QUALITY SAMPLING

Quarterly groundwater quality sampling outlined in the IEMP for total uranium and target FRL parameter analysis will continue during start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules. Just prior to start-up, and quarterly during start-up, additional sampling will be conducted at each new extraction well for analysis of major anions and cations to monitor for changes in water chemistry of the aquifer in the area around the extraction wells. Data will be used to help determine if pumping could be changing the aquifer geochemistry such that the stability and/or mobility of the uranium in the groundwater is affected. The additional sampling effort will be coordinated with quarterly IEMP sampling. Groundwater from each extraction well will be sampled quarterly for the major anions and cations listed in Table 3-1.

Since groundwater samples will be collected from each extraction well as the wells are being pumped, purging of the wells prior to sampling will not be necessary. All analyses will be conducted using procedures which meet Analytical Support Level (ASL B) as established in the Sitewide CERCLA Quality (SCQ) Plan as referenced in Table 3-2. ASL B is specified for this program since the data will be used for surveillance monitoring purposes. Sample collection protocols are identified in the SCQ and in specific procedures referenced in the SCQ. The following procedures and guidance sections of the SCQ are used to conduct groundwater monitoring:

Standard Operating Procedures

ADM-02	Field Project Prerequisites
SC-GWM-FO-201	Groundwater Sampling Activities
EP-GWM-202	Groundwater Sample Shipment

Sitewide CERCLA Quality (SCQ) Assurance Project Plan

Section 5	Field Activities
Section 6	Sampling Requirements
Section 7	Sample Custody
Section 9	Analytical Procedures
Appendix I	Field Calibration Requirements
Appendix J	Field Activity Methods
Appendix K	Sampling Methods

Samples will be sent to either an on-site or "acceptable" off-site laboratory. Samples will be sent to the FEMP on-site laboratory if capacity is available provided the analysis can be performed on-site, and if required detection limits can be achieved.

Direct Push Sampling

Direct push sampling methods (e.g., Geoprobe™) will be used to collect groundwater samples for the purpose of determining changes to the vertical profile of the total uranium plume as a result of start-up. As was done for the Restoration Area Verification Sampling (RAVS) project (DOE 1997f), the sampling tool will be used to collect groundwater samples from different vertical depths within the aquifer, rather than at a fixed vertical monitoring depth. This activity is being conducted as part of the Re-Injection Demonstration Test Plan (DOE 1997d). It is discussed here because the sampling will also support start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules.

As explained in Section 4.4 of the Re-Injection Demonstration Test Plan (DOE 1997d), prior to start-up of the South Field Extraction (Phase-1) Module, direct push sampling will take place at seven locations. One location downgradient of each re-injection well and one location between Re-Injection Wells 22108 and 22109 and between Re-Injection Wells 22109 and 22240, Figure 3-1. The samples will be analyzed for major anions and cations as well as total uranium. Results from the analysis will be used to establish a baseline of plume dimensions and groundwater geochemistry prior to pumping in the South Field Extraction (Phase-1) and South Plume Modules and Re-Injection in the Re-Injection Demonstration Test Module.

Direct push sampling will take place during the re-injection demonstration at three locations. The area of re-injection that corresponds to the highest total uranium concentrations in the aquifer in the area of re-injection is being targeted for monitoring. This area is located around re-injection Wells 22108 and 22109 (Figure 3-1). Locations 1 and 2 are between re-injection Wells 22108 and 22109, and 22109 and 22240, respectively. Monitoring here will provide data to determine if the plume is moving between either of these three re-injection wells. Location 3 is located downgradient for re-injection Well 22109 and will provide data to determine if the uranium plume is migrating beneath re-injection Well 22109. All three locations will be sampled just prior to the start of re-injection and then quarterly for a time period of one year. The data will be used to construct cross sections that illustrate the vertical dimension of the total uranium plume through time.

During the last round of sampling, following completion of the Re-injection Demonstration, all seven locations which were sampled prior to the start of pumping in the South Field Extraction (Phase-1) Module will be sampled again to determine how the vertical dimension of the total uranium plume and aquifer geochemistry has changed in response to one year of pumping and re-injection operations. Results will help determine if there is an immediate need for installing the contingency off-property extraction well (RW-8).

3.5 WATER LEVEL MONITORING

Water levels will be collected within the extraction wells and in a network of existing monitoring wells surrounding the South Plume and South Field Area to determine if hydraulic capture of the 20 μg/L total uranium plume is being achieved. Water level monitoring activities for start-up of the South Field Extraction (Phase-1) and South Plume Optimization Modules will be coordinated with IEMP water level monitoring activities. Specific details of the monitoring are as follows:

Monitoring within the Extraction Wells

Pressure transducers and data loggers will be used to monitor the water level inside each new extraction well to document the relationship between the water level in the extraction well and the depth of the pump intake. As operational experience with the wells is collected the water level in each extraction well will be used to assist in determining when maintenance of the well screen may be required.

Monitoring in the Aquifer

Water levels will be monitored in the aquifer during start-up. Just prior to the start of pumping in the South Field Extraction (Phase-1) Module, water levels will be collected from 81 monitoring wells (both Type 2 and Type 3) located around the immediate area of the South Plume and South Field. Table 3-3 lists the 81 monitoring wells that will be monitored and Figure 3-2 illustrates where the wells are located. Water level measurements will be collected within two days following start-up of the South Field Extraction (Phase-1) Module and will continue on a weekly schedule until water levels in the aquifer have appeared to stabilized to the new pumping.

After water levels in the aquifer have stabilized to pumping from the South Field Extraction (Phase-1) wells, the two South Plume Optimization Wells will be started. Water levels will be measured within two days of start-up and then continue weekly until water levels in the aquifer appear to have stabilized once more. After water levels in the aquifer have stabilized to pumping from both the South Field Extraction (Phase-1) and South Plume Optimization Wells, re-injection will begin in the five Re-Injection Demonstration Wells and water levels will be collected within two days of start-up and then conducted weekly until it appears that the aquifer has once again stabilized to the pumping and re-injection.

Once the aquifer has appeared to stabilize to all of the new pumping and re-injection, water level monitoring will be cut back to a quarterly schedule in accordance with the quarterly water level monitoring program outlined in the IEMP. In the IEMP, water levels are monitored quarterly in 159 monitoring wells (both Type 2 and Type 3); which includes the 81 to be monitored for this start-up plan. Figure 3-3 illustrates the location of the 159 monitoring wells.

3.6 WELL-SPECIFIC FLOW DIRECTION MONITORING

The colloidal borescope has been used at the FEMP for more than a year to evaluate flow directions in the South Plume Area. Data and results have been reported in the biannual South Plume Removal Action Design Monitoring Evaluation Program Plan System Evaluation Reports. The instrument appears to give reliable flow directions in the vicinity of pumping wells.

The Colloidal Borescope will be used to help determine what influence pumping and re-injection is having on the groundwater flow direction at discrete locations within the aquifer when deemed appropriate.

3.7 WELL MAINTENANCE CHECKS

Lessons learned from operation of the South Plume Extraction Wells will be used to establish a maintenance program for each new extraction well. During start-up, the new extraction wells will undergo quarterly maintenance checks. If unacceptable screen plugging conditions are observed then the screen will be super-chlorinated in a manner similar to procedures outlined in the OMMP. Maintenance checks at the extraction wells will likely include:

- Routine cleaning and chlorination of the well screen
- Flow controller calibration
- Flow totalizer calibration
- Flow meter cleaning and calibration
- Flow control valve maintenance (i.e., inspection, cleaning, re-building)
- Biological sampling
- Short term draw down tests.

Water level data collected from the extraction wells themselves, will be used to monitor the specific capacity of each new extraction well during start-up. Reduction in specific capacity will be used to assist in establishing a long term frequency for routine well maintenance activities. Biological activity will also be evaluated for the selection of long term well maintenance activities. Short term draw down tests will be used to assess well performance also. Following start-up, routine maintenance will continue as part of the OMMP.

TABLE 3-1

ANALYTE LIST FOR EXTRACTION WELLS DURING START-UP

List of Analytes		
Aluminum	Fluoride	Silicon
Alkalinity	Iron	Sodium
Ammonia	Magnesium	Total suspended solids
Bi-carbonate	Manganese	Sulfate
Calcium	Nitrate as N	Total dissolved solids
Carbonate	Phosphate	Total uranium
Chloride	Potassium	

TABLE 3-2

SAMPLING PROTOCOLS

Constituent	Method	Sample Type	ASL	Holding Time[a]	Preservation[a]	Container[a,b]
General Chemistry:						
Alkalinity	310.1[d] or 2320B[e]	Grab	B	14 Days	Cool to 4°C	Plastic or glass
Ammonia	350.1[d], 350.3[d], 4500C[e], or 4500F[e]	Grab	B	28 Days	Cool to 4°C, H_2SO_4 to pH < 2	Plastic or glass
Bicarbonate	33.076[h]	Grab	B	14 Days	Cool to 4°C	Plastic or glass
Carbonate	33.076[h]	Grab	B	14 Days	Cool to 4°C	Plastic or glass
Chloride	352.2[d], 300.(all)[d] or 4500B[e]	Grab	B	28 Days	None	Plastic or glass
Fluoride	340.2[d] or 4500C[e]	Grab	B	28 days	None	Plastic
Nitrate/Nitrite	353.1[d], 353.2[d], 4500D[e], or 4500E[e]	Grab	B	28 days	Cool to 4°C, H_2SO_4 to pH < 2	Plastic or glass
Phosphorus	365.(all)[d] or 4500E[e]	Grab	B	28 days	Cool to 4°C, H_2SO_4 to pH < 2	Plastic or glass
Sulfate	375.2[d], 300.0[d], or 4500E[e]	Grab	B	28 days	Cool to 4°C	Plastic or glass
Total Dissolved Solids	160.1[d] or 2540C[e]	Grab	B	7 Days	Cool to 4°C	Plastic or glass
Total Suspended Solids	160.2[d] or 2540D[e]	Grab	B	7 Days	Cool to 4°C	Plastic or glass
Inorganics:						
Metals	7000[c] or 6010[c]	Grab	B	6 months	HNO_3 to pH < 2	Plastic or glass
Radionuclides: (All Radiological)	SCQ[f]	Grab	B[g]	Six months or 5 x half-life, whichever is less	HNO_3 to pH < 2	Plastic or glass
Field Parameters[i]:		Grab	A	NA[j]	NA[j]	NA[j]

[a]Appropriate preservative, holding time, and container requirements will be used for the corresponding method.
[b]Container size is left to the discretion of the individual laboratory.
[c]"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846.
[d]"Methods for Chemical analysis of Water and Wastes, EPA 600/4-79-020.
[e]"Standard Methods for the Analysis of Water and Wastewater," 17th edition.
[f]Radionuclide analyses do not have standard methods; however, the analytical specifications for these parameters are provided in Appendix G of the SCQ.
[g]The ASL may become more conservative, if it is necessary to meet detection limits.
[h]"Official Methods of Analysis of the Association of Official Analytical Chemist"
[i]Field parameters include dissolved oxygen, pH, specific conductance, temperature and turbidity.
[j]NA = Not applicable

TABLE 3-3

WATER LEVEL MONITORING WELLS FOR START-UP OF THE SOUTH FIELD EXTRACTION (PHASE-1) AND SOUTH PLUME OPTIMIZATION MODULES

List of Wells				
2002	2107	2733	3070	3881
2014	2125	2880	3093	3897
2015	2166	2881	3095	3898
2016	2385	2897	3096	3899
2017	2387	2898	3106	3900
2020	2390	2899	3125	21064
2044	2396	3014	3385	21065
2045	2397	3015	3390	22299
2046	2398	3017	3396	22300
2048	2399	3020	3398	22301
2049	2402	3044	3402	32302
2065	2434	3046	3551	32303
2068	2545	3049	3552	32304
2070	2550	3065	3624	32305
2093	2551	3068	3733	32306
2095	2552	3069	3880	32307
2096				

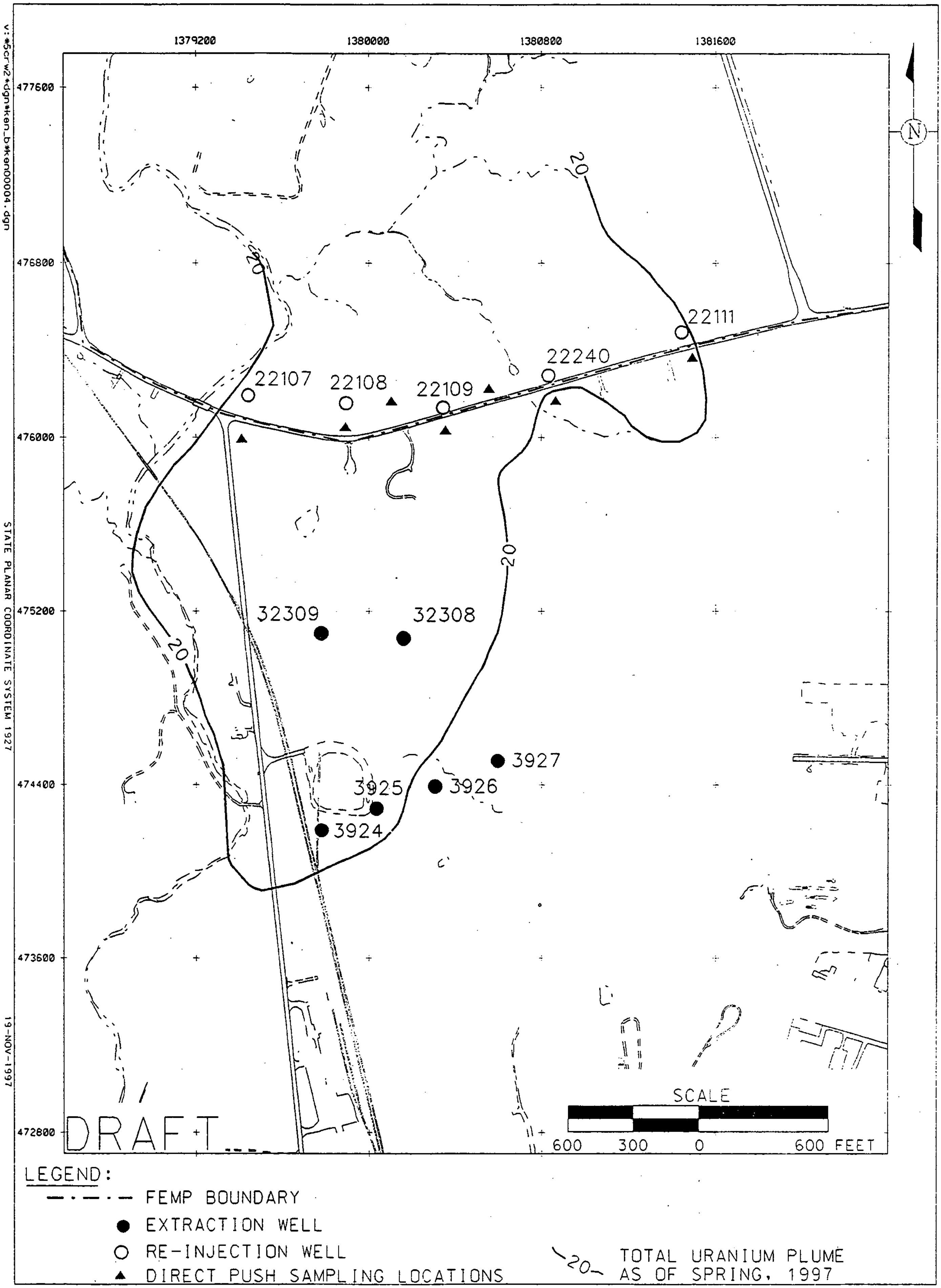
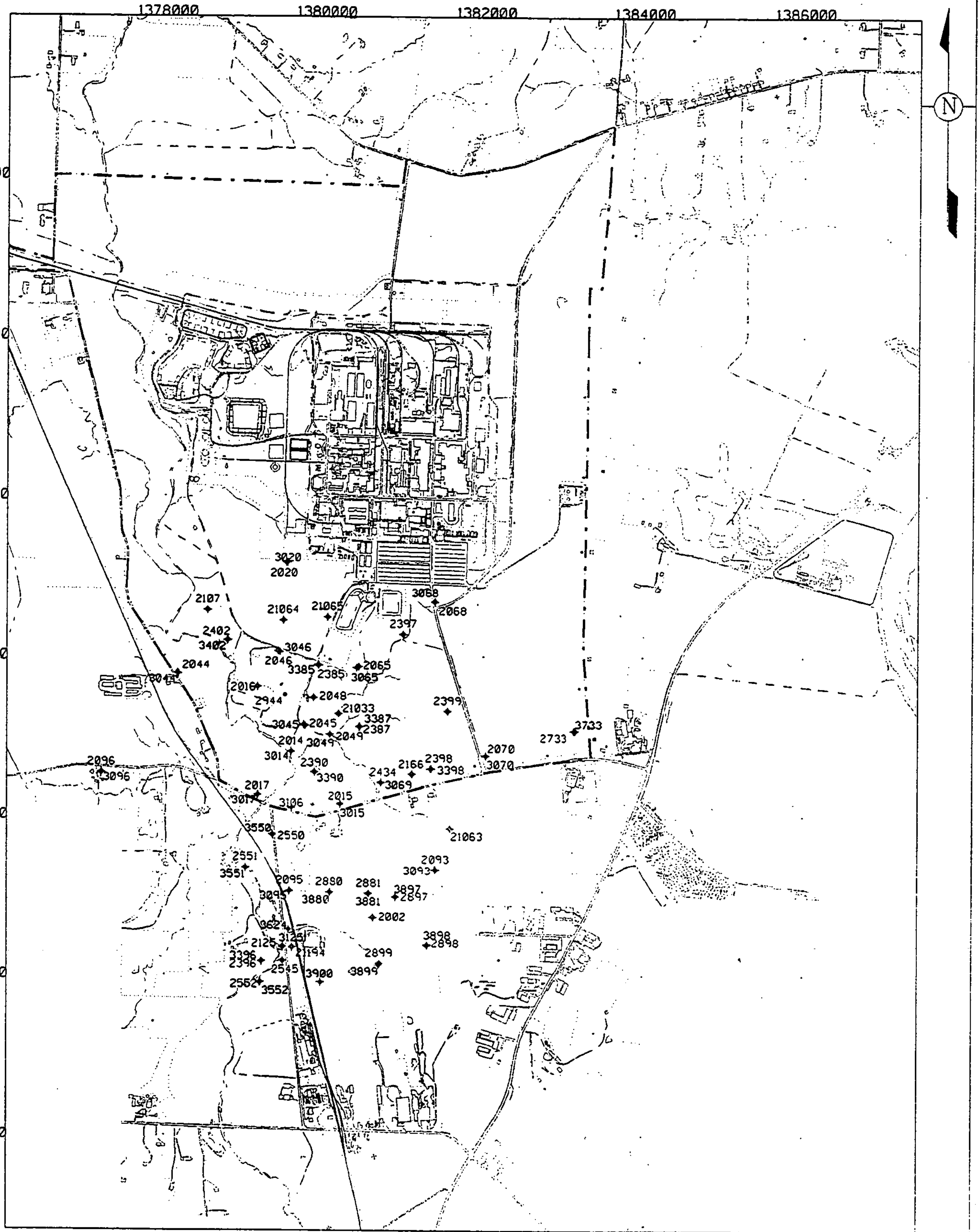


FIGURE 3-1. DIRECT PUSH SAMPLING LOCATIONS

v:\5crw2\dgn\ken_b\ken00002.dgn

STATE PLANAR COORDINATE SYSTEM 1927

19-NOV-1997



LEGEND:

— · — · — FEMP BOUNDARY

+ 2046 TYPE 2 MONITORING WELL

+ 3046 TYPE 3 MONITORING WELL

SCALE

1800 900 0 1800 FEET

DRAFT

FIGURE 3-2. GROUNDWATER ELEVATION MONITORING WELLS

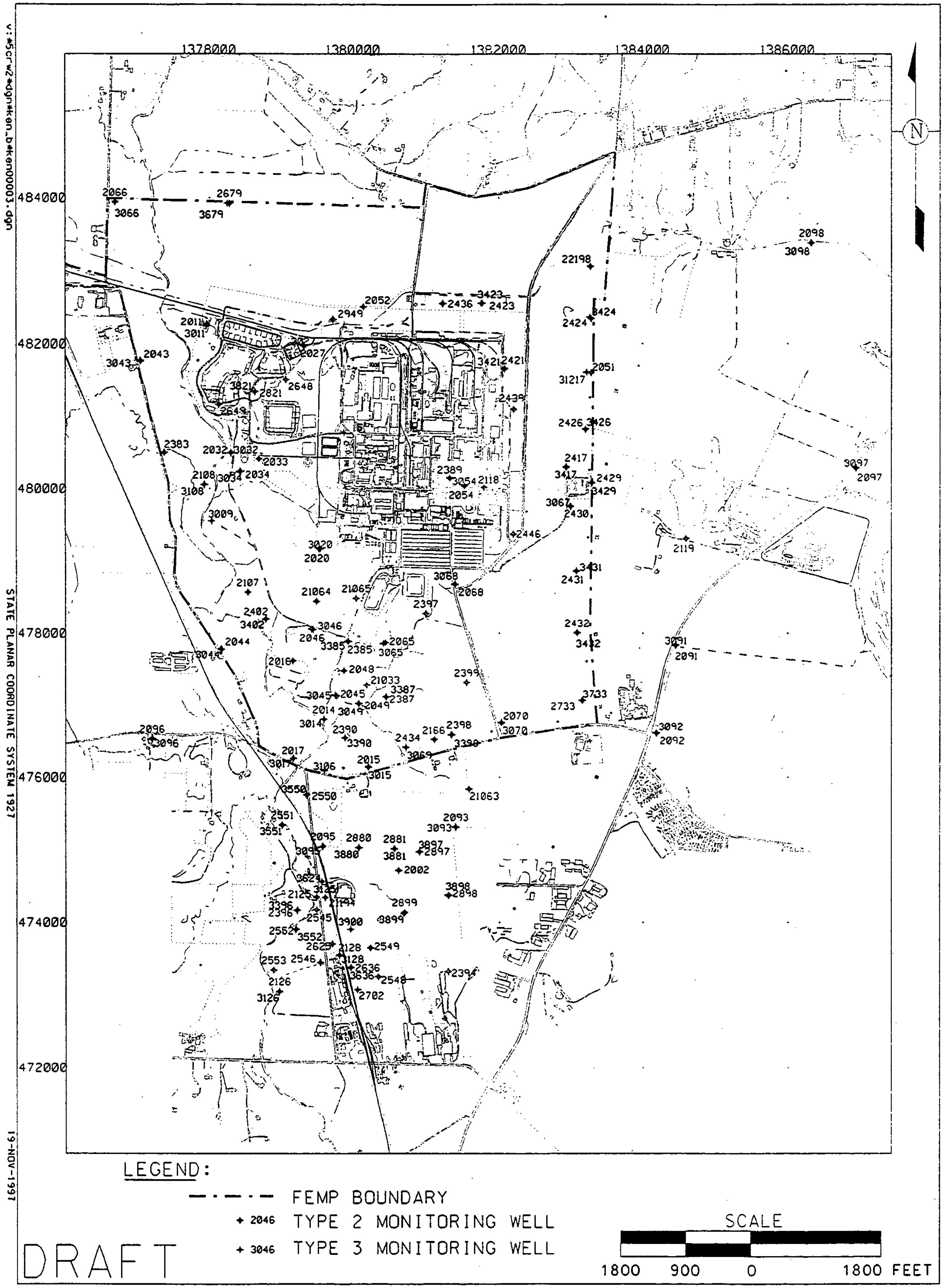


FIGURE 3-3. IEMP GROUNDWATER ELEVATION MONITORING WELLS

4.0 DATA EVALUATION

Data collected during start-up monitoring will be used to answer the following questions:

- What will the long term sampling frequency be for total uranium at each new extraction well?
- What are the biological conditions within each new extraction well?
- What are the resultant groundwater flow patterns and capture zones for the systems?
- What is the water quality of the groundwater being pumped by each new extraction well?
- Has a hydraulic barrier been created at the southern boundary of the FEMP?
- Is there a need for off-property contingency Well RW-8?
- What are the projected long term maintenance needs for each new extraction well?

How data will be evaluated with respect to these questions is presented in more detail below.

<u>What will the long term sampling frequency be for total uranium at each new extraction well?</u>
Groundwater samples collected from each new extraction well will be analyzed for total uranium. The well-specific total uranium concentrations will be graphed against time to determine the rate of change of the uranium concentration in the pumped groundwater.

The rate of change will be used to determine a sampling frequency for each individual extraction well for the long term tracking of well performance and for controlling treatment operations. If the rate of change in uranium concentration with time is low, then the sampling frequency will be less frequent. Like-wise, if the rate of change in uranium concentration with time is high, then the well will be sampled more frequently.

Extraction wells located in the heart of the total uranium plume will have initial pumped groundwater total uranium concentrations that are above 20 μg/L. It is anticipated that the rate of change in the total uranium concentration will be low for these wells. Extraction wells located at or near the edge of the total uranium plume will have initial pumped groundwater total uranium concentrations that are near or below 20 μg/L. The rate of change in the total uranium concentration of pumped groundwater from these wells could be high, as the plume is drawn toward the wells.

The longer term sampling frequency initially defined during start-up for each individual extraction well may be periodically adjusted (if warranted) based on the change of the uranium concentration to satisfy wastewater treatment operation needs discussed in the OMMP and remedy assessment monitoring needs discussed in the IEMP.

<u>What are the biological conditions within each new extraction well?</u>
Biological sampling data will be tabulated by well. Tables will list the well being sampled, the date and time that the sample was collected, and the results of each sample collected. The manufacturer of the BART kits provides a means for determining the aggressiveness of the bacteria detected in the water. An attempt will be made to correlate the bacteria data with well performance data to determine the best routine maintenance schedule and program for each well.

<u>What are the resultant groundwater flow patterns and capture zones for the systems?</u>
Water level data collected from monitoring wells in the aquifer will be tabulated and used to create water level maps. Water level maps will be produced based on the monitoring frequency presented in Section 3.0 for the collection of the data. Capture zones will be determined from the water table maps. Water level measurements will also be compared to water level predictions made using the FEMP groundwater model to determine how accurately the model predicted water levels.

Total uranium sampling of the plume will be conducted quarterly as part of the monitoring program already defined in the IEMP. Hydraulic capture of the 20 μg/L total uranium plume will be assessed by overlaying capture zone maps on top of the plume maps. The effect that seasonal change will have on water levels and capture of the total uranium plume will also be evaluated. Hydraulic capture changes are acceptable to the degree that long term capture of the total uranium plume is maintained. The FEMP groundwater model is a steady state model that is calibrated using average water levels measured in 1993. Water level predictions made using the FEMP groundwater model will not be sensitive enough to predict seasonal variations measured in the field. It may be determined that during the spring, when recharge is high, that small portions of the uranium plume appear to be located outside of the pumping induced capture zone. In the summer though, when recharge is low, the hydraulic capture zone may expand enough to re-capture the small portions of the plume that were outside of the pumping induced capture zone back in the spring, resulting in a "net" capture of the plume. However, several quarters worth of water level data will be needed before the seasonal relationship between hydraulic capture and plume capture is understood. It is recognized that changes to individual well pumping rates may need to be implemented to achieve "net" plume capture.

What is the water quality of the groundwater being pumped by each new extraction well?
Major anion and cation data collected during start-up will be tabulated and select parameters may be graphed to illustrate data trends. Work conducted for the re-injection project (DOE 1995 and DOE 1996a) indicates that changes in the general chemistry of the groundwater (i.e., pH, Eh, iron concentration, dissolved oxygen content) could impact the mobility of uranium in the Great Miami Aquifer. Uranium is strongly attracted to iron hydroxide which could form in the Great Miami Aquifer if aquifer conditions are changed. If iron hydroxide forms it could hinder movement of uranium to the extraction wells. It is predicted that pumping and re-injection will not alter chemical conditions in the aquifer such that the stability or mobility of the uranium will be affected. Data collected during start-up will be used to assess this prediction and document if any changes to the general water chemistry of the aquifer, amenable to the precipitation of iron hydroxide, are occurring.

Has a hydraulic barrier been created at the southern boundary of the FEMP?
This question is key to start-up monitoring activities. As presented earlier in Section 1.0, this situation is one of the criteria used in assessing the need for a contingency off-property well (RW-8). Evaluating whether or not the total uranium plume is migrating between or beneath the re-injection wells will be based on water level map interpretations (discussed earlier) and water quality data collected using the direct push sampling tool, and groundwater flow and velocity data collected using the colloidal borescope.

Water quality data obtained with a direct push sampling tool will be used to construct vertical profiles of the uranium plume. Cross sections of the uranium plume will be prepared and compared through time to determine if the plume is migrating between or beneath the re-injection wells. This activity is further discussed in the Re-Injection Demonstration Test Plan (DOE 1997d).

Is there a need for contingency off-property Well RW-8?
As discussed above and in Section 1.0, criteria have been established for determining the need for a contingency off-property well (RW-8). During start-up, monitoring data will be utilized to begin

determining if off-property contingency well RW-8 (formally known as 3N) is required to achieve remedial objectives.

What are the projected long term maintenance needs for each new extraction well?

Data collected during start-up will be used to define what the anticipated long term maintenance needs for each new extraction well are for long term implementation. The well specific program will become part of the OMMP following start-up.

5.0 SCHEDULES, DELIVERABLES AND REPORTING

Enforceable schedules for the initiation of the aquifer remedy can be found in the Remedial Action Work Plan for Aquifer Restoration at Operable Unit 5 (DOE 1997e). The RA Work Plan lists the enforceable "commence operations" dates for the AWWT Expansion Facility, the South Field Extraction (Phase-1) Module, the Re-Injection Demonstration Module, and the South Plume Optimization Module. This start-up plan presents a preferred sequencing for start-up of the modules and the strategy and preferred sequencing for the start-up of individual wells within each module.

Table 5-1 outlines the start-up monitoring and reporting commitments made in this start-up plan and presents a schedule for conducting the activities. Data and resulting interpretations will be reported in the IEMP quarterly status/update reports and annual comprehensive reports. Upon completion of start-up activities, the OMMP and IEMP will be revised as necessary to provide for the long term maintenance and remedy performance of the South Field Extraction (Phase-1) and South Plume Optimization Modules.

TABLE 5-1

SOUTH FIELD EXTRACTION SYSTEM (PHASE-1) AND SOUTH PLUME OPTIMIZATION START-UP MONITORING AND REPORTING COMMITMENTS

Activity	Schedule	Commitment/Requirement
Sample for Total Uranium at each new Extraction Well	Variable	Collect a groundwater sample from each new extraction well (for analysis of total uranium, ASL-B). Wells with uranium concentration ≤ 20 will be sampled immediately following start-up, every six hours for the first day, and daily from day two until the rate of change at the well is understood. Wells with uranium concentration > 20 will be sampled every two days until the rate of change at the well is understood.
Downhole Camera Surveys	Variable	Survey each new extraction well prior to installation of the pump, at the start of pumping and at each quarterly scheduled well maintenance, if the pump is pulled.
Biological Sampling	Quarterly	Sample each new extraction well at the start of pumping and at each quarterly scheduled well maintenance. Sample for iron-related bacteria, slime-forming bacteria, and total aerobic bacteria using prepared biological activity reaction test kits.
Groundwater Quality Sampling	Quarterly	Integrate with quarterly IEMP sampling. Collect groundwater samples from each new extraction well and sample at ASL-B for the Analytes defined in Table 3-1. Sampling protocols are defined in Table 3-2.
Direct Push Sampling	Variable	As needed to define the vertical extent of the total uranium plume.
Water Level Measurements	Weekly at startup, then quarterly	At the start of pumping, monitor 81 wells weekly until water level changes have stabilized. A list of the 81 wells can be found in Table 3-3. After stabilization, continue quarterly in agreement with the IEMP.
Identify Well-Specific Groundwater Flow Directions	Variable	Use the colloidal borescope to measure colloidal flow directions in select wells if deemed necessary.
Maintenance Checks	Quarterly	Conduct quarterly maintenance checks of each new extraction well until a permanent program has been established.
Reporting	Quarterly	As part of IEMP quarterly status/update reports.
Update Table 2-2	Prior to start-up	Add development information for RW-7.
Revise IEMP	Upon Completion	Upon completion of start-up activities, revise IEMP as necessary to incorporate new long term monitoring needs identified during start-up
Revise OMMP	Upon Completion	Upon completion of start-up activities, revise OMMP as necessary to incorporate long term maintenance and operational needs identified during start-up.

6.0 MANAGEMENT AND RESPONSIBILITIES

This section defines the roles and responsibilities of key management and technical personnel associated with the completion of the work defined in this start-up plan. Descriptions of some of the key technical responsibilities of project personnel or organizations are provided below.

The DOE Operable Unit 5 Team Leader is responsible for:

- Providing direction and oversight to the completion of start-up plan activities
- Acting as the point of contact within DOE and for the regulators and stakeholders for all communications concerning work carried out under this start-up plan.

The Fluor Daniel Fernald (FDF) Aquifer Restoration Project Director is responsible for:

- Providing overall project management and technical guidance to the Fluor Daniel Fernald team
- Ensuring the necessary resources are allocated to the project for the efficient and safe completion of start-up plan activities
- Overseeing and auditing start-up plan activities to ensure that the work is being performed efficiently and in accordance with all regulatory requirements and commitments, DOE Orders, site policies and procedures, and safe working practices.

The FDF Project Manager is responsible for:

- The safe and prompt completion of work outlined in this Start-up Monitoring Plan
- Oversight and programmatic direction of sampling activities
- Providing a technical lead for the collection and interpretation of sampling data
- Establishing and maintaining the scope, schedule, and cost baseline
- Reporting to the DOE Operable Unit 5 Team Leader and Fluor Daniel Fernald Aquifer Restoration Project Director on the status of start-up plan activities and on the identification of any problems encountered in the accomplishment of the start-up plan
- Managing the funding to complete the sampling and data analysis activities
- Requesting borescope and geoprobe data.

The FDF Technical Lead is responsible for:

- Reporting to the Fluor Daniel Fernald Project Manager on the progress of start-up plan activities

- Collection, interpretation, and reporting of sampling data

- Recommending borescope and geoprobe needs.

The FDF Water Monitoring Team will be responsible for:

- Coordinating and conducting down hole camera surveys
- Coordinating and conducting biological monitoring in extraction wells
- Collection of water level data in extraction wells and monitoring wells
- Collection of water quality data from extraction wells and monitoring wells
- Conducting borescope surveys
- Data management.

The FDF Soil and Miscellaneous Media Projects Team will be responsible for:

- Direct push sampling.

The FDF Waste Water Treatment Operations Team will be responsible for:

- Process Control Sampling
- Conducting Predictive and Preventive Maintenance
- Operation of the extraction well systems.

7.0 SUPPORTING ACTIVITIES

7.1 DATA MANAGEMENT

Field documentation and analytical data results will be verified to ensure conformance to the appropriate SCQ sections and appendices. The process for management of the field and analytical data is described in the Environmental Data Management Plan (EDMP) (FDF 1996).

Field documentation will be verified for accuracy and completeness by the sampling team followed by an independent field data validation in accordance with SCQ requirements for the corresponding ASL. All chemical and radiological data results will meet all applicable quality requirements specified in the SCQ for the respective ASL (SCQ Section 11.0 and Appendix F). The quality of analytical data will be evaluated by independent project personnel.

Both the field and analytical data will be entered into a controlled database using a double key or equivalent method to ensure accuracy. The hard copy data will be managed in the project files in accordance with FEMP record keeping procedures and DOE orders.

7.2 HEALTH AND SAFETY

The Fluor Daniel Fernald (FDF) Health and Safety Department is responsible for the development and implementation of health and safety requirements for this start-up monitoring plan. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified field work will be addressed.

All involved personnel will receive adequate training to the health and safety requirements prior to implementation of the field work required by this Start-up Monitoring Plan. Daily safety meetings will be conducted prior to beginning field work to address specific health and safety issues.

All FDF employees and subcontractor personnel who will be performing field work required by this start-up monitoring plan are required to have completed all site job-specific required training. For areas subject to more restrictive radiological controls where the potential for exposure is greater, Radiation Work Permits (RWPs) are necessary and will be obtained prior to the field work being performed in those areas. A radiological control technician will be assigned to each field crew performing any activities in an area requiring an RWP.

7.3 QUALITY ASSURANCE/QUALITY CONTROL

Groundwater Monitoring Sampling events will follow Quality Assurance/Quality Control (QA/QC) protocol established in Section 4 and Appendix K of the SCQ.

7.3.1 Project Requirements for Surveillances

Self-assessment of work processes and operations will be undertaken to assure quality of performance. Self-assessment will be performed by the Project Manager, and will encompass technical and procedure requirements. Such self-assessment may be conducted at any point in the project.

Independent assessment will be performed by the FEMP QA organization by conducting surveillances. At a minimum, one surveillance will be conducted, consisting of monitoring/observing ongoing project activity and work areas to verify conformance to specified requirements. Surveillances will be planned and documented in accordance with Section 12.3 of the SCQ.

7.3.2 Field Changes to the Start-up Monitoring Plan

Prior to the implementation of field changes, the Project Manager will be informed of the proposed field changes. Once approval has been obtained (verbal or written) from the Project Manager and QA representative for the field changes to the test plan, the field changes may be implemented. Field changes to the start-up monitoring plan will be noted on a Variance Request form. QA must receive the completed Variance Request form, which includes the signatures of the Project Manager, and the QA/QC Representative, within one week of the granting of the verbal approval.

7.3.3 Quality Assurance Samples

Field quality control samples will be taken according to the frequency recommended in the SCQ. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as decontamination or sampling technique, may be responsible for introducing bias in the projects analytical results. The following types of quality control samples will be collected: sampling equipment rinsates, field blanks, and duplicate samples as outlined in Section 6 and Appendix K of the

SCQ. Each QC sample is preserved using the same method for groundwater samples. The QC sample frequencies will be tracked to ensure the proper frequency requirements are met as follows:

- Equipment Blanks: Collect one rinsate sample every 20 groundwater samples that are collected using reusable sampling equipment. If less than 20 samples are collected a rinsate is still required. Rinsates are not required when dedicated well equipment or disposable sampling equipment is utilized.

- Field Blanks: Collect one field blank for each day of groundwater sampling.

- Field Duplicates (blind): One duplicate sample will be collected for every 20 groundwater samples or fraction thereof if less than 20 samples are collected.

The field samples associated with each QC sample will also be tracked to ensure traceability in the event that contaminants are detected in the QC sample.

7.4 WASTE DISPOSITION

The following wastes will be generated during sampling activities:

- Purge water
- Contact Wastes
- Equipment decontamination solutions.

The following subsections provide the proposed disposition methodology for each type of water generated.

Purge Water and Decontamination Solutions

Groundwater purged from the wells and solutions used to decontaminate equipment used during sampling will be contained and transported to the FEMP wastewater system for proper disposal. If historic data for a well indicate the purge water is potentially a RCRA waste, the purge water will be drummed at the well and moved to the FEMP's controlled holding area until analytical results are returned and appropriate disposition can be made.

Contact Wastes

Contact wastes such as personal protective equipment (PPE), paper towels, and other solid investigation-derived waste will be placed in plastic bags or 55-gallon drums and transported to the FEMP for appropriate disposition.

7.5 DECONTAMINATION

Sampling equipment will be decontaminated following sample collection from each well to prevent cross-contamination of samples. The decontamination of equipment will be performed in accordance with the Level II method referenced in Appendix K.11 and described in Section 6.4.1 of the SCQ.

REFERENCES

Fluor Daniel Fernald, "1996 Environmental Data Management Plan," Fluor Daniel Fernald, Cincinnati, OH.

S.A. Smith, 1995, "Monitoring and Remediation Wells, Problem Prevention, Maintenance, and Rehabilitation," Lewis Publishers, New York, NY.

U.S. Dept. of Energy, 1997a, "Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1)," Final, Fernald Environmental Management Project, U.S. Dept. of Energy, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997b, "Integrated Environmental Monitoring Plan," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997c, "Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment Project (OMMP)," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997d, "Re-Injection Demonstration Test Plan," Draft, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997e, "Remedial Action Work Plan for Aquifer Restoration at Operable Unit 5," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997f, "Restoration Area Verification Sampling Program Project Specific Plan," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997g, "South Plume Performance Monitoring and Maintenance Plan," Draft, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1996a, "Phase II, South Field Injection Test Report for Operable Unit 5," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1996b, "Record of Decision for Remedial Actions at Operable Unit 5," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1996c, "Remedial Design Work Plan for Remedial Actions at Operable Unit 5," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1995, "South Field Injection Test Report," Final, U.S. Dept. of Energy, Fernald Field Office, Cincinnati, OH.