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GROUNDWATER QUALITY ASSESSMENT PROGRAM OUTLINE

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FEED MATERIALS PRODUCTION CENTER

GROUNDWATER QUALITY ASSESSMENT PROGRAM OUTLINE

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GROUNDWATER QUALITY ASSESSMENT PROGRAM OUTLINE

1.0 INTRODUCTION

Waste Pit #4 at the Feed Materials Production Center in Fernald, Ohio is subject to regulations of the Resource Conservation and Recovery Act (RCRA). Interim status regulations (as described in Task A7 of the Federal Facilities Compliance Agreement (FFCA) are addressed by this Response which presents a Groundwater Quality Assessment Program Outline (GQAPO) prepared in conformance with 40CFR 265.93 (a). The intent of this Outline is to present a groundwater monitoring program which is capable of identifying:

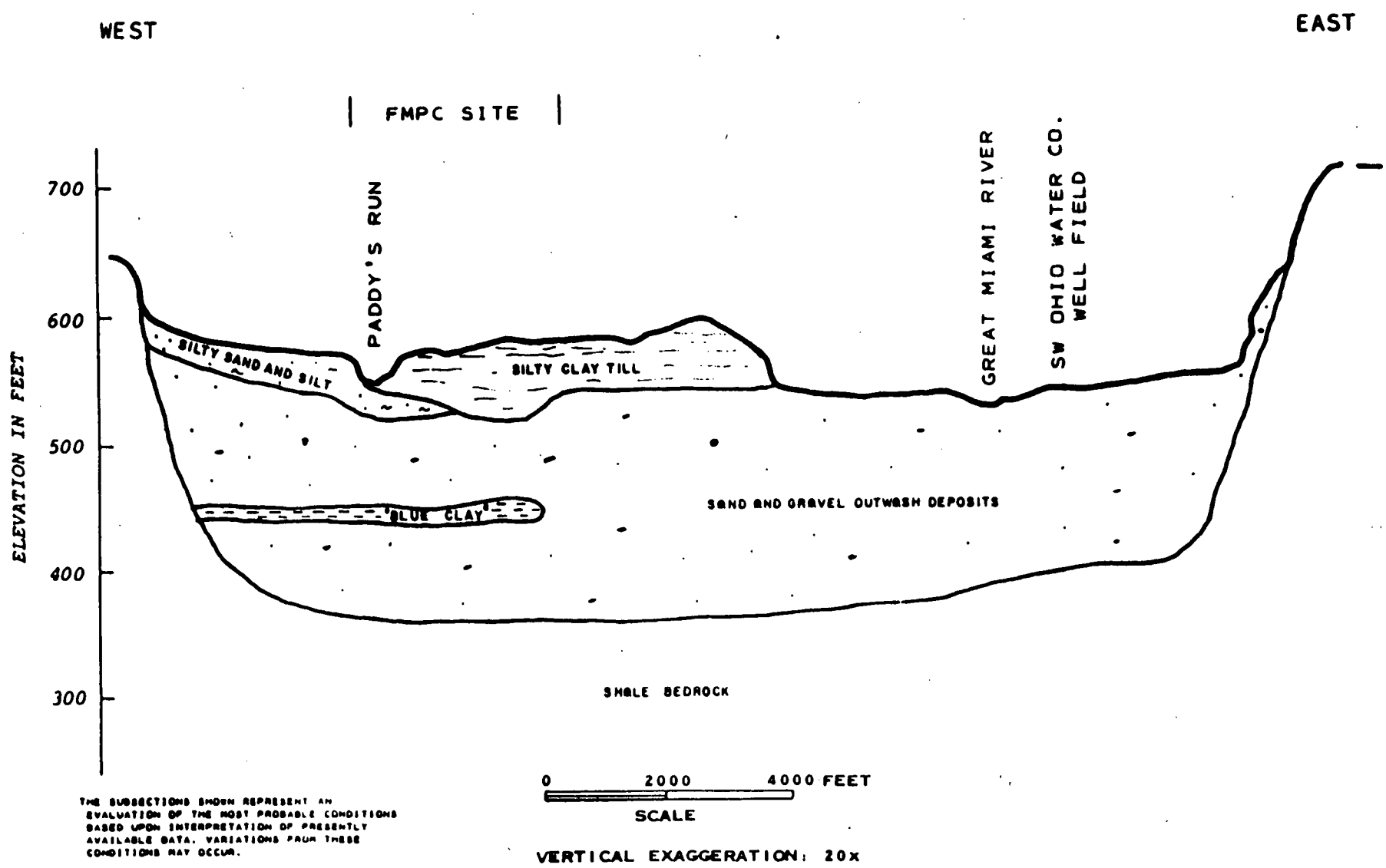
- Whether hazardous waste or hazardous waste constituents have entered the groundwater.
- The rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater.
- The concentration of hazardous waste or hazardous waste constituents in the groundwater.

In the event that implementation of the GQAPO becomes necessary, a more detailed Work Plan will be developed for review and approval by the appropriate regulatory agencies prior to GQAPO initiation. This Groundwater Quality Assessment Program Outline will be modified as necessary to address groundwater quality in each of the groundwater bearing regiemes which underly Pit 4.

2.0 FMPC GEOLOGY AND HYDROLOGY

The FMPC is located in a two-mile wide valley filled with glacial deposits. This valley parallels the Great Miami River between the towns of Ross and Hooven, Ohio. A generalized geologic cross-section for the FMPC site area is presented in Figure 1.

- In Late Ordovician time (approximately 450 million years ago) sediments which would become a predominantly flat-lying shale with thin interbedded limestone were deposited in a shallow sea. This shale (a part of the Cincinnatian Series) is the relatively impermeable bedrock which now underlies the FMPC site area.
- Sometime prior to, or perhaps contemporaneous with, Pleistocene glaciation, a large watercourse (larger than the present-day Great Miami River) cut its



THE SUBSECTIONS SHOWN REPRESENT AN EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPRETATION OF PRESENTLY AVAILABLE DATA. VARIATIONS FROM THESE CONDITIONS MAY OCCUR.

GENERALIZED GEOLOGIC CROSS SECTION OF NEW HAVEN TROUGH

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FIGURE 1

channel into this shale bedrock to a level of more than 200 feet below that of the present-day Great Miami River. This approximately two-mile wide channel (informally called the New Haven Trough) maybe an abandoned course of the ancestral Ohio River.

- During subsequent Pleistocene glacial advances and retreats across the site area (Illinoisan-approximately 300,000 years to 400,000 years ago and Wisconsinan-approximately 100,000 years ago) the New Haven Trough was filled with about 200 feet of glacial sediments. These sediments were deposited by water running from the margins of the glaciers and consisted mainly of well sorted sand and gravel. Deposited on top of these sediments was a blanket of clay-rich, relatively impermeable glacial till from a more recent event.

- Erosion by the Great Miami River and its tributaries then removed significant portions of the glacial till and left terrace remnants which stand topographically higher than surrounding bottom lands. The FMPC site lies on top of one of these terrace remnants.

2.1 SAND AND GRAVEL AQUIFER

Unconformably overlying the shale bedrock is a sequence of highly permeable sand and gravel glacial outwash deposits laid down by the meltwaters of receding continental ice sheets. These outwash deposits generally consist of an unconsolidated medium to coarse grained, olive brown 200 foot thick layer of sand and gravel. The sand and gravel layer is arranged in irregularly alternating layers of silty sand, medium to coarse sand, and medium to coarse gravel.

In the vicinity of the Waste Pit Storage Area, this layer is separated into two units by a 10 to 20 foot thick layer of greenish-black silty clay. The FMPC production wells are completed below this "blue clay" layer. This blue clay layer underlies about 360 acres of the site and apparently occurs only in the vicinity of the Waste Pit Storage Area and the production wells. It was probably deposited in an ice marginal lake or as a backwater deposit of a glacial stream. The top of this "blue clay" layer lies about 125 feet below the land surface.

Hydrologically, the sand and gravel above and below the "blue clay" layer acts as a single unit. The "blue clay" layer is not sufficiently extensive to act as an aquitard and no significant head differences exist between wells completed above and below this layer.

Transmissivities and hydraulic conductivities for the sand and gravel are reported to range from 35,000 gpd/ft to 300,000 gpd/ft and 270 ft/day to 370 ft/day respectively. Total porosities have been estimated at 25%. Average hydraulic gradients for the area measured by the USGS from water level measurements made in August, 1982 are low and were calculated to range from 0.001 ft/ft to 0.005 ft/ft. Using this data, the rate of groundwater movement (horizontal groundwater velocity) is calculated to range between 1.1 ft/day and 9.3 ft/day.

Figure 2 is a Dames & Moore water level contour map for the sand and gravel aquifer. This map shows that groundwater movement is generally to the south and east in the area around Pit 4. The upper 20 to 30 feet of the sand and gravel deposits are not saturated and water in this aquifer occurs approximately 60 to 90 feet below land surface depending upon surface elevation and thickness of till.

2.2 GLACIAL TILL

At the surface of the site and overlying the sand and gravel outwash deposits is a 20 to 50 foot thick layer of glacial till composed of a dense, olive-gray silty clay. The till varies in texture and composition both laterally and vertically and contains lenses of poorly sorted fine to medium grained sand and gravel. The base of the till occurs at about elevation of 540 ft MSL and overlies the sand and gravel outwash deposits.

To the west and south of the site, the silty clay till laterally grades into a sequence of silty sand and silt with some layers of silty clay. The silty clay till continuous to the north and east of the site and directly overlies the bedrock in these areas. In the lower reaches of Paddy's Run and the storm Sewer Outfall Ditch, the silty clay till has been eroded away and the underlying sand and gravel are exposed.

A saturated zone occurs within the silty clay till approximately 4 to 9 feet below land surface in some areas of the FMPC site. This saturated zone was encountered in three shallow wells around Pit 4 (MW-19TP, MW-21TP and MW-22TP) and is probably recharged by precipitation. It was not detected in test pits near well clusters to the east and south of the Waste Pit Storage Area. This saturated zone may be present because of vertical variations of composition and texture of the till, or near-surface weathering or desiccation induced fracturing of the till.

Aquifer testing of this saturated zone has measured hydraulic conductivities of 0.2 ft/day to 2.5 ft/day with associated transmissivities of 3.5 gpd/ft to 150 gpd/ft.

3.0 IDENTIFICATION OF WHETHER HAZARDOUS WASTE OR HAZARDOUS WASTE CONSTITUENTS HAVE ENTERED THE GROUNDWATER

This section of the Pit 4 Groundwater Quality Assessment Program Outline describes the four techniques which are used to identify whether hazardous waste or hazardous waste contituents have entered the groundwater. These techniques include: statistical re-evaluation, well re-sampling or sampling of additional wells, review of operational procedures and additional well installation.

3.1 STATISTICAL RE-EVALUATION

The use of the student's t-test is required for groundwater monitoring data under 40 CFR 265 Subpart F. However, this test, which assumes the data sets are random samples from normally distributed populations, often gives "false positives" for indicator parameters.

In the event that initial students t-test analyses of data obtained from quarterly RCRA sampling events indicate significant concentrations of hazardous waste or hazardous waste constituents, further statistical evaluation will be conducted. The Wilcoxon Two-Sample Rank Sum Test will be used as a secondary check to evaluate the significance of statistical increase.

The Wilcoxon Two-Sample Rank Sum Test can be used to identify if there is statistical difference betwen upgradient and downgradient wells. This test does not assume that the data are from normal populations. The test does assume that the data consists of two independent randon samples, sample 1 from popu- lation 1 and sample 2 from population 1 and u2 denotes the mean of population. The null hypothesis asserts that the two populations equivalent, and thus under this hypothesis ul=u2. This test is relatively insensitive to outliers (a value which is serveral orders of magnitude lower or higher than the majority of values in a set).

A kurtosis test also can be used to test the number and location of wells that could be sampled if a set of data is a random sample from a normally distributed population. The kurtosis of a distribution describes its degree of peakedness or, more exactly, its peakedness relative to the length and size of its tails. A distribution that is relatively flat and has short tails is of low kurtosis and is said to be platykurtic. A distribution with a sharp peak and long tapering tails is of high kurtosis and is termed leptokurtic. The normal distribution is considered to be of intermediate kurtosis, and is said to be mesokurtic.

A series of kurtosis tests, the Geary test, can be used for identifying if the sets of data for the downgradient wells are random samples from normally distributed populations.

The ultimate goal of the above test is to verify mathematically that hazardous waste or hazardous waste constituents have entered the groundwater. Actual implementation of the (GQAPO) as described in this document is contingent on the identification of hazardous waste or hazardous waste constituents have entered the groundwater.

3.2 WELL RE-SAMPLING OR SAMPLING OF ADDITIONAL EXISTING WELLS

Additional analytical data beyond that obtained from quarterly sampling at the facility may be necessary to confirm the presence of hazardous waste or hazardous waste constituents materials in the groundwater. Wells will be resampled in order to confirm data accuracy and repeatability if warranted.

Extensive groundwater monitoring programs are underway at the Feed Materials Production Center. Associated with these programs is the drilling and installation of numerous specifically to monitor Pit 4, a number of them could be sampled for this purpose.

The number and location of wells that could be sampled to provide supplementary groundwater quality data related to Pit 4 cannot be specified at this time. However, wells currently are available both upgradient and downgradient of Pit 4 in predominant groundwater flow directions. Groundwater sampling will be conducted with strict adherence to EPA approved procedures (Ref. 1 and 2).

3.3 REVIEW OF OPERATIONAL PROCEDURES

In the event of a statistically significant increase in water quality indicator criteria, a review of recent Pit 4 operational/disposal procedures will be conducted. This review will help assess if a change in operational or disposal practices at the Pit or the site may have effected local groundwater quality. The review will include correlation of recently disposed waste with affected water quality indicators, examination of inspection reports and manifest or log sheets for unusual occurrences, and an assessment of the physical integrity of the wells reporting the statistically significant increase. Recent weather conditions also will be evaluated as well as non-FMPC activities in the site area.

3.4 ADDITIONAL WELL INSTALLATION

Wells may be installed on-site and off-site as part of the Groundwater Quality Assessment Program if they are needed to identify whether or not hazardous waste or hazardous waste constituents have entered the groundwater. These wells would be placed so as to assist in the characterization of the source or sources of groundwater pollution. A variety of well drilling techniques are suitable to subsurface conditions. Two of the appropriate methods used successfully at the site are rotary wash or hollow stem augers (Ref. 2).

A typical well schematic is presented in Figure 2. Well pipe and screen material will be stainless steel with PVC in the unsaturated portion of the aquifer. Well screen slot size will be selected on-site according to the sediment encountered. A seal with a minimum thickness of 2 feet will be installed immediately above the sand pack which surrounds the screen. A sand/bentonite mixture will be used as backfill. To prevent the inflow of surface water along the riser pipe, a secondary seal of grout will be placed at the ground surface. Protective casings with vented locking caps also will be installed for each monitoring well.

4.0 INDENTIFICATION OF RATE AND EXTENT OF MITIGRATION OF HAZARDOUS WASTE OR HAZARDOUS WASTE CONSTITUENTS IN THE GROUNDWATER

This section of the Groundwater Quality Assessment Program Outline introduces the 5 techniques which are used to delineate the rate and extent of migration of hazardous wastes or hazardous waste constituents in the groundwater. The techniques that will be discussed are: sampling or resampling of wells, installation of additional monitoring wells, hydrologic testing of aquifer properties, computer modeling of contaminant transport and the use of geophysical surveys.

4.1 SAMPLING OR RE-SAMPLING OF WELLS

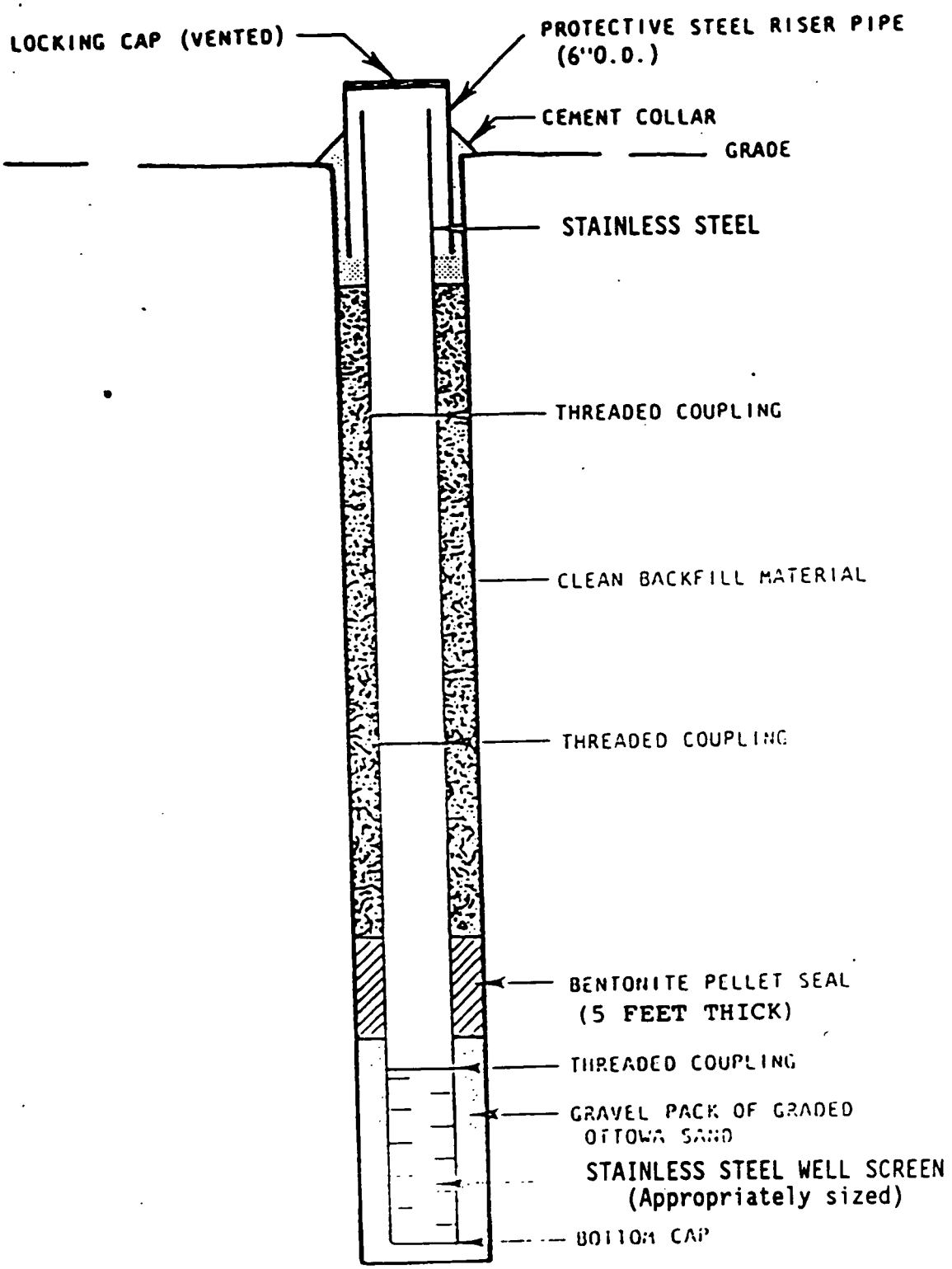
Sampling conducted during the first part of the Groundwater Quality Assessment Program (as outlined in Section 3.0) was focused in an area close to the predicted point of contaminant entry to groundwater. In order to define the extent of migration of hazardous substances once they have been identified, additional samplng is required. A number of wells are cur- rently in place across the facility and surrounding area. Selected wells may be chosen for sampling in a attempt to delineate the dispersive boundaries of the hazardous substances.

4.2 INSTALLATION OF ADDITIONAL MONITORING WELLS

Many existing wells at the FMPC were placed for reasons other than to specifically monitor Pit #4. Therefore, the installation of additional wells may be required. These wells would be placed at greater distances from the point of contaminant introduction to the groundwater system in order to delineate plume boundaries. Monitoring well drilling and installation procedures which were outlined in Section 3.4 will be followed.

4.3 HYDROLOGIC TESTING OF AQUIFER PROPERTIES

In order to estimate the rate of migration of hazardous substances, aquifer properties need to be evaluated. Sieve analyses of selected aquifer sediments collected during well installation yield a plot of grain size distribution. A



TYPICAL MONITOR WELL SCHEMATIC

DAMES & MOORE

FIGURE 2

characterization of the water bearing capacity of these sediments then is possible.

In situ hydraulic conductivity will be measured through the use of slug tests. During these tests, water level recovery is recorded in response to an instantaneous change in the volume of water in the well. In-situ measurements of aquifer properties averaged over a large aquifer volume are provided by pump tests. During this field test, water is pumped at a known rate from a well and drawdown is measure in one or more observation wells. Analyses of pump test data yields estimates of aquifer transmissivity and storativity. Other tests of aquifer properties may be conducted as needed (Ref. 3 & 4).

4.4 COMPUTER MODELING OF CONTAMINANT TRANSPORT

A groundwater species transport model will be used in conjunction with quantitiative contaminant concentrations at selected well locations to aid in the prediction of the extent of hazardous wastes or hazardous waste constituents in the groundwater. The model also will be used to aid in the prediction of the rate and future extent of contamination. The hydraulic aquifer properties discussed in Section 4.3 would be used as necessary in order to calibrate the model to actual site conditions.

The aquifer model will yield a continuous estimate of the plume boundaries and will integrate the scattered contaminant concentration data points derived from the monitoring well sampling program. A two dimensional horizontal (plan view) effluent transport model has been used previously to successfully model the flow system at the site.

4.5 GEOPHYSICAL SURVEY METHODS

Geophysical survey methods may be effective in tracing the location of hazardous wastes or hazardous waste constituents in the groundwater. The use of these methods is contingent on the properties of the detected hazardous substances in the groundwater. A particular method will be selected after the completion of initial stages at the Groundwater Quality Assessment Programs. For example, if barium chloride salts are found to be present in the groundwater, either alone or in conjunction with other hazardous constituents, electrical resistivity methods may effectively define the plume of contamination.

5.0 IDENTIFICATION OF THE CONCENTRATION OF HAZARDOUS WASTE OR HAZARDOUS WASTE CONSTITUENTS IN GROUNDWATER

Contaninant types and concentrations will be identified during part of the GQAPO described in Sections 3.0 and 4.0. Selected initial samples collected will be anlayzed for priority pollutants and those parameters listed in 40 CFR 261, Appendix VIII. Upon completion of these analyses, hazardous waste or

hazardous waste constituents which have reached groundwater will be identified. Samples collected in order to define the extent of contaminant migration will be tested for a series indicator paramenters. These paramenters will consist of those compounds which were found in detectable concentrations during initial sampling. All samples will be analyzed in accordance with EPA laboratory protocol (Ref. 5 and 6).

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ACRONYMS

CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
FFCA	Federal Facilities Compliance Agreement
FMPC	Feed Materials Production Center
GQAPO	Groundwater Quality Assessment Program Outline
MSL	Mean Sea Level
NPDES	National Pollutant Discharge Elimination System
RCRA	Resource Conservation and Recovery Act
TP	Test Pit
USGS	United States Geological Survey