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Systems Plan
for
Remediation Area 1, Phase II

FDF Project No: 20710
Document No.: 20710-PL-0003

November 1997
Revision C
90 Percent Design Review

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Subcontract No. 2-21487
Project Order 175

PARSONS

175 Tri-County Parkway
Cincinnati, Ohio 45246

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Systems Plan for Groundwater Collection and Transfer Remediation Area 1, Phase II

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CONTENTS

SECTION

1.0 Introduction 1

1.1 Purpose of Systems Plan 1

2.0 System Description and Intended Performance 2

3.0 Operation 3

3.1 Description of Equipment 3

3.2 Pre-Startup 3

3.3 Startup (By Contractor) 6

3.4 System Procedures 7

3.5 Potential Problems 7

3.6 Maintenance 8

4.0 Activities, Records, and Reports 9

LIST OF ILLUSTRATIONS

TABLES

3-1 Manual Valve Operating Positions

4-1 Summary of Records and Reports

4-2 Equipment Maintenance and Calibration Schedule

LIST OF ACRONYMS AND ABBREVIATIONS

AWWT	Advanced Waste Water Treatment Facility
FDF	Fluor Daniel Fernald, Inc.
FEMP	Fernald Environmental Management Project
gpm	gallons per minute
kVA	Kilo Volt Amperes
N/A	Not Applicable
MWI	Maintenance Work Instructions
OSDF	On-Site Disposal Facility
PCE	Perchloroethylene
RCRA	Resource Conservation and Recovery Act
STP	Sewage Treatment Plant
SWRB	Stormwater Retention Basin
V	Volts
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

The Fernald Environmental Management Project (FEMP) is a 1,050-acre facility located in southwestern Ohio approximately 18 miles northwest of downtown Cincinnati. The mission of the facility was to provide high-purity uranium metal products to support United States defense programs. Production operations were discontinued in 1989. Subsequently, the Department of Energy (DOE) decided to decontaminate and dismantle the facility and began environmental remediation of the site.

To facilitate management of the environmental remediation activities, the site was divided into seven sitewide remediation areas. Several of these areas will be remediated in phases. Area 1 is subdivided into two major phases (Phase I and Phase II). Remediation of Area 1, Phase I was completed in March 1997.

Area 1, Phase II, encompasses approximately 153 acres and is located in the southeastern part of the FEMP. It is bordered on the east and south by the FEMP boundary; on the west by the South Access Road, an unnamed stream and former production area.; and on the north by Area 1, Phase I, and the On-Site Disposal Facility (OSDF). The terrain in the project area is rolling pasture. The Sewage Treatment Plant (STP) and Phase I of the North Entrance Road are either partially or completely located in this area. A former trap shooting range is also located in the area. The remediation activities within the Area 1, Phase II project will include: demolition of below grade structures, removal of subsurface utility lines, and excavation at the Sewage Treatment Plant (STP); demolition of concrete pads, and excavation of lead contaminated soils at the former Trap Range Area; surface stripping around the STP excavation area (see Construction Drawings for location); and miscellaneous activities including removal of agricultural drain tiles, and removal of sediments from existing sediment basins used during the Area 1, Phase I remedial activities.

1.1 Purpose of Systems Plan

This systems plan describes the STP Water Handling System, the wheel wash/decontamination facility, and their performance requirements. The selected Contractor will prepare a Systems Implementation Manual that presents the processes, methods, and details to implement this plan.

2.0 SYSTEM DESCRIPTION AND INTENDED PERFORMANCE

The STP Water Handling System, (see construction drawings and specifications for detailed information) consists of the following:

1) Excavation Sump Pump: The Excavation Sump Pump will transfer water from the excavation sump to the receiving tanks. Minimize sediment loading.

2) Receiving Tanks: Tanks will store water pumped from the STP area. An earthen secondary containment berm is provided. Water collected within the berm will be pumped to the receiving tanks.

3) Transfer Pumps: Pumps will transfer water via forcemain from the receiving tanks to the AWWTF Phase I or to tanker trucks for transport to pretreatment and discharge to AWWTF Phase II.

4) Remediation Generated Water Transfer Line: Under normal operation, water collected in the Receiving Tanks will be pumped via a storm drain connector to the controlled storm sewer system for treatment at AWWTF Phase I. As an option, during periods of SWRB overflow, water in these tanks may be discharged to the sedimentation basin.

5) Equipment Decontamination Facility: the wheels of haul trucks will be cleaned of mud and debris at a wash facility. Washing will be accomplished with portable pressure washers. Drainage from the facility is routed to a sump for transfer to the Water Handling System receiving tanks. A steam cleaner is optional

The STP Water Handling System will be used to collect, store, analyze, and transfer water collected in the STP area and influent/effluent pipeline excavations, and wastewater from the wheel wash/decontamination facility.

3.0 OPERATION

3.1 Description of Equipment

Electrical power at 480 volts, three phase, is supplied to each transfer pump through cable in conduit (ductbank) from a starter rack located near the pump. The sump pump in the Equipment Decontamination Facility is fuel powered and furnished by the Contactor.

Motor overloads in the combination starter will protect the motor.

The pumps are electric motor-driven, centrifugal pumps with stainless steel impellers, cast iron housing, stainless steel shafts, and mechanical seals. Valves are manually operated type; check valves are silent check type.

A 480 volt, three-phase, main fused disconnect switch is located in the starter rack near the pumps. The switch may be used to disconnect all electrical power to the pump combination starters and local transformer/panel combination.

All electrical equipment enclosures are rated type 3R or 4, according to National Electrical Manufacturers' Association 250, and are located on an equipment rack for the transfer pumps. A 5 kVA, 480-120/240V, single-phase transformer/panel combination is provided with six 20 amp branch circuits. These provide 120 volt power for instrumentation and a local duplex receptacle.

Submersible power and control cables are furnished with submersible pump and cable entry seals are designed to ensure a watertight and submersible seal.

The Contractor will be required to provide a portable wash water supply tank and washing equipment at the wheel wash/decontamination facility.

The receiving tanks are the flexible fabric (bladder) type. Four tanks of 25,000 gallon capacity each are provided.

3.2 Pre-Startup

The Contractor shall install, test and check the system in accordance with the construction drawings and specifications. Before the system is started, the following checks will be performed by Fluor Daniel Fernald, Inc. (FDF).

1) Check the construction acceptance documents to ensure that every component is constructed according to the plans and specifications and acknowledge acceptance.

2) Check the accuracy of the documents for all applicable and relevant functional technical tests (shop or field) for the electrical and mechanical equipment and acknowledge acceptance.

3) Make sure that all relevant site-specific procedural requirements, permits, and coordinations are complete.

Pre-startup tests shall be performed in the following order: (1) electrical and (2) mechanical. The Contractor shall install, start up, test, and ensure the system is functional for the duration of remediation activities and remove all as part of site restoration.

3.2.1 Electrical Pre-Startup Tests and Inspections

1) Check voltage at the main 480 V disconnect switch at pole NP-7. Voltage should measure a minimum of 475 volts between phases.

2) Visually inspect the interior of the starter for completion of installation, including fuses, control transformer, lights, and switch. Verify installation of motor overload heaters sized in accordance with the pump manufacturer's instructions.

3) Throw the switch to the "ON" position to supply power to the starter and distribution transformer/panel.

4) Switch on the distribution panel main circuit breaker, secondary main breaker, and branch circuit breakers for the instrumentation and receptacle. Verify 120 volts available at receptacles, with correct polarity and grounding. Verify operation of Ground Fault Circuit Interrupter circuit breaker.

3.2.2 Mechanical Pre-Startup Tests and Inspections

1) Visually inspect the mechanical installation and equipment, noting completion of construction.

2) Position the manual valves as listed below:

Table 3-1 - Manual Valve Operating Positions

Valve No.	Location	Initial Position
V100	Receiving Tanks Supply Header	Closed
V101 through V104	Receiving Tanks Sample/Drain	Closed
V105	Receiving Tank (TNK-1) Outlet	Closed
V106	Receiving Tank (TNK-2) Outlet	Closed
V107	Receiving Tank (TNK-3) Outlet	Open
V108	Receiving Tank (TNK-3) Isolation	Closed
V109	Truck Unloading	Closed
V110	Receiving Tank (TNK-4) Outlet	Closed
V111	Transfer Pump (PMP-1) Suction	Open
V112	Transfer Pump (PMP-2) Suction	Open
V113	Transfer Pump (PMP-1) Discharge	N/A (Check Valve)
V114	Transfer Pump (PMP-2) Discharge	N/A (Check Valve)
V115	Transfer Pump (PMP-1) Discharge	Closed
V116	Transfer Pump (PMP-2) Discharge	Closed
V117	Pressure Gauge (PI 102) Isolation	Open
V118	Transfer Pump Discharge to SWRB	Closed
V120	Transfer Pump Discharge to Tank Truck	Closed
V121 through V124	Receiving Tanks Level Standpipe Isolation	Open
V125	Pressure Gauge (PI 103) Isolation	Open
V126	Pressure Gauge (PI 104) Isolation	Open
V127	Receiving Tanks Supply Header	Closed

3.3 Startup (By Contractor)

The following are the steps needed for startup of the STP Water Handling System. The steps should be followed in the order listed.

3.3.1 Electrical

The FDF lockout/tagout procedures shall be followed during the testing phases of construction to safeguard personnel from electrical hazards. Construction acceptance testing shall be witnessed and documented by the FDF Quality Assurance/Quality Control Department.

NOTE: To prevent operation of the pump during the following tests 1 through 4, temporarily disconnect power leads to the pump motor at the contactor terminals or remove overload heaters.

1) Throw the circuit breaker to the "ON" position, applying power to the starter and associated control circuits. Verify that the correct voltage is present.

2) Depress the start button for each pump. Verify that the main contactor energizes.

3) Disconnect the power by opening the circuit breaker, check for voltage on load side of breaker - if no voltage then reinstall the motor wiring or heater elements for normal operation of the pumps. If voltage is present, open disconnect switch at pole NP-5 and replace circuit breaker.

4) With water in the tank, operate each pump and verify pump operation, checking for correct rotation and any abnormal operation or vibration.

3.3.2 Mechanical

1) Fill portion of the tank with clean water.

2) Push the "start" button and observe the following:
   (1) Check the pump for normal operation without unusual sounds.
   (2) Check for leakage.

3) Push the "stop" button if any unusual conditions are observed. If the pump is running normally, stop it when the water level reaches low-level. Correct any problems encountered before proceeding further with the startup.

4) Check to see that the pump stops at no flow signal from the flow transmitter.

5) Repeat Steps 1 through 4 for each pump.

6) Working with the equipment supplier, perform acceptance operating tests to demonstrate the ability of each pump to meet the full range of operating flow rates and operating points as shown on pump curves.

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3.3.3 Shutdown

At the successful completion of the above tests and checks, push the "stop" button.

3.4 System Procedures

During remediation, pump start will be manually initiated and pump stops automatically. Operation of the pump is indicated by a red "run" indicating light. Operation of the pressure washer should be by a qualified person in accordance with the manufacturer's operation manual.

3.5 Potential Problems

1) Description and Remedy:
Caution: Comply with current FDF lockout/tagout procedures before attempting a remedy.

Problem	Result	Remedy
Pump fails to start	No Flow	1) Refer to vendor Operations and Maintenance (O&M) Manual. 2) Check if 480 volt power is energized. 3) Check operation of start and stop buttons. 4) Check for tripped overload relay. 5) Check continuity of motor internal protection circuits (repair motor). 6) Start second pump.
Pump fails to stop	Pump runs dry	1) Refer to vendor O&M Manual. 2) Check operation of start and stop buttons. 3) Check/repair flow transmitter. 4) Check/repair contactor for welded contacts.

Problem	Result	Remedy
Pipeline plugs	1) No flow	1) Determine where plug is located. Drain water to a tank truck and transport for treatment.
	2) Pump deadheads	2) Clean out pipeline.

3.6 Maintenance

1) Valves: Follow procedures given in current applicable maintenance work instructions.

2) Pumps: Refer to pump vendor O&M manuals and current applicable maintenance work instructions.

3) Cleaning of sediment from the tanks must be performed by the Contractor when required, with disposal of collected materials as directed by FDF.

4) Keep system from freezing.

4.0 ACTIVITIES, RECORDS, AND REPORTS

Table 4-1 provides a list of activities, and records and reports associated with the STP Water Handling System. The frequency of each activity is also included in the table. Further details on maintenance and calibration frequencies associated with system equipment are provided in Table 4-2. FDF will maintain copies of all pertinent records and reports.

Table 4-1 - Summary of Records and Reports

Report	Frequency
Maintenance and Calibration	
Pump Inspection Report	Annually
Piping Inspection Report	Annually
Tank Inspection Report	Annually
Valve System Inspection Report	Annually
Other Monitoring	
Check for Sediment	Monthly

Table 4-2 - Equipment Maintenance and Calibration Schedule

Item	Maintenance Schedule
Pumps	Inspect annually per FDF MWI PCP100
Control Panel	Annually
Main Disconnect Switch and Starter	Inspect monthly for moisture
Motor Starters and Controls	Annually
Main Disconnect Switch	Monthly
Water Level Switch Calibration	Semi-annually
Flow Meter	Semi-annually

APPENDIX E

AREA 1, PHASE II STRUCTURES AND FACILITIES

TABLE E-1
SUMMARY OF AREA 1 PHASE II AT- AND BELOW-GRADE FACILITIES AND STRUCTURES

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Non-Contaminated Pipelines/Utility Lines					
AWWT Wastewater Effluent Line (FT-4-12" W)	Sector 3	12-in carbon steel line (abandoned) from AWWT to M.H. 175 at STP Area. Replaced by the AWWT Discharge Line (GW1-24"-01).	Segment from east side of former North Access Road to MH 175 (approx. 560 LF) will be abandoned and plugged prior to being excavated and dispositioned under A1PII.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00442 (22-4015) Section View: None Identified
AWWT Discharge Line (GW-24")	Sector 3	24-in HDPE line (operational) from SWRB Valve House (Building 18Q) to SMH176B.	To remain in service since it is the main discharge from the site and planned remediation in pipeline vicinity limited to excavation of surface soil and construction of A1PII Conveyance Channel.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 22H-5500-P-00667 22A-5500-P-00707 Section View: 18A-4445-G-01084 18A-4445-G-01086 18A-4445-G-01087 18A-4445-G-01088
AWWT Discharge Line (GW-20")	Sector 3	20-in HDPE bypass line (operational) from GW-24" to the DO Facility (Building 18P).	To remain in service since it is the main discharge from the site and planned remediation in pipeline vicinity limited to excavation of surface soil.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 22H-5500-P-00667 22A-5500-P-00707 Section View: 18A-4445-G-01084 18A-4445-G-01086 18A-4445-G-01087 18A-4445-G-01088

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TABLE E-1
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Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
AWWT Discharge Line (GW2-24", GW3-24")	Sector 3	24-in HDPE discharge line (operational) from the DO Facility (Building 18P) to SMH176B. Includes associated piping.	To remain in service since it is the main discharge from the site and planned remediation in pipeline vicinity limited to excavation of surface soil.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 22H-5500-P-00667 22A-5500-P-00707 Section View: 18A-4445-G-01084 18A-4445-G-01086 18A-4445-G-01087 18A-4445-G-01088
AWWT Discharge Line (ST-24")	Sector 3	24-in HDPE discharge line (operational) from SMH176B through the parshall Flume Building to FEMP fenceline and on to Great Miami River.	To remain in service since it is the main discharge from the site and planned remediation in pipeline vicinity limited to excavation of surface soil.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 22H-5500-P-00667 22A-5500-P-00707 Section View: 18A-4445-G-01084 18A-4445-G-01086 18A-4445-G-01087 18A-4445-G-01088
Leachate Transmission Gravity Line (WW-4"/8"-A-1000)	Sector 2	4"/8" leachage conveyance line from the OSDF to the biodenitrification surge lagoon	To remain in service for OSDF leachate transport. Planned remediation in pipeline vicinity limited to surface disturbance.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 92X-5900-G-00251 92X-5900-G-00254 92X-5900-G-00261 92X-5900-G-00266 92X-5900-G-00262 Section View: 92X-5900-G-00259
Crude Oil Pipeline	Sector 1	20-in carbon steel pipeline (operational), owned and operated by Mid-Valley, runs diagonally across southeast quadrant of A1PII in Mid-Valley right -of-way.	This pipeline is in service and shall not be disturbed	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 93X-5900-G-00327 93X-5900-G-00335 93X-5900-G-00343 Section View: None Identified

000017

TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Telephone Cables - (400 Pair Cable) Orange Fiber Optic Line - (100 Pair Cable) 4" PVC	Sectors 2 & 3	Buried abandoned cable on the east side of the Old North Entrance Road. Current operating cable is buried along the east side of the North Entrance Road from near the STP Access Road northward to Phase II Relocation, then overland on poles on the east side of Phase II North Entrance Road.	Planned remediation in vicinity limited to excavation of surface soil.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 22F-5500-P-00663 22A-5500-P-00664 22H-5500-P-00667 Section View: 00A-5500-G-01321
Fuel Gas Line (FG-14-4"V)	Sectors 2 and 3	4-in carbon steel pipe (abandoned) with asbestos-containing bituminouswrap extends from property line near DO Facility to Former Production Area, then north to the OSDF Sediment Basin. Must be certified as abandoned by CG&E.	Aprox. 1370 LF will be excavated and dispositioned under the A1PII Project.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 22A-5500-P-00664 Section View: None Identified
Fire Water Line (DW-4")	Sector 3	4-in cast iron pipe (operational) from Former Production Area to STP, and distributed within STP.	Segment from east side of old North Entrance Road to STP fence (approx. 560 LF) will be abandoned prior to being excavated and dispositioned under the A1PII Project. Portions within STP to be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 22A-5500-P-00664 Section View: None Identified
Fire Hydrants (LFH 36, 37, 38)	Sector 3	Fire hydrants, part of fire protection system at STP.	To be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified

000018
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TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Potable Water Line (DW-3")	Sector 3	3-in carbon steel pipe (abandoned) from Former Production Area to STP, and distributed within STP.	Segment from east side of old North Entrance Road to STP fence (approx. 560 LF) will be excavated and dispositioned under the A1PII Project. Portions within STPto be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 22A-5500-P-00664 Section View: None Identified
Electric Duct	Sector 3	21-in x 20-in concrete duct bank to the DO Facility Substation, Bldg 16K, approx. 3 ft deep. May include transite (asbestos) conduit. Wire may have asbestos insulation	Segment from east side of former North Access Road to DO Bldg and Substation (approx. 860 LF) will be abandoned prior to being excavated and dispositioned under the A1PII Project.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 22A-5500-P-00664 Section View: None Identified
Electrical Manholes (EMH-241 & TMH-S438)	Sector 3	Manholes on Electric Duct.	Manholes will be excavated with the Electrical Duct.	Above-Grade: N/A At/Below Grade: SCEP	Plan View: 75A-5500-G-00104 22A-5500-P-00664 Section View: None Idencified
Electrical Manholes (TMH-S439 & TMH-S440)	Sector 3	Manholes on Electric Duct at the DO Facility Substation (Bldg. 18K).	To remain in service.	Above-Grade: N/A At/Below Grade: N/A	Plan View: 75A-5500-G-00192 22A-5500-P-00707 18A-4445-G-1172 Section View: None Idencified

000019

TABLE E-1
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Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Buried Electric Cable and Overland Lines with associated Lights Pole	Sectors 1, 2 & 3	Electric cable (buried and overland0 runs along Former Production Area Fence in Sector 2 and along Entrance Roads in Sectors 2 and 3.	To remain in service.	Above-Grade: N/A At/Below Grade: N/A	Plan View: 22F-5500-P-00663 22A-5500-P-00664 22H-5500-P-00667 Section View: None Identified
Agricultural Drainage Tiles	Sectors 2 & 3	Vitrified clay tiles for drainage of former agricultural land. Nominal 4 in. diameter, 2 ½ - 4 ft. deep; approximately 4000 LF.	Normally 4-in diameter, 2½ to 4 ft deep (approx. 4000 LF), to be excavated and dispositioned as debris under the A1PII Project	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 22A-5500-P-00707 Section View: None Identified
Storm Drains	Sector 3	Various drainage structures in and around STP.	To be removed as part of overall excavation of STP.		Plan View: 22H-5500-P-00667. Section View: None Identified
Pipelines with Associated Contamination					
STP Wastewater Influent Line (SN-8" L1)	Sector 3	8-in cast iron force main from Former Production Area to Primary Sedimentation Tanks at the STP.	Segment from east side of former North Entrance Road to STP fence (approx. 560 LF) will be abandoned prior to being excavated and dispositioned under the A1PII Project. Portion within STP to be removed as part of averall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 22-4015 Section View: None Identified

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TABLE E-1
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Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
STP Wastewater Effluent Line (SN-16" C.I.)	Sector 3	16-in cast iron line (operational) from MH175 to MH176C. Older 16-in cast iron portion from MH176C to FEMP property boundary and extending off-property to Great Miami river has been abandoned.	Segment from the STP Fence to the FEMP boundary (approx. 575 LF) will be excavated and dispositioned under the A1PII Project. Portion from MH175 to STP fence to be removed as part of overall excavation of STP. Abandoned 16-in is plugged down stream of SMH 176C.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 Section View: None Identified
STP Wastewater Effluent Line (STI-20")	Sector 3	20-in HDPE line from SMH 176C to SMH 176B.	Segment (approx. 85 LF) will be removed under the A1PII Project.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 22-4015 Section View: None Identified
Lines within STP	Sector 3	Various wastewater and sludge lines within STP fence.	To be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 22A-5500-P-00707 Section View: None Identified

000021

TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Manholes					
Manhole 172	Sector 3	Manhole on line from Primary Settling Basins (25G) to Trickling Filters (25H).	See Building 25A. To be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Manhole 173	Sector 3	Manhole on line from Primary Settling Basins (25G) to Trickling Filters (25H).	See Building 25A. To be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Manhole 174	Sector 3	Manhole on line from Primary Settling Basins (25G) to Trickling Filters (25H).	See Building 25A. To be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Manhole 175	Sector 3	Manhole at junction of 12-in AWWT Wastewater Effluent Line and 16-in STP Wastewater Effluent Line.	See Building 25A. To be removed as part of overall excavation of STP.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: 18A-5500-G-00928 18A-5500-G-00932 18A-5500-G-00963
Manhole 176A	Sector 3	Manhole on abandoned portion of STP Combined Wastewater Effluent Line.	To be removed in conjunction with removal of abandoned line.	Above-Grade: N/A At/Below Grade: SCEP	Plan View: 75A-5500-G-00192 18A-4445-G-1172 Section View: None Identified

000022
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TABLE E-1
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Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Manhole 176B	Sector 3	Manhole at junction of STP Wastewater Effluent Line and AWWT Wastewater Effluent Line.	To remain in service.	Above-Grade: N/A At/Below Grade: SCEP	Plan View: 75A-5500-G-00192 18A-4445-G-1172 Section View: None Identified
Manhole 176C	Sector 3	Manhole on STP Wastewater Effluent Line.	To be removed under A1PII Project.	Above-Grade: N/A At/Below Grade: SCEP	Plan View: 75A-5500-G-00192 18A-4445-G-1172 Section View: None Identified
At/Below-Grade Structures					
Chlorination Bldg. & Contaminant Berm (25A)	Sector 3	STP Facility was used beginning in 1952 for treatment of sanitary waste and, for a period, process wastewater. The STP Facility currently operates to treat sanitary waste. 10' x 15' x 8' high , single-story cinder block structure with reinforced concrete floor that houses a chlorine feed system for disinfecting wastewater when the UV Disinfection System (25D) is off-line. An attached, below-grade portion of the building is an approximately 9' x 17' x 8' deep reinforced concrete structure that served as a chlorine mixing and contact tank. (74 yd^3 at- and below-grade concrete)	The STP Facility will be taken out of service and replaced prior to D&D of above-grade portions by FC&DP then excavation and disposal of remainder under the the A1PII Project. Deep excavation is anticipated for STP area as a result of U-total contamination of subsurface soil.	Above-Grade: FC&DP At/Below Grade: SCEP Breakline: 595.0' (final floor elev.) 25A-7000-M-00044 25A-2450-S-00016	Plan View: 75A-5500-G-00192 25A-5500-A-00181 Section View: (5250-25M-5031) (3025-H-984A)

000023

TABLE E-1
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Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
MH 175/Effluent Line Sampling Bldg. (25B)	Sector 3	Manhole #175 is upstream of the junction of the effluent line from the UV Disinfection Building (25D) and the effluent line from the Storm Water Retention Basin (SWRB) (18E). The single-level, Sampling Building (12' x 12' x 10' high, structural steel frame with non-insulated, corrugated fiberglass siding and roofing on a concrete floor slab) is installed beside MH 175 and houses a sampler and acid injection system. Associated with the building are a 4' x 6' x 5'-7" deep access manhole with 4" thick reinforced concrete walls and a 3'-6" x 3'-6" x 6'-6" wet well with 6" thick reinforced concrete walls. (20 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: FC&DP At/Below Grade: SCEP Breakline: 595.0' (top of final floor slab.)	Plan View: 75A-5500-G-00192 25A-5500-A-00184 Section View: None Identified
U.V. Disinfection Bldg. (25D)	Sector 3	13' x 15' x 9' high, single-level building, plus 6' below grade, with reinforced concrete walls and floors that houses two UV disinfection systems (used to destroy bacteria prior to discharge), a flow meter, and effluent sampling equipment. (42 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: SCEP At/Below Grade: SCEP Breakline: N/A	Plan View: 75A-5500-G-00192 25A-5500-A-00185 Section View: None Identified

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TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Digester Control Bldg. (25E)	Sector 3	20' x 20' x 16' high, two-story concrete block building that houses various equipment for operating the Digester and burning the digester gas. The building has a concrete first floor and roof and a 6", reinforced concrete slab, with a 2'-4" deep, grating-covered pit and trench built into it, and is constructed on spread footings. (16 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: FC&DP At/Below Grade: SCEP Breakline: 596'7" (Top of floor slab)	Plan View: 75A-5500-G-00192 25A-5500-A-00182 5250-25M-5010 Section View: 5250-25S-4041 5250-25S-4042 5250-25M-5034 5250-25M-5035
Digester (F-25E-3)	Sector 3	40' diameter x 16' high, reinforced concrete structure that was used to anaerobically stabilize and reduce the volume of sludge. It has a conical floor that slopes 5' from the outside wall (at elevation 593'-9") to the bottom (elevation 588'-9") , which is 4' diameter. The floor and bottom are 1' thick, while the wall is 1'-8" thick, from the top (elevation 618'-9") to the top of the ground slope around it (elevation 598'-7"), and 2'1¾" to the bottom of the walls (elevation 593'-9"). The tank has internal piping and a floating cover. (112 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: FC&DP At/Below Grade: SCEP Breakline: 598'1" (Top of berm around tank)	Plan View: 75A-5500-G-00192 25A-5500-A-00182 5250-25M-4013 5250-25M-5010 Section View: 5250-25S-4042 5250-25M-5035

000025

TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Final Sedimentation Tanks (F-25E-2)	Sector 3	Two, 12' x 30' x 8' deep reinforced concrete tanks, including internal mechanisms to remove scum and sludge, used to separate solids from the discharge from the Trickling Filters (25H) prior to chlorination. (100 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: SCEP At/Below Grade: SCEP Breakline: N/A	Plan View: 75A-5500-G-00192 5250-25M-4013 3025-S-986A Section View: 5250-25S-4026 5250-25M-5007 5250-25M-5032
Sludge Drying Beds (25F)	Sector 3	Approximately 70' x 92' x 5' deep, in-ground structure (precast concrete walls are supported by 20" diameter x 12' deep concrete footings) with a combination sand and gravel bed and a collection drain system used to concentrate sludge following treatment in the Digester (25E). Liquids are pumped to the Trickling Filters (25H). Considered Hazardous Waste Management Unit (HWMU) because it was determined to have received RCRA F002 listed spent solvent (tetrachloroethene). (15 yd^3 at- and below-grade concrete)	Spent solvent reportedly resulted in contamination of perched water. Perched water containing tetrachloroethene that is removed during excavation of STP Area will be pretreated to remove tetrachloroethene prior to disposal in the AWWT.	Above-Grade: N/A? At/Below Grade: SCEP Breakline: N/A	Plan View: 75A-5500-G-00192 5250-25M-4013 Section View: 5250-25M-5009 3025-AGAF#5A 3025-F-983A

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TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Primary Settling Basins (25G)	Sector 3	Two 12' x 30' x 26' deep reinforced concrete basins, including upstream bar screen and comminuter, used to separate suspended solids from the influent. Sludge was discharged to the Digester (25E) and effluent was discharged to the Trickling Filters (25H). (504 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: SCEP At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 5250-25M-4013 25A-5500-A-00183 Section View: 5250-25S-5006 5250-25S-5017 5250-25S-5018 5250-25S-5033 3025-F-982A
Trickling Filters (F-25E-4 & 5)	Sector 3	Two, 40' diameter x 7' high, reinforced concrete tanks, including a four-arm rotary distributor and underdrain system, and filled with a bed of porous slag (3 to 4 inches in diameter). Recirculation pumps are used to elevate the wastewater to the distributors. The filters are used to biologically remove contaminants from the wastewater using bacteria attached to the slag. (242 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: SCEP At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 5250-25M-4013 Section View: 5250-25M-5020
Recirculation Pumps Sump and Valve Pit (F-25E-6)	Sector 3	Various structures in the STP. (35 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: SCEP At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Hose House	Sector 3	(5 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: SCEP At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified

000027

TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
STP Incinerator (39D)	Sector 3	16' x 20' footprint; above-ground piece of structure (abandoned) supported by a strutural steel frame and sitting on an approximately 26'x 60' reinforced concrete foundation, which has been extended to the east and south with asphalt. There is a 145' long x 6" curb along the north side of the pad and asphalt, and a 12" reinforced concrete trench along the west side that discharges into a sump used to pump runoff from the pad to the Chlorine Contact Tank (25A). Used to burn a variety of wastes from the site from November 1954 through December 1979, including uncontaminated trash and uranium and thorium contaminated trash. (29 yd^3 at- and below-grade concrete)	Air emissions from incinerator probable source of on-property and off-property surface soil contamination in the vicinity of the STP. FC&DP will D&D above-grade portions of incinerator prior to excavation and disposal of remainder under the A1PII Project.	Above-Grade: FC&DP At/Below Grade: SCEP Breakpoint: 595' (Approx. Elev. top of slab.)	Plan View: 75A-5500-G-00192 Section View: 20-4017 20-4018
Flume Building (Outfall Line Pit) (18R)	Sector 3	Receives treated discharge from STP/AWWT/DO Facility for combined dicharge to Great Miami River.	Facility to remain in place.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 75A-5500-G-00192 18A-4445-G-1172 Section View: None Identified
Dissolved Oxgen (DO) Bldg. (18P)	Sector 3	Facility used to oxygenate combined plant discharges to ensure NPDES dissolved oxygen limit is met (operational, not currently in use).	Facility to remain in place.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 75A-5500-G-00192 18A-4445-G-1172 Section View: 18A-4445-G-1173

000028
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TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Aeration Tank	Sector 3	Part of DO Facility (operational, currently not in use)	See Building 18P.	Above-Grade: FC&DP At/Below Grade: SCEP Breakpoint: 592'-5" (elev. top of slab)	Plan View: 75A-5500-G-00192 18A-4445-G-1172 Section View: 18A-4445-G-1173
Dissolved Oxygen Facility Substation (16K)	Sector 2	Transformer on concrete slab serving Dissolved Oxygen Facility (operational).	See Building 18P.	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 75A-5500-G-00192 18A-4445-G-1172 Section View: 18A-4445-G-1173
Trap Range Bldg. and associated facilities (28F)	Sector 1	Originally Skeet Range Building (90), 15' x 15' x 9' high, single-story steel frame structure (abandoned) with metal siding and roofing and a concrete floor. Concrete Firing Line slabs and concrete trap house bunker are nearby.	FC&DP will D&D above-grade portions prior to excavation and disposal of remainder under the A1PII Project.	Above-Grade: FC&DP At/Below Grade: SCEP Breakpoint: Top of at-grade slab	Plan View: 75A-5500-G-00192 Section View: None Identified
Sumps	Sector 3	Various sumps located throughout the STP. (23 yd^3 at- and below-grade concrete)	To be excavated and dispositioned under the A1PII Project.	Above Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	See entries for STP Area Facilities above
Flumes, pump pits, valve pits	Sector 3	Various structures located throughout the STP. (35 yd^3 at- and below-grade concrete)	To be excavated and dispositioned under the A1PII Project.	Above Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	See entries for STP Area Facilities above

000029

TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Fencing					
STP-Area Perimeter Fence	Sector 3	8-ft high, 2800 LF galvanized steel chain link fence and gates enclosing STP Area.	To be removed and dispositioned under the A1PII Project.	Above-Grade: SCEP At/Below Grade: SCEP Breakline: N/A	Plan View: See Dwg G0003 Section View: None Identified
FEMP Perimeter Fence	Sectors 1 & 3	4-5 ft high wire fence	To remain in place.	Above-Grade: SCEP At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Roadways					
STP Access Road	Sector 3	Paved road from North Entrance Road to STP. (1500 LF, 20 ft wide [370 yd^3 asphalt])	To be excavated and dispositioned under the A1PII Project.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: See Dwg G0001 Section View: None Identified
Rerouted North Entrance Road (Phase I)	Sectors 2 & 3	Paved road segment from A1PI/A1PII boundary to junction with original North Entrance Road.	Will be excavated, regraded by others after installation of North Entrance Road Phase II alignment.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
South Entrance Road	N/A	Paved road	Not part of A1PII.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Miscellaneous Access Roads	Sectors 1, 2 &3	Gravel access roads to monitoring wells, etc.	Certify in place	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified

000030
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TABLE E-1
CONTINUED

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
Pipe Culverts	Sectors 1, 2 & 3	Pipe culverts along and/or beneath STP Access Road, North Entrance Road.	Excavate from beneath STP Access Road; certify culverts beneath Old North Entrance Road in place. North Entrance Road Phase II alignment to remain for remediation (if necessary) and certification by others.	Above-Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: Various
Trailers					
Trailer T-107	Sector 3	Construction Trailer adjacent to STP Area	Will be removed by FDF prior to remediation operations under the A1PII Project.	Above-Grade: FDF At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Trailer T-307	Sector 3	Construction Trailer adjacent to STP Area	See Trailer T-107.	Above-Grade: FDF At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Trailer T-515	Sector 3	Construction Trailer adjacent to STP Area	See Trailer T-107.	Above-Grade: FDF At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Miscellaneous Structures					
Containment Dike	Sector 3	Concrete dike in STP Area (7 yd^3 at- and below-grade concrete)	See Building 25A.	Above-Grade: SCEP At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified

000031

Facility / Structure	Location	Description	Remarks	Remedial Assignment/ Breakline	Reference Drawings
STP Ancillaries, Other???	Sector 3	Miscellaneous materials 5 yd^3	To be removed by A1PII	Above-Grade: N/A At/Below Grade: N/A Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Other Facilities (e.g. Laydown yard)	Adjacent to STP Area	Gravel	Portions not excavated as part of STP excavation to be certified in place	Above Grade: N/A At/Below Grade: SCEP Breakpoint: N/A	Plan View: See Dwg 00463 Section View: None Identified
Overhead Electric Distribution Line	Sectors 2 & 3	13.2 kvA Volt AC Insulated copper on wood poles from Former Production Area to STP (operational).	FDF will de-energize and D&D conductor prior to excavation and disposal of wood poles as debris under the A1PII Project.	Above-Grade: FC&DP At/Below Grade: SCEP Breakpoint: 3 ft above grade (to be painted orange)	Plan View: 75A-5500-G-00192 Section View: None Identified
Utility Pole w/ Warning Siren	Sector 3	Warning siren on wood pole near DO Facility.	To remain in place	Above-Grade: FC&DP At/Below Grade: FC&DP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Electric Transmission Line	Sectors 2 & 3	138 kvA Volt AC overhead type conductor on steel lattice structures along south and east property boundary and across Sector 3 near STP Area to Former Production Area. CG&E ownership and right-of way (operational).	To remain in place	Above-Grade: N/A At/Below Grade: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified
Benchmarks	Sectors 2 & 3	Miscellaneous Benchmarks	A1PII remediation not expected to require removal of benchmarks.	Above-Grade: SCEP At/Below Grade: SCEP Breakpoint: N/A	Plan View: 75A-5500-G-00192 Section View: None Identified

FC&DP = Facilities Closure and Demolition Project
D&D = Decontamination and Dismantlement

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1 of 3

TABLE E-2
EXISTING MONITORING WELLS

Sector	Official Name	Northing 1983	Easting 1983sp	Reason
1	2070	476781.37	1350560.02	IEMP Monitoring
1	3070	476791.60	1350557.08	IEMP Monitoring
1	3733	477096.63	1351676.36	IEMP Monitoring
1	2733	477100.05	1351692.04	IEMP Monitoring
1	2400	477928.86	1350346.82	IEMP Monitoring
1	2432	478031.61	1351613.27	IEMP Monitoring
1	3432	478044.38	1351615.30	IEMP Monitoring
1	4432	478054.67	1351620.83	IEMP Monitoring
1	1905	478616.47	1349786.00	Not in Use
1	2431	478886.20	1351606.01	IEMP Monitoring
1	3431	478895.98	1351606.72	IEMP Monitoring
2	4446	479409.92	1350727.47	Not in Use
2	11487	479750.41	1350925.69	Not in Use
2	2430	479783.18	1351528.30	IEMP Monitoring
2	3067	479789.54	1351519.16	IEMP Monitoring
2	2067	479790.41	1351527.98	Not in Use
2	4067	479802.02	1351525.38	IEMP Monitoring
2	3429	480102.34	1351823.86	IEMP Monitoring
2	2429	480112.01	1351824.02	IEMP Monitoring
2	3417	480314.51	1351463.44	IEMP Monitoring
2	2417	480332.90	1351464.84	IEMP Monitoring
2	2426	480850.24	1351733.70	IEMP Monitoring
2	3426	480860.32	1351733.15	IEMP Monitoring
2	4426	480865.66	1351724.77	IEMP Monitoring
3	2421	481681.26	1350605.32	IEMP Monitoring
3	3421	481692.05	1350605.70	IEMP Monitoring

TABLE E-3
ABANDONED MONITORING WELLS

Sector	Official Name	Northing 1983	Easting 1983sp	Status
1	1733	477109.82	1351688	PAA2
1	11131	478537.73	1351287	
1	11130	478540.45	1351264	PAA2
1	11505	479209.17	1351197	PAA2
1	11504	479215.15	1351205	PAA2
2	11548	479737.95	1350943	PAA3
2	1844	479930.33	1351332	PAA3
2	1843	479935	1351053	PAA3
2	1448	480015.79	1351643	PAA2
2	1447	480020.94	1351550	PAA3
2	11693	480088.52	1351312	PAA3
2	1444	480099.57	1351723	PAA2
2	1442	480114.55	1351642	PAA2
2	1441	480121.4	1351552	PAA2
2	1443	480152.53	1351763	PAA2
2	11067	480223.1	1351314	PAA3
2	1152	480440.42	1350637	PAA2
2	11547	480448.18	1350943	PAA3
2	2420	480486.57	1351151	PAA3
2	11685	480721.77	1350663	PAA3
2	1064	480748.2	1350724	PAA3
2	2064	480749.51	1350715	PAA3
2	4064	480759.64	1350725	PAA3
2	3064	480759.94	1350715	PAA3
2	4439	481113.68	1350731	PAA3
2	2439	481123.95	1350730	PAA4
3	11502	481297.57	1351268	PAA3
3	11503	481307.01	1351261	PAA3
3	11498	481573.21	1350966	PAA3
3	11499	481573.25	1350976	PAA3
3	11500	481820.15	1351269	PAA3

TABLE E-3
(continued)

Sector	Official Name	Northing 1983	Easting 1983sp	Status
3	11557	481822.75	1351262	PAA3
3	11485	481822.75	1351262	
3	11484	481826.25	1351282	PAA3
3	11501	481833.45	1351270	PAA3
3	11546	481845.51	1351271	PAA3

Status Codes:
PAA Method of Abandonment Unknown
PAA1 Plugged in Place
PAA2 Complete Removal - Pulled Riser & Screen
PAA3 Complete Removal - Pulled Riser & Screen and Overdrilled
PAA4 Partial Removal - Pulled Riser

Wells with no status code are considered active.

APPENDIX F

INTEGRATED MEASUREMENT APPROACH FOR REMEDIATION OF AREA 1, PHASE II

TABLE OF CONTENTS

F.1 Introduction F-1
F.1.1 Purpose F-2
F.1.2 Remediation Process and Associated Data Needs F-2
F.1.3 Previous FEMP Studies on Environmental Measurement Approaches F-3
F.1.3.1 HPGe Gamma Spectrometry Comparability Study F-4
F.1.3.2 RTRAK Applicability Study F-5
F.1.4 Strengths and Limitations of Measurement Approaches Used F-7
F.1.4.1 Collection of Physical Samples for Laboratory Analysis F-7
F.1.4.2 Collection of Data with Field-Deployable Instruments F-8
F.1.4.2.1 In-Situ Gamma Spectrometry User's Manual F-9
F.1.4.2.2 Strengths and Limitations of HPGe Measurements F-9
F.1.4.2.3 Strengths and Limitations of RTRAK Measurements F-10

F.2 Predesign Investigations/evaluations Relative to Data Comparability F-11
F.2.1 PSP for Predesign Investigation Survey F-11

F.3 Integrated Approach for Environmental Measurements in A1PII F-12
F.3.1 Above-WAC Excavation F-12
F.3.1.1 Data Needs and Associated Quality Levels F-13
F.3.1.2 Sequence of Activities and Measurement Approach F-13
F.3.1.3 Quality Assurance and Quality Control F-14
F.3.2 RCRA Excavation F-14
F.3.2.1 Data Needs and Associated Quality Levels F-14
F.3.2.2 Sequence of Activities and Measurement Approach F-15
F.3.2.3 Quality Assurance and Quality Control F-15
F.3.3 Below-WAC/Above-FRL Excavation F-16
F.3.3.1 Data Needs and Associated Quality Levels F-16
F.3.3.2 Sequence of Activities and Measurement Approach F-17
F.3.3.3 Quality Assurance and Quality Control F-17
F.3.4 Precertification F-17
F.3.4.1 Data Needs and Associated Quality Levels F-17
F.3.4.2 Sequence of Activities and Measurement Approach F-18
F.3.4.3 QA/QC F-18
F.3.5 Certification F-19
F.3.5.1 Data Needs and Associated Quality Levels F-19
F.3.5.2 Sequence of Activities and Measurement Approach F-19
F.3.5.3 QA/QC F-20

F.4 Summary F-20
F.4.1 Remediation Process and Data Needs F-20
F.4.2 Integrated Measurement Approach F-21

LIST OF TABLES

Table F-1 Summary of Trigger Levels for Some Field-Deployable Instruments
Table F-2 HPGe Minimum Detectable Concentrations Compared to FRLs

LIST OF FIGURES

Figure F-1 XRF vs Laboratory Total Lead for the Former FEMP Firing Range
Figure F-2 HPGe vs Laboratory Total Uranium Data Area 1 Phase II
Figure F-3 Uranium Levels vs Gross Counts

APPENDIX F

INTEGRATED MEASUREMENT APPROACH FOR REMEDIATION OF AREA 1, PHASE II

F.1 INTRODUCTION

This appendix discusses the field and laboratory measurements that will be used by the Fernald Environmental Management Project (FEMP) to delineate soil excavation boundaries in Remediation Area 1 Phase II (A1PII), to demonstrate attainment of Final Remediation Levels (FRLs), and to satisfy Waste Acceptance Criteria (WAC) established for the On-Site Disposal Facility (OSDF). The integration of field and laboratory measurements provides the remediation process with real-time monitoring of both gamma-emitting radionuclides and metals during construction activities, the ability to bias sample locations to ensure that above-WAC and hot-spot (i.e., a contaminant concentration equal to or greater than three times its FRL) areas can be delineated accurately for removal, and the opportunity to continue the demonstration of reliable certification measurements using in-situ gamma spectrometry. In particular, an improvement in the certification process can be realized by using in-situ gamma spectrometry because of its ability to simultaneously provide accurate measurements of multiple radionuclides that represent average concentrations over a given area.

The nature and extent of soil contamination at the FEMP site poses considerable demands on the coordination of characterization and excavation activities carried out during the remediation process. In many remediation areas, data generated from RI activities are not comprehensive for the purpose of preparing detailed engineering designs and excavation drawings, and additional radiological surveys and sampling programs must be implemented to collect the needed data. Real-time, field-deployable instruments have the capability to satisfy a major portion of these additional data needs, and their use will be integrated with discrete sampling and subsequent laboratory analysis to maintain efficiency in the remediation process. Field-deployable instruments that have been demonstrated to provide data useful for making remediation decisions include:

- Sodium iodide (NaI) and high-purity germanium (HPGe) detectors for in-situ measurement of gamma-emitting radionuclides
- Geiger-Mueller counters for screening gross gamma/beta disintegrations
- Portable X-Ray Fluorescence (XRF) for metals (except mercury)
- Photo-ionization detectors (PID) for volatile and semi-volatile organic compounds.

The application of NaI and HPGe detectors to the in-situ measurement of gamma-emitting radionuclides has been described, for example, by Miller et. al. (1994), the International Commission on Radiation Units and Measurements (1994), and Fong and Alvarez (1997). Detailed assessments of the data quality produced by these field-deployable radiological instruments are provided in the U.S. DOE reports "Comparability of In-Situ Gamma Spectrometry and Laboratory Data" (DOE 1997a) and "RTRAK Applicability Study" (DOE 1997b). Three addenda to the above reports have expanded and improved the assessment of data quality and comparability of in-situ gamma spectrometry: "Comparability of Total Uranium Data as Measured by In-Situ Gamma Spectrometry and Four Laboratory Methods" (DOE 1997c), "RTRAK Applicability Measurements in Locations of Elevated Radionuclide Concentrations" (DOE 1997d), and "Comparability of In-Situ Gamma Spectrometry and Laboratory Measurements of Radium-226"(DOE 1997e).

Geiger-Mueller counters are used to screen both special materials encountered during excavation activities and subsurface soil cores to locate elevated activity areas for sampling purposes. The use of PIDs is limited to field investigations and excavations dealing with removal of soil, tanks, pipes, drums, or other containers containing fuels and solvents. A portable XRF instrument has been used at the former Firing Range (Area 2, Phase I) for rapid assessment of lead concentrations in soil samples collected there, and WAC trigger levels have been established on the basis of those data (Figure F-1). Operational details for the above instruments are described in FDF field procedures.

F.1.1 Purpose

The purpose of this appendix is two fold:

1) To describe how in-situ field measurements are integrated with the laboratory analytical program to delineate above-WAC, above-FRL, and potential RCRA excavation boundaries; to support precertification and certification activities; and,

2) To provide area-specific (A1PII) comparability data that validates the use of in-situ gamma spectrometry in A1PII.

F.1.2 Remediation Process and Associated Data Needs

The remediation process carried out in A1PII will follow the general approach outlined in Sections 3.0 and 4.0 of the Sitewide Excavation Plan (SEP) (DOE 1997f) and Sections 2.0 and 3.0 of this Implementation Plan. Steps in the remediation of A1PII include:

000040

- Predesign investigations to establish the extent of above-WAC material, the extent of soil with the potential to exhibit the toxicity characteristic, and the extent of above-FRL material
- Preparation of the remedial design (i.e., the IRDP)
- Soil excavation of above-WAC, RCRA, and below-WAC impacted materials
- Precertification and certification activities
- Grading and restoration activities.

Data needs are primarily tied to establishing the horizontal and vertical excavation boundaries for above-WAC material (technetium-99 and/or total uranium), toxicity characteristic waste (lead), and above-FRL soil volumes; and to demonstrating that soil remaining after completion of the excavations can be certified as meeting the established FRLs. Additional data needs are centered on:

- Monitoring excavated surfaces to determine if all above-WAC material and/or potentially toxicity characteristic waste have been removed
- Identifying locations where uranium-238, thorium-232, and/or radium-226 levels exceed three times their FRL value (i.e., hot-spot identification)
- Determining if FRLs (20 mg/kg of total uranium in one area at the STP, and 82 mg/kg in the remaining portions of A1PII) and the ALARA goal (50 mg/kg of total uranium in excavated areas) have been attained.

Real-time, field-deployable instruments have been used in the predesign investigations and precertification activities to characterize soil for select constituents of concern (COCs). During soil excavation activities, field instruments will be used to monitor the excavated surfaces at intervals discussed in Section F.3. Radiological monitoring will also be conducted during excavation activities if special materials are encountered (Section 3.5).

F.1.3 Previous FEMP Studies on Environmental Measurement Approaches

Several FEMP soil studies have been completed where real-time field measurements have been collected and compared to laboratory analytical results to assess the viability of using field instruments to increase the efficiency of remediation activities. Miller et. al., (1994) used in-situ gamma spectrometry to measure uranium in FEMP soil and found good agreement between in-situ measurements and laboratory measurements for uranium-238. As part of a collaboration between Sandia National Laboratories and Fluor Daniel Fernald (FDF), HPGe and NaI gamma-ray detectors

were used to determine the level of uranium contamination in FEMP soil. Rautman et al. (1994) issued a report on this joint study indicating additional site-specific testing was warranted to demonstrate the potential usefulness of the in-situ measurements in achieving quick quantitative assessments of gamma-emitting radionuclides. Results from these two initial studies warranted further evaluation of a field-deployable HPGe system at the FEMP site. In the summer of 1995, FDF personnel used a field-deployable HPGe instrument to collect gamma spectra and compared the results to laboratory measurements of total uranium, thorium-232, and radium-226. Total uranium data from the field and laboratory measurements correlated well, and thorium-232 and radium-226 results also indicated acceptable comparability between the methods.

F.1.3.1 HPGe Gamma Spectrometry Comparability Study

The encouraging results from the preliminary field investigations discussed above led DOE to proceed with a comprehensive in-situ gamma spectrometry comparability study at the FEMP site. Part A of the comprehensive study was conducted to determine if certification decisions at the Certification Unit (CU) level, based on HPGe measurements, were comparable to certification decisions based on laboratory analysis of discrete soil samples. In Part B of the study, HPGe measurements were compared to laboratory alpha- and gamma-spectrometry measurements on discrete soil samples collected from 10 site locations, where total uranium concentrations varied from approximately 5 to 300 ppm. Two additional contaminated sites were evaluated after the initial report (DOE 1997a) was issued to increase the comparability range of total uranium to 1,100 ppm (i.e., a value close to the WAC limit for uranium) and to investigate the comparison of HPGe measurements to laboratory mass measurements by gamma spectrometry, BromoPADAP, and Inductively Coupled Plasma Mass Spectrometry methods. Results from this add-on work were issued in an addendum (DOE 1997c) to the initial report (DOE 1997a). Additional details on experimental design, instrument operating conditions (e.g., viewing window, acquisition time, and detector height), and data reduction are discussed in the report and its addendum. A second addendum report was issued (DOE 1997e) that extends the comparability of radium-226 to higher concentration levels and also presents an algorithm that allows HPGe radium-226 measurements to be corrected to compensate for radium-222 excavation from soils.

Results presented in the initial reports and its addenda indicate that pass/fail decisions for CUs are similar regardless of whether the data are from HPGe or laboratory measurements. The initial report

further demonstrated that total uranium, thorium-232, cesium-137, and potassium-40 measurements obtained by the HPGe instrument are comparable to laboratory analytical results. Accurate (i.e., similar to laboratory analysis) results for total uranium can be obtained with the HPGe instrument up to uranium WAC levels (1,030 ppm) and for thorium-232 up to levels approximately five times its FRL (5 times 1.5 pCi/g = 7.5 pCi/g). Using the correction algorithm discussed in an addendum report (DOE 1997e), acceptable comparability of radium-226 measurements can be obtained up to concentrations approximately 10 times the FRL (1.7 pCi/g x 10 = 17 pCi/g). The HPGe instrument provides excellent short-term precision (i.e., well within the ±20 percent guideline) on sequential measurements for total uranium, thorium-232, radium-226, cesium-137, and potassium-40. Preliminary data relative to long-term precision based upon repeated measurements collected at a single field station also indicated good precision occurring over a period of several months.

As noted in the July 1997 HPGe Comparability Study, the MDCs for various radionuclides are low enough for HPGe to be used in A1PII for FRL certification attainment. By analogy with the statistical methodology used for certification testing, the MDC acceptance criteria for a given analyte will be that the 95 percent upper confidence limit of the MDC must be less than the FRLs of concern for ASL D analysis. By analogy with radiochemistry performance specification in the SCQ, a less stringent acceptance criterion for ASL B will be that the 90 percent upper confidence limit of the MDC must be less than the FRL of concern. Table F-2 shows the 90 and 95 percent upper confidence limits in relation to the FRLs for A1PII. Given the data in this table, the HPGe technique should easily be capable of detecting each radionuclide when it is present at the FRL in A1PII.

F.1.3.2 <u>RTRAK Applicability Study</u>

The radiation tracking (RTRAK) system consists of a John Deere tractor with a mounted boom that holds one 4x4x16-inch NaI detector and associated electronics. A rapid assessment of surface gamma photon activity in open areas is obtained with this equipment, and 100 percent coverage of the area may be achieved. RTRAK may be operated at various speeds and gamma photon spectra may be collected using various acquisition times. The RTRAK Applicability Study (DOE 1997b) demonstrated that gamma spectra nominally collected every four seconds at a speed of one mile per hour are sufficient to achieve the requisite data quality. At this speed and data acquisition time, a field of view of approximately 100 ft^2 for an individual measurement is attained. The data are tied to coordinates using global positioning system (GPS) software integrated with the data collection system. The collected

gamma spectrum may be processed to generate gross gamma counts or radionuclide-specific activities for uranium-238, thorium-228, radium-226, cesium-137, and potassium-40. A more detailed description of this unit and its capabilities is provided in the report "RTRAK Applicability Study" (DOE 1997b) and its addendum (DOE 1997d).

Data from the RTRAK Applicability Study (1997l) and its addendum (DOE 1997d) may be used to generate trigger levels. The method of setting trigger levels is explained in the DOE 1997d report and will be amplified in a forthcoming memorandum as noted below. Basically, however, RTRAK's ability to meet trigger levels is based upon RTRAK precision at a given concentration. In general, to meet a trigger level of 70 percent of the FRL for total uranium (14 or 57 ppm), thorium-232 (1.05 pCi/g), and radium-226 (1.2 pCi/g), individual measurements obtained from a 4-second data acquisition time must be aggregated. The number of individual measurements that must be aggregated to meet the acceptable precision at the indicated trigger levels are greater than 280, 18, 2, and 5, respectively. (Trigger levels and aggregation of measurements were discussed in detail at the October 9, 1997, real-time work group technical meeting. Based upon decisions consensually agreed to at the meeting, a memorandum is in preparation detailing the 70 percent action levels.) The number of samples needed for aggregation indicates that screening for the total uranium FRL of 20 ppm in A1PII is not practical using the RTRAK, but that screening for the total uranium FRL of 82 ppm, as well as the FRLs for thorium-232 and radium-226, is practical. Additional information on preliminary trigger levels and the number of aggregate measurements needed to meet these preliminary levels for hot-spot and WAC values (uranium only) is summarized in Table F-1, as they apply to A1PII. A comprehensive discussion of suggested trigger levels for uranium-238, thorium-232, and radium-226 will be detailed in a forthcoming memorandum as noted above.

The accuracy of the RTRAK system was assessed in the RTRAK Applicability Study (DOE 1997b) by comparing measurements collected by the RTRAK with measurements obtained by the field-deployable HPGe instrument. RTRAK and HPGe Measurements taken in the same locations exhibit good agreement. This is the case for both static and dynamic RTRAK measurements. This comparison indicates the RTRAK system can be useful for discerning contamination patterns above FRLs for thorium-232 and radium-226, identifying hot spots for all three isotopes, providing quantitative presertification data, and delineating above-WAC areas for total uranium (Table F-1). Therefore, screening remediation areas with the RTRAK allows the more accurate HPGe to be focused on the

needed areas. Further discussion on the application of these techniques to the A1PII remediation is provided in Sections F.2 and F.3 of this appendix.

F.1.4 Strengths and Limitations of Measurement Approaches Used

The collection of both physical samples and field measurements constitutes a rational, integrated approach to meeting remediation data needs. Limitations in the data provided by one approach are commonly compensated by data obtained from the other approach. Discussion in this section highlights the strengths and limitations of the proposed measurement approaches.

F.1.4.1 Collection of Physical Samples for Laboratory Analysis

Analytical laboratories can provide quantitative information on a large number of potential COCs (e.g., radionuclides, metals, organic compounds) using a very small volume of soil and industry-standard equipment and protocols. Although the nature and types of data obtained from laboratory analysis of discrete samples is diverse and quantitative, a considerable limitation is the inability of a discrete soil sample to adequately represent a heterogenous soil system without extremely intensive sampling. Therefore, many discrete soil samples must be collected, analyzed, and statistically evaluated to determine an average or mean concentration for COCs in the soil volume of interest. Moreover, discrete soil samples are likely to miss small hot spots or above-WAC areas. While the discrete soil-sampling approach is currently used for final certification and release of remediated areas, it is neither cost effective nor time efficient when implemented at every step of the remediation process to provide analytical needs. For example, excavation proceeding in lifts requires a quick assessment of radionuclide activity on newly-cut surfaces to determine if OSDF WAC are met prior to excavating the next lift. In this case, collection of physical samples for laboratory analysis is not a practical approach due to the delay imposed upon the excavation activity while waiting for analytical results from the laboratory. Although laboratory results from predesign investigations will provide some surface and subsurface information on COC concentrations, it is not reasonable to assume that these data will provide a comprehensive picture of surface and subsurface conditions in heterogenous media. Therefore, the collection of data with field-deployable instruments is a vital component of the remediation program.

F.1.4.2 Collection of Data with Field-Deployable Instruments

Field-deployable systems that are providing useful data to the FEMP remediation program consist of analytical and survey instruments. Analytical instruments include the HPGe, RTRAK, and Radiation Scanning System (RSS) for assessment of gamma-emitting radionulides and a portable XRF unit to assess hazardous metal concentrations in soil. The RSS is a smaller version of the RTRAK that may be used in areas which cannot be accessed by the RTRAK (e.g., forested areas). Survey instruments include Geiger-Mueller counters to scan for gross gamma/beta activity and PID meters to monitor for hazardous organic vapors. A major use of field-deployable systems has been to assess gamma activity derived from uranium and its gamma emitting daughters in surface soil and subsurface cores, as uranium is the most widespread and abundant COC across the site.

The HPGe, RTRAK, and RSS systems are capable of screening quality quantitative (ASL A for RTRAK/RSS) data to highly quantitative (ASL B or D for HPGe) data on distinct gamma-emitting radionuclides and/or gross gamma activity in surface soil. These instruments measure the average gamma photon flux from a given surface area, as determined by the height of the instrument above the surface. For the HPGe detector, the average gamma photon flux is measured quantitatively for uranium-235, uranium-238, thorium-232, and radium-226. The RTRAK and RSS systems use NaI detectors to either measure gross gamma activity and/or uranium-238, thorium-232, and radium-226.

A portable XRF instrument has been used to assess lead concentrations in lead-contaminated soil associated with the former Firing Range. This instrument can be used for in-situ analyses or ex-situ, with a discrete sample of soil, to provide a quantitative measurement of lead concentration. This is useful to estimate the location of the boundary of above-lead-FRL boundary (i.e., lead less than 400 mg/kg), and to bias the collection of samples for laboratory analysis. Because the measurement is based on a discrete small volume of soil, XRF has the same limitations discussed above for physical samples collected for laboratory analysis (i.e., it may not provide the needed data to make proper decisions in heterogeneous areas without a large number of analyses). Additionally, it is limited in its application by low precision as metal concentrations decrease. Therefore, its use is generally restricted to areas where the concentration of a metal COC is greater than 100 mg/kg.

F.1.4.2.1 In-Situ Gamma Spectrometry User's Manual

The in-situ gamma spectrometry work group has identified the development of a user's manual as a major priority for the real-time measurement program. This manual would contain discussions on measurement limitations, measurement strategies, and measurement guidelines. This document is tentatively scheduled for completion of a first draft by the end of January 1998. The following sections fill an interim need by presenting some strengths and limitations of in-situ gamma spectrometry pertinent to A1PII.

F.1.4.2.2 Strengths and Limitations of HPGe Measurements

A major strength of the HPGe instrument lies in its ability to provide a rapid (900 second/15 minute) quantitative measurement of the activity of uranium-235, uranium-238, thorium-232, and radium-226 over a large surface area (approximately 110 m^2). Results from the report "Comparability of In-Situ Gamma Spectrometry and Laboratory Data" (DOE 1997a) and its addenda (DOE 1997c,e) indicate that the HPGe instrument is capable of producing good precision and accuracy (relative to laboratory measurements) for uranium-238 and thorium-232 at activities corresponding to their FRLs, while for radium-226 good precision is obtained, but only acceptable accuracy.

A second major strength of HPGe is that this measurement technique provides a better average over the survey unit for a given number of measurements than physical samples collected for laboratory analysis. This results from the fact that the HPGe is measuring tons of soil rather than potentially non-representative kilogram (or less) sized quantities. Considering the fact that a dose model is tied to the average concentration of a radionuclide over a specified area, obtaining that average in the most efficient and representative manner is advantageous for arriving at the correct decision rule.

A third major strength of HPGe that is particularly important for excavation operations is that a single measurement (without the necessity of aggregating measurements as must be done for RTRAK data) may satisfy three different data objectives. First, the measurement can indicate whether the area has potentially exceeded WAC concentrations. Second, the measurement can provide information on the existence of hot spots, and third, it can provide information on whether the FRL has been attained in the area measured.

A fourth major strength is that the detector height may be raised or lowered to provide different fields of view. Thus, HPGe has the option of being used to focus in on different size areas from small to large. This is particularly important in heterogeneous areas.

The limitations to the use of HPGe in A1PII are primarily three fold. First, the HPGe may not be able to recognize small hot spots or small WAC exceedance areas if the area of elevated contamination is very small relative to the field of view of the HPGe at a given detector height. Second, if used in the early morning, "bad radon" conditions may result in falsely elevated measured radium-226 concentrations. Third, if used in small confined areas, such as pits or trenches, correction factors may be needed to adjust the data to take into account the geometry of the area.

F.1.4.2.3 Strengths and Limitations of RTRAK Measurements

The RTRAK system provides a rapid assessment of potential hot-spot and above-WAC zones within remediation areas at 100 percent coverage, which cannot be achieved by physical sampling. This strength is a vital component of the remediation process, as it identifies contaminated soil that can easily be missed by the collection of discrete soil samples. Additionally, usable maps are readily provided on contamination patterns and anthropogenic surface features (e.g., roads). Finally, in addition to gross counts, RTRAK produces quantitative data for uranium-238, uranium-235, thorium-232, and radium-226.

The RTRAK Applicability Study (DOE 1997b) and its addendum (DOE 1997d) identify the primary limitations of the RTRAK system as:

- Large fractional uncertainty at low concentrations and high minimum detection concentrations for individual measurements, especially uranium-238. This necessitates the aggregation of multiple measurements, particularly at low concentrations near FRLs. However, while aggregation of measurements reduces uncertainties and minimum detector concentrations, aggregation also results in a loss of spatial resolution. This results in an increase in the minimum size of an area of elevated concentration that can be detected.

- In A1PII, the low FRL of 20 ppm for total uranium in a certain portion of the STP effectively precludes the use of RTRAK for FRL screening for uranium given its low degree of precision for individual measurements at such concentration levels and the very high number of data points (280) that must be aggregated to achieve acceptable precision at the FRL trigger level. However, use of the RTRAK is applicable to the remainder of A1PII, where the total uranium FRL is 82 ppm, as well as for thorium-

232. In these areas, only 18 aggregated measurements are required to achieve acceptable precision at the trigger level of 70% of the FRL.

- A potential for false high radium-226 measurements when "bad radon" conditions are present in the early morning
- Certain areas may prove not to be well-suited for RTRAK or RSS operations (e.g., rugged terrain). In such areas, HPGe will be used. One such area is the STP, where excavation depths may approach 25 feet.

The first of these limitations can be resolved by aggregating measurements. One consequence of aggregation of measurements is a loss of spatial resolution in defining the radionuclide distribution. For a four-second acquisition time, the number of aggregated measurements necessary to achieve the trigger level criterion of 70 percent of the FRL is given in Table F-1.

F.2 PREDESIGN INVESTIGATIONS/EVALUATIONS RELATIVE TO DATA COMPARABILITY

Preliminary data from the predesign investigation activities (Appendix B) have been used to assess the necessity of establishing an area-specific correlation between in-situ gamma spectrometry and laboratory data. The HPGe Comparability Study (DOE 1997a,m) demonstrated that HPGe and laboratory data for total uranium are comparable and, when plotted against each other, fall along a perfect correlation line having a slope of 1.0. Data from the predesign investigations verify that the same relationship between HPGe and laboratory data holds for A1PII.

One Project-Specific Plan (PSP) incorporating in-situ gamma spectrometry measurements for total uranium has been implemented as part of the predesign investigation for A1PII. These results are briefly summarized below. In addition, data from laboratory and field XRF measurements, as described in the Area 2, Phase I Implementation (DOE 1997g), have been used to establish action levels of 300 mg/kg for above-FRL lead contamination and 150 mg/kg for above-BTV lead contamination (Figure F-1).

F.2.1 PSP for Predesign Investigation Survey

As described in Section 2.2.6, the objective of this investigation was to use the RTRAK and HPGe detector systems, supplemented by laboratory analysis of physical samples collected in every acre of A1PII and in areas where scanning showed elevated areas of contamination, to help delineate those areas requiring excavation within the boundaries of A1PII and those areas where soil contamination may exceed WAC. The physical samples were analyzed for total uranium in the laboratory using

Inductively Coupled Plasma Mass Spectrometry (ICPMS). All areas accessible by RTRAK were scanned and one HPGe measurement was taken in each approximately 1 acre area. Five HPGe measurements per acre were also taken where RTRAK measurements exceeded 66 ppm and physical samples were taken to confirm HPGe measurements.

In all, 112 physical samples were analyzed for toal uranium, and 112 HPGe measurements were taken at a detector height of 1.0 meter (field of view is a circle with a 6-meter radius). The average of the data from the 112 physical samples was 13.61 ppm with a standard deviation of 13.42 ppm. The average of the 112 HPGe data was 19.70 ppm with a standard deviation of 14.79 ppm. This indicates that there is a tendency for HPGe data to be slightly higher than co-located laboratory data from physical samples for total uranium. Nonetheless, these HPGe data meet the criterion of good comparability given in Section 3.2.2 of the Comparability Study Report (i.e., the average relative percent deviation between the two data sets is 18.3%; the cutoff for good comparability is 20% [needed for ASL D], and for acceptable comparability is 35% [needed for ASL B]).

In addition to the good comparability between HPGe and laboratory data, a good degree of correlation of HPGe with laboratory measurements is quite good, as illustrated in Figure F-2. Thus, low values in one data set correlate well with low data values in the other data set. The same statement holds for higher total uranium concentrations. The regression line fitted through the points has a correlation coefficient (expressed as R^2) of 0.87. Given the good comparability and good correlation of these results, laboratory and HPGe data are consistent with data and data quality parameters in the HPGe Comparability Study, and there is no need to have A1P2 area specific guidelines or calibration factors.

F.3 INTEGRATED APPROACH FOR ENVIRONMENTAL MEASUREMENTS IN A1PII

This section summarizes the proposed approach for integrating field measurements with laboratory data during above-WAC excavations, excavations of characteristically hazardous material, excavations of below-WAC/above-FRL material, precertification activities, and the certification process in A1PII.

F.3.1 Above-WAC Excavation

Material containing uranium above the OSDF WAC has been delineated by the RI/FS and predesign investigation and consists of approximately 35 yd^3 of sludge in the Sludge Drying Beds at the STP. HPGe measurements and/or analysis of discrete samples will be used to demonstrate that all above-

WAC material has been removed prior to initiating removal of below-WAC/above-FRL material. If additional above-WAC areas are identified by HPGe measurements and/or by analysis of discrete samples during this and other A1PII excavations, they will be delineated and excavated for offsite disposal.

F.3.1.1 Data Needs and Associated Quality Levels

Actions required to collect the data needed for the above-WAC excavation of uranium contaminated material include:

- Delineation of horizontal and vertical extent of uranium concentration above the OSDF WAC (delineated on design drawings)
- Potential identification of additional material containing uranium above the OSDF WAC during excavation
- Assessment of the gross gamma activity associated with any encountered special materials.

The needed data will be collected by scanning with the Geiger-Mueller counter at quality level ASL A to assess gross gamma activity of encountered special materials and by HPGe measurements and/or laboratory analysis of discrete samples at ASL B to verify removal of all above-WAC material in the STP.

F.3.1.2 Sequence of Activities and Measurement Approach

As discussed in Section 3.3.4.2, the delineated volume of above-WAC sludge will be excavated and placed in boxes for offsite disposal. Upon removal of the sludge, the entire surface of the Sludge Drying Beds will be subjected to RSS and/or HPGe measurements to quantify total uranium in excess of the WAC. Complete coverage by HPGe will be performed at a 0.3 meter (1.0 ft) detector height. The 1.0 ft detector height will be used because of the relatively small size of the dried sludge beds (54' x 87'). A 1.0 ft detector height equates to a 211 ft^2 field of view. Therefore, approximately 20 HPGe measurements will suffice for complete coverage. Detector read times will be 15 minutes in duration so the total sludge drying area can be measured in 5 hours of measurement time. If the RSS or HPGe measurements indicate above-WAC levels of uranium, additional material will be excavated. As needed, discrete soil samples will be collected for analysis to demonstrate removal of all uranium that is above the WAC.

If special materials (Section 3.3.4.5) are identified by visual observation during excavation, excavation will pause to assess the gross activity of the material with a Geiger-Mueller counter. If the gross activity of the material exceeds 90,000 dpm, the excavation will be stopped to upgrade personal protective gear and remove the radioactive material.

F.3.1.3 Quality Assurance and Quality Control

Quality assurance and control measures will be implemented during all phases of the construction activity and field measurements. Above-WAC boundaries will be clearly marked in the field with fencing or rope based on RI/FS predesign data. These boundaries may be changed based on HPGe measurements or analytical results received on discrete samples. The contractor will be responsible for controlling field conditions in a manner that allows HPGe measurements and/or physical samples to be collected without interfering with ongoing excavation activities.

Independent assessment will be conducted to verify compliance to excavation design, PSP/DQOs, above-WAC material tracking documentation, and IRDP requirements for above-WAC areas. The documentation demonstrating WAC attainment at the active working grade will be verified before above-WAC boundaries are removed. Data obtained in support of above-WAC excavation must be managed such that waste profiles can certify material shipment for offsite disposal.

F.3.2 RCRA Excavation

Material that exceeds the FRL for lead (400 mg/kg) has been delineated by analytical results from the RI/FS and predesign investigations. This material consists of approximately 1,960 yd^3 of lead-contaminated soil located in the former Trap Range. This material has been shown to exhibit the toxicity characteristic for lead (i.e., a leaching solution yields more than 5 mg/l of lead in the Toxicity Characteristic Leaching Procedure [TCLP] test). A summary of the sampling activity to support the treatment and excavation of this material follows.

F.3.2.1 Data Needs and Associated Quality Levels

Actions required to collect data needed for the lead-contaminated soil treatment and excavation include:

- Delineation of the horizontal and vertical extent of lead-contaminated soil that exceeds the lead FRL of 400 mg/kg, all assumed to be characteristically hazardous
- Demonstration that stabilized soil is not characteristically hazardous

000052

The needed data will be obtained as follows:

- Collect discrete samples and analyze for lead with ICP (Inductively Coupled Plasma spectrometry) at data quality level ASL B to establish excavation boundaries.
- Conduct TCLP analysis of discrete samples at ASL B to demonstrate success of soil treatment
- Conduct total lead analysis on discrete samples using ICP at ASL B to demonstrate removal of all soil containing lead above the FRL.

F.3.2.2 Sequence of Activities and Measurement Approach

As discussed in Section 3.1.4, soil with lead contamination that exceeds the FRL, as delineated by sampling and laboratory analysis, will be stabilized in-situ. The treatment is expected to be carried out on the top six inches of soil. After stabilization, discrete samples will be collected for TCLP analysis to demonstrate that the toxicity characteristic has been removed in order to allow disposition to the OSDF. Sample density and criteria for demonstrating removal of the toxicity characteristic will be in accordance with SW-846 (EPA 1986), using a upper confidence level on the mean of 90 percent. After passing the TCLP test, the stabilized material will be loaded into trucks and hauled to the OSDF for disposal.

Upon completion of the above-FRL excavation, XRF measurements will be made to verify removal of material containing lead above its FRL. These measurements will be made in-situ or using discrete samples. As indicated in Table F-1, a 300-second count time using a trigger level of 300 mg/kg lead will be utilized. If XRF data indicate that additional above-FRL material is present, the material will be stabilized and excavated. Upon confirmation that all above-FRL material has been removed, the Trap Range area will be precertified (Section F.3.4) and certified as attaining FRLs.

F.3.2.3 Quality Assurance and Quality Control

Stabilized soils with above-FRL concentrations will be loaded into trucks for disposition to the OSDF. Other lead contaminated soil will also be dispositioned to the OSDF.

All lead laboratory samples will be analyzed to ASL B validated data packages, with 10 percent validation of those packages. The field data associated with validated chemical data will also be validated.

The excavation boundary for above-FRL (characteristically hazardous) lead concentrations will be identified on final construction drawings.

F.3.3 Below-WAC/Above-FRL Excavation

Material containing COCs above established FRLs but below OSDF WAC have been delineated using existing RI data and predesign investigations. Material that has been designated for below-WAC/above-FRL excavation in the STP consists of approximately 19,750 yds^3 of sludge and surrounding soil and approximatly 1,860 yds^3 of soil outside of the STP. It should be noted that the total uranium FRL in a portion of the STP is 20 mg/kg. A summary of the integrated measurement approach applied to the excavation of this material follows.

F.3.3.1 Data Needs and Associated Quality Levels

Actions required to collect data needed for the above-FRL excavation include:

- Delineation of the horizontal and vertical extent of soil containing uranium and other COCs that are above their FRLs on excavation design drawings
- Identification of additional above-WAC material during excavation
- Assessment of the gross gamma activity associated with any encountered special materials.

A high level of confidence must be placed in the data used to establish the below-WAC and above-FRL soil boundaries. Therefore, data will be collected using HPGe measurements (uranium) at a detector height of 1.0 meter (a triangular grid pattern will be used to give complete coverage at a measuremetn density of 38 per acre) and/or the laboratory measurements for metals at ASL B or higher. Data may also be collected at ASL A using a Geiger-Mueller counter to assess gross gamma activity of encountered special materials.

HPGe measurements that support the location of uranium at levels above its WAC and the below-FRL boundary for uranium will be done at ASL B. Predesign investigation determinations of final boundaries for FRL attainment will be at ASL B. Additionally, ASL B, C, or D data may be required to support waste disposition profiles and will be determined in PSPs.

F.3.3.2 Sequence of Activities and Measurement Approach

As discussed in Sections 3.2.3 and 3.3.4, soil and debris designated for excavation as below WAC/above FRL will be loaded and hauled to the OSDF for staging or disposal. Upon reaching the below-FRL design floor of the excavation, the floor will be precertified (Section F.3.4). If above-WAC material or special materials are encountered during the excavation, excavation will be stopped to assess the extent of above-WAC material with HPGe or physical samples and gross activity of the special material will be assayed with a Geiger-Mueller counter, as noted in Section F.3.1.2. If HPGe is used, a detector height of 1.0 ft with a read time of 15 seconds will be employed. Special materials will be segregated and staged in the Special Materials Transfer Area.

F.3.3.3 Quality Assurance and Quality Control

During excavation, QA will perform surveillances to verify compliance to A1PII related FEMP procedures, PSPs, A1PII PEP, A1PII IRDP, WAC Attainment Plan, OSDF Impacted Materials Placement Plan, SEP and the SCQ with respect to field sampling, field measurements, analytical analyses and related data management of soil data. Nonconformances will be submitted to the A1PII Project Manager and the A1PII Construction Manager for nonconformance resolution and corrective action implementation.

F.3.4 Precertification

Upon completion of all excavation activities in A1PII, the precertification phase will be implemented to prepare the remediation area for certification. A summary of the use of field and laboratory measurements in the precertification process follows.

F.3.4.1 Data Needs and Associated Quality Levels

Actions required to meet the data needs for precertification activities include:

- Delineate area where further excavation is required due to the average activity of primary radionuclides exceeding established FRLs
- Delineate hot spot areas for excavation
- Perform physical sampling activities for other COCs, as needed

Data collected for the precertification process include:

- Use of RTRAK/RSS (at ASL A) and HPGe (at ASL B) measurements to verify the removal of hot spots and that average total uranium, thorium-232, and radium-226 activities are below their FRLs

- Use of discrete samples to verify that the Trap Range area has no lead or arsenic hot pots remaining and that lead and arsenic concentrations are below their FRLs.

F.3.4.2 Sequence of Activities and Measurement Approach

The activities associated with establishing a list of COCs and delineating CU boundaries during the precertification process are described in the SEP (Section 3.4). Activities in this precertification sequence that are relevant to the use of field and laboratory measurements include:

- A 100 percent coverage scan with RSS or RTRAK equipment in areas having a total uranium FRL of 82 ppm. Data will be acquired at a 4-second read time at a speed of 1 mph. Data profiles will be offset by 2 meters to yield complete coverage.

- Selective use of HPGe to evaluate potential hot spots identified by the RSS/RTRAK scan in areas having a total uranium FRL of 82 ppm. The detector height will depend on the area and concentration of the hot spot indicated by the RSS/RTRAK scan.

- Additional HPGe measurements in locations where hot spot removal and/or further excavation takes place. The detector height will depend upon the size and concentration of the hot spot for hot spots approaching the field of view of the detector at a 1.0 m height (6-meter radius field of view). For hot spots smaller than 3 meter radius circles, a 1.0 ft HPGe detector height will be employed.

- Physical sampling activities for lead and arsenic, as well as radiological and other nonradiological COCs, as needed.

- Complete coverage in areas having an FRL for total uranium of 20 ppm will be carried out by HPGe. A detector height of 1.0 meter will be used with a data acquisition time of 15 minutes. Using a triangular grid pattern, 38 measurements per acre will suffice for complete coverage.

The major benefit of using the RTRAK, RSS, or HPGe instrument in the precertification process is their ability to measure the average total uranium and thorium-232 activities over a larger area to obtain good, representative agerage measurements that well characterize the area to be certified.

F.3.4.3 QA/QC

The results of precertification measurements will be documented in accordance with respective PSPs. The purpose of the scanning and sampling plan will be to assess the residual gamma activity of primary ASCOCs in the soil. The resulting patterns of radiological activity will be plotted. Once certification

sample points are determined, additional assurance of FRL attainment will be provided by conducting HPGe measurements above designated certification sample locations.

The precertification data, documentation, and residual contamination plots will be verified by project personnel to project program requirements. The resulting reports will become part of the Certification Design Letter.

F.3.5 Certification

Upon completion of all precertification activities in A1PII, the certification phase will be implemented to prepare the CUs for release to the restoration process. A summary of the use of real-time measurements in the certification process follows.

F.3.5.1 Data Needs and Associated Quality Levels

Actions required to meet the data needs for certification activities include:

- Collect physical samples and submit for laboratory analysis to demonstrate that all CU-specific COCs meet certification criteria for each individual CU. Certification criteria are discussed in Section 3.4 of the SEP
- Collect HPGe measurements to compare field data and decisions made with the data to primary radionuclide activities obtained from laboratory analysis
- Collect and analyze additional samples and perform additional certification measurements with the HPGe if the CU fails certification.

Data measurements for the certification process include using HPGe measurements at ASL D requiring excavation to verify that the average total uranium and thorium-232 activities are below their FRL in each CU and that no hot spots remain, and laboratory analysis at ASL D for all CU-specific COCs to demonstrate compliance with established FRLs. HPGe measurements and physical samples should be taken at the same locations. An HPGe detector height of 1.0 meters will be used with a 15-minute data acquisition time.

F.3.5.2 Sequence of Activities and Measurement Approach

The sequence of activities carried out during the certification process are described in the SEP (Section 3.4). Activities within the certification sequence that are applicable to the use of field and laboratory measurements include use of the HPGe instrument to perform measurements in the CUs for

primary radionuclide certification and the collection of physical samples for laboratory analysis of all CU-specific COCs. HPGe measurements will be compared to laboratory results to continue the assessment of using HPGe for final certification of total uranium, thorium-232, and radium-226 (i.e., primary radiological COCs). As the body of laboratory and field data grows, it is probable that a sufficient level of confidence will be reached to allow primary radionuclides to be certified using the HPGe instrument. The number of HPGe measurements and physical samples will be determined as specified in the SEP. HPGe measurements will be co-located ithheight of 1.0 m above the locations where physical samples are collected. A 15-minute data acquisition time will be employed.

F.3.5.3 QA/QC

All analytical data collected for certification will be in accordance to the SCQ at ASL D. All associated field QCs must be specified in PSP/DQOs. A minimum of 10 percent of the data packages will be validated, including the associated field data packages.

Statistical treatment of CU data will be to SEP requirements in certifying average ASCOC FRL attainment. Data sets used in statistical calculations will be controlled in a manner that can be traced from the Certification Report back to the SED CU data set. Associated calculations and spreadsheets will be independently verified.

F.4 SUMMARY

F.4.1 Remediation Process and Data Needs

The remediation process carried out in A1PII will follow the general approach outlined in Section 3 of the SEP. Steps in the remediation of A1PII include:

- Predesign investigations to establish the extent of above-WAC material, lead-contaminated soil with the potential to exhibit the toxicity characteristic
- Site-preparation activities to create retention basins and ditches, to establish any needed staging areas, and to connect utilities
- Use of pre-design PSPs and information obtained during site preparation activities to prepare the IRDP
- Soil excavation of above-WAC, potential RCRA, and below-WAC volumes
- Precertification and certification activities

000058

- Grading and restoration activities

Data needs are primarily tied to establishing the horizontal and vertical excavation boundaries for total uranium contamination that exceeds the OSDF WAC, potential RCRA characteristic waste (lead), and below-WAC soil volumes, and demonstrating that soil remaining after completion of the excavations can be certified as meeting the established FRLs. Additional data needs are centered on determining if all above-WAC material has been removed, identifying locations where total uranium, thorium-232, and/or radium-226 levels exceed the hot-spot criterion, and identifying lead contamination that exceeds the BTV.

Real-time, field-deployable instruments will be used during the predesign, excavation, and precertification phases to characterize soil for select COCs. During site-preparation and soil-excavation activities, real-time field instruments will be used to monitor the surfaces of each lift and to assess the radionuclide activity of encountered special materials. Data resulting from predesign investigations demonstrate that HPGe data is comparable to laboratory data in A1PII and there is no need for area-specific calibration factors.

The remedial actions carried out at A1PII will be supported by a variety of data collection activities that involve the use of RTRAK, RSS, and HPGe instruments for the assessment of primary radionuclide activities, a Geiger-Mueller counter to screen gross-gamma activity of any encountered special materials, a portable XRF instrument to estimate select heavy metal concentrations. The primary benefits offered by the use of these instruments includes assessment of average total uranium and thorium-232 activity in heterogeneous media and the ability to direct excavation.

F.4.2 Integrated Measurement Approach

The integrated measurement approach proposed for A1PII can be generalized as follows:

- Use RTRAK/RSS or HPGe to determine the distribution of above-WAC uranium and also to determine the above-FRL contamination patterns of total uranium and thorium-232 on the surfaces being monitored.
- Use a Geiger-Mueller counter to assess gross-gamma activity of any encountered special materials.
- In areas with the potential to contain material that exhibits the toxicity characteristic for lead, conduct field XRF measurements to estimate the RCRA excavation boundary.

- Collect confirmation samples for laboratory analysis at base of RCRA excavation.
- Use visual monitoring for special materials during excavation activities and assess special materials, if exhumed.
- Use HPGe, RSS, and RTRAK during precertification to evaluate residual patterns of contamination for hot spot identification and FRL attainment. RSS and RTRAK will only be used in areas where uranium FRLs are 82 ppm.
- Collect HPGe measurements and physical samples for CU Certification to compare field data and decisions based upon those data to data and decisions obtained/made from laboratory analysis of physical samples.

REFERENCES

Fong, Show H., and Joseph L. Alverez, 1997, "Data Quality Objectives for Surface-Soil Cleanup Operation Using *In Situ* Gamma Spectrometry for Concentration Measurements," Health Physics, Volume 72, Number 2 (February 1997), DOE EML, New York, NY.

Miller, Kevin M., Peter Shebell, and Gladys A. Klemic, 1994, "In Situ Gamma Ray Spectrometry for the Measurement of Uranium in Surface Soils," Health Physics, Volume 67, Number 2 (February 1994), DOE EML, New York, NY.

Rautman, C.A., M.V. Cromer, G.C. Newman and D.A. Besio, "1994 Fernald Field Characterization Demonstration Program Data Report," SAND95-3024 (December 1995), Cincinnati, OH.

U.S. Dept. of Energy, 1996a, "Operable Unit 3 Record of Decision for Final Remedial Actions," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

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

U.S. Dept. of Energy, 1997a, "Comparability of In-Situ Gamma Spectrometry and Laboratory Data," Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997b, "RTRAK Applicability Study," Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997c, "Comparability of Total Uranium Data as Measured by In-Situ Gamma Spectrometry and Four Laboratory Methods," Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997d, "RTRAK Applicability Measurements in Locations of Elevated Radionuclide Concentrations," Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997e, "Comparability of In-Situ Gamma Spectrometry and Laboratory Measurements of Radium-226," Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997f, "Sitewide Excavation Plan," SEP, Rev. C Draft, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997g, "Implementation Plan for Area 2 Phase I Soil Characterization and Excavation Project," Rev. C Draft, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste," SW-846, 3rd Edition, US EPA, Office of Solid Waste and Emergency Response, Washington, DC.

TABLE F-1
SUMMARY OF TRIGGER LEVELS FOR SOME FIELD-DEPLOYABLE INSTRUMENTS

Instrument	Analyte	Remediation Driver	Trigger Level (TL)	Number of Measurements to Reach TL[a]
RTRAK or RSS System	Total Uranium	Above WAC	240 pCi/g	1 w/ 4s count
		Hot Spot (FRL=20 mg/kg)	14.0 pCi/g	33 w/ 4s count
		(FRL=82 mg/kg)	57.3 pCi/g	2 w/ 4s count
		Above FRL (20 mg/kg)	4.66 pCi/g	280 w/ 4s count
		(82 mg/kg)	19.1 pCi/g	18 w/ 4s count
	Thorium-232	Hot Spot	3.15 pCi/g	1 w/ 4s count
		Above FRL	1.05 pCi/g	2 w/ 4s count
	Gamma-emitting radionuclides	Above WAC	18,000 gross counts per second [b]	1 w/ 4s count
XRF System	Lead	Above FRL	300 mg/kg	1 w/ 300s count

[a] Entry "1 w/ 4s count" read as 1 aggregated measurement with a four-second counting time for each measurement.
[b] See Figure F-3.

TABLE F-2
HPGe MINIMUM DETECTABLE CONCENTRATIONS COMPARED TO FRLs

Analyte	MDC	95% UCL	90% UCL	FRL
Total Uranium	5.8 ppm	6.2 ppm	6.1 ppm	20 or 82 ppm
Thorium-232	0.075 pCi/g	0.076 pCi/g	0.075 pCi/g	1.5 pCi/g
Radium-226	0.076 pCi/g	0.078 pCi/g	0.077 pCi/g	1.7 pCi/g

Figure F-1
XRF vs Laboratory Total Lead for the Former FEMP Firing Range

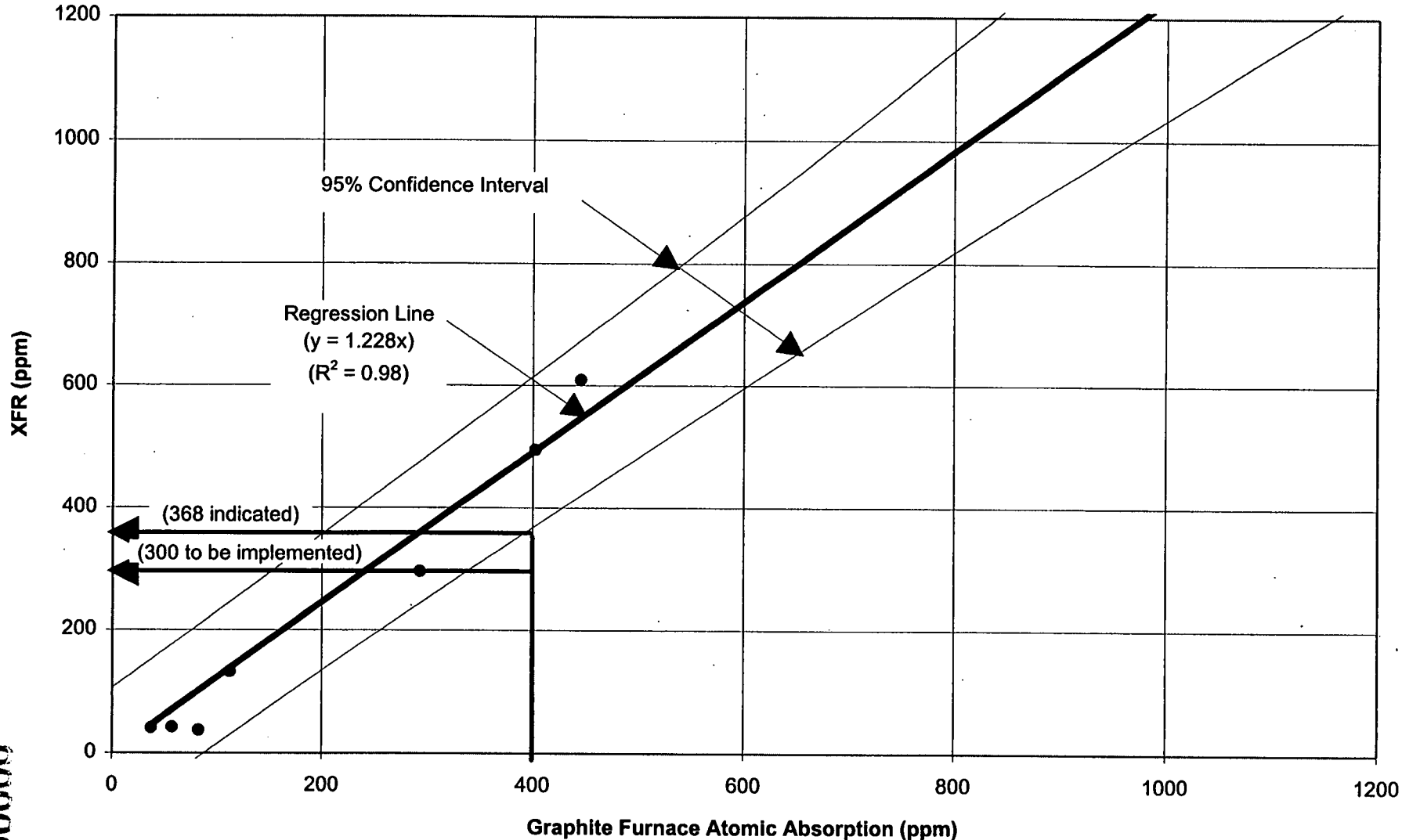


Figure F-2
HPGe vs Laboratory Total Uranium Data
Area 1, Phase II

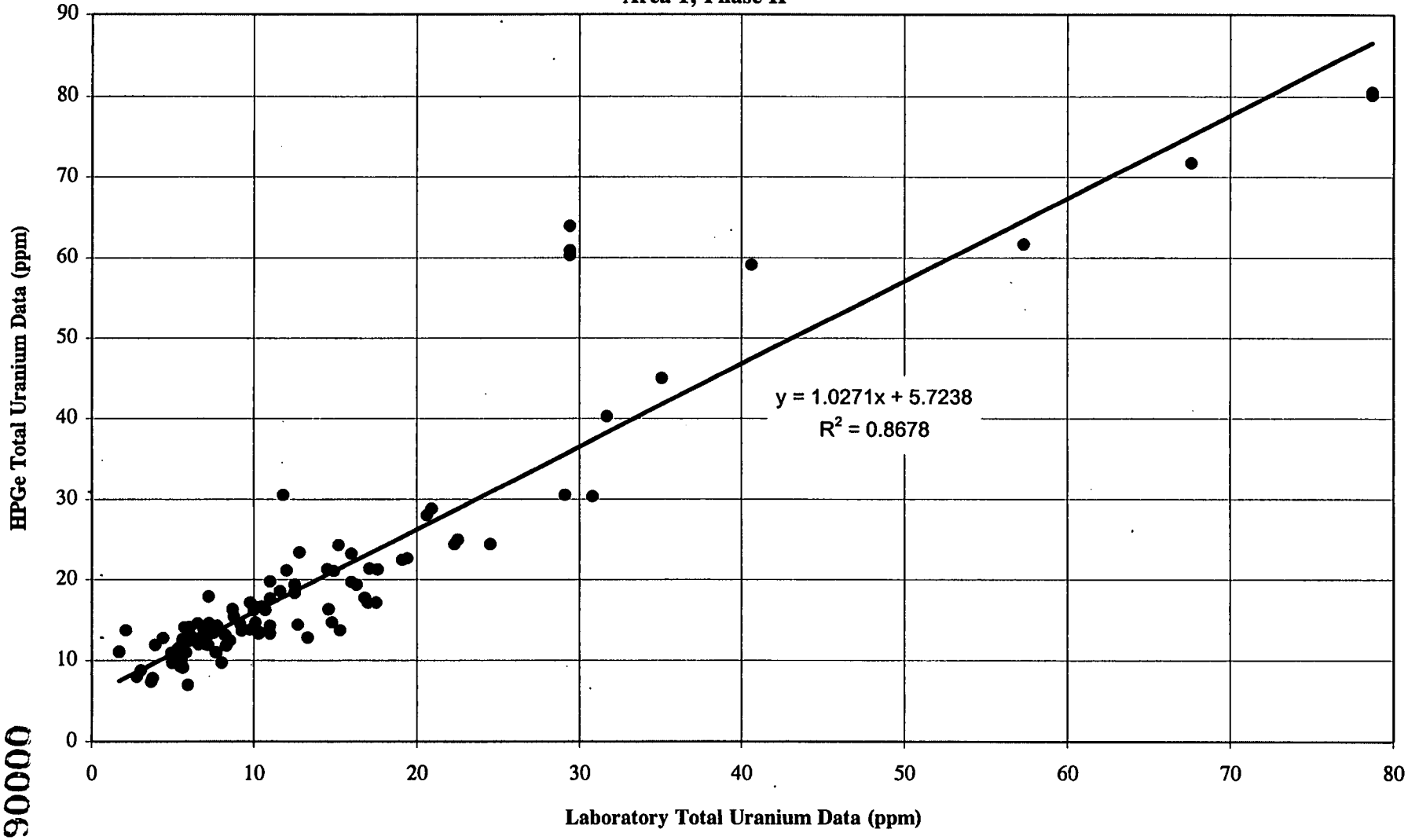
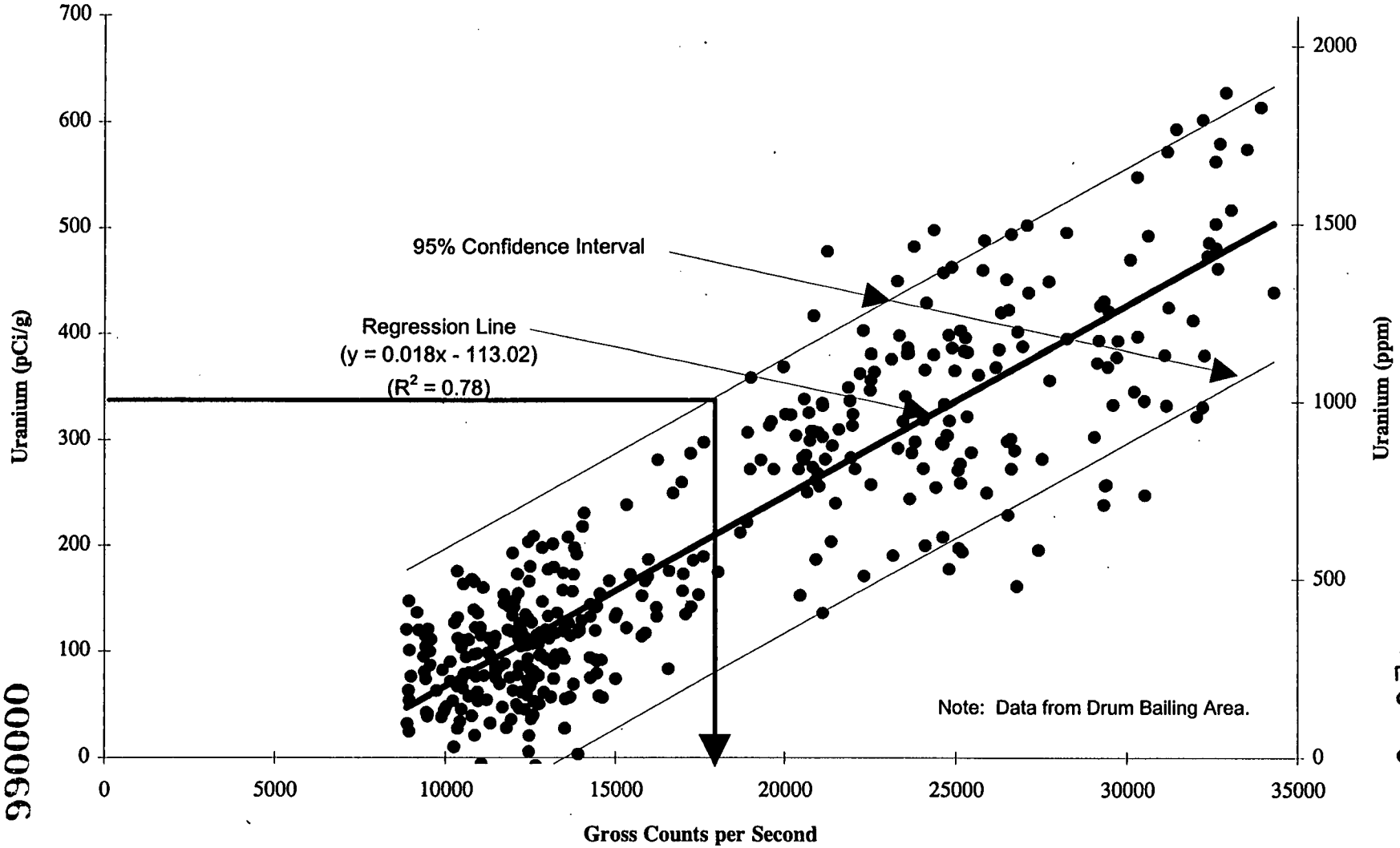


Figure F-3
Uranium Levels vs Gross Counts



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Earthwork and Impacted Material Calculations for Remedial Design Services Remediation Area 1, Phase II

FDF Project No. 20710

November 1997
90 Percent Design Review

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Subcontract No. 2-21487
Project Order 175

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175 Tri-County Parkway
Cincinnati, Ohio 45246

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PO-175 SOIL REMEDIATION OF AREA 1, PHASE II

QUANTITY ASSUMPTIONS:

Quantities are preliminary and are based on the drawings dated November 4, 1997. The preliminary draft of the implementation plan was also used as an information guide.

The STP area earth excavation and concrete quantities are based on the existing facility drawings. It is assumed an overall depth of 2 feet was used for excavation quantities in the STP fence area. All underground utilities including the bedding materials are removed and hauled to the OSDF for burial. Some utility trenches outside the STP area are considered clean and this material is used as backfill.

Excavation quantities in the trap range area are based on the Kriged Model. Excavation quantities with a level of 400 ppm will be stabilized and then disposed of in the OSDF. Other soils with a contamination level of 200 ppm will be directly hauled to the OSDF.

Approximately 35 cubic yards of sludge, remaining on site, is considered RCRA materials and is expected to be hauled off site. Although no above "WAC" material is expected, an allowance of 25 cubic yards is assumed.

	PO - 175 REMEDIATION OF AREA 1, PHASE II			
	PRELIMINARY QUANTITIES			
Item No.	Description	Quantity	Unit	OSDF Catagory
	Impacted Material (To OSDF)			
1	Excavation within STP fence area	29,500	BCY	1
2	Excavation @ Sector 2, 11 Acre (6" Stripping)	8,873	BCY	1
3	Excavation @ Sector 3, 1 Acre (6" Stripping)	807	BCY	1
3	Trap Range Area Excavation (400ppm)	1,958	BCY	TC
	(Based on Kriged Model, 105,200 sf, @ 6" depth)			
4	Plain & Reinforced Concrete of all facilities below grade	1,540	CY	2
	(Incl. footings,below grade walls & slabs,ductbanks,			
	and manholes etc.)			
5	Bedding materials in utility trenches outside STP fence	1,170	CY	1
	(Assumed to be clean but not suitable for backfill,			
	however excavated trench soil will be used for backfill)			
6	Asphalt from paved roads (incl. site access road)	590	CY	2
	Assumed 4" thk. existing asphalt			
7	Gravel with soil mix under paved asphalt, assumed 8"thk	1,180	CY	1
8	Utility pipes within & outside STP area, dirty & clean	110	CY	3
9	4000 LF,Agricultureal drainage tiles, Vitrified Clay 4" dia.	13	CY	2
10	2800 LF, Chain Link Fence, 8 ft. high	138	CY	3
11	Sludge Volume RCRA Waste (Offsite Disposal)	35	CY	F-List 'AWAC'
12	Misc. materials such as Hose house,Curbs,Sumps,	50	CY	3
	valve boxes, electrical poles etc.			
13	Special Material Above WAC to be Disposed of Off-site	25	CY	AWAC Cont'ngcy.
	Non Impacted Material (Not Going To OSDF)			
1	Sediment Basin Excavation	34,170	BCY	
2	Outfall Excavation	8,000	BCY	
3	Conveyance Channel	10,270	BCY	

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REV	BY	DATE	CK	DATE	TITLE Soil Remediation Area 1 Phase II	Project
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Total Soil vol. To O.S.D.F.

Deep Pockets Exc. 10,700 B.C.Y.

Trickling Filters 2618* " --- (One filter 2182 + 20% of other; 80% of one filter is in deep exc.)

Digester Control 200* "

Final Sedimentation Tank 802 "

Imhoff Tank 1015 "

Piping Excavation 2782 " (within S.T.P. area)

Bedding Material 1166** " (Outside S.T.P. area Utilities)

General Excavation (2'-0" depth) 9255 "

U.V. Disinfection Bldg 267 "

Recirc. Pumps & Pits 267 "

29,072 B.C.Y.

Less bedding Material (1,166) C.Y.

27,906

Add 5% Contingency 29,301 Say 29,500 C.Y.

* Part of the exc. included in deep Pockets Exc.

** Only bedding material of outside S.T.P. Utilities goes to O.S.D.F. Rest of excavated material will be used for backfill.

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DEEP EXCAVATION POCKETS

REV	BY	DATE	CK	DATE	TITLE Trickling Filter Area next to Tank Forms	Project
						PO No.
					AUTHOR SHEET OF	

Refer Dwg 92X-5900-G-00456

			Ave. D.	Vol.
Yellow Area:-				
130' x 30/2 + 130x4	2470			
(65+30)/2 x 15 + 20/2 x 8	793	4038 ft²	1.5	6057
35/2 x 10 + 100x6	775			
Pink Area:				
400' x 17' + 120x3	7160	7920 ft²	3'	23,760
50x20/2 + 65x8/2	760			
Blue Area:				
(95+70)/2 x 25	970			
(70+100)/2 x 25	2125	5880	5'	29,400
(100+75)/2 x 22	1925			
85x10 + 140x4	1410			
[25' x 22']	(550)			
Green Area:-				
25x22'		550	6'	3,300
280x4'		1120	7'	7,840
Red Area:-				
255x4		1020	9'	9,180

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Voilet Area:

240 x 4	960	11'	10,560

White Area:

215 x 4'	860	13'	11,180

Navy Blue Area:

205 x 4	820	15'	12,300
$\frac{80+55}{2} \times 30$	2025	16'	32,400

145,977

≈ 5,407 C.Y.

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CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE	Project
					IMHOFF TANK & SLUDGE DRYING BEDS AREAS	
						PO No.
					AUTHOR SHEET OF	

Ref. Dwg. 92X-5900-G-00456

	Area	Depth	Vol
Yellow Area:			
50×5 + 110×16 + 120×10	3210		
45×10 + 45×8/2 + 45×3/2	698		
60×8 + 30×10 + 25×8	980		
10×20/2 + 70×1 + 50×12	770		
	5658	1.5'	8,487
Pink Area:			
60×12 + 55×20 + 50×13	2470		
80×10 + 50×6 + 25×6/2	1175		
55×15 + 40×10 + 85×7	1820		
40×8 + 45×30/2 + 30×8	1235		
	6700	3'	20,100
Blue Area:			
135×9 + (53+30)/2 × 42	2958		
(70+50)/2 × 24 + 65×5 + 120×7	2605		
15×36/2 + (40+26)/2 × 35 +	1425		
26×26/2 + (55+38)/2 × 19 + 10×30/2	1372		
338 + 883.5 + 155			
	8,360	5'	41,800
White Area:			
90×75/2 + 75×16/2	3975		
Less {[60×25/2] + [30×22/2]}	(1080)		
+ (45+35)/2 × 20 + 35×15/2	1063		
	3958	7'	27,706
Green Area:			
60×25/2 + 30 + 22/2	1080	8'	8,640

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106,733 C.F

≈ 3953 C.Y.

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REV	BY	DATE	CK	DATE	TITLE Sampler Stn. & Surrounding Area	Project
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Pink Area:-

$80 \times 4 + 25 \times 18$	770		
$42 \times 12 + 35 \times 25$	1379		
$42 \times 15 + 40 \times 10$	1030		
45×20	900		
	4079	3'	12,237

Yellow Area:-

$70 \times 4 + 65 \times 4$	540		
Yellow Area $25 \times 12 + \frac{60+40}{2} \times 20$	1300		
$70 \times 10 + 2 \times \frac{1}{2} \times 30 \times 12$	1060		
55×6	330		
	3,230	1.5	4845

White Area:

$3.14/4 \times 65^2 + \frac{50+35}{2} \times 10$	3742		
$\frac{30+10}{2} \times 40$	800		
	4542	4'	18,168

35,250 c.f.

= 1306 c.y.

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Trickling Filters: -

Excavation within the Filters: -

Vol. $= 3.14 \times 40^2/4 \times 7'$ = 8792 (By others)

Exc. below slab

$= 3.14 \times 40^2/4 \times 2'$ = 2512

Side slopes $= \frac{1}{2} \times 7 \times 7 \times 3.14 \times 40$ = 3077

Inlet & outlets $= 2 \times 6 \times 6 \times 8'$ = 576

Embankments $= \pi(90^2 - 50^2) \times 3'$ Ave. = 52,752

58,917 C.F. ≈ 2182

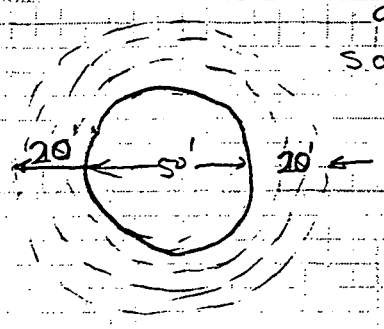
For One Trickling Filter

for Two " " 135,418 C.F.

≈ 4364 CY

Assume 40% in deep pocket exc.

so the remaining = 2618 CY.



$\pi(90^2 - 50^2) \times 3' =$

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REV	BY	DATE	CK	DATE	TITLE	Project
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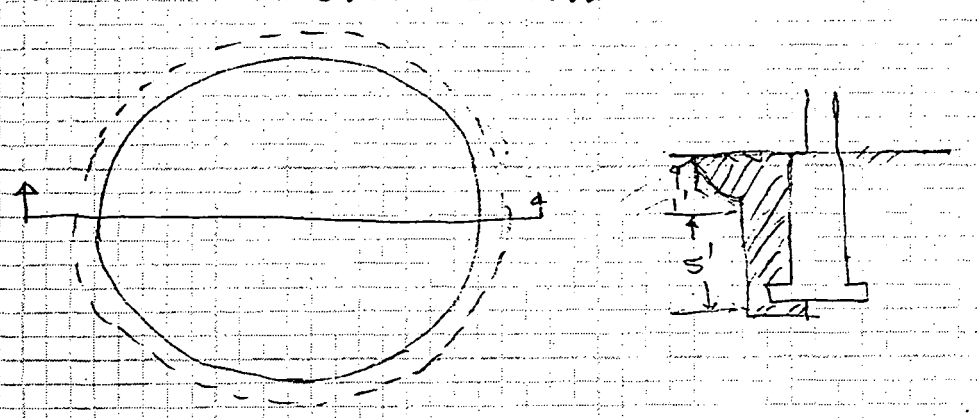
Digester and Control Bldg:-

Assume 2' around the digester to remove the ring wall:-

Excavate from El. 598'-1" to 592'-0"



Exc. of Ring wall

$= \pi D \times (2' \times 5' + 3' \times 1')$

$= 3.14 \times 45' \ (13 \text{ sq. ft.}) = 1837$

Bottom of Tank $= \pi D^2/4 \times 1'-0''$
1'-0" below conc.

$= 3.14 \times \frac{48^2}{4} \times 1'-0'' = 3620$

Control Bldg:

$20' \times 20' \times 3'-0''$ Av. $= 1200$

6657

≈ 250 c.y.

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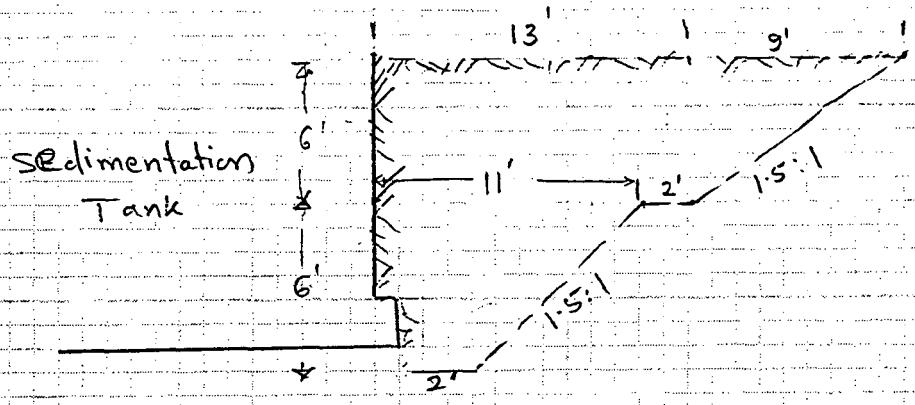
Final Sedimentation Tank



Cross Sectional Area: (For sides)

$= [12 \times 2 + (12+6)/2 \times 9 + 6 \times 2 + \frac{1}{2} \times 9 \times 6]$

$= 24 + 81 + 12 + 27$

$= 144$ S.Ft.

Exc. Vol. $= [32.75' + 4' + 28.0' + 4'] \times 2 \times 144$

$= 19,800$

Bottom of Tank Exc. $= 33' \times 28' \times 2'$

$= 1,848$

Total Vol. $= 21,648 \approx 802$ c.y.

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8

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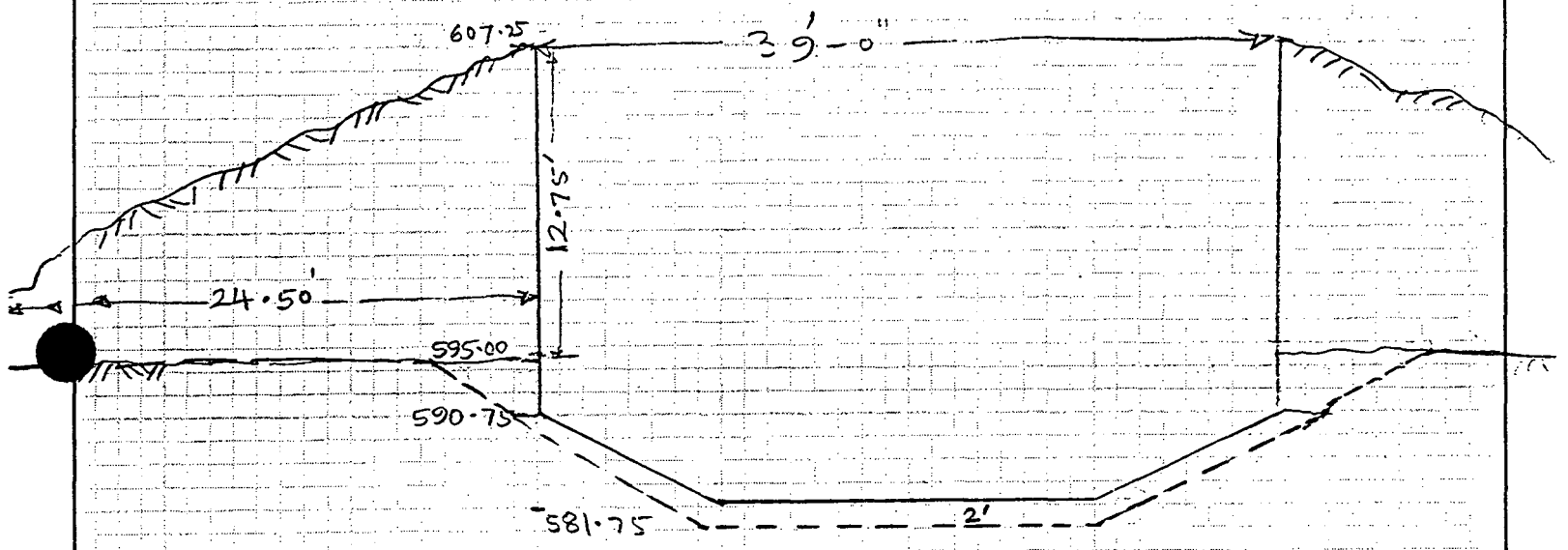
IMHOFF TANK EXC:



Embankment Excavation:

Vol. $= \frac{1}{2} \times 24.5 \times 12.75 \times 2(39' + 23')$

$= 19,367$ c.f.

Quarters $= 4 \times 2 \times \frac{1}{2} \times 24.50 \times 12.75 = 1,250$ c.f.

Foundation Exc $= 39 \times 23 \times 2' + 2 \times \left(\frac{2+8}{2}\right) \times 4 \times 124$

$= 1794 + 4960$

$= 6,754$ c.f.

Total Vol. $= 27,371$ C.F $\approx 1,015$ c.y.

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9

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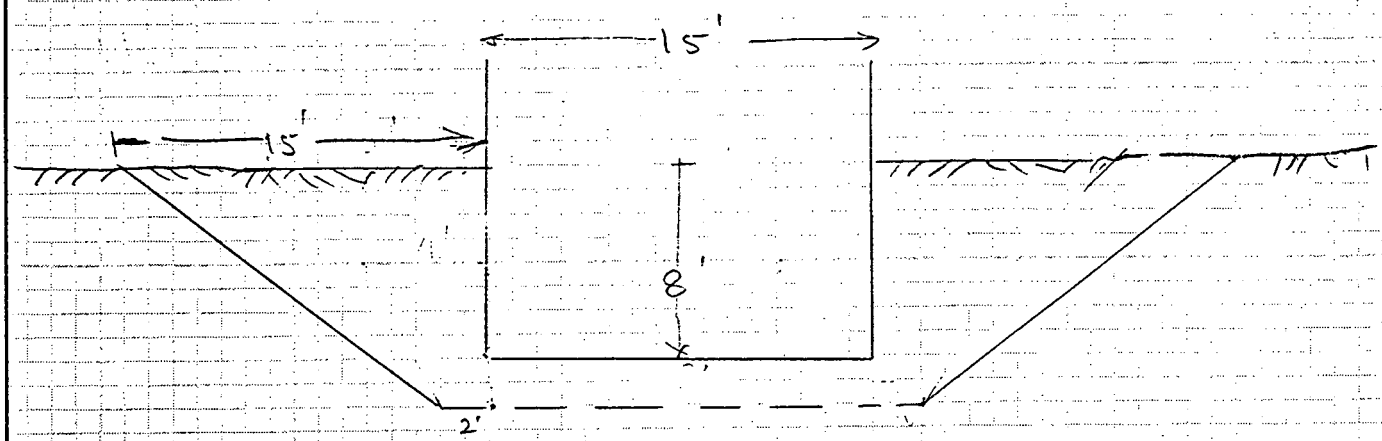
U.V. Disinfection Bldg:—



BLDG. Foundation Exc = 15'×17'× 2' = 510

slopes vol. = $\left[\left(\frac{15+2}{2}\right)\times 10'\right]\times\times\times\left[(15+17)\times 2\right]$

= 5440

Stairway well = 15×5'×2 = 150

slopes = 15×4×8'×2 = 960

Piping Exc. (outside) =

2×4'×8'×10'd = 640

Total Exc = 7190 c.F

≈ 267 c.y.

000079

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CALCULATION SHEET

2050

~~1098~~

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Sampler station:

Manhole 175:

Vol. Exc = 6'x6'x6'

Valve Access Manhole:

$= 6' \times 8' \times 12' + \frac{1}{2}(6' \times 6') \times 20'$ = 936

Bldg. Excavation = 30' x 30' x 2' = 1800

Metering M.H. = 8' x 8' x 9' = 576

Wet well $= [\underbrace{13' \times 8' \times 2'}_{\text{Gen. Exc.}} + \underbrace{(7' \times 5' \times 7')}_{\text{wet well}} + \underbrace{\tfrac{1}{2} \times 8 \times 8 \times 24}_{\text{+ slopes}}]$

208 + 245 + 768 = 1221

Containment Dike = $\underbrace{\tfrac{1}{2} \times 8' \times 8' \times 40'}_{\text{slopes}} + \underbrace{12 \times 12 \times 2}_{\text{Bottom}}$ = 1568

Pipe Exc = $60' \times 4' \times 8' + 120 \times \frac{1}{2} \times 4 \times 4$ = 2880

8981 c.f.

= 335 c.y.

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11

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						PO No.
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General Excavation of the S.T.P Area.

Assume 1' to be excavated from the Existing Contour through the S.T.P. Area.

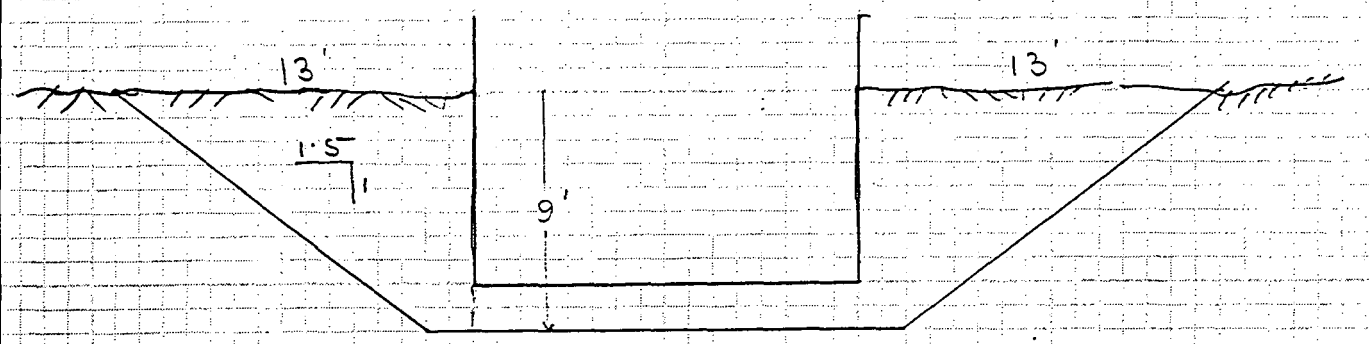
Total Exc. Vol:— $357' \times 350' \times 2' = 249,900$ c.f.

≈ 9255 c.y.

000081

REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Recirculation Pumps & Pits:



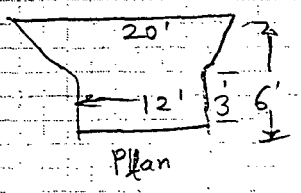
Bottom Pit Exc. = 12.25×12×2' = 294

slopes Exc. = $\left[\frac{13+2}{2}\times 9\right]\times 4\times 12 = 5400$

Piping to Trickling Filters = 2×22×4×4

= 704

Flume Exc. = $\frac{20+12}{2}\times 6\times 6' + 12\times 3\times 6' = 792$



Total Excavation = 7190 c.f. ≈ 267 C.Y.

PARSONS ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE Excavation Qty.	Project
						PO No.
					AUTHOR SHEET OF	

Dwg. 25A-5500-A-00181
5250-25M-5031
3025-H-984A

Chlorination Bldg.

Excavation:

Bldg. Exc:

$15.83' \times 16.67 \times 5'$ = 1320

$4.5' \times 3.5' \times 4'$ = 63

Chlorine Tank: $16.67 \times 11 \times 13'$ = 2384

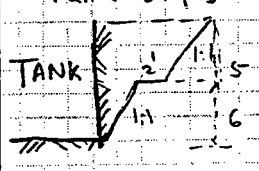
$6'-0'' \times 3.5' \times 11'$ = 231

slopes for Box = $[\frac{1}{2} \times 6 \times 6 + \frac{1}{2} \times 5 \times 5 + 5 \times 2][6 + 2 \times 3.5]$

= $[18 + 12.5 + 10][13]$ = 527

Tank slopes = $[18 + 12.5 + 10][2 \times (16.67 + 11)]$

= $40.5 \times 2 \times 27.67$ = 2241



6766

Gen. exc. around Bldg.

$[2 \times 15.83' + 16.67] \times 1 \times 5'$ = 242

10" CI Pipe $65' \times 2' \times 4'$ = 520

4" CI Pipe $60' \times 2' \times 4'$ = 480

8008 C.F.

≈ 300 C.Y.

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14

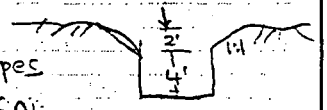
PARSONS ERA PROJECT

CALCULATION SHEET

2050 ~~1002~~

REV	BY	DATE	CK	DATE	TITLE Utilities Excavation	Project PO-175
						PO No.
					AUTHOR SHEET OF	1 of 2

Utilities Excavation



slopes

San. line 16" From MH 175 to MH 176C — 540' x 4' x 6' = 12960 + 2160 (slopes 540 x 4)

San. line 8" Force Main — 560' x 3' x 6' = 10080 + 2240

San. Line 10" To MH 175 — 140' x 4' x 6' = 3360 + 560

San. line 10" To Fac. 25D — 2 x 40' x 4' x 6 = 1920 + 320

San. Line 10" Bypass to Final Sedimentation Tank — 175' x 4' x 6' = 4200 + 700

S. Line 10" to Sedi. Tank — (40' + 30') x 4' x 6' = 1680 + 280

4" from 25D to S Tank — 85' x 2' x 6' = 1020 + 340

8" To trickling Filter — 2 x 60' x 3' x 6' = 2160 + 480

S. Line 10" Main N.S. — 210' x 4 x 6' = 5040 + 840

S. Line 4" Main N.S. — 250' x 2 x 4 = 2000 —

D.W. Line 2" N.S. — 440' x 2 x 4 = 3520 —

8" ⌀ Culvert — (90' + 65') x 4 x 6 = 3240 + 620

10" x 20" Conc. Ducts — 160' x 5' x 5' = 4000 —

2" elec. line (south side) — 335' x 2' x 4' = 2680 —

3 #4 Elec. line From 25E to 25A Fac — 270' x 2' x 4' = 2160 —

Fuel Gas line 1" — 285' x 2' x 4' = 2280 —

Storm Sewer 6" — 90' x 3' x 6' = 1620 + 360

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P.T.O.

PARSONS ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

San. 10" @ Sludge Drying Bed — 180' x 4 x 6' = 4320 + 720

San. 10" From MH174 to Imhoff tank — 30' x 4 x 6' = 720 + 120

San 6" From Main to Imhoff — 50' x 3' x 6' = 900 + 200

San. 6" around the drying beds — (260' + 26x30') x 3' x 6' = 18720 + 4160

San. 8" By Pass bet Digester & Imhoff — 70 3' x 6' = 1260 + 280

San 6" Digester to Imhoff tank — 100 3' x 6' = 1800 + 400

Fuel Gas line 4" from D.O facility to former production Area } — 1370 x 3' x 4' 16,640 — 108,080

Fire Water line 4" } East side of N. Access to Fence } — 2x700 x 2' x 4' 11,200
Potable " " 3" }

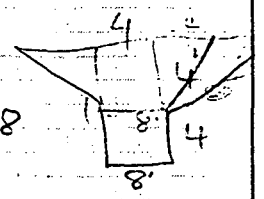
Concrete Duct Bank 24" x 26" To 21" x 20" } " } — 1,075 x 4' x 5' 21,500

Agriculture Drainage tiles ? 4000 L.F x 4" CPV Pipe 2.5d. 20,000

12" HDPE line from AWWTF to MH175 — 700 x 4' x 4' 11,200

Manhoes Excavation-

Manhole Excavations: — 6x(8 x 8 x 8' + 8x32)
172, 173, 174, 175, 176A
176C = 6x(768) = 4608 4,608



191,368

≈ 7090 c.y.

$\approx \frac{1}{2} \times \frac{4 \times 4}{16} = 8$

* Does not include utilities within Dissolved Oxygen facility.

Clean Materials, Excavated soil will be used for Backfill.
4312 c.y.

Remain Exc. 2778 c.y.

(16)

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REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Outside S.T. Area Bedding Material to ODE Pipe Vol. Conc. Vol.

San. 8" — 560 x 4' x 4' = 8960 CF. 200 CF.

12" HDPE — 700 x 2' x 2' = 2800 " 530 CF.

4300

Conc. Duct — 1075 x 2 x 2 = conc. material

16" CI pipe — 540 x 4 x 4 = 8640 750

4" Gas Pi — 1370 x 2 x 2 = 5480 117

4" & 8" DW — 1400 x 2 x 2 = 5600 120

31,480 CF. (1166 CY.)

8" Culvert Pipe — 135' 48

Conc. Duct bank 160' x 10" x 20" 222

Asphalt for roads — 589 c.y.

Gravel & sand mix for roads — 1180 c.y.

(Incl. Access rd STP) —

Sand —

Gravel —

Within S.T. Area

10" San. 885 L.F. $\frac{3.14}{4} \times .83^2 \times 885$

6" San. 1190 L.F.

8" San. 280 L.F.

4" " 335 L.F.

See next page.

000086

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ERA PROJECT

CALCULATION SHEET

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						PO No.
					AUTHOR SHEET OF	

Asphaltic Pavement: -

Roads Inside S.T.P. Area:

Asphaltic Conc. 4" Gravel mix 8"

$180 \times 12 + 20 \times 8 + \frac{40+12}{2} \times 25$ — 2970 S.F.

$\frac{75+12}{2} \times 30 + 170 \times 12 + 100 \times 50$ — 8345 "

$210 \times 12 + 100 \times 12 + \frac{40+12}{2} \times 20$ — 4240 "

160×12 — 1920 "

Access Rd. = 1500' × 20' — 30,000 "

47,475 — 15,904 cf — 31,808 c.f

≈ 589 c.y. — 1180 c.y.

000087

04/96

NA/ENG025

18

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2050

REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Pipe Vols:-

Inside S.T.P. Area:-

	L.F.	Volume C.F.
10" San. Pipe	885	480
8" " "	190	67
6" " "	1280	251
4" " "	335	30
2" water	440	10
		838

Outside S.T.P. Area

12" Effluent line	700	550
16" CI Pipe	540	750
8" San. Force Main	560	200
8" Culvert	135	48
4" Gas pipe	1370	117
4" & 3" Water line	1400	120
4" VTF Clay Pipe	4000	342
		2127

Total Pipe Vol:- 2965 C.F.

≈ 110 C.Y.

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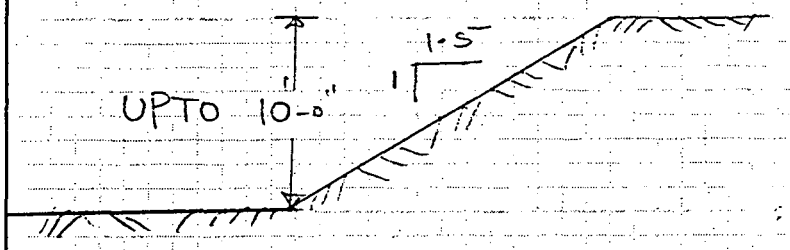
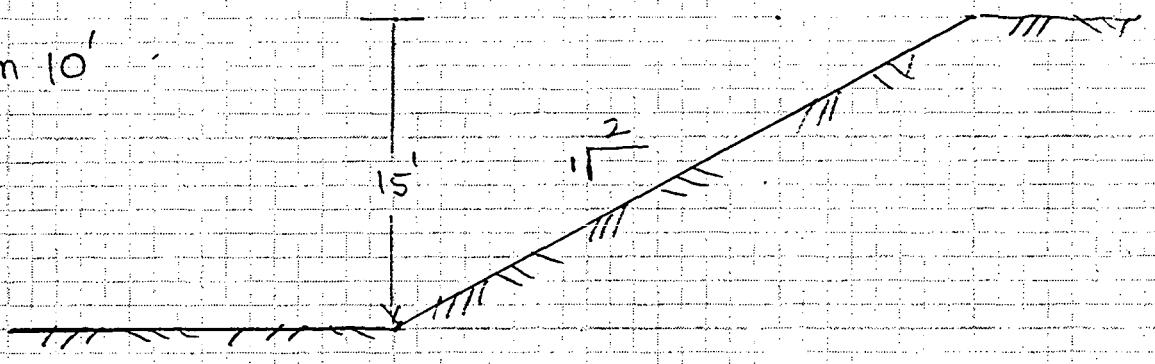
						PO No.
					AUTHOR SHEET OF	

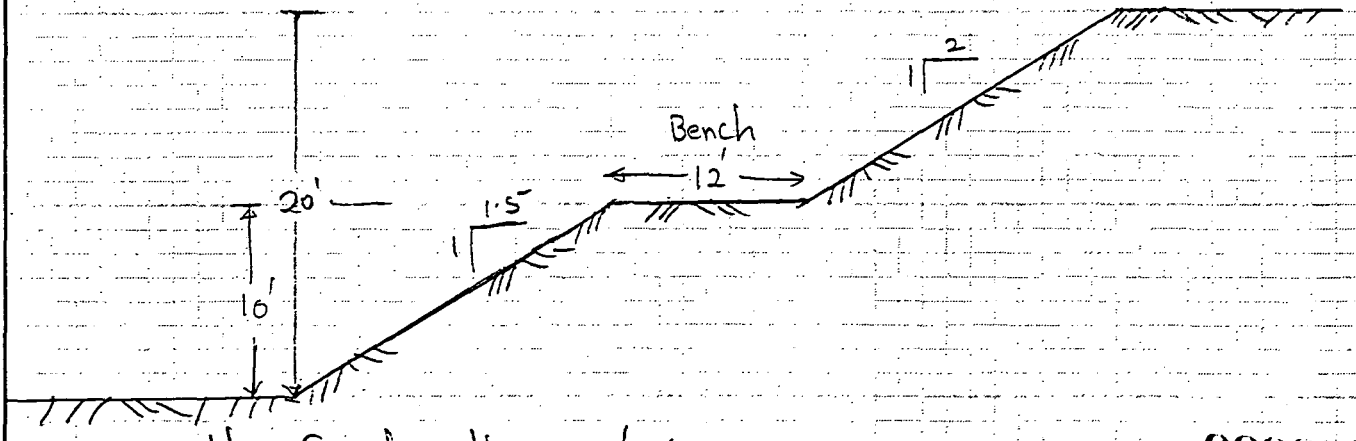
TYPICAL CROSS SECTION OF EXC.



Less than 10'



Between 10 & 15' Depth



Depth Greater than 15-0"

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PARSONS ERA PROJECT

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2050 ~~1092~~

REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Total Conc. Volume to O.S.D.F.

	C.Y.
Chlorination Bldg & Contact Basin	74
Sampling Bldg, & Valve access M.H.	20
U.V. Disinfection Bldg	42
Digester & Control Bldg.	128
Sludge drying Bed	15
Primary Settling Tank (Imhoff tank)	504
Final Sedimentation Tank	100
Trickling Filters	242
Recirc. Pump sump & Valve Pit	35
Incinerator Pad	29
Contaminant dyke	7
Conc. Duct Banks	168
Conc. Manholes	120
Fence post Bases	5
Misc. Pits & boxes etc.	50
	1539 C.Y.

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21

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REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
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Preliminary

Spot Checks on Concrete Qty (Rest of Qty from Title I)

Digester & Control Bldg:-

Main Tank:- FDN. Wall

$\pi D \times 1.70' \times 5.33'$

$3.14 \times 42' \times 1.7 \times 5.33 = 1195$

Bottom slab:- $\frac{\pi D^2}{4} \times 1' = \frac{3.14 \times 48^2}{4} \times 1' = 1809$

Control Bldg:-

FDN G.B: $-(23.33 + 2 \times 22') \times 1' \times 2.5' = 168$

Sump pit slab: $-(22' \times 16') \times 0.5' = 176$

Wall: $(22' \times 2.75' \times 0.5' = 30$

F.F. slab: $22' \times 6' \times 0.5' = 66$

3444 c.f

≈ 128 c.y.

000091

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REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Primary Sedimentation Tank (Imhoff Tank) Ref:- Dwg. sheet #44 To 50

Bottom Slab: $42.5' \times 23' \times 1'$ = 977.5

Peri. Walls : $2(23'+39') \times 1.25' \times 15'$ = 2325

Center Wall :- $21' \times 1' \times 13'$ = 273

Conc. ftg. cols. : $-3 \times 3 \times 2' \times 2' \times 2'$ = 72

conc. wall : $-3 \times 3 \times 1' \times 1' \times 3.5'$ = 32

Slab (Inner) :- $22 \times 23' \times 1.25'$ = 632.5

Section BB Conc :- $4 \times \frac{5' \times 4'}{2} \times 5.75'$ = 230

Bottom Slab $23' \times 6.5' \times 1'$ = 149.5

Sect. CC wall's :- $2(23'+39') \times 1' \times 15'$ = 1860

Class D Conc :- $\frac{39.42'+19'}{2} \times 8' \times 23'$ = 5375

Conc. wall Jaw @ Grade :- $2(23'+39') \times .67' \times 6'$ = 498

Comminuter walls :- $[7'+7.66 \times 2] \times .83 \times 8'$ = 148

$-[7'+7.66 \times 2] \times 1.5' \times 10'$ = 335

$- 12' \times .83 \times 8'$ = 80

ftg. $12' \times 1.5 \times .83'$ = 15

slab conc. $- 9' \times 7.75' \times 4'$ = 279

Setteling Compartments:-

Vert. wall $4 \times 6.5 \times .67' \times 11'$ = 192

Slant walls $4 \times 6.5 \times .5' \times 11'$ = 143

13,616.5 C.F.

504 C.Y.

000092

NA/ENG025

04/96

23

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CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Final Sedimentation Tank:—

Perimeter walls :- $2(34' + 25') \times 1'\text{-}0'' \times 10' =$ 1180

Center wall :- $(4+6) \times 1'\text{-}0'' \times 10' =$ 100

$25' \times 1'\text{-}0'' \times 10'$ 250

Bottom slab :- $23.67 \times 25' \times 1'\text{-}5' =$ 888

Sct. A-A

Bottom slab Sect. B-B :- $\left(2 \times \frac{1}{2} \times 4 \times 4 + \frac{5+1}{2} \times 4\right) \times 3.83' =$ 62

$+ 25 \times 5.83' \times 1' =$ 146

Scum Pipe Chamber walls :- $(4.25 + 3.54) \times 6' \times .67' =$ 45

slab $3.5 \times 3 \times 0.67' =$ 7

2678

$\approx$ 100 c.y.

000093

04/96 NA/ENG025

(24)

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REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Trickling Filters

Tank Wall foundation

Perimeter $\pi D = 40 \times 3.14$
$= 125.6'$

Wall Fdn $= 125.6 \times 2.5 \times .83 =$ 261

Tank walls $= 125.6 \times .83 \times 7.2' =$ 751

Tank slabs $= 3.14 \times \frac{40 \times 40}{4} \times .67 =$ 842

Flume Chamber walls $= 2 \times 3 \times 3.5' \times 7.2' =$ 151

Sed. c-c slabs $= 2 \times 3.5 \times 3.5' \times 1.5 =$ 37

Foundation for arm supports $\}$:- $5' \times 5' \times 6' =$ 150

2192

$\approx$ 82 c.y.

for two trickling Filter = 164 c.y.

Underdrain blocks & cover blocks $= \frac{\pi D^2}{4} \times .83$

$= \frac{\pi \times 40^2}{4} \times .83$

$= 1042.48$

≈ 38.6

For two filter = 77.2 C.y.

000094

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CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE	Project
						PO No.
					AUTHOR SHEET OF	

Containment dyke

Walls - 4 × 9 × .5 × 6' = 108

Slab 9 × 9 × 0.5 = 40.5

Foundation Piers = 4 × 1.5 × 1.5 × 3' = 27

176 cf ≈ 7 cy

000095

CHLORINE CONTACT TANK & BUILDING 25A

WALL	2.75' x 26.83', .83' ÷ 27 =	2050 7.2 cu yds.
"	3.67' x 16.67' x .83' ÷ 27	1.22 cu yds.
"	2.25' x 1' x 15.83' ÷ 27	4.24 cu yds
"	2.25 x 1' x 16.67 ÷ 27	5.09 " "
"	2.75' x 1' x 4.83 x 2 ÷ 27	3.12 " "
"	2.75' x 1 x 4' x 1 ÷ 27	1.3 " "
"	2.67' x .83' x 2.75 ÷ 27	2.33 " "
"	2.67' x 2.16' x 9.05 ÷ 27	6.25 " "
"	2.75 x 4' x .83 ÷ 27	1.076
"	2.50' x 2.75 x .83 x 2 ÷ 27	1.34
"	3.16' x 2.83' x .67 x 2 ÷ 27	.44
"	3.16' x 4.5 x .67 ÷ 27	.35
"	15.22 x .83 x 2' ÷ 27	3.29
	14.99 x 2' x .67 ÷ 27	2.98
	BASE SLAB	
Section "A"	21' x 1.16' x 12' ÷ 27	10.83 cu yds.
Section "B"	12' x 1.16' x 17.67 ÷ 27	9.11 " "
	FOOTINGS	
Section "B"	1.5' x 17.67' x .83 ÷ 27	.81 cu yds
" "C"	16.16' x 1.5' x .83 ÷ 27 x 2	1.50 " "
" "	16.16' 1.33 x .83 ÷ 27	.66 " "
	GRADE SLAB	
Sect B.B	16.83' x .67' x 16.67 ÷ 27	6.96 cu yds.

000096

(27)

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CHLORINE CONTACT TANK & BUILDING 25A

CONCRETE STOOP

SLAB	.67' x 11' x 3' ÷ 27 =	.82 cu.yds
WALLS	3.5 x .67 x 2.5' x 2 ÷ 27	.43 " "
SIDE WALL	9.66 x .67 x 2.5 ÷ 27	.60 " "
	TOTAL THIS BUILDING	73.82 cu.yds

TRICKLING FILTERS

BEST GUESS

Ring WALL	1'-0" x 40.5' x 7.3' =	33.93 cu.yds
BASE	1.25 x 20.25 x 20.25 x 3.1416 ÷ 27	59.44 " "
FOOTER	1.50 x 3' x 40.5' x 3.1416 ÷ 27	21.21 " "
SIDE BOXES	3.5' x 7.3' x 3 ÷ 27 x 2	5.4 " "
BASE	4.5 x 4.5 x .5 ÷ 27 x 2	.75
		121.13 " "

COVER BLOCKS .83 x 20' x 20' x 3.1416 ÷ 27 = 38.43 cu yds

38.43 + 121.13 x 2 FILTERS = 319.52 cu yds

77.3 x 1 MHA = 77 MHAS.

WALLS	(1.5)	79.06 cu yds	118.59
BASE	(2.5)	163.2	408
			603.59 ÷ 319.52 = 1.889 MHs

Not USED see p. 25

000097

MH #175, SAMPLING BLDG., ACID STORAGE

2050

FOOTER PAD	9.5' x 9.5' x 1' ÷ 27	=	3.34 cu.yds.
WALLS	9.5 x .5' x 2 ÷ 27	=	.35 " "
	9' x .5' x 2 ÷ 27	=	.33 " "
	SAFETY SHOWER		
WALL	4' x .5' x 2' ÷ 27		.15 " "
	3.25 x .5' x 2' x 2 ÷ 27		.24 " "
	SAMPLING BLDG.		
WALL	2.5' x .5' x 2' ÷ 27		.314 " "
	5' x .5 x 2 ÷ 27		.185 " "
	SAFETY SHOWER		
BASE	3' x 4' x 1' ÷ 27		.44 cu. yds.
	PIPE SUPPORTS		
	1' x 1.5' x 1 x 4 EA. ÷ 27		.22 " "
	ALLOWANCE - SUMP FNDT'S		.25
	TOTAL		5.22 cu.yds.
	SAMPLING BLDG.		
WET WELL - WALLS	7' x .5' x 7' x 2 EA. ÷ 27		1.81 cu.yds.
	4' x .5' x 7' x 2 ÷ 27		1.03 " "
BASE	6' x 4' x 1 ÷ 27		.89 " "
	ACCESS MANHOLE		
WALLS	5.58 x .5' x 6' x 2 ÷ 27		1.24 cu.yds.
	3' x .5' x 6' x 2 ÷ 27		.67 "
BASE	5' x 3' x 1' ÷ 27		.56
	METERING MH. PAD		
	6' x 6' x .5 ÷ 27		[redacted] .67 cu.yds.

000098

MH. #175, SAMPLING BLDG., ACID STORAGE

12' x 12' x .5 ÷ 27 =	2.67 cu.yds
8' x 13' x .5 ÷ 27 =	1.93
	7.93
− 12' x 12' x .5 ÷ 27 =	2.67
5 x 71.5 ÷ 27 =	.65
	3.32 cu yds
SUB TOTAL PAD	4.61 cu.yds
+ 4' x 1.5' x .5 ÷ 27	.11
TOTAL	4.72 cu.yds
MANOLE 175 USE VALVE ACCESS MH.	2.5 cu yds
TOTAL	19.91 cu.yds

USE 1.5 MHRS.

PRIMARY SEDIMENTATION TANK FNDT'S
(EXISTING IMHOFF TANK CONVERTED TO
PRIMARY SEDIMENTATION TANK)

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~~1090~~

SLUDGE DRYING BEDS

2050

PRECAST WALLS

1.5' x .16' x 8.83' Lg ÷ 27 x 15 EA = 1.11 cyds.

1.5' x .16' x 4' Lg. ÷ 27 x 5 EA = .18 " "

FOOTINGS - 20 EA.

1.67' x 1.67' x .83' 1.72 cu.yds

PIERS - 20 EA.

1' x 1' x 3.5' (ADDED PRIMY) x 20 ÷ 27 2.59 cu yds

CONCRETE PIPE SUPT'S.

3.14 x 2' x .83' x 27 ÷ 27 = .39 cu.yd

SLUDGE DISTRIBUTION BOX

WALLS 5.33' x .67 x 5.5' x 4 WALLS ÷ 27 x 3 EA. 8.73 cu.yd

14.72

SPLASH PLATE

2' x 2' x .33 x 4 EA ÷ 27 .20 "

TOTAL 14.92 "

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FLUMES & PITS

SECTION E-E - 4036 Dwg.

SLAB TOP

2.33' x .33' x 12.52 ÷ 27 = 36 cu.yds.

2.33' x .33 x 1.5' ÷ 27 = .043 " "

BASE .5 x 2' x 14.08' ÷ 27 = .52

WALLS .5' x say 2' Hi x 14.08 ÷ 27 x 2 = 1.043

x 2 = 3.93 cu.yds. For 2 Flumes

MISC. OPEN FLUMES (carry lead Dwgs) say 8 yds

PUMP & VALVE PITS

WALLS - 22.35' x 6' x say 1' thick x 2 ÷ 27 = 5.44 cu.yds

16.67' x 6' x " 1" " x 3 ÷ 27 = 7.11 " "

5' x 6' x 1' x 1 ÷ 27 = 1.11 " "

BASE 13.25' x 13.01' x .83 ÷ 27 = 5.3 " "

MISC. x 4

34.94

INCINERATOR PAD

NET WALL .67' x 1.5' x 145' ÷ 27 = 1.15 cu.yds.

CONC. TRENCH NEW DUMP 2' x .5' x 58' ÷ 27 = 2.15 " "

EXIST. CONC. PAD

40' x 25 x say .8 ÷ 27 = 18.52 cu.yds.

20' x 15 x .5 ÷ 27 = 5.56 " "

24.08 cu.yds.

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PARSONS ERA PROJECT CALCULATION SHEET

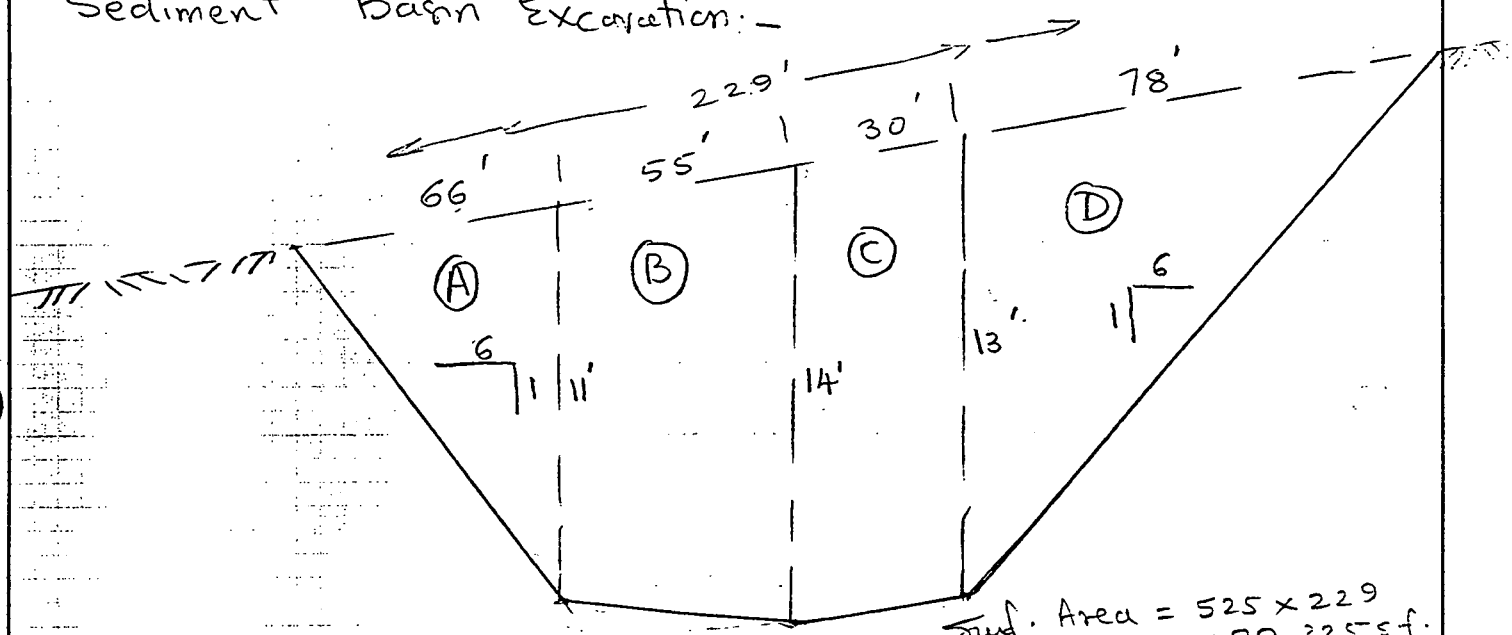
REV	DATE	BY	CK	TITLE PO-175 Area 1, Phase II Soil Remediation	PAGE NUMBER 2050
					COST CENTER
				AUTHOR Bob Nemade SHEET 1 OF 2	OU

Sediment Basin Area

Dumped Rock:

$80' \times 70' \times 1.5' \div 27 = 311$ C.Y.

Sediment Basin Excavation:-



Surf. Area = 525 x 229
= 120,225 s.f.
@6" D = 2230 C.Y.

Total Area of C.S. =

A = $\frac{1}{2} \times 66 \times 11 = 363$

B = $\frac{14+11}{2} \times 55' = 688$

C = $\frac{14+13}{2} \times 30' = 405$

D = $\frac{1}{2} \times 78 \times 13 = 507$

1963 s.f.

Total Vol = $470' \times 1963 \div 27 = 34{,}170$

000102

PARSONS ERA PROJECT

CALCULATION SHEET

REV	DATE	BY	CK	TITLE	PAGE NUMBER
					COST CENTER
				AUTHOR SHEET OF	OU

Outfall

Excavation:

$\frac{94+16}{2} \times 13' \times 320' \div 27 = 7944$ BCY Say 8000 BCY

Geotex

$320 \times \frac{41}{9} = 1460$ S.Y.

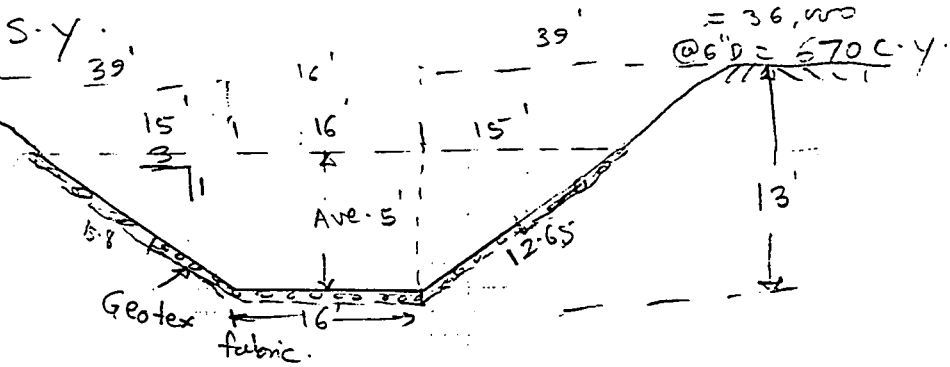
Rocks 18" depth

730 C.Y.

Surf. Area

$350 \times 100 = 36{,}000$

@6" D = 670 C.Y.



Conveyance Channel Excavation: –

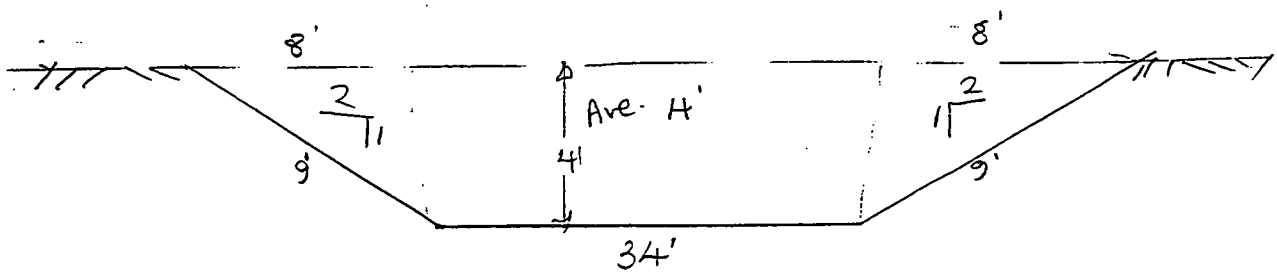
$\frac{50+34}{2} \times 4' \times 1650' \div 27$

$= 10{,}270$ C.Y.

Blanket Area

$34+18 = 52' \times 1650 \div 9$

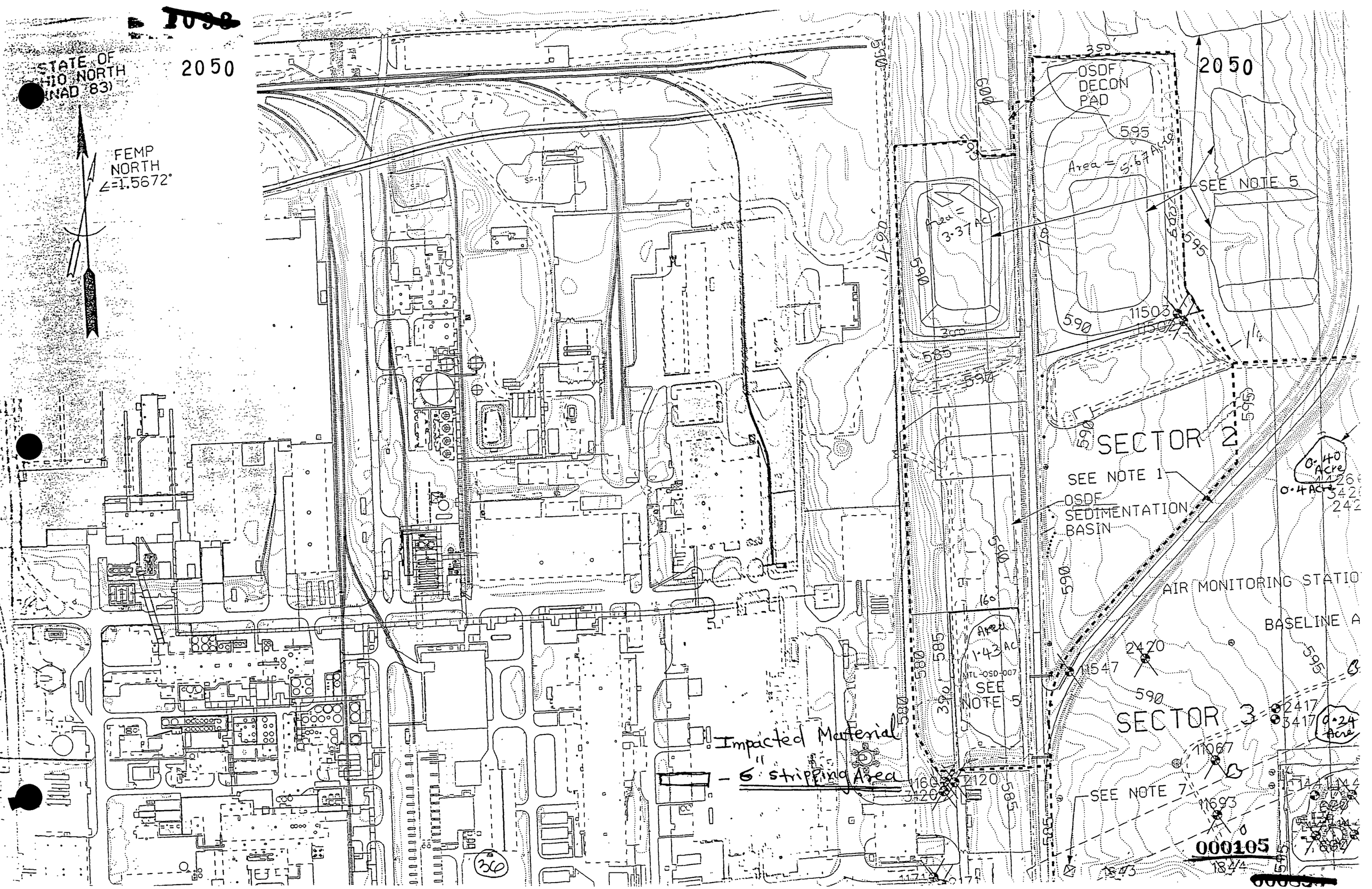
$= 9535$ S.Y.



000103

ENG.021(03/91)

TANK FARM AREA
SOIL STOCKPILE AREA
2050
SEE NOTE 2
595
600
605
1320
000104


STATE OF OHIO NORTH (NAD 83)
FEMP NORTH ∠=1.5672°
2050
OSDF DECON PAD
Area = 5.67 AC
SEE NOTE 5
Area = 3.37 AC
SECTOR 2
SEE NOTE 1
OSDF SEDIMENTATION BASIN
0.40 Acre
0.4 Acre
AIR MONITORING STATIO
BASELINE A
Area 1.43 AC
NTL-OSD-007
SEE NOTE 5
SECTOR 3
0.24 Acre
Impacted Material
6" stripping Area
SEE NOTE 7
000105