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PLAN

SAMPLING PLAN FOR THE CHARACTERIZATION
OF STORMWATER RUNOFF AT THE
FEED MATERIALS PRODUCTION CENTER

Department of Energy
FEED MATERIALS PRODUCTION CENTER
Fernald, Ohio

For: Westinghouse Materials Company of Ohio

Prepared by:

ROY F. WESTON, INC.

October 1987

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TABLE OF CONTENTS

SECTION Page
1.0 BACKGROUND 1
2.0 OBJECTIVES 3
3.0 LOGISTICS 5
4.0 SAMPLE IDENTIFICATION/NUMBERING 6
5.0 SURFACE RUNOFF SAMPLING 8
5.1 Objectives 8
5.2 Sampling Frequency 8
5.3 Sample Locations 8
5.4 Sampling Methodology 9
5.5 Surface Water Sample Containers and Preservatives for Off-Site Shipping and Storage 12
5.6 Field Analysis and Preparation 12
5.7 Off-Site Laboratory Analysis 13
5.8 Sample Identification and Numbering 14
5.9 Deliverables 14

LIST OF TABLES

Table No. Page
1 Two Digit Designations for Identifying Sample/Masurement Locations 7
2 Surface Water Containers and Preservatives 11

LIST OF FIGURES

Figure No. Page
1 Site Map of the Feed Materials Production Center, Fernald, Ohio 2
2 Sampling Location Map 10



LIST OF APPENDICES

	<u>Page</u>
APPENDIX A. SAMPLE CONTROL AND DOCUMENTATION	15
APPENDIX B. GUIDE TO THE HANDLING, PACKAGING, AND SHIPPING OF FMPC SAMPLES	22
APPENDIX C. DECONTAMINATION OF FIELD EQUIPMENT	25
APPENDIX D. SURFACE RUNOFF SAMPLING TECHNIQUES	28
APPENDIX E. FIELD METHODS FOR ANALYSIS OF STORMWATER RUNOFF	33
APPENDIX F. ANALYTICAL LABORATORY PROCEDURES TO BE USED FOR FMPC SAMPLE ANALYSES	46



SAMPLING PLAN FOR THE CHARACTERIZATION
OF STORMWATER RUNOFF AT THE
FEED MATERIALS PRODUCTION CENTER

1.0 BACKGROUND

The FMPC is located in a rural area of southwestern Ohio approximately ten miles northwest of Cincinnati and eight miles southwest of Hamilton. The site occupies 1,050 acres and is bounded by Highway 126 to the north, a transmission line to the east, Willey Road to the south, and the Chesapeake and Ohio Railroad to the west. Figure 1 shows the major site features.

Westinghouse Materials Company of Ohio (WMCO) operates the facility for the Department of Energy. The basic mission of the FMPC is the conversion of uranium-containing residues, uranium hexafluoride, and uranium tetrafluoride to uranium metal. A variety of chemical and metallurgical processes are employed for the manufacture of the uranium products. During the manufacturing processes, other non-uranium chemicals and compounds are also introduced. Following dissolution in nitric acid, the uranium is removed from impure materials through solvent extraction, yielding a uranyl nitrate solution. Evaporation and heating convert the nitrate solution to uranium trioxide (UO_3) powder. This compound is reduced to uranium dioxide (UO_2) with hydrogen and then converted to uranium tetrafluoride (UF_4) by reaction with anhydrous hydrogen fluoride. Uranium metal is produced by reacting UF_4 and magnesium metal in a refractory-lined reduction vessel. This primary uranium metal is then remelted with scrap uranium metal to yield a purified uranium ingot which is shipped off site for extrusion.

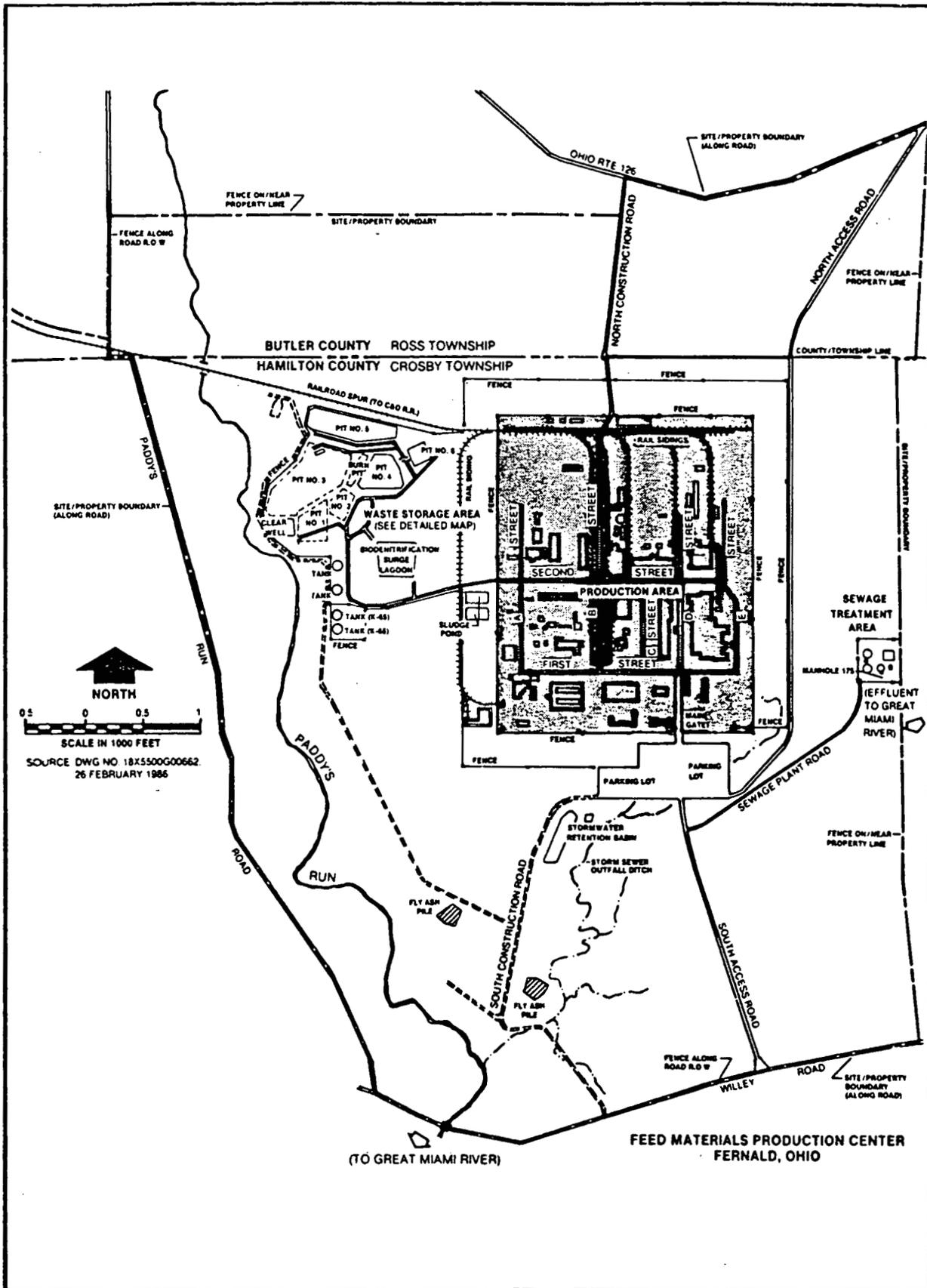


FIGURE 1 MAP OF THE SITE



Various oil products and other organic and inorganic chemical constituents are stored and used at the FMPC in support of production activities. These materials are frequently stored in tanks and drums for ultimate use in process operations. Large quantities of kerosene and tributyl phosphate, with lesser quantities of 1,1,1-trichloroethane, are stored on site in tanks and process vessels. Anhydrous hydrofluoric acid, potassium hydroxide, sodium hydroxide, and anhydrous ammonia are stored throughout the plant, with the main storage area located in a central tank farm. Liquid chemicals and oils are received in 55-gallon drums, stored, and distributed to the process facilities in quantities sufficient to maintain normal operations. Many of the tanks, drums, and other storage systems are located outdoors, and thus, could potentially result in the release of hazardous constituents to waters of the state in the event of a spill or accident. Other facilities, such as the hazardous waste storage areas, solid waste storage areas, scrap piles, and material transfer areas, also could potentially release hazardous constituents into runoff conveyance systems draining the site.

2.0 OBJECTIVES

A characterization of FMPC stormwater runoff is being conducted to evaluate the nature and extent of radiological and chemical components in surface waters draining the site. The information collected during the characterization will be used to support preparation of a Best Management Practices (BMP) Plan for the FMPC.

The work objectives of this Plan are designed to:

- 
 - o Characterize the type and quantity of potentially hazardous chemical and radioactive constituents in the FMPC surface water runoff;
- 
 - o Estimate radiological and chemical constituent migration;
 - o Evaluate the present nature, severity, and extent of radiological and chemical constituents;
 - o Provide input for the development of the Best Management Practices Plan.

The Sampling Plan for the FMPC storm sewers and surface drainages presents sampling procedures and analytical requirements needed for monitoring stormwater runoff. The following field activities are addressed in this plan:

- o Logistics
- o Surface Runoff Sampling Protocol

For the field activities listed above, this plan addresses the following topics:

- o Sampling Frequency
- o Sampling Locations
- o Sampling Methodology
- o Sample Containers and Preservatives
- o Sample Identification and Numbering
- o Field Characteristics Analyses
- o Outside Laboratory Analyses



3.0 LOGISTICS

Due to the limited nature of on-site sampling activities to be conducted (one day storm sampling event; one day baseflow sampling event), a logistics support facility will not be established. All sampling and sampling support activities will be carried out through the use of two cargo vans, which will be driven to each sampling point.

WESTON will mobilize its sampling crews based on a predicted storm event of sufficient intensity to result in surface runoff in the ditches and streams draining the FMPC. Mobilization will only be initiated upon approval of the WMCO Project Manager. The baseflow sampling event associated with the FMPC storm sewer system will be conducted during a period in which no rainfall runoff is occurring. This event will also be conducted only upon approval of the WMCO Project Manager.

Access to areas within the plant security fence will be conducted by a Q-cleared WESTON employee, who will escort no more than three uncleared sampling personnel at any one time. Except during the escort of sampling personnel to the Waste Storage Area, only one uncleared person will typically be escorted. Access permits to the Waste Storage Area will be obtained before entry is expected to be required.

Decontamination of sampling equipment is expected to require only detergent and water, followed by deionized water. Therefore, decon waters will be released to the streams from which they are sampled.



4.0 SAMPLE IDENTIFICATION/NUMBERING

For each sample taken during the course of the field investigation, a coding system will be used to identify various information concerning each sample. This identification includes:

- o Project identification - FMP will be used to designate the Feed Materials Production Center.
- o Sample or measurement type and location - a two letter designation following the project identification code.

The sample types and corresponding codes for this investigation consist of the following:

DD = Drainage Ditch (surface runoff)
MH = Man Hole (storm sewer runoff)
PP = Pilot Plant (storm sewer runoff)
CT = Cooling Tower (storm water collected in sump)

A two digit designation indicating the sample location will be used following the sample type code. These two digit designations are presented in Table 1.

- o Sample number - a two digit code will also be used to consecutively number samples taken from each location.

For example FMP-MH11-01 designates the Feed Materials Production Center, the first storm water sample taken from Manhole 11.



Table 1 Two Digit Designations for Identifying Sample/Measurement Locations

<u>Sample/Measurement Locations</u>	<u>Letter Code</u>	<u>Two Digit Code</u>
Manhole 11	MH	11
Manhole 12	MH	12
Manhole 14	MH	14
Manhole 15	MH	15
Manhole 17	MH	17
Manhole 18	MH	18
Manhole 19	MH	19
Manhole 22	MH	22
Manhole 26	MH	26
Manhole 30	MH	30
Manhole 33	MH	33
Manhole 35	MH	35
Manhole 57	MH	57
Manhole 58	MH	58
Cooling Tower	CT	01
Pilot Plant	PP	01
Drainage Ditch 01	DD	01
Drainage Ditch 02	DD	02
Drainage Ditch 03	DD	03
Drainage Ditch 04	DD	04
Drainage Ditch 05	DD	05
Drainage Ditch 06	DD	06
Drainage Ditch 07	DD	07
Drainage Ditch 08	DD	08
Drainage Ditch ...	DD	...
Drainage Ditch 23	DD	23



All information pertinent to field activities must be recorded on various forms (e.g., logbooks, sample tags, photographs). Each field worker must keep detailed records of inspections and investigations, and thoroughly review all notes before leaving the site. Appendix A details sample document control and provides appropriate labeling techniques.

5.0 SURFACE RUNOFF SAMPLING

This section describes the surface runoff sampling protocol that will be carried out at numerous locations in the storm sewers. Additional sampling will be performed in surface drainages on the FMPC site.

5.1 Objectives

The objective of sampling surface runoff is to obtain information on the quality of surface water in the storm sewers and surface drainages leaving the FMPC. The sampling strategy was designed in an effort to isolate sources of chemical and radiological constituents entering the various drainages on the site. The sampling locations were specified by WMCO.

5.2 Sampling Frequency

Storm sewers will be sampled twice, once during dry weather (baseflow) and again during a rainfall event. Drainage ditches will only be sampled once.

5.3 Sample Locations

Locations for sampling surface water will consist of the following:



1) Plant Stormwater Collection System

Samples will be collected from sixteen manholes and catch basins associated with the FMPC stormwater collection system. Two sets of samples will be taken, one during dry weather (baseflow condition), and the second during a storm event of sufficient magnitude as determined by WMCO.

2) Site Runoff (Drainage Ditches)

The samples taken will be collected during a storm event of sufficient magnitude to produce enough runoff to cause water to flow in the drainage ditches.

a) Waste Storage Area. Three samples will be collected from drainage ditches in the Waste Storage Area.

b) Outside Plant and Waste Storage Areas. Twenty samples will be collected from the FMPC site, but outside the plant and Waste Storage Area boundaries.

Specific sample collection locations for the stormwater collection system and drainage ditches are shown on Figure 2.

5.4 Sampling Methodology

Most of the drainage areas in and around the FMPC are small and usually dry except during storm events. These areas shall be sampled by hand using a pond or dip sampler. Samples shall be transferred to the appropriate container as listed in Table 2.

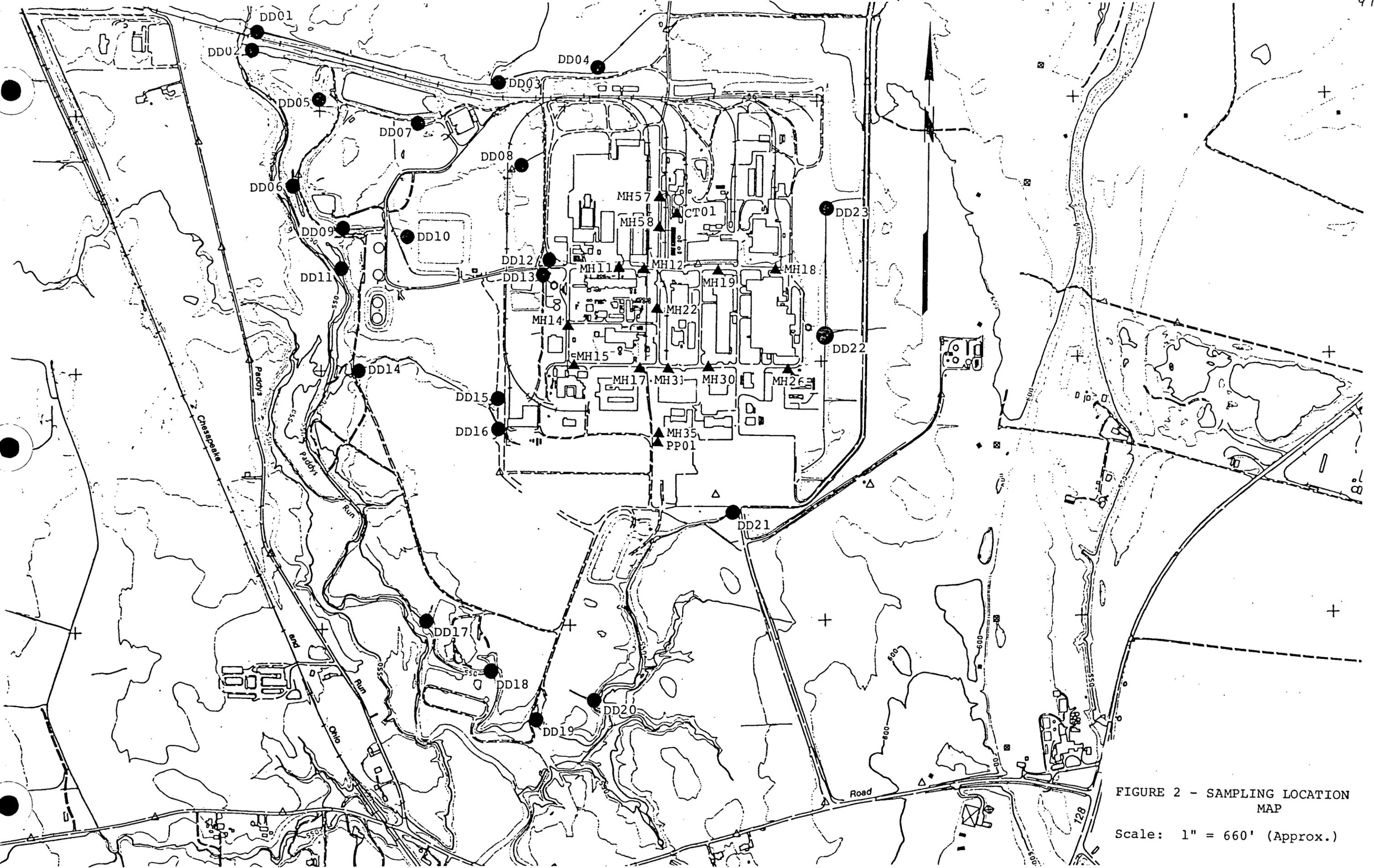


FIGURE 2 - SAMPLING LOCATION MAP
 Scale: 1" = 660' (Approx.)

Table 2 Surface Water Containers and Preservatives

<u>Specified Analysis</u>	<u>Sample Container</u>	<u>Sample Size</u>	<u>Preservation</u>	<u>Holding Time Days</u>	<u>Reporting Units</u>
1,1,1 TCE Perchloro- ethylene	40 ml vial w/Teflon- lined sili- con rubber septum	40 mL	cool, 4°C	14	ug/L
Metals	Polyethylene or glass	1 L	pH <2, HNO ₃	180	ug/L
U, Th, Beta, Alpha	Cubitaner	4 L	pH <2, NHO ₃	6 mos.	Variable
<u>Anions</u>					
Chloride	Polyethylene	50 ml	Cool to 4°C	28 days	mg/l
Fluoride	Polyethylene	300 ml	Cool to 4°C	28 days	mg/l
Nitrate	Polyethylene	50 ml	Cool to 4°C	2 days	mg/l
Sulfate	Polyethylene	50 ml	Cool to 4°C	28 days	mg/l
<u>Indicators</u>					
TDS	Polyethylene	250 ml	Cool to 4°C	28 days	mg/l
TSS	Polyethylene	250 ml	Cool to 4°C	28 days	mg/l
TOC	Amber glass w/Septum cup	60 ml	Cool to 4°C	28 days	mg/l
TOX	Amber glass w/Septum cup	250 ml	H ₂ SO ₄ to pH2 Cool to 4°C	28 days	mg/l
Oil & Grease	Amber glass w/Septum cup	1000 ml	Cool to 4°C H ₂ SO ₄ to pH<2	28 days	mg/l



If feasible, drainages shall be sampled at mid-depth in the mid-section or deepest flow channel. Samples will be collected directly into the sample container if the water is deep enough. The storm sewers shall be sampled with a dip sampler attached to the end of a telescopic pole or rope. At the time of sample collection, flow measurements will be conducted.

All sampling equipment will be cleaned prior to use. If wading into the water is necessary, the sampling technician shall be careful not to disturb bottom sediments and to wait until sediments settle prior to obtaining the sample. Procedures for obtaining these samples are presented in Appendix D.

5.5 Surface Water Sample Containers and Preservatives for Off-Site Shipping and Storage

Table 2 also lists the appropriate container and preservative to be used for sample storage and shipment to off-site laboratories. Packaging, labeling, and shipping of samples are addressed in Appendix B. Chain of Custody forms and procedures are presented in Appendix A. These must accompany the sample at all times to document sample transfer from the field to the laboratory.

5.6 Field Analyses and Preparation

The following field analyses shall be performed during sampling. Appendix E details the Standard Operating Procedures for each analysis.

<u>Analysis</u>	<u>EPA Method No.</u>
pH	150.1
Conductivity	120.1



Flow measurements will also be conducted as described in Appendix D.

To protect sampling and laboratory personnel from potential exposure to possible hazardous or radioactive contaminants, all samples will be decontaminated prior to packaging. After each sample is collected, sample containers will be washed on the exterior with a detergent, rinsed with tap water, and dried with paper towels. These decontamination rinse waters will be released into the FMPC sewer system.

5.7 Off-Site Laboratory Analyses

It is estimated that 55 samples will be taken during the surface water sampling protocol. These will be sent off-site for analysis of all specified parameters. In addition, six blind duplicates, six field blanks, and two trip blanks will be sent to the laboratory for external quality control. The 55 samples and external quality control samples will be analyzed for the following parameters:

Chemical Analysis

Indicators - Total dissolved solids (TDS)
Total suspended solids (TSS)
Total organic carbon (TOC)
Total organic halides (TOX)
Oil and grease

Metals - Cu, Mg, Mn, Pb, Al, Ba, Ca, Fe, Na, Zn, Cr



Anions - Chloride
Sulfate
Nitrate
Fluoride

Organics - 1,1,1-Trichloroethane (1,1,1-TCE) ✓
Perchloroethylene (tetrachloroethylene)

Radiological Analyses - Total uranium
Total thorium
Gross alpha
Gross beta

Analytical procedures to be used for FMPC samples are described in Appendix F.

5.8 Sample Identification and Numbering

All surface water sampling locations and associated sample numbers shall be identified using the code described in Section 4.0.

5.9 Deliverables

The following deliverables shall be submitted by WESTON:

- o Results of Field Laboratory Analysis
- o Results of Outside Laboratory Analyses
- o Completed Chain of Custody Forms
- o Memorandum describing field activities including documentation of sample collection and handling techniques.



APPENDIX A
SAMPLE CONTROL AND DOCUMENTATION



1.0 SAMPLE CONTROL AND DOCUMENTATION

The purpose of document control is to assure that all documents for the FMPC project will be accounted for when the project is completed. Accountable documents will include items such as logbooks, filed data records, correspondence, sample tags, chain of custody reports, and analytical records. Each document will bear a serial number and should be listed, with the number, in a project document inventory assembled at the project's completion. Waterproof ink must be used in recording all data in documents bearing serial numbers.

A documentation coordinator will number all logbooks, sample tags, and chain of custody records. In a logbook, he shall record transfer of other logbooks to individuals who have been designated to perform specific tasks on the project. All project logbooks are to be turned over to the coordinator at the completion of each work period, and to a central file at the completion of the field activity.

Field Logbook - All information pertinent to a field activity must be entered in a bound book with consecutively numbered pages. Entries in the logbook must include at least the following:

Date and time of entry

Purpose of sampling

Name and address of field contact (Federal, state, local representative)

Producer of waste and address (if known)

Type of process producing waste (if known)

Type of waste (sludge, wastewater, etc.)

Description of sample

Waste components and concentrations (if known)

Number and size of sample taken

Description of sampling point

Date and time of collection of sample



Collector's sample identification number(s) and/or name

References such as maps of the sampling site

Field observations

Any field measurements made

Because sampling situations vary widely, notes should be as descriptive and inclusive as possible. Someone reading the entries should be able to reconstruct the sampling situation from the recorded information. Language must be objective, factual, and free of personal feelings or any other inappropriate terminology. If anyone other than the person to whom the logbook was assigned makes an entry, he must date and sign it.

1.1 Sample Labels

Each sample must be sealed immediately after it is collected and labeled using waterproof ink. Label tags may be filled out prior to collection to minimize handling of the sampling containers. Figure A-1 provides an example of the common sample label to be used on FMPC samples.

Occasionally, sample containers will be marked in the field using an etching tool rather than immediately applying a sample label or tag. This avoids possible label contamination problems and subsequent decontamination difficulties. In this case, the data intended for the sample label will be written into a sampling logbook and transcribed onto the label after the sample containers have been decontaminated.

Labels must be firmly affixed to the sample containers. The container must be dry enough for a gummed label to be securely attached.

FIGURE A-1
EXAMPLE OF OFFICIAL SAMPLE LABEL

WATER SAMPLE IDENTIFICATION TAG

SITE ID _____ LOCATION ID _____
SAMPLE ID _____
BOTTLE ID _____
PRESERVATION METHOD _____
LOG DATE _____ LOG TIME _____
SAMPLER(S) _____
COMMENTS: _____



1.2 Sample Collection and Identification

The number of persons involved in collecting and handling samples will be kept at a minimum. Guidelines established in this manual for sample collection, preservation, and handling should be used. Field records will be completed at the time the sample is collected and will be signed or initialed, including the date and time, by the sample collector(s). Field records will contain the following information:

Unique sampling or log number as discussed in Section 4.0 of the Sampling Plan

Date and time

Source of sample (including name, location, and sample type)

Preservative used (if any)

Analysis required

Name of collector(s)

Pertinent field data

One member of the sampling team is to be appointed field custodian -- the documentation coordinator is a good choice. Samples will be turned over to the field custodian by team members who collect the samples. The field custodian will document each transaction and the sample will remain in his custody until it is shipped to the laboratory.

1.3 Chain of Custody Procedures

As in any other activity that may be used to support litigations, regulatory agencies must be able to provide the chain of possession and custody of any samples which are offered for evidence or which form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed or destroyed. The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and handling of the sample from the moment of its collection through analysis and its introduction as evidence.



A sample is in someone's "custody" if:

It is in one's actual possession, or

It is in one's view, after being in one's physical possession, or

It is in one's physical possession and then locked up so that no one can tamper with it, or

It is kept in a secured area, restricted to authorized personnel only.

When transferring the samples, the transferee must sign and record the date and time on the chain of custody record (Figure A-2). Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody must fill in the appropriate section of the chain of custody record. To minimize custody records, the number of custodians in the chain of possession will be minimized.

The field custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes filling out, dating, and signing the appropriate portion of the chain of custody record.

All packages sent to the laboratory will be accompanied by the chain of custody record and other pertinent forms. A copy of these forms will be retained by the originating office (either carbon or photocopy). Mailed packages will be registered with return receipt requested. For packages sent by common carrier, receipts will be retained as part of the permanent chain of custody documentation. Samples to be shipped must be packed so as not to break and the package sealed or locked so that any tampering can be readily detected.



APPENDIX B
GUIDE TO THE HANDLING, PACKAGING, AND
SHIPPING OF FMPC SAMPLES



1.0 SAMPLE HANDLING, TRANSPORT AND STORAGE

Samples collected during site characterization operations will have to be transported to laboratories in Pennsylvania for analysis. The transportation of samples must be accomplished not only in a manner designed to protect the integrity of the sample, but also to prevent any detrimental effects from the potentially hazardous nature of the samples. Regulations for packaging, marking, labeling and shipping of hazardous material, hazardous substances and hazardous wastes are promulgated by the U.S. Department of Transportation (DOT) and described in the Code of Federal Regulations (49 CFR 171 through 177, in particular, 172.402h, Packages Containing Samples). In general, these regulations were not intended to cover the shipment of samples collected at hazardous waste sites. However, the U.S. EPA has deemed it prudent to package, mark, label, and ship samples observing these DOT procedures. The information contained in this appendix is for general guidance and, although factual, should not be misconstrued as identical to DOT regulations for transportation of hazardous materials.

Samples collected at the FMPC site shall be classified as environmental samples. In general, environmental samples are collected off-site such as water samples from the various drainages and are not expected to be contaminated with high levels of toxic substances.

1.1 Environmental Samples

Samples judged to be environmental are not considered hazardous material; however, environmental samples will be packaged and shipped according to the following procedures.

1.1.1 Packing

Environmental samples can be packaged following the procedures for samples classified as "flammable liquids" or "flammable solids. Marking, labeling, and shipping papers do not apply. Environmental samples can also be packaged without being placed inside metal cans as required for "flammable liquids". Sample containers properly identified and with a sealed lid, in sealed polyethylene bags, can be packed in fiberboard containers or metal picnic cooler-type containers. Sufficient incombustible, absorbent cushioning material will be used to minimize the possibility of sample container breakage.



1.1.2 Marking and Labeling

Sample containers must have a completed sample identification tag. The outside container should be marked "Environmental Sample." No DOT marking and labeling is required.

1.1.3 Shipping Papers

No DOT shipping papers are required.

1.1.4 Transportation

There are no DOT restrictions on mode of transportation.

1.2 Samples Classified as Radioactive (TMC, GJ/TMC-13 U-70A)

The Federal regulations governing the transport of radioactive sample material are extremely complex and reflect overlapping jurisdiction from many Federal agencies. The important features of the Department of Transportation regulations, are summarized with their application to samples contaminated with uranium and associated daughter radionuclides, are summarized in 49 CFR 173.

In general, samples collected at the FMPC will not be classified radioactive for transport purposes and will therefore require no special attention to be considered in compliance with regulations (based on results of previous sampling/analysis programs at the FMPC conducted by WESTON and WMCO).



APPENDIX C
DECONTAMINATION OF FIELD EQUIPMENT



DECONTAMINATION PROCEDURES

1.0 GENERAL APPLICABILITY

This procedure describes the methods to be used for the decontamination of all field equipment which becomes potentially contaminated during a sample collection task. The equipment may include split spoons, bailers, trowels, shovels, hand augers, or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross-contamination between samples and also helps to maintain a clean working environment for the safety of all field personnel involved, including the environment.

Decontamination is mainly achieved by rinsing with liquids which include: soap and/or detergent solutions, tap water, deionized water, and methanol. Equipment is usually air dried after being cleaned or may be wiped dry with chemical free cloths or paper towels if immediate re-use is needed.

The frequency of equipment use dictates that most decontamination be accomplished at each sampling between collection points. Waste products produced by the decontamination procedures such as waste liquids, solids, rags, gloves, etc. will be collected and disposed of properly as directed by Westinghouse.

2.0 RESPONSIBILITIES

It is the primary responsibility of the site operations manager to assure that the proper decontamination procedures are followed and that all waste materials produced by decontamination are properly stored and disposed of.

It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that any contaminants are not negligently introduced to the environment.



3.0 SUPPORTING MATERIALS

Cleaning liquids: soap and/or detergent solutions, tap water, deionized water

Personal safety gear (defined in Project Health and Safety Plan)

Chemical-free paper towels

Disposable gloves

Waste storage containers: drums boxes, plastic bags

Cleaning containers: plastic buckets, galvanized steel pans

Cleaning brushes

4.0 METHODS OR PROTOCOL FOR DECONTAMINATION

4.1 General Procedures

Adequate supplies of all materials must be kept on hand. This includes all rinsing liquids and other materials listed in Section 3.0. The standard procedures listed in the following section can be considered the procedure for full field decontamination.

4.2 Standard Procedures

Remove any solid particles from the equipment or material by brushing and then rinsing with available tap water. This initial step is performed to remove gross contamination.

Wash equipment sampler with the soap or detergent solution.

Rinse with tap water.

Rinse with deionized water.

Repeat entire procedure or any parts of the procedure if necessary.

Allow the equipment or material to air dry.

Dispose of any soiled materials in the designated disposal container.



APPENDIX D
SURFACE RUNOFF SAMPLING TECHNIQUES



SURFACE RUNOFF SAMPLING TECHNIQUES

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure describes the basic techniques and considerations to be followed for the collection of water samples from storm sewers and drainage ditches using a bailer or dipper. The specific details of sample collection are dependent upon local site conditions as well as the purpose of the water quality study.

2.0 APPARATUS

The bailer consists of a stainless steel or teflon tube attached to a rope or cord that can be lowered down narrow pipes to collect aqueous samples. The bailer will be equipped with a float valve at the bottom to allow sample water to enter from the bottom of the bailer. This valve should allow the sample to flow freely upward into the bailer, but make a tight seal to prevent leakage of sample when the bailer is withdrawn. Bailers are readily available, and will not require special fabrication.

3.0 GENERAL COMMENTS AND PRECAUTIONS

- Do not use bailers constructed of nonfluorocarbon plastic containing organic materials.
- Do not use rope or cord made of nonfluorocarbon plastics, or containing organic materials. Cotton cord is recommended as it can be used once and discarded. Wetted rope can not be decontaminated.
- Decontaminate bailer using decon solution and water.

4.0 MATERIALS

- o Sample Plan - surface water sampling protocol
- o Site area maps
- o Sample containers and preservatives
- o Insulated containers (e.g., coolers) for sample storage and large quantities of ice.



- o Field equipment for analyses specified in the sampling program. Include calibration standard for any field measurements.
- o Dipper
- o Weighted tape measure or ridged gage
- o Field data sheets and/or log book
- o First aid kit

5.0 PROCEDURES

5.1 Sample Location Selection

The selection of sampling locations where mixing is incomplete should be avoided if an average composition is required. Use of a field conductivity meter is recommended for determining the uniformity of the water composition across the width and depth of the water body. Once the sampling point is selected, it must be fixed by detailed description, maps, or with the aid of stakes or other landmarks so that the sampling can be repeated if needed.

5.2 Stream Sampling

- 5.2.1 In shallow streams (those that can be traversed safely on foot) the sample container can be filled directly with the flowing water. Unless otherwise specified, the sample shall be collected at mid-depth in the mid-section or deepest flow channel of the stream.

5.3 Sampling Using a Bailer

1. Clean beaker, clamp and handle per decon instructions.
2. Turn dipper so the mouth of the beaker faces down and insert into water. Turn beaker right side up when dipper is at the desired depth. Allow beaker to fill completely as shown by the cessation of air bubbles.
3. Raise dipper and transfer sample to container.



6.0 SAMPLE HANDLING AND PRESERVATION

- 6.1 In general, the shorter the time lapse between sample collection and analysis, the more reliable the results will be. Certain water-quality parameters, including pH, temperature and dissolved oxygen, are closely related to the environment of the water and meaningful results can only be obtained by in-situ field measurements.
- 6.2 The EPA has developed a list of recommended sample containers, preservatives and maximum holding times for water quality measurements (Federal Register 44:69464). Unless specified in the sampling plan, this list should be followed. Preservatives can be added directly to the sample containers in the field after filling, or the containers can be pre-preserved. All samples should be placed on ice immediately after collection and should remain on ice until delivery to the analytical laboratory.

7.0 DESCRIPTION

Records must be kept of every sample collected and each bottle must be marked with a waterproof label. The field record must provide sample identification as well as the name of the sample collector, the date, time and exact locations of the collection point, and results of all field water quality measurements. Other information such as weather and stream flow conditions should also be noted. All documentation shall be retained in the appropriate project files.

8.0 MEASUREMENT OF FLOW

At the time samples are collected, the flow rate of the storm sewer or drainage ditch will be estimated. Several alternative methods will be used depending on the equipment available, runoff conditions and the practicality of measurements.

The preferred method to measure flow involves the use of a current meter, such as a Pygmy-Price, Marsh-McBirney or the equivalent. Given a value for the average velocity, 'v', and the cross sectional area 'a', then the flow 'q' can be determined by the following equation:

$$q = va$$

If use of a flow meter is impractical or impossible, it is possible to estimate the average velocity of flow by the use of the Manning equation:



$$V = \frac{1.49 R^{2/3} S^{1/2}}{n}$$

- where: v = average velocity in feet per second
- R = the hydraulic radius, or the ratio of the cross sectional arc to the wetted perimeter.
- S = the energy gradient, which is the slope of the water surface
- n = the Manning roughness coefficient

Manning's equation is expected to be used to estimate the flow in the sewers. Given the diameter, the slope, and the material of construction of the sewer pipe, the depth of flow can be measured and the approximate flow can then be calculated.

If none of these methods is available, then other methods which may be used include timing the filling of a calibrated bucket, timing floating objects through sewers, etc.

9.0 REFERENCES

USEPA, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Office of Waste and Emergency Response, SW846, 2nd Ed., 1982.

Fetter, C. W., Jr., Applied Hydrogeology, University of Wisconsin-Oshkosh, Charles E. Merrill Publishing Co., A. Bell & Howell Company, Columbus, Ohio 43216.



APPENDIX E
FIELD METHODS FOR ANALYSIS OF STORMWATER RUNOFF

Temperature
pH
Conductance
Dissolved Oxygen



TEMPERATURE

METHOD 170.1 (THERMOMETRIC)

STORET NO. 00010

1. SCOPE AND APPLICATION

- 1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.

2. SUMMARY OF METHOD

- 2.1 Temperature measurements may be made with any good grade of mercury-filled or dial type centrigrade thermometer, or a thermistor.

3. COMMENTS

- 3.1 Measurement device should be routinely checked against a precision thermometer certified by the National Bureau of Standards.

4. PRECISION AND ACCURACY

- 4.1 Precision and accuracy for this method have not been determined.

5. REFERENCE

- 5.1 The procedure to be used for this determination is found in: Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 125, Method 212(1975).



pH

METHOD 150.1 (ELECTROMETRIC)

STORET NO.
Determined on site 00400
Laboratory 00403

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes and acid rain (atmospheric deposition).

2.0 SUMMARY OF METHOD

2.1 The pH of a sample is determined electrometrically using either a glass electrode in combination with a reference potential or a combination electrode.

3.0 SAMPLE HANDLING AND PRESERVATION

3.1 Samples should be analyzed as soon as possible preferably in the field at the time of sampling.

3.2 High-purity waters and waters not at equilibrium with the atmosphere are subject to changes when exposed to the atmosphere, therefore the sample containers should be filled completely and kept sealed prior to analysis.

4.0 INTERFERENCES

4.1 The glass electrode, in general, is not subject to solution interferences from color, turbidity, colloidal matter, oxidants, reductants or high salinity.

4.2 Sodium error at pH levels greater than 10 can be reduced or eliminated by using a "low sodium error" electrode.

4.3 Coatings of oily material or particulate matter can impair electrode response. These coatings can usually be removed by gentle wiping or detergent washing, followed by distilled water rinsing. An additional treatment with hydrochloric acid (1 + 9) may be necessary to remove any remaining film.

4.4 Temperature effects on the electrometric measurement of pH arise from two sources. The first is caused by the change in electrode output at various temperatures. This



interference can be controlled with instruments having temperature compensation or by calibrating the electrode-instrument system at the temperature of the samples. The second source is the change of pH inherent in the sample at various temperatures. This error is sample dependent and cannot be controlled. It should therefore be noted by reporting both the pH and temperature at the time of analysis.

5.0 APPARATUS

5.1 pH Meter Laboratory or field model. A wide variety of instruments are commercially available with various specifications and optional equipment.

5.2 Glass electrode.

5.3 Reference electrode - a calomel, silver-silver chloride or other reference electrode of constant potential may be used.

NOTE I: Combination electrodes incorporating both measuring and reference functions are convenient to use and are available with solid, gel type filling materials that require minimal maintenance.

5.4 Magnetic stirrer and Teflon-coated stirring bar.

5.5 Thermometer or temperature sensor for automatic compensation.

6.0 REAGENTS

6.1 Primary standard buffer salts are available from the National Bureau of Standards and should be used in situations where extreme accuracy is necessary.

6.1.1 Preparation of reference solutions from these salts requires some special precautions and handling¹ such as low conductivity dilution water, drying ovens, and carbon dioxide free purge gas. These solutions should be replaced at least once each month.

6.2 Secondary standard buffers may be prepared from NBS salts or purchased as a solution from commercial vendors. Use of these commercially available solutions, that have been validated by comparison to NBS standards, are recommended for routine use.

¹National Bureau of Standards Special Publication 20.



7.0 CALIBRATION

- 7.1 Because of the wide variety of pH meters and accessories, detailed operating procedures cannot be incorporated into this method. Each analyst must be acquainted with the operation of each system and familiar with all instrument functions. Special attention to care of the electrodes is recommended.
- 7.2 Each instrument/electrode system must be calibrated at a minimum of two points that bracket the expected pH of the samples and are approximately three pH units or more apart.
- 7.2.1 Various instrument designs may involve use of a "balance" or "standardize" dial and/or slope adjustment as outlined in the manufacturer's instructions. Repeat adjustments on successive portions of the two buffer solutions as outlined in procedure 8.2 until readings are within 0.05 pH units of the buffer solution value.

8.0 PROCEDURE

- 8.1 Standardize the meter and electrode system as outlined in Section 7.
- 8.2 Place the sample or buffer solution in a clean glass beaker using a sufficient volume to cover the sensing elements of the electrodes and to give adequate clearance for the magnetic stirring bar.
- 8.2.1 If field measurements are being made the electrodes may be immersed directly in the sample stream to an adequate depth and moved in a manner to insure sufficient sample movement across the electrode sensing element as indicated by drift free (<0.1 pH) readings.
- 8.3 If the sample temperature differs by more than 2°C from the buffer solution, the measured pH values must be corrected. Instruments are equipped with automatic or manual compensators that electronically adjust for temperature differences. Refer to manufacturer's instructions.
- 8.4 After rinsing and gently wiping the electrodes, if necessary, immerse them into the sample beaker or sample stream and stir at a constant rate to provide homogeneity and suspension of solids. Rate of stirring should minimize the air transfer rate at the air water interface of the sample.



Note and record sample pH and temperature. Repeat measurement on successive volumes of sample until values differ by less than 0.1 pH units. Two or three volume changes are usually sufficient.

- 8.5 For acid rain samples it is most important the the magnetic stirrer is not used. Instead, swirl the sample gently for a few seconds after the introduction of the electrode(s). Allow the electrode(s) to equilibrate. The air-water interface should not be disturbed while measurement is being made. If the sample is not in equilibrium with the atmosphere, pH values will change as the dissolved gases are either absorbed or desorbed. Record sample pH and temperature.

9.0 CALCULATION

- 9.1 pH meters read directly in pH units. Report pH to the nearest 0.1 unit and temperature to the nearest °C.

10.0 PRECISION AND ACCURACY

- 10.1 Forty-four analysts in twenty laboratories analyzed six synthetic water samples containing exact increments of hydrogen-hydroxylions, with the following results:

<u>pH Units</u>	<u>Standard Deviation pH Units</u>	<u>Accuracy As Bias %</u>	<u>Bias, pH Units</u>
3.5	0.10	-0.29	-0.01
3.5	0.11	-0.00	
7.1	0.20	+1.01	+0.07
7.2	0.18	-0.03	-0.002
8.0	0.13	-0.12	-0.01
8.0	0.12	+0.16	+0.01

(FWPCA Method Study 1, Mineral and Physical Analyses)

- 10.2 In a single laboratory (EMSL), using surface water samples at an average pH of 7.7, the standard deviation was ± 0.1 .



BIBLIOGRAPHY

1. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p. 460(1975)
2. Annual Book of ASTM Standards, Part 31, "Water", Standard D1293-65, p. 178(1976).
3. Peden, M.E. and Skowron, L.M. Ionic Stability of Precipitation Samples. Atmospheric Environment, Vol. 12, pp. 2323-2349, 1978.



CONDUCTANCE

METHOD 120.1, (SPECIFIC CONDUCTANCE, UMHOS AT 25^oC)

STORET NO. 00095

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to drinking, surface and saline waters, domestic and industrial wastes and acid rain (atmospheric deposition).

2.0 SUMMARY OF METHOD

2.1 The specific conductance of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge-type or equivalent.

2.2 Samples are preferable analyzed at 25^oC. If not, temperature corrections are made and results reported at 25^oC.

3.0 COMMENTS

3.1 Instrument must be standardized with KCI solution before daily use.

3.2 Conductivity cell must be kept clean.

3.3 Field measurements with comparable instruments are reliable.

3.4 Temperature variations and corrections represent the largest source of potential error.

4.0 SAMPLE HANDLING AND PRESERVATION

4.1 Analyses can be performed either in the field or laboratory.

4.2 If analysis is not completed within 24 hours of sample collection, sample should be filtered through a 0.45 micron filter and stored at 4^oC. Filter and apparatus must be washed with high quality distilled water and pre-rinsed with sample before use.



5.0 APPARATUS

5.1 Conductivity bridge, range 1 to 1000 umho per centimeter.

5.2 Conductivity cell, cell constant 1.0 or micro dipping type cell with 1.0 constant. YSI #3403 or equivalent.

5.3 Thermometer

6.0 REAGENTS

6.1 Standard potassium chloride solutions, 0.01 M: Dissolve 0.7456 gm of pre-dried (2 hour at 105°C) KCL in distilled water and dilute to 1 liter at 25°C.

7.0 CELL CALIBRATION

7.1 The analyst should use the standard potassium chloride solution (6.1) and the table below to check the accuracy of the cell constant and conductivity bridge.

Conductivity 0.01 m KCL

°C	Micromhos/cm
21	1305
22	1332
23	1359
24	1386
25	1413
26	1441
27	1468
28	1496

8.0 PROCEDURE

8.1 Follow the direction of the manufacturer for the operation of the instrument.

8.2 Allow samples to come to room temperature (23 to 27°C), if possible.

8.3 Determine the temperature of samples within 0.5°C. If the temperature of the samples is not 25°C, make temperature correction in accordance with the instruction in Section 9 to convert reading to 25°C.



9.0 CALCULATION

9.1 These temperature corrections are based on the standard KCl solution.

9.1.1 If the temperature of the sample is below 25°C, add 2% of the reading per degree.

9.1.2 If the temperature is above 25°C. subtract 2% of the reading per degree.

9.2 Report results as Specific Conductance umhos/cm at 25°.

10.0 PRECISION AND ACCURACY

10.1 Forty-one analysts in 17 laboratories analyzed six synthetic water samples containing increments of inorganic salts, with the following results:

<u>Increment As</u> <u>Specific Conductance</u>	<u>Precision As</u> <u>Standard Deviation</u>	<u>Accuracy As</u> <u>Bias,</u> <u>%</u>	<u>Bias,</u> <u>umhos/cm</u>
100	7.55	-2.02	-2.0
106	8.14	-0.76	-0.8
808	66.1	-3.63	-29.3
848	79.6	-4.54	-38.5
1640	106	-5.36	-87.9
1710	119	-5.08	-86.9

10.2 In a single laboratory (EMSL) using surface water samples with an average conductivity of 536 umhos/cm at 25°C, the standard deviation was ±6.



OXYGEN, DISSOLVED

METHOD 360.1 (MEMBRANE ELECTRODE)

STORET NO. 00299

1.0 SCOPE AND APPLICATION

- 1.1 The probe method for dissolved oxygen is recommended for those samples containing materials which interfere with the modified Winkler procedure such as sulfite, thiosulfate, polythionate, mercaptans, free chlorine or hypochlorite, organic substances readily hydrolyzed in alkaline solutions, free iodine, intense color or turbidity and biological flocs.
- 1.2 The probe method is recommended as a substitute for the modified Winkler procedure in monitoring streams, lakes, outfalls, etc., where it is desired to obtain a continuous record of the dissolved oxygen content of the water under observation.
- 1.3 The probe method may be used as a substitute for the modified Winkler procedure in BOD determinations where it is desired to perform nondestructive DO measurements on a sample.
- 1.4 The probe method may be used under any circumstances as a substitute for the modified Winkler procedure provided that the probe itself is standardized against the Winkler method on samples free of interfering materials.
- 1.5 The electronic readout meter for the output from dissolved oxygen probes is normally calibrated in convenient scale (0 to 10, 0 to 15, 0 to 20 mg/l for example) with a sensitivity of approximately 0.05 mg/liter.

2.0 SUMMARY OF METHOD

- 2.1 The most common instrumental probes for determination of dissolved oxygen in water are dependent upon electrochemical reactions. Under steady-state conditions, the current or potential can be correlated with DO concentrations. Interfacial dynamics at the probe-sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary. For precision performance, turbulence should be constant.



3.0 SAMPLE HANDLING AND PRESERVATION

3.1 See 4.1, 4.2, 4.3, 4.4 under Modified Winkler Method (360.2)

4.0 INTERFERENCES

4.1 Dissolved organic materials are not known to interfere in the output from dissolved oxygen probes.

4.2 Dissolved inorganic sales are a factor in the performance of dissolved oxygen probe.

4.2.1 Probes with membrane respond to partial pressure of oxygen which, in turn, is a function of dissolved inorganic salts. Conversion factors for seawater and brackish waters may be calculated from dissolved oxygen saturation versus salinity data. Conversion factors for specific inorganic sale may be developed experimentally. Broad variations in kinds and concentrations of salts in samples can make the use of a membrane probe difficult.

4.3 Reactive compounds can interfere with the output or the performance of dissolved oxygen probes.

4.3.1 Reactive gases which pass through the membrane probes may interfere. For example, chlorine will depolarize the cathode and cause a high probe-output. Long-term exposures to chlorine will coat the anode with the chloride of the anode metal and eventually desensitize the probe. Alkaline samples in which free chlorine does not exist will not interfere. Hydrogen sulfide will interfere with membrane probes if the applied potential is greater than the half-wave potential of the sulfide ion. If the applied potential is less than the half-wave potential, an interfering reaction will not occur, but coating of the anode with the sulfide of the anode metal can take place.

4.4 Dissolved oxygen probes are temperature sensitive, and temperature compensation is normally provided by the manufacturer. Membrane probes have a temperature coefficient of 4 to 6 percent/^oC dependent upon the membrane employed.



5.0 APPARATUS

5.1 No specific probe or accessory is especially recommended as superior. However, probes which have been evaluated or are in use and found to be reliable are the WESTON & Stack DO Analyzer Model 30, the Yellow Springs Instrument (YSI) Model 54, and the Beckman Fieldlab Oxygen Analyzer.

6.0 CALIBRATION

Follow manufacturer instructions.

7.0 PROCEDURE

Follow manufacturer instructions.

8.0 CALCULATION

Follow manufacturer instructions.

9.0 PRECISION AND ACCURACY

Manufacturer's specification claim 0.1 mg/l repeatability with \pm 1% accuracy.

Bibliography

1. Standard methods for the Examination of Water and Wastewater, 14th Edition, p 450, Method 422F(1975).



APPENDIX F
ANALYTICAL LABORATORY PROCEDURES TO BE USED FOR
FMPC SAMPLE ANALYSES



1.0 INTRODUCTION

This analysis plan describes the methods which will be used for analysis of samples from storm sewers and surface drainages at the Feed Materials Production Center in Fernald, Ohio. The sample matrices are anticipated to include storm sewer and surface runoff water.

2.0 ANALYTICAL METHODS

2.1 Chemical Analyses

The methods to be used for analysis of metals, organics, and general water quality criteria in FMPC stormwater samples are listed in Table F.1.

2.2 Radiochemical Analyses

The radiochemical analyses of the FMPC samples will include all or some of the following:

- Liquid Matrix
- Total uranium
- Total thorium
- Gross alpha
- Gross beta

The procedures used will be outlined in the Health and Safety Laboratory Procedures Manual (HASL 300) contained in the EML Procedures Manual (DOE, 1982).

3.0 DETECTION LIMITS

The target detection limits for inorganic and organic HSL compounds are listed in Tables F.2 F.3 and F.4. Achieving these detection limits depends on the sample matrix. Highly contaminated samples requiring dilution will have detection limits higher than those listed.



TABLE F.1

ANALYTICAL METHODS

<u>Analyte</u>	<u>Method</u>
Metals Copper, Magnesium, Manganese, Lead, Aluminum, Barium, Calcium, Iron, Sodium, Zinc, Chromium	6000/7000 series
pH	EPA 150.1
Specific Conductance	EPA 120.1
TDS	EPA 160.1
TSS	EPA 260.2
TOX	EPA 9020
TOC	EPA 415.1
Oil & Grease	EPA 4132.2
N-NO ₃	SM 429
Cl (ic)	SM 429
SO ₄ (ic)	SM 429
F (ic)	SM 429
1,1,1 TCE, Perchloroethylene	EPA 601



TABLE F.2

Organic Substance Analysis List and
Contract Required Detection Limits (CRDL)

Volatiles	CAS Number	Target Detection Limits
		Low Water ^a ug/L
1. 1,1,1-Trichloroethane	71-55-6	5
2. Tetrachloroethylene	127-18-4	5

^a Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water CRDL.



TABLE F.3

Elements Determined by Inductively Coupled
Plasma Emission or Atomic Absorption Spectroscopy

Element	Target Detection Limit ^{1,2} (ug/L)
Aluminum	200
Barium	200
Calcium	5000
Chromium	10
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Sodium	5000
Zinc	20



TABLE F.4
INORGANIC ANALYSIS OF AQUEOUS SAMPLES
TARGET DETECTION LIMITS

<u>ANALYTE</u>	<u>TARGET DETECTION LIMIT (mg/l)</u>
Total Dissolved Solids	1
Total Suspended Solids	1
Total Organic Halides	.005
Total Organic Carbon	1
Oil and grease	1
Nitrates	.02
Chlorides	.1
Sulfates	5
Fluorides	.3

Method References



1. U.S.E.P.A. Statement of Work, "Organic Analysis Multi-Media, Multi-Concentration," 7/85.
2. U.S.E.P.A. Statement of Work "Inorganic Analyses Multi-Media, Multi-Concentration" SOW 785, July 1985.
3. "Test Methods for Evaluating Solid Waste, "Office of Solid Waste and Emergency Response, Washington D.C. 20460, Revised April, 1984.