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GROUNDWATER STUDY TASK B WORK PLAN
OCTOBER 1985

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DAMES & MOORE/NLO

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WORK PLAN

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Department of Energy G-000-0062
Feed Materials Production Center

GROUNDWATER STUDY
TASK B WORK PLAN

Prepared By:

Dames & Moore

Pearl River, New York

For:

NLO, Inc.

October 1985

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Dames & Moore
1 Blue Hill Plaza
Fifth Floor
Pearl River, New York 10965
(914) 735-1200

October 29, 1985

Mr. Robert Weidner
Director
Health, Safety and Environmental Division
NLO, Inc.
7400 Willey Road
Fernald, Ohio 45030

Re: NLO SUBCONTRACTOR S- 1094
Groundwater Study Task B Work Plan

Dear Mr. Weidner:

We are pleased to herewith transmit twenty (20) copies of the Task B Work Plan prepared under the referenced contract. This Work Plan incorporates revisions and comments provided to us in your letter of July 16, 1985.

As you know, the purpose of the Task B Work Plan was to describe the field program to investigate each of the potential sources identified under the Task A effort. This Work Plan was used to collect the data presented in our recently completed Task C report.

Sincerely yours,

DAMES & MOORE

Robert P. Blauvelt
Principal Investigator

RPB/dc

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1.0 INTRODUCTION

This plan has been prepared to describe the field activities associated with an ongoing groundwater study at the Department of Energy's Feed Material Production Center (FMPC) in Fernald, Ohio. This study was initiated to identify the source(s) of above background concentrations of uranium present in three offsite wells. This plan has been prepared by Dames & Moore under contract # S-1094.

Recent routine groundwater monitoring of both onsite and offsite wells by FMPC Health & Safety Division personnel has led to the detection of above background concentrations of uranium in the groundwater. These concentrations were, in all cases, lower than the maximum permissible concentration for uranium in water released to an uncontrolled area. A groundwater study was initiated in order to identify the potential source(s) of these above background uranium concentrations in the offsite wells and to recommend remedial actions (Reference 1).

1.1 Project Background

The first phase of this groundwater study was completed on June 15, 1984 by Dames & Moore with the submission of the draft Task A Report (Reference 2). The Task A report summarized and evaluated existing facility data and identified five potential sources for the above background concentrations of uranium in the offsite groundwater. They were (in order of importance):

- Sediments and waters contained in Paddy's Run and the Storm Sewer Outfall Ditch
- Covered and Active flyash pile
- Waste Pit Storage Area
- Plant Production Area
- Scrap Waste Pile

This plan will outline the data collection activities necessary to confirm/refute each of these areas as potential sources.

1.2 Compatibility With USEPA/OEPA Guidelines

This plan has been prepared to ensure its compatibility with similar types of studies conducted under United States Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency (OEPA) guidelines.

As a basis for its preparation, this plan has used the criteria listed in the Resource Conservation and Recovery Act (RCRA: 264.90-98) and Ohio EPA Hazardous Waste Rules (Chapter 3745-65). Briefly summarized, these criteria are:

- o Monitor for parameters which provide a reliable indication of the presence of hazardous constituents in the groundwater (i.e., uranium). (Section 3.0)
- o Establish background (upgradient) values for each monitored constituent. (Section 5.1)
- o Utilize consistent sampling and analysis procedures that are designed to provide a reliable indication of groundwater quality. (Section 3.0)
- o Certification by a qualified geologist or geotechnical engineer. (Section 2.2)
- o Construction of monitoring wells that maintain the integrity of the borehole and the collection of representative ground-water samples (Section 2.2)

- o Installation of a groundwater monitoring system capable of obtaining representative water quality from the uppermost aquifer passing the point of compliance (i.e., downgradient of the potential sources) (Section 2.1)

- o Statistical analysis to determine if a significant increase in the concentration of the indicator parameters has occurred. (Section 5.0)

Each of these criteria are incorporated into this work plan and are described in the section indicated in parenthesis.

2.0 MONITOR WELL INSTALLATION

Five monitor well clusters* will be installed at various locations around the FMPC. The locations of these well clusters are shown in Figure 2-1. The rationale for their location is presented in Table 2-1 and is based on the results of the Task A Study, and the recent USGS report (Reference 23).

2.1 Locations and Depths

Well locations were chosen to provide subsurface sediment and water quality information downgradient of the potential source areas for the above background concentration of uranium in the groundwater. Each well will monitor a specific source area and data gathered during installation and sampling will be used to quantify the percentage of uranium contribution originating from each source area (if any). These wells will also be used to eliminate potential source areas from further consideration if the data collected does not indicate the presence of above-ground concentrations of uranium.

Depths have been estimated utilizing existing geotechnical data available for other areas of the FMPC. The shallow well clusters will monitor the uppermost water bearing zone. This zone, as described in the Task A report, has been labelled the surficial till layer and it contains numerous perched and localized groundwater systems (References 3, 4).

No monitoring of this zone is currently being conducted at the FMPC. This layer will be the main focus of our investigation because:

- o It is the disposal unit. All waste pits and source areas occur within or on this unit.

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*A well cluster consists of two wells, one shallow, one deep, drilled within a few feet of each other.

- It is within this layer that leachate emanating from the source area will first migrate.

- Cross sections compiled from available boring logs (Reference 2) indicate that this layer may be hydrologically connected to the shallow sand and gravel aquifer. It is in this shallow sand and gravel aquifer that the above background uranium concentrations have been detected.

Wells installed in this layer will also fulfill USEPA/OEPA criteria to monitor the uppermost aquifer downgradient of the point of compliance (i.e., downgradient of the potential source area). The deep aquifer wells (#'s 16d-19d) will provide water quality information for the deeper sand and gravel layers, and will be used in later hydrogeologic testing to measure the degree of connection between the two water bearing zones. Wells will be drilled in such a manner so as to keep to a minimum cross contamination potential. The drilling rig, tools, mud trough, etc. will be throughly washed and scrubbed with a concentrated Isoclene solution and triple rinsed upon arrival at the FMPC, between each borehole, and before leaving the site. Well drilling will proceed from the potentially "cleanest" site area to the potentially "dirtiest" site area. All well construction materials (pipe, sand, etc.) will be new and fresh, non-uraniferous water from FMPC site supply wells will be utilized in washing procedures.

Vadose zone monitoring is not considered an appropriate part of the field program at this time. This is because of anticipated inclement weather which would not permit the successful operation of the needed instrumentation. It is expected that the field program will be implemented during the winter of 1984-85 and lysimeters and other types of vadose zone monitoring devices cannot operate at temperatures below freezing.

The need for vadose zone monitoring will be re-evaluated after analysis of data collected as part of this field program.

2.2 Specifications and Drawings

This section presents the list (Table 2-2) of construction specficiations for the wells installed at the FMPC. These specifications have been designed to insure bore hole integrity and to allow for the collection of representative groundwater samples. A typical well schematic illustrating these specifications is shown in Figure 2-2.

The Layne Ohio Company of Columbus, Ohio has been selected by Dames & Moore to perform this drilling. The Layne Ohio Company was founded in 1882. In the past 5 years the Layne Company has installed over 100 monitoring wells and are currently working at 4 hazardous waste sites for several industrial clients. They are members of the National Water Well Association and are licensed by the State of Ohio. Drilling operations for Layne will be directed by Mr. Robert Garrison a Certified Master Driller with over 5 years experience in the drilling and installation of these types of monitoring wells.

Mr. Robert Blauvelt, a Certified Professional Geologist, will technically supervise the placement, drilling, sampling and construction of all monitoring wells. Mr. Blauvelt holds a Masters Degree in geology and has over 7 years experience in groundwater investigations.

2.3 Sediment Logging, Sampling, and Analysis

During drilling, representative sediment samples will be collected and logged (described). This is done in order to classify the physical properties of the sediments and to assist in the preparation of detailed stratigraphic sections. Sediment logging will be done according to standard geotechnical practices with such sample characteristics as color, grain size, composition, etc. being noted. Dames & Moore logging forms (Figure 2-3) will be used to standardize these descriptions.

Sediment samples will be collected using standard split spoon sampling techniques. The number of hammer blows needed to advance the spoon every 6" will be recorded. The spoon will be rinsed in tap water after each sample is collected to remove residual sediments. Split spoon samples will be taken at 5 foot intervals during drilling, or more often, as directed by the field geologist or geotechnical engineer.

Data derived from subsurface sediment analysis will contribute to an understanding of aquifer composition, make-up and flow characteristics. These data will also be needed as inputs into the Groundwater Study Task C Computer Modelling efforts. A representative number of these sediment samples will be analyzed for the following:

- GRAIN SIZE - This provides a quantitative measurement of grain size distribution in a sediment sample. The sediment then can be specifically classified as a clay, silt, etc. under the Unified Soil Classification System. This data will be needed to make accurate stratigraphic correlations between borings. These tests will be performed by the Dames & Moore soils laboratory in Cincinnati.

- PERMEABILITY - This test will provide a measurement of the rate of water flow through a cross-sectional area of sediment under a given hydraulic gradient, according to ASTM Method # D-2434-68. This data will be used to predict flow velocities and groundwater yields for the various aquifers. It will also be performed by the Dames & Moore soils laboratory in Cincinnati.

- URANIUM - Selected sediment samples will be analyzed for their uranium content. This will assist in delineating the extent of the subsurface distribution of the uraniferous groundwaters as well as aid in focusing additional drilling efforts. Analyses will be performed by the NLO laboratory.

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2.4 Surveying

Upon completion of drilling activities, the locations and elevations of all monitoring wells will be surveyed using a licensed land surveyor. This survey will be used to establish plant elevations as starting datums and will spot check/amend elevations provided on the FMPC site topographic map of March, 1959 (Reference 5). Accurate elevation data are essential for the preparation of groundwater flow and other maps.

Dames & Moore has chosen the firm of Louis W. Graf and Associates of Cincinnati to perform this work. Mr. Louis Graf, licensed land surveyor will be directing the surveying of the wells and other critical site locations. In the event that Louis W. Graf and Associates were unable to perform this work, another qualified surveying firm would be utilized.

2.5 Well Development and Hydrogeologic Testing

Well development is designed to remove the fine sands and silt/clay material from the formation surrounding the well screen and allow formation waters to flow freely to the well (Reference 6). The fundamental process of development is to induce alternate reversals of flow through the screen openings that will rearrange the formation particles. This process (Reference 6):

- Corrects any damage to or clogging of the water bearing zone which might occur as a side effect to the drilling.
- Increases the porosity and permeability of the sand pack material in the vicinity of the well.
- Stabilizes the sand pack around a screened well so that the well will yield water free of sand.

All wells installed as part of this task will be properly developed using overpumping development techniques. Overpumping is pumping the well at a higher rate than the well will be pumped when it is put in service (i.e., sampled). This method has the advantage of being least disruptive to both the natural permeability of the formation and the enclosing sand pack. This method is typically used on small diameter wells and can be done by the driller using standard rig equipment. A minimum pumping time of 1-2 hours per well is anticipated and all wells will be developed until they yield clear (sand-free) water. Water derived from the development process will be discharged into nearby surface drainage channels. Disinfection or other chemical treatment of the wells will not be done.

Hydrogeologic testing of selected new and existing wells will be done to:

- Provide the data necessary to estimate in-situ aquifer characteristics such as transmissivity, specific yield, and hydraulic conductivity.
- Characterize the degree of hydrologic connection between the surficial till layer and the upper sand and gravel aquifer.
- Indicate the existence of any impervious boundaries which may limit the extent of the aquifer.
- Identify sources of recharge to the aquifer which may not be readily apparent.

Well clusters which have been selected for testing are shown in Table 2-3. Reasons for choosing these wells have also been indicated.

Testing will consist either of short term (5-8 hours) pumping tests or recovery tests. All necessary measurements during these tests will be made utilizing calibrated Dames & Moore water resources equipment. Water derived from the testing process will be discharged into nearby surface drainage channels beyond the estimated area of influence that will develop during the well testing.

Pumping Tests

A pumping test involves continuous removal of water at a given rate from a well and the subsequent observation of the reaction of the aquifer to this removal (Reference 7) both in the well being pumped and a nearby observation well. The change in water level (called drawdown) caused by continuous pumping results in the creation of a cone-like zone of depression surrounding the well. This cone is unique in shape and lateral extent and is dependent upon aquifer characteristics (Reference 7).

Wells will be pumped until three or more drawdown measurements fall on a straight line. This indicates that equilibrium conditions have been established and that the test can be stopped (Reference 7).

Recovery Tests

This test will be utilized in wells with yields too low to allow continuous pumping. It will also be used in wells for which there are no nearby observation wells. This test involves the removal of water from the well (by either pumping or rapid bailing) and the measurement of the rate at which the water returns to pre-pumping levels. Such tests provide an independent check of pumping test results (Reference 9). Measurement of recovery will be made until water levels return to 90% of their pre-withdrawal levels.

Two general types of analyses are available for determination of aquifer characteristics from pump test data (Reference 8):

- o Steady state or equilibrium methods which yield values of transmissivity and related permeability.
- o Transient or nonequilibrium methods which also yield storativity and boundary conditions.

Methods of data analysis recorded from the pumping tests on the FMPC wells cannot be specified at this time. The choice of analytical methods is dependent upon the features of the test including its duration, the number and location of observation wells and the volume or rate of water withdrawn.

All pumping test data analysis will follow procedures established by the U.S. Geological Survey as described in References 7 and 9.

2.6 Down Hole Well Logging

In June of 1984, 5 test wells were geophysically logged using a Mt. Sopris Model 1000-C portable borehole logger. Gamma-Ray logging is a borehole geophysical procedure based on measuring the natural radiation of gamma rays from certain radioactive elements (U, K, Th) that occur in varying amounts in the subsurface sediments (Reference 6). The log is a diagram showing the relative emission of gamma rays, measured in counts per second, plotted against depth below the surface.

Changes in radiation are commonly associated with differences making up successive strata. In most cases clay and shale contain more of these elements (U, K, Th) than do limestone, sandstone and sand. The log of unconsolidated formations indicate principally clay beds at those depths where the gamma-ray intensity is high, and indicates sand strata where the intensity is lower (Reference 6).

Selected test wells (NLO's # 1d, 8d, 9, 10, 11) were logged at the FMPC to:

- o attempt to identify potentially favorable zones for shallow groundwater movement,
- o detect anomalously high gamma-ray horizons in the subsurface which may be related to uranium migration,

- o determine if this methodology could be used to further refine non-detailed drilling logs.

Reproductions of the logs and an interpretation of the information provided by them is shown in Appendix 3.

Results of this well logging can be summarized as follows:

- o No anamously high zones of gamma ray activity were detected which were interpreted to be the result of uraniferous groundwaters.

- o Response spectra obtained by the logging equipment were too low to provide any additional detailed information on the subsurface sediments. This was due to the wide diameters of several of the wells, their steel casings, and the general nature of site sediments.

In general, this technique did not prove to be a useful method to allow for a more detailed description of the borehole or for correlations between widely spaced wells.

2.7 Health & Safety

In accordance with DOE Document No. PM-N-01, "Streamlining the Safety Documentation Process," dated October 9, 1979, a Safety Analysis Report is not required since the monitoring wells are considered a non-safety related exception (Reference 10).

However, as part of any field investigation involving potentially hazardous substances, Dames & Moore prepares a Health & Safety Plan for its employees and subcontractors. This plan evaluates the risks of the planned activity and assigns levels of protection based upon the anticipated degree of hazard. A copy of this plan has been included as Appendix 1.

This plan complies with DOE Order No. 5480-1A as well as specific NLO requirements. Because of the very low levels of uranium detected in the groundwaters, Dames & Moore has determined that Level D protection be required. Level D is the lowest level of personnel protection and calls for the use of gloves, hard hats, boots, etc. No special radiological protection is necessary. Respiratory protection will be limited to surgical mask type dust filters to be used only if dusty conditions are present.

If during the course of the field program, data are gathered which indicate a need for changing the assigned level of personnel protection, the plan would be modified as necessary.

Prior to drilling/sampling efforts, a Pre-Construction Activities Meeting will be held for Dames & Moore employees and subcontractors scheduled to work on the site. At this meeting related safety requirements will be discussed and finalized.

3.0 WATER SAMPLING PROCEDURES

Following the installation of well clusters, a set of groundwater samples will be taken from the new and existing onsite wells. Samples will be collected according to the methods outlined by the USEPA in References 11 and 12.

Sampling activities can be broken down into three separate steps: pre-sampling measurements, well evacuation, and sample acquisition. A discussion of laboratory methods to be used for sample analysis is provided in Section 4.1.

In order to minimize the possibility for cross contamination, groundwater samples will be collected beginning at the well least likely to contain above background concentrations of uranium (up-gradient well) and ending at the well most likely to contain the highest level of above background concentrations of uranium. Sampling order has been chosen based on the analytical results available from past samplings by NLO, the proximity of the cluster to the nearest suspected uranium source, and the geologic conditions present at the site. Table 3-1 describes the samples to be taken. Figure 2-1 shows the sampling points.

3.1 Pre-Sampling Measurements

Figure 3-1 is an example of the Dames & Moore Field Sampling Record to be used during the well sampling activities at the FMPC. This form is self-explanatory and will be completed for each well sampled.

3.2 Well Evacuation

In order to obtain a representative sample of the groundwater, the water within the well casing and in close proximity to the well screen must be removed (Reference 12). The recommended amount of water to be removed from the well is dependent upon many factors including well characteristics, types of sampling equipment, and the parameters being tested. It is anticipated that between 4 and 10 casing volumes of water will be removed prior to sampling the well. Well water will be evacuated either by purge pumping or bailing.

Pumping

The majority of wells currently in place at the FMPC, and most of those to be installed under this program have (or will have) dedicated 3.75" submersible pumps and discharge tubing installed in them. These pumps will be used to purge and sample the wells. Purge water withdrawn from the wells will be discharged to a nearby surface drainage channel. As each of these pumps are dedicated to a single well, no special cleaning of the pump or discharge tubing prior to or after sampling will be required.

Bailing

It is anticipated that several of the shallow wells in the surficial till layer will have recoveries too slow to allow for continuous pumping. In this case, wells will be bailed using a 2 foot long, 1.75" inch i.d. stainless steel bailer with a teflon check valve bottom. If the well is bailed dry prior to removing the required volumes it will be allowed to reach 80% of recovery and then immediately sampled.

New nylon weave rope will be used in the manipulation of the bailer and separate lengths will be dedicated to each well and disposed of after use.

A biodegradable, non-phosphate cleaning solution (e.g., ALCONOX) will be used to clean the bailer upon completion of well evacuation. The bailer will then be triple rinsed with distilled water prior to reuse. All bailed water, as well as the wash and rinse water, will be discharged to nearby surface drainage channels.

3.3 Sample Collection

After removal of the required volumes from the wells, field measurements of pH, conductivity, and temperature will be made by calibrated equipment. The sample bottle will then be clearly labelled in permanent ink. The pump discharge tubing will be placed near the bottom of the sample bottle and gradually withdrawn as the container fills. Water from the bailer will be minimally handled and transferred immediately to the sample bottle.

All sample bottles will be filled to the top without overflowing. Caps will be firmly hand tightened to prevent leakage. Because of the relatively low turbidity of the ground water at this location, no field filtering of samples will be required.

As each full set of samples is collected from each monitoring point, they will be stored in sampling kits comprised of an ice chest containing the coolants, and holding and shipping instructions. This sampling kit will be provided by the analytical laboratory (EAL) and will be shipped to the lab, via overnight carrier, along with the appropriate chain-of-custody documents upon completion of the sampling efforts.

As part of our ongoing QA program, field blanks consisting of distilled, deionized water will be collected between selected wells to assure the effectiveness of the cleaning and sample handling procedures. In addition to the field blanks, two types of trip blanks will be collected. These consist of sample bottles filled with deionized, distilled water and capped in the laboratory. One trip blank remains capped and accompanies the samples at all times until returning to the lab where it is opened and tested along with the other samples. The other trip blank is set aside during the sampling of the wells and left open to the atmosphere. The purpose of these trip blanks is to ensure that proper sample bottle preparation and handling techniques have been employed, and to evaluate the potential for atmospheric contamination of sampling equipment. At least one trip blank of each type will be collected each day of sampling.

3.4 Surface Water and Seep Sampling

To supplement water quality data collected from the monitoring well network, 3 seep samples downgradient and 1 seep sample upgradient of the FMPC will be taken. Figure 2-1 shows the approximate location of seep sampling points. Seep sampling methodology and analysis will be compatible with those techniques used in monitor well sampling. Seep samples will be used in subsequent data analysis to:

- o measure the rates and impacts of direct seepage discharge on the FMPC's surface drainages.
- o confirm/refute previously identified areas of the FMPC property as potential uranium sources.
- o when compared with well results, provide an indirect measure of site sediments attenuation capacity.
- o when measured over a period of time, provide surface water infiltration data.

Seep samples will be collected in the following manner:

- o a field reconnaissance will be made to identify likely seepage points adjacent to the Waste Pit Storage Area, Paddy's Run, and Storm Sewer Outfall Ditch.
- o a Seep Collection Pan (Figure 3-2) will be installed at the indicated locations.

- water from this pan will be collected using a peristaltic pump with dedicated teflon tubing. Samples will be handled similarly to those collected by the monitor wells with submersible pumps.

The FMPC surface waters are fed in part, by discharges of seepage and groundwaters. To aid in the prediction of ultimate impacts to downstream receptors of uraniferous waters, 7 surface water samples will be collected. The locations of these samples are shown in Figure 2-1. Surface water sampling has been a component of the FMPC's environmental monitoring program since plant operations were started in 1950's (Reference 13). Therefore, surface water samples collected as part of this study will use NLO established procedures and protocols.

4.0 LABORATORY ANALYTICAL METHODS

As each full set of sample bottles is collected from each monitoring point, they will be placed immediately into an insulated sampling kit. Temperatures of the samples will be maintained as close as possible to a maximum of 4 °C (39°F). Preservatives (1.5 ml conc. nitric acid per liter of sample) will have been added to sample bottles prior to delivery to the field by EAL laboratory personnel. A total of 31 groundwater, 3 seep, and 7 surface water samples will be analyzed for uranium.

4.1 Laboratory Analysis

The method of choice for accurate radiological determination of uranium is alpha spectrometry. The water sample is traced with ^{232}U and the ^{234}U, ^{235}U components are spectrometrically isolated and quantified after equilibration with the tracer and purification by classical chemical methods including precipitations, selective ion-exchange, adsorption-desorption, extractions, etc. The final purified uranium fraction is electrodeposited on a stainless steel disc for measurement on any of 32 installed alpha detectors coupled to an ND 6600 multi-channel pulse height analyzer system. The observed count rate of each isotope is converted to pCi/liter of sample using appropriate aliquot factors, counting efficiencies, yield correction factors, etc.

The isotopic results (in pCi/l) will be used to calculate total uranium on a weight basis. This is accomplished by calculating ug of each isotope from alpha spectrometric data (pCi/l) and then summing the ug of U-238, U-234, and U-235 per liter.

The minimum detection limit for any given isotope is 0.2 pCi per liter using a sample size of one-half liter. Each sample will be laboratory filtered (0.45 micron membrane) prior to analysis to separate filtrate from any suspended solids. If high uranium levels are found in a specific sample, the suspended solids would then be analyzed to enable determinations of partition coefficients as a function of ionic conditions, particle sizes, etc.

Dames & Moore has chosen EAL of Richmond, California as our subcontracted laboratory. EAL has been in business since 1970 and is widely recognized as one of the nation's leading environmental monitoring laboratories for radio-chemical analysis. EAL has worked directly for both the DOE and NRC and is currently performing required radio-chemical analysis for numerous low-level radioactive-waste burial sites.

4.2 Quality Assurance

EAL laboratory was audited by Dames & Moore QA in March 1982 with no adverse findings. However, EAL will be audited again by QA prior to their participation on this project to ensure their effectiveness of implementing QA on the analytical data. A chain-of-custody form will be implemented (Figure 4-1) and checked periodically by QA for completeness.

Internal QA procedures in use by EAL are provided for review in Appendix 2.

5.0 DATA EVALUATION PROCEDURES

Data evaluation procedures will consist of a statistical evaluation of past and recent ground and surface waste quality data, and a geologic evaluation of the information obtained from the boring and sediment sampling program. In addition, a computer modelling study will later be utilized to predict future water quality trends/distributions and to assist in conceptual remedial design alternatives, should they prove necessary. Modelling efforts are discussed in more detail in Reference 14.

5.1 Statistical Evaluation

Previously collected uranium water quality analytical data, along with data generated as a result of this study, will be compiled and statistically evaluated. This evaluation is necessary to:

- Establish accurate and verifiable background concentrations of uranium in the groundwater in this portion of southwestern Ohio. This is important because of the lack of a regulatory standard for this parameter, the use of other non-site specific, generic background values which may be higher or lower than those present in the Fernald area, and the need to develop a standard of comparison because of the often very low levels of "above background" concentrations reported at the site.

- Identify the monitoring points which are truly exceeding background levels (taking into account normal uranium concentrations). This is also needed to remain consistent with USEPA/OEPA guidelines.

- Determine the concentration and distribution of uranium in each of the FMPC's three hydrogeologic regimes.

- Extrapolate the contribution (load) each potential source area has input into the groundwater.

- Evaluate current FMPC sampling schedules and methodologies to see if they are consistent with groundwater flows and discharges.

Statistical evaluation will include application of the following tests to the uranium water quality data:

- Geometric averaging - Geometric averaging is equivalent to the arithmetic averaging of the logarithm of the data values. It is calculated as the (n)th root of the product of the (n) data values. The geometric average corresponds to the use of a log-normal distribution rather than a standard Gaussian distribution to represent the variation of the measured value data due to independent, uncontrollable parameters (e.g., seasonal changes) (Reference 17). Geometric averaging will be used to determine background uranium concentrations upgradient of the FMPC. Analytical data from selected off-site and onsite wells will be grouped and a geometric average determined. This average will become the standard to which other downgradient values are compared. This type of averaging has already been recognized by several investigators as being more suitable for certain types of environmental data (References 18, 19, 20).

- Student's t-test - Downgradient uranium values will be grouped by well and compared to the background value using the student's t-test (Reference 21). This test assumes a normal distribution of the data which may not be the case for these water quality values. However, it will be used in this study to remain consistent with USEPA/OEPA guidelines.

Prior to the use of the t-test, data will be tested for normality utilizing the following methods:

- o Special Purpose Test (Skewness and Kurtosis)
- o General Purpose (Goodness of Fit)

If data is found to be not normal, the Wilcoxon Test (a test which does not assume a normal distribution) will also be used to evaluate the data. Additional information on this test can be found in Reference 2.

5.2 Geological Evaluation

A geologic evaluation of the data collected during the boring, sediment sampling, and well testing process will be conducted. This evaluation will consist of the following:

- o Production and interpretation of numerous site cross sections and fence diagrams through key areas of the FMPC. As discussed in the Task A report (Reference 2), the subsurface geologic conditions at this facility are complex and directly control the movement of uraniferous groundwater, which may be migrating from the source areas. These cross sections and fence diagrams (prepared in accordance with procedures given in References 15 and 16) will provide an understanding of site geology, locate zones of likely leachate migration, and be used in the calibration of the computer model.

- o Analysis of sediment sampling and well testing data will be used to calculate aquifer properties which in turn, control the movement of uraniferous groundwaters. Hydraulic conductivity, transmissivity, and porosity will be calculated (using the techniques provided in References 7 and 9) for the various hydrologic regimes at the site. Travel times to surface water bodies and off-site receptors will also be calculated for leachate emanating from, and dissolved uranium in surface water infiltrating from the various sources.

6.0 COST ESTIMATE AND SCHEDULE

Field activities to be performed in this task can be broken down into three categories:

- o Well Drilling
- o Aquifer Testing
- o Sampling and Surveying

Table 6-1 provides a detailed breakdown of costs for each of these field activities. These costs (not including pump purchase and installation charges) are consistent with the Dames & Moore proposal of December 9, 1983. NLO will be kept advised on a daily basis as to the status and progress of our field program during the performance of the work. These estimates will not be exceeded without prior approval by NLO. Figure 6-1 illustrates the anticipated duration and completion of each activity in weeks after Work Plan approval.

6.1 Well Drilling

Well drilling will commence within 2 weeks of final approval of this plan by NLO/DOE. Costs have been based on an anticipated 1 person, 7 day effort (7 man-days) to install and develop all the monitoring wells, assuming good weather and no access/security restrictions beyond normal NLO escorting practices for uncleared personnel in production/waste management areas.

6.2 Aquifer Testing

Upon completion of drilling and well development activities, the aquifer testing program will commence. We estimate a 2 person, 5 day effort (10 man-days) to complete all pumping/recovery testing. This assumes no access/security restrictions, good weather, and no breakdown of the pumps currently installed in existing NLO monitoring wells. If Dames & Moore equipment fails (e.g., pumps, generator, etc.) NLO will not be charged for down time. In addition, field time may increase if extended pumping of wells is required to induce necessary aquifer equilibrium conditions.

6.3 Sampling and Surveying

Well sampling will begin immediately upon conclusion of the aquifer testing program. We estimate that all water samples can be collected within a 2 person, 4 day period (8 man-days) . This assumes good weather and no access/security restrictions. Thirty-one groundwater, 3 seep, and 7 surface water samples will be collected and analyzed for uranium from within the FMPC property. No offsite sampling is anticipated at this time.

It does need to be recognized that collection of some additional samples may be prudent in the event that variable field conditions are encountered. Also, revised sampling protocols may require collection of additional samples. If additional sampling is necessary, Dames & Moore will notify NLO and obtain their concurrence before initiating such activities.

Surveying of wells and other site areas will also take place during water sampling activities. We anticipate a 2 person 2 day effort (4 man-days) assuming good weather and no access/security restrictions beyond normal NLO escorting practices for uncleared personnel in production/waste management areas.

TABLES

TABLE 2-1

Monitor Well Locations and Rationale

NLO Well #	Location (Figure 2-1)	Estimated Depths (Ft)	Drilling Order	Rationale
16s 16d	Fly ash pile	15 40	4 3	Initial indications from sampling of wells 14s and 14d indicate that the flyash piles may be contributing to the elevated levels of uranium detected in the groundwater. Wells 14s and 14d are downgradient of the active flyash pile but are close to both Paddy's Run and Storm Sewer Outfall Ditch and water quality data from wells 14s and 14d may be influenced by these potential sources. The proposed well cluster (16s and 16d) is located as close as possible to the inactive flyash pile and will yield water quality results more representative of groundwaters emanating directly from the pile. In addition, this cluster will provide needed subsurface soil information in this area as well as water table elevation data critical to the definition of local groundwater movements.
17s 17d	Willey Road	40 90	2 1	This well cluster will be used to evaluate water quality downgradient of Paddy's Run. It will also provide needed subsurface sediment and water level elevations in the anamolous groundwater trough area identified by the USGS.

TABLE 2-1 (Continued)

Monitor Well Locations and Rationale

NLO Well #	Location (Figure 2-1)	Estimated Depths (Ft)	Drilling Order	Rationale
18s 18d	East of Paddy's Run	15 40	6 5	This well cluster will be used to evaluate water quality data downgradient of the waste pit storage area. It will also provide needed subsurface and water level information in this area of the site.
19s 19d	Waste pit storage area	15 40	10 9	Gather subsurface soil information and water quality data downgradient of waste pit storage area. These wells will be located in an area where above background levels have been detected in monitoring well number 10. These wells will monitor groundwater at shallower elevations than monitor well number 10 and will be used to identify preferential leachate pathways in the shallow subsurface sediments.
20s 20d	Southwest Production Area	15 40	8 7	This well cluster will be used to monitor water quality downgradient of the Plant Production Area (especially the Pilot Plant). It will also be used to provide needed subsurface sediment and water level information in this area of the site.

TABLE 2-2

Monitor Well Construction Specifications

(1) DRILLING - Drilling will be 8" open hole using standard mud rotary techniques.

(2) CASING - 4" Inside diameter schedule 40 PVC, Flush joint threaded and coupled, Teflon Tape between lengths, No glue.

(3) SCREEN - 4" Inside diameter, schedule 40 PVC, Slotted Screen, sized according to formation and gravel pack, 5 Foot Length for each well, bell end or similar bottom cap.

(4) PUMP - Each well to be equiped with a 15 gpm, one hp, submersible pump. Pumps to have a built in electrical breaker, and a plug-in terminal cord suitable for use with a generator. Pumps to be installed have been sized according to estimated well depth, purchase cost, and estimated yield of the aquifer.

(5) RISER - At ground level, a 6" inside diameter protective steel riser pipe with vented, locking cap to be installed at each well. Pipe will extend approximately 2 feet above grade.

(6) SURFACE SEAL - At ground level, a 2-foot square, 5-feet thick concrete pad to be constructed at each well. Pad to be graded to promote surface runoff away from well.

(7) GRAVEL PACK - Gravel pack to be installed the length of the well screen to one foot above top of well screen. Gravel pack to be graded Ottawa sand, sized appropriately for well screen.

(8) SUBSURFACE SEAL - A 3 foot thick bentonite pellet seal to be installed around annular space extending from top of gravel pack to depths deemed necessary by the geologist or geotechnical engineer. Above the seal, annular space to be backfilled with clean backfill materials to within 3 feet of surface.

(9) SEDIMENT SAMPLING - During drilling, split spoon or undisturbed sediment samples to be collected at every five foot interval or at the direction of the field geologist or geotechnical engineer. Appropriate sample containers to be provided by the driller.

(10) SUPERVISION - All drilling, construction, and sampling of monitoring wells to be directed by a qualified Dames & Moore geologist or geotechnical engineer.

TABLE 2-3

Well Cluster Testing Rationale

Well Clusters to be Tested	Type of Test	Rationale
16s, d	Pumping	Adjacent to Flyash Pile (one of the primary sources). Observe Possible Barrier/Recharge Effects by Paddy's Run.
18s, d	Pumping	Downgradient of Waste Pit Area (one of the primary sources). Numerous Observation Wells Nearby.
14s, d	Pumping	Between Two Sources (Paddy's Run, Storm Ditch). Use Clusters 15 and 20 for Observation Wells.
12s, d	Recovery	Upgradient, Need Data on Water Flows Into Site.
19s, d	Pumping	Will Pump Production Wells to see if they act as barrier.
13, 15s	Recovery	Obtain General Aquifer Information.

TABLE 3-1

FMPC Sampling Stations

Sampling Station	Type	Description	Analytical Parameters: Field pH	S.C.	Temp	DO	Lab Isotopic U	FE
P-1	W	Plant Production Well	X	X	X	X	X	X
P-2	W	Plant Production Well	X	X	X	X	X	X
P-3	W	Plant Production Well	X	X	X	X	X	X
T-1s	W	East of Waste Pit Area	X	X	X	X	X	X
T-1d	W	East of Waste Pit Area	X	X	X	X	X	X
T-3	W	West of Waste Pit Area	X	X	X	X	X	X
T-4	W	Southwest of Waste Pit Area	X	X	X	X	X	X
T-5	W	Southwest of Waste Pit Area	X	X	X	X	X	X
T-8s	W	Southeast of Waste Pit Area	X	X	X	X	X	X
T-8d	W	Southeast of Waste Pit Area	X	X	X	X	X	X
T-9	W	South of Waste Pit Area	X	X	X	X	X	X
T-10	W	East of Waste Pit Area	X	X	X	X	X	X
T-11	W	Northwest of Waste Pit Area	X	X	X	X	X	X
T-12	W	North Access Road	X	X	X	X	X	X
T-13s	W	East Production Area Fence	X	X	X	X	X	X
T-14s	W	Junction of Paddy's Run and Storm Sewer Ditch	X	X	X	X	X	X
T-14d	W	Junction of Paddy's Run and Storm Sewer Ditch	X	X	X	X	X	X
T-15s	W	Willey Road	X	X	X	X	X	X
T-15d	W	Willey Road	X	X	X	X	X	X
T-16s	W	South Inactive Flyash Pile	X	X	X	X	X	X
T-16d	W	South Inactive Flyash Pile	X	X	X	X	X	X
T-17s	W	Willey Road at Paddy's Run	X	X	X	X	X	X
T-17d	W	Willey Road at Paddy's Run	X	X	X	X	X	X
T-18s	W	East of Paddy's Run	X	X	X	X	X	X
T-18d	W	East of Paddy's Run	X	X	X	X	X	X
T-19s	W	East of Waste Protection Area	X	X	X	X	X	X
T-19d	W	East of Waste Protection Area	X	X	X	X	X	X
T-20s	W	Southwest Production Area	X	X	X	X	X	X
T-20d	W	Southwest Production Area	X	X	X	X	X	X

TABLE 3-1 (Continued)
FMPC Sampling Stations

Sampling Station	Type	Description	pH	S.C.	Temp	DO	U	FE
			Analytical Parameters: Field				Lab Isotopic	
S-1	SP	North of Inactive Flyash Pile	X	X			X	
S-2	SP	West of Waste Pit Area	X	X			X	
S-3	SP	North of Waste Pit Area	X	X			X	
SS-1	SW	North end of Storm Sewer Ditch	X	X	X	X	X	X
SS-2	SW	Midpoint of Storm Sewer Ditch	X	X	X	X	X	X
SS-3	SW	South of intersection of Paddy's Run Storm Sewer Ditch	X	X	X	X	X	X
PR-1	SW	At Paddy's Run Railroad Bridge	X	X	X	X	X	X
PR-2	SW	West of Waste Pit Storage Area	X	X	X	X	X	X
PR-3	SW	West of Inactive Flyash Pile	X	X	X	X	X	X
PR-4	SW	West of Test Well No. 9	X	X	X	X	X	X
OS-1	WO	Willey Road	X	X	X	X	X	X
OS-2	WO	Paddy's Run Road	X	X	X	X	X	X
OS-3	WO	Paddy's Run Road	X	X	X	X	X	X

Explanation:

W = Groundwater Sample From An Onsite Well
SP = Groundwater Sample From A Seep Station
WO = Groundwater Sample From An Offsite Well

Table 6-1
TASK B FIELD PROGRAM & COST ESTIMATE

6.1 Drilling of Well Clusters (NLO's # 16-20)

ITEM	COST	SOURCE
o Drilling Mobilization/Demobilization	$ 2,250.00	Layne Quote of 12/5/84
o 390 Feet of 8" mud Rotary, Open Hole Drilling with Split Spoon Sample at 5' Intervals ($26/Foot)	$10,140.00	Layne Quote of 12/5/84
o 4" PVC Materials with Silicia Sand Pack, Bentonite Seal, Steel Protector Pipe, and Cement Collar $750 per Well plus $4.50 per foot of drilling after the first 10' of drilling (10 Wells x 750' x 290 Feet)	$ 8,805.00	Layne Quote of 12/5/84
o Well Development: 1.5 hours Per Well x 10 Wells x $120/hour	$ 1,800.00	Layne Quote of 12/5/83
o 7 Pump Assemblies	$ 2,800.00	NLO Estimate of 8/18/83
o Steam Cleaning of Rig and Tools Between Wells (10 hours at $95/hour)	$ 950.00	Layne Quote of 12/5/84
o Dames & Moore Engineering labor and Expenses (7 Man Days in Field at $650/day)	$ 4,550.00	
o Sample Analysis (30 Samples) at $100/sample.	3,000.00	Dames & Moore Lab. Cincinnati, Ohio
Subtotal	$34,295.00	

Other Conditions

- o NLO To Provide All Necessary Water
- o All Well Sites To Be Easily Accessible
- o Steam Cleaning Equipment To Be Provided By NLO
- o No special precautions needed in area of personal safety. Standard Safety equipment and practices apply.
- o NLO to provide Uranium analysis of designated sediment samples.
- o No special security clearances needed.

TABLE 6-1 (CONT'D)
TASK B FIELD PROGRAM & COST ESTIMATE

6.2 Aquifer Testing

Item	Cost	Source	Other Conditions
o Dames & Moore Engineering Labor and Expenses - 10 man days at $650/day	$6,500.00	Task B Report Section 6.2	o No Special Security Clearance needed.
o Dames & Moore Water Resources Equipment (Pumps, Flow Meter, Generator, Etc.) - 5 days at $200/day)	$1,000.00	Task B Report Section 6.2	o Water disharged directly to ground
			o No Failure of NLO Pumps
Subtotal	$7,500.00		

6.3 Sampling

Item	Cost	Source	Other Conditions
o EAL Laboratory Costs for 41 Water Samples, Filtered and Analyzed for Uranium 5 lots (8 at $84/lot + 11 Kits at $40/Kit)	$1,455.00	EAL Quote of 12/1/83	o No Special Security Clearances Needed
			o Temporary Storage Space in NLO Wharehouse
o Shipping of Sample Kits via overnight express (11 Shipments at $50/Shipment)	$ 550.00	Federal Express Quote	o Sample Pick-up at NLO
o Dames & Moore Engineering Labor and Expenses ($650/day at 8 man days)	$5,200.00	Task B Report Section 6.3.	
o Surveying (2 Days at $1,000/Day)	$2,000.00	Graf Associates Quote of 12/1/83	
Subtotal	$ 9,205.00		
Total Task B Implementation Cost =	$51,000.00		

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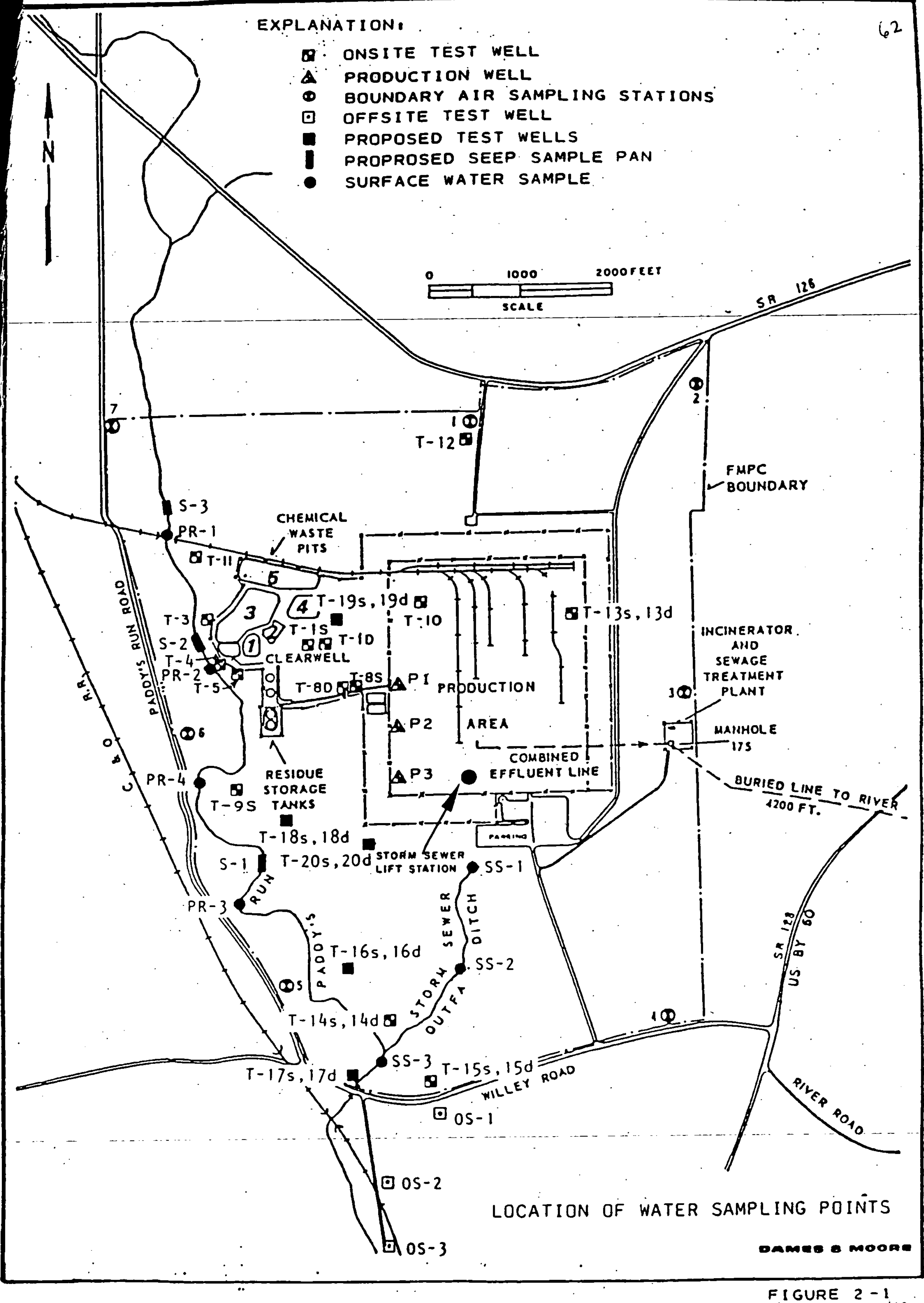
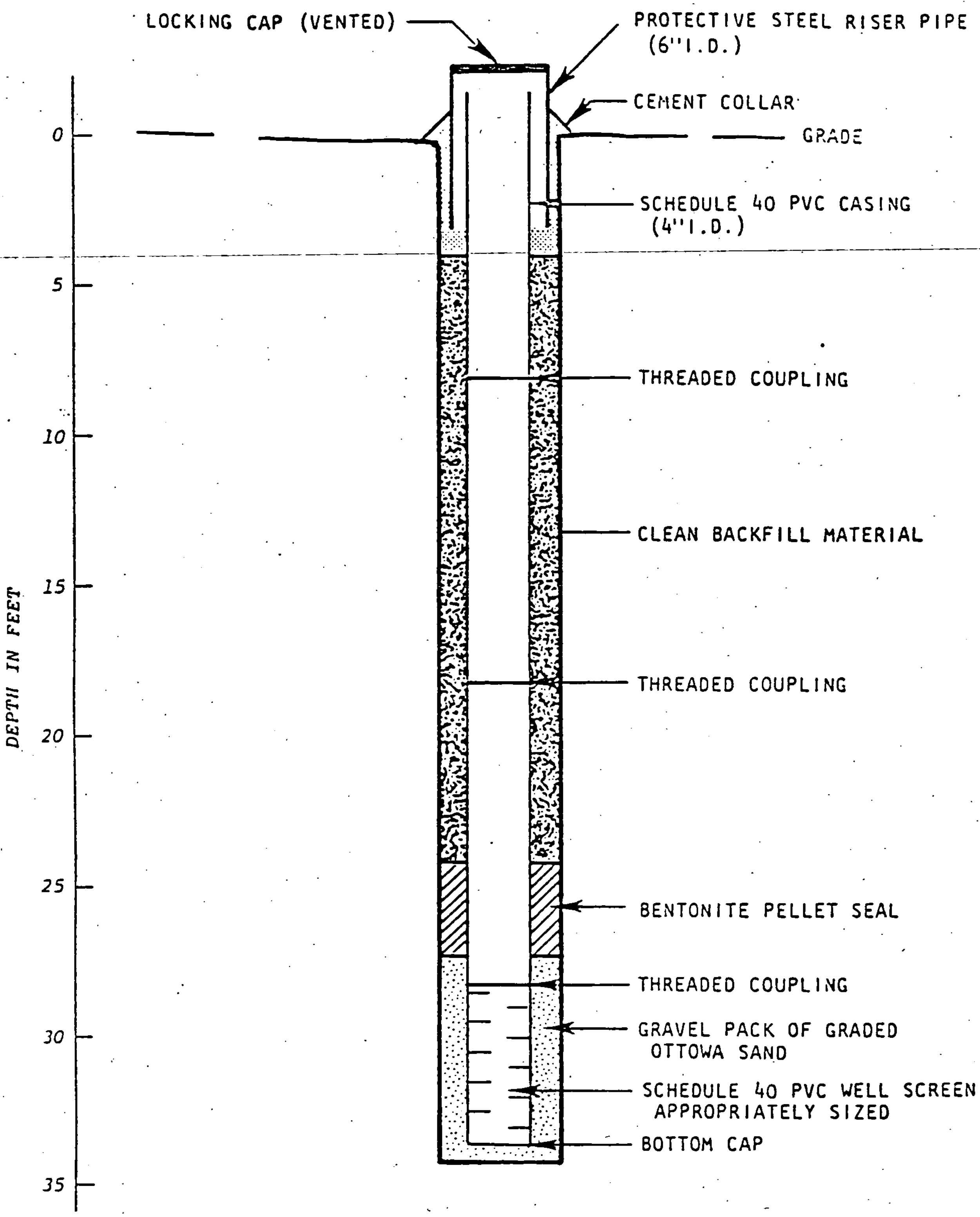
FIGURES

Dames & Moore



LOCATION OF WATER SAMPLING POINTS

FIGURE 2-1



TYPICAL MONITOR WELL SCHEMATIC

DAMES & MOORE

Figure 2-2

Dames & Moore

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION

DRILLING METHOD:	BORING NO.
	SHEET OF
SAMPLING METHOD:	DRILLING
	START / FINISH

WATER LEVEL					START TIME	FINISH TIME
TIME						
DATE					DATE	DATE
CASING DEPTH						

DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

Figure 2-3

CHK'D BY ____ DATE ____

628 1 (3) (REV 11-80)

FIGURE 3-1
DAMES & MOORE
FIELD SAMPLING RECORD

Job ____________________ Date __________
Job # ____________________

Well # __________ Well Diameter __________
Location ____________________

I Water Level Measurements (From Top of Casing) in Feet.
Total Well Depth:
Depth to Water:
Height of Water Column:
Volume Conversion Factor:
Gallons in Well:

Conversion Factor
0.16 = 2" ID
0.65 = 4" ID
1.47 = 6" ID

II Well Evacuation
Pumping: Submersible
Nitrogen
Centrifugal

Bailing: Kemmerer
Bucket Bailer
Other (Describe)

Pump On:
Pump Off:
Pumping Time:
Pumping Rate:
Gallons Removed:

Bailing Started:
Bailing Stopped:
Gallons Removed:

III Sampling
Withdrawal: Pumped (describe)
Bailed (describe)

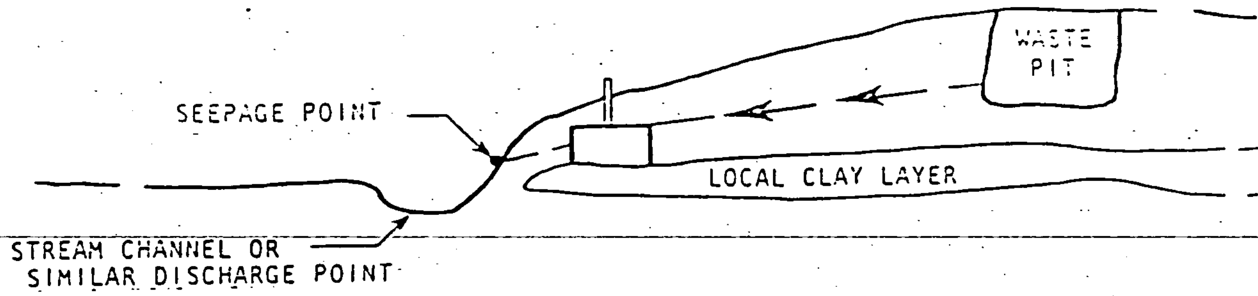
Time: Date:
Sample I.D. #:
Trip Blank #:
No. of containers filled (primary lab):
No. of containers filled (replicate samples):
Physical appearance and odor:

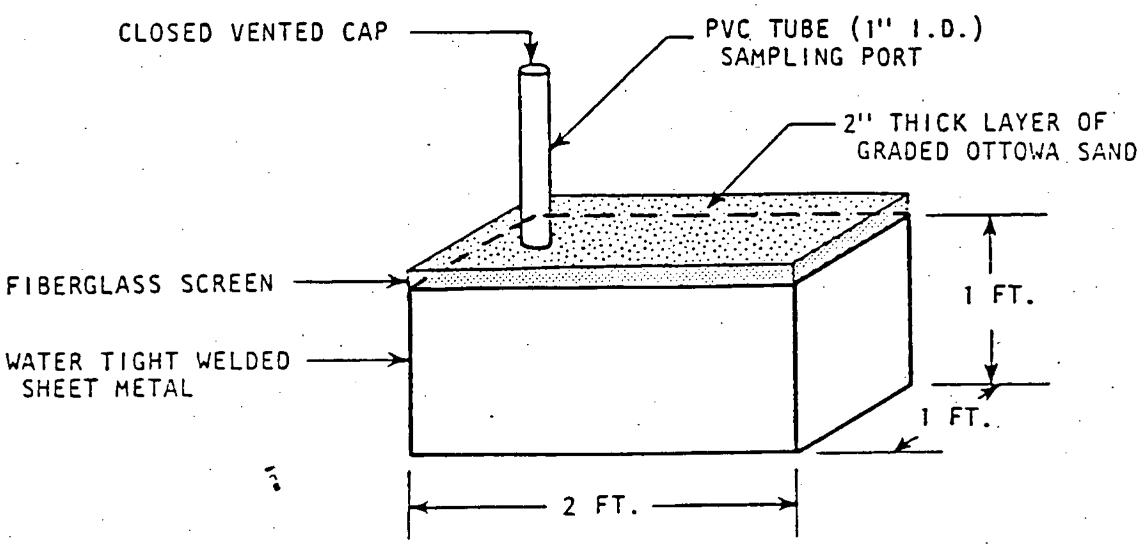
Refrigerated: Date:
Time:

Field Tests (Before After Evacuation)
Temperature (°C/°F):
pH:
Spec Cond (umhos/cm):
Dissolved oxygen (mg/l):

Weather:

Comments:





VOLUME = 15 GALLONS

SEEP COLLECTION PAN

Modified from Reference 12

DAMES & MOORE

FIGURE 3-2

Dames & Moore
20 Haarlem Avenue
White Plains, New York 10603
(914) 761-6323
TWX: 710-568-0323

SAMPLE I.D. NO.
DAY, MONTH, YEAR

Chain of Custody Record

REASON FOR SAMPLING
WITNESSES
COLLECTION PROCEDURE
METHOD OF PRESERVATION
REMARKS:

COLLECTED BY

PRINTED NAME	UNIT	PURPOSE OF TRANSFER
SIGNATURE X	TIME AND DATE	

CUSTODY TRANSFERRED TO

PRINTED NAME	UNIT	PURPOSE OF TRANSFER
SIGNATURE X	TIME AND DATE	

CUSTODY TRANSFERRED TO

PRINTED NAME	UNIT	PURPOSE OF TRANSFER
SIGNATURE X	TIME AND DATE	

CUSTODY TRANSFERRED TO

PRINTED NAME	UNIT	PURPOSE OF TRANSFER
SIGNATURE X	TIME AND DATE	

RECEIVED IN LABORATORY BY

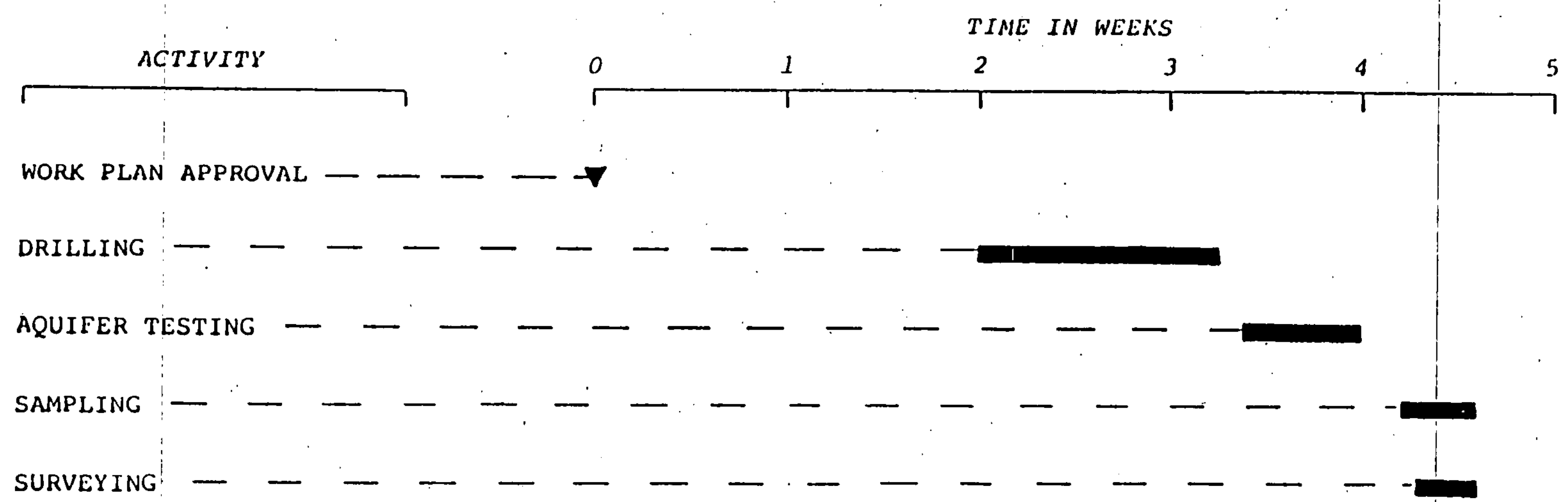
PRINTED NAME	UNIT	PURPOSE OF TRANSFER
SIGNATURE X	TIME AND DATE	

LOGGED IN BY

PRINTED NAME	UNIT	ACCESSION NO.
SIGNATURE X	TIME AND DATE	

91-14-12 (1/78)

Figure 4-1



TASK B WORK PLAN FIELD ACTIVITIES SCHEDULE

DAMES & MOORE

FIGURE 6-1

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REFERENCES CITED

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APPENDIX 1.0

DAMES & MOORE HEALTH & SAFETY PLAN

DAMES & MOORE
HEALTH AND SAFETY PLAN

Project Name and Number: NLO
10805-161-23

Project Site Location: Fernald, Ohio

Project Manager: Bob Berlin

On-Site Safety Officer: Bob Blauvelt

Plan Preparer: Dara Gray

Preparation Date: 7/24/84

Plan Approvals:

Office Safety Coordinator

Dara Gray 7/25/84
(date)

Managing Principal-in-Charge

Janie Cline / NS 7/25/84
(date)

Project Manager

Robert E Berlin 7/25/84
(date)

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Contents | Page

I. PURPOSE

The purpose of this Plan is to assign responsibilities, establish personnel protection standards and mandatory safety practices and procedures, and provide for contingencies that may arise while operations are being conducted at the site.

II. APPLICABILITY

The provisions of the Plan are mandatory for all on-site Dames & Moore employees and subcontractors engaged in hazardous and/or radioactive material management activities including but not limited to initial site reconnaissance, preliminary field investigations, mobilization, project operations, and demobilization.

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III. RESPONSIBILITIES

A. Project Manager

The PM shall direct on-site investigation and operational efforts. At the site, the PM, assisted by the on-site Safety Officer, has the primary responsibility for:

1. Assuring that appropriate personnel protective equipment is available and properly utilized by all on-site personnel.

2. Assuring that personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and in planned procedures for dealing with emergencies.

3. Assuring that personnel are aware of the potential hazards associated with site operations.

4. Monitoring the safety performance of all personnel to ensure that the required work practices are employed.

5. Correcting any work practices or conditions that may result in injury or exposure to hazardous substances.

6. Preparing any accident/incident reports (see attached Accident Report Form).

7. Assuring the completion of Plan Acceptance and Feedback forms attached herein.

B. Project Personnel

Project personnel involved in on-site investigations and operations are responsible for:

1. Taking all reasonable precautions to prevent injury to themselves and to their fellow employees.

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2. Implementing Project Health and Safety Plans, and reporting to the PM for action any deviations from the anticipated conditions described in the Plan.
3. Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the PM.

IV. BACKGROUND

Site History

NLO's Feed Material Production Center (FMPC) is a DOE facility utilized for the production of metallic uranium fuel core for the DOE's production reactors. The feed materials utilized include uranium ore concentrates and various recycled compounds and metals.

Dames & Moore Activity

Dames & Moore will be conducting a ground water investigation to determine the source(s) of the above-background levels of uranium detected in the groundwater. On-site activities will include site reconnaissance, well drilling (rotary wash), soil sampling (split spoon sampler), and water sampling (bailer).

Suspected Hazards

The potential hazards associated with the on-site activities have been determined to be those associated with uranium, based on the results of previous ground water analyses. The presence of elevated levels of sulfates and nitrates in the groundwater does not present a potential health risk.

V. EMERGENCY CONTACTS AND PROCEDURES

Should any situation or unplanned occurance require outside or support services, the appropriate contact from the following list should be made:

Agency	Person to Contact	Telephone
Client Safety Officer	Robert Weidner	513-738-6233
Police		
Fire		
Ambulance		
Hospital		
D&M Project Manager	B. Berlin	914-761-6323
D&M FH&SPO Director	D. Gray (office)	914-761-6323
	(home)	914-962-5423

In the event that an emergency develops on site, the procedures delineated herein are to be immediately followed. Emergency conditions are considered to exist if:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on scene.

- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

The following emergency procedures should be followed:

a) Personnel on-site should use the "buddy" system (pairs). Buddies should pre-arrange hand signals or other means of emergency signals for communication in case of lack of radios or radio breakdown (see the following item).

b) Site work area entrance and exit routes should be planned, and emergency escape routes delineated by the Project Manager.

c) Visual contact should be maintained between "pairs" on-site with the team remaining in close proximity in order to assist each other in case of emergencies.

d) Wind indicators visible to all on-site personnel should be provided by the Project Manager to indicate possible routes for upwind escape.

e) The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated, should result in the evacuation of the field team and re-evaluation of the hazard and the level of protection required.

f) In the event that an accident occurs, the PM is to complete an Accident Report Form for submittal to the MPIC of the office, with a copy to the health and safety program office. The MPIC should assure that followup action is taken to correct the situation that caused the accident.

VI. HAZARD CHARACTERISTICS AND PROTECTION REQUIRED

The potential hazards resulting from the on-site activities are those associated with exposure to radiological contaminants, specifically uranium. The levels anticipated are not high enough to warrant radiological monitoring during drilling and sampling activities.

In order to reduce the potential for contact with the contaminants, the personnel protective equipment specified in Table 1 will be worn by all personnel during on-site activities.

TABLE 1

Protective Equipment Required for On-Site Activities

Activity/Location	Protective Equipment
Drilling and Sampling	Disposable coveralls Rubber gloves Rubber boots (steel-toed) Hard hat Dust masks*

*If conditions are dry and dusty, dust masks will be worn.

VII. STANDARD SAFE WORK PRACTICES

General

1) Eating, drinking, chewing tobacco, smoking and carrying matches or lighters is prohibited in the contaminated or potentially contaminated area or where the possibility for the transfer of contamination exists.

2) Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, etc. Avoid, whenever possible, kneeling on the ground, leaning or sitting on equipment or ground. Do not place monitoring equipment on potentially contaminated surface (i.e., ground, etc.).

3) Field crew members shall be familiar with the physical characteristics of investigations, including:
   - wind direction in relation to the ground zero area
   - accessibility to associates, equipment, vehicles
   - communication
   - hot zone (areas of known or suspected contamination)
   - site access
   - nearest water sources

4) The number of personnel and equipment in the contaminated area should be minimized consistent with site operations.

5) All wastes generated during D&M and/or subcontractor activities site should be disposed of as directed by the Project Manager.

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Drilling and Sampling Practices

For all drilling and sampling activities, the following standard safety procedures shall be employed.

1) All drilling and sampling equipment should be cleaned before proceeding to the drill site.

2) At the drill or sampling site, sampling equipment should be cleaned after each use.

3) Work in "cleaner" areas should be conducted first where practical.

4) The minimum number of personnel necessary to achieve the objectives shall be within 25 feet of the drilling or sampling activity.

5) Appropriate emergency and backup subcontracted personnel should remain 25 feet from the drilling or sampling activity where practical.

VIII. DECONTAMINATION PROCEDURES

1) Locate a decontamination area.

2) Establish a personnel decontamination station consisting of a basin with soapy water, a rinse basin with plain water and a can with a plastic bag.

3) Wash and rinse boots and gloves.

4) Remove disposable suit and discard in plastic bag.

5) Upon leaving the contamination area, all personnel will proceed through the appropriate Contamination Reduction Sequence as described above.

6) All protection gear should be left on-site during lunch break following decontamination procedures.

IX. FORMS

The following forms are enclosed in this section:

Plan Acceptance Form
Plan Feedback Form
Accident Report Form

The Plan Acceptance Form should be filled out by all employees working on the site. The Plan Feedback Form should be filled out by the on-site safety officer and any other on-site employee who wishes to fill one out. The Accident Report Form should be filled out by the Project Manager in the event that an accident occurs.

ALL COMPLETED FORMS SHOULD BE RETURNED TO THE FIRMWIDE HEALTH AND SAFETY PROGRAM OFFICE.

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

Instructions: This form is to be completed by each person to work on the subject project work site and returned to the Program Director-Firmwide Health and Safety Program Office in White Plains.

Job. No. 10805-161-23

Client

Project NLO Groundwater Investigation

Date ____________

I represent that I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

____
Signed

____
Date

PLAN FEEDBACK FORM

Problems with plan requirements:

Unexpected situations encountered:

Recommendations for future revisions:

PLEASE RETURN TO THE FIRMWIDE HEALTH AND SAFETY OFFICE-WP

ACCIDENT REPORT FORM

SUPERVISOR'S REPORT OF ACCIDENT		DO NOT USE FOR MOTOR VEHICLE OR AIRCRAFT ACCIDENTS
TO	FROM TELEPHONE (include area code)	
NAME OF INJURED OR ILL EMPLOYEE		
DATE OF ACCIDENT	TIME OF ACCIDENT	EXACT LOCATION OF ACCIDENT
NARRATIVE DESCRIPTION OF ACCIDENT		
NATURE OF ILLNESS OR INJURY AND PART OF BODY INVOLVED		LOST TIME YES ☐ NO ☐

PROBABLE DISABILITY (Check One)

FATAL	LOST WORK DAY WITH ___ DAYS AWAY FROM WORK	LOST WORK DAY WITH ___ DAYS OF RESTRICTED ACTIVITY	NO LOST WORK DAY	FIRST AID ONLY
☐	☐	☐	☐	☐

CORRECTIVE ACTION TAKEN BY REPORTING UNIT

CORRECTIVE ACTION WHICH REMAINS TO BE TAKEN (by whom and by when)

NAME OF SUPERVISOR	TITLE
SIGNATURE	DATE

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APPENDIX 2.0

EAL QUALITY ASSURANCE

PROCEDURES

QUALITY ASSURANCE AND CONTROL - NUCLEAR SCIENCES DEPARTMENT

QUALITY ASSURANCE

The goal of a quality program is to assure that information of the highest attainable precision and accuracy is obtained in the investigation, through pre-planned control of all project elements which may directly or indirectly have an impact on the integrity of the information.

EAL maintains such a quality assurance program for all its radiological and conventional programs. This QA program complies with or exceeds applicable regulatory requirements.

SUMMARY OF QUALITY ASSURANCE FOR RADIOANALYTICAL PROGRAMS

EAL Corporation has maintained an independent Quality Assurance Program for environmental monitoring and radioanalytical programs for many years. A formal Quality Assurance Program (QAP) has been employed for a number of years. This program was developed to ensure compliance with identified requirements related to the production of analytical data. All concurrent processes affecting sample integrity, sensitivity as well as reproducibility and accuracy of the data are controlled and audited in a prescribed manner.

The quality assurance program is delineated in an EAL-produced QA manual: "Quality Assurance Manual for EAL Programs". Relative to environmental monitoring programs, it meets the requirements of the following regulations, standards or guides:

a. 10CFR50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants" as they apply to the conduct of environmental monitoring programs.

b. ANS-3.2, ANSI N18.7-1976, "American National Standard, Administrative Controls and Quality for the Operational Phase of Nuclear Power Plants, Revision of N18.7-1972".

c. ANSI N45.2.13-1976, "Quality Assurance Requirements for Control of Procurement Items and Services for Nuclear Power Plants".

d. Nuclear Regulatory Commission (NRC) Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations)-Effluent Streams and the Environment", Revision 1, February 1979.

e. The EAL program closely corresponds to the "Handbook for Analytical Quality Control in Radioanalytical Laboratories", EPA 600/7-77-088, August 1977.

The State of California, Department of Public Health, has approved EAL as a commercial laboratory for the performance of analytical examinations for Radiochemistry, Complete Chemical, Fish Toxicity Bioassay, and Complete Bacteriological. The EAL manual also meets the requirements of ERDA, RDT Standard F 2-4T (December 1974) Quality Verification Program Requirements", as they apply to the conduct of plutonium and/or uranium isotopic fuel analysis programs. The State of California has also licensed EAL for clinical radiobioassay and approved the laboratory for radioassay of drinking water.

Categories outlined in the Q.A. Plan are:

1. ORGANIZATION
2. QUALITY ASSURANCE PROGRAM
3. DESIGN CONTROL
4. PROCUREMENT DOCUMENT CONTROL
5. INSTRUCTIONS, PROCEDURES AND DRAWINGS
6. DOCUMENT CONTROL
7. CONTROL OF PURCHASED MATERIAL, EQUIPMENT AND SERVICES
8. CONTROL OF SPECIAL PROCESSES
9. IDENTIFICATION AND CONTROL OF MATERIALS PARTS AND COMPONENTS
10. INSPECTION
11. TEST CONTROL
12. CONTROL OF MEASURING AND TEST EQUIPMENT
13. HANDLING, STORAGE AND SHIPPING
14. INSPECTION, TEST AND OPERATING STATUS
15. NON-CONFORMANCES
16. CORRECTIVE ACTION

Thus the Q.A. Program provides for program implementation, review, audit and corrective action for the various laboratory operations and quality control points. These include personnel training and proficiency, instrument background and stability checks, blanks, standards, calibrations, procedure approval, data verification, etc. In radiological programs, completed data and test results are subject to final review and evaluation by the cognizant Project Manager before issuance of the final report to the client.

The EAL Quality Assurance Program ensures top quality and reliable data at a reasonable price. The design control feature of the program permits flexibility to meet particular project needs.

Arrangements may be made for periodic audit of EAL facilities by the clients' organizations. Also, Certificates of Conformance (as delineated in ANSI N45.2.13-1976) will be supplied, when requested.

QUALITY CONTROLS

EAL participates in the EPA Environmental Radioactivity Laboratory Inter-comparison Studies Program and numerous intercalibrations and comparisons with prime laboratories and clients. Standards from recognized authorities such as NBS, UKAEA and others are processed on a frequent basis. EAL also participates in collaborative programs of procedure testing and standardization of reference standards.

In conjunction with EAL's programs for radiochemical surveys of nuclear reactor sites, a small, unofficial program for the comparison of procedures for the determination of total beta activity in environmental samples has been maintained with the California State Department of Public Health. Vegetation, marine plant and animal, and water samples have been split between the two laboratories for a comparison of analytical results. A rigorous preventative maintenance program has been in use at EAL for many years. This program calls for the shutdown of individual instruments on a periodic basis, testing of all components, replacing components as necessary, then re-testing to insure all circuits are functioning properly. The length of time between preventative maintenance procedures varies with the type of equipment, the established failure rate as a function of time and the percent utilization. This program has made breakdowns a rarity.

After preventative maintenance, standard procedures are used to bring the equipment back on line. These include high voltage plateaus, discriminator setting tests, efficiency and background checks, etc., as applicable to a particular unit. These tests are also performed periodically during use to insure proper equipment operation. Chi-square tests are used to determine reproducibility of count results. The system of instrument quality control checks is controlled by a computer progam. The program not only schedules and records the results of checks but also automatically flags out instruments which fail the QC tests and will not allow data from a malfunctioning instrument to be calculated until the tests come within acceptable limits.

Geiger and proportional beta counters are tested daily with ^{36}Cl standards. Plateaus are checked at least monthly. Periodic backgrounds are updated for use in calculating data.

Gross alpha counters are tested daily with ^{237}Np sources. These sources are also used to take plateau curves since the presence of the ^{233}Pa daughter provides a test to insure discrimination against beta particles.

All gamma and X-ray spectrometers are tested weekly with ^{137}Cs or ^{55}Fe standards. Backgrounds are taken bi-monthly and used to update the computer system's disk stored background spectrums. Any significant change in the resolution, background or efficiency is detected by a testing program which prints out a message to that effect. The Ge(Li) Gamma Spectrometers are routinely checked for linearity and efficiency with ^{226}Ra and its daughters.

Alpha spectrometer efficiencies are tested monthly with multi-standards of ^{233}U, ^{239}Pu and ^{241}Am. Backgrounds are taken bi-monthly and used to update the previously stored background inventory.

In addition to the above-mentioned periodic tests, standards are usually processed in conjunction with samples. These tests and calibrations are in addition to interlaboratory calibrations and the various isotope calibration programs using externally standardized solutions.

To insure that chemical procedures are functioning properly, sample blanks and spiked samples are processed periodically with the samples. The quality assurance program is carefully tailored to complement the specific analyses performed on each project.

In summary, EAL's quality assurance program is comprised of a complex array of methods and techniques. These include instrumentation checks of efficiency, background, etc. The processing of many standards available from both commercial laboratory and government agencies, constant checking of analytical procedures for precision and accuracy by processing spike samples and blanks and finally, the institution of special quality assurance programs specifically oriented to each analytical program.

QUALITY ASSURANCE PROGRAM - ENVIRONMENTAL SCIENCES DEPARTMENT

The EAL Environmental Sciences Department Quality Assurance Program Plan provides laboratory personnel with guidelines and specifications to ensure that the precision, accuracy, completeness, representativeness, and comparability of data generated by laboratory personnel is both known and documented. The QA plan is thus a working document used to determine the acceptability of all field and laboratory measurements of chemical, physical, or biological parameters. EAL's QA program satisfies the environmental monitoring and measurement requirements mandated or supported by State and Federal regulatory agencies, including the Environmental Protection Agency (EPA), the National Institute for Occupational Safety and Health (NIOSH), the U.S. Department of Health and Human Services, the Nuclear Regulatory Commission, and the California Department of Health Services. The QA program addresses the policies, organization, objectives, and specific quality control activities routinely employed by EAL Corporation to satisfy the intended end use of laboratory data.

The Environmental Sciences Department has a Quality Assurance Coordinator reporting directly to the department manager. The QA Coordinator has direct interaction with program managers, laboratory supervisors, and technicians, in efforts to upgrade and document Standard Operating Procedures (SOP's).

Sampling Procedures

Many samples processed by EAL Corporation are not collected by EAL laboratory personnel. EAL generally provides clients with detailed information regarding proper containers, reagents, preservation and holding requirements, transportation, storage, and disposal instructions. EAL provides clean sample containers upon request, and will check to ensure that samples are properly preserved upon receipt in the laboratory area. When EAL is requested to provide field services for collection of solid, liquid, or gaseous substances, including biological or radioactive materials, sampling is in strict accordance with approved methodology. Forms, notebooks, and procedures to record sample history, sampling conditions, and analyses to be performed, are retained on company file for a minimum of five years.

Sample Custody

All samples are assigned a unique laboratory identification number, marked directly on the container to denote customer number, sample set number and sample number. New customers are added to a chronological listing of customers; the set number is incremented for each new group of samples received. The sample number denotes location in the current set. The lab has designated a sample custodian for chain-of-custody samples, as well as back-up custodians for this purpose. The duties and responsibilities of log-in personnel are clearly defined in written procedure manuals which are maintained in the log-in area. Locked refrigerators, freezers, incubators, ovens and cabinets are available for chain-of-custody samples. Standardized forms are used for tracking all samples through the entire analytical process.

Calibration Procedures and Frequency

Standard operating procedures for each type of measurement are maintained in laboratory notebooks and are readily available to lab technicians and supervisors. Quality control check standards are used to record instrument sensitivity and linearity and verify proper response. Methods and calibration curves are dated, initialed, and documented by the analyst in bound notebooks.

QA Objectives for Measurement Data

All laboratory work will be conducted in accordance with guidelines established in the following documents:

1. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", U.S. EPA-EMSL, Cincinnati, Ohio, EPA-600/4-79-019, March, 1979.
2. "Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples", EPA-600/1-79-008, January, 1979.
3. "Handbook for Analytical Control in Radioanalytical Laboratories", EPA-600/7-77-088, August, 1977.
4. "Manual for the Interim Certification of Laboratories Involved in Analyzing Public Drinking Water Supplies - Criteria and Procedures", EPA-600/8-78-008, August 1978.
5. "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", U.S. Nuclear Regulatory Commission, Regulatory Gui e 4.15, Revision 1, February, 1979.

6. "Quality Assurance Handbook for Air Pollution Measurement Systems. Volume I - Principals", EPA-600/9-76-005, March, 1976.

7. "Quality Assurance Handbook for Air Pollution Measurement Systems. Volume III - Stationary Source Specific Methods", EPA-600/4-77-0276, August, 1977.

8. "Industrial Hygiene Laboratory Quality Control - (Manual 587)", Division of Training and Manpower Development, NIOSH, Cincinnati, January, 1980. U.S. Government Printing Office 1980/657-147/5842, P.O. H1387.

9. "Quality Control Manual", Analytical Committee of American Industrial Hygiene Association, Akron, Ohio, 1980.

Data Reduction, Validation, and Reporting

Central to EAL's quality control program is a comprehensive data processing system. Using an IBM 1130 computer disk oriented operation system and data base, the system performs four essential functions:

I Control of sample inventories by assigning sample identification numbers and monitoring sample progress.

II Control of data accuracy, by performing all routine analytical calculations and flagging difficulties with printed warnings.

III Control of data reliability by maintaining, automatically summarizing, and plotting quality control files. Calculated precision and accuracy control limits are used to flag outliers.

IV Control overall data compatibility by checking for proper reporting units, and performing ionic balances and total solids-to-specific conductance comparisons, as applicable.

Accuracy of all computer calculated results is assured by a verification process. No computer calculated data are considered valid until the actual input data have been received and initialed as being correct. All raw data as well as summary of final results are stored for convenient access for later review.

To facilitate scheduling and satisfactory progress of the work in-house, a summary of all work in process is printed in order by due date, sample identification, customer name, sample type, laboratory sections involved, percent completed. The estimated dollar value is listed for each set of samples received.

To avoid errors which would result from transferring data from lab books to computer coding forms, EAL uses bound, custom-made coding forms as lab books. There are three different formats for lab books now in use; titrimetric raw data, gravimetric raw data, and one for all analyses which involve a standard curve.

Analytical data is entered into these books as it is generated. This information is then zeroxed and submitted to the computer room. The data on the forms is keypunched, verified, and read into the computer.

Internal Quality Control Checks

Precision:

Replicate standards and/or samples will be used to estimate the precision of each analytical test procedure. Data control limits will be established to satisfy the requirements of specific measurement projects, based on prior knowledge of the measurement system and method validation studies.

Accuracy:

Processed standards and/or spiked samples will be used to estimate analyte recovery for each test procedure. Data control limits will be established and documented as above.

Completeness:

In general, data control limits will be based on the mean precision and accuracy values determined in the laboratory. When practical, warning limits will be set at the mean values $\pm$ 2 standard deviations; acceptance limits will be set at the mean values $\pm$ 3 standard deviations. Experience with this system indicates that at least ninety percent of all analytical data will be of acceptable quality for a given testing period. Samples with questionable results will be re-analyzed during a successive testing period, whenever possible.

Representativeness:

Whenever possible, samples will be collected and aliquotted so that analysis results will be representative of the media and conditions being measured.

Comparability:

Unless otherwise specified, all data will be calculated and reported in units consistent with other organizations reporting similar data to allow comparability of data bases.

Corrective Action:

The overall responsibility for providing an aggressive quality assurance program to insure the quality of all laboratory data will remain with the Department Manager. Each of the laboratory managers within the department, including the General Chemistry, Industrial Hygiene, GC/MS, General Organic, Radiochemistry, and Microscopy Laboratories, is responsible for the results of the QC program as applied to their laboratory. The QA Coordinator is responsible for enforcing the requirement for documented data quality, reviewing and reporting quality trends, and coordinating improvements in the QA system.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Ref: 8S

OCT 3 1979

Mr. Richard Gerdes
LFE Environmental Analysis Laboratories
2030 Wright Avenue
Richmond, California 94804

Dear Mr. Gerdes:

We have received all the information which was necessary to make the decision concerning the certification status of the LFE laboratory. Based on this information and the recommendation of my technical staff, I hereby grant reciprocal "Provisional Interim Certification" to LFE Environmental Analysis Laboratories for the analysis of public water supply samples for the following parameters:

Gross alpha activity;
Gross beta activity;
Radium 226; and
Uranium

This certification is contingent on the following conditions:

The laboratory must maintain certification through the California Department of Health Services;

The laboratory must continue using EPA approved methods;

Copies of the results of future cross check analyses of the EPA/Las Vegas samples must be submitted to my office as they become available;

The enclosed forms must be completed by LFE and returned to my office by December 1, 1979; and

The laboratory must request another on-site evaluation by the State of California and it must be completed by September 1, 1980, with a copy of the report sent to my office.

If you have questions concerning this matter, contact Thomas L. Staible at 303-837-4935.

Sincerely yours,

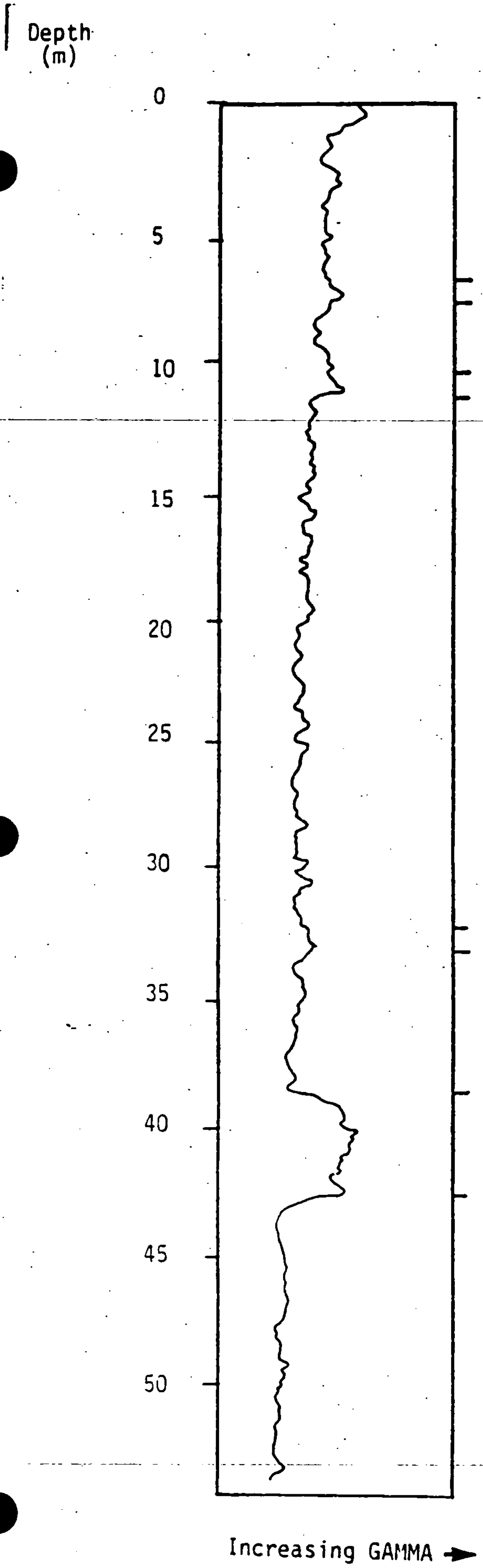
Irwin L. Dickstein, Director
Surveillance and Analysis Division

cc: Dr. B.R. Tamplin, Chief
Sanitation and Radiation Laboratory Section
California Department of Health Services

Dr. George Morgan, Director
EMSL/Las Vegas

APPENDIX 3.0

GEOPHYSICAL SURVEY LOGS



Dames & Moore Interpretation

Mixed Clay, Sand and Gravel

Clay

Clay

Sand & Gravel

Clay

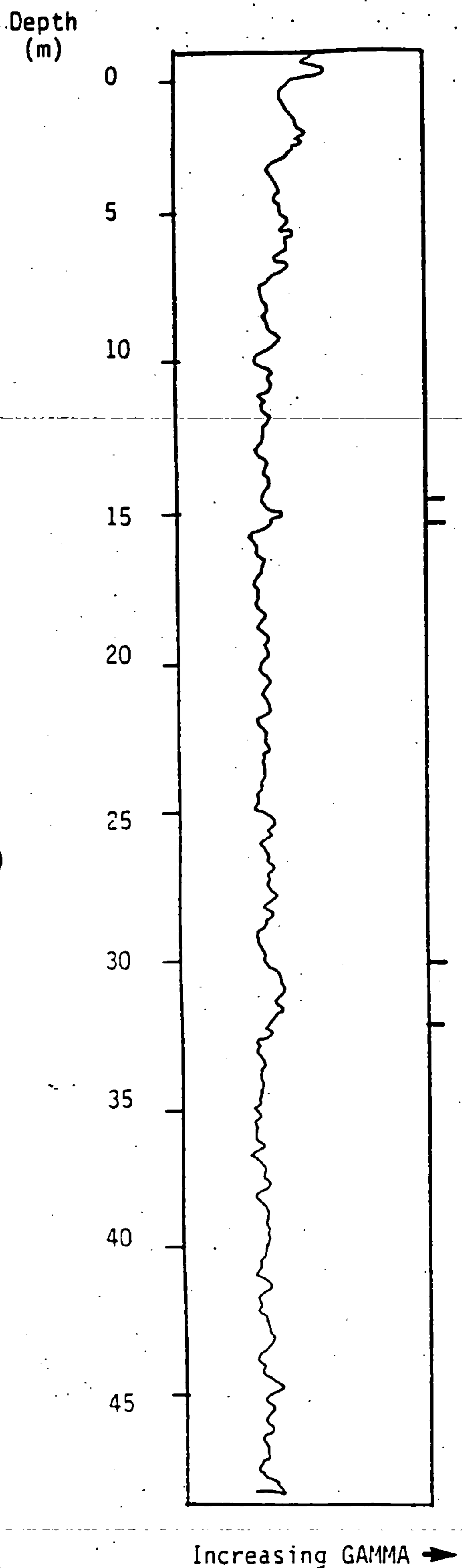
Sand & Gravel

Clay

Drillers Log (m)

0-3.7: Yellow Clay
3.7-4.6: Gravel & Yellow Clay
4.6-12.2: Blue Clay with some Gravel
12.2-13.7: Sandy Yellow Clay
13.7-40: Sand Some Gravel
40-44.2: Blue Clay
44.2-46.4: Sand & Gravel
46.4-51-9: Medium & Coarse Sand
51.9-54.9: Fine Sand

Log of Well # 1d



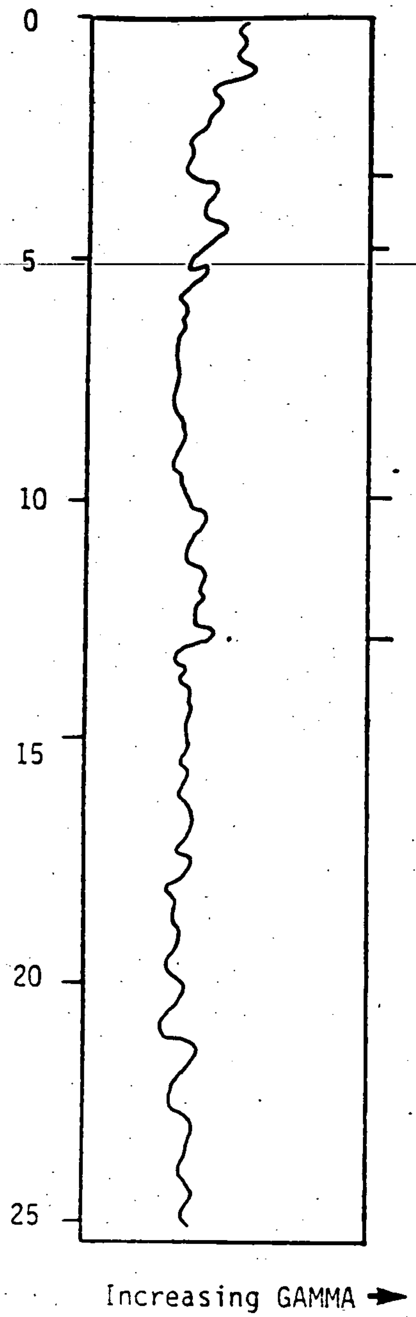
Dames & Moore Interpretation

- Sand & Gravel
- Clay
- Sand
- Sand & Gravel
- Clay
- Sand & Gravel

Drillers Log (m)

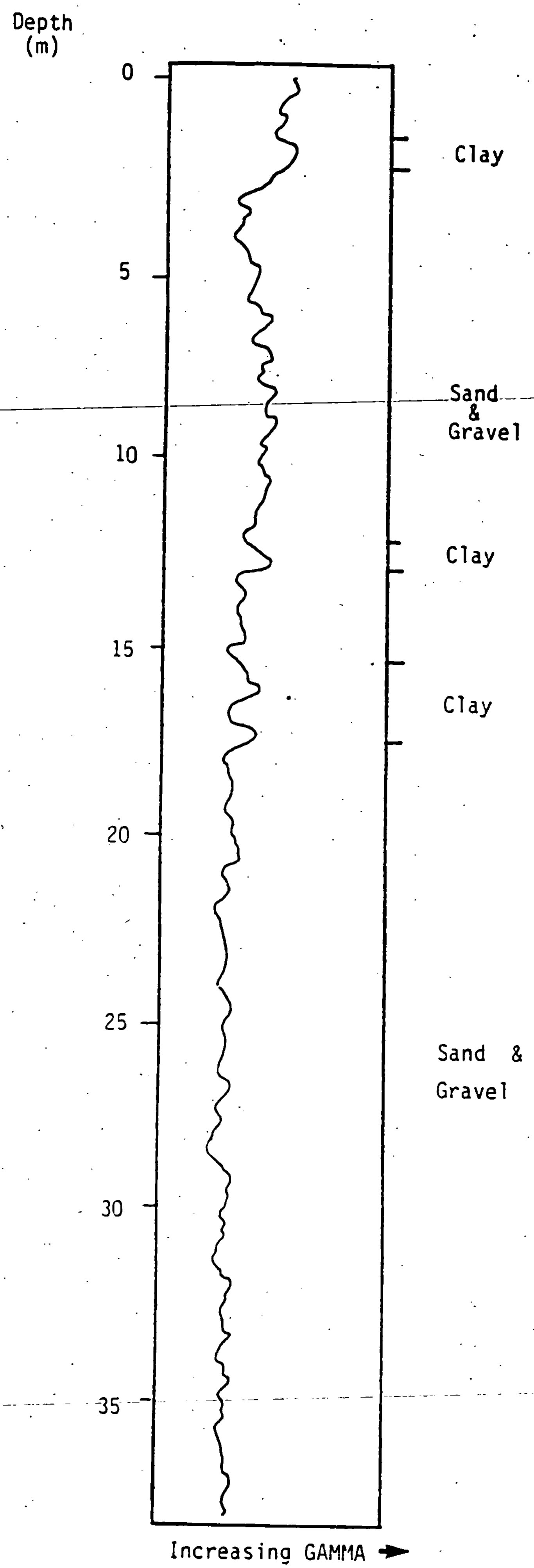
0-0.61:	Top Soil
0.61-2.44:	Blue Muck
2.44-11.1:	Blue Clay
11.1-11.6:	Sand and Some Blue Clay
11.6-18.3:	Sand
18.3-18.6:	Blue Clay
18.6-35.4:	Sand & Some Gravel
35.4-37.2:	Blue Clay
37.2-45.8:	Sand & Gravel
45.8-50.3:	Med & Fine Sand

Log of Well #8d



Dames & Moore Interpretation	Drillers Log (m)
Clay	0-4.5: Yellow Clay; 4.5-6.3: Sandy Yellow Clay
Sand	
Clay	
Sand and Gravel	6.3-16.8: Sand; 16.8-21.4: Sand and some Gravel; 21.4-27.9: Sand

Log of Well # T-9



Drillers Log (m)

0-2.4: Yellow Clay

2.4-5.5: Blue Clay
5.5-5.8: Muddy Gravel

5.8-14.6: Blue Clay
14.6-15.9: Blue Gravel

15.9-19.2: Yellow Coarse Sand & Gravel

19.2-21.4: Gray Sand & Clay Balls

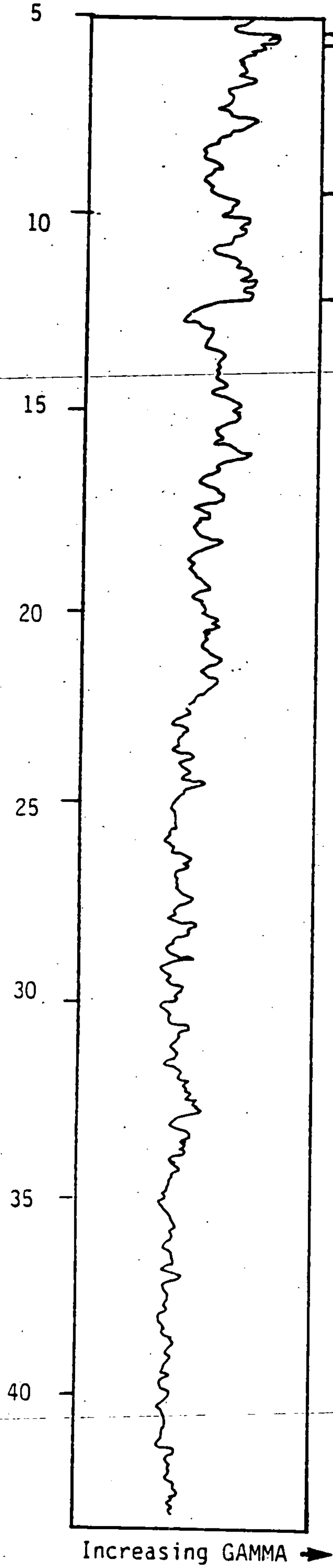
21.5-25.9: Gray Sand & Gravel

21.5-39.7: Gray Sand & Gravel

Log of Well # 10

62

Depth (m)



Dames & Moore Interpretation

- Clay
- Clay with Some Sand
- Sand & Gravel with some clay
- Sand & Gravel

Drillers Log (m)

- 0-4.27: Yellow Clay
- 4.27-8.5: Blue Clay & Gravel
- 8.5-12.2: Gray Clay
- 12.2-13.7: Blue Clay
- 13.7-19.5: Yellow Sand
- 19.5-27.1: Gray Sand & Gravel
- 27.1-28.1: Dark Gray Sand & Clay Balls
- 28.1-30.5: Gray Sand & Gravel
- 30.5-39.7: Gray Sand and Boulders

Log of Well # T-11