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SOUTH PLUME GROUNDWATER RECOVERY SYSTEMS PUMP TEST WORK PLAN MARCH 1993 REVISION NO. 2

DOE-FN/EPA

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WORK PLAN

4307

South Plume Groundwater Recovery System Pump Test Work Plan

Fernald Environmental Management Project
March 1993
Revision No. 2

Submitted by:
U.S. Department of Energy
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South Plume Groundwater Recovery System
Pump Test ~~And Model Validation~~ Work Plan

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DMEPP	South Plume Recovery System - Design, Monitoring, and Evaluation Program Plan
DOE	United States Department of Energy
FEMP	Fernald Environmental Management Program
FERMCO	Fernald Environmental Remediation Management Corporation
FMPC	Feed Materials Production Center
GMRP	Groundwater Monitoring and Response Plan
gpm	gallons per minutes
IAWWT	Interim Advanced Waste Water Treatment
ID	inner diameter
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
PTP	Pump Test and Model Validation Work Plan
PTWP	Pump Test Work Plan
PVC	Polyvinyl Chloride
SCQ	Sitewide CERCLA Quality Assurance Project Plan
QAPP	Quality Assurance Project Plan (RI/FS Work Plan, Volume V)
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RW	Recovery Well
SPPZ	South Plume Piezometer
SSLS	Storm Sewer Lift Station
SWIFT	Sandia Waste Isolation Flow and Transport
SWRB	Storm Water Retention Basin
TSS	Total Suspended Solids
USCS	Unified Soil Classification System
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WEMCO	Westinghouse Environmental Management Company of Ohio

SECTION 1

INTRODUCTION

1.1 Purpose

The Pump Test ~~and Model Validation~~ Work Plan (~~PTP~~ PTWP) provides specific guidance in implementing the pump test task of the design confirmation program described in Section 3 of the South Plume Groundwater Recovery System - Design, Monitoring, and Evaluation Program Plan (DMEPP). The design confirmation program described in the DMEPP consists of three components:

1) Pump test
2) Groundwater model ~~validation~~ calibration
3) Groundwater model ~~recalibration (if necessary)~~ post audit

The goal of the design confirmation program is to verify the design (and change if necessary) and improve the operation of the south plume recovery wells. An additional goal is to enhance confidence in the groundwater model by ~~validating~~ recalibrating the model with pump test and recovery well operation data. ~~The model validation will determine if recalibration is required. Recalibration will further refine the input parameters of the model and make it more reflective of the groundwater flow conditions at the site.~~ The ~~validated and~~ recalibrated~~, if necessary,~~ groundwater model will then be used for periodic recovery well system evaluations. These evaluations will determine if the recovery system is meeting the removal action objectives and will assess the performances of the model. The recovery system evaluation is discussed in the South Plume Groundwater Monitoring and Response Plan (GMRP) in Appendix B of the DMEPP.

This document describes in detail, rates, locations of pumped and observation wells, and pump test procedures required for conducting the pump test. Results from the pump test will be used to set initial recovery well depths and pumping rates and for model recalibration. The PTWP was originally titled the Pump Test and Model Validation Work Plan (PTP) and was included as Appendix A of the DMEPP. The PTP is revised here to incorporate Ohio Environmental Protection Agency (Ohio EPA) and United States Environmental Protection Agency (US EPA) comments and is reissued as a stand-alone document. Text related to model validation and recalibration has been deleted from this document. In response to the US EPA comments, model calibration and post-audit activities have been redefined and will be included in the revised DMEPP.

1.2 Content of the Pump Test ~~and Model Validation~~ Work Plan

The ~~PTP~~ PTWP includes the following:

1) Design information on recovery well ~~RW-4~~ 3927 (the test well) and the piezometer and observation well network

2) Details of the pump test implementation, preparation of a Pump Test Report and Vertical Capture Letter Report ~~and analysis of resulting data~~

~~3) Methods for model validation consisting of comparing pump test and operational recovery system data with SWIFT III groundwater model simulations~~

~~4) Methods for any required recalibration of the groundwater model~~

1.3 Approach and Rationale

A five-well recovery system will be constructed to capture uranium-contaminated groundwater and to prevent further expansion of the South Plume (Figure 1-1). Each well will pump groundwater at rates ranging from 400 to 650 gallons per minute (gpm) per well. The selection of approximate well locations and the pumping range was based on Sandia Waste Isolation Flow and Transport (SWIFT) III groundwater modeling simulations (ASI/IT 1992). ~~The SWIFT groundwater model of the site has never been formally validated. Therefore, a design confirmation program consisting of a pump test, model validation, and model recalibration was included as part of the start-up process for the recovery system.~~ Results from the pump test will be used to set initial recovery well pumping rates. After the recovery system is operational, well field monitoring of groundwater elevation data and pump test data will be used to ~~validate~~ recalibrate the groundwater model. Once ~~validated, and~~ recalibrated ~~if necessary~~, the model will be used to predict the effects of recovery well pumpage, to aid in system evaluation, and to select pumping rates over the life of the recovery system.

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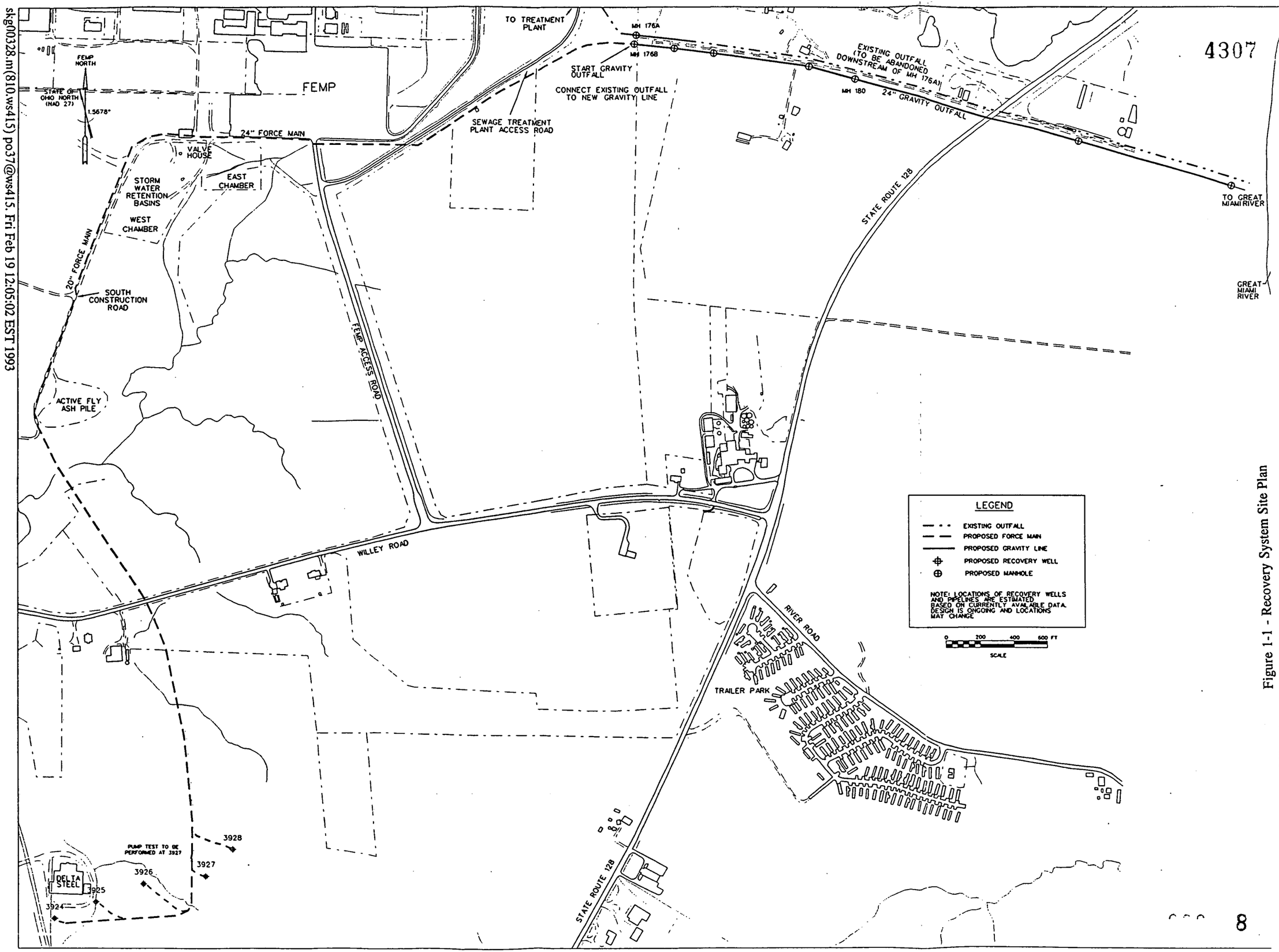

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Figure 1-1 - Recovery System Site Plan

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SECTION 2

GROUNDWATER PUMPING TEST

2.1 Objective

The pump test acquires data for calculating hydraulic properties of the Great Miami Aquifer. Data from this test will be analyzed using selected methods to determine the hydraulic conductivity, storage capability, and anisotropic conditions that may exist in the vicinity of the proposed recovery well field. This information will also be used to help set screened intervals of the recovery wells, for setting initial pumping rates for the recovery system, and for ~~validating~~ recalibration of the groundwater model. Over the course of the test, samples will be collected periodically from the pumped well to assess changes in groundwater geochemistry and to project uranium concentration of the pumped groundwater.

The pumping test will be performed in three stages. The first stage will involve a step drawdown test to determine the optimum flow rate for the constant rate test. The second stage of the pump test will be a 72-hour (or longer, if required) constant rate test. Unless otherwise suggested by the step-drawdown test, it is projected that the constant rate test will use a flow rate of approximately 1,200 gpm. The high flow rate is necessary to stress this aquifer sufficiently so that measurable drawdowns can be achieved in the piezometers and observation wells, particularly at distances greater than 100 feet. The third stage of the test will consist of an aquifer recovery period where groundwater elevations will be observed and recorded in the piezometers, monitoring/observation wells, and the recovery well immediately after the constant rate test pumping has ceased. Successful pump tests at or near this flow rate have been documented in the Venice area, now called Ross (Dove 1961), and at the Chem Dyne Superfund Site in Hamilton, Ohio (CH_2M Hill 1984).

2.2 Management and Responsibilities for Pump Test

Figure 2-1 shows the organizational relationship between the contractors who will be involved in the pumping test. Recovery well ~~RW-4~~ 3927 will be used as the test well; therefore, performance of the test requires coordination between the recovery system design contractor (A.M. Kinney) and the contractor responsible for designing the pumping test (PARSONS). The recovery well used as the test well and any new piezometers used as observation wells will be designed by A.M. Kinney. This document provides design criteria to A.M. Kinney so that the test well and piezometers will meet the specific requirements of the pump test. Field activities associated with the pumping test will be implemented in accordance with this work plan and associated specifications provided by PARSONS.

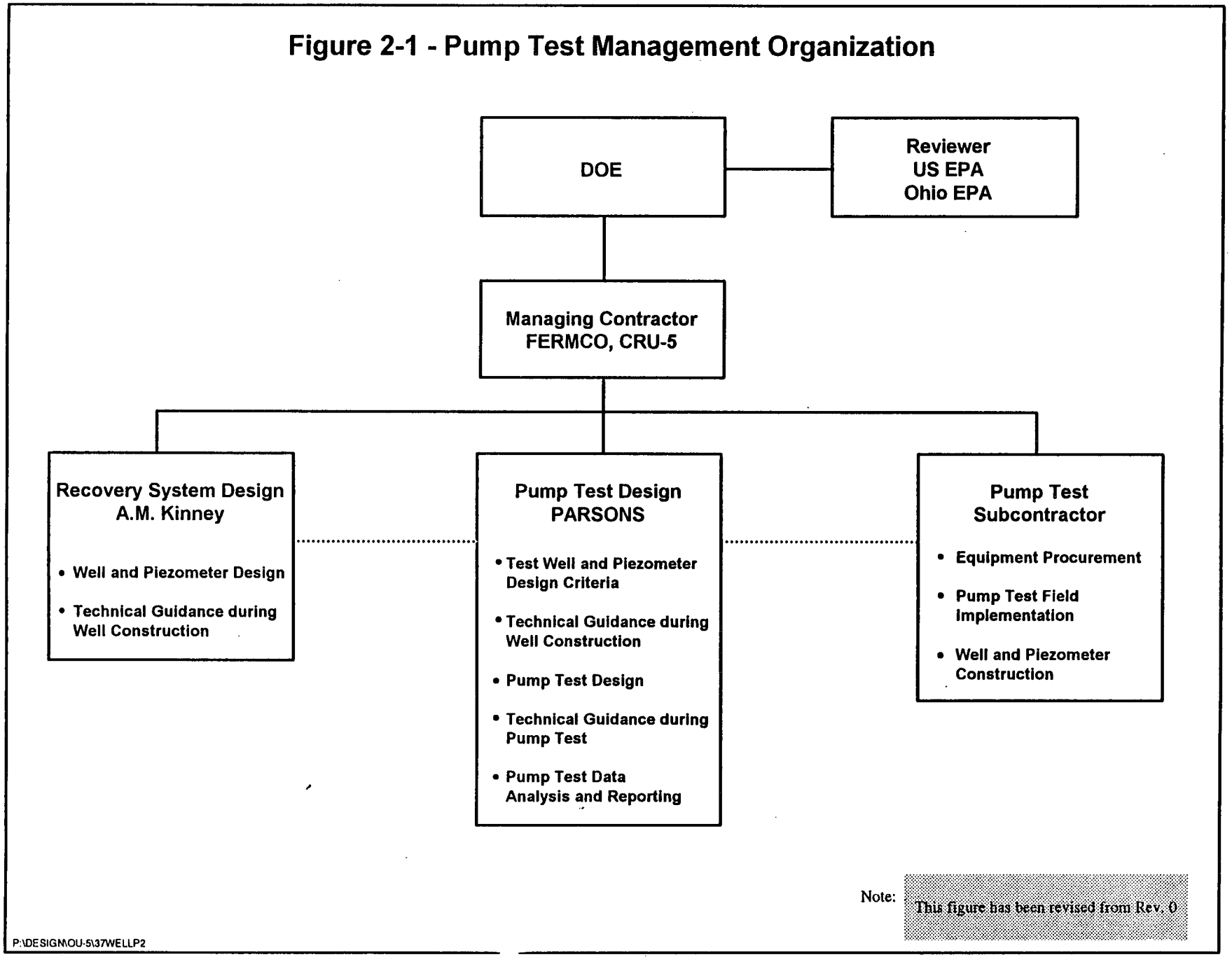


Figure 2-1 - Pump Test Management Organization

Table 2-1 - Agencies, Contractors, and Subcontractors Providing Response to Field Changes and Contingencies

Organization	General Responsibilities
United States Environmental Protection Agency (US EPA)	Regulatory Requirements
Ohio EPA	Regulatory Requirements
United States Department of Energy (DOE)	Policy and Procedural Guidance
Fernald Environmental Remediation Management Corporation (FERMCO)	Procedural Guidance Construction Management
PARSONS	Well and Pump Test Requirements
A.M. Kinney	Well Specifications Procedures and Overall Recovery System Design
Pump Test Subcontractor	Test Well Drilling, Casing and Screen Piezometer Well Installation Pump and Temporary Equipment Installation and Operation Drawdown and Recovery Measurements
Emergency Response	Health and Safety, fire, ambulance, hospital, and police

This table has been revised from Revision 0.

Several agencies, contractors, and subcontractors will be directly or indirectly involved in performing the pumping test. Table 2-1 provides the groups that may be called on to provide instructions and responses to contingencies and field changes during construction of the wells and performance of the pump test. Thirty days prior to drilling and testing, the managing contractor shall prepare a list of representatives (with phone numbers) from each group in Table 2-1. This list will be provided to all parties involved in the test.

2.3 Well Placement and Design

The pump test well ~~(RW-4)~~ 3927 and observation wells will be designed by A.M. Kinney. PARSONS, as pump test designer, defines specific criteria for A.M. Kinney to incorporate into their

design. These specific criteria are included below. PARSONS and A.M. Kinney will provide on-site technical guidance during well construction.

2.3.1 Test Configuration

Piezometers are located to be consistent with data analysis techniques so that the aquifer's hydraulic properties may be estimated accurately. Figure 2-2 illustrates locations for the test well ~~(RW-4)~~ 3927, piezometers, and monitoring wells in the area. Certain monitoring wells that currently exist or that will be installed prior to the pumping test will also be used as observation wells. Monitoring wells, proposed in accordance with the South Plume ~~Groundwater Monitoring and Response Plan~~ GMRP (Appendix B of the DMEPP), are shown on Figure 2-2 as these are projected to be installed prior to the commencement of the pump test. Staff gauges will be located in Paddy's Run to monitor any effects of the stream as a boundary to the test. Approximate staff gauge locations are shown on Figure 2-2. Appropriately located stilling wells may be substituted for staff gauges. Figure 2-3 presents the layout of piezometers to be installed in connection with this pump test. Further details on the staff gauge installation and recommendations for the use of stilling wells will be provided in the data background letter report.

Piezometers ~~SPZZ 2, 3, and 4~~ 3911, 3921, and 3922 are aligned southeast of ~~RW-4~~ 3927 at distances of 25, 50, and 200 feet respectively (see Figure 2-3) downgradient of the test well in the direction of groundwater flow so that straight line distance drawdown methods of aquifer analysis can be applied. These distances were selected based on the analysis described in Subsection 2.3.2. Piezometers ~~SPPZ 1 and 5~~ 3910 and 3923 are located in different quadrants ~~than SPPZ 2, 3, and 4~~ so that the effects of anisotropy can be measured. These five piezometers are screened at approximately the same depth as the screen bottom of ~~RW-4~~ 3927 so that methods of aquifer analysis for partially penetrating wells can be applied (see Subsection 2.5). In order to assess the test well's vertical influence, other piezometers will be installed in the vicinity of ~~SPPZ 2~~ 3911 at incrementally greater depths.

For the pump test, observation wells are divided into two groups, primary and secondary, as shown on Tables 2-2 and 2-3. Primary wells, which include a control (background) well and the observation wells closest to the pumping well, will have water levels automatically measured either periodically (data logger) or continuously (chart recorder) during the pump test and will be the wells used for curve-matching analysis. Monitoring well 2015 will serve as the control (background) well and will be measured automatically with a chart recorder.

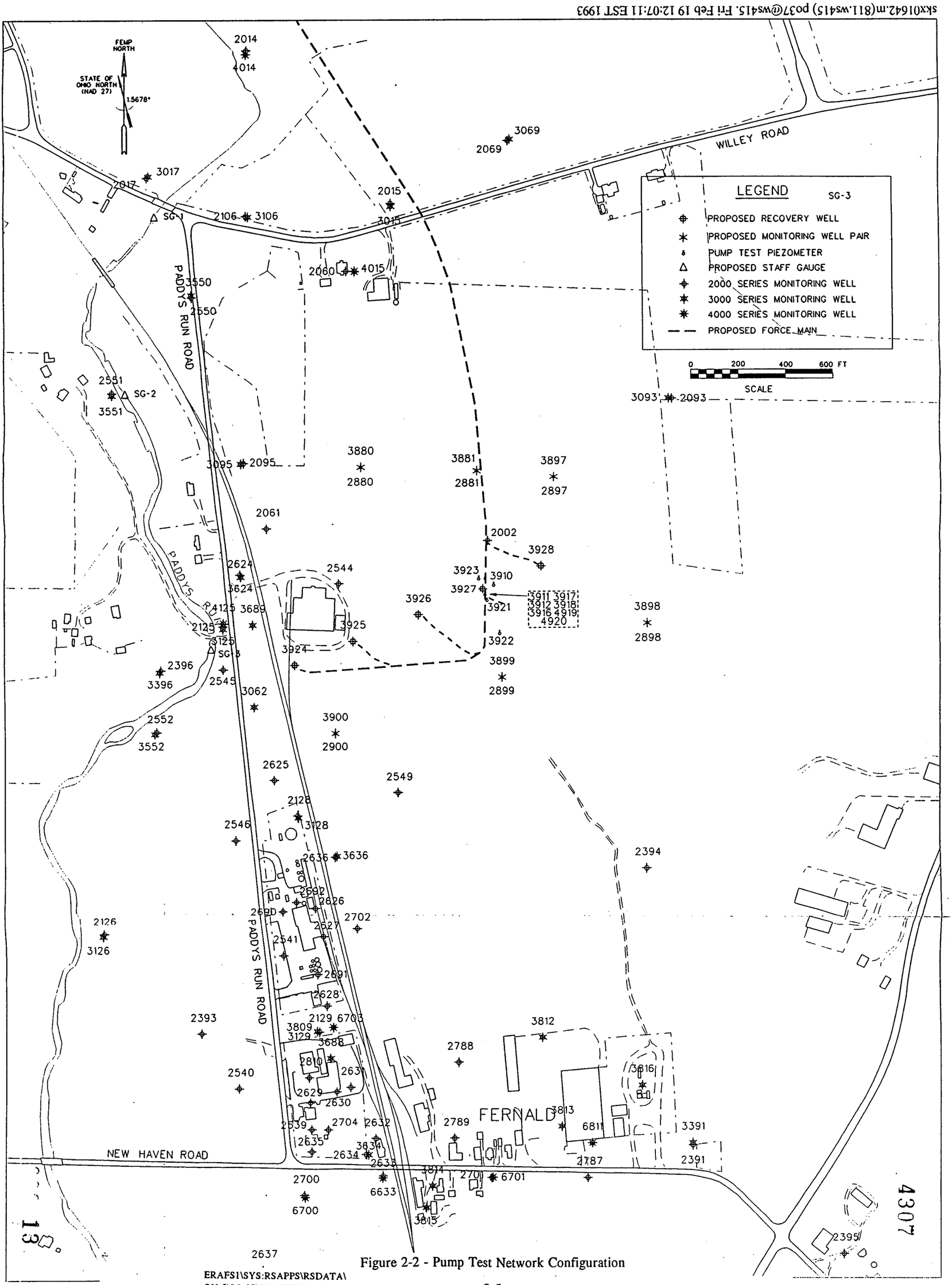
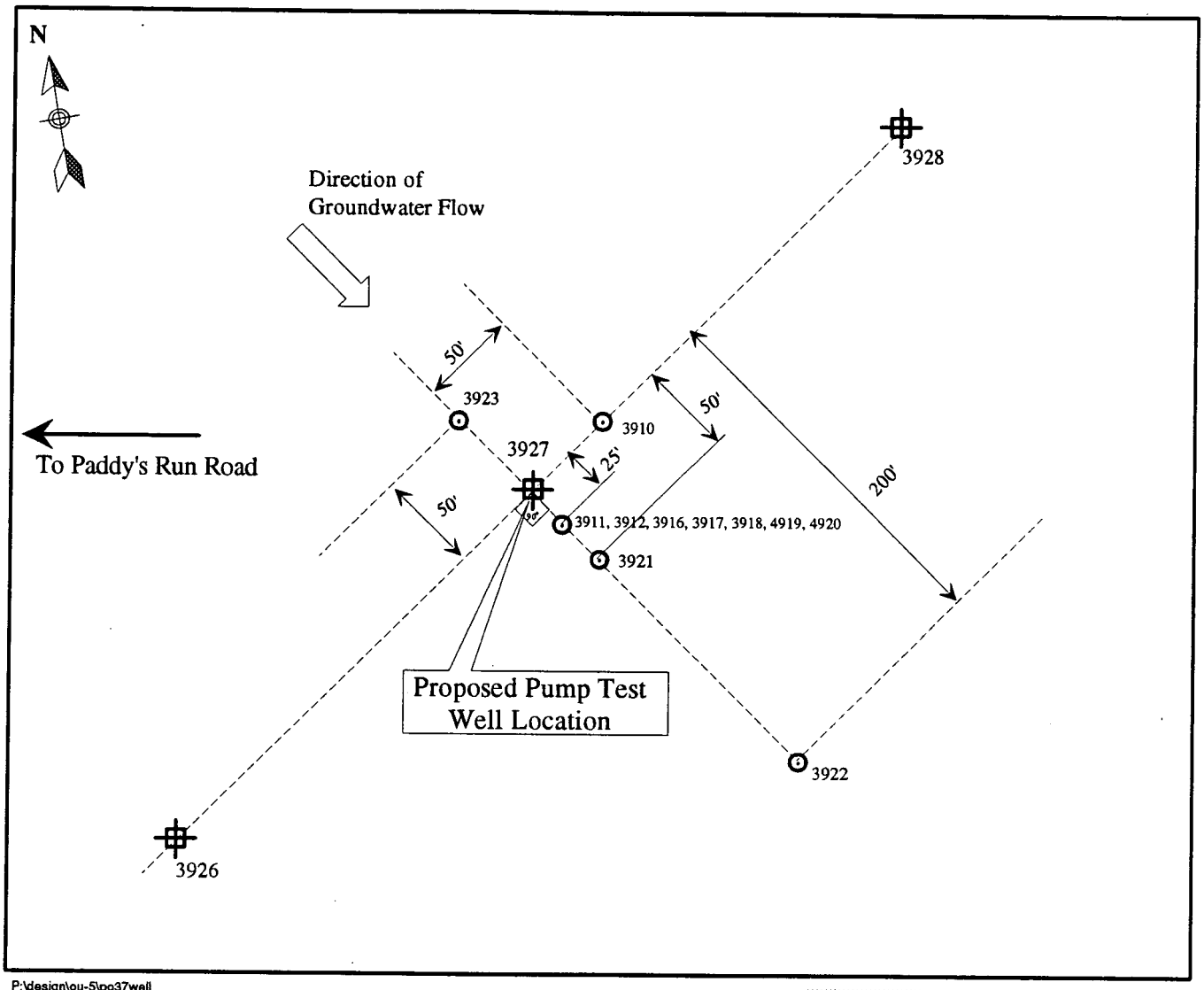


Figure 2-2 - Pump Test Network Configuration



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Note: This figure has been revised from Rev. 0
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⊙ Proposed piezometer

⊕ Proposed recovery well location

---------- Bearing Line

Figure 2-3 - Proposed Locations for Piezometers

Table 2-2 - Pump Test Primary Observation Wells and Piezometers and Measurement Requirements

Primary Wells	Measurement Device	Minimum Measurement Frequency
~~SPPZ-1~~ 3910	Transducer/Datalogger	1) Four readings taken daily ~~readings~~ 7 days prior to the ~~before~~ test 2) During test, see Table 2-9.
~~SPPZ-2A~~ 3911	Transducer/Datalogger	
~~SPPZ-2B~~ 3912	Transducer/Datalogger	
~~SPPZ-2C~~ 3916	Transducer/Datalogger	
~~SPPZ-2D~~ 3917	Transducer/Datalogger	
~~SPPZ-2E~~ 3918	Transducer/Datalogger	
~~SPPZ-2F~~ 4919	Transducer/Datalogger	
~~SPPZ-2G~~ 4920	Transducer/Datalogger	
~~SPPZ-3~~ 3921	Transducer/Datalogger	
~~SPPZ-4~~ 3922	Transducer/Datalogger	
~~SPPZ-5~~ 3923	Transducer/Datalogger	
2002	Transducer/Datalogger	
SPM-~~2001~~ 2880	Float/Recorder	Continuous for 7 days before test through end of recovery period.
SPM-~~2003~~ 2897	Float/Recorder	
SPM-~~2005~~ 2899	Float/Recorder	
~~SPM-2006~~	~~Float/Recorder~~	
2015	Float/Recorder	

Table 2-3 - Pump Test Secondary Observation Wells, Staff Gauges, and Measurement Requirements

Secondary Wells	Measurement Device	Measurement Frequency
~~SPM-3001~~ 3880	Steel tape or electric sounder	Daily readings from 7 days before test through the end of the recovery period. Two readings the first day of test, one before pump start up and one after pump start up.
~~SPM-3002~~ 3881	Steel tape or electric sounder	
~~SPM-3003~~ 3897	Steel tape or electric sounder	
~~SPM-3004~~ 3900	Steel tape or electric sounder	
~~SPM-3005~~ 3899	Steel tape or electric sounder	
~~SPM-3006~~ 3898	Steel tape or electric sounder	
~~SPM-2002~~ 2881	Steel tape or electric sounder	
~~SPM-2004~~ 2900	Steel tape or electric sounder	
~~SPM-2006~~ 2898	Steel tape or electric sounder	
2128	Steel tape or electric sounder	
3128	Steel tape or electric sounder	
2636	Steel tape or electric sounder	
3636	Steel tape or electric sounder	
2548	Steel tape or electric sounder	
2549	Steel tape or electric sounder	
2543	Steel tape or electric sounder	
2394	Steel tape or electric sounder	
2093	Steel tape or electric sounder	
3093	Steel tape or electric sounder	
3015	Steel tape or electric sounder	
2106	Steel tape or electric sounder	
3106	Steel tape or electric sounder	
2095	Steel tape or electric sounder	

Table 2-3 - Pump Test Secondary Observation Wells, Staff Gauges, and Measurement Requirements (Continued)

Secondary Wells	Measurement Device	Measurement Frequency
3095	Steel tape or electric sounder	
2544	Steel tape or electric sounder	
2624	Steel tape or electric sounder	
3624	Steel tape or electric sounder	
2125	Steel tape or electric sounder	
3125	Steel tape or electric sounder	
2625	Steel tape or electric sounder	
SG-1	Steel tape or electric sounder	
SG-2	Steel tape or electric sounder	
SG-3	Steel tape or electric sounder	

Secondary wells, monitoring wells farther from the pumping well, will have water elevations measured with steel tapes or electric sounders during the pump test and with less frequency. Staff gauges (SG-1, 2, and 3) in Paddy's Run are monitored at the same frequency as secondary wells. Steel tapes will be available as back-up measuring devices in the event of electric sounder failure. Some of these wells may show drawdown at these more remote locations due to non-homogeneous or anisotropic conditions; however, the data cannot be treated as reliable for curve matching analysis. Tables 2-2 and 2-3 show the frequency of measurements. If recovery wells ~~RW-1, 2, 3, and 5~~ 3924, 3925, 3926, and 3928 have been installed prior to the pumping test, arrangements will be made to monitor their water levels as well.

2.3.2 Basis of Observation Well Layout

The pumping test layout, described in Subsection 2.3.1, was based on field data from similar pumping tests and supported with simplified scoping calculations. The field data includes information from the pumping tests for the Albright and Wilson alternate water supply (located approximately 1 mile southwest of the Fernald Environmental Management Project [FEMP]) (ASI/IT 1991), the collector wells near Venice (Ross), Ohio (approximately 1 mile east of the FEMP) (Dove 1961), and the Chem Dyne Site in Hamilton, Ohio (approximately 10 miles northeast of the FEMP) (CH_2M Hill

1984). The scoping calculations were performed using the United States Geological Survey (USGS) 3-D groundwater model MODFLOW (McDonald and Harbaugh 1988).

Field data plots were available for several wells on the Venice test. The test well was pumped at approximately 1,000 gpm. After 12 hours, the observation wells exhibited approximate drawdowns of 2.5, 1.5, and 0.75 feet at distances of 50, 100, and 200 feet respectively from the test well. In the Chem Dyne test, data on only one observation well was available; however, after pumping the test well at approximately 1,000 gpm for 14 hours, the observation well exhibited slightly less than 3 feet of drawdown at a distance of 53 feet from the test well. The Albright and Wilson alternate water supply pumping test only stressed the aquifer at 380 gpm. Observation wells were located at distances of 25 and 300 feet from the test well. After pumping the test well for 72 hours, no drawdown occurred in either of the observation wells. ~~From~~ By using distance drawdown plots of the Venice test data and assuming similar hydrogeologic properties/materials in the vicinity of 3927 to that of the Venice test well, it is estimated that approximately 3 to 4 feet of drawdown will occur at a distance of 25 feet from the test well if it is pumped at 1,200 gpm.

Simplified simulations of the proposed pump test were performed using MODFLOW. The model was configured to simulate drawdown effects caused by a partially penetrating well by creating a simplified two-layer system with pumping simulated in the top layer. A 30 x 30 cell grid was developed with cell dimensions of 25 feet in the "x" and "y" directions, and simplified boundary conditions were created. A two-layer system was created in the "z" direction. The upper layer was 135-feet thick with a saturated thickness of 35 feet. The lower layer was 120-feet thick and fully saturated. A well was centered on the grid and, by pumping only the upper layer, the effects of partial penetration were simulated. Boundary conditions included no-flow boundaries on the initial and terminating cell columns of the grid and constant head boundaries (set at 900 feet) on the uppermost and lowermost rows of the grid. The model was operated in steady-state mode and drawdown effects were produced for 24 hours of pumpage. Various flow rates were used including the projected flow rate of 1,200 gpm for the proposed pump test. Hydraulic conductivity values from the Venice test (Dove 1961), the SWIFT III model (ASI/IT 1990), and a value similar to the Chem Dyne test were used. Table 2-4 shows the drawdown results of these simulations.

At distances of 100 to 300 feet, the model predicted drawdown similar to the data acquired in the Venice test when using hydraulic conductivity values similar to those used in the SWIFT model (4.5×10^2 feet/day) and derived from the Venice test (3.87×10^2); however, the model predicted lower drawdown values at distances from 25 to 100 feet. When a hydraulic conductivity value similar to that derived from the Chem Dyne test was used (1.47×10^2), the predictions for drawdowns matched more closely to well drawdowns lying at distances of 25 to 100 feet away from the pumped well, but were not as close to drawdown data over 100 feet away.

Given the low drawdowns at distances greater than 200 feet for pump tests performed in the vicinity of the FEMP and similar model results, the piezometer locations described above were selected.

2.3.3 Procedures for Well/Piezometer Construction

Regardless of management responsibility, the installation of all wells and piezometers shall be consistent with guidelines provided in the ~~draft~~ "FEMP Sitewide Comprehensive Environmental Response, Compensation, and Liability Act ~~(CERCLA)~~ Quality Assurance Project Plan" (~~QAPjP~~ SCQ) (WEMCO 1992a).

Procedures pertaining to well installation activities are referenced to the section of the ~~QAPjP~~ SCQ in Table 2-5. A.M. Kinney will develop specifications for recovery well and piezometer construction from the Quality Assurance Project Plan (*Remedial Investigation/Feasibility Study [RI/FS] Work Plan, Volume V*) (QAPP) and any applicable task-specific procedures.

Table 2-4 - Model Drawdown Results
(Pump Rate 1,200 gpm)

Hydraulic Conductivity (Distance from Pumping Well (ft)	**25**	**50**	**75**	**100**	**125**	**150**	**175**	**200**
IT Swift K=450 ft/day	2.0	1.3	1.0	1.0	0.7	0.6	0.6	0.5
Dove/Spieker K=387 ft/day	2.2	1.4	1.1	1.0	0.8	0.8	0.7	0.6
K=200 ft/day	3.6	2.6	2.2	1.9	1.6	1.5	1.3	1.2

Note: Drawdown measured in feet
K = hydraulic conductivity

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Table 2-5 - Well Installation Procedures

	REFERENCE
Administrative Procedures	~~FEMP QAPjP (Draft March 1992)~~ SCQ (WEMCO 1992a)
Chain-of-Custody	Section 7.1
Corrective Action	Section 15.2
Daily Logs	Section 5.1 and Appendix J, Subsection J.4.1
Variances	Section 15.4
Field Procedures	
General Drilling Practices	Section 5.2.1 and Appendix J, Subsection J.4.2
Subsurface Soil Sampling	Appendix K, Subsection K.5.3
Monitoring Well/Piezometer Design, Installation, and Abandonment	Section 5.2.2 and Appendix J, Subsection J.4.3 *EM-GW-004
Well Development	Section 5.2.3 and Appendix J, Subsection J.4.4
Borehole Geophysical Logging	Section 5.3.1
	Section 5.2.5 and Appendix J, Subsection J.4.6
Field Screening of Samples for Radioactive Contamination	Appendix K, Subsection K.5.3.2
Decontamination	Appendix K, Subsection K.11
Field Storage and Shipment of Samples	Appendix K, Subsection K.10
Laboratory Test Procedures	
Grain Size Analysis	Attachment I, Volume V, Method No. FM-GTT-0031

* Well abandonment will also follow this procedure listed in the *WEMCO Environmental Monitoring Procedures Manual, Rev. 28 (June 16, 1992).*

Table 2-6 - Test Well ~~(RW-4)~~ 3927 Design Requirements

Parameter	Criteria
Pump Test Well (RW-4)	Estimated State Coordinates - 474511 N and 1380589 E
Static Water Level Depth (Relative to ground surface)	Approximately 65 to 70 feet
Base of Well Screen Depth (Relative to ground surface)	Approximately 105 to 110 feet
Anticipated Drawdown	10-20 feet at 1,200 gpm
Well Size	Sufficient diameter to pump ~~1,200~~ 1,500 gallons per minute and meet screen entrance and uphole velocity requirements. Uphole velocity less than 5 feet/second
Screen	1) Screen interval from top of water table to 40 feet below water table 2) Screen entrance velocity less than or equal to 0.1 feet/second
Pump Inlet Placement	Below base of screen
Pump Flow Rate	Variable - between 500 and ~~1,200~~ 1,500 gpm with ability to sustain a maximum ~~1,200~~ 1,500 gpm for 12 days. Up to 21 million gallons of water may be pumped to the SWRB and gravity outfall during the test (based on 1,200 gpm).
Pump Type	Anticipate submersible or vertical shaft turbine
Pumping Appurtenances	1) Backflow preventer - check valve to prevent water in discharge line from re-entering well 2) Flow Control - variable speed drive or throttled discharge valve 2) Flow measurement - flow meter and orifice weir on discharge line 3) Sampling - sampling port on discharge line
Drawdown Measurement	Configuration of well and pump shall allow for the measurement of water elevation in the pump test well and the filter pack immediately outside the test well screen. Stilling pipe consisting of 1-inch PVC pipe inside the well is recommended. A 1-inch ID stainless-steel pipe or well with a screen length equivalent to the test well shall be installed in the filter pack at the same depth as the test well.

2.3.4 Design and Installation of Test Well (RW-4)

Design considerations (PARSONS 1992a) regarding the construction of the test well were prepared and submitted to ~~WEMCO~~ FERMCO. This information, revised to incorporate recent comments, has been included in this document. ~~In order~~ To accommodate the high flow rates anticipated for the pumping test, the design of ~~RW-4~~ 3927 will be different from the other four recovery wells. Table 2-6 details the specific design requirements for ~~RW-4~~ 3927. Drilling will be in accordance with Subsection 5.2.1 of the ~~QAPjP~~ SCQ. The test well will be drilled by approved methods to an approximate depth of 110 feet below ground level (40 feet below the top of the water table). Drilling and well construction specifications will be prepared by the design contractor, A.M. Kinney.

Representative split spoon samples will be taken every 10 feet over the 40-foot screened interval for screen slot determination. Based on nearby well data, split spoon sampling will be from 70 feet to 110 feet below ground surface. Samples will be classified in accordance with the United Soil Classification System (USCS). Samples will be retained by the field geologist and archived as directed by ~~WEMCO~~ FERMCO. Split spoon samples will be selected for sieve and other geotechnical parameter analyses as determined by PARSONS or A.M. Kinney. When the recovery well boring has reached total depth, a natural gamma borehole survey will be taken through the casing to determine the presence of clay layers in the sand and gravel aquifer. Table 2-5 references procedures for acquiring borehole geophysical logs. ~~For comparison purposes, b~~ Boring logs for wells in the area of RW-4 ~~are enclosed in Attachment A~~ are located in the Groundwater Report (DOE 1990).

Prior to selection of the well screen, grain size analysis will be performed by the well screen manufacturer in accordance with methods referenced in Table 2-5. This analysis will ensure that the proper slot size (and gravel pack if required) is selected that will meet minimum requirements for screen entrance velocity and that the structural integrity of the screen will be maintained. The screened interval of the test well shall have a slot size of sufficient open area to maintain a screen entrance velocity at or below 0.1 feet/second. If a gravel pack is required, the material shall consist of clean, smoothly rounded grains.

Well development will be conducted as specified by A.M. Kinney. ~~No procedures for recovery wells currently exist under the FEMP sitewide SCQ; therefore, procedures and standards shall be developed by FERMCO~~. Well development specifications should meet standards for production wells with special consideration to the fact that ~~RW-4~~ 3927 ~~will~~ may flow for 3 to 12 days at a rate ~~(1,200 gpm)~~ (up to 1,500 gpm) that is two to three times its normal operating range. Cuttings from the recovery well drilling and development operations will be drummed and disposed as directed by the Site Managing Contractor. Groundwater from development operations will be discharged to the Storm Water Retention Basin (SWRB) via the new force main or as directed by the Site Managing Contractor.

2.3.5 Design and Installation of Piezometers

A total of eleven piezometers will be required for the pump test. Five 2-inch inner diameter (ID) piezometers ~~(SPPZ 1, 2A, 3, 4, and 5)~~ 3910, 3911, 3921, 3922, and 3923 will be installed at a depth of approximately 110 feet below the ground surface (40 feet below the top of the water table) at the locations shown in Figure 2-3. ~~In order~~ To assess the test well's vertical influence, four 2-inch ID piezometers ~~(SPPZ 2B, 2C, 2D, and 2E)~~ 3912, 3916, 3917, and 3918 will be installed and screened at 10-foot increments below the base of ~~SPPZ 2A~~ 3911 with the deepest set at approximately 150 feet below ground level. The actual depth of each well will depend on the elevation of the water table at each location and the depth to bedrock. At the same location, two additional piezometers will be set at approximately 40-foot increments to a depth of approximately 230 feet below ground level. One of these piezometers ~~(SPPZ 2G)~~ 4920 will be set in sand and gravel material immediately above bedrock. The other ~~(SPPZ 2F)~~ 4919 will be screened at a depth midway between ~~SPPZ 2E~~ 3918 and ~~SPPZ 2G~~ 4920. The field geologist will be responsible for selecting the total depth of each well.

Table 2-7 presents design criteria for the piezometers. The screened interval will be 5 feet at the base of each piezometer. For piezometers ~~SPPZ 1, 3, 4, and 5,~~ 3910, 3921, 3922, and 3923, continuous corings (3 inch ID minimum) will be collected over the screened interval. Samples will be classified in accordance with the USCS. To gain a better understanding of the aquifer's vertical heterogeneity, a continuous core (3 inch ID minimum) will be required from the deepest piezometer in the ~~SPPZ 2~~ cluster . The core will be taken from 10 feet above the water table to the base of the boring (top of bedrock). No coring will be required from any other piezometers in the ~~SPPZ 2~~ cluster. Core samples will be selected for sieve and other geotechnical parameter analysis as determined by the pump test analyzer. Sample analysis is the responsibility of the pump test analyst. At total depth, a natural gamma log will be run at all the piezometer locations (only at the deepest piezometer ~~at SPPZ 2~~ [4920] in the piezometer cluster), so that changes in lithology can be correlated accurately in the vicinity of the pump test.

A natural filter pack will be used that allows the aquifer material to collapse around the screen. Piezometers will be developed and their integrity will be tested in accordance with methods prescribed in the ~~QAPjP~~ SCQ (WEMCO 1992a) as referenced in Table 2-5. Cuttings will be drummed and disposed of as prescribed by the Site Managing Contractor. A representative from PARSONS will be available for consultation on site during piezometer installation.

Table 2-7 - Piezometer Design Requirements

Piezometer Number	Screen and Casing Diameter Minimum ID	Screen and Casing Material[1]	Screen Slot Size	Screen Interval at Base of Piezometer	Distance/ Direction from Test Well[3]	Approximate Depth	Estimated Easterly State Planer Coordinates[2]	Estimated Northerly State Planer Coordinates[2]
3910	2 in.	PVC	0.01 inch	5 ft.	50 ft. NE	110	1,380,641	474,530
3911	2 in.	SST	0.01 inch	5 ft.	25 ft. SE	110	1,380,604	474,488
3912	2 in.	SST	0.01 inch	5 ft.	25 ft. SE	120	1,380,604	474,488
3916	2 in.	SST	0.01 inch	5 ft.	25 ft. SE	130	1,380,604	474,488
3917	2 in.	SST	0.01 inch	5 ft.	25 ft. SE	140	1,380,604	474,488
3918	2 in.	SST	0.01 inch	5 ft.	25 ft. SE	150	1,380,604	474,488
4919	2 in.	SST	0.01 inch	5 ft.	25 ft. SE	190	1,380,604	474,488
4920	2 in.	SST	0.01 inch	5 ft.	25 ft. SE	230	1,380,604	474,488
3921	2 in.	PVC	0.01 inch	5 ft.	50 ft. SE	110	1,380,613	474,465
3922	2 in.	PVC	0.01 inch	5 ft.	200 ft. SE	110	1,380,667	474,325
3923	2 in.	PVC	0.01 inch	5 ft.	50 ft. NW	110	1,380,576	474558

This table has been revised for Revision 1.

1 SST = Stainless Steel
PVC = Polyvinyl Chloride
2 Locations from FEMP Drawing 18A-4445-C-1186
3 See Figure 2-3

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After the complete recovery system is operational for 3 months and the necessary information has been acquired for the model validation effort, piezometers ~~SPPZ 1, 3, 4, and 5~~ 3910, 3921, 3922, and 3923 will be abandoned. The piezometers will be abandoned in accordance with procedures referenced in Table 2-5 and in accordance with Westinghouse Environmental Management Company of Ohio (WEMCO) Groundwater Programs Procedure EM-GW-0004. Piezometers ~~SPPZ 2A, 2B, 2C, 2D, 2E, 2F, and 2G~~ 3911, 3912, 3916, 3917, 3918, 4919, and 4920 will become permanent monitoring wells.

2.4 Aquifer Test Design and Field Implementation

As discussed in Subsection 2.1, data will be acquired in three stages during the pumping test:

1) A step drawdown test
2) A 72-hour constant rate test (longer if required by delayed yield effects)
3) A water level recovery period

Each stage of the test will be used to define the next stage. Each stage is detailed in the following sections. Figure 2-4 is a schedule of activities (not including well drilling) associated with the performance of the pumping test. This pump test design is based on Stallman (1971), U.S. Department of the Interior (1981), Driscoll (1986), Walton (1987), and Kruseman and de Ridder (1990).

2.4.1 Required Personnel

During actual performance of the pumping test the following personnel will be required at various times on site:

1) Task Manager: Responsible for overall coordination of the project

2) Lead Pump Test Specialist: Responsible for test setup and procedures

3) Technicians: Responsible for data collection and well measurements

4) Data Logger Equipment Specialist (manufacturer's representative): Responsible for setup, verification, and operation of datalogger and pressure transducer data collection devices

5) Field Labor Foreman and Crew: Responsible for heavy equipment moving and piping hookups and assisting in operation of discharge lines

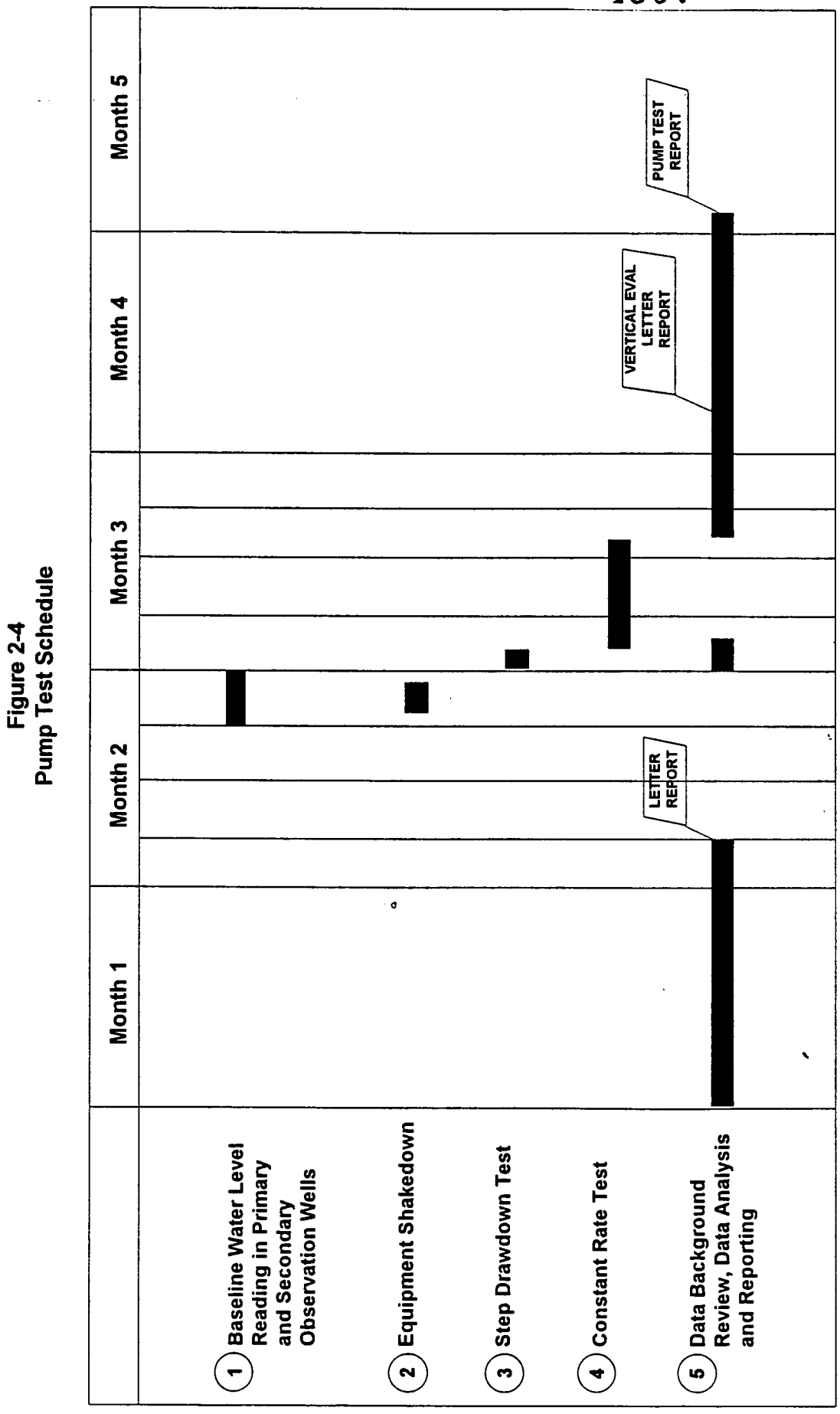

Figure 2-4 - Pump Test Schedule

6) Pump Operator (and Helper if required): Responsible for operating the pump, maintaining flow at required levels, and also responsible for power source

7) Analytical Lab Specialist: Responsible for collecting groundwater samples during the test

All managers, specialists, operators, and technicians shall possess the necessary skills and experience to perform their respective tasks during the pumping test. Participants shall be able to address contingencies competently and efficiently so that valuable time and data is not lost. Margins for error will be very small because of the difficulty and expense in repeating the pump test exercise. All field contingencies should be resolved to the fullest extent possible during the equipment shakedown period described below. An experienced team will maximize the likelihood of a successful test.

2.4.2 Test Equipment

The following equipment will be required:

1) Submersible or vertical shaft turbine pump that can be accommodated by the test well with check valve to prevent water from siphoning back into the well. Pump must be capable of pumping ~~1,200~~ 1,500 gpm against static and friction head necessary to pump the water to the SWRB.

2) Power source for the pump capable of continuous operation for as long as 12 days. If an internal-combustion engine, it shall be equipped with a tachometer.

3) Piping and necessary fittings from the pump to the force main with a minimum capacity of ~~1,200~~ 1,500 gpm.

4) Power source for the ancillary field equipment.

5) Gate valve or other flow control device to control discharge from the test well.

6) Flow meter with a totalizer to measure flow in gpm and total discharge in gallons.

7) An orifice weir (for backup flow measurement) with manometer tube, to be installed at the SWRB discharge point.

8) Sixteen channel data logger with 16 transducers with necessary fittings and cables (Hermit by In Situ, or equivalent). Data logger and transducer system shall be capable of recording at rates as frequently as two readings per second. Transducers shall be sized for appropriate pressure ratings.

9) A single channel data logger and transducer for backup purposes, particularly during recovery period.

10) Four gear-driven, float-type automatic water level chart recorders (Stevens Type F or equal).

11) Twenty steel tapes with chalk or electrical water level measuring tapes (both types at least 200 feet long and graduated in hundredths of a foot) for water level measurement.

12) Stop watches and digital wrist watches capable of being synchronized within 1 second for each member of the pump test team.

13) Light plant for overnight activities.

14) Portable hand-held lighting (e.g., flashlights and lanterns) for each member of the team.

15) Hand-held radio communicators as determined by the field task manager.

16) A weather station capable of measuring barometric pressure, temperature, and rainfall; the FEMP meteorological tower is suitable if approval is secured.

17) Combined pH, specific conductance, and dissolved oxygen meter.

18) Thermometers (at least two).

19) Sample bottles and shipping containers.

20) Portable computer.

21) Log-log 3- by 5- cycle and semi-log 3-cycle graph paper for plotting drawdown data.

22) Distilled water and equipment for decontamination of probes and steel tapes.

23) Sampling port on flowline for groundwater sampling.

24) Health and safety equipment and clothing.

25) Indelible pens and/or pencils.

26) Field notebook and water level recording forms.

27) Pump Operator's Field Log.

28) Three staff gauges located in Paddy's Run (see Figure 2-2).

2.4.3 Procedures

Procedures for performing the tasks associated with the pump test will be consistent with guidelines provided in the draft FEMP ~~QAPjP~~ SCQ (WEMCO 1992a) and new procedures developed as part of this ~~PTP~~ PTWP. These procedures are referenced in Table 2-8. The new procedures are described in detail in Attachment B. Exceptions to these procedures will be approved by ~~WEMCO~~ FERMCO and PARSONS prior to implementation.

2.4.4 Equipment Shakedown and Background Data

~~In order~~ To minimize unforeseen problems, all equipment will be subjected to a performance shakedown at least 2 days prior to the test. Power supplies, the pump, flow lines and discharge collection systems, valves, gauges, meters, lighting, recorders, data loggers, communicators, and any other equipment subject to mechanical, structural, and/or electrical failure will be inspected and field tested prior to startup of the pumping test. The shakedown test should include a practice run that replicates the first step of the Step Drawdown Test and demonstration of the 1,500 gpm pumping rate. Records shall be maintained by the operator(s).

Water level measurements of the test well, piezometers, and primary observation wells will be collected four times a day for 1 week prior to the start of the test. Continuous recorders will be installed in four of the monitoring wells that will not be equipped with pressure transducers and allowed to collect data for 1 week prior to the test. Records shall be maintained by the operator(s).

2.4.5 Handling of Pump Test Water

For the Great Miami Aquifer, the effects of delayed yield are likely to occur but not before 7 days of pumping at 1200 gpm. The test might actually take 12 days before these effects are seen, however, provisions for pump test discharge will assume a 7 day test. During the first 24 hours, approximately 1.73 million gallons of water will be produced and discharged through the new force main to the SWRB. This water will be routed to and treated by the SWRB-Interim Advanced Waste Water Treatment (IAWWT) Plant (300 gpm nominal capacity). After 24 hours, the full existing pumping capacity of the SWRB (minimum 550 gpm) will be used with the excess capacity pumped around the IAWWT and discharged directly to the river. This will result in a maximum accumulation of 6.2 million gallons of water during a 7 day test. The SWRB will remain at the 550 gpm rate for a sufficient period after the test to draw down the level of the SWRB.

Table 2-8 - Pump Test Procedures

Administrative Procedures	**Reference***
Chain-of-Custody	Section 7.1
Corrective Action	Section 15.2
Daily Logs	Section 5.1 and Appendix J, Subsection J.4.1
Variances	Section 15.4
Field Procedures	
Ground Water Level Measurement	Appendix K, Subsection K.4.2.1
Water Level Measurements - Metal Tape	New Procedure, Attachment B of ~~PTP~~ PTWP
Water Level Measurements - Float/Recorder**	New Procedure, Attachment B of PTWP
Water Level Measurements - Transducer/Data Logger **	New Procedure, Attachment B of PTWP
Water Level Measurement Form	New Procedure, Attachment B of ~~PTP~~ PTWP
Aquifer/Permeability Testing	Section 5.2.5 and Appendix J, Subsection J.4.6
Measurement of Discharge Orifice Weir	New Procedure, Attachment B of ~~PTP~~ PTWP
Groundwater Sampling	New Procedure, Attachment B of ~~PTP~~ PTWP
Field Screening of Samples for Radioactive Contamination	Appendix K, Subsection K.5.3.2
Decontamination	Appendix K, Subsection K.11
Field Storage and Shipment of Samples	Appendix K, Subsection K.10
Field Calibration Requirements	Appendix I
Field Analytical Method for Natural Water Samples	Appendix K, Subsection K.4.1
Field Test:	
Temperature	Appendix K, Subsection K.4.1.1
pH	Appendix K, Subsection K.4.1.2
Specific Conductance	Appendix K, Subsection K.4.1.3
Dissolved Oxygen	Appendix K, Subsection K.4.1.4
Laboratory Test Procedures	
Total Uranium	Attachment I, Volume V, Method No. FM-RAD-0120

*Note: Reference sections are from FEMP ~~QAPjP~~ SCQ (Draft March 1992) except for new procedures included in Attachment B.

**Note: These procedures will be supplied by the Pump Test Subcontractor.

Similarly, the Storm Sewer Lift Station (SSLS) will be used to minimize the amount of runoff water accumulating in the SWRB during the test. Also, the 550 gpm pumping rate will be used, if necessary, prior to the test so that the SWRB is at a low level when the test commences.

In the event that construction work is completed to the extent that a tie-in to the existing 16-inch gravity outfall could allow direct discharge to the Great Miami River, that option will be considered. The US EPA will be informed if this change is made.

By conducting this test over a 7-day period with substantial accumulation of groundwater in the retention basins, the SSLS must be activated and remain activated even during a significant rain event to prevent the basins from overflowing. Standard procedure during a rain event is to deactivate the SSLS thus allowing runoff to collect in the retention basin for quiescent settling of solids prior to discharge to the river. If a rain event occurs during this pump test, and with the SSLS activated, the potential exists for Total Suspended Solids (TSS) excursions above the National Pollution Discharge Elimination System (NPDES) effluent limitations at both the SSLS (30 mg/l monthly average; 45 mg/l daily maximum) and Manhole 175 (30 mg/l monthly average; 45 mg/l daily maximum). Mass loading limitations for TSS and other regulated pollutants may also be adversely impacted. Moreover, because this groundwater has a low dissolved oxygen content there is concern that without additional aeration, the NPDES effluent limitation, requiring a minimum effluent dissolved oxygen level of 5.0 parts per million (ppm), can probably not be achieved. Dissolved oxygen is a State of Ohio Water Quality Standard.

In addition, pursuant to the Director's Findings and Orders effective June 26, 1987, the FEMP has been required to construct the retention basins with capacity to "...collect and hold all stormwater runoff from the (Feed Materials Production Center) FMPC process area, including the FMPC parking lots, resulting from a 10-year, 24-hour storm event." The FEMP would be vulnerable in handling such a storm during the pump test when a significant accumulation of groundwater is stored in the retention basins.

The FEMP will require relief from any enforcement actions relative to NPDES permit/Clean Water Act compliance, the causes of which are directly attributable to the discharge of the accumulated groundwater during this pump test.

2.4.6 Step Drawdown Test

A step drawdown test will be conducted to determine well yield and optimum pumping rate for the constant rate pumping test. The test well will be pumped at ~~three~~ four successively higher rates: 600, 900, 1,200, and ~~1,200~~ 1,500 gpm. Each step will have a duration of 2 hours, or longer if the water level in the pumping well has not stabilized. During each step period, flow will be maintained at + or - 5 percent (within the tolerance interval suggested by Stallman, 1971) of the designated rate by

means of a throttling device or other flow control method. Records of the test including time durations shall be maintained by the equipment operators and the Lead Pump Test Specialist (or his designated assistant).

Water levels will be automatically measured in the test well and primary observation wells will be recorded with pressure transducers linked to a data logger. Water levels also will be monitored periodically using electrical water level indicators and/or steel measuring tapes so that data logger readings can be cross checked. Tables 2-2 and 2-3 list all the wells and piezometers to be used for observation purposes during the test and the method of water level measurement. Information from the drawdown measurements will be used to determine if the well can pump at a sufficiently high rate to stress the aquifer adequately.

Water level measurements shall be recorded on a form similar to that shown in Attachment B. Water levels will be measured relative to the top of the well casing reference point. Installation, calibration, and use of the datalogger and pressure transducer system will be accomplished by a representative of the manufacturer/supplier.

If the step drawdown test is interrupted at any point so that the aquifer begins to recover, then the aquifer will be allowed to fully equilibrate and the test will be repeated from the beginning (time=0).

2.4.7 Constant Rate Test

After the step drawdown test and before commencement of the constant rate test, the aquifer must be allowed to recover and stabilize at or near pre-pumping levels. For this test, the aquifer should recover and stabilize until the day following the step drawdown test, 12 hours, or a period equal to the duration of the step test, whichever is longer.

The test well will be pumped at a constant rate of 1,200 gpm (unless the step drawdown test suggests differently) for a minimum period of 72 hours ~~or~~ and until the effects of delayed yield are observed (which may require 7 to 12 days of pumping). The maximum duration of ~~the~~ a single constant rate test will be 12 days. Discharge will be maintained within + or - 5 percent of the designated rate by means of a throttled gate valve or other flow control method. Discharge will be checked and adjusted as necessary every 10 minutes during the first hour of pumping and at 30 minute intervals thereafter. The discharge and time of measurement will be recorded and any adjustment will be noted. The flow rate will be recorded every minute for the first 10 minutes of the test and every 5 minutes thereafter.

As in the step test, drawdown in the test well and the primary observation wells will be recorded automatically with the pressure transducer and datalogger system. Also, water levels in these wells will be monitored with manual water level indicators every 20 minutes during the first 1,000 minutes of the test and hourly for the remainder of the test using either the Ground Water Level Measurement

Procedure or the Water Level Measurement - Metal Tape Procedure as appropriate. Time will be recorded in minutes. The water level drawdown data, measured in feet, will be plotted against a logarithmic time scale; therefore, water level data will be collected more frequently during the early time portion of the test to provide sufficient data points for curve matching analysis. Measurement intervals for piezometers and wells are defined according to Table 2-9 (In Situ, Inc. 1992 and Walton 1987). Since the datalogger transducer system will be preprogrammed to collect more data points at the beginning of the test and is capable of recording at rates as frequently as two readings per second, sufficient data points will be available for the logarithmic data plots. The data logger will be downloaded at least every 24 hours during the course of the test.

Groundwater samples will be collected from the pumping well four times during the first day of the constant rate test and two times on each remaining day of the test. The samples will be field tested for pH, specific conductance, dissolved oxygen, and temperature. Samples will also be analyzed for total uranium content using the FEMP on-site laboratory. Procedures are listed in Table 2-8.

If the constant rate test is interrupted at any point so that the aquifer begins to recover, then the aquifer will be allowed to fully equilibrate and the test will be repeated from the beginning (time=0).

Table 2-9 - Measurement Intervals for Piezometers and Observation Wells

Time Since Start of Pumping	Approximate Time Intervals
Primary Observation Wells and Piezometers (Connected to Data Logger)	
0 - 20 Seconds	0.5 Seconds
20 - 60 Seconds	1 Second
1 - 10 Minutes	12 Seconds
10 - 100 Minutes	2 Minutes
100 - 1,000 Minutes	20 Minutes
1,000 - completion	200 Minutes
Secondary Observation Wells and Piezometers	
0 - 24 Hours	2 Times per Day
24 Hours - Shutdown of Pump	1 Time per Day

Note: This table has been revised for Rev. 1.

2.4.8 Aquifer Recovery Measurements

The water level recovery measurements will begin simultaneously with pump shutdown. The monitoring of rising water levels will be recorded in the same ~~manner~~ sequence as during pumping. Using the data logger system, measurements will be recorded automatically at the intervals shown in Table 2-9. ~~at 0.5 second intervals during the first 10 minutes of recovery, at 1 minute intervals for the next 10 minutes, at 5 minute intervals for the next 100 minutes, and at 15 minute intervals until required recovery is achieved.~~ At least one piezometer or the test well will be equipped with an independent water level measurement system to assure that early time recovery data is not lost. Measurements will continue for approximately 24 hours or until three successive water level measurements at 1-hour or greater intervals show less than 0.1-foot difference in recovery at the test well (Unites States Department of the Interior 1981).

2.5 Aquifer Test Reporting

2.5.1 Data Analysis

Based on the observed response of the aquifer, appropriate analytical techniques will be selected to calculate the aquifer properties. The screen of ~~RW-4~~ the test pump well (3927) has been specified to penetrate only the top ~~35~~ 40 feet of the aquifer. Since the well penetrates less than 85 percent of total aquifer thickness, the test well is defined as a partial penetration of the unconfined aquifer (Todd 1980). For the step drawdown test, methods based on Jacobs' equations (Walton 1987) and the Hantush-Bierschenk method (Kruseman and de Ridder 1990) will be used to calculate well yield and well efficiency.

For the constant rate test, a delayed yield response is quite possible if not probable from this type of aquifer. For time drawdown analysis, methods have been developed by Neuman and Streltsova (Kruseman and de Ridder 1990) and also Lohman (1972). If semi-confined conditions exist, other analytical methods described by Walton, Hantush, and Neuman-Witherspoon (Kruseman and de Ridder 1990) will be applied. The Theis method will be applied regardless of aquifer type. The Straight-line (Cooper-Jacob) method of aquifer analysis will be plotted for the southeast trending line of piezometers ~~(SPPZ 2, 3, and 4)~~ 3911, 3921, and 3922; however, this method assumes fully penetrating conditions. This method will be used strictly for comparative purposes.

If the aquifer demonstrates semi-confined behavior during the test, estimates of aquifer horizontal anisotropy will be derived using methods developed by Papadopulos and Hantush. Effects of vertical anisotropy will be calculated for semi-confined conditions using methods developed by Weeks and Hantush. For unconfined conditions, vertical anisotropy will be calculated using methods derived by Streltsova or Neuman (Kruseman and de Ridder 1990).

2.5.2 Pump Test Report

A report will be prepared immediately after completion of the pump test to document the results of the pump test effort. This report will be independent from the Model ~~Validation~~ Calibration Report defined in the DMEPP, although data and analysis from this report will be used in preparing the Model ~~Validation~~ Calibration Report. The Pump Test Report will contain background information, a description of the pump test, the analysis of the data including the calculated hydraulic parameters, groundwater quality from the pumped well, and conclusions and recommendations. Copies of tabulated and graphed data sets, assumptions used in data analysis, and associated backup data will also be included.

The report writing effort will commence 2 months prior to the projected date of pump test implementation and will include the collection of the background information specified below. This information will be collected to anticipate any issues that might affect pump test implementation or data analysis. A letter report containing this data will be completed 2 weeks prior to the commencement of the pump test. The data background letter report will identify issues that may affect implementation of the pump test. At the completion of the pump test, the remaining portions of the report will be written. The report will be issued 6 to 8 weeks after completion of the pumping test.

In addition, a vertical capture letter report will be written 2 weeks after the pump test. This letter report will recommend screen lengths for the recovery wells and set the initial recovery well pumping rates. The content of this report was described in Subsection 3.1.2 of the DMEPP text.

Prior to the test, the following information will be gathered:

1) Records of groundwater elevations from one well in the vicinity of the test equipped with a pressure transducer and recorder for 2 months prior to the test

2) Records of temperature, humidity, barometric pressure, and precipitation for a period of 1 year preceding the proposed test date

3) Available stream gauging data for the Great Miami River in the vicinity of the site and Paddy's Run so that fluctuations can be determined

4) Identification of any nearby pumping wells including pumping rates that might cause interference with the test well

5) Identification of any surface discharge to groundwater which might affect the test data

2.6 Health and Safety

Health and safety requirements for well drilling, soil investigations, pump testing, and groundwater sampling shall be provided in a site-specific health and safety plan. The contractor responsible for field implementation of these activities shall prepare and administer this plan. The work to be performed shall be consistent with the health and safety plan prepared for the South Groundwater Contamination Plume Removal Action Part 2 and Part 3 (WEMCO 1992b). ~~WEMCO~~ FERMCO will provide the necessary work permits required by FEMP procedures. Also, ~~WEMCO~~ FERMCO will provide the necessary health and safety supervision and personnel to conduct this work safely.

Subcontractor personnel shall have completed the necessary FEMP training and medical monitoring requirements prior to commencement of work on this project. Training and medical monitoring requirements are defined by ~~WEMCO~~ FERMCO.

SECTION 3

QUALITY ASSURANCE/QUALITY CONTROL

All work will be conducted in accordance with the requirements of the overall quality assurance program at the FEMP which is described in the Sitewide Quality Assurance Program Description. Drilling, sampling, well and piezometer installation, pump testing, and laboratory testing shall be assigned the proper quality level by ~~WEMCO~~ FERMCO. Site Policy and Procedure Number FMPC-711 provides guidelines for matching of quality program requirements to the quality levels. Specific quality items will be reviewed by ~~WEMCO~~ FERMCO to verify that the quality requirements are adequate and consistent with the assigned quality level. Field quality control should also be consistent with guidance provided in the draft FEMP ~~QAPjP~~ SCQ (WEMCO 1992a). For items not covered in the ~~QAPjP~~ SCQ, guidance may be obtained (with FEMP management approval) from the ~~Remedial Investigation/Feasibility Study~~ RI/FS Work Plan, Volume V, "Quality Assurance Project Plan (QAPP)," Revision 3, March, 1988 (DOE 1988).

SECTION 4

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ATTACHMENT A

WELL INSTALLATION AND SOIL SAMPLING RECORDS

These records are contained in the Groundwater Report (DOE 1990) and are no longer presented as an individual appendix.

ATTACHMENT B

PROCEDURES

Water Level Measurements - Float/Recorder

This procedure will be provided by the pump test subcontractor responsible for operating the specific equipment. The procedure will be submitted to FERMCO/DOE for approval after award of the subcontract and 30 days prior to commencement of the pump test. This procedure will be provided to the US EPA and Ohio EPA for information.

Water Level Measurements - Transducer/Datalogger

This procedure will be provided by the pump test subcontractor responsible for operating the specific equipment. The procedure will be submitted to FERMCO/DOE for approval after award of the subcontract and 30 days prior to commencement of the pump test. This procedure will be provided to the US EPA and Ohio EPA for information.

Water Level Measurements - Metal Tape

The steel tape method for measuring the depth to water is a simple and reliable method in observation wells between 1-1/2 and 6 inches in diameter. The steel tape method utilizes a steel tape with a popper. The popper is a metal cylinder 1 to 1-1/2 inches in diameter and 2 to 3 inches long with a concave undersurface and is fastened to the end of a steel tape. The steel tape with a popper is used in the following manner.

1) Chalk the steel tape with either carpenter's chalk or ordinary blackboard chalk which changes shade upon becoming wet.

2) Extend the chalked steel tape with a popper into the well. A few inches above the water the popper should be dropped to hit the water surface, where it will make a distinct "pop."

3) Adjust the length of the tape to determine the point at which the popper just hits the surface.

4) Extend a portion of the chalked tape below the water surface. Take a reading at a designated measuring point at the top of the casing. All water level measurements shall be taken from the same measuring point.

5) Retract the metal tape. The line of the color change of the chalked portion of the tape denotes the length of tape immersed in water.

6) Subtract the length of color change of the chalked portion of the tape from the reading at the measuring point for the depth to water.

Cascading water in a well may mask the mark of the true water level on the tape. In small-diameter wells, the volume of the weight may cause the water level to rise in the pipe, and the measurement may be somewhat inaccurate. Operating noises and lack of clearance may hinder the use of poppers.

Source: Bureau of Reclamation, 1981. *Groundwater Manual, Revised Edition, U.S. Department of the Interior.* Washington, D.C.: U.S. Government Printing Office.

Testing of Observation Wells

To determine the response to changing water stages, each observation well or piezometer should be tested as follows:

1) Inject a known volume of water into each well and measure subsequent decline of water level. The initial rise of water should be dissipated within a few minutes (to within about 0.01 of the initial rise) if the observation well is to reflect changes of head in the aquifer during the test.

2) Total depth, diameter, and screened interval should be known for each observation well and recorded in the field log book.

3) Radial distances from the control well to each observation well shall be measured.

Source: Bureau of Reclamation, 1981. *Groundwater Manual, Revised Edition,* U.S. Department of the Interior. Washington, D.C.: U.S. Government Printing Office.

Stallman, R.W., 1971. *Aquifer Test Design, Observation, and Data Analysis, Technicians of Water Resources Investigations of the U.S. Geological Survey,* Book 3, Chapter B1.

Measurement of Discharge - Orifice Meter

When used in conjunction with a pipeline, the orifice may be placed at the end of the pipeline, or it may discharge into a tank or reservoir which feeds the pipeline. The pipe and orifice shall be sized based on the attached table. To assure accurate measurements, the pipe orifice assemblies shall be installed as follows:

1) Position the manometer tube tap at least three pipe diameters from the orifice plate and accurately located on the horizontal diameter of the pipe.

2) Place the manometer tube tap at least 10 pipe diameters ahead of an elbow, valve, reducer, or similar fitting.

3) The manometer tap fitting should have an ID of 1/8 to 1/4 inch and must be smooth and flush with the inside surface of the pipe.

4) The pipe should be placed truly horizontal by measuring with a carpenters level.

5) The pipe shall be full of water at all times and the water must fall freely from the orifice into the air without any obstructions.

6) Before each measurement, the bottom of the pipe immediately behind the orifice plate shall be cleaned of sand or other debris.

7) The interior of the pipe shall be clean, smooth, and free of grease.

8) The manometer hose and gauge should be free of air bubbles whenever a reading is being made.

9) Manometer readings shall not register less than 1 inch greater than the inside radius of the pipe nor greater than 60 inches. If readings are more or less than these values, the orifice size should be changed.

10) There shall be no leaks between the pump head and the orifice plate.

11) Lower the hose and tube below the manometer tap and allow water to flow through it for a short time to clear all air bubbles and sand from the system prior to making a reading.

Surging commonly associated with many pumps shall be dampened to permit easier, more accurate readings to be made. If regular surging is evident in the tube, the range of such surging shall be noted and the mean taken of the readings.

When very large discharges are to be measured, or the range of discharges to be measured exceeds that of a single orifice, an arrangement using two pipe orifices is suggested.

Source: Bureau of Reclamation, 1981. *Groundwater Manual, Revised Edition,* U.S. Department of the Interior. Washington, D.C.: U.S. Government Printing Office.

Groundwater Sampling

The primary technical consideration in groundwater sampling is to obtain a representative sample of the groundwater body at the well location. The following minimum guidelines and techniques are required during sample withdrawal.

1) Set up sampling equipment to avoid interference with sampling activities.

2) Place plastic sheeting on ground, if necessary, to prevent spillage of water and to avoid contamination of equipment by contact with ground or other uncontrolled surface.

3) Avoid effects of the following conditions to ensure representative samples of groundwater.
   (1) Sample temperature may change rapidly after it is brought to the surface.
   (2) The pH may change from loss of carbon dioxide through degassing or adsorption, which could affect alkalinity and oxidation of certain compounds.
   (3) Dissolved gases may be lost as a result of a pressure change.
   (4) Organic samples may be affected by volatilization, adsorption, photodegradation, or contamination from sampling materials or airborne gases.

4) Complete a groundwater sample collection form for each sample with information specified in FEMP draft QAPP, Appendix K, Subsection K.9 plus the following data.
   (1) Description of water level measuring point
   (2) Depth to water
   (3) Depth of well from well construction diagram
   (4) Well casing diameter and borehole diameter from well construction diagram
   (5) Monitored interval and screen length

5) Purge water caught between sample port and flow line.

6) Obtain samples from sample port in accordance with the stability and volatility of parameters to be tested in the following order.
   (1) Field Measurements (temperature, pH, specific conductance, and dissolved oxygen)
   (2) Volatile organic compounds
   (3) Total organic halogens
   (4) Total organic carbon
   (5) Extractable organic compounds
   (6) Total Metals
   (7) Dissolved metals
   (8) Phenols
   (9) Cyanide

(10) Sulfate and chloride

(11) Turbidity

(12) Nitrate and ammonia

(13) Radionuclides

7) Collect excess water generated during sampling in appropriate containers.

8) Dispose of water that is believed (based on past sampling data) not to contain constituents classified as hazardous waste under the Resource Conservation and Recovery Act (RCRA).

9) Store water that has unknown constituents and is potentially hazardous waste in a designated area until classification is determined (based on analysis of the water for Toxicity Characteristic Leaching Procedure parameters) and a disposal method chosen. Observe ~~Resource Conservation and Recovery Act~~ RCRA requirements for duration of storage.

10) Decontaminate sampling equipment between wells.

11) Take field measurements at well site on unpreserved samples as described in the FEMP QAPP (draft), Appendix K Subsection K.4.1. Keep samples collected for field measurements separate from samples preserved for shipment to laboratory.

12) Number and label samples as specified in the FEMP QAPP, Section 7.

13) Store and preserve samples as specified in the FEMP QAPP, Appendix A, Table 6-1.

14) Complete Sitewide Analysis Request Custody Record ~~(SAR/CR)~~ (Form 7-1, Appendix B) as Specified in the FEMP QAPP, Section 7.

Source: WEMCO/FEMP ~~QAPjP~~ SCQ, 1992

South Plume Groundwater Recovery System Pump Test
Water Level Measurement Form

4307

Elevation (MSL): _____ top of casing

Observation well/piezometer no.: _____

Pumped well no.: _____

Pump test performed by(Name): _____

Company: _____

Reference point measurements by: _____

Method of measurement: _____

Depth Correction: _____

b = _____

Average Q at end of test _____ gpm r = ____ ft.

r^2 = _____

Date	Hour:Min	t (min)	t′ (min)	t/t′	s (ft.)	s′ (ft.)	(s_p - s′)	Meter Reading (gals.)	Ave. Q	Remarks

b = aquifer thickness (ft)
r = distance from pumped well to observation well or piezometer (ft.)
Q = flow rate (gpm)

s = measured drawdown (ft.)
s′ = residual drawdown (ft.) at t′
s_p = drawdown at end of pumping period (final s)
t = elapsed time since pumping began (min)
t′ = elapsed time since pumping stopped (min)

Reference: Bureau of Reclamation (1981) and Stallman (1971)