SUPPLIER DOCUMENT SUBMITTAL

FDF PROJECT NO.: 20111	CONTRACT NO: GEO	SUBMITTAL NO.: 023	REV.: 0	DATE: 10/31/01	Page 1 of 1

FROM:

GeoSyntec Consultants
MS 38

SIGNATURE: Sheila Gilbey X 3418

TO: FDF ENGINEERING/CONSTRUCTION DOCUMENT CONTROL (ECDC), MS 52-7

RECEIVED BY: [signature] DATE: 10/31/01

			DOCUMENT FAMILY									SUBMITTAL TYPE				SUBMITTAL ACTION		
QTY	DOCUMENT NUMBER	REV	PRO	H&S	MED	TRG	CON	ENG	QAC	OPER	TITLE/DESCRIPTION	DRFT	CFC	INF	ASSOCIATED SPECIFICATION	A	B	C
4	Complete Reports 20111-RP-0007							X			Enhanced Permanent Leachate			X		X		
											Transmission System CQA Final Report							
3	Text Only 20111-RP-0007							X			Enhanced Permanent Leachate			X		X		
											Transmission System CQA Final Report							

REVIEW DISTRIBUTION

NAME	MS	NAME	MS	NAME	MS
COMPLETE REPORT		**TEXT ONLY**			
(1) ECDC	52-7	(1) JIM JENKINS	19		
(2) ~~OHIO EPA AND U.S. EPA~~ MW M GRIFFIN 11/1/01	52-5	(1) DAVID BRETTSCHNEIDER	52-5		
(1) DON PFISTER - DOE	45	(1) J.D. CHIOU	64		

NO COMMENTS: ✓ COMMENTS: (PLEASE USE SPACE BELOW FOR COMMENTS OR INDICATE IF ATTACHMENTS)

ORIGI

RECEIVED BY: [signature] DATE: 11/01/01
(SIGN/DATE AND RETURN A COPY TO ECDC, MS 52-7)

SUBMITTAL TYPE: (BY SUPPLIER)
CFC - CERTIFIED FOR CONSTRUCTION
INF - INFORMATION/RECORD
DRFT - DRAFT/PRELIMINARY

SUBMITTAL ACTION CODE: (BY FDF)
A - Conforms to the Subcontract Requirements
B - Minor Comments - Incorporate and Resubmit
C - Revise and Resubmit (SEE COMMENTS)

INSTRUCTIONS FOR COMPLETING THE SUPPLIER DOCUMENT SUBMITTAL:

Supplier Submittal Instructions

1 Enter the FDF project number or CWO number.

2 Enter the Contract number.

3 Enter the Submittal number.

4 Enter Submittal revision number.

5 Enter the date the Submittal was prepared.

6 Enter Page Number(s) of submittal.

7 Enter name and address of the Organization submitting the documents and signature of the individual preparing the Submittal.

8 (FDF) ECDC will verify correctness and sign and date stamp receipt of submittal.

9 Enter the quantity of each document submitted to FDF.

10 Enter unique identification number for each document.

11 Enter the revision of each document listed on submittal.

12 Check the appropriate Document Family identified by the Submittal Register.

13 Enter the title and/or a brief description for each document.

14 Enter an "**X**" in the appropriate SUBMITTAL TYPE column for each document listed on the submittal.

15 Enter the specification number associated with each document.

16 (FDF) ECDC will check the Submittal Action Code from the sticker attached to the submittal by the reviewer.

17 (FDF) ECDC will enter the Approver and Reviewers of the listed documents per the Master Submittal Distribution List.

18 (FDF) ECDC will enter the mail stop for the personnel listed in block 17 of the submittal.

19 (FDF) If no comments enter **(X)** in block, **OR** List any discrepancies: (ie; documents, revision numbers, quantities, missing documents, etc.;) and any other comments deemed necessary and applicable to the submittal.

20 Sign and Date. Return to ECDC, MS 52-7.

GEOSYNTEC CONSULTANTS

1100 Lake Hearn Drive, Suite 200
Atlanta, Georgia 30342-1523 • USA
Tel. (404) 705-9500 • Fax (404) 705-9400

31 October 2001

Fluor Fernald, Inc.
P.O. Box 538704
Cincinnati, Ohio 45243-8704

Attention: Mr. Michael W. Griffin

Subject: Construction Quality Assurance Final Report
Enhanced Permanent Leachate Transmission System
On-Site Disposal Facility
Fernald Environmental Management Project
Fernald, Ohio

Dear Mr. Griffin:

GeoSyntec Consultants (GeoSyntec) is pleased to present Fluor Fernald, Inc. with the enclosed copies of the Construction Quality Assurance (CQA) Final Report for the Enhanced Leachate Transmission System (EPLTS) project. As requested in your 18 October E-mail, four (4) sets of the complete final report (narrative and appendices) are being submitted to ECDC (MS:52-7) for distribution as follows:

- 1 set for ECDC Project File 20111.7.2;
- 2 sets for distribution to Ohio EPA and U.S. EPA; and
- 1 set for DOE- Fernald, to be submitted to Mr. Don Pfister (MS:45).

In addition, three copies of the narrative and Appendix A (Photographic Documentation) are being submitted to ECDC (MS:52-7) for distribution to the following: (i) Mr. David Brettschneider (MS:52-5); Mr. Jim Jenkins (MS:19); and Dr. J.D. Chiou (MS:64). With the formal submittals of the enclosed copies of the CQA Final Report completes GeoSyntec's scope of work on the EPLTS project.

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
Sig: [illegible] Date: 11/01/01

GQ1341-03.1/F013005-LTR

GeoSyntec appreciates the opportunity to work with Fluor Fernald, Inc. and DOE-Fernald on the EPLTS project. Should you have any questions regarding the report, please do not hesitate to contact the undersigned.

Sincerely,

Kwasi Badu-Tweneboah, Ph.D., P.E.
Senior Project Manager

Enclosures

Copies to:

ECDC (Fluor Fernald, Inc. MS:52-7)
David Brettschneider (Fluor Fernald, Inc. MS:52-5)
Jim Jenkins (Fluor Fernald, Inc. MS:19)
J.D. Chiou (Fluor Fernald, Inc. MS:64)
Rob Janke (DOE-Fernald MS:45)
Jay Jalovec (DOE-Fernald MS:45)
Don Pfister (DOE-Fernald MS:45)
Dave Phillips (GeoSyntec Atlanta)
Jay Beech. (GeoSyntec Atlanta)
GeoSyntec Project File

GQ1341-03.1/F013005-LTR

PROD #7284 Vol 1

CONSTRUCTION QUALITY ASSURANCE

FINAL REPORT

ENHANCED PERMANENT
LEACHATE TRANSMISSION SYSTEM
ON-SITE DISPOSAL FACILITY

United States Department of Energy
Fernald Environmental Management Project
Fernald, Ohio

REVISION 0
OCT. 2001
VOLUME I

CONSTRUCTION QUALITY ASSURANCE
FINAL REPORT

ENHANCED PERMANENT LEACHATE TRANSMISSION SYSTEM

ON-SITE DISPOSAL FACILITY

United States Department of Energy
Fernald Environmental Management Project
Fernald, Ohio

prepared by

GEOSYNTEC CONSULTANTS

7400 Willey Road
Hamilton, Ohio 45103

under

Fluor Fernald, Inc.
Contract No. 95PS005028

REVISION 0
OCTOBER 2001
VOLUME I

CONSTRUCTION QUALITY ASSURANCE FINAL REPORT ENHANCED PERMANENT LEACHATE TRANSMISSION SYSTEM ON-SITE DISPOSAL FACILITY

October 2001
Revision 0

United States Department of Energy

Fernald Environmental Management Project
Fernald, Ohio

Prepared by

GeoSyntec Consultants
Fernald Field Office
7400 Willey Road, MS:38
Hamilton, Ohio 45013

Under

Fluor Fernald, Inc.
Subcontract 95PS005028

TABLE OF CONTENTS

ACRONYM LIST AL-1

1. INTRODUCTION 1

1.1 Terms of Reference 1
1.2 Background 2
1.3 Report Organization 4

2. PROJECT DESCRIPTION 6

3. CONSTRUCTION QUALITY ASSURANCE PROGRAM 9

3.1 Scope of Services 9

3.1.1 Overview 9
3.1.2 Review of Documents 9
3.1.3 CQA Field Operations 10
3.1.4 Final Report and Record Drawings 13

3.2 Personnel 14

3.2.1 Project Personnel 14
3.2.2 GeoSyntec's On-Site Personnel Schedule 16

4. CONSTRUCTION QUALITY ASSURANCE - EARTHWORK 18

4.1 General 18
4.2 Changes in Drawings and Specifications 19
4.3 Conformance Testing Activities 19
4.4 Field Monitoring Activities 21

5. CONSTRUCTION QUALITY ASSURANCE - CONCRETE STRUCTURES 25

5.1 General 25
5.2 Changes in Drawings and Specifications 25
5.3 Material Testing and Documentation 25
5.4 Field Monitoring Activities 26

6. CONSTRUCTION QUALITY ASSURANCE - HDPE PIPES 29

6.1 General 29
6.2 Changes in Drawings and Specifications 30
6.3 Pipe Conformance Testing and Documentation 30
6.4 Field Monitoring Activities 30

6.4.1 Delivery and Placement 30
6.4.2 Testing Activities 32

7. CONSTRUCTION QUALITY ASSURANCE - CONCRETE PROTECTIVE LINER 35

7.1 General 35
7.2 Changes in Drawings and Specifications 35
7.3 Quality Control Testing and Documentation 35
7.4 Field Monitoring Activities 35

7.4.1 Delivery and On-Site Storage 35
7.4.2 Deployment 36
7.4.3 Trial Welds 36
7.4.4 Production Welding 36
7.4.5 Nondestructive Seam Testing 37
7.4.6 Concrete Protective Liner Repairs 38

7.4.6.1 Repairs of Welded Joints 38
7.4.6.2 Repair of Voids 38

8. CONSTRUCTION QUALITY ASSURANCE - MECHANICAL 40

9. CONSTRUCTION QUALITY ASSURANCE - ELECTRICAL 41

10. SUMMARY AND CONCLUSIONS 42

REFERENCES 44

APPENDICES

Appendix A: Photographic Documentation

Appendix B: Weekly Field Reports, Meeting Minutes, and Correspondence
- Weekly Field Reports
- Meeting Minutes
- Correspondence
  - Fluor Fernald
  - GeoSyntec Consultants
  - Contractor

Appendix C: Personnel Logs

Appendix D: Materials Submittals and Laboratory Test Results
- On-Site Soil Materials
- Off-Site Soil Materials
  - Compacted Fill
  - Embedment Fill
  - Aggregate Base
  - Riprap
- Concrete Materials
- HDPE Pipes and Fittings
- Concrete Protective Liner
- Geotextile
- Vegetation
- Culverts
- Monitoring Well Covers
- Painting
- Metal Wall Louvers
- Pre-Engineered Buildings
- Lapeyre Stairs
- Fibergrate

Appendix E: Field Test Results
- Compacted Fill
  - Nuclear Moisture/Density Test Results

- Drive Cylinder Test Results

Controlled Density Fill
- Placement Forms
- CDF Test Reports

Concrete
- Placement Forms
- Concrete Test Reports

Painting Field Reports

Appendix F: HDPE Pipe Test Logs

Butt Fusion Joining

Pneumatic Testing Results

Hydrostatic Pressure Test Results
- GeoSyntec Consultants
- Contractor

CCT Video Survey and Inspection Logs
- GeoSyntec Consultants
- Contractor

Appendix G: Concrete Protective Liner Monitoring Logs

Trial Seam Logs
- GeoSyntec Consultants
- Contractor

Production Seam Summary Logs
- Valve House No. 1
- Valve House No. 2
- Valve House No. 3
- Valve House No. 4
- Valve House No. 5
- Valve House No. 6
- Control Valve House

Repair Summary and Location Logs
- Valve House No. 1
- Valve House No. 2
- Valve House No. 3
- Valve House No. 4
- Valve House No. 5
- Valve House No. 6

- Control Valve House

Appendix H: As-Built Survey Data and Record Drawings

As-Built Survey Data

- Valve Houses and GIS
- Top of LTS Pipe
- Miscellaneous

Record Drawings

- Valve House No. 1
- Valve House No. 2
- Valve House No. 3
- Valve House No. 4
- Valve House No. 5
- Valve House No. 6
- Control Valve House

Appendix I: Mechanical Equipment Submittals and Test Results

Manufacturer Submittals and Product Data

- Process Piping
- Tanks and Pumps
- Valves
- Piping Insulation
- Heating
- Fans

Process Piping Welding and Pressure Test Results

- Welder Qualifications
- Pressure Test Results

Appendix J: Electrical Equipment Submittals and Test Results

Manufacturer Submittals and Product Data

- Raceways
- Panels
- Poles and Pole Hardware
- Grounding
- Lighting
- Controls, Instrumentation, and Flow Meters

Electrical Testing and Results

- Electrical Testing Procedures

- Calibration Certificates
- Continuity Checks
- Ground Resistance Tests
- Pole Megger Tests
- Pole Mounted Transformer Tests

Appendix K: Requests for Clarification of Information (RCIs)

Appendix L: Design Change Notices (DCNs)

Appendix M: Nonconformance Reports (NCRs)
GeoSyntec Consultants
Fluor Fernald
Contractor

ACRONYM LIST

ACI	American Concrete Institute
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing and Materials
CCT	Closed-Circuit Television
CDF	Controlled Density Fill
CFC	Certified-For-Construction
CM	Construction Manager
CQA	Construction Quality Assurance
CQC	Construction Quality Control
CVH	Control Valve House
DCN	Design Change Notice
DCP	Design Criteria Package
DOE	Department of Energy
EPLTS	Enhanced Permanent Leachate Transmission System
FEMP	Fernald Environmental Management Project
FMSM	Fuller, Mossbarger, Scott, and May
GIS	Gravity Inlet Structure
HDPE	High Density Polyethylene
ILTS	Interim Leachate Transmission System
LCS	Leachate Collection System
LDS	Leak Detection System
LLRW	Low-Level Radioactive Waste
LTS	Leachate Transmission System
MDD	Maximum Dry Density
NCR	Nonconformance Report
O&M	Operations and Maintenance

ACRONYM LIST

OAC	Ohio Administrative Code
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
PLS	Permanent Lift Station
QA	Quality Assurance
QC	Quality Control
RCI	Request for Clarification of Information
RCRA	Resource Conservation and Recovery Act
RLCS	Redundant Leachate Collection System
SDFP	Soil and Disposal Facility Project
SWMEC	Surface Water Management and Erosion Control
SWP	Soil and Water Project
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VH	Valve House
WAC	Waste Acceptance Criteria
WAO	Waste Acceptance Organization

1. INTRODUCTION

1.1 Terms of Reference

This final report summarizes the Construction Quality Control (CQC) and Construction Quality Assurance (CQA) activities performed by GeoSyntec Consultants (GeoSyntec) during the construction of the Enhanced Permanent Leachate Transmission System (EPLTS) for the On-Site Disposal Facility (OSDF) at the Fernald Environmental Management Project (FEMP), located near Fernald, Ohio. The EPLTS consists of the permanent leachate transmission system (LTS) gravity line; LTS valve houses (VHs) for each OSDF cell (a total of six); and a control valve house (CVH) near the existing LTS permanent lift station (PLS). The EPLTS is located on the west side of the OSDF, outside the limit of impacted material placement, but within the battery limit. The EPLTS project also included: (i) the demolition of previously constructed manholes MH-1, MH-2, and MH-3 that collected liquids via dual-containment pipes from Cells 1, 2, and 3, respectively; (ii) the tie-in of the dual-containment pipes from Cells 1, 2, and 3 to newly constructed VHs 1, 2, and 3, respectively; and (iii) the stub-outs from newly constructed VHs 4, 5, and 6 for future tie-in to dual-containment pipes from Cells 4, 5, and 6, respectively. These construction activities are hereafter collectively referred to as the EPLTS construction project.

CQC and CQA activities performed by GeoSyntec will be collectively referred to as CQA activities in this report. The CQA activities performed by GeoSyntec included monitoring, testing and documentation of the construction of the various components of the EPLTS project. The CQA activities were performed to confirm that the construction materials, and construction and testing procedures, which were monitored, were in compliance with the construction drawings, technical specifications, and approved design and/or specification changes.

This report was prepared for Fluor Fernald, Inc. under Subcontract 95PS005028 by Dr. Kwasi Badu-Tweneboah, P.E., Mr. Collin P. Sukow and Mr. T. Byran York, E.I.T, all of GeoSyntec. In accordance with GeoSyntec's internal review policy, Dr. John F. Beech, P.E. and Mr. David J. Bonnett, P.E., both of GeoSyntec, reviewed the report.

1.2 Background

The OSDF is a mixed low-level radioactive waste (LLRW) disposal facility dedicated to the FEMP that, upon completion, will cover approximately 90 acres (36 hectares). The OSDF is owned by the Department of Energy (DOE) and is being constructed, operated for waste disposal, and closed under the management of Fluor Fernald, Inc. as part of the overall FEMP remediation activities.

DOE intends to build only one OSDF. Therefore, the OSDF is designed to accommodate all or any portion of the total volume of impacted material meeting the waste acceptance criteria (WAC) that results from remediation of the operable units. The total volume of material from all operable units is estimated to be 2.5 million bank/unbulked (i.e., in-place prior to excavation) cubic yards. The OSDF will be constructed over a period of time (to be determined, depending on availability of funding).

The first year (1997) of construction included the OSDF Phase I liner system for Cell 1 and the overall Leachate Management System projects. The Leachate Management System projects consisted of: (i) the OSDF LTS component that included manholes MH-1, MH-2, and MH-3, respectively, for Cells 1, 2, and 3, and a dual-containment high density polyethylene (HDPE) gravity piping system from manhole MH-1 to the PLS; and (ii) the Leachate Conveyance System that consisted of a force main from the PLS to the biosurge lagoon. The interface between OSDF Phase I and the overall Leachate Management System was at the stub-out of the manholes for Cell 1 leachate collection and leak detection systems. Construction of the OSDF Phase I liner system for Cell 1, the OSDF LTS and the Leachate Conveyance System occurred between August and December 1997. A CQA Final Report for the OSDF Phase I Cell 1 liner system and the overall Leachate Management System construction was prepared and issued by GeoSyntec in January 1998 [GeoSyntec, 1998a].

The second year (1998) of construction included the OSDF Phase II liner system for Cell 2 and placement of impacted material in Cell 1. Construction of the Cell 2 liner system occurred between June and November 1998. A CQA Final Report for the OSDF Phase II Cell 2 liner system construction was prepared and issued by GeoSyntec in December 1998 [GeoSyntec, 1998b]. Placement of impacted material in Cells 1 and 2 began in June 1998 and November 1998, respectively.

The Leachate Management System was approved for use in late December and went into operation in December 1997. The system was operated until late January 1999 when a buildup of liquid was observed in leachate collection system (LCS) manhole MH-3. The findings from the investigations to determine the sources and causes of the observed liquids in the system are presented in two separate reports prepared by Fluor Fernald [1999] and GeoSyntec [1999a].

The construction of an interim leachate transmission system (ILTS) occurred between April and July 1999 [GeoSyntec, 1999b]. The ILTS project consisted of: (i) slip-lining the carrier pipe of the dual-containment system between manhole MH-1 and manhole MH-3; (ii) construction of an interim leachate gravity line from manhole MH-3 to the PLS; and (iii) repair and testing of the dual-containment pipes of the then permanent LTS north of manhole MH-2. Following construction of the ILTS, the temporary LTS gravity line from MH-3 to the PLS was decommissioned. (This temporary LTS gravity line will be removed during the 2001 OSDF construction season.) Construction of the Cell 3 liner system, as part of the OSDF Phase II projects, occurred between April and November 1999 [GeoSyntec, 1999c]. Placement of impacted materials in Cell 3 began in November 1999.

Based on the lessons learned from the operation and investigations on the constructed Leachate Management System, DOE and Fluor Fernald committed to design and construct an enhanced permanent leachate transmission system to: (i) replace the ILTS, the retrofitted, but suspect, components of the LTS gravity line from MH-1 to MH-3, and other suspect components of the dual-containment pipes from Cells 1, 2, and 3; and (ii) improve the operability and maintainability of the OSDF LTS components of the overall Leachate Management System. In particular, the EPLTS was designed to satisfy the applicable or relevant and appropriate requirements (ARARs) contained in Ohio Administrative Code (OAC) 3745-27-08(C)(5) and the functional requirements contained in the Design Criteria Package (DCP) [GeoSyntec, 2000]. The EPLTS therefore consists of construction of three double-walled gravity drain pipes from Cells 1, 2, and 3; LTS valve house (VH) for each cell; leak detection system (LDS), and leachate collection system (LCS) and redundant LCS (RLCS) collection tanks and associated piping and valving within the valve house; permanent double-walled gravity LTS pipe; and control valve house (CVH) upgradient of the PLS.

This CQA Final Report presents a summary of the CQA monitoring, testing and documentation activities performed by GeoSyntec during the construction of the EPLTS.

1.3 Report Organization

The remainder of this final report is organized as follows:

- A description of the project is provided in Section 2.
- A description of the CQA program, including a summary description of specific tasks performed under the program, and a listing of project personnel, are presented in Section 3.
- A description of the CQA monitoring and testing activities performed during the earthwork portion of the project is provided in Section 4.
- A description of the CQA monitoring and testing activities performed during the concrete work portion of the project is provided in Section 5.
- A description of the CQA monitoring and testing activities performed during the installation of the HDPE piping system components of the project is presented in Section 6.
- A description of the CQA monitoring and testing activities performed during the installation of the concrete protective liner is presented in Section 7.
- A description of the CQA monitoring and testing activities performed during the installation of the mechanical components of the project is presented in Section 8.
- A description of the CQA monitoring and testing activities performed during the installation of the electrical components of the project is presented in Section 9.
- A summary of the observations resulting from the CQA monitoring and testing activities performed by GeoSyntec; and a conclusion statement that the EPLTS project was constructed in general accordance with the project specifications, construction drawings, and approved design and/or specification changes are presented in Section 10.

Documentation and record drawings on the results of the CQA monitoring and testing activities performed by GeoSyntec are contained in the appendices to this report. Weekly reports prepared by the CQA Site Manager and Resident Engineer are also included in the appendices. Daily reports prepared by the CQA monitors have been compiled and filed on-site; these daily reports can be made available upon request.

2. PROJECT DESCRIPTION

The EPLTS consists of certain components of the overall Leachate Management System, which is designed and constructed to convey leachate generated from each of the OSDF cells to the biosurge lagoon (i.e., advanced wastewater treatment facility). For the purpose of this report, the EPLTS specifically includes components up to the PLS. The EPLTS construction project covered by this report includes the following:

- six valve houses, VH-1 to VH-6, for Cells 1 to 6, respectively, with associated collection tanks, piping and valving systems within each valve house; each valve house is constructed of reinforced-concrete footing and foundation walls, and lined with HDPE concrete protective liner material to provide secondary containment;

- a control valve house, CVH, upgradient of the PLS, with associated piping and valving systems to regulate LTS flow prior to discharge into the PLS; the CVH is also constructed of reinforced-concrete footing and foundation walls, and lined with HDPE concrete protective liner material to provide secondary containment;

- permanent dual-containment (i.e., 6-in. (150-mm) diameter carrier and 10-in. (250-mm) diameter containment) LTS piping system from valve house VH-1 to the control valve house (CVH); this system has a total length of about 3425 ft (1045-m);

- tie-in of the LDS, LCS, and RLCS dual containment pipes from Cells 1, 2, and 3 to the respective VH-1, VH-2, and VH-3; and

- installation of LDS, LCS, and RLCS dual containment pipe stub-outs from VH-4, VH-5, and VH-6 for future connection to their respective cells.

The Certified-For-Construction (CFC) Drawings and Technical Specifications, dated March 2000, were prepared by GeoSyntec, Atlanta, Georgia in accordance with the terms of Fluor Fernald Subcontract 95PS005028. The prime contractor for construction of the EPLTS project was The STAVER Group, Inc. (STAVER) of Franklin, Ohio. The HDPE pipes, process piping, valves, tanks, and other mechanical components of the EPLTS project were installed by Rieck Mechanical Electrical Services, Inc. (RIECK) of Dayton, Ohio as a subcontractor to STAVER. Installation of

the concrete protective liner component of the valve houses for the EPLTS was performed by ISCO Industries, Inc. (ISCO) of Huntsville, Alabama as a subcontractor to STAVER. The electrical components of the EPLTS project were installed by B&J Electrical Co., Inc. (B&J) of Cincinnati, Ohio, as a subcontractor to STAVER. The closed-circuit television (CCT) video surveys and inspections of the LTS carrier pipes were carried out by Roto-Rooter, Inc. (Roto-Rooter) of Cincinnati, Ohio, as subcontractor to RIECK and/or STAVER. All other construction work was performed directly by STAVER. The surveyor retained by STAVER for the EPLTS project was Baumann Engineering (Baumann) of Cincinnati, Ohio. CQA monitoring, testing, and documentation were provided by GeoSyntec. Fluor Fernald Quality Assurance (QA) also conducted independent CQA monitoring of the construction activities. A list of primary personnel involved in the EPLTS construction project is included in Section 3.2 of this report.

Construction activities monitored by GeoSyntec's CQA personnel for the EPLTS project included, among others, the following:

- excavation and subgrade preparation (including placement of controlled density fill (CDF)) for the valve houses, control valve house and gravity-inlet structures (GIS);
- formwork, rebar installation and placement of concrete for the footings and walls of the valve houses and control valve house;
- trenching and excavation for the LTS piping systems;
- placement and compaction of embedment fill for the LTS piping systems;
- installation and welding of HDPE piping systems;
- hydrostatic and/or pneumatic testing of the HDPE piping systems;
- installation and testing of the process piping and valving systems in each valve house;
- installation and spark testing of concrete protective liner (i.e., Bekaplast liner) in each valve house and control valve house;
- erection of pre-engineered buildings over each valve house and control valve house;

- demolition of manholes MH-1, MH-2, and MH-3;
- tie-in of the existing LDS, LCS, and RLCS dual containment pipes from Cells 1, 2, and 3 to their respective valve houses VH-1, VH-2, and VH-3;
- placement and compaction of backfill, over and around, piping systems and valve houses; and
- final grading and interim seeding of the construction area.

The approval process for construction materials used during the EPLTS project required the contractor to submit manufacturer's data, quality control (QC) certifications, supplier's certifications, and shop drawings to the Construction Manager (CM) for review and approval. The Fluor Fernald CM, Engineering and QA, and the GeoSyntec Resident Engineer reviewed, commented (as needed), and approved construction materials for use during construction. The submittal details and approvals are summarized in the Resident Engineer's weekly reports, and are also included in the appendices to this final report.

Construction of the EPLTS project began on 29 May 2000 and was substantially completed on 27 June 2001. Earthwork and concrete work associated with the EPLTS project began on 30 May 2000. STAVER and ISCO began the installation of the concrete protective liners as part of the formwork and concrete placement for the valve houses on 12 July 2000. RIECK began butt-fusion welding of the HDPE pipes for the gravity LTS line on 4 August 2000. B&J Electrical began installation of the wooden poles for the electrical line on 14 August 2000. ISCO began welding and sparking testing of the concrete protective liners on 21 August 2000. Roto-Rooter performed the CCT video surveys and inspections of the as-constructed LTS carrier pipes from 4 to 18 January 2001. STAVER began the demolition of the existing Cells 1, 2, and 3 manholes on 26 February 2001. STAVER and RIECK began the tie-in of the LDS, LCS, and RLCS pipes from Cells 1, 2, and 3 to VH-1, VH-2, and VH-3, respectively, on 2 April 2001. STAVER completed final grading and interim seeding of the EPLTS construction work area on 27 June 2001.

3. CONSTRUCTION QUALITY ASSURANCE PROGRAM

3.1 Scope of Services

3.1.1 Overview

The scope of CQA services performed by GeoSyntec during the construction of the EPLTS project included:

- review of documents;
- monitoring, testing, and documentation of field operations; and
- preparation of final report and record drawings.

These services are described in the following subsections of this report.

3.1.2 Review of Documents

As previously noted, this final report summarizes the CQA activities performed by GeoSyntec during the EPLTS construction. The CQA activities conducted by GeoSyntec were intended to satisfy the requirements of the following documents:

- "Certified-For-Construction Technical Specifications, Enhanced Permanent Leachate Transmission System, 20111-TS-0001 On-Site Disposal Facility", Revision 0, prepared by GeoSyntec Consultants, dated March 2000; and
- "Enhanced Permanent Leachate Transmission System Certified-For-Construction Drawings", Revision 0, prepared by GeoSyntec Consultants, dated March 2000.

During construction, design change notices (DCNs) were prepared which modified these documents. Documents containing the details of these DCNs are referenced in the appropriate sections of this report, and are included as an appendix to this final report. Also included in the appendices are requests for clarifications (RCIs) and nonconformance reports (NCRs).

The above documents (including the DCNs and RCIs) will be collectively referred to as the project documents in this final report. Prior to the commencement of on-site

CQA activities, GeoSyntec CQA personnel reviewed the project documents for familiarity.

3.1.3 CQA Field Operations

The following activities were performed as part of GeoSyntec's on-site CQA services:

Earthwork:

- collecting conformance test samples of soils considered for use as compacted trench backfill and granular components of the EPLTS project;
- performing geotechnical conformance testing in either the on-site or off-site geotechnical laboratories;
- reviewing and evaluating geotechnical laboratory conformance test results to ensure compliance with the requirements of the project documents;
- monitoring excavation operations for the gravity-inlet structures, valve houses, and control valve house;
- monitoring the demolition and excavation operations for exposing the existing HDPE piping system and manholes at Cells 1, 2, and 3 affected by the EPLTS project;
- monitoring trenching operations for installation of the piping system for the EPLTS project;
- monitoring placement and compaction of embedment fill and trench backfill around pipes, valve houses, and gravity-inlet structures; and
- testing of the in-place moisture/density of the compacted trench backfill.

Concrete Structures:

- collecting concrete and controlled density fill (CDF) samples for on-site and off-site laboratory testing;
- reviewing and evaluating concrete and CDF test results to confirm compliance with the requirements of the project documents; and

- monitoring the placement of concrete, grout and CDF for the valve house and control valve house foundations and walls.

HDPE Pipes:

- tracking the delivery of the HDPE pipes stockpiled on the site;
- collecting and reviewing HDPE pipe manufacturers' certification documents to verify compliance with the requirements of the project documents;
- visual monitoring of trial welds and production welding of HDPE pipes;
- visual monitoring of the installation of the HDPE pipes for the LTS line from VH-1 to the CVH, and the simultaneous butt-fusion welding of the LDS, LCS, and RLCS pipes from Cells 1, 2, and 3 to VH-1, VH-2, and VH-3, respectively;
- visual monitoring of the hydrostatic pressure and pneumatic testing of the permanent dual-containment piping system from VH-1 to CVH; and the LDS, LCS, and RLCS pipes from Cells 1, 2, and 3 to VH-1, VH-2, and VH-3, respectively; and
- monitoring the CCT video surveys and inspections of the LTS carrier pipes from VH-1 to CVH.

Concrete Protective Liner:

- visual monitoring of the concrete protective liner sheets delivered to the site to observe whether the sheets had been damaged during transportation or handling;
- reviewing manufacturer's quality control (QC) documents to verify compliance with the requirements of the project documents;
- monitoring installation of concrete protective liner panels on the floor and walls of the valve houses and control valve house;
- monitoring trial seaming operations and field testing;
- monitoring concrete protective liner panel production seaming operations;
- monitoring non-destructive testing of the concrete protective liner seams; and

- monitoring repairs to concrete protective liner, including filling voids within the lined floors with epoxy grout.

Mechanical:

- reviewing manufacturer's product data, QC certificates and other documentation to confirm compliance with the project documents;
- visual monitoring of the installation of the mechanical components of the EPLTS project, including process piping and appurtenances, valves, tanks, pumps, etc.; and
- monitoring and documenting the pressure testing of process piping and appurtenances.

Electrical:

- reviewing manufacturer's product data, QC certificates and other documentation to confirm compliance with the project documents;
- visual monitoring of the installation of electrical components of the EPLTS project, including switches and receptacles, conductors and terminations, grounding, lighting, switches and electrical panels, etc.; and
- monitoring and documenting the testing of grounding and other electrical components of the EPLTS project.

In addition, CQA personnel monitored the installation of other miscellaneous work related to the EPLTS project. These included, among others, erection of pre-engineered buildings over the valve houses and control valve house, painting, installation of concrete bollards, and repairs to the horizontal monitoring wells for Cells 1, 2 and 3.

During construction activities involving monitoring and/or testing, the observations made, and test results obtained, by GeoSyntec CQA personnel were compared to the project documents. Fluor Fernald CM and QA and/or the appropriate contractor were notified of deficiencies in construction practices and/or materials so that the appropriate corrective actions could be taken. The corrective actions were monitored and/or tested by CQA personnel to assure compliance with the project documents.

Upon substantial completion of construction and testing of each phase of the EPLTS project, including review of surveyor's certification data, progress reports and

test results summaries were prepared and submitted to Fluor Fernald. Copies of these summaries are included in the appendices to this report. This final certification report includes all construction required by the project documents.

3.1.4 Final Report

Record drawings and this CQA final report were prepared as the final task of the CQA program. This final report summarizes the CQA monitoring, testing, and documentation activities performed by GeoSyntec.

During construction, documentation of on-site CQA activities was maintained by CQA personnel. Daily documentation consisted of daily field reports and testing and monitoring logs. These documents were used to prepare weekly field summaries. CQA personnel also documented the results of on-site geotechnical laboratory testing and reviewed results of off-site geotechnical and concrete laboratory testing conducted as part of the CQA program. In addition, manufacturer QC certificates, test results for the HDPE pipe and concrete protective liner materials, and submittals for the mechanical and electrical components of the EPLTS were provided to GeoSyntec for review; these documents are included in the appendices to this final report. Descriptions of the construction activities and the CQA documentation are presented in the narrative sections of this report.

Volume I of this CQA final report contains the narrative sections of the report and Appendix A. Volume II of this report contains Appendices B through C; Volume III contains Appendices D and E; Volume IV contains Appendices F through I; and Volume V contains Appendices J through M. A summary of the documentation included in the appendices to the final report is provided below:

- Appendix A: Photographic Documentation
- Appendix B: Weekly Field Reports, Meeting Minutes, and Correspondence
- Appendix C: Personnel Logs
- Appendix D: Materials Submittals and Laboratory Test Results
- Appendix E: Field Test Results

- Appendix F: HDPE Pipe Test Logs
- Appendix G: Concrete Protective Liner Monitoring Logs
- Appendix H: As-Built Survey Data and Record Drawings
- Appendix I: Mechanical Equipment Submittals and Test Logs
- Appendix J: Electrical Equipment Submittals and Test Logs
- Appendix K: Requests for Clarification of Information (RCIs)
- Appendix L: Design Change Notices (DCNs)
- Appendix M: Nonconformance Reports (NCRs)

3.2 Personnel

3.2.1 Project Personnel

Senior personnel or representatives for the firms involved in the project are as follows:

Department of Energy (Facility Owner)

- Jay A. Jalovec, DOE Fernald OSDF Project Manager
- Robert J. Janke, DOE Fernald SWP Team Leader
- Donald A. Pfister, P.E., DOE Fernald Facility Representative

Ohio Environmental Protection Agency (Regulatory Agency)

- Tom Ontko, Federal Facilities Oversight Representative

Fluor Fernald, Inc. (Owner's Representative)

- Linda Barlow, Waste Acceptance Organization (WAO) Representative
- David J. Brettschneider, P.E., Project Manager
- Dick Butterfield, Construction Engineer
- Tim Cherry, Construction Engineer
- A. Cleeter, Safety & Health Field Support

- Lorenzo Copeland, Construction Engineer
- Corey Fabricante, Radiological Control Representative
- Willie Frazier, Construction Contracts Manager
- Michael W. Godber, Quality Assurance Co-Team Leader
- Michael W. Griffin, Project Engineer
- Alan Hohnhorst, Contracts and Acquisition Representative
- Jack W. Hughes, Engineering and Construction Manager
- James C. Jenkins, P.E., D.E.E., Project Engineer
- Robert W. Kneip, P.E., Engineering
- Keith Lanning, Safety & Health Team Leader
- Jack McCormick, Surveying Representative
- Gary Pope, Construction Coordination
- Mike Ramirez, WAO Representative
- B. Scott Wheeler, Quality Assurance Co-Team Leader
- Muriel K. Vigus, Quality Assurance Field Support
- Paul J. Volker, Quality Assurance Field Support

GeoSyntec Consultants (CQA Consultant)

- Kwasi Badu-Tweneboah, Ph.D., P.E., Project Manager
- John F. Beech, Ph.D., P.E., Principal-in-Charge
- Anthony R. Dickman, Engineering Technician
- David Evans, Engineering Technician
- Scott Quammen, Site Health & Safety Representative
- Kenneth Sparks, Senior Engineering Technician
- Collin P. Sukow, CQA Site Manager
- T. Byran York, E.I.T., Senior Engineering Technician

Fuller, Mossbarger, Scott, and May (FMSM) Engineers, Inc. (Off-site Concrete Materials Testing Laboratory)

- Stan A. Harris, Laboratory Manager

GeoTesting Express of Georgia, Inc. (Off-site Geotechnical Laboratory)

- Barry Sigmon, P.G., Laboratory Manager

The STAVER Group, Inc. (Contractor, senior personnel only)

- Darrell Chasteen, Superintendent
- Jim Donaldson, Safety Lead

- Charlie Dilbert, Labor Foreman
- M. Robert Lindsay, Safety Lead
- David Opalka, Project Manager
- Shawn Penick, Rodbuster Foreman
- Chad Ramey, Safety Lead
- Rick Sagraves, Carpenter Foreman
- Ronald Wood, QA/QC Manager

Rieck Mechanical Electrical Services, Inc. (Subcontractor, senior personnel only)

- David Seubert, Piping Foreman
- Dick Seubert, Piping Foreman

B&J Electrical Co., Inc. (Subcontractor, senior personnel only)

- Denny Dickerson, Electrical Foreman

ISCO Industries, LLC (HDPE Pipe Supplier and Liner Installer)

- Rick Hart, Technical Sales Manager
- Jack Olsen, Superintendent and QA/QC Chief/Inspector

Baumann Engineering (Contractor's Surveyor)

- Thomas P. Baumann, P.L.S., Head of Surveying

3.2.2 GeoSyntec's On-Site Personnel Schedules

GeoSyntec project personnel were present on site according to the following schedules:

• K. Badu-Tweneboah, Ph.D., P.E., Project Manager	30 May 2000 – 01 January 2001 13 February 2001 – 27 June 2001
• C.P. Sukow, CQA Site Manager	30 May 2000 – 21 November 2000 28 November 2000 – 22 December 2000 02 January 2001 – 02 February 2001 15 February 2001 – 27 June 2001
• S. Quammen, Senior Engineering Technician	30 May 2000 – 20 October 2000 30 October 2000 – 03 November 2000 15 November 2000 – 22 November 2000
• David Evans, Engineering Technician	30 May 2000 – 30 June 2000 06 July 2000 – 10 November 2000

	22 November 2000 – 22 December 2000
	29 December 2000 – 03 January 2001
	09 January 2001 – 25 January 2001
	05 February 2001 – 27 June 2001
• Mike Humphreys, Engineering Technician	30 May 2000 – 28 December 2000
	16 April 2001 – 04 May 2001
• Anthony Dickman, Engineering Technician	05 June 2000 – 30 November 2000
	18 December 2000 – 27 June 2001
• Ken Sparks, Senior Engineering Technician	05 June 2000 – 13 September 2000
	28 September 2000 – 06 October 2000
	13 October 2000 – 22 November 2000
	27 November 2000 – 20 December 2000
	26 December 2000 – 20 April 2001
	04 May 2001 – 22 May 2001
	26 June 2001 – 27 June 2001
• T. Byran York, E.I.T., Senior Engineering Technician	30 August 2000 – 08 September 2000
	12 September 2000
	15 September 2000 – 19 September 2000
	02 October 2000 – 11 October 2000
	02 January 2001 – 12 January 2001
	30 January 2001 – 05 March 2001
	12 March 2001 – 09 April 2001
	30 April 2001 – 14 May 2001
	21 May 2001 – 27 June 2001
• Sheila Abney, Administrative Assistant	1 June 2000 – 27 June 2001

4. CONSTRUCTION QUALITY ASSURANCE – EARTHWORK

4.1 General

GeoSyntec monitored the construction of the earthwork components of the EPLTS project. Different earthwork materials were used to construct the various components of the EPLTS project. These materials included existing subgrade material, compacted fill, controlled density fill, pipe embedment fill material, road base aggregate, and riprap. The earthwork construction activities using these materials are generally described below.

- The bottom of the valve houses, control valve house, gravity-inlet structures and pipe trench were excavated and graded to the required subgrade elevations. Subgrade preparation activities were visually monitored by CQA personnel. Isolated areas of soft or loose materials were typically undercut and replaced with either controlled density fill (CDF) or compacted fill as described below.

- The subgrade under the valve house and control valve house foundations were undercut and replaced with 4- to 6-in. (100- to 150-mm) thick layer of CDF. CQA monitored the placement of the CDF and collected cylinders for compressive strength testing in accordance with American Society for Testing and Materials (ASTM) Test Method D 4832. Testing was performed by an off-site laboratory (Fuller, Mossbarger, Scott and May, Engineers, Inc. (FMSM), Cincinnati, Ohio).

- Fill material used to replace soft spots under the pipe trench or excavations consisted of compacted fill material, which was obtained from the cut (excavation and trenching) areas, or from off-site borrow sources. Both sources of material were approved through conformance testing of samples in addition to review of supplier's certification results for the off-site borrow fill material. The compacted fill was placed in approximately 8-in. (200-mm) thick loose lifts and compacted to a minimum degree of compaction of 95 percent of the maximum dry density (MDD), as determined by the standard Proctor compaction test (ASTM D 698).

- Embedment fill was placed in nominal 7-in. (175-mm) thick loose lifts to the elevation of the bottom of pipe or culvert, around the pipe, and to a depth of 12-in. (300-mm) above the pipe or culvert. Embedment fill material was obtained

from off-site borrow sources, and was approved through conformance testing of samples and review of supplier's certification test results. The embedment fill was compacted with a minimum of four passes of a hand tamper or vibratory pad foot compactor, as appropriate.

- Base aggregate material was used to construct the access corridor, other roads and parking area components of the EPLTS project. The material was obtained from off-site borrow sources, and was approved through review of supplier's certification test results. The base aggregate material was placed and compacted, in accordance with Items 304.04 and 304.05 of Ohio Department of Transportation (ODOT) Specifications, to meet the requirements of the Technical Specifications.

- Riprap was used to construct drainage channel linings, placed around gravity inlet structures and culvert outlets, and also used for temporary slope protection and other surface-water management and erosion control (SWMEC) measures. The riprap materials (both Type C and Type D Dumped Rock Fill) were obtained from off-site borrow sources, and were approved through review of supplier's certification test results. The riprap materials were placed in accordance with the requirements of the Technical Specifications.

CQA personnel monitored these earthwork construction activities and performed the appropriate testing to confirm compliance with the project documents. Testing was performed and documented by CQA personnel. The testing was carried out either: (i) in-place; (ii) on-site, in the geotechnical laboratory; or (iii) off-site testing laboratory.

4.2 Changes in Drawings and Specifications

RCIs and DCNs of the earthwork drawings and specifications were processed and approved according to procedures described in FEMP Document No. ED-12-5002 titled "Engineering Design Change Process." RCIs and DCNs were approved, as appropriate, by the design organization and the regulatory agency (i.e., OEPA). Copies of the RCIs and DCNs are presented in Appendix K and Appendix L, respectively.

4.3 Conformance Testing Activities

Soil samples were obtained from proposed sources, prior to construction, to verify conformance with the project specifications for each material type. Also during construction, samples were obtained from the on-site soils and from the delivered

material for conformance testing, as required by the project documents. CQA personnel obtained representative samples of compacted fill and embedment fill materials from the appropriate source depending on the material type.

Compacted fill material used in EPLTS construction was obtained from the on-site soils in the excavation and trenching areas and from off-site borrow source. The off-site borrow source for the fill material was from the Welch Sand & Gravel, Inc. (Welch) plant located in Ross, Ohio. The embedment fill material (ODOT Type A-3 Sand Cover) was obtained from the Welch quarry in Ross, Ohio. The base aggregate material (ODOT No. 304 aggregate) was also obtained from the Welch quarry in Ross, Ohio. The Type C and D riprap materials were obtained from the New Point Stone Co., Inc. (New Point) quarry in Greensburg, Indiana.

The following geotechnical laboratory tests, when appropriate, were performed on the compacted fill, embedment fill and base aggregate materials:

- Moisture content tests were performed on samples of the compacted fill material in general accordance with ASTM D 2216.

- Particle-size distribution tests were performed on compacted fill and embedment fill materials in general accordance with ASTM D 422 and ASTM C 136, respectively. Atterberg limits tests were performed on compacted fill material in general accordance with ASTM D 4318. The Unified Soil Classification System (USCS) was used to classify the materials in general accordance with ASTM D 2487.

- Standard Proctor compaction tests were conducted on the soils used for compacted fill material. The tests were performed in general accordance with ASTM D 698.

The results of geotechnical laboratory tests performed on the soil materials used for the EPLTS construction are presented in Appendix D. A total of 8 index tests (i.e., moisture content, particle-size distribution, Atterberg limits and classification tests) were performed on the compacted fill material. The compacted fill material used for the EPLTS construction classified as GC, SC, SM, ML or CL according to the USCS, when evaluated in accordance with ASTM D 2487 with maximum particle size of 5.0-in. (130-mm). A total of 21 standard Proctor compaction tests were performed on the compacted fill material.

A total of 6 index tests (particle-size distribution and classification tests) were performed on the embedment fill material. The embedment fill material classified as SP according to the USCS.

The base aggregate material was tested by the supplier (Welch) and met the requirements of the project documents (i.e., ODOT No. 304 aggregate). Similarly, the Type C and D riprap materials were tested by the supplier (New Point) and met the requirements of the project documents (i.e., ODOT Type C and D Dumped Rock Fill). The material certification test results provided by the suppliers are presented in Appendix D.

Tables 4-1 and 4-2 present summaries of the geotechnical tests performed on the compacted fill and embedment fill, respectively, for the EPLTS construction project.

4.4 Field Monitoring Activities

GeoSyntec's CQA personnel monitored the excavation operations, subgrade preparation, placement and compaction of fill material for the EPLTS project. During excavation for valve house foundations or pipe trenches, topsoil, organic matter (i.e., stumps, roots, or vegetation), and any other deleterious material unsuitable for subgrade material were excavated and stockpiled on-site prior to construction of the valve house or pipe foundation.

In areas where soft or loose materials were detected, the areas were undercut and compacted fill (or controlled density fill) was placed. In cut areas and during fill placement, the surface was monitored by CQA personnel to confirm that deleterious materials were removed.

As-built survey data for the valve houses and GIS foundations were reviewed by CQA personnel to confirm compliance with the survey tolerances of the project documents. The as-built survey data, provided by Baumann, are included in Appendix H.

The compacted fill material was placed in controlled lifts (as described previously) using dump trucks and using a bulldozer to spread the material. The horizontal lifts were then compacted using a vibratory sheepsfoot compactor. When there was inclement weather that impacted the exposed lift of compacted fill, prior to further placement of subsequent lifts, the surface of the top lift was scarified using the tracks of a bulldozer, allowed to dry or wetted before additional fill was placed.

GeoSyntec supplied two nuclear gauges (i.e., Troxler Model 3440, Serial No. 20979 and Model 3430, Serial No. 27418) which were used to perform moisture/density tests. The gauges were calibrated daily prior to use by placing the gauge on its standardization block and confirming its moisture and density count. (These counts were recorded on a standard count log, which is presented in Appendix E). The results of the nuclear moisture/density tests were also verified periodically by comparing the tests with results observed using the drive cylinder method (i.e. ASTM D 2937).

In-place nuclear moisture/density tests were performed on lifts of compacted fill used for backfilling pipe trenches, valve house excavations, and other fill area. The tests were performed in general accordance with ASTM D 2922 and ASTM D 3017. Compacted fill was compacted to a minimum degree of compaction of 95 percent of the maximum dry unit weight, as determined by the standard Proctor compaction test (ASTM D 698). CQA personnel conducted in-place nuclear moisture/density tests at a minimum frequency of 5 tests per area per lift of soil around valve house excavations or one test per 1,000 lineal ft (305 lineal m) per lift along pipe trenches in accordance with the project documents (see Table 4-1). A total of 582 field moisture/density tests were performed. Of these, 36 tests failed to meet the minimum percent compaction requirement. In each case of a failing test, the contractor reworked or removed and replaced the material, and recompacted the area surrounding the failure and then CQA personnel retested the area. This procedure was repeated until satisfactory moisture/density test results were obtained in each location. The results of the field moisture/density tests are presented in Appendix E.

CQA personnel visually monitored the placement and compaction operations of embedment fill to assure that the nominal lift thickness was used and the minimum number of passes was performed by the contractor.

TABLE 4-1

ENHANCED PERMANENT LEACHATE TRANSMISSION SYSTEM COMPACTED FILL

DESCRIPTION	TEST STANDARD	PROJECT[1] SPECIFICATIONS	TEST FREQUENCY (yd^3)	NUMBER OF TESTS PERFORMED (FAILURES)
LABORATORY TEST				
Particle Size: Sieve	ASTM D 422	100% Finer than 5.0 inch	1 per 5,000	10
Compaction	ASTM D 698	---	1 per 5,000	21
Moisture	ASTM D 2216 ASTM D 4643	---	1 per 5,000	21 ---
Soil Classification	ASTM D 2487	GC, SC, SM, ML, CL, or CH	1 per 5,000	8
Atterberg Limits	ASTM D 4318	---	1 per 5,000	8
FIELD TEST				
Drive Cylinder: Soil density Soil moisture	 ASTM D 2937 ASTM D 2216	 --- ---	1 per 25 Passing Nuclear Tests	24
Nuclear Gauge: Soil density Soil moisture	 ASTM D 2922 ASTM D 3017	 ≥ 95% NONE	1/1000 L.F./lift or 5/Area/Lift	582 (36)

NOTE: (1) Reference Section 02200 of the Technical Specifications for further details.

TABLE 4-2

ENHANCED PERMANENT LEACHATE TRANSMISSION SYSTEM EMBEDMENT FILL

DESCRIPTION	TEST STANDARD	PROJECT[1] SPECIFICATIONS	TEST FREQUENCY (yd^3)	NUMBER OF TESTS PERFORMED (FAILURES)
LABORATORY TEST				
Particle Size: Sieve	ASTM c 136	Section 703.06 Ohio DOT	1 per 1,000	6 (1)
Soil Classification	ASTM D 2487	GW, GP, SW, or SP	1 per 1,000	6
FIELD TEST				
Depth Verification: Survey	Visual	7 in. thick (compacted)[2]	None	None

NOTES:
(1) Reference Section 02215 of the Technical Specifications for further details.
(2) Compaction was achieved using a minimum of four passes with a vibratory plate or pad foot compactor.

5. CONSTRUCTION QUALITY ASSURANCE – CONCRETE STRUCTURES

5.1 General

GeoSyntec monitored the placement and installation of the concrete structures for the EPLTS. Controlled density fill (CDF), concrete and reinforcement steel (rebar) were used to construct the foundations and walls for the valve houses and control valve house. Grout (i.e., setting bed) was placed during the installation of the concrete protective liner on the floors of the valve houses and control valve house. Additional concrete was used to construct the cover over portions of the LTS pipe, cover slabs for the horizontal monitoring wells and bollards along the east sides of the valve houses. Principal field activities are summarized in Section 3.1.3.

CQA personnel monitored these construction activities, sampled and performed tests to confirm compliance with the project documents. CQA performed on-site slump, temperature and air content tests on the concrete loads delivered to the site for the valve houses. CDF and concrete cylinders were prepared and tested by an off-site laboratory. CQA personnel reviewed the CDF and concrete cylinder test results to confirm compliance with the project documents.

5.2 Changes in Drawings and Specifications

RCIs and DCNs of the concrete and related work drawings and specifications were processed and approved according to procedures described in FEMP document ED-12-5002 titled "Engineering Design Change Process". The RCIs and DCNs were approved as appropriate by the design organization and regulatory agency. Copies of the RCIs and DCNs are presented in Appendix K and Appendix L, respectively.

5.3 Material Testing and Documentation

The concrete, grout and CDF used for the EPLTS project were supplied by Miami Valley Ready Mix of Harrison, Ohio. The rebar shop drawings for the valve houses and control valve house foundations and walls were prepared by Contractors Materials Company of Cincinnati, Ohio. The concrete materials and mix design as well as rebar shop drawings were submitted by STAVER for review and approval. These documentations are presented in Appendix D. CQA personnel reviewed this documentation and verified that the concrete mix design and shop drawings were in compliance with the requirements of the project documents.

5.4 Field Monitoring Activities

CQA personnel monitored the concrete placement operations, including formwork, steel reinforcement and concrete placement for the valve house walls and foundations. The formwork and steel reinforcement activities included checking the number and size of rebars, spacing, and clearance (i.e., concrete cover) to confirm compliance with the shop drawings and project documents. CQA personnel also monitored the delivery and placement of concrete for the valve house foundations and walls as well as concrete for other parts of the EPLTS project. As part of the concrete placement operations (including CDF), CQA personnel performed field-testing on the freshly delivered concrete mixes, and prepared concrete cylinders for each day of concrete placement activities. The following field and off-site laboratory tests were performed on samples of concrete and CDF used for the EPLTS project.

- Ambient and concrete (or CDF) temperatures were measured and recorded in accordance with American Concrete Institute (ACI) Standard ACI 304.
- Slump (or flowability for CDF) tests were performed on concrete and CDF samples in accordance with ASTM C 143.
- Visual monitoring of the consistency of the grout used to install the concrete protective liner on the floors of the valve houses and control valve house.
- Air content tests were performed on concrete samples in accordance with ASTM C 231.
- Concrete cylinders were tested at an off-site laboratory for compressive strength in accordance with ASTM C 39. The cylinders were generally tested at 2-, 7-, and 28-day curing periods.
- CDF cylinders were also tested at an off-site laboratory for compressive strength in accordance with ASTM D 4832. The cylinders were generally tested at 3-, 7-, 14-, 30-, 60-, and 90-day curing periods.

The results of the field and laboratory tests performed during concrete and CDF placement operations for the EPLTS are presented in Appendix E. Tables 5-1 and 5-2 present summaries of the tests performed on the concrete and CDF used for the EPLTS construction project, respectively.

TABLE 5-1

ENHANCED PERMANENT LEACHATE TRANSMISSION SYSTEM CONCRETE TESTING

DESCRIPTION	TEST STANDARD	PROJECT SPECIFICATIONS(1)	TEST FREQUENCY	NUMBER OF TESTS REQUIRED	NUMBER OF TESTS PERFORMED
LABORATORY					
Compressive Strength (28 days)	ASTM C 39	4000 psi	1/100 yd^3 or 1/day	21	26(2)
FIELD					
Temperature	ACI 305/306	Per ACI 305/306	1/100 yd^3 or 1/day	21	29(2)
Air Entrainment	ASTM C 231	5% ± 1%	1/100 yd^3 or 1/day	21	29
Slump	ASTM C 143	5 inches ± 2 inches	1/100 yd^3 or 1/day	21	29

NOTES: (1) Reference Section 03100 of the Technical Specifications for further details.
(2) Field tests were only performed for concrete used for pipe covers, bollards, cover slabs, and valve house step pads construction.

TABLE 5-2

ENHANCED PERMANENT LEACHATE TRANSMISSION SYSTEM CONTROLLED DENSITY FILL TESTING

DESCRIPTION	TEST STANDARD	PROJECT SPECIFICATIONS	TEST FREQUENCY	NUMBER OF TESTS REQUIRED	NUMBER OF TESTS PERFORMED
LABORATORY					
Compressive Strength (30 days)	ASTM D 4832	20 psi	1 per valve house	7	6(1)

NOTES: (1) No tests were performed during VH-1 floor placement. DCN No. 20111-016, which provided the requirements for sampling and testing CDF, was approved after VH-1 was completed.

6. CONSTRUCTION QUALITY ASSURANCE – HDPE PIPES

6.1 General

GeoSyntec monitored the installation of the various HDPE pipes for the EPLTS project. Installation activities that were monitored by GeoSyntec CQA personnel included the following:

- main LTS pipe, consisting of 6-in. (150-mm) nominal diameter HDPE Standard Dimension Ratio (SDR) 11 solid-wall gravity carrier pipe inside a 10-in. (250-mm) nominal diameter HDPE SDR-11 solid-wall containment pipe, from VH-1 to the CVH;
- replacement of approximately 50-ft (15-m) long HDPE SDR-11 dual-containment piping systems, consisting of a 6-in. (150-mm) nominal diameter carrier pipe inside a 10-in. (250-mm) nominal diameter containment pipe, for the LDS, LCS, and RLCS lines from Cells 1, 2, and 3 to VH-1, VH-2, VH-3, respectively, using simultaneous thermal butt-fusion joining procedures;
- installation of approximately 20-ft (6-m) long HDPE SDR-11 dual containment pipe stubs, consisting of 6-in. (150-mm) nominal diameter carrier pipe inside a 10-in. (250-mm) nominal diameter containment pipe, for the LDS, LCS, and RLCS lines from VH-4, VH-5, and VH-6 for future tie-in to Cells 4, 5, and 6, respectively;
- installation of a 14-gauge insulated stranded copper wire to top of LTS pipeline prior to backfilling;
- installation of HDPE pipe fittings and appurtenances inside each valve house and the control valve house;
- hydrostatic and pneumatic pressure testing of the dual-containment piping systems; and
- closed-circuit television (CCT) video surveys and inspections of the LTS pipeline as well as the LDS, LCS, and RLCS pipelines from VH-1, VH-2, and VH-3 to Cells 1, 2, and 3, respectively.

6.2 Changes in Drawings and Specifications

RCIs and DCNs were processed and approved according to procedures described in FEMP document ED-12-5002 titled "Engineering Design Change Process". These RCIs and DCNs were approved, as appropriate, by the design organization and regulatory agency. Copies of the RCIs and DCNs are presented in Appendices K and L, respectively.

6.3 Pipe Conformance Testing and Documentation

The pipes for the EPLTS project were manufactured by Phillips Driscopipe of Richardson, Texas, and supplied by ISCO. The manufacturer provided the QC certifications for each lot of pipe supplied. The manufacturer's QC certificates are presented in Appendix D. CQA personnel reviewed this documentation and verified that the pipe property data were in compliance with the requirements of the project documents.

6.4 Field Monitoring Activities

6.4.1 Delivery and Placement

Upon delivery to the site, the pipes were placed in laydown areas approved by the Fluor Fernald CM. The pipes were transported from the laydown area to the construction area by a track hoe or a front-end forklift using nylon straps. The pipe was deployed or temporarily stored adjacent to the construction area.

Prior to installation, approximately 200-ft to 400-ft (60- to 120-m) long sections of pipe were constructed in the laydown areas or construction areas. The pipe sections were joined using thermal butt-fusion welding techniques. The CQA activities associated with the pipe joining techniques are described below.

CQA personnel monitored the HDPE pipe butt-fusion welding procedures to ensure the following:

- trial butt-fusion joints were made to verify conditions were adequate at the beginning of each day for each fusion apparatus used that day (trial joining was made under the same conditions as the actual joining);

- the ends of the pipes to be joined were cleaned and the pipe sections were placed in a portable welding unit;
- the welder tightly secured the pipe section in the welding unit clamps to allow the ends of the pipes to be trimmed with the facing tool immediately prior to the application of the heat disk;
- the ends of the pipe sections were heated for approximately one minute using a 400 to 500°F (204 to 260°C) heating disk;
- the welder quickly removed the heating disk and joined the pipes with pressure to create a roll back bead;
- the butt-fusion weld was allowed to cool for a minimum period of 30 minutes, prior to the joined pipes being released from the welding unit; and
- the above activities were performed in general accordance with pipe and welding unit manufacturers' procedures (see pipe manufacturer's submittal in Appendix F).

The above procedures were generally used to separately join nominal lengths of the 6-in. (150-mm) nominal diameter carrier pipe and the 10-in. (250-mm) nominal diameter containment pipes for the main LTS gravity line. The constructed sections of the carrier pipe were then pushed into sections of constructed containment pipe and then dragged into the LTS trench.

For the tie-in of the LDS, LCS, and RLCS pipes from Cells 1, 2, and 3, the dual containment pipes were simultaneously joined using the Fluid-Lok® Simultaneous Butt-Fusion Welding procedure (see Appendix F).

The width and depth of the trench for the pipeline varied with the location and the number of additional pipes that shared the common excavation. For example, the LDS, LCS, and RLCS pipes that penetrated the valve houses to the cells shared common excavation. Embedment fill was placed in nominal 7-in. (175-mm) thick loose lifts up to one lift over the pipe. The top of the pipe was surveyed to confirm compliance with the pipe grades and tolerances required by the project documents. The as-built survey data were reviewed by CQA personnel prior to placement of additional lifts of embedment fill over the pipe. The as-built survey data, provided by Baumann, are included in Appendix H.

Compacted fill (cohesive material) was then used as backfill to final grade. The backfill was placed in approximately 8-in. (200-mm) thick loose lifts. Hand-operated compaction equipment was used to achieve compaction of the embedment and trench backfill materials. Details of the placement and compaction of the embedment fill and trench backfill materials are discussed in Section 4.

6.4.2 Testing Activities

As part of the CQA activities, tests were performed on the installation of the HDPE pipes for the EPLTS project. The following tests were conducted or monitored by CQA personnel for the compacted trench backfill, embedment fill, or piping systems:

- Particle-size distribution and classification tests were performed on samples of compacted trench backfill and embedment fill materials as described in Section 4.3.

- In-place nuclear moisture/density tests were conducted on the compacted fill used in backfilling the LTS gravity trenches and around the valve houses, as discussed in Section 4.4.

- Bent strap tests were performed on trial welds made each day to confirm joint integrity, operator procedure, and fusion machine set-up. CQA personnel monitored the bent strap tests performed by RIECK, as described below.

- CCT video surveys and inspections of the existing LDS, LCS, and RLCS pipelines from Cells 1, 2, and 3 to manholes MH-1, MH-2, and MH-3, respectively, prior to removal and tie-in to valve houses VH-1, VH-2, and VH-3. CQA personnel monitored the CCT video surveys and inspections, as described below.

- Preliminary pneumatic and final hydrostatic pressure tests were conducted on the carrier and containment pipes of the main LTS gravity pipeline. These tests were monitored by CQA personnel and are discussed below.

- Preliminary and final pneumatic tests were conducted on the dual-containment pipes of the LDS, LCS, and RLCS lines from Cells 1, 2, and 3 to VH-1, VH-2, and VH-3, respectively. These tests were monitored by CQA personnel and are discussed below.

- CCT video surveys and inspections of the main LTS gravity pipeline from VH-1 to VH-2, from VH-2 to VH-3, from VH-3 to VH-4, from VH-4 to VH-5, from VH-5 to VH-6, and from VH-6 to the CVH. These were monitored by CQA personnel, as described below.

CQA personnel monitored the bent-strap and pressure testing performed by others (i.e., STAVER and RIECK) and documented the test results. The bent-strap test was performed on trial welds by cutting a specimen through the joint area; visually inspecting the cut surface of the pipe at the joint for voids or non-bonded areas; and bending the specimen 180 degrees so that the ends of the specimen touch to verify if the joint holds. Trial weld samples were archived by Fluor Fernald QA. Results of the trial welds are presented on the Butt Fusion Joining Logs in Appendix F.

CQA personnel monitored the CCT video surveys and inspections of the carrier pipes. Copies of the CCT videotapes of the main LTS gravity pipeline were made available to GeoSyntec CQA personnel to prepare the CCT video survey and inspection logs presented in Appendix F.

A 10-psi (70-kPa) pneumatic test was initially performed as a preliminary test to check each joint. Final hydrostatic pressure tests were then performed after the complete sections of the dual-containment pipes for the main LTS gravity line were installed. For these tests, the contractor typically tested the pipes with water to minimum test pressures of 60-psi (410-kPa) for the carrier pipe and 15-psi (102-kPa) for the containment pipe. CQA personnel monitored the hydrostatic pressure tests for a minimum period of 3 hours during which time the pressure in the pipe was recorded. An allowance for expansion/contraction of the pipe during hydrostatic pressure testing was included in the pass/fail criterion for the pressure test.

An alternate test that consisted of pressurizing the pipes over a 4-hour period, at 70-psi (480-kPa) internal pressure for the carrier pipe and 25-psi (170-kPa) internal pressure for the containment pipe, was also performed on some sections of the installed pipe. After holding the pipe at the test pressure over a 4-hour period, the test pressure was dropped by 10-psi (70-kPa), monitored for one hour for any drop (greater than 5 percent of target value) or visible leaks.

For the LDS, LCS, and RLCS pipes from Cells 1, 2, and 3 to VH-1, VH-2, and VH-3, respectively, the preliminary and final pressure testing was a 10-psi (70-kPa) pneumatic test. During the preliminary and final pneumatic testing of the Cell 1 LDS and Cell 3 RLCS piping sections, in accordance with the Technical Specifications,

minor pressure drops were measured and recorded. The minor pressure drops suggested potential leaks in either the 6-in. (150-mm) nominal diameter carrier pipe or the 10-in. (250-mm) nominal diameter containment pipe. Fluor Fernald subsequently evaluated the suspect sections of the Cell 1 LDS and Cell 3 RLCS pipes. A copy of the report presenting the findings from the evaluation is included in Appendix B. A third leak (apparently from a hole on the containment pipe) was also found on the existing Cell 3 LCS pipeline during the preliminary pneumatic test. However, this section of pipe was removed and replaced as part of the tie-in for the EPLTS project. The replaced section of the Cell 3 LCS pipe passed the final pneumatic test.

The pressure test results and CQA documentation from the installation of the HDPE pipes are presented in Appendix F.

7. CONSTRUCTION QUALITY ASSURANCE – CONCRETE PROTECTIVE LINER

7.1 General

GeoSyntec monitored the installation of the concrete protective liner component of the EPLTS project. Principal field activities are summarized in Section 3.1.3. Non-conforming or questionable practices observed by CQA personnel were brought to the attention of the Fluor Fernald CM and QA for review and correction. The panel layout record drawings for the concrete protective liner installed in the valve houses and control valve house are presented in Appendix H.

7.2 Changes in Drawings and Specifications

RCIs and DCNs of the concrete protective liner and related work drawings and specifications were processed and approved according to procedures described in FEMP document number ED-12-5002 entitled "Engineering Design Change Process". These RCIs and DCNs were approved, as appropriate, by the design organization and regulatory agency. Copies of the RCIs and DCNs issued for the EPLTS project are presented in Appendices K and L, respectively.

7.3 Quality Control Testing and Documentation

The concrete protective liner used for lining the concrete walls and floors of the valve houses was a 200-mil (5.0-mm) thick HDPE geomembrane sheets manufactured by Atlas Minerals & Chemicals, Inc. with the product name of Bekaplast. Quality control (QC) tests were performed on the resin and sheets by the resin supplier and manufacturer, respectively. The manufacturer's QC certificates, for each sheet, were reviewed by CQA personnel and were found to be in compliance with the project documents. The manufacturer's QC documentation included resin and geomembrane certifications and is presented in Appendix D.

7.4 Field Monitoring Activities

7.4.1 Delivery and On-Site Storage

Upon delivery to the site, the concrete protective liner sheets were stored in a laydown area approved by the Fluor Fernald CM. CQA personnel periodically monitored the delivery, unloading, and storage procedures. The CQA personnel

compared the sheet numbers to the sheets that were sampled and tested at the manufacturer's plant and also to the bill of lading. CQA personnel observed that procedures were used that minimized the potential for damage to the sheets.

7.4.2 Deployment

The concrete protective liner sheets were deployed by positioning and fastening sheets on the walls or floors of the valve houses in accordance with the approved panel layout drawing and manufacturer's recommendations. The sheets were deployed in conjunction with concrete placement for the walls, and grout placement for the floors of the valve houses and control valve house. Copper tape (i.e. conductive material) was placed behind all factory welds and field joints for spark testing after installation.

Concrete protective liner deployed for the floors were placed over a grout mix (i.e., setting bed). The panels were laid into place and pressed in. Plywood was evenly placed over the panels and sand bagged to ensure a flat surface during the curing process.

Details of the concrete protective liner panel placement were recorded by CQA personnel on the panel placement monitoring logs presented in Appendix G.

7.4.3 Trial Welds

Prior to production welding of wall-mounted or floor panels of concrete protective liner sheets, the installer prepared trial welds at the beginning of each day. Trial weld coupons were accepted by passing spark test in accordance with the manufacturer's recommendations.

A total of 43 trial welds were observed by CQA personnel during the production welding of the liner sheets. Additional trial welds were performed during the repairs to the installed liner. Trial seam samples were not archived. The trial seam test results are presented in Appendix G.

7.4.4 Production Welding

CQA personnel monitored production welding of concrete protective liner panel seams. Welding of seams and repairs were made using hand-held extrusion welders. The panel seams were prepared by scraping the edges of the material to expose virgin material. The top of the seam was then extruded. During or after welding, the seams

were visually examined for workmanship and continuity. Concrete protective liner production welding logs are presented in Appendix G.

Cap strips were used to weld wall-mounted concrete protective liner sheets with gaps greater than 0.56-in. (14-mm). The following procedure was used during cap strip installation:

- The cap strip was from the same batch of concrete protective liner sheets used for the walls.
- The width of the strip was wide enough to bridge the gap between the two sheets with a minimum overlap of 1-in. (25-mm) on each side of the gap.
- An extrusion bead with slight overflow was applied to fill the gap prior to attaching the cap strip. The extrudate overflow was ground to a flat surface to accommodate the cap strip.
- A conductive tape (for spark testing) was attached to each edge of the cap strip prior to installation to the wall.
- The installer used a tacker tip and hand gun to temporarily heat bond the cap strip in place.
- The cap strip was extrusion welded to each sheet. The weld was spark tested after cooling. If any leaks were found, the weld was repaired.
- Two 0.16-in. (4-mm) rod welds were used to cover a welded strip if root rod was used.

7.4.5 Nondestructive Seam Testing

Nondestructive testing of concrete protective liner seams was visually monitored by CQA personnel. The seams were nondestructively spark tested by the installer for continuity. Any portions of the weld that failed the spark test were repaired and retested, as described in Section 7.4.6 of this report.

The spark test requires a conductive material (e.g., copper tape) be inserted or attached to seam just prior to or during fabrication and/or field seaming. The field seams and areas adjacent to seam are checked to be dry prior to testing. The voltage applicator is moved along the seam at a uniform rate. Any seam discontinuity is detected by the generation of a spark. The suspect area is marked for repair as described

in the following section. Concrete protective liner spark test results are presented in Appendix G.

7.4.6 Concrete Protective Liner Repairs

7.4.6.1 Repairs of Welded Joints

The procedures presented in this subsection were used by the installer during the repair of the following welded joints:

- repair of rod welds;
- repair of extrusion welds; and
- repair of nail holes.

Rod welded joints were repaired by locating the exact point of the defect; removing all welds 1- to 1.5-in. (25- to 38-mm) on either side of the defect by scraping, applying a 0.12-in. (3-mm) rod as root weld; and allowing the weld to cool and spark test before applying two 0.16-in. (4-mm) rods to complete the repair by scraping between each pass.

Extrusion welds were repaired by locating the exact point of the defect; using an extrusion gun to preheat 1-in. (25-mm) from the tapered area and welding from this point through the repair and at least 1-in. (25-mm) beyond the end of the second taper to ensure a good weld fusion through the repair; and allowing the weld to cool and spark testing as described in Section 7.4.5.

Nail holes were repaired as follows: (i) nails were removed; (ii) scraping the area around the nail hole and out at least 2- to 2.5-in. (50- to 64-mm) in opposite directions from the nail hole in preparation for extrusion welding; (iii) extrusion welding over the nail hole by starting 2- to 2.5-in. (50- to 64-mm) away and welding directly over the hole, continuing for another 2- to 2.5-in. (50- to 64-mm) beyond the nail hole; and (iv) allowing the welding to cool and spark testing as described in Section 7.4.5.

7.4.6.2 Repair of Voids

Voids found under or behind the concrete protective liner (especially on the valve house floors) were repaired by injecting a cementatious grout material to fill the voids behind the liner. The following procedure was used to repair voids:

- Holes, slightly smaller than the insertion fitting, were drilled through the concrete protective liner sheet into the voided areas;
- The insertion fitting was screwed into two adjacent holes, allowing the fitting to cut its own thread into the plastic sheet;
- The grout material was mixed in accordance with manufacturer's recommendations; the fluidity of the grout was adjusted to accommodate the type of void to be filled;
- The mixed grout was placed in an empty one quart caulking cartridge, the tip of the cartridge was cut, the seal in the cartridge pierced and then placed in caulking gun, and hose assembly was attached to the cartridge and to insertion fitting;
- The caulking gun was pumped slowly until the grout reached the next insertion fitting;
- The pumping unit and the insertion fitting were removed from the first hole. The pumping unit was attached to the second insertion fitting. The first insertion was cleaned and screwed into the third hole. The first hole was temporarily closed using a 0.25-in. (5-mm) pipe plug. This pattern was continued until the void was completely filled and all drilled holes were plugged.
- The grout was allowed to cure before removing the pipe plugs.
- Disc seals were extrusion welded over the holes.

Appendix G presents repair summary logs for the concrete protective liner. Seam and panel repair locations are also presented in Appendix G. Complete panel layout drawings indicating the location of seam and panel repairs, for each valve house and CVH, are shown on the Record Drawings presented in Appendix H.

8. CONSTRUCTION QUALITY ASSURANCE – MECHANICAL

GeoSyntec CQA personnel periodically monitored the installation of the mechanical components of the EPLTS project. The mechanical components included: (i) process piping and appurtenances; (ii) tanks, flexible hoses, and tank transfer pumps; (iii) valves; (iv) piping insulation; (v) heating system; and (vi) fans. GeoSyntec CQA personnel also periodically monitored other related mechanical components of the project, including identification and labeling of valves and other mechanical equipment; painting work; etc.

RCIs and DCNs of the mechanical and related work drawings and specifications were processed and approved according to procedures described in FEMP document number ED-12-5002 entitled "Engineering Design Change Process". These RCIs and DCNs were approved, as appropriate, by the design organization and regulatory agency. Copies of the RCIs and DCNs issued for the EPLTS project are presented in Appendix K and Appendix L, respectively.

The mechanical components of the EPLTS project were supplied and installed by RIECK and STAVER. The manufacturer's submittals (including QC certificates, product data and other relevant documentation) were reviewed by CQA personnel to confirm compliance with the requirements of the project documents. The manufacturer's QC documentation and product data are presented in Appendix I.

CQA personnel periodically monitored the installation of the various mechanical components to confirm compliance with the project documents. In particular, CQA personnel monitored the pressure testing of process piping and appurtenances performed by RIECK in accordance with the requirements of the project documents. The pressure test results and CQA documentation are presented in Appendix I.

9. CONSTRUCTION QUALITY ASSURANCE – ELECTRICAL

GeoSyntec CQA personnel periodically monitored the installation of the electrical components of the EPLTS project. The electrical components included: (i) raceways, (ii) conductors and terminations; (iii) outlets, junctions and pull boxes; (iv) switches and receptacles; (v) manual disconnect switches and electrical panels; (vi) overhead service; (vii) grounding; (viii) lighting; and (ix) controls, instrumentation, and flow meters. GeoSyntec also periodically monitored other related electrical components of the project, including installation of the wooden poles for the electrical lines.

RCIs and DCNs of the electrical and related work drawings and specifications were processed and approved according to procedures described in FEMP document number ED-12-5002 entitled "Engineering Design Change Process". These RCIs and DCNs were approved, as appropriate, by the design organization and regulatory agency. Copies of the RCIs and DCNs issued for the EPLTS project are presented in Appendix K and Appendix L, respectively.

The electrical components of the EPLTS project were supplied and installed by B&J Electrical and STAVER. The manufacturer's submittals (including QC certificates, product data and other documentation) were reviewed by CQA personnel to confirm compliance with the requirements of the project documents. The manufacturer's QC documentation and product data are presented in Appendix J.

CQA personnel periodically monitored the installation of the various electrical components to confirm compliance with the project documents. In particular, CQA personnel monitored the grounding installation and testing performed by B&J Electrical in accordance with the requirements of the project documents. The grounding test results and CQA documentation are presented in Appendix J.

10. SUMMARY AND CONCLUSIONS

Construction of the OSDF EPLTS project for the FEMP was carried out during the period from 29 May 2000 to 27 June 2001. During this time, GeoSyntec provided on-site CQA personnel to monitor the construction of the OSDF EPLTS project. As part of the CQA activities, GeoSyntec on-site CQA personnel monitored the construction and installation of the following components of the EPLTS:

- six valve houses (VH-1 to VH-6) and a control valve house; each constructed of reinforced-concrete footing and foundation walls, and lined with HDPE concrete protective liner material to provide secondary containment;
- permanent dual-containment LTS piping system from VH-1 to the control valve house;
- replacement of the SDR-26 HDPE pipes with SDR-11 HDPE pipes for the LDS, LCS, and RLCS dual-containment piping system from Cells 1, 2, and 3 to VH-1, VH-2, and VH-3, respectively;
- installation of LDS, LCS, and RLCS dual-containment pipe stub-outs from VH-4, VH-5, and VH-6 for future connection to their respective cells; and
- mechanical, electrical and other components of the EPLTS project.

During construction of the above components, CQA personnel verified that conformance and CQA testing were performed on the construction materials at the frequencies required in the project documents, and that materials meeting the project document requirements were used. CQA personnel also verified that conditions or materials identified as not conforming to the project documents were replaced, repaired, and/or retested, and that all non-conformances associated with the construction were resolved through disposition by the Fluor Fernald Construction Manager with concurrence by the Fluor Fernald Engineering, Quality Assurance and the GeoSyntec Project Manager. Copies of the non-conformance reports (NCRs) written during construction of the EPLTS project are included as Appendix M to this CQA final report.

Based on GeoSyntec's understanding of the project requirements, the results of testing conducted as part of the CQA monitoring activities, and the documentation by GeoSyntec's on-site CQA personnel as described in this report, it is concluded that the EPLTS for the OSDF was constructed in general accordance with the project documents (i.e., Technical Specifications, Construction Drawings, and all applicable DCNs). To the best of our information, knowledge, and belief, it is our professional opinion that the EPLTS has been constructed satisfactorily for the intended use as part of the overall OSDF Leachate Management System, as described in the OSDF Design Criteria Package and other related documents.

STATE OF OHIO
KWASI BADU-TWENEBOAH
E-55354
REGISTERED PROFESSIONAL ENGINEER

Kwasi Badu-Tweneboah, Ph.D., P.E.
Project Manager
Ohio P.E. No. E-55354

REFERENCES

Fluor Daniel Fernald, "*Leachate Conveyance System Leak Investigation*", Prepared for United States Department of Energy Fernald Environmental Management Project, Fernald, Ohio, April 1999.

GeoSyntec Consultants, "*Construction Quality Assurance Final Report, On-Site Disposal Facility, Phase I and Leachate Conveyance System*", Revision 0, Prepared for United States Department of Energy Fernald Environmental Management Project, Fernald, Ohio under Fluor Daniel Fernald Subcontract 95S0005028, January 1998a, Vols. I through IX.

GeoSyntec Consultants, "*Construction Quality Assurance Final Report, On-Site Disposal Facility, Phase II Cell 2*", Revision 0, Prepared for United States Department of Energy Fernald Environmental Management Project, Fernald, Ohio under Fluor Daniel Fernald Subcontract 95S0005028, Dec 1998b, Vols. I through VII.

GeoSyntec Consultants, "*Evaluation of Leachate Transmission System On-Site Disposal Facility, Fernald Environmental Management Project*", Revision B, Prepared for United States Department of Energy Fernald Environmental Management Project, Fernald, Ohio (FDF Project No. 20100) under Fluor Daniel Fernald Subcontract 95S0005028, Apr 1999a, Vols. I and II.

GeoSyntec Consultants, "*Construction Quality Assurance Final Report, Interim Leachate Conveyance System On-Site Disposal Facility*", Revision A, Prepared for United States Department of Energy Fernald Environmental Management Project, Fernald, Ohio under Fluor Daniel Fernald Subcontract 95S0005028, Sep 1999b, Vols. I and II.

GeoSyntec Consultants, "*Construction Quality Assurance Final Report, On-Site Disposal Facility, Phase II Cell 3*", Revision 0, Prepared for United States Department of Energy Fernald Environmental Management Project, Fernald, Ohio under Fluor Daniel Fernald Subcontract 95S0005028, Nov 1999c, Vols. I through VI.

GeoSyntec Consultants, "*Design Criteria Package, On-Site Disposal Facility, Phase III*", Revision 1B, Prepared for United States Department of Energy Fernald Environmental Management Project, Fernald, Ohio under Fluor Daniel Fernald Subcontract 95PS005028, Apr 2000.

APPENDIX A

APPENDIX A

PHOTOGRAPHIC DOCUMENTATION

Photo 1. Entrance to the FEMP Site.

Photograph 2. STAVER Crew installing a Concrete Riser for the GIS.
(06 June 2000)

Photograph 3. Compaction of Soil Backfill around Reinforced Concrete Pipe and GIS.
(13 June 2000)

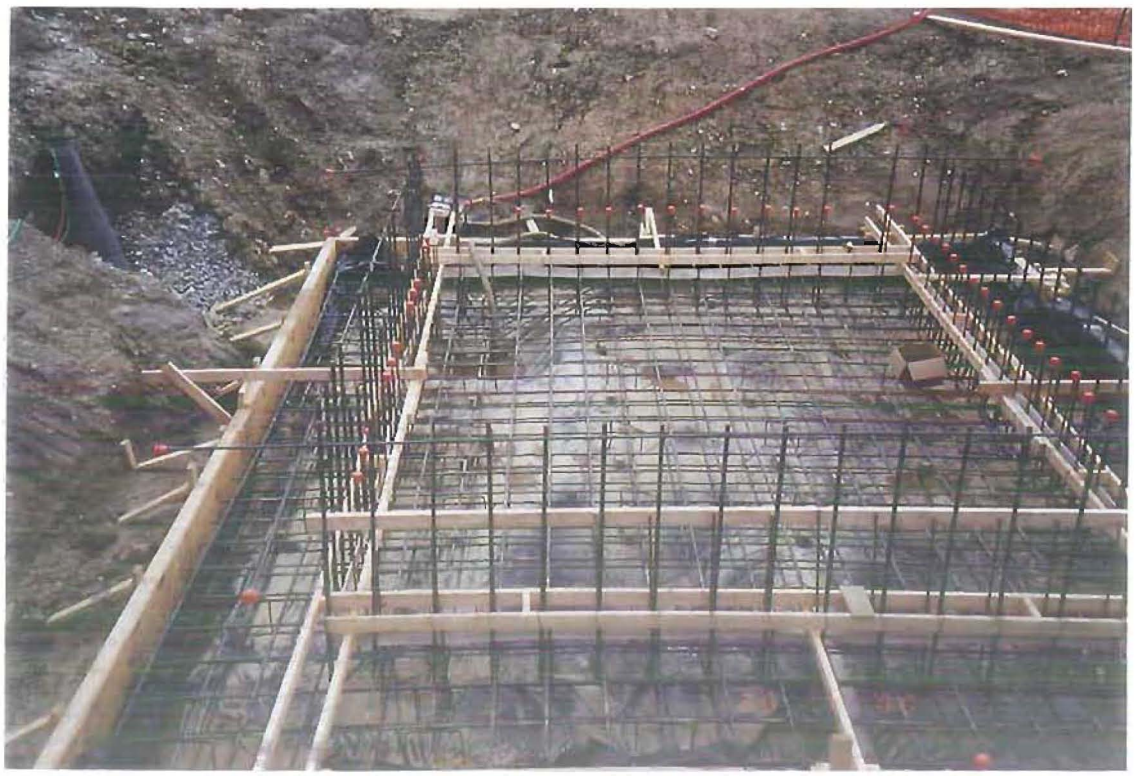
Photograph 4. Completed GIS prior to Placement of Rip Rap.
(20 September 2000)

Photograph 5. Completed GIS after Rip Rap Placement.
(01 August 2001)

Photograph 6. Excavation for Valve House No. 1 (VH-1) Foundation (Stage 1 Demolition). (15 June 2000)

Photograph 7. Placement of Controlled Density Fill for VH-1 Foundation. (26 June 2000)

Photograph 8. Formwork for VH-1 Footing.
(20 June 2000)



Photograph 9. Formwork and Reinforcement Steel (Rebar) for VH-1 Footing.
(26 June 2000)

Photograph 10. CQA Personnel Preparing Test Cylinders During Concrete Placement. (08 September 2000)

Photograph 11. CQA Personnel Preparing Test Cylinders During Concrete Placement. (08 September 2000)

Photograph 12. Concrete Placement Operations for VH-1 Footing.
(27 June 2000)

Photograph 13. Interior Formwork and Rebar Installation for VH-1 Walls.
(25 July 2000)

Photograph 14. Rebar Installation with Pipe Penetration for the East Wall of VH-4.
(14 September 2000)

Photograph 15 Concrete Placement for the South Wall of VH-4.
(29 August 2000)

Photograph 16.Concrete Placement for the South Wall of VH-3.
(08 September 2000)

Photograph 17. LTS Pipe Trench Excavation from VH-1 to VH-2.
(14 August 2000)

Photograph 18. Compaction of Embedment Fill in Pipe Trench from VH-1 to VH-2.
(22 August 2000)

Photograph 19. Installation of Dual-Containment HDPE Pipe for the LTS from VH-1 to VH-2.
(22 August 2000)

Photograph 20. Grade Control Survey of LTS Pipeline.
(29 September 2000)

Photograph 21. Installation of 14-Gauge Insulated Stranded Copper Wire to Top of Pipe and Placement of Embedment Fill around Pipe. Note that Pipe Joints are exposed for Hydrostatic Pressure Testing. (18 September 2000)

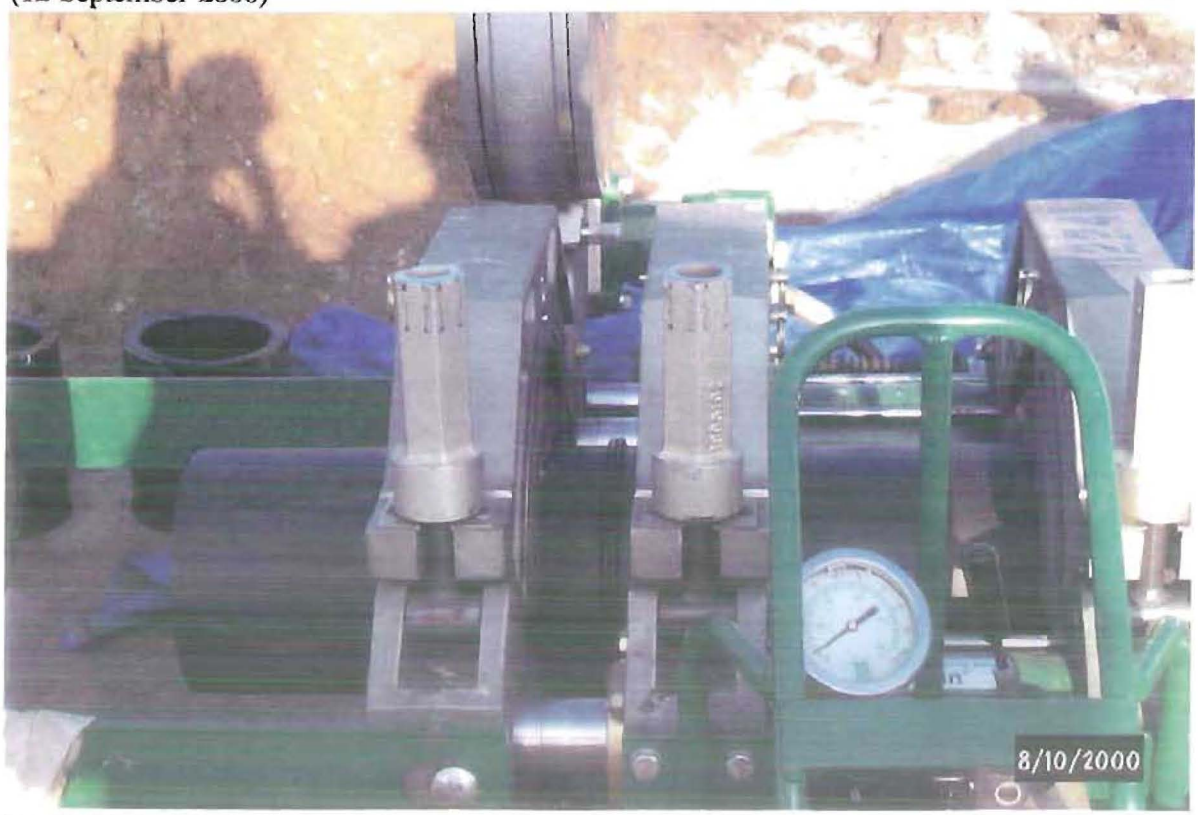
Photograph 22 Placement and Compaction of 12-in. thick Loose Lift of Embedment Fill over HDPE Pipe.
(29 September 2000)

Photograph 23. Compaction of additional lifts of Embedment Fill in Pipe Trench.
(8 September 2000)

Photograph 24. Placement and Compaction of Loose Lifts of Compacted Fill Material around VH-2.
(21 August 2000)

Photograph 25. In-place Nuclear Moisture/Density Tests of Compacted Fill around VH-3.
(13 August 2000)

Photograph 26. Drive Cylinder and Nuclear Moisture/Density Tests on West Side of VH-3. (12 September 2000)



Photograph 27. Trial Weld of 6-in. Diameter SDR-11 HDPE Pipe. (10 August 2000)

Photograph 28. Bent Strap Test of Trial Weld on 10-in. Diameter SDR-11 HDPE Pipe.
(13 August 2000)

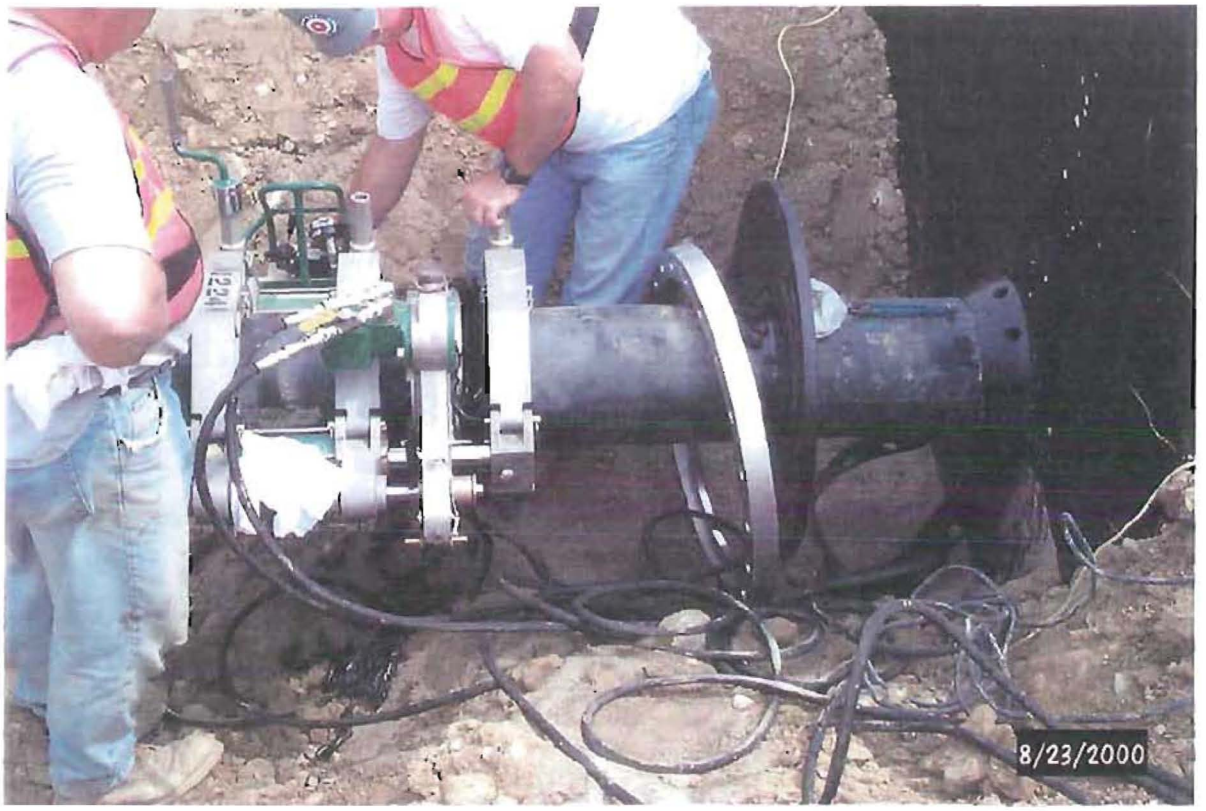
Photograph 29. Leak Check on Pipe Joint during Preliminary Pneumatic Testing.
(10 August 2000)

Photograph 30. Installation of Pipe Fittings and Test Gauges for Hydrostatic Pressure Testing of 6-in. HDPE Pipe from VH-1 to VH-2.
(27 August 2000)

Photograph 31. Pressure Gauge Connection during Hydrostatic Pressure Testing of 6-in. HDPE Pipe from VH-1 to VH-2. (27 August 2000)

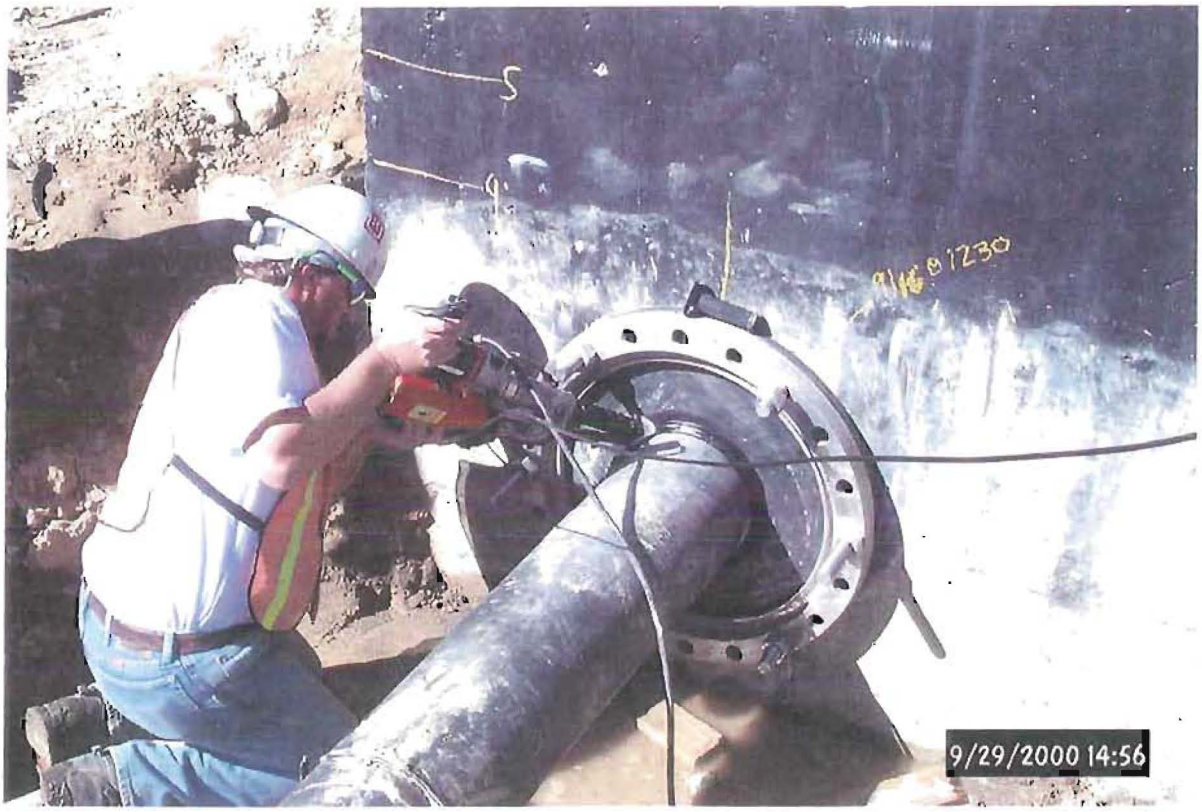
Photograph 32. Details of Test Gauge with Pressure Relief Valve, Flange Connection, and Pipe Plugs during Hydrostatic Pressure Testing.
(04 April 2001)

Photograph 33. Penetration of LDS, LCS, and LCS-R Pipes through West Wall of VH-6.
(12 October 2000)



Photograph 34. Thermal Butt-Fusion Welding of LTS Pipeline with stainless steel flange, HDPE flatstock plate, and EPDM gasket for sealing Type I Wall Penetration at VH-2. (23 August 2000)

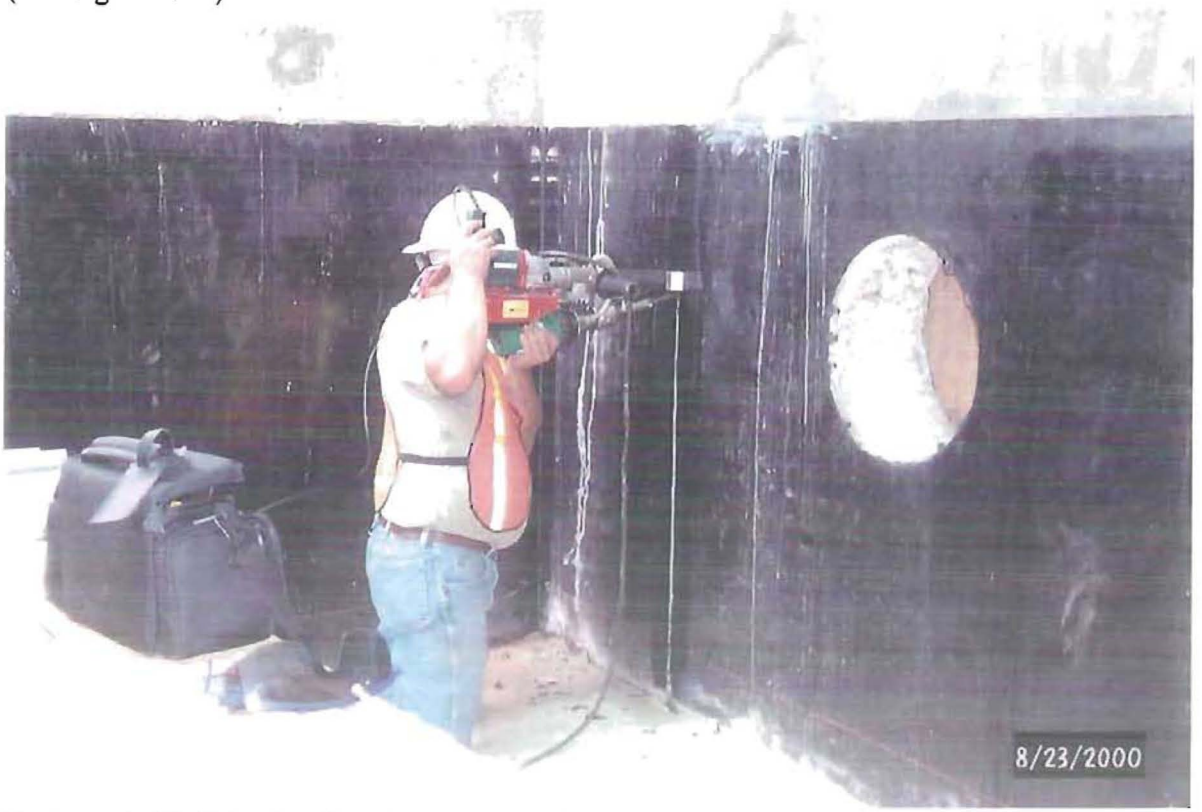
Photograph 35. Anchors Used to Seal Type I Wall Penetration at VH-2. (21 September 2000)



Photograph 36. Extrusion Welding of Pipe to HDPE flatstock plate for sealing around Wall Penetration at VH-2.
(29 September 2000)

Photograph 37. Installation of Concrete Protective Liner (Bekaplast) along Corners of VH-3 Wall During Formwork and Rebar Installation. (22 August 2000)

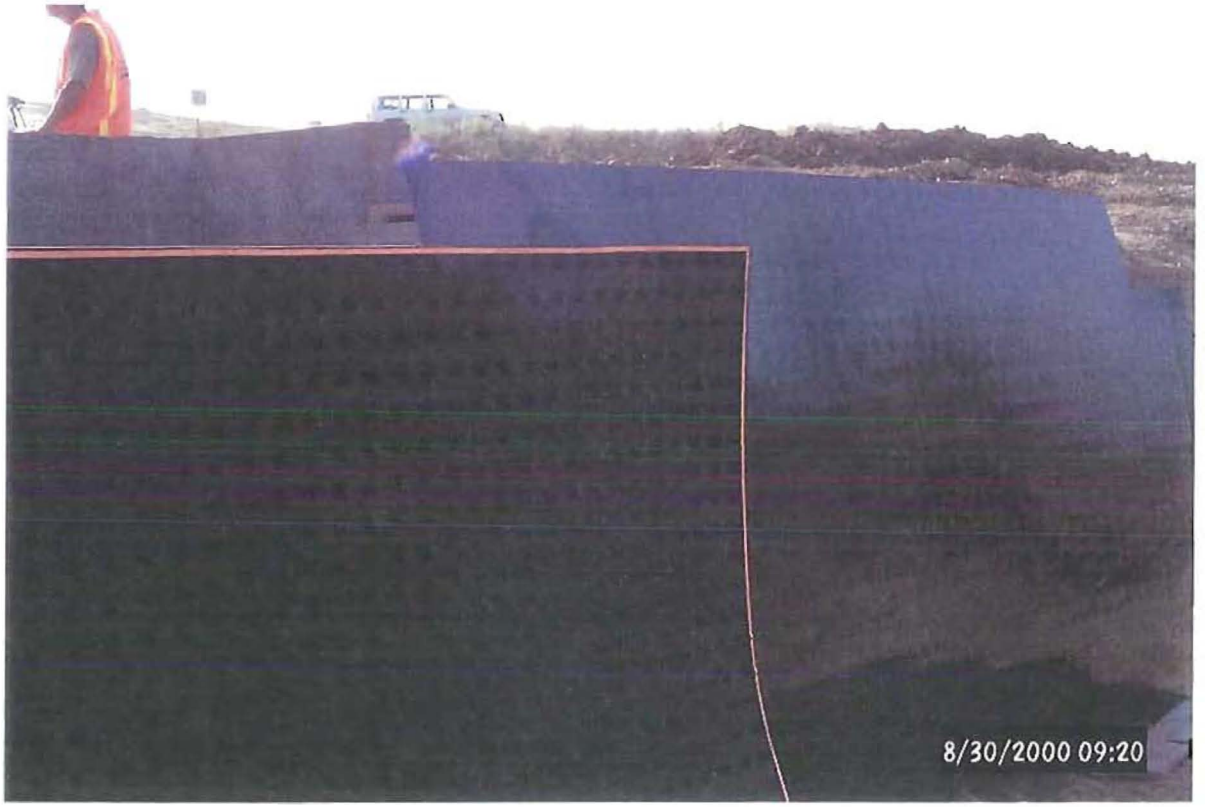
Photograph 38. Installing Concrete Protective Liner Panels for Valve House Walls.
(22 August 2000)



Photograph 39. Extrusion Welding Concrete Protective Liner Panels inside Valve House Walls.
(23 August 2000)

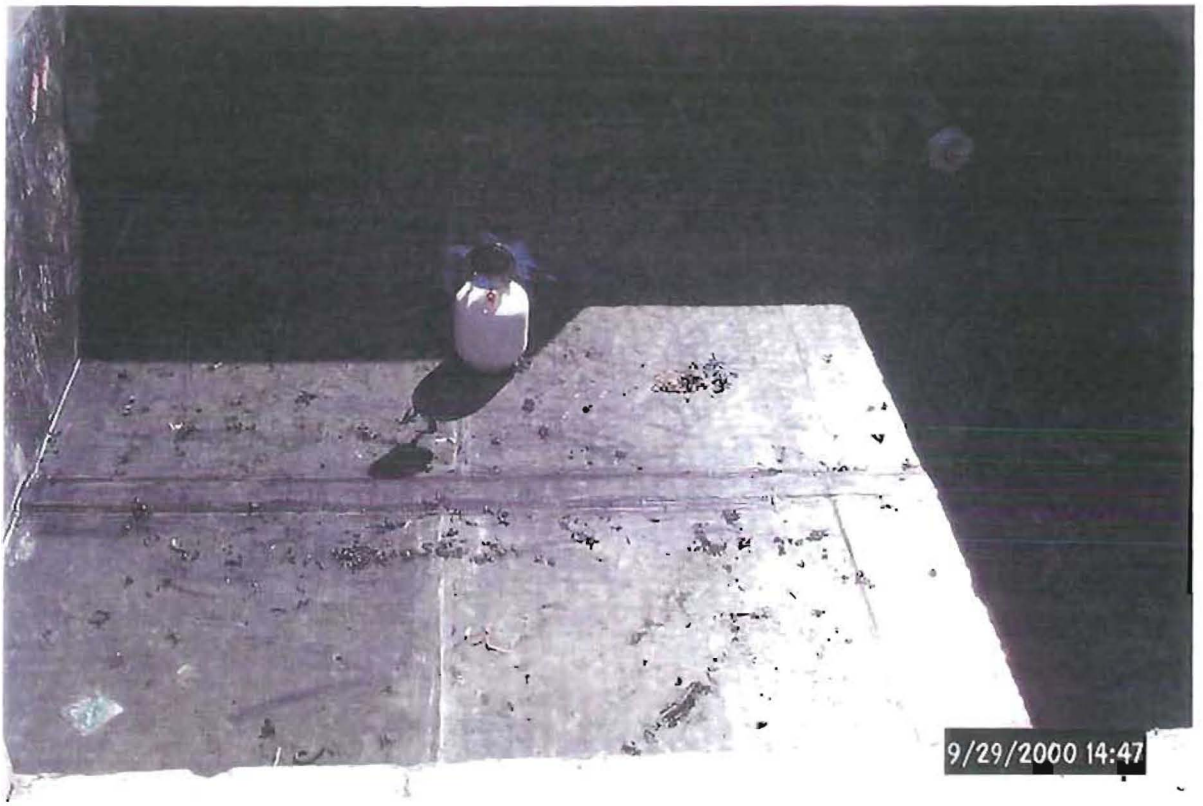
Photograph 40. Extrusion Welding of Cap Strip over Concrete Protective Liner Panel Seams.
(24 August 2000)

Photograph 41. Installation of Rebars and Anchors in VH-2 Floor prior to Concrete Protective Liner Installation.
(21 September 2000)



Photograph 42. Concrete Protective Liner Panels with Copper Strips for Spark Testing to be deployed on VH Floor.
(30 August 2000)

Photograph 43. Grout Placement and Concrete Protective Liner Installation on VH-2 Floor.
(21 September 2000)



Photograph 44. Completed Welding of Concrete Protective Liner on VH-2 Floor.
(29 September 2000)

Photograph 45. Waterproofing Concrete Walls of VH-2.
(17 August 2000)

Photograph 46. Cad Welding for Grounding Grid Around VH-1.
(09 October 2000)

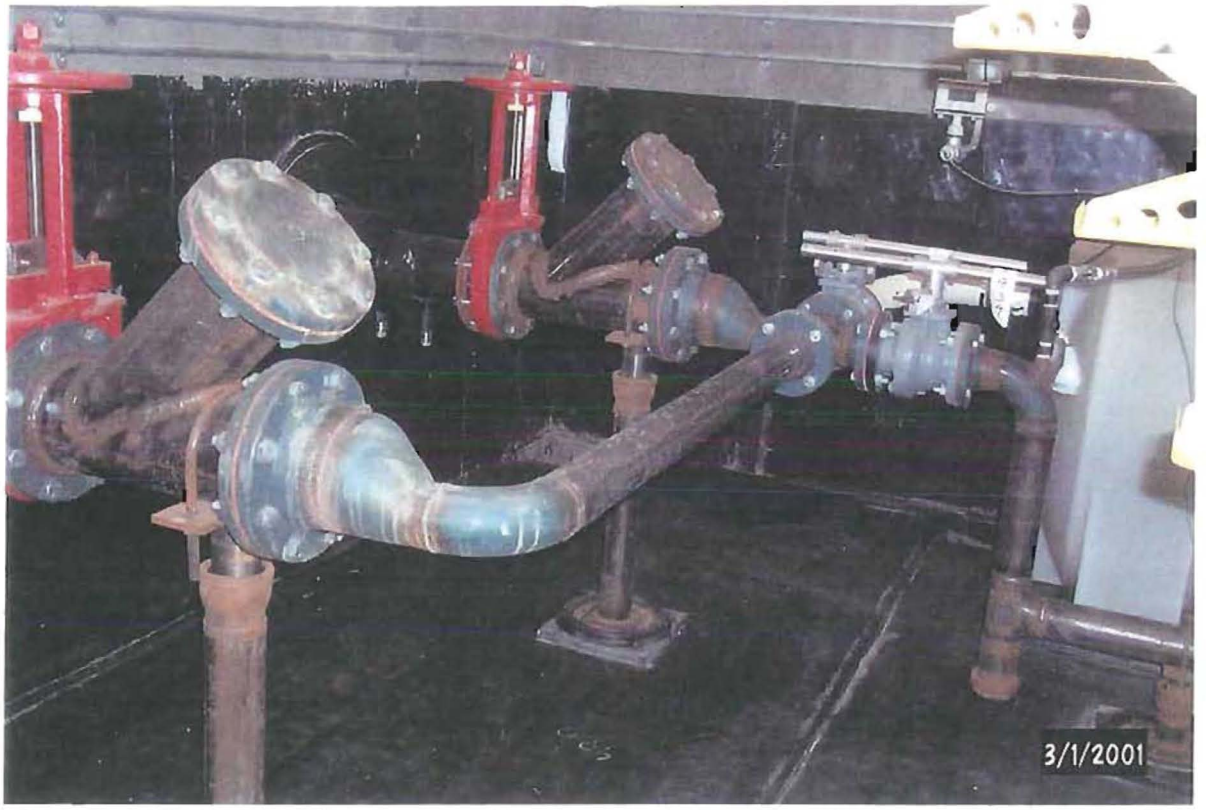
Photograph 47. Erection of Pre-Engineered Building on VH-1.
(31 October 2000)

Photograph 48. Erection of Pre-Engineered Building on VH-1.
(31 October 2000)

Photograph 49. Drilling for Installation of Electrical Wooden Pole near the North Side of VH-2. (07 September 2000)

Photograph 50. Backfilling and Compaction Around the Base of the Electrical Wooden Pole. (07 September 2000)

Photograph 51. Installation of Cross Arms and Mounting Items to Electrical Wooden Pole. (20 September 2000)



Photograph 52. Surface Finishing of Carbon Steel Piping System inside Valve House. (01 March 2001)

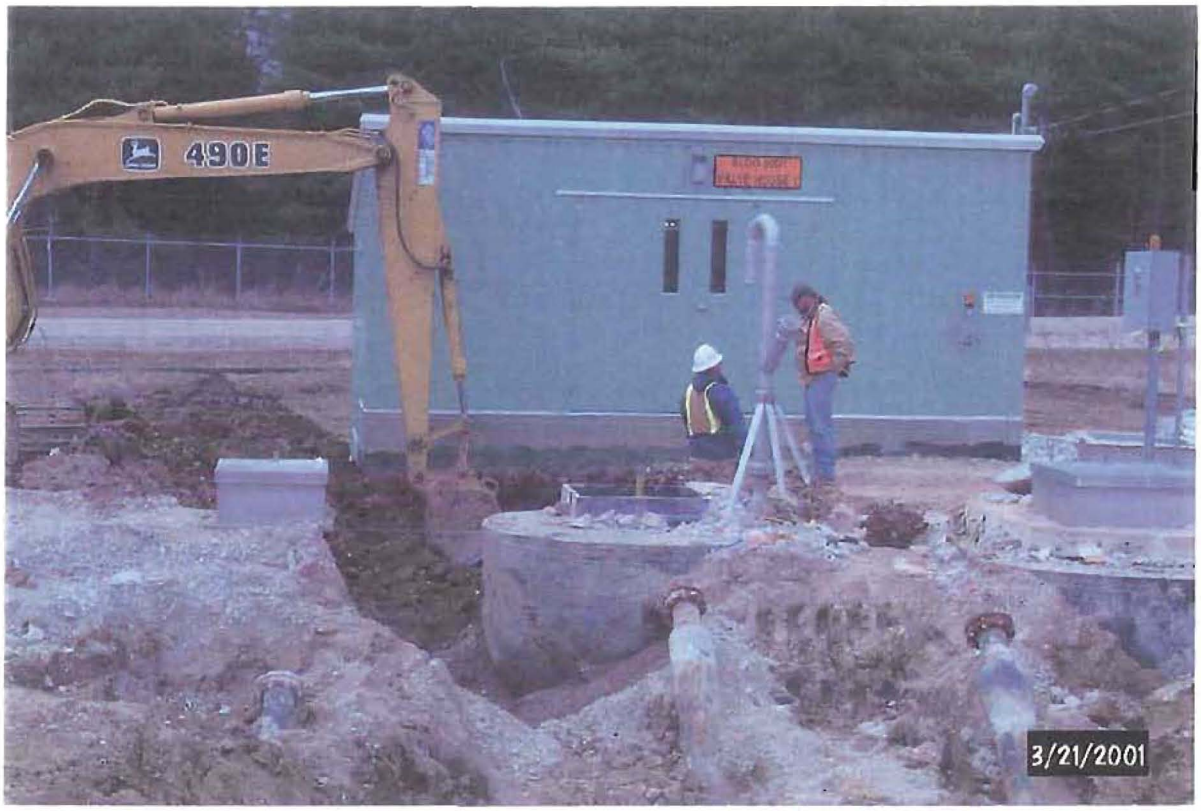
Photograph 53. Completed Surface Finishing of Carbon Steel Piping System inside Valve House (08 March 2001)

Photograph 54. Stage 1 Demolition Activities at Cell 1.
(26 February 2001)

Photograph 55. Stage 2 Demolition Activities at Cell 2.
(28 February 2001)

Photograph 56. Stage 2 Demolition Activities at Cell 2 with Horizontal Monitoring Well exposed. (28 February 2001)

Photograph 57. Stage 2 Demolition Activities Completed at Cell 2. (20 March 2001)



Photograph 58. Stage 3 Demolition Activities at Cell 1.
(21 March 2001)

Photograph 59. Stage 3 Demolition Activities at Cell 2 with Exposed LDS and LCS-R Pipes.
(16 April 2001)

Photograph 60. Stage 3 Excavation to expose LDS, LCS, and LCS-R Pipes for Tie-in to VH-1 at Cell 1. (30 March 2001)

Photograph 61. Removal of a Portion of the 6-in. HDPE SDR-26 LDS Line for VH-1 Tie-in. (04 April 2001)

Photograph 62. Lifting the New LDS HDPE SDR-11 Pipe for tie-in to the Existing SDR-11. HDPE Pipe
(05 April 2001)

Photograph 63. Completed Tie-in of LDS, LCS, and LCS-R Pipes at Cell 3.
(15 May 2001)

PARSONS
2443 Crowne Point Drive
Cincinnati, OH 45241
(513) 554-4455 (Phone)
(513) 554-6572 (Fax)

facsimile transmittal

To: Jeanie Rosser Fax: 648-3648

From: Ken Gerard x139 Date: 28 Oct 02

Re: RCI 20800-002R Pages: Cover + 6

CC:

☐ Urgent ☐ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

Per conversation w/ Chris Neumann.

Will process original once we receive it.

Any questions, please contact me.

KG 10/28/02

RCI/DCN FORM

REQUEST FOR CLARIFICATION OF INFORMATION / DESIGN CHANGE NOTICE

(1) PROJECT/CWO/RES NO.:	(2) S/C NO.:	(3) Pg. 1 of 4	(4) DATE:
20800			10/23/02

(5) PROJECT/CWO/RES/S/C TITLE:	(6) RCI NO.:
Area 3A/4A Excavation	20800-002R
(7) RCI/DCN TITLE:	(6) DCN NO.:
Plant 5 West Slope Alteration	

(8) DOCUMENTS AFFECTED	(8) DOCUMENT NOS.	(8) REV.	(9) OTHER
Construction Drawing	99X-5900-G-00752	0	

(10) REQUESTOR:	(11) CE / PE
NAME (Print & Sign) DATE	NAME (Print & Sign) DATE

(12) [X] RCI-DESCRIPTION (13) [ ] DCN-JUSTIFICATION, EXISTING CONDITION & REQUESTED/PROPOSED CHANGE

Is it acceptable to excavate a 3-foot key along the west bank of the Plant 5 excavation and slope the bank at 4:1 to meet existing grade as shown on attached sketch and plan view? The purpose for this request is to create a staging area for the hydraulic rams with some limited containment capacity in case the hydraulic fluid within the casing should be released. The hydraulic rams will be pulled by crane and staged in the keyed excavation. Note 2 on Construction Drawing 99X-5900-G-00752 appears to suggest that this plan is acceptable.

DESIGN ORGANIZATION RCI – DCN SUMMARY DESCRIPTION

(14) RCI/DCN SUMMARY DESCRIPTION

Acceptable to proceed as outlined in the RCI. See attached.

(15) REVIEWS COMPLETED

- [ ] Configuration Management SSC Review Complete — DO NAME (Print & Sign) DATE
- [ ] Impact Assessment Review Complete — DO NAME (Print & Sign) DATE
- [X] Technical Review Complete — PE NAME (Print & Sign) DATE; K. Gerard / K. Gerard (Parsons) 10/28/02; DO NAME (Print & Sign) DATE
- [ ] ED-12-4010 Review Complete — PE NAME (Print & Sign) DATE

(16) DOES CE AGREE WITH SOLUTION: [ ] NO [ ] YES

IS A PURCHASE REQUISITION REQUIRED: [ ] NO [ ] YES

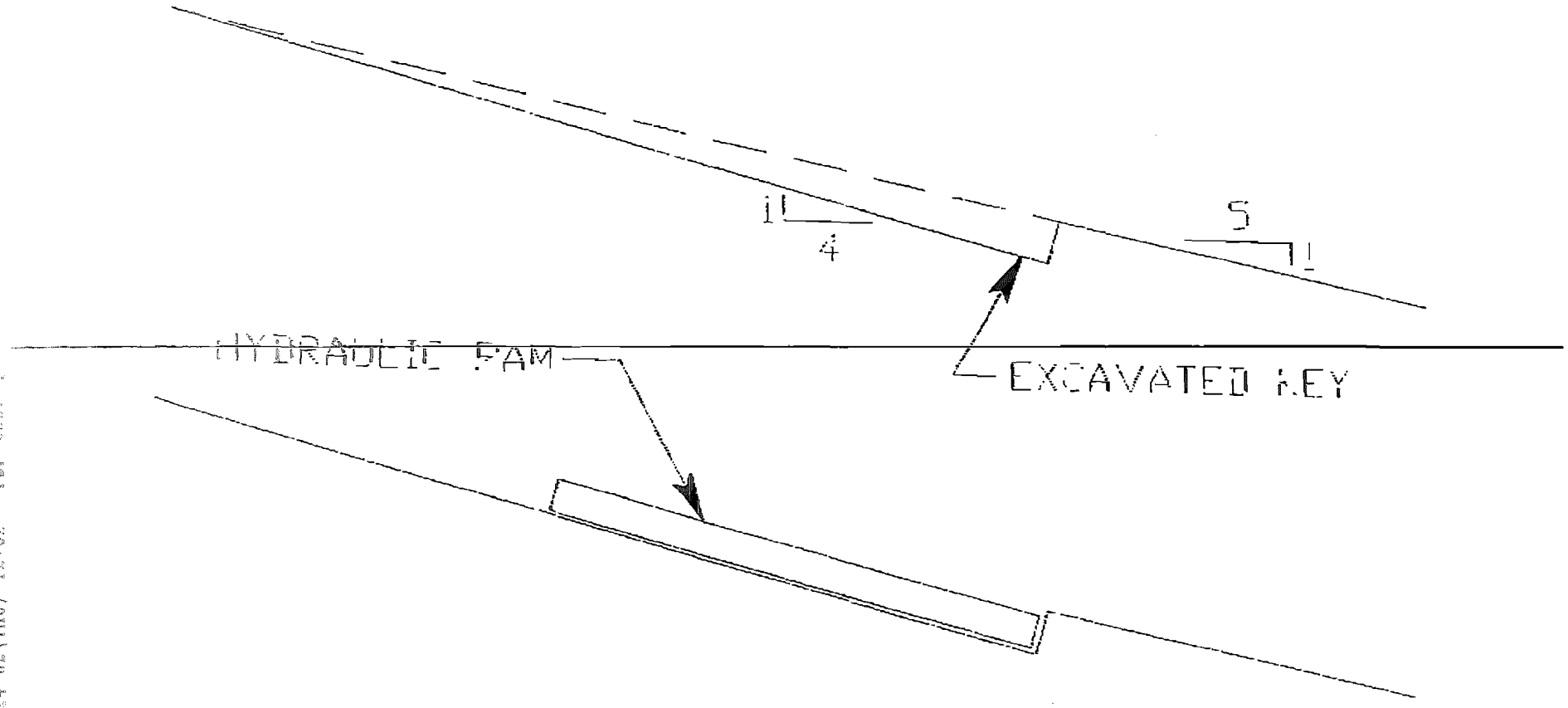
CE NAME (Print & Sign) DATE

(17) FIELD WORK COMPLETED:

Post-it® Fax Note 7671
To KEN GERARD Date 10/24 # of pages ▶ 4
Co./Dept. PARSONS From NEUMANN
Phone # 554-6572 Co. JACOBS
Fax # 554-4455 X139 Phone # Fax # 678-4784

HYDRAULIC RAM STAGING AREA

20800-SK-001



PAGE 4 OF 4

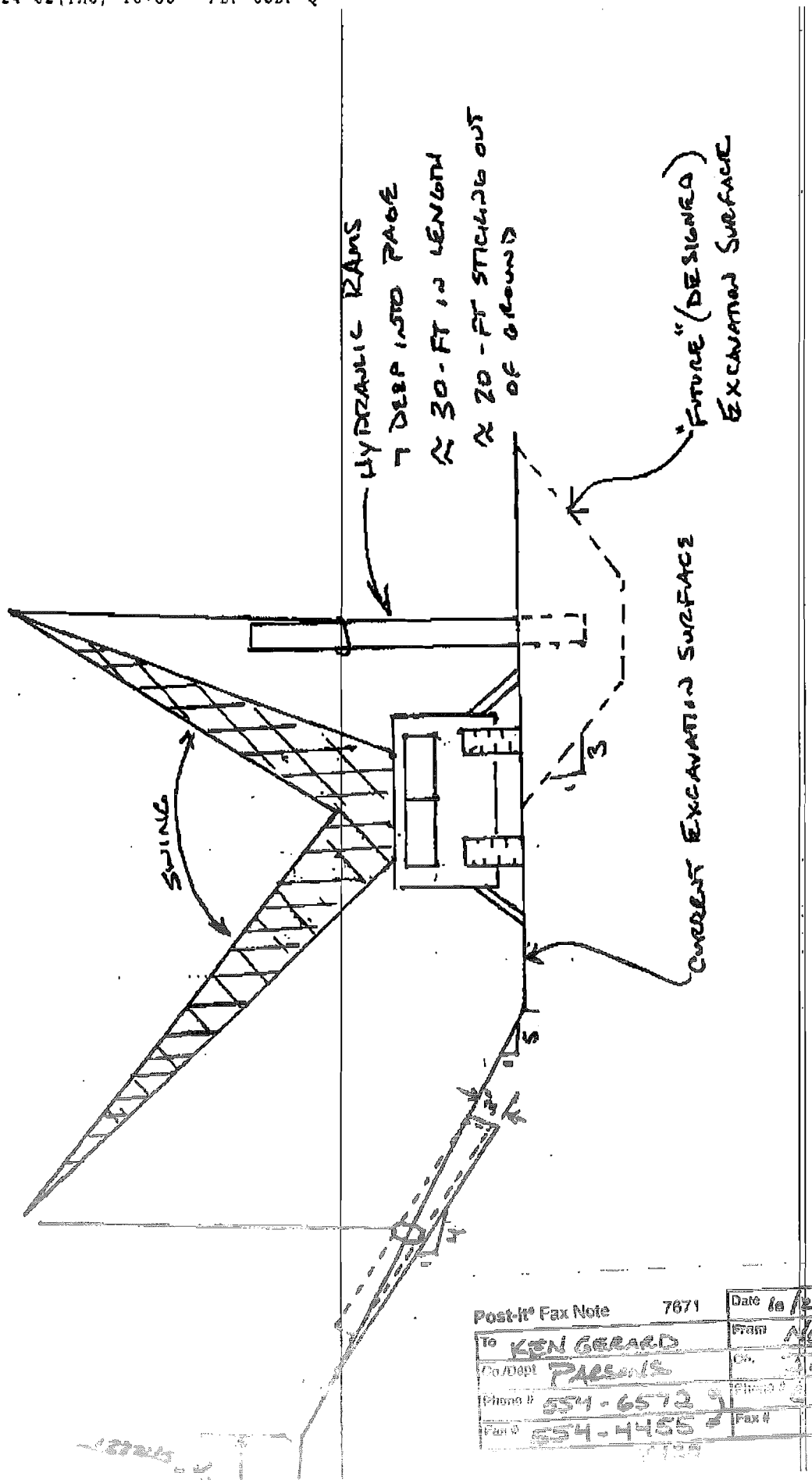
Plant5westopo.txt

CURRENT AS-BUILT TOPO
OF PLANT 5 WEST

```
1,480580.569,1349740.239,560.243,GRND
2,480575.962,1349709.495,560.045,TOE
3,480550.069,1349709.284,560.167,TOE
4,480526.175,1349708.711,560.459,TOE
5,480501.342,1349707.969,560.896,TOE
6,480497.989,1349737.733,560.789,GRND
7,480513.673,1349696.367,564.186,BRK/PAINT
8,480527.704,1349696.635,563.903,BRK/PAINT
9,480538.583,1349696.737,563.965,BRK/PAINT
10,480563.955,1349697.324,564.156,BRK/PAINT
11,480566.681,1349697.566,564.194,BRK/PAINT
12,480577.690,1349697.572,564.171,BRK/PAINT
13,480580.034,1349671.568,569.723,BRK/PAINT
14,480565.857,1349669.958,569.869,BRK/PAINT
15,480529.686,1349668.134,570.002,BRK/PAINT
16,480513.867,1349666.887,569.984,BRK/PAINT
17,480515.082,1349622.595,576.716,BREAK
18,480532.900,1349630.252,575.339,BREAK
19,480567.614,1349634.898,574.702,BREAK
20,480583.787,1349629.377,576.028,BREAK
21,480584.522,1349622.292,577.939,TOP
22,480562.021,1349621.320,577.957,TOP
23,480539.905,1349621.086,578.476,TOP
24,480515.226,1349619.677,578.077,TOP
25,480514.770,1349617.149,578.199,TOE
26,480514.565,1349613.077,579.987,TOP
27,480514.116,1349606.855,579.922,GND
28,480542.220,1349606.899,579.756,GND
29,480542.233,1349611.110,579.827,TOP
30,480542.507,1349613.607,578.500,TOE
31,480568.181,1349614.508,577.946,TOE
32,480568.325,1349610.943,580.118,TOP
33,480568.053,1349607.303,579.681,GND
34,480589.893,1349608.283,579.721,GND
35,480589.468,1349612.535,579.676,TOP
36,480589.369,1349615.798,577.999,TOE
```

NOTE:

"PAINT" INDICATES LOCATION FOR KEY TO BE EXCAVATED



Post-it® Fax Note 7671 | Date 10/24 | # of pages ▶ 1
To KEN GERARD | From NEUMANN
Co./Dept. PARSONS | Co. JACOBS
Phone # 554-6572 | Phone # 78-4784
Fax # 554-4455 | Fax #

Gerard, Ken

From: Sutton, Gary
Sent: Monday, October 28, 2002 2:09 PM
To: 'Neumann, Christopher'; McNulty, Greg
Cc: 'Snider, Anthony'; 'Harbin, Kevin'; 'Russell, David'; 'Rosser, Jeannie'; Gerard, Ken
Subject: RE: RCI 20800-002R

Chris,

This is Greg McNulty. The RCI looks ok. So, the answer is YES. You can go forth with the planned approach that was outlined in the RCI.

Greg McNulty

-----Original Message-----
From: Neumann, Christopher
Sent: Monday, October 28, 2002 11:42 AM
To: McNulty, Greg; Sutton, Gary
Cc: Snider, Anthony; Neumann, Christopher; Harbin, Kevin; Russell, David; Rosser, Jeannie; Gerard, Ken
Subject: RCI 20800-002R

Gary,
This e:mail has been sent to you at Greg's request. Please notify him when you receive this.

Greg,
I apologize for the hassle and for not clarifying in our phone conversations last Thursday. As typical in the construction industry, an expedited response to RCI 20800-002R is necessary to meet the schedule for SDFP Construction. SDFP Construction was planning to begin the work as early as last Saturday with a late start of today. Due to weather, this activity was postponed with a new early start of tomorrow, Tuesday, and a late start of Wednesday. Knowing that a quick response was necessary, the RCI was specifically written to produce a response of "yes" or "agree" unless the plan does not, in your interpretation, fall under the guidelines of Note 2 on Dwg 99X-5900-G-00752. This accelerated schedule does not allow for standard protocol of waiting for the original RCI to be received from ECDC and sending the original back to ECDC with your response. Please send your planned response to the RCI, faxed to you on Thursday, October 24th, via e:mail as a "reply to all" to thi!
s e:mail which will be attached to the RCI copy in the field until your official response is received on the original. Please call me if you have any questions.
Thank you,
Chris Neumann
(513) 648-4784

********** DISCLAIMER **********
The information transmitted is intended only for the person or entity to which it is addressed and may contain confidential and/or privileged material. If you are not the intended recipient of this message you are hereby notified that any use, review, retransmission, dissemination, distribution, reproduction or any action taken in reliance upon this message is prohibited. If you received this in error, please contact the sender and delete the material from any computer. Any views expressed in this message are those of the individual sender and may not necessarily reflect the views of the company.
****