Fernald Environmental

FERMCO
Restoration Management Corporation

(now renamed Fluor Daniel Fernald) P. O. Box 538704 Cincinnati, Ohio 45253-8704 (513) 648-3000

2-205.4

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June 16,1997

Fernald Environmental Management Project
Letter No. C:SWP(SCEP):97-0030

Tom Schneider, OEPA
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, OH 45402-2086

James A. Saric, USEPA
United States Environmental Protection Agency
Region V (SRF-5J)\77 W. Jackson Boulevard
Chicago, IL 60604-35905

Dear Mr. Saric and Mr Schneider:

Per Rob Janke's request, enclosed for your information, review, and comment, please find the following Certified-for-Construction (CFC) documents for the Site Preparation work for the Area 2, Phase I (Southern Waste Units):

-Construction Drawings
-Technical Specifications
-Surface Water Management Plan

These documents are provided in accordance with the DOE letter to you on June 13 (See attached). If you have any questions or comments on these documents please call Rob Janke at 648-3124.

Sincerely,

Arlen Hunt

Arlen Hunt
Project Manager
Soil Characterization and Excavation Project

AEH:GNJ:jrw
Enclosure

Fernald Environmental
FERMCO
(now renamed Fluor Daniel Fernald)
Restoration Management Corporation
(now renamed Fluor Daniel Fernald)

c: R. Beaumier, TPSS/DERR,OHPA-Columbus
F. Bell, ATSDR
R. Geiger, PRC
N. Hallein, EM-42/CLOV
G. Jablonowski, USEPA-V, 5HRE-8J
M. Rochotte, OEPA-Columbus
R. Vandegrift, ODOH\
D. Ward, GeoTrans
T. Schneider, OEPA-Dayton (total of 3 copies of enc.)
R. Janke, MS45, DOE-FEMP
D. Pfister, MS45, DOE-FEMP
EDC, MS45, FDF
G. Jones, MS52-5, FDF
A. Klimek, MS52-5, FDF
AR Coordinator/78
File Record Storage Copy 106.4.34.5

w/o attachments

D. Carr, MS9, Fluor Daniel Fernald (FDF)
J.D. Chiou, MS52-5, FDF
T. Hagen, MS65-2, FDF
J. Harmon, MS90, FDF
A. Hunt, MS52-5, FDF

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Technical Specifications
for
Waste Units Remediation Project
Southern Waste Units
Site Preparation Package
Subcontract No. FSC607

20401- TS- 0001

May 1997
Revision 0

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Project No. 20400

FOR
INFORMATION
ONLY

PARSONS

25 Merchant Street
Cincinnati, Ohio 45246

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L- 802

Technical Specifications
for
Waste Units Remediation Project
Southern Waste Units
Site Preparation Package
Subcontract No. FSC607

May 1997
Revision 0

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Project No. 20400

PARSONS

25 Merchant Street
Cincinnati, Ohio 45246

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Technical Specifications for Waste Units Remediation Project Southern Waste Units Site Preparation Package Subcontract No. FSC607

WBS No. 1.1.1.1.2.3.6
May 1997
Revision 0

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Project No. 20400

PARSONS

25 Merchant Street
Cincinnati, Ohio 45246

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U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Subcontract No. FSC607

WASTE UNITS REMEDIATION PROJECT
SOUTHERN WASTE UNITS
TECHNICAL SPECIFICATIONS

PARSONS

Approved by: J. Michael Usher, Project Manager — 12 June 97 Date

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SUBCONTRACT NO. FSC607

WBS NO. 1.1.1.1.2.3.6
TECHNICAL SPECIFICATIONS

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01450	MATERIAL DOCUMENTATION	0	05/30/97
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02713	GEOMEMBRANE LINER	0	05/30/97

02720	SITE DRAINAGE AND WATER MANAGEMENT	0	05/30/97
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02900	SOIL PREPARATION AND SEEDING	0	05/30/97
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16311	PRIMARY SWITCHGEAR	0	05/30/97
16370	OVERHEAD POWER DISTRIBUTION	0	05/30/97
16462	DRY-TYPE TRANSFORMER/PANELBOARDS	0	05/30/97

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16470	PANELBOARDS	0	05/30/97
16500	LIGHTING	0	05/30/97
16855	HEATING CABLES	0	05/30/97

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U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Subcontract No. FSC607

WASTE UNITS REMEDIATION PROJECT
SOUTHERN WASTE UNITS
TECHNICAL SPECIFICATIONS

Division 1

PARSONS

Prepared by: Wayne Moore by Steve Nelson 6/12/97
Franklin M. Parton Jr (01050, 01450) 6/12/97
Date

Checked by: Carlton C. Schroeder 6/12/97
Kenneth H. Gerard 6/12/97
Date

Carlton C. Schroeder
6/12/97

Franklin M. Parton Jr 6/12/97
STATE OF OHIO
FRANKLIN M. PARTON, JR.
NO. E-57614
REGISTERED PROFESSIONAL ENGINEER

Date: 05/30/97 01000 WBS No: 1.1.1.1.2.3.6
Rev.: 0 RE: WM SCEP/165/SWU/SITE

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SECTION 01000
GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

A. This specification and accompanying construction documents describe all work for the site preparation phase of the Southern Waste Units (SWU) portion of the Waste Units Remediation Project (WURP). The SWUs consist of the Inactive Flyash Pile (IFP), South Field (SF), and the Active Flyash Pile (AFP). The site preparation phase includes, but is not limited to:

1. Tapping an existing water line in three locations and installation of three new drinking water lines.
2. Installation and construction of erosion sediment control facilities including runon and runoff control ditches and silt fence and berm.
3. Construction of three retention basins and installation of associated lift stations and double-walled transfer line.
4. Clearing trees and brush and stump grinding.
5. Surveying for construction layout and as-built drawings.
6. Excavation, removal, and stockpiling of materials.
7. Construction of a support area and installation of two trailers.
8. Chipping trees and brush and stockpiling wood chips.
9. Preparation of subgrade and placement of geomembrane liner in ditches, basins, and stockpile areas.
10. Development, operation, and reclamation of a borrow area to provide clay material for lining three retention basins.
11. Hauling (from the borrow area), placement, and compaction of the clay materials as a bottom liner in the three retention basins, followed by placement of an overlying goemembrane liner.

12. Removal/installation/relocation of chain link fencing, installation of construction fencing, and removal of plastic chain fencing.
13. Construction of a wheel wash facility.
14. Installation and extension of drainage pipes.
15. Installation of a new electric power line and associated electrical work for project facilities.
16. Operation and maintenance of constructed facilities until turnover to the excavation subcontractor.
17. Construction of stockpiles.
18. Relocating a rip-rap stockpile.
19. Preparation of a FDF approved Safe Work Plan for performing the site preparation work.
20. Geotechnical sampling and testing.
21. Dust control and associated FDF approved plan.
22. Placement and installation of dumped rock fill.
23. Relocation of gravel roadway (located west of Retention Basin #2).
24. Material tracking.
25. Installation of SFES discharge and treatment lines.

B. In all cases where the words “Fluor Daniel Fernald, Incorporated” or “FDF” appear in these specifications, it shall be understood to refer to Fluor Daniel Fernald, Incorporated (FDF) Construction Manager.

C. In all cases where the words "A/E Subcontractor" or “Engineer” appear in these specifications, it shall be understood to refer to PARSONS or to such other individuals or organizations acting within the scope of the specific duties entrusted to them.

D. In all cases where the terms "Vendor" or "Seller" or "Manufacturer" or similar terms appear in these specifications or in the appendices to these specifications, they shall be understood to refer to an individual or firm(s) providing materials, equipment, or services.

E. In all cases where the term "Subcontractor" appears in these specifications, it shall be understood to refer to the Site Preparation Construction Subcontractor.

F. The Subcontractor shall provide written procedures for FDF's review and approval of all plans and tests to be performed as identified in the drawings and specifications. These procedures shall provide detailed step-by-step operations with sign-off columns and shall be submitted and approved prior to testing. Generally, all field test instruments shall have been calibrated, prior to use on this subcontract, by an independent calibration laboratory whose calibration equipment and instruments are fully traceable to National Institute of Science and Technology (NIST) standards. The Subcontractor shall maintain individual certification of calibration which evidences traceability to NIST standards for all field test instruments used on this subcontract.

G. Work shall be accomplished in accordance with the following code requirements:
1. Ohio Basic Building Code (OBBC) 1995.
2. Uniform Building Code (UBC) 1994.
3. Code for Safety to Life from Fire in Buildings and Structures (NFPA 101, Life Safety Code) - 1994.
4. All other National Fire Protection Association (NFPA) Codes - All inclusive, including 1996 revisions.
5. Occupational Safety and Health Administration (OSHA) - 29 CFR 1910 and 29 CFR 1926.
6. FDF Lockout/Tagout Procedure OP-0004.
7. Ohio Plumbing Code - 1993.

1.2 SITE AND SCOPE

A. The intent of these specifications is to provide all technical information required and necessary to perform and complete the work as required by the Contract.

B. The Subcontractor shall provide all labor, services, materials, and equipment, and shall do all work

necessary to accomplish this within the limits of work as defined in the accepted bid and Contract.

1.3 LISTS OF MATERIALS, MANUFACTURERS, OR EQUIPMENT SUPPLIERS

A. The listing of materials, equipment, manufacturers' names, or equipment suppliers in these specifications in no way precludes the offerer from proposing alternate materials, equipment, manufacturers' names, or equipment suppliers of any of the items to be furnished within the scope of these specifications, except where specifically precluded by these specifications. These lists are intended to identify the types and general quality of those items that will be included in the offerer's proposal. It is the offerer's responsibility to propose the materials, manufacturers' names, or equipment that is best suited for this project in combined terms of quality and price.

1.4 SUBMITTALS - SHOP DRAWINGS, SAMPLES, AND OTHER DATA

A. Section 01011 has the submittal listing. Refer to Part 6, Statement of Work and Part 7, technical specifications, and drawings for additional submittal requirements. The Subcontractor is responsible for providing all submittals required in the subcontract whether listed in Section 01011 or not. Any submittals not in conformance with these requirements will be returned without review for correction and resubmittal:

1. Safe Work Plan. The Safe Work Plan shall include general information and approach and will include specific documents described in the technical specifications.
2. Assemble and submit, if required, in logically arranged folders, the following:

   All instruction bulletins, diagrams, lubrication schedules, operating instructions, parts lists, and pamphlets for equipment and apparatus furnished, including vendor's or manufacturer's recommended

procedure for lifting, handling, and installing equipment.

3. Submittals for equipment shall include manufacturer's catalog "cut sheets" or similar information bulletins indicating the model number or catalog number, ratings, size, weight, and performance curves and data. Indicate operating point on curves and tabular data for each piece of equipment that curves or data represent.
4. Submit wiring diagrams or connection diagrams for equipment items, accompanied by adequately defined symbols list. Schematic and wiring diagrams must be prepared in accordance with ANSI/IEEE Publication Y32E, "Electrical and Electronics Graphics Symbols and Reference Designations." Individual 8-1/2 by 11-inch elementary and wiring drawings are not acceptable.
5. Indicate all performance data, construction material finishes, and modifications to manufacturer's standard design specified.
6. Locate termination points for all required external wiring.
7. Indicate roughing-in, foundation, and support point dimensions.
8. Submit written test procedures for all required testing. Include criteria for acceptable performance. Submit test reports after completion of tests.
9. Submit Material Safety Data Sheets (MSDSs), for all cutting oils, caulks, sealants, lubricants, paints, etc., and all other similar compounds.
10. The Engineer's review of such submittals shall not relieve the Subcontractor from any responsibility for deviations from contract drawings or specifications, unless the Subcontractor has in writing called FDF's attention to such deviations at the time of submission, nor shall it relieve the Subcontractor from responsibility for errors of any sort in the submittals nor from responsibility for the proper fitting and construction of the work.
11. Submittals will be reviewed with respect to such factors as quality of draftsmanship, legibility,

and evidence that the Subcontractor is aware of the necessity and importance of adequately detailing and illustrating special features and conditions relating to the work. Dimensions, sizes, construction details, and directive notes shown will be reviewed for accuracy, compliance with the specifications, adequacy, interferences, etc., on a spot check or incomplete basis to establish that the Subcontractor has given such factors careful attention.

12. Any changes marked on submittals during review will be for the purpose of indicating the requirements of the contract documents, and no change in the contract amount is authorized by such markings.
13. When submittals are found to be satisfactory with respect to the above factors and within the scope of the review outlined above, they will be returned by FDF to the Subcontractor bearing certificate attachment permitting the Subcontractor to employ them in the furtherance of the Subcontractor's work under the contract. The Subcontractor shall understand that such permission shall not relieve the Subcontractor of the responsibilities for the full performance of the work required under the contract in conformance with the contract documents governing such performance, nor for any other deficiencies in the submittals such as inaccuracies, discrepancies, omissions, interferences in the work itself, or with the work of other contractors, whether or not such deficiencies were observed or noted in the course of the review of the shop drawings.
14. The Subcontractor shall verify all field dimensions required for shop drawings.

1.5 REFERENCES

A. The publications listed in the technical specifications form part of this specification. Each publication shall be the latest revision and addendum in effect at the time of issue of contract and of issue of the

specification unless notified otherwise. Except as modified herein or by the details of the drawings, work included in this specification shall conform to the applicable provisions of these publications.

1.6 MANUALS AND SPARE PARTS LISTS

A. Copies of manufacturers recommended spare parts list (including critical long-lead time spare parts) shall be submitted prior to the shipment of any item of equipment.

B. A Systems Implementation Manual shall be prepared so as to provide optimum readiness of the equipment and systems being furnished. The Systems Implementation Manual shall be coordinated with the requirements as noted in the accompanying Systems Plan.

C. The cover of the Systems Implementation Manual shall include the following information:
   1. Project Title - Waste Units Remediation Project Southern Waste Units Site Preparation Package
   2. WBS No. - 1.1.1.1.2.3.6
   3. Engineer - PARSONS
   4. Construction Manager - FDF
   5. Subcontractor Name.

D. The Systems Implementation Manual shall be bound into one or more volumes for ease of handling and shall have an index. The manual shall include descriptive literature, drawings, performance curves and rating data, test reports, and spare parts lists. The maintenance section shall divide maintenance procedures into two categories, "Preventive Procedures" and "Corrective Procedures," and a subsection for "Safety Precautions." Preventive maintenance shall include cleaning and adjustment instructions. Corrective Maintenance shall include instructions and data arranged in the normal sequence of corrective maintenance (i.e., troubleshooting) (logical effect to cause), then repair and replacement of parts, then the parts list. Safety Precautions shall comprise a list of safety precautions and instructions to be followed

before, during, and after making repairs, adjustments, or routine maintenance.

E. Submit complete sets of the final approved manual prior to the shipment of the equipment or system.

1.7 SPECIFICATION EXPLANATION

A. General: The technical specifications are of the abbreviated, simplified, or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the Subcontractor shall," "in conformity therewith," "shall be," "as noted on the drawings," "according to the plans," "a," "the," and "all" are intentional. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the drawings.

The Subcontractor shall provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled either on the drawings, or specified herein, or both, including all labor, materials, equipment, and incidentals necessary and required for their completion and installation unless stated otherwise.

For convenience of reference and to facilitate the letting of contracts, the specifications may be separated into titled divisions. Such separations, however, shall not operate to make the Engineer an arbitrator to establish the limits of subcontracts in any manner. The following defines the separations referred to in the specifications.

1.	Division:	Separate numbered division of specifications (e.g., Div. 16)
2.	Section:	Separate numbered section of a division (e.g., Sec. 16020)
3.	Article:	Separate numbered article of a section (e.g., Article 2.1)

B. Definitions: Certain terms and words as used throughout the specifications shall be defined as follows, unless otherwise particularly specified:

1. "Provide": Furnish and install, complete, in place.
2. "Indicated": As shown on the drawings and/or specified.
3. "Directed," "Authorized," "Permitted": Shall be as directed, authorized, or permitted by FDF.
4. "Selected": Shall be as selected by the Engineer or FDF.
5. "Satisfactory," "Acceptable": Satisfactory or acceptable to FDF.
6. "Necessary," "Required," "Suitable": As necessary, required, or suitable for the intended purpose as determined by FDF.
7. "Submit": Submit to FDF unless otherwise specified

1.8 ABBREVIATIONS FOR REFERENCED STANDARDS AND SPECIFICATIONS

A. The following list denotes abbreviations used in these technical specifications:

Abbreviation	Authority
AASHTO	American Association of State Highway and Transportation Officials.
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFP	Active Flyash Pile
AGC	Associated General Contractors of America
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
APA	American Plywood Association

Abbreviation	Authority
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
DHI	Door and Hardware Institute
FDF	Fluor Daniel Fernald, Incorporated
FGMA	Flat Glass Marketing Association
FM	Factory Mutual System
FRL	Final Remediation Level
GA	Gypsum Association
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IFP	Inactive Flyash Pile
IMIAC	International Masonry Industry All-Weather Council
MBMA	Metal Building Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Science and Technology

Abbreviation	Authority
NPCA	National Paint and Coatings Association
OBBC	Ohio Basic Building Code
ODOT	Ohio Department of Transportation
OSDF	On-Site Disposal Facility
PACM	Presumed Asbestos Containing Material
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDCA	Painting and Decorating Contractors of America
PIV	Post Indicator Valve
PS	United States Department of Commerce, Voluntary Products Standards
SDI	Steel Deck Institute
SF	South Field
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
SWU	Southern Waste Units
UL	Underwriters Laboratories, Inc.
WURP	Waste Units Remediation Project

END OF SECTION

SECTION 01011
SUBMITTALS LISTING

A. Submittal Requirements: Submittals required include drawings and/or data for all items listed below:

1. "AA" designates that these items are special requirements as defined in detail in the applicable technical specification section.
2. "BB" designates that shop drawings are required.
3. "CC" designates that catalog cuts are required.
4. "DD" designates that Material Certificates are required.
5. "EE" designates that Certificates of Conformance are required.
6. "FF" designates that engineering calculations are required.
7. "GG" designates that spare parts list is required.
8. "HH" designates that Systems Implementation Manuals are required.
9. "II" indicates that manufacturer's material safety data sheets (MSDSs) are required.
10. "JJ" indicates that wiring diagrams for power, signal, and control wiring are required.
11. "KK" indicates that tests, which are to be witnessed by FDF, are required.
12. "LL" indicates that test reports are required.
13. "NN" indicates to be included in the Safe Work Plan.

B. See the accompanying sheets for submittal schedules.

END OF SECTION

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PARSONS
ERA PROJECT

Section 01011
Submittals Listing

Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
SECTION 01000														
Safe Work Plan														X
SECTION 01050														
Surveyor Qualifications	X													
As-Built Record Drawings	X													
Surveying Field Notes	X													
SECTION 01450														
Material Documentation Work Plan	X					X								X
SECTION 02100														
Traffic Control Plan						X								X
Dust Control Plan				X					X					X
Site Clearing Work Plan														X
Monitoring/Extraction Well Protective Barrier	X													

Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
SECTION 02200														
Excavation Work Plan														X
Material Source/Test Data				X								X		
Construction QC Data											X	X		
Geotechnical Lab	X													
SECTION 02205														
Impacted Material Work Plan														X
Competent Persons Training Certificate (Asbestos and Rad Worker II)	X													
Material Source/Test Data				X							X	X		
Construction QC Data											X	X		
SECTION 02225														
Sheeting and Shoring Plan		X				X								X
Material Source/Test Data				X								X		
Construction QC Data											X	X		
SECTION 02270														
Silt Fence			X									X		
Dumped Rock Fill (Riprap)				X										
Geotextile Fabric			X		X									
Erosion Control Blanket			X		X									
QA/Program/Inspection														X

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Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
SECTION 02506														
Aggregate Source	X													
Aggregate				X							X	X		
Geotextile			X		X									
Material Testing Laboratory	X													
SECTION 02510														
Bituminous Aggregate				X					X					
Aggregate Base	X			X	X	X					X	X		
Tack Coating			X		X				X					
Prime Coating			X		X				X					
Joint Sealant			X		X				X					
SECTION 02667														
Pipe/Fittings/Valves/Accessori es			X	X							X	X		
Pipe Joining Compounds			X		X				X					
Hydrostatic Test Report												X		
Performance Certificate					X									
Disinfection Report												X		
Bacteriological Report												X		
Verification of Personnel Experience	X													

Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
SECTION 02668														
Pipe/Fittings/Valves/ Accessories			X	X							X	X		
Pipe Joining Compounds			X		X				X					
Hydrostatic Test Report												X		
HDPE Manholes		X									X	X		
Verification of Personnel Experience	X													
SECTION 02669														
Pipe/Fittings/Valves/Accessori es			X	X							X	X		
Pipe Joining Compounds			X		X				X					
Hydrostatic Test Report												X		
Verification of Personnel Experience	X													
SECTION 02713														
Geomembrane Liner				X	X								X	
Geomembrane Liner Installation	X	X										X	X	
SECTION 02720														
Water Management Plan	X													X
Culvert Pipe- CMP			X											
Riser Assembly	X	X		X								X		

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Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
Inspection Reports											X	X		
Corrugated HDPE Pipe			X	X										
HDPE Pipe			X	X										
Construction QC Data											X	X		
SECTION 02831														
Products and Materials		X	X						X					
SECTION 02900														
Seed				X										
Mulch				X										
Plant Nutrients			X		X				X					
SECTION 02999														
Construction Fence			X	X										
Caution Signs		X												
Buoys			X	X										
SECTION 03001														
Concrete Mix/Supplier	X			X								X		
Channel Grating			X											
Oil/Water Separator			X											
Curing Compound			X						X					
Joint Sealer			X						X					

Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
Water Stops			X											
Placement Records (Concrete)	X													
Placement of Reinforcing		X												
SECTION 13125														
Shop Drawings		X	X											
Support Location Plan		X	X											
Wall and Roof System Dimensions and Construction Details		X	X											
Down Spout/Splash Block Locations		X	X											
Tie-Down Location Plan and Details		X	X											
Product Data- Mechanical Components		X	X					X		X		X		
Manufacturers Installation Instructions	X	X	X					X		X				
Connection of Fire and Evac Alarm to Site System										X	X	X		
SECTION 13126														
Support Location Plan		X	X											
Tie-Down Location Plan and Details		X	X											
Connection of Fire and Evac Alarm to Site System										X	X	X		

Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
SECTION 15060														
Product Data for Pipe Fittings, Valves, and Accessories		X	X		X			X			X	X		
Test Procedures	X													
Welding	X								X					
SECTION 15090														
Piping Supports/Anchors		X	X											
Welding	X								X					
SECTION 15160														
Product Data for Pumps	X	X	X		X		X	X		X		X		
SECTION 15170														
Motors			X		X					X		X		
SECTION 15250														
Product Data for Insulation Materials			X		X				X					
SECTION 16050														
Combination Magnetic Motor Starters			X		X					X				
Selector Switches			X		X									
Conduit Receptacles			X		X									

Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
Wire and Cable			X		X									
Instrument Cable			X		X									
Nameplates			X		X									
Wire Markers			X		X									
Wireway and Aux. Cutters			X		X									
Splicing and Term. Components			X		X									
Boxes			X		X									
Cabinets			X		X									
Supporting Devices			X		X									
Underground Warning Tape			X		X									
Inspection and Testing											X	X		
SECTION 16118														
Conduit and Fittings			X		X									
Warning Tape			X		X									
SECTION 16121														
Medium Voltage Cable			X		X							X		
Cable Terminations			X		X							X		
SECTION 16170														
Grounding Electrodes and Conductors			X	X										

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Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
Equipment Grounding Conductors			X	X										
Testing Equipment Certification	X													
Ground System Testing											X	X		
SECTION 16311														
15 kV Fused Switch		X	X		X			X		X		X		
Bus Connection Kit		X	X		X					X		X		
SECTION 16370														
Poles			X		X									
Crossarms		X	X		X									
Pole Hardware			X		X									
Insulators			X		X			X						
Line Conductors			X		X									
Arresters and Cut-Outs			X		X					X				
Pole Mtd. Disc. Switches		X	X		X			X		X				
Fuses			X		X			X						
Pole Mounted Transformers			X		X					X				
Anchors			X		X									
SECTION 16462														
Transformer/Panelboards		X	X		X		X	X		X	X	X		

Material/Equipment/ Item/Description	Special Reqts AA	Shop Dwgs BB	Catalog Cuts CC	Material Certif DD	Certif Conform EE	Eng'g Calcs FF	Spare Parts GG	Systems Implem Manual HH	MSDS II	Wiring Diagram JJ	Witness Tests KK	Test Rpt LL	Samples MM	Safe Work Plan NN
SECTION 16470														
Panelboards		X	X		X		X	X		X	X	X		
SECTION 16500														
Luminaires and Lampholders	X		X		X									
Ballasts			X		X									
Lamps	X		X		X									
Exit Signs			X		X									
Emergency Lighting Units			X		X									
Photoelectric Control			X		X									
SECTION 16855														
Heating Cable and Accessories		X	X		X							X		

SECTION 01012
SCHEDULE OF DRAWINGS

1.1 DRAWINGS

The following drawings are hereby made a part of this contract:

	Drawing Number	Sheet Number	Drawing Title
1.	92X-5900-X-00319	X0001	Project Title Sheet
2.	92X-5900-X-00320	X0002	Drawing Index
3.	92X-5900-X-00321	X0003	Legend and General Notes
4.	92X-5900-G-00350	G0001	Traffic Flow Plan
5.	92X-5900-G-00281	G0002	Master Site/Utility Plan
6.	92X-5900-G-00348	G0003	Existing Conditions Plan
7.	92X-5900-G-00400	G0004	Survey Information and Soil Stripping Plan
8.	92X-5900-G-00282	G0005	Site Plan
9.	92X-5900-G-00284	G0006	Site Plan- Support Area
10.	92X-5900-G-00283	G0007	Site Plan- Wheel Wash Area
11.	92X-5900-G-00390	G0008	Site Plan- Paddys Run Area
12.	92X-5900-G-00303	G0009	Enlargement- Retention Basin #1
13.	92X-5900-G-00371	G0010	Enlargement- Retention Basin #2
14.	92X-5900-G-00372	G0011	Enlargement- Retention Basin #3
15.	92X-5900-G-00311	G0012	Erosion and Sediment Control- Sheet 1 of 2
16.	92X-5900-G-00368	G0013	Erosion and Sediment Details- Sheet 2 of 2
17.	92X-5900-G-00304	G0014	Transfer Line- Plan and Profile- Sheet 1 of 3
18.	92X-5900-G-00305	G0015	Transfer Line- Plan and Profile- Sheet 2 of 3
19.	92X-5900-G-00306	G0016	Transfer Line- Plan and Profile- Sheet 3 of 3

	Drawing Number	Sheet Number	Drawing Title
20.	92X-5900-G-00312	G0017	Wheel Wash Pad-Structural Details
21.	92X-5900-G-00310	G0018	Wheel Wash Sump Discharge- Profile and Details
22.	92X-5900-G-00307	G0019	Water Line Details
23.	92X-5900-G-00309	G0020	Miscellaneous Details-Sheet 1 of 2
24.	92X-5900-G-00308	G0021	Miscellaneous Details-Sheet 2 of 2
25.	92X-5900-G-00411	G0022	Material Documentation Plan
26.	92X-5900-G-00452	G0023	Miscellaneous Details-Sheet 3 of 3
27.	92X-5900-G-00453	G0024	Site Plan - Borrow Area
28.	92X-5900-N-00295	N0001	Piping and Instrumentation Diagram-Symbols and Legend
29.	92X-5900-N-00290	N0002	Piping and Instrumentation Diagram-Wastewater Collection and Transfer
30.	92X-5900-N-00291	N0003	Piping and Instrumentation Diagram-Drinking Water System
31.	92X-5900-E-00405	E0001	Symbols and Legend
32.	92X-5900-E-00404	E0002	Single Line Diagram - West Side 13.2 kV Feeders
33.	92X-5900-E-00377	E0003	Single Line Diagrams / Elevations - Lift Station No's. 1,2 & 3
34.	92X-5900-E-00378	E0004	Single Line Diagrams / Elevations - Wheel Wash Facility & Support Area
35.	92X-5900-E-00379	E0005	Overall Site Power Plan
36.	92X-5900-E-00381	E0006	Panel Schedules
37.	92X-5900-E-00380	E0007	Elementary Diagrams
38.	92X-5900-E-00406	E0008	Cable and Conduit Schedules
39.	92X-5900-E-00382	E0009	Details - Sheet 1

	Drawing Number	Sheet Number	Drawing Title
40.	92X-5900-E-00407	E0010	Details - Sheet 2
41.	92X-5900-E-00408	E0011	Details - Sheet 3
42.	92X-5900-E-00409	E0012	Details - Sheet 4
43.	92X-5900-E-00376	E0013	Details - Sheet 5

END OF SECTION

SECTION 01050
SURVEYING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Survey.

B. Submittals.

C. Project record documents.

1.2 QUALITY ASSURANCE

A. Employ a Land Surveyor registered in the State of Ohio to oversee and certify survey work as required of this section.

B. Survey work shall be under the direct supervision of a person with at least 5 years of experience in construction surveying.

C. Submit the Ohio Registered Land Surveyor's name, license number, and qualifications/experience of the person who will be supervising the actual field work within 15 days from the Notice to Proceed. Approval must be granted from FDF prior to starting survey work.

1.3 SUBMITTALS FOR REVIEW

A. Provide submittals as required by Section 01011 and by Part 6 of the Contract Documents.

B. Submit Surveyor qualifications to FDF and receive approval before starting survey work.

C. On request, submit documentation verifying accuracy of survey work.

D. Submit scaleable copies of completed as-built site drawings and certificate signed and sealed by the Land

Surveyor. As a minimum, surveys shall be performed and submitted within 15 days at the following intervals:

1. Prior to commencement of work.
2. At completion of retention basin excavation, prior to placement of infiltration barrier.
3. At completion of placement of infiltration barrier in retention basins.
4. At completion of construction work. This shall also include topographical data of the borrow area, impacted material stockpile and non-impacted material stockpile.

E. Drawings are to follow format and symbology as furnished by FDF in Intergraph Microstation files. Surveyor is to furnish scaleable hard copy as well as electronic files of completed survey drawings.

F. Submit copy of all field notes. Field notes shall be legibly recorded on standardized field note forms. Notation shall be consistently applied to all project survey work; the stake marking format and the field book notation shall be compatible.

1.4 PROJECT RECORD DOCUMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. Maintain an accurate and current set of red-line drawings with as-built locations. Data shall be incorporated within one week of construction.

1.5 EXAMINATION

A. Verify locations of survey control points prior to starting work. Identify control used on submittals.

B. Promptly notify FDF of any discrepancies discovered.

1.6 SURVEY REFERENCE POINTS

A. Locate and protect survey control and reference points as shown on the construction drawings.

B. Control datum for survey is established by FDF, as indicated on construction drawings.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report the loss or destruction of any reference point or relocation required because of changes in grades or other reasons. Damaged or destroyed survey monuments shall be reestablished by FDF at Subcontractor's expense.

1.7 SURVEY REQUIREMENTS

A. All survey shall be performed to Class 3 standards and specification of ACSM (American Congress on Surveying and Mapping) as defined below. Elevation shall be referenced to NGVD of 1929 and horizontal coordinate to NAD 1983.

Position Closure	1:5,000
Angles Accurate to	14 sec.
Distance Accurate to	0.007 ft.
(per 100 feet)	(1:15,000)
Rejection limit or spreads	
between D & R and sets	10 sec.
Number of positions or sets	
1" Instrument	2 Pos.
10" Instrument	1 Set 2DR
20" Instrument	1 Set 4DR
30" Instrument	1 Set 6DR
1' Instrument	1 Set 8DR
Azimuth Closure	30" N[1]
Azimuth Closure per	
angle point	10 Sec.
Number of Repetitions	
(distance measurements)	1
Taping Criteria[2]	
Temperature	Accurate to $+6^{0}$ F
Tension	Accurate to +3# of standard
Calibration	**
Type of Target	Plumb Bob String or Fixed

1. N = Number of angle stations carrying azimuth. The smallest value for the azimuth closure criteria will apply.
2. Properly calibrated electronic distance measuring equipment may be used in place of metal tapes.
** Standardized tape or one calibrated with a standardized tape.

B. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. All proposed utilities including underground and overhead shall be shown with coordinates. Utilities shall include spot elevations at 100 ft intervals and location data including curve data. Surface features (i.e., manholes, PIVs, lift stations, utility poles) are to be included.
2. All proposed roadways, parking, and gravel areas shall be identified. The principal points of definitions shall be shown including road intersections, centerline, and curve information. Pavement width, culverts, other surface features shall be shown from point of definition.
3. Topographic contours shall be shown to nearest foot. Field run data shall be taken to adjacent existing undisturbed area (100 ft minimum) to create a smooth contour transition.
4. Structures (i.e., wheel wash facility, trailers) shall be located by a minimum of two coordinates and outside dimensions.

C. Perform surveys to determine quantities for partial payment.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01450
MATERIAL DOCUMENTATION

PART 1 GENERAL

1.1 SCOPE

A. This section presents material documentation requirements. The subcontractor shall document (monitor, record, and report) movement of all impacted and non-impacted material moved between Material Tracking Locations (MTLs) and Grids in the SWUs as described herein. Material documentation shall include the type, quantity, and location of all material moved in the SWUs. This documentation is only required for materials moving into or out of the MTLs or Grids. Materials handled but retained in a given MTL or Grid are not included.

1.2 RELATED SECTIONS

A. Section 01050 - Surveying.

B. Section 02200 - Non Impacted Material Earthwork.

C. Section 02205 - Impacted Material Excavation and Handling.

D. Section 02225 - Trenching.

E. Section 02270 - Erosion and Sediment Control.

1.3 REFERENCE DRAWING

A. Drawing Index No. 92X-5900-G00411 (Sheet No. G0022) Civil - Material Documentation Plan.

1.4 TERMINOLOGY

A. Material Tracking Locations - The specific areas identified in this specification and as shown on the Civil - Material Documentation Plan (Sheet No. G0022)

delineate select geographic areas in the SWUs. MTLs include:

1. Impacted Material Stockpile.
2. Non Impacted Material Stockpile #1.
3. Non Impacted Material Stockpile #2.
4. Retention Basin #1.
5. Retention Basin #2.
6. Retention Basin #3.
7. North Area.
8. Support Area.
9. Wheel Wash Area.
10. Ditch 1.
11. Ditch 2.
12. AFP Ditches.
13. Non Impacted Material Stockpile Ditches.
14. Ditch 8.
15. Borrow Area.

B. Grids are identified 200 ft by 200 ft areas in the SWUs. Grids correspond to areas that will be used to document material not contained within MTLs. An example Grid is L12-42 as shown on the Material Documentation Plan (Sheet No. G0022).

1.5 SUBMITTALS

A. Submit for approval a Material Documentation Work Plan as part of the safe work plan which describes the detailed procedures that will be used to implement this specification.

1.6 QUALITY

A. Material documentation reports shall be provided to FDF at the end of each working day. Quantities shall be estimated to the nearest 10 cubic yards for material moved into or out of each MTL or Grid during that day.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

A. Provide all personnel and equipment to document material movement as described herein.

3.1 PREPARATION

A. Field stake and/or adequately delineate all MTLs and Grids in the field.

B. Subcontractor shall educate and familiarize all appropriate competent personnel (minimum of 3) with the material documentation requirements.

3.2 REPORTING REQUIREMENTS

Report type, quantity and location of all material moved into or out of all MTLs or Grids on a daily basis.

A. Describe type of material, based on visual observation in accordance with the criteria presented in Sections 02200, 02205, 02225, and herein. Present a general description such as "soil and soil-like material (including flyash, gravel, etc.)", "debris", "mixed", or "special material".

1. Examples of general descriptions of mixed material include:
   a. 10 percent concrete debris/90 percent soil.
   b. 25 percent ground wood stumps/75 percent soil.
2. Special material will include atypical items such as buried drums or other unusual items.

B. Estimate quantities of material by volume moved based on visual observations. Use number of trucks/haul vehicles and their capacity and estimate volumes in approximate cubic yards.

C. Report material movement to and from each MTL and/or Grid worked in each day. Use MTLs to the extent possible. Use Grid if no MTL is available.

3.3 PROCEDURES

A. Comply with detailed procedures contained in subcontractors approved Material Documentation Work Plan.

B. Provide a written summary of material documentation to FDF field personnel every day that material is moved.

C. Material transported to any location shall use a IIMS Transfer Paper for documentation purposes, included in Part 4 of the Contract Documents, Exhibit 1A.

D. FDF may spot check and work with Subcontractor to assist with implementation of this specification.

END OF SECTION

U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Subcontract No. FSC607

WASTE UNITS REMEDIATION PROJECT
SOUTHERN WASTE UNITS
TECHNICAL SPECIFICATIONS

Division 2

PARSONS

Prepared by: Franklin M. Parton Jr. 6/12/97
Date

Checked by: J. FERN 6/12/97
Date

Franklin M. Parton Jr. 6/12/97
STATE OF OHIO
FRANKLIN M. PARTON, JR.
NO. E-57614
REGISTERED PROFESSIONAL ENGINEER

Date: 05/30/97 02000 WBS No: 1.1.1.1.2.3.6
Rev.: F RE: WM SCEP/165/SWU/SITE

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clearing and chipping.

B. Traffic Control.

C. Removal of fencing.

D. Installation of fencing.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 01050 - Surveying.

D. Section 02200 - Non-impacted Material Earthwork.

E. Section 02205 - Impacted Material Excavation and Transportation.

F. Section 02270 - Erosion and Sediment Control.

G. Section 02720 - Site Drainage and Water Management.

H. Section 02831 - Chain Link Fences.

I. Section 02999 - Miscellaneous and Specialty Items

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation (ODOT): Construction and Material Specifications, January 1, 1997. Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011 and by Part 6 of the Contract Documents.

B. Submit a Traffic Control Plan to be approved by FDF prior to any site clearing or earth-moving operations. The plan should include as a minimum; planned traffic routes, planned crossings of major utilities (i.e., gas line, drinking water line, and groundwater line), and a plan to protect the existing utilities at the crossings. The crossing protection at a minimum should be a one-inch thick steel plate (length and width sized to accommodate the trenches and equipment to be used) or an equivalent alternative. Provide calculations for all crossing protection and all alternatives to the one-inch thick steel plate.

C. Submit a Dust Suppression Plan in accordance with Part 6 of the Contract Documents prior to initiating site clearing or earthmoving operations. The Dust Suppression Plan shall be approved by FDF prior to any site clearing or earth-moving operations. Along with the plan, the manufacturer's Material Safety Data Sheets' (MSDS) recommendations for material handling and usage for any applicable proposed dust suppressant agents or crusting agents along with the MSDS, shall be submitted. FDF approval is required prior to application of any dust suppressant agent or crusting agent.

D. Submit a site clearing work plan to be approved by FDF prior to initiating site clearing operations. The plan shall describe equipment, safety procedures, scheduling, personnel protective equipment, tree handling and transportation, and prevention of cross contamination.

E. Monitoring/extraction well protective barrier detail.

PART 2 PRODUCTS

2.1 MATERIALS

A. Dust suppression materials shall be nonhazardous and biodegradable. Water shall be potable.

B. Crusting agent shall be Pine Sap Emulsion by Cousins Dust Control Environmental Services or an approved equivalent.

C. Materials for traffic control.

D. Materials for monitoring/extraction well protective barrier.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that existing utilities in the work area and all monitoring/extraction wells designated to remain are staked, flagged, and identified.

B. Install an approved protective barrier around existing monitoring wells and extraction wells designated to remain as indicated on the construction drawings. If excavation is to occur in proximity to monitoring wells and/or extraction wells designated to remain, hand excavate the area within the protective barrier. If damage to existing monitoring wells occurs, all repairs will be completed by FDF at the Subcontractor's expense.

C. Verify that all utilities to be removed, or tapped to, have been properly isolated and drained (valve turned closed and locked) prior to commencement of work. FDF is to properly isolate and/or drain utilities (to empty pipe) that are to be abandoned or connected to, unless hot tap is specified on construction drawings.

D. Install perimeter erosion and sediment control measures prior to any major grading activities in accordance with Section 02270.

E. Notify FDF 2 days prior to need for required permits. Provide specific information necessary for permit application. FDF is responsible for obtaining all FEMP permits.

3.2 Clearing and Chipping

A. Clear all trees and brush in accordance with this specification within the limits of work except as noted on the construction drawings.

B. All trees and other vegetation shall be cut a foot above grade and handled as a clean material, chipped, shredded, and placed in the Wood Chip Stockpile as shown on the construction drawings. Minimize contact with ground to prevent contamination of fallen trees. The stockpile is to be turned over as necessary to prevent combustion.

C. During site clearing and earthmoving operations, fugitive emissions, principally dust, shall be controlled using water misting/spraying techniques and/or dust suppressant agent as described in Part 6 of the Contract Documents. Water is not to be used for misting/dust suppression directly from hydrant. Water from hydrant for misting is to be a supply only. The subcontractor is to provide for means of pressure and spraying.

D. During site clearing and earth-moving operations use a crusting agent on any disturbed flyash material to minimize dust and/or erosion.

3.3 REMOVAL OF FENCING

Remove existing yellow plastic chain, tee posts and signs at perimeter of SWUs and turn over to FDF.

3.4 INSTALLATION OF FENCING

A. Install chain link fence and gates at locations indicated on the construction drawings and in accordance with Section 02831.

B. Install construction fence in accordance with Section 02999 and at the locations indicated on the construction drawings. Construction fence shall be field located.

C. FDF will delineate with fencing the Lead Contaminated Soil Area and the Above WAC Excavation Area. Comply with all training requirements and site controls when working in the Above WAC Excavation Area. The subcontractor is prohibited from working in the Lead Contaminated Soil Area.

3.5 PROTECTION

A. Verify and protect from damage all utilities, monitoring wells, extraction wells, structures, survey monuments, and survey control points that remain (shown on the construction drawings). If the subcontractor damages existing monitoring well, extraction wells, structures, and/or survey monuments, repairs will be completed by FDF at the subcontractor's expense.

B. Maintain existing roadways at the construction site and provide dust suppression as per the approved dust suppression plan.

END OF SECTION

SECTION 02200
NON IMPACTED MATERIAL EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

This specification section describes excavation and placement of all non impacted material necessary to complete the site preparation phase of the Southern Waste Units (SWUs) Project. Impacted material is addressed in Section 02205. It shall include all associated geotechnical testing. The work to be performed in accordance with this section shall include, but is not limited to the following:

A. Erosion and sediment control facilities.

B. General grading for roads.

C. Other facilities constructed from non-impacted material, as shown on the construction drawings and as required to perform the work.

D. Borrow area development.

E. Infiltration Barrier placement.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 01050 - Surveying.

D. Section 02100 - Site Preparation.

E. Section 02205 - Impacted Material Excavation and Handling.

F. Section 02270 - Erosion and Sediment Control.

G. Section 02506 - Aggregate Surface.

I. Section 02720 - Site Drainage and Water Management.

J. Section 02900 - Soil Preparation and Seeding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation (ODOT): Construction and Material Specifications, January 1, 1997. Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

B. American Society for Testing and Materials (ASTM):

1.	ASTM D698-91	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 [600 kN-m/m]).
2.	ASTM D2216-92	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
3.	ASTM D2487-93	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4.	ASTM D2922-91	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5.	ASTM D3017-88	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) (R 1993).
6.	ASTM D4643-93	Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

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1.5 SUBMITTALS

Provide the following submittals as required in Section 01011 and Part 6 of the Contract Documents.

A. Excavation Work Plan will be a part of the Safe Work Plan: The Excavation Work Plan will address both impacted and non-impacted material and shall address the following:

1. List of equipment to be used.
2. Methods for water management and equipment to be used (if any).
3. Sequencing and construction of stockpiles shown on the construction drawings.
4. Method of coordination of survey work with construction.
5. Schedule of excavation activities showing sequencing, production, and time.
6. Plan for controlling fugitive emissions during construction activities.
7. Identifying, moving, and placing Presumed Asbestos Containing Material (PACM).
8. Working in Contamination Areas using Radiological Worker II trained personnel.
9. Material Tracking Procedures.
10. Method and technique to prevent cross contamination of stockpiles.
11. Borrow Area Development and Hauling Plan.
12. Infiltration Barrier Placement Plan.

B. Qualification Summary of Independent Off-Site Geotechnical Laboratory: Submit a summary of qualifications meeting the license requirements Part 8.B.2.4.3.2 of the Contract Documents for an independent off-site geotechnical laboratory for approval by FDF. The laboratory must be approved by FDF before earthwork activities can begin. A qualification summary is not required for on-site laboratory.

C. On-site Material Sources: To the extent possible, use on-site material for required fill. Submit, as a part of the excavation work plan, a plan to use/reuse on-site material to perform the work.

D. Off-site Material Sources: Submit name of off-site material suppliers and detailed descriptions of proposed material. All sources and proposed material must be approved by FDF. Change of source requires approval by FDF.

E. Geotechnical Test Results: Submit results of all geotechnical tests by the approved independent geotechnical lab including:
   1. Standard Proctor moisture density tests.
   2. Sieve analysis.
   3. Density tests.
   4. Proctor curves for each type material used for approval by FDF prior to use.

1.6 QUALITY ASSURANCE PROGRAM

A. Survey Verification and Layout: Verify the existing utilities, topography, and drainage features shown on the construction drawings and inform FDF of any differences or conflicts with proposed work. Stake the locations of all earthwork in the field and review all proposed work with FDF in the field. Assure that all work is laid out and built in accordance with the requirements on the construction drawings and these specifications. Survey work shall be performed under the direction of a professional licensed surveyor in accordance with Section 01050 - Surveying.

B. Independent Geotechnical Laboratory: Arrange and pay for the services of a qualified, independent geotechnical testing laboratory. The qualifications of the laboratory, meeting Part 8 of the Contract Documents, must be submitted to FDF and approved in writing prior to initiating excavation activities. The laboratory must provide documentation of compliance with this specification.

PART 2 PRODUCTS

2.1 MATERIALS

Non-impacted Material consists of non-fill material and any material which is not contaminated by previous FEMP practices. This material includes, but is not limited to soil and debris. To the extent practical on-site materials shall be used. Use of any off-site material must be approved in writing by FDF prior to bringing any material onto the FEMP site. The types of non-impacted material addressed by this section shall include:

A. Unclassified Material: This material shall include all excavation (below any impacted material), soil stockpile, and all earthwork not otherwise certified by FDF as below FRLs.

B. Coarse Aggregate: Conforming to ODOT Item 304 - Aggregate Base as modified herein. No slag materials will be allowed for use on site. Aggregate shall be crushed carbonate, crushed gravel, or other types of suitable materials meeting the following gradation requirements:

C. Infiltration Barrier: Clay soil material (CL) obtained from the borrow area.

PART 3 EXECUTION

A. Contact between and/or mixing of impacted material and non-impacted material shall be prevented. Material that is commingled with impacted material shall be designated as impacted material and managed in accordance with Section 02205 at no additional cost to FDF. Equipment and materials used in impacted material areas shall be kept separate from other equipment and materials until it is approved for release by FDF in accordance with Part 4 of the Contract Documents.

3.1 PREPARATION

A. Establish site boundaries and access controls.

B. Survey and layout all earthwork in accordance with Section 01050 - Surveying.

C. FDF will flag existing utilities in the field. Maintain markings as described in Section 02100.

D. Notify FDF when the actual conditions differ in any manner from those specified in the contract documents, or when soft or spongy areas or other unusual soil conditions are encountered.

E. Install appropriate erosion and sediment control measures in accordance with Section 02270 and as indicated on the construction drawings.

F. Clear areas in accordance with Section 02100.

G. Dewater excavations as required.

3.2 PROTECTION

A. Prevent surface water runoff from entering into excavation or to adjacent properties.

B. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

C. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

D. Reshape and recompact fills subjected to vehicular traffic to final grade and to compaction requirements.

E. Protect finished work and existing features which will remain.

F. Seed and mulch in accordance with Section 02900.

G. Protect existing groundwater monitoring wells and extraction wells in the area and in the vicinity of the work area.

H. FDF will identify and delineate the areas with above WAC material and lead contaminated soil. Prevent traffic and potential cross-contamination in these areas.

3.3 GENERAL EXCAVATION

A. Classification of excavation material (impacted or non-impacted) and subsequent disposition shall be as indicated on the construction drawings. Any deviations from the construction drawings shall be determined and approved by FDF.

B. Excavate non-impacted material to the lines and grades indicated on the construction drawings.

C. Perform grading and other operations to maintain site drainage. Accumulated water shall be removed promptly. No material shall be placed in standing water or on spongy soils. Water is to be handled in accordance with the water management component of the Safe Work Plan. See Section 02720 for water management requirements.

3.4 FILLING AND EMBANKMENT

A. Prepare subgrade as follows:

1. Compact exposed subgrade to density requirements for subsequent fill materials. When existing ground surface has a density of less than the density specified, break up the ground surface, pulverize, adjust moisture content to specified limits, and compact to specified density.
2. Cut out soft areas of subgrade not capable of in situ compaction. Fill with unclassified material and compact to density equal to or greater than requirements for subsequent fill material.

B. Do not fill over porous, wet, frozen, spongy, or other unsatisfactory subgrade surfaces. Where unsatisfactory subsurface conditions in an area of fill are observed, excavate unsatisfactory material to satisfactory subgrade as approved by FDF.

C. Fill areas to contours and elevations shown. Place and compact fill materials in continuous level layers not exceeding 6 inches compacted depth. Do not use frozen or saturated materials.

D. Slope grade away from pads at a minimum 1/4-inch per foot, unless noted otherwise.

E. Dust Suppression: See Section 02100 and Part 6 of the Contract Documents.

F. Stockpile non impacted soil in the non impacted material stockpile areas as indicated on the construction drawings. Non impacted material shall be placed on the non impacted material stockpile in lifts no more than 12 inches thick and compacted with two passes of a tamping foot or mesh/grid foot roller or equivalent. Maximum height of the stockpile shall be 20 feet with maximum side slopes of 2H:1V.

3.5 COMPACTION

A. The minimum density requirements shall be 95 percent of Standard Proctor Maximum Dry Density. Maintain optimum moisture content within ±4 percent of fill materials to attain required compaction or as otherwise required for effective dust suppression.

3.6 FINISH OPERATIONS

A. Grading and Tolerances: Grading shall be performed within 0 to +0.5 feet of the grades shown on the construction drawings.

B. House Keeping: Leave the area in a clean and neat condition. Grade and stabilize site surface to prevent free standing surface water.

C. Seed all disturbed areas in accordance with Section 02900.

3.7 BORROW AREA

A. Install erosion and sediment control structures.

B. Strip top 6 inches of topsoil and stockpile on-site.

C. Excavate CL material to provide positive drainage to erosion and sediment control structures.

D. After completion of borrow operation, place stockpiled topsoil over excavated areas and seed and mulch in accordance with Section 02900.

E. Do not excavate deeper than 5 feet without written approval from FDF.

3.8 INFILTRATION BARRIER

A. Place infiltration barrier material in 8-inch loose lifts to obtain a total compacted thickness of 1-foot minimum.

B. The minimum density requirements of the infiltration barrier shall be 95 percent of Standard Proctor Dry Density. Maintain moisture content between -1 and +2 percent of optimum to attain required compaction.

C. Roll Infiltration Barrier with steel smooth drum roller prior to geomembrane placement.

3.9 FIELD QUALITY CONTROL

A. In-place density testing will be performed in accordance with ASTM D2922. Nuclear density gauge (ASTM D2922) will be calibrated in accordance with the manufacturer's requirements. Documentation of this calibration will be provided to FDF. Register any nuclear or radiological sources brought on site in accordance with Part 8 of the Contract Documents.

B. Moisture tests will be performed in accordance with ASTM D3017, ASTM D2216 or ASTM D4643 as applicable.

C. Moisture-density curves will be determined in accordance with ASTM D698 (Standard Proctor). The test results must be reviewed and approved by FDF prior to use.

D. If in-place density and/or moisture tests indicate that work does not meet specified requirements, remove work and replace or recompact to specified requirements. If visual inspection indicates that work has not been performed as specified, correct work to comply with the requirements.

E. Soil classification shall be performed in accordance with ASTM D2487.

F. Frequency of Tests: Frequency of in-place density and moisture testing shall be whichever of the following requires the greatest number of tests:
   1. Once each day of work filling.
   2. Once every lift of material.
   3. Once every 500 cubic yards of fill.

   Frequency may be lessened only by FDF.

G. Notify FDF of activities that will require testing/inspection prior to the start of such activities.

END OF SECTION

SECTION 02205
IMPACTED MATERIAL EXCAVATION AND HANDLING

PART 1 GENERAL

1.1 SECTION INCLUDES

This section provides requirements for excavation and handling of impacted material encountered during the site preparation phase of the SWUs Project. For excavating and placement of non-impacted material, see Section 02200. Impacted material excavation and handling shall also include all associated geotechnical testing. Classification of excavation material (impacted or non impacted) and subsequent disposition shall be as indicated on the construction drawings. Any deviations from the construction drawings shall be determined and approved by FDF. The work described by this specification shall include, but is not limited to:

A. The top 12-inch layer of material in the retention basin areas.

B. Grinding the stumps in place in the borrow area and the retention basin areas.

C. Presumed Asbestos Containing Material (PACM).

D. Other impacted material and debris encountered during excavation.

Subcontractor personnel working in the impacted materials area shall comply with the FEMP's Health and Safety requirements, including PPE. Personnel shall also comply with all applicable site training requirements and in accordance with Part 8 of the Contract Documents. All personnel working with impacted material in a Contamination Area shall be FEMP Radiological Worker II trained. A minimum of one subcontractor work crew shall be FEMP Radiological Worker II trained. A minimum of one OSHA asbestos competent person (Ohio Department of Health Certified) and two persons with FEMP asbestos O&M training (or equivalent), shall be on site during excavation.

1.2 **RELATED SECTIONS**

A. Section 01050 - Surveying.

B. Section 02100 - Site Preparation.

C. Section 02200 - Non Impacted Material Earthwork.

D. Section 02270 - Erosion and Sediment Control.

1.3 **REFERENCE DRAWINGS**

A. See Section 01012 for the Schedule of Drawings.

1.4 **REFERENCES**

A. State of Ohio, Department of Transportation (ODOT): Construction and Material Specifications, January 1, 1997. Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

B. American Society for Testing and Materials (ASTM):

1.	ASTM D698-91	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 [600 kN-m/m]).
2.	ASTM D2216-92	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
3.	ASTM D2487-93	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4.	ASTM D2922-91	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5.	ASTM D3017-88	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) (R 1993).

6. ASTM D4643-93 Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

1.5 SUBMITTALS

Provide the following submittals in accordance with the requirements of Section 01011.

A. Excavation Work Plan - See requirements in Section 02200

B. Qualification summary of independent geotechnical laboratory meeting Part 8 of the Contract Documents.

C. Geotechnical Test Results.

PART 2 PRODUCTS

2.1 MATERIALS

Impacted material consists of all material placed in the area by previous DOE operations and includes soil, debris, and flyash. Impacted material addressed by this section includes:

A. Surface soil and other debris not certified being below FRLs by FDF.

B. Ground stumps and surface soil.

C. Flyash in the former running track area.

D. PACM.

E. Other impacted materials.

PART 3 EXECUTION

Perform work in accordance with the requirements in this specification and as further described in the Safe Work Plan.

A. Subcontractor is to maintain visual observation of excavation and shall notify FDF of any change in material.

B. FDF shall furnish all materials, equipment, and personnel for impacted material characterization.

3.1 PREPARATION

A. Establish site boundaries and access controls.

B. Survey and layout all impacted material work in accordance with Section 01050.

C. Clear all trees and brush from the retention basin areas in accordance with Section 02100.

D. Notify FDF when conditions differ from those in the contract documents.

E. Install appropriate erosion and sediment control measures as shown on the construction drawings.

F. Complete non impacted material excavation in the areas proposed for initial installation of geomembrane liner. (Retention basins and ditches).

G. Prior to excavation perform the following process for PACM detection: 1) walk the site, 2) identify PACM, 3) encapsulate (water down), 4) double bag or wrap in two layers of poly material, 5) label, 6) stockpile separately, and 7) banner the PACM stockpile within the impacted material stockpile area.

3.2 EXCAVATION

A. Remove top 12 inches of soil in area of basins not certified by FDF. Place in the impacted material stockpile on the South Field in the area designated on the construction drawings.

B. Grind (with FDF approved stump grinder) all stumps within borrow and retention basin areas to a minimum depth of 12 inches or to the bottom of the root-mass within 18 inches of the stump in all horizontal directions. Grind to pieces generally smaller than 6 inches in length.

C. Excavate the ground stump wood chips and the top 12 inches of soil from the retention basin areas and stockpile on the South Field in the impacted material stockpile shown on the construction drawings.

D. Upon discovery of PACM during excavation follow the requirements of Article 3.1.G of this specification.

E. Upon discovery of materials requiring contamination posting or other additional control, stop work in that area until FDF establishes proper controls for the area. FDF may require 7 working days to address the problem. During that time, work in another location at no additional cost.

F. Equipment and material used in the excavation of the impacted material shall remain in the impacted material area until decontaminated, if necessary, and approved for release by FDF in accordance with Part 4 of the Contract Documents.

G. Unexpected discovery of cultural resources: Upon the unexpected discovery of historic, prehistoric, or archeological sites, features, or objects, immediately cease ground disturbing activities at the find and contact FDF.

3.3 PLACEMENT OF MATERIAL

A. Stockpile impacted material (top 12 inches) from the retention basin areas in the impacted material stockpile designated on the South Field.

B. Stockpile the remainder of the excavation from the retention basin areas in the non impacted material stockpile.

C. FDF will perform monitoring of construction activities for occupational exposure purposes; this monitoring will not relieve the Subcontractor of regulatory responsibilities.

3.4 COMPACTION

A. Impacted material stockpiled on the South Field shall be placed in lifts no more than 12 inches thick and compacted with two passes of a tamping foot or mesh/grid foot roller or equivalent. Maximum height of the stockpile shall be 20 feet with maximum side slopes of 2H:1V.

3.5 FINISH OPERATIONS

A. Grading and Tolerances:
Plus or minus 0.25 feet of the grades shown on construction drawings, except for the retention basins which shall be 0.1 feet.

B. Seeding and Mulching:
Seeding and mulching shall be per Section 02900, Soil Preparation and Seeding.

3.6 FIELD QUALITY CONTROL

In-place density testing will be performed in accordance with ASTM D2922. Nuclear density gauge (ASTM D2922) will be calibrated in accordance with the manufacturer's requirements. Documentation of this calibration will be provided to FDF. Register any nuclear or radiological sources brought on site in accordance with Part 8 of the Contract Documents. Impacted material stockpile will be compacted by equipment approved by FDF. All placed soil materials shall be subjected to the following tests:

A. Soil Classification shall be performed in accordance with ASTM D2487.

B. Moisture tests will be performed in accordance with ASTM D3017, ASTM D2216 or ASTM D4643 as applicable.

C. Moisture-density curves will be determined in accordance with ASTM D698 (Standard Proctor). The test results must be reviewed and approved by FDF prior to use.

D. If in-place density and/or moisture tests indicate that work does not meet specified requirements, remove work and replace or recompact to specified requirements. If visual inspection indicates that work has not been performed as specified, correct work to comply with the requirements.

E. Frequency of Tests: Frequency of in-place density and moisture testing for placement of the fill materials shall be whichever of the following requires the greatest number of tests:
   1. Once each day of placement.
   2. Once every layer of infiltration barrier in each basin or ditch.
   3. Once every 500 cubic yards of material.

F. Notify FDF of activities that will require testing/ inspection prior to the start of such activities.

END OF SECTION

SECTION 02225
TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation of trenches, compaction of bedding and backfill over storm culverts, drinking water line, transfer line, wheel wash discharge line, discharge line, treatment line, electrical conduits and associated fittings, and appurtenances to elevation.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 01050 - Surveying.

D. Section 02100 - Site Preparation.

E. Section 02200 - Non Impacted Material Earthwork.

F. Section 02205 - Impacted Material Excavation and Handling.

G. Section 02270 - Erosion and Sediment Control.

H. Section 02667 - Drinking Water Lines.

I. Section 02668 - Transfer Line.

J. Section 02669 - Discharge Line and Treatment Line.

K. Section 02720 - Site Drainage and Water Management.

L. Section 02900 - Soil Preparation and Seeding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation (ODOT): Construction and Material Specifications, January 1, 1997. Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

B. American Society for Testing and Materials (ASTM):

1.	ASTM D698-91	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 [600 kN-m/m]).
2.	ASTM D2216-92	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
3.	ASTM D2487-93	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4.	ASTM D2922-91	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5.	ASTM D3017-88	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) (R 1993).
6.	ASTM D4643-93	Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

1.5 SUBMITTALS

Provide the following submittals as required in Section 01011 and Part 6 of the Contract Documents.

A. Shoring and Sheeting Plan: Provide a shoring and sheeting plan as a part of the Safe Work Plan. The sheeting and shoring plan shall address removal of

utilities deeper than 4 feet and all locations where cut slopes shall be steeper than 2H:1V. Describe materials of shoring system to be used. Provide plans, sketches, manufacturer's tabulated data or details, along with calculations by a registered professional engineer. All custom engineered systems shall be approved by an engineer registered in the State of Ohio. Indicate sequence and method of installation and removal.

B. Geotechnical Test Results: Submit results of all geotechnical tests by the approved geotechnical lab including:
   1. Standard Proctor moisture density tests.
   2. Sieve analysis.
   3. Density tests.
   4. Proctor curves for each type material used for approval by FDF prior to use.

C. As-built Drawings: Provide as-built drawings in accordance with Section 01050.

1.6 QUALITY ASSURANCE PROGRAM

A. Survey Layout: Assure that all work is laid out and built in accordance with the requirements on the construction drawings and these specifications. Survey work shall be in accordance with Section 01050.

B. Independent Geotechnical Laboratory: Arrange and pay for the services of a qualified, independent geotechnical testing laboratory. The qualifications of the laboratory, meeting Part 8 of the Contract Documents, must be submitted to FDF and approved in writing prior to initiation of excavation activities. The laboratory must provide documentation of compliance with this specification.

PART 2 PRODUCTS

2.1 MATERIALS

On-site materials shall be used for earthwork activities during excavation, bedding and backfilling for utilities

unless approved in writing by FDF prior to bringing any material onto the FEMP site.

A. Unclassified Material: Material excavated for utility installation shall be reused for backfill of the trenches.

B. Coarse Aggregate: Conforming to ODOT Item 304 - Aggregate Base as modified herein. No slag material will be allowed for use on site. Aggregate shall be crushed carbonate, crushed gravel, or other types of suitable materials meeting the following gradation requirements:

C. Pipe Bedding: Sand - natural river or bank sand; free of loam, friable or soluble materials, organic matter; graded in accordance with ASTM D2487; within the following limits:

Sieve Size	Percent Passing
No. 4	70-100
No. 40	20-90
No. 200	0-40

On-site material excavated from the Great Miami Aquifer (from the retention basins) shall be used as pipe bedding provided it meets the above requirements.

PART 3 EXECUTION

Contact between and/or mixing of impacted material and non-impacted material shall be prevented. Material that contacts impacted material shall be treated as an impacted material in accordance with Section 02205 at no additional cost to FDF. Equipment and materials used in impacted material areas shall be kept separate from other equipment and materials until it is properly decontaminated. Impacted material shall be addressed in accordance with Section 2205.

3.1 PREPARATION

A. Verify all backfill/bedding materials to be reused are acceptable. Verify areas to be backfilled are free of debris, snow, ice or water and that surfaces are not frozen.

B. Survey and layout all work in accordance with Section 01050.

C. Maintain, identify, and protect existing utilities and features to remain.

D. Notify FDF when the actual conditions differ in any manner from those specified in the contract documents, or when soft or spongy areas or other unusual soil conditions are encountered.

E. Install appropriate erosion and sediment control measures in accordance with Section 02270 prior to start of any earthmoving operations.

F. Immediately stop work and notify FDF if other utility lines not shown on the construction drawings and/or reference drawings are encountered during trenching.

3.2 PROTECTION

A. Grade excavation and trench top perimeter to prevent surface water runoff from entering into excavation or to adjacent properties.

B. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

C. Protect finished work and existing features which will remain.

D. Protect denuded areas in accordance with Section 02270.

E. Protect existing groundwater monitoring wells and extraction wells in the area and in the vicinity of the work area.

3.3 EXCAVATION

A. Trenches and excavations shall be in accordance with OSHA 29 CFR 1926, Subpart P - Excavations.

B. Excavate trenches to a width necessary for proper installation of pipe to be accommodated as shown on the construction drawings.

C. Grade bottom of trench to provide uniform bearing and support pipe on properly compacted bedding throughout length of pipe except where necessary to hand excavate for coupling for proper sealing of pipe joints.

D. Keep trench bottom free of standing water. Provide dewatering pumps as required.

E. Notify FDF immediately of unexpected subsurface conditions.

F. Hand excavate for coupling after trench has been fine graded to ensure uniform bearing is provided for pipe.

G. Remove soft, spongy, or otherwise unstable materials encountered at elevation of pipe which will not provide a firm foundation for the pipe. Extend bedding depth as necessary to reach firm materials.

H. Backfill unauthorized excavation at Subcontractor's expense with compacted earth as stipulated by FDF.

3.4 PIPE BEDDING

A. Place bedding in level layers not exceeding 6 inches compacted depth to the depths as shown on the drawings.

B. Compact bedding by five passes of compaction equipment. Each pass shall overlap each preceding pass by at least 2 inches. Compaction equipment shall be vibratory and impart at least 2,000 foot-pounds of impact energy with a frequency of 500 bpm, which is similar to a medium size excavator mounted tamping plate/ram.

C. Employ a placement method that does not disturb or damage pipe or trench.

D. Support pipe during placement and compaction of bedding fill.

E. When proposed utilities cross the existing 6-inch gas line, the existing 6-inch drinking water line, and/or the existing 20-inch groundwater line, place compacted bedding material to an elevation one foot above the highest utility. Backfill from this point to the original ground elevation with coarse aggregate as specified herein for vehicle crossing locations.

3.5 BACKFILLING

A. Prepare subgrade as follows:
   1. Compact exposed subgrade to density requirements for subsequent backfill materials. When existing ground surface has a density of less than the density specified, break up the ground surface, pulverize, adjust moisture content to specified limits, and compact to specified density.
   2. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with material and compact to density equal to or greater than requirements for subsequent fill material.

B. Do not backfill over porous, wet, frozen, spongy, or other unsatisfactory subgrade surfaces. Where unsatisfactory subsurface conditions in an area of backfill are observed, excavate unsatisfactory material to satisfactory subgrade as approved by FDF.

C. Backfill trenches in non-traffic areas with unclassified material to contours and elevations shown. Place and compact fill materials in level layers not exceeding 12 inches loose depth. Do not use frozen or saturated materials. Compact backfill to 90 percent Standard Proctor as determined by ASTM D2922.

D. Backfill trenches in traffic areas with aggregate. Place and compact in 6-inch lifts and compact to 95 percent Standard Proctor as determined by ASTM D2922.

E. Maintain optimum moisture content as determined by ASTM D3017, ASTM D2216 or ASTM D4643, as applicable, (within ±4 percent) of backfill materials to attain required compaction density.

F. Seed all disturbed areas in accordance with Section 02900.

G. Dust Suppression: See Section 02100 and Part 6 of the Contract Documents.

H. Install underground warning tape.

3.7 FIELD QUALITY CONTROL

A. Moisture-density curves will be determined in accordance with ASTM D698 (Standard Proctor).

B. If in-place density and/or moisture tests indicate that work does not meet specified requirements, remove work and replace or recompact to specified requirements. If visual inspection indicates that work has not been performed as specified, correct work to comply with the requirements.

C. Frequency of Tests (Backfill only): Frequency of in-place density and moisture testing shall be whichever of the following requires the greatest number of tests:
   1. Once each day of work filling.
   2. Once every layer of fill.
   3. Once every 500 cubic yards of fill.
   4. Once every 200 feet of trench.

D. Notify FDF Manager of activities that will require testing/inspection prior to the start of such activities.

E. Register any nuclear or radiological sources brought on site in accordance with Part 8 of the Contract Documents.

END OF SECTION

SECTION 02270
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soil erosion and sedimentation control for areas of the Subcontractor's work area which are graded or disturbed as a part of the contract work.

B. Installation and maintenance of all temporary erosion and sediment control facilities and measures.

C. Installation of erosion control blankets.

D. Dumped rock fill for ditches, erosion control areas, SWRB overflow, and swale repair as indicated on the construction drawings.

E. Geotextile underneath geomembrane liner.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02100 - Site Preparation.

D. Section 02200 - Non Impacted Material Earthwork.

E. Section 02205 - Impacted Material Excavation and Handling.

F. Section 02720 - Site Drainage and Water Management.

G. Section 02900 - Soil Preparation and Seeding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation (ODOT): Construction and Material Specifications, January 1, 1997.

B. State of Ohio, Department of Natural Resources (ODNR): Rainwater and Land Development, Ohio's Standard for Stormwater Management, Land Development, and Urban Stream Protection - 1996.

C. American Society for Testing and Materials (ASTM):

1.	ASTM D1777-96	Standard Test Method for Measuring Thickness of Textile Materials (R 1975).
2.	ASTM D3776-96	Standard Test Method for Mass Per Unit Area (Weight) of Woven Fabric (R 1990).
3.	ASTM D3786-87	Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting
4.	ASTM D4491-95	Standard Test Method for Water Permeability of Geotextiles by Permissivity.
5.	ASTM D4533-91	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
6.	ASTM D4632-91	Standard Test Method for Grab Breaking Load and Elongation of Textiles.
7.	ASTM D4751-95	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
8.	ASTM D4833-88	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011 and Part 6 of the Contract Documents.

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1.6 QUALITY ASSURANCE PROGRAM

A. Inspect sediment control measures weekly and after each rain exceeding 0.5 inches to evaluate the effectiveness of the control measures and for maintenance of the control measures. Records of inspections shall be kept on file at Subcontractor's site office and shall be submitted monthly to FDF.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stakes: Stakes shall be hardwood with a minimum length of 2 feet, 8 inches in height and 2 inches by 2 inches in width.

B. Silt Fence: Materials shall conform to ODOT Item 712.09, Type C for material as described in ODOT Section 207.02 and as specified in the construction drawings.

C. Dumped Rock Fill: Dumped rock fill shall meet the requirements of ODOT Item 601.07 for the type specified on the construction drawings.

D. Non-woven geotextile fabric for dumped rock fill and geomembrane liner bedding similar to Trevira No. 1125™ or approved equivalent.

E. Erosion Control Blankets: Similar to North American Green Type C125 or approved equal. The erosion control blanket shall be constructed of 100 percent coconut fiber stitch bonded between a heavy duty UV stabilized bottom net and a heavy duty UV stabilized top net. The cuspated (crimped) netting shall form prominently closely spaced ridges across the entire width of the mat. The nettings shall be stitched together on 1.5 inch centers with UV stabilized polyester thread to form a permanent three dimensional structure. The mat shall have the following physical properties and rated for two years service life for use on slopes of 1:1.

1. Material Content
   a. Coconut fiber: 100 percent; 0.5 lb/yd^2
   b. Nettings: Top - Heavy UV stabilized; polypropylene; 3 lbs per 1,000 ft^2. Bottom - Heavy UV stabilized; polypropylene; 3 lbs per 1,000 ft^2.
   c. Thread: UV stabilized polyester.

2. Physical Specifications (Roll)
   a. Width: 6.5 feet
   b. Length: 83.5 feet
   c. Weight: 30 lbs ±10 percent
   d. Area: 60 yd^2

PART 3 EXECUTION

Construct protective devices as specified herein, and as required on the construction drawings.

3.1 SILT FENCES

A. Install in accordance with ODNR and manufacturer's recommendations. Place at locations shown on construction drawings prior to start of earthwork. Remove accumulated silts when deposition reaches one-half the height of the silt fence or sooner if accumulated sediment prevents proper performance of silt fence.

3.2 EROSION CONTROL BLANKETS

A. Install in accordance with manufacturer's recommendations in the ditches shown on the construction drawings. All blankets shall be properly anchored with wire staples in patterns and sizes recommended by manufacturer.

3.3 GEOTEXTILE

A. Install geotextile on prepared subgrade underneath the geomembrane liner in accordance with the manufacturer's recommendations.

3.4 INACTIVE EXPOSED EXCAVATION & CONSTRUCTION AREAS

A. All exposed denuded (i.e., no vegetation) construction and impacted material excavation/stockpile areas that are inactive shall be stabilized by means of temporary seeding in accordance with Section 02900. Forty-five days is the maximum time that an area can be left in a exposed denuded state. If the exposed area will not be worked for a period of 45 days, the soils must be stabilized within 7 days.

3.5 RETENTION BASINS

A. Vegetation/grass is to be established on slopes of all retention basins from the sediment clean out elevation to the top of slope.

B. Slopes and bottom of retention basin are to be maintained. The area is to be kept free of any erosion rills and gullies.

C. See Section 02900 for seeding.

D. Remove accumulated sediments, debris, and obstructions. In no case shall sediment build up to a depth greater than levels indicated on the drawings.

E. All sediments removed shall be transported to the impacted material stockpile located within South Field as indicated on the construction drawings.

F. Inspect and maintain infiltration barrier as required to maintain the one-foot of barrier material over the GMA. Prior to startup, after winter shut down, proofroll and recompact the infiltration barrier as necessary to re-establish the original thickness and compaction. Proofrolling of the ditches and retention basin side slopes is not required.

3.6 DUMPED ROCK FILL

A. Install in accordance with ODOT Item 601.07 in ditches where indicated on the construction drawings.

B. Install geotextile with dumped rock fill in accordance with ODOT Item 601.08 in ditches where indicated on the construction drawings.

3.7 REMOVAL OF TEMPORARY EROSION CONTROL FACILITIES

A. Proposed sediment control facilities on the construction drawings are placed as a minimum. Install additional temporary facilities as required to maintain control of erosion and sedimentation.

B. Temporary erosion control facilities installed shall be removed at the direction of FDF after the disturbed areas are stabilized with grass or other measures approved by FDF.

END OF SECTION

SECTION 02506
AGGREGATE SURFACE

PART 1 GENERAL

1.1 SCOPE

A. Installation and compaction requirements for aggregate surfaces for roads and the support area. Section also addresses geotextile fabric.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non-impacted Material Earthwork.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing And Materials (ASTM):

1.	ASTM D698-91	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
2.	ASTM D2216-92	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
3.	ASTM D2922-91	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. ASTM D3017-88 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

B. State of Ohio, Department of Transportation (ODOT), Construction and Material Specifications, January 1, 1997: Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011 and Part 6 of the Contract Documents.

B. Materials Source: Submit names of imported materials suppliers. Change of source requires FDF's approval.

C. Material suppliers shall be required to certify that supplied materials meet specifications prior to use.

D. Submit name and address of testing laboratory for approval. Provide FDF with copies of all lab/field test results.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate materials shall meet the requirements of ODOT Item 304. Aggregate: The aggregate shall be crushed carbonate stone, crushed gravel, or other types of suitable materials meeting the requirements of this item. No slag materials will be allowed for use on site.

B. Geotextile fabrics shall conform to ODOT Item 712.09, Type D.

1. The fabric shall consist of a woven polyester or polypropylene fibers formed into a woven fabric.

2. Product and manufacturers.
   a. 500X by Nicolon/Mirifi Group.
   b. 2002 by Amoco Fabrics and Fibers Co.
   c. Or approved equal.

PART 3 EXECUTION

3.1 SURVEY AND CONSTRUCTION STAKEOUT

A. Verify grades and elevations of subgrade are correct.

3.2 SUBGRADE PREPARATION

A. Verify that compacted subgrade is dry and not frozen, soft, or spongy.

3.2 GEOTEXTILE INSTALLATION

Place geotextile on subgrade in accordance with manufacturer's installation instructions and as follows:

A. Geotextile fabric shall be placed directly over the subgrade. The geotextile fabric shall be placed and temporarily anchored in such a manner that placement of overlying materials will not excessively stretch or tear the fabric.

B. Geotextile fabric shall be installed to limits and grades indicated on plans for all new work. The geotextile shall not be dragged across the subgrade. The geotextile fabric shall be unrolled as smooth as possible on the prepared subgrade. Wrinkles and folds in the geotextile shall be removed by stretching and placing of sod staples or small aggregate piles as required. The fabric shall be installed according to the manufacturer's suggestion at curve locations.

C. The geotextile shall be field joined, factory seamed, or manufactured in seamless width. Methods of field joining shall include overlapping of adjacent edges and ends of geotextile or sewing of adjacent edges and ends of geotextile. Sand bags or other weights may be used for

temporary anchoring. Overlap at edges and ends of geotextile shall be per Manufacturer's Installation Instructions.

D. The geotextile fabric shall extend to the edges of the road aggregate surface.

E. Exposure of geotextiles to elements between lay down and cover shall be a maximum of 7 days to minimize damage potential by ultraviolet light.

F. Construction traffic shall not be permitted directly on the geotextile fabric.

3.4 AGGREGATE INSTALLATION

A. End dumping or tailgate dumping shall not be permitted directly onto the geotextile fabric. The aggregate shall be dumped adjacent to the fabric or on previously placed stone. The aggregate shall be spread from the backdumped pile using a bulldozer, loader, track hoe, or grader, with care being taken to avoid damage to the fabric by blades, tracks, tires, or buckets. The initial lift of aggregate on the geotextile fabric shall be a minimum thickness of 6 inches after compaction and shall be compacted with a smooth drum roller to the required density.

3.5 COMPACTING AGGREGATE

Compact aggregate surface to 95 percent of optimum density in accordance with ASTM D698. Maintain within ±4 percent of optimum moisture content of fill materials to attain required compaction density.

3.6 FIELD QUALITY CONTROL

A. Work shall be performed in accordance with ODOT Item 304 requirements.

B. Tolerances

1. The top of the aggregate surface shall be a uniformly smooth grade surface without high or low points and shall not be more than 0.25 feet above or below specified grades.
2. The thickness of the finished aggregate course shall be no less, at any point, than the thickness indicated on the construction drawings.

C. Frequency of Tests: Frequency of in-place density and moisture testing shall be whichever of the following requires the greatest number of tests:

1. Once each day of work filling.
2. Once every lift of material.
3. Once every 500 cubic yards of fill.

D. Maintain all aggregate surfaces to the minimum requirements of this specification and the construction drawings.

END OF SECTION

SECTION 02510
ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.1 SCOPE

A. This section describes the asphaltic concrete paving and aggregate base that will be used to pave the access roads to and from the wheel wash pad.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non-impacted Material Earthwork.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing And Materials (ASTM):
1. ASTM D698-91 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

B. State of Ohio, Department of Transportation Construction and Material Specifications, January 1, 1997 (ODOT). Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Weather Limitations: Shall be in accordance with ODOT Item 401.05.

1.6 QUALITY ASSURANCE

A. Materials and workmanship specified herein with the referenced State Standard specifications shall be in accordance with the referenced articles, sections, and paragraphs of the standard except that contractual and payment provisions do not apply. Where the term "Engineer" is used, it shall mean FDF. Where the term "State" is used, it shall mean DOE.

1.7 SUBMITTALS

A. Submit the following in accordance with Section 01011 and Part 6 of the Contract Documents.

1. Mix Design: Develop mix design and submit results of laboratory tests performed on each mix design in accordance with ODOT Item 441.
2. Certificates: Submit certificates, signed by the producer, that paving materials conform to mix design and specification requirements.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Equipment used in paving operations shall be in accordance with ODOT Item 401.

2.2 MATERIALS

A. Bituminous aggregate base shall meet the requirements of ODOT Item 301.

B. Aggregate base shall meet the requirements of ODOT Item 304.

1. Aggregate: The aggregate shall be crushed carbonate stone, crushed gravel, or other types of suitable materials meeting the requirements of this item. No slag materials will be allowed for use on site.

C. Asphalt concrete shall meet the requirements of ODOT Item 403.
   1. Composition: Coarse aggregate (No. 8) and fine aggregate shall be combined in such proportions that the resulting blend shall be as directed by the approved design mix.

D. Tack coat shall meet the requirements of ODOT Item 407.
   1. Material: The bituminous material shall meet the applicable requirements of 702 and shall be one of the following: 702.02 RC-70, RC-250, or 702.04 RS-1, SS-1, SS-1h, CRS-1, CSS-1, or CSS-1h. Cut-back asphalt 702.02 may be used only after September 15 and before May 15.

E. Prime coat shall meet the requirements of ODOT Item 408.
   1. Material: The bituminous material shall meet the applicable requirements of 702 and shall be one of the following: 702.02 RC-70, RC-250, MC-30, MC-70, MC-250, or 702.03 Primer 20.

F. Joint sealant shall meet the requirements of ODOT Item 407.
   1. Material: The bituminous material shall be one of the following:
      a. SS-1.
      b. CSS-1.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify gradients and elevations of base.

B. Verify that compacted subgrade is dry.

3.2 AGGREGATE BASE CONSTRUCTION

A. Fill areas to contours and elevations using unfrozen materials.

B. Place base materials in continuous layers not exceeding 6 inches compacted depth.

C. Compact to 95 percent of optimum density in accordance with ASTM D698.

D. Maintain within ±4 percent of optimum moisture content of fill materials to attain required compaction density.

3.3 PLACING ASPHALT PAVEMENT

A. Apply prime coat to finished base surface in accordance with manufacturer's instructions.

B. Place bituminous asphalt base course within 8 hours of priming aggregate base surface.

C. Clean bituminous surface and apply tack coat as required prior to placing succeeding courses of asphalt.

D. Spread, compact, and finish each course of asphalt pavement by rolling to achieve even and smooth finish, without roller marks in accordance with ODOT Item 401. Hand-compact in areas inaccessible to rolling equipment.

3.4 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.

B. Compacted Scheduled Thickness: Within 1/4 inch of design thickness.

C. Variation from True Elevation: Within 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Perform work in accordance with ODOT requirements.

B. Coordinate and pay for all testing which shall be performed by an independent testing laboratory.

C. All inspections and tests shall be provided to FDF within 24-hours of completion.

D. Notify FDF of testing/inspection activities at least 24-hours prior to the start of all tests or inspections.

END OF SECTION

SECTION 02667
DRINKING WATER LINES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings for drinking water lines (DW).

B. Disinfection of drinking water lines and subsequent testing and reporting of those lines.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non-impacted Material Earthwork.

D. Section 02225 - Trenching.

E. Section 03001 - Concrete.

F. Section 15060 - Pipe Fittings, Valves, and Accessories.

G. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM A36/A36M-96 Carbon Structural Steel.
2. ASTM A53-96 Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

3.	ASTM A325-96	Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
4.	ASTM D3035-95	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
5.	ASTM D3261-95	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
6.	ASTM D3350-96	Standard Specification for Polyethylene Plastic Pipe and Fittings Material.

B. American Water Works Association (AWWA):

1.	AWWA B300-92	Standard for Hypochlorites.
2.	AWWA B301-92	Standard for Liquid Chlorine.
3.	AWWA B302-95	Standard for Ammonium Sulfate.
4.	AWWA B303-95	Standard for Sodium Chlorite.
5.	AWWA C104/ A21.4-95	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
6.	AWWA C105/ A21.5-93	Polyethylene Encasement for Ductile-Iron Pipe Systems.
7.	AWWA C110/ A21.10-93	Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids.
8.	AWWA C111/ A21.11-95	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
9.	AWWA C115/ A21.15-94	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Fittings.
10.	AWWA C150/ A21.50-91	Thickness Design of Ductile-Iron Pipe.
11.	AWWA C151/ A21.51-91	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.

12. AWWA C500-93 — Metal-Seated Gate Valves for Water Supply Service.
13. AWWA C550-90 — Protective Epoxy Interior Coatings for Valves and Hydrants.
14. AWWA C600-93 — Installation of Ductile-Iron Water Mains and Their Appurtenances.
15. AWWA C651-92 — Standards for Disinfecting Water Mains.
16. AWWA C906-90 — Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.
17. AWWA M12-75 — Simplified Procedure for Water Examination.

C. Ohio Revised Code (ORC):
1. ORC 3745-83 — Operational Requirements.

D. American Welding Society, Inc. (AWS):
1. AWS D1.1-96 — Structural Welding Code - Steel.

E. State of Ohio, Department of Transportation (ODOT), Construction and Materials Specifications, January 1, 1997.

F. Steel Structures Painting Council (SSPC):
1. SSPC SP 6-94 — Surface Preparation Specification No. 6 - Commercial Blast Cleaning.

1.5 SUBMITTALS

A. Product Data: Provide data on all pipe materials, pipe fittings, valves, accessories, and the methods and equipment for HDPE fusion welding.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Provide As-Built information in accordance with Section 01050 - Surveying.

D. Certificate: Certify that cleanliness of water lines meets or exceeds specified requirements.

E. Verification of a minimum of five years experience in HDPE pipe installation and fusion/extrusion welding.

F. Project Record Documents: Provide data below.
   1. Disinfection report; record:
      a. Type and form of disinfectant used.
      b. Date and time of disinfectant injection start and time of completion.
      c. Test locations.
      d. Initial and 24-hour disinfectant residuals (quantity in treated water), in ppm, for each outlet sampled.
      e. Date and time of flushing start and completion.
      f. Disinfectant residual after flushing, in ppm, for each outlet sampled.
   2. Bacteriological report: Submit to FDF.

1.6 QUALITY ASSURANCE

A. Piping and Valves: Manufacturer's name and pressure rating marked on valve body and side of pipe.

B. Perform work in accordance with AWWA C651.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe
   1. High-Density PE Pipe: AWWA C906 (PE 3408), ASTM D3035, ASTM D3350, SDR and pressure rating as indicated on drawings.
      a. Fitting: AWWA C906, molded, butt fusion weld to pipe.

b. Joints: Butt fusion, flanged gasket joints, and molded adapter pipe at interface connections with ductile iron or carbon steel pipe and valves, bolts per ASTM A325.

c. Trace Wire: Magnetic detectable conductor, blue colored plastic covering.

2. Ductile Iron Pipe: AWWA C151, Class 55:

a. Fittings: AWWA C110, Ductile iron cement lined, standard thickness per AWWA C150. All fittings and pipe at valves shall be flanged per AWWA C115, bolts per ASTM A325.

b. Jackets: AWWA C105, PE encasement.

c. Cement Lined: AWWA C104, cement mortar lined.

d. Joints: AWWA C111, push-on, rubber gasket.

e. Welding: Shop welding - AWS D1.1.

3. Carbon Steel: See Section 15060 for materials and installation.

B. Gate Valves (Underground)

1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, Class 125 flanged ends, control rod, extension box, and valve key.

C. Bedding Materials

1. Bedding: As specified in Section 02225 of this specification package.

D. Backfill Materials

1. Backfill: As specified in Section 02225 of this specification package.

E. Backflow Preventer: As specified on the construction drawings.

F. Post Hydrant: See Section 15060 for materials and installation.

G. Backflow Preventer Assembly: AWWA approved reduced pressure principle backflow preventer similar to Conbraco Industries, Inc., Model 40-208-02 with ball valves, flanged ends and 1/4-inch test cocks.

H. Guard Posts: Steel pipe, ASTM A53, Schedule 40.

I. Protective Coatings for Valves:
   1. Interior - Factory applied heat-cured epoxy coating conforming to AWWA C550.
   2. Exterior - Two coats of factory applied zinc chromate primer and two coats finish coating in accordance with metal painting specifications in Part 3.3.E.

J. Tapping Sleeves: JCM 412 Flanged Outlet Tapping Sleeve by JCM Co. or approved equivalent.

K. Disinfection Chemicals:
   1. Chemicals: AWWA B300, Hypochlorite; AWWA B301, Liquid Chlorine; AWWA B302, Ammonium Sulfate; and AWWA B303, Sodium Chlorite.
   2. The above listed chemicals will be considered hazardous by FEMP standards if they become waste or if allowed to spill.

2.2 ACCESSORIES

A. Concrete: See Section 03001.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions. Any discrepancies should be brought to FDF's attention in a written statement immediately upon discovery.

B. Verify that service connection and site utility water main size, location, and invert are as indicated.

C. Regulatory Requirements for Disinfection:
   1. Conform to applicable code or regulation for performing the work of this section, to include US Public Health Service Drinking Water Standards identified in AWWA M12 as well as ORC 3745-83.

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3.2 PREPARATION

A. Ream pipe and tube ends and remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Excavate pipe trench in accordance with Section 02225 of this specification package for work of this section. Locate all existing utilities in the area and determine if they will interfere with the proposed utility.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Installation - Pipe: HDPE

1. Install pipe to indicated elevation to within tolerance of 5/8-inches at structures.
2. Install HDPE piping and fittings to AWWA C906 (by butt weld fusion method, in accordance with ASTM D3261).
3. Route pipe in line as shown on drawing. The minimum bending radius shall be as specified by the pipe manufacturer. Pipe shall be in a straight route at connections.
4. Install pipe to allow for expansion and contraction without stressing pipe or joints as per manufacturer's recommendation.
5. Establish elevations of buried piping to ensure not less than 3.5 feet of cover.
6. Install trace wire continuous over top of pipe, 6 inches above pipe line; coordinate with Section 02225 of this specification package.
7. Backfill trench in accordance with Section 02225 of this specification package.

B. Installation of Pipe and Valves: Carbon Steel, Fittings and Post Hydrants

1. See Section 15060 for materials and installation.

C. Installation - Guard Post

1. Excavate for post and concrete in accordance with Section 02200.
2. Hand trim and remove loose material in excavation.

3. Position pipe in hole, maintaining clearances as specified on drawings.
4. Place concrete around and in pipe in accordance with Section 03001.
5. Paint post after concrete cures in accordance with ODOT Item 514.

D. Installation - Tapping Sleeves.
1. Make a wet tap into existing water line using tapping sleeve and tapping valve. After completing wet tap, install balance of fittings and pipeline to complete the work.

E. Shop and Field Painting Specification:
For Steel Plate and Shapes, Pipe and Fittings
1. Prepare surfaces in accordance with Steel Structures Painting Council (SSPC) SP-6.
2. Prime all bare metal not in contact with concrete/grout with one coat Tnemec Series 6 Epoxo Line Primer. Apply two-coats of Tnemec Series 66 Hi-Build Epoxoline for the finish coat. Follow SSPC Paint 13 and Paint 20.

F. Excess Debris and Waste: Shall be stockpiled in either the impacted material stockpile or the non impacted material stockpile.

G. For concrete installation see Section 03001.

3.4 DISINFECTION

A. Introduce treatment into piping system.

B. Maintain disinfectant in system for 24 hours.

C. Flush, circulate, and clean until required cleanliness is achieved; use potable water.

D. Replace permanent system devices removed for disinfection.

E. Seal the piping system immediately after disinfection to ensure that contaminants do not enter the system.

F. Containerize all flush water. Water shall be dechlorinated or otherwise treated and disposed of per FDF.

3.5 **FIELD QUALITY CONTROL**

A. Perform hydrostatic tests on all lines in accordance with AWWA C600. Notify FDF at least 24 hours in advance of planned testing.

B. Provide analysis and testing of treated water in accordance with AWWA C651. Submit report to FDF within one week after completion of test.

C. All testing and disinfection shall be complete and accepted by FDF prior to connecting existing water supply line.

END OF SECTION

SECTION 02668
TRANSFER LINE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings for stormwater transfer force main.

B. HDPE Manholes, frames, and lid.

C. Clean-outs.

D. Air Release Valves.

E. Guard posts.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non-impacted Material Earthwork.

D. Section 02225 - Trenching

E. Section 02720 - Site Drainage and Water Management.

F. Section 03001 - Concrete.

G. Section 15060 - Pipe Fittings, Valves, and Accessories.

H. Section 15160 - Lift Station Pumps.

I. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1.	ASTM A36/ A36M-96	Standard Specification for Carbon Structural Steel.
2.	ASTM A53-96	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
3.	ASTM A325-96	Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
4.	ASTM D3035-95	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
5.	ASTM D3261-95	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
6.	ASTM D3350-96	Standard Specification for Polyethylene Plastic Pipe and Fittings Material.

B. American Water Works Association (AWWA):

1.	AWWA C500-93	Metal-Seated Gate Valves for Water Supply Service.
2.	AWWA C550-90	Protective Epoxy Interior Coatings for Valves and Hydrants.
3.	AWWA C906-90	Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.
4.	AWWA C600-93	Installation of Ductile-Iron Water Mains and Their Appurtenances.

C. American Welding Society, Inc. (AWS):

1.	AWS D1.1-96	Structural Welding Code - Steel.

D. State of Ohio, Department of Transportation (ODOT), Construction and Materials Specifications, January 1, 1997.

E. Steel Structures Painting Council (SSPC):

1.	SSPC SP 6-94	Surface Preparation Specification No. 6 - Commercial Blast Cleaning.
2.	SSPC Paint 13-91	Red or Brown One-Coat Shop Paint.
3.	SSPC Paint 20-91	Zinc Rich Primers (Type I, Inorganic and Type II, Organic).

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011 and Part 6 of the Contract Documents.

B. Product Data: Provide data on all pipe materials, pipe fittings, valves, accessories, the methods and equipment for HDPE fusion welding, HDPE manholes, and manhole frame and cover.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Verification of a minimum of five years experience in HDPE manhole installation and HDPE single and double contained pipe installation and fusion/extrusion welding.

E. Provide as-built information in accordance with Section 01050.

F. Provide detailed shop drawings for approval of all HDPE manholes. Drawings shall show plan and section view of manhole, invert of pipes, pipe sizes, pipe orientation, and weld types/details.

1.6 QUALITY ASSURANCE

A. Piping and Valves: Manufacturer's name and pressure rating marked on valve body and side of pipe.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe

1. High-Density PE Pipe: AWWA C906 (PE 3408), ASTM D3035, SDR and pressure rating as indicated on drawings.
   a. Fitting: AWWA C906, molded, butt fusion weld to pipe.
   b. Joints: Butt fusion for HDPE joints, flanged gasket joints, and molded adapter pipe at interface connections with ductile iron or carbon steel pipe and valves.
   c. Trace Wire: Magnetic detectable conductor, green colored plastic covering.
   d. Dual Containment Pipe: All dual containment pipe and fittings shall be prefabricated using carrier and containment sizes, and SDR ratings as indicated on drawings. Support spacers shall be used in the annular space between the pipes to ensure a continuous space between to accommodate possible leakage from the carrier pipe. The carrier pipe shall extend 6 inches beyond containment pipe on all prefabricated pipe sections and fittings. All joints shall be per the manufacturer's recommendation.
2. Carbon Steel: See Section 15060 for materials and installation.

B. Bedding Materials

1. Bedding: Fill as specified in Section 02225 of this specification package.

C. Backfill Materials

1. Backfill: Fill as specified in Section 02225 of this specification package.

D. Manhole: HDPE, ASTM D3350. Pipe resin is cell classification 3454-34C and a plastic pipe Institute Rating of PE 3408. The manhole shall have lifting lugs capable of supporting manhole during placement and shipping. The cylinder and outlet shall be fabricated from HDPE pipe with SDR, same as pipe, as indicated on drawings. All components shall be joined by butt fusion, saddle fusion, socket fusion, or extrusion welding. Hot air welding is not acceptable. Each manhole shall be identified by appropriate manhole number visibly marked on interior and exterior. HDPE molded pipe stubs and ductile iron flanged backup rings in manholes shall be installed in manhole by shop fabrication.

E. Manhole frame and lid shall be as noted on the construction drawings.

F. For lift station pumps and guide rail see Section 15160. For lift station controls and electrical, see Section 16050.

G. Guard Posts: Steel pipe, ASTM A53, Schedule 40.

H. Protective Coatings for Valves:
1. Interior - Factory applied heat-cured epoxy coating conforming to AWWA C550.
2. Exterior - Two coats of factory applied zinc chromate primer and two coats finish coating in accordance with metal painting specifications in Part 3.3.D.

I. Manhole Pipe Supports:
Material used shall meet the following specifications:
1. Structural Steel - ASTM A36.
2. Bolts, Nuts, and Washers - ASTM A325.
3. Welding - AWS D1.1 Class E70XX electrodes.
4. Expansion Anchors: Drilled expansion bolts for securing steel to concrete.
   a. Kwik Bolt, by Hilti, Inc.
   b. Parabolt, by Molly Fastener Group.
   c. Wedge Anchors, by ITW Ramset/Red Head.

J. Clean outs shall be as specified on the construction drawings.

K. Air Release Valves shall be as specified on the construction drawings.

2.2 ACCESSORIES

A. Concrete: See Section 03001.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions. Any discrepancies should be brought to FDF's attention in a written statement immediately upon discovery.

3.2 PREPARATION

A. Ream pipe and tube ends and remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Excavate pipe trench in accordance with Section 02225 of this specification package for work of this section. Locate all existing utilities in the area and determine if they will interfere with the proposed utilities.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Installation - Manhole and Pipe: HDPE
1. Maintain separation of transfer line from potable water piping (18-inch vertical minimum).
2. Install pipe to indicated elevation to within tolerance of 5/8 inches at structures.
3. Install HDPE piping, manholes, and fittings to AWWA C906 (by butt weld fusion method, in accordance with ASTM D3261).

4. Route pipe in line as shown on construction drawing. The minimum bending radius shall be as specified by the pipe manufacturer. Pipe shall be in a straight route at manhole connections.
5. Install pipe to allow for expansion and contraction without stressing pipe or joints as per manufacturer's recommendation.
6. Form and place concrete for thrust blocks at each "Tee" of pipe main.
7. Establish elevations of buried piping to ensure not less than 3.5 feet of cover.
8. Install trace wire continuous over top of pipe, 6 inches above pipe line.
9. Backfill trench in accordance with Section 02225 of this specification package.

B. Installation of Pipe and Valves: Carbon steel, fittings, valves in clean outs, air release valves and lift station.
   1. See Section 15060 for materials and installation.

C. Installation - Guard Post
   1. Excavate for post and concrete in accordance with Section 02200.
   2. Hand trim and remove loose material in excavation.
   3. Position pipe in hole, maintaining clearances as specified on drawings.
   4. Place concrete around and in pipe in accordance with Section 03001.
   5. Paint post after concrete cures in accordance with ODOT Item 514.

D. Shop and Field Painting Specification:
   For Steel Plate and Shapes, Pipe and Fittings
   1. Prepare surfaces in accordance with Steel Structures Painting Council (SSPC) SP-6.
   2. Prime all bare metal not in contact with concrete/grout with one coat Tnemec Series 6 Epoxo Line Primer. Apply two-coats of Tnemec Series 66 Hi-Build Epoxoline for the finish coat. Follow SSPC Paint 13 and Paint 20.

E. For concrete installation at manholes, thrust blocks, and valves, see Section 03001.

3.4 FIELD QUALITY CONTROL

A. Perform hydrostatic tests on carrier lines in accordance with AWWA C600. The allowable leakage rate for the carrier line testing is zero. Notify FDF at least 24 hours in advance of planned testing. Submit report to FDF within one week after completion of test.

B. Perform pneumatic tests on all containment lines in accordance with manufacturer's recommendation. Subcontractor may perform hydrostatic testing on containment lines in lieu of pneumatic testing in accordance with the manufacturer's recommendation. Provide a mechanism to remove all trace water in the containment line if hydrostatic testing is chosen. The allowable leakage rate for the containment line testing is zero. Notify FDF at least 24 hours in advance of planned testing. Submit report to FDF within one week after completion of test.

C. Each HDPE manhole shall be hydrostatically or pneumatic tested before and after installation by the following method:

1. Hydrostatic:
   a. The manhole filled with potable water to within 6 inches of top.
   b. Monitor the water level for a four hour period. The water level should not drop during this time period. Retest manhole until acceptable and drain.
2. Pneumatic: Tested in accordance with manufacturer's recommendation.

END OF SECTION

SECTION 02669
DISCHARGE LINE AND TREATMENT LINE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings for underground discharge line and treatment line.

B. Valves and tap connections.

C. Air-relief manholes, frames, and lid.

D. Clean-outs.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non Impacted Material Earthwork.

D. Section 03001 - Concrete.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D3035-95 — Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
2. ASTM D3261-95 — Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

3.	ASTM D3350-96	Standard Specification for Polyethylene Plastic Pipe and Fittings Material.

B. American Water Works Association (AWWA):

1.	AWWA C104/ A21.4-95	Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
2.	AWWA C105/ A21.5-93	Polyethylene Encasement for Ductile-Iron Pipe Systems.
3.	AWWA C110/ A21.10-93	Ductile-Iron and Gray-Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids.
4.	AWWA C111/ A21.11-95	Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
5.	AWWA C115/ A21.15-94	Flanged Ductile Iron Pipe with Threaded Flanges.
6.	AWWA C150/ A21.50-91	Thickness design of Ductile Iron Pipe.
7.	AWWA C151/ A21.51-91	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
8.	AWWA C500-93	Metal-Seated Gate Valves for Water Supply Service.
9.	AWWA C504-94	Rubber-seated Butterfly Valves.
10.	AWWA C512-92	Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
11.	AWWA C600-93	Installation of Ductile-Iron Water Mains and Their Appurtenances.
12.	AWWA C906-90	Polyethylene (PE) Pressure Pipe and Fittings, 4-Inch through 63-Inch, for Water Distribution.

1.5 **SUBMITTALS**

A. Product Data: Provide data on pipe materials, pipe fittings, valves, accessories, and the methods and equipment for HDPE fusion welding, HDPE manholes, and manhole frame and cover.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. As-built drawings in accordance with Section 01050.

1.6 **QUALITY ASSURANCE**

A. Piping and Valves: Manufacturer's name and pressure rating marked on valve body.

1.7 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver, store, protect, and handle products to construction site.

B. Deliver and store valves in shipping containers or pallets with labeling in place.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Pipe
1. Ductile Iron Pipe: AWWA C151, Class 55:
   a. Fittings: AWWA C110, Ductile iron cement lined, standard thickness per AWWA C150. All fittings and pipe at valves shall be flanged per AWWA C115.
   b. Jackets: AWWA C105, PE encasement.
   c. Cement Lined: AWWA C104, cement mortar lined.
2. High-Density PE Pipe: AWWA C906 (PE 3408), ASTM D3035, SDR 11 for 150 psi pressure rating (150 psi test pressure rating).
   a. Fitting: AWWA C906, molded, butt fusion weld to pipe.

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b. Joints: Butt fusion, flanged gasket joints, and molded adapter pipe at interface connections with ductile iron pipe and valves.

c. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering.

B. Gate Valves

1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, Class 125 flanged ends, control rod, extension box, and valve key.

C. Bedding shall be in accordance with Section 02225.

D. Manhole: HDPE, ASTM D3350. Pipe resin is cell classification 3454-34C.

E. Manhole frame and lid shall be heavy-duty cast iron as noted on the drawings.

F. Air Release Valve: Valve shall be screwed inlet connection and shall be cast iron body, top, and inlet flange, stainless steel float and trim with BUNA-N seat to meet AWWA C512.

G. Post Indicating Valves: Post Indicating Valves Assembly - U.L. listed and FM approved.

1. Sizes 4 inches - 14 inches, AWWA C500 gate valves, flanged ends Class 150, post assembly shall show open and shut, handcrank operator above ground, non-rising stem, and break-flange to separate the top works without removing the valve from the line.

2.2 ACCESSORIES

A. Concrete: 3,000 psi (minimum) as specified in Section 03001.

PART 3 EXECUTION

3.1 EXAMINATION

Verify existing conditions. Bring any discrepancies to FDF, in writing, for resolution prior to start of work.

3.2 PREPARATION

A. Ream pipe and tube ends and remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare pipe connections to equipment by using flanges or unions.

D. Excavate pipe trench in accordance with Section 02225. Locate existing utilities in the area and determine if they will interfere with the proposed utility. Notify FDF if there is an interference.

E. Remove existing pipe to the extent necessary to make new tie ins. Tie-in locations shall be adjusted to conform to field conditions.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Installation - Pipe: Ductile Iron Pipe

1. Install pipe to indicated elevation to within tolerance of 5/8 inches at structures.
2. Install ductile iron piping and fittings to AWWA C600.
3. Route pipe in straight line except as shown on drawing.
4. Install pipe to allow for expansion and contraction without stressing pipe or joints as per manufacturer's recommendations.
5. Slope water pipe and position drain at low points.
6. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main, except large radii bends.

7. Establish elevations of buried piping to ensure not less than 3.5 feet of cover.
8. Backfill trench in accordance with Section 02225.

B. Installation - Pipe: HDPE

1. Install pipe to indicated elevation to within tolerance of 5/8 inches at structures.
2. Install HDPE piping and fittings to AWWA C906 (by butt weld fusion method, in accordance with ASTM D3261).
3. Route pipe in line as shown on drawing.
4. Install pipe to allow for expansion and contraction without stressing pipe or joints as per manufacturer's recommendation.
5. Install access fittings to permit cleanout.
6. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main.
7. Establish elevations of buried piping to ensure not less than 3.5 feet of cover. Five feet of cover is required when pipe is within 100 feet of the toe of the active Fly Ash pile.
8. Install trace wire continuous over top of pipe, buried 6 inches below finish grade, above pipe line; coordinate with Section 02225.
10. Backfill trench in accordance with Section 02225.

C. Installation - Valves:

1. Set valves on solid bearing of concrete.
2. Center and plumb valve box over valve. Set box cover flush with finished grade.

3.4 FIELD QUALITY ASSURANCE

A. Perform hydrostatic tests on water line in accordance with AWWA C600 and Section 15060. Notify FDF at least 24 hours in advance of planned testing. Submit report within 1 week after completion of test.

B. The new pipes shall be hydrostatically tested prior to tie-in. The test shall be run at 50 psi above the working pressure of the water main and hold within specifications for 2 hours.

$$Allowable\ Leakage = \frac{LD\sqrt{p}}{498,168}$$

L = Length of Pipe in Test in Feet
D = Diameter of Pipe in Inches
p = Test Pressure (operating Pressure + 50 psi = 110 psi + 50 psi)

Answer = Allowable Leakage in Cubic Feet over a 2-Hour Period.

Unless otherwise instructed by FDF, use 100 psi as the operating pressure for testing purposes.

END OF SECTION

SECTION 02713
GEOMEMBRANE LINER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geomembrane materials, manufacture, fabrication, and installation of a geomembrane liner on the stormwater retention basin bottom and side slopes, ditches and underneath the Non Impacted Material Stockpiles.

B. Geotextile material as specified in Section 02270.

C. Use of geosynthetics for erosion control is specified in Section 02270.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non Impacted Material Earthwork.

D. Section 02270 - Erosion and Sediment Control.

E. Section 02720 - Site Drainage and Water Management.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D638-96 — Standard Test Method for Tensile Properties of Plastics.
2. ASTM D746-95 — Standard Test Method for Brittleness Temperature of

		Plastics and Elastomers by Impact.
3.	ASTM D1004 REV A -94	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
4.	ASTM D1204-94	Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperatures.
5.	ASTM D1505-85	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
6.	ASTM D4437-84	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

B. Federal Test Method Standard (FTMS):

1.	FTMS 101B-71	Method 2065, Puncture Resistance and Elongation Test.

C. United States Environmental Protection Agency (US EPA):

1.	US EPA Technical Guidance Document EPA/600/2-88/052	Lining of Waste Containment and Other Impoundment Facilities, 1988.
2.	US EPA Technical Guidance Document EPA/530/SW-91/051	Inspection Techniques for the Fabrication of Geomembrane Field Seams, May 1991.

D. Geosynthetics Research Institute (GRI):

1.	GRI Test Method GM6	Standard Practice for Pressurized Air Channel Test for Dual Seamed Geomembranes, latest revision.

E. National Sanitation Foundation (NSF):

1.	Standard Number 54-93	Flexible Membrane Liners.

1.5 DEFINITIONS OF TERMS

A. Manufacturer: The manufacturer is the firm or corporation responsible for production of the finished rolls of geomembrane material from raw material polymer to be used in the project. The manufacturer is responsible for the condition of the geomembrane until the material is accepted by the Construction Manager or his/her field representative upon delivery. The manufacturer shall produce a consistent product meeting the project specifications and shall provide quality control documentation for the product specified herein.

B. Liner Subcontractor: The Liner Subcontractor is the firm responsible for installation of the geomembrane. The Liner Subcontractor shall be the manufacturer or an approved installer trained and certified to install the manufacturer's geomembrane. The Liner Subcontractor shall provide an Installation Supervisor responsible for the field crew.

C. Film Tear Bond (FTB): A failure in the ductile mode of one of the bonded sheets by testing prior to complete separation to the bonded area as depicted in US EPA Technical Guidance Document EPA/600/2-88/052. A seam shall be classified as a FTB if no greater than 10 percent of the seam width peels (separates) at any point.

D. Geomembrane: A synthetic lining material, also referred to as a flexible membrane liner (FML).

1.6 QUALITY ASSURANCE PROGRAM

A. A laboratory shall be maintained by the manufacturer of the geomembrane materials at the point of manufacture to ensure quality control in accordance with ASTM and FTMS testing procedures (referenced in Section 1.4, as applicable). That laboratory shall maintain records of its quality control results and provide to Flour Daniel Fernald (FDF), prior to shipment, a Certificate of Compliance stating that all rolls of geomembrane

material supplied are in compliance with specification physical properties requirements.

B. The certificate shall include the name of the manufacturer, chemical composition, product description, statement of compliance to specification physical properties requirements, and the signature of authorized official attesting to the information required.

C. Testing of factory fabricated seams for geomembrane shall be performed by the manufacturer. The manufacturer shall inspect and test 100 percent of factory fabricated seams in accordance with these specifications.

D. Testing of geomembrane materials during construction will be performed by subcontractor.

E. Geomembrane shall be randomly sampled and tested in accordance with the manufacturer's approved QC manual. Samples not meeting the minimum requirements specified shall result in the rejection of the applicable sheets.

F. The Liner Subcontractor shall have installed a minimum of 1 million ft^2 of High-Density Polyethylene (HDPE) geomembrane.

G. The Installation Supervisor shall have demonstrated experience in installing and seaming of a minimum of 500,000 ft^2 of HDPE geomembrane liner systems for similar applications. The Installation Supervisor shall remain on site and be responsible for the liner layout, seaming, patching, repairs, testing coordination with FDF, and all other activities associated with installation of the geomembrane.

1.7 SUBMITTALS

A. Provide submittals as required by Section 01011.

B. Submit samples of the proposed geomembrane.

C. Submit a Certificate of Compliance from the manufacturer in accordance with Part 6 of the Contract Documents for the geomembrane material.

D. Submit quality control certificates issued by the producer of the raw materials used to manufacture the geomembrane. These certificates shall include the following.
   1. Origin, identification, and production plant location of the resin used to manufacture the geomembrane.
   2. Reports of testing conducted to verify the quality of the resin including the stabilization compounds used to manufacture the geomembrane, with signature of authorized official. Properties testing typically performed by the resin manufacturer shall be included in the reports.

E. Shop Drawings: Submit shop drawings showing proposed geomembrane panel layout, panel size, shop and field seams, and location of test coupons. The drawings shall include number or letter or panels and cross-reference surrounding panels, details of seaming the geomembrane, connections, penetrations, pipe boot fabrication, and other construction related details. Shop drawings shall be prepared in accordance with Part 6 of the Contract Documents.

F. As-builts: Submit as-built drawings showing geomembrane panel layout, panels size, seam type and location, location of test coupons, and areas where repairs were made. Drawings shall be prepared in accordance with Part 6 of the Contract Documents.

G. Submit inspection and testing data for factory fabricated seams.

H. Submit geomembrane manufacturer's quality control manual including description of laboratory facilities.

I. Submit results of the manufacturer's physical properties testing in accordance with the approved QA

Manual. Testing shall include, but not be limited to, the typical properties outlined in Table 1.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Each roll of geomembrane shall be marked to show the following minimum information:
   1. Name of manufacturer.
   2. Product type.
   3. Physical dimensions (length and width).
   4. Roll identification number.

B. The Liner Subcontractor shall review, inspect, and place into proper storage all materials received on site until their installation. All such materials shall be inspected to verify their conformance with the requirements of these specifications and that they are free of defects. Any nonconforming or defective materials shall be clearly marked and promptly repaired per approved procedure or removed from the job site.

C. When the geomembrane materials are delivered to the construction site, FDF, or designated representative, will inspect to confirm that the material is the material that was specified and that the material is not damaged. Inspection activities shall prevent, detect, and correct the following:
   1. Puncture from nails or splinters.
   2. Tears from operation of equipment or inadequate packaging.
   3. Blocking (the bonding together of adjacent membrane layers), which may be caused by excessive heat.
   4. Crumpling or tearing from inadequate packaging support.

D. Handling
   1. Palleted geomembrane panels shall be accordion folded width-wise and length-wise without causing damage to the geomembrane.
   2. Banding straps around the geomembrane and pallet shall be properly cushioned so as not to cause damage to any part of the geomembrane panel.

3. The stacking of palleted geomembrane panels on top of one another is not permitted.
4. Damage shall be avoided by careful handling of the geomembrane material during preparation for shipment and of the packaged crates and rolls of material.
5. When damage to a crate or roll cover has occurred, careful examination of the underlying material is required. If damage is found, the Liner Subcontractor and FDF should carefully examine the entire shipment for damage.

E. Storage: Sufficient quantities of materials shall be stockpiled to meet project schedule and requirements. Materials shall be stored on site at locations designated by FDF.

F. The Liner Subcontractor shall be responsible for unloading, storage, and care of the geomembrane material until such material has been incorporated into the work. Materials shall be stored in a manner that prevents damage in accordance with the manufacturer's recommendations. The materials shall be stored on a prepared surface (excluding wooden pallets) and shall not be stacked more than two rolls high.

G. The Liner Subcontractor shall be responsible for replacing any damaged or unacceptable material at no expense to FDF.

1.9 SEQUENCING AND SCHEDULING

A. The Liner Subcontractor shall provide a sequence and schedule of work for the approval of FDF.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. HDPE liner shall be Hyperflex, by GSE Lining Technologies Systems Inc., equivalent products by SERROT Corp., POLY-FLEX Corp., National Seal Company, or other approved equal.

B. Materials manufactured by others may be submitted to FDF for consideration.

2.2 EQUIPMENT

A. The Liner Subcontractor shall use appropriate installation and welding equipment per the manufacturer's instructions.

B. Welding Equipment: The welding equipment used shall be capable of continuously monitoring and controlling the extrusion/fusion zone. The fillet-extrusion welding device provides continuous dynamic integration of the extrudate into the sheet material through the means of rotating tips in the nozzle. The composition of the extrudate (welding rod) is identical to the flexible membrane liner. This method of seaming is applied for all tees, patches, "fishmouths," and detail work. The fusion welding device employs a dual hot wedge (hot shoe) and compression. The system lifts both layers of flexible membrane liner off the subgrade, and fusion is brought about by melting the sheets against the hot wedge and compressing the two melted surfaces together, resulting in a total integration of the layers.

2.3 MATERIALS

A. Liner: The liner membrane shall be designed and manufactured specifically for the purpose of containment of liquids in hydraulic structures. It shall be manufactured from new, first-quality HDPE resin and shall meet the physical requirements indicated in the Physical Properties Table (Table 1).

B. Other Materials

1. Boots for pipe and power pole penetrations shall be prefabricated and designed to fit site-specific conditions for the intended slope and size of pipe. Boots shall be of the same material as the geomembrane.

C. Typical Physical Properties:

Table 1 - Typical Geomembrane Physical Properties

Typical Properties	Test Method	Gage (Nominal) 60 mil (1.5 mm) HDPE
Density g/cc. (Min.)	ASTM D1505	0.94
Tensile Properties (Typical) 1. Tensile Strength at Break (Pounds/inch width) 2. Tensile Strength at Yield (Pounds/inch width) 3. Elongation at Break (Percent) 4. Elongation at Yield (Percent)	ASTM D 638 Type IV Dumb Bell at 2 ipm	 300 144 800 15
Tear Resistance Initiation, lbs. (Typical)	ASTM D1004 Die C	50
Low Temperature Brittleness, F (Typical)	ASTM D746 Procedure B	-120
Dimensional Stability, Percent Change Each Direction (Max.)	ASTM D1204 212 degrees F 1 hr.	±1
Puncture Resistance, Pounds (Typical)	FTMS 101B Method 2065	90

2.4 FACTORY FABRICATION

A. Geomembrane liner shall be factory seamed into panels as large as possible for transportation and for the areas to be lined. Geomembrane liner for ditches should be factory seamed and transported as one piece if possible.

B. Factory fabrication shall be performed under environmental conditions as recommended by the manufacturer.

C. The geomembrane material shall be continuously inspected for uniformity, damage, imperfections, holes, cracks, thin spots, foreign materials, tears, punctures, and blisters. Any imperfections shall be immediately repaired and reinspected.

D. All seams shall be visually inspected and results documented.

E. Nondestructive seam testing shall be performed on all fabricated seams over their full length in accordance with ASTM D4437 and the manufacturer's quality control manual. Test methods shall be vacuum chamber or pressurize air channel, except air lance may be used on inaccessible seams.

F. All inspection and testing of factory seams shall be performed by the manufacturer's laboratory.

G. Failure of the material and/or seams to meet all the requirements of these specifications may be cause for rejection of the geomembrane material and/or seams, as appropriate.

H. In addition to visual inspection and nondestructive testing, a 48-inch sample shall be taken from each factory seam welding unit used in this work at the beginning of every work shift and every 4 hours of production thereafter. Samples shall be from the same production lot as the field panels (i.e., will not require patching of fabricated panels). Test specimens shall be cut at quarter points from each 48-inch seam sample (a total of three places) and tested for factory seam shear strength and peel adhesion. The seam shear strength shall be tested in accordance with ASTM D4437, as modified in Annex A of NSF 54, and shall have a tensile strength of at least 90 percent of the parent geomembrane strength. Failure of seam shall be classified as FTB. The peel adhesion shall be tested in accordance with ASTM D4437, as modified in Annex A of NSF 54, and shall provide a peel strength that is greater than 60 percent of the parent geomembrane yield strength. Failure of seam shall be classified as FTB.

PART 3 EXECUTION

3.1 PREPARATION

A. The earthen surface shall be smooth and true to grade with no exposed rocks, stones, sticks, roots, or other sharp objects or debris of any kind larger than 2" in any direction.

B. Before starting installation of the liner, the Liner Subcontractor shall inspect the substrate for suitability with the requirements of the liner. The liner installer shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work.

C. During the time of liner installation, the Liner Subcontractor shall be responsible for protection and maintenance of the exposed subgrade until final acceptance of the liner.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Verify gradients and elevation of sub-base.

B. Verify that subgrade is dry.

C. Install geotextile on prepared subgrade in Non Impacted Material Stockpile locations in accordance with the Construction Drawings prior to geomembrane liner installation. Geotextile installation shall be in accordance with the Construction Drawings and manufacturer's recommendations. Geotextile as specified in Section 02270.

D. Geomembrane liner shall be placed and anchored in such a manner that fabric will not excessively stretch or tear.

E. Appropriate measures shall be taken during installation to provide sufficient slack in the liner to avoid the generation of excessive stresses in the liner due to temperature changes.

F. Field seams shall be made using either the dual hot wedge (fusion) welding or the fillet-extrusion welding process (for areas not accessible with the dual hot wedge method). Field seams shall be made only when weather conditions are favorable. The contact surfaces shall be free of dirt, dust, moisture, or other foreign material. The contact surfaces shall be aligned with sufficient overlap and bonded in accordance with the liner manufacturer's recommended procedures. Wrinkles shall be smoothed out, and seams shall be inspected by nondestructive testing techniques to verify their integrity.

G. Deployment

1. The geomembrane shall be deployed following the manufacturer's recommendations so that, at the time of installation, it will contain a minimum of wrinkles and be under minimum stress.
2. Each panel/roll of the geomembrane shall be rolled out and installed in accordance with the approved shop drawings. The layout shall be designed to keep field joining of the geomembrane to a minimum and to be consistent with proper methods of geomembrane installation.
3. The geomembrane shall be unfolded or unrolled so as to prevent damage to the underlying or prepared subgrade or geotextile.
4. Should punctures, rips, or tears be encountered in the geomembrane material, the Liner Subcontractor shall immediately notify FDF and repair as necessary.

H. Seaming Weather Conditions

1. Normal Weather Conditions
   a. The normal required weather conditions for seaming are as follows:
      1) Ambient temperature as recommended by the manufacturer.
      2) No precipitation or other excessive moisture, such as fog, dew, or ponded water.
      3) No excessive winds.

b. These weather conditions shall be fulfilled during seaming process.

2. Cold Weather Conditions

a. If the ambient temperature is below 40 degrees F, seaming of geomembrane shall not be permitted unless the Liner Subcontractor can demonstrate to FDF's satisfaction that geomembrane seam quality is not adversely impacted. The following conditions shall also be met to ensure a quality seaming process:

1) Preheating the surface of the geomembrane to achieve normal temperature range.

2) Preheating may be waived by FDF if the Liner Subcontractor demonstrates that satisfactory welds of equivalent quality may be obtained without preheating at the expected temperature of installation.

3) Preheating devices shall be approved by the manufacturer.

4) Care shall be taken to ensure that surface temperatures are not lowered below the minimum required surface temperature for welding due to winds.

5) Additional destructive test samples shall be taken at FDF's discretion.

6) Trial seams shall be performed under the same ambient temperature conditions as the actual seams.

3. Warm Weather Conditions

a. If the ambient temperature is above 104 degrees F, seaming of geomembrane shall not be permitted unless the Liner Subcontractor can demonstrate to FDF's satisfaction that geomembrane seam quality is not adversely impacted.

b. Test seams shall be performed under the same ambient temperature conditions as the actual seams.

c. Additional destructive test samples shall be taken at FDF's discretion.

I. Field Seaming

1. Panel field seaming shall be performed using the dual hot wedge welding techniques as outlined in Section 7 of US EPA Technical Guidance Document EPA/530/SW-91/051. Welding equipment and seaming temperatures shall be in accordance with the manufacturer's recommendations.
2. Field seams shall be oriented parallel to the line of maximum slope.
3. Unless directed otherwise by FDF, minimum overlap for field seams shall be in accordance with the manufacturer's recommendations.
4. The welding equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the lining material to ensure that changes in environmental conditions will not affect the integrity of the weld.
5. Welding of field seams with an extrusion welder is only acceptable for repairing holes in the liner, repairing failed seams revealed by nondestructive testing, repairing areas where destructive testing is performed, at pipe/liner penetration boots, and other areas where the hot wedge welding machines cannot be used due to space restrictions.

J. The liner shall be placed over the prepared surface in such a manner as to ensure minimum handling. The geomembrane shall not be dragged over rough subgrade surfaces. Any damage to the base surface resulting from liner installation or liner handling equipment shall be repaired by the Liner Subcontractor at its own expense prior to placement of the liner. Vehicular traffic across the geomembrane shall not be allowed. The panels shall be such lengths and widths and shall be placed in such a manner as to minimize field seaming.

K. In areas where wind is prevalent, liner installation shall be started at the upwind side of the project and proceed downwind. The leading edge of the liner shall be secured at all times with sandbags or other means sufficient to hold it down during high winds.

L. Sandbags shall be used as required to hold the liner in position during installation. Materials, equipment, or other items shall not be dragged across the surface of the liner nor be allowed to slide down slopes on the liner.

M. Liner panels shall be closely fit and sealed around inlets, outlets, and other projections through the liner. All piping, structures, and other projections through the liner shall be sealed as shown on the Construction Drawings.

N. All joints shall be tightly bonded on completion of the work. Any liner surface showing injury resulting from scuffing, penetration by foreign objects, or distress from rough subgrade shall be repaired or replaced as approved by FDF.

O. Each suspect location shall be nondestructively tested using methods described in Section 1.4 as appropriate. The Liner Subcontractor shall not proceed with any materials which will cover locations that have been repaired until satisfactory test results have been obtained.

P. Pipe/Liner Penetration Boots

1. The geomembrane boots shall be furnished and installed where indicated on the Construction Drawings.
2. The geomembrane boots shall terminate in a skirt section suitable for welding to the geomembrane.
3. Boots and skirts shall fit snugly around the pipe or power pole. Prefabricated material shall be designed to fit site-specific conditions for the intended size and slope of pipe.
4. The geomembrane shall be secured to the pipe or power pole with clamps as shown on the Construction Drawings after pipe/liner penetration boots have been tested.

Q. Any wrinkles that can fold over shall be repaired either by cutting out excess material or, if possible, allowing the liner to contract due to temperature

reduction prior to placing the overlying material. In no case shall material be placed over the geomembrane which could result in the geomembrane folding.

R. Destructive Seam Testing

1. Two types of samples shall be taken at each location, one for field tests and one for laboratory tests.
2. For the field tests, two seam samples, 1 inch wide by 12 inches long with the seam centered across the length shall be taken 42 inches apart. These sample coupons shall be removed by the Liner Subcontractor for every 500 feet of seam length. A minimum of three samples shall be tested, including at least one for each day's production seaming.
3. Upon obtaining each sample, assign a number to the sample and mark it accordingly. Record sample location on the layout drawing. Record the purpose of the sample (i.e., statistical, routing, or suspicious weld area).
4. These samples shall be tested in the field using a tensiometer capable of quantitatively measuring shear and peel strengths.
5. The sample coupon shall be divided into three equal parts: one part for laboratory testing, one part to the Construction Manager for archive storage, and one part to the Liner Subcontractor for field testing. The sample coupon shall be tested in the testing laboratory for shear strength and peel adhesion.

S. Repair Procedures

1. Any portion of the geomembrane failing a destructive test, nondestructive test, or any damaged portion shall be repaired in accordance with this section and the manufacturer's recommendations.
2. All surfaces shall be clean and dry at the time of the repair.
3. The repair procedures, materials, and techniques shall be approved in advance of the specific

repair by FDF. Approved methods from which the selected repair shall be chosen are as follows:

a. Patching - used to repair large holes, tears, large panel defects, and destructive sample locations.

b. Capping - used to repair failed welds or to cover seams where welds cannot be nondestructively tested.

c. Removal - used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles) from the installed geomembranes.

4. If a sample fails one of the destructive tests, the seam shall be reconstructed using one of the following methods:

   a. The seam shall be reconstructed between the location of the sample which failed and the location of the next passing sample in each direction.

   b. The welding path is retraced to an intermediate location at least 10 feet from the location of the failed sample and a second sample is taken for additional testing. If the second test sample passes, the seam shall then be reconstructed between the location of the second test and the original sampled location. If the second test fails, this process shall be repeated.

5. All acceptable seams shall extend between two locations where samples passed the required test and shall include one test location along the reconstructed seam.

6. Each major repair requiring a patch or cap shall be identified on the as-built drawing.

7. Each repair shall be numbered and logged by the Liner Subcontractor. Each repair shall be nondestructively tested using methods described in this section. Repairs which pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more than 100 feet long may be sufficient to require destructive test sampling, at FDF's discretion.

Failed tests indicate that the repair shall be redone and retested until passing test results are achieved. FDF shall observe all nondestructive testing of repairs. The Liner Subcontractor shall record the number of each repair, the test location, date, and test outcome.

3.3 QUALITY CONTROL

A. General: The Liner Subcontractor shall conduct a fully documented quality assurance/quality control program to ensure that all installation work is performed which will result in a secure, watertight liner. All quality control inspection and testing shall be performed by qualified personnel who are thoroughly knowledgeable about all installation procedures and techniques used. Three copies of all inspection and test reports generated by the Liner Subcontractor shall be submitted to FDF not later than the second work day following their generation. As a minimum, the Liner Subcontractor shall provide written verification of the results of all of the following inspections and tests.

B. Weld Quality Control

1. A trial seam, 3 feet long, from each welding machine shall be run each day prior to liner seaming and under the same conditions as exist for the liner seaming. Additionally, at least once every 4 hours during continuous operation.
   a. Samples of seam shall be cut from the test weld 1/4 inch to 1/2 inch wide and tested by field tensiometer in the peel and shear modes.
   b. Should failure of the seam occur, another trial seam shall be prepared and tested. If the additional sample fails, the seaming apparatus and seamer shall not be accepted until deficiencies are corrected.
   c. The trial seam shall be marked with the time of day, date, ambient temperature, and welding machine used in its production.
   d. The seam sample shall be kept for subsequent testing on laboratory tensiometer equipment

in accordance with the applicable ASTM D1004 and D4437 tests. If either sample fails through the weld, the welding machine shall be adjusted as appropriate and another test weld produced and tested until satisfactory results are achieved. A calibrated, hand-operable tensile testing machine shall be furnished by the Liner Subcontractor for the purpose of tensile testing.

2. All welds, on completion of the work, shall be tightly bonded. Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of HDPE membrane.
3. A quality control technician, employed by the Liner Subcontractor, shall follow behind each seam crew and perform a visual inspection of the seamed area. Defective seams shall be marked and repaired in accordance with manufacturer's published repair procedure.
4. No "fishmouths" shall be allowed within the seam area. Where "fishmouths" occur, the material shall be cut and overlapped, and an overlap-extrusion weld shall be applied.

B. Nondestructive Testing: All field seams (100 percent) shall be tested nondestructively. Fillet-extrusion welds are tested with a vacuum chamber in accordance with ASTM 4437. Hot wedge welds shall be dual seam pressure tested, pressurizing the air channel created by the split face design of the hot wedge per GRI GM-6.

C. Destructive Seam Testing
1. Two types of samples shall be taken at each location, one for field tests and one for laboratory tests.
2. For the field tests, two seam samples, 1 inch wide by 12 inches long with the seam centered across the length shall be taken 42 inches apart. These sample coupons shall be removed by the Liner Subcontractor for every 500 feet of seam length, unless more frequent testing is required by FDF. A minimum of three samples shall be tested,

including at least one for each day's production seaming. The seams shall not be covered by another material before they have been tested and accepted by FDF.

3. Upon obtaining each sample, assign a number to the sample and mark it accordingly. Record sample location on the layout drawing. Record the purpose of the sample (i.e., statistical, routing, or suspicious weld area).
4. These samples shall be tested in the field using a tensiometer capable of quantitatively measuring shear and peel strengths.
5. The sample coupon shall be divided into three equal parts: one part for laboratory testing, one part to the Construction Manager for archive storage, and one part to the Liner Subcontractor for field testing. The sample coupon shall be tested in the testing laboratory for shear strength and peel adhesion.

D. Repair Procedures

1. Any portion of the geomembrane failing a destructive test, nondestructive test, or any damaged portion shall be repaired in accordance with this section and the manufacturer's recommendations.
2. All surfaces shall be clean and dry at the time of the repair.
3. The repair procedures, materials, and techniques shall be approved in advance of the specific repair by FDF. Approved methods from which the selected repair shall be chosen are as follows:
   a. Patching - used to repair large holes, tears, large panel defects, and destructive sample locations.
   b. Capping - used to repair failed welds or to cover seams where welds cannot be nondestructively tested.
   c. Removal - used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles) from the installed geomembranes.

4. If a sample fails one of the destructive tests, the seam shall be reconstructed using one of the following methods:
   a. The seam shall be reconstructed between the location of the sample which failed and the location of the next passing sample in each direction.
   b. The welding path is retraced to an intermediate location at least 10 feet from the location of the failed sample and a second sample is taken for additional testing. If the second test sample passes, the seam shall then be reconstructed between the location of the second test and the original sampled location. If the second test fails, this process shall be repeated.
5. All acceptable seams shall extend between two locations where samples passed the required test and shall include one test location along the reconstructed seam.
6. Each major repair requiring a patch of cap shall be identified on the as-built drawing.
7. Each repair shall be numbered and logged by the Liner Subcontractor. Each repair shall be nondestructively tested using methods described in this section. Repairs which pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more than 100 feet long may be sufficient to require destructive test sampling, at FDF's discretion. Failed tests indicate that the repair shall be redone and retested until passing test results are achieved. FDF shall observe all nondestructive testing of repairs. The Liner Subcontractor shall record the number of each repair, the test location, date, and test outcome.

3.4 CLEANING

Remove and manage excess materials in accordance with the subcontract, Part 6, Scope of Work.

3.5 **PROTECTION**

A. Provide protection from damage until anchorage and welding of seams has been accomplished and all testing and inspections are completed and final acceptance by FDF has been received.

END OF SECTION

SECTION 02720
SITE DRAINAGE AND WATER MANAGEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site storm drainage piping, gravity conveyance piping, fittings, accessories, and bedding.

B. Site surface drainage and stormwater retention basins.

C. Control of surface water and removal of ponded water from construction areas.

D. Requirements for Water Management Plan including surface water and perched groundwater

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non-impacted Material Earthwork.

D. Section 02205 - Impacted Material Excavation and Handling.

E. Section 02270 - Erosion and Sediment Control.

F. Section 02667 - Drinking Water Lines.

G. Section 03001 - Concrete.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation, Construction and Material Specifications, January 1, 1997 (ODOT). Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

B. American Society for Testing and Materials (ASTM):

1.	ASTM D1248-84	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
2.	ASTM D2321-89	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Application.
3.	ASTM D3035-95	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
4.	ASTM F405-96	Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
5.	ASTM F477-95	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Water Works Association (AWWA):

1.	AWWA C901-88	Polyethylene (PE) Pressure Pipe and Tubing 1/2-inch through 3-inch, for Water Systems.
2.	AWWA C906-90	Polyethylene (PE) Pressure Pipe and Fittings 4-inch through 63-inch, for Water Distribution.

D. American Association of State Highway and Transportation Officials (AASHTO):

1.	AASHTO M36-91	Standard Specification for Corrugated Steel Pipe,

Metallic-Coated, for Sewers and Drains.

2. AASHTO M294-94 Specification for Corrugated Polyethylene Pipe, 12 to 36 Inch Diameter Pipe.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011 and Part 6 of the Contract Documents.

B. Water Management Plan: Plans and details describing methods for storm water collection, run on control, points of discharge, and methods to protect exposed contaminated areas at end of day's work or during inclement weather for denuded slopes and excavations. The plan will be submitted to FDF for review and approval as part of the Safe Work Plan prior to initiation of construction.

C. Provide as-built information in accordance with Section 01050.

D. Test Reports: Test reports for all tests required under Field Quality Control.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

A. Corrugated HDPE for West Pump Station Culvert Diversion

1. Smooth interior, corrugated exterior high-density polyethylene pipe conforming to AASHTO M294 Type S pipe and fittings shall be made of polyethylene compounds that meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM D1248 and ASTM F405.
2. Fittings shall be factory made by the manufacturer of the pipe. No field fabricated fittings will be allowed.
3. Coupling bands/sleeves shall be watertight, gasketed, bell type with an indentation in the center to ensure proper positioning of the pipe.

Coupling bands/sleeves shall be factory installed on one end of the pipe. Gaskets shall be a solid cross section ring conforming to ASTM F477.

4. Corrugated pipe, fittings, couplings bands/ sleeves, gaskets and gasket lubricant shall be supplied by the manufacturer of the pipe.

B. Corrugated Metal Pipe

1. Corrugated metal storm pipe shall be in accordance with AASHTO M36 and ODOT 707. Corrugated metal drain pipe shall be galvanized, of the size and type specified on the construction drawings.
2. Storm drain pipe, culverts, and fittings as identified on drawing shall be corrugated steel, 14-gage thickness. Culverts shall have standard metal flared sections.
3. Coupling bands shall be corrugated, galvanized steel bands in accordance with AASHTO M36. Pipe sections with rerolled ends shall be joined with annular corrugated connecting bands. Helical corrugated pipe ends shall be joined using helical corrugated connecting bands.

C. High-Density Polyethylene (HDPE) Pipe AWWA C906 (PE 3408), ASTM D3035 for wheel wash sump discharge line.

1. Fitting: AWWA C901, molded.
2. Joints: Butt fusion, flanged gasket joints at interface connections with ductile iron pipe and valves.
3. Trace Wire: Magnetically detectable conductor, green.

2.2 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 02225.

B. Cover: As specified in Section 02225.

2.3 CONCRETE AND CONCRETE ACCESSORIES

A. Materials: Refer to Section 03001.

B. All precast concrete shall meet the requirements of ODOT 706.13 with 5 1/2 percent air void content in the hardened concrete.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Verify that excavation trenches are ready to receive work.

3.2 PREPARATION

A. Hand trim excavations. Correct over-excavation according to the requirements of Section 02225 of this specification package.

3.3 INSTALLATION

A. General
1. If rock is encountered, the excavation shall be carried no less than 6 inches and no more than 12 inches below the bottom of pipe materials. Approved compacted material shall be used to backfill from rock excavation prior to installation.
2. All compacted backfill shall meet the requirements of unclassified backfill in accordance with Section 02225. Backfill compaction shall conform to the requirements of Section 02225.
3. See Section 02225 for the frequency of samples.
4. Excavation shall conform to Section 02225.

B. Installation of Corrugated Metal Pipe
1. The pipe and fittings shall be free of foreign inclusions and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining.
2. All pipe shall be laid as shown in the drawings.
3. Joints for corrugated metal pipe shall be made with corrugated galvanized steel coupling bands in accordance with AASHTO M36.

4. Paint welds, cuts and holes with a zinc based paint.

C. The west pump station culvert diversion (north of the Inactive Flyash Pile) is to be extended as shown on the drawings. This extension is temporary. Subcontractor is to install extension and repair as necessary, including replacement if required.

D. See Section 02667 for installation of HDPE pipe joined by fusion welding. Install in accordance with ASTM D2321.

E. Stormwater that is encountered during or collects in excavations is to be conveyed to the retention basins for conveyance to SWRB.

F. In other construction areas stormwater control shall be achieved by gravity or by pumps. All methods shall be of sufficient capacity to maintain excavation work in the dry. Runon into work areas is to be minimized (i.e., grading and diversions).

3.4 FIELD QUALITY CONTROL

A. Inspection:
1. Inspection shall include checking for proper alignment and location of all drainage pipe prior to backfill.
2. All inspections shall have a report filed with FDF within one week after the test.

B. Notify FDF of testing and/or inspection activities at least 24 hours prior to the start of all tests or inspections.

C. Testing of backfill compaction shall be as specified in Section 02225.

END OF SECTION

SECTION 02831
CHAIN LINK FENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Permanent fence framework, fabric, and accessories to be installed south of the South Field and near the Support Area as indicated on the construction drawings.

B. Excavation for post bases; concrete foundation for posts and center drop for gates.

C. Manual gates and related hardware.

D. Fence repair, as needed, as a result of relocation or of Subcontractor's construction or site clearing activities.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02100 - Site Clearing.

D. Section 02200 - Non-impacted Material Earthwork.

E. Section 16170 - Grounding and Bonding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1.	ASTM A121 Rev. A-92	Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.

2.	ASTM A123 Rev. A-89	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3.	ASTM A153 A153M-95	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4.	ASTM A392 -96	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5.	ASTM A570 A570M-95	Standard Specification for Steel, Sheet and Strip, carbon, Hot-Rolled, Structural Quality.
6.	ASTM F567-93	Standard Practice for Installation of Chain Link Fence.
7.	ASTM F669-92	Standard Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence.
8.	ASTM F1234-93	Standard Specification for Protective Coating on Steel Framework for Fences.

1.5 SYSTEM DESCRIPTION

A. Fence Height: 6 feet nominal (with three strands of barbed wire 1 foot high on extension arms, if applicable) as indicated on drawings.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Fence Post and Rail Strength: Conform to ASTM F669.

D. Gate Sizes: As shown on drawings.

1.6 SUBMITTALS

A. Provide submittals as required by Section 01011 and Part 6 of the Contract Documents.

B. As-Built Drawings: Indicate plan layout, size, type, and swing of gates.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framing (Steel): ASTM A570 zinc coated hot rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi. External surface triple coating per ASTM F1234, Type B and Type D with 1.01 ± 0.1 ounce zinc per square foot and 30±15 micrograms of chromate per square inch. Coat internal surface after welding with a zinc-rich based organic coating (91 percent min. zinc powder).

B. Fabric Wire (Steel): ASTM A392 zinc-coated, 9-gage wire fabric, 2-inch diamond mesh interwoven wire, top salvage twisted tight, bottom salvage knuckle end closed. Fabric wire on-site can be reused if approved by FDF.

C. Barbed Wire: ASTM A121 galvanized steel; 12-gage wire, to match existing fence.

D. Concrete: See Section 03001.

E. Gates: Swing gates internally braced to prevent sag. Fabric equivalent to that of fence; secure to frame with tension bars and hook bolts. Extend top frame of gates vertically to provide three rows of barbed wire, if applicable. Fence fabric and rails may be reused if in sound condition. Reuse existing fence fabric, posts and fence accessories where possible.

F. Components
1. Corner and Terminal Posts: 2-7/8 inch, outside diameter.
2. Top and Brace Rail: 1-5/8 inch, outside diameter, plain end, sleeve coupled.
3. Tension Wire: 6-gage galvanized steel, single strand.
4. Tie Wire: 6-gage galvanized steel wire.
5. Line Posts: 2-3/8-inch outside diameter.

6. Gate Posts: 2-7/8-inch outside diameter.
7. Gate Frame: 1-7/8-inch diameter for welded fabrication.

2.2 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Extension Arms: Cast steel galvanized, to accommodate three strands of barbed wire, single arm, sloped to 45 degrees up from horizontal.

D. Gate Hardware: Hinges shall be galvanized, malleable iron hinges. Ball and socket bottom hinge to sustain gate weight. Install gate with a positive type latching device and padlocking capabilities and double gates with center plunger rod catches. Secure gates in open position with semiautomatic outer catches to secure gates in open position.

E. Drive Anchor: Two angles, 36-inch length, 1-1/4 inches by 1-1/4 inches by 1/4 inch.

F. Fasteners: Galvanized steel.

2.3 FINISHES

A. Components and Fabric: Galvanized to ASTM A123; 2.0 ounces/square feet coating.

B. Hardware: Galvanized to ASTM A153, 2.0 ounces/square feet coating.

C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install framework, fabric, accessories, and gates in accordance with the manufacturer's instructions and ASTM F567.

B. Set all posts plumb in accordance with details on the drawings. Where concrete footings are used, top of footing shall be 2 inches above finish grade. Slope top of concrete for water runoff.

C. Brace gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end.

D. Provide top rail through line post tops and splice with 6-inch long rail sleeves.

E. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less, as per manufacturer's recommendations.

F. Position bottom of fabric 1 inch above finished grade.

G. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

H. Attach fabric to end and corner posts with tension bars and tension bar clips.

I. Install bottom tension wire stretched taunt between terminal posts, as per manufacturer's recommendations.

J. Install support arms sloped outward and attach barbed wire; tension and secure.

K. Install gates plumb, level, and secure for full opening without interference. Adjust and lubricate hardware for smooth operation.

L. Coat areas where the galvanized finish has been damaged, using zinc-enriched paint.

M. Install grounding as noted on the details, in accordance with Section 16170.

3.2 FIELD QUALITY CONTROL

A. Erection Tolerances
   1. Maximum Variation from Plumb: 1/4 inch.
   2. Maximum Offset from True Position: 1 inch.

B. Patch, repair, or replace any material damaged by the Subcontractor to match undamaged material.

END OF SECTION

SECTION 02900
SOIL PREPARATION AND SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary and permanent seeding, fertilizing, and mulching to stabilize soil stockpiles, disturbed areas, and denuded areas to remain undisturbed for more than 45 calendar days.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non-impacted Material Earthwork.

D. Section 02270 - Erosion and Sediment Control.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation (ODOT), Construction and Material Specifications, January 1, 1997.

1. Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011 and Part 6 of the Contract Documents.

B. Certificates: Provide written certification from supplier of seed to state that the seed delivered to the project complies with the following:
   1. Seed varieties and mixture comply with requirements of the specifications.
   2. Purity and germination rate comply with the requirements of the specifications.

C. Provide written certification from supplier of fertilizer to state that the items delivered to the project comply with the requirements of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in original, sealed containers. Seed in damaged packaging will not be accepted. Containers shall show:
   1. Names and percentage of each seed variety.
   2. Year of production, percentage of purity, minimum germination rate, and date of packaging.
   3. Net weight.

B. Deliver plant nutrients in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. Store materials in a dry area, free from wetting and physical damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Seed
   1. Varieties of grass involved in the work of this section shall be the following.
      a. Permanent seeding:
         1) 40 percent Kentucky Bluegrass.
         2) 40 percent Creeping Red Fescue.
         3) 20 percent Annual Ryegrass.
      b. Temporary seeding: 100% Annual Ryegrass
   2. Mixture shall be clean, guaranteed 95 percent pure, and have a minimum germination rate of 85 percent within 1 year of test.

B. Soil Materials
   1. As specified in Section 02200.

C. Plant Nutrients
   1. Fertilizer:
      a. Fertilizer shall be VCOTE 34-0-14 (no substitution allowed).

D. Water
   1. Potable, clean, and free of substances or matter which could inhibit vigorous growth of grass.

E. Materials used for mulching shall be straw or hay. Mulch shall be reasonably free of weed seed and such foreign materials as may detract from their effectiveness as a mulch or injure desired plant growth.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Verify that the soil surface is ready to receive work of this section and that final dressing is within reasonably close conformity to lines, grades, and cross-sections as shown on the construction drawings.

B. Prepare soil by tilling/cultivating to eliminate uneven areas and low spots. Maintain lines, levels, and contours. Make changes in grade gradual. Blend slopes into level areas.

C. Remove debris, weeds, and undesirable plants and their roots.

D. Repeat cultivation in areas where equipment used for hauling and spreading has compacted subsoil.

3.2 APPLICATION

A. Application of Plant Nutrients:
   1. Apply fertilizer at the rate of 4 pounds per 1000 square feet.

2. Mix thoroughly into upper 2 inches.
3. Lightly water to aid the distribution of fertilizer.

B. Seeding:
1. Apply permanent seed mixture at a minimum rate of 130 lbs per acre in accordance with ODOT Item 659.09. When applying seed with a broadcast spreader, apply evenly in two intersecting directions.
2. Do not seed areas in excess of that which can be mulched on same day.
3. Permanent seeding as specified above shall be performed between March 15 and October 15.
   a. All seeding performed between October 15 and March 15 shall be temporary seeding in accordance with ODOT Item 207. Areas seeded with the temporary seed mix shall be reseeded with the permanent seed mixture during the specified application period.
4. Immediately following seeding, apply mulch.
5. Mulch shall be spread in a 1 to 2 inch layer.
6. Apply water with a fine spray immediately after each area has been mulched. Wet soil to approximately 4 inches deep, at a rate of 120 gallons per 1,000 square feet.

C. Coordinate seeding with Section 02270 - Erosion Control. Areas requiring additional measures after the application of seed shall be closely coordinated with this Section.

3.3 TEMPORARY SEEDING

A. All areas of temporary seeding, such as soil stockpiles and denuded areas to remain undisturbed for more than 45 days, shall be seeded with Annual Ryegrass sown at the rate of 2 pounds per 1000 square feet and mulched.

B. Mulch for temporary seeding shall be as described herein for permanent seeding.

3.4 FIELD QUALITY CONTROL

A. Notify FDF at least three working days prior to date of anticipated inspection.

1. To qualify for acceptance, an area shall have a good, clean stand of perennial grass.
2. Coverage shall be at least 95 percent of the area, and no bare spots shall exceed 3 square feet.
3. Areas that fail to meet requirements of the specifications shall be repaired or re-seeded as necessary to produce an acceptable stand of grass.

END OF SECTION

SECTION 02999
MISCELLANEOUS AND SPECIALTY ITEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of construction fence at the limit of work and other locations as indicated on the construction drawings.

B. Fabrication and installation of caution signs.

C. Installation of ring buoys.

1.2 RELATED SECTIONS

Not Used.

1.3 REFERENCES

A. ODOT Construction and Material Specifications, Item 603.

B. OSHA 29 CFR Part 1926

1.4 DELIVERY STORAGE AND HANDLING

A. Construction fence, signs, and buoys shall be delivered to the site and protected from damage. Damaged items will be removed from the site and replaced at the subcontractor's expense.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011 and Part 6 of the Contract Documents.

B. Twenty days prior to the start of work, submit for review and approval the following:
   1. Construction fence.
   2. Caution signs, drawing to scale including color notations.

3. Buoys.

PART 2 PRODUCTS

2.1 PRODUCTS INCLUDED

A. Caution signs, flat sheet aluminum, 0.063-inch thick, 12-inch minimum dimension in any one direction, yellow reflective sheeting background, black lettering a minimum of one inch in height, all capital letters, standard block lettering. Signs shall read as follows:

CAUTION - DROWNING HAZARD, LIFE VEST REQUIRED WITHIN 5 FEET OF WATER

B. Construction fence shall be yellow, high density polyethylene, 4-foot height, opening size approximately 4-inches by 1/2-half inch, minimum tensile strength of 2000 lbs/ft of width. Posts shall be steel "T" as indicated on the construction drawings. Rebar shall not be permitted.

C. Buoys and line shall be U.S., Coast Guard approved, as required by OSHA in 1926.106.

PART 3 EXECUTION

3.1 CONSTRUCTION FENCING

A. Install construction fence along the Limits of Work at the locations designated on the construction drawings. The construction fence shall be field located. The fence posts shall be driven. Secure and stretch the fence fabric to the posts in order to eliminate any sags horizontally and vertically. The bottom of the fence fabric shall be installed to a maximum of 2 inches above the finished grade.

3.2 CAUTION SIGNS

A. Install caution signs on metal posts at 100 foot intervals (at a minimum per side) along the perimeter of the basins. Metal posts shall be driven and the sign securely bolted to the posts.

3.3 RING BUOYS

A. Provide ring buoys and 90 feet of line at maximum 200 foot intervals around the perimeter of each sediment trap and sediment basin. Buoys and line shall be hung on metal or wood posts. The buoys shall be installed at approximately four feet above grade. Inspect each ring buoy for defects or damage. Repair or replace any damaged buoys.

3.4 GENERAL

A. All signs, construction fence, posts, and buoys associated with the retention basin shall remain the property of FDF and shall remain on site.

END OF SECTION

U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Subcontract No. FSC607

WASTE UNITS REMEDIATION PROJECT
SOUTHERN WASTE UNITS
TECHNICAL SPECIFICATIONS

Division 3

PARSONS

Prepared by: Franklin M. Parton Jr. 6/12/97
Date

Checked by: J. FERN 6/12/97
Date

Franklin M. Parton Jr. 6/12/97

STATE OF OHIO
FRANKLIN M. PARTON, JR.
NO. E-57614
REGISTERED PROFESSIONAL ENGINEER

Date: 05/30/97 03000 WBS No: 1.1.1.1.2.3.6
Rev.: 0 RE: WM SCEP/165/SWU/SITE

SECTION 03001
CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete work for wheel wash pad, manhole bases, electrical switch gear pad extension, electrical service panel rack pad, duct banks, miscellaneous guard posts, fence post bases, and other miscellaneous concrete.

B. Formwork and accessories.

C. Reinforcement and accessories.

D. Cast-in-place concrete and accessories.

E. Finishing and curing.

F. Sampling and testing of concrete work.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02200 - Non-impacted Material Earthwork.

D. Section 02667 - Drinking Water Lines.

E. Section 16118 - Underground Ductbanks.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Concrete Institute (ACI):

1.	ACI 301-96	Specifications for Structural Concrete for Buildings.
2.	ACI 305R-91	Hot Weather Concreting.
3.	ACI 306R-88	Cold Weather Concreting.
4.	ACI 318/318 R-95	Building Code Requirements for Structural Concrete (ACI 318-95) and Commentary (ACI 318R-95).
5.	ACI SP-66-94	ACI Detailing Manual.

B. American Society for Testing and Materials (ASTM):

1.	ASTM A185-94	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
2.	ASTM A615-A615M-Rev A-96	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3.	ASTM C31/C31M-96	Standard Practice for Making and Curing Concrete Test Specimens in the Field.
4.	ASTM C33-93	Concrete Aggregates.
5.	ASTM C39-96	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
6.	ASTM C94-96	Ready Mixed Concrete.
7.	ASTM C109/C109M-95	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
8.	ASTM C143-Rev. A-90	Standard Test Method for Slump of Hydraulic Cement Concrete.
9.	ASTM C150-96	Portland Cement.
10.	ASTM C157-93	Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete (AASHTO T160).
11.	ASTM C231-Rev B-91	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12.	ASTM C260-95	Air-Entraining Admixtures for Concrete.
13.	ASTM C309-95	Liquid Membrane-Forming Compounds for Curing Concrete.
14.	ASTM C494-92	Chemical Admixtures for Concrete.

15. ASTM C882-91 Standard Test for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
16. ASTM C920-95 Elastomeric Joint Sealants.

C. U. S. Department Of Commerce, Voluntary Products Standards(PS):
1. PS 1-83 Plywood.

1.5 SUBMITTALS

A. Product Data: Concrete mix designs, including documentation of aggregate sources and most recent sieve analysis. Sieve analyses must not be older than 1 year.

B. Concrete Supplier: Name and address of the transit-mix concrete supplier. Supply typical batch ticket and history per ASTM C94.

C. Test Reports: Test reports for all tests required under Article 3.3.A.

D. Placement Records: Records of time, dates, and locations of concrete placing operations upon completion of section work.

E. Reinforcing Placement: Provide reinforcement fabrication drawings showing placement of all reinforcing, inserts, sleeves, etc.

1.6 TECHNICAL CLARIFICATION

A. ACI 301: References are made to ACI 301 to abbreviate text of this section. Only those portions of ACI 301 referred to specifically in this section shall apply.

B. Amend Subparagraph 1.3.1 of ACI 301 to change the following titles to read (wherever they occur in ACI 301):

ACI 301	Change to Read
Architect/Engineer	PARSONS
Owner	FDF

C. Formwork shall be in accordance with Chapter 4 of ACI 301 unless specified otherwise in this section.

D. Perform concrete reinforcing work in accordance with Chapter 5 of ACI 301, unless specified otherwise in this section.

E. Perform cast-in-place concrete work in accordance with Chapters 7, 8, 10, 11, and 12 in ACI 301, unless specified otherwise in this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Tags: Reinforcing bar tags shall be made of durable material and marked in a legible manner with waterproof markings; not less than one tag per bundle, attached by wire. Identification tags shall show the grade, number of pieces, size, and mark or length of bars.

PART 2 PRODUCTS

The listing of materials suppliers below in no way precludes the Subcontractor from proposing alternate suppliers of any of the materials to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of materials and general quality of those materials that will be included in the Subcontractor's proposal. It is the Subcontractor's responsibility to propose materials that are best suited for this project in combined terms of quality and price.

2.1 MATERIALS

A. Oil/Water Separator:

1. The Oil/Water Separator shall be a two interconnected chamber precast unit constructed of polymer concrete with a 220 gallon capacity. The unit shall be designed to entrap solids and float oils.

2. Four-inch inlet and outlet pipe for connection to 4-inch diameter pipe running to and from the Separator.
3. The unit shall be covered with cover plates constructed from 1/4-inch steel diamond plate. The cover plates shall be coated with two carbonic zinc coatings. Cover plates and support channels shall be designed to support slow speed pneumatic tire vehicle loadings of twenty tons gvt (gross vehicle weight) and five tons single wheel load. Cover plates shall be provided with a handle, ring, or other means of facilitating the removal of the plate to allow cleaning of the unit.

B. Plywood Forms: Not less than 5/8-inch thick, 5-ply Douglas fir plywood conforming to PS 1, and as manufactured by a member of the American Plywood Association; B-B Plyform, Class I, Exterior-APA, with plyform faces sanded and oiled.

C. Prefabricated Type Forms: Matched, tight fitting, stiffened to support weight of concrete.

D. Form Release Agent: Colorless mineral oil which will not stain concrete or impair natural bonding characteristics of subsequent coatings.

E. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars; plain finish.

F. Welded Steel, Wire Fabric: ASTM A185, plain type welded wire fabric.

G. Tie Wire: Minimum 16-gage annealed type wire.

H. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

I. Fabrication: Fabricate concrete reinforcing in accordance with ACI SP-66 and Chapter 7 and 12 of ACI 318.

J. Cement: Normal, Portland cement, conforming to requirements of ASTM C150, Type I.

K. Admixtures:
1. Air Entrainment: Conforming to ASTM C260.
2. Water Reducing and Retarding: Conforming to requirements of ASTM C494.

L. Aggregates:
1. Normal Weight Concrete: Conforming to requirements of ASTM C33.
2. Maximum aggregate size: 1 inch.

2.2 ACCESSORIES

A. Chamfer Strips: Chamfered, wood strip type; 3/4-inch by 3/4-inch size.

B. Nails, Spikes, and Anchorages: Sized as required and of sufficient strength and character to maintain formwork in place while placing concrete.

C. Form Ties: Removable or snap-off type; designed to prevent form deflection; of adjustable length, cone type, with waterproofing washer; and free of defects that could leave holes larger than 1 inch in concrete surface.

D. Curing Compound: Conforming to the requirements of ASTM C309, clear; must not impair natural bonding characteristics of subsequent coatings.

E. Joint Sealer: Elastomeric joint sealant conforming to ASTM C920; Type S or Type M, Grade P, Class 25.
1. Acceptable products and suppliers (or equal):
   a. Sikadur 51 SL, by Sika Corp.
   b. Sonolastic SL-1, by Sonneborn Building Products.

F. Patching Grout: Premixed, nonshrink epoxy grout, capable of developing minimum compressive strength of 3,000 psi in 24 hours, conforming to ASTM C109. The grout must not shrink or expand more than 5 percent

when tested in accordance with ASTM C157 and achieve a minimum bond strength of 1,200 psi in 24 hours when tested in accordance with ASTM C882.

G. Waterstops: Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F. Working temperature range, preformed corners, with heat-welded jointing.

2.3 CONCRETE

A. Mix Proportions:

1. The following mix designs shall be used for cast-in-place concrete.

a. Slabs

Specified Strength (28 days)	4,000 psi
Total Air Content:	5 ± 1-1/2 percent
Specified Slump:	4 inches ± 1 inch
Maximum Aggregate Size:	1 inch
Maximum Water/Cement Ratio:	0.35 (per ACI 318, Section 5.4)

Water Reducing and retarding admixtures as required per ASTM C494.

b. Ductbank

Specified Strength (28 days)	2,500 psi
Specified Slump:	6 inches ± 1-1/2
Max. Aggregate Size	3/8 inch
Max. Water/Cement Ratio	0.80

c. Fence posts, guard posts, and other miscellaneous concrete

Specified Strength (28 days)	3,000 psi
Total Air Content:	5 ± 1-1/2 percent
Specified Slump:	3 inches ± 1-1/2
Maximum Aggregate Size:	1-1/2 inches
Maximum Water/Cement Ratio:	0.55

2. The work has been designed for concrete having a minimum compressive strength at 28 days as determined by ASTM C39. The water/cement ratio shall be determined by consideration of the specified strength, the water-reducing admixtures, the slump required for proper placement, air entraining requirements, the maximum allowable aggregate size and its specific gravity, the fineness modulus of the fine aggregate and its specific gravity, and the amount of water carried on the aggregates. The mix designs shall be proportioned in accordance with ACI 318, Section 5.3 or Section 5.4.
3. Provide all equipment necessary to determine and control the actual proportions of materials entering the batch. Slumps shall be recorded for each trial batch.

B. Water Content: In calculating the total water content in any mix, the amount of water carried on the aggregate shall be included. The water on the aggregate shall be determined periodically by test, and the amount of free water on the aggregate shall be subtracted from the water allowed in the mix. In all cases, the amount of water to be used shall be the minimum amount required to produce a plastic mixture of the specified strength and slump.

C. Mixing and Delivery: Mixing and delivery of concrete shall be scheduled so that all concrete placing operations can be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after introduction of mixing water to cement and aggregates, in accordance with Section 11 of ASTM C94. When air temperature has fallen to or is expected to fall below 40 degrees F, the recommendations for cold weather concreting contained in ACI 306R shall be followed. When the air temperature exceeds 90 degrees F, the recommendations for hot weather concreting contained in ACI 305R shall be followed.

PART 3 EXECUTION

3.1 PREPARATION

A. Erect formwork and bracing to achieve design requirements in accordance with requirements of Chapter 4 of ACI 301.
   1. Provide bracing to ensure stability of formwork.
   2. Align joints and make watertight. Keep number of form joints to a minimum.
   3. Provide chamfer strips on external corners of permanently exposed edges.
   4. Shore or strengthen formwork subject to overstressing by construction loads.

B. Application - Form Release Agent: Apply form release agent on formwork in accordance with manufacturer's instructions.
   1. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
   2. Keep surfaces coated prior to placement of concrete.

C. Form Cleaning: Clean and remove foreign matter within forms as erection proceeds.
   1. Clean formed cavities of debris prior to placing concrete.
   2. Flush with water or vacuum to remove remaining foreign matter.
   3. Ensure that water and debris drain to exterior.
   4. During cold weather, remove ice and snow from within forms. Do not use de-icing salts or water to clean out forms.

D. Tolerances: Construct formwork to maintain tolerances required by ACI 301, Section 4.3.

E. Form Removal: Forms or bracing shall not be removed until concrete has gained sufficient strength to carry its own weight and imposed loads.
   1. Loosen forms carefully.
   2. Do not wedge with pry bars, hammers, or tools against finished concrete surfaces.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Place, support, and secure reinforcement against displacement. Do not deviate from required position.

B. Maintain concrete cover around reinforcing according to the requirements of Chapter 5 of ACI 301, Chapter 7 of ACI 318, and as shown on construction drawings.

C. Provide formed openings where required for work to be embedded in concrete.

D. Coordinate work of other sections in forming and setting openings, slots, recesses, sleeves, bolts, anchors, and other inserts.

E. Install concrete accessories straight, level, and plumb, or as called out on the construction drawings in accordance with manufacturer's instructions.

F. Place concrete continuously between forms or other limits indicated on the construction drawings.
   1. Place concrete in accordance with Chapter 8 of ACI 301 and Chapter 5 of ACI 318.
   2. Ensure that reinforcement and forms are not disturbed during concrete placement.

H. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

3.3 TESTING

A. Testing: Field tests (take slumps, air, and cylinders) and laboratory tests shall be performed on specimens. Concrete testing shall be performed in accordance with Chapter 16 of ACI 301 for each 50 cubic yards, or fraction thereof, of each mix design placed in any 1 day.
   1. Slump Tests: ASTM C143. One sample for each strength test.
   2. Air Content Tests: ASTM C231. One sample for each strength test.

3. Test Cylinders: ASTM C31. One set of three cylinders for above quantities.
4. Compressive Strength: ASTM C39. One specimen tested at 7 days and two specimens tested at 28 days.

3.4 PROTECTION

A. Provide concrete curing and protection in accordance with Chapter 12 of ACI 301.
   1. Apply slab curing compound, where used, in accordance with the approved manufacturer's recommendations.

B. Provide finishes for formed concrete surfaces as defined in Chapter 10 of ACI 301.

C. Provide finishes and tolerances for slabs in accordance with Chapter 11 of ACI 301.
   1. Provide troweled finish with Class A tolerance on all exposed slabs.

END OF SECTION

U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Subcontract No. FSC607

WASTE UNITS REMEDIATION PROJECT
SOUTHERN WASTE UNITS
TECHNICAL SPECIFICATIONS

Division 13

PARSONS

Prepared by: Wayne Moore by Steve Nelson 6/12/97
Date

Checked by: Carlton C. Schroeder 6/12/97
Date

Carlton C. Schroeder
6/12/97

Date: 05/30/97 13000 WBS No: 1.1.1.1.2.3.6
Rev.: 0 RE: WM SCEP/165/SWU/SITE

SECTION 13125
MODULAR RADIOLOGICAL CONTROL FACILITY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duplex System (One Required): A personnel radiological control facility composed of two nominal 14 feet by 60 feet interconnected modular units combining separate men's and women's locker rooms, each consisting of locker area, emergency showers, sinks, and a common break room. Interior ceiling height to be 8 feet 0 inches minimum. The duplex facility will consist of designed, shop fabricated, and fire-resistant modular trailer units.

B. Mechanical and electrical requirements. Electrical requirements herein are for modular radiological control facility only. Where these requirements conflict with those of other specification sections, the requirements of this section govern for the modular radiological control facility only.

C. Fire and evacuation alarm system requirements.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02100 - Site Preparation.

D. Section 02200 - Non Impacted Material Earthwork.

E. Section 16050 - Basic Electrical Materials and Methods.

F. Section 16170 - Grounding and Bonding.

G. Section 16855 - Heating Cables.

1.3 REFERENCE DRAWINGS

A. SKA04502, Duplex Manufactured Trailer, Floor Plan (See Attachment A).

B. 44X-5500-E-00210, Radiological Control Unit Facilities, 2-Plex and 4-Plex Electrical Single Line and Grounding (See Attachment B).

C. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. Conform to the OBBC and local building code. Where Hamilton County code requirements vary from the OBBC, the Hamilton County code shall govern.

B. Cooperate with regulatory agency or authority and provide data as requested.

C. National Fire Protection Association (NFPA):
   1. NFPA 70 — National Electrical Code, 1996 Edition.
   2. NFPA 72-93 — National Fire Alarm Code.

D. Underwriter's Laboratories, Inc. (UL):
   1. Electrical Construction Materials Directory - 96.

E. American Society for Testing and Materials (ASTM):
   1. E84 Rev-A-97 — Standard Test Method for Surface Burning Characteristics of Building Materials

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)

1.5 SYSTEM DESCRIPTION

DESIGN REQUIREMENTS - STRUCTURAL

A. System and components to withstand dead loads, live loads, snow load, and wind load calculated in accordance with the Ohio Basic Building Code, OBBC. Design constants shall be as follows:
   1. Ground Snow Load (P_g): 25 psf
   2. Snow Exposure Factor (C_e): 0.7
   3. Importance Factor (I): 1.0
   4. Effective Velocity Pressure (P_e): 20 psf (80 mph basic wind speed, Exposure C)
   5. Floor Live Load: 50 psf

B. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

C. Assembly to permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

D. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

DESIGN REQUIREMENTS - MECHANICAL

A. Thermal resistance of Wall System: R value of 11 minimum.

B. Thermal Resistance of Roof System: R value of 30 minimum.

C. Thermal Resistance of Floor System: R value of 19 minimum.

D. Heating & Cooling: Air source wall mount heat pumps, 48,000 Btu/hr. capacity per unit, one for each 14 feet by 60 feet module. Each heat pump to be equipped with supplemental electric resistance heaters, 15 kW @ 480 V, balanced across the 3 phases (5 kW each).

E. Ductwork: Design in accordance to the methods given by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). Fabricate in accordance with methods given in the Sheet Metal and Air Conditioning Contractors (SMACNA) Manuals.

F. Plumbing: Design cold potable water, hot water, and sanitary systems in accordance with OBBC. Sanitary (grey) water from the emergency showers and sinks shall be collected in hold tanks located beneath the trailer facility. The tanks shall be configured to provide a total storage capacity of 1,000 gallons. Prior to placing the tanks beneath the trailer facility, the site shall be leveled and pressure-treated plywood shall be placed on the ground with electric heat pads provided beneath the hold tanks. The tanks shall be interconnected with a discharge pipe located so as to protrude through the trailer skirting. Tanks and pipe shall be insulated using a minimum R-13 insulating material.

G. Fire Protection: Minimum of one (1) ten (10) lb. size "ABC" type fire extinguisher at each exterior door.

DESIGN REQUIREMENTS - ELECTRICAL

A. Electrical work shall be designed and installed in accordance with NFPA 70 and drawing 44X-5500-E-00210 (Attachment B).

B. Electrical equipment shall be listed for the purpose specified and indicated according to Underwriter's Laboratories (UL) Electrical Construction Materials Directory.

C. The HVAC and water heaters are to be 480 V, 3-Phase. The lights and the remaining electrical requirements are to be served from the 208/120 V, 3-Phase, 4-Wire panel.

D. A separate 208/120 V, 3-Phase, 60 Hz panel shall be furnished and mounted outside each modular section in a NEMA 3R enclosure.

E. The panel shall have a 100 amp main breaker minimum.

F. The panels shall be mounted on the same end of the trailer as the HVAC unit.

G. Wire: Use copper insulated wire in electrical circuits. Minimum wire size shall be 12 gauge unless noted otherwise.

H. Conduit: Electrical wiring to be installed in EMT conduit. Minimum size to be 1/2 inch conduit. A separate green grounding wire shall be installed. No conduit runs shall be used for equipment grounding.

I. Receptacle circuits are to be rated at 20 amps. Receptacle and light switches shall be labeled identifying the appropriate circuit breaker and shall have fixed labels to identify serviced circuits. Provide dedicated circuits for PCMs, fire and evacuation alarm systems, and storage tank heat pads.

J. 480 V, 3-Phase equipment shall be wired to a fused safety switch located on the same end of the trailer as the panel. Appropriate size fuses shall be installed.

K. Exit Signs: Install low energy consumption solid state, LED, exit signs with battery back-up at exits.

L. Emergency Lights: Provide emergency egress lighting with battery back-up to illuminate the paths to exits.

M. A lighting level of 60 footcandles shall be provided at a height of three feet above the floor.

N. Lighting shall be controlled by switches, not breakers.

O. General interior lighting shall be 4 feet 0 inches double tube surface fluorescent (T8) fixtures each with diffusers, electronic ballast and lights. Other interior and exterior lighting shall be incandescent.

P. Provide one (1) 50 watt high pressure sodium light fixture with photo cell and light, outside of each exterior door. Teron Catalog No. CA50 or equal.

Q. Electrical outlets at porter's closet and external receptacles within 6 feet of sink serving counter top surfaces shall be GFCI type.

R. Telephone: Each modular complex shall be equipped with a minimum of four (4) telephone outlets. Telephone raceways are to be 3/4 inch EMT conduits. Run conduit from each outlet to central junction box at the front of the trailer. Locate outlets per attached engineering sketches.

S. Telephone/communication junction boxes are to be located on the same end of the trailer sections which comprise the complex and shall be surface mounted. Exterior junction boxes shall be rated NEMA 3R minimum and shall be mounted with taps to accommodate two (2) inch conduits.

T. Telephone/communication outlets shall be provided with a blank ivory cover plate for single outlet box (wire and receptacle to be supplied by telephone company, minimum four (4) telephone outlets per modular complex).

U. Electrical outlet devices shall be ivory with ivory cover plates.

V. Grounding: Trailer frame and metallic sheathing shall be grounded to breaker panel.

W. High water level alarm for water hold tanks. The alarm will be equipped with a warning light and audible alarm.

DESIGN REQUIREMENTS - FIRE AND EVACUATION ALARM

A. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connections to the central fire alarm equipment.

B. Install fire and evacuation alarm equipment specified herein and indicated on sketch SKA04502. Honeywell, FDF's alarm systems Subcontractor, will make final terminations and perform acceptance testing of the new panel.

1.6 SUBMITTALS

A. Submit complete set of shop drawings within two (2) weeks of Contract award. Submit twelve (12) copies and one (1) reproducible.

B. Indicate recommended location of structural supports.

C. Indicate the number and location of intermediate support columns.

D. Indicate wall and roof system dimensions and general construction details.

E. Indicate number and location of downspouts.

F. Indicate tie-down requirements for wind loads.

G. Product Data: Provide data on mechanical components.

H. Manufacturer's Installation Instructions: Indicate preparation requirements and assembly sequence.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with a minimum ten (10) years experience.

1.8 WARRANTY

A. Provide five-year warranty.

B. Warranty: Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading.

C. Guarantee that mating modular sections are capable of weather-tight field fit-up.

PART 2 PRODUCTS

2.1 MANUFACTURERS - BUILDING SYSTEM

A. Manufactured Structures Corporation, System OBBC Model 1464.

B. Other acceptable manufacturers offering equivalent systems.

2.2 MATERIALS - MODULAR UNITS

A. Materials - Architectural/Structural

1. Framing: Structural shapes or cold rolled steel.
2. Under-floor Bottom Plate: Non-combustible.
3. Floor Underlayment: 3/4-inch plywood, pressure treated. Fire-retardant treated for all wood products.
4. Walls: Fire-resistant construction, metal stud framing with gypsum board interior.
5. Insulation: Batt glass fiber type, faced with reinforced foil, friction fit.
6. Roofing: Galvanized steel, 30 ga.
7. Ceiling: 1/2-inch vinyl coated gypsum, Group 2 vinyl weight. (Class 1 flame spread with rosettes)
8. Exterior Siding: Manufacturer's standard corrugated aluminum.
9. Skirting: Manufacturer's standard corrugated aluminum.
10. Interior Wall Covering: 1/2-inch vinyl coated gypsum, Group 2 vinyl weight. Exposed surface shall have been tested by a recognized testing lab, as having a flame spread rating not to exceed 25 and single developed rating not in excess of 50 per ASTM E 84.
11. Flooring: Commercial grade sheet vinyl.

12. Doors, Exterior: Hollow Metal type, 36 inches by 80 inches, 16 gauge, insulated, glass side light, door closer, shop primed and finish painted. Keyed lock-set to accept "Best" core.
13. Doors, Interior: Hollow Metal type, 36 inches by 80 inches, 18 gauge, 24-inch square door grill, passage-set.
14. Windows: Manufacturer's standard horizontal slider with insect screen where required by building code. Translucent glass in locker, shower or sink areas.
15. Gutters & Downspouts: Fabricate of same material and finish as siding metal.

B. Materials - HVAC
1. Heat Pump: 48,000 Btuh cooling, 15 kW heating, wall mounted self-contained air cooled, with hermetic reciprocating compressor, crankcase heater, and pressure service ports on refrigerant piping to evaporator and condenser. Adjustable outside air intake and return air through wall grille with two inch cleanable media filter. Thermostat to be programmable located five feet above floor in clean area.
2. Ductwork: Galvanized steel, fabricated and installed per SMACNA. Insulated with two inch fiberglass having vapor barrier. Flexible joint at HVAC unit outlet. Ceiling diffusers to be white enamel aluminum with adjustable dampers.
3. Exhaust Fans: 300 CFM ceiling mount with roof cap in each shower room and break room. Fans in shower areas, aluminum or plastic for corrosion resistance. Fans interlocked with light switch.

C. Materials - Plumbing
1. Showers: Heavy gauge steel with baked enamel finish, 32-inch square nominal, center drain with tempered glass door in aluminum frame. The shower must be drained through a filtration system with a minimum of a 5 micron final filter to remove asbestos.

2. Water Heater: Electric 120 gallon storage type, 480 V-3 phase, 162 gallon per hour recovery, ASME tank 300 psig hydrostatic tested, glass lined tank with anode rods and ASME pressure-temperature relief valves.
3. Shower Supply: Fixed spray shower head with 3 gpm maximum flow, single lever thermostatic mixing valve.
4. Faucets: Centerset with gooseneck spout and aerator, 4-inch wrist action handles.
5. Waste and Vent Piping: ABS DWV with solvent welded joints. Each unit to have waste lines manifolded to one outlet.
6. Water Piping: Type "L" copper with soldered sweat fittings manifolded to one inlet. Solder shall contain no lead.
7. Fixture Traps and Drains: Chromium plated brass traps with screen inlet drains in lavatories. Shower drains, PVC or ABS with screen inlet. Provide adapters for dissimilar materials where required.
8. Hold Tanks: Polyethylene holding tanks interconnected so as to provide a total storage capacity of 1,000 gallons. Interconnecting and discharge pipe to be 3-inch PVC. Discharge pipe will protrude through trailer skirting. Insulate tanks and pipe with a minimum R-13 insulating material. Level tank base under trailers and install pressure-treated plywood and heat pads prior to installing tanks. Install level alarm with audible alarm and warning light.

D. Materials - Fire and Evacuation Alarm
1. Fire Alarm Circuit Conductors: 18/2 wire; Initiating device insulation color coded red and yellow; Signal device circuit insulation color coded brown and yellow.
2. Wiring (Safety Devices): Fire Alarm Horns/Strobes - 18/2 yellow/brown wire; All Input Zones - 18/2 yellow/red wire.
3. Smoke Detectors: Ionization type; Honeywell TC805C or approved equal.
4. Heat Detectors: Combination rate-of-rise and fixed temperature; Honeywell T4057A (135 degrees F setting and 15 degrees F per minute rate-of-rise) or approved equal.

5. Manual Pull Stations: Honeywell S464A or approved equal.
6. Horn with Strobe: Flush/Surface mounted, audio/visual type with strobe; Honeywell SC716B1001 or approved equal.
7. End of Line Resistors: 1.9 K ohms.
8. Motorola Monitor II Pager with charger amplifier: Motorola's HOYUMC3112, HOYUMC3122, and NLN3039A or approved equal.
9. Fire Alarm Panel: Honeywell FS 90 or approved equal.
10. Lightning Protectors shall be used on fire alarm branch circuits or evacuation branch circuits when entering or leaving facility.

E. Materials - Accessories

1. Lockers: Enamel finish sheet steel, double tier type, 12 inches wide by 15 inches deep by 72 inches high.
2. Fire Extinguisher: 10 lb. capacity, ABC type, one mounted at each exit door.
3. Tables (2 required.): Metal frame with metal legs, 30 inches by 72 inches, laminated plastic, "Formica" or hardboard top.
4. Chairs (16 required.): Metal frame, stackable type.
5. Towel Bins: Sheet metal with enamel finish, 3 cubic feet minimum capacity.
6. Hand/Hair Dryers: Surface mount, cast iron with porcelain enameled finish, 115V, 20 amp. McMaster-Carr #2876k71 or equal.
7. Anti-C Storage Cabinets: Minimum 22 gauge metal with enamel finish, 36 inches wide by 18 inches deep by 72 inches high, 5 or 6 shelves.
8. Locker Room Benches: Lengths as indicated on Drawings. Benches anchored to floor.
9. Counter Tops: Laminated plastic "Formica" top finish.
10. Soap Dispenser (One per sink): McMaster-Carr #2379K32 or equal.
11. Paper Towel Dispensers (One per each sink grouping): 22 gauge steel minimum.
12. Coat & Hat Wall Racks (Two per break room): Two shelf type, aluminum tubing construction, 72 inches long, McMaster-Carr #4711T31 or equal.

13. Coat & Hat Wall Hooks (Four units per monitoring room): Horizontal type, chrome plated steel, with 6 each double hooks per 36 inches long unit.
14. Mirrors (One per sink): 1/4-inch plate glass, stainless steel frame.
15. PCMs: Furnished by FDF.
16. Friskers: Furnished by FDF.
17. Card Readers: Furnished by FDF.
18. Hand & Foot Monitors: Furnished by FDF.
19. Waste Drums: Furnished by FDF.
20. Stairs with hand railings are to be provided at entrances/exits from the trailers. The landings shall be level and at the same elevation as the doorways. Steps are to be a minimum 44 inches long with a minimum tread depth of 11 inches. The stair landings and steps shall have permanent, non-skid walking surfaces and will be securely arranged to resist movement.

2.3 FINISHES

A. Framing Members: Clean, prepare, and coat with black asphalt undercoating, 3 mil minimum thickness.

B. Exterior Surfaces of Wall Components and Accessories: Precoated enamel on aluminum, color as selected from manufacturer's standard range.

C. Vinyl Sheet Flooring: Color and pattern as selected from flooring manufacturer's standard range.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install the modular radiological control facility trailer to be ready for use when first needed to avoid delays in the work.

B. Install the modular radiological control facility trailer at the designated location indicated on the plans. Set and level the trailer on concrete block piers in accordance

with the trailer manufacturer's requirements. Anchor the trailer to prevent rollover, slipping, etc. during high winds. Set and level stairs and landings to minimize tripping hazards. Provide locking entrances to prevent unauthorized entry.

C. Equipment connections and other necessary work within new Data Gathering Panel (DGP) shall be coordinated with FDF's fire alarm service company (Honeywell) at the direction of FDF. Subcontractor shall arrange and pay for the services of the fire alarm service company for performing necessary DGP work.

D. Use 18 AWG minimum size conductors for fire alarm detection and signal circuit conductors. Install wiring in EMT conduit.

E. Check that fire alarm detection end-of-lines device are with last device or in a separate box adjacent to last device in circuit.

F. Connect new DGP to four pairs from the new phone service.

3.2 FIELD QUALITY CONTROL

A. Test fire and evacuation alarm system in accordance with NFPA 72H and local fire department requirements. Tests to be witnessed by FDF QA and FDF Fire Protection. Demonstrate normal and abnormal modes of operation, and required responses to each.

3.3 UTILITIES/SERVICING

A. Install temporary utility services or make connections to existing services provided by FDF.

B. Grey water hold tanks shall be periodically emptied (when indicated by the high water level alarm) and will be coordinated with FDF on the disposition of the water.

3.4 TERMINATION/RELEASE

A. At completion of site preparation activities, restore trailer and contents to prework conditions. Housekeeping and repairs/replacements will be done to the satisfaction of FDF. When authorized by FDF, release the modular radiological control facility to FDF, including office equipment and interior components.

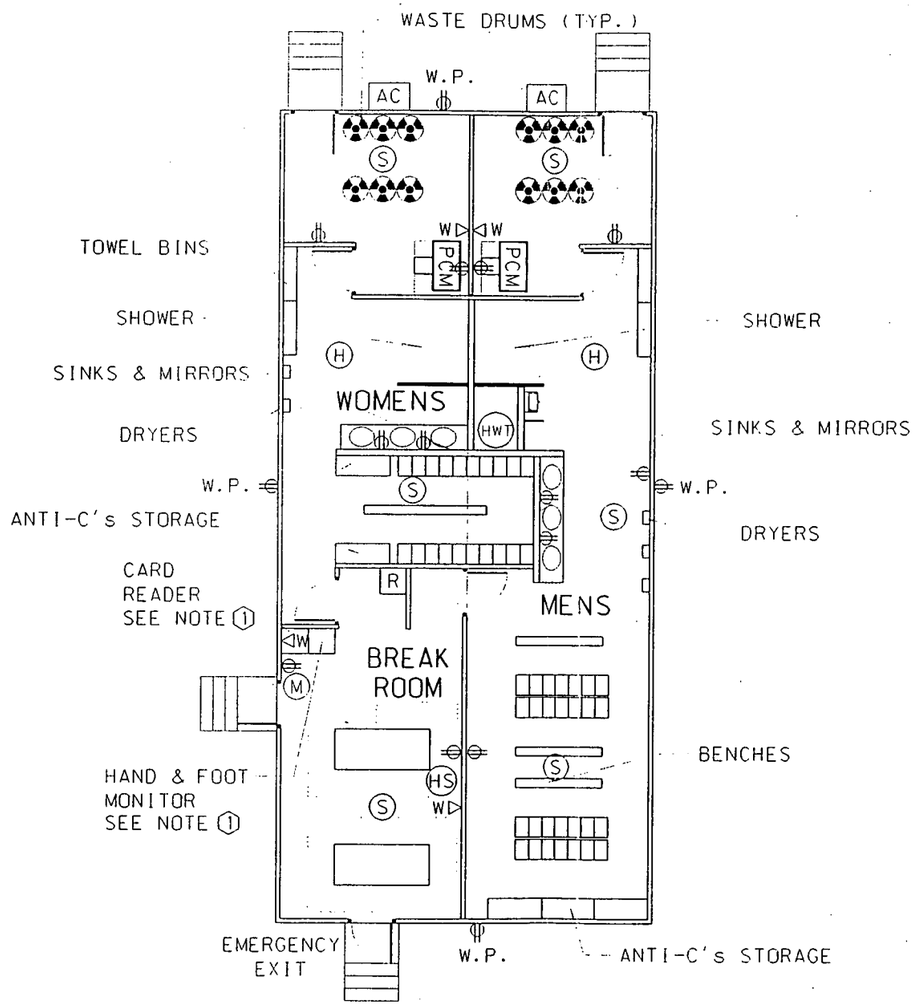
END OF SECTION

ATTACHMENT A

SKETCH SKA04502

ska04502.m po165@ws421. Wed Apr 23 08:27:13 EDT 1997

RADIOLOGICAL CONTROL POINT FACILITY



DUPLEX MANUFACTURED TRAILER FLOOR PLAN

NOTES

1. CARD READER AND HAND & FOOT MONITOR (FDF PROVIDED)

LEGENDS

- WASTE DRUMS (FDF PROVIDED)
- LOCKERS: DOUBLE 12"W×18"D×72"H
- PCM — PERSONNEL CONTAMINATION MONITOR (FDF PROVIDED)
- HWT — HOT WATER TANK
- W — PHONE LOCATIONS (4 REQ'D.)
- W.P. — EXTERIOR WEATHER PROOF RECEPTICAL LOCATIONS (4 REQ'D.)
- DUPLEX RECEPTICAL LOCATIONS (12 REQ'D.)
- S — SMOKE DETECTOR
- H — HEAT DETECTOR
- M — MANUAL PULL STATION
- HS — HORN STROBE
- R — RAPID RECEIVER FOR EVACUATION SYSTEM

SCALE

0 10 20 FEET

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION			

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ARCHITECTURAL
PLAN
RADIOLOGICAL CONTROL POINT FACILITY

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. TOFE	01/14/97	W. MOORE	01/14/97	G. MELNTYR	01/14/97

PLANT/BLDG. NO. | FLOOR | SCALE | CLASS

SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL

A-E PROJECT NO.	DATE	FERNCO PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
		00-90701	SKA04502		0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
SCEP/PO-165

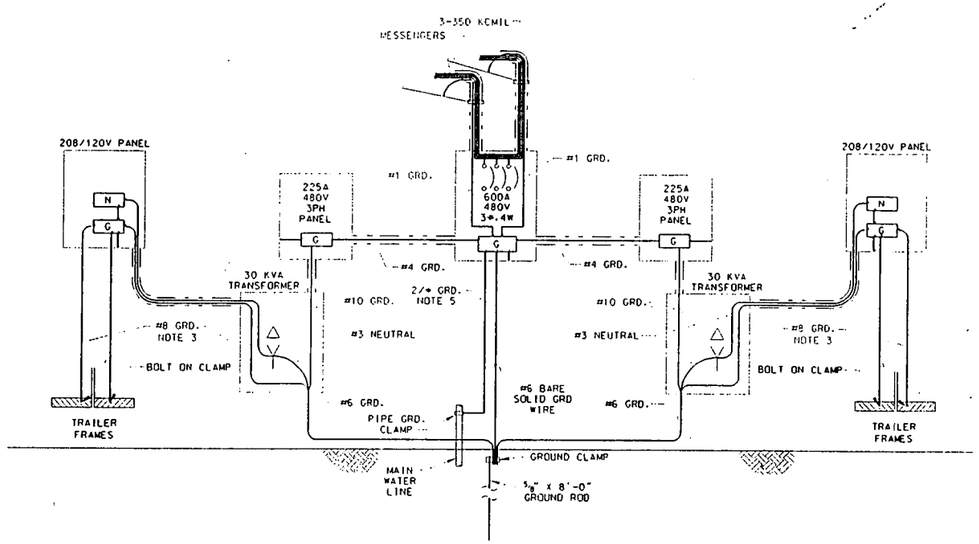
186

ATTACHMENT B

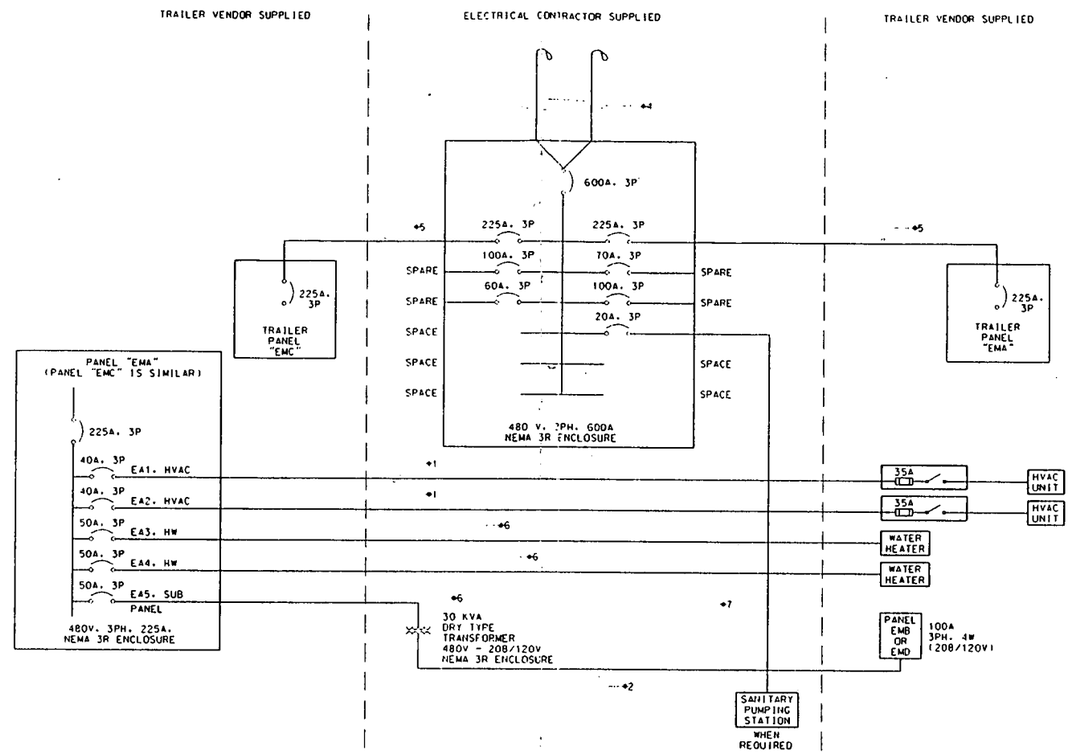
DRAWING 44X-5500-E-00210

R44xe0210.m sys@ws421. Wed Apr 23 08:28:13 EDT 1997

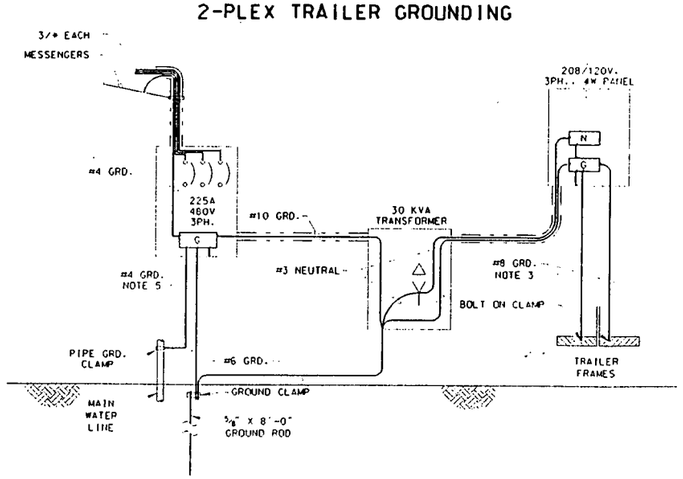
4-PLEX TRAILER GROUNDING



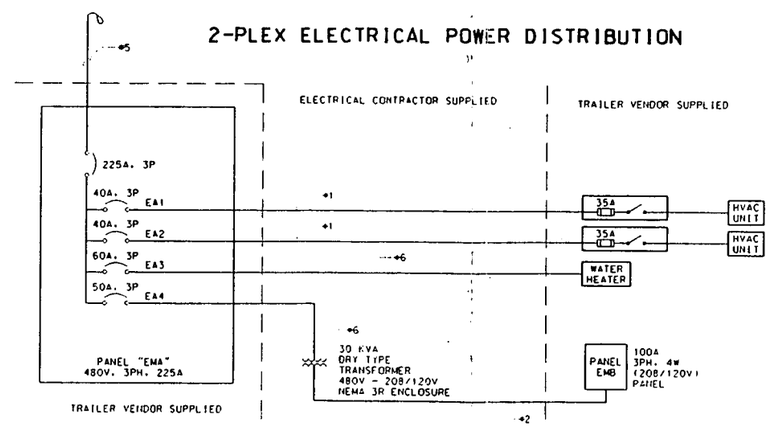
4-PLEX ELECTRICAL POWER DISTRIBUTION



2-PLEX TRAILER GROUNDING



2-PLEX ELECTRICAL POWER DISTRIBUTION



NOTES

1. ALL WIRING TO BE COPPER WITH THWN INSULATION UNLESS NOTED.
2. ALL GROUND WIRE IS TO BE COPPER.
3. TRAILER VENDER TO INSTALL
4. USE SEALTIGHT CONDUIT WHERE REQUIRED
5. REQUIRED WHEN WATER LINE IS METAL

#1 = 3-#8 AND 1-#10 GRD. 3/4"C
#2 = 4-#3 AND 1-#8 GRD. 1 1/4"C
#3 = 3-#4 AND 1-#8 GRD. 1 1/4"C
#4 = 2-3" CONDUITS EACH WITH 3-350 KCMIL AND 1-#1GRD
#5 = 3-3/# AND 1-#4 GRD. 2"C
#6 = 3-#6 AND 1-#10 GRD.. 3/4" C
#7 = 3-#12 AND 1-#12 GRD.. 3/4" C

NO.	REVISIONS	DATE	DWN. BY	APPD.	NO.	REVISIONS	DATE	DWN. BY	APPD.	REF. DWG NO.
					1	REDESIGN FOR AS-BUILT	10-26-94	MET		
					0	CFC	3-24-94	MEL	GEP	

FORMAT REVISED 3/7/95

NOTE: FERMCO C.A.D. DRAWING NOT TO BE REVISED MANUALLY

PERFORMANCE GRADE 1 2 3 4 5
BY: DATE:

APPROVALS				
CIVIL & STR.			SAFETY ENG.	3-23-94
ELECTRICAL			MAINTENANCE	
ENGINEER	R.C. WORSLEY	3-22-94	Q.A.	3-23-94
INSTRUMENT			FIRE PROTECT.	3-23-94
MECHANICAL			WASTE MANAGE.	
CM		3-23-94	SECURITY	
CHECKED	GEP		CRUD ENG.	3-23-94
APPROVED	G.E. PAUK	3-24-94	RAD ENG.	3-23-94

FERNALD ENVIRONMENTAL RESTORATION MANAGEMENT CORPORATION
PERMCO
Fernald Environmental Management Project
U.S. DEPARTMENT OF ENERGY

PRODUCTION AREA: TRAILERS
RADIOLOGICAL CONTROL UNIT FACILITIES
2-PLEX AND 4-PLEX
ELEC SINGLE LINE AND GROUNDING

RES 228.7
DATE 2-23-94
DRAWN M. LOHFE

44X-5500-E-00210 | 1

FILE NAME:

SECTION 13126
MODULAR FIELD OFFICE FACILITY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single System (One Required): A field office facility composed of a single modular unit. The facility will meet the requirements of an ODOT Type C field office trailer with a minimum of 1000 sq. ft. of floor space. Approximately 100 sq. ft. of floor space will be partitioned off (with lockable door) for use by FDF Construction Manager. An additional 400 sq. ft. of open work space will be provided for use by FDF construction personnel. The single facility will consist of a designed, shop fabricated, and fire-resistant modular trailer unit.

B. Mechanical and electrical requirements. Electrical requirements herein are for modular field office facility only. Where these requirements conflict with those of other specification sections the requirements of this section govern for the modular field office facility only.

C. Subcontractor installed fire and evacuation alarm system requirements.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals.

C. Section 02100 - Site Preparation.

D. Section 02200 - Non Impacted Material Earthwork.

E. Section 16050 - Basic Electrical Materials and Methods.

F. Section 16170 - Grounding and Bonding.

1.3 REFERENCE DRAWINGS

A. SKA04503, Field Office Facility, Fire and Evacuation Alarm System Plan (See Attachment A).

B. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. Conform to the OBBC and local building code. Where Hamilton County code requirements vary from the OBBC, the Hamilton County code shall govern.

B. Comply with applicable requirements of NFPA Code 241, "Building Construction and Demolition Operations", the ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition", and the NECA National Joint Guideline NJG-6 "Temporary Job Utilities and Services".

C. Comply with applicable requirements of NEMA and UL standards and governing regulations.

D. National Fire Protection Association (NFPA):
   1. NFPA 70 — National Electrical Code, 1996 Edition.
   2. NFPA 72-93 — National Fire Alarm Code.

E. Underwriter's Laboratories, Inc. (UL):
   1. Electrical Construction Materials Directory - 96.

1.5 SYSTEM DESCRIPTION

DESIGN REQUIREMENTS - STRUCTURAL

A. Comply with the requirements of the Ohio Basic Building Code governing the construction, installation, and maintenance of temporary modular field office facilities.

DESIGN REQUIREMENTS - MECHANICAL

A. The facility shall have provisions for maintaining room temperature between 68 degrees and 80 degrees F.

B. Fire Protection: Minimum of one (1) ten (10) lb. size "ABC" type fire extinguisher at each exterior door.

DESIGN REQUIREMENTS - ELECTRICAL

A. Electrical work shall be designed and installed in accordance with NFPA 70.

B. Electrical equipment shall be listed for the purpose specified and indicated according to the UL Electrical Construction Materials Directory.

C. The HVAC is to be 480 V, 3-Phase. The lights and the remaining electrical requirements are to be served from the 208/120 V 3-Phase 4-Wire panel.

D. A separate 208/120 V panel shall be furnished and mounted outside in a NEMA 3R enclosure.

E. The panel shall have a 100 amp main breaker minimum.

F. Exit Signs: Provide visible exit signs at exits.

G. Telephone: Install telephones in the field office facility. Separate telephone service shall be provided for the FDF construction personnel and for a separate facsimile line. Post a list of operational and emergency telephone numbers.

H. Grounding: Trailer frame, metallic sheathing, and other nonelectrical metal parts, as well as electrical parts shall be grounded through connection to a grounding bus in the modular field office facility distribution panel.

DESIGN REQUIREMENTS - FIRE AND EVACUATION ALARM

Subcontractor installed fire and evacuation alarm system meeting the following design requirements:

A. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connection to the central fire alarm equipment.

B. Install fire and evacuation alarm equipment specified herein and indicated on sketch SKA04053. Honeywell, FDF's alarm systems Subcontractor, will make final terminations and perform acceptance testing of the new panel.

1.6 SUBMITTALS

A. Indicate recommended location of structural supports.

B. Indicate tie-down requirements for wind loads.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with a minimum ten (10) years experience.

1.8 WARRANTY

A. Provide five-year warranty.

B. Warranty: Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading.

PART 2 PRODUCTS

2.1 MATERIALS - MODULAR UNIT

A. Materials - Architectural
   1. Fire Extinguisher: 10 lb. capacity, ABC type.
   2. Separate enclosed room for FDF construction personnel with:
      (1) 1 - Telephone (on separate line)
      (2) 1 - Desk and Chair Set
      (3) 1 - 30 inch by 72 inch Work Table
      (4) 1 - 4-Drawer, Legal Size, Lockable Metal Filing Cabinet.
   3. The remaining office space shall be provided with:
      (1) 2 - Telephones
      (2) Base Radio and 4- Hand-Held Units
      (3) 4 - Desk and Chair Sets
      (4) 2 - 30 inches by 72 inches Work Tables

(5) 1 - 4 Drawer, Legal Size, Lockable Metal Filing Cabinet
(6) 2 - 2 Drawer, Metal Filing Cabinet
(7) 2 - Plan Racks
(8) 1 - Plain Paper Facsimile Machine (on separate line)
(9) 1 - Copier with Automatic Paper Feed Capable of Making Copies up to 11 inches by 17 inches in size
(10) 1 - 3 feet by 8 feet (minimum) Conference Table with 8 chairs.

4. Stairs with hand railings are to be provided at all entrances/exits from the trailer. The landings shall be level and at the same elevation as the doorways. Steps are to be a minimum 44 inches long with a minimum tread depth of 11 inches. The stair landings and steps shall have permanent, non-skid walking surfaces and will be securely arranged to resist movement.

B. Materials - Fire and Evacuation Alarm

1. Fire Alarm Circuit Conductors: 18/2 wire; Initiating device insulation color coded red and yellow; Signal device circuit insulation color coded brown and yellow.
2. Wiring (Safety Devices): Fire Alarm Horns/Strobes - 18/2 yellow/brown wire; All Input Zones - 18/2 yellow/red wire.
3. Smoke Detectors: Ionization type; Honeywell TC805C or approved equal.
4. Heat Detectors: Combination rate-of-rise and fixed temperature; Honeywell T4057A (135 degrees F setting and 15 degrees F per minute rate-of-rise) or approved equal.
5. Manual Pull Stations: Honeywell S464A or approved equal.
6. Horn with Strobe: Flush/Surface mounted, audio/visual type with strobe; Honeywell SC716B1001 or approved equal.
7. End of Line Resistors: 1.9 K ohms.
8. Motorola Monitor II Pager with charger amplifier: Motorola's HOYUMC3112, HOYUMC3122, and NLN3039A or approved equal.
9. Fire Alarm Panel: Honeywell FS 90 or approved equal.

10. Lightning Protectors shall be used on fire alarm branch circuits or evacuation branch circuits when entering or leaving facility.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install the modular field office trailer to be ready for use when first needed to avoid delays in the work.

B. Install the modular field office trailer at the designated location indicated on the plans. Set and level the trailer on concrete block piers in accordance with the trailer manufacturer's requirements. Anchor the trailer to prevent rollover, slipping, etc. during high winds. Set and level stairs and landings to minimize tripping hazards. Provide locking entrances to prevent unauthorized entry.

C. Equipment connections and other necessary work within the new Data Gathering Panel (DGP) shall be coordinated with FDF's fire alarm service company (Honeywell) at the direction of FDF. Arrange and pay for the services of the fire alarm service company for performing necessary DGP work.

D. Use 18 AWG minimum size conductors for fire alarm detection and signal circuit conductors. Install wiring in EMT conduit.

E. Check that fire alarm detection and end-of-lines device are with last device or in a separate box adjacent to last device in circuit.

F. Connect new DGP to four pairs from the new phone service.

3.2 FIELD QUALITY CONTROL

A. Test fire and evacuation alarm system in accordance with NFPA 72H and local fire department requirements. Tests to be witnessed by FDF QA and FDF Fire Protection. Demonstrate normal and abnormal modes of operation and required responses to each.

3.3 UTILITIES

A. Install temporary utility services or make connections to existing services provided by FDF.

3.4 TERMINATION/RELEASE

A. At completion of site preparation activities, restore trailer and contents to prework conditions. Housekeeping and repairs/replacements will be done to the satisfaction of FDF. When authorized by FDF, release the modular field office facility to FDF, including office equipment and interior components.

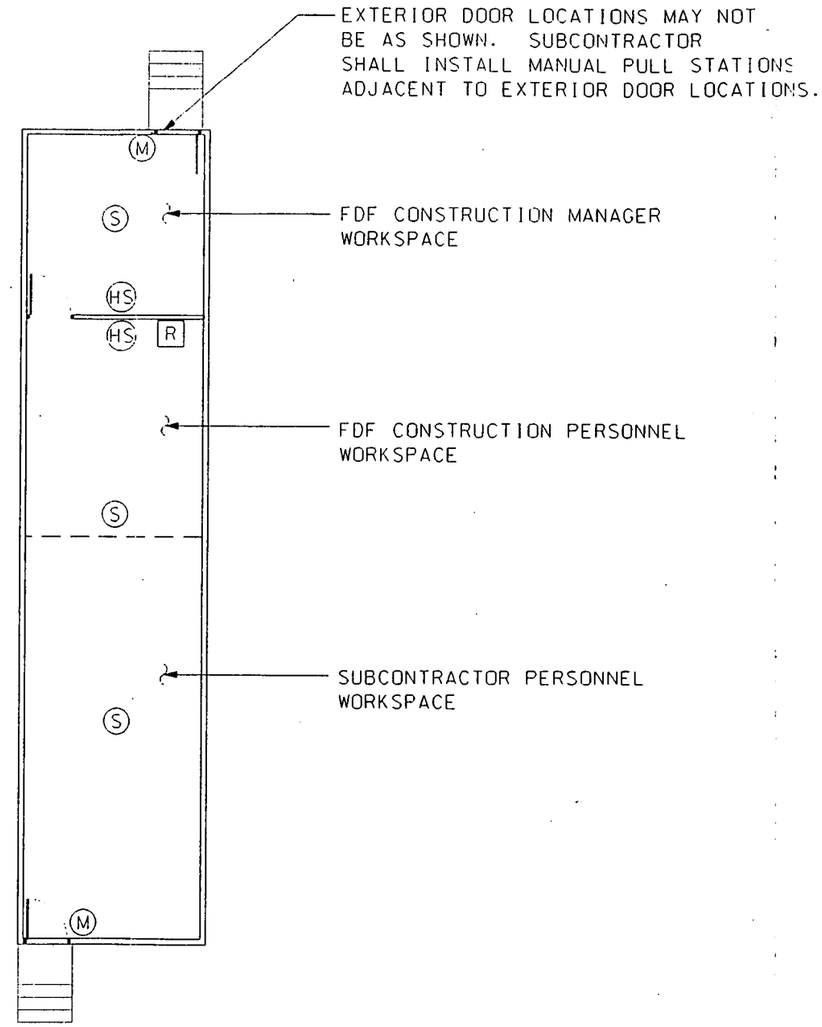
END OF SECTION

ATTACHMENT A

SKETCH SKA04503

ska04503.m po165@ws421. Wed Apr 23 08:15:18 EDT 1997

FIELD OFFICE FACILITY



FIRE AND EVACUATION ALARM SYSTEM PLAN

N.T.S.

NOTES

LEGENDS

- (S) SMOKE DETECTOR
- (H) HEAT DETECTOR
- (M) MANUAL PULL STATION
- (HS) HORN STROBE
- [R] RAPID RECEIVER FOR EVACUATION SYSTEM

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A.E.	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION			

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ARCHITECTURAL PLAN
FIELD OFFICE FACILITY

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. PROSKI	01/30/97	V. MOORE	01/30/97	G. MELINTY	01/30/97

PLANT FIELD ORD. NO.	FLOOR	SCALE	CLASS
		N.T.S	

SUBMITTED FOR APPROVAL | FERMCO CPU APPROVAL

A.E. DATE | DATE

PREPARED UNDER FERMCO PROJECT ORDER NUMBER	A/E PROJECT NO.	TEMP PROJECT NO.	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
SCEP/PO-165		00-90701	SKA04503		0

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U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Subcontract No. FSC607

WASTE UNITS REMEDIATION PROJECT
SOUTHERN WASTE UNITS
TECHNICAL SPECIFICATIONS

Division 15

PARSONS

Prepared by: Oscar W. Carlson 5-28-97
Date

Checked by: Sal Ahl 5/28/97
Date

STATE OF OHIO
OSCAR W. CARLSON, JR.
60196
REGISTERED
PROFESSIONAL ENGINEER
Oscar W Carlson, Jr.
5-28-97

Date: 05/30/97
Rev.: 0 RE: WM

15000

WBS No: 1.1.1.1.2.3.6
SCEP/165/SWU/SITE

SECTION 15060
PIPE, FITTINGS, VALVES, AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe.

B. Fabricated piping assemblies.

C. Fittings.

D. Valves.

E. Specialty items.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 02667 - Drinking Water Lines.

D. Section 02668 - Transfer Line.

E. Section 15090 - Piping Supports and Anchors.

F. Section 15250 - Insulation.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES, AND STANDARDS

A. American Society of Mechanical Engineers (ASME):
1. ASME A13.1-81 Scheme for the Identification of Piping Systems (R1993).

2.	ASME B16.5-88 1992 Addenda	Pipe Flanges and Flanged Fittings.
3.	ASME B16.22-95	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
4.	ASME B16.25-92	Buttwelding Ends.
5.	ASME B31.3-96	Process Piping.

B. American Society for Nondestructive Testing (ASNT):

1.	ASNT-SNT-TC-1A-92	Personnel Qualifications and Certification Recommended Practice, December 1992 Edition.

C. American Society for Testing and Materials (ASTM):

1.	ASTM-A53-96	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2.	ASTM-A105/ A105M-96	Standard Specification for Carbon Steel Forgings for Piping Applications.
3.	ASTM A126-95	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
4.	ASTM A182/ A182M-96	Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
5.	ASTM A193/ A193M-Rev. A-96	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
6.	ASTM-A194/ A194M-96	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
7.	ASTM-A216/ A216M-93	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.

8.	ASTM-A234/ A234M Rev. A-96	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
9.	ASTM-A307-94	Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
10.	ASTM B32-96	Standard Specification for Solder Metal
11.	ASTM B61-93	Standard Specification for Steam or Valve Bronze Castings.
12.	ASTM B62-93	Standard Specification for Composition Bronze or Ounce Metal Castings.
13.	ASTM B88-96	Standard Specification for Seamless Copper Water Tube.
14.	ASTM B828-92	Standard Specification for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

D. American Welding Society (AWS):

1.	AWS A5.1-91	Carbon Steel Electrodes for Shielded Metal Arc Welding.

E. Ohio Plumbing Code - January 1993.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01011.

B. Product Data for pipe, fittings, valves, and accessories.

C. Shop drawings for shop-fabricated piping assemblies, including spool piece drawings.

D. Installation, maintenance, and operation instruction manuals for valves and accessories.

E. Certificates of conformance that material and equipment meet specification requirements.

F. Test procedures for required testing. Test procedures shall include criteria for acceptable performance.

G. Procedures for repair or replacement of piping failing tests and/or examination.

H. Pressure test and examination reports.

I. Welder and examiner qualifications, procedure qualification records, and welding procedure specifications.

1.6 QUALITY ASSURANCE

A. Except where more stringent requirements are specified or indicated, the work specified herein shall conform to ASME B31.3.

B. Welding Procedures and Qualifications
   1. Fabrication, assembly, and erection shall be in accordance with ASME B31.3.
   2. Welder qualifications shall be made available to, and approved by, FDF.
   3. Nondestructive testing personnel qualifications shall be in accordance with ASNT SNT-TC-1A.

C. Inspection, Examination, and Testing
   1. Inspection, examination, and testing shall be in accordance with ASME B31.3.
   2. FDF shall be given advance written notification prior to any testing.
   3. A written report of the examination and testing shall be submitted to FDF following the successful completion of examination and testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Materials shall be cleaned to remove chips, slag, weld spatter, oil, grease, debris, and other foreign material prior to packaging for shipment. Openings shall be covered, capped, or plugged to prevent damage and the ingress of foreign materials during shipment and storage. Tape alone shall not be used for sealing openings.

B. Storage and Handling

1. Piping materials and prefabricated assemblies shall be stored off the ground and handled with care so that physical damage, contamination, or corrosion of the piping materials does not occur. End seals of pipe, flange covers, valve covers, and similar protection shall not be removed until necessary for cleaning, fabrication, inspection, and erection.
2. Welding rods and electrodes shall be stored, handled, and identified to ensure the use of the proper welding rod. Electrode ovens for the storage of low-hydrogen welding rods shall be used.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Piping and Valve Specification

1. Piping materials and valves shall meet the requirements indicated on the piping material data sheets in Attachment A.
2. For underground piping, see Sections 02667 and 02668.
3. Provide one spare valve for each size and type installed.
4. Air Release Valve installed in the Lift Station is specified on the drawings.

B. Post Hydrant: Hydrant shall be exposed, non-freeze post type hydrant. Complete with bronze casing and cast aluminum casing guard, all bronze interior parts, bronze seat, and replaceable seat washer and non-turning operating rod and operating key. Drain port shall be tapped into housing.

2.2 LABELING

A. Valve Identification

1. Each valve shall be identified with the unique valve number and description, as shown on the P&IDs.
2. The tag shall not be attached to any part of the valve which may interfere with valve operation.
3. Valve identification tags on insulated valves shall be located outside the insulation jacketing and be easily accessible for inspection.
4. Label size shall be based on using 1/2-inch letters.
5. Labels shall be constructed of nonreflective corrosion-resistant materials, with good contrast and legibility.

B. Pipe Identification

1. Identify the flow medium and the flow direction for piping systems including insulated pipe by labeling adjacent to each valve, adjacent to abrupt pipe directional change, and at intervals of 50 feet along exposed pipe. Pipes shall be labeled as indicated on the P&IDs and in accordance with ASME A13.1.
2. Content, size, material type, line number, and insulation requirements for each pipeline shall be identified on drawings as follows. Refer to the P&ID symbols and legend for additional information.

<u>Example</u> ST - 4" - A - 1000 - ET

Medium Code	Size	Material Code	Line Number	Insulation
ST	4"	A	1000	ET

C. Product Marking

1. Piping materials shall be marked in accordance with the applicable ASTM specification as indicated on the piping material data sheets in Attachment A.
2. Welding rod and electrode packages shall be marked in accordance with AWS A5.1.
3. Welding rods and electrodes shall be identified in accordance with AWS A5.1. In addition, welding rods 1/8-inch diameter and over shall be marked or stamped with positive identification marks at intervals of not more than 18 inches. Such marks shall include the classification number of the welding rod and the trade designation of the manufacturer.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Primer Application

1. Non-insulated carbon steel piping shall be prime coated after fabrication.

B. Ream copper pipe and tube ends, and remove burrs.

3.3 ERECTION/INSTALLATION

A. Layout, Cutting, and Fitting Up

1. Piping shall be Category D fluid service under ASME B31.3.
2. Assembled piping shall be installed without springing, forcing, or cold bending. Cutting or otherwise weakening structural members to facilitate piping installation shall not be permitted.
3. Butt-welded pipe shall be beveled in accordance with ASME B16.25.

4. Install valves with stems upright or horizontal, not inverted.
5. Slope field-routed piping and tubing, and arrange to drain at all low points.

B. Welding

1. Welding electrodes shall be in accordance with AWS A5.1.
2. Socketwelds shall be made by shielded metal arc or gas tungsten arc welding process.
3. Socketweld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch or no more than 1/8 inch.
4. Field welding shall be minimized through maximum use of shop-fabricated piping assemblies.
5. Arc strikes and weld starts shall not be made on the base metal outside the weld groove nor inside an area which will be encompassed by a fillet or socket weld. Inadvertent arc strikes outside a weld zone shall be removed by grinding or filing, and the arc strike area shall be visually examined under 5X magnification.
6. Soldering shall be in accordance with ASTM B828.

C. Flanged Joints

1. Flange isolation kits shall be used between all dissimilar metal flanges.
2. The mating surfaces of the flanges shall be in a plane that is perpendicular to the axis of the pipe. Flanges shall be rotated so that the bolt holes straddle the vertical flange centerline. Gaskets shall be evenly centered between the flange faces with ring-type gaskets engaging fully upon raised-face flanges. Flanges shall mate flush and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. Bolts shall be torqued within the flange manufacturer's recommended range and tightening sequence.
3. Where a raised-face flange mates with a flat-face flange, it shall be substituted with a flat-face

flange of the material type specified on the attached Piping Material Data Sheet.

4. Flat ring-type gaskets shall be used between steel flanges equipped with raised serrated faces.
5. Where metallic flanges are bolted to non-metallic flanges, both shall be flat-faced flanges. Full-face gaskets shall be used.
6. When piping, valves, fittings, or equipment having cast iron flanges are used, mating flanges shall be flat faced with full-faced gaskets.
7. Flanged joints shall be made with new gasket and bolting materials. Bolts and nuts damaged during installation shall be replaced.

D. At least 5 percent of fabricated piping shall be visually examined by an examiner qualified and certified in accordance with ASNT SNT-TC-1A.

3.4 QUALITY CONTROL

A. Hydrostatic Testing

1. Piping systems shall be hydrostatically leak tested in accordance with ASME B31.3, Chapter VI.
2. Pressure vessels, equipment, and instruments shall not be included in these tests if they will be damaged by the test pressure.
3. Equipment which is not to be subjected to the pressure test shall be disconnected from the piping and a pipe spool inserted in its place, or the equipment may be isolated by way of a single-line blind. Valves may be used provided that the valve is suitable for the proposed test procedure.
4. Hydrostatic test pressures shall be 1.5 times the design pressure, as shown in the following table:

SERVICE	MEDIUM CODE	MATERIAL CODE	DESIGN PRESSURE (psig)	TEST PRESSURE (psig)
Potable Water	DW	A, C1	100	150
Stormwater	ST	A	100	150

5. Leak testing shall not start until the testing procedure has been approved by FDF.
6. Connections/joints (including welds) shall be left uninsulated, unpainted, and exposed for examination for leakage during testing.
7. The piping system shall be examined prior to leak testing to ensure that connections are tight.
8. Test pressure gauges shall be calibrated no more than 90 days prior to the hydrostatic leak test. Gauges shall be selected so that the test pressures are at the mid-range of the gauge. Documentation shall be maintained and made available showing reliability of calibrated equipment.
9. Every precaution shall be taken during testing to ensure personnel safety.
10. Pressure gauges shall not be subjected to pressure in excess of their scale range.
11. Control valves (unless being tested) shall be set and maintained in the full OPEN position.
12. Lines containing check valves shall have the pressure applied upstream of the check valve so that pressure is applied under the seat.
13. Joints found to be defective shall be repaired and retested. Retest pressures shall be the same as those originally specified for the test.
14. Hydrostatic test pressures shall not be applied until the piping system and the testing medium have reached thermal equilibrium.
15. High-point vents and low-point drains shall be provided for hydrostatic tests.

B. Plumbing shall be inspected and tested to ensure compliance with the Ohio Plumbing Code.

3.5 CLEANING

A. System Cleaning and Flushing

1. The interior and exterior of pipe shall be kept clean at all times.

B. Disinfection of Water Distribution Systems: See Section 02667.

END OF SECTION

ATTACHMENT A

PIPING MATERIAL DATA SHEETS

PIPING MATERIAL DATA SHEET	MAT'L CODE (SPEC) A PAGE 1 OF 3

RATING: CLASS 150
FACING: RF
MATERIAL: CARBON STEEL

CORROSION ALLOWANCE: 0.125"
PRESSURE LIMIT: PER ASME/ANSI B16.5
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			PIPE		
		1/2" - 2"	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, EXTRA STRONG, PLAIN ENDS		
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, ASTM A53 GRADE B, STANDARD WEIGHT, BEVELED ENDS		
			FLANGES		
		1/2" - 2"	CLASS 150, CARBON STEEL, RF, ASTM A105, SOCKETWELD (XS BORE)		
		2-1/2" - LARGER	CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STANDARD WEIGHT BORE)		
		1/2" - LARGER	CLASS 150, BLIND, CARBON STEEL, ASTM A105, RFSF		
			FITTINGS		
		1/2" - 2"	CLASS 3000, CARBON STEEL, ASTM A105, SOCKETWELD		
		1/2" - 2"	CLASS 3000, THREADED CARBON STEEL, ASTM A105;		
			THREADOLET	1, 4	
			CAP	1	
			PLUG, ROUNDHEAD	1	
			PLUG, HEX HEAD	4	
		2-1/2" - LARGER	SEAMLESS CARBON STEEL, BUTT WELD ENDS, ASTM A234 GRADE WPB, STANDARD WEIGHT		
			SWAGES		
		1/2" - 8"	SCHEDULE 80 CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED, PLAIN OR THREADED)	2	
			GASKETS		
		1/2" - LARGER	TEFLON, 1/8 INCH THICK		
			BOLTING		
			STUD BOLTS WITH 2 HEAVY HEX NUTS, ASTM A193 GRADE B7/ASTM A194 GRADE 2H		

PIPING MATERIAL DATA SHEET	MAT'L CODE (SPEC) A PAGE 2 OF 3

RATING: CLASS 150
FACING: RF
MATERIAL: CARBON STEEL

CORROSION ALLOWANCE: 0.125"
PRESSURE LIMIT: PER ASME/ANSI B16.5
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM TO	DESCRIPTION	NOTES	REV
			GATE VALVES		
		1/2" - 2"	CLASS 800, CARBON STEEL, ASTM A105, SOCKETWELD ENDS, OS&Y, BOLTED BONNET, SOLID WEDGE, 12% CR TRIM.	5	
		2-1/2"- LARGER	CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, 11-13 CR TRIM, OS&Y.	5	
			BALL VALVES		
		1/2" - 2"	1500 PSI WOG, CARBON STEEL, ASTM A216 GRADE WCB, THREE PIECE, SOCKETWELD, CHROMIUM PLATED BALL, TFE SEATS, LEVER OPERATOR, APOLLO 83-600 SERIES OR EQUAL	5	
		2-1/2" - 4"	CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR, APOLLO 88-200 SERIES OR EQUAL.	5	
		6" - LARGER	CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR, APOLLO 88-200 SERIES OR EQUAL.	5	
			CHECK VALVES		
		2-1/2" - LARGER	CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF, FLANGE, CHROME TRIM, BOLTED COVER, SWING TYPE, LUNKENHEIMER FIG. 1572 OR EQUAL	3	
			PIPE NIPPLES		
			CARBON STEEL, ASTM A53, GRADE B		
		1/2" - 2"	SCH 160, TBE, SMLS 3" LONG		
		1/2" - 2"	SCH 160, TBE, SMLS 6" LONG		
		1/2" - 2"	SCH 160, POE-TOE, SMLS 3" LONG		
		1/2" - 2"	SCH 160, POE-TOE, SMLS 6" LONG		
			NOTES		
			1. USE FOR UNVALVED VENTS AND DRAINS. 2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER. 3. INSTALL IN HORIZONTAL POSITION OR WITH FLOW UP. 4. USE FOR PROCESS DRAINS. 5. EQUIP VALVE WITH LOCKING DEVICE WITH NOT LESS THAN 3/8" DIAMETER HOLE FOR LOCK.		

PIPING MATERIAL DATA SHEET

MAT'L CODE C1
(SPEC)
PAGE 3 OF 3

RATING: CLASS 150
FACING: N/A
MATERIAL: COPPER

CORROSION ALLOWANCE: N/A
PRESSURE LIMIT: 150 psig
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM	SIZE TO	DESCRIPTION	NOTES	REV
				TUBING		
		1/4" - 2"		SEAMLESS COPPER, ASTM B88, TYPE L, HARD DRAWN		
				FITTINGS		
		1/4" - 2"		WROUGHT COPPER AND BRONZE, ASME B16.22, 150 PSIG		
				FLANGES		
		1" - 2"		BRONZE, ASME B16.22, 150 PSIG, SLIP-ON FLANGES		
				JOINTS		
				SOLDER, ASTM B32, GRADE 95TA		

SECTION 15090
PIPING SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping supports, anchors, and accessories.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 15060 - Pipe, Fittings, Valves, and Accessories.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES AND STANDARDS

A. American Society for Testing and Materials (ASTM):
1. ASTM A36/A36M-96 Standard Specification for Carbon Structural Steel.

B. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):
1. ANSI/ASME B31.3-96 Process Piping.

C. Manufacturers Standardization Society (MSS):
1. MSS-SP-58-93 Pipe Hangers and Supports - Materials, Design, and Manufacture.
2. MSS-SP-69-91 Pipe Hangers and Supports - Selection and Application.
3. MSS-SP-89-91 Pipe Hangers and Supports - Fabrication and Installation Practices.

D. American Welding Society (AWS):

1. AWS A5.1-91 — Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
2. AWS D1.1-96 — Structural Welding Code - Steel, 13th Edition.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

1. Pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction incorporating a design safety factor of five.
2. Anchors and guides shall be used to prevent excessive forces or moments on pipe or equipment caused by hydraulic surges.
3. Hangers and support types for lines shall be selected to withstand static and dynamic load conditions and shall take into consideration limitations imposed by the surrounding structures, equipment, adjacent piping, etc. Consideration shall be given to the following loads:
   a. Weight of the pipe, valves, fittings, insulation materials, hanger components, and normal fluid contents.
   b. Loads imposed during erection.
4. Support Spacing:
   a. Hangers and supports shall be spaced in accordance with ASME B31.3 and Attachment A.
5. Restrictions:
   a. Pipe support assemblies shall be used only for supporting pipelines. Electrical trays, instrument trays, cable, and tubing shall be supported from separate assemblies unless written approval has been received from FDF. Pipe hanger rods or supports shall not pass through ducts nor through electrical or instrument trays.
6. Combination Supports:
   a. Where the piping design incorporates multiple horizontal pipelines with the bottom of the pipelines at the same elevation, rack-type supports shall be used. Where multiple

pipelines are supported on a single support member, consideration shall be given to the difference in expansion of the pipelines and possible resultant misalignment of the support during normal operation.

7. Unit Support:
   a. Where single horizontal pipelines are to be supported, the selection of the pipe attachment shall be based on the application, considering workability, function, strength, and economics. This attachment may be a pipe clamp, clevis, U-bolt, double-rod roll, or other pipe attachment best suited for the condition. The movement of the pipe due to hydraulic surges and other sources shall be considered. The attachments between the pipe and the supporting structure (usually hanger rod) shall be able to swivel at the ends to accommodate a 4-degree movement of the pipe.
8. Structural Integrity:
   a. The supports shall be designed and installed so that they cannot become disengaged by movements of the supported pipe. A lock nut shall be used to prevent turning and disengagement.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Section 01011.

B. For piping supports and anchors for piping 2 inches in diameter and smaller: shop drawings which indicate support type and location, arrangement, dimensions, materials, weld details, and anchor details.

C. Welder and examiner qualifications, procedure qualification records, and welding procedure specifications in accordance with AWS D1.1.

1.7 QUALITY ASSURANCE

A. Pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction. Welded construction shall comply with AWS D1.1.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Materials shall be cleaned to remove chips, slag, weld spatter, oil and grease, debris, and other foreign matter prior to packing for shipment.

B. Storage and Handling

1. Piping support materials and piping hanger systems shall be stored off the ground and handled with care so that physical damage or contamination of the materials does not occur.
2. Welding rods and electrodes shall be stored, handled, and identified to ensure the use of proper welding rod. Electrode ovens for the storage of low-hydrogen welding rods shall be used.

PART 2 PRODUCTS

2.1 MATERIALS

A. Hangers, supports, and component parts shall be constructed of galvanized carbon steel and comply with MSS-SP-58 and MSS-SP-69. Standard, commercially available hangers shall be used wherever possible.

B. ASTM A36 steel shall be used for plate and structural shape support components.

C. Expansion Anchors: Drilled expansion bolts for securing steel to concrete.

a. Kwik Bolt, by Hilti,Inc.
b. Parabolt, by Molly Fastener Group.
c. Wedge Anchors, by ITW Ramset/Red Head.

2.2 FABRICATION

A. Welding
1. Welding shall be in accordance with AWS A5.1 and AWS D1.1.

B. Shop Assembly
1. Any parts made in the fabricator's shop shall be completely shop assembled and painted, as far as practical, prior to shipment to the site.

2.3 LABELING

A. Product Marking
1. Welding rods and electrodes shall be identified with at least one imprint per rod showing an AWS classification number in accordance with AWS A5.1. In addition, welding rods 1/8 inch in diameter and over shall be marked or stamped with positive identification marks at intervals of not more than 18 inches. Such marks shall include the classification number of the welding rod and the trade designation of the manufacturer. Filler metal requirements shall conform to AWS A5.1.

PART 3 EXECUTION

3.1 PREPARATION

A. Protection
1. Welding/fabricating activities shall be protected from inclement weather.

B. Painting
1. Structural steel pipe support material systems shall be prime and finish coated after fabrication.

3.2 ERECTION/INSTALLATION

A. Installation
1. Hanger and support components shall be installed in accordance with MSS-SP-89.

B. Structural Connections for Pipeline Supports

1. Locations: Pipeline supports and/or hangers shall be attached to structural members. The supports shall be located at the following places and at intermediate points so that the maximum support spacing is not exceeded:
   a. For changes in direction on horizontal or sloped lines, refer to the attached allowable pipe spans chart.
   b. Within 2 feet on one side of valves on horizontal or sloped lines.
2. Cold Lines: Hanger rods supporting cold pipelines, or lines whose point of support does not move, may be bolted directly to angle, beam, or supporting members.
3. Prohibited Attachments: Pipelines shall not be attached to the following:
   a. Grating.
   b. Other pipe hangers or other pipes.
4. Supports shall be provided to avoid the need for temporary supports in the following cases:
   a. Where regular maintenance necessitates the removal of equipment.
   b. Where flanged connections must be broken to remove or insert spectacle blinds.

3.3 ADJUSTING

A. At Pumps: Where required, the suction piping and discharge piping adjacent to pumps shall be supported with an adjustable support.

B. Riser Guides: Risers that may sway or vibrate from pump pulsations or mechanical equipment operation shall be guided. The guides/braces shall prevent movement resulting from equipment operation/vibration, but shall not limit or restrain movement of pipe due to thermal expansion. On overflow lines, a brace or restraint shall be installed near the discharge.

C. Vertical Adjustment:

1. Rod-type hangers shall be provided with a means of vertical adjustment after erection. If a turnbuckle is used, the right hand thread shall be at the top, so that turning to the right will raise the pipe.

D. Riser Piping:

1. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to riser piping shall be by riser clamps and/or lugs welded to the pipe.

END OF SECTION

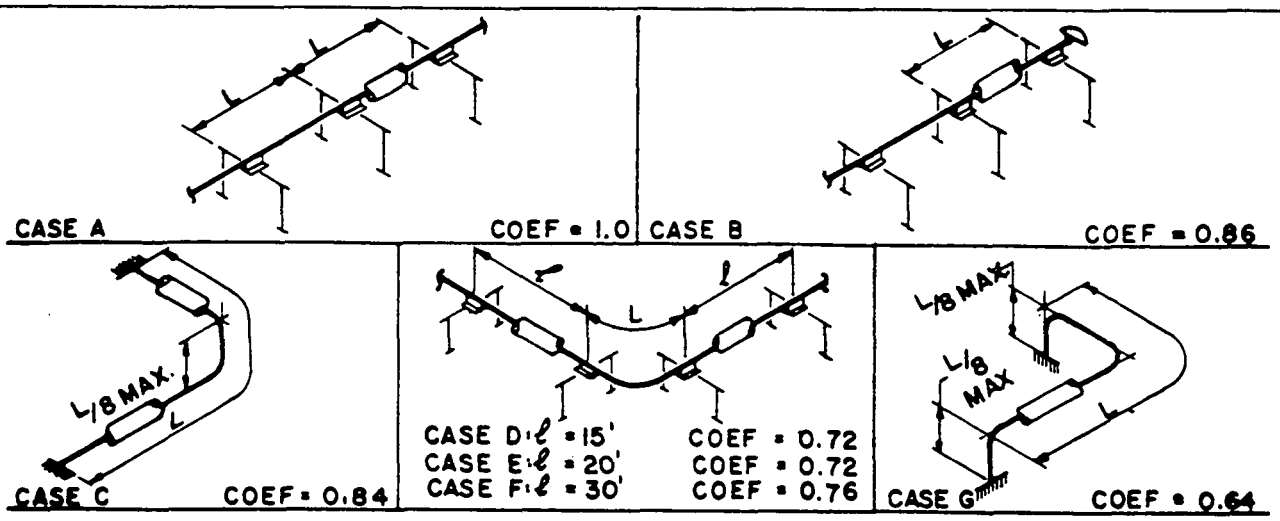
ATTACHMENT A

ALLOWABLE PIPE SPANS

PARSONS Engineering Department Design Guide	Design Guide ber DSG-PD-602	App LL	Date Jan 1993	Sheet of 1 - 1

Subject

ALLOWABLE PIPE SPANS



Notes:

1. The limiting factors are deflection and weight stress. Pipe span not entered if weight stress of 6,000 pounds per square inch (psi) is exceeded.
2. The pipe spans are based on carbon steel pipe with modulus of elasticity of 30×10^6 psi. This chart can be applicable to alloy pipe.
3. Deflection is based on a compromise between a beam with fixed-ends and for a free-ended beam, $d = 17.1\ (wl^4/EI)$.
4. This chart is adequate for standard-wall and extra-strong walled pipe.
5. Boxed figures represent Parsons standard. Job instructions may allow deviation.
6. When using Cases B, C, D, E, F, and G, multiply pipe span by their coefficient.
7. These spans are the maximum to be used under American National Standards Institute B31.3, Piping. Design conditions and other codes should be investigated before using these spans.

PIPE SIZE	1	1½	2	3	4	6	8	10	12	14	16	18	20	24	DEF'L
BARE PIPE	—	—	—	—	—	—	—	36	38	42	45	47	50	54	1/4
	14	17	19	24	27	33	38	43	46	49	52	55	58	64	1/2
	15	18	21	25	29	35	40	46	49	52	55	58	62	68	5/8
	16	19	22	26	30	37	42	48	52	55	58	62	65	71	3/4
	17	21	23	28	32	40	45	—	—	—	—	—	—	—	1
BARE PIPE + WATER	—	—	—	—	—	—	—	31	33	35	36	37	39	42	1/4
	14	17	19	22	25	29	33	36	39	40	42	44	46	48	1/2
	14	18	20	23	26	31	35	39	41	43	45	47	48	52	5/8
	15	19	21	24	27	33	37	41	43	45	47	49	51	—	3/4
	16	20	22	26	29	35	40	—	—	—	—	—	—	—	1
PIPE + 2" INSUL.	—	—	—	—	—	—	—	34	36	39	42	44	47	52	1/4
	12	15	17	22	25	31	36	41	42	46	50	52	56	61	1/2
	13	16	18	23	26	33	38	43	45	49	53	56	59	65	5/8
	13	17	19	24	27	35	40	45	47	52	55	58	62	68	3/4
	14	18	20	26	28	37	42	—	—	—	—	—	—	—	1
PIPE + 2" INSUL. +0.8 WATER	—	—	—	—	—	—	—	31	33	35	36	37	39	42	1/4
	12	15	16	20	23	29	33	36	39	40	42	44	46	48	1/2
	12	16	17	22	25	31	35	39	41	43	45	47	48	52	5/8
	13	17	18	23	26	32	36	41	43	45	47	49	51	—	3/4
	14	18	20	25	28	34	39	—	—	—	—	—	—	—	1

SECTION 15160
LIFT STATION PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Three automatically controlled lift station pumps and two non-installed spare pumps.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 15170 - Motors.

D. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American National Standards Institute (ANSI):
1. ANSI B16.1-89 Cast Iron Pipe Flanges and Flanged Fittings.

1.5 SUBMITTALS

A. Support Literature:
1. Submit dimensional drawings with size, weight, ratings, materials of construction, pump curves, completed pump data sheet, and test procedures from the pump manufacturer for the pump and related equipment specified herein.
2. Installation, Operation, and Maintenance Manual:
   a. The pump manufacturer shall supply a complete set of comprehensive written instructions to enable an operator to properly operate and maintain the equipment supplied. Content of

the instructions shall assume the operator is familiar with pumps, motors, piping, and valves, but that the operator has not previously operated nor maintained the exact equipment supplied.

b. The instructions shall be prepared as a system manual applicable solely to the pump equipment and related devices supplied by the manufacturer, as specified herein.

c. The instructions shall include, but not be limited to, the following:

(1) Descriptions of, and operating instructions for, each major component of the complete pump package as supplied.

(2) Instructions on operation of the pump and pump controls in intended modes of operation.

(3) Instruction for adjustments which must be performed at initial start-up of pump equipment, adjustments required after the replacement of liquid level control system components, and adjustments as required in the course of preventative maintenance as specified by the manufacturer.

(4) Service instructions for major components not manufactured by the pump package manufacturer, but supplied by the manufacturer in accordance with the specifications. In such case, the literature supplied by the actual manufacturer shall be incorporated as appendices.

(5) Electrical schematic diagram of the pump and control package.

(6) Layout drawings of the pump package as supplied showing the location of submersible pumps, baseplates, and guide assemblies. Drawings shall provide necessary information to ensure proper installation and alignment of the guides and baseplate to the pump.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. KSB, Inc., or equal.

2.2 PUMPS

A. See Attachment A - Pump Data Sheets.

B. See Section 15170 for Motor data.

C. Impeller shall be of cast iron and precision balanced. Balancing shall not deform or weaken the impeller. Impeller fasteners shall be non-corroding.

D. Design shall provide for proper balance of pump and guide shoe from the discharge connection while using a single lift chain.

E. Components: Other major pump components such as stator housing, seal housing, and bearing brackets shall be of structural grade steel or cast iron. Exposed fasteners and lock washers shall be of stainless steel.

F. Shaft Seal:
   1. The pump shaft shall be sealed against leakage by a double mechanical seal.
   2. The rotating seal faces shall be lubricated from an oil-filled reservoir between pump and motor, the oil serving as both lubricating and cooling media. The reservoir shall have separate oil fill and drain plugs to ensure accuracy when measuring lubricant level, and for ease of maintenance.
   3. Seal shall require no special maintenance or routine adjustment. However, it shall be easily inspected or replaced. No seal damage shall result from operating the pump for short periods without liquid.

2.3 DISCHARGE

A. Description:

1. Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design shall ensure an automatic and firm connection of the pump to the discharge piping when lowered into place.

B. Baseplate:

1. A cast iron base with integral guide system pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base shall be designed with an integral 90-degree elbow for connection to the vertical discharge piping utilizing standard ANSI B16.1 Class 125 flanges.

C. Discharge Connection:

1. Each pump shall be provided with a replaceable cast iron guide shoe attached to the pump discharge flange. A replaceable seal shall be provided as an integral part of the guide shoe to form a seal with the baseplate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.

D. Guide Rail System and Method of Operation:

1. Schedule 40 stainless steel guide rail pipe or stainless steel cable shall be provided for each pump.
2. Upper guide system brackets and a lifting chain shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.

3. The guide shoe shall direct the pump down the guide system and onto the discharge connection in a simple linear movement. The design shall ensure that the buildup of sludge and grease on guide rails will not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit the full weight of the pump to the baseplate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide system, or lifting chain.
4. An eyelet shall be provided at the upper end of the lifting chain for attaching to the wet well access frame.
5. Bolts, machine screws, nuts, washers, and lockwashers for complete assembly of the guide rails and discharge elbow shall be stainless steel.
6. Adjust final length of guide and lifting systems in the field.

2.4 LABELING

A. Equipment identification: Pumps shall be provided with a permanently attached stainless steel nameplate indicating equipment name, number, model number, and rated capacity. Lettering shall be manufacturer's standard size and shall be stamped.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 ERECTION/INSTALLATION/APPLICATION

A. The installation of the equipment shall be in accordance with the manufacturer's installation manual.

B. A copy of the manufacturer's installation and service manual for each piece of the equipment shall be available at the site.

3.3 QUALITY CONTROL

A. Tests: Acceptance operating tests shall be performed after installation. Adjust or replace the equipment to meet the specification requirements and retest the equipment.

B. Inspection: Notify FDF of testing and inspection activities prior to the start of all tests and/or inspections.

3.4 MANUFACTURER ASSISTANCE

A. The manufacturer shall provide installation supervision and start-up assistance. Service assistance shall be in accordance with the manufacturer's warranty.

3.5 DEMONSTRATION

A. Demonstrate ability to meet full range of operating flow rates and operating points as shown on pump curves.

END OF SECTION

ATTACHMENT A

PUMP DATA SHEETS

PUMP DATA SHEET

PROJECT TITLE:	Waste Units Remediation - SWU		PROJECT ORDER: 165
PUMP NAME:	SWRB PMP-1 - include name for spare		QUANTITY: 1 + 1 spare
TYPE PUMP:	Submersible centrifugal		DRAWING NUMBER 92X-5900-N-00290
TYPE DRIVER: Submersible electric motor	SUPPLY W/PUMP	X YES NO	
MANUFACTURER AND MODEL NO.:	KSB, Inc., Model KRT K100-400, or equal		EQUIP NO.: PMP-1 & include name for spare

OPERATING CONDITIONS

FLUID PUMPED: STORMWATER		AT A PUMPING TEMPERATURE OF:	60 °F
SPECIFIC GRAVITY: 1.0 AT 60°F	AT P.T.	VISCOSITY:	AT P.T.
SOLIDS IN FLUID: 1-5 WT%	DENSITY: NA	SIZE: ≤1/2" dia.	ABRASIVE: NO
NATURE OF SOLIDS: NA		FLUID VAPOR PRESSURE:	FT. of FLUID @ P.T.
DESIGN CAPACITY: 400 GPM AT 160 FT. TH at P.T.		DESIRED RANGE: 350 GPM TO 450 GPM	
SUCTION PRESS: NA FT. PSIG	DISCHARGE PRESS: FT. PSIG		NPSH AVAIL: NA at P.T.

PUMP SPECIFICATIONS

TYPE PUMP: Centrifugal, direct-connected	NO. STAGES: 1	RPM: 3600 max.
TYPE IMPELLER: Open	SIZE: IN.	MAX SIZE: IN.
EFFICIENCY AT DESIGN CAPACITY: (min) %	BHP @ DESIGN CAPACITY:	MAXIMUM BHP: 50
TYPE BEARINGS: Oil-lubricated, anti-friction		
TYPE COUPLING:	LUBRICATION:	
TYPE OF SEAL: Double Mechanical		

CONNECTIONS - SIZE & RATING

SUCTION: IN. LB. Flange		DISCHARGE: 4 IN. Class 125 Flange	
VENT: IN. LB.		DRAIN: IN.	

CONSTRUCTION MATERIALS

RESTRICTIONS:	
CASING: Cast iron	IMPELLER: Cast iron
SHAFT: Stainless steel	SHAFT SLEEVE: Stainless steel
CASE RING:	IMP. RING:
DISCHARGE ELBOW: Cast iron	RELIEF VALVE:

ELECTRIC MOTOR

VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE
460	3	60		YES				

REMARKS: 1) Vendor shall complete data sheet as required.
2) Provide one set of recommended pump spare parts.

Date: 05/30/97 15160 WBS No: 1.1.1.1.2.3.6
Rev.: 0 RE: OC [A] 1 of 3 SCEP/165/SWU/SITE

PUMP DATA SHEET

PROJECT TITLE:	Waste Units Remediation - SWU		PROJECT ORDER: 165
PUMP NAME:	SWRB PMP-2 - include name for spare		QUANTITY: 1 + 1 spare
TYPE PUMP:	Submersible centrifugal		DRAWING NUMBER 92X-5900-N-00290
TYPE DRIVER: Submersible electric motor	SUPPLY W/PUMP	X YES NO	
MANUFACTURER AND MODEL NO.:	KSB, Inc., Model KRT K40-250, or equal		EQUIP NO.: PMP-2 & include name for spare

OPERATING CONDITIONS

FLUID PUMPED: STORMWATER		AT A PUMPING TEMPERATURE OF:	60 °F
SPECIFIC GRAVITY: 1.0 AT 60°F	AT P.T.	VISCOSITY:	AT P.T.
SOLIDS IN FLUID: 1-5 WT%	DENSITY: NA	SIZE: ≤1/2" dia.	ABRASIVE: NO
NATURE OF SOLIDS: NA		FLUID VAPOR PRESSURE:	FT. of FLUID @ P.T.

DESIGN CAPACITY: 100 GPM AT 150 FT. TH at P.T.	DESIRED RANGE: 75 GPM TO 125 GPM	
SUCTION PRESS: NA FT. PSIG	DISCHARGE PRESS: FT. PSIG	NPSH AVAIL: NA at P.T.

PUMP SPECIFICATIONS

TYPE PUMP: Centrifugal, direct-connected	NO. STAGES: 1	RPM: 3600 max.
TYPE IMPELLER: Open	SIZE: IN.	MAX SIZE: IN.
EFFICIENCY AT DESIGN CAPACITY: (min)%	BHP @ DESIGN CAPACITY:	MAXIMUM BHP: 17
TYPE BEARINGS: Oil-lubricated, anti-friction		
TYPE COUPLING:	LUBRICATION:	
TYPE OF SEAL: Double Mechanical		

CONNECTIONS - SIZE & RATING

SUCTION: IN. LB. Flange	DISCHARGE: 2 IN. Class 125 Flange
VENT: IN. LB.	DRAIN: IN.

CONSTRUCTION MATERIALS

RESTRICTIONS:	
CASING: Cast iron	IMPELLER: Cast iron
SHAFT: Stainless steel	SHAFT SLEEVE: Stainless steel
CASE RING:	IMP. RING:
DISCHARGE ELBOW: Cast iron	RELIEF VALVE:

ELECTRIC MOTOR

VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE
460	3	60		YES				

REMARKS: 1) Vendor shall complete data sheet as required.
2) Provide one set of recommended pump spare parts.

Date: 05/30/97 15160 WBS No: 1.1.1.1.2.3.6
Rev.: 0 RE: OC [A] 2 of 3 SCEP/165/SWU/SITE

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PUMP DATA SHEET

PROJECT TITLE:	Waste Units Remediation - SWU		PROJECT ORDER: 165
PUMP NAME:	SWRB PMP-3		QUANTITY: 1
TYPE PUMP:	Submersible centrifugal		DRAWING NUMBER 92X-5900-N-00290
TYPE DRIVER: Submersible electric motor	SUPPLY W/PUMP	X YES NO	
MANUFACTURER AND MODEL NO.:	KSB, Inc., Model KRT K40-250, or equal		EQUIP NO.: PMP-3

OPERATING CONDITIONS

FLUID PUMPED: STORMWATER		AT A PUMPING TEMPERATURE OF:	60 °F
SPECIFIC GRAVITY: 1.0 AT 60°F	AT P.T.	VISCOSITY:	AT P.T.
SOLIDS IN FLUID: 1-5 WT%	DENSITY: NA	SIZE: ≤1/2" dia.	ABRASIVE: NO
NATURE OF SOLIDS: NA		FLUID VAPOR PRESSURE:	FT. of FLUID @ P.T.
DESIGN CAPACITY: 100 GPM AT 135 FT. TH at P.T.		DESIRED RANGE: 75 GPM TO 125 GPM	
SUCTION PRESS: NA FT. PSIG	DISCHARGE PRESS: FT. PSIG		NPSH AVAIL: NA at P.T.

PUMP SPECIFICATIONS

TYPE PUMP: Centrifugal, direct-connected	NO. STAGES: 1	RPM: 3600 max.
TYPE IMPELLER: Open	SIZE: IN.	MAX SIZE: IN.
EFFICIENCY AT DESIGN CAPACITY: (min)%	BHP @ DESIGN CAPACITY:	MAXIMUM BHP: 17
TYPE BEARINGS: *Oil-lubricated, anti-friction*		
TYPE COUPLING:	LUBRICATION:	
TYPE OF SEAL: Double Mechanical		

CONNECTIONS - SIZE & RATING

SUCTION: IN. LB. Flange		DISCHARGE: 2 IN. Class 125 Flange	
VENT: IN. LB.		DRAIN: IN.	

CONSTRUCTION MATERIALS

RESTRICTIONS:			
CASING:	Cast iron	IMPELLER:	Cast iron
SHAFT:	Stainless steel	SHAFT SLEEVE:	Stainless steel
CASE RING:		IMP. RING:	
DISCHARGE ELBOW: Cast iron		RELIEF VALVE:	

ELECTRIC MOTOR

VOLTS	PHASE	HERTZ	H.P.	NON-OVERLOAD	CLASS	GROUP	RPM	TYPE
460	3	60		YES				

REMARKS: 1) Vendor shall complete data sheet as required.
2) Provide one set of recommended pump spare parts.

Date: 05/30/97 15160 WBS No: 1.1.1.1.2.3.6
Rev.: 0 RE: OC [A] 3 of 3 SCEP/165/SWU/SITE

SECTION 15170
MOTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low-voltage, three phase induction motors.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 15160 - Lift Station Pumps.

D. Section 16050 - Basic Electrical Materials and Methods.

E. Section 16170 - Grounding and Bonding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
1. ABMA 9-90 — Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11-90 — Load Ratings and Fatigue Life for Roller Bearings.

B. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 112-91 — Standard Test Procedure for Polyphase Induction Motors and Generators.

C. National Electrical Manufacturers Association (NEMA):
   1. NEMA MG 1-93 — Motors and Generators.
   2. NEMA MG 13-84 — Frame Assignments for AC Integral-Horsepower Induction Motors.

D. National Fire Protection Association (NFPA):
   1. NFPA 70 — National Electrical Code, 1996 Edition.

E. Underwriters Laboratories, Inc. (UL):
   1. Electrical Construction Materials Directory-96.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011.

B. Product Data: Provide full load amps, impedances, normal and short-circuit current ratings, NEMA frame size, and additional standard nameplate data. Provide efficiency and power factor for each of 1/2, 3/4, and full load. Provide dimensional enclosure details.

C. Test Reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112.

1.6 QUALITY ASSURANCE PROGRAM

A. Conform to NFPA 70 and NEMA MG 1.

B. Motors shall be listed in the UL Electrical Construction Materials Directory for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Reliance Electric.
   2. U. S. Motors.
   3. General Electric.

2.2 EQUIPMENT

A. General Construction and Requirements

1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics. Motors shall be suitable for driven equipment.
2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
3. Visible Nameplate: Indicating motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame.
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90-degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided.
5. Motor Service Factor: Furnish motors with service factors required herein. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor were 1.0.
6. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

B. Three Phase - Squirrel Cage Induction Motors

1. Motors shall be 460 V, three phase, 60 Hz.
2. Motors shall have a 1.15 service factor or higher.
3. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.

4. Starting Torque: To be matched to the driven equipment.
5. Starting Current: Not to exceed six times full-load current.
6. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
7. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors or as required by the driven equipment.
8. Insulation System: Non-hygroscopic NEMA Class F or better.
9. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and for compliance with performance data.
10. Motor Frames: NEMA MG 13 standard T-frames of steel, or cast iron with end brackets of cast iron.
11. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours.
12. Sound Power Levels: To NEMA MG 1.
13. Motors shall be high-efficiency type.
14. Motors shall be totally enclosed fan cooled (TEFC), unless specified or indicated otherwise.
15. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.
16. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.

17. Lift Station Pump Motors Special Requirements:

a. Watertight Integrity: Static seals at watertight mating surfaces shall be of the "O" ring type. Use of auxiliary sealing compounds shall not be required. The power and control cables shall enter the motor through a terminal housing. The pump and electrical cables shall be capable of continuous submergence without loss of waterproof integrity. The watertight integrity of the motor housing and shaft seal shall be tested during manufacture by pressurizing the motor cavity and submerging in water with motor operating.

b. Motor Protection: The motor shall be equipped with internal thermal and moisture switches. Three separate thermostatic switches (minimum) shall be embedded into the stator windings (one per phase). Each switch shall open independently and terminate motor operation if temperature of the protected winding reaches the high temperature setpoint. A mechanically activated, moisture-sensing, micro switch shall be installed in the motor housing. The switch shall be capable of detecting airborne moisture and terminate operation of motor before liquid enters the cavity. Use of probes or floats that rely on the presence of liquid to initiate signal are not acceptable.

c. Starts per hour: Motor shall be capable of 10 starts per hour.

C. Performance Schedule: Three Phase - Energy efficient, TEFC.

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
1-1/2	3600	143T	82	85
2	3600	145T	82	87
3	3600	145T	84	85
5	3600	182T	85	86
7-1/2	3600	184T	86	88
10	3600	213T	87	86
15	3600	215T	89	89
20	3600	254T	90	89
25	3600	256T	90	92
30	3600	284T	91	91
40	3600	286T	92	92
50	3600	324T	93	89
60	3600	326T	93	91
75	3600	364T	93	88
100	3600	365T	92	88
1	1800	143T	82	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	86	86
5	1800	184T	87	87
7-1/2	1800	213T	88	86
10	1800	215T	89	85
15	1800	256T	91	85
20	1800	256T	91	86
25	1800	284T	91	85
30	1800	286T	92	88
40	1800	324T	92	83
50	1800	326T	93	85
60	1800	364T	93	88
75	1800	365T	93	88
100	1800	404T	93	83

For motors larger than 100 hp, provide manufacturer's standard high-efficiency motor.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install motors in accordance with manufacturer's instructions.

B. Motors shall be aligned with the respective driven equipment as specified in related sections.

C. External metal frames of motors and their respective driven equipment shall be connected to ground.

END OF SECTION

SECTION 15250
INSULATION

PART I GENERAL

1.1 SECTION INCLUDES

A. Pipe and Equipment Insulation.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 15060 - Pipe, Fittings, Valves, and Accessories.

D. Section 15090 - Piping Supports and Anchors.

E. Section 16855 - Heating Cables.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES, CODES AND STANDARDS

A. American Society for Testing and Materials (ASTM):

1.	ASTM B209-95	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2.	ASTM C552-91	Standard Specification for Cellular Glass Thermal Insulation.

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01011.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Insulation Materials

1. Insulation materials shall be identified, inspected, controlled, and protected in a manner that will assure conformance with the referenced codes and standards.
2. Care shall be taken in the storage and handling of all insulation material so that contamination by grease, moisture, or other foreign matter does not occur. Insulation materials shall be stored off the ground, protected from the weather, and handled so that physical damage to the insulation material does not occur.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cellular glass: Board and molded (rigid), inorganic, maximum 'k' value of 0.345 Btu-inch/hour per square foot per degree F at 75 degrees F, conforming to ASTM C552.

B. Jacketing Aboveground: Aluminum, Alloy 3003, H14 temper, 0.020 inches thick, embossed, conforming to ASTM B209.

C. Jacketing - Underground Heat Trace Applications: Wrapping consisting of polymer modified bituminous compound with a 4-mil, high-density, cross laminate, polyethylene top film and release paper backing, total thickness of 40 mils.

D. Elbow insulation covers: Aluminum, Alloy 1100, H14 temper.

E. Bedding Compound: Non-volatile, .008 perm inch; service temperature range of -60 degrees F to 180 degrees F; application temperature 40 degrees F to 100 degrees F.

2.2 ACCESSORIES

A. Insulation Bands:
   1. Piping: 1/2-inch wide by 0.015-inch thick, 304 stainless steel bands.
   2. Equipment: 3/4-inch wide by 0.015-inch thick, 304 stainless steel bands.

B. Screws: Number 8, by 1/2-inch, sheet metal type 302 or 304 stainless steel.

PART 3 EXECUTION

3.1 FIELD CONDITION

A. Ensure site is ready to receive work before start of construction.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Piping, which includes valves, fittings, and flanges, shall be insulated and jacketed when the suffix "ET" appears in the pipe line number as indicated on the drawings. Equipment shall be insulated when required on the drawings.

B. Install materials in accordance with the manufacturer's instructions.

C. Flanges shall have removable insulation and aluminum jacketing to permit servicing of take-down joints. Removable covers may be fabricated from segments of block insulation or from preformed sectional pipe covering and premolded components. A removable cover shall be of the same material as the adjoining pipe insulation.

D. Fill joints and seams with bedding compound to form a smooth surface.

E. Insulation shall be stopped at a sufficient distance from flanges to permit ease of bolt removal. Insulation shall be beveled at a 45-degree angle at this point.

F. Install jacketing with screws on 3-inch centers on fittings and valves where banding is not possible.

G. Labels indicating "asbestos-free" shall be attached to the outside of insulation jacketing, and adjacent to piping and equipment identification labels.

H. Pipe Insulation

1. Piping and heat tracing shall be tested in accordance with Sections 15060 and 16855 before installing insulation.
2. Piping shall be insulated and jacketed as follows:

Piping	Insulation Material	Minimum Thickness	Jacketing
Aboveground Piping			
1-1/2" and smaller	Cellular Glass	1-1/2"	Aluminum
2" through 4"	Cellular Glass	1-1/2"	Aluminum
6" through 8"	Cellular Glass	2"	Aluminum
10" and over	Cellular Glass	2-1/2"	Aluminum
Below Grade Piping	Cellular Glass	1-1/2"	Polymer Modified Bituminous Compound

3. Insulation shall be applied in a single layer with joints tightly butted, and shall be secured in place with bands on 12-inch centers.
4. Aluminum jacketing shall be applied directly over insulation (except below grade applications). Minimum lap for longitudinal joints shall be 1 inch, and minimum lap for circumferential joints shall be 2 inches. The jacketing shall be secured in place with bands on 9-inch centers.
5. Premolded elbow insulation and aluminum elbow covers shall be installed at elbows. Aluminum jacketing shall be used for all other fittings, valves, flanges, etc.
6. Lap seams against weather.

7. Finish insulation at supports, protrusions, and interruptions. At pipe supports, remove only enough insulation to provide a snug fit.
8. Inserts shall be of the same thickness, material, and contour as adjoining piping insulation. For intersection at tees or other equipment, use block or curved segments. Miter cut to fit neatly on the surface, with joints tightly butted.
9. Seal jacketing below ground per manufacturer's recommendation.
10. Insulated valves and piping systems shall be labeled in accordance with Section 15060.

I. Equipment Insulation

1. Apply insulation board directly to equipment surfaces with joints staggered and tightly butted. Secure insulation in place with stainless steel bands on 18-inch centers.
2. Board insulation shall be cemented to irregular surfaces and voids shall be filled with bedding compound.
3. Apply aluminum jacketing over insulation with 3-inch minimum lap on longitudinal and circumferential joints; secure in place with bands on 12-inch centers.
4. Equipment shall be insulated as follows:

Insulation Material	Minimum Thickness
Cellular Glass	2-1/2"

5. Insulation shall be cut away from equipment identification nameplates and beveled at a 45-degree angle.
6. Equipment and heat tracing shall be tested before installing insulation.

END OF SECTION

U.S DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Subcontract No. FSC607

WASTE UNITS REMEDIATION PROJECT
SOUTHERN WASTE UNITS
TECHNICAL SPECIFICATIONS

Division 16

PARSONS

Prepared by: Thomas P. Ferrell 6/12/97
Date

Checked by: James C Cooper 12 JUNE 1997
Date

STATE OF OHIO
JAMES C. COOPER
E-63507
REGISTERED PROFESSIONAL ENGINEER

James C Cooper
12 JUNE 1997

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Combination magnetic motor starters.

B. Selector switches.

C. Receptacles.

D. Conduit.

E. Wire and cable.

F. Instrument cable.

G. Nameplates.

H. Wire markers and cable tags.

I. Wireway and auxiliary gutters.

J. Splicing and termination components.

K. Boxes.

L. Cabinets.

M. Supporting Devices.

N. Underground Warning Tape.

O. Electrical Testing, General.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 02200 - Non Impacted Material Earthwork.

D. Section 15160 - Lift Station Pumps.

E. Section 15170 - Motors.

F. Section 16118 - Underground Ductbanks.

G. Section 16170 - Grounding and Bonding.

H. Section 16370 - Overhead Power Distribution.

I. Section 16462 - Dry Type Transformers/Panelboards.

J. Section 16500 - Lighting.

K. Section 16855 - Heating Cables.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI C80.1-90 — Rigid Steel Conduit-Zinc Coated.

B. InterNational Electrical Testing Association (NETA):
   1. NETA ATS-95 — Acceptance Testing Specification for Electrical Power Distribution Equipment.

C. National Fire Protection Association (NFPA):
   1. NFPA 70 — National Electrical Code, 1996 Edition.

D. National Electrical Manufacturers Association (NEMA):

1.	NEMA AB 1-93	Molded Case Circuit Breakers and Molded Case Switches.
2.	NEMA ICS 1-93	Industrial Control and Systems General Requirements.
3.	NEMA ICS 2-93	Industrial Control and System Controllers, Contractors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
4.	NEMA ICS 4-93	Industrial Control and Systems Terminal Blocks.
5.	NEMA ICS 6-93	Industrial Control and Systems Enclosures.
6.	NEMA OS 1-89	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
7.	NEMA WD 1-83	General Requirements for Wiring Devices.
8.	NEMA WD 6-88	Wiring Devices - Dimensional Requirements.
9.	NEMA 250-91	Enclosures for Electrical Equipment (1,000 Volts Maximum).

E. Underwriters Laboratories Inc. (UL):

1.	UL 360-96	UL Standard for Safety Liquid-Tight Flexible Steel Conduit.
2.	UL 486A-91	UL Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3.	UL 510-94	UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
4.	UL 854-96	Service-Entrance Cables.
5.	UL 870-95	UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings.
6.	Electrical Construction Materials Directory - 95.	

1.5 SUBMITTALS

A. Provide submittals as required by Section 01010.

1.6 QUALITY ASSURANCE PROGRAM

A. Work shall comply with NFPA 70. Use of conduit for equipment ground is prohibited.

B. Products shall be listed in the UL Electrical Construction Materials Directory, for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Combination Magnetic Motor Starters

1. Combination Magnetic Motor Starters: NEMA ICS 1, NEMA ICS 2, AC general purpose Class A magnetic starter for induction motors for the rated horsepower combined with a magnetic circuit breaker, NEMA AB 1, with instantaneous magnetic trip in each pole. Starter, circuit breaker, and control power transformer shall be in a common enclosure. Terminals, minimum 75 degrees C rated.
2. Provide externally operable handle interlocked to prevent opening of cover with circuit breaker in the ON position. Allow handle to be lockable in the OFF position.
3. Contactor Coil Operating Voltage: 120 V, 60 Hz.
4. Overload Relay: NEMA ICS 2, bimetal.
5. Control Power Transformer: 120 V secondary, 50 VA minimum. Provide fused primary and secondary of transformer, and ground unfused leg of secondary to enclosure.
6. Enclosure: NEMA ICS 6, Type 3R or 4, outdoor; or Type 12, indoor.
7. Heater elements shall be included, as required, for the described service conditions.

8. Two auxiliary contacts (electrically dry), one each, normally closed and normally open, in addition to the hold-in contact, shall be provided.

B. Selector Switches
1. Enclosure, NEMA ICS 6, Type 3R or 4.
2. Two-position, maintained contact (start/stop), as indicated.
3. Three-position, maintained contact (hand/off/auto or local/off/remote), as indicated.

C. Receptacles
1. Convenience Receptacle: 125 V, 15/20 A, NEMA WD 1, heavy-duty, general use with metal cover plate; conforming to NEMA WD 6, Configuration 5-20. 125 V, 30 A, NEMA WD 1, heavy-duty, general use with metal cover plate; conforming to NEMA WD 6, Configuration 5-30. Furnish with weatherproof "while in use" covers for outdoors, wet or industrial locations.
2. Convenience receptacles in potentially wet environments, in addition to those required by NFPA 70, shall be GFCI type for personnel protection with covers to protect the receptacle from water during usage.

D. Cabinets
1. Boxes: Galvanized steel with removable endwalls.
2. Box Size: As indicated in Section 13401.
3. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
4. Knockouts: Provide as required for conduits indicated plus 25 percent spare.
5. Provide metal barriers to form separate compartments wiring of different systems and voltages.
6. Provide accessory feet for free-standing equipment.

7. Terminal Blocks: NEMA ICS 4.
   a. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
   b. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
8. Provide ground bus and ground terminal block, each connector bonded to enclosure.
9. Provide plastic channel with hinged or snap-on covers for internal wiring raceway.

2.2 MATERIALS

A. Conduit
   1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Rigid steel intermediate metal conduit (IMC) shall be acceptable for interior spaces. Conduit shall be 1/2 inch diameter minimum.
   2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 1/2 inch diameter minimum, 5 feet in length (maximum) unless indicated on drawings.
   3. Conduit connections shall be threaded.

B. Wire and Cable

1. Single conductor, 600 volt insulated copper conductor. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and No. 10 AWG shall be solid. Conductors No. 8 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Power and lighting conductor insulation shall be Type THW, XHHW, or THWN. Conductors required to be rated 90 degrees C in accordance with NFPA 70 shall be insulation Type XHHW-2 or THW-2. Direct burial cable shall be type USE, conforming to UL 854.

C. Instrument Cable

1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

D. Nameplates

1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor slip on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat shrinkable tags with 1/8-inch-high letters. Cable markers shall be Raychem-type TMS or approved equal.

F. Wireway and Auxiliary Gutters

1. Wireway and Auxiliary Gutters: General purpose, NEMA ICS 6, Type 3R enclosure with knockouts on bottom.
2. Size: As required.
3. Cover: Screw cover with full gasketing.
4. Fittings: UL 870, lay-in type with removable top, bottom, and side; captive screws.
5. Material: Carbon steel.
6. Finish: Rust-inhibiting primer coating with gray enamel finish.

G. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs, rated 75 degrees C minimum, on stranded conductors.

H. Boxes and Cover Plates

1. Junction and Pull Boxes
   a. Junction and pull boxes shall be sized as indicated in accordance with NFPA 70, Article 370.
   b. Junction and pull boxes located indoors shall be code-gauge, galvanized sheet steel and shall be of welded construction with conduit knockouts or raceway openings and hinged or screwed covers as indicated. Type 3R, according to NEMA 250.
   c. Junction and pull boxes located outdoors shall have screwed, gasketed covers, and watertight hubs. Type 3R, according to NEMA 250.
2. Device and Outlet Boxes
   a. Device and outlet boxes shall be pressed steel, zinc, or cadmium coated in accordance with NEMA OS 1 unless otherwise indicated.
   b. Outlet boxes shall not be smaller than 4 inches octagonal by 1-1/2 inches deep and shall be provided with the proper size knockouts for the conduits intended. Unused knockouts shall remain closed or shall be sealed with knockout closures.

c. Device or outlet boxes shall be of unit construction of a size required for the number of switches or outlets called for on the project design drawings. No sectional device boxes shall be permitted.

d. Surface-mounted outlet boxes for receptacles, switches, or similar devices shall be cast type.

I. Supporting Devices

1. Support Channel shall be galvanized or painted steel.
2. Support hardware and accessories shall be corrosion resistant.
3. Supports shall be of all-welded construction.

J. Underground Warning Tape

1. 4-inch-wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Ensure site is ready to receive work before start of construction.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Conduit

1. Route conduit parallel or at right angles to building lines. Provide conduit supports at approximately 8-foot intervals. Route conduit so as not to create a hazard for tripping or to compromise head clearance. Minimum height above floor shall be 7 feet, 6 inches.

2. Cut conduit square using saw or pipecutter. Cut ends of conduit shall be reamed smooth.
3. Install no more than the equivalent of three 90 degree bends between junction boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
4. Use Form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps, provide junction box with weep hole.
5. Provide cast metal boxes such as FS or FD in damp or wet locations.
6. Provide 1/8-inch nylon pull cord in empty conduits. Cap empty conduits to prevent entry of moisture and foreign objects.
7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.
8. Conduit and supports are to be field routed. They are not indicated explicitly on drawings.

B. Wire and Cable

1. Swab conduit before installing cable. Remove burrs, dirt, or other debris. For existing conduit, pull a mandrel through before pulling cable to verify roundness and bending radii.
2. When pulling cable into conduit, use wire pulling compound.
3. Splices shall be made only in outlet or junction boxes.
4. Provide equipment grounding conductor along with phase conductors in conduits.
5. Multiconductor cables shall contain an integral ground conductor.
6. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made.

7. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows:

480Y/277V	Phase A	Yellow
	Phase B	Orange
	Phase C	Brown
	Neutral (grounded)	Gray
	Ground	Green
208Y/120V	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral (grounded)	White
	Ground	Green
	Plant Fire	Red and Yellow
	Alarm System	Brown and Yellow

8. Install cables buried directly in earth in the following manner:
   a. Excavate cable trenches according to Section 02225. Provide a minimum cable cover of 24 inches below finished grade for power conductors operated at 600 volts and less. Trenches shall be not less than 8 inches wide, and shall be in straight lines between cable markers. Cable plows shall not be used. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 3 inches apart.
   b. When rock is encountered, remove to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch.
   c. Do not unreel and pull cables into the trench from one end. Unreel cable on grade and lift into position onto bedding as indicated.
   d. Provide warning tape, minimum 12 inches above top of cable.

e. Bury cables directly in earth, except under roadways, where cables shall be installed in plastic ducts encased in concrete, as indicated. Slope ducts to drain.

f. Use heat shrink adhesive coated caps on cable ends or tape cable ends immediately after cutting to prevent moisture from entering the cable. Varnish the tape when cable is not expected to be connected for at least 72 hours.

g. Separate cables crossing other cables or metal piping from each other by not less than 12 inches of well tamped earth.

h. Provide cables in one piece without splices between connections except where the distance exceeds the lengths in which cables are manufactured.

i. Bends in cables shall have an inner radius not less than 12 times the cable diameter.

j. Leave a horizontal slack of approximately 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary connections.

k. Provide an identification slab at each change of direction of cable, over the ends of ducts or conduits which are installed under paved areas and roadways, and over each splice. Identification slabs shall be of concrete approximately 20 inches square by 6 inches thick and shall be set flat in the ground so that top surface projects not less than 3/4 inch, nor more than 1 1/4 inches aboveground. The concrete shall have a compressive strength of not less than 3000 psi and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable" on the top surface before concrete hardens. Inscribe circuit numbers as indicated on drawings on slabs as directed. Letters or figures shall be approximately 2 inches high and grooves shall be approximately 1/4 inch in width and depth. Install slabs so that the side nearest the inscription on top shall include an arrow indicating the side nearest the cable.

C. Nameplates

1. Clean surfaces prior to installing nameplates.
2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws.

D. Wire and Cable Markers

1. Provide wire markers on each conductor in pull boxes and junction boxes and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.

E. Disconnect Switches

1. Mounting supports shall not be fastened to or penetrate wall panels.

F. Receptacles

1. Install convenience receptacles 48 inches above finished floor. Receptacle mounting supports shall not be fastened to or penetrate wall panels.
2. Label receptacles with panelboard and circuit number from which they are served.

G. Combination Magnetic Motor Starters

1. Install motor controllers where indicated on drawings.
2. Install motor controller with center line of disconnect operator 54 inches above finished floor.
3. Install overload heater element in motor controller to match motor characteristics.
4. Provide engraved nameplate identifying motor served.

H. Selector Switches

1. Mount selector switches at a mounting height of 54 inches above the floor adjacent to the equipment controlled. Provide slotted channel mounting supports where building column or wall is not suitable for support.

I. Clearances

1. Clearances from points of access to electrical equipment and other devices shall conform to the requirements of NFPA 70.
2. Equipment control devices and other electrical equipment requiring operation or maintenance shall have a minimum working clearance of 3 feet from the surface of operation or access, unless greater clearance is required by NFPA 70.

J. Boxes

1. Coordination of Box Locations
   a. Provide electrical boxes as indicated and as required for splices, taps, wire pulling, and equipment connections.
   b. Electrical box locations indicated are approximate unless dimensioned.
   c. Locate and install boxes to allow access.

d. Do not install boxes back to back in walls. Provide 6-inches (minimum) separation in non-acoustic rated walls and 24 inches (minimum) separation in acoustic rated walls.

e. Coordinate mounting heights of boxes and locations of outlets mounted above counters, benches, and backsplashes to ensure locations are useful.

f. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

2. Outlet Box Installation

a. Firmly secure in place outlet or utility boxes concealed in the construction. Set outlet or utility boxes true, square, and flush with the finish surfaces for the application of the appropriate cover plate.

b. Provide knockout closures for unused knockout openings.

c. Support boxes independently of conduit except for cast boxes when connected to two rigid metal conduits, both supported within 12 inches of the box to be supported.

d. Use multiple gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

3. Pull and Junction Box Installation

a. Support pull and junction boxes independently of conduit.

K. Cabinets

1. Install cabinet fronts plumb.

L. Supporting Devices

1. Installation of structural steel framing, concrete pads, etc., shall be complete before installing supporting devices.

2. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structures in accordance with manufacturer's recommendations as indicated.

3. Use expansion anchors for support on concrete surfaces.

4. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
5. Do not drill structural steel members for installing support devices.
6. Fabricate supports from structural steel or steel channel. Rigidly bolt to structural steel to present a neat appearance. Use hexagon head bolts with spring lock washers under nuts.
7. Install freestanding electrical equipment on concrete pads.
8. Install surface mounted cabinets and enclosures with four anchors (minimum). Provide steel channel supports to stand cabinets and enclosures 1 inch from the wall.

3.3 QUALITY CONTROL

A. Electrical Inspection and Testing - General

1. Electrical inspection and testing for work in this section and in other electrical sections shall conform to the following requirements and to NETA ATS. Tests required by NETA ATS for electrical work on this project shall be performed unless specific instruction is provided otherwise. Any additional requirements or exceptions shall be as noted in the other electrical sections for the specific electrical work of that section only.
2. Testing shall be witnessed by FDF, CQC Consultant-Quality Control personnel (who must approve results) and manufacturer's service representative(s), if required. Notice of testing must be furnished 7 days in advance.
3. Submit test results and calibration data on approved forms.
4. Perform operational tests to demonstrate control and interlocking wiring.
5. Visual inspections shall be performed for phasing and connections. Phasing shall be A, B, C clockwise at all three phase disconnects.
6. Repair or replacement of components where test results are unacceptable, including those damaged during testing process, is required.

B. Electrical Inspection and Testing - This Section

1. Perform continuity and operation tests on power and control circuits. Low voltage thermographic survey of cable connections required by NETA ATS are not required. Wire insulation for conductors No. 6 AWG and larger shall be megger tested between each conductor and ground. A 1000-volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 100 megohms.
2. Insulation resistance tests shall not be performed on solid state equipment unless authorized by its manufacturer and in strict accordance with the manufacturer's recommendations. Solid state equipment includes static ground fault devices, such as ground fault circuit interrupters.
3. Confirm that electrical connections to utilization equipment have been made in accordance with manufacturer's instructions.
4. Perform motor tests according to NETA ATS.
5. Motor windings shall be checked for continuity.
6. Motor windings rated 460 volts nominal shall be megger tested with a 1,000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 100 megohms. Motor and phase rotation shall be checked with a phase rotation tester manufactured by G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.
   a. Motor and phase rotation shall be verified before energizing motors.
   b. Motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment in the presence of FDF.

END OF SECTION

SECTION 16118
UNDERGROUND DUCTBANKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underground Ductbanks.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 02200 - Non-Impacted Material Earthwork.

D. Section 03001 - Concrete.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI C80.1-90 — Rigid Steel Conduit - Zinc-Coated.

B. Institute of Electrical and Electronic Engineers (IEEE):
   1. IEEE C2-97 — National Electrical Safety Code.

C. National Fire Protection Association (NFPA):
   1. NFPA 70 — National Electrical Code, 1996 Edition.

D. National Electrical Manufacturers Association (NEMA):
   1. NEMA TC 3-90 — PVC Fittings for Use with Rigid PVC Conduit and Tubing.

2. NEMA TC 6-90 PVC and ABS Plastic Utilities Duct for Underground Installation.

E. Underwriters Laboratories, Inc. (UL):
1. Electrical Construction Materials Directories, 1995.

1.5 PROJECT CONDITIONS

A. Accurately record actual locations of exact routing of ductbank by field survey.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70 and IEEE C2.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.8 PROJECT CONDITIONS

A. Verify routing and termination locations of ductbank prior to excavation for rough-in.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rigid Steel Conduit: ANSI C80.1.

B. Plastic Utilities Duct: NEMA TC 6; PVC.

C. Plastic Utility Duct Fittings: NEMA TC 3.

2.2 ACCESSORIES

A. Underground Warning Tape: 4-inch-wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavation, base material installation, and compaction are completed.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Underground Duct:

1. Install power ductbank 36 inches (minimum) to top of ductbank below finished grade.
2. Install duct with minimum slope of 4 inches per 100 feet. Slope duct to manholes.
3. Cut duct square using saw or pipe cutter; de-burr cut ends.
4. Insert duct to shoulder of fittings; fasten securely.
5. Join nonmetallic duct using adhesive as recommended by manufacturer.
6. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
8. Provide suitable fittings to accommodate expansion and deflection where required.
9. Terminate duct at manhole entries using end bell.
10. Stagger duct joints vertically in concrete encasement 6 inches minimum.
11. Use suitable separators and chairs installed not greater than 4 feet on centers.
12. Band ducts together before placing concrete.
13. Securely anchor duct to prevent movement during concrete placement.
14. Place concrete under provisions of Section 03001. Use mineral pigment to color concrete red.

15. Provide minimum 3-inch concrete cover at bottom, top, and sides of ductbank.
16. Provide pull rope in each duct except sleeves and nipples. Minimum 1/2-inch, 4,000 psi tensile strength polypropylene.
17. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.
18. Perform excavations and backfill trenches under provisions of Section 02200 of this specification package.
19. Interface installation of underground warning tape with backfilling. Install tape below finished surface as indicated on drawings.
20. All duct end bells shall be rigid steel.
21. Perform penetrations and sealing of duct bank with lift station manholes and junction boxes according to manufacturer's instructions.

END OF SECTION

SECTION 16121
MEDIUM-VOLTAGE CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Medium-voltage cable.

B. Cable terminations.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American National Standards Institute (ANSI):
1. ANSI C2-97 National Electrical Safety Code.

B. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code, 1996 Edition.

C. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
1. IEEE 48-96 Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.

D. National Electrical Manufacturers Association (NEMA):
   1. NEMA WC 8-88 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

E. Underwriters Laboratories, Inc. (UL), Electrical Construction Materials Directories, 1995.

F. National Electrical Testing Association (NETA):
   1. NETA ATS-95 Acceptance Testing Specification for Electrical Power Distribution Equipment.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011.

1.6 QUALITY ASSURANCE PROGRAM

A. See Section 01000.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept cable and accessories on site in manufacturer's packaging. Inspect for damage.

B. Store and protect in accordance with manufacturer's instructions.

C. Protect from weather. Provide adequate ventilation to prevent condensation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Medium-Voltage Cable
   1. Okonite.
   2. Houston Wire & Cable.
   3. Kerite.
   4. Rome.

B. Cable Terminations and Cable Splices
   1. 3M.
   2. Raychem.
   3. RTE.

2.2 MATERIALS

A. Medium-Voltage Cable
   1. Description: NEMA WC 8; ethylene propylene rubber insulated cable.
   2. Voltage: 15 kV, ungrounded.
   3. Conductor: Copper, concentric, stranded with foil conductor shield.
   4. Construction: Single conductor with metal tape insulation shielding.
   5. Insulation Level: 133 percent.
   6. Insulation Jacket: PVC, 80 mils minimum thickness.

B. Cable Terminations and Cable Splices
   1. Description: IEEE 48; Class 1, cable termination in kit form with stress cone, shield ground connection, and accessories and molds required for proper application.

C. Tape Termination and Splices
   1. Description: IEEE 48; Class 1, tape termination kit with semi-conductive tape, stress control tape, splicing tape, vinyl plastic tape, stress cone, mechanical ground straps, and cable preparation kit.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Verify existing conditions prior to beginning installation. Notify FDF if conditions affect the work specified or indicated on drawings.

3.2 PREPARATION

A. Use swab to clean ducts before pulling cables.
B. Run mandrel through duct to confirm absence of pinch points or obstructions.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Conform to requirements of NFPA 70 and ANSI C2.

B. Install cable and accessories in accordance with manufacturer's instructions.

C. Avoid abrasion and other damage to cables during installation.

D. Use suitable lubricants and pulling equipment.

E. Do not exceed manufacturer's recommended maximum cable pulling tensions and minimum bending radius.

F. Ground cable shield at each termination and splice.

G. Label each cable on both ends with phase A, B, or C as determined by testing required herein.

3.4 QUALITY CONTROL

A. Furnish products listed and classified by UL as suitable for purpose specified and shown.

B. Inspect exposed cable sections for physical damage.

C. Inspect cable for proper connections as shown on the contract drawings.

D. Inspect shield grounding, cable supports, and terminations for proper installation.

E. Perform DC high potential test of each conductor in accordance with NEMA WC 8 and/or NETA ATS. Ground other conductors in the circuit during the test. Perform test on existing cable after installation. Perform test on new 15kV cable before making tap onto existing cable.

F. Apply test voltage in at least 10 equal incremental increases to maximum test voltage.

	Maximum Voltage	10 Increments of:
New Cables 15 kV	65 kV	6.5 kV
Existing Cables 13.2 kV	49 kV	4.9 kV

G. Record leakage current at each increment, allowing for charging current decay.

H. Hold maximum test voltage for 10 minutes.

I. Test Reports: Record results of cable test in tabular form, in plots of current versus voltage for incremental voltage steps, and current versus time at 30-second intervals at maximum voltage. Submit for approval.

J. Prior to connection to pole mounted bare conductors, test phase rotation of cables to assure that phase A, B, and C are aligned as indicated.

K. Inspection and testing shall be by Subcontractor and may be observed by FDF.

END OF SECTION

SECTION 16170
GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

D. Fence grounding.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 15170 - Motors.

D. Section 16050 - Basic Electrical Materials and Methods.

E. Section 16370 - Overhead Power Distribution.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. InterNational Electrical Testing Association (NETA):
   1. NETA ATS-95 — Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association (NFPA):
   1. NFPA 70 — National Electrical Code, 1996 Edition.

C. Underwriters Laboratories, Inc. (UL):
   1. UL 467-93 — UL Standard for Safety Grounding and Bonding Equipment.
   2. Electrical Construction Materials Directory-95.

1.5 SYSTEM DESCRIPTION

A. Rod electrode and grounding connections.

B. Grounding System Resistance: 5 ohms maximum.

1.6 SUBMITTALS

A. Provide submittals as required by Section 01011.

B. Provide certification of ground testing instrumentation.

C. Provide record of as-built locations of grounding electrodes, if grounding electrodes are required.

1.7 QUALITY ASSURANCE PROGRAM

A. Conform to requirements of NFPA 70.

B. Furnish products listed in the UL Electrical Construction Materials Directory as suitable for the purpose specified and indicated.

C. Provide certification of ground testing instrumentation according to NETA ATS.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers
   1. Mechanical Connectors
      a. Burndy.
      b. Ideal.
      c. Ilsco.

2. Exothermic Connections
   a. Cadweld.
   b. Thermoweld.

2.2 MATERIALS

A. Rod Electrode
   1. Copper-clad steel, 3/4-inch diameter, 10-foot length.

B. Mechanical Connectors
   1. Bronze.

C. Wire
   1. Stranded copper.
      a. Grounding Conductor: Size to meet NFPA 70 requirements.

D. Grounding and bonding materials shall conform to UL 467.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Verify that final backfill and compaction have been completed before driving rod electrodes.

B. Verify that underground utilities will not interfere with the proposed rod locations prior to driving rod electrodes.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Install products in accordance with manufacturer's instructions.

B. Install additional rod electrodes as required to achieve specified resistance to ground.

C. Equipment Grounding Conductor: Provide separate, insulated conductor with each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

D. Connect ground conductors to reinforcing bars in foundation before pouring concrete. Tie to structural steel members when they are installed, by exothermic connection.

E. Ground metal equipment enclosures by attachment to ground rod system, the building steel, or existing periphery grounding system.

F. Ground pole-mounted equipment and static line conductors as indicated on the drawings.

G. Drive ground rods until the top is 12 inches below grade.

H. Fence Grounding: Fences shall be grounded with a ground rod at each fixed gate post and at each corner post:

1. Drive ground rods as indicated.
2. Attach a No. 4 AWG copper conductor, by fusion weld process, to the ground rods and extend it underground to the immediate vicinity of the fence post.
3. Lace the conductor vertically into 12 inches of fence mesh and fasten it by two approved bronze compression fittings, one to bond the wire to the post and the other to bond the wire to the fence. Each gate section shall be bonded to its gatepost by a 1/8-inch by 1-inch flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.3 QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation as defined by contract documents and manufacturer's instructions. Accurately record as-built locations of grounding electrodes if required, and submit to FDF. Test instrumentation shall conform to NETA ATS. Provide certification for instrumentation.

B. Measure the system's resistance to the ground; perform testing in accordance with instrument manufacturer's recommendations using the fall-of-potential method. Measure resistance at each pole and at each 480 V service as a minimum. Provide written test reports indicating overall resistance to ground and resistance of each electrode to ground.

END OF SECTION

SECTION 16311
PRIMARY SWITCHGEAR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provision, installation, and testing of outdoor primary switchgear containing:
   1. 15 kV fused disconnect switch.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 16118 - Underground Ductbanks.

C. Section 16121 - Medium-Voltage Cable.

D. Section 16170 - Grounding and Bonding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI C37.20.3-87 (Rev. 1992) — Metal-Enclosed Interrupter Switchgear.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. IEEE C62.1-89 — Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits.
   2. IEEE 48-96 — Standard Test Procedures and Requirements for High-Voltage AC Cable Terminations.

C. InterNational Electrical Testing Association (NETA):

1. NETA ATS-95 — Acceptance Testing Specification for Electrical Power Distribution Equipment.

D. National Fire Protection Association (NFPA):

1. NFPA 70 — National Electrical Code, 1996 Edition.

1.5 SYSTEM DESCRIPTION

A. Three phase, 60 Hz outdoor primary metal enclosed switch shall be provided, installed, and tested as indicated on drawings. Switch shall be an addition to primary switchgear on the medium voltage side of unit substation N18-1, supplied by Siemens - ITE. Nameplate information follows:

1. Switchboard Type

Series:	HV
S.O.:	1716472-1
System:	13.2 kV, 3 phase, 3 wire, delta, 600 A Bus

The switch enclosure shall be equipped with a cable exit "top hat" compartment, dimensions as indicated and with an oversized cable compartment 18 inches deeper than that of the original switchgear. Switch shall be furnished with a connection kit of minimum 600 A capacity for bus connection to original switch as indicated. Switch shall be configured for future reversal of power flow by reversing line and load connections from those indicated. (i.e., in the future, the overhead line will be connected to the line or source side of the switch and the connection to N18-1 will become the load side of the switch.)

B. Final field testing shall be provided upon completion of the primary switchgear installation. Testing will be performed by a testing firm as a subcontractor to the installation subcontractor. The testing firm shall be certified according to NETA ATS.

1.6 SUBMITTALS

A. Provide submittals as required by Section 01011.

B. Provide product data for equipment and materials specified. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short-circuit current ratings, dimensions, enclosure, and other relevant details.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum 5 years documented experience.

B. Conform to requirements of NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect switchgear from moisture and debris. Provide auxiliary heating in switchgear.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Siemens Energy & Automation, Inc. only for compatibility and bus connection to existing installed equipment (substation N18-1). Local representative is Nick Soldano, 4770 Duke Drive, Suite 381, Mason, OH 45040 (513-398-9288).

2.2 PRODUCTS/EQUIPMENT

A. Primary Switchgear
1. Description: fused air interrupter load break switch, conforming to ANSI C37.20.3. Switch shall be compatible for bus connection as indicated to primary switch of existing substation noted in 1.5.
2. Construction: Outdoor.
3. Finish: Manufacturer's standard acrylic enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
4. Main Buses: Copper.

5. Incoming cable terminals: For incoming circuits, 15 kV, 133 percent insulation, shielded, copper 1/c 350 kcmil cables per phase. Provide insulated or grounded, physical isolation for cable terminals from load and line side of switch.
6. Voltage: 13.2 kV, three phase, 60 Hz.
7. Maximum Design Voltage: 15 kV.
8. Basic Impulse Level: 95 kV.
9. Continuous and short-circuit current ratings: As furnished with substation N18-1.
10. Furnish 6 fuses for switches.
11. Provide spring-charged stored energy mechanism, manually charged.
12. Enclosure: Weatherproof for outdoor use, ventilated and gasketed with padlocking features.
13. Surge Arresters: IEEE C62.1, distribution class for ungrounded system, factory connected to incoming cable terminals.

2.3 ACCESSORIES

A. Incoming Cable Terminations: Conform to IEEE 48.

B. Nameplates: White with black lettering, fastened with screws.

C. Space Heaters: 120 volt, sized by Manufacturer; compatible with heaters provided for existing substation N18-1.

2.4 SOURCE QUALITY CONTROL

A. Testing: Perform factory acceptance tests for each section of the switchgear as required by relevant national standards cited in Article 2.2. Tests may be witnessed by FDF.

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordinate construction of foundation anchors and embediments with the specific requirements of the equipment.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Install in accordance with manufacturer's instructions.

B. Install line and ground connecting conductors associated with surge arresters according to NFPA 70 and manufacturer's instructions.

C. Provide new engraved plastic nameplates, white lamicoid with black core mounted on outside of each cubicle, identifying equipment served, as indicated on the single-line diagrams. Letters shall be 5/16 inch high.

D. Connect space heater in switch to power source in existing substation N18-1. Wire according to manufacturer's instructions.

3.3 FIELD QUALITY ASSURANCE

A. Perform operational and final acceptance testing on switchgear to verify operation and field wiring connections after installation. Testing will be performed by a testing firm as a subcontractor to the installation subcontractor. Testing firm shall be certified according to NETA ATS. Testing shall conform to applicable sections of NETA ATS.

END OF SECTION

SECTION 16370
OVERHEAD POWER DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Poles.

B. Crossarms.

C. Pole hardware.

D. Insulators.

E. Line conductors.

F. Arresters and cut-outs.

G. Pole-mounted load interrupting disconnect switches.

H. Fuses for cut-outs and switches.

I. Pole-mounted distribution transformers.

J. Anchors.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 16050 - Basic Electrical Materials and Methods.

D. Section 16170 - Grounding and Bonding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. National Fire Protection Association (NFPA):

1.	NFPA 70	National Electrical Code, 1996 Edition.

B. American National Standards Institute (ANSI):

1.	ANSI C2-97	National Electrical Safety Code.
2.	ANSI C29.2-92	Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type.
3.	ANSI C29.4-89	Wet-Process Porcelain Insulators - Strain Type.
4.	ANSI C29.5-84	Wet-Process Porcelain Insulators - Low and Medium Voltage Types.
5.	ANSI C29.7-92	Porcelain Insulators - High Voltage Line-Post Type.
6.	ANSI C37.30-92	Definitions and Requirements for High-Voltage Air Switches, Insulators, and Bus Supports.
7.	ANSI C135.1-79	Galvanized Steel Bolts and Nuts for Overhead Line Construction.
8.	ANSI C135.22-88	Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction.
9.	ANSI O5.1-92	Wood Poles Specifications and Dimensions.

C. American Society for Testing and Materials (ASTM):

1.	ASTM A36/A36M-96	Standard Specification for Carbon Structural Steel.
2.	ASTM A475-95	Standard Specification for Zinc-Coated Steel Wire Strand.
3.	ASTM A675/A675M Rev. A-90	Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
4.	ASTM B231-95	Concentric-Lay-Stranded Aluminum 1350 Conductors.
5.	ASTM B232-92	Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR).
6.	ASTM B2-94	Medium-Hard Drawn Copper Wire
7.	ASTM D698-91	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

D. American Wood-Preservers Association (AWPA):

1.	AWPA C4-89	Poles - Pressure Process.
2.	AWPA C25-89	Standard for the Preservative Treatment of Crossarms by the Pressure Process.

E. Institute of Electrical and Electronics Engineers (IEEE):

1.	IEEE C62.11-93	Metal-Oxide Surge Arresters for AC Power Circuits.

F. National Electrical Manufacturers Association (NEMA):

1. NEMA LA 1-92 — Surge Arresters.
2. NEMA WC 7-88 — Cross-Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

G. Underwriters Laboratories, Inc. (UL):

1. UL 96-94 — UL Standard for Safety Lightning Protection Components.
2. Electrical Construction Materials Directory-95.

1.5 SYSTEM DESCRIPTION

A. Poles specified herein shall be furnished by FDF for installation by Subcontractor. Existing poles to be removed shall be returned to FDF.

1.6 QUALITY ASSURANCE PROGRAM

A. Installing Subcontractor: Company specializing in manufacturing products specified in this section with a minimum of 3 years experience. Experience of the past 3 years shall include 3 different medium voltage aerial pole line installations each of at least 5,000 circuit feet.

B. Conform to requirements of NFPA 70 and ANSI C2.

C. Furnish products, where available, listed in the UL Electrical Construction Materials Directory, as suitable for the purpose specified and indicated.

D. Installation shall comply with ANSI C2, Heavy Loading District, Grade B Construction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect poles from damage and decay by stacking to provide free circulation of air. Maintain 1 foot (300 mm) minimum spacing between bottom pole and ground or ground vegetation. Do not store poles above decayed or decaying wood.

B. Stack poles stored for more than 2 weeks on decay-resistant skids arranged to support poles without noticeable pole distortion.

C. Handle treated poles with tools which will not produce an indentation greater than 1 inch (25 mm) deep. Do not drag treated poles along ground. Do not apply tools to that section of treated poles between 1 foot (300 mm) above and 2 feet (600 mm) below ground line.

PART 2 PRODUCTS

2.1 MATERIALS

A. Poles
1. Wood Poles: ANSI O5.1; treated southern pine poles of length and class indicated.
2. Select poles for straightness, minimum sweeps, and short crooks.
3. Preservative: ANSI O5.1 and AWPA C4, Pentachlorophenol.
4. Apply preservative to poles as required by AWPA C4 with minimum net retention of 12 lbs/ft^3 (285 kg/m^3). Obtain complete sapwood penetration.

B. Crossarms
1. Crossarms: Straight-grained southern pine, free of twists to within 0.1 inch per foot of length, with bends and twists in only one direction.
2. Apply preservative to crossarms as required by AWPA C25 with minimum net retention of 8 lbs/cu ft (190 kg/cu m).
3. Crossarm Dimensions: as indicated.

C. Pole Hardware

1. Miscellaneous Pole Hardware: Hot-dipped galvanized after fabrication.
2. Crossarm Braces: Flat structural steel zinc coated to ASTM A675, span, as indicated, formed in one piece from 1/4 by 1-1/4 inch steel.
3. Eye Bolts and Nuts: ANSI C135.1.
4. Ground Rods: Copperweld 3/4 inch O.D. by 10 foot - 0 inches long.
5. Butt Plate: Copper.
6. Pole-top Insulator Pins: ANSI C135.22.
7. Hot-line Clamps: Screw type with concealed threads. Fill thread chamber with corrosion-resistant compound.
8. Bail Clamps: Self clamping type. Fill contact grooves corrosion-resistant compound.
9. Guy Strand: High strength, seven-strand steel cable galvanized to ASTM A475, Class A or B.
10. Guy Termination: Preformed wire type.
11. Guy Guards: 8-foot (2 m) long plastic, colored yellow.
12. Ground Wire: Soft drawn solid copper conductors, 4 AWG minimum size.
13. Air Terminal: UL 96; 18-inch copper air terminal.
14. Guy Adapter: Tripleye.

D. Insulators

1. Insulators: Radio interference free wet process porcelain insulators with minimum wet flashover rating of 80 kV.
2. Line Post Insulators: ANSI C29.7; Class 57.1.
3. Suspension Insulators: ANSI C29.2; Class 52.9.
4. Pin Insulators: ANSI C29.5; Class 55.5.
5. Guy Strain Insulators: ANSI C29.4; Class 54.1.

E. Line Conductors

1. Medium-voltage Line Conductors: Bare aluminum conductor steel reinforced, size as indicated: ASTM B232. Bare aluminum conductor, size as indicated: ASTM B231. Medium drawn copper wire, size as indicated: ASTM B2.

F. Arresters and Cutouts

1. Combination Surge Arresters/ Fuse cutouts: arranged for crossarm mounting. Arresters, IEEE C62.11, metal oxide, RMS rating shall be 15 kV. Fused Cutouts, ANSI C37.42, drop-out type, rated 110 kV BIL, 200 A continuous current and adequate for interrupting rating of fuses specified herein. Where indicated, arresters or cut-outs may be used and furnished individually.

G. Pole-mounted load interrupting disconnect switches

1. Pole-mounted switch shall be vertical or horizontal as indicated, three-pole gang operated, with a padlock arrangement for locking in both open and closed positions. Steel parts shall be hot-dip galvanized. Operating rods shall be isolated from the switch by an insulating link or section located as close to the switch as possible. Switch shall be designed for double crossarm mounting and for breaking a 3/4-inch coating of ice before contacts are opened or closed. Switch shall be rated 110 kV BIL and comply with ANSI C37.30 for voltage and current requirements indicated.

H. Fuses for cut-outs and pole mounted load interrupting disconnect switches.

1. Fuses: Type K, rated as indicated; minimum symmetrical interrupting rating at 13.2 kV, 10 kA for cut-outs and 12.5 kA for disconnect switches.

I. Pole-Mounted Distribution Transformers

1. ANSI C57.12.20, single phase, oil filled, self-cooled with primary bushings and secondary terminations, Basic Impulse Level of 125 kV, temperature rise of 65 degrees C above 30 degrees C ambient, ratings as indicated. Transformers shall be rated for 14.4 kV minimum in the delta primary configuration indicated. Provide standard primary taps with externally-operated tap changer. Taps shall be full current, two at 2-1/2 percent each above and two at 2-1/2 percent each below normal voltage. Provide standard accessories with dial type thermometer.

J. Anchors

1. Helical Screw Anchors: Galvanized steel, ASTM A36/36M.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Verify that field measurements are as shown on drawings.

B. Verify that there are no underground utilities located below the poles prior to installation.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Install products in accordance with manufacturer's instructions.

B. Plug unused holes in poles using treated wood dowel pins. Treat field-cut gains and field-bored holes with preservative.

C. Shorten poles when required by cutting from top end. Apply hot preservative to shortened end of pole.

D. Set poles in straight line. Place curved poles with curvature in line with lead pole. Maintain an even grade.

E. Dig setting holes large enough to permit use of power tampers to full depth. Place earth in maximum 6-inch (150 mm) layers and pack to 95 percent density per ASTM D698.

F. Rake poles located at corners, angles, and dead ends so that poles are vertical after line installation.

G. Do not install poles along the edge of cuts and embankments or where soil may be washed out.

H. Identify each pole using aluminum marker stamped with characters 2-1/2 inches (60 mm) high, minimum. Locate to provide maximum visibility from roadway and fasten with aluminum nails. Obtain identifying numbers from FDF.

I. Minimum depths in normal firm ground, measured from lower side of pole:

OVERALL LENGTH	DEPTH FOR STRAIGHT LINES	DEPTH AT CURVES, CORNERS, AND POINTS OF EXTRA STRAIN
30'	5'-6"	5'-6"
35'	6'-0"	6'-0"
40'	6'-6"	6'-6"
45'	7'-0"	7'-6"
50'	7'-6"	8'-0"
55'	7'-6"	8'-0"

J. Set crossarms at right angles to line for straight runs; and to bisect the angle of turns in line direction.

K. Provide two braces for each crossarm.

L. Install conductors to ANSI C2. Maintain clearances required by ANSI C2, except as follows: phase to phase - 20 inches, phase to ground - 16 inches, above roads, 480 V conductors - 23 feet, over buildings, all conductors, 8 feet. Conductor arrangement shall be phase A, B, C from north to south and from east to west for horizontal construction.

M. Conductor taps shall be made with bail clamps and hot line connectors using compression connectors. Taps shall not be made directly on line conductors. Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose.

N. Install guys and anchors according to ANSI C2 requirements.

O. Use small diameter steel probe to verify area is free of underground obstructions prior to installation of anchors.

P. Bond metal enclosures on poles to pole ground wire in accordance with NFPA 70, ANSI C2 and manufacturer's instructions.

Q. After initial energizing of transformers, measure the secondary voltage and adjust to nominal voltage by changing taps.

END OF SECTION

SECTION 16462
DRY TYPE TRANSFORMER/PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dry type, two-winding transformers integrated with primary and secondary main breakers and feeder breakers.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 16050 - Basic Electrical Materials and Methods.

D. Section 16170 - Grounding and Bonding.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. InterNational Electrical Testing Association (NETA):

1.	NETA ATS-95	Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Electrical Manufacturers Association (NEMA):

1.	NEMA AB 1-93	Molded Case Circuit Breakers and Molded Case Switches.
2.	NEMA PB 1-90	Panelboards.

3.	NEMA PB 1.1-91	General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
4.	NEMA ST 20-92	Dry Type Transformers for General Applications.
5.	NEMA 250-91	Enclosures for Electrical Equipment (1000 Volts Maximum).

C. National Fire Protection Association (NFPA):

1.	NFPA 70	National Electrical Code, 1996 Edition.

D. Underwriters Laboratories, Inc. (UL):

1. Electrical Construction Materials Directory-95.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011.

B. Product Data: Include outline and support point dimensions of enclosures and accessories; unit weight; voltage; kVA, number of phases, impedance ratings, and characteristics; X/R ratio; tap configurations; insulation system type; rated temperature rise; and main bus ampacity, integrated short circuit ampere rating, circuit breaker, arrangement, and sizes.

C. Transformer Test Reports:

1. Factory Test: NEMA ST 20. Indicate loss data; efficiency at 25, 50, 75, and 100 percent rated loads; and sound level.
2. Field Test: Indicate primary and secondary voltages as measured.

1.6 QUALITY ASSURANCE PROGRAM

A. Conform to requirements of NFPA 70.

B. Furnish products listed in the UL Electrical Construction Materials Directory for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver transformers/panelboards individually wrapped for protection and mounted on shipping skids.

B. Accept transformers/panelboards on site. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer/panelboards' internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Siemens.

B. Westinghouse.

C. Square D.

2.2 EQUIPMENT

A. Two-winding transformers
   1. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers; ratings as indicated on contract drawings.
   2. Insulation system and average winding temperature rise for rated kVA as follows:
      a. 1-30 kVA: Class 185 with 115 degrees C rise.

b. 16-500 kVA: Class 220 with 115 degrees C rise.

3. Case Temperature: Do not exceed 40 degrees C rise above ambient at warmest point.
4. Winding Taps:
   a. Transformers: NEMA ST 20. Transformers shall have four full current taps, two at 2-1/2 percent each above and two at 2-1/2 percent each below normal voltage.
5. Sound Levels: NEMA ST 20, not to exceed 85 dBA at 3 feet.
6. Basic Impulse Level: 10 kV.
7. Ground core and coil assembly to enclosure by means of a visible, flexible copper grounding strap.
8. Mounting: Suitable for wall or floor mounting.
9. Coil Conductors: Continuous windings with terminations brazed or welded.
10. Enclosure: NEMA ST 20. Provide lifting eyes or brackets.
11. Isolate core and coil from enclosure, using vibration-absorbing mounts.
12. Nameplate: Include connection data and overload capacity based on rated allowable temperature rise.

B. Branch Circuit Panelboards

1. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
2. Enclosure: NEMA PB 1; Type 3R conforming to NEMA 250.
3. Cabinet Size: As shown on manufacturer's drawings.
4. Cabinet Front: Hinged cover with paddle lock hinge.
5. Provide an integrated unit with transformer. Finish in manufacturer's standard gray enamel.
6. Provide panelboards with copper bus, ratings as scheduled on drawings. Provide copper ground bus in each panelboard.
7. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.

8. Molded Case Circuit Breakers: NEMA AB 1; plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, rated for 75 degrees C copper conductors. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where required. Provide 20 percent spare breakers installed in the panelboard.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install transformer/panelboards in accordance with NEMA PB 1.1.

B. Install plumb, and in accordance with manufacturer's instructions, and as indicated on contract drawings.

C. Height: 6 feet, 6 inches to top of transformer section.

D. Provide grounding connections in accordance with Section 16170.

E. Provide filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

G. Provide engraved plastic nameplates identifying transformer/panelboard equipment number.

H. After initial energizing of transformers, measure the secondary voltage and adjust to nominal voltage by changing taps.

3.2 QUALITY CONTROL

A. Test according to general requirements of Section 16050 and to the relevant requirements of NETA ATS.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, grounding, and conformance of installation to contract documents and manufacturer's instructions. Check tightness of wiring and mounting connections for circuit breakers and transformer prior to energizing.

C. Record primary and secondary voltages; submit to FDF.

D. Measure steady state load currents at each panelboard feeder. Rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power panelboards.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 01011 - Submittals.

C. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. National Electrical Manufacturers Association (NEMA):

1. NEMA AB 1-93	Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA PB 1-90	Panelboards.
3. NEMA PB 1.1-91	General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
4. NEMA 250-91	Enclosures for Electrical Equipment (1000 Volts Maximum).

B. InterNational Electrical Testing Association (NETA):

1. NETA ATS-95	Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code, 1996 Edition.

D. Underwriters Laboratories, Inc. (UL):
1. Electrical Construction Materials Directories-95.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011.

1.6 QUALITY ASSURANCE PROGRAM

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 PROJECT CONDITIONS

A. Project Record Documents:
1. Record actual locations of products; indicate actual branch circuit arrangement.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Siemens.

B. Westinghouse.

C. Square D.

2.2 EQUIPMENT

A. Circuit Breaker Panelboards:
1. Circuit Breaker Panelboards: NEMA PB 1, circuit breaker type.

2. Panelboard Bus: Copper, ratings as indicated on contract drawings. Provide copper ground bus in each panelboard. Incoming bus shall have lugs suitable for cables indicated.
3. Minimum Integrated Short Circuit Rating: 18,000 amperes rms symmetrical, or as indicated on contract drawings.
4. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type, thermal magnetic trip circuit breakers with common trip handle for all poles, lockable using external devices. Provide UL-listed circuit breakers. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Breakers shall have lugs suitable for cables indicated.
5. Enclosure: NEMA 250, Type 12 (indoor) or Type 3R (outdoor).
6. Cabinet Box: 6 inches deep; 20 inches wide.
7. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, and flush lock, keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards horizontal and plumb. Install in accordance with manufacturer's instructions.

C. Height: 6 feet to top of panelboard.

D. Install panelboards as indicated on contract drawings.

E. Provide filler plates for unused spaces in switchboards and panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

G. Provide engraved plastic nameplates.

H. Provide working clearance in accordance with NFPA 70, minimum 36 inches from front.

3.2 QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits. Submit recordings of steady load currents after balancing.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

C. Inspect and test accordance with NETA ATS except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

END OF SECTION

SECTION 16500
LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Luminairies and lampholders.

B. Ballasts.

C. Lamps.

D. Exit signs.

E. Emergency lighting units.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. National Fire Protection Association (NFPA):

1.	NFPA 70	National Electrical Code, 1996 Edition.
2.	NFPA 101-94	Code for Safety to Life from Fire in Buildings and Structures.

B. National Electrical Manufacturer's Association (NEMA):

1.	NEMA WD 6-88	Wiring Devices - Dimensional Requirements.

C. American National Standards Institute (ANSI):
1. ANSI C82.4-92 Ballasts for High Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).

D. Underwriters Laboratories, Inc. (UL):
1. Electrical Construction Materials Directory - 1995

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011.

B. Product Data: Provide dimensions, ratings, and performance data including photometric and beamspread plots.

1.6 QUALITY ASSURANCE PROGRAM

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 101.

C. Products shall be listed in the UL Electrical Construction Materials Directory, for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Luminaries
1. Furnish high pressure sodium fixtures as indicated on drawings.
2. Factory install ballasts, lamps, and accessories.
3. Pendant luminaries: Provide swivel hangers, pendant rods, tubes, and chains as required to install luminaries at appropriate height.

B. Exit Signs
1. Description: LED type exit sign fixture suitable for use as emergency lighting unit.

2. Housing: Extruded aluminum.
3. Face: Translucent face with red letters on white background.
4. Directional Arrows: Universal type for field adjustment.
5. Mounting: Universal for field selection.
6. Battery: 6 volt, nickel-cadmium type, with 1.5 hour capacity.
7. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within 12 hours.
8. Input Voltage: 120 volts, 60 Hz.

C. Emergency Lighting Units
1. Description: Self-contained emergency lighting unit with rechargeable battery.
2. Input voltage: 120 volts.
3. Battery: Nickel-cadmium type with 1.5 hour capacity.
4. Battery Charger: Dual rate type capable of recharging discharged battery to full charge within 12 hours.
5. Lamps: 12 watt, sealed-beam type.
6. Electrical connection: 6-foot cord with NEMA WD 6-type 5-15 plug cap.

2.2 ACCESSORIES

A. Ballasts
1. High Intensity Discharge (HID) Ballast:
   a. Description: ANSI C82.4 HID lamp ballast.
   b. Description: HID lamp ballast.
   c. Provide ballast suitable for lamp specified.
   d. Voltage: Match luminaire voltage.

B. Lamps
1. High-Pressure Sodium Lamps: Clear, suitable for ballast, furnished in luminaire, and for burning positions.

C. Photoelectric Control
1. Control above maximum footcandles: provide with adjustable cutoff point.

2. Load control: Sized for fixture, 120 volts.
3. Provide photoelectric controls for exterior lighting.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Examine substrate and supporting grids for luminaries.

B. Examine each luminaire to determine suitability for lamps specified.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Install in accordance with manufacturer's instructions.

B. Install suspended luminaries and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at height indicated on drawings.

C. Support luminaries independent of ceiling framing.

D. Install surface-mounted luminaries and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

3.3 QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation according to project documents and manufacturer's instructions.

3.4 ADJUSTING

A. Adjust exit sign directional arrows.

B. Relamp luminaries that have failed lamps at substantial completion.

3.5 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.6 DEMONSTRATION

A. Provide minimum of 2 hours demonstration of luminaire operation.

END OF SECTION

SECTION 16855
HEATING CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heating cable and accessories.

1.2 RELATED SECTIONS

A. Section 01000 - General Requirements.

B. Section 01011 - Submittals Listing.

C. Section 15060 - Pipe, Fittings, Valves, and Accessories.

D. Section 15250 - Insulation.

1.3 REFERENCE DRAWINGS

A. See Section 01012 for the Schedule of Drawings.

1.4 REFERENCES

A. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code, 1996 Edition.

B. National Electrical Manufacturers Association (NEMA):
1. NEMA ICS 6-93 Industrial Controls and Systems Enclosures.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01011.

B. Annotated drawings reflecting installed features requiring freeze protection, for approval.

C. Record Drawings: Submit after installation and testing of freeze protection equipment and materials.

1.6 SYSTEM DESCRIPTION

A. Heat tracing for pipe and any other outdoor equipment requiring freeze protection with outside temperature at -10 degrees F. Pipes to be protected are indicated on contract P&ID drawings. Work includes design of heat trace system as well as products and execution herein specified.

1.7 QUALITY ASSURANCE PROGRAM

A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum 3 years experience.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate installation of heating cable with installation of piping and piping insulation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Raychem.
2. Chromalox.
3. Thermon.

2.2 MATERIALS

A. Heating Cable
1. Self-limiting, parallel resistance electric tracing cable with grounding shield around conductors. Maximum output temperature 150 degrees F.
2. Rating: 120 V or as required.

2.3 ACCESSORIES

A. Thermostat: Type 4X according to NEMA ICS 6, adjustable setpoint, suitable for -30 degrees F to 140 degrees F.

B. Power termination kits, splice kits, tee kits, and end seals supplied by heating cable manufacturer and suitable for use with the heating cable provided shall be utilized.

C. Provide stainless steel identification tags for all devices. Include assembly and circuit numbers.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Verify that the piping system is complete, tested, and ready for heating equipment.

B. Verify field measurements shown on drawings. Where installation differs from drawings, annotate drawings and submit for approval before installation.

C. Verify that required utilities are available, in proper locations, and ready for use.

D. Follow these guidelines for cable wattage and maximum circuit length, or provide Supplier information to support alternate lengths:

Pipe OD	Cable Wattage	Max. Length, ft. (20 A, 120 V)	Max. Length, ft. (30 A, 120 V)
1-1/2 inch or less	3 watts/ft	265	330
1-1/2 to 3 inch	5 watts/ft	185	270
3 inch to 6 inch	8 watts/ft	130	200
8 inch	10 watts/ft	105	160
10 inch	15 watts/ft	80	120
12 inch	15 watts/ft	80	120

3.2 ERECTION/INSTALLATION/APPLICATION

A. Install heat trace material on piping system as indicated on drawings. Install to allow for heat trace cable to be moved aside during maintenance of piping system.

B. Install in accordance with manufacturer's instructions and NFPA 70. Serve cable circuits from GFCI circuit breakers as manufacturer's instructions and NFPA require for the use.

C. Avoid pinching and making sharp bends in cable.

D. Prevent damage by sharp objects during installation.

E. Do not install electric tracing cables across expansion joints.

F. Electric heat trace cables shall be installed in the 7 and 8 o'clock positions or in the 4 and 5 o'clock positions on horizontal runs of pipes.

G. Accurately record actual locations of heating cable, thermostats, and branch circuit connections.

3.3 FIELD QUALITY ASSURANCE

A. Test continuity of heating cable.

B. Measure insulation resistance to manufacturer's recommended values. Use test instruments in accordance with manufacturer's instructions.

C. Perform continuity and insulation resistance test on completed cable installation prior to installation of thermal insulation.

3.4 DEMONSTRATION

A. Demonstrate operation of heating cable controls.

3.5 RECORD DRAWINGS

A. Provide drawings showing actual heating cable installation. Include cable lengths, cable catalog numbers, indicating lights, and other similar details.

END OF SECTION

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Systems Plan
Waste Units Remediation Project
Southern Waste Units
Subcontract No. FSC607

20401-PL-0002

May 1997
Revision 0

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Project No. 20400

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Systems Plan
Waste Units Remediation Project
Southern Waste Units
Subcontract No. FSC607

May 1997
Revision 0

Environmental Remedial Action Project
Fernald Environmental Management Project
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FDF Project No. 20400

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25 Merchant Street
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Systems Plan for Wastewater Collection and Transfer
Southern Waste Units

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LIST OF ACRONYMS AND ABBREVIATIONS

FDF	Fluor Daniel Fernald, Inc.
FEMP	Fernald Environmental Management Project
gpm	gallons per minute
HDPE	High-Density Polyethylene
H-O-A	Hand-Off-Auto (selector switch)
kVA	Kilo Volt Amperes
N/A	Not Applicable
MWI	Maintenance Work Instructions
OSDF	On-Site Disposal Facility
SWRB	Storm Water Retention Basin
SWUs	Southern Waste Units
V	Volts

1.0 INTRODUCTION

The Fernald Environmental Management Project (FEMP) is a 1,050-acre facility located in southwestern Ohio approximately 18 miles northwest of downtown Cincinnati. The FEMP facility contains low-level radioactive, solid, and hazardous wastes. Much of the impacted material is to be disposed of in the On-Site Disposal Facility (OSDF) in accordance with the Operable Units' Records of Decision. Approximately 2.5 million cubic yards of material will be removed from the FEMP operable units during remediation activities and will be placed in the OSDF for permanent disposition.

1.1 Background

The Operable Unit 2 waste units consist of the following:

1) Active Flyash Pile
2) Inactive Flyash Pile
3) South Field
4) Lime Sludge Ponds
5) Solid Waste Landfill

The South Field, Inactive Flyash Pile, and the Active Flyash Pile are collectively known as the Southern Waste Units (SWUs). The Lime Sludge Ponds and Solid Waste Landfill are scheduled to be remediated at a later date. Integrated remedial design packages will be developed for each one at that time.

1.2 Purpose of System Plan

This system plan describes the retention basin collection and transfer system, the wheel wash facility, the oil-water separator for the SWUs, and their performance requirements. The selected site preparation subcontractor will prepare a Systems Implementation Manual that presents the details, methods and procedures to implement this plan.

2.0 SYSTEM DESCRIPTION AND INTENDED PERFORMANCE

The retention basin collection and transfer system (see construction drawings and specifications for detailed information) consists of the following:

1) Retention Basins: Retention Basins Nos. 1, 2, and 3 collect run-off stormwater and pumped water from the excavation sumps. Water from these basins flows by gravity through risers to the lift stations.

2) Lift Stations: Three lift stations are installed (one for each retention basin). Each lift station contains one submersible centrifugal pump. Lift Station No. 1 has a 400 gpm pump; and Lift Stations No. 2 and 3 each have 100 gpm pumps. The lift station pumps discharge to the transfer line. Piping inside the lift station is carbon steel, and underground piping is double-walled, high-density polyethylene (HDPE). Lift Stations No.1 and 2 will be provided with non-installed spare pumps. One common spare will be utilized for Stations No. 2 and 3.

3) Transfer Line: Water collected in the lift stations is pumped to the Stormwater Retention Basin (SWRB) through a 6-inch HDPE pipe. This 6-inch HDPE pipe is contained in a 10-inch HDPE pipe. Four clean-outs are provided in the pipeline to permit draining and cleaning of the piping, and three automatic air release valves are provided at high points to remove trapped air.

4) Wheel Wash Facility: the wheels of haul trucks will be cleaned of mud and debris at a concrete wash facility. Washing will be accomplished with a motor driven portable cold water pressure washer. Drainage from the facility is routed through an oil-water separator for collection of oil and solid particles.

The intended purpose of the retention basin collection and transfer system is to handle the surface water that will be generated in the SWU's during remediation. The system was designed to handle and manage water generated by runoff from a 10-year 24 hour storm.

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3.0 OPERATION

3.1 Description of Equipment

Electrical power at 480 volts, three phase, is supplied to each lift station pump through cable in conduit (ductbank) from a starter rack located near the lift station. A 13.2 kV aerial service will be extended into this area. Local transformers will step voltage down to the 480 volts required.

Electrical controls at the lift station include a pump Hand-Off-Auto (H-O-A) selector switch. During maintenance, the pump(s) may be run manually by placing the selector switch in the "HAND" position. This will bypass the level controls and the pump will continue to run until switched off, regardless of level. Motor overloads in the starter and internal motor protection consisting of a moisture sensor and winding temperature sensors will protect the motor.

The pumps are electric motor-driven, submersible centrifugal pumps with cast iron impellers, cast iron housing, stainless steel shafts, and double mechanical seals. The pumps are designed for guide rail (pipe or cable) installation. Ball valves are manually operated type; check valves are swing type.

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

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

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

The pressure washer is driven by a 480 volt electric motor and delivers 4 gpm of cold water at an operating pressure of 2,200 psig. It is portable and is provided with a gun valve and 100 feet of pressure hose. A 30-foot power cord is provided for connecting to a receptacle located adjacent to the wheel wash facility.

The oil-water separator has a capacity of 220 gallons and is constructed of polymer concrete. It operates on the principle of specific gravity where heavy solid particles (sand, silt, etc.) are trapped in the bottom of an inlet chamber, and lighter than water oil is collected at the surface of the outlet chamber. Clean

water drains out through an outlet from the bottom of the outlet chamber. The separator has no moving parts and no operator attendance is required.

3.2 Pre-Startup

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

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

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

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

Pre-startup tests shall be performed in the following order: (1) electrical and (2) mechanical. The Site Preparation Subcontractor shall install, start up, test, and implement until turnover of the system to the Excavation Subcontractor. The Excavation Subcontractor will implement and ensure the system is functional for the duration of excavation and remove all as part of site restoration.

3.2.1 Electrical Pre-Startup Tests and Inspections

1) The 13.2kV overhead feeder line should be energized. Check voltage at the main 480 V disconnect switch after local step down transformer. Voltage should measure a minimum of 475 volts between phases.

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

3) Verify installation of fuses in main disconnect switch. Throw the switch to the "ON" position to supply power to the starter and distribution transformer/panel.

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

5) Cover the photocell on the light fixture to check operation of the lamp.

3.2.2 Mechanical Pre-Startup Tests and Inspections

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

2) Position the manual valves as listed below:

Table 3-1 - Manual Valve Operating Positions

Valve No.	Location	Initial Position
V100	Lift Station No. 1	N/A (check valve)
V101	Lift Station No. 1	Open
V102	Lift Station No. 2	N/A (check valve)
V103	Lift Station No. 2	Open
V104	Lift Station No. 3	N/A (check valve)
V105	Lift Station No. 3	Open
V106 through V109	CO-1 through CO-4	Closed

3.3 Startup (By Subcontractor)

The following are the steps needed for startup of the retention basin collection and transfer system. The steps should be followed in the order listed.

3.3.1 Electrical

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

NOTE: To prevent operation of the pump during the following tests 1 through 4, temporarily disconnect power leads to the pump motor at the contactor terminals or remove overload heaters (see Drawing 92X-5900-E-00380, Sheet No. E0007).

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

2) Turn the H-O-A switch for each pump to "HAND." Verify that the main contactor energizes and that the "PUMP RUNNING" indicating light is on.

3) The pumps are equipped with internal thermal and moisture detectors. Disconnect the control wires at the terminal block for each pump, one wire at a time to verify continuity through these circuits.

4) Disconnect the power using the fused disconnect switch and reinstall the motor wiring or heater elements for normal operation of the pumps.

5) With water in the sump, operate each pump in the "HAND" position and verify pump operation, checking for correct rotation and any abnormal operation or vibration.

3.3.2 Mechanical

1) Fill the lift station No. 1 wet well with clean water to approximately midway between the low-level stop and high-level start positions. Verify that H-O-A selector switch is in the "OFF" position.

2) Turn the H-O-A selector switch to "HAND" and observe the following:
   (1) Check the pump for normal operation without unusual sounds.
   (2) Check for leakage at the discharge elbow connection.

3) Turn the H-O-A selector switch to "OFF" if any unusual conditions are observed. If the pump is running normally, stop it when the water level reaches the low-level stop. Correct any problems encountered before proceeding further with the startup.

4) Reset the H-O-A selector switch to "AUTO" and refill the sump with water. Check to see that the pump starts properly at the high-level start position and stops at the low-level stop position.

5) Repeat Steps 1 through 4 for Lift Stations No. 2 and No. 3.

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

3.3.3 Shutdown

At the successful completion of the above tests and checks, turn all the switches and controls to the "OFF" position.

3.4 System Procedures

During construction, the pumps will be operated with the local pump H-O-A selector switches set in the "AUTO" position. Pump start will be automatically initiated by water level in accordance with the wet well level controls. The level control signal completes the circuit to the starter contactor, starting the pump. The circuit is maintained until a low level signal is received from the level controls, which drops out the relay and the starter contactor. Operation of the pump is indicated by a red "run" indicating light. Operation of the pressure washer should be by a qualified person in accordance with the manufacturer's operation manual.

Table 3-1 lists the manual valve operating positions.

3.5 Potential Problems

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

Problem	Result	Remedy
Pump fails to start	Wet well fills to high level alarm point	1) Refer to vendor Operations and Maintenance (O&M) Manual. 2) Check if 480 volt power is energized. 3) Check selector switch position. 4) Check for tripped overload relay. 5) Check continuity of motor internal protection circuits (repair motor). 6) Check/repair level controls. 7) Install spare pump/motor.
Pump fails to stop	Pump runs dry	1) Refer to vendor O&M Manual. 2) Check selector switch position. 3) Check/repair level controls. 4) Check/repair contactor for welded contacts.

Problem	Result	Remedy
Pump discharge header check valve leaks	Wet well refills quickly after pump stops, resulting in frequent cycling of pump.	Remove and repair or replace check valve.
Pipeline plugs	1) No flow to SWRB 2) Pump deadheads	1) Determine where plug is located by opening the valves located in the cleanouts in successive order. Drain water to a tank truck and transport to SWRB for treatment. 2) Clean out pipeline.

3.6 Maintenance

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

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

3) Cleaning of the oil-water separator should be performed by the subcontractor when required with disposal of collected materials as directed by FDF.

4.0 ACTIVITIES, RECORDS, AND REPORTS

Table 4-1 provides a list of activities, and records and reports associated with the retention basin collection and transfer system. The frequency of each activity is also included in the table. Further details on maintenance and calibration frequencies associated with system equipment are provided in Table 4-2. Refer to Appendix A for vendor-recommended maintenance and calibration procedures. FDF will maintain copies of all pertinent records and reports.

Table 4-1 - Summary of Records and Reports

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

* Sediment to be removed and transferred to the OSDF if it meets OSDF Waste Acceptance Criteria.

Table 4-2 - Equipment Maintenance and Calibration Schedule

Item	Maintenance Schedule
Pumps	Inspect annually per FDF MWI PCP100
Control Panel	Annually
Main Disconnect Switch and Starter	Inspect monthly for moisture
Indicating Lights	"Push-to-test" monthly
Motor Starters and Controls	Annually
Main Disconnect Switch	Monthly
Water Level Probe Calibration	Semi-annually

Surface Water Management Plan for Waste Units Remediation Project Southern Waste Units Subcontract No. FSC607

20401-PL-0001

May 1997
Revision 0

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Project No. 20400

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25 Merchant Street
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Surface Water Management Plan
for
Southern Waste Units

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APPENDICES

A Calculations

B Drainage Area Maps

LIST OF ACRONYMS AND ABBREVIATIONS

AFP	Active Flyash Pile
AWWT	Advanced Wastewater Treatment (Facility)
cfs	cubic feet per second
DOE	United States Department of Energy
FEMP	Fernald Environmental Management Project
FDF	Fluor Daniel Fernald, Inc.
FRL	Final Remediation Level
GMA	Great Miami Aquifer
gpm	gallons per minute
HDPE	High Density Polyethylene
IFP	Inactive Flyash Pile
NPDES	National Pollutant Discharge Elimination System
ODNR	Ohio Department of Natural Resources
OSDF	On-Site Disposal Facility
SF	South Field
SWMP	Surface Water Management Plan
SWPPP	Stormwater Pollution Prevention Plan
SWRB	Stormwater Retention Basin
SWUs	Southern Waste Units
WAC	Waste Acceptance Criteria
WURP	Waste Units Remediation Project

EXECUTIVE SUMMARY

This Surface Water Management Plan (SWMP) addresses surface water management of the Southern Waste Units (SWUs) during remediation. This SWMP addresses erosion and sedimentation, stormwater runoff, and other surface water issues at the SWUs.

The SWUs consist of the South Field (SF), the Inactive Flyash Pile (IFP), and the Active Flyash Pile (AFP) areas. The remediation of the SWUs involve the removal of approximately 340,000 bank cubic yards of impacted material consisting of soil, debris (fill), and flyash. The SWUs remediation project will be performed in two phases- 1) Site Preparation, and 2) Excavation. The site preparation phase of the SWUs Project is scheduled to begin in the summer of 1997. The excavation phase of the SWUs Project is scheduled to begin in 1998. The excavation phase is scheduled to require two construction seasons.

Three retention basins (Nos. 1, 2, and 3) will be constructed in the SWUs area to manage surface water during remediation. The retention basins will be lined with one ft. of compacted clay overlain by a geomembrane liner. The non-impacted soil stockpiles and selected collection ditches will be lined with a geomembrane liner. Both sediment and stormwater storage capacity will be provided in the retention basins. A minimum of 27 cubic yards/watershed acre of storage capacity in each basin will be provided for sediment storage. Stormwater storage capacity has been provided above the sediment level to store the runoff from a 10-year, 24-hour storm. Stormwater collected in the basins will discharge through riser pipes and gravity flow to lift stations located adjacent to each of the retention basins. From the lift stations, collected runoff will be pumped through a common double-walled pipe to the Stormwater Retention Basin (SWRB), and subsequently conveyed to the Advanced Wastewater Treatment (AWWT) facility for treatment prior to discharge to the Great Miami River.

The overall operation of the surface water management system was planned and designed to minimize the generation of contaminated runoff and to collect potentially contaminated surface water prior to discharge. Run-on control ditches will be constructed prior to remediation to prevent water from upgradient areas from flowing across the construction area. These run-on control ditches will remain after remediation to prevent potential recontamination. Runoff from disturbed areas will drain to collection ditches which will route the runoff to the retention basins. These basins provide temporary storage while allowing for additional sediment removal prior to runoff being conveyed to the SWRB and AWWT. Excavation of the SWU with the highest known contamination (IFP) was prioritized; it will be excavated first. Within the IFP and other areas, excavation will be performed to minimize potential cross-contamination.

Upon completion of remediation/excavation activities the site will be graded to drain and graded to approximate original (1952) topographical conditions, where possible.

SECTION 1

INTRODUCTION AND SWU DESCRIPTION

1.1 Introduction

The Fernald Environmental Management Project (FEMP) is a 1,050-acre facility located in southwestern Ohio approximately 18 miles northwest of downtown Cincinnati. The FEMP contains low-level radioactive, solid, and hazardous wastes. The Operable Unit 2 Waste Units Remediation Project (WURP) consists of the following waste units:

- Active Flyash Pile (AFP)
- Inactive Flyash Pile (IFP)
- South Field (SF)
- Lime Sludge Ponds (LSPs)
- Solid Waste Landfill (SWL).

The SF, IFP, and the AFP are collectively known as the Southern Waste Units (SWUs). The LSPs and SWL have been separated from the SWUs due primarily to remedial action schedule; it was determined that since the IFP contributes a greater source of contamination to the Great Miami Aquifer (GMA), the SWUs remediation was of high priority. Therefore, the LSPs and SWL will be addressed separately from the SWUs.

This SWMP addresses surface water management during remediation of the SWUs. The SWUs project will involve excavation and removal of approximately 340,000 bank cubic yards of impacted material from the SWUs. Impacted material consists of all material placed in the area by previous United States Department of Energy (DOE) operations and includes soil, debris (fill), and flyash. Most of the impacted material will be placed in the OSDF. In addition, approximately 3,400 cubic yards of material will be transported to the Above-WAC Queue Area pending shipment to an off-site permitted commercial disposal facility. Approximately 100 cubic yards of lead-contaminated soil will be excavated and shipped offsite for treatment and disposal.

1.2 Purpose

The FEMP is operating under a National Pollutant Discharge Elimination System (NPDES) Permit which requires the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP). This SWPPP became effective May 1, 1996. Section 6 of the SWPPP addresses discharges related to construction activities. The measures outlined in the SWMP and details shown on the construction

drawings and specifications will be implemented to effectively manage stormwater and limit the amount of erosion and the release of sediment that will occur during the remediation of the SWUs.

Stormwater, erosion and sediment control measures are also required to minimize release of radiological contaminants. This SWMP has been prepared as a guide to minimize construction-related impacts on water quality from erosion and sedimentation, and minimize the spread of contamination during remediation of the SWUs. During remediation, Fluor Daniel Fernald, Inc. (FDF) will perform required NPDES monitoring at the permitted stormwater outfalls and comply with all applicable Federal, State, DOE, and FEMP requirements.

1.3 Scope

This SWMP provides the following information:

- Background discussion of the scope of the SWUs project,
- Description of the SWUs proposed surface water management system for the Southern Waste Units Remediation Project,
- Description of proposed general and area-specific erosion and sediment control measures,
- Description of the type and frequency of maintenance activities required to support the control measures.

The SWMP addresses stormwater management, erosion prevention, sediment control, hydrologic and hydraulic loading, physical site characteristics that impact the selection and implementation of control measures, and references to established design criteria. Supporting engineering data and calculations are attached as Appendix A.

1.4 Construction Drawings and Specifications

The construction within the SWU will be accomplished in 2 phases; The site preparation phase and the excavation phase. Construction drawings and specifications from both phases are incorporated herein by reference. They will be a part of the subcontract bid documents for that phase of remediation of the SWUs. The site preparation phase construction will address the stormwater and erosion control measures herein discussed (including the retention basins and ditches), the support area, wheel wash area, transfer line and all other items required to remove impacted material from the SWU. The excavation phase construction will address the removal of impacted material from the SWU and the subsequent disposition of that material.

SECTION 2

SURFACE WATER MANAGEMENT SYSTEM

2.1 Overall Approach

The principal objectives of surface water management in the SWUs are to prevent or minimize stormwater runon to the work areas and to control water and runoff which has come into contact with contamination and/or impacted material. Runon from upgradient areas will be prevented (via diversion ditches and berms) from flowing into the construction area; this will minimize the generation of contaminated stormwater and sediment. Runon control ditches will be designed to handle the 10-year, 24-hour storm event. Surface water in the SWUs project will be treated as potentially contaminated and will be collected in ditches and conveyed to three retention basins. Water from the retention basins will then be pumped to the SWRB and subsequently to the AWWT facility for treatment. The design for basins used in stormwater controls are based on a 10-year, 24-hour storm event. Water that enters the excavations during construction will be collected in excavation sumps and handled as described in this plan.

The SWUs consist of the IFP, SF, and the AFP areas and cover approximately 15.8 acres within a total watershed area of 26.0 acres. The SWUs have steep outslopes to the west, south, and southwest. The IFP and SF outslopes are heavily vegetated with trees and brush. Existing drainage consists of sheet flow and shallow concentrated flow that is generally uncontrolled before reaching Paddys Run. A portion of the IFP is situated adjacent to Paddys Run. A rock embankment was constructed under Removal Action 29 along a section of the eastern bank of Paddys Run to protect the IFP from stream erosion.

Because of the proximity of the SWUs to Paddys Run and the nature of the remediation activities, a surface water management system will be used during remediation. Some components of the surface water control system will remain in operation through restoration of the SWUs area. The surface water management system will include diversion ditches and berms to prevent runon from entering the remediation areas, and excavation sumps, collection ditches, retention basins, lift stations, and transfer lines to control runoff. Existing drainage patterns and facilities will be utilized for stormwater management, wherever possible, by implementing improvements to convey design flows and incorporating erosion control materials and revegetation to limit erosion along drainage paths. Where necessary, new ditches or diversion berms will be constructed to redirect existing drainage paths away from the construction area.

See Figure 2-1 for the overall operation of the surface water management system.

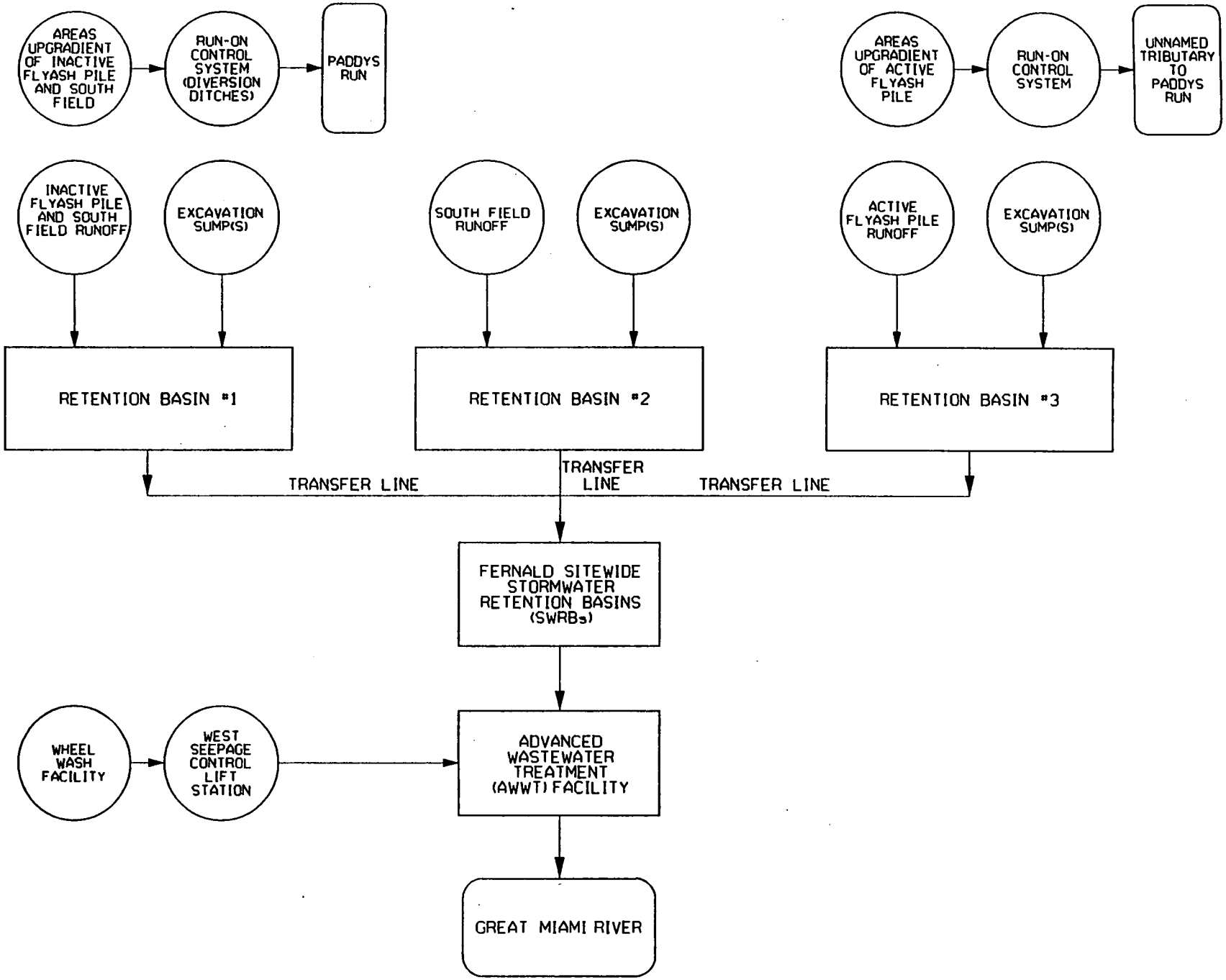

FIGURE 2-1. SURFACE WATER MANAGEMENT SYSTEM FOR SOUTHERN WASTE UNITS

2.2 Specific System Components

Specific components of the surface water management system are shown in Figure 2-1 and are described below. See the construction drawings and technical specifications for detailed design information concerning stormwater controls. See Appendix A for design calculations. Drainage area maps are presented in Appendix B.

2.2.1 Diversion Ditches and Related Devices

Runon from upgradient areas will be collected and diverted around the excavation area. Runon will be handled by diversion ditches and other components generally located north of the SWUs.

A ditch (designated as D-12 on the construction drawings) north of the existing road (that runs along the northern edge of the IFP and SF) will be constructed to intercept runon and convey this water westward to a new pipe under the road and into an existing catch basin. This catch basin is located at the northwest corner of the IFP, and has an 18-inch corrugated polyethylene pipe which conveys this runon to an existing drainage way, approximately 300 feet north of the existing National Pollution Discharge Elimination System (NPDES) Discharge Point No. *4004 at Paddys Run. An earthen berm will be constructed around the existing catch basin to collect potential runon water from the south side of the road and prevent potentially contaminated runoff from entering the system. The existing 18-inch pipe will be extended to discharge at the existing NPDES Discharge Point No. *4004. Impacted runoff will be diverted away from NPDES Discharge Point No. *4004 and into the retention basins.

An earthen berm will be constructed across a low area (topographically) north of the AFP to ensure that runon water will not enter the AFP remediation area.

The runon control components of the surface water management system will remain in place after restoration to prevent runon from uncertified areas upgradient from potentially contaminating the restored areas of the SWUs.

2.2.2 Excavation Sumps

As remediation is performed, active areas of excavation will be graded to drain to collection points located within the excavation area to the extent practical. Temporary excavation sumps will be excavated at these collection points to temporarily hold the stormwater. Water will be pumped out of the sumps and into retention basins on an as-needed basis to keep the excavation area functional. Multiple sumps/pumps may be used for dewatering of the excavation area and will be moved as the excavation of the work face progresses.

2.2.3 Collection Ditches and Related Devices

Collection ditches will be constructed around the perimeter of the remediation/construction areas to collect and convey stormwater runoff to the SWUs retention basins. Where possible, the channel slopes will follow the existing topography to minimize excavation. The ditches will be trapezoidal (flat bottom) or triangular in shape depending on anticipated flow rates and site constraints. All ditches will be lined to prevent channel erosion with either erosion control blanket or dumped rock, depending on the design flow velocities, see Summary of Ditch Performance, Sheet B34, Appendix A. Collection ditches excavated into the sand and gravels of the GMA will be lined with a geomembrane liner.

2.2.4 Retention Basins

The SWUs project area is divided into three major drainage areas (P1, P2, and P3 as shown in Appendix B) based on existing topography (drainage areas). Three retention basins (one per drainage area) will be constructed to retain potentially contaminated stormwater runoff. Non-impacted soil removed during basin construction will be placed in non-impacted soil stockpile areas (stockpile #1 and stockpile #2 as indicated on the construction drawings). Material in the non-impacted soil stockpile areas will be used to reclaim the retention basins during the restoration phase of the project.

Each retention basin will have a lift station which will pump runoff to the SWRB. The lift station will consist of a manhole, pump, and related piping/wiring/etc., and will be located adjacent to each basin. A high density, polyethylene (HDPE) riser/intake structure will be constructed inside the basin to feed the lift station. The riser will be designed with three hooded orifices sized to prevent starvation of the pump. The top of the riser will have a cap-type trash rack/anti-vortex device. Construction details for the lift station and riser/intake structure are shown on the construction drawings.

Overflow outlets will be provided for all three basins. The overflow outlets will consist of open, trapezoidal channels with invert elevations above the top of the riser pipe and below the top elevation of the basin embankment. The overflow outlets will not discharge unless the 10-year, 24-hour storm is exceeded. However, all three basins are located in the 100-year floodplain. A preliminary calculation performed for a previous project indicates that runoff from the 25-year storm will flood the area of the basins and will likely overtop the tops of the retention basins. Therefore, in the event of a storm that exceeds the 10-year, 24-hour storm event during the two year construction period, water may flow into the overflow outlets rather than out. During flows that exceed the 10-year storm, the SWRB will bypass the AWWT and discharge directly to the Great Miami River. During these periods of stormwater bypass, the outlet pumps from the retention basins will not operate.

After remediation and SWU restoration is completed, all three retention basins will be removed and backfilled. The compacted clay subgrade and geomembrane liner will be removed and hauled to the OSDF and the basins backfilled with material from the non-impacted soil stockpile.

The retention basins and respective drainage areas are described as follows:

2.2.4.1 Retention Basin 1

The proposed (developed conditions) P1 watershed is approximately 15.2 acres in size and contains the IFP and a portion of the SF and non-impacted soil stockpile area. Runoff will be collected and conveyed to Retention Basin 1 (see Construction Drawings and calculations) via collection ditches D1, D2 (D2A & D2B), D3, and D4. Retention Basin 1 will be located south of the IFP and SF and will cover approximately 1.5 acres of surface area. This basin is designed to retain the runoff volume from a 10-year, 24-hour storm event without discharge to the environment. A lift station with a 400 gallons per minute (gpm) pump system will be installed to pump collected runoff to the SWRB. Anticipated dewatering time for a 10-year, 24-hour storm event is approximately 72 hours. A 20-foot wide, open trapezoidal channel will be constructed to provide positive drainage for overflow occurring from storm events in excess of the 10-year, 24-hour storm or during sufficiently large sequential rain events.

Basin 1 will be constructed almost entirely by excavation with only a minimal amount of fill used for berms. Because Basin 1 is located within the GMA, the bottom and side slopes of the basin will be lined with one ft. of compacted clay and a geomembrane liner.

2.2.4.2 Retention Basin 2

The proposed (developed conditions) P2 watershed is approximately 6.0 acres in size and contains the SF and the remainder of the non-impacted soil stockpile area. Runoff will be collected and conveyed to Basin 2 through collection ditches D5, D6, D7, and D8 (D8A & D8B). Basin 2 will be located south of the SF and will cover approximately 0.5 acre of surface area. This basin is designed to retain the runoff volume from a 10-year, 24-hour storm event without discharge to the environment. A lift station with a 100 gpm pump system will be provided to pump collected runoff to the SWRB. Anticipated dewatering time for a 10-year, 24-hour storm event is approximately 72 hours. A 15-foot wide, open trapezoidal channel will be constructed to provide positive drainage for overflow occurring from storm events in excess of the 10- year, 24-hour storm.

Basin 2 will be constructed by excavation. Because this basin is located within the GMA, the bottom and side slopes of the basin will be lined with one ft. of compacted clay and a geomembrane liner.

2.2.4.3 Retention Basin 3

The proposed (developed conditions) P3 watershed is approximately 4.8 acres in size and contains the AFP. Runoff will be collected and conveyed to Basin 3 through collection ditches D9, D10 (D10A & D10B) and D11. Basin 3 will be located south of the AFP and will cover approximately 0.4 acre of surface area. This basin is designed to retain the runoff volume from a 10-year, 24-hour storm event without discharge to the environment. A lift station with a 100 gpm pump system will be provided to pump collected runoff to the SWRB. Anticipated dewatering time for a 10-year, 24-hour storm event is approximately 72 hours. A 15-foot wide, open trapezoidal channel will be constructed to provide positive drainage for overflow occurring from storm events in excess of the 10-year, 24-hour storm.

Basin 3 will be constructed by excavation. Because this basin is located within the GMA, the bottom and side slopes of the basin will be lined with one ft. of compacted clay and a geomembrane liner.

2.2.5 Transfer Line

A double-walled, HDPE pipe will be installed to convey runoff collected in the retention basins to the SWRB. The main transfer line begins at the lift station at Basin 1 and proceeds in an eastward direction where the lift stations for Basins 2 and 3 discharge into the transfer line. From Basin 3 the transfer line runs northward, east of the AFP, until reaching the termination point at the SWRB diversion box (see construction drawings). Cleanouts will be provided at strategic low points along the run of pipe. Air relief valves will be provided at strategic high points.

2.2.6 SWRB and AWWT

The SWRB will receive all water pumped from the SWUs retention basins. Under normal conditions, the SWRB is pumped to the AWWT facility for treatment and discharge, consistent with the NPDES and OU-5 ROD requirements.

2.2.7 Wheel Wash Facility

A wheel wash facility will be constructed at the SWUs north of the IFP. It will be used to remove mud and debris from the wheels and undercarriage of haul vehicles prior to using the haul road. Water from the wheel wash facility will gravity flow via underground pipe through an oil-water separator to the west seepage control lift station and be pumped to the AWWT.

2.3 OVERALL SYSTEM OPERATION

A major goal of the surface water management system is to prevent potentially contaminated surface water from being discharged to the environment prior to treatment. Initial management will be provided by constructing diversion ditches and berms at strategic locations to prevent surface water runon from entering the area of the SWUs that will be remediated. Runoff from the area of the SWUs that will be remediated will be managed through a series of excavation sumps and collection ditches, which collect and convey runoff from the remediation areas to three earthen retention basins.

The retention basins will provide temporary storage for runoff. The basins also provide pre-treatment of the water by providing detention time for sediments to settle out. Lift stations are provided to transfer runoff stored in the basins to the SWRB through a double-walled, HDPE transfer line. At the SWRB the potentially contaminated runoff is stored until it can be treated at the AWWT. During high flow conditions when the SWRB is at full capacity, the pumps at the retention basin lift stations will be shut off until adequate drawdown at the SWRB.

At the AWWT facility the water will be treated as required prior to being released to the Great Miami River.

SECTION 3

STORMWATER MANAGEMENT

Stormwater management as described in this Surface Water Management Plan addresses the peak runoff that discharges (and will discharge) from the site during existing, construction/remediation, and restoration conditions. The goal of stormwater management is to prevent a significant increase in the peak runoff during remediation and restoration activities.

The SWUs project site is currently vegetated and consists of sheet flow and shallow concentrated flow in the upper watershed areas, leading to concentrated flows in drainage ways around the site. All stormwater from the SWUs project site presently flows into Paddys Run. Prior to the start of remediation a surface water management system will be implemented to prevent runon to the site, and collect and convey runoff from the site for storm events up to the 10-year, 24-hour storm. Since runoff from the site will be pumped to the SWRB, the peak runoff from the site to Paddys Run will be reduced during remediation/excavation.

After remediation the site will be restored to the approximate original topography. Land use after remediation will be undeveloped with a vegetated cover. Based on an undeveloped land use scenario, the peak and total amount of runoff from the SWUs after remediation can be expected to be similar to the conditions that existed in 1952.

SECTION 4

EROSION AND SEDIMENT CONTROL MEASURES

4.1 Overall Concept

Soil conservation practices, combining vegetative and structural measures, have been incorporated in construction documents to mitigate soil erosion damage, off-site sediment migration, and water pollution from erosion. Many of these measures will be long-term in nature and will become part of the completed construction project (i.e., grading, and permanent seeding). Other measures will be temporary and will be removed by the excavation subcontractor at the completion of excavation and restoration. The selection of erosion and sediment control measures was based on several general principles including the following:

- minimization of erosion through project design,
- incorporation of temporary and permanent erosion control measures,
- removal of sediment prior to discharge.

Erosion and sediment control measures incorporated into the SWUs project incorporate applicable State, Federal, DOE, and FEMP requirements. The FEMP standards for erosion and sediment control follow the Ohio Department of Natural Resources (ODNR) and United States Soil Conservation Service standards for construction and materials. Vegetative stabilization, silt fencing, and ditch protection will be implemented in accordance with Ohio Department of Transportation Construction and Material Specifications and the Location and Design Manual, Volume Two, Drainage. A generalized description of proposed erosion and sediment control measures is presented in this section. Construction details for erosion and sediment control measures are included in the construction drawings and specifications.

4.2 Specific Components

There are two types of erosion and sediment control components: temporary and long-term measures. Temporary measures include silt fencing, crusting agents, stabilization measures (vegetation, matting, dumped rock), and sediment storage capacity within retention basins. Long-term measures include design features such as grading, vegetation, and dumped rock. Both temporary and long-term measures are discussed below.

4.2.1 Silt Fencing

Silt fencing will be used to intercept sheet flow, retain sediments, and disperse flow prior to runoff reaching the collection ditches. Prior to clearing, grading, and excavation activities, silt fencing will be installed along downgradient perimeters to prevent migration of sediment eroded from exposed areas. Silt fencing will consist of a woven filter fabric attached to wooden posts. Silt fencing will be constructed so that the toe of the filter fabric is securely buried to prevent water from undercutting the fence. Silt fencing will be installed in accordance with details presented on the drawings and in accordance with manufacturers recommendations. The locations presented on the construction drawings for the project areas are considered the minimum necessary during construction. Intermediate silt fencing may be used by the subcontractor to control and slow down flows in active excavation areas. The subcontractor shall install breaks and overlaps in the silt fencing to allow vehicle access to the construction areas.

Inspection of silt fence shall occur at regular intervals as outlined in Section 6.

4.2.2 Temporary Stabilization

As a result of phased construction, portions of the project areas may be left in intermediate/incomplete conditions. Intermediate areas may include rough graded areas awaiting final grading. Intermediate areas where activities will not resume for a period of 45 consecutive days or greater shall be stabilized (e.g., seeded with a quick germinating seed mixture, covered with a layer of straw mulch, or application of a crusting agent) within 7 days. Temporary measures will help to stabilize exposed soil and limit erosion. As construction progresses, areas containing temporary vegetation, straw mulch, or the crusting agent will be left in place until final seeding or until construction resumes.

4.2.3 Retention Basins

Although the primary purpose of the retention basins is to collect and hold runoff for treatment, the basins also provide an additional measure of sediment control. Runoff is detained in the retention basins until pumped to the SWRB. Because the rate of pumping to the SWRB is less than 1 cubic feet per second (cfs) (one cfs is 448.8 gallons per minute), which is small compared to discharges from standard outlet structures (usually several cfs), the retention basins provide a large detention storage time for sediments to settle out.

To account for the sediment removal capability of the retention basins, the basins have been designed with sediment storage capacities in excess of the 27 cubic yards per watershed acre as recommended in the ODNR's "Rainwater and Land Development Manual". For storm routing purposes, the sediment storage volume was assumed as dead storage (i.e., at full sediment capacity) and was not included in the basin

volume computations. The designed versus required sediment storage capacity for each basin is given below:

Retention Basin 1

Watershed Area = 15.2 Acres
Sediment Storage Required = 0.25 Acre-Feet
Sediment Storage as Designed = 0.38 Acre-Feet

Retention Basin 2

Watershed Area = 6.0 Acres
Sediment Storage Required = 0.10 Acre-Feet
Sediment Storage as Designed = 0.11 Acre-Feet

Retention Basin 3

Watershed Area = 4.8 Acres
Sediment Storage Required = 0.08 Acre-Feet
Sediment Storage as Designed = 0.10 Acre-Feet

4.2.4 Grading and Design Features

Grading design features incorporated into the construction drawings to control erosion include runon controls, limiting steep slopes, routing runoff to surface water collection ditches, limiting discharge and flow velocities in the collection ditches to the extent practical, and lining collection ditches with erosion control blankets or dumped rock as required to maintain non-erosive velocities.

4.2.5 Vegetation

Subsequent to final remediation of the project areas, a revegetation program will be implemented to establish a permanent variety of vegetation. The vegetation layer (turf type grass) will reduce erosion, enhance evapotranspiration of water, and improve the quality of water leaving the area. The project area will be seeded in stages as remediation is completed. In addition to seeding with a permanent variety of grass seed, mulch and erosion control blankets will be placed to prevent erosion during turf establishment. Mulch will be placed on graded slopes, and erosion control blankets will also be used in all grass ditches. As an aid to turf establishment, seeded areas will be fertilized with a starter fertilizer as described in the technical specifications.

4.2.6 Dumped Rock

Where added erosion protection is necessary for protection from excessive velocities, diversion ditches will be lined with dumped rock. Also, the existing drainageway north of the AFP, and where the unnamed tributary discharges into Paddys Run just west of the IFP, will be lined with dumped rock. Dumped rock will be placed in these locations to prevent further erosion as shown on the construction drawings.

4.3 Design Criteria and Standards

The criteria used to design the various components of the surface water management plan are described below.

- Retention basins are designed to retain the runoff from a 10-year, 24-hour storm event (minimum) without discharge to the environment.

- Retention basins are designed with a sediment storage capacity which exceeds 27 cubic yards per watershed acre.

- Pump rates at the lift stations are designed to convey accumulated water from the design storm (10-year, 24-hour) event in approximately 72 hours.

- Runon and diversion and collection ditches (drainage ditches) and culverts are designed based on a 10-year, 24-hour storm frequency, see Summary of Ditch Performance, Sheet B34, Appendix A.

Various standards and good engineering practices were used in the technical portion of the design. See calculations in Appendix A for a listing and discussion of the standards and practices used.

SECTION 5

IMPLEMENTATION

Because of the large expanse of area that will be impacted by remediation, relatively steep slopes, and close proximity to Paddys Run, intensive erosion control measures will be required to minimize erosion and maximize the capture of sediment. In conjunction with stormwater management measures, silt fencing will be installed along perimeter downslope areas and drainage ditches, where necessary, prior to the beginning of excavation activities.

Once excavation of impacted material and contaminated soil begins, erosion and sediment control measures will be integrated with stormwater management measures. Runoff from the active working face will either be gravity drained to collection ditches and basins, or collected in excavation sumps and pumped to collection ditches or directly to the retention basins. Runoff from all areas will be routed to the retention basins until the areas are certified below FRLs. The subcontractors will be required to periodically remove sediments from silt fences, drainage ditches, and basins to maintain desired performance. Sediment removed from silt fences, drainage ditches, and basins will be managed as impacted material and disposed of in the OSDF.

Any area left exposed for more than 45 consecutive days without any immediate plans for future work will be stabilized using a quick germinating seed mix, covered with straw mulch, or covered with a crusting agent (see construction drawings for proposed stormwater and sediment controls). Areas will also be stabilized to the extent practical prior to winter shutdown.

5.1 General Construction Practices

In general, it is advantageous to disturb only as much area as necessary to accommodate construction needs. Limiting the extent of grading and excavation will minimize disturbed areas subject to erosion at any given time. However, disturbed areas may be expanded to separate work areas and provide more room to work for safety reasons. The construction phasing ultimately incorporated into the work plan is dependent on several factors including the following:

- subcontractor's management strategies,
- construction conditions,
- seasonal and weather conditions.

The following construction practices will be followed as a general rule.

- All erosion and sediment control measures are to be installed prior to or as the first step in excavation.

- Disturbed/exposed areas will be excavated as quickly as practical. Disturbed areas which will remain unworked for 45 consecutive days or greater will be stabilized with a temporary vegetative cover or other measures, such as mulching, within 7 days.

- All erosion and sediment control measures shall be maintained and/or modified as approved by FDF in accordance with regulatory criteria during construction to comply with this plan.

- Potential cross-contamination from vehicle traffic will be prevented by stabilization of entry/exit routes, wheel washing, and monitoring vehicles exiting the work zone.

5.2 Construction Sequencing

The following sections discuss the general erosion control sequencing plan (during site preparation) and the excavation sequencing plan.

5.2.1 General Erosion Control Sequencing Plan (During Site Preparation)

Step 1. Establish site boundaries and access controls.

Step 2. Install silt fence and diversion ditches in locations indicated on the construction drawings.

Step 3. Strip the top 12 inches of soil (if not certified below FRLs by FDF) from areas designated for retention basin construction and stockpile the material within the boundaries of the impacted material stockpile within the SF to be field located as noted on the construction drawings.

Step 4. Complete excavation of retention basins to lines and grades shown on the plans. Prior to excavation (to the extent practical), FDF will determine whether material to be excavated is below FRLs. During excavation FDF may perform additional monitoring with real-time instruments. Soil suspected to be impacted (not below FRLs) will be placed in Impacted Material Stockpile shown on the construction drawings. Other soil will be placed in the Non-Impacted Material Stockpile Areas as shown on the construction drawings.

Step 5. Install risers, barrels, lift stations, and transfer lines for the retention basins as shown on the construction drawings.

Step 6. Install compacted clay subgrade and geomembrane liner in the retention basins.

Step 7. Divert flow into the retention basins by constructing collection ditches.

Step 8. Construct wheel wash pad and associated devices.

5.2.2 Excavation Sequencing Plan

Step 1. Establish site boundaries and access controls.

Step 2. Establish erosion, siltation, and surface water controls in locations indicated on the plans and as shown in the details. Confirm that all erosion and sediment controls are in place and all runoff from potentially contaminated and disturbed areas flows to the retention basins.

Step 3. Clear remaining trees and vegetation. Stumps will be ground in place and excavated with surface soil removal.

Step 4. Excavate impacted material to the limits indicated on the construction drawings.

Step 5. Where the GMA is exposed, cover with a geomembrane liner as shown on the construction drawings.

Step 6. When excavation is completed in a discrete area, certification samples will be collected (by FDF).

Step 7. Upon certification that soils remaining in the remediation area meet FRLs, restoration grading shall be performed.

Step 8. Install stabilization blankets and apply seed and mulch to all disturbed areas.

Step 9. Upon verification that the excavation meets FRLs and has an established stand of vegetation, accumulated sediments, compacted clay subgrade, and the geomembrane liner shall be removed from the retention basins.

Step 10. Install temporary erosion and sedimentation controls for decommissioning of retention basins.

Step 11. Upon certifying that retention basins 1, 2, and 3 meets FRLs, basins are to be backfilled, seeded, and mulched following removal of associated barrels, risers, lift stations, and transfer line.

Step 12. Remove temporary erosion and sedimentation controls following completion of final grading activities and after the excavation areas have an established stand of vegetation. Seed and mulch any areas disturbed by this activity.

SECTION 6

SEDIMENT CONTROL MAINTENANCE AND MONITORING

6.1 Monitoring and Inspection

The erosion and sediment controls identified in this SWMP will be monitored by a qualified representative of the subcontractor and FDF every 7 calendar days or within 24 hours of a precipitation event of 0.5 inches or greater during the construction phase of the project. Inspections will include areas under excavation, unstabilized exposed areas, erosion control measures, and locations where vehicles enter/exit the project area. Where portions of the project area have been completed and permanent erosion control measures have been implemented, inspection will be conducted at least once every month until the entire project area is completely stabilized. All inspections will be conducted and documented in accordance with the SWPPP.

Disturbed areas and areas used for storage of materials that are exposed to the elements will be inspected for evidence of, or for the potential of, pollutants entering local drainage systems. Locations where vehicles exit the project area will be inspected for evidence of off-site tracking of contaminated soil or impacted material.

If the inspections indicate that control measures are not adequate or effective, modifications to the control measure will be implemented immediately by FDF. A report summarizing the scope of the inspection, name of the inspector, inspection date, observations relating to the implementation of this plan, and corrective action measures (if any) will be made and retained in the FDF project files to demonstrate compliance. The reports will either identify any areas of noncompliance with this plan, or contain a certification that control measures are effective and in compliance with this plan.

6.2 Maintenance

Erosion and sediment controls will be maintained in good operating condition until the project area has been completely stabilized and the soils remaining in the project area are certified to meet FRLs. Specific maintenance procedures will address silt fencing, drainage ditches, retention basins, and the wheel wash pad.

Silt Fencing

As sediment collects along the silt fences, the fences will be cleaned to maintain desired removal performance and prevent structural failure of the fence. Sediment will be removed by the subcontractor and managed as impacted material and placed in the impacted material stockpile for subsequent placement into the OSDF. The perimeter silt fencing will remain in place until excavation activities in the area are completed and vegetative cover or other erosion control measures are adequately established.

Drainage Ditches

The subcontractor will be required to periodically remove sediment from the drainage ditches to maintain conveyance. Sediment removed from ditches will be managed as impacted material and placed in the impacted material stockpile for subsequent placement into the OSDF.

Retention Basins

The subcontractor will be required to periodically remove sediment from the retention basins to maintain desired sediment storage capacity. Sediment removed from basins will be managed as impacted material and placed in the impacted material stockpile for subsequent placement into the OSDF.

Wheel Wash Pad

Sediments will be removed from the trench and oil/water separator as required. The sediments removed from the Wheel Wash Pad will be managed as impacted material and placed in the OSDF.

APPENDIX A

CALCULATIONS

PARSONS
ERA PROJECT

DESIGN CALCULATIONS INDEX

Discipline CIVIL Project Order No. 165 OU No. 2

CALCULATION NO.	SUBJECT	COMPUTER GENERATED (Y/N)	ORIGINATING AUTHOR	CHECKED BY	REV. NO./ DATE
15-01	STORMWATER MANAGEMENT	BOTH	T. BROWN	B. PARTON	0/ 5/22/97

APPROVED _____ DATE _____
Technical Lead

10/96 ENG023

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PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS TITLE AND SUMMARY SHEET

Date 5/22/97
Sheet 1 of 12

Proj. Order No. 165 Calculation No. 15-01

Project Title SOUTHERN WASTE UNITS

Calculation Subject STORMWATER MANAGEMENT Date Verified/Checked 6-12-97

STATUS: PRELIMINARY ____ FINAL X SUPERSEDED ____ VOID ____

STATEMENT OF PROBLEM

1) Determine size of three retention basins required to collect and retain runoff from the 10 yr-24 hr precipitation event.

2) Determine size of collection ditches and culverts required to convey a 10-yr storm event to the retention basins.

3) Determine size of sediment trap required to accommodate borrow area excavation.

SUMMARY OF CONCLUSIONS

1) The basins, as shown on Dwg. 92X-5900-G-00282 are of sufficient size to collect runoff from the 10 yr-24 hr storm event.
2) Ditches and culverts shown on Dwg. 92X-5900-G-00282, Dwg. 92X-5900-G-00283, and 92X-5900-G-00453 are of sufficient size to convey the 10-yr storm event to the basins.
3) Sediment trap is of sufficient size to accommodate borrow area.

Originator's Signature and Date: 6-12-97

CHECKING METHOD

1. Review ____
2. Alternate Calculation ____

Checker's Signature and Date: 6-12-97

Lead Discipline Engineer's Signature and Date: 6-12-97

Rev. No.	Sheet No.	Description	Reviser's Signature/Date	Checker's Signature/Date	Approved by Signature/Date

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS BASIS SHEET

Revision No. 0
Sheet 2 of 12

Proj. Order No. 165 Calculation No. 15-01

Project Title Southern Waste Units

Calculation Subject Stormwater Management Date Verified/Checked 6-12-97

Prepared By: T. Brown TB Checked/Verified By: Frank Parker Jr

Date 5/22/97

SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS

Data Sources

1. PARSONS DWGs. (used to create drainage area maps)
2. Haestad Methods. 1989. Quick TR-55™ *Urban Hydrology for Small Watersheds*
3. Haestad Methods. 1989. Pond-2™ *Detention Pond Analysis*
4. Haestad Methods. 1995. Flow Master™ v 5.13
5. U.S. Weather Bureau. *Rainfall Frequency Atlas of the United States*
6. Soil Conservation Service. *Soil Survey of Hamilton County, Ohio*. August 1982
7. ODOT. *Location and Design Manual, Vol. 2, Drainage Design*
8. FHWA. *Hydraulic Design of Highway Culverts*. HDS No. 5. 1985
9. Brater, E.F., & King, H.W., *"Handbook of Hydraulics"*, 6th ed., 1976. McGraw-Hill

CODES

Applicable sections of the Ohio Department of Natural Resources *Rainwater and Land Development Manual*

ASSUMPTIONS

1. Retention basins: The retention basins will be in place and operational prior to excavation. Therefore, the contributing watershed areas prior to, and during excavation were examined to identify the worst-case for storm volumes.

ENGINEERING CALCULATIONS
BASIS SHEET
SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS (continued)

2. Ditches and Culverts: Both existing and proposed conditions were evaluated, with the one producing the highest flow rates used in design.
3. The Rainfall Intensity-Frequency-Duration Curve for the Fernald area has the shortest duration equal to 10 minutes. The time of concentrations (t_c) computed for drainage areas P1, P2, and P3 were less than 10 minutes. Since the drainage areas for ditches are smaller than basin drainage areas (and subsequent t_c's for ditches less than those for basins), calculations for t_c for ditch and culvert drainage areas were not performed (except for Ditch-12, and Culvert-4). Instead, the smallest duration (10 min.) from the Rainfall Intensity-Frequency-Duration Curve were used to calculate rainfall intensities. For Ditch-12 and Culvert-4, t_c's were calculated using SCS methodologies due to the relatively large, flat drainage areas.
4. Basins were designed with an overflow outlet to provide positive drainage for storm events in excess of the 10-year, 24-hour storm.
5. Ditches were designed based on uniform flow.
6. The existing ditches and 24" dia. culvert at the proposed wheel wash area were designed under Calculation No. 15-02, for PO158 (Haulroad Upgrade Project), and is included for information as an attachment to this calculation.
7. The existing catch basin and 18" corrugated HDPE storm drain located west of the Inactive Flyash Pile was designed under Calculation No. 15-01, for PO139 (Design of Seepage Collection & Removal of Sediment), and is included for information as an attachment to this calculation.
8. The Contingency Stockpile Area (Stockpile #2), located north-northwest of ditch-12, may or may not be utilized, depending on the amount of excess soil. Therefore, ditches 8A, 8B, and Basin 2 were designed assuming that this stockpile area would be utilized.

9. Dumped Rock Fill will be used in ditches that do not have a geomembrane liner where flow velocities are greater than 4.0 fps. ODOT Type "C" dumped rock fill will be used in all ditches due to the small geometrical shape of the ditches.

10. Ditches 2B, 3-7, and 9 will have a geomembrane liner. Where velocity checks are used, flow depths will be determined using a broad-crested weir analysis.

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

OU: 2 PO: 165 Job Number: 7663-0165-11112-141

Computer Code: QTR-55 Version: 5.46

Code Verification Status: REV 0, Nov 1992

Description of Program: Developes runoff hydrographs per SCS TR-55, Determines peak flows per Modified Rational Method

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: To determine volume of runoff produced by 10-yr, 24-hr storm event, Retention Basins will be sized to accommodate these volumes.

To determine peak flows for design of ditches and culverts.

Run Performed By: T. Brown

Date/Time of Run: 1/15/97

Computer Time of Run: n/a

Input Filename: See attached list on Sheets 8-11

Output Filename: See attached list on Sheets 8-11

Files Saved to Diskname: p:\engdata\c&sdata\po165\swu\swcalc Disk Location: network directory, backup with discipline files

Results: Refer to calculation

Performed By: T. Brown TB Date: 6-12-97

Checked By: Frank Pantaj Date: 6-12-97

Approved By: Date:

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

OU: 2 PO: 165 Job Number: 7663-0165-11112-141

Computer Code: POND -2 Version: 5.17

Code Verification Status: REV 0, NOV 1992

Description of Program: Computes solution for routing inflow hydrograph generated by OTR-55 and generates an outflow hydrograph using level-pool routing techniques

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: Used to size retention basins to ensure no discharge for 10-year, 24-hour storm event.

Run Performed By: T. Brown

Date/Time of Run: 1/96 - 1/97

Computer Time of Run: n/a

Input Filename: See attached list on Sheets 8-11

Output Filename: See attached list on Sheets 8-11

Files Saved to Diskname: p:\engdata\c&sdata\po165\swu\swcalc Disk Location: network directory, backup with discipline files

Results: Refer to calculation

Performed By: T. Brown TGB Date: 6-12-97

Checked By: Frank Pala Jr Date: 6-12-97

Approved By: Date:

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

OU: 2 PO: 165 Job Number: 7663-0165-11112-141

Computer Code: Flow Master Version: 5.13

Code Verification Status: Rev 0, Feb. 1997

Description of Program: Computes solutions to uniform flow open channel hydraulic problems

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: Used to evaluate and select drainage channel geometry and acceptable lining material.

Run Performed By: T. Brown

Date/Time of Run: 11/96 - 1/97

Computer Time of Run: n/a

Input Filename: See attached list on Sheets 8-11

Output Filename: See attached list on Sheets 8-11

Files Saved to Diskname: p:engdata\c&sdata\po165\swu\swcalc Disk Location: network directory, backup with discipline files

Results: Refer to calculation

Performed By: T. Brown TUB Date: 6-12-97

Checked By: Frank Parker Jr Date: 6-12-97

Approved By: Date:

RESULTS:

The results from the routing the 10-year, 24-hour storm event through the retention basins are as follows:

RETENTION BASIN 1

Q_{10} =	72 CFS
Initial Storage (Assumed full of sediment) =	0.38 Ac-Ft
Overflow Elev. =	537.7
Water Surface Elev. (WSE_{10}) =	537.11
Q_{10} Discharge =	0 CFS

RETENTION BASIN 2

Q_{10} =	28 CFS
Initial Storage (Assumed full of sediment) =	0.11 Ac-Ft
Overflow Elev. =	536.0
Water Surface Elev. (WSE_{10}) =	535.90
Q_{10} Discharge =	0 CFS

RETENTION BASIN 3

Q_{10} =	21 CFS
Initial Storage (Assumed full of sediment) =	0.10 Ac-Ft
Overflow Elev. =	540.0
Water Surface Elev. (WSE_{10}) =	539.89
Q_{10} Discharge =	0 CFS

The retention basins do not discharge the 10-year, 24-hour storm event and are acceptable.

The diversion ditches and culverts were designed to accommodate a 10-year storm event. The results for diversion ditches and culverts are included within the body of the calculations.

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ATTACHMENT A, RETENTION BASINS

Methodology

This calculation is performed by examining the existing and proposed conditions to identify the "worst case" for storm volumes.

The existing drainage area for each basin is computed using the existing topography. The proposed drainage area for each basin is computed on the final grading plan. Time of concentrations are determined using sheet flow, shallow concentrated flow, and channel flow as required by the drainage characteristics of each drainage area. See Drainage Area Map in Appendix B of the Surface Water Management Plan. A weighted curve number is developed for each drainage area based on soil types and conditions within the drainage area. The proposed 10 yr - 24 hr inflow hydrographs are then developed using SCS Technical Release No. 55 and the computer program Quick TR-55.

The drainage areas for each basin under existing and proposed conditions are as follows:

	EXISTING	PROPOSED
Basin 1	14.33 AC	15.23 AC
Basin 2	7.04 AC	6.1 AC
Basin 3	4.78 AC	4.78 AC

By inspection, The worst-case volume condition for basin 1 and basin 3 will occur during proposed conditions due to the size of the drainage areas and the use of higher curve numbers for disturbed conditions. However, for basin 2 it is not apparent which condition will generate the largest storm runoff volume. Therefore, runoff hydrographs will be generated for each condition and routed through the storage volume estimate routine of the Pond-2 computer program. The condition which produces the largest estimated storage volume will be used as the worst-case and will be routed through the basin.

Stage-storage information is developed from the grading plans for each basin. This information is entered into the Pond-2 computer program. Since the basins retain the design storm instead of regulating outflow, an outflow rating table is not required. Also, the pumping rate at the lifts stations (400 gallons per minute at basin 1, and 100 gpm at basins 2 & 3) was not considered when routing the design storm event.

The 10 yr - 24 hr inflow hydrographs are then routed through the basins using level-pool reservoir routing techniques found in the Pond-2 computer program. Maximum water surface elevations due to storage of the entire storm volume are evaluated to ensure that adequate volume is provided to contain the 10 yr - 24 hr storm event.

Calculations are included on the following pages.

SHT A2

RETENTION BASIN 1

Quick TR-55 Ver.5.46 S/N:
Executed: 14:23:24 04-26-1997 C:\PO165PRP\P1.TCT

RETENTION BASIN - 1

Tc COMPUTATIONS FOR: P1

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		BARE	
Manning's roughness coeff., n		0.0110	
Flow length, L (total < or = 300)	ft	280.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0210	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.05	= 0.05

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	240.0	
Watercourse slope, s	ft/ft	0.1120	
$Avg.V = Csf * (s)^{0.5}$	ft/s	5.3996	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.01	= 0.01

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	10.00	
Wetted perimeter, Pw	ft	12.47	
Hydraulic radius, r = a/Pw	ft	0.802	
Channel slope, s	ft/ft	0.0080	
Manning's roughness coeff., n		0.0400	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.8758	
Flow length, L	ft	305	
T = L / (3600*V)	hrs	0.03	= 0.03

::

TOTAL TIME (hrs) 0.09

USE 0.1 HRS

SHT A4

Quick TR-55 Ver.5.46 S/N:
Executed: 14:23:24 04-26-1997 C:\PO165PRP\P1.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN - 1

Subarea descr.	Tc or Tt	Time (hrs)
P1	Tc	0.09

USE 0.1 HRS

P1 WATERSHED, CHANNEL FLOW
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	P1 WATERSHED, CHANNEL FLOW
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft

Results		
Discharge	28.68	cfs
Flow Area	10.00	ft^2
Wetted Perimeter	12.47	ft
Top Width	12.00	ft
Critical Depth	0.69	ft
Critical Slope	0.028706	ft/ft
Velocity	2.87	ft/s
Velocity Head	0.13	ft
Specific Energy	1.13	ft
Froude Number	0.55	
Flow is subcritical.		

Notes:

THIS ANALYSIS WAS TO DETERMINE THE FLOW AREA, WETTED PERIMETER, AND HYDRAULIC RADIUS OF D-3 FLOWING 1 FT DEEP.

RESULTS USED TO DETERMINE TRAVEL TIME OF FOR CHANNEL FLOW COMPONENT OF TIME OF CONCENTRATION OF P1 DRAINAGE AREA.

SHTA6

Quick TR-55 Ver.5.46 S/N:
Executed: 14:26:02 04-26-1997

RETENTION BASIN 1
59% HoA, 20% HeF, 10% MaB,
10% Gn, 1% Gravel Road

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN
HoA, (C): FALLOW, BARE SOIL	8.97	91
MaB, (C): FALLOW, BARE SOIL	1.52	91
HeF, (B): FALLOW, BARE SOIL	3.04	86
Gn, (B): FALLOW, BARE SOIL	1.55	86
Gravel Road	0.15	91
COMPOSITE AREA --->	15.23	89.5 ~~(89)~~ (90)

::

SHT A7

Quick TR-55 Ver.5.46 S/N:
Executed: 09:23:55 05-02-1997

RETENTION BASIN 1
59% HoA, 20% HeF, 10% MaB,
10% Gn, 1% Gravel Road

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	15.23	~~89~~ USE 90

SEE SHT A6

SHT A8

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-26-1997 14:32:20
Watershed file: --> C:\PO165PRP\P1 .MOP
Hydrograph file: --> C:\PO165PRP\P1-10.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/use	
P1	15.23	90.0	0.10	0.00	4.10	3.01	I.05	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 15.23 acres or 0.02380 sq.mi
Peak discharge = 72 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P1	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-26-1997 14:32:20
Watershed file: --> C:\PO165PRP\P1 .MOP
Hydrograph file: --> C:\PO165PRP\P1-10.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P1	72	12.1
Composite Watershed	72	12.1

SHT A10

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-26-1997 14:32:20
Watershed file: --> C:\PO165PRP\P1 .MOP
Hydrograph file: --> C:\PO165PRP\P1-10.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
P1	2	2	4	24	46	72	45	16	11
Total (cfs)	2	2	4	24	46	72	45	16	11

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
P1	9	7	6	5	5	4	4	3	3
Total (cfs)	9	7	6	5	5	4	4	3	3

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
P1	3	2	2	2	2	2	2	1	1
Total (cfs)	3	2	2	2	2	2	2	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
P1	1	1	1	1	0
Total (cfs)	1	1	1	1	0

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-26-1997 14:32:20
Watershed file: --> C:\PO165PRP\P1 .MOP
Hydrograph file: --> C:\PO165PRP\P1-10.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	2	14.8	2
11.1	2	14.9	2
11.2	2	15.0	2
11.3	2	15.1	2
11.4	3	15.2	2
11.5	3	15.3	2
11.6	4	15.4	2
11.7	11	15.5	2
11.8	17	15.6	2
11.9	24	15.7	2
12.0	46	15.8	2
12.1	72	15.9	2
12.2	45	16.0	2
12.3	16	16.1	2
12.4	11	16.2	2
12.5	9	16.3	2
12.6	7	16.4	2
12.7	6	16.5	2
12.8	5	16.6	2
12.9	5	16.7	2
13.0	5	16.8	1
13.1	4	16.9	1
13.2	4	17.0	1
13.3	4	17.1	1
13.4	4	17.2	1
13.5	4	17.3	1
13.6	3	17.4	1
13.7	3	17.5	1
13.8	3	17.6	1
13.9	3	17.7	1
14.0	3	17.8	1
14.1	3	17.9	1
14.2	2	18.0	1
14.3	2	18.1	1
14.4	2	18.2	1
14.5	2	18.3	1

14.6	2	18.4	1
14.7	2	18.5	1

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-26-1997 14:32:20
Watershed file: --> C:\PO165PRP\P1 .MOP
Hydrograph file: --> C:\PO165PRP\P1-10.HYD

RETENTION BASIN 1
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	1	22.4	1
18.7	1	22.5	1
18.8	1	22.6	1
18.9	1	22.7	1
19.0	1	22.8	1
19.1	1	22.9	1
19.2	1	23.0	1
19.3	1	23.1	1
19.4	1	23.2	1
19.5	1	23.3	1
19.6	1	23.4	1
19.7	1	23.5	1
19.8	1	23.6	1
19.9	1	23.7	1
20.0	1	23.8	1
20.1	1	23.9	1
20.2	1	24.0	1
20.3	1	24.1	0
20.4	1	24.2	0
20.5	1	24.3	0
20.6	1	24.4	0
20.7	1	24.5	0
20.8	1	24.6	0
20.9	1	24.7	0
21.0	1	24.8	0
21.1	1	24.9	0
21.2	1	25.0	0
21.3	1	25.1	0
21.4	1	25.2	0
21.5	1	25.3	0
21.6	1	25.4	0
21.7	1	25.5	0
21.8	1	25.6	0
21.9	1	25.7	0
22.0	1	25.8	0
22.1	1	25.9	0
22.2	1		
22.3	1		

SHTA14

POND-2 Version: 5.17
S/N:

RETENTION BASIN NO. 1

CALCULATED 04-26-1997 14:52:34
DISK FILE: C:\PO165PRP\SW1 .VOL

Planimeter scale: 1 inch = 40 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
531.40	0.00	0.00	0.00	0.00	0.00
532.00	5.27	0.19	0.19	0.04	0.04
533.00	16.74	0.61	1.15	0.38	0.42
534.00	23.83	0.88	2.22	0.74	1.16
535.00	25.38	0.93	2.71	0.90	2.07
536.00	26.97	0.99	2.88	0.96	3.03
537.00	28.60	1.05	3.06	1.02	4.05
538.00	31.45	1.16	3.31	1.10	5.15
539.00	35.20	1.29	3.67	1.22	6.38
540.00	36.27	1.33	3.94	1.31	7.69

Elevations With Areas Interpolated From
The Closest Two Planimeter Readings

532.90	-----	0.56	1.09	0.33	0.36
537.70	-----	1.12	3.26	0.76	4.81
537.80	-----	1.13	3.28	0.87	4.92
537.90	-----	1.14	3.29	0.99	5.04
538.10	-----	1.17	3.49	0.12	5.27
538.20	-----	1.18	3.51	0.23	5.39
538.30	-----	1.20	3.53	0.35	5.50
538.40	-----	1.21	3.55	0.47	5.63
538.50	-----	1.22	3.57	0.59	5.75
538.60	-----	1.24	3.59	0.72	5.87
538.70	-----	1.25	3.61	0.84	5.99
538.80	-----	1.26	3.63	0.97	6.12
538.90	-----	1.28	3.65	1.09	6.25
539.10	-----	1.30	3.88	0.13	6.51
539.20	-----	1.30	3.89	0.26	6.64

* Incremental volume computed by the Conic Method for Reservoir Volumes.

POND-2 Version: 5.17 S/N:
EXECUTED: 04-26-1997 14:51:38

Return Freq: 10 years

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**********************
*                    *
*  RETENTION BASIN 1 *
*                    *
*                    *
*                    *
*                    *
**********************
```

Inflow Hydrograph: C:\PO165PRP\P1-10 .HYD
Rating Table file: C:\PO165PRP\SW1 .PND

----INITIAL CONDITIONS----
Elevation = 532.90 ft — MAX SED. CLEANOUT ELEV
Outflow = 0.00 cfs
Storage = 0.38 ac-ft — MAX SED. STORAGE VOLUME

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
531.40	0.0	0.000
532.00	0.0	0.040
533.00	0.0	0.420
534.00	0.0	1.160
535.00	0.0	2.070
536.00	0.0	3.030
537.00	0.0	4.050
537.70	0.0	4.810
537.90	4.8	5.040
538.00	8.8	5.150
538.10	13.7	5.270
538.30	25.1	5.500
538.50	37.8	5.750
538.70	52.6	5.990
538.90	69.4	6.250
539.00	78.3	6.380
539.10	87.5	6.510
539.20	96.6	6.640
540.00	183.5	7.690

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
9.7	9.7
101.6	101.6
280.7	280.7
500.9	500.9
733.3	733.3
980.1	980.1
1164.0	1164.0
1219.7	1224.5
1246.3	1255.1
1275.3	1289.0
1331.0	1356.1
1391.5	1429.3
1449.6	1502.2
1512.5	1581.9
1544.0	1622.3
1575.4	1662.9
1606.9	1703.5
1861.0	2044.5

Time increment (t) = 0.100 hrs.

SHT A16

POND-2 Version: 5.17 S/N:
EXECUTED: 04-26-1997 14:51:38

Return Freq: 10 years

Pond File: C:\PO165PRP\SW1 .PND
Inflow Hydrograph: C:\PO165PRP\P1-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW1-10 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	2.00	-----	92.4	92.4	0.00	532.90
11.100	2.00	4.0	96.4	96.4	0.00	532.94
11.200	2.00	4.0	100.4	100.4	0.00	532.99
11.300	2.00	4.0	104.4	104.4	0.00	533.02
11.400	3.00	5.0	109.4	109.4	0.00	533.04
11.500	3.00	6.0	115.4	115.4	0.00	533.08
11.600	4.00	7.0	122.4	122.4	0.00	533.12
11.700	11.00	15.0	137.4	137.4	0.00	533.20
11.800	17.00	28.0	165.4	165.4	0.00	533.36
11.900	24.00	41.0	206.4	206.4	0.00	533.59
12.000	46.00	70.0	276.4	276.4	0.00	533.98
12.100	72.00	118.0	394.4	394.4	0.00	534.52
12.200	45.00	117.0	511.4	511.4	0.00	535.05
12.300	16.00	61.0	572.4	572.4	0.00	535.31
12.400	11.00	27.0	599.4	599.4	0.00	535.42
12.500	9.00	20.0	619.4	619.4	0.00	535.51
12.600	7.00	16.0	635.4	635.4	0.00	535.58
12.700	6.00	13.0	648.4	648.4	0.00	535.63
12.800	5.00	11.0	659.4	659.4	0.00	535.68
12.900	5.00	10.0	669.4	669.4	0.00	535.73
13.000	5.00	10.0	679.4	679.4	0.00	535.77
13.100	4.00	9.0	688.4	688.4	0.00	535.81
13.200	4.00	8.0	696.4	696.4	0.00	535.84
13.300	4.00	8.0	704.4	704.4	0.00	535.88
13.400	4.00	8.0	712.4	712.4	0.00	535.91
13.500	4.00	8.0	720.4	720.4	0.00	535.94
13.600	3.00	7.0	727.4	727.4	0.00	535.97
13.700	3.00	6.0	733.4	733.4	0.00	536.00
13.800	3.00	6.0	739.4	739.4	0.00	536.03
13.900	3.00	6.0	745.4	745.4	0.00	536.05
14.000	3.00	6.0	751.4	751.4	0.00	536.07
14.100	3.00	6.0	757.4	757.4	0.00	536.10
14.200	2.00	5.0	762.4	762.4	0.00	536.12
14.300	2.00	4.0	766.4	766.4	0.00	536.13
14.400	2.00	4.0	770.4	770.4	0.00	536.15
14.500	2.00	4.0	774.4	774.4	0.00	536.17
14.600	2.00	4.0	778.4	778.4	0.00	536.18
14.700	2.00	4.0	782.4	782.4	0.00	536.20
14.800	2.00	4.0	786.4	786.4	0.00	536.22
14.900	2.00	4.0	790.4	790.4	0.00	536.23
15.000	2.00	4.0	794.4	794.4	0.00	536.25
15.100	2.00	4.0	798.4	798.4	0.00	536.26
15.200	2.00	4.0	802.4	802.4	0.00	536.28
15.300	2.00	4.0	806.4	806.4	0.00	536.30
15.400	2.00	4.0	810.4	810.4	0.00	536.31

POND-2 Version: 5.17 S/N:
EXECUTED: 04-26-1997 14:51:38

Return Freq: 10 years

Pond File: C:\PO165PRP\SW1 .PND
Inflow Hydrograph: C:\PO165PRP\P1-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW1-10 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	2.00	4.0	814.4	814.4	0.00	536.33
15.600	2.00	4.0	818.4	818.4	0.00	536.35
15.700	2.00	4.0	822.4	822.4	0.00	536.36
15.800	2.00	4.0	826.4	826.4	0.00	536.38
15.900	2.00	4.0	830.4	830.4	0.00	536.39
16.000	2.00	4.0	834.4	834.4	0.00	536.41
16.100	2.00	4.0	838.4	838.4	0.00	536.43
16.200	2.00	4.0	842.4	842.4	0.00	536.44
16.300	2.00	4.0	846.4	846.4	0.00	536.46
16.400	2.00	4.0	850.4	850.4	0.00	536.47
16.500	2.00	4.0	854.4	854.4	0.00	536.49
16.600	2.00	4.0	858.4	858.4	0.00	536.51
16.700	2.00	4.0	862.4	862.4	0.00	536.52
16.800	1.00	3.0	865.4	865.4	0.00	536.54
16.900	1.00	2.0	867.4	867.4	0.00	536.54
17.000	1.00	2.0	869.4	869.4	0.00	536.55
17.100	1.00	2.0	871.4	871.4	0.00	536.56
17.200	1.00	2.0	873.4	873.4	0.00	536.57
17.300	1.00	2.0	875.4	875.4	0.00	536.58
17.400	1.00	2.0	877.4	877.4	0.00	536.58
17.500	1.00	2.0	879.4	879.4	0.00	536.59
17.600	1.00	2.0	881.4	881.4	0.00	536.60
17.700	1.00	2.0	883.4	883.4	0.00	536.61
17.800	1.00	2.0	885.4	885.4	0.00	536.62
17.900	1.00	2.0	887.4	887.4	0.00	536.62
18.000	1.00	2.0	889.4	889.4	0.00	536.63
18.100	1.00	2.0	891.4	891.4	0.00	536.64
18.200	1.00	2.0	893.4	893.4	0.00	536.65
18.300	1.00	2.0	895.4	895.4	0.00	536.66
18.400	1.00	2.0	897.4	897.4	0.00	536.67
18.500	1.00	2.0	899.4	899.4	0.00	536.67
18.600	1.00	2.0	901.4	901.4	0.00	536.68
18.700	1.00	2.0	903.4	903.4	0.00	536.69
18.800	1.00	2.0	905.4	905.4	0.00	536.70
18.900	1.00	2.0	907.4	907.4	0.00	536.71
19.000	1.00	2.0	909.4	909.4	0.00	536.71
19.100	1.00	2.0	911.4	911.4	0.00	536.72
19.200	1.00	2.0	913.4	913.4	0.00	536.73
19.300	1.00	2.0	915.4	915.4	0.00	536.74
19.400	1.00	2.0	917.4	917.4	0.00	536.75
19.500	1.00	2.0	919.4	919.4	0.00	536.75
19.600	1.00	2.0	921.4	921.4	0.00	536.76
19.700	1.00	2.0	923.4	923.4	0.00	536.77
19.800	1.00	2.0	925.4	925.4	0.00	536.78
19.900	1.00	2.0	927.4	927.4	0.00	536.79
20.000	1.00	2.0	929.4	929.4	0.00	536.79

SHT A18

POND-2 Version: 5.17 S/N:
EXECUTED: 04-26-1997 14:51:38

Return Freq: 10 years

Pond File: C:\PO165PRP\SW1 .PND
Inflow Hydrograph: C:\PO165PRP\P1-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW1-10 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	1.00	2.0	931.4	931.4	0.00	536.80
20.200	1.00	2.0	933.4	933.4	0.00	536.81
20.300	1.00	2.0	935.4	935.4	0.00	536.82
20.400	1.00	2.0	937.4	937.4	0.00	536.83
20.500	1.00	2.0	939.4	939.4	0.00	536.84
20.600	1.00	2.0	941.4	941.4	0.00	536.84
20.700	1.00	2.0	943.4	943.4	0.00	536.85
20.800	1.00	2.0	945.4	945.4	0.00	536.86
20.900	1.00	2.0	947.4	947.4	0.00	536.87
21.000	1.00	2.0	949.4	949.4	0.00	536.88
21.100	1.00	2.0	951.4	951.4	0.00	536.88
21.200	1.00	2.0	953.4	953.4	0.00	536.89
21.300	1.00	2.0	955.4	955.4	0.00	536.90
21.400	1.00	2.0	957.4	957.4	0.00	536.91
21.500	1.00	2.0	959.4	959.4	0.00	536.92
21.600	1.00	2.0	961.4	961.4	0.00	536.92
21.700	1.00	2.0	963.4	963.4	0.00	536.93
21.800	1.00	2.0	965.4	965.4	0.00	536.94
21.900	1.00	2.0	967.4	967.4	0.00	536.95
22.000	1.00	2.0	969.4	969.4	0.00	536.96
22.100	1.00	2.0	971.4	971.4	0.00	536.96
22.200	1.00	2.0	973.4	973.4	0.00	536.97
22.300	1.00	2.0	975.4	975.4	0.00	536.98
22.400	1.00	2.0	977.4	977.4	0.00	536.99
22.500	1.00	2.0	979.4	979.4	0.00	537.00
22.600	1.00	2.0	981.4	981.4	0.00	537.01
22.700	1.00	2.0	983.4	983.4	0.00	537.01
22.800	1.00	2.0	985.4	985.4	0.00	537.02
22.900	1.00	2.0	987.4	987.4	0.00	537.03
23.000	1.00	2.0	989.4	989.4	0.00	537.04
23.100	1.00	2.0	991.4	991.4	0.00	537.04
23.200	1.00	2.0	993.4	993.4	0.00	537.05
23.300	1.00	2.0	995.4	995.4	0.00	537.06
23.400	1.00	2.0	997.4	997.4	0.00	537.07
23.500	1.00	2.0	999.4	999.4	0.00	537.07
23.600	1.00	2.0	1001.4	1001.4	0.00	537.08
23.700	1.00	2.0	1003.4	1003.4	0.00	537.09
23.800	1.00	2.0	1005.4	1005.4	0.00	537.10
23.900	1.00	2.0	1007.4	1007.4	0.00	537.10
24.000	0.00	1.0	1008.4	1008.4	0.00	537.11
24.100	0.00	0.0	1008.4	1008.4	0.00	537.11
24.200	0.00	0.0	1008.4	1008.4	0.00	537.11
24.300	0.00	0.0	1008.4	1008.4	0.00	537.11
24.400	0.00	0.0	1008.4	1008.4	0.00	537.11
24.500	0.00	0.0	1008.4	1008.4	0.00	537.11
24.600	0.00	0.0	1008.4	1008.4	0.00	537.11

POND-2 Version: 5.17 S/N:
EXECUTED: 04-26-1997 14:51:38

Return Freq: 10 years

Pond File: C:\PO165PRP\SW1 .PND
Inflow Hydrograph: C:\PO165PRP\P1-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW1-10 .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	0.00	0.0	1008.4	1008.4	0.00	537.11
24.800	0.00	0.0	1008.4	1008.4	0.00	537.11
24.900	0.00	0.0	1008.4	1008.4	0.00	537.11
25.000	0.00	0.0	1008.4	1008.4	0.00	537.11
25.100	0.00	0.0	1008.4	1008.4	0.00	537.11
25.200	0.00	0.0	1008.4	1008.4	0.00	537.11
25.300	0.00	0.0	1008.4	1008.4	0.00	537.11
25.400	0.00	0.0	1008.4	1008.4	0.00	537.11
25.500	0.00	0.0	1008.4	1008.4	0.00	537.11
25.600	0.00	0.0	1008.4	1008.4	0.00	537.11
25.700	0.00	0.0	1008.4	1008.4	0.00	537.11
25.800	0.00	0.0	1008.4	1008.4	0.00	537.11
25.900	0.00	0.0	1008.4	1008.4	0.00	537.11

SHT A20

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: C:\PO165PRP\SW1 .PND
Inflow Hydrograph: C:\PO165PRP\P1-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW1-10 .HYD

Starting Pond W.S. Elevation = 532.90 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 72.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 537.11 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.38 ac-ft
Peak Storage From Storm = 3.79 ac-ft

Total Storage in Pond = 4.17 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

PEAK ELEV 537.11 < OVERFLOW ELEV 537.7

∴ BASIN IS ACCEPTABLE

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

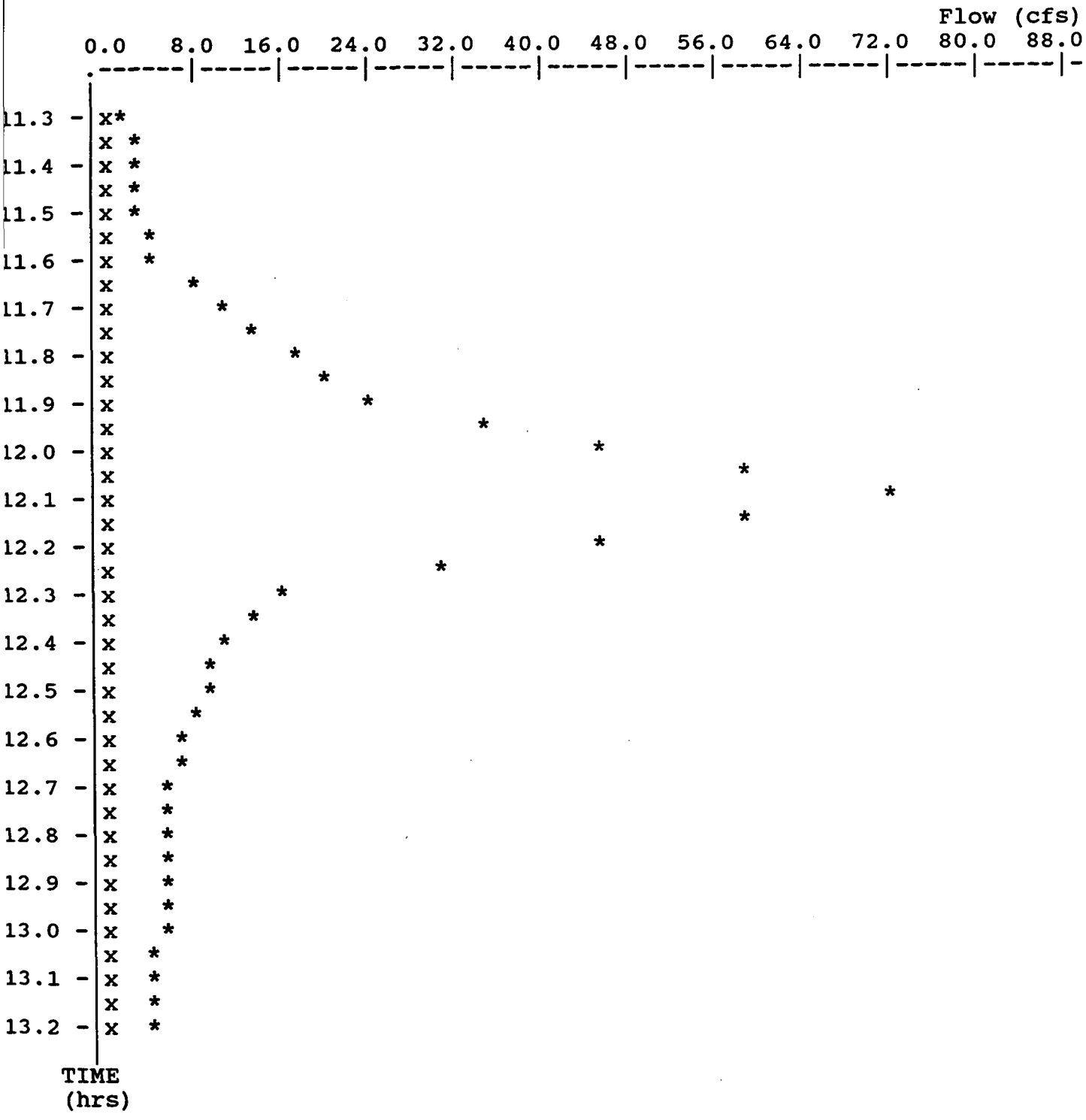
POND-2 Version: 5.17 S/N:

Return Freq: 10 years

Pond File: C:\PO165PRP\SW1 .PND
Inflow Hydrograph: C:\PO165PRP\P1-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW1-10 .HYD

EXECUTED: 04-26-1997
14:51:38

Peak Inflow = 72.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 537.11 ft



SHTA22

```
*  File:  C:\PO165PRP\P1-10    .HYD   Qmax =    72.0 cfs
x  File:  C:\PO165PRP\SW1-10   .HYD   Qmax =     0.0 cfs
```

RETENTION BASIN 2

SHT A24

Quick TR-55 Ver.5.46 S/N:
Executed: 10:55:59 05-05-1997 C:\PO165EXT\P2.TCT

RETENTION BASIN 2
EXISTING CONDITIONS

Tc COMPUTATIONS FOR: P2

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		RANGE	
Manning's roughness coeff., n		0.1300	
Flow length, L (total < or = 300)	ft	266.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0450	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.24	= 0.24

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	160.0	
Watercourse slope, s	ft/ft	0.0970	
$Avg.V = Csf * (s)^{0.5}$	ft/s	5.0251	
where: Unpaved Csf = 16.1345 Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.01	= 0.01

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	1.48	← FROM DITCH 8B CALC.
Wetted perimeter, Pw	ft	3.85	
Hydraulic radius, r = a/Pw	ft	0.384	
Channel slope, s	ft/ft	0.1000	
Manning's roughness coeff., n		0.0600	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	4.1518	
Flow length, L	ft	280	
T = L / (3600*V)	hrs	0.02	= 0.02

::

TOTAL TIME (hrs) 0.27

Quick TR-55 Ver.5.46 S/N:
Executed: 10:55:59 05-05-1997 C:\PO165EXT\P2.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN 2
EXISTING CONDITIONS

Subarea descr.	Tc or Tt	Time (hrs)
P2	Tc	0.27

SHT A26

Quick TR-55 Ver.5.46 S/N:
Executed: 14:03:30 04-29-1997

RETENTION BASIN 2, EXISTING CONDITIONS
HoA 51.0%, Gn 36.9%, HeF 6.4%,
GRAVEL ROAD 3.0%,
MaC2 2.9%

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA (C): BRUSH, FAIR	2.43	70	
HoA (C): FALLOW, BARE SOIL	1.16	91	
Gn (B): BRUSH, FAIR	1.00	56	
Gn (B): FALLOW, BARE SOIL	1.60	86	
HeF, (B): BRUSH, FAIR	0.45	56	
MaC2, (C): BRUSH, FAIR	0.19	70	
GRAVEL ROAD	0.21	91	
COMPOSITE AREA --->	7.04	74.8	(75)

::

Quick TR-55 Ver.5.46 S/N:
Executed: 14:03:30 04-29-1997

RETENTION BASIN 2, EXISTING CONDITIONS
HoA 51.0%, Gn 36.9%, HeF 6.4%,
GRAVEL ROAD 3.0%,
MaC2 2.9%

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	7.04	75

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-05-1997 10:57:59
Watershed file: --> C:\PO165EXT\P2 .MOP
Hydrograph file: --> C:\PO165EXT\P2-10.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
P2	7.04	75.0	0.30	0.00	4.10	1.74	I.16	.16

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 7.04 acres or 0.01100 sq.mi
Peak discharge = 12 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P2	0.27	0.00	0.30	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

SHT A29

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-05-1997 10:57:59
Watershed file: --> C:\PO165EXT\P2 .MOP
Hydrograph file: --> C:\PO165EXT\P2-10.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P2	12	12.2
Composite Watershed	12	12.2

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-05-1997 10:57:59
Watershed file: --> C:\PO165EXT\P2 .MOP
Hydrograph file: --> C:\PO165EXT\P2-10.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
2	0	0	1	2	4	7	12	12	9
otal (cfs)	0	0	1	2	4	7	12	12	9

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
2	6	4	3	2	2	1	1	1	1
otal (cfs)	6	4	3	2	2	1	1	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
2	1	1	1	1	1	1	0	0	0
otal (cfs)	1	1	1	1	1	1	0	0	0

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
2	0	0	0	0	0
otal (cfs)	0	0	0	0	0

SHT A31

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-05-1997 10:57:59
Watershed file: --> C:\PO165EXT\P2 .MOP
Hydrograph file: --> C:\PO165EXT\P2-10.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	0	14.8	1
11.1	0	14.9	1
11.2	0	15.0	1
11.3	0	15.1	1
11.4	0	15.2	1
11.5	1	15.3	1
11.6	1	15.4	1
11.7	1	15.5	1
11.8	2	15.6	1
11.9	2	15.7	1
12.0	4	15.8	1
12.1	7	15.9	1
12.2	12	16.0	1
12.3	12	16.1	1
12.4	9	16.2	1
12.5	6	16.3	0
12.6	4	16.4	0
12.7	3	16.5	0
12.8	2	16.6	0
12.9	2	16.7	0
13.0	2	16.8	0
13.1	1	16.9	0
13.2	1	17.0	0
13.3	1	17.1	0
13.4	1	17.2	0
13.5	1	17.3	0
13.6	1	17.4	0
13.7	1	17.5	0
13.8	1	17.6	0
13.9	1	17.7	0
14.0	1	17.8	0
14.1	1	17.9	0
14.2	1	18.0	0
14.3	1	18.1	0
14.4	1	18.2	0
14.5	1	18.3	0

SAT A32

802

14.6	1	18.4	0
14.7	1	18.5	0

SHT A33

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-05-1997 10:57:59
Watershed file: --> C:\PO165EXT\P2 .MOP
Hydrograph file: --> C:\PO165EXT\P2-10.HYD

RETENTION BASIN 2
EXISTING CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	0	22.4	0
18.7	0	22.5	0
18.8	0	22.6	0
18.9	0	22.7	0
19.0	0	22.8	0
19.1	0	22.9	0
19.2	0	23.0	0
19.3	0	23.1	0
19.4	0	23.2	0
19.5	0	23.3	0
19.6	0	23.4	0
19.7	0	23.5	0
19.8	0	23.6	0
19.9	0	23.7	0
20.0	0	23.8	0
20.1	0	23.9	0
20.2	0	24.0	0
20.3	0	24.1	0
20.4	0	24.2	0
20.5	0	24.3	0
20.6	0	24.4	0
20.7	0	24.5	0
20.8	0	24.6	0
20.9	0	24.7	0
21.0	0	24.8	0
21.1	0	24.9	0
21.2	0	25.0	0
21.3	0	25.1	0
21.4	0	25.2	0
21.5	0	25.3	0
21.6	0	25.4	0
21.7	0	25.5	0
21.8	0	25.6	0
21.9	0	25.7	0
22.0	0	25.8	0
22.1	0	25.9	0
22.2	0		
22.3	0		

400

```
Quick TR-55 Ver.5.46    S/N:
Executed: 10:43:15   05-05-1997    c:\po165prp\P2.TCT

                              RETENTION BASIN 2
                            PROPOSED CONDITIONS


                    Tc COMPUTATIONS FOR: P2

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                       1
     Surface description                        BARE
     Manning's roughness coeff., n                   0.0110
     Flow length, L (total < or = 300)    ft     250.0
     Two-yr 24-hr rainfall, P2            in     3.000
     Land slope, s                      ft/ft    0.0280
                          0.8
         .007 * (n*L)
     T = -------------                  hrs       0.04                  =  0.04
            0.5    0.4
          P2   *   s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                   2          3
     Surface (paved or unpaved)?               Unpaved    Unpaved
     Flow length, L                       ft    210.0      220.0
     Watercourse slope, s               ft/ft   0.1190     0.0100

                            0.5
     Avg.V =   Csf *   (s)              ft/s   5.5658     1.6135
     where:    Unpaved Csf = 16.1345
               Paved   Csf = 20.3282

     T = L / (3600*V)                   hrs      0.01  +    0.04    =  0.05

 CHANNEL FLOW
     Segment ID                                  N/A
     Cross Sectional Flow Area, a      sq.ft     0.00
     Wetted perimeter, Pw                 ft     0.00
     Hydraulic radius, r = a/Pw           ft    0.000
     Channel slope, s                  ft/ft    0.0000
     Manning's roughness coeff., n              0.0000

                       2/3     1/2
           1.49   *   r    *   s
     V =  --------------------          ft/s    0.0000
                      n

     Flow length, L                       ft        0

     T = L / (3600*V)                    hrs     0.00                   =  0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                            TOTAL TIME (hrs)          0.09
```

USE 0.1 hrs

SHT A35

Quick TR-55 Ver.5.46 S/N:
Executed: 10:43:15 05-05-1997 c:\po165prp\P2.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN 2
PROPOSED CONDITIONS

Subarea descr.	Tc or Tt	Time (hrs)
P2	Tc	0.09

USE 0.1 hrs

402

Quick TR-55 Ver.5.46 S/N:
Executed: 14:09:42 04-29-1997

RETENTION BASIN 2, PROPOSED CONDITIONS
HoA 49.5%, Gn 38.1%, HeF 6.6%,
GRAVEL ROAD 3.5%,
MaC2 2.3%

RUNOFF CURVE NUMBER DATA

::

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA (C): FALLOW, BARE SOIL	3.00	91	
Gn (B): FALLOW, BARE SOIL	2.31	86	
HeF, (B): FALLOW, BARE SOIL	0.40	86	
MaC2, (C): FALLOW, BARE SOIL	0.14	91	
GRAVEL ROAD	0.21	91	
COMPOSITE AREA --->	6.06	88.8	(89)

::

SHT A37

Quick TR-55 Ver.5.46 S/N:
Executed: 14:09:42 04-29-1997

RETENTION BASIN 2, PROPOSED CONDITIONS
HoA 49.5%, Gn 38.1%, HeF 6.6%,
GRAVEL ROAD 3.5%,
MaC2 2.3%

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
	6.06	89

404

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-29-1997 14:10:13
Watershed file: --> C:\PO165PRP\P2 .MOP
Hydrograph file: --> C:\PO165PRP\P2-10.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
P2	6.06	89.0	0.10	0.00	4.10	2.92	I.06	.10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 6.06 acres or 0.00947 sq.mi
Peak discharge = 28 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P2	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-29-1997 14:10:13
Watershed file: --> C:\PO165PRP\P2 .MOP
Hydrograph file: --> C:\PO165PRP\P2-10.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P2	28	12.1
Composite Watershed	28	12.1

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-29-1997 14:10:13
Watershed file: --> C:\PO165PRP\P2 .MOP
Hydrograph file: --> C:\PO165PRP\P2-10.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
P2	1	1	1	9	18	28	17	6	4
Total (cfs)	1	1	1	9	18	28	17	6	4

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
P2	3	3	2	2	2	2	1	1	1
Total (cfs)	3	3	2	2	2	2	1	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
P2	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
P2	0	0	0	0	0
Total (cfs)	0	0	0	0	0

SHT AH1

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-29-1997 14:10:13
Watershed file: --> C:\PO165PRP\P2 .MOP
Hydrograph file: --> C:\PO165PRP\P2-10.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	1	14.8	1
11.1	1	14.9	1
11.2	1	15.0	1
11.3	1	15.1	1
11.4	1	15.2	1
11.5	1	15.3	1
11.6	1	15.4	1
11.7	4	15.5	1
11.8	6	15.6	1
11.9	9	15.7	1
12.0	18	15.8	1
12.1	28	15.9	1
12.2	17	16.0	1
12.3	6	16.1	1
12.4	4	16.2	1
12.5	3	16.3	1
12.6	3	16.4	1
12.7	2	16.5	1
12.8	2	16.6	1
12.9	2	16.7	1
13.0	2	16.8	1
13.1	2	16.9	1
13.2	2	17.0	1
13.3	1	17.1	1
13.4	1	17.2	1
13.5	1	17.3	1
13.6	1	17.4	1
13.7	1	17.5	1
13.8	1	17.6	1
13.9	1	17.7	1
14.0	1	17.8	0
14.1	1	17.9	0
14.2	1	18.0	0
14.3	1	18.1	0
14.4	1	18.2	0
14.5	1	18.3	0

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14.6	1	18.4	0
14.7	1	18.5	0

SHT A43

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 04-29-1997 14:10:13
Watershed file: --> C:\PO165PRP\P2 .MOP
Hydrograph file: --> C:\PO165PRP\P2-10.HYD

RETENTION BASIN 2
PROPOSED CONDITIONS

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	0	22.4	0
18.7	0	22.5	0
18.8	0	22.6	0
18.9	0	22.7	0
19.0	0	22.8	0
19.1	0	22.9	0
19.2	0	23.0	0
19.3	0	23.1	0
19.4	0	23.2	0
19.5	0	23.3	0
19.6	0	23.4	0
19.7	0	23.5	0
19.8	0	23.6	0
19.9	0	23.7	0
20.0	0	23.8	0
20.1	0	23.9	0
20.2	0	24.0	0
20.3	0	24.1	0
20.4	0	24.2	0
20.5	0	24.3	0
20.6	0	24.4	0
20.7	0	24.5	0
20.8	0	24.6	0
20.9	0	24.7	0
21.0	0	24.8	0
21.1	0	24.9	0
21.2	0	25.0	0
21.3	0	25.1	0
21.4	0	25.2	0
21.5	0	25.3	0
21.6	0	25.4	0
21.7	0	25.5	0
21.8	0	25.6	0
21.9	0	25.7	0
22.0	0	25.8	0
22.1	0	25.9	0
22.2	0		
22.3	0		

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POND-2 Version: 5.17 S/N:

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

Inflow Hydrograph: C:\PO165EXT\P2-10 .HYD
Qpeak = 12.0 cfs

Estimated Outflow: C:\PO165EXT\ESTIMATE.EST
Qpeak = 0.0 cfs

Approximate Storage Volume
(computed from t= 11.00 to 25.90 hrs)

0.9 acre-ft

SHT A45

POND-2 Version: 5.17 S/N:

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Qpeak = 28.0 cfs

Estimated Outflow: C:\PO165PRP\ESTIMATE.EST
Qpeak = 0.0 cfs

Approximate Storage Volume
(computed from t= 11.00 to 25.90 hrs)

1.3 acre-ft

NOTE: VOLUME ESTIMATE FOR EXISTING CONDITIONS = 0.9 AC-FT (SHT A4

VOLUME ESTIMATE FOR PROPOSED CONDITIONS = 1.3 AC-FT

USE PROPOSED CONDITIONS FOR ROUTING

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POND-2 Version: 5.17
S/N:

RETENTION BASIN 2
W/3:1 SIDE SLOPES

CALCULATED 05-05-1997 11:20:06
DISK FILE: c:\po165prp\SW2-T1 .VOL

Planimeter scale: 1 inch = 10 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
528.70	0.00	0.00	0.00	0.00	0.00
529.00	23.70	0.05	0.05	0.01	0.01
530.00	39.96	0.09	0.22	0.07	0.08
531.00	59.85	0.14	0.34	0.11	0.19
532.00	79.45	0.18	0.48	0.16	0.35
533.00	100.13	0.23	0.62	0.21	0.56
534.00	121.62	0.28	0.76	0.25	0.81
535.00	146.91	0.34	0.92	0.31	1.12
536.00	178.14	0.41	1.12	0.37	1.49
537.00	190.43	0.44	1.27	0.42	1.91

Elevations With Areas Interpolated From
The Closest Two Planimeter Readings

530.30	-----	0.10	0.29	0.03	0.11
536.10	-----	0.41	1.23	0.04	1.53
536.20	-----	0.41	1.24	0.08	1.57
536.30	-----	0.42	1.24	0.12	1.61
536.40	-----	0.42	1.24	0.17	1.66
536.50	-----	0.42	1.25	0.21	1.70
536.60	-----	0.43	1.25	0.25	1.74
536.70	-----	0.43	1.26	0.29	1.78
536.80	-----	0.43	1.26	0.34	1.83
536.90	-----	0.43	1.26	0.38	1.87

* Incremental volume computed by the Conic Method for Reservoir Volumes.

SHT A47

POND-2 Version: 5.17 S/N:
EXECUTED: 04-29-1997 14:14:07

Return Freq: 10 years

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**********************
*                    *
*   RETENTION BASIN 2 *
*                    *
*                    *
*                    *
*                    *
**********************
```

Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Rating Table file: C:\PO165PRP\SW2-T1 .PND

----INITIAL CONDITIONS----
Elevation = 530.30 ft – MAX SEDIMENT CLEANOUT ELEV.
Outflow = 0.00 cfs
Storage = 0.11 ac-ft – MAX SEDIMENT STORAGE VOLUME

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
528.70	0.0	0.000
529.00	0.0	0.010
530.00	0.0	0.080
530.30	0.0	0.110
531.00	0.0	0.190
532.00	0.0	0.350
533.00	0.0	0.560
534.00	0.0	0.810
535.00	0.0	1.120
536.00	0.0	1.490
536.10	3.2	1.530
536.20	6.5	1.570
536.30	9.7	1.610
536.40	13.0	1.660
536.50	16.2	1.700
536.60	22.1	1.740
536.70	29.6	1.780
536.80	35.2	1.830
536.90	45.1	1.870
537.00	65.6	1.910

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
2.4	2.4
19.4	19.4
26.6	26.6
46.0	46.0
84.7	84.7
135.5	135.5
196.0	196.0
271.0	271.0
360.6	360.6
370.3	373.5
379.9	386.4
389.6	399.3
401.7	414.7
411.4	427.6
421.1	443.2
430.8	460.4
442.9	478.1
452.5	497.6
462.2	527.8

Time increment (t) = 0.100 hrs.

POND-2 Version: 5.17 S/N:
EXECUTED: 04-29-1997 14:14:07

Return Freq: 10 years

Pond File: C:\PO165PRP\SW2-T1 .PND
Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW2-10T .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	1.00	-----	26.6	26.6	0.00	530.30
11.100	1.00	2.0	28.6	28.6	0.00	530.37
11.200	1.00	2.0	30.6	30.6	0.00	530.44
11.300	1.00	2.0	32.6	32.6	0.00	530.52
11.400	1.00	2.0	34.6	34.6	0.00	530.59
11.500	1.00	2.0	36.6	36.6	0.00	530.66
11.600	1.00	2.0	38.6	38.6	0.00	530.73
11.700	4.00	5.0	43.6	43.6	0.00	530.91
11.800	6.00	10.0	53.6	53.6	0.00	531.20
11.900	9.00	15.0	68.6	68.6	0.00	531.58
12.000	18.00	27.0	95.6	95.6	0.00	532.21
12.100	28.00	46.0	141.6	141.6	0.00	533.10
12.200	17.00	45.0	186.6	186.6	0.00	533.84
12.300	6.00	23.0	209.6	209.6	0.00	534.18
12.400	4.00	10.0	219.6	219.6	0.00	534.31
12.500	3.00	7.0	226.6	226.6	0.00	534.41
12.600	3.00	6.0	232.6	232.6	0.00	534.49
12.700	2.00	5.0	237.6	237.6	0.00	534.55
12.800	2.00	4.0	241.6	241.6	0.00	534.61
12.900	2.00	4.0	245.6	245.6	0.00	534.66
13.000	2.00	4.0	249.6	249.6	0.00	534.71
13.100	2.00	4.0	253.6	253.6	0.00	534.77
13.200	2.00	4.0	257.6	257.6	0.00	534.82
13.300	2.00	4.0	261.6	261.6	0.00	534.87
13.400	1.00	3.0	264.6	264.6	0.00	534.91
13.500	1.00	2.0	266.6	266.6	0.00	534.94
13.600	1.00	2.0	268.6	268.6	0.00	534.97
13.700	1.00	2.0	270.6	270.6	0.00	534.99
13.800	1.00	2.0	272.6	272.6	0.00	535.02
13.900	1.00	2.0	274.6	274.6	0.00	535.04
14.000	1.00	2.0	276.6	276.6	0.00	535.06
14.100	1.00	2.0	278.6	278.6	0.00	535.08
14.200	1.00	2.0	280.6	280.6	0.00	535.11
14.300	1.00	2.0	282.6	282.6	0.00	535.13
14.400	1.00	2.0	284.6	284.6	0.00	535.15
14.500	1.00	2.0	286.6	286.6	0.00	535.17
14.600	1.00	2.0	288.6	288.6	0.00	535.20
14.700	1.00	2.0	290.6	290.6	0.00	535.22
14.800	1.00	2.0	292.6	292.6	0.00	535.24
14.900	1.00	2.0	294.6	294.6	0.00	535.26
15.000	1.00	2.0	296.6	296.6	0.00	535.29
15.100	1.00	2.0	298.6	298.6	0.00	535.31
15.200	1.00	2.0	300.6	300.6	0.00	535.33
15.300	1.00	2.0	302.6	302.6	0.00	535.35
15.400	1.00	2.0	304.6	304.6	0.00	535.38

SHT A49

POND-2 Version: 5.17 S/N:
EXECUTED: 04-29-1997 14:14:07

Return Freq: 10 years

Pond File: C:\PO165PRP\SW2-T1 .PND
Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW2-10T .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	1.00	2.0	306.6	306.6	0.00	535.40
15.600	1.00	2.0	308.6	308.6	0.00	535.42
15.700	1.00	2.0	310.6	310.6	0.00	535.44
15.800	1.00	2.0	312.6	312.6	0.00	535.46
15.900	1.00	2.0	314.6	314.6	0.00	535.49
16.000	1.00	2.0	316.6	316.6	0.00	535.51
16.100	1.00	2.0	318.6	318.6	0.00	535.53
16.200	1.00	2.0	320.6	320.6	0.00	535.55
16.300	1.00	2.0	322.6	322.6	0.00	535.58
16.400	1.00	2.0	324.6	324.6	0.00	535.60
16.500	1.00	2.0	326.6	326.6	0.00	535.62
16.600	1.00	2.0	328.6	328.6	0.00	535.64
16.700	1.00	2.0	330.6	330.6	0.00	535.67
16.800	1.00	2.0	332.6	332.6	0.00	535.69
16.900	1.00	2.0	334.6	334.6	0.00	535.71
17.000	1.00	2.0	336.6	336.6	0.00	535.73
17.100	1.00	2.0	338.6	338.6	0.00	535.75
17.200	1.00	2.0	340.6	340.6	0.00	535.78
17.300	1.00	2.0	342.6	342.6	0.00	535.80
17.400	1.00	2.0	344.6	344.6	0.00	535.82
17.500	1.00	2.0	346.6	346.6	0.00	535.84
17.600	1.00	2.0	348.6	348.6	0.00	535.87
17.700	1.00	2.0	350.6	350.6	0.00	535.89
17.800	0.00	1.0	351.6	351.6	0.00	535.90
17.900	0.00	0.0	351.6	351.6	0.00	535.90
18.000	0.00	0.0	351.6	351.6	0.00	535.90
18.100	0.00	0.0	351.6	351.6	0.00	535.90
18.200	0.00	0.0	351.6	351.6	0.00	535.90
18.300	0.00	0.0	351.6	351.6	0.00	535.90
18.400	0.00	0.0	351.6	351.6	0.00	535.90
18.500	0.00	0.0	351.6	351.6	0.00	535.90
18.600	0.00	0.0	351.6	351.6	0.00	535.90
18.700	0.00	0.0	351.6	351.6	0.00	535.90
18.800	0.00	0.0	351.6	351.6	0.00	535.90
18.900	0.00	0.0	351.6	351.6	0.00	535.90
19.000	0.00	0.0	351.6	351.6	0.00	535.90
19.100	0.00	0.0	351.6	351.6	0.00	535.90
19.200	0.00	0.0	351.6	351.6	0.00	535.90
19.300	0.00	0.0	351.6	351.6	0.00	535.90
19.400	0.00	0.0	351.6	351.6	0.00	535.90
19.500	0.00	0.0	351.6	351.6	0.00	535.90
19.600	0.00	0.0	351.6	351.6	0.00	535.90
19.700	0.00	0.0	351.6	351.6	0.00	535.90
19.800	0.00	0.0	351.6	351.6	0.00	535.90
19.900	0.00	0.0	351.6	351.6	0.00	535.90
20.000	0.00	0.0	351.6	351.6	0.00	535.90

416

POND-2 Version: 5.17 S/N:
EXECUTED: 04-29-1997 14:14:07

Return Freq: 10 years

Pond File: C:\PO165PRP\SW2-T1 .PND
Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW2-10T .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	0.00	0.0	351.6	351.6	0.00	535.90
20.200	0.00	0.0	351.6	351.6	0.00	535.90
20.300	0.00	0.0	351.6	351.6	0.00	535.90
20.400	0.00	0.0	351.6	351.6	0.00	535.90
20.500	0.00	0.0	351.6	351.6	0.00	535.90
20.600	0.00	0.0	351.6	351.6	0.00	535.90
20.700	0.00	0.0	351.6	351.6	0.00	535.90
20.800	0.00	0.0	351.6	351.6	0.00	535.90
20.900	0.00	0.0	351.6	351.6	0.00	535.90
21.000	0.00	0.0	351.6	351.6	0.00	535.90
21.100	0.00	0.0	351.6	351.6	0.00	535.90
21.200	0.00	0.0	351.6	351.6	0.00	535.90
21.300	0.00	0.0	351.6	351.6	0.00	535.90
21.400	0.00	0.0	351.6	351.6	0.00	535.90
21.500	0.00	0.0	351.6	351.6	0.00	535.90
21.600	0.00	0.0	351.6	351.6	0.00	535.90
21.700	0.00	0.0	351.6	351.6	0.00	535.90
21.800	0.00	0.0	351.6	351.6	0.00	535.90
21.900	0.00	0.0	351.6	351.6	0.00	535.90
22.000	0.00	0.0	351.6	351.6	0.00	535.90
22.100	0.00	0.0	351.6	351.6	0.00	535.90
22.200	0.00	0.0	351.6	351.6	0.00	535.90
22.300	0.00	0.0	351.6	351.6	0.00	535.90
22.400	0.00	0.0	351.6	351.6	0.00	535.90
22.500	0.00	0.0	351.6	351.6	0.00	535.90
22.600	0.00	0.0	351.6	351.6	0.00	535.90
22.700	0.00	0.0	351.6	351.6	0.00	535.90
22.800	0.00	0.0	351.6	351.6	0.00	535.90
22.900	0.00	0.0	351.6	351.6	0.00	535.90
23.000	0.00	0.0	351.6	351.6	0.00	535.90
23.100	0.00	0.0	351.6	351.6	0.00	535.90
23.200	0.00	0.0	351.6	351.6	0.00	535.90
23.300	0.00	0.0	351.6	351.6	0.00	535.90
23.400	0.00	0.0	351.6	351.6	0.00	535.90
23.500	0.00	0.0	351.6	351.6	0.00	535.90
23.600	0.00	0.0	351.6	351.6	0.00	535.90
23.700	0.00	0.0	351.6	351.6	0.00	535.90
23.800	0.00	0.0	351.6	351.6	0.00	535.90
23.900	0.00	0.0	351.6	351.6	0.00	535.90
24.000	0.00	0.0	351.6	351.6	0.00	535.90
24.100	0.00	0.0	351.6	351.6	0.00	535.90
24.200	0.00	0.0	351.6	351.6	0.00	535.90
24.300	0.00	0.0	351.6	351.6	0.00	535.90
24.400	0.00	0.0	351.6	351.6	0.00	535.90
24.500	0.00	0.0	351.6	351.6	0.00	535.90
24.600	0.00	0.0	351.6	351.6	0.00	535.90

SHT A51

POND-2 Version: 5.17 S/N:
EXECUTED: 04-29-1997 14:14:07

Return Freq: 10 years

Pond File: C:\PO165PRP\SW2-T1 .PND
Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW2-10T .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	0.00	0.0	351.6	351.6	0.00	535.90
24.800	0.00	0.0	351.6	351.6	0.00	535.90
24.900	0.00	0.0	351.6	351.6	0.00	535.90
25.000	0.00	0.0	351.6	351.6	0.00	535.90
25.100	0.00	0.0	351.6	351.6	0.00	535.90
25.200	0.00	0.0	351.6	351.6	0.00	535.90
25.300	0.00	0.0	351.6	351.6	0.00	535.90
25.400	0.00	0.0	351.6	351.6	0.00	535.90
25.500	0.00	0.0	351.6	351.6	0.00	535.90
25.600	0.00	0.0	351.6	351.6	0.00	535.90
25.700	0.00	0.0	351.6	351.6	0.00	535.90
25.800	0.00	0.0	351.6	351.6	0.00	535.90
25.900	0.00	0.0	351.6	351.6	0.00	535.90

418

POND-2 Version: 5.17 S/N:
EXECUTED: 04-29-1997 14:14:07

Return Freq: 10 years

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: C:\PO165PRP\SW2-T1 .PND
Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW2-10T .HYD

Starting Pond W.S. Elevation = 530.30 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 28.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 535.90 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.11 ac-ft
Peak Storage From Storm = 1.34 ac-ft

Total Storage in Pond = 1.45 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

PEAK ELEV 535.90 < OVERFLOW OUTLET ELEV 536.0

∴ BASIN IS ACCEPTABLE

SHT A53

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

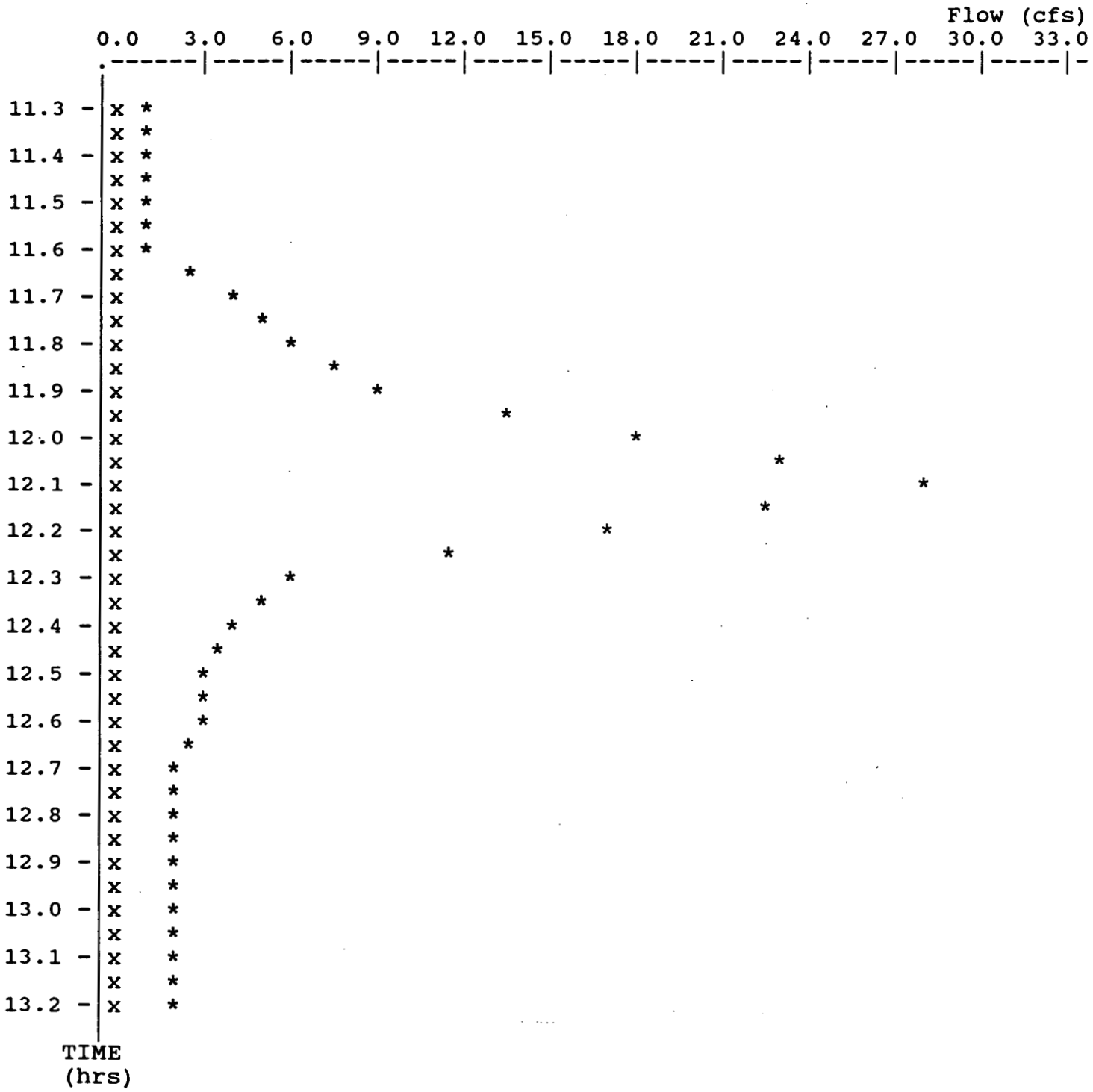
POND-2 Version: 5.17 S/N:

Return Freq: 10 years

Pond File: C:\PO165PRP\SW2-T1 .PND
Inflow Hydrograph: C:\PO165PRP\P2-10 .HYD
Outflow Hydrograph: C:\PO165PRP\SW2-10T .HYD

EXECUTED: 04-29-1997
14:14:07

Peak Inflow = 28.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 535.90 ft



SHT A54 802

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*  File:  C:\PO165PRP\P2-10    .HYD   Qmax =    28.0 cfs
x  File:  C:\PO165PRP\SW2-10T .HYD   Qmax =     0.0 cfs
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SHTAES

RETENTION BASIN 3

SHA71

POND-2 Version: 5.17 S/N:
EXECUTED: 01-15-1997 08:54:53

Return Freq: 10 years

Pond File: C:\PO165\SW3-T1 .PND
Inflow Hydrograph: C:\PO165\P3-10 .HYD
Outflow Hydrograph: C:\PO165\SW3-10T .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	0.00	0.0	257.2	257.2	0.00	539.89
24.800	0.00	0.0	257.2	257.2	0.00	539.89
24.900	0.00	0.0	257.2	257.2	0.00	539.89
25.000	0.00	0.0	257.2	257.2	0.00	539.89
25.100	0.00	0.0	257.2	257.2	0.00	539.89
25.200	0.00	0.0	257.2	257.2	0.00	539.89
25.300	0.00	0.0	257.2	257.2	0.00	539.89
25.400	0.00	0.0	257.2	257.2	0.00	539.89
25.500	0.00	0.0	257.2	257.2	0.00	539.89
25.600	0.00	0.0	257.2	257.2	0.00	539.89
25.700	0.00	0.0	257.2	257.2	0.00	539.89
25.800	0.00	0.0	257.2	257.2	0.00	539.89
25.900	0.00	0.0	257.2	257.2	0.00	539.89

POND-2 Version: 5.17 S/N:
EXECUTED: 01-15-1997 08:54:53

Return Freq: 10 years

Pond File: C:\PO165\SW3-T1 .PND
Inflow Hydrograph: C:\PO165\P3-10 .HYD
Outflow Hydrograph: C:\PO165\SW3-10T .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	0.00	0.0	257.2	257.2	0.00	539.89
20.200	0.00	0.0	257.2	257.2	0.00	539.89
20.300	0.00	0.0	257.2	257.2	0.00	539.89
20.400	0.00	0.0	257.2	257.2	0.00	539.89
20.500	0.00	0.0	257.2	257.2	0.00	539.89
20.600	0.00	0.0	257.2	257.2	0.00	539.89
20.700	0.00	0.0	257.2	257.2	0.00	539.89
20.800	0.00	0.0	257.2	257.2	0.00	539.89
20.900	0.00	0.0	257.2	257.2	0.00	539.89
21.000	0.00	0.0	257.2	257.2	0.00	539.89
21.100	0.00	0.0	257.2	257.2	0.00	539.89
21.200	0.00	0.0	257.2	257.2	0.00	539.89
21.300	0.00	0.0	257.2	257.2	0.00	539.89
21.400	0.00	0.0	257.2	257.2	0.00	539.89
21.500	0.00	0.0	257.2	257.2	0.00	539.89
21.600	0.00	0.0	257.2	257.2	0.00	539.89
21.700	0.00	0.0	257.2	257.2	0.00	539.89
21.800	0.00	0.0	257.2	257.2	0.00	539.89
21.900	0.00	0.0	257.2	257.2	0.00	539.89
22.000	0.00	0.0	257.2	257.2	0.00	539.89
22.100	0.00	0.0	257.2	257.2	0.00	539.89
22.200	0.00	0.0	257.2	257.2	0.00	539.89
22.300	0.00	0.0	257.2	257.2	0.00	539.89
22.400	0.00	0.0	257.2	257.2	0.00	539.89
22.500	0.00	0.0	257.2	257.2	0.00	539.89
22.600	0.00	0.0	257.2	257.2	0.00	539.89
22.700	0.00	0.0	257.2	257.2	0.00	539.89
22.800	0.00	0.0	257.2	257.2	0.00	539.89
22.900	0.00	0.0	257.2	257.2	0.00	539.89
23.000	0.00	0.0	257.2	257.2	0.00	539.89
23.100	0.00	0.0	257.2	257.2	0.00	539.89
23.200	0.00	0.0	257.2	257.2	0.00	539.89
23.300	0.00	0.0	257.2	257.2	0.00	539.89
23.400	0.00	0.0	257.2	257.2	0.00	539.89
23.500	0.00	0.0	257.2	257.2	0.00	539.89
23.600	0.00	0.0	257.2	257.2	0.00	539.89
23.700	0.00	0.0	257.2	257.2	0.00	539.89
23.800	0.00	0.0	257.2	257.2	0.00	539.89
23.900	0.00	0.0	257.2	257.2	0.00	539.89
24.000	0.00	0.0	257.2	257.2	0.00	539.89
24.100	0.00	0.0	257.2	257.2	0.00	539.89
24.200	0.00	0.0	257.2	257.2	0.00	539.89
24.300	0.00	0.0	257.2	257.2	0.00	539.89
24.400	0.00	0.0	257.2	257.2	0.00	539.89
24.500	0.00	0.0	257.2	257.2	0.00	539.89
24.600	0.00	0.0	257.2	257.2	0.00	539.89

SHT A69

POND-2 Version: 5.17 S/N:
EXECUTED: 01-15-1997 08:54:53

Return Freq: 10 years

Pond File: C:\PO165\SW3-T1 .PND
Inflow Hydrograph: C:\PO165\P3-10 .HYD
Outflow Hydrograph: C:\PO165\SW3-10T .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	1.00	2.0	252.2	252.2	0.00	539.81
15.600	1.00	2.0	254.2	254.2	0.00	539.84
15.700	1.00	2.0	256.2	256.2	0.00	539.87
15.800	0.00	1.0	257.2	257.2	0.00	539.89
15.900	0.00	0.0	257.2	257.2	0.00	539.89
16.000	0.00	0.0	257.2	257.2	0.00	539.89
16.100	0.00	0.0	257.2	257.2	0.00	539.89
16.200	0.00	0.0	257.2	257.2	0.00	539.89
16.300	0.00	0.0	257.2	257.2	0.00	539.89
16.400	0.00	0.0	257.2	257.2	0.00	539.89
16.500	0.00	0.0	257.2	257.2	0.00	539.89
16.600	0.00	0.0	257.2	257.2	0.00	539.89
16.700	0.00	0.0	257.2	257.2	0.00	539.89
16.800	0.00	0.0	257.2	257.2	0.00	539.89
16.900	0.00	0.0	257.2	257.2	0.00	539.89
17.000	0.00	0.0	257.2	257.2	0.00	539.89
17.100	0.00	0.0	257.2	257.2	0.00	539.89
17.200	0.00	0.0	257.2	257.2	0.00	539.89
17.300	0.00	0.0	257.2	257.2	0.00	539.89
17.400	0.00	0.0	257.2	257.2	0.00	539.89
17.500	0.00	0.0	257.2	257.2	0.00	539.89
17.600	0.00	0.0	257.2	257.2	0.00	539.89
17.700	0.00	0.0	257.2	257.2	0.00	539.89
17.800	0.00	0.0	257.2	257.2	0.00	539.89
17.900	0.00	0.0	257.2	257.2	0.00	539.89
18.000	0.00	0.0	257.2	257.2	0.00	539.89
18.100	0.00	0.0	257.2	257.2	0.00	539.89
18.200	0.00	0.0	257.2	257.2	0.00	539.89
18.300	0.00	0.0	257.2	257.2	0.00	539.89
18.400	0.00	0.0	257.2	257.2	0.00	539.89
18.500	0.00	0.0	257.2	257.2	0.00	539.89
18.600	0.00	0.0	257.2	257.2	0.00	539.89
18.700	0.00	0.0	257.2	257.2	0.00	539.89
18.800	0.00	0.0	257.2	257.2	0.00	539.89
18.900	0.00	0.0	257.2	257.2	0.00	539.89
19.000	0.00	0.0	257.2	257.2	0.00	539.89
19.100	0.00	0.0	257.2	257.2	0.00	539.89
19.200	0.00	0.0	257.2	257.2	0.00	539.89
19.300	0.00	0.0	257.2	257.2	0.00	539.89
19.400	0.00	0.0	257.2	257.2	0.00	539.89
19.500	0.00	0.0	257.2	257.2	0.00	539.89
19.600	0.00	0.0	257.2	257.2	0.00	539.89
19.700	0.00	0.0	257.2	257.2	0.00	539.89
19.800	0.00	0.0	257.2	257.2	0.00	539.89
19.900	0.00	0.0	257.2	257.2	0.00	539.89
20.000	0.00	0.0	257.2	257.2	0.00	539.89

POND-2 Version: 5.17 S/N:
EXECUTED: 01-15-1997 08:54:53

Return Freq: 10 years

Pond File: C:\PO165\SW3-T1 .PND
Inflow Hydrograph: C:\PO165\P3-10 .HYD
Outflow Hydrograph: C:\PO165\SW3-10T .HYD

INFLOW HYDROGRAPH

TIME (hrs)	INFLOW (cfs)
11.000	1.00
11.100	1.00
11.200	1.00
11.300	1.00
11.400	1.00
11.500	1.00
11.600	1.00
11.700	3.00
11.800	5.00
11.900	7.00
12.000	14.00
12.100	21.00
12.200	13.00
12.300	5.00
12.400	3.00
12.500	3.00
12.600	2.00
12.700	2.00
12.800	2.00
12.900	2.00
13.000	1.00
13.100	1.00
13.200	1.00
13.300	1.00
13.400	1.00
13.500	1.00
13.600	1.00
13.700	1.00
13.800	1.00
13.900	1.00
14.000	1.00
14.100	1.00
14.200	1.00
14.300	1.00
14.400	1.00
14.500	1.00
14.600	1.00
14.700	1.00
14.800	1.00
14.900	1.00
15.000	1.00
15.100	1.00
15.200	1.00
15.300	1.00
15.400	1.00

ROUTING COMPUTATIONS

I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
-----	24.2	24.2	0.00	534.20
2.0	26.2	26.2	0.00	534.28
2.0	28.2	28.2	0.00	534.37
2.0	30.2	30.2	0.00	534.45
2.0	32.2	32.2	0.00	534.53
2.0	34.2	34.2	0.00	534.61
2.0	36.2	36.2	0.00	534.70
4.0	40.2	40.2	0.00	534.86
8.0	48.2	48.2	0.00	535.16
12.0	60.2	60.2	0.00	535.57
21.0	81.2	81.2	0.00	536.24
35.0	116.2	116.2	0.00	537.17
34.0	150.2	150.2	0.00	537.95
18.0	168.2	168.2	0.00	538.31
8.0	176.2	176.2	0.00	538.47
6.0	182.2	182.2	0.00	538.59
5.0	187.2	187.2	0.00	538.68
4.0	191.2	191.2	0.00	538.76
4.0	195.2	195.2	0.00	538.84
4.0	199.2	199.2	0.00	538.92
3.0	202.2	202.2	0.00	538.98
2.0	204.2	204.2	0.00	539.02
2.0	206.2	206.2	0.00	539.05
2.0	208.2	208.2	0.00	539.08
2.0	210.2	210.2	0.00	539.11
2.0	212.2	212.2	0.00	539.15
2.0	214.2	214.2	0.00	539.18
2.0	216.2	216.2	0.00	539.21
2.0	218.2	218.2	0.00	539.25
2.0	220.2	220.2	0.00	539.28
2.0	222.2	222.2	0.00	539.31
2.0	224.2	224.2	0.00	539.35
2.0	226.2	226.2	0.00	539.38
2.0	228.2	228.2	0.00	539.41
2.0	230.2	230.2	0.00	539.44
2.0	232.2	232.2	0.00	539.48
2.0	234.2	234.2	0.00	539.51
2.0	236.2	236.2	0.00	539.54
2.0	238.2	238.2	0.00	539.58
2.0	240.2	240.2	0.00	539.61
2.0	242.2	242.2	0.00	539.64
2.0	244.2	244.2	0.00	539.68
2.0	246.2	246.2	0.00	539.71
2.0	248.2	248.2	0.00	539.74
2.0	250.2	250.2	0.00	539.78

SHT A67

POND-2 Version: 5.17 S/N:
EXECUTED: 01-15-1997 08:54:53

Return Freq: 10 years

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************************
*                      *
*   RETENTION BASIN 3  *
*                      *
*                      *
*                      *
*                      *
************************
```

Inflow Hydrograph: C:\PO165\P3-10 .HYD
Rating Table file: C:\PO165\SW3-T1 .PND

----INITIAL CONDITIONS----
Elevation = 534.20 ft —— MAX SEDIMENT CLEANOUT ELEV.
Outflow = 0.00 cfs
Storage = 0.10 ac-ft —— MAX SEDIMENT STORAGE

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
532.50	0.0	0.000
533.00	0.0	0.010
534.00	0.0	0.080
535.00	0.0	0.180
536.00	0.0	0.300
537.00	0.0	0.450
538.00	0.0	0.630
539.00	0.0	0.840
540.00	0.0	1.090
540.20	3.6	1.140
540.40	10.3	1.190
540.60	18.8	1.250
540.80	28.3	1.310
541.00	39.5	1.370

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
2.4	2.4
19.4	19.4
43.6	43.6
72.6	72.6
108.9	108.9
152.5	152.5
203.3	203.3
263.8	263.8
275.9	279.5
288.0	298.2
302.5	321.3
317.0	345.4
331.5	371.0

Time increment (t) = 0.100 hrs.

POND-2 Version: 5.17
S/N:

RETENTION BASIN 3
W/3:1 SIDE SLOPES
1' DEEPER

CALCULATED 01-15-1997 08:50:47
DISK FILE: C:\PO165\SW3-T1 .VOL

Planimeter scale: 1 inch = 10 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
532.50	0.00	0.00	0.00	0.00	0.00
533.00	26.52	0.06	0.06	0.01	0.01
534.00	36.29	0.08	0.22	0.07	0.08
535.00	47.04	0.11	0.29	0.10	0.18
536.00	58.73	0.13	0.36	0.12	0.30
537.00	71.40	0.16	0.45	0.15	0.45
538.00	85.08	0.20	0.54	0.18	0.63
539.00	99.71	0.23	0.64	0.21	0.84
540.00	115.31	0.26	0.74	0.25	1.09
541.00	131.90	0.30	0.85	0.28	1.37

Elevations With Areas Interpolated From
The Closest Two Planimeter Readings

540.20	-----	0.27	0.81	0.05	1.14
540.40	-----	0.28	0.82	0.11	1.19
540.60	-----	0.29	0.83	0.17	1.25
540.80	-----	0.29	0.84	0.22	1.31

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 11-25-1996 12:13:34
Watershed file: --> C:\PO165\P3 .MOP
Hydrograph file: --> C:\PO165\P3-10.HYD

RETENTION BASIN 3

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	0	22.4	0
18.7	0	22.5	0
18.8	0	22.6	0
18.9	0	22.7	0
19.0	0	22.8	0
19.1	0	22.9	0
19.2	0	23.0	0
19.3	0	23.1	0
19.4	0	23.2	0
19.5	0	23.3	0
19.6	0	23.4	0
19.7	0	23.5	0
19.8	0	23.6	0
19.9	0	23.7	0
20.0	0	23.8	0
20.1	0	23.9	0
20.2	0	24.0	0
20.3	0	24.1	0
20.4	0	24.2	0
20.5	0	24.3	0
20.6	0	24.4	0
20.7	0	24.5	0
20.8	0	24.6	0
20.9	0	24.7	0
21.0	0	24.8	0
21.1	0	24.9	0
21.2	0	25.0	0
21.3	0	25.1	0
21.4	0	25.2	0
21.5	0	25.3	0
21.6	0	25.4	0
21.7	0	25.5	0
21.8	0	25.6	0
21.9	0	25.7	0
22.0	0	25.8	0
22.1	0	25.9	0
22.2	0		
22.3	0		

14.6	1	18.4	0
14.7	1	18.5	0

SHTA63

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 11-25-1996 12:13:34
Watershed file: --> C:\PO165\P3 .MOP
Hydrograph file: --> C:\PO165\P3-10.HYD

RETENTION BASIN 3

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	1	14.8	1
11.1	1	14.9	1
11.2	1	15.0	1
11.3	1	15.1	1
11.4	1	15.2	1
11.5	1	15.3	1
11.6	1	15.4	1
11.7	3	15.5	1
11.8	5	15.6	1
11.9	7	15.7	1
12.0	14	15.8	0
12.1	21	15.9	0
12.2	13	16.0	0
12.3	5	16.1	0
12.4	3	16.2	0
12.5	3	16.3	0
12.6	2	16.4	0
12.7	2	16.5	0
12.8	2	16.6	0
12.9	1	16.7	0
13.0	1	16.8	0
13.1	1	16.9	0
13.2	1	17.0	0
13.3	1	17.1	0
13.4	1	17.2	0
13.5	1	17.3	0
13.6	1	17.4	0
13.7	1	17.5	0
13.8	1	17.6	0
13.9	1	17.7	0
14.0	1	17.8	0
14.1	1	17.9	0
14.2	1	18.0	0
14.3	1	18.1	0
14.4	1	18.2	0
14.5	1	18.3	0

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 11-25-1996 12:13:34
Watershed file: --> C:\PO165\P3 .MOP
Hydrograph file: --> C:\PO165\P3-10.HYD

RETENTION BASIN 3

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
P3	1	1	1	7	14	21	13	5	3
Total (cfs)	1	1	1	7	14	21	13	5	3

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
P3	3	2	2	2	1	1	1	1	1
Total (cfs)	3	2	2	2	1	1	1	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
P3	1	1	1	1	1	0	0	0	0
Total (cfs)	1	1	1	1	1	0	0	0	0

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
P3	0	0	0	0	0
Total (cfs)	0	0	0	0	0

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 11-25-1996 12:13:34
Watershed file: --> C:\PO165\P3 .MOP
Hydrograph file: --> C:\PO165\P3-10.HYD

RETENTION BASIN 3

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
P3	21	12.1
Composite Watershed	21	12.1

Quick TR-55 Version: 5.46 S/N:

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 11-25-1996 12:13:34
Watershed file: --> C:\PO165\P3 .MOP
Hydrograph file: --> C:\PO165\P3-10.HYD

RETENTION BASIN 3

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
P3	4.78	88.0	0.10	0.00	4.10	2.82	I.07 .10

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 4.78 acres or 0.00747 sq.mi
Peak discharge = 21 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
P3	0.10	0.00	**	**	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

SHT A59

Quick TR-55 Ver.5.46 S/N:
Executed: 16:46:05 01-20-1997

RETENTION BASIN 3
HoA 35%, MoE2 30%, Gn 15%, HeF 11.6%
GRAVEL SURFACE = 8.4%%
ASSUMED ANY VEG AREA AS BARE

RUNOFF CURVE NUMBER SUMMARY

::

Subarea Description	Area (acres)	CN (weighted)
P3	4.78	88

426

Quick TR-55 Ver.5.46 S/N:
Executed: 16:46:05 01-20-1997

RETENTION BASIN 3
HoA 35%, MoE2 30%, Gn 15%, HeF 11.6%
GRAVEL SURFACE = 8.4%%
ASSUMED ANY VEG AREA AS BARE

RUNOFF CURVE NUMBER DATA

::

Composite Area: P3

SURFACE DESCRIPTION	AREA (acres)	CN	
HoA, (C): FALLOW, BARE SOIL	1.67	91	
MoE2, (B): FALLOW, BARE SOIL	1.43	86	
Gn, (B): FALLOW, BARE SOIL	0.72	86	
HeF, (B): FALLOW, BARE SOIL	0.56	86	
GRAVEL ROAD	0.40	91	
COMPOSITE AREA --->	4.78	88.2	(88)

::

Quick TR-55 Ver.5.46 S/N:
Executed: 12:09:06 11-25-1996 c:\po165\P3.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

RETENTION BASIN 3

Subarea descr.	Tc or Tt	Time (hrs)
P3	Tc	0.03

USE 0.1 hrs

Quick TR-55 Ver.5.46 S/N:
Executed: 12:09:06 11-25-1996 c:\po165\P3.TCT

RETENTION BASIN 3

Tc COMPUTATIONS FOR: P3

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		BARE SOIL	
Manning's roughness coeff., n		0.0110	
Flow length, L (total < or = 300)	ft	222.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0810	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.02	= 0.02

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	145.0	
Watercourse slope, s	ft/ft	0.0760	
$Avg.V = Csf * (s)^{0.5}$	ft/s	4.4480	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.01	= 0.01

CHANNEL FLOW

Segment ID		N/A	
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.03

USE 0.1 hrs

POND-2 Version: 5.17 S/N:
EXECUTED: 01-15-1997 08:54:53

Return Freq: 10 years

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: C:\PO165\SW3-T1 .PND
Inflow Hydrograph: C:\PO165\P3-10 .HYD
Outflow Hydrograph: C:\PO165\SW3-10T .HYD

Starting Pond W.S. Elevation = 534.20 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow = 21.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 539.89 ft

***** Summary of Approximate Peak Storage *****

Initial Storage = 0.10 ac-ft
Peak Storage From Storm = 0.96 ac-ft

Total Storage in Pond = 1.06 ac-ft

Warning: Inflow hydrograph truncated on left side.

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

PEAK ELEV = 539.89 < OVERFLOW OUTLET ELEV 540.0 ∴

BASIN IS ACCEPTABLE

SHT A73

>>>>>> Warning, peak outflow = last ordinate point. <<<<<<

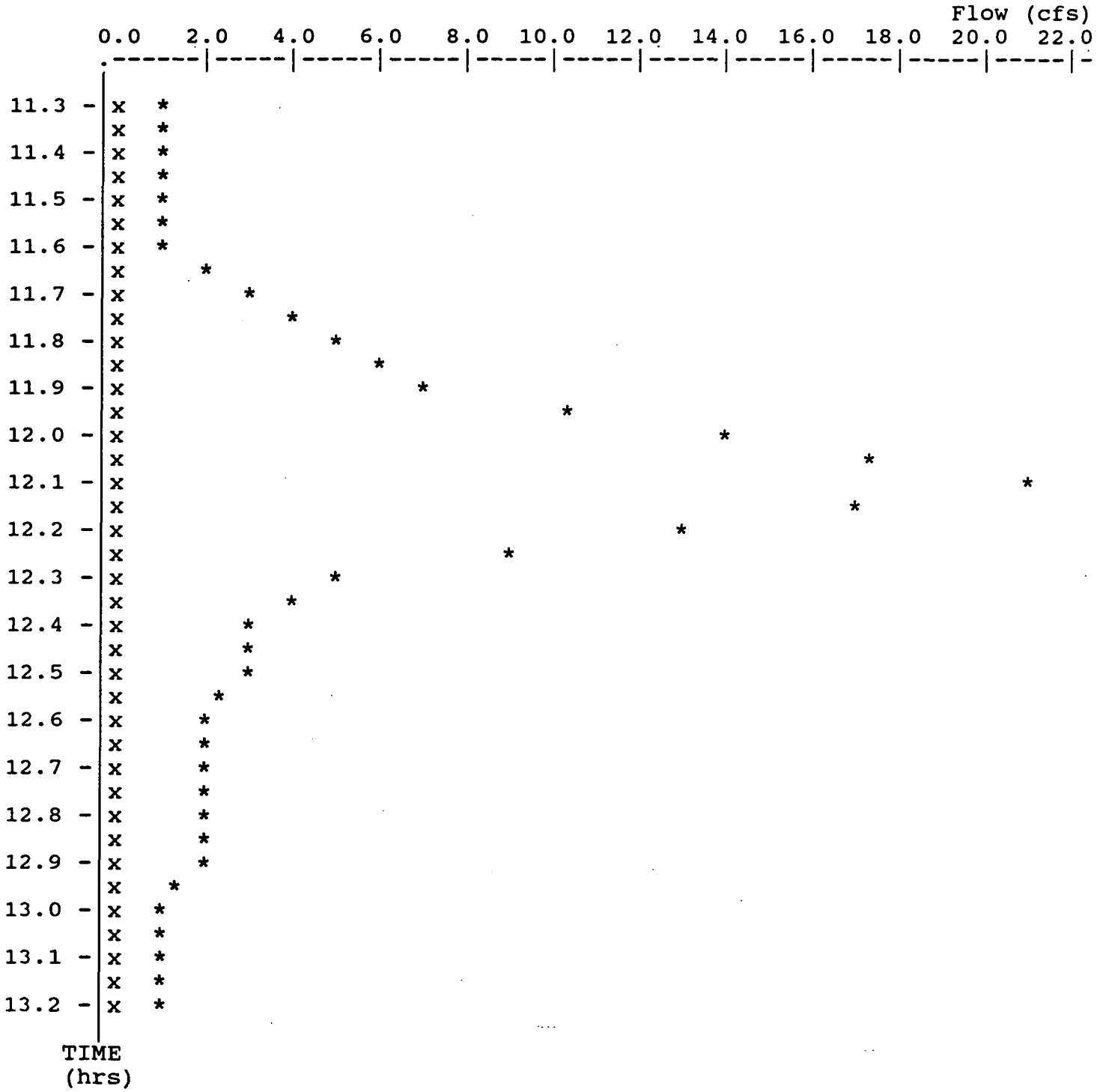
POND-2 Version: 5.17 S/N:

Return Freq: 10 years

Pond File: C:\PO165\SW3-T1 .PND
Inflow Hydrograph: C:\PO165\P3-10 .HYD
Outflow Hydrograph: C:\PO165\SW3-10T .HYD

EXECUTED: 01-15-1997
08:54:53

Peak Inflow = 21.00 cfs
Peak Outflow = 0.00 cfs
Peak Elevation = 539.89 ft



440

```
*  File:  C:\PO165\P3-10    .HYD   Qmax =    21.0 cfs
x  File:  C:\PO165\SW3-10T .HYD   Qmax =     0.0 cfs
```

ATTACHMENT B, DITCHES

Methodology

This calculation is performed using the "worst case" scenario for peak flows. Each ditch was evaluated under existing conditions (after construction of ditches and basins, but before remediation activities begin), and proposed conditions (after remediation activities have been completed).

The Modified Rational Method (Reference 2) was used to determine peak flows for the 10 year frequency storm event. After drainage areas (existing and proposed) were calculated for each ditch, a weighted runoff coefficient (C) was determined based on land use area and type. A rainfall intensity was selected based on the shortest duration (duration = 10 min for all ditches except ditch 12) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

Ditch 12 has a large, relatively flat drainage area (see last assumption on this page). SCS procedures were used to find the time of concentration (duration) for the ditch 12 drainage area. The rainfall intensity was selected based on the time of concentration (duration) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

With the peak flows known for both existing and proposed conditions, the highest peak flow was selected for design. Ditches were designed based on the uniform flow theory using Manning's equation. In most cases ditch slopes varied. In one instance the bottom width varied. In order to evaluate ditch design and performance of ditch lining, the worst case flow conditions for velocity and flow depth were considered for the three types of ditch lining (i.e. erosion control blanket, dumped rock fill, or exposed geomembrane liner). The Flow Master computer program was used to evaluate the effects of the varying components on the performance of the ditch (Reference 4).

Ditch sections 2A and 2B, and ditch sections 2C and 2D are all the same ditch. Ditch sections 2A and 2B will be constructed to accommodate existing conditions. The section of ditch labeled 2A has channel slopes of approximately 10% and will be lined with riprap (dumped rock fill). The section of ditch labeled 2B has flat channel slopes (approx. 0.8%), and will be lined with erosion control blanket.

Ditch section 2C under proposed condtiions is the same section as 2A under existing conditions. Since ditch section 2C under proposed conditions has less flow than section 2A under existing condtiions, section 2C will not be modified.

Ditch section 2D will replace ditch section 2B during grading activities. This ditch section will have a flat channel slope (approx 0.7%) with a varying left-side slope.

Ditch 12 will be designed assuming that an existing culvert located east of the drainage area (see Proposed Conditions, Sheet 2 of 2 drainage area map) becomes clogged and forces additional water into the normal drainage area for Ditch 12.

Ditches 13 & 14 and the existing 24" culvert at the wheel wash area were originally designed under Calculation No. 15-02, PO158 (Haul Road Upgrade Project). These ditches were relocated eastward to accommodate construction of the Wheel Wash Facility. The total drainage area or land use did not change. Therefore, the design geometry proposed for these ditches under PO158 will be used on this project. New calculations are not provided.

Two types of ditch lining were evaluated for most ditches; vegetated using erosion control blankets, and dumped rock fill. Ditches 2B, 3-7, and 9 will have an exposed geomembrane liner. Roughness coefficients for the erosion control blanket and dumped rock fill were selected from Reference 7, and are as follows:

Erosion Control Blankets $n = 0.04$
Riprap $n = 0.06$

Maximum flow velocity for using erosion control blankets as a lining material was established at 4.0 feet per second (Reference 7).

Roughness coefficient for the exposed geomembrane liner was derived from values typically used for polyethylene pipe:

Geomembrane liner $n = 0.009$

Calculations are included on the following pages.

SHT B3

TABLE 1

DRAINAGE AREA AND PEAK FLOW SUMMARY

DITCH	EXISTING CONDITIONS		PROPOSED CONDITIONS	
	DRAINAGE AREA (AC)	FLOW (CFS)	DRAINAGE AREA (AC)	FLOW (CFS)
DITCH - 1	1.57	3.88	0.54	2.18
DITCH - 2A	3.45	8.18	N/A	N/A
DITCH - 2B	3.45	8.18	N/A	N/A
DITCH - 2C	N/A	N/A	1.82	6.09
DITCH - 2D	N/A	N/A	3.54	12.65
DITCH - 3	8.40	19.31	6.63	25.33
DITCH - 4	0.69	2.67	0.69	2.67
DITCH - 5	0.62	2.37	0.62	2.37
DITCH - 6	0.47	1.79	0.47	1.79
DITCH - 7	1.76	5.90	2.04	7.87
DITCH - 8A	1.80	5.88	1.45	5.56
DITCH - 8B	3.21	9.21	1.82	7.02
DITCH - 9	3.31	11.50	3.42	13.22
DITCH - 10 (A & B)	0.41	1.34	0.27	0.88
DITCH - 11	1.17	4.28	0.85	3.24
DITCH - 12	7.52	8.91	7.52	8.91
DITCH - 13	DESIGNED UNDER PO158, HAUL ROAD UPGRADE			
DITCH - 14	DESIGNED UNDER PO158, HAUL ROAD UPGRADE			
DITCH - 15	0.20	1.0	0.2	1.0

Quick TR-55 Ver.5.46 S/N:
Executed: 15:18:48 10-27-1996

DITCH-1
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	1.46						
GRAVEL RD	0.900	0.11						
			10.00	0.454	0.454	5.450	1.57	3.88

SHT B5

Quick TR-55 Ver.5.46 S/N:
Executed: 14:50:44 10-27-1996

DITCH-1
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE, S>4:1	0.700	0.43						
GRAVEL RD	0.900	0.11						
			10.00	0.741	0.741	5.450	0.54	2.18

446

Quick TR-55 Ver.5.46 S/N:
Executed: 06:37:27 02-04-1997

DITCH-2A
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	3.34						
GRAVEL ROAD	0.900	0.11						
			10.00	0.435	0.435	5.450	3.45	8.18

SHT B7

Quick TR-55 Ver.5.46 S/N:
Executed: 06:38:22 02-04-1997

DITCH-2B
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	3.34						
GRAVEL ROAD	0.900	0.11						
			10.00	0.435	0.435	5.450	3.45	8.18

448

Quick TR-55 Ver.5.46 S/N:
Executed: 06:43:08 02-04-1997

DITCH-2C
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE, >4:1	0.700	0.82						
WOODED, FAIR	0.500	0.89						
GRAVEL ROAD	0.900	0.11						
			10.00	0.614	0.614	5.450	1.82	6.09

SHT B9

Quick TR-55 Ver.5.46 S/N:
Executed: 06:43:50 02-04-1997

DITCH-2D
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE, >4:1	0.700	2.54						
WOODED, FAIR	0.500	0.89						
GRAVEL ROAD	0.900	0.11						
			10.00	0.656	0.656	5.450	3.54	12.65

450

Quick TR-55 Ver.5.46 S/N:
Executed: 15:56:04 10-27-1996

DITCH-3
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. S>4:1	0.420	8.37						
GRAVEL ROAD	0.900	0.03						
			10.00	0.422	0.422	5.450	8.40	19.31

SHT B11

Quick TR-55 Ver.5.46 S/N:
Executed: 15:00:44 01-22-1997

DITCH-3
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	6.60						
GRAVEL ROAD	0.900	0.03						
			10.00	0.701	0.701	5.450	6.63	25.33

Quick TR-55 Ver.5.46 S/N:
Executed: 15:07:33 04-26-1997

DITCH-4
DRAINAGE AREA P1
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.66						
GRAVEL ROAD	0.900	0.03						
			10.00	0.709	0.709	5.450	0.69	2.67

SHT B13

Quick TR-55 Ver.5.46 S/N:
Executed: 15:06:30 04-26-1997

DITCH-4
DRAINAGE AREA P1
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.66						
GRAVEL ROAD	0.900	0.03						
			10.00	0.709	0.709	5.450	0.69	2.67

Quick TR-55 Ver.5.46 S/N:
Executed: 14:15:21 04-28-1997

DITCH-5
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.62						
			10.00	0.700	0.700	5.450	0.62	2.37

SHT B15

Quick TR-55 Ver.5.46 S/N:
Executed: 14:16:50 04-28-1997

DITCH-5
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.62						
			10.00	0.700	0.700	5.450	0.62	2.37

456

Quick TR-55 Ver.5.46 S/N:
Executed: 14:18:30 04-28-1997

DITCH-6
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.47						
			10.00	0.700	0.700	5.450	0.47	1.79

SHT B17

Quick TR-55 Ver.5.46 S/N:
Executed: 14:19:02 04-28-1997

DITCH-6
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.47						
			10.00	0.700	0.700	5.450	0.47	1.79

458

Quick TR-55 Ver.5.46 S/N:
Executed: 16:06:06 04-29-1997

DITCH-7
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG. FAIR	0.420	0.59						
BARE,>4:1	0.700	1.09						
GRAVEL RD	0.900	0.08						
			10.00	0.615	0.615	5.450	1.76	5.90

SHT B19

Quick TR-55 Ver.5.46 S/N:
Executed: 07:34:14 04-29-1997

DITCH-7
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	1.96						
GRAVEL RD	0.900	0.08						
			10.00	0.708	0.708	5.450	2.04	7.87

460

SHT B20

Quick TR-55 Ver.5.46 S/N:
Executed: 10:46:30 04-30-1997

DITCH-8A
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.10						
VEG, FAIR	0.420	0.67						
GRAVEL RD	0.900	0.03						
			10.00	0.599	0.599	5.450	1.80	5.88

SHT B21

Quick TR-55 Ver.5.46 S/N:
Executed: 14:47:00 04-29-1997

DITCH-8A
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.42						
GRAVEL RD	0.900	0.03						
			10.00	0.704	0.704	5.450	1.45	5.56

462

Quick TR-55 Ver.5.46 S/N:
Executed: 10:46:56 04-30-1997

DITCH-8B
DRAINAGE AREA P2
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.10						
VEG, FAIR	0.420	2.04						
GRAVEL RD	0.900	0.07						
			10.00	0.526	0.526	5.450	3.21	9.21

SHT B23

Quick TR-55 Ver.5.46 S/N:
Executed: 14:48:13 04-29-1997

DITCH-8B
DRAINAGE AREA P2
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE	0.700	1.75						
GRAVEL RD	0.900	0.07						
			10.00	0.708	0.708	5.450	1.82	7.02

464

Quick TR-55 Ver.5.46 S/N:
Executed: 16:47:01 01-20-1997

DITCH-9
DRAINAGE AREA P3
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	2.63						
BARE	0.700	0.40						
GRAVEL RD	0.900	0.28						
			10.00	0.637	0.637	5.450	3.31	11.50

SHT B25

Quick TR-55 Ver.5.46 S/N:
Executed: 16:47:37 01-20-1997

DITCH-9
DRAINAGE AREA P3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	2.89						
GRAVEL RD	0.900	0.28						
VEG, POOR	0.600	0.25						
			10.00	0.709	0.709	5.450	3.42	13.22

466

Quick TR-55 Ver.5.46 S/N:
Executed: 09:27:01 11-24-1996

DITCH-10 (10A AND 10B)
DRAINAGE AREA P3
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.41						
			10.00	0.600	0.600	5.450	0.41	1.34

SHT 827

Quick TR-55 Ver.5.46 S/N:
Executed: 09:27:45 11-24-1996

DITCH-10 (10A AND 10B)
DRAINAGE AREA P3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.27						
			10.00	0.600	0.600	5.450	0.27	0.88

468

Quick TR-55 Ver.5.46 S/N:
Executed: 16:49:52 01-20-1997

DITCH-11
DRAINAGE AREA P3
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.89						
GRAVEL	0.900	0.28						
			10.00	0.672	0.672	5.450	1.17	4.28

SHT B29

Quick TR-55 Ver.5.46 S/N:
Executed: 16:49:22 01-20-1997

DITCH-11
DRAINAGE AREA P3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.57						
GRAVEL	0.900	0.28						
			10.00	0.699	0.699	5.450	0.85	3.24

470

Quick TR-55 Ver.5.46 S/N:
Executed: 14:03:23 02-04-1997

DITCH-12
EXISTING/PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
WOODS	0.300	6.32						
VEG, FAIR	0.420	1.00						
GRAVEL ROAD	0.900	0.20						
			20.40	0.332	0.332	3.570	7.52	8.91

```
Quick TR-55 Ver.5.46   S/N:
Executed: 14:02:25   02-04-1997    c:\po165d\D12P.TCT

                              DITCH 12


                  Tc COMPUTATIONS FOR: DITCH 12

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                   1
     Surface description                   WOODS, LT
     Manning's roughness coeff., n              0.4000
     Flow length, L (total < or = 300)    ft     122.0
     Two-yr 24-hr rainfall, P2            in     3.000
     Land slope, s                       ft/ft   0.0500
                          0.8
          .007 * (n*L)
     T = --------------                  hrs      0.30         =  0.30
             0.5    0.4
          P2    *   s

 SHALLOW CONCENTRATED FLOW
     Segment ID
     Surface (paved or unpaved)?
     Flow length, L                       ft       0.0
     Watercourse slope, s                ft/ft   0.0000

                            0.5
     Avg.V =   Csf *   (s)                ft/s   0.0000
     where:    Unpaved Csf = 16.1345
               Paved   Csf = 20.3282

     T = L / (3600*V)                     hrs      0.00         =  0.00


 CHANNEL FLOW
     Segment ID                                   2
     Cross Sectional Flow Area, a       sq.ft     7.50
     Wetted perimeter, Pw                 ft      8.71
     Hydraulic radius, r = a/Pw           ft     0.861
     Channel slope, s                    ft/ft   0.0130
     Manning's roughness coeff., n               0.0400

                         2/3    1/2
          1.49   *   r    *   s
     V = --------------------             ft/s   3.8441
                     n

     Flow length, L                       ft       485

     T = L / (3600*V)                     hrs      0.04         =  0.04

   :::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                         TOTAL TIME (hrs)        0.34
```

Quick TR-55 Ver.5.46 S/N:
Executed: 14:02:25 02-04-1997 c:\po165d\D12P.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

DITCH 12

Subarea descr.	Tc or Tt	Time (hrs)
DITCH 12	Tc	0.34

SHT B33

TIME OF CONCENTRATION, DITCH 12
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	TIME OF CONC., DITCH 12
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.013000	ft/ft
Depth	1.50	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft

Results		
Discharge	28.76	cfs
Flow Area	7.50	ft^2
Wetted Perimeter	8.71	ft
Top Width	8.00	ft
Critical Depth	1.25	ft
Critical Slope	0.027917	ft/ft
Velocity	3.83	ft/s
Velocity Head	0.23	ft
Specific Energy	1.73	ft
Froude Number	0.70	
Flow is subcritical.		

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SHT B34

DITCHES 13 & 14 DESIGNED UNDER PO158, HAUL ROAD UPGRADE PROJECT

SHT B35

Quick TR-55 Ver.5.46 S/N:
Executed: 09:39:59 06-10-1997

DITCH 15
EXISTING AND PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
GRAVEL	0.900	0.20						
			10.00	0.900	0.900	5.450	0.20	0.98

476

TABLE 2

SUMMARY OF DITCH PERFORMANCE

DITCH	Q (CFS)	SLOPE (%)		VELOCITY (FPS)		FLOW DEPTH (FT)		COMMENTS
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
DITCH - 1	3.88	0.5	3.6	1.6	3.4	0.8	1.1	EROSION CONTROL BLANKET
DITCH - 2A	8.18	10.0	10.0	4.5	4.5	1.0	1.0	DUMPED ROCK FILL
DITCH - 2B	8.18	0.8	0.8	7.2	7.2	0.8	0.8	GEOMEMBRANE LINER
DITCH - 2C	6.09 CFS < 8.18 CFS UNDER EXISTING CONDITIONS, USE SAME AS D-2B							
DITCH - 2D	12.65	0.7	0.7	1.3	2.3	0.6	1.4	EROSION CONTROL BLANKET
DITCH - 3	25.33	0.7	0.7	7.0	8.1	0.4	0.6	GEOMEMBRANE LINER
DITCH - 4	2.67	0.9	0.9	4.9	4.9	0.2	0.2	GEOMEMBRANE LINER
DITCH - 5	2.37	1.5	1.5	5.7	5.7	0.2	0.2	GEOMEMBRANE LINER
DITCH - 6	1.79	1.4	1.4	5.1	5.1	0.2	0.2	GEOMEMBRANE LINER
DITCH - 7	7.87	1.1	2.9	7.5	10.4	0.3	• D_n = 0.4 • D_w = 1.6	GEOMEMBRANE LINER
DITCH - 8A	5.88	0.8	0.8	2.2	2.2	1.2	1.2	EROSION CONTROL BLANKET
DITCH - 8B	9.21	10.0	10.0	4.6	4.6	1.0	1.0	DUMPED ROCK FILL
DITCH - 9	13.22	1.1	6.7	7.8	14.1	0.2	• D_n = 0.4 • D_w = 1.7	GEOMEMBRANE LINER
DITCH - 10A	1.34	4.3	4.3	2.8	2.8	0.5	0.5	EROSION CONTROL BLANKET
DITCH - 10B	1.34	20.0	20.0	3.7	3.7	0.4	0.4	DUMPED ROCK FILL
DITCH - 11	4.28	2.6	4.0	3.1	3.6	0.8	0.8	EROSION CONTROL BLANKET
DITCH - 12	8.91	0.8	1.8	2.4	3.1	0.8	1.0	EROSION CONTROL BLANKET
DITCH - 13	DITCH DESIGNED UNDER P0158, HAUL ROAD UPGRADE							EROSION CONTROL BLANKET
DITCH - 14	DITCH DESIGNED UNDER P0158, HAUL ROAD UPGRADE							EROSION CONTROL BLANKET
DITCH - 15	1.0	2.5	3.0	2.1	2.3	0.5	0.5	EROSION CONTROL BLANKET

• D_n = Normal flow depth • D_w = Flow depth upstream of velocity check

SHT B36 8 02

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SHT B37

DITCH-1 (D1)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-1 (D1)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.005000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	3.88	cfs

Results		
Depth	1.09	ft
Flow Area	2.38	ft²
Wetted Perimeter	4.88	ft
Top Width	4.37	ft
Critical Depth	0.75	ft
Critical Slope	0.037554	ft/ft
Velocity	1.63	ft/s
Velocity Head	0.04	ft
Specific Energy	1.13	ft
Froude Number	0.39	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 on slopes from 0.5% to 3.6% (See Rating Table).

Use Erosion Control Blanket for channel lining

DITCH-1 (D1)
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-1 (D1)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	3.88 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020
Channel Slope	0.005000	0.036000	0.031000 ft/ft

Rating Table

Channel Slope (ft/ft)	Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.005000	0.040	1.09	1.63
0.005000	0.060	1.27	1.20
0.036000	0.040	0.75	3.41
0.036000	0.060	0.88	2.52

SHT B39

DITCH 2A, EXISTING CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2A, EXISTING CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	8.18	cfs

Results		
Depth	0.82	ft
Flow Area	1.36	ft^2
Wetted Perimeter	3.68	ft
Top Width	3.29	ft
Critical Depth	1.01	ft
Critical Slope	0.033997	ft/ft
Velocity	6.03	ft/s
Velocity Head	0.57	ft
Specific Energy	1.39	ft
Froude Number	1.66	
Flow is supercritical.		

Notes:

Velocity > 4.0 fps for n = 0.04, Not acceptable

Use Riprap for channel lining on steep section

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DITCH 2A, EXISTING CONDITIONS
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2A, EXISTING CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.100000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	8.18 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.82	6.03
0.060	0.96	4.45

SHT B41

DITCH 2B, EXISTING CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2B, EXISTING CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	8.18	cfs

Results		
Depth	0.76	ft
Flow Area	1.14	ft^2
Wetted Perimeter	3.38	ft
Top Width	3.02	ft
Critical Depth	1.01	ft
Critical Slope	0.001721	ft/ft
Velocity	7.16	ft/s
Velocity Head	0.80	ft
Specific Energy	1.55	ft
Froude Number	2.05	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 8.2 fps: OK

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DITCH 2C, PROPOSED CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2C PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	8.18	cfs

Results		
Depth	0.82	ft
Flow Area	1.36	ft^2
Wetted Perimeter	3.68	ft
Top Width	3.29	ft
Critical Depth	1.01	ft
Critical Slope	0.033997	ft/ft
Velocity	6.03	ft/s
Velocity Head	0.57	ft
Specific Energy	1.39	ft
Froude Number	1.66	
Flow is supercritical.		

Notes:

This is same ditch with same discharge as ditch 2A under existing conditions.

SHT B43

DITCH 2C, PROPOSED CONDITIONS
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2C PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.100000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	8.18 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.82	6.03
0.060	0.96	4.45

DITCH 2D, PROPOSED CONDITIONS
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D, PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.007000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	12.70	cfs

Results		
Depth	1.35	ft
Flow Area	5.51	ft^2
Wetted Perimeter	8.62	ft
Top Width	8.13	ft
Critical Depth	1.02	ft
Critical Slope	0.031514	ft/ft
Velocity	2.31	ft/s
Velocity Head	0.08	ft
Specific Energy	1.44	ft
Froude Number	0.49	
Flow is subcritical.		

Notes:

DITCH 2D WITH VARYING LEFT SIDE SLOPE.

TWO CRITERIA FOR ACCEPTANCE:
1.COMPARE LEFT SIDE SLOPE WITH FLOW DEPTH TO ENSURE FREEBOARD,
2. COMPARE VELOCITY TO ENSURE THAT
V < 4.0 FPS FOR EROSION CONTROL BLANKET.

OK FOR BOTH

DITCH 2D, PROPOSED CONDITIONS
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D, PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Mannings Coefficient	0.040
Channel Slope	0.007000 ft/ft
Right Side Slope	2.000000 H : V
Discharge	12.70 cfs

Input Data			
	Minimum	Maximum	Increment
Left Side Slope	4.000000	60.000000	2.000000 H : V

Rating Table

Left Side Slope (H : V)	Depth (ft)	Velocity (ft/s)
4.000000	1.35	2.31
6.000000	1.21	2.17
8.000000	1.11	2.06
10.000000	1.04	1.97
12.000000	0.98	1.90
14.000000	0.93	1.84
16.000000	0.89	1.79
18.000000	0.85	1.75
20.000000	0.82	1.71
22.000000	0.80	1.67
24.000000	0.77	1.64
26.000000	0.75	1.61
28.000000	0.73	1.58
30.000000	0.71	1.56
32.000000	0.70	1.53
34.000000	0.68	1.51
36.000000	0.67	1.49
38.000000	0.66	1.47
40.000000	0.64	1.46
42.000000	0.63	1.44
44.000000	0.62	1.42
46.000000	0.61	1.41
48.000000	0.60	1.39

SHT B46

DITCH 2D, PROPOSED CONDITIONS
Rating Table for Triangular Channel

Rating Table		
Left Side Slope (H : V)	Depth (ft)	Velocity (ft/s)
50.000000	0.59	1.38
52.000000	0.59	1.37
54.000000	0.58	1.36
56.000000	0.57	1.34
58.000000	0.56	1.33
60.000000	0.56	1.32

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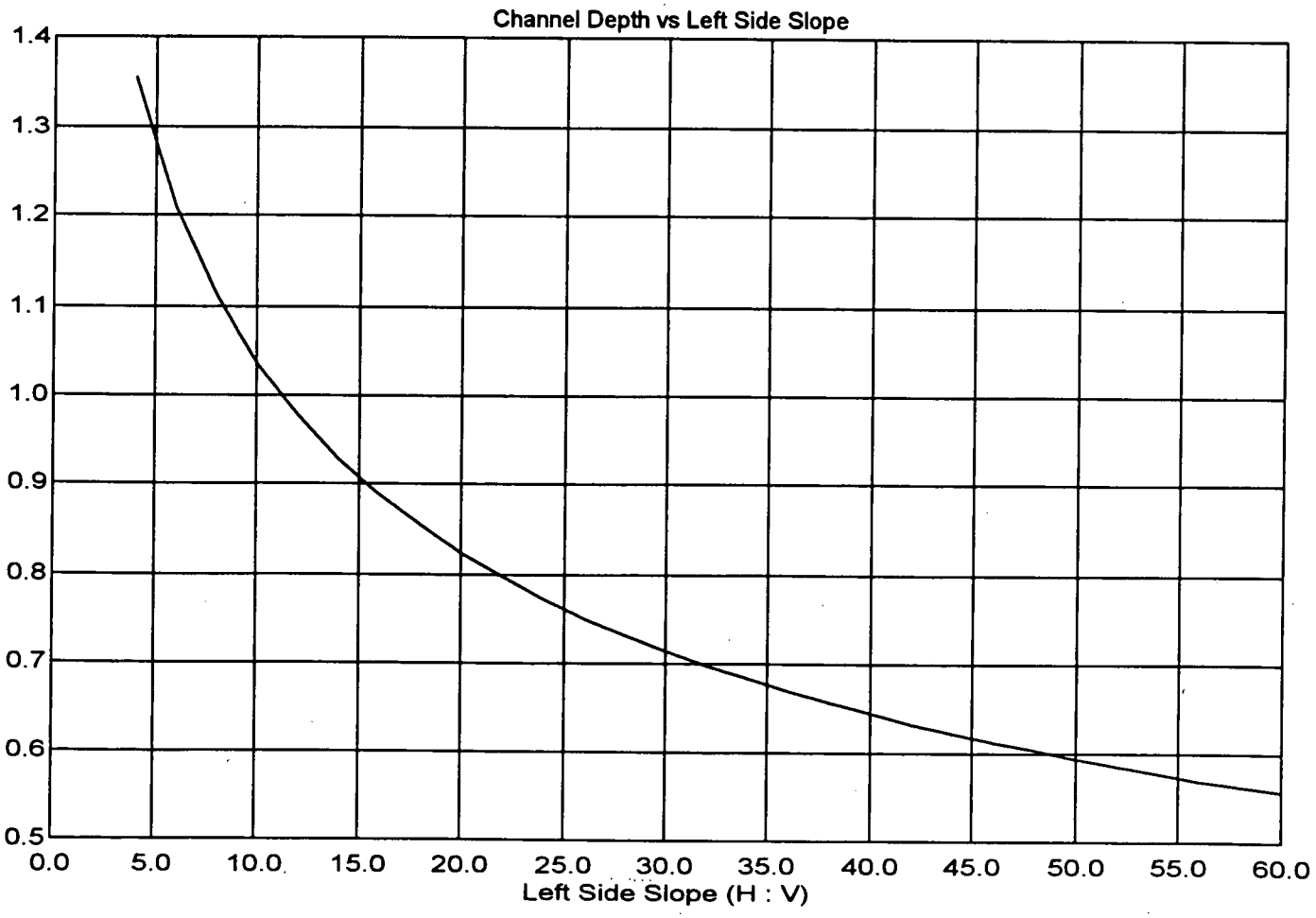
DITCH 2D, PROPOSED CONDITIONS
Plotted Curves for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 2D, PROPOSED CONDITIONS
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Channel Slope	0.007000 ft/ft	
Right Side Slope	2.000000 H : V	
Discharge	12.70	cfs

Input Data			
	Minimum	Maximum	Increment
Left Side Slope	4.000000	60.000000	2.000000 H : V



SHT B46

DITCH-3 (D3)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-3 (D3)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.006700	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	25.33	cfs

Results		
Depth	0.60	ft
Flow Area	3.12	ft^2
Wetted Perimeter	6.68	ft
Top Width	6.40	ft
Critical Depth	0.92	ft
Critical Slope	0.001432	ft/ft
Velocity	8.13	ft/s
Velocity Head	1.03	ft
Specific Energy	1.63	ft
Froude Number	2.05	
Flow is supercritical.		

Notes:

NOTE: 4' WIDE DITCH SECTION DOES NOT GET TOTAL "Q"

GEOMEMBRANE LINER

V = 8.1 fps: OK

4.89

SHT B49

802

DITCH-3 (D3)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-3 (D3)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Mannings Coefficient	0.009
Channel Slope	0.006700 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	25.33 cfs

Input Data	Minimum	Maximum	Increment
Bottom Width	4.00	8.00	4.00 ft

Rating Table		
Bottom Width (ft)	Depth (ft)	Velocity (ft/s)
4.00	0.60	8.13
8.00	0.41	6.96

SHT B50

DITCH-4 (D4)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-4 (D4)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.008600	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	2.67	cfs

Results		
Depth	0.22	ft
Flow Area	0.54	ft^2
Wetted Perimeter	2.99	ft
Top Width	2.89	ft
Critical Depth	0.34	ft
Critical Slope	0.001943	ft/ft
Velocity	4.91	ft/s
Velocity Head	0.37	ft
Specific Energy	0.60	ft
Froude Number	2.00	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 4.91 fps: OK

491

SHT B51

802

DITCH-5 (D5)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-5 (D5)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.015000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	2.37	cfs

Results		
Depth	0.18	ft
Flow Area	0.42	ft^2
Wetted Perimeter	2.79	ft
Top Width	2.71	ft
Critical Depth	0.32	ft
Critical Slope	0.001977	ft/ft
Velocity	5.69	ft/s
Velocity Head	0.50	ft
Specific Energy	0.68	ft
Froude Number	2.56	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 5.7 fps: OK

SHT B52

DITCH-6 (D6)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-6 (D6)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.014000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	1.79	cfs

Results		
Depth	0.15	ft
Flow Area	0.35	ft^2
Wetted Perimeter	2.69	ft
Top Width	2.61	ft
Critical Depth	0.27	ft
Critical Slope	0.002064	ft/ft
Velocity	5.06	ft/s
Velocity Head	0.40	ft
Specific Energy	0.55	ft
Froude Number	2.42	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

V = 5.1 fps: OK

493

DITCH-7 (D7)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-7 (D7)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.011000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	7.87	cfs

Results		
Depth	0.38	ft
Flow Area	1.05	ft^2
Wetted Perimeter	3.70	ft
Top Width	3.52	ft
Critical Depth	0.63	ft
Critical Slope	0.001671	ft/ft
Velocity	7.48	ft/s
Velocity Head	0.87	ft
Specific Energy	1.25	ft
Froude Number	2.41	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

Vmin = 7.5 fps @ S = 1.1% - OK
Vmax = 10.4 fps @ S = 2.9% - USE VELOCITY CHECK

SHT B54

DITCH-7 (D7)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-7 (D7)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.009	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	2.00	ft
Discharge	7.87	cfs

Input Data	Minimum	Maximum	Increment
Channel Slope	0.011000	0.028600	0.017600 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.011000	0.38	7.48
0.028600	0.29	10.43

NORMAL DEPTH

FOR FLOW DEPTH UPSTREAM OF VELOCITY CHECK, USE BROAD-CRESTED WEIR

$Q = CLH^{3/2}$ where $C = 2.61$ (REFERENCE 9 for $h = 0.4$)

$L = 6'$

$$H = \left(\frac{Q}{CL}\right)^{2/3} = \left(\frac{7.87}{2.61 \times 6}\right)^{2/3} = 0.63 \text{ ft}$$

FLOW DEPTH = 1.0 ft (velocity check h) + 0.63 ft = $\boxed{1.63 \text{ ft}}$

495

DITCH-8A (D8A)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-8A (D8A)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000001	H : V
Right Side Slope	2.000000	H : V
Discharge	5.88	cfs

Results		
Depth	1.17	ft
Flow Area	2.73	ft^2
Wetted Perimeter	5.22	ft
Top Width	4.67	ft
Critical Depth	0.88	ft
Critical Slope	0.035527	ft/ft
Velocity	2.16	ft/s
Velocity Head	0.07	ft
Specific Energy	1.24	ft
Froude Number	0.50	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for slope = 0.8% - OK

Use Erosion Control Blanket for channel lining

SHT B56

DITCH-8B (D8B)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-8B (D8B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	9.21	cfs

Results		
Depth	0.86	ft
Flow Area	1.48	ft^2
Wetted Perimeter	3.85	ft
Top Width	3.44	ft
Critical Depth	1.06	ft
Critical Slope	0.033465	ft/ft
Velocity	6.22	ft/s
Velocity Head	0.60	ft
Specific Energy	1.46	ft
Froude Number	1.67	
Flow is supercritical.		

Notes:

Velocity > 4.0 fps for n = 0.04, Not acceptable

Use Riprap for channel lining

SAT BE7

802

DITCH 8B (D8B)
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-8B (D8B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.100000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	9.21 cfs

Input Data			
	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.86	6.22
0.060	1.00	4.59

SHT B5B

DITCH-9 (D9)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-9 (D9)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.011000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	13.22	cfs

Results		
Depth	0.36	ft
Flow Area	1.69	ft^2
Wetted Perimeter	5.61	ft
Top Width	5.44	ft
Critical Depth	0.62	ft
Critical Slope	0.001573	ft/ft
Velocity	7.80	ft/s
Velocity Head	0.95	ft
Specific Energy	1.30	ft
Froude Number	2.46	
Flow is supercritical.		

Notes:

GEOMEMBRANE LINER

Vmin = 7.8 fps @ S = 1.1% - OK

Vmax = 14.1fps @ S = 6.7% - USE VELOCITY CHECK

SHT B59

802

DITCH-9 (D9)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-9 (D9)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.009	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	4.00	ft
Discharge	13.22	cfs

Input Data	Minimum	Maximum	Increment
Channel Slope	0.011000	0.066700	0.055700 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.011000	0.36	7.80
0.066700	0.21	14.08

NORMAL DEPTH

FOR FLOW DEPTH UPSTREAM OF VELOCITY CHECK, USE BROAD-CRESTED WEIR

$Q = CLH^{3/2}$ WHERE $C = 2.61$ (REFERENCE 9, TABLE 5-3)

$L = 8$ ft

$$H = \left(\frac{Q}{CL}\right)^{2/3} = \left(\frac{13.22}{2.61 \times 8}\right)^{2/3} = 0.74 \text{ ft}$$

FLOW DEPTH = 1.0 ft (velocity check ht) + 0.74 ft = $\boxed{1.74 \text{ ft}}$

SHT B 60

DITCH-10A (D10A)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10A (D10A)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.043000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	1.34	cfs

Results		
Depth	0.49	ft
Flow Area	0.48	ft^2
Wetted Perimeter	2.19	ft
Top Width	1.96	ft
Critical Depth	0.49	ft
Critical Slope	0.043270	ft/ft
Velocity	2.80	ft/s
Velocity Head	0.12	ft
Specific Energy	0.61	ft
Froude Number	1.00	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 on 4.3% slope, OK

Use Erosion Control Blanket for channel lining

DITCH-10A (D10A)
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10A (D10A)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.043000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	1.34 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.49	2.80
0.060	0.57	2.06

SHT B62

DITCH-10B (D10B)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10B (D10B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.060	
Channel Slope	0.200000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	1.34	cfs

Results		
Depth	0.43	ft
Flow Area	0.36	ft^2
Wetted Perimeter	1.91	ft
Top Width	1.71	ft
Critical Depth	0.49	ft
Critical Slope	0.097364	ft/ft
Velocity	3.67	ft/s
Velocity Head	0.21	ft
Specific Energy	0.64	ft
Froude Number	1.40	
Flow is supercritical.		

Notes:

Velocity > 4.0 fps for n = 0.04 on steeper slopes,
(See Rating Table), Not acceptable

Use Riprap for channel lining

DITCH-10B (D10B)
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-10B (D10B)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Channel Slope	0.200000 ft/ft
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	1.34 cfs

Input Data			
	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020

Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.040	0.37	4.98
0.060	0.43	3.67

SHT B64

DITCH-11 (D11)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-11
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.026000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	4.28	cfs

Results		
Depth	0.83	ft
Flow Area	1.38	ft^2
Wetted Perimeter	3.72	ft
Top Width	3.33	ft
Critical Depth	0.78	ft
Critical Slope	0.037065	ft/ft
Velocity	3.10	ft/s
Velocity Head	0.15	ft
Specific Energy	0.98	ft
Froude Number	0.85	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 on slopes from 2.6% to 4.0% (See Rating Table) OK

Use Erosion Control Blanket for channel lining

505.

DITCH-11 (D11)
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH-11
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data	
Left Side Slope	2.000000 H : V
Right Side Slope	2.000000 H : V
Discharge	4.28 cfs

Input Data	Minimum	Maximum	Increment
Mannings Coefficient	0.040	0.060	0.020
Channel Slope	0.026000	0.040000	0.014000 ft/ft

Rating Table

Channel Slope (ft/ft)	Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.026000	0.040	0.83	3.10
0.026000	0.060	0.97	2.28
0.040000	0.040	0.77	3.64
0.040000	0.060	0.89	2.69

SHT E66

DITCH 12 (REVISED)
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 12 (REVISED)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	8.90	cfs

Results		
Depth	0.96	ft
Flow Area	3.77	ft^2
Wetted Perimeter	6.30	ft
Top Width	5.85	ft
Critical Depth	0.68	ft
Critical Slope	0.032473	ft/ft
Velocity	2.36	ft/s
Velocity Head	0.09	ft
Specific Energy	1.05	ft
Froude Number	0.52	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 OK

Use Erosion Control Blanket for channel lining.

507.

DITCH 12 (REVISED)
Rating Table for Trapezoidal Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH 12 (REVISED)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	2.00	ft
Discharge	8.90	cfs

Input Data	Minimum	Maximum	Increment
Channel Slope	0.008000	0.017500	0.009500 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.008000	0.96	2.36
0.017500	0.79	3.14

SHT 68

DITCH - 15

Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH - 15
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.025000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	1.00	cfs

Results		
Depth	0.49	ft
Flow Area	0.47	ft^2
Wetted Perimeter	2.17	ft
Top Width	1.94	ft
Critical Depth	0.43	ft
Critical Slope	0.044992	ft/ft
Velocity	2.12	ft/s
Velocity Head	0.07	ft
Specific Energy	0.56	ft
Froude Number	0.76	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04: OK

Use Erosion Control Blanket for Channel Lining

SAT 69

DITCH - 15
Rating Table for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	DITCH - 15
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Discharge	1.00	cfs

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.025000	0.030000	0.005000 ft/ft

Rating Table		
Channel Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
0.025000	0.49	2.12
0.030000	0.47	2.27

ATTACHMENT C, CULVERTS

Methodology

This calculation is performed using the "worst case" scenario for peak flows. Each culvert was evaluated under existing conditions (after construction of ditches and basins, but before remediation activities begin), and proposed conditions (after remediation activities have been completed).

The Modified Rational Method (Reference 2) was used to determine peak flows for the 10 year frequency storm event. After drainage areas (existing and proposed) were calculated for each culvert, a weighted runoff coefficient (C) was determined based on land use area and type. A rainfall intensity was selected based on the shortest duration (duration = 10 min for all culverts except culvert 4) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

Culvert 4 has a large, relatively flat drainage area. SCS procedures were used to find the time of concentration (duration) for the culvert 4 drainage area. The rainfall intensity was selected based on the time of concentration (duration) using the Rainfall Intensity-Frequency-Duration Curve for the Fernald area (Reference 7).

Calculations are included on the following pages.

SHT C2

Quick TR-55 Ver.5.46 S/N:
Executed: 15:17:59 01-20-1997

CULVERT 1

EXISTING/PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	0.60						
GRAVEL	0.900	0.90						
			10.00	0.820	0.820	5.450	1.50	6.70

512

PROJECT: Southern Waste Units
Culvert - 1

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

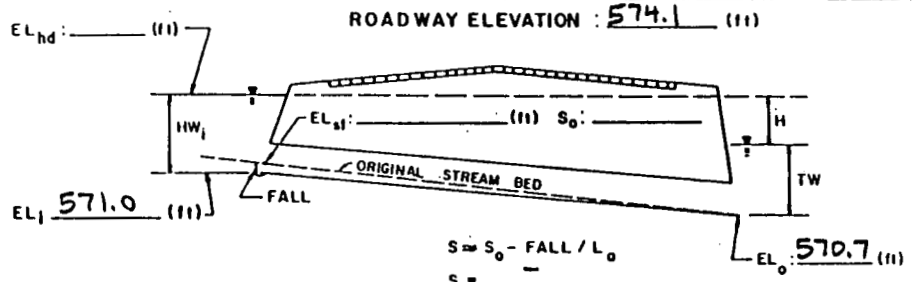
SEE ADD'L. SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	6.7	*

ROADWAY ELEVATION: 574.1 (ft)



$S = S_o - FALL / L_o$

$S =$ —

$L_o = \approx 30'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" Φ CMP	6.7	6.7	1.8	2.25	–	573.3	0.5	1.0	1.1	1.1	0.9	2.2	574.0	574.0	–	OUTLET CONTROL TOO HIGH
TRY 18" Φ CMP	6.7	6.7	1.13	1.70	–	572.7	0.5	0.95	1.2	1.2	0.9	0.85	572.8	572.8	—	OUTLET CONTROL OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW /D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

o. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION: * ASSUME OUTLET DRAINAGEWAY FLOWING 0.5' DEEP

PROJECTING ENDS ∴ $K_e = 0.9$

CULVERT BARREL SELECTED:

SIZE: 18" Φ

SHAPE: ROUND

MATERIAL: CMP n 0.024

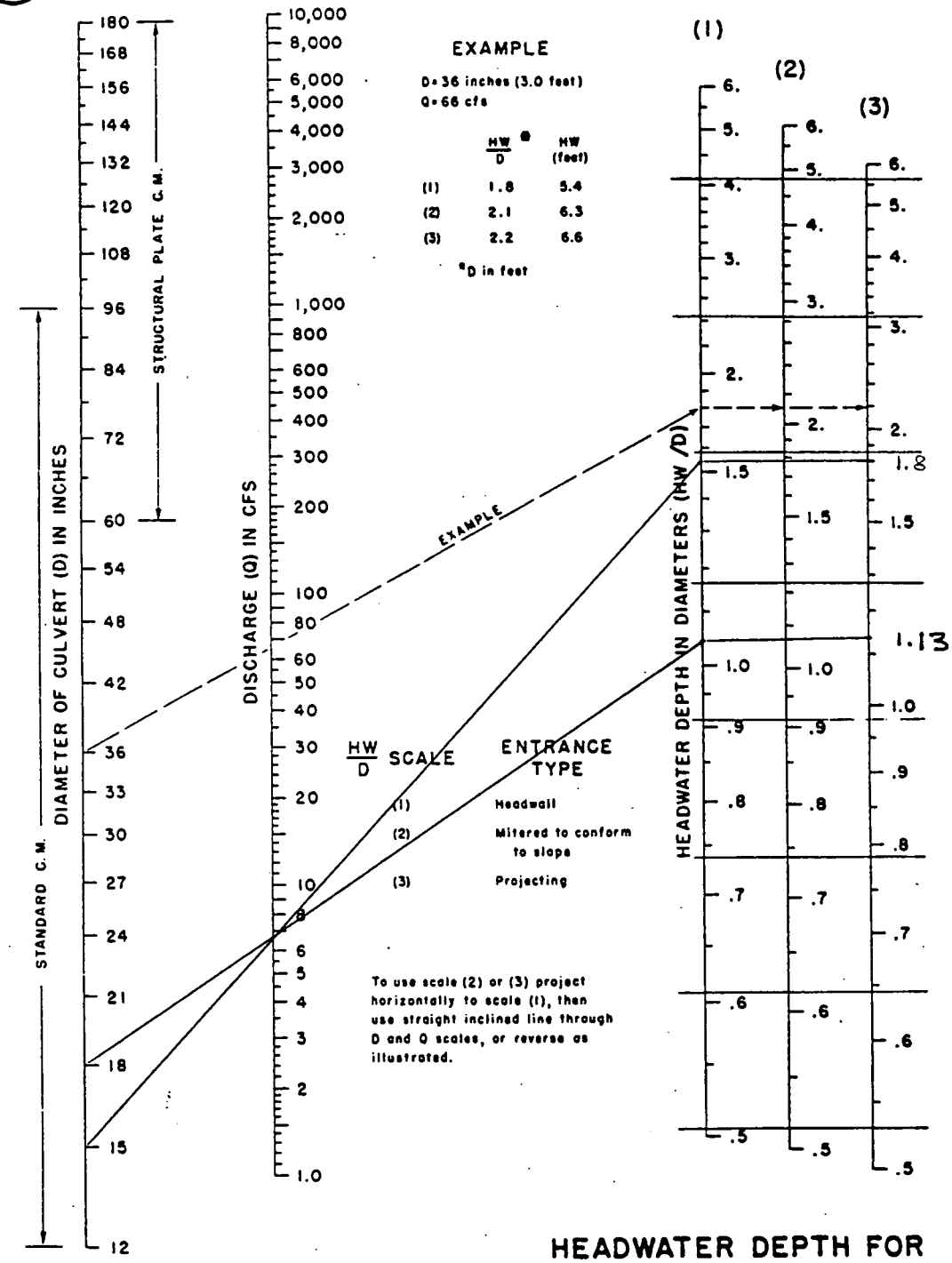
ENTRANCE: PROJECTING

240

5/3

SHT C3 802

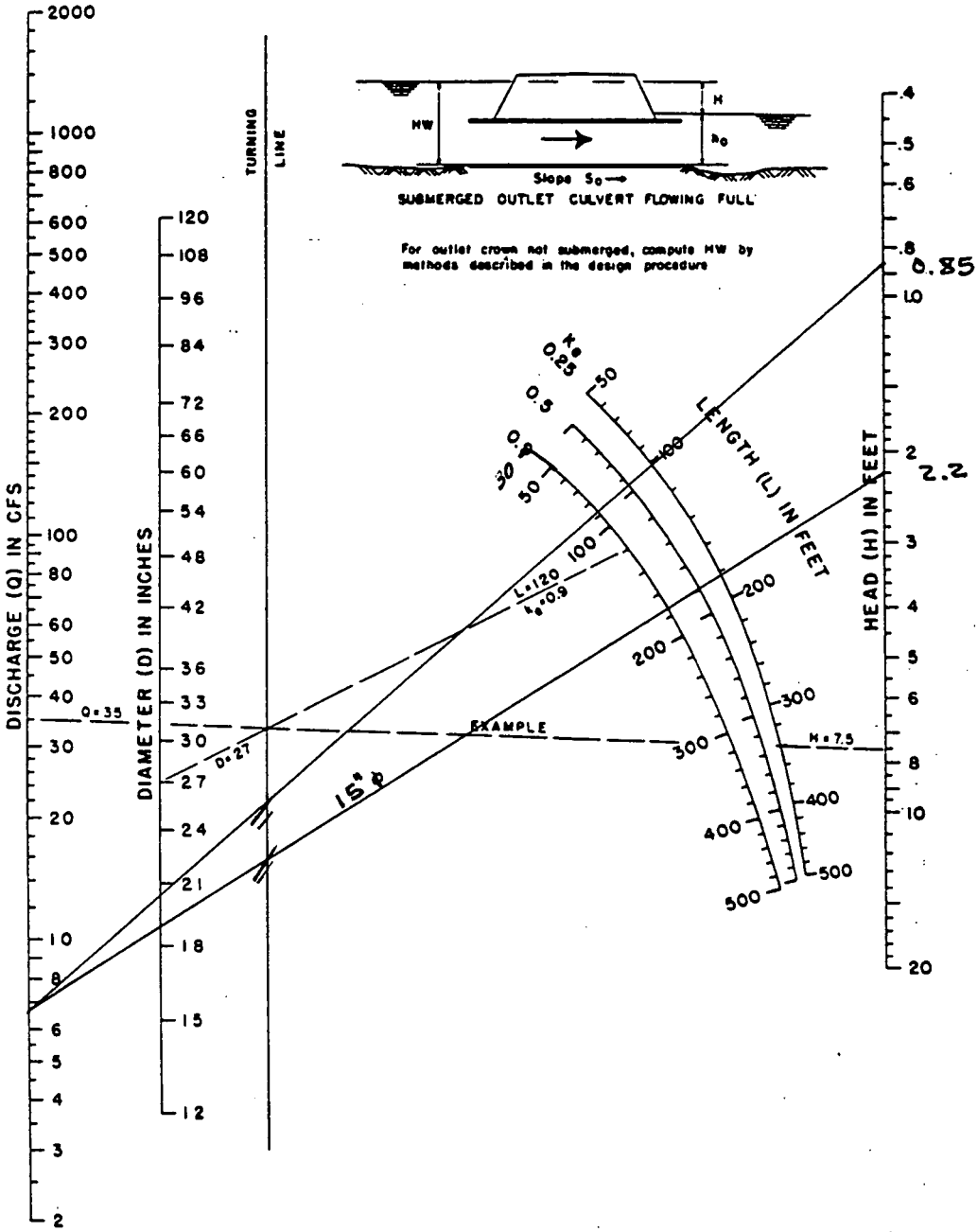
CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

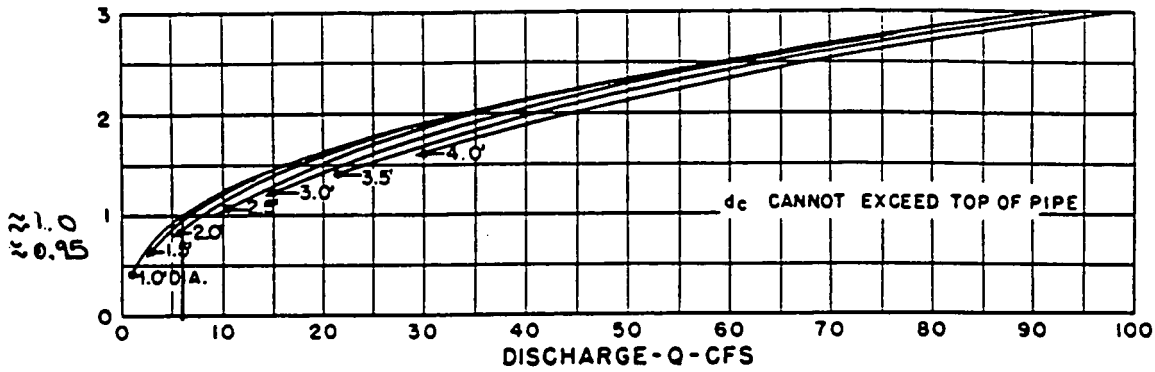
CHART 6

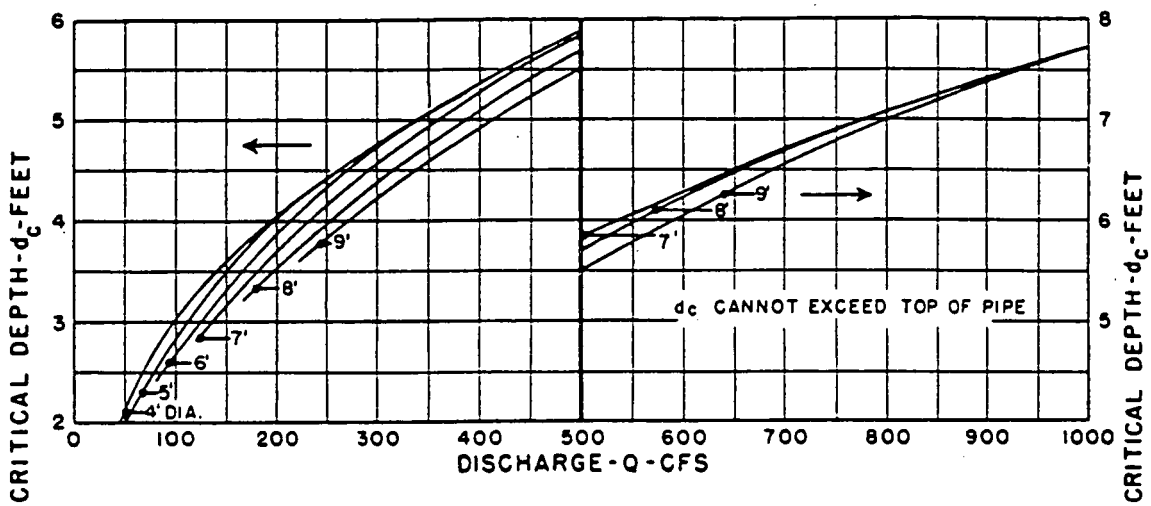


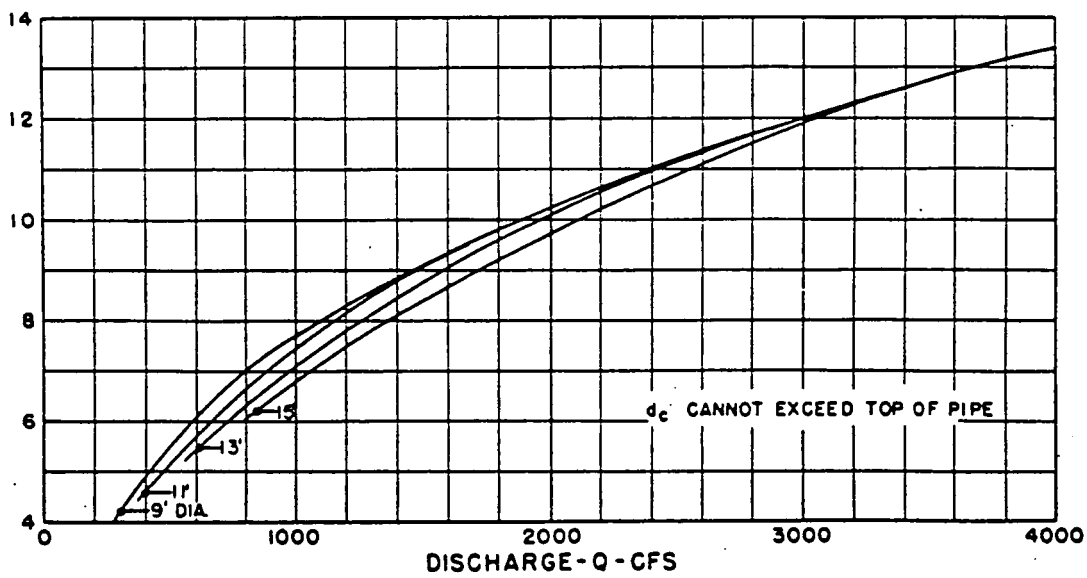
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

516.

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

SHT C8

Quick TR-55 Ver.5.46 S/N:
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CULVERT 2
USE SAME AS D11
EXISTING CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.89						
GRAVEL	0.900	0.28						
			10.00	0.672	0.672	5.450	1.17	4.28

Quick TR-55 Ver.5.46 S/N:
Executed: 16:48:20 01-20-1997

CULVERT 2
USE SAME AS D11
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	0.57						
GRAVEL	0.900	0.28						
			10.00	0.699	0.699	5.450	0.85	3.24

520

PROJECT: SOUTHERN WASTE UNITS CULVERT-2	STATION:	CULVERT DESIGN FORM
	SHEET ____ OF ____	DESIGNER / DATE: ____ / ____
		REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

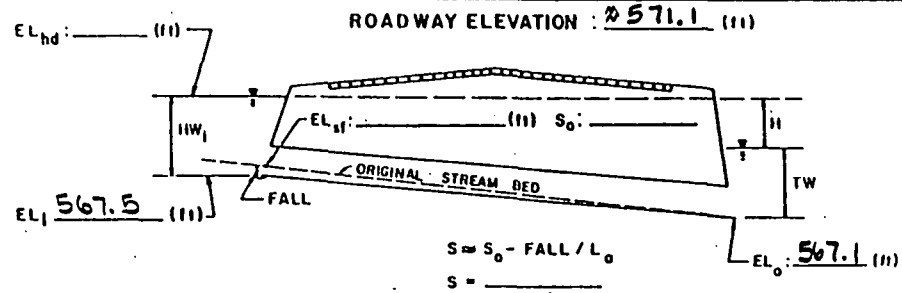
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	4.3	*

ROADWAY ELEVATION: ≈ 571.1 (ft)



$S \approx S_o - FALL / L_o$

$S =$ ____

$L_o = \approx 40'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW i/D (2)	HW i	FALL (3)	EL hi (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c + D}{2}$	h_o (6)	h_e	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" ϕ CMP	4.3	4.3	1.12	1.4	–	568.9	0.8	0.8	1.03	1.03	0.9	0.9	569.0	569.0	—	OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- o. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho. HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION: * ASSUME OUTLET FLOWING FULL, FROM D-11 CALC, DEPTH FOR n = 0.04 DITCH = 0.77' ⇒ USE TW = 0.8'

PROJECTING ENDS ∴ $K_e = 0.9$

CULVERT BARREL SELECTED:

SIZE: 15" ϕ

SHAPE: ROUND

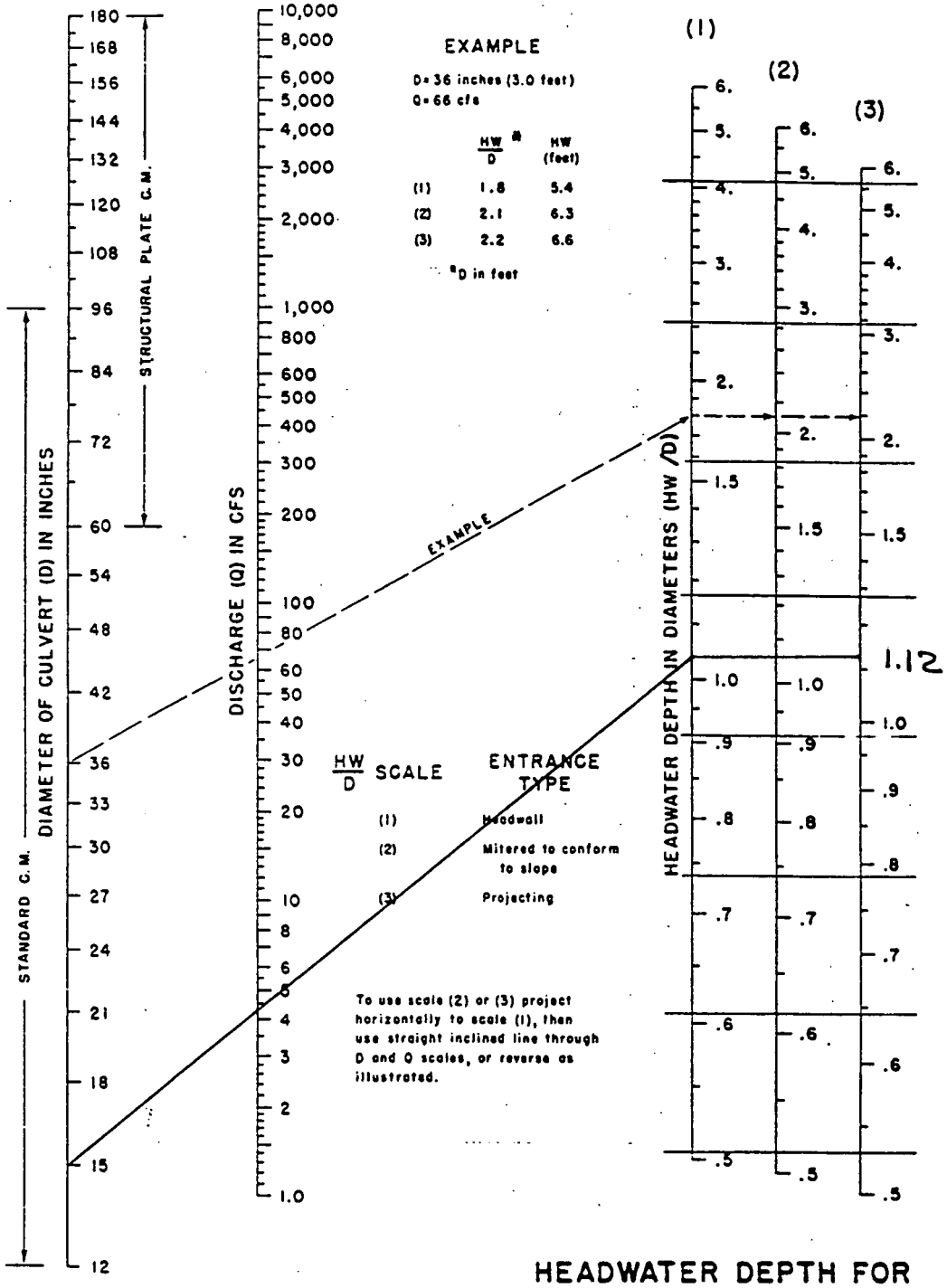
MATERIAL: CMP n 0.024

ENTRANCE: PROJECTING

240

SHT C10

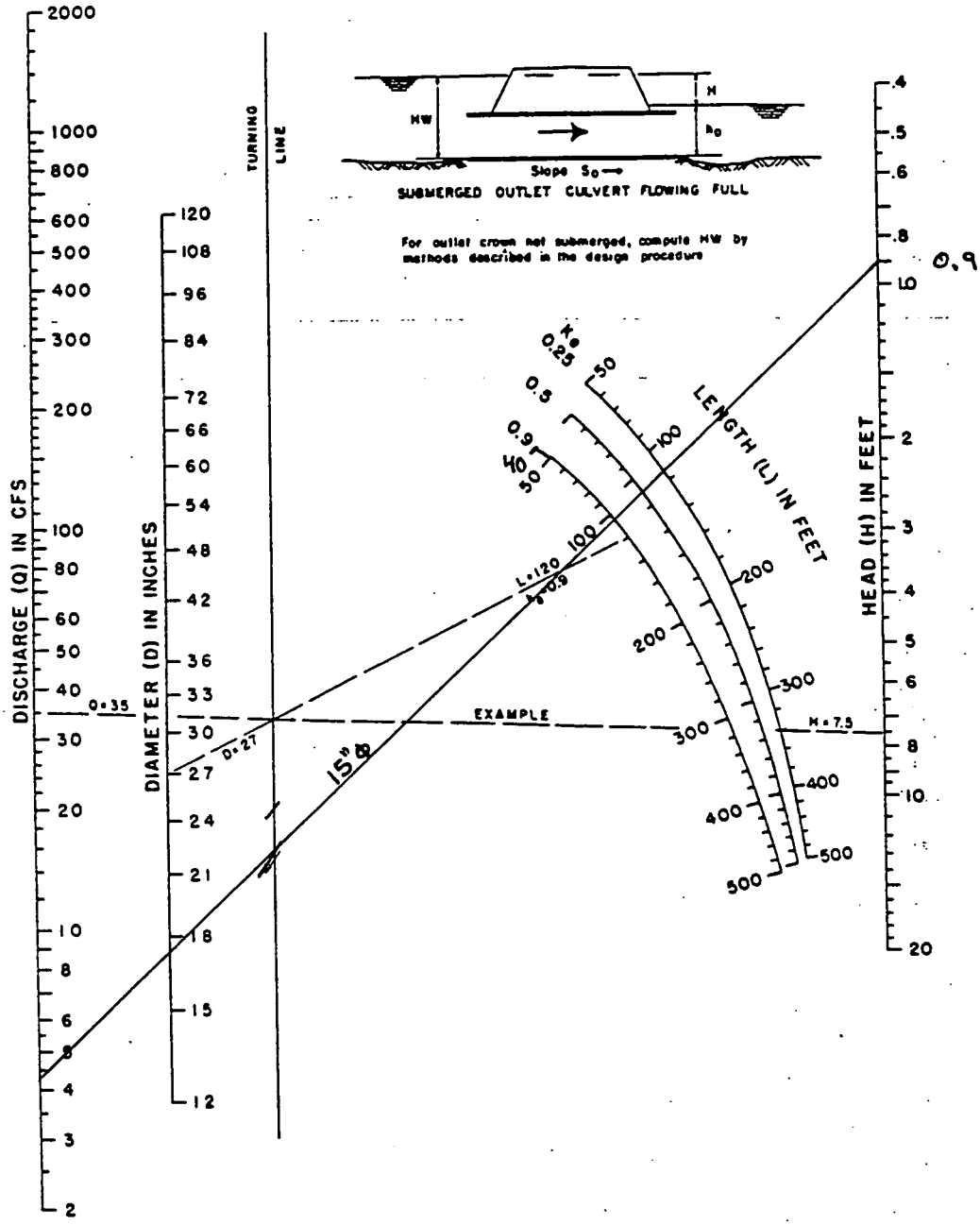
CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 6

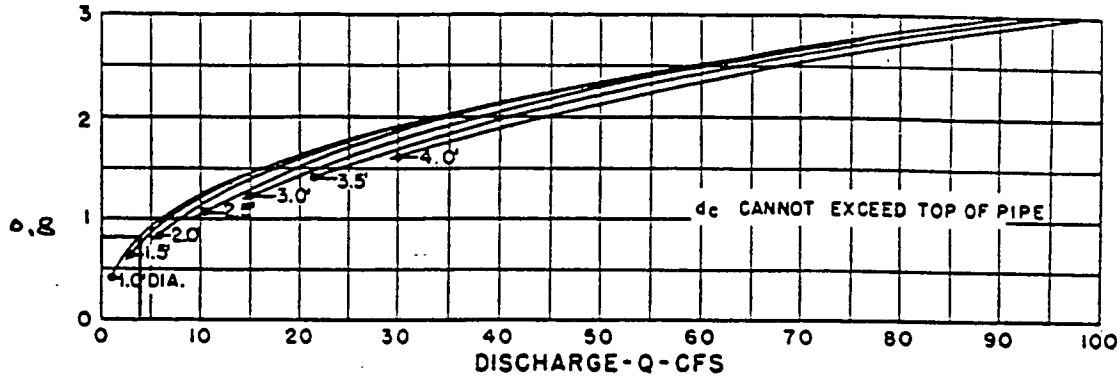


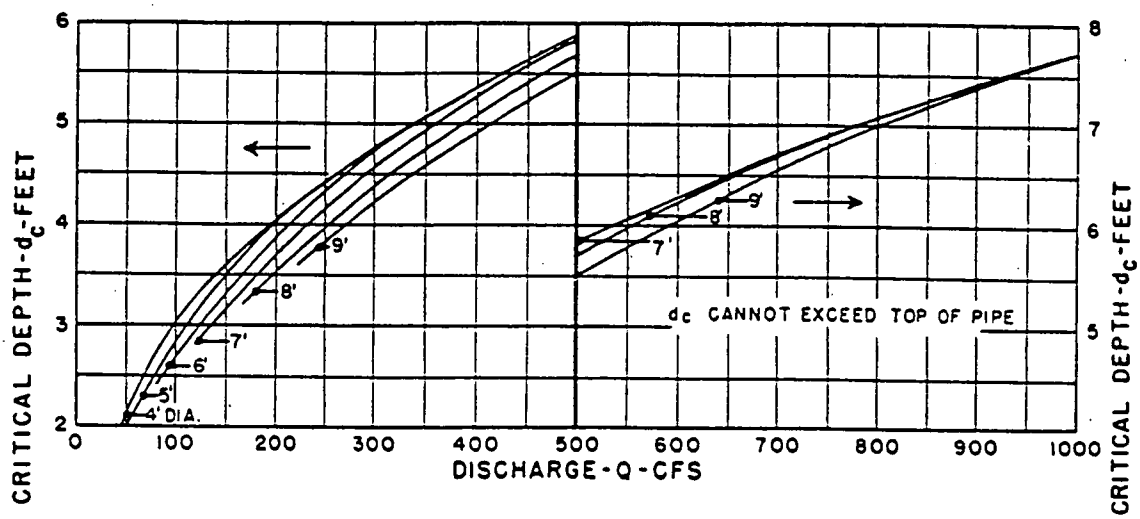
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

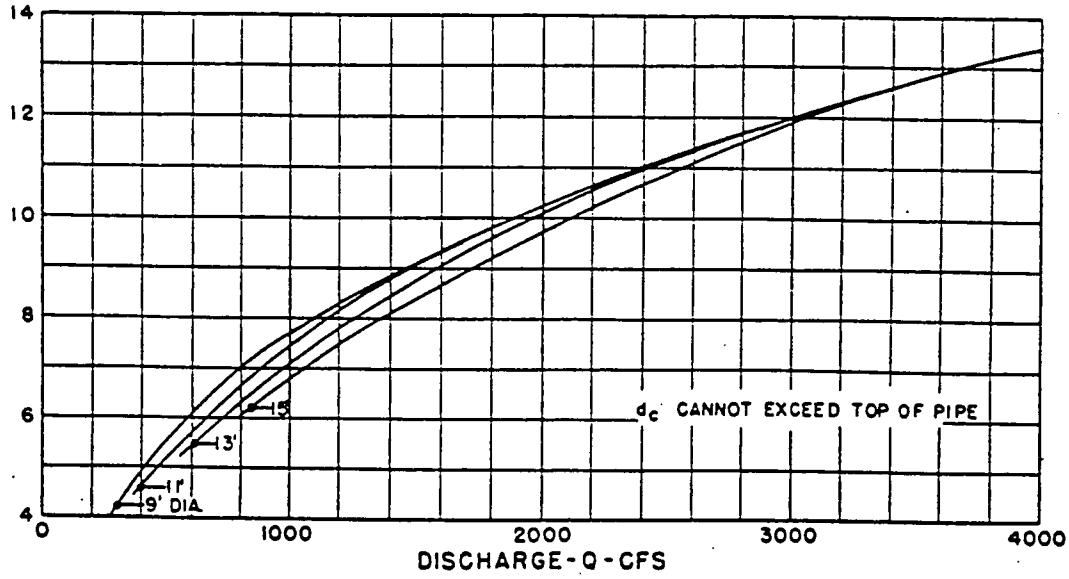
BUREAU OF PUBLIC ROADS JAN. 1963

522

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

SHT C14

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

524

Quick TR-55 Ver.5.46 S/N:
Executed: 14:39:46 04-28-1997

DITCH-5 & 6 COMBINED
CULVERT 3
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	1.09						
			10.00	0.700	0.700	5.450	1.09	4.16

526

PROJECT: SOUTHERN WASTE UNITS
CULVERT - 3

STATION: N/A

SHEET — OF —

CULVERT DESIGN FORM

DESIGNER / DATE: ____ / ____

REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

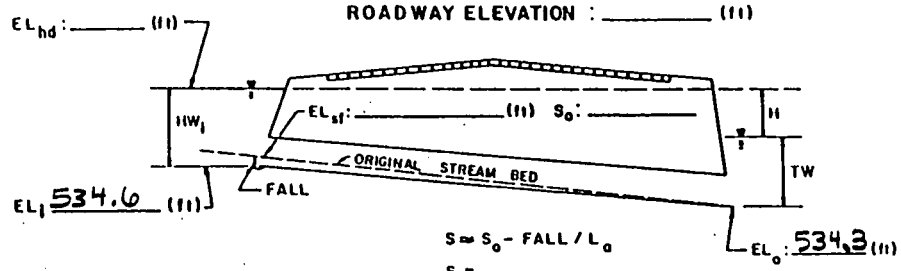
SEE ADD'L SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	4.2	*

ROADWAY ELEVATION: ____ (ft)



$S \approx S_o - FALL / L_o$

$S =$ ____

$L_o \approx 45'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" Φ CMP	4.2	4.2	1.1	1.38	—	536.0	0.8	0.8	1.03	1.03	0.9	0.82	536.15	536.15	—	OUTLET CONTROL

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29 n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION: * ASSUME D-7 FLOWING FULL. FROM D-7 CALC, DEPTH = 0.8 FT

PROJECTING, $K_e = 0.9$

CULVERT BARREL SELECTED:

SIZE: 15"

SHAPE: ROUND

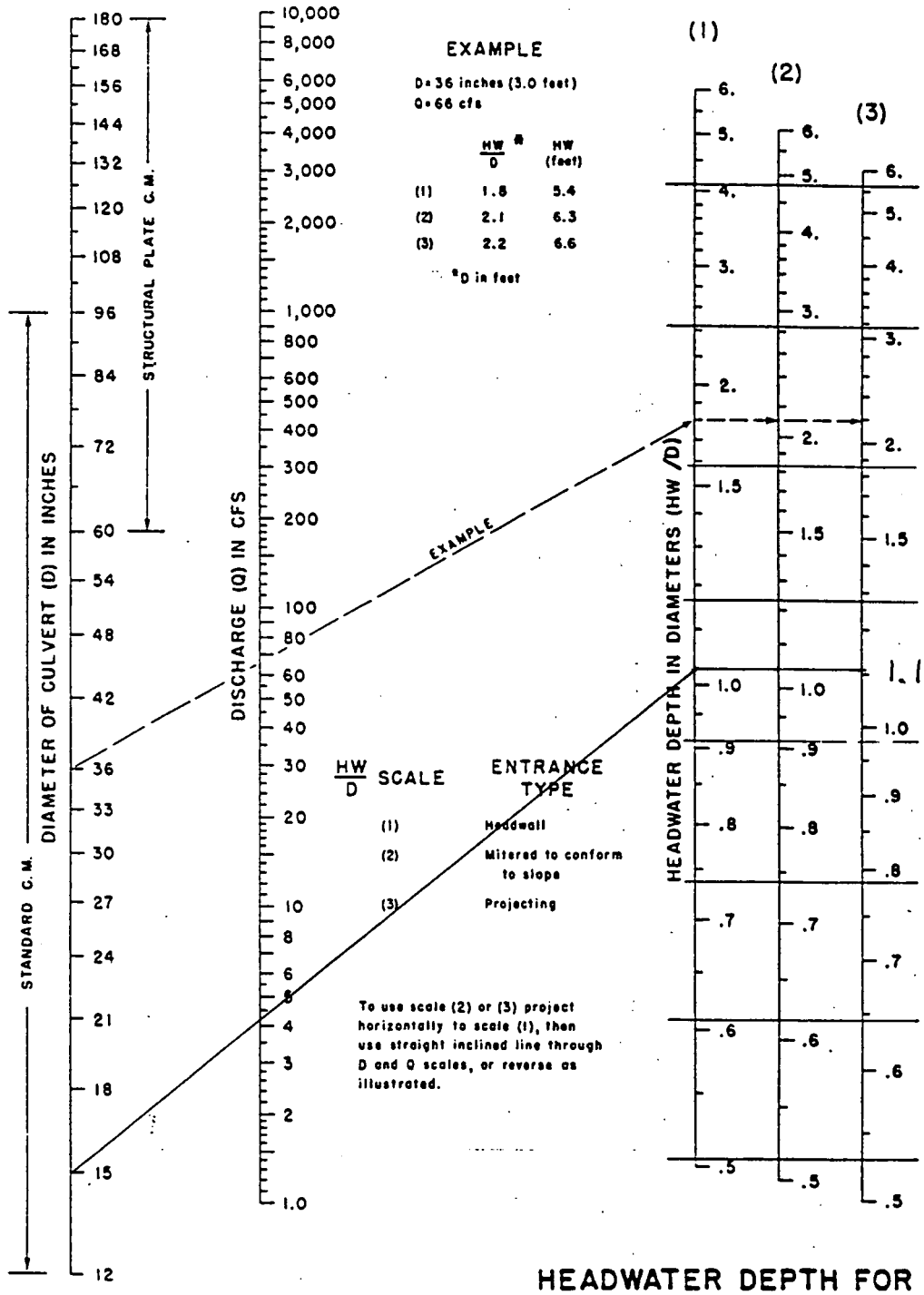
MATERIAL: CMP n 0.024

ENTRANCE: PROJECTING

240

Sht C16

CHART 2



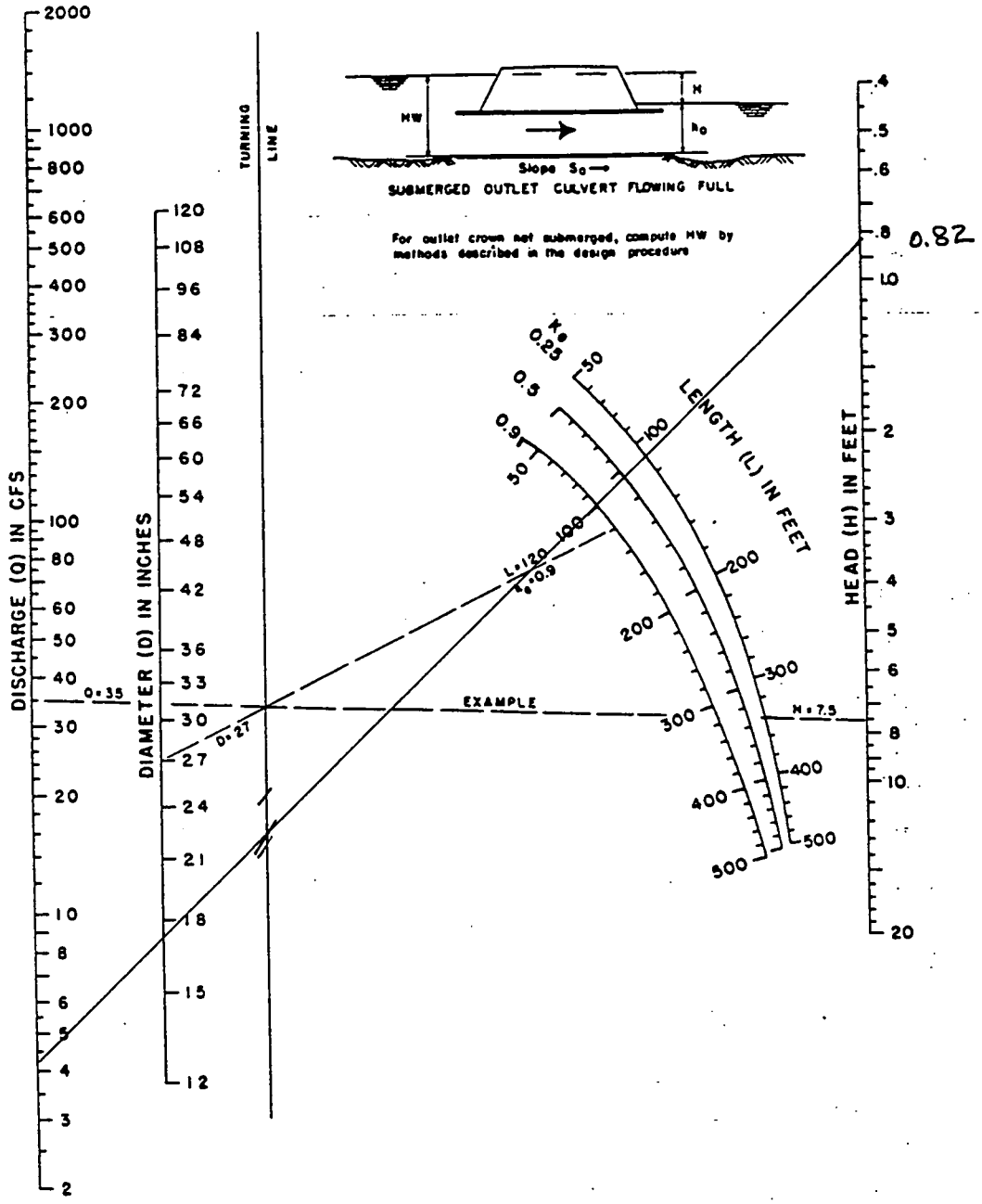
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

527

SHT C18

CHART 6



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

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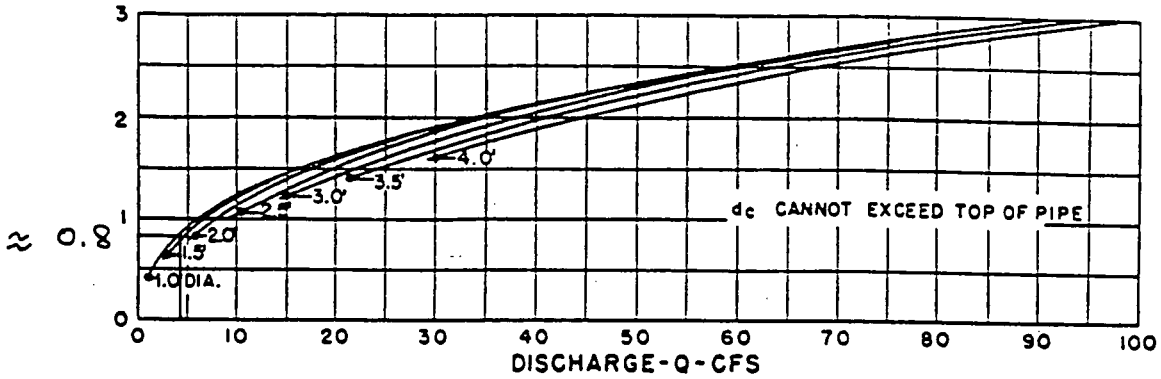
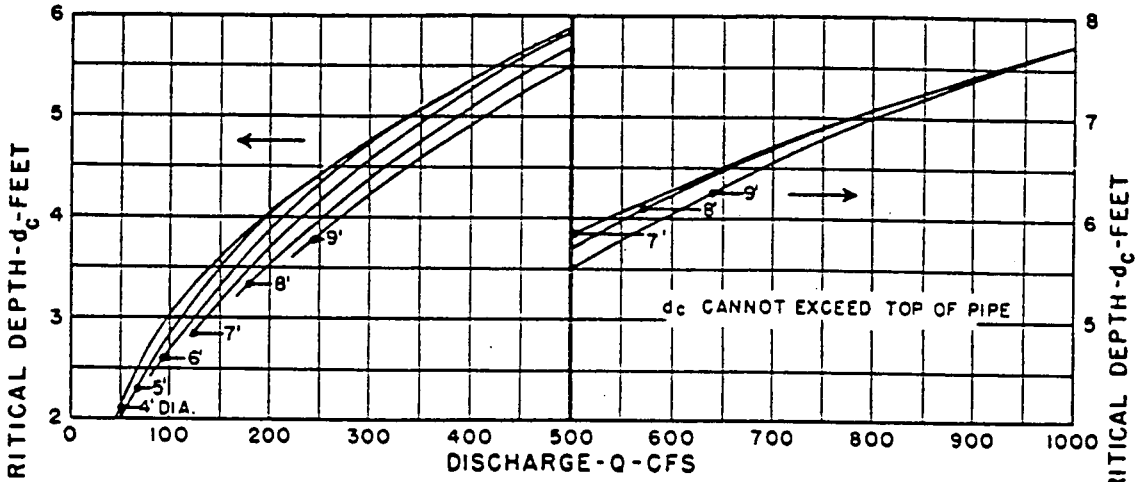
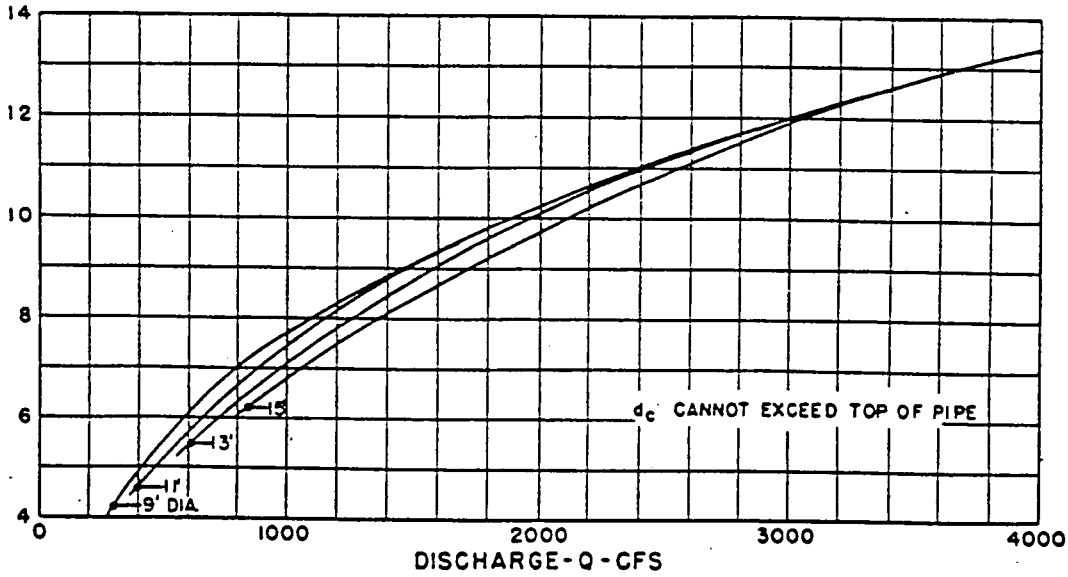
CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

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TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

SHT C21

Quick TR-55 Ver.5.46 S/N:
Executed: 13:44:02 02-04-1997

CULVERT 4

PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
WOODS	0.300	8.10						
VEG, FAIR	0.420	2.01						
GRAVEL RD	0.900	0.20						
BARE,(WDCHP)	0.700	0.50						
			39.00	0.352	0.352	2.750	10.81	10.46

SHT C22

Quick TR-55 Ver.5.46 S/N:
Executed: 13:42:27 02-04-1997 c:\po165d\C4.TCT

CULVERT 4

Tc COMPUTATIONS FOR: CULVERT 4

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		WOODS, LT	
Manning's roughness coeff., n		0.4000	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.000	
Land slope, s	ft/ft	0.0500	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.62	= 0.62

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	345.0	
Watercourse slope, s	ft/ft	0.0290	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.7476	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.03	= 0.03

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

:::

TOTAL TIME (hrs) 0.65

Quick TR-55 Ver.5.46 S/N:
Executed: 13:42:27 02-04-1997 c:\po165d\C4.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

CULVERT 4

Subarea descr.	Tc or Tt	Time (hrs)
CULVERT 4	Tc	0.65

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PROJECT: SOUTHERN WASTE UNITS
CULVERT - 4

STATION: _____
SHEET _____ OF _____

CULVERT DESIGN FORM
DESIGNER / DATE: _____ / _____
REVIEWER / DATE: _____ / _____

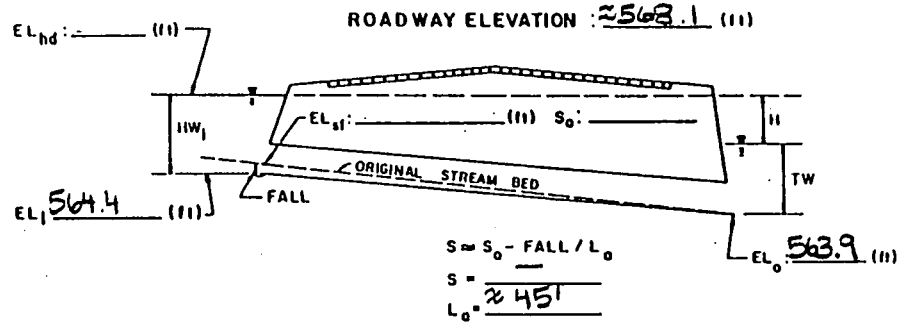
HYDROLOGICAL DATA

SEE ADD'L SHTS.
- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: — ☐ STREAM SLOPE: —
- ☐ CHANNEL SHAPE: —
- ☐ ROUTING: — ☐ OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	10.5	2'

ROADWAY ELEVATION: ≈568.1 (ft)



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW i/D (2)	HW i	FALL (3)	EL hi (4)	OUTLET CONTROL TW (5)	d c	(d c + D)/2	h o (6)	h e	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 18" Φ	10.5	10.5	1.8	2.7	—	567.1	2	1.3	1.4	2	0.9	2.4	568.3	568.3	—	
TRY 24" Φ	10.5	10.5	0.95	1.9	—	566.3	2	1.2	1.6	2	0.9	0.7	566.6	566.6	—	
TRY 21" Φ	10.5	10.5	1.2	2.1	—	566.5	2	1.25	1.5	2	0.9	1.2	567.1	567.1	—	

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:
- a. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho. HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

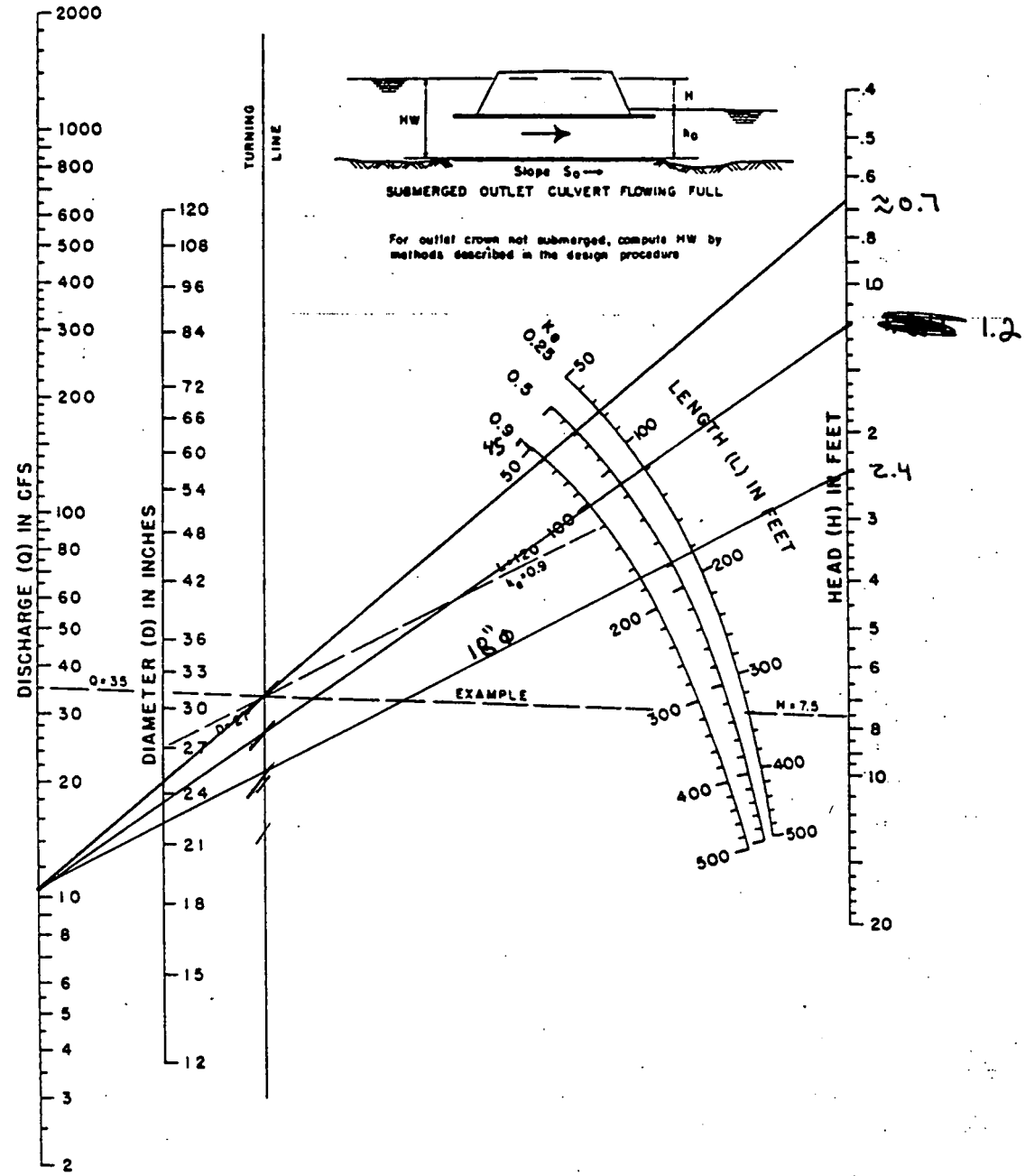
COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:
SIZE: 21" Φ
SHAPE: CIRCULAR
MATERIAL: CMP n 0.024
ENTRANCE: PROJECTING

240

SHT C24

CHART 6

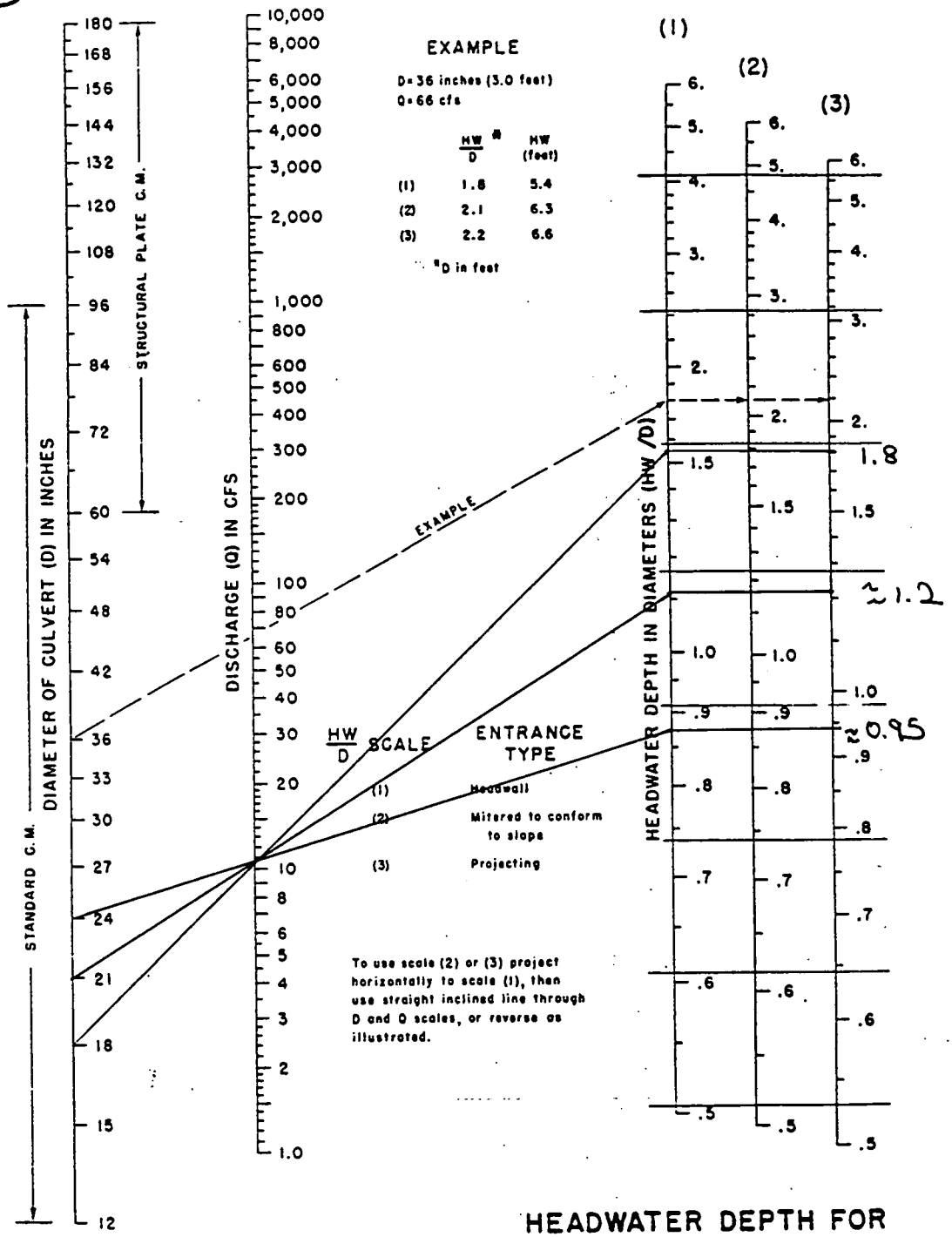


HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

SHT C26

CHART 2

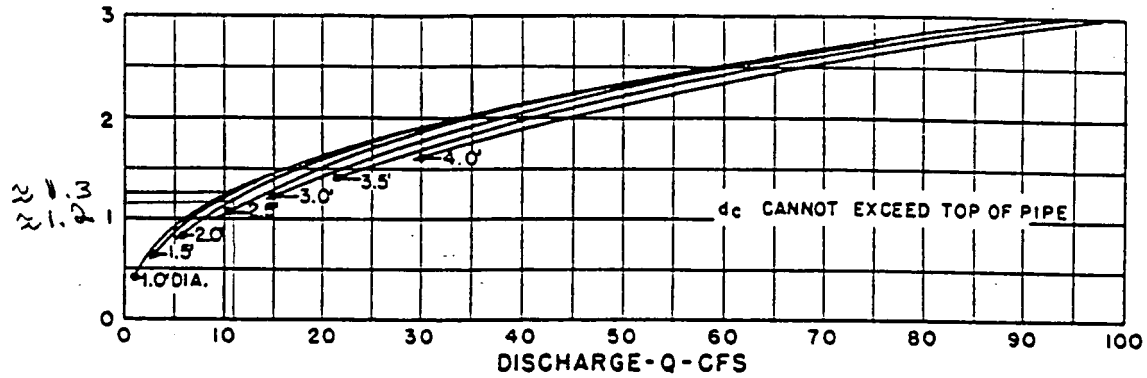


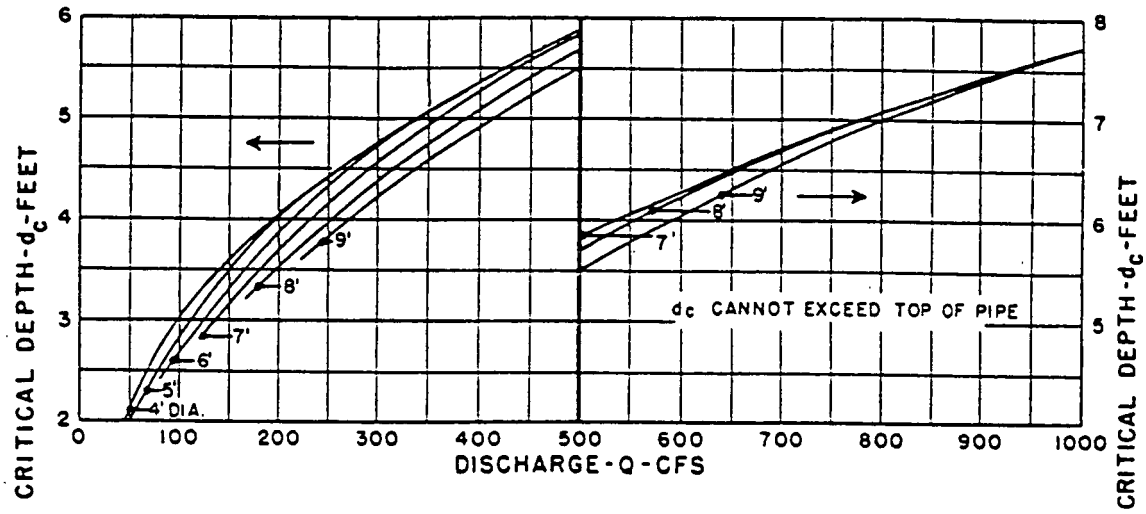
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

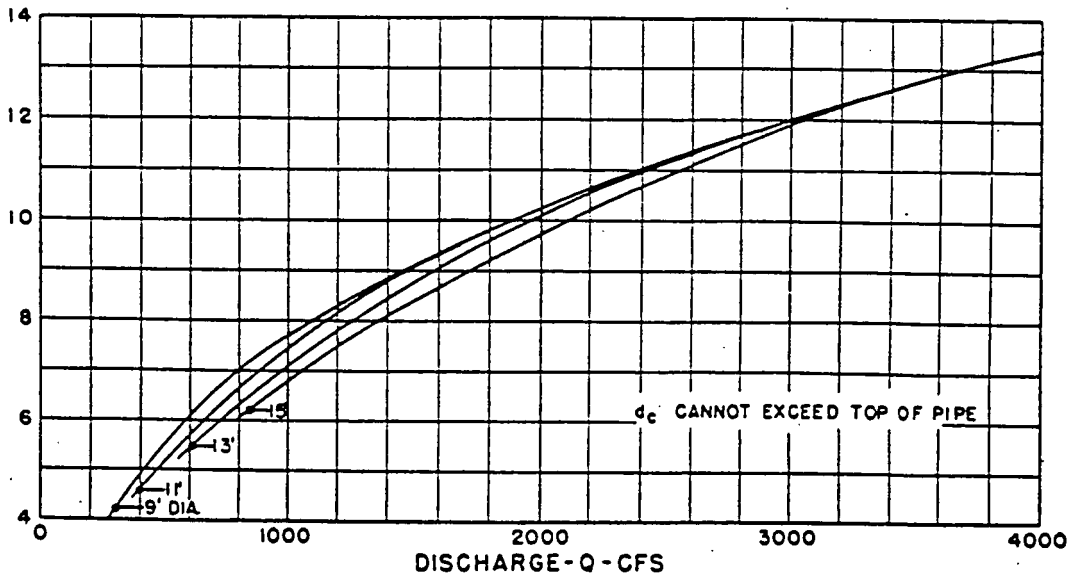
BUREAU OF PUBLIC ROADS JAN. 1963

536

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

SHT C28

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

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Quick TR-55 Ver.5.46 S/N:
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CULVERT 5

PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
PAVEMENT	0.900	0.50						
			10.00	0.900	0.900	5.450	0.50	2.45

540

PROJECT: SOUTHERN WASTE UNIT CULVERT-5	STATION: ____ SHEET ____ OF ____	CULVERT DESIGN FORM DESIGNER / DATE: ____ / ____ REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

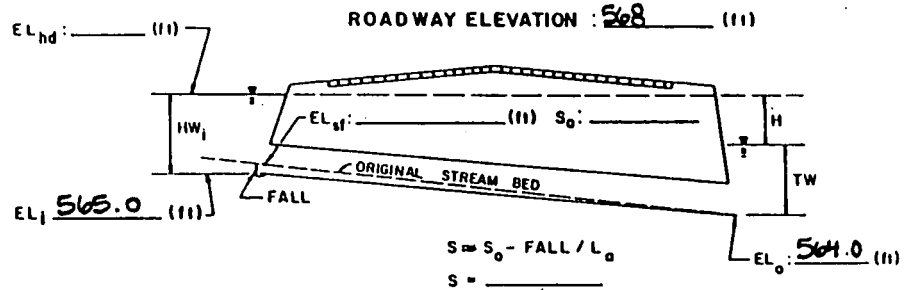
SEE ADD'L. SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	2.5	2

ROADWAY ELEVATION: 568 (ft)



$S = S_o - FALL / L_o$

$S =$ ____

$L_o \approx 95'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW i/D (2)	HW i	FALL (3)	EL hi (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c + D}{2}$	h_o (6)	k_e	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" ϕ	2.5	2.5	0.78	0.98	—	565.98	2	0.6	0.93	2	0.9	0.55	566.6	566.6	—	OUTLET CONTROL
TRY 18" ϕ	2.5	2.5	0.59	0.89	—	565.89	2	≈0.6	1.05	2	0.9	≈ 0	566.0	566.0	—	OUTLET CONTROL

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

PROJECTING ENDS

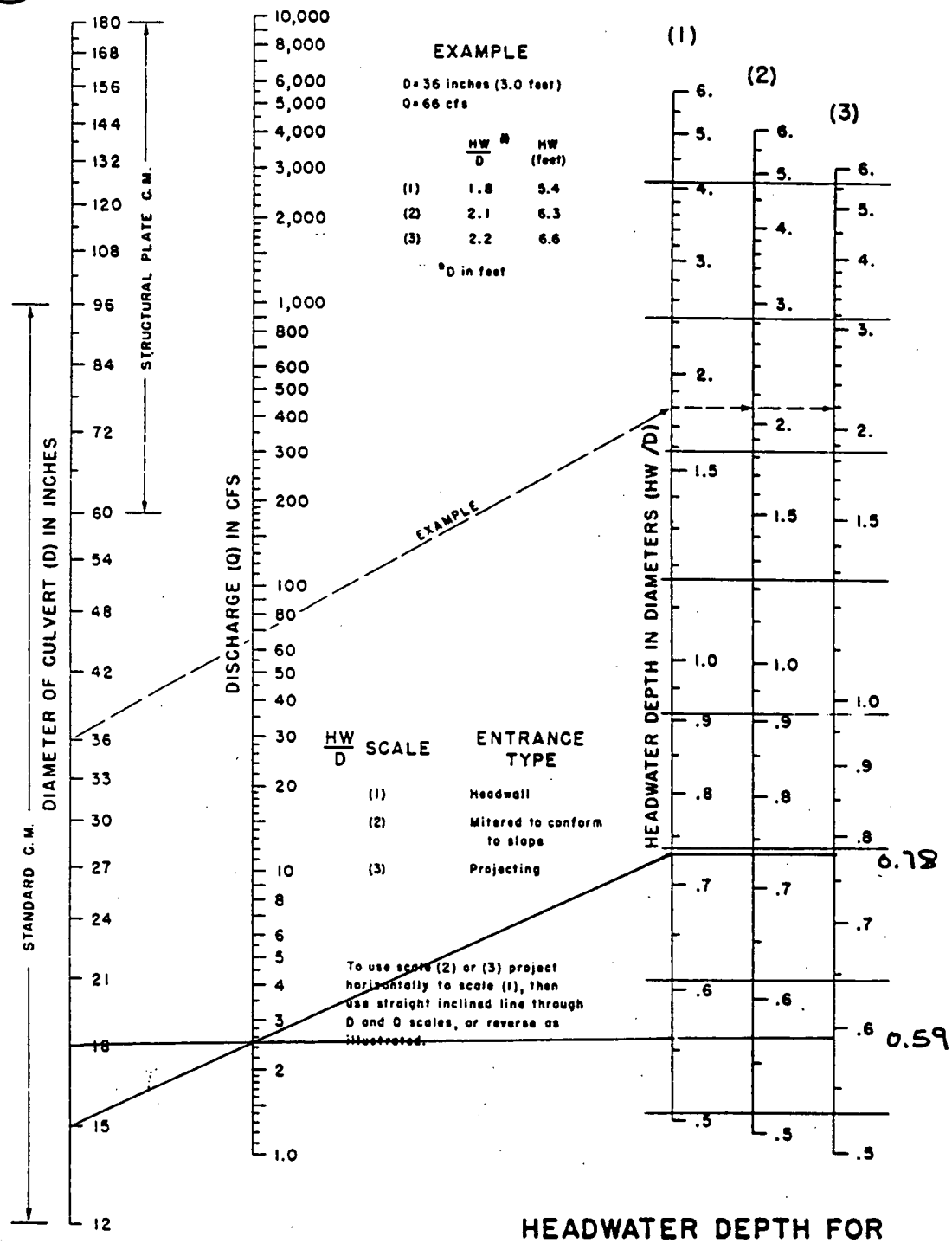
CULVERT BARREL SELECTED:

SIZE: 15" ϕ
SHAPE: ROUND
MATERIAL: CMP n 0.024
ENTRANCE: PROJECTING

240

SHT C30

CHART 2



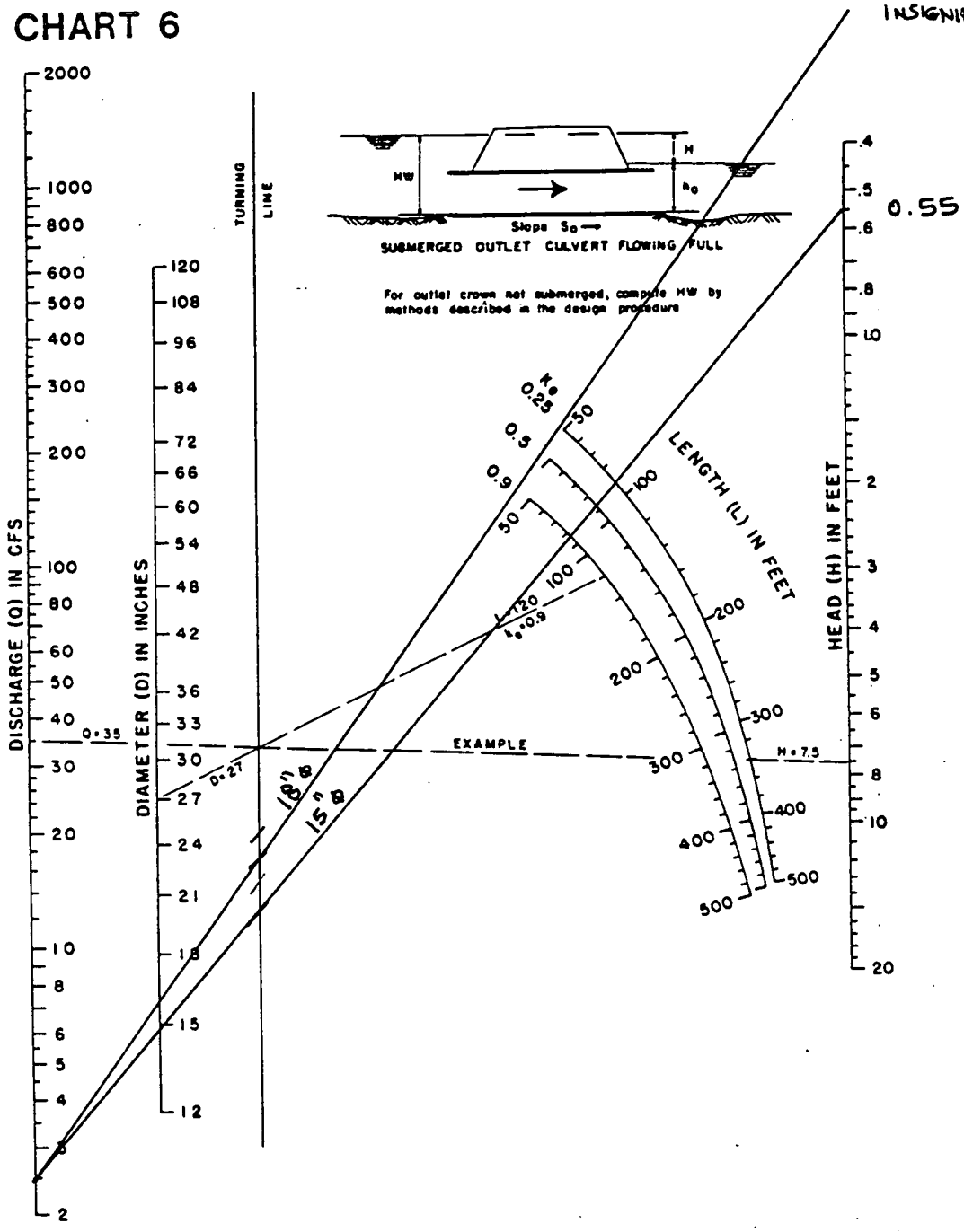
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

SHT C32

CHART 6

INSIGNIFICANT

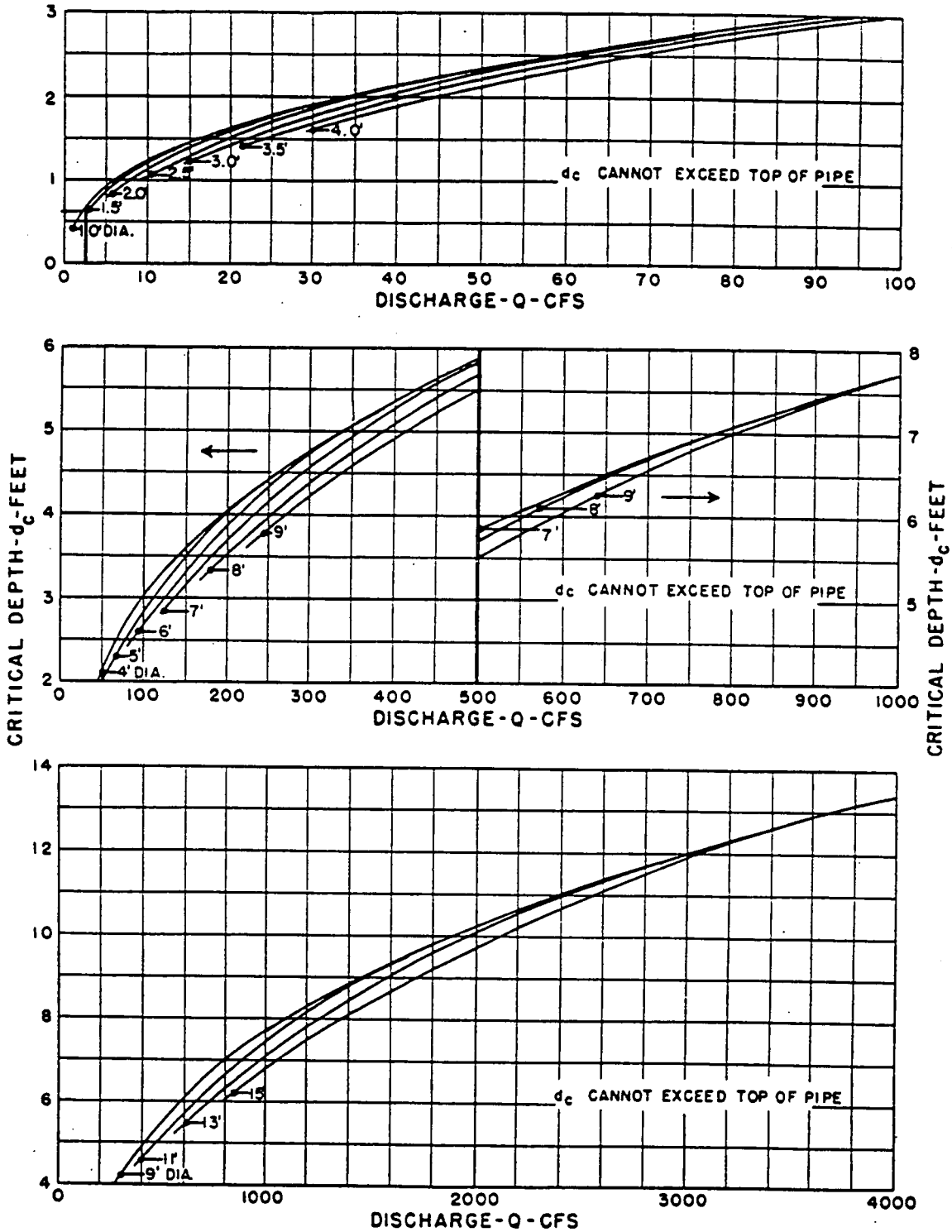


HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

542

CHART 4



BUREAU OF PUBLIC ROADS
JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

SHT C35

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CULVERT-6
EXISTING AND PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	1.00						
			10.00	0.700	0.700	5.450	1.00	3.81

545

546

PROJECT: SOUTHERN WASTE UNITS
CULVERT - 6 (CONTINGENCY CULVERT)

STATION: —

SHEET — OF —

CULVERT DESIGN FORM

DESIGNER / DATE: — / —

REVIEWER / DATE: — / —

HYDROLOGICAL DATA

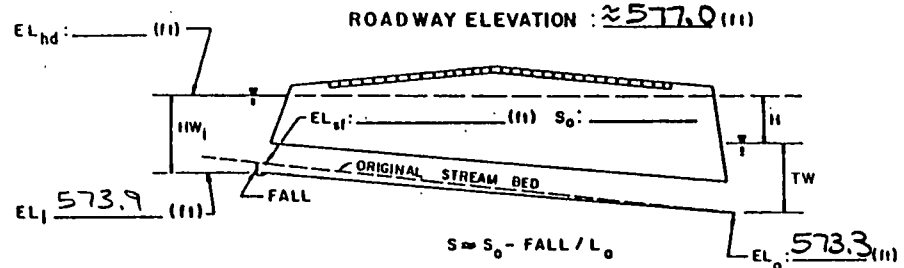
SEE ADD'L. SHTS.

- [x] METHOD: RATIONAL
- [ ] DRAINAGE AREA: — [ ] STREAM SLOPE: —
- [ ] CHANNEL SHAPE: —
- [ ] ROUTING: — [ ] OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	3.81	*

ROADWAY ELEVATION: ≈577.0 (ft)



$S \approx S_o - FALL / L_o$

$S =$

$L_o = \approx 55'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 15" ϕ	3.8	3.8	1.0	1.25	—	575.2	1.2	0.7	1.0	1.2	0.9	0.9	576.4	576.4	—	OUTLET CONTROL OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION: * ASSUME TW AT FLOW DEPTH FOR DITCH 2A, FROM CALC FOR 2A, TW = 1.2 FT

CULVERT BARREL SELECTED:

SIZE: 15"

SHAPE: ROUND

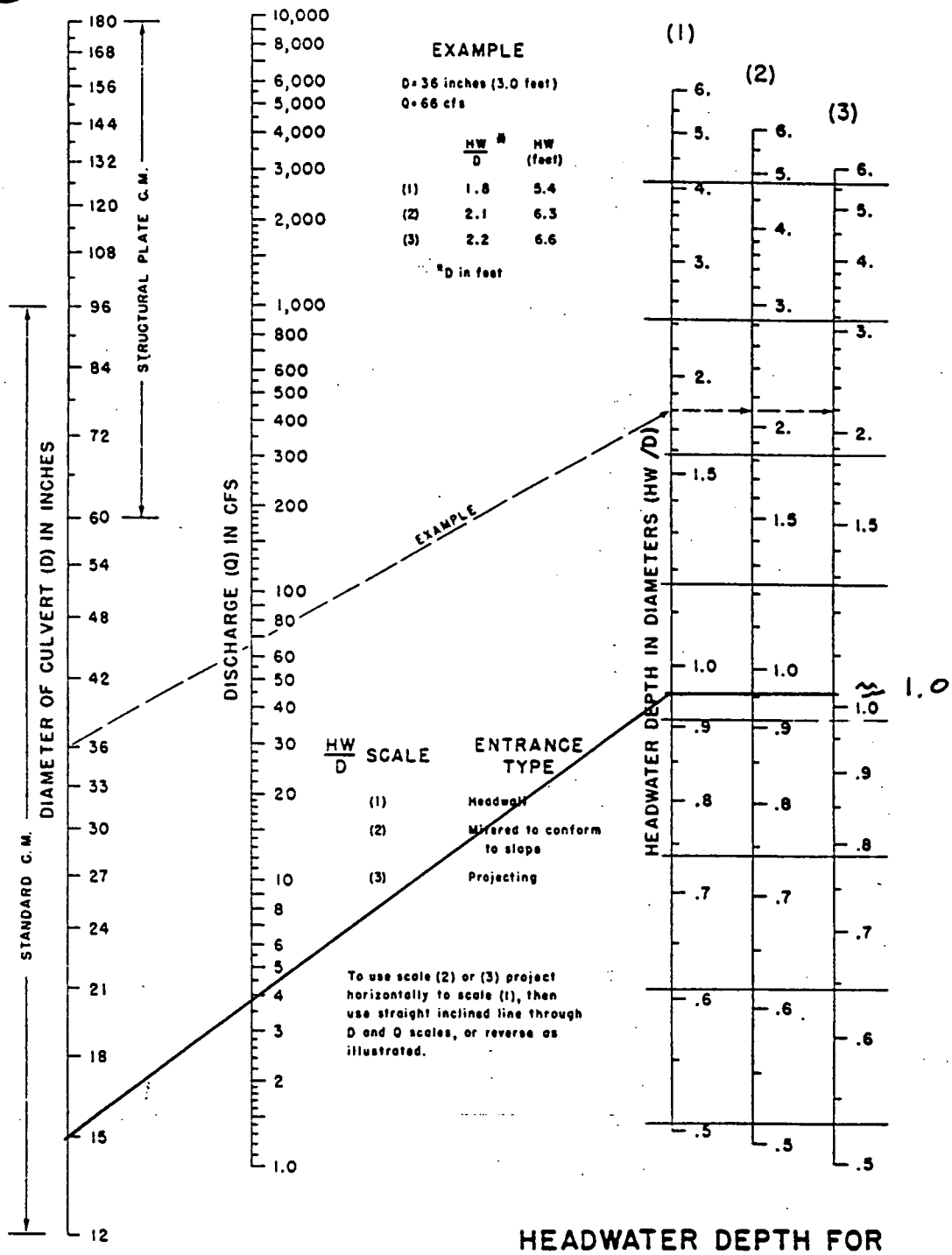
MATERIAL: CMP n 0.024

ENTRANCE: PROJECTING

240

SHT C36

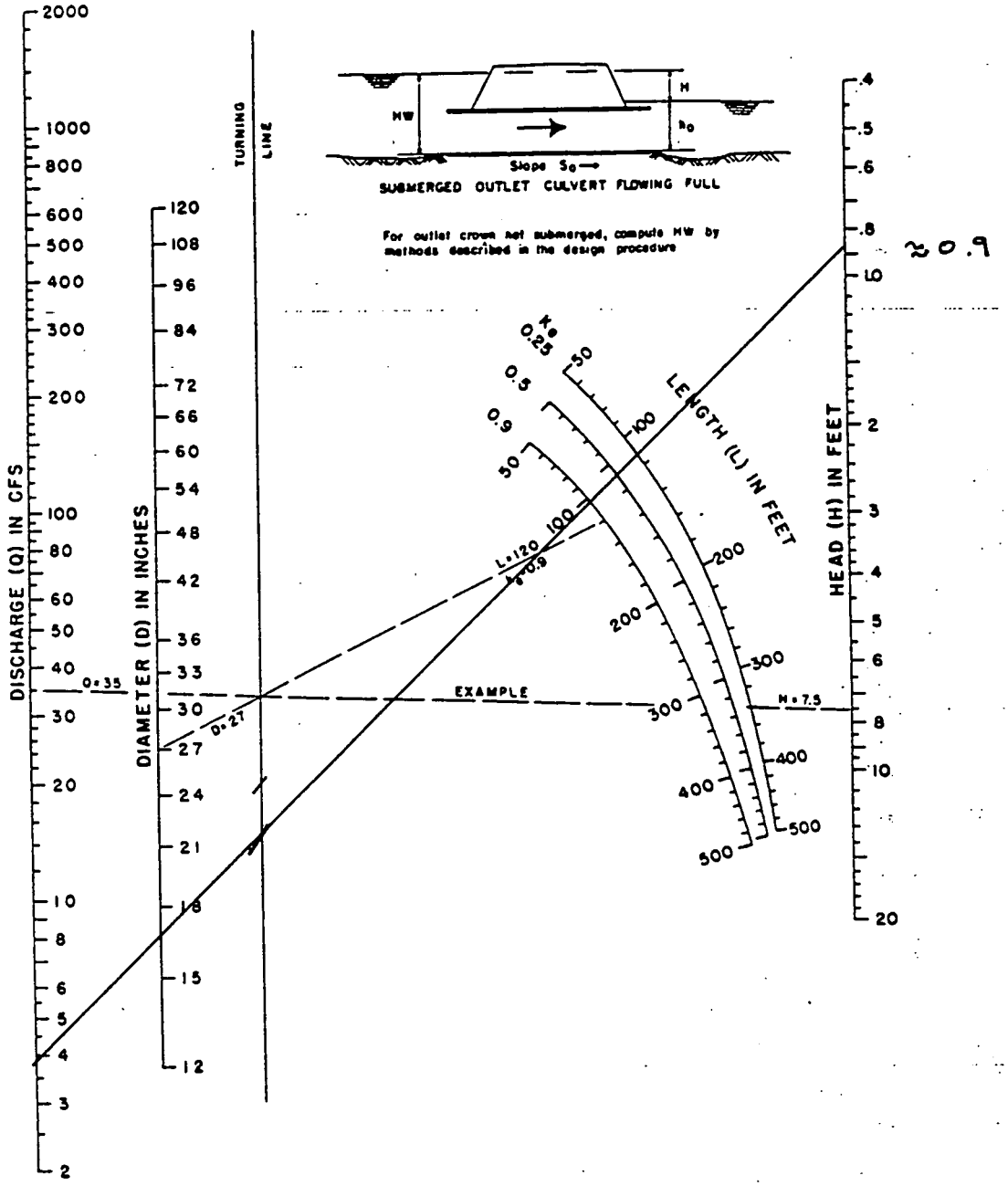
CHART 2



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 6

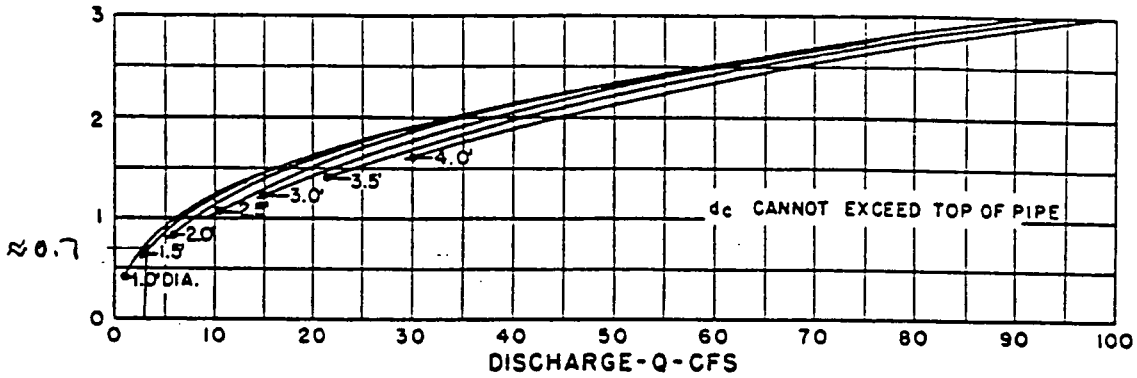


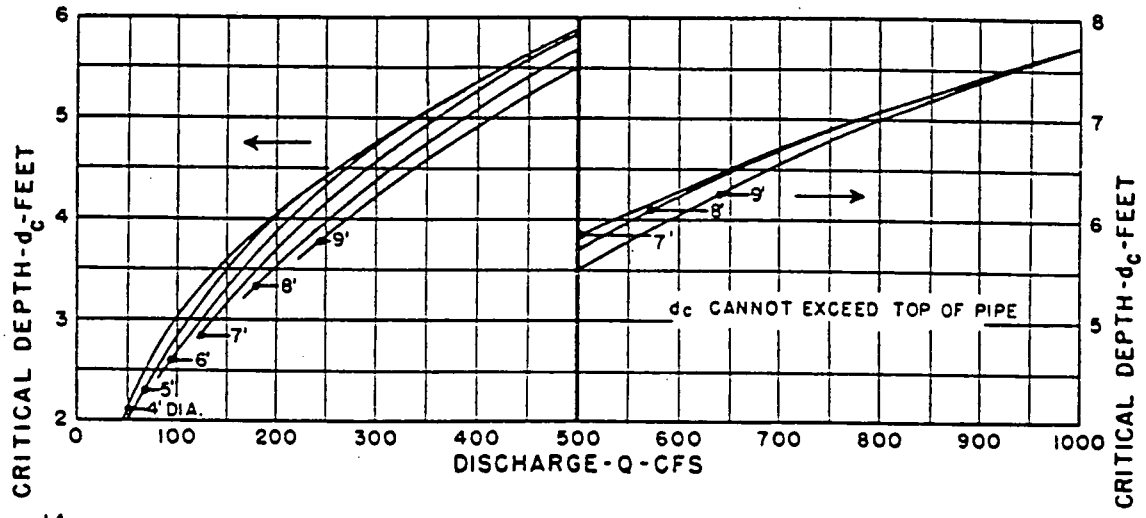
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

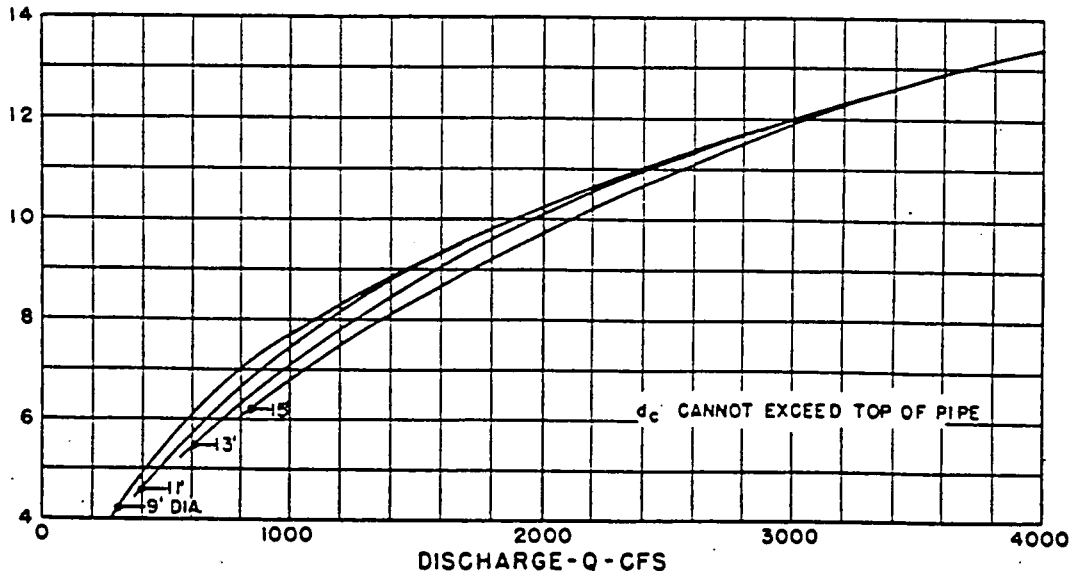
BUREAU OF PUBLIC ROADS JAN. 1963

548

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

SHTC40

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

550

Quick TR-55 Ver.5.46 S/N:
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CULVERT-7
EXISTING AND PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
GRAVEL	0.900	0.20						
			10.00	0.900	0.900	5.450	0.20	0.98

552

PROJECT: SOUTHERN WASTE UNITS CULVERT -7	STATION:	CULVERT DESIGN FORM
	SHEET ____ OF ____	DESIGNER / DATE: ____ / ____
		REVIEWER / DATE: ____ / ____

HYDROLOGICAL DATA

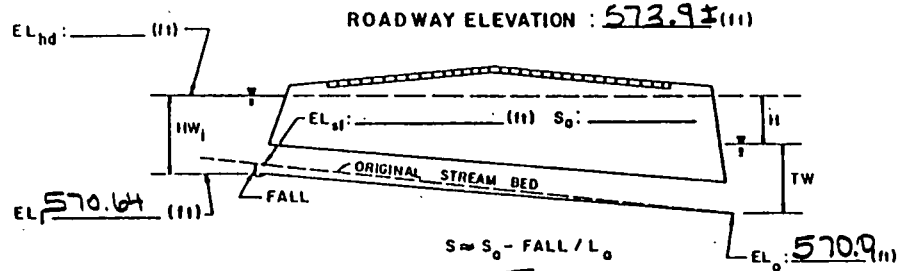
SEE ADD'L SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: — ☐ STREAM SLOPE: —
- ☐ CHANNEL SHAPE: —
- ☐ ROUTING: — ☐ OTHER: —

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
10	0.98	*

ROADWAY ELEVATION: 573.9 ± (ft)



$S \approx S_o - FALL / L_o$

$S =$ —

$L_o = \approx 30'$

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW i/D (2)	HW i	FALL (3)	EL hi (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c + D}{2}$	h_o (6)	k_e	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
TRY 12" ϕ CMP	1.0	1.0	0.64	0.64	—	571.3	1	0.4	0.7	1	0.9	≈0	571.0	571.3	—	INLET CONTROL: OK

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho. HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

* ASSUME TW = 1.0 ft

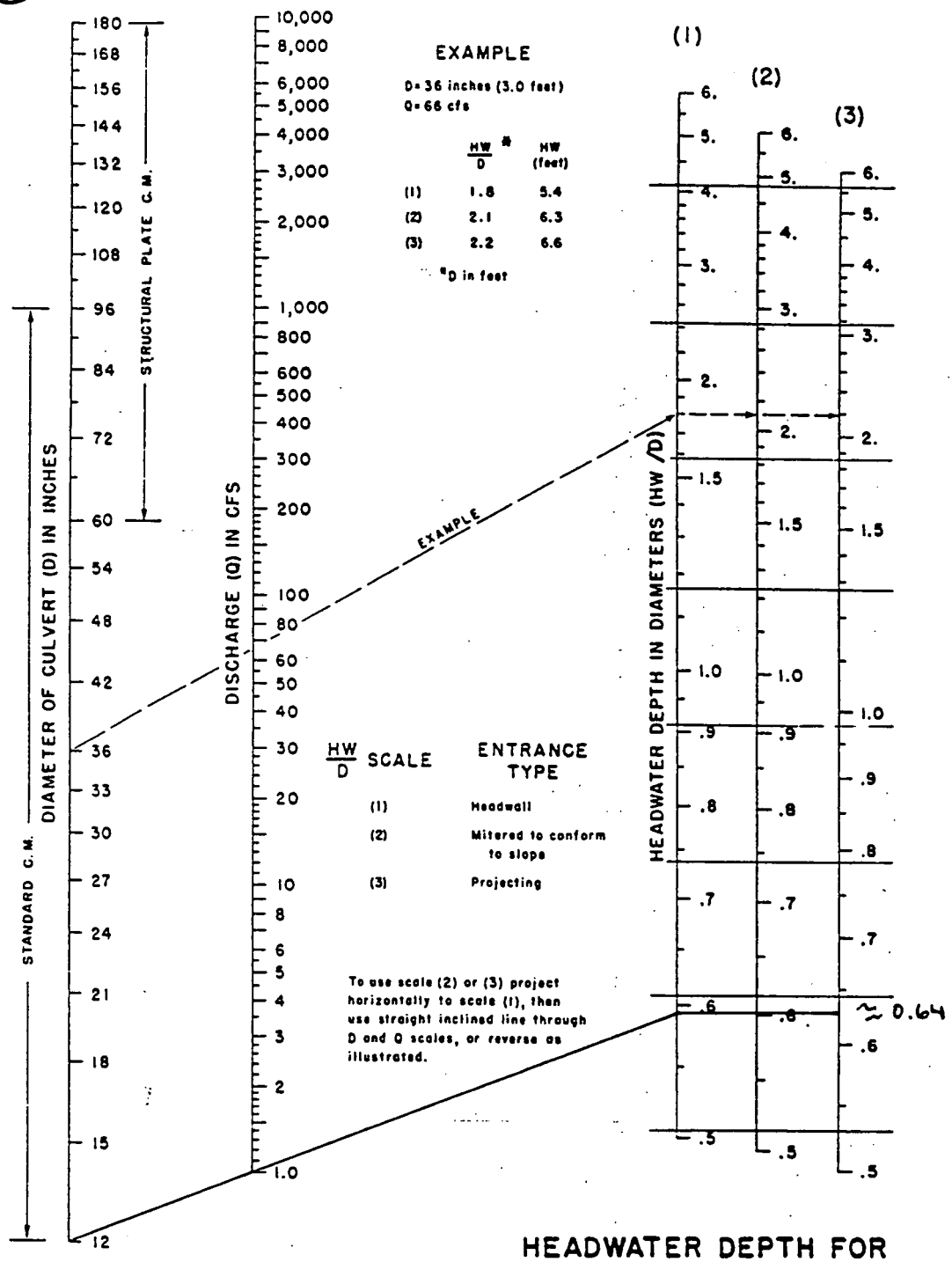
CULVERT BARREL SELECTED:

SIZE: 12"
SHAPE: ROUND
MATERIAL: CMP n=0.024
ENTRANCE: PROJECTING

240

54T C42

CHART 2



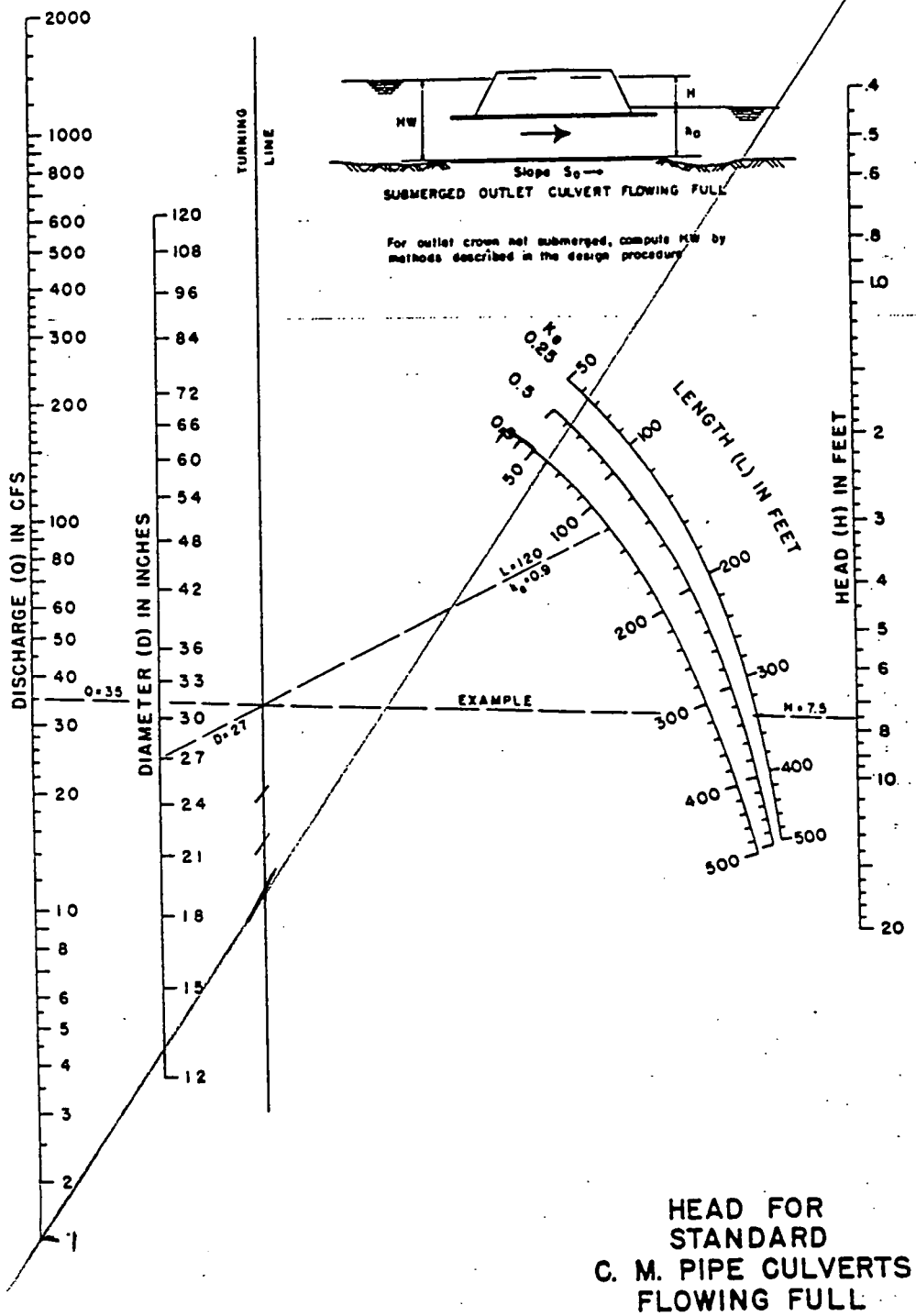
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

SHT C44

CHART 6

INSIGNIFICANT

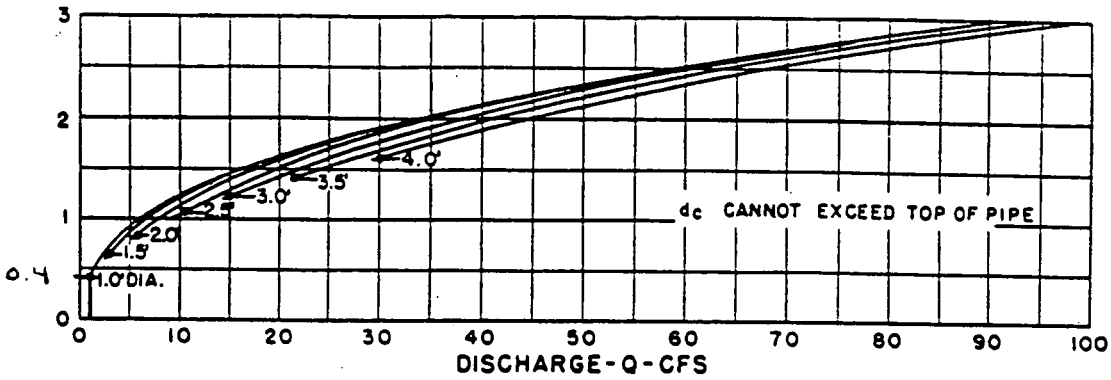


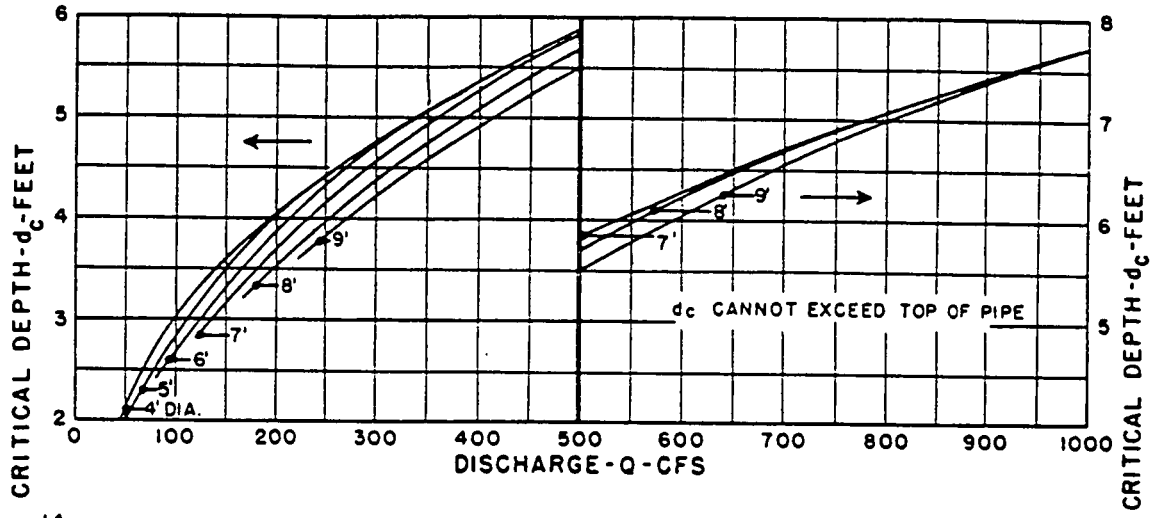
HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

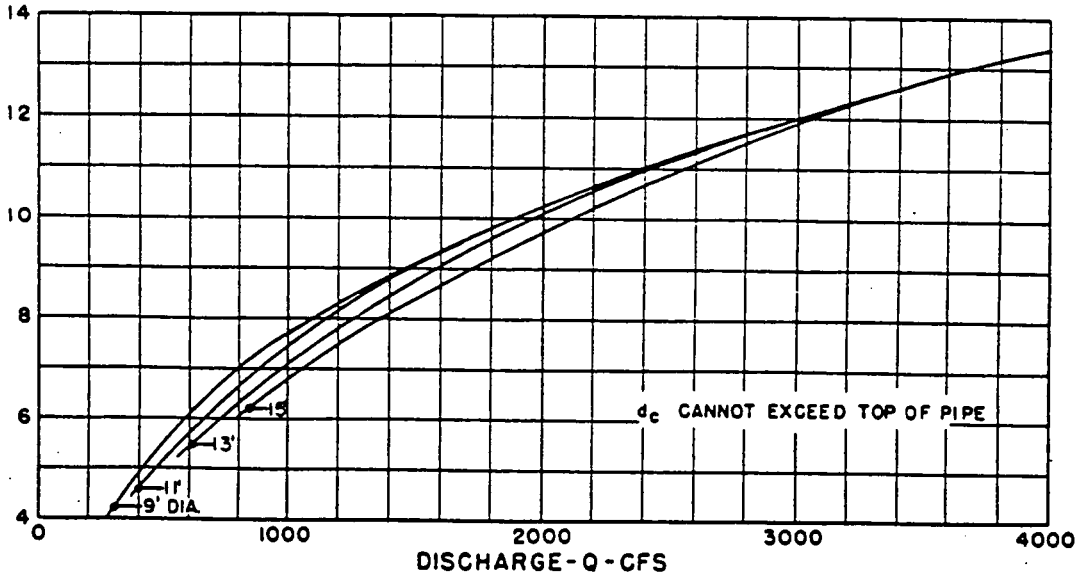
BUREAU OF PUBLIC ROADS JAN. 1963

554

CHART 4







BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

TABLE 12 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full Entrance head loss

$$H_e = k_e \left(\frac{V^2}{2g} \right)$$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be

ATTACHMENT D, BORROW AREA DRAINAGE

Methodology

The borrow area (shown on the Drainage Area Maps, Appendix B) was added to the project as this calculation package was being finalized.

Drainage structures for the borrow area consists of a sediment trap, one conveyance ditch (BA1), which conveys flows to the sediment trap, and one diversion ditch (BA2) which diverts flows away from the borrow area.

The sediment trap is designed based on criteria outlined in the Ohio Department of Natural Resources *"Rainwater and Land Development Manual"*. The required sediment trap volume is based on 67 cubic yards per acre of drainage area. The maximum sediment volume (maximum sediment cleanout elevation) is 40% of the required volume.

The conveyance ditch (BA1) and diversion ditch (BA2) are designed using the same methodology as outlined in Attachment B, Ditches.

Calculations are included on the following pages.

SAT D2

Quick TR-55 Ver.5.46 S/N:
Executed: 19:44:31 06-11-1997

DITCH - 1
BORROW AREA
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
BARE,>4:1	0.700	2.70						
			10.00	0.700	0.700	5.450	2.70	10.3

558

Quick TR-55 Ver.5.46 S/N:
Executed: 19:47:59 06-11-1997

DITCH - 2
BORROW AREA
PROPOSED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 10 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
VEG, POOR	0.600	1.20						
PAVED RD	0.950	0.20						
			10.00	0.650	0.650	5.450	1.40	4.96

SHT D4

BORROW AREA DITCH - 1 (BA1)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	BORROW AREA DITCH - 1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	10.30	cfs

Results		
Depth	1.44	ft
Flow Area	4.15	ft^2
Wetted Perimeter	6.45	ft
Top Width	5.77	ft
Critical Depth	1.11	ft
Critical Slope	0.032968	ft/ft
Velocity	2.48	ft/s
Velocity Head	0.10	ft
Specific Energy	1.54	ft
Froude Number	0.51	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04 OK

Use Erosion Control Blanket for Channel Lining

BORROW AREA DITCH - 2 (BA2)
Worksheet for Triangular Channel

Project Description	
Project File	c:\po165d\swu.fm2
Worksheet	BORROW AREA DITCH - 2
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	5.00	cfs

Results		
Depth	1.10	ft
Flow Area	2.42	ft^2
Wetted Perimeter	4.92	ft
Top Width	4.40	ft
Critical Depth	0.83	ft
Critical Slope	0.036304	ft/ft
Velocity	2.07	ft/s
Velocity Head	0.07	ft
Specific Energy	1.17	ft
Froude Number	0.49	
Flow is subcritical.		

Notes:

Velocity < 4.0 fps for n = 0.04, OK

Use Erosion Control Blanket for Channel Lining

PARSONS
ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE SOUTHERN WASTE UNITS	
0	TJB TJB	6/97				
						OU2
					AUTHOR T. BROWN SHEET D6	PO 165

SEDIMENT TRAP

Drainage Area: 5.5 acres

Total storage volume required: 67 cubic yards X 5.5 acres = 368.5 cubic yards
368.5 cubic yards X 27 cubic feet/cubic yards = 9,949.5 cubic feet

Maximum sediment cleanout volume: Total storage volume X 0.40

SEDIMENT TRAP STAGE-STORAGE-VOLUME

ELEV. (ft)	AREA (ft^2)	AREA (ft^2)	DEPTH (ft)	INCR. VOL. (ft^3)	CUM. VOL. (ft^3)
571.0	3,956				
		4,370	1	4,370	4,370
572.0	4,784				
		5,234	1	5,234	9,604
573.0	5,684				
		6,170.5	1	6,170.5	15,774.5
574.0	6,657				
			TOTAL VOLUME		15,774.5

TOTAL VOLUME REQUIRED: 9,949.5 cubic feet

TOTAL DESIGN VOLUME: 15,774.5 cubic feet

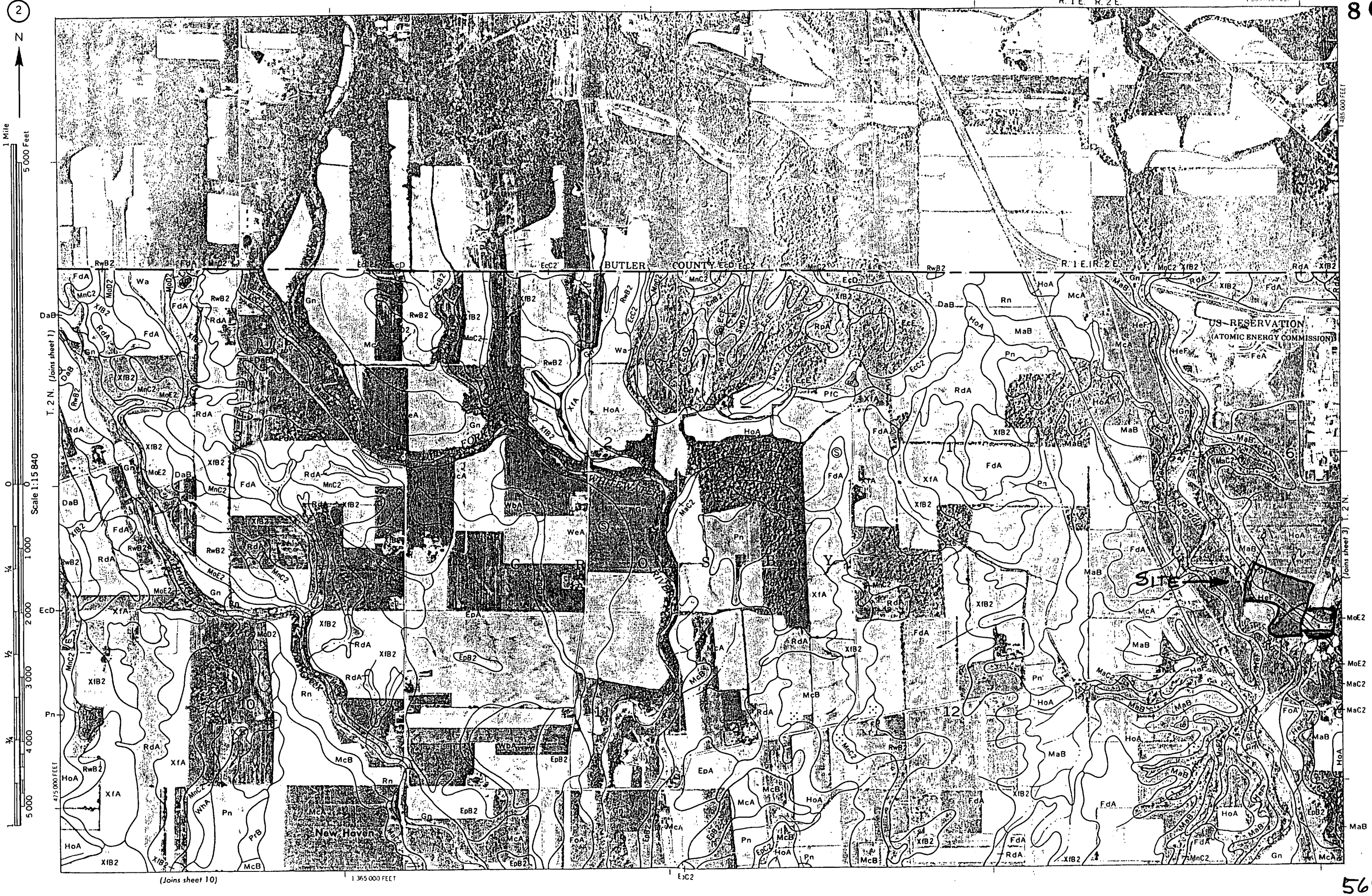
MAXIMUM SEDIMENT CLEANOUT VOLUME: 6.309.8 cubic feet

TOTAL DESIGN VOLUME > TOTAL REQUIRED VOLUME: SEDIMENT TRAP IS ACCEPTABLE

ATTACHMENT E

1) Soils Map (Reference 6)
2) Rainfall Intensity-Duration-Frequency Curve (Reference 7)

SHEET 802



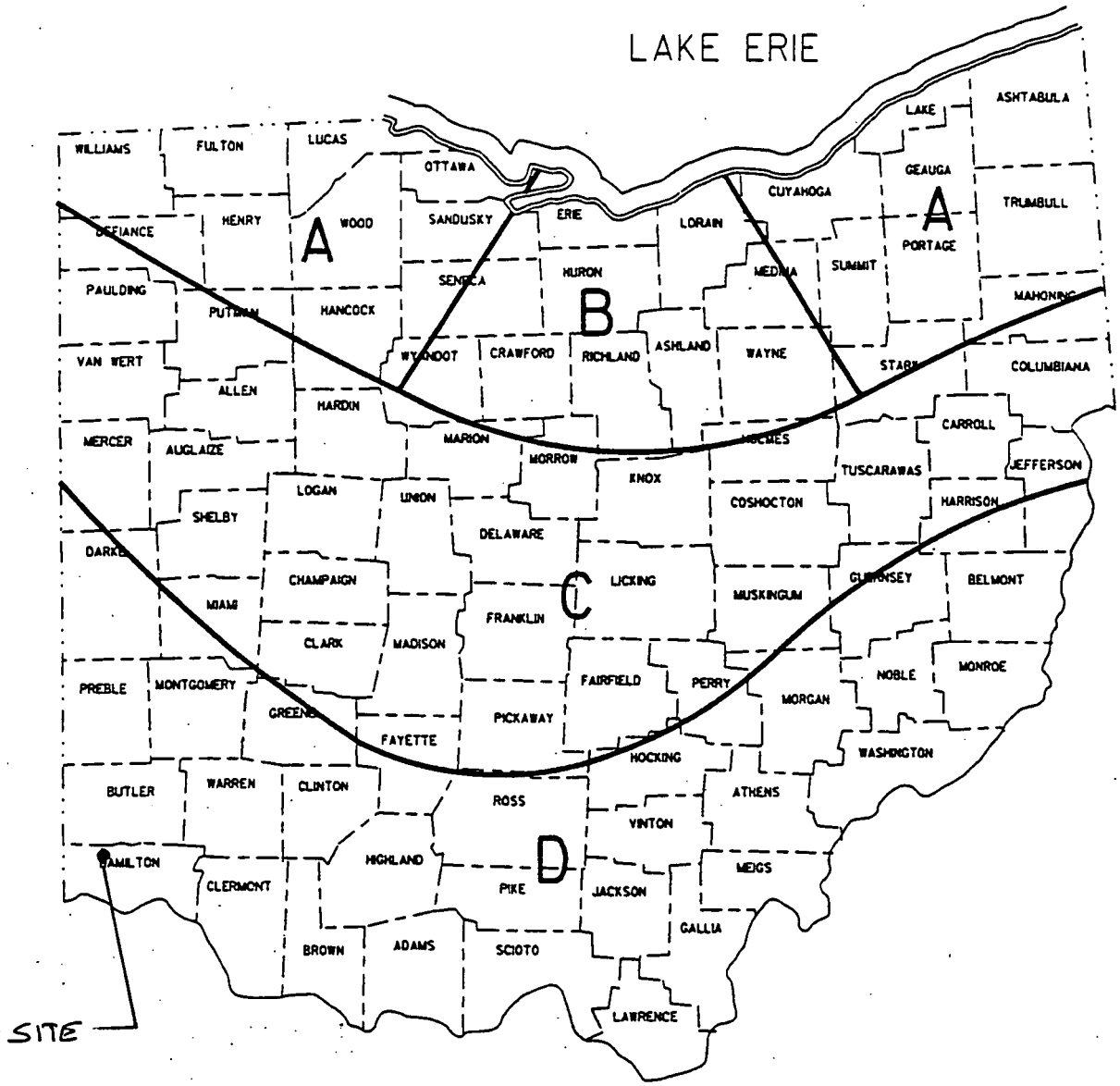
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

564

RAINFALL INTENSITY ZONE MAP

1101-3

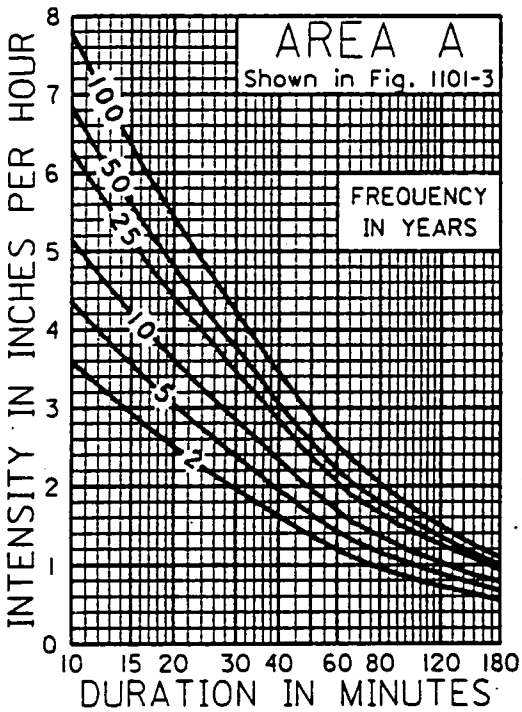
REFERENCE SECTION
1101.24

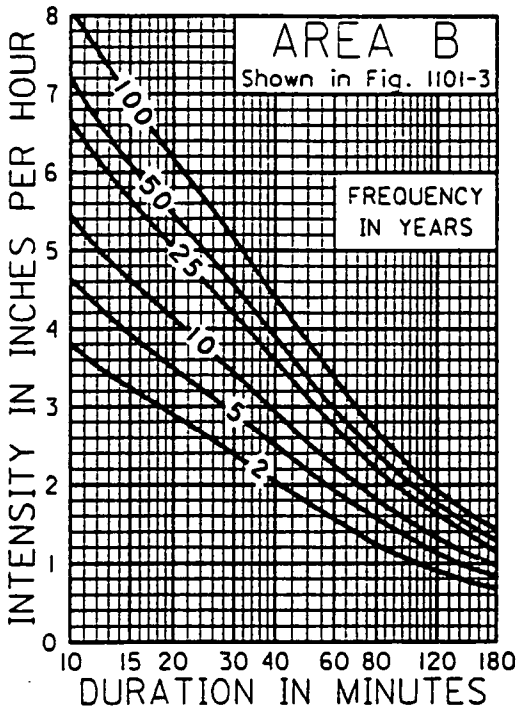


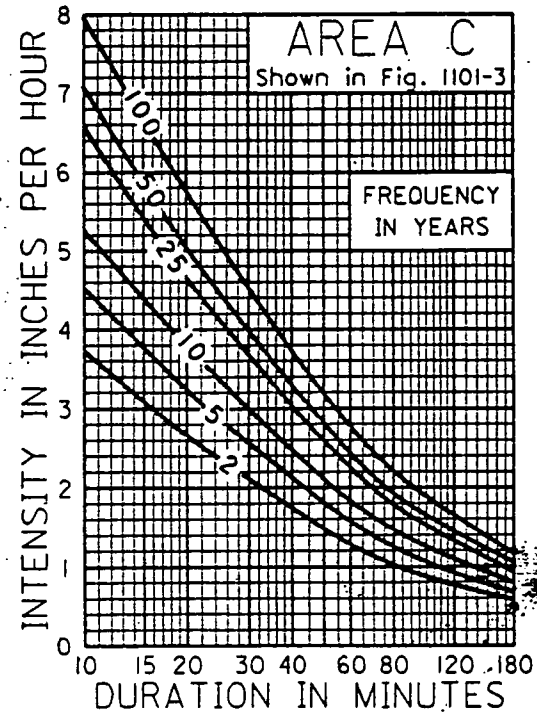
SHT E3

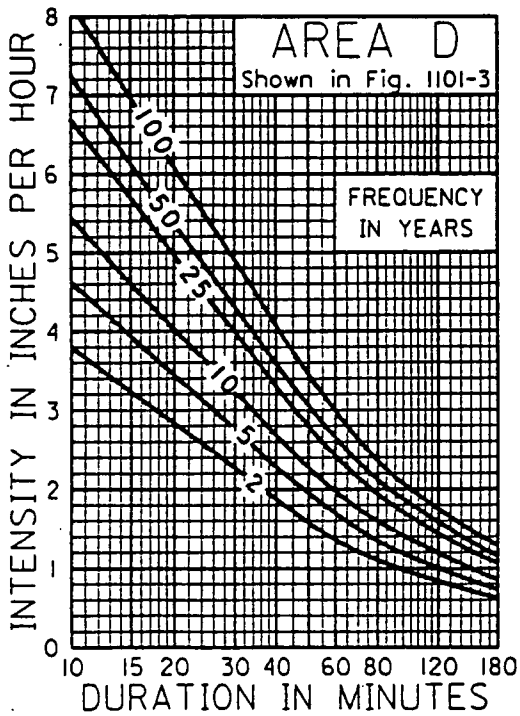
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.24

RAINFALL INTENSITY-FREQUENCY-DURATION CURVES









USE D CURVE

566

ATTACHMENT F

Calculation 15-02

PO158

Haulroad Drainage

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS TITLE AND SUMMARY SHEET

Date 7/23/96
Sheet 1 of 2

Proj. Order No. 158 Calculation No. 15-02

Project Title HAUL ROAD CONSTRUCTION

Calculation Subject DRAINAGE Date Verified/Checked 5/21/96

STATUS: PRELIMINARY ____ FINAL X SUPERSEDED ____ VOID ____

STATEMENT OF PROBLEM

DITCH & CULVERT DESIGN CALCULATIONS FOR THE HAUL ROAD.
HAUL ROAD MAXIMUM DITCH VELOCITY IS 2 FT/SEC.

SUMMARY OF CONCLUSIONS	Originator's Signature and Date
DITCHES ARE DESIGNED AND PLOTTED IN THE PROFILE AND CROSS SECTIONS	A J Shannon 5/21/96 REV 7/8/96
CHECKING METHOD	**Checker's Signature and Date**
1. Review X 2. Alternate Calculation ____	Am Christo 5/21/96 REV 7/8/96
	Lead Discipline Engineer's Signature and Date
	John Gatesley 7/23/96

Rev. No.	Sheet No.	Description	Reviser's Signature/Date	Checker's Signature/Date	Approved by Signature/Date

05/93 ENG080

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS BASIS SHEET

Revision No. 0
Sheet 2 of 2

Proj. Order No. 158 Calculation No. 15-02

Project Title HAUL ROAD CONSTRUCTION

Calculation Subject DRAINAGE Date Verified/Checked 5/21/96

Prepared By: [illegible] Checked/Verified By: [illegible]

Date 5/21/96 REV 7/8/96

SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS

- ASSUMPTIONS - STATED IN CALCULATIONS
- CODES - ODOT LOCATION & DESIGN MANUAL
- SOURCES - PLAN DRAWINGS

De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 1 of 3
Made by: AJS Date: 7/3/96
Checked by: [illegible] Date: 7/8/96

Revised Conduit Design

Assumptions/Criteria

- Use Inlet Control: Allowable HW = D ($\frac{HW}{D} = 1$)
  Use ODOT L&D Manual, Fig 1100-245 (Attachment B)
- Use Corrugated Metal Pipe
- Design based on 25-year peak discharge, Rational Method
- 2 fps maximum ditch velocity ahead of Sta 121+00
- 3 fps maximum ditch velocity below Sta 121+00

Sta 101+20

A = 12.39 Acres

Overland flow width ≈ 800 ft

Ground slope = 0.01 = 1.0%

T_o = 33 min (Attachment D)

$$T_D = \frac{(106+50 - 101+20)}{3 \text{ fps}} = 176.67 \text{ sec} = 2.9 \text{ say } 3 \text{ min}$$

T_c = 36 min

i_{25} = 3.6 in/hr

$Q_{25} = 0.3(3.6)(12.39)$

$= 13.4$ cfs

Required Pipe Size is 24" (Attachment B)

Sta 109+30

A = 10.44 Acres

Overland flow width ≈ 800 ft

Ground slope = 1.0%

T_o = 33 min

$$T_D = \frac{109+30 - 106+50}{3 \text{ fps}} = 93.3 \text{ sec} = 1.56 \text{ say } 2 \text{ min}$$

$T_c = T_o + T_D = 35$ min

$i_{25} = 3.65$ in/hr

$Q_{25} = 0.3(3.65)(10.44)$

$= 11.4$ cfs

Req'd Pipe Size is 24" (Attachment B)

Sta 119+12

A = 9.15 Acres (East Side from Sta 116+50 to the K-65 Trench @ 126+50)

Overland flow width = 350 ft, Ground slope ≈ 0.8%

T_o = 26 min

$$T_D = \frac{(126+50 - 119+12)}{3 \text{ fps}} \times \frac{1}{60} = 4.1 \text{ min}$$

T_c = 30 min

i_{25} = 4 inches/hr

De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 3 of 3
Made by: AJS Date: 7/3/96
Checked by: Amc Date: 7/8/96

Sta 119+12 (cont)

$Q_{25} = 0.3(4.0)(9.15)$

$= 10.98$ cfs say 11 cfs

Required pipe size is 24" (Attachment B)

---

ipe Slopes

Assumptions / Restrictions

- Maximum velocity of 3 fps for stations below 121+00
- Velocity based on full flow using Mannings Equation

$$S_{MAX.\,ALLOWABLE} = \left[\frac{V\,n}{1.49(A/P)^{2/3}}\right]^2 \quad \text{where}$$

$V = 3$ fps

$A = \pi r^2 = 3.141$ ft^2

$P = 2\pi r = 6.283$ ft

} All Pipes are 24" dia.

$n = 0.024$ (Attachment C)

$$S_{MAX.\,ALLOWABLE} = \left[\frac{(3\text{ fps})(0.024)}{1.49\,(0.500)^{2/3}}\right]^2$$

$S_{MAX.} = 0.0059$

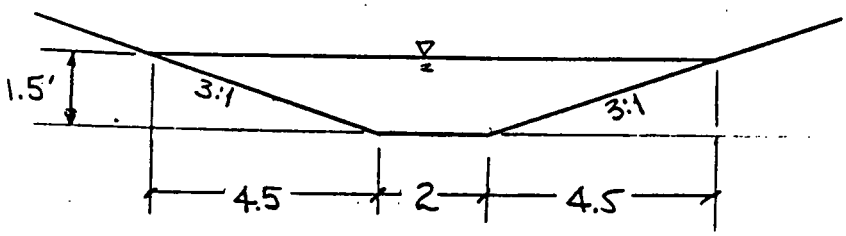
De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 1 of 5
Made by: AJS Date: 5/17/96
Checked by: AMC Date: 5/22/96
Reiteration of Previous Calcs by DCB

Ditch Design

Assumptions / Restrictions

- Max velocity of 2 fps for Stations greater than 121+00
- Max velocity of 3 fps for Stations less than 121+00
- Trapezoidal Ditch Section; 2 foot bottom, 3:1 slopes
- Design Flow depth 1.5 ft. maximum



$A = 9.75\ ft^2$

$P = 11.49\ ft$

$R = A/P = 0.849\ ft$

ince capacity is not an issue on the Haul Rd due to small
ischarges, the main objective will be to control the velocity
y means of restricting the allowable ditch slope.

De Leuw, Cather
Engineers and Planners

Subject: Haul Road
Job No. 660620
Sheet No. 2 of 5
Made by: AJS Date: 5/17/96
Checked by: AMC Date: 5/22/96

Reiteration of Previous Calc's by DCB

V = 3 fps (Sta 121+00 forward) n = 0.04 for sod lining
(ODOT L&D Manual, Table 1102-2 Attachment F)

$$S = \left[\frac{Vn}{1.49 R^{2/3}}\right]^2$$

$$= \left[\frac{(3\text{fps})(0.04)}{(1.49)(0.849)^{2/3}}\right]^2$$

$$= 0.008$$

$$= 0.80\% \text{ maximum}$$

V = 2 fps (Sta 121+00 back)

$$S = \left[\frac{(2\text{fps})(0.04)}{(1.49)(0.849)^{2/3}}\right]^2$$

$$= 0.0036$$

$$= 0.36\% \text{ maximum}$$

$$S = \left[\frac{(2\text{fps})(0.06)}{(1.49)(0.849)^{2/3}}\right]$$

$$= 0.008$$

$$= 0.80\% \text{ max}$$

Sta 121+00 to Sta 128+35

ΔElev = 573.05 − 569.10 = 3.95 ft

S = 3.95 ft / 735 ft = 0.0054

$$n = \frac{1.49}{V} R^{2/3} S^{1/2} = \frac{1.49}{2}(0.849)^{2/3}(0.0054)^{1/2} = 0.049$$

Use RCP, n = 0.06

AJS 5/14/96
Sheet 3 of 5
ck FNC 5/22/96

Haul Road Ditch Checks (Steps)

- Restrict velocity to 2 fps maximum
- Minimize Use of Rock Channel Protection
  (try to limit to 'step' area)

Sta 130+07 to Sta 141+00
Ditch Length = 1093 ft
Drainage Area = 2.03 acres (from previous calcs)

From plans, the overland flow width to the high end of the ditch is 50 feet (±), and the ground slope is approximately 2% (0.02)

T_o = 10 min (L&D Manual, Figure 1101-1, Attachment D)

Based on a ditch velocity of 2 fps

T_D = 1093 ft / 2 ft/sec = 546.5 sec = 9 min

$T_c = T_o + T_D$ = 19 min

From Fig 1101-2, i_{25} = 5 inches/hr (Attachment E)

Q_{25} = 0.3 (5)(2.03) = 3.04 cfs

Assume a flow depth of 1.5 feet, trapezoidal cross section with a bottom width of 2 feet and 3:1 side slopes, and sod lining ($n = 0.04$).

Then the flow area is

$$A = \tfrac{1}{2}\left[2 + 2 + 2(3)(1.5)\right](1.5) = 9.75\ ft^2$$

The wetted perimeter is

$$P = 2 + 2\left[(1.5)^2 + (4.5)^2\right]^{1/2} = 11.49\ ft$$

And the hydraulic radius is

$$R = A/P = 9.75/11.49 = 0.849\ ft$$

The ditch flow capacity is

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

For $S = 0.008$, $Q = 29.12$ cfs $\gg$ Max. discharge $= 3$ cfs

For $S = 0.006$, $Q = 25.22$ cfs $\gg 3$ cfs

Let $S = 0.006$ and find normal depth for $Q = 3$ cfs (peak flow in the ditch 'step' area).

Sheet 5 of 5
AJS 5/14/96
CK AMC 5/22/96

Let $d = 0.5$ ft

$A = \frac{1}{2}[2 + (2 + 2(3)(0.5))](0.5) = 1.75 \text{ ft}^2$
$P = 2 + 2[(0.5)^2 + (1.5)^2]^{1/2} = 5.16$ ft
$R = A/P = 0.339$ ft

$$Q = \frac{1.49}{0.04}(1.75)(0.339)^{2/3}(0.006)^{1/2} = 2.45 \text{ cfs}$$

Let $d = 0.6$ ft

$A = \frac{1}{2}[2 + (2 + 2(3)(0.6))](0.6) = 2.28 \text{ ft}^2$
$P = 2 + 2[(0.6)^2 + (1.8)^2]^{1/2} = 5.79$ ft
$R = A/P = 0.393$ ft

$$Q = \frac{1.49}{0.04}(2.28)(0.393)^{2/3}(0.006)^{1/2} = 3.53 \text{ cfs}$$ OKAY

$V = Q/A = 3.53/2.28 = 1.55$ f.p.s. OKAY

∴ In step area, use 0.60% ditch grade and 2-foot drops lined with Rock Channel Protection locally. Remainder of ditch to be lined with sod. Step interval is 200 ft.

1101 Estimating Design Discharge

1101.1 General

In order to properly design highway drainage facilities, it is essential that a reasonable estimate be made of the design and check discharges. Some of the more important factors affecting runoff are duration, intensity and frequency of rainfall, and the size, imperviousness, slope and shape of the drainage area. Also a proper evaluation should be made of probable changes in land use throughout the drainage area.

1101.2 Procedures

1101.21 Statistical Methods

The statistical methods developed by the U.S. Geological Survey and published in USGS Water Resources Investigations Reports 89-4126 and 86-4197 are recommended for estimating runoff from larger drainage areas. A description and limitations of these methods are described in Section 1003.

1101.22 Rational Method

The Rational method is considered to be more reliable for estimating runoff from small drainage areas, usually less than 6 acres; and for areas that contribute sheet flow only to the roadway ditch or pavement. The design discharge "Q" is obtained from the equation Q = CiA where:

C = Coefficient of runoff

i = Average rainfall intensity, in inches per hour, for a given storm frequency and for a duration equal to the time of concentration

A = Drainage area, in acres

The time of concentration is the time required for runoff to flow from the most remote point of the drainage area to the point of concentration. The point of concentration could be a culvert inlet or the checkpoint in a roadway ditch used to determine the need for protection. Time of concentration is ordinarily designated by T and is the summation of the time of overland flow "t_o" and the time of ditch flow "t_d".

Overland flow is that flow not carried in a discernible channel, and the time of such flow may be obtained from Figure 1101-1 or a similar overland flow chart.

1101.23 Coefficient Of Runoff

The recommended value for the coefficient of runoff for various contributing surfaces are shown in Table 1101-1. Where two values are shown, the higher value ordinarily applies to the steeper slopes.

Table 1101-1

Types of Surface	Coefficient of Runoff "C"
Pavement & Paved Shoulders	0.9
Berms and slopes 4:1 or flatter	0.5
Berms and slopes steeper than 4:1	0.7
Contributing Areas:	
Residential (single family)	0.4-0.6
Residential (multi-unit)	0.5-0.7
Woods	0.3
Cultivated	0.3-0.6

The total width contributing flow to a given point usually consists of surfaces having a variable land cover and thereby require a weighted coefficient of runoff "C". The weighted coefficient is obtained by averaging the coefficients for the different types of contributing surfaces, as noted in the following example:

Contributing Width "W"	Land Use	"C"	"CW"
20 Ft.	Paved Area	0.9	18
40 Ft.	Earth Berms & Slopes	0.7	28
140 Ft.	Residential Area	0.6	84
200 Ft.			130

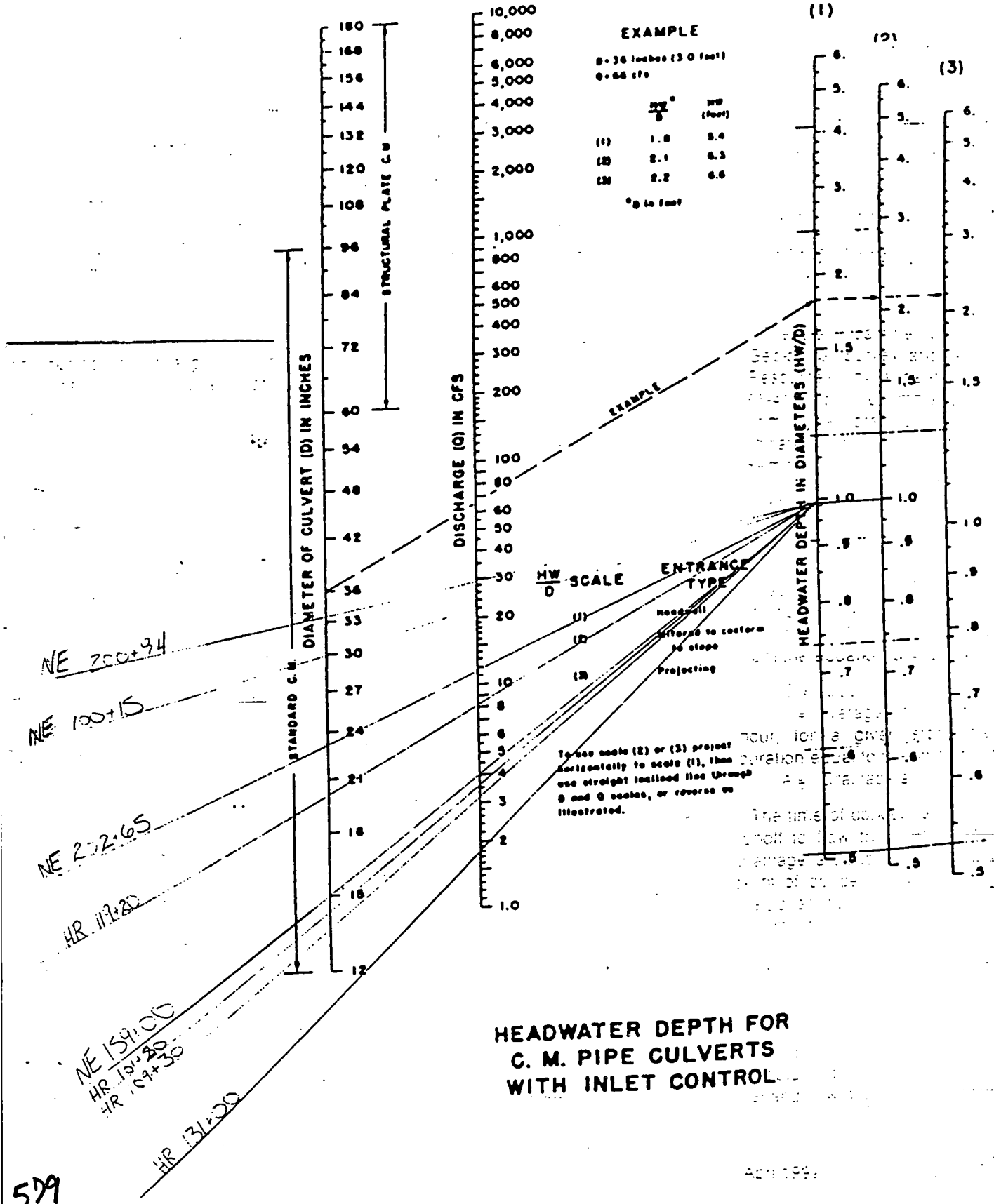
$$\text{Weighted "C"} = \frac{130}{200} = 0.65$$

1101.24 Rainfall Intensity

The average rainfall intensity "i" in inches per hour may be obtained from the Intensity-Frequency-Duration curves shown on Figure 1101-2. Each set of curves applies to a specific geographic area, A, B, C or D as shown on the Rainfall Intensity Zone Map, Figure 1101-3. The geographic areas were established from an analysis of rainfall records obtained from Weather Bureau stations in Ohio. Some political subdivisions may have developed curves for their specific area similar to Figure 1101-2. Such curves may be based on a much longer period of record,

Attachment B

Fig. 1100-245



HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

April 1964

91

579

TABLE 10.6 TYPICAL VALUES OF THE ROUGHNESS COEFFICIENT n

Lined Canals	n
Cement plaster	0.011
Untreated gunite	0.016
Wood, planed	0.012
Wood, unplaned	0.013
Concrete, troweled	0.012
Concrete, wood forms, unfinished	0.015
Rubble in cement	0.020
Asphalt, smooth	0.013
Asphalt, rough	0.016
Corrugated metal	0.024
Unlined Canals	
Earth, straight and uniform	0.023
Earth, winding and weedy banks	0.035
Cut in rock, straight and uniform	0.030
Cut in rock, jagged and irregular	0.045
Natural Channels	
Gravel beds, straight	0.025
Gravel beds plus large boulders	0.040
Earth, straight, with some grass	0.026
Earth, winding, no vegetation	0.030
Earth, winding, weedy banks	0.050
Earth, very weedy and overgrown	0.080

Manning Equation—Traditional System of Units

It can be shown that, in converting from SI to the traditional system one must apply a factor equal to 1.49 if the same value of n is used in systems. Thus in the traditional system the discharge equation using n is given as

$$Q = \frac{1.49}{n} A R_h^{2/3} S_0^{1/2}$$

EXAMPLE 10.16 If the channel of Example 10.15 has a slope what is the discharge in the channel and what is the numerical value ning's n for this channel?

Solution From Example 10.15, we have an f value of 0.130, and the mate value of R_h is 4.3 ft. In Example 10.14 it was shown that

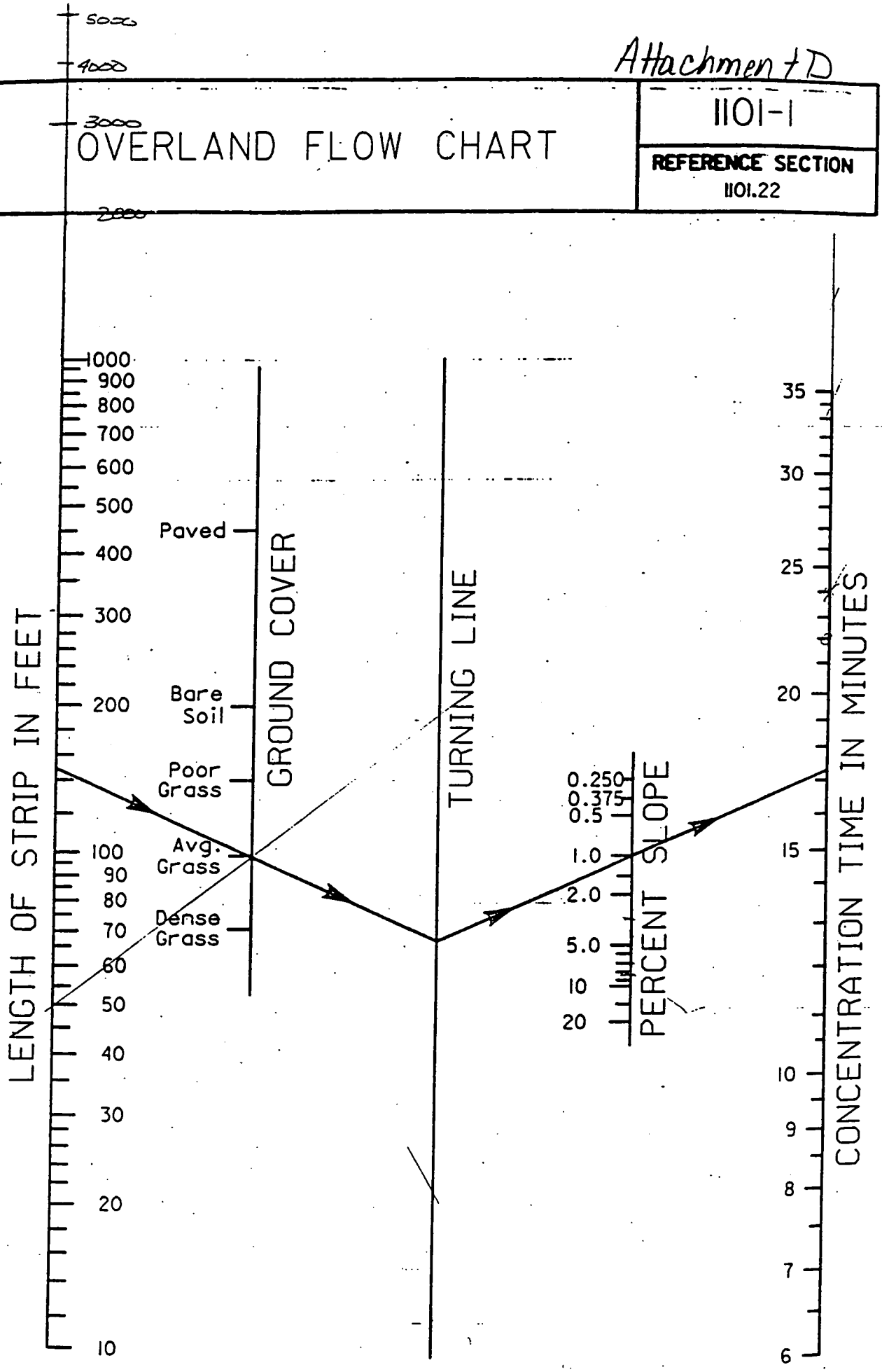
$$V = \sqrt{\frac{8g}{f}}\sqrt{R_h S_0}$$

Attachment D

OVERLAND FLOW CHART

1101-1

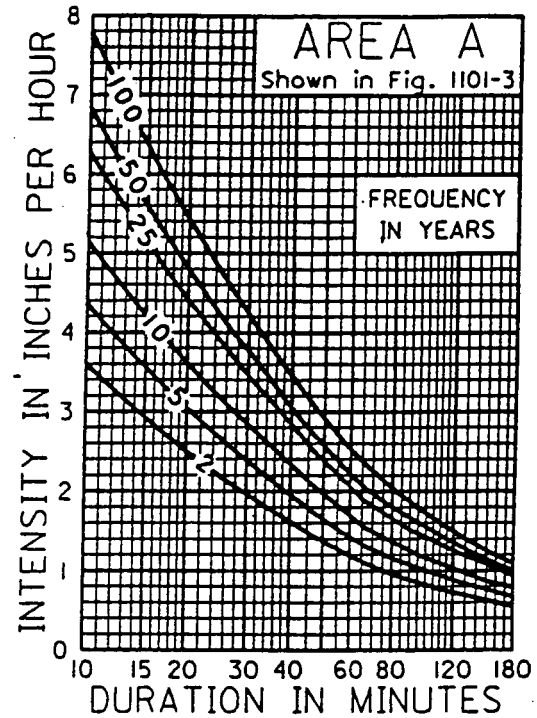
REFERENCE SECTION
1101.22

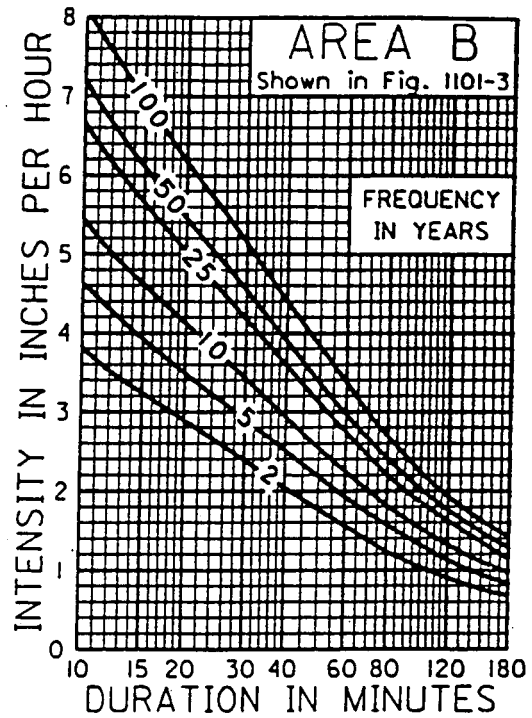


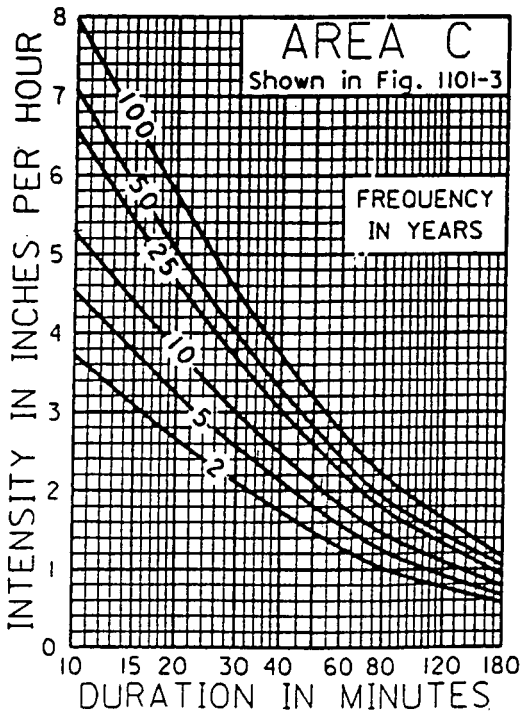
Attachment E

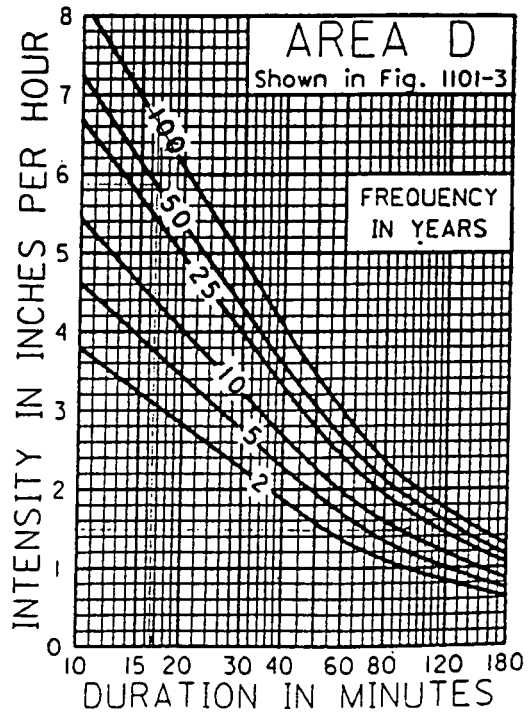
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.24

RAINFALL INTENSITY-FREQUENCY-DURATION CURVES









Attachment F

1102.3 Ditch Design Criteria - Design Traffic Exceeding 2000 ADT

1102.31 Design Frequency

It is recommended that a 10-year frequency storm be used to determine the depth of flow, and a 5-year frequency be used to determine the velocity of flow and the depth of ditch lining where needed. Where a flexible ditch lining is required for calculated velocities exceeding the allowable for seed, the minimum width of the lining shall be 7-1/2 feet. The depth of flow shall be limited to an elevation 12 inches below the edge of pavement for the design discharge. Other ditches, including toe of slope, should not be overtopped by the design discharge.

1102.32 Velocity

The velocity for the five-year frequency storm should not exceed the values shown in Table 1102-1 for the various soil types and flexible linings.

Table 1102-1

ALLOWABLE DITCH VELOCITIES
(Ft. Per. Sec.)

Soil Type	Seed Lining (659)	Sod Lining (660)	Jute or Excelsior Matting (667) or (668)
Sand	1.5	3.5	3.0
Firm Loam	2.0	4.0	4.0
Clay	2.5	5.0	4.0
Gravel	3.5	6.0	5.0
Weathering Shale	4.5	6.0	5.0

If the calculated velocity exceeds that shown in the table, a concrete lining should be considered only as a last resort. Also Type B, C or D Rock Channel Protection may be used to line the ditch if the nearest point of the lining is outside the design clear zone or located behind guardrail. Item 838 Seeding and Erosion Control with Matting may be used in lieu of rock, where average flow velocity is less than 10 feet per second and the ditch slope is less than 10%. Type B or C rock should be considered for lining ditches on steep grades that carry flow from the end of a cut section down to the valley floor.

1102.33 Roughness

Suggested values for Manning's Roughness Coefficient "n" for the various types of open water carriers covered in Section 1102.2 are listed in Table1102-2.

Table 1102-2

Type of Lining	Roughness Coefficient
Bare Earth	.02
Seeded	.03
Sod	.04
Jute Mat.	.04
Excelsior Mat.	.04
Item 838 Matting	.04
Concrete	.015
Bituminous	.018
Grouted Riprap	.02
Rock Channel Protection	.06 for ditches .04 for large channels

1102.34 Catch Basin Types

The Standard CB-4, 5 and 8 Catch Basins are suitable for the standard roadside designs covered in the Roadway Design Manual. The tilt built into the basin top provides a self-cleaning feature when the basins are used on continuous grades and the wide bar spacing minimizes clogging possibilities, thereby resulting in an efficient design. The bases of the 4, 5 and 8 Catch Basins can be expanded to accommodate larger diameter conduits by specifying 4A, 5A or 8A Basins, detailed on Standard Drawing CB-458A. The bar spacing can be decreased, when desirable for safety reasons, by specifying Grate E for the CB-4 and Grate B for CB-5. The following catch basin types are generally recommended based on the size and shape of the ditch.

A. Standard CB-4 for depressed medians wider than 40 feet.

B. Standard CB-5 for 40 foot radius roadside or median ditches (Use grate B where pedestrian traffic may be expected).

C. Standard CB-8 for 20 foot radius roadside or depressed medians 40 feet or less in width.

D. Standard CB-2-2-A catch basins may be used in trapezoidal toe ditches where the basin is located outside the design clear zone or behind guardrail and the protruding feature of the basin is

ATTACHMENT G

Calculation 15-01

PO139

Design of Seepage Collection & Removal of Sediment

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS TITLE AND SUMMARY SHEET

Date 20 Feb 95
Sheet 1 of 2

Proj. Order No. 139 Calculation No. 15-01

Project Title Seepage Design and Sediment Removal

Calculation Subject Storm Drainage Date Verified/Checked

STATUS: PRELIMINARY ____ FINAL X SUPERSEDED ____ VOID ____

STATEMENT OF PROBLEM

Determine the peak runoff for the 25-year, 24-hour storm event for the proposed diversion pipe and size the pipe using corrugated HDPE. (Per FERMCO CRU-2 direction)

SUMMARY OF CONCLUSIONS

The peak discharge is 9 cfs and the pipe is 18 inch diameter.

Originator's Signature and Date

Kenneth F. Gerard 2/28/95

CHECKING METHOD

1. Review X
2. Alternate Calculation ____

Checker's Signature and Date

CR TOMONGIN 3/17/95

Lead Discipline Engineer's Signature and Date

Ed Kuhn 3/17/95

Rev. No.	Sheet No.	Description	Reviser's Signature/Date	Checker's Signature/Date	Approved by Signature/Date

PARSONS
ERA PROJECT

ENGINEERING CALCULATIONS BASIS SHEET

Revision No. 0
Sheet 2 of 60

Proj. Order No. 139 Calculation No. 15-01

Project Title Seepage Design and Sediment Removal

Calculation Subject Storm Drainage Date Verified/Checked 3/17/95

Prepared By: K. Gerard Checked/Verified By: CR TOMONGIN

Date 2/20/95

SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS

Data Sources

1. PARSONS DWG. (used as DA Map)
2. Haestad Methods, 1989. *Quick TR-55™ Urban Hydrology for Small Watersheds*
3. SCS Ohio 24-Hour Rainfall (inches)
4. SCS, August 1982. *Soil Survey of Hamilton County, Ohio*
5. Advanced Drainage Systems, Inc. (ADS), 1988. N-12 Pipe product literature
6. ODOT, *Location and Design Manual, Volume Two, Drainage Design*
7. Brater, Ernest F. & Horace Williams King, 1976. *Handbook of Hydraulics*, Sixth Ed. New York: McGraw-Hill Book Company
8. Heald, C.C., Ed., 1992. *Cameron Hydraulic Data Book*, 17 ed. Woodcliff Lake, N.J.: Ingersoll-Rand

Codes

1. DOE Order 6430.1A / RM-FMPC-0001

Assumptions

1. Use SCS TR-55 to determine peak discharge. (Haestad Methods Quick TR-55).
2. Use SCS storm events for Hamilton County, Ohio. (Ref 3)
3. Pipe will be used for a short term, low-traffic area. Per FERMCO CRU-2 directive to use HDPE pipe material, use corrugated polyethylene pipe using ADS N-12 pipe data. Mannings n for ADS N-12 is o.010 - 0.012. Use 0.011 to account for the bends.

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ENGINEERING CALCULATIONS
BASIS SHEET
SUMMARY OF DATA SOURCES - CODES - ASSUMPTIONS (continued)

4. Land use is mixed. Use weighted Runoff Curve Number. See D.A. Map (in the back of the calculations) and calculations for land use, acreage, and coverage conditions used. All ground coverage conditions were assumed to be in good condition.

5. From Reference 4, the soils in the vicinity of the site and their HSG are as follows:

Gn	Genesee Loam, HSG B (This is most likely in the Paddy's Run Flood Plain and not in the DA)
HeF	Hennepin Silt Loam, 35 to 60 % slopes, HSG B (This is most likely in the steep slope areas adjacent to Paddy's Run and not in the DA)
HoA	Henshaw Silt Loam, 0 to 2 % slopes, HSG C
MaB	Markland Silty Clay Loam, 2 to 6 % slopes, HSG C
MaC2	Markland Silty Clay Loam, 6 to 12 % slopes, HSG C

A copy of the soil survey map is in the back of the calculations. Given the information from the soil survey map, HSG C is used for all land uses for the peak discharge calculations.

6. For computing Tc segment DE, the same open channel assumed to exist between the proposed pipe and the gravel road was assumed to exist where the runoff goes under the gravel road (existing culvert is assumed to exist and is operational).

7. For computing Tc segment DE, the proposed open channel between the proposed pipe and the gravel road is assumed to be a 2 ft. flat bottom trapezoidal ditch with 4:1 side slopes, rip rap lined.

8. Other assumptions are as specified in the calculations.

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

CRU: 2 PO: 139 Job Number: 7663-0139-11112-120

Computer Code: OTR-55 Version: 5.46

Code Verification Status: REV 0, Nov 1992

Description of Program: Computes peak discharge per SCS TR-55 Method

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: To determine peak discharge to size proposed storm drain

Run Performed By: K. Gerard

Date/Time of Run: 2/20/95

Computer Time of Run: n/a

Input Filename: WESTPIPE.***, *** = RCN, TCT, GPD

Output Filename: same as input

Files Saved to Diskname: a:\po139\SD Disk Location: with calc set w/ backup with discipline files

Results: Peak discharge for 25-year, 24-hour storm is 9 cfs.

Performed By: K. Gerard Date: 2/28/95

Checked By: CR TOMONGIN Date: 3/7/95

Approved By: Ed Kuhn Date: 3/17/95

PARSONS
ERA PROJECT

COMPUTER CALCULATION SUMMARY SHEET

CRU: 2 PO: 139 Job Number: 7663-0139-11112-120

Computer Code: FlowMaster Version: 3.41

Code Verification Status: REV 0, Dec 1992

Description of Program: Computes solutions to open channel hydraulics problems

Source of Data: Refer to Data Sources, Sheet 2

Purpose/Description of Calculation: To determine Tc values and to size proposed storm drain

Run Performed By: K. Gerard

Date/Time of Run: 2/20/95 - 2/28/95

Computer Time of Run: n/a

Input Filename: WESTPIPE.H&H & PRODITCH.H&H

Output Filename: same as input

Files Saved to Diskname: a:\po139\SD Disk Location: with calc set w/ backup with discipline files

Results: Refer to the calculations.

Performed By: K. Gerard Date: 2/28/95

Checked By: CR TOMONGIN Date: 3/17/95

Approved By: E. Kaba Date: 3/17/95

REV	BY	DATE	CK	DATE	TITLE	
0	KG	2/20/95	CRT	3/17/95	Design of Seepage Collection & Sediment Removal	
					Storm Drain	CRU- 2
					AUTHOR: K. Gerard SHEET 6 OF	PO - 139

RESULTS

The results of the peak discharge calculations are as follows:

2-yr 3 cfs
10-yr 7 cfs
25-yr 9 cfs

The table below summarizes the results of the pipe design calculations for a pipe slope at 0.6%:

	Dia.	$V_{2\text{-}Yr}$ fps	$V_{25\text{-}Yr}$ fps	Q_{FULL} cfs	Q_{MAX} cfs
ADS	15"	4.84	--	5.91	•
ADS	18"	4.81	6.18	9.62	10.34
ADS	24"	4.69	6.36	20.71	22.28

• not calculated

CONCLUSIONS AND RECOMMENDATIONS

The velocity is sufficient at the 2-year storm to provide self cleaning of sediment. An 18" HDPE (ADS N-12) pipe is large enough for the 25-year storm and is recommended.

ODOT Table 1107-1 indicates that 6.5 l.f. of 6" stone, Type C is required. This is based on a V = 6.2 fps for the $Q_{25\text{-}Yr}$ condition.

An ODOT No. 2-2-A catch basin was evaluated and found acceptable when modified for an East Jordan Iron Works, (EJIW), 6610 grate.

ATTACHMENT A

SUPPORTING CALCULATIONS

Quick TR-55 Ver.5.46 S/N:
Executed: 09:17:20 02-20-1995

PO-139 RA #31
Design of Seepage Collection
and
Sediment Removal

RUNOFF CURVE NUMBER DATA

::

Composite Area: West Pipe

SURFACE DESCRIPTION	AREA (acres)	CN
Open Space/good/HSG C	3.13	74
Woods/good/HSG C	8.48	70
Gravel/HSG C	0.29	89
COMPOSITE AREA --->	11.90	71.5

72

::

SEE D.A. MAP

A-1

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Tc Calc

Comment: Tc Segment B-C

Solve For Discharge

Given Input Data:

Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.040
Channel Slope....	0.0250 ft/ft
Depth.....	0.50 ft

Computed Results:

Discharge.....	1.08 cfs
Velocity.....	2.16 fps
Flow Area.....	0.50 sf
Flow Top Width...	2.00 ft
Wetted Perimeter.	2.24 ft
Critical Depth...	0.45 ft
Critical Slope...	0.0446 ft/ft
Froude Number....	0.76 (flow is Subcritical)

ASSUME Tc SEGMENT HAS THE INPUT DATA GIVEN

Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

A-2

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Tc Calc

Comment: Tc Segment D-E

Solve For Discharge

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	4.00:1 (H:V)
Right Side Slope.	4.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.0250 ft/ft
Depth.....	0.60 ft

Computed Results:

Discharge.....	9.30 cfs ≈ PEAK DISCHARGE, OK
Velocity.....	3.52 fps
Flow Area.....	2.64 sf
Flow Top Width...	6.80 ft
Wetted Perimeter.	6.95 ft
Critical Depth...	0.60 ft
Critical Slope...	0.0252 ft/ft
Froude Number....	1.00 (flow is Critical)

ASSUME Tc SEGMENT HAS THE INPUT DATA GIVEN,

Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

```
Quick TR-55 Ver.5.46   S/N:
Executed: 09:07:52   02-20-1995    a:\po139\sd\WESTPIPE.TCT

                    PO-139    RA #31
        Design of Seepage Collection and Sediment Removal


              Tc COMPUTATIONS FOR: West Pipe

SHEET FLOW (Applicable to Tc only)
    Segment ID                                     AB
    Surface description                       woods
    Manning's roughness coeff., n                 0.4000
    Flow length, L (total < or = 300)        ft    210.0
    Two-yr 24-hr rainfall, P2                in    3.000
    Land slope, s                           ft/ft  0.0025
                     0.8
        .007 * (n*L)
    T = --------------                       hrs     1.54              =  1.54
            0.5    0.4
          P2   *  s

SHALLOW CONCENTRATED FLOW
    Segment ID                                     CD
    Surface (paved or unpaved)?                    Unpaved
    Flow length, L                           ft    270.0
    Watercourse slope, s                    ft/ft  0.0075

                         0.5
    Avg.V =  Csf *  (s)                     ft/s   1.3973
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                         hrs     0.05              =  0.05


CHANNEL FLOW
    Segment ID                                     BC        DE
    Cross Sectional Flow Area, a           sq.ft    0.50      2.64
    Wetted perimeter, Pw                     ft     2.24      6.95
    Hydraulic radius, r = a/Pw               ft    0.223     0.380
    Channel slope, s                        ft/ft  0.0250    0.0250
    Manning's roughness coeff., n                  0.0400    0.0350

                    2/3    1/2
        1.49  *  r    *  s
    V = --------------------                ft/s   2.1673    3.5305
                  n

    Flow length, L                           ft      260       125

    T = L / (3600*V)                         hrs     0.03  +   0.01    =  0.04
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                                 TOTAL TIME (hrs)        1.63
```

A-4

Quick TR-55 Version: 5.46 S/N:

>>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<<

PO-139 RA #31
Design of Seepage Collection and Sediment Removal

CALCULATED
DISK FILE: a:\po139\sd\WESTPIPE.GPD

Drainage Area	(acres)	11.9	--->	0.0186 sq.mi.
Runoff Curve Number	(CN)	72		
Time of Concentration,Tc	(hrs)	1.63		
Rainfall Distribution	(Type)	II		
Pond and Swamp Areas	(%)	0	--->	0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	2	10	25
Rainfall, P, 24-hr (in)	3.0	4.1	4.8
Initial Abstraction, Ia (in)	0.778	0.778	0.778
Ia/p Ratio	0.259	0.190	0.162
Unit Discharge, * qu (csm/in)	222	239	246
Runoff, Q (in)	0.81	1.53	2.05
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	3	7	9

Summary of Computations for qu

Ia/p	#1	0.100	0.100	0.100
C0	#1	2.553	2.553	2.553
C1	#1	-0.615	-0.615	-0.615
C2	#1	-0.164	-0.164	-0.164
qu (csm)	#1	260.210	260.210	260.210
Ia/p	#2	0.300	0.300	0.300
C0	#2	2.465	2.465	2.465
C1	#2	-0.623	-0.623	-0.623
C2	#2	-0.117	-0.117	-0.117
qu (csm)	#2	212.799	212.799	212.799
* qu (csm)		222	239	246

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond & Swamp Adj.)

A-5

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Description: Proposed Pipe at West Pump Station

Solve For Actual Depth

Given Constant Data;

Slope..... 0.0060
Mannings n..... 0.011 ADS N-12 *
Q_2=Discharge..... 3.00

Variable Input Data	Minimum	Maximum	Increment By
Diameter	1.25 15"	2.00 24"	0.25

* ADS Recommends a "n" value of 0.010 — 0.012.

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VARIABLE				COMPUTED	COMPUTED	COMPUTED	
Diameter ft	Channel Slope ft/ft	Mannings 'n'	Discharge cfs Q2-YR	Depth ft	Velocity fps	Capacity Full cfs	
1.25	0.0060	0.011	3.00	0.63	4.84	5.91	
1.50	0.0060	0.011	3.00	0.58	4.81	9.62	
~~1.75~~	~~0.0060~~	~~0.011~~	~~3.00~~	~~0.54~~	~~4.75~~	~~14.51~~	N/A
2.00	0.0060	0.011	3.00	0.51	4.69	20.71	

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Description: Proposed Pipe at West Pump Station

Solve For Actual Depth

Given Constant Data;

Slope..... 0.0060
Mannings n..... 0.011 * ADS N-12
Q_{25}=Discharge..... 9.00 cfs

Variable Input Data	Minimum	Maximum	Increment By
Diameter	1.25	2.00	0.25
	15"	24"	

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VARIABLE				COMPUTED	COMPUTED	COMPUTED	
Diameter ft	Channel Slope ft/ft	Mannings 'n'	Discharge cfs	Depth ft	Velocity fps	Capacity Full cfs	
Unable to compute this instance. (1.25' Ø Too Small)							
1.50	0.0060	0.011	9.00	1.15	6.18	9.62	
~~1.75~~	~~0.0060~~	~~0.011~~	~~9.00~~	~~1.00~~	~~6.35~~	~~14.51~~	N/A
2.00	0.0060	0.011	9.00	0.92	6.36	20.71	

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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Description: Proposed Pipe at West Pump Station

Solve For Full Flow Capacity

Given Constant Data;

Slope..... 0.0060
Mannings n..... 0.011 ADS N-12
Discharge..... 5.91

Variable Input Data	Minimum	Maximum	Increment By
Diameter	1.25	2.00	0.25
	15"	24"	

VARIABLE			COMPUTED	COMPUTED	COMPUTED	COMPUTED
Diameter ft	Channel Slope ft/ft	Mannings 'n'	Discharge cfs	Depth ft	Velocity fps	Capacity Full cfs
1.25	0.0060	0.011	5.91	1.25	4.82	5.91
1.50	0.0060	0.011	9.62	1.50	5.44	9.62
~~1.75~~	~~0.0060~~	~~0.011~~	~~14.51~~	~~1.75~~	~~6.03~~	~~14.51~~ N/A
2.00	0.0060	0.011	20.71	2.00	6.59	20.71

Open Channel Flow Module, Version 3.41 (c)
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Comment: Proposed Pipe at West Pump Station

Solve For Actual Discharge @ 0.94D

Given Input Data:

	Diameter.....	1.50 ft	18"
	Slope.....	0.0060 ft/ft	
	Manning's n.....	0.011	ADS N-12
0.94D =	Depth.....	1.41 ft	

Computed Results:

QMAX =	Discharge.....	10.34 cfs
V@QMAX =	Velocity.....	6.00 fps
	Flow Area.....	1.72 sf
	Critical Depth....	1.24 ft
	Critical Slope....	0.0069 ft/ft
	Percent Full.....	94.00 %
	Full Capacity.....	9.62 cfs
	QMAX @.94D.....	10.34 cfs
	Froude Number.....	0.68 (flow is Subcritical)

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: West Diversion Pipe

Comment: Proposed Pipe at West Pump Station

Solve For Actual Discharge @ 0.94 D

Given Input Data:

D =	Diameter.....	2.00 ft	24"
	Slope.....	0.0060 ft/ft	
	Manning's n.....	0.011	ADS-N-12
0.94D =	Depth.....	1.88 ft	

Computed Results:

QMAX =	Discharge.....	22.28 cfs
VMAX =	Velocity.....	7.27 fps
	Flow Area.....	3.06 sf
	Critical Depth....	1.68 ft
	Critical Slope....	0.0066 ft/ft
	Percent Full.....	94.00 %
	Full Capacity.....	20.71 cfs
	QMAX @.94D.....	22.28 cfs
	Froude Number.....	0.71 (flow is Subcritical)

Open Channel Flow Module, Version 3.41 (c) 1991
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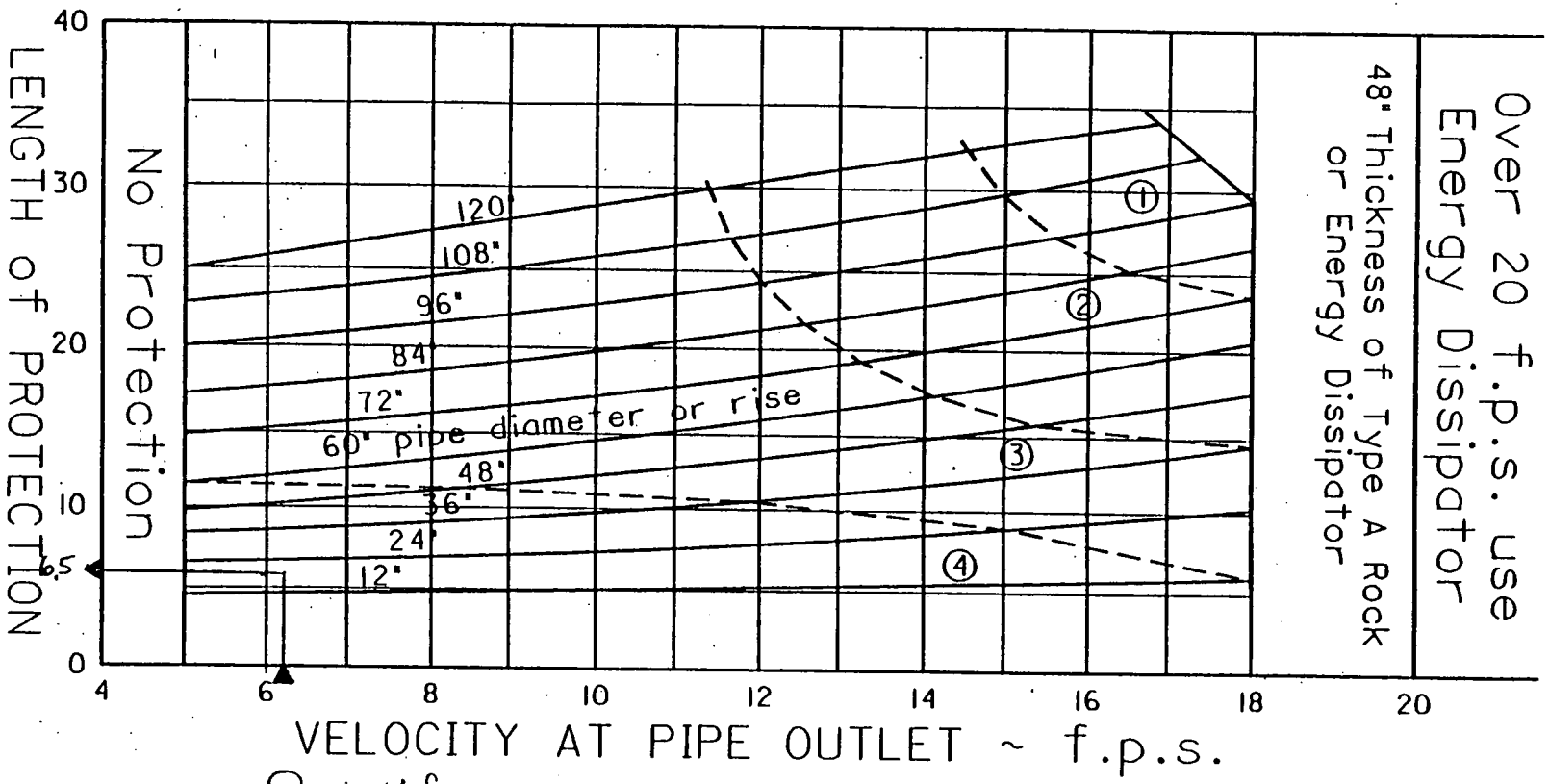
ROCK CHANNEL PROTECTION AT CULVERT AND STORM SEWER OUTLETS

1107-1

REFERENCE SECTION 1107.2



$Q_{25} = 4$ cfs

$V_{25} = 6.2$ fps

NOTES

Rock size (6", 12", 18") indicates the square opening on which 85% of the material, by weight, will be retained.

The width of protection shall be the width of the headwall, with 4' being the minimum.

(Where a stream bed will withstand the calculated velocity without erosion, no rock channel protection will be required.)

LEGEND	ROCK TYPE
① 48" of 18" rock	A
② 36" of 18" rock	A
③ 30" of 12" rock	B
④ 18" of 6" rock	C

A-4

605

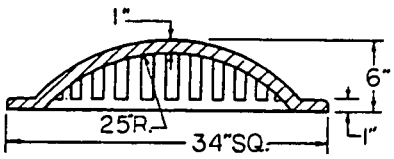
802

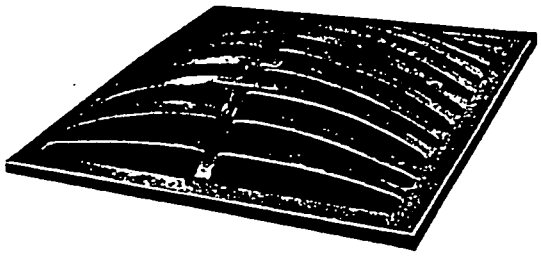
PARSONS ERA PROJECT CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE
	KG	2/24/95	CRT	3/17/95	SEEPAGE CONTROL & SEDIMENT REMOVAL STORM DRAIN
					CRU 2
					AUTHOR K. Gerard SHEET OF PO 139

Heavy Duty
6610

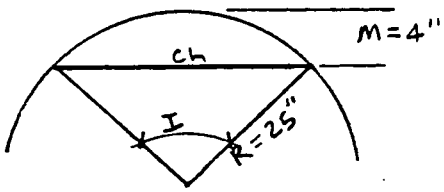
190 pounds total weight
Approximately 600 square inches of opening





104 *Always Specify EJIW Number*

***East Jordan Iron Works**, East Jordan, Michigan USA, 1-800-874-4100*



$M = R(1 - \cos I/2)$

$4" = 25"(1 - \cos I/2)$

$\cos I/2 = 1 - 0.16$

$I/2 = 32.8598°$

$Ch = 2R \sin I/2$

$= 2(25)(\sin 32.8598)$

$Ch = 27.13"$

ASSUME Ch IS THE PERIMETER DIMENSION / SIDE

ON LONG SLOT SIDES, MINUS 1" FOR STEEL, $2(26.13) = 52.26"$

ON SHORT OPENING SIDE, 10 - 1" BARS OR 17.13"/SIDE $2(17.13) = 34.26$

OPENING LENGTH @ PERIMETER $= 86.52"$

OR $7.2'$

USE 7.2' FOR WEIR LENGTH, Lg, FOR WEIR CALCULATIONS.

$Q_w = 3.087 L H^{3/2}$ REF 7., pg 5-24

FOR ORIFICE FLOW CONDITIONS

$Q_o = C a (2gh)^{1/2}$ REF 7, pg 4-3

$C = 0.66$ (ASSUMED. SEE TABLE 4-5, REF 7 FOR 10:1 RECTANGLE @ h = 1FT.)

PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/23/95
CRU-2 KG

FIND: Head, H, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume weir flow conditions using EJIW 6610 grate

Given:

Q25 =	9	cfs	Q = 3.087*L*H ^ (3/2)
Lw =	4	lf	Q = Qw + Qg
h =	0.42	ft	Qw = weir flow
Lg =	7.2	lf	Qg = grate flow

H, ft	Q, cfs	Qw	Hg, ft	Qg
0.42	3.36	3.36	0.00	0.00
0.50	3.36	3.36	0.00	0.00
0.58	3.74	3.36	0.08	0.38
0.67	4.53	3.36	0.17	1.17
0.75	5.44	3.36	0.25	2.08
0.83	6.52	3.36	0.33	3.16
0.92	7.90	3.36	0.42	4.54
1.00	9.25	3.36	0.50	5.89
1.16	12.30	3.36	0.66	8.94
1.25	14.19	3.36	0.75	10.83
1.33	15.97	3.36	0.83	12.61

Note:

1. There are 2-2' wide openings which are the Lw for "weir flow" condition. Weir height = h.
2. Maximum "Weir flow" is assumed when H = h. When H > 0.50', then its "grate flow" which is also calculated by weir flow equation. Hgrate = H-0.50'. The grate is 1" thick and its top elev. is 6" above the weir elev.
3. Lg is the inside perimeter of the inlet.
4. An efficiency factor of 0.75 is used for the grate condition to compensate for grating and trash accumilation.
5. Lg based on East Jordon Iron Works, (EJIW), 6610 grate.
6. Hg is measured from the base of grate.

PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/23/95
CRU-2 KG

FIND: Head, H, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume weir flow conditions using EJIW 6610 grate

Given:

7	Q25 =	9	cfs	Q = 3.087*L*H^(3/2)
	Lw =	3.33	lf	Q = Qw + Qg
9	h =	0.42	ft	Qw = weir flow
	Lg =	7.2	lf	Qg = grate flow

	A	B	C	D	E
	H, ft	Q, cfs	Qw	Hg, ft	Qg
13	0.42	+C13+E13	3.087*$A:$B$8*($A:$B$9^1.5)	+A13-$A:$B$9	0.75*3.087*$A:$B$10*(D13)^1.5
	0.50	+C14+E14	3.087*$A:$B$8*($A:$B$9^1.5)	+A14-$A:$B$9	0.75*3.087*$A:$B$10*(D14)^1.5
15	0.58	+C15+E15	3.087*$A:$B$8*($A:$B$9^1.5)	+A15-$A:$B$9	0.75*3.087*$A:$B$10*(D15)^1.5
	0.67	+C16+E16	3.087*$A:$B$8*($A:$B$9^1.5)	+A16-$A:$B$9	0.75*3.087*$A:$B$10*(D16)^1.5
17	0.75	+C17+E17	3.087*$A:$B$8*($A:$B$9^1.5)	+A17-$A:$B$9	0.75*3.087*$A:$B$10*(D17)^1.5
	0.83	+C18+E18	3.087*$A:$B$8*($A:$B$9^1.5)	+A18-$A:$B$9	0.75*3.087*$A:$B$10*(D18)^1.5
19	0.92	+C19+E19	3.087*$A:$B$8*($A:$B$9^1.5)	+A19-$A:$B$9	0.75*3.087*$A:$B$10*(D19)^1.5
	1.00	+C20+E20	3.087*$A:$B$8*($A:$B$9^1.5)	+A20-$A:$B$9	0.75*3.087*$A:$B$10*(D20)^1.5
21	1.16	+C21+E21	3.087*$A:$B$8*($A:$B$9^1.5)	+A21-$A:$B$9	0.75*3.087*$A:$B$10*(D21)^1.5
	1.25	+C22+E22	3.087*$A:$B$8*($A:$B$9^1.5)	+A22-$A:$B$9	0.75*3.087*$A:$B$10*(D22)^1.5
23	1.33	+C23+E23	3.087*$A:$B$8*($A:$B$9^1.5)	+A23-$A:$B$9	0.75*3.087*$A:$B$10*(D23)^1.5

Note:

1. There are 2-2' wide openings which are the Lw for "weir flow" condition. Weir height = h.
2. Maximum "Weir flow" is assumed when H = h. When H > 0.50', then its "grate flow" which is also calculated by weir flow equation. Hgrate = H-0.50'. The grate is 1" thick and its top elev. is 6" above the weir elev.
3. Lg is the inside perimeter of the inlet.
4. An efficiency factor of 0.75 is used for the grate condition to compensate for grating and trash accumilation.
5. Lg based on East Jordon Iron Works, (EJIW), 6610 grate.
6. Hg is measured from the base of grate.

\PO139\SS\139SD.WK3 A:

(This sheet is B in the LOTUS 1-2-3 file. Used to display formulas from A:)

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PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/24/95
CRU-2 KG

FIND: Head, h, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume orifice flow conditions using EJIW 6610 grate

Given:

area, a =	600	sq in	Qo = C*a*(2*g*h) ^ (1/2)
	4.17	sq ft	H = Head – from bottom of weir
C =	0.66		hg = Head – above base of grate
g =	32.2	ft/s ^ 2	Q = Q – Total Flow
Qw =	3.36	cfs (from side weirs. See weir calc)	

H, ft	Q, cfs	Qw, cfs	hg ft	a, sq ft	Qo cfs
0.42	3.36	3.36	0	0.00	0.00
0.50	3.36	3.36	0.00	0.00	0.00
0.58	4.11	3.36	0.08	0.67	0.75
0.67	5.68	3.36	0.17	1.42	2.32
0.75	7.50	3.36	0.25	2.08	4.14
0.83	9.64	3.36	0.33	2.75	6.28
0.92	12.37	3.36	0.42	3.50	9.01
1	15.06	3.36	0.50	4.17	11.70

Note:
1. Assumes that there is no increase in weir flow under orifice flow conditions.
2. Assume an efficiency factor of 0.75 used for the grate condition to compensate for trash accumulation.
3. Assumes that the full 600 sq ft opening value is available when the water surface elevation is equal to the top elevation of the grate. The area, a, is proportional to the hg; a = (hg/0.5')*4.17 sq ft up to O.5'. Initially, there will be weir flow which will transition to orifice. The "worst case" would be when hg is measured from the top of the grate and not the base.
4. EJIW – East Jordon Iron Works
5. The grate is 1" thick and its top elev. is 6" above the weir elev.

.\PO139\SS\139SD.WK3 C:

PO 139 SEEPAGE CONTROL & SEDIMENT REMOVAL 2/24/95
CRU-2 KG

FIND: Head, h, for bypass pipe inlet using ODOT STD. No. 2-2-A
Assume orifice flow conditions using EJIW 6610 grate

Given:

47	area, a =	600	sq in	Qo =	C*a*(2*g*h)^(1/2)
		4.17	sq ft	H =	Head - from bottom of weir
49	C =	0.66		hg =	Head - above base of grate
	g =	32.2	ft/s^2	Q =	Q - Total Flow
51	Qw =	3.36	cfs (from side weirs. See weir calc)		

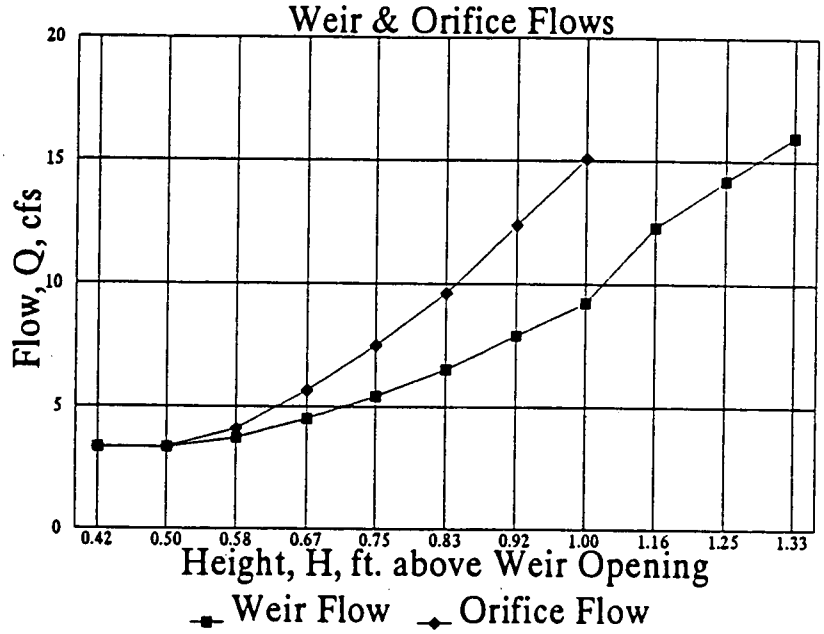
	A H, ft	B Q, cfs	C Qw, cfs	D hg ft	E a, sq ft	F Qo cfs
56	0.42	+C56+F56	+$C:$B$51	0	(D56/0.5)*$C:$B$48	0.75*$C:$B$49*E56*(2*$C:$B$10*D56)^0.5
	0.50	+C57+F57	+$C:$B$51	+A57-0.5	(D57/0.5)*$C:$B$48	0.75*$C:$B$49*E57*(2*$C:$B$10*D57)^0.5
58	0.58	+C58+F58	+$C:$B$51	+A58-0.42	(D58/0.5)*$C:$B$48	0.75*$C:$B$49*E58*(2*$C:$B$10*D58)^0.5
	0.67	+C59+F59	+$C:$B$51	+A59-0.42	(D59/0.5)*$C:$B$48	0.75*$C:$B$49*E59*(2*$C:$B$10*D59)^0.5
60	0.75	+C60+F60	+$C:$B$51	+A60-0.42	(D60/0.5)*$C:$B$48	0.75*$C:$B$49*E60*(2*$C:$B$10*D60)^0.5
	0.83	+C61+F61	+$C:$B$51	+A61-0.42	(D61/0.5)*$C:$B$48	0.75*$C:$B$49*E61*(2*$C:$B$10*D61)^0.5
62	0.92	+C62+F62	+$C:$B$51	+A62-0.42	(D62/0.5)*$C:$B$48	0.75*$C:$B$49*E62*(2*$C:$B$10*D62)^0.5
	1	+C63+F63	+$C:$B$51	+A63-0.42	+$C:$B$48	0.75*$C:$B$49*E63*(2*$C:$B$10*D63)^0.5

Note:
1. Assumes that there is no increase in weir flow under orifice flow conditions.
2. Assume an efficiency factor of 0.75 used for the grate condition to compensate for trash accumulation.
3. Assumes that the full 600 sq ft opening value is available when the water surface elevation is equal to the top elevation of the grate. The area, a, is proportional to the hg; a = (hg/0.5')*4.17 sq ft up to 0.5'. Initially, there will be weir flow which will transition to orifice. The "worst case" would be when hg is measured from the top of the grate and not the base.
4. EJIW - East Jordon Iron Works
5. The grate is 1" thick and its top elev. is 6" above the weir elev.

\PO139SS\139SD.WK3 C:
(This sheet is D in the LOTUS 1-2-3 file. Used to display formulas from C:)

610

Grate Flow Conditions



PARSONS ERA PROJECT CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL STORM DRAIN	CRU 2
0	KG	2/28/95	CRT	2/28/95		
					AUTHOR K. Gerard SHEET OF	PO 139

CALCULATE THE EQUIVALENT LENGTH OF PIPE FOR 22½° BEND

$L = KD/f$ (pg 3-120)

D = ID, ft
K = Resistance Coefficient, use 0.10. (pg 3-113) (30°)
f = Friction Factor

FIND: f

ASSUME N-12 HDPE HAS SIMILAR FRICTION PROPERTIES AS COPPER, BRASS, LEAD, TIN OR GLASS PIPE

HAZEN-WILLIAMS - C = 130 (pg 3-8)
ABSOLUTE ROUGHNESS ε = 0.000005' (pg 3-5)

$\varepsilon/D = 0.000005'/1.5' = 0.0000033$

$R = \frac{VD}{\nu}$ (pg 3-6)

V = velocity, fps
D = ID, ft
ν = Kinematic viscosity, ft²/sec.

Assume ν of fluid is similar to fresh water at 60°F, or 1.13 centistokes. (pg 4-45) (pg 4-27)

(1.13 centistokes)(0.0000107639) = 0.0000121 ft²/sec

For full flow conditions. (Q_F = 9.62 cfs) V = 5.44 fps

$R = (5.44\text{ fps})(1.5\text{ ft})/0.0000121\text{ ft}^2/\text{s}$

R = 674,882
6.75×10^5

Using Moody diagram, f = 0.0125

L = (0.10)(1.5')/(0.0125) = 12' each bend or 36' for 3 bends.

L_{TOTAL} = 212' + 36' = 248' USE 250' FOR CALCULATIONS.

NOTE: ALL PAGE No. REFERENCES TAKEN FROM CAMERON HYDRAULIC DATA

PARSONS
ERA PROJECT

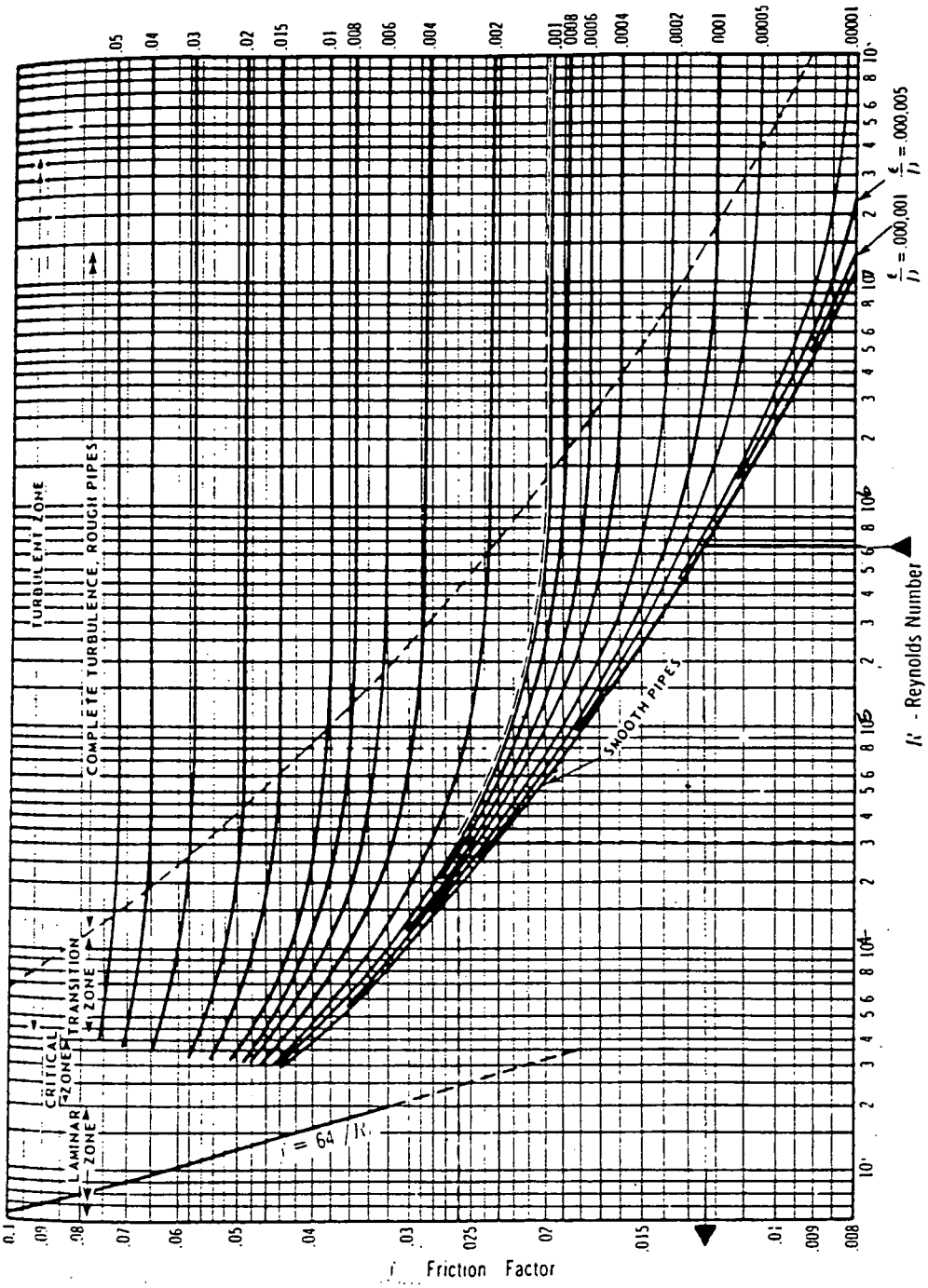
CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL STORM DRAIN	CRU 2
0	KG	2/28/95	CRT	2/17/95		
					AUTHOR K. Gerard SHEET OF	PO 139

Friction Factors for Commercial Pipe

(for Darcy-Weisbach formula, page 3-3)

Relative Roughness $= \frac{\epsilon}{D}$



Moody diagram. (V. L. Streeter, "Fluid Mechanics," 5th ed. Copyright 1971 by McGraw-Hill Book Company, New York)

Note: Chart shows relation of relative roughnesss — ϵ/D where ϵ is absolute roughness in feet and D is diameter in feet.

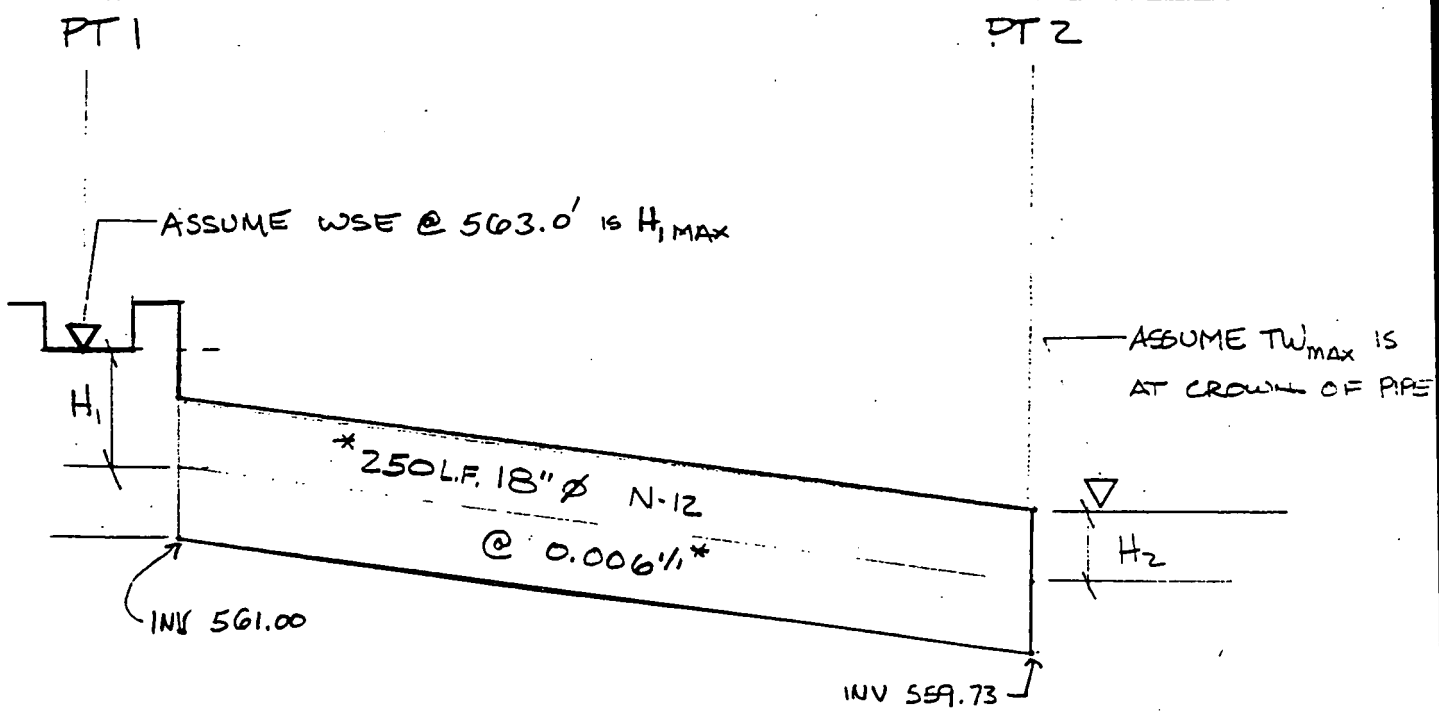
(REF. No. 8)
pg 3-11

PARSONS
ERA PROJECT

CALCULATION SHEET

REV	BY	DATE	CK	DATE	TITLE	DESIGN OF SEEPAGE COLLECTION AND SEDIMENT REMOVAL STORM DRAIN	CRU 2
0	KG	2/28/95	CRT	3/17/95			
					AUTHOR K. Gerard	SHEET OF	PO 139

CHECK PIPE UNDER PRESSURE FLOW CONDITIONS



* 212' actual + 36' for bends. Invert elevations and S shown based on actual.

$$H_{1_{MAX}} = 1.25' \times 62.4\ lbs/CF \times 1SF/144\ in^2 = 0.54\ psi$$

$$Q_F = 9.62\ cfs \times 7.48\ gal/cf \times 60s/min = 4317\ gpm \quad \text{use } 4320\ gpm$$

$$H_2 = 0.75' \times 62.4\ lb/CF \times 1SF/144\ in^2 = 0.27\ psi$$

SEE FLOWMASTER CALCULATIONS FOR HAZEN-WILLIAMS EQUATION.

Pressure Pipe Analysis & Design
Circular Pipe

Worksheet Name: West Diversion Pipe

Comment: Using 1/16 Bends

Solve For Pressure @ 1

Given Input Data:

Elevation @ 1.....	561.75	ft
Elevation @ 2.....	560.48	ft
Pressure @ 2.....	0.27	psi
Q_{FULL} = Discharge.....	4320.00	gpm (9.62 cfs)
Diameter.....	18.00	in
Length.....	250.00	ft
Hazen-Williams C..	130.00	

Computed Results:

Pressure @ 1.....	0.29	psi <0.54 psi ∴ OK
Velocity.....	5.45	fps
Headloss.....	1.32	ft
Energy Grade @ 1..	562.89	ft
Energy Grade @ 2..	561.56	ft
Friction Slope....	5.289	ft/1000 ft

SEE SKETCH / CALC

Open Channel Flow Module, Version 3.41 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

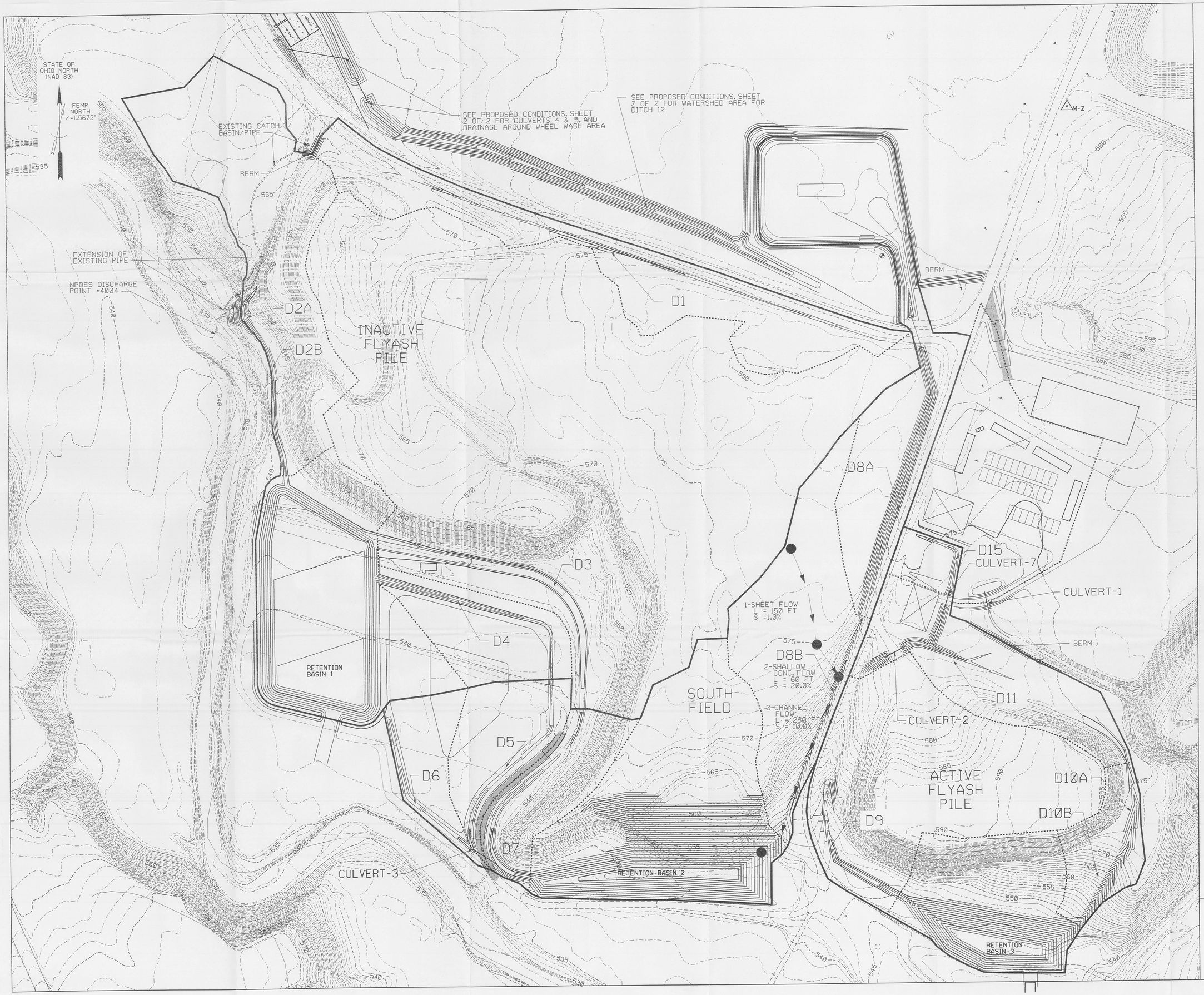
— SHEET NUMBER 2

B-1

617

APPENDIX B

DRAINAGE AREA MAPS



LEGEND

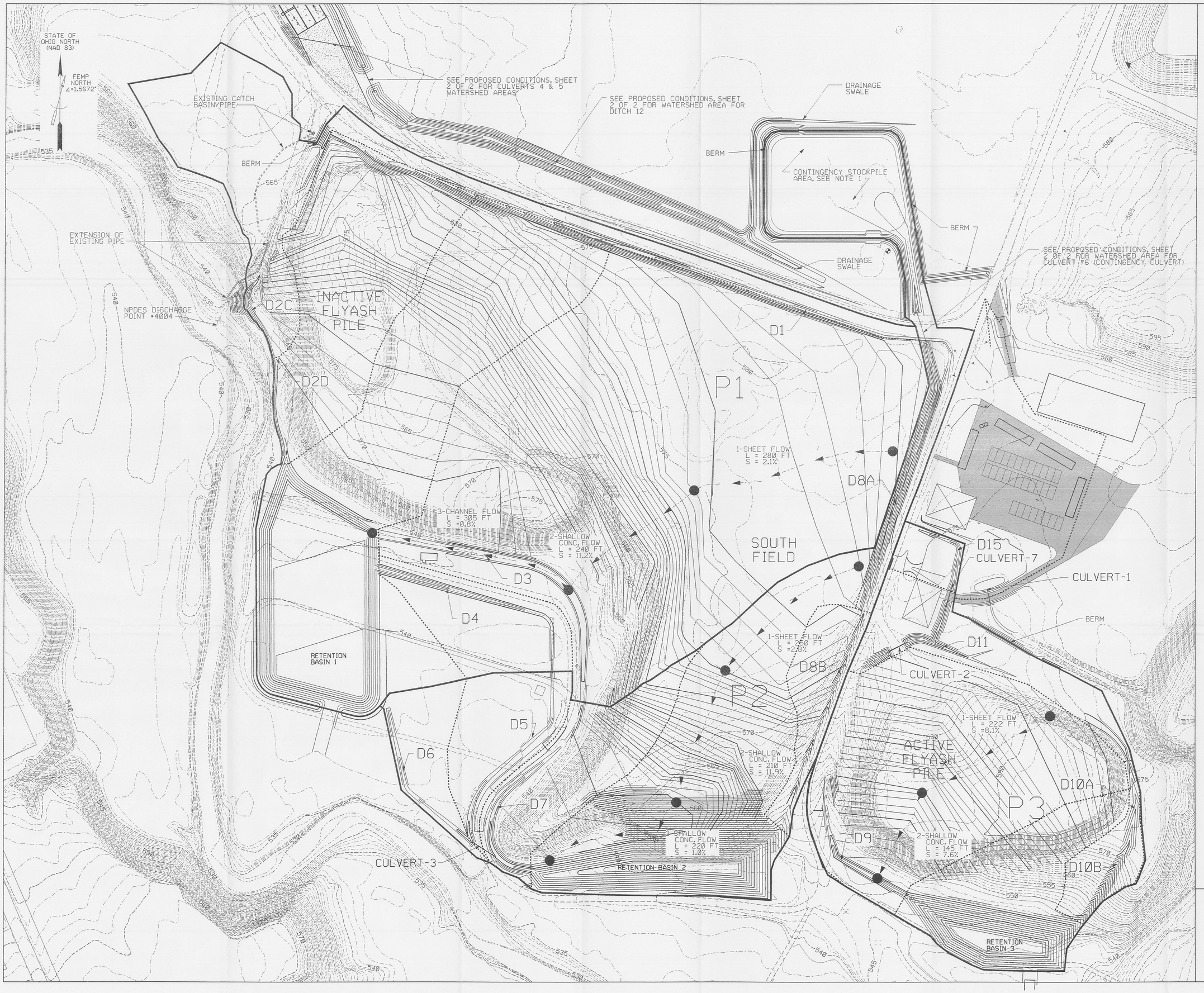
RETENTION BASIN DRAINAGE AREA

DITCH/CULVERT DRAINAGE AREA

EXISTING CONDITIONS

50 0 50 100

SCALE: 1" = 50'



1. CONTINGENCY STOCKPILE AREA (STOCK PILE #2) IS PROVIDED FOR ADDITIONAL SOIL STORAGE SHOULD PRIMARY STOCKPILE AREA BECOME TOO SMALL. DITCHES 8A, 8B, AND BASIN 2 ARE DESIGNED TO ACCOMMODATE THE CONTINGENCY STOCKPILE AREA IF USED.

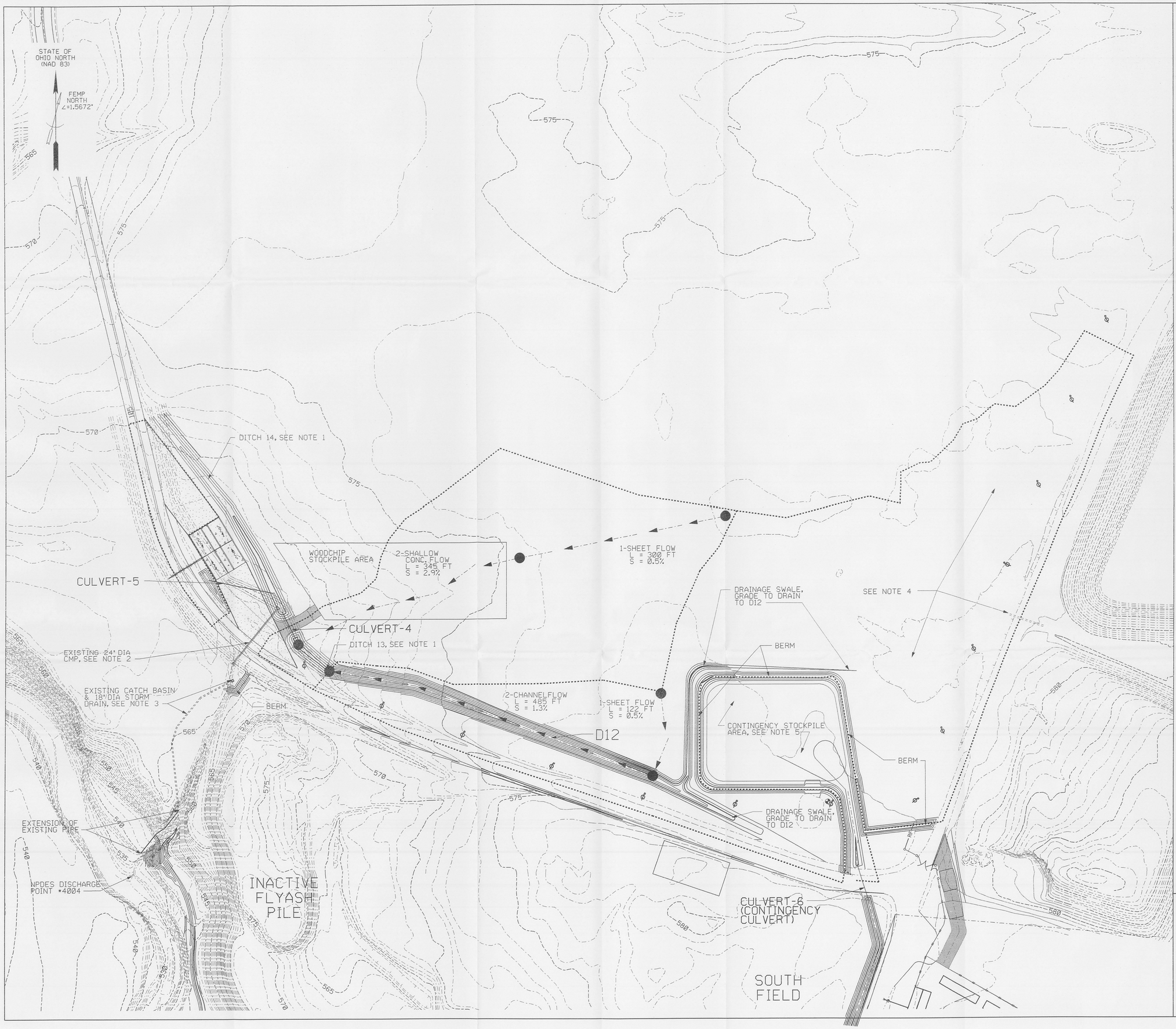
LEGEND

RETENTION BASIN DRAINAGE AREA — P1

DITCH/CULVERT DRAINAGE AREA

PROPOSED CONDITIONS
SHEET 1 OF 3

50 0 50 100
SCALE: 1" = 50'



NOTES:

1. EXISTING DITCHES IN THIS AREA WERE ORIGINALLY DESIGNED UNDER THE HAULROAD UPGRADE PROJECT, (P0158), CALCULATION NO. 15-02. DITCHES 13 & 14 WILL BE THE SAME SIZE AS THE EXISTING DITCHES AND WILL BE USED TO ROUTE RUNOFF AROUND NEW WORK.
2. EXISTING 24" DIA CMP WAS DESIGNED UNDER THE HAULROAD UPGRADE PROJECT (P0158), CALCULATION NO. 15-02.
3. EXISTING 18" DIA STORM DRAIN AND CATCH BASIN WERE DESIGNED UNDER THE SEEPAGE COLLECTION AND SEDIMENT REMOVAL PROJECT, (P0139), CALCULATION NO. 15-01.
4. DITCH-12 AND CULVERT-4 WERE DESIGNED ASSUMING THAT THE EXISTING CULVERT SHOWN WAS PLUGGED. IT WAS FURTHER ASSUMED THAT THE RUNOFF FROM THE ADDITIONAL DRAINAGE AREA SHOWN WOULD FLOW SOUTH TO DITCH-12 AND CULVERT-4.
5. CONTINGENCY STOCKPILE AREA (STOCKPILE #2) IS PROVIDED FOR ADDITIONAL SOIL STORAGE SHOULD PRIMARY STOCKPILE AREA BECOME TOO SMALL. DITCHES 8A, 8B, AND BASIN 2 ARE DESIGNED TO ACCOMMODATE THE CONTINGENCY STOCKPILE AREA IF USED.

LEGEND

DITCH/CULVERT DRAINAGE AREA

EXISTING POWER POLE

PROPOSED CONDITIONS
SHEET 2 OF 3

50 0 50 100
SCALE: 1" = 50'

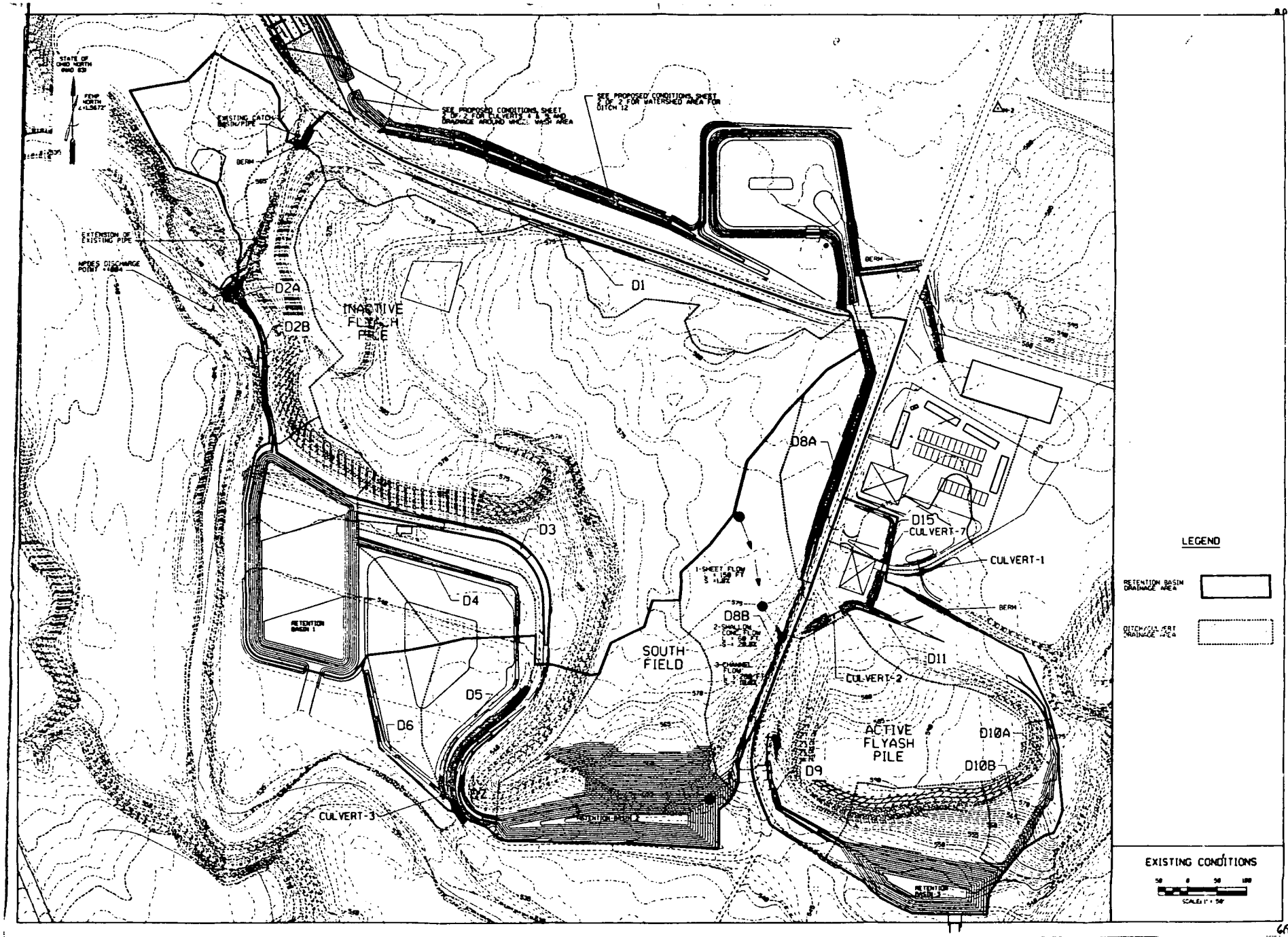
SEDIMENT TRAP DRAINAGE AREA

DITCH DRAINAGE AREA

PROPOSED CONDITIONS
SHEET 3 OF 3

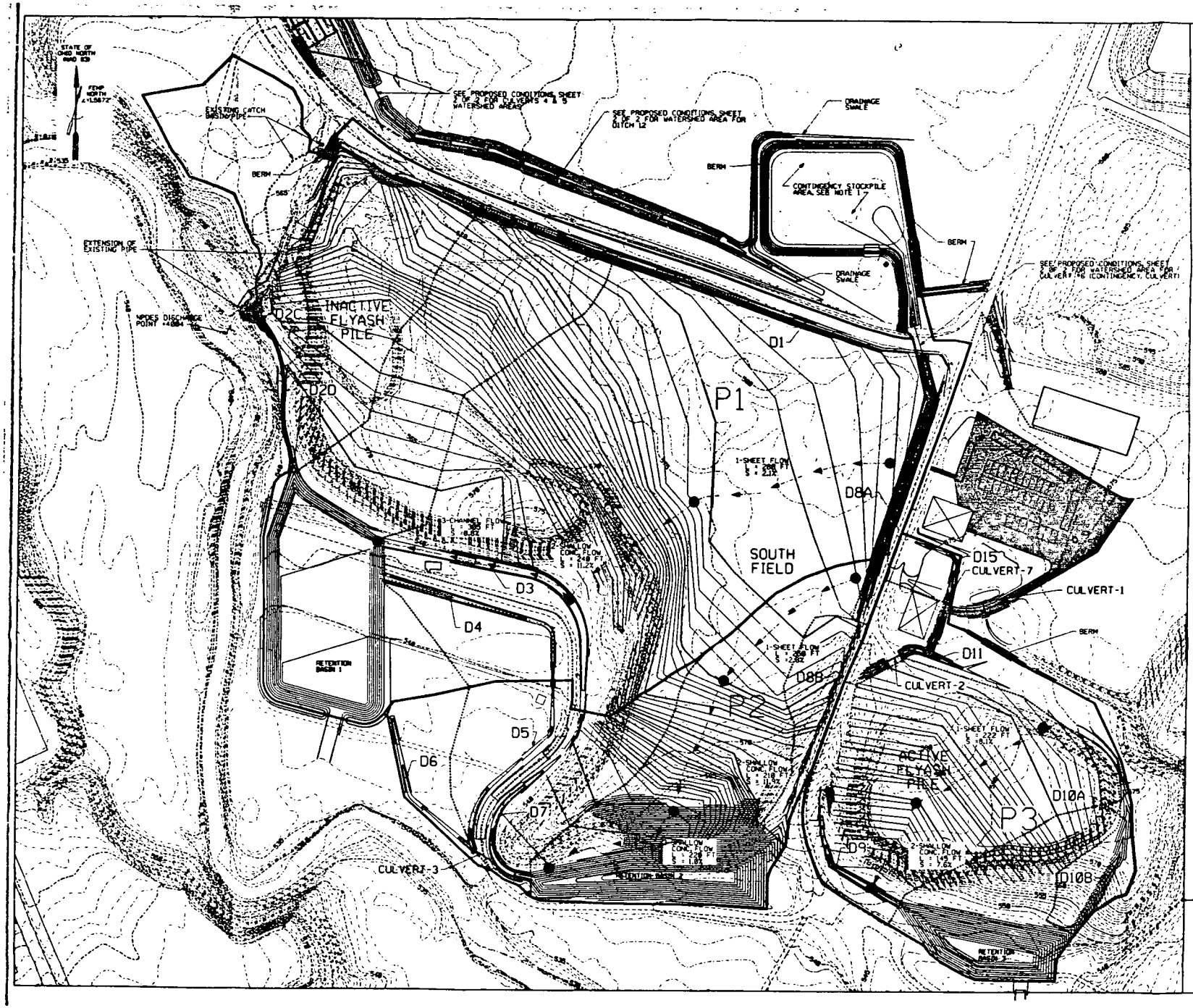
50 0 50 100

SCALE: 1" = 50'


STATE OF OHIO NORTH
FENW NORTH
SEE PROPOSED CONDITIONS SHEET 2 OF 2 FOR CULVERTS 4 & 5 AND DRAINAGE AROUND WELL WASH AREA
SEE PROPOSED CONDITIONS SHEET 2 OF 2 FOR WATERSHED AREA FOR DITCH 12
EXISTING CATCH BASIN/PIPE
BERM
EXTENSION OF EXISTING PIPE
NPDES DISCHARGE POINT
D2A
D2B
INACTIVE FLYASH PILE
D1
D3
D4
D5
D6
D7
D8A
D8B
D9
D10A
D10B
D11
D15
CULVERT-1
CULVERT-2
CULVERT-3
CULVERT-7
RETENTION BASIN 1
RETENTION BASIN 2
RETENTION BASIN 3
SOUTH FIELD
ACTIVE FLYASH PILE
1-SHEET FLOW
2-SHALLOW CONC. FLOW
3-CHANNEL FLOW
LEGEND
RETENTION BASIN DRAINAGE AREA
DITCH/CULVERT DRAINAGE AREA
EXISTING CONDITIONS
SCALE: 1" = 50'

619

8020



1. CONTINGENCY STOCKPILE AREA (STOCK PILE #1) IS PROVIDED FOR ADDITIONAL SOIL STORAGE SHOULD PRIMARY STOCKPILE AREA BECOME TOO SMALL. DITCHES 5A, 5B, AND BASIN 2 ARE DESIGNED TO ACCOMMODATE THE CONTINGENCY STOCKPILE AREA IF USED.

LEGEND

RETENTION BASIN DRAINAGE AREA — P1

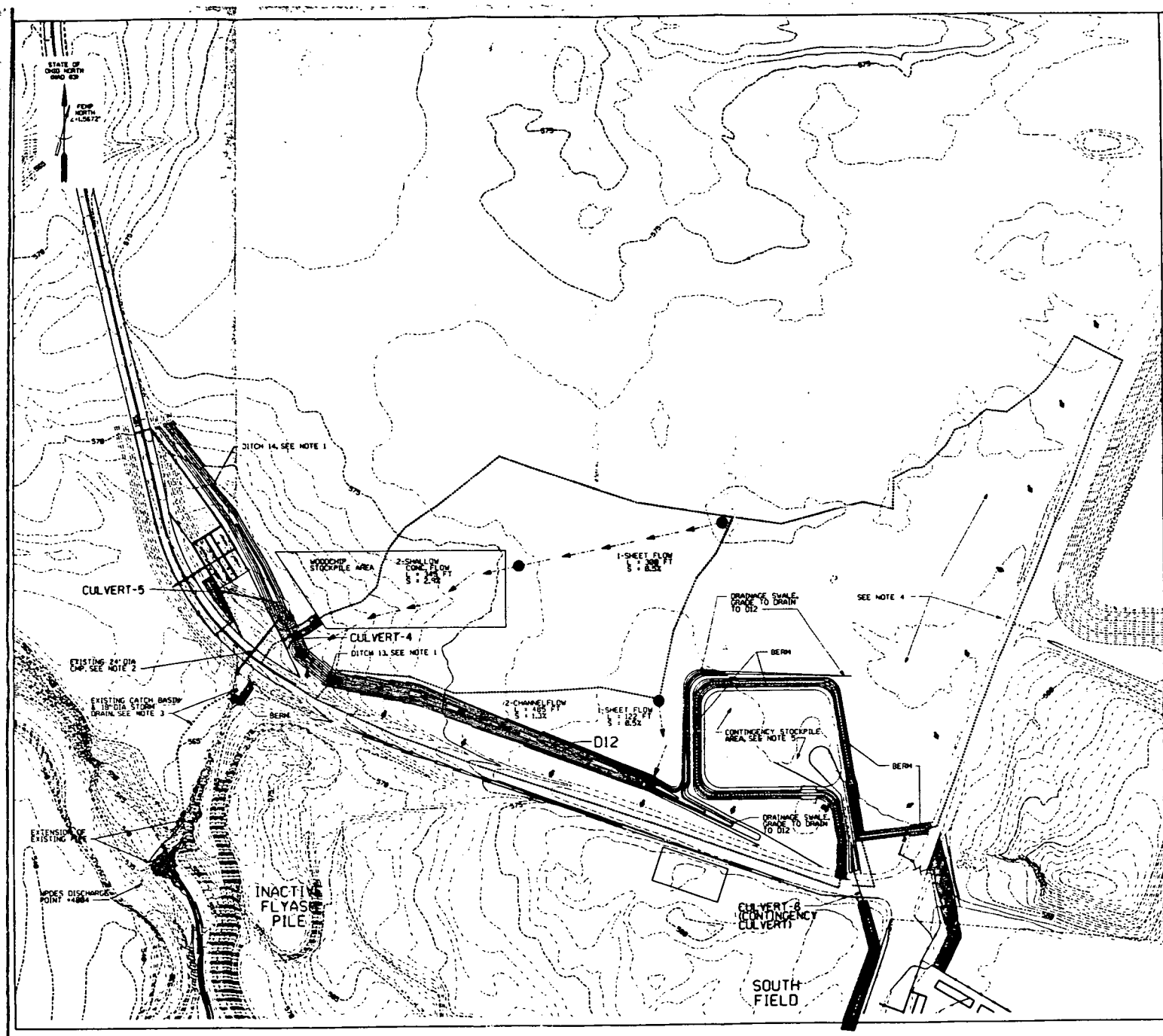
DITCH/CULVERT DRAINAGE AREA

PROPOSED CONDITIONS
SHEET 1 OF 3

SCALE: 1" = 50'

620

8020



NOTES:

1. EXISTING DITCHES IN THIS AREA WERE ORIGINALLY DESIGNED UNDER THE HAULROAD UPGRADE PROJECT, (P0158), CALCULATION NO. 15-82. DITCHES 13 & 14 WILL BE THE SAME SIZE AS THE EXISTING DITCHES AND WILL BE USED TO ROUTE RUNOFF AROUND NEW WORK.
2. EXISTING 24" DIA CMP WAS DESIGNED UNDER THE HAULROAD UPGRADE PROJECT (P0158), CALCULATION NO. 15-82.
3. EXISTING 18" DIA STORM DRAIN AND CATCH BASIN WERE DESIGNED UNDER THE SEEPAGE COLLECTION AND SEDIMENT REMOVAL PROJECT, (P0139), CALCULATION NO. 15-81.
4. DITCH-12 AND CULVERT-4 WERE DESIGNED ASSUMING THAT THE EXISTING CULVERT SHOWN WAS PLUGGED. IT WAS FURTHER ASSUMED THAT THE RUNOFF FROM THE ADDITIONAL DRAINAGE AREA SHOWN WOULD FLOW SOUTH TO DITCH-12 AND CULVERT-4.
5. CONTINGENCY STOCKPILE AREA (STOCKPILE #21) IS PROVIDED FOR ADDITIONAL SOIL STORAGE SHOULD PRIMARY STOCKPILE AREA BECOME TOO SMALL. DITCHES 8A, 8B, AND BASIN 2 ARE DESIGNED TO ACCOMMODATE THE CONTINGENCY STOCKPILE AREA IF USED.

LEGEND

DITCH/CULVERT DRAINAGE AREA

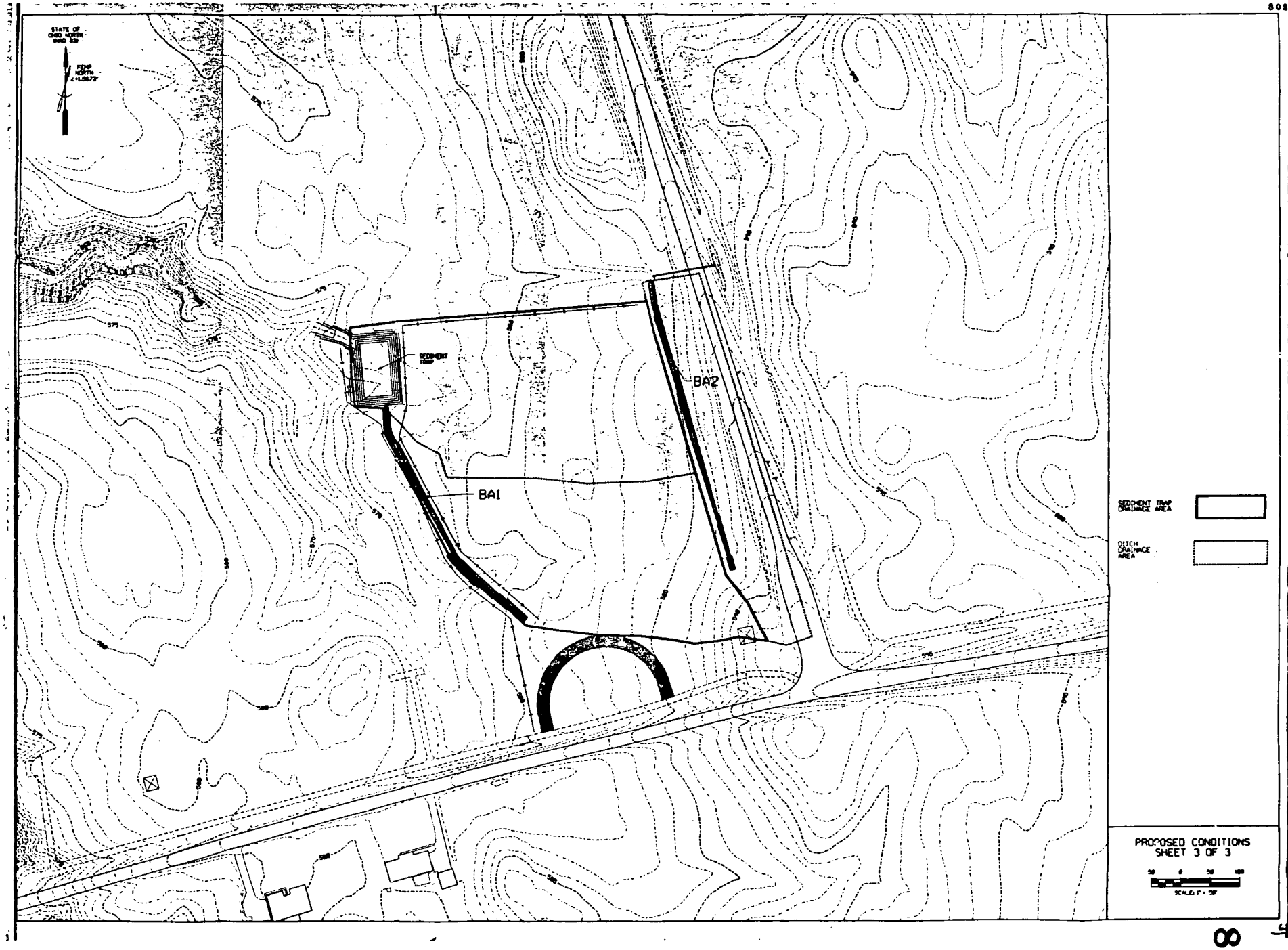
EXISTING POWER POLE

PROPOSED CONDITIONS
SHEET 2 OF 3.

SCALE: 1" = 50'

621

802


STATE OF OHIO NORTH OHIO ED
TRUE NORTH
SEDIMENT TRAP
BA1
BA2
SEDIMENT TRAP DRAINAGE AREA
DITCH DRAINAGE AREA
PROPOSED CONDITIONS
SHEET 3 OF 3
SCALE: 1" = 50'

802

622

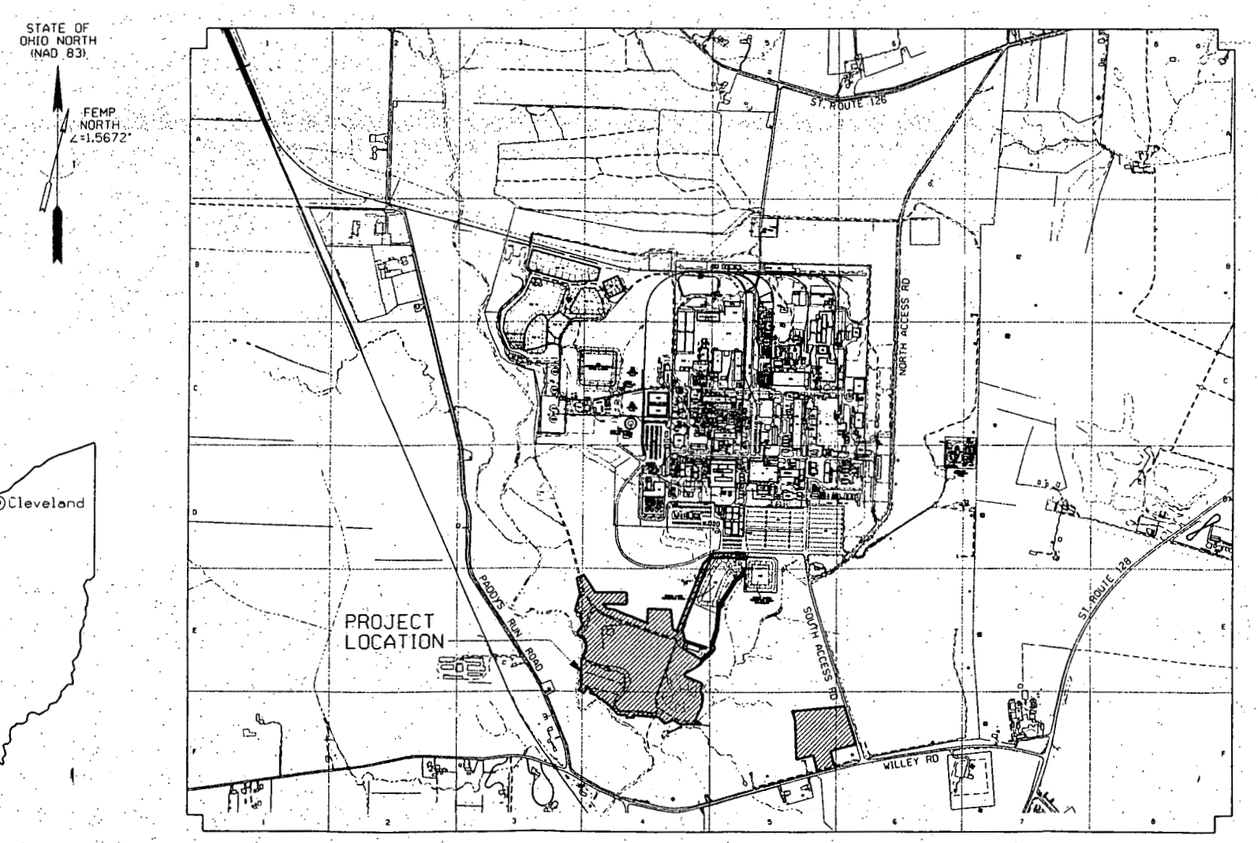
UNITED STATES DEPARTMENT OF ENERGY

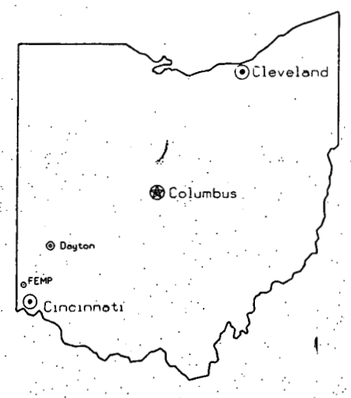
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

WASTE UNITS REMEDIATION PROJECT

SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

SUBCONTRACT NO. FSC607
FDF PROJECT NO. 20400





PARSONS

The Ralph M. Parsons Company • Parsons Main, Inc. • Engineering-Science, Inc.

ARCHITECTS - ENGINEERS
CINCINNATI, OHIO

600' 0' 600' 1200'
GRAPHIC SCALE: 1"=600'

NOTES

FOR INFORMATION ONLY

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JWU	N/A	6/13/97

DETAILS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
PROJECT TITLE SHEET 623

STATE OF OHIO — FRANKLIN M. PARTON, JR. — REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. ESPARZA	03/11/96		6/13/97	K. GERARD	1/18/97

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		1"=600'	

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	FERNCO PROJECT NO.
A-E DATE 6/13/97	N/A	20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	TEMP PROJECT NO	DRAWING INDEX CODE NO	SHEET NO	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-X-00319	X0001	0

INDEX OF DRAWINGS

INDEX CODE NO.	DRAWING NO.	SHEET NO.	REVISION NO.	DRAWING TITLE	REMARKS
	92X-5900-X-00319	X0001	0	PROJECT TITLE SHEET	
	92X-5900-X-00320	X0002	0	DRAWING INDEX	
	92X-5900-X-00321	X0003	0	LEGEND AND GENERAL NOTES	
	92X-5900-G-00350	G0001	0	CIVIL - TRAFFIC FLOW PLAN	
	92X-5900-G-00281	G0002	0	CIVIL - MASTER SITE/UTILITY PLAN	
	92X-5900-G-00348	G0003	0	CIVIL - EXISTING CONDITIONS PLAN	
	92X-5900-G-00400	G0004	0	CIVIL - SURVEY INFORMATION AND SOIL STRIPPING PLAN	
	92X-5900-G-00282	G0005	0	CIVIL - SITE PLAN	
	92X-5900-G-00284	G0006	0	CIVIL - SITE PLAN - SUPPORT AREA	
	92X-5900-G-00283	G0007	0	CIVIL - SITE PLAN - WHEEL WASH AREA	
	92X-5900-G-00390	G0008	0	CIVIL - SITE PLAN - PADDYS RUN AREA	
	92X-5900-G-00303	G0009	0	CIVIL - ENLARGEMENT RETENTION BASIN #1	
	92X-5900-G-00371	G0010	0	CIVIL - ENLARGEMENT RETENTION BASIN #2	
	92X-5900-G-00372	G0011	0	CIVIL - ENLARGEMENT RETENTION BASIN #3	
	92X-5900-G-00311	G0012	0	CIVIL - EROSION AND SEDIMENT CONTROL - SHEET 1 OF 2	
	92X-5900-G-00368	G0013	0	CIVIL - EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	
	92X-5900-G-00304	G0014	0	CIVIL - TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	
	92X-5900-G-00305	G0015	0	CIVIL - TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	
	92X-5900-G-00306	G0016	0	CIVIL - TRANSFER LINE - PLAN AND PROFILE - SHEET 3 OF 3	
	92X-5900-G-00312	G0017	0	CIVIL - WHEEL WASH PAD - STRUCTURAL DETAILS	
	92X-5900-G-00310	G0018	0	CIVIL - WHEEL WASH SUMP DISCHARGE - PROFILE AND DETAILS	
	92X-5900-G-00307	G0019	0	CIVIL - WATER LINE DETAILS	
	92X-5900-G-00309	G0020	0	CIVIL - MISCELLANEOUS DETAILS - SHEET 1 OF 3	
	92X-5900-G-00308	G0021	0	CIVIL - MISCELLANEOUS DETAILS - SHEET 2 OF 3	
	92X-5900-G-00411	G0022	0	CIVIL - MATERIAL DOCUMENTATION PLAN	
	92X-5900-G-00452	G0023	0	CIVIL - MISCELLANEOUS DETAILS - SHEET 3 OF 3	
	92X-5900-G-00453	G0024	0	CIVIL - SITE PLAN - BORROW AREA	
	92X-5900-N-00295	N0001	0	MECHANICAL PROCESS - PIPING AND INSTRUMENTATION DIAGRAM - SYMBOLS AND LEGEND	
	92X-5900-N-00290	N0002	0	MECHANICAL PROCESS - PIPING AND INSTRUMENTATION DIAGRAM - WASTEWATER COLLECTION AND TRANSFER	
	92X-5900-N-00291	N0003	0	MECHANICAL PROCESS - PIPING AND INSTRUMENTATION DIAGRAM - DRINKING WATER SYSTEM	
	92X-5900-E-00405	E0001	0	ELECTRICAL - SYMBOLS AND LEGEND	
	92X-5900-E-00404	E0002	0	ELECTRICAL - SINGLE LINE DIAGRAM - WEST SIDE 13.2 KV FEEDERS	
	92X-5900-E-00377	E0003	0	ELECTRICAL - SINGLE LINE DIAGRAMS / ELEVATIONS - LIFT STATION NO. 1, 2, AND 3	
	92X-5900-E-00378	E0004	0	ELECTRICAL - SINGLE LINE DIAGRAMS / ELEVATIONS - WHEEL WASH FACILITY AND SUPPORT AREA	
	92X-5900-E-00379	E0005	0	ELECTRICAL - OVERALL SITE POWER PLAN	
	92X-5900-E-00381	E0006	0	ELECTRICAL - PANEL SCHEDULES	
	92X-5900-E-00380	E0007	0	ELECTRICAL - ELEMENTARY DIAGRAMS	
	92X-5900-E-00406	E0008	0	ELECTRICAL - CABLE AND CONDUIT SCHEDULES	
	92X-5900-E-00382	E0009	0	ELECTRICAL - DETAILS - SHEET 1	
	92X-5900-E-00407	E0010	0	ELECTRICAL - DETAILS - SHEET 2	
	92X-5900-E-00408	E0011	0	ELECTRICAL - DETAILS - SHEET 3	
	92X-5900-E-00409	E0012	0	ELECTRICAL - DETAILS - SHEET 4	
	92X-5900-E-00376	E0013	0	ELECTRICAL - DETAILS - SHEET 5	

NOTES

FOR INFORMATION ONLY

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00319	PROJECT TITLE SHEET	X0001
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/12/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
DRAWING INDEX 624

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. ESPARZA	03/11/96		6/12/97	K. GERARD	1/18/97

PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS

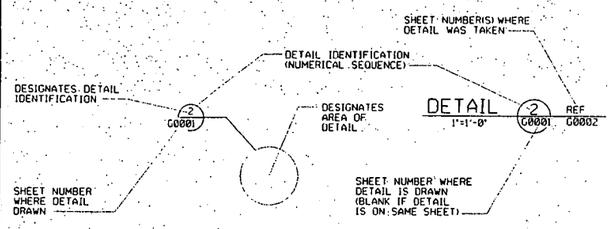
SUBMITTED FOR APPROVAL: 6/12/97 | FERNCO CRU APPROVAL: N/A | FERNCO PROJECT NO.: 20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-X-00320	X0002	0

STATE OF OHIO — FRANKLIN M. PARTON, JR. NO. E-47014 — REGISTERED PROFESSIONAL ENGINEER

GENERAL LEGEND



ABBREVIATIONS

AFP	ACTIVE FLYASH PILE
BSL	BIODENITRIFICATION SURGE LAGOON
BF	BACKFLOW PRVENTOR
EXIST	EXISTING
FDF	FLUOR DANIEL FERNALD
FEMP	FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FRL	FINAL REMEDIATION LEVEL
FS	FEASIBILITY STUDY
GMA	GREAT MIAMI AQUIFER
IFP	INACTIVE FLYASH PILE
OSDF	ON-SITE DISPOSAL FACILITY
OU-2	OPERABLE UNIT 2
RAD II	RADIOLOGICAL WORKER II
RI	REMEDIAL INVESTIGATION
SHT	SHEET
SF	SOUTH FIELD
SWM	STORMWATER MANAGEMENT
SWUS	SOUTHERN WASTE UNITS (CONSISTING OF AFP, IFP, AND SF)
TYP	TYPICAL
WAC	WASTE ACCEPTANCE CRITERIA

UTILITY SYMBOLS

EXISTING		PROPOSED
ST	STORM SEWER	ST
FG	FUEL GAS	
DW	DRINKING WATER	DW
FT	FILTRATE OR EFFLUENT	
OE	OVERHEAD ELECTRICAL	OE
G	ELECTRIC GROUND	G
GW	GROUND WATER	
WW	WASTE WATER	WW
	TRANSFER LINE	TRANSFER LINE
	DISCHARGE LINE AND TREATMENT LINE	GW

GRADING SYMBOLS

EXISTING		PROPOSED
x 584.9	SPOT ELEVATION	x 589.4
584	CONTOUR - MINOR	584
585	CONTOUR - MAJOR	585
(TOE)	SLOPE INDICATOR	(TOE)

SYMBOLS LEGEND

EXISTING		PROPOSED
	POST INDICATOR VALVE (PIV)	
	FIRE HYDRANT (FH)	
	MANHOLE (MH)	S OR D
OR	CATCH BASIN (CB)	
	POLE	
	ELECTRICAL MANHOLE	E
	GATE VALVE	
1313	MONITORING WELL	
E	EXTRACTION WELL	
	GRAVEL SURFACE	
	ASPHALTIC CONCRETE PAVING	
	CONCRETE PAD	
	BUILDING/TRAILER	
	CHAIN LINK FENCE	
	TREE LINE	
	DECIDUOUS TREE	
	CONIFEROUS TREE	
	CENTERLINE DRAINAGE DITCH	
	RIVER/CREEK	
	TO BE REMOVED	
	SILT FENCE	S S
	SILTATION BERM	SB SB
	ELECTRICAL TRANSFORMER	T
	TRANSMISSION TOWER	
	HEADWALL	
	BENCH MARK	
XX XX	CONSTRUCTION/WIND BARRIER FENCE	XX XX
	SIGN	
	BOLLARD/GUARD POST	
PB	ELECTRICAL PULL BOX	
	ROAD CENTERLINE OR BASELINE	
	PIPE BEND	OR
	PIPE TEE	
	REDUCER	
	FENCE GATE	
	APPROXIMATE ELEVATION OF GROUNDWATER	
	LIMIT OF WORK	
	WOODCHIP STOCKPILE AREA	
	GEOMEMBRANE LINER	
	GEOMEMBRANE LINER/ INFILTRATION BARRIER	
	APPROXIMATE LIMIT OF ABOVE WAC EXCAVATION AREA	
	APPROXIMATE LIMIT OF LEAD CONTAMINATED SOIL AREA	
	ROPE FENCING	
	FLOW LINE	
	100 YR FLOOD PLAIN	

GENERAL NOTES

1. EXISTING TOPOGRAPHY PREPARED BY PARSONS FROM DIGITAL MAPPING BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY PROVIDED BY WOOLPERT CONSULTANTS FLOWN ON APRIL 9, 1992. OTHER SOURCES OF EXISTING INFORMATION SHOWN ON DRAWINGS WERE PROVIDED BY FDF; THESE SOURCES INCLUDE:

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP CADD GRID/UTILITY DRAWINGS
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS
   FEMP OU-2 REMEDIAL INVESTIGATION REPORT, AND FEASIBILITY STUDY REPORT, 1995
   IT SURVEY, 1994

2. HORIZONTAL CONTROL SHOWN ON THE DRAWINGS IS BASED UPON NORTH AMERICAN DATUM 1983 (NAD 83). SEE SHEET G0004 FOR PROJECT SURVEY CONTROL.

3. VERTICAL CONTROL SHOWN ON THE DRAWINGS IS BASED UPON NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD 29). SEE SHEET G0004 FOR PROJECT SURVEY CONTROL.

4. GEOLOGICAL AND CROSS SECTION INFORMATION TAKEN FROM FEMP REMEDIAL INVESTIGATION REPORT (RI), 1995, FEASIBILITY REPORT (FS), 1995, SITE GEOTECHNICAL REPORT, AND FEMP 3-D CADD MODEL. THE RI AND FS ARE AVAILABLE TO THE SUBCONTRACTOR FOR REVIEW UPON REQUEST. ACTUAL LOCATIONS AND DEPTHS MAY BE DIFFERENT AND SHALL BE DETERMINED IN THE FIELD DURING CONSTRUCTION.

5. LOCATION AND DEPTH OF EXISTING UTILITIES ARE APPROXIMATE. FDF IS TO LOCATE UTILITIES PRIOR TO EXCAVATION FOR CONSTRUCTION. SUBCONTRACTOR IS TO VERIFY UTILITY LOCATIONS. IF LOCATION AND DEPTH ARE DIFFERENT OR IF UNKNOWN UNCHARTED UTILITIES ARE DISCOVERED, SUBCONTRACTOR IS TO INFORM FDF BEFORE PROCEEDING.

6. FIGURED DIMENSIONS TAKE PRECEDENCE OVER SCALED DIMENSIONS. CHECK GRAPHIC SCALE BEFORE SCALING.

7. DIMENSIONS AND/OR ELEVATIONS MARKED THUS (+/-) SHALL BE VERIFIED IN THE FIELD BY SUBCONTRACTOR.

8. RESTRICT ALL ACTIVITIES TO THE IMMEDIATE PROJECT AREA AND WITHIN THE 'LIMIT OF WORK'. ALL AREAS DISTURBED OUTSIDE THE LIMIT OF WORK SHALL BE REPAIRED BY THE SUBCONTRACTOR AT NO COST TO FDF.

9. MAINTAIN AND PROTECT UTILITY MARKINGS.

10. NOTES ON DRAWINGS SHALL BE UNDERSTOOD TO REFER TO REQUIREMENTS OF SITE PREPARATION SUBCONTRACTOR UNLESS NOTED OTHERWISE. EXAMPLE: 'MAINTAIN AND PROTECT UTILITY MARKINGS' IS UNDERSTOOD TO MEAN 'SITE PREPARATION SUBCONTRACTOR SHALL MAINTAIN AND PROTECT UTILITY MARKINGS'.

11. REFERENCES TO SUBCONTRACTOR SHALL INDICATE THE SITE PREPARATION SUBCONTRACTOR.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00319	PROJECT TITLE SHEET	X0001
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-G-00400	SURVEY INFORMATION AND SOIL STRIPPING PLAN	G0004

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMM	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
LEGEND AND GENERAL NOTES 625

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
B. PARTON	03/11/96		6/13/97	K. GERARD	1/18/97

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		NONE	

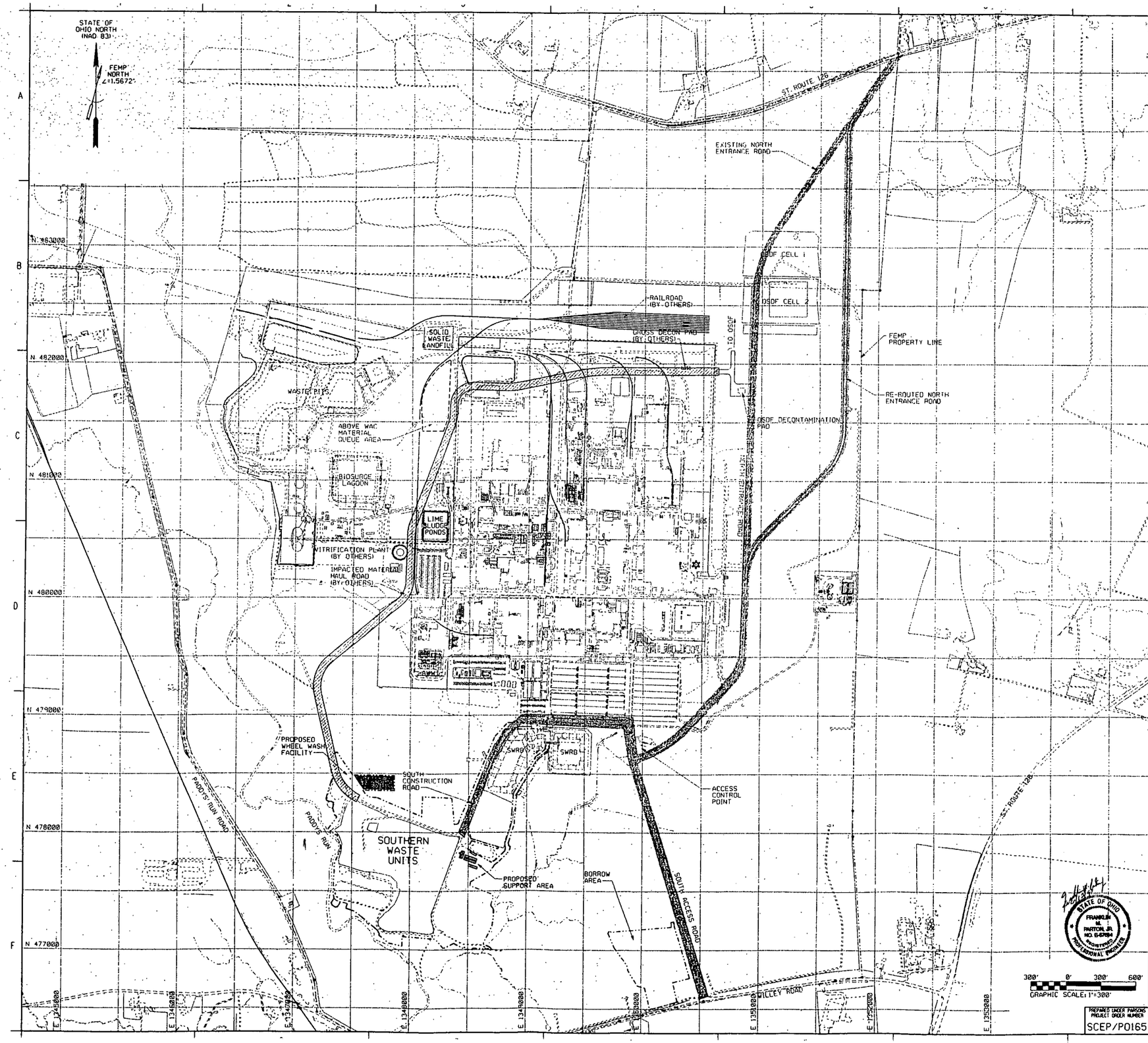
SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	FERNCO PROJECT NO.
A-E DATE 6/13/97	N/A DATE	20400

DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-X-00321	X0003	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165

STATE OF OHIO FRANKLIN M. PARTON, JR. NO. E-67814 REGISTERED PROFESSIONAL ENGINEER 6/13/97

802



NOTES

1. THE RE-ROUTED NORTH ENTRANCE ROAD WILL BE UNDER CONSTRUCTION IN THE SUMMER OF 1997, AND MAY BE COMPLETED DURING/WHILE THE SUBCONTRACTOR IS PERFORMING SITE PREPARATION WORK. DURING CONSTRUCTION, THERE MAY BE TIMES WHEN THERE IS NO OPEN NORTH ENTRANCE ROAD AT THE FEMP. THE SITE PREP SUBCONTRACTOR SHALL USE THE OPERATIONAL ROAD FOR ACCESS.

2. THE IMPACTED MATERIAL HAUL ROAD MAY BE COMPLETED OR UNDER CONSTRUCTION DURING THE SITE PREP SUBCONTACTORS WORK. THE SITE PREP SUBCONTRACTOR SHALL COORDINATE HIS WORK IN THE AREA THROUGH FDF.

SITE ACCESS/SUPPORT AREA ACCESS

IMPACTED MATERIAL HAUL ROAD

LIMIT OF WORK

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMM	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
TRAFFIC FLOW PLAN 626

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	10/10/96		6/13/97	K. GERARD	1/18/97

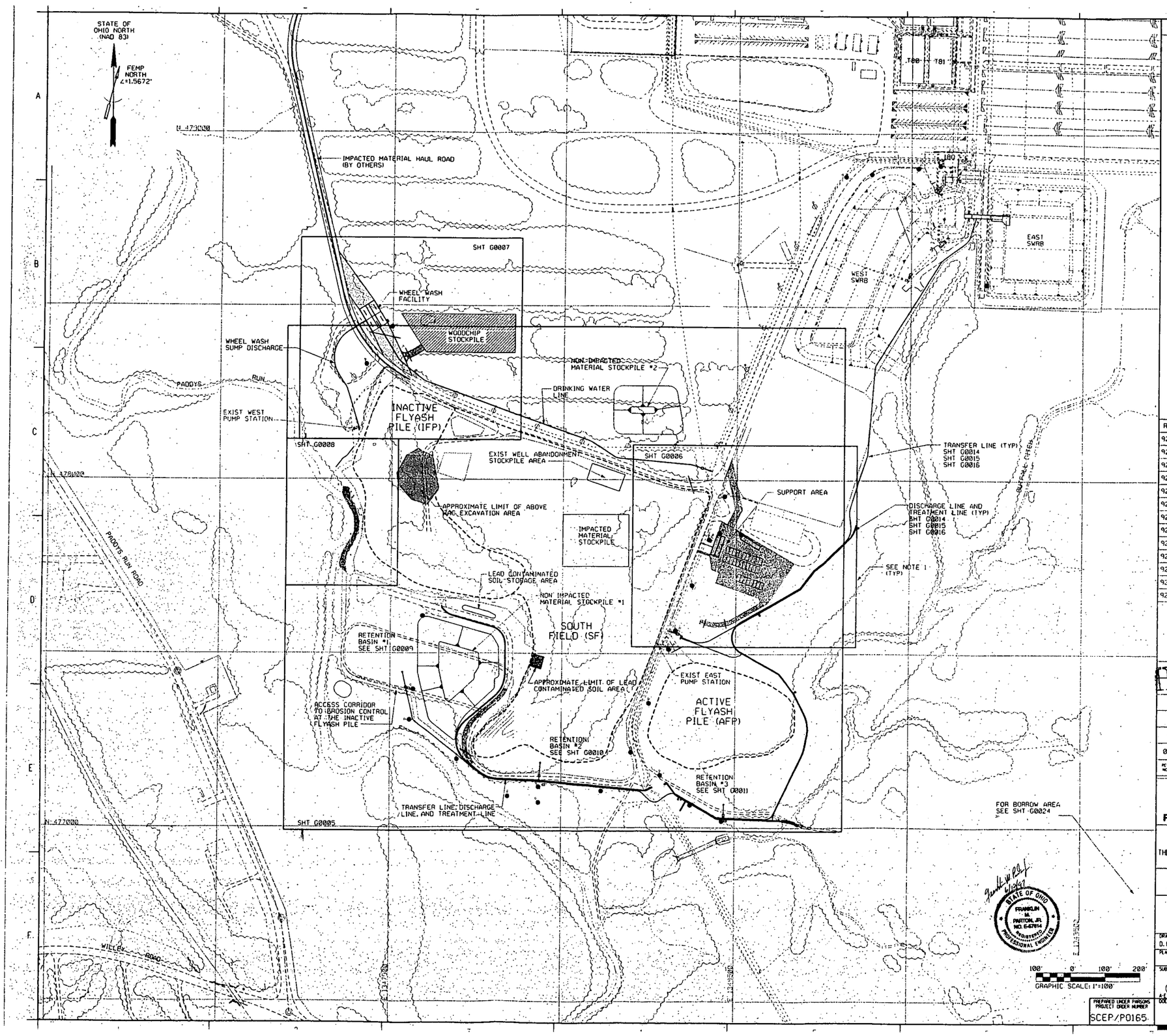
PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		1"=300'	

SUBMITTED FOR APPROVAL	FERMCO CRU APPROVAL	FERMCO PROJECT NO
DATE 6/10/97	N/A	20400

DOE PROJECT NO.	TEMP PROJECT NO	DRAWING REF CODE NO.	SHEET NO.	REV. NO
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00350	G0001	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
SCEP/P0165

STATE OF OHIO FRANKLIN M. PARTON, JR. NO. 6-07694 REGISTERED PROFESSIONAL ENGINEER



NOTES

1. RECTANGULAR SHAPES INDICATE LIMITS OF SHEETS TO REFERENCE.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00284	SITE PLAN - SUPPORT AREA	G0006
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00390	SITE PLAN - PADDYS RUN AREA	G0008
92X-5900-G-00303	ENLARGEMENT RETENTION BASIN #1	G0009
92X-5900-G-00371	ENLARGEMENT RETENTION BASIN #2	G0010
92X-5900-G-00372	ENLARGEMENT RETENTION BASIN #3	G0011
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00306	TRANSFER LINE - PLAN AND PROFILE - SHEET 3 OF 3	G0016
92X-5900-G-00453	SITE PLAN - BORROW AREA	G0024

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JWU	N/A	6/13/97

STATUS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
MASTER SITE/UTILITY PLAN 627

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	02/28/96		6/9/97	K. GERARD	1/18/97

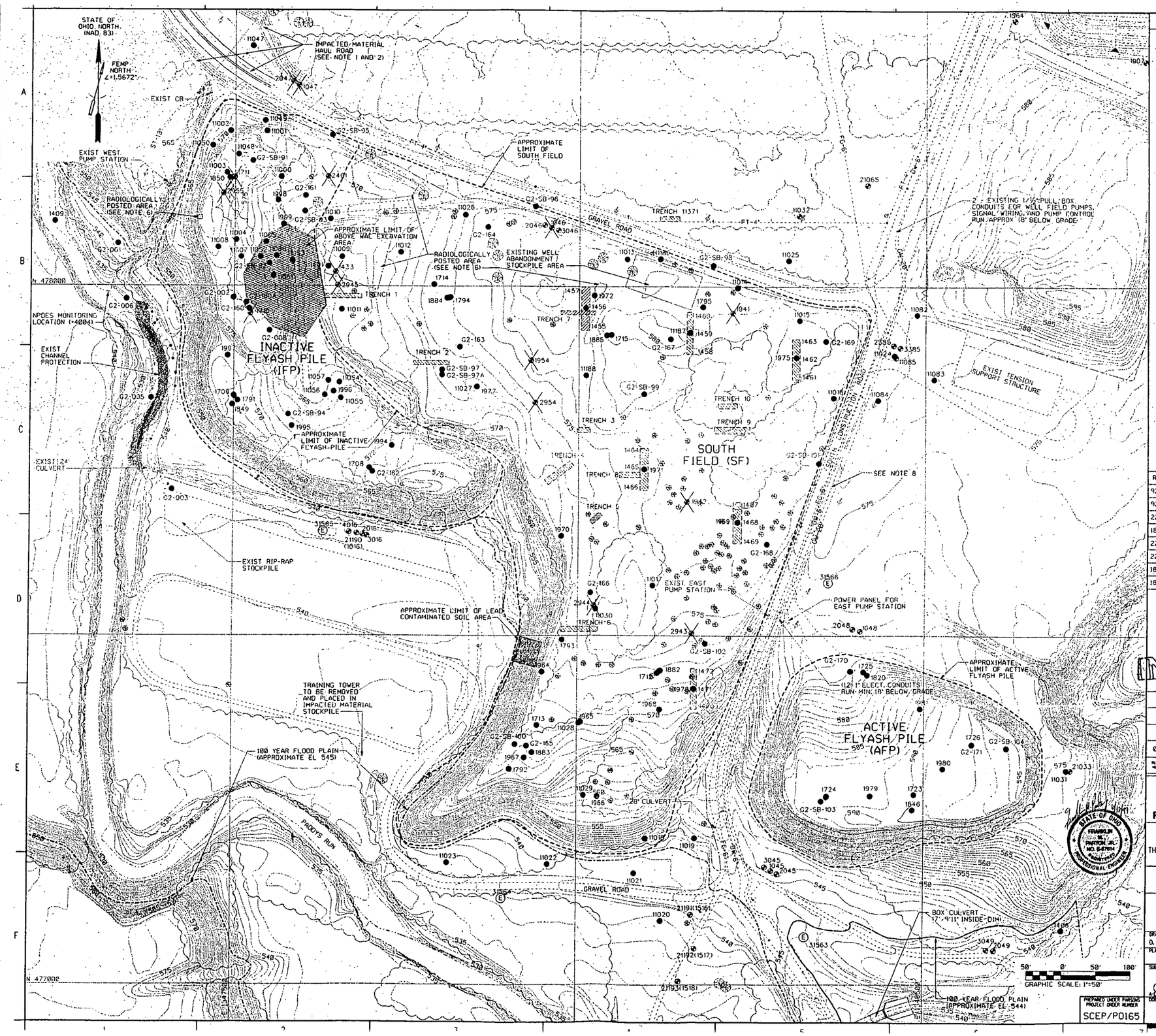
PLANT/BLDG NO. | FLOOR | SCALE 1"=100' | CLASS

SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL N/A | FERNCO PROJECT NO. 20400

A-E DATE 6/13/97

DOE PROJECT NO.	FEMP PROJECT NO.	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701		92X-5900-G-00281	G0002	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165



NOTES

1. IMPACTED MATERIAL HAUL ROAD WILL BE CONSTRUCTED IN THE SUMMER OF 1997 AND MAY NOT BE COMPLETED WHEN SOUTHERN WASTE UNITS SITE PREPARATION CONSTRUCTION BEGINS.
2. THE TOPOGRAPHIC AND PLANIMETRIC FEATURES SHOWN IN THE WHEEL WASH AREA AS EXISTING ARE FROM DESIGN DRAWINGS AND NOT "AS-BUILT". THE SUBCONTRACTOR SHALL INSPECT THE WORK AREA PRIOR TO STARTING WORK AND NOTIFY FDF OF ANY DISCREPANCIES IN WRITING.
3. SEE FLY ASH PILES AND SOUTH FIELD WASTE UNITS GEOTECHNICAL REPORT DATED APRIL, 1996 REVISION 0 FOR SOIL BORING LOCATIONS AND INFORMATION.
4. THE LIMITS OF THE INACTIVE FLYASH PILE (IFP), SOUTH FIELD (SF), AND ACTIVE FLYASH PILE (AFP) SHOWN ON THIS DRAWING ARE SHOWN FOR GENERAL INFORMATION ONLY.
5. FDF WILL COORDINATE ABANDONMENT OF DESIGNATED MONITORING WELLS BY OTHERS. PROTECT ALL EXISTING MONITORING WELLS AND EXTRACTION WELLS THAT ARE TO REMAIN. SEE SPECIFICATION 02100.
6. NOTIFY FDF 24 HOURS PRIOR TO PERFORMING WORK WITHIN EXISTING RADIOLOGICALLY POSTED AREAS. ALL WORK WITHIN THESE AREAS SHALL BE PERFORMED BY RAD II PERSONNEL WITH APPROPRIATE PPE REQUIREMENTS.
7. SUBCONTRACTOR TO USE CAUTION WHEN CROSSING EXISTING UTILITIES THAT RUN NORTH/SOUTH ALONG EXISTING ROAD.
8. DW-6", HDPE, 3.5' DEPTH
   REF DRAWING 22A-5500-G-00807 AND 18A-4445-G-01086

   FG-6", HDPE, 2' DEPTH
   REF DRAWING 22X-5500-P-00868 AND 22X-5500-P-00872

   GW-20", HDPE FORCE MAIN, 4' DEPTH
   REF DRAWING 18A-4445-G-01095 AND 18A-4445-G-01086

LEGEND

G2-169 ●	SOIL BORING
1970 ⊕	MONITORING WELL TO REMAIN
1970 ⊗	MONITORING WELL TO BE ABANDONED BY OTHERS
1463 1462 1461 ▨	INVESTIGATION TRENCH (BACKFILLED)
Ⓔ	EXTRACTION WELL TO REMAIN

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
22A-5500-G-00807	AS-BUILT PLAN	N/A
18A-4445-G-01086	DESIGN PLAN/PROFILE	N/A
22X-5500-P-00868	AS-BUILT PLAN	N/A
22X-5500-P-00872	AS-BUILT PIPE BEDDING DESIGN	N/A
18A-4445-G-01095	DESIGN PIPE BEDDING	N/A
18A-4445-G-01086	DESIGN PLAN/PROFILE	N/A

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

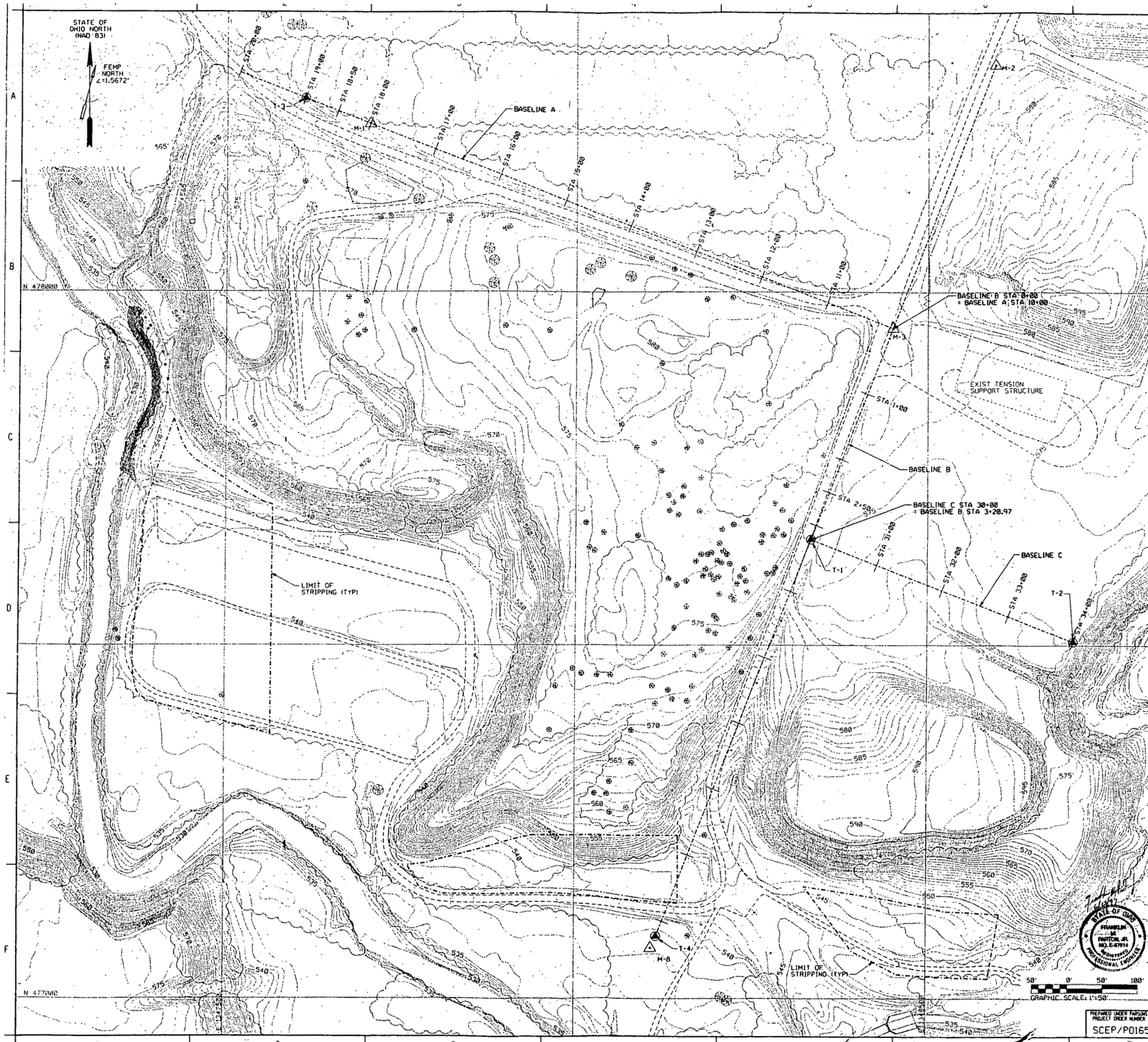
PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
EXISTING CONDITIONS PLAN 628

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	10/18/96		6/13/97	K. GERARD	1/18/97
PLANT/BLDG. NO.		FLOOR		SCALE 1"=50'	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL N/A		FERNCO PROJECT NO. 20400	
A-E DATE 6/13/97					

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
SCEP/P0165	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00348	G0003	0

802



NOTES

1. EXISTING BENCHMARK INFORMATION PROVIDED BY FDF.
2. ANY BENCHMARKS DAMAGED DURING CONSTRUCTION SHALL BE REPLACED BY FDF AT THE SUBCONTRACTOR'S EXPENSE.
3. STRIP TOP 12 INCHES OF MATERIAL WITHIN THE LIMITS OF STRIPPING AS SHOWN ON THIS DRAWING. PLACE MATERIAL IN IMPACTED MATERIAL STOCKPILE AS SHOWN ON G0005.

BENCHMARK INFORMATION

BENCHMARK	NORTHING	EASTING	ELEVATION	REMARKS
M-1	478238.04	1347705.25	573.848	A
M-2	478321.86	1348595.65	576.678	A
M-3	477948.93	1348451.10	577.413	A
M-8	477071.65	1348110.41	537.47	A
T-1	477649.66	1348335.09	TBS	TBS
T-2	477505.09	1348708.05	TBS	TBS
T-3	478274.21	1347611.94	TBS	TBS
T-4	477088.48	1348117.58	TBS	TBS

A CONCRETE MONUMENT WITH X IN 3-1/2" ALUMINUM PLATE
TBS TO BE SET WITH IRON PIN AND PLASTIC SURVEYORS CAP A MINIMUM OF 48" DEEP.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005

FOR INFORMATION ONLY

REV. NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
SURVEY INFORMATION AND SOIL STRIPPING PLAN

629

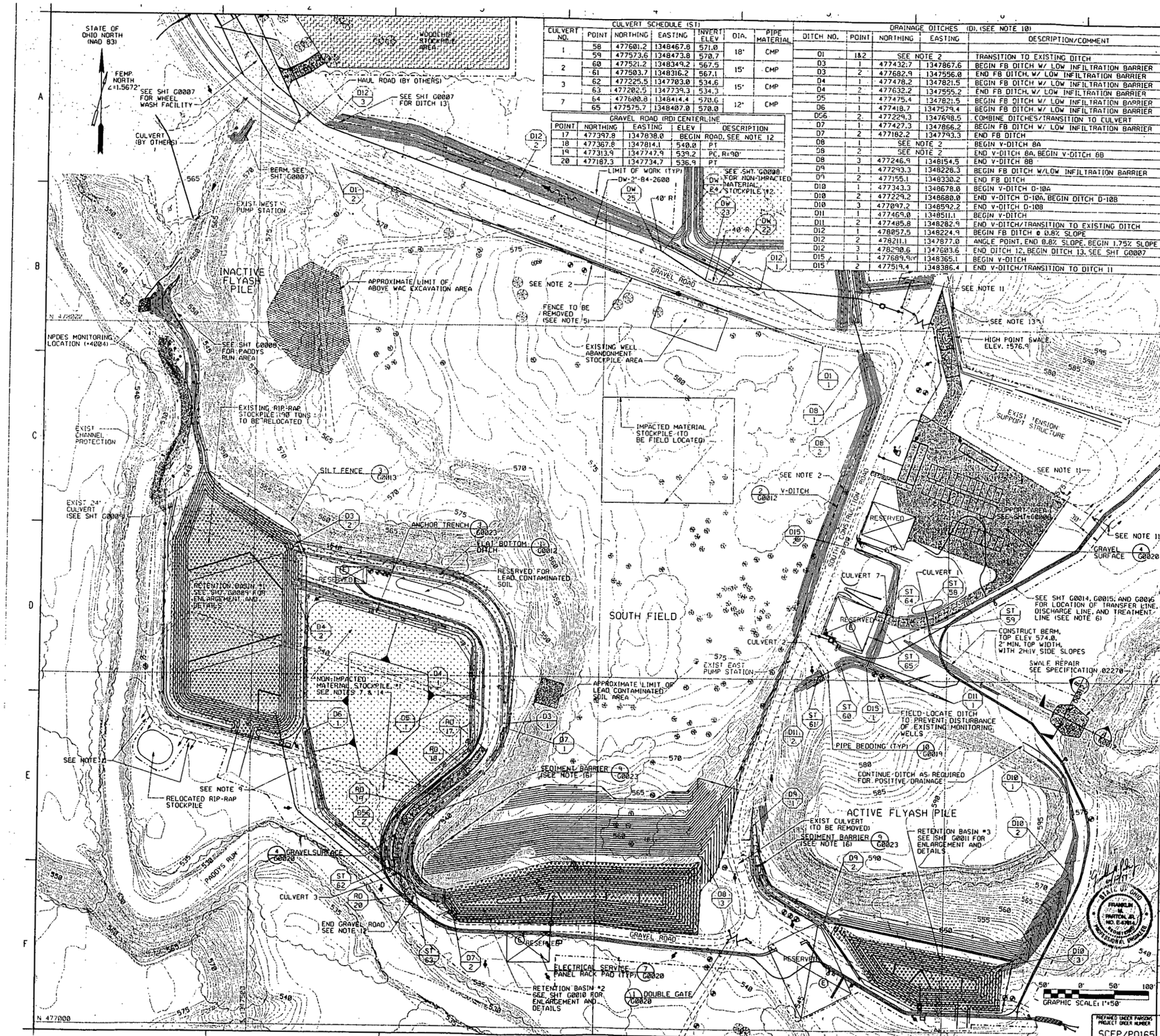
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	12/17/96		6/13/97	K. GERARD	1/18/97

PLANT/BLDG NO	FLOOR	SCALE	CLASS
		1"=50'	

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	FERNCO PROJECT NO.
A-E DATE 6/13/97	N/A	20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO	SHEET NO.	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00400	G0004	0

802



CULVERT SCHEDULE (ST)						
CULVERT NO.	POINT	NORTHING	EASTING	INVERT ELEV	DIA.	PIPE MATERIAL
1	58	477601.2	1348467.8	571.0	18"	CMP
	59	477573.6	1348473.8	570.7		
2	60	477521.2	1348349.2	567.5	15"	CMP
	61	477503.7	1348316.2	567.1		
3	62	477225.5	1347703.0	534.6	15"	CMP
	63	477202.5	1347739.3	534.3		
7	64	477600.8	1348414.4	570.6	12"	CMP
	65	477575.7	1348407.0	570.0		

GRAVEL ROAD (RD) CENTERLINE				
POINT	NORTHING	EASTING	ELEV	DESCRIPTION
17	477397.8	1347838.0		BEGIN ROAD, SEE NOTE 12
18	477367.8	1347814.1	540.0	PT
19	477313.9	1347747.9	539.2	PC, R=90'
20	477187.3	1347734.7	536.9	PT

DRAINAGE DITCHES (D), (SEE NOTE 10)				
DITCH NO.	POINT	NORTHING	EASTING	DESCRIPTION/COMMENT
D1	1&2	SEE NOTE 2		TRANSITION TO EXISTING DITCH
D3	1	477432.7	1347867.6	BEGIN FB DITCH W/ LOW INFILTRATION BARRIER
D3	2	477682.9	1347556.0	END FB DITCH, W/ LOW INFILTRATION BARRIER
D4	1	477478.2	1347821.5	BEGIN FB DITCH W/ LOW INFILTRATION BARRIER
D4	2	477632.2	1347555.2	END FB DITCH, W/ LOW INFILTRATION BARRIER
D5	1	477475.4	1347821.5	BEGIN FB DITCH W/ LOW INFILTRATION BARRIER
D6	1	477418.7	1347579.4	BEGIN FB DITCH W/ LOW INFILTRATION BARRIER
D5&6	2	477229.3	1347698.5	COMBINE DITCHES/TRANSITION TO CULVERT
D7	1	477427.3	1347866.2	BEGIN FB DITCH W/ LOW INFILTRATION BARRIER
D7	2	477182.2	1347793.3	END FB DITCH
D8	1	SEE NOTE 2		BEGIN V-DITCH 8A
D8	2	SEE NOTE 2		END V-DITCH 8A, BEGIN V-DITCH 8B
D8	3	477246.9	1348154.5	END V-DITCH 8B
D9	1	477293.3	1348228.3	BEGIN FB DITCH W/LOW INFILTRATION BARRIER
D9	2	477155.1	1348330.2	END FB DITCH
D10	1	477343.3	1348678.0	BEGIN V-DITCH D-10A
D10	2	477229.2	1348680.0	END V-DITCH D-10A, BEGIN DITCH D-10B
D10	3	477097.2	1348592.2	END V-DITCH D-10B
D11	1	477469.0	1348511.1	BEGIN V-DITCH
D11	2	477485.8	1348282.9	END V-DITCH/TRANSITION TO EXISTING DITCH
D12	1	478057.5	1348224.9	BEGIN FB DITCH @ 0.8% SLOPE
D12	2	478211.1	1347877.0	ANGLE POINT, END 0.8% SLOPE, BEGIN 1.75% SLOPE
D12	3	478290.6	1347683.6	END DITCH 12, BEGIN DITCH 13, SEE SHT G0007
D15	1	477689.9	1348365.1	BEGIN V-DITCH
D15	2	477519.4	1348386.4	END V-DITCH/TRANSITION TO DITCH 11

NOTES

1. RESERVED AREAS SHALL BE USED BY OTHER CONTRACTORS. SITE PREP CONTRACTOR SHALL ALLOW ACCESS TO THESE AREAS.
2. FIELD ROUTE THE DITCH. A MINIMUM OF 5' SHALL BE MAINTAINED FROM THE EDGE OF EXISTING ROAD TO CENTERLINE OF DITCH. AVOID EXISTING UTILITY/SEEPAGE COLLECTION LINES.
3. EROSION/SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO EXCAVATION.
4. PROTECT ALL EXISTING MONITORING WELLS AND EXTRACTION WELLS TO REMAIN. SEE SPECIFICATION 02100.
5. REMOVE EXISTING PLASTIC CHAIN FENCE, POSTS, AND SIGNS WITHIN LIMIT OF WORK.
6. LIMIT OF WORK FOR THE TRANSFER, DISCHARGE AND TREATMENT LINES IS 15' BEYOND THE OUTSIDE LINE.
7. SURFACE OF NON-IMPACTED MATERIAL STOCKPILE AREAS SHALL BE COVERED WITH A GEOMEMBRANE LINER PRIOR TO PLACEMENT OF NON-IMPACTED MATERIAL.
9. SEE SHT G0012 FOR EROSION AND SEDIMENT CONTROL CONSTRUCTION SEQUENCE AND NOTES.
9. CLEAR TREES TO PROVIDE ACCESS CORRIDOR TO EXIST CHANNEL PROTECTION AT THE INACTIVE FLYASH PILE.
10. SEE SHT G0012 FOR DETAILS AND INVERT ELEVATIONS OF DITCHES.
11. THE LIMIT OF WORK AS SHOWN ON THE DRAWINGS INDICATES THE LOCATION OF THE PROPOSED CONSTRUCTION FENCE, EXCEPT BETWEEN MARKERS INDICATED.
12. GRADE TO MATCH EXISTING ROAD.
13. GRADE SWALE TO PROVIDE POSITIVE DRAINAGE.
14. NON-IMPACTED MATERIAL STOCKPILES SHALL BE IN ACCORDANCE WITH SPECIFICATION 02200 FOR MAXIMUM HEIGHT AND SIDE SLOPE LIMITS.
15. THE LIMIT OF WORK AS SHOWN ON DRAWINGS INDICATES CLEARING LIMITS EXCEPT AS NOTED ON THE PLAN SHEETS.
16. PLACE BARRIER AT UPSTREAM RADIUS POINT OF CURVE OF DITCH.

DRINKING WATER COORDINATES (DW)			
POINT	NORTHING	EASTING	DESCRIPTION
22	478062.1	1348164.0	BEGIN BEND
23	478068.3	1348145.7	END BEND
24	478108.1	1348084.0	BEGIN BEND
25	478112.2	1348075.7	END BEND

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00348	EXISTING CONDITIONS PLAN	G0003
92X-5900-G-00284	SITE PLAN - SUPPORT AREA	G0006
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00398	SITE PLAN - PADDYS RUN AREA	G0008
92X-5900-G-00303	ENLARGEMENT RETENTION BASIN #1	G0009
92X-5900-G-00371	ENLARGEMENT RETENTION BASIN #2	G0010
92X-5900-G-00372	ENLARGEMENT RETENTION BASIN #3	G0011
92X-5900-G-00311	EROSION AND SEDIMENT CONTROL - SHEET 1 OF 2	G0012
92X-5900-G-00368	EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00306	TRANSFER LINE - PLAN AND PROFILE - SHEET 3 OF 3	G0016
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-G-00452	MISCELLANEOUS DETAILS - SHEET 3 OF 3	G0023

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNIT REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

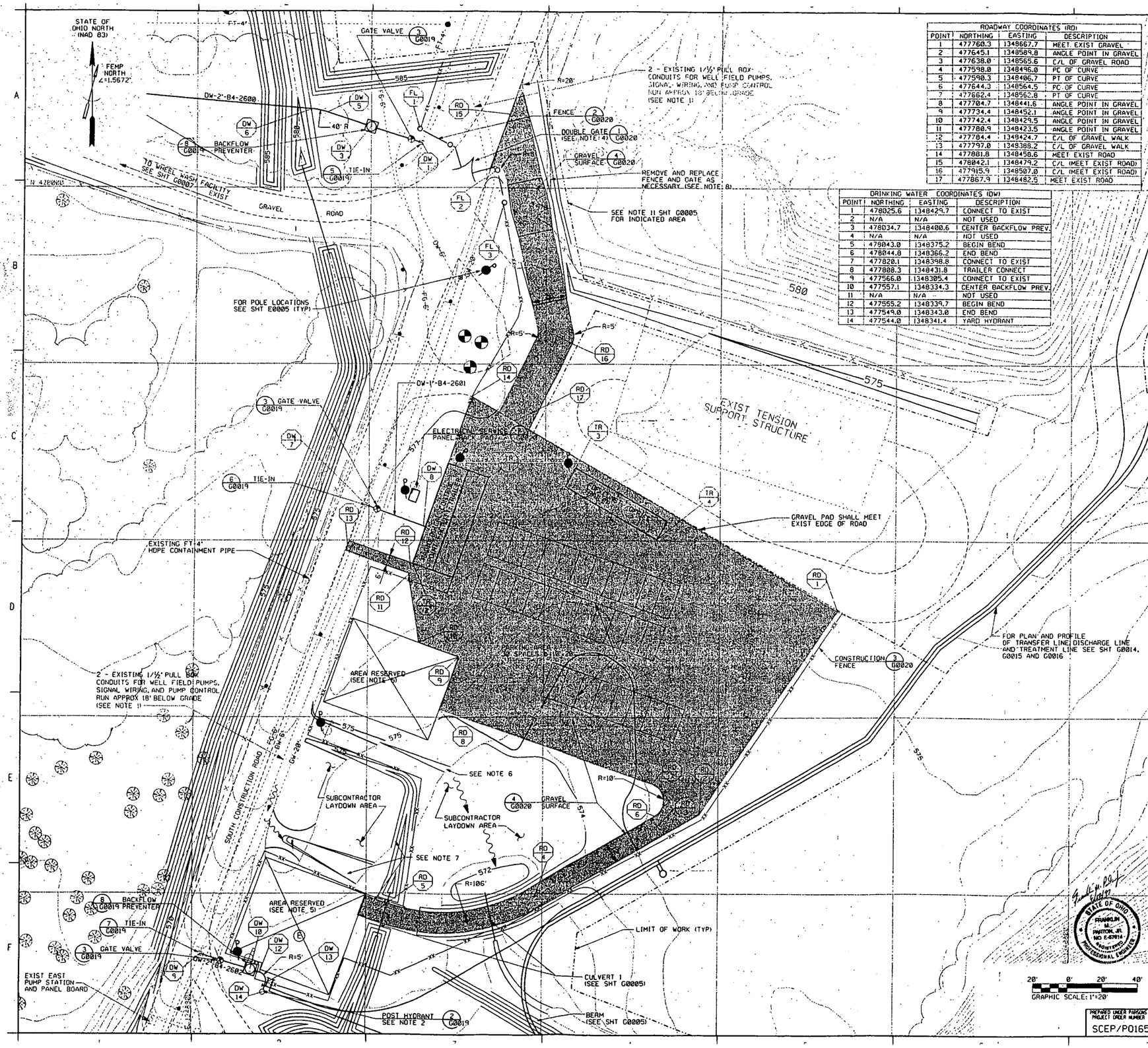
DRAWING TITLE
CIVIL
SITE PLAN

630

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	02/28/96		6/13/97	K. GERARD	1/18/97
PLANT/BLDG NO		FLOOR		SCALE 1"=50'	CLASS

SUBMITTED FOR APPROVAL — DATE 6/13/97
FERNCO CRU APPROVAL — N/A — DATE
FERNCO PROJECT NO 20400

PREPARED UNDER PARSONS PROJECT UNDER NUMBER	DOE PROJECT NO	TEAM PROJECT NO	DRAWING INDEX CODE NO	SHEET NO	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00282	G0005	0



ROADWAY COORDINATES (RD)			
POINT	NORTHING	EASTING	DESCRIPTION
1	477760.3	1348667.7	MEET EXIST GRAVEL
2	477645.1	1348589.8	ANGLE POINT IN GRAVEL
3	477638.0	1348565.6	C/L OF GRAVEL ROAD
4	477598.0	1348496.0	PC OF CURVE
5	477590.3	1348406.7	PT OF CURVE
6	477644.3	1348564.5	PC OF CURVE
7	477662.4	1348562.8	PT OF CURVE
8	477704.7	1348441.6	ANGLE POINT IN GRAVEL
9	477734.4	1348452.1	ANGLE POINT IN GRAVEL
10	477742.4	1348429.5	ANGLE POINT IN GRAVEL
11	477780.9	1348423.5	ANGLE POINT IN GRAVEL
12	477784.4	1348424.7	C/L OF GRAVEL WALK
13	477797.0	1348388.2	C/L OF GRAVEL WALK
14	477881.8	1348456.6	MEET EXIST ROAD
15	478042.1	1348479.2	C/L (MEET EXIST ROAD)
16	477915.9	1348507.0	C/L (MEET EXIST ROAD)
17	477867.9	1348482.5	MEET EXIST ROAD

DRINKING WATER COORDINATES (DW)			
POINT	NORTHING	EASTING	DESCRIPTION
1	478025.6	1348429.7	CONNECT TO EXIST
2	N/A	N/A	NOT USED
3	478034.7	1348400.6	CENTER BACKFLOW PREV.
4	N/A	N/A	NOT USED
5	478043.0	1348375.2	BEGIN BEND
6	478044.8	1348366.2	END BEND
7	477820.1	1348398.8	CONNECT TO EXIST
8	477808.3	1348431.8	TRAILER CONNECT
9	477566.0	1348305.4	CONNECT TO EXIST
10	477557.1	1348334.3	CENTER BACKFLOW PREV.
11	N/A	N/A	NOT USED
12	477555.2	1348339.7	BEGIN BEND
13	477549.0	1348343.0	END BEND
14	477544.0	1348341.4	YARD HYDRANT

NOTES

1. UTILITY LOCATIONS ARE APPROXIMATE. INSPECT THE WORK AREA PRIOR TO CONSTRUCTION AND STARTING WORK AND NOTIFY FDF OF ANY DISCREPANCIES IN WRITING.
2. POST HYDRANT AT AFP FOR DUST CONTROL WATER SUPPLY ONLY. DIRECT CONNECTION TO HYDRANT FOR SPRAYING NOT AUTHORIZED. PROVIDE TEMPORARY STORAGE TANK FOR SPRAY WATER. USE THE POST HYDRANT TO FILL TEMPORARY STORAGE TANK DURING NON-PEAK PERIODS OF WATER DEMAND AT THE FEMP.
3. SANITARY WATER IS TO BE COLLECTED IN TANK IN ACCORDANCE WITH SPECIFICATION 13125 AND LATER REMOVED AND DISPOSED OF BY SUBCONTRACTOR AT DIRECTIVE OF FDF.
4. DOUBLE SWING GATE AND ROADWAY MUST REMAIN CLEAR AT ALL TIMES FOR EMERGENCY VEHICLE ACCESS INTO PROJECT AREA. THE GATE IS TO BE CLOSED EXCEPT FOR EMERGENCY ACCESS.
5. AREAS RESERVED ARE FOR OTHER PROJECTS BUT CAN BE USED FOR INSTALLATION OF OVERHEAD ELECTRIC AND WATER LINES. MAINTAIN AND ALLOW ACCESS TO THESE AREAS DURING CONTRUCTION.
6. FIELD LOCATE 1' DEEP DRAINAGE SWALE NORTH OF SUBCONTRACTOR LAYDOWN AREA WITHIN THE SOIL CONTAMINATION AREA TO PREVENT SURFACE WATER RUN ON.
7. LOCATE 1' DEEP DRAINAGE SWALE AROUND PERIMETER OF SUBCONTRACTOR LAYDOWN AREA AS SHOWN. GRADE FOR POSITIVE DRAINAGE TO DITCH 11.
8. RELOCATE EXISTING FENCE AND GATE AS REQUIRED TO CONSTRUCT GRAVEL SURFACE AND DITCH. REINSTALL THE FENCE AND GATE ALONG LIMIT OF WORK.

FENCE COORDINATES (FL)			
POINT	NORTHING	EASTING	DESCRIPTION
1	478033.6	1348428.1	BEGIN OF NEW FENCE
2	478010.2	1348472.0	ANGLE POINT ON FENCE
3	477991.8	1348476.1	END OF NEW

PROPOSED TRAILER COORDINATES (TR)			
POINT	NORTHING	EASTING	DESCRIPTION
1	477836	1348468	NE CORNER
2	477787	1348426	SW CORNER
3	477841	1348518	NW CORNER
4	477801	1348564	SE CORNER

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00281	MASTER SITE/UTILITY PLAN	G0002
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00306	TRANSFER LINE - PLAN AND PROFILE - SHEET 3 OF 3	G0016
92X-5900-G-00307	WATER LINE DETAILS	G0019
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-E-00379	ELECTRICAL - OVERALL SITE POWER PLAN	E0005

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
SITE PLAN - SUPPORT AREA

631

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D.R. FOX	02/28/96		6/13/97	K. GERARD	01/18/97

PLANT/BLDG NO | FLOOR | SCALE 1"=20' | CLASS

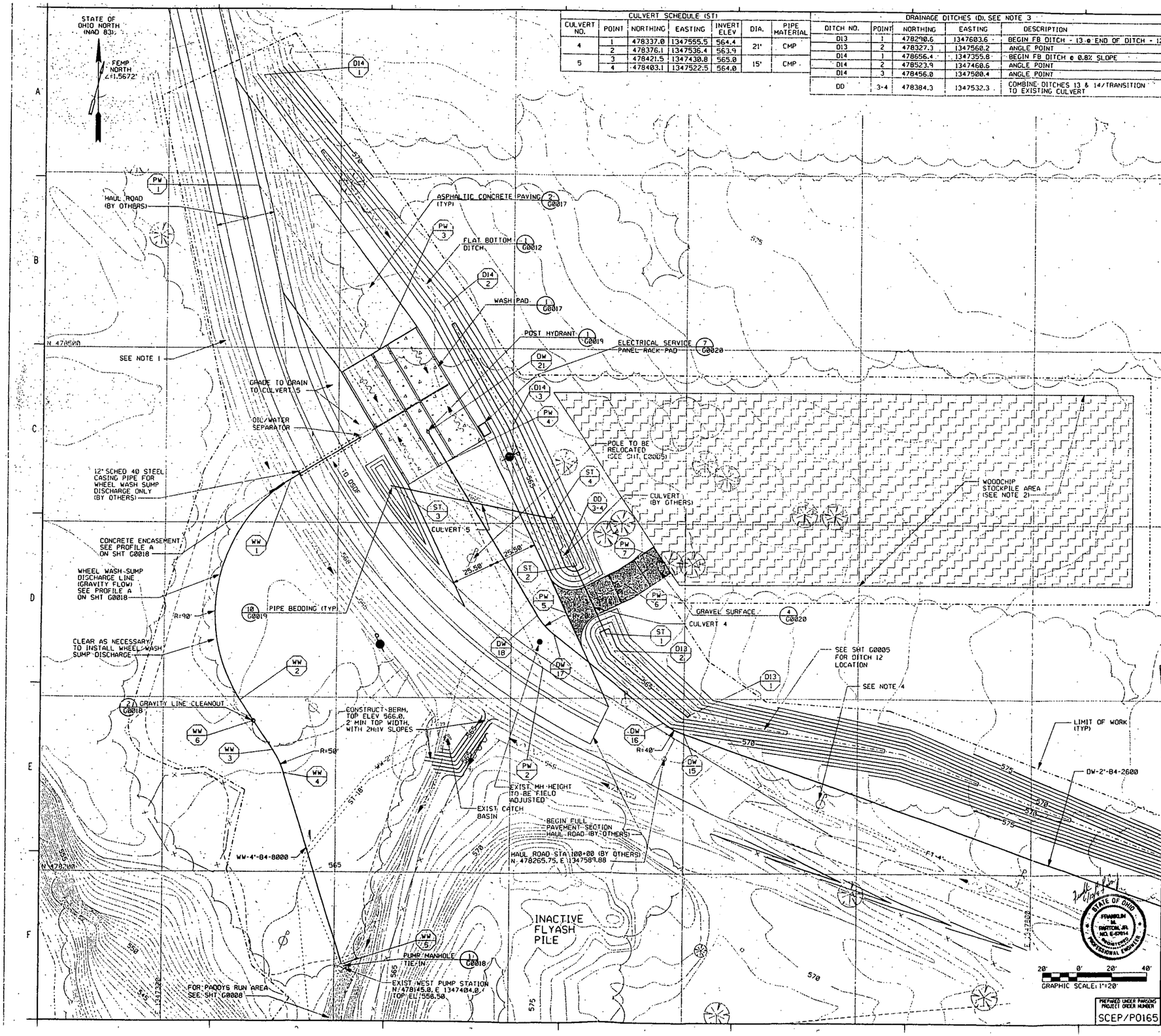
SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL N/A | FERNCO PROJECT NO. 20400

DATE 6/13/97

DOE PROJECT NO	FEMP PROJECT NO	DRAWING INDEX CODE NO	SHEET NO	REV. NO
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00284	G0006	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/PO165

802



CULVERT SCHEDULE (ST)						
CULVERT NO.	POINT	NORTHING	EASTING	INVERT ELEV	DIA.	PIPE MATERIAL
4	1	478337.0	1347555.5	564.4	21"	CMP
	2	478376.1	1347536.4	563.9		
5	3	478421.5	1347430.8	565.0	15"	CMP
	4	478403.1	1347522.5	564.0		

DRAINAGE DITCHES (D), SEE NOTE 3				
DITCH NO.	POINT	NORTHING	EASTING	DESCRIPTION
D13	1	478290.6	1347603.6	BEGIN FB DITCH - 13.0' END OF DITCH - 12
D13	2	478327.3	1347560.2	ANGLE POINT
D14	1	478656.4	1347355.8	BEGIN FB DITCH @ 0.8% SLOPE
D14	2	478523.9	1347460.6	ANGLE POINT
D14	3	478456.0	1347500.4	ANGLE POINT
DD	3-4	478384.3	1347532.3	COMBINE DITCHES 13 & 14/TRANSITION TO EXISTING CULVERT

NOTES

1. CONTOURS SHOWN ALONG THE PROPOSED HAUL ROAD WERE GENERATED FROM DESIGN DRAWINGS AND ARE APPROXIMATE AND COULD VARY. FIELD VERIFY AND INFORM FDF OF DIFFERENT CONDITIONS.
2. HAUL ROAD CONSTRUCTION WILL BE IN PROGRESS BY OTHERS. WOODCHIP STOCKPILE AREA DESIGNATED AS HAUL ROAD CONTRUCTION LAYDOWN AREA. COORDINATE WITH HAUL ROAD SUBCONTRACTOR THROUGH FDF.
3. SEE SHT G0012 FOR DETAILS AND INVERT ELEVATIONS OF DITCHES.
4. ADJUST GRADING AS NECESSARY TO PREVENT DISTURBANCE OF EXISTING POLES.

PAVEMENT AND WHEEL WASH COORDINATES (PW)			
POINT	NORTHING	EASTING	DESCRIPTION
1	478593.1	1347353.3	℄ OF PAVEMENT
2	478317.4	1347518.8	℄ OF PAVEMENT
3	478499.3	1347423.8	℄ WHEEL WASH
4	478435.2	1347462.6	℄ WHEEL WASH
5	478349.0	1347531.8	℄ ACCESS ROAD
6	478365.5	1347566.5	℄ ACCESS ROAD
7	478379.8	1347587.7	℄ ACCESS ROAD

DRINKING WATER COORDINATES (DW)			
POINT	NORTHING	EASTING	DESCRIPTION
15	478280.1	1347600.8	BEGIN BEND
16	478286.3	1347589.2	END BEND
17	478336.6	1347525.0	BEGIN BEND
18	478347.5	1347515.4	END BEND
19	N/A	N/A	NOT USED
20	N/A	N/A	NOT USED
21	478452.26	1347452.22	YARD HYDRANT

WASTE WATER COORDINATES (WW)			
POINT	NORTHING	EASTING	DESCRIPTION
1	478425.1	1347373.5	BEGIN BEND
2	478298.3	1347345.1	END BEND
3	478270.0	1347364.3	BEGIN BEND
4	478256.9	1347370.6	END BEND
5	478147.1	1347404.9	CONNECT TO EXIST
6	478286.5	1347353.1	CLEANOUT

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-Y-00321	LEGEND AND GENERAL NOTES	Y0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00390	SITE PLAN - PADDYS RUN AREA	G0008
92X-5900-G-00311	EROSION AND SEDIMENT CONTROL - SHEET 1 OF 2	G0012
92X-5900-G-00312	WHEEL WASH PAD - PLAN AND DETAILS	G0017
92X-5900-G-00310	WHEEL WASH SUMP DISCHARGE	G0018
92X-5900-G-00307	WATER LINE DETAILS	G0019
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMM	N/A	6/13/97

APPROVALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
SITE PLAN - WHEEL WASH AREA

632

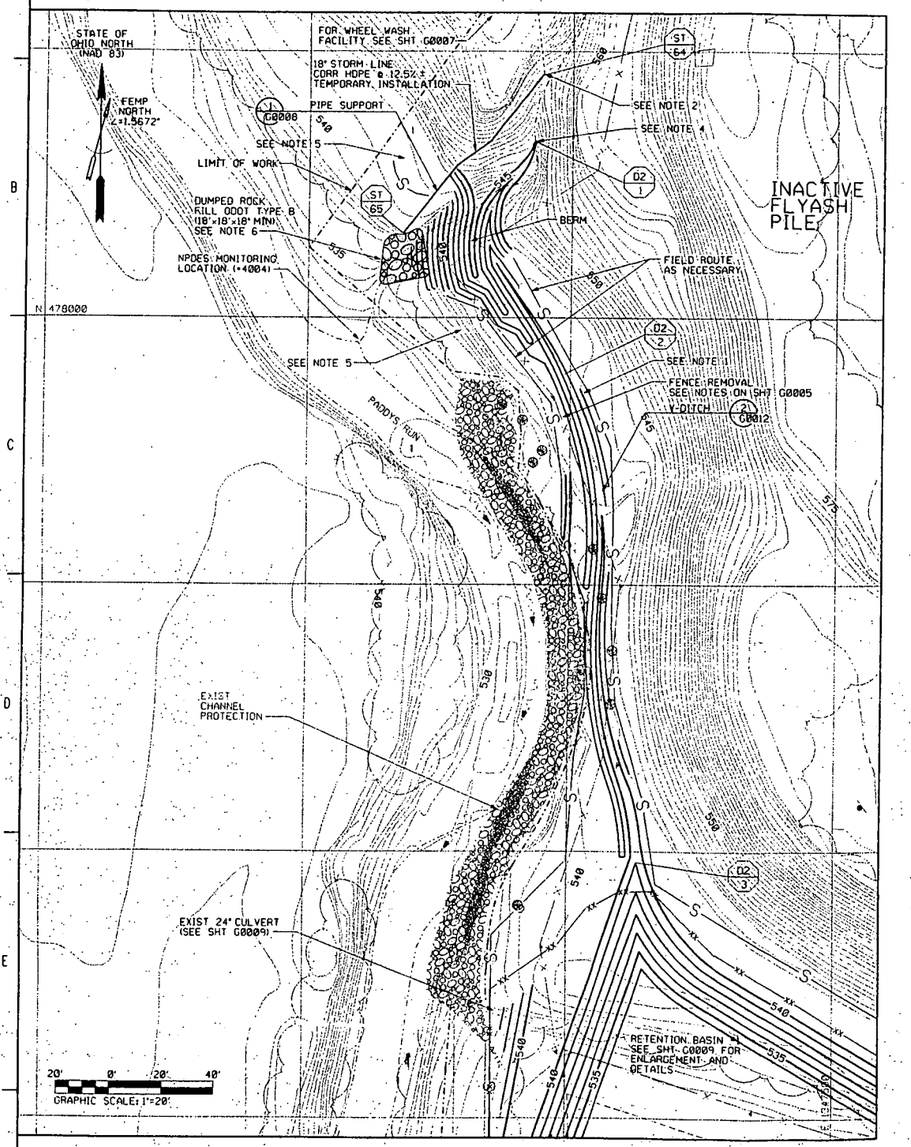
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	02/28/96		6/10/97	K. GERARD	01/18/97
PLANT/BLDG NO.				SCALE 1"=20'	CLASS
SUBMITTED FOR APPROVAL		FERMCO CRU APPROVAL N/A		FERMCO PROJECT NO. 20400	

APPROVAL DATE 6/13/97

DOE PROJECT NO.	FEMP PROJECT NO	DATE	DRAWING INDEX CODE NO	SHEET NO.	REV. NO
	WBS 1.1.1.1.2.3.6 00-90701		92X-5900-G-00283	G0007	0

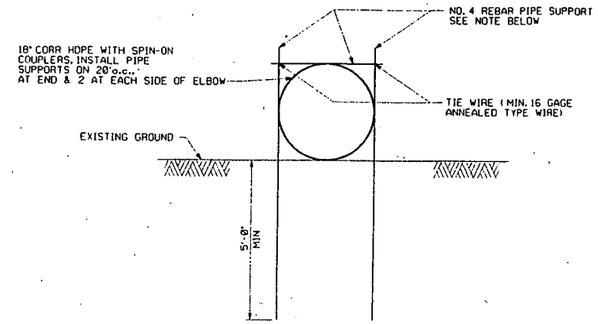
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165

STATE OF OHIO FRANKLIN M. PARTICLIR NO. E-67914 REGISTERED PROFESSIONAL ENGINEER



PIPE SCHEDULE (ST)					
POINT	NORTHING	EASTING	INVERT ELEV	DIA.	PIPE MATERIAL
64	MEET EXIST			18"	CORR. HDPE
65	EXTEND PIPE ALONG TOE OF SLOPE TO ELEV 540.0				

DRAINAGE DITCHES (D). SEE NOTE 3				
DITCH NO.	POINT	NORTHING	EASTING	DESCRIPTION/COMMENT
D2	1	478066	1347387	BEGIN V-DITCH 2A WITH INFILTRATION BARRIER
D2	2	477979	1347398	END V-DITCH 2A, BEGIN V-DITCH 2B WITH INFILTRATION BARRIER
D2	3	477796	1347426	END V-DITCH 2B

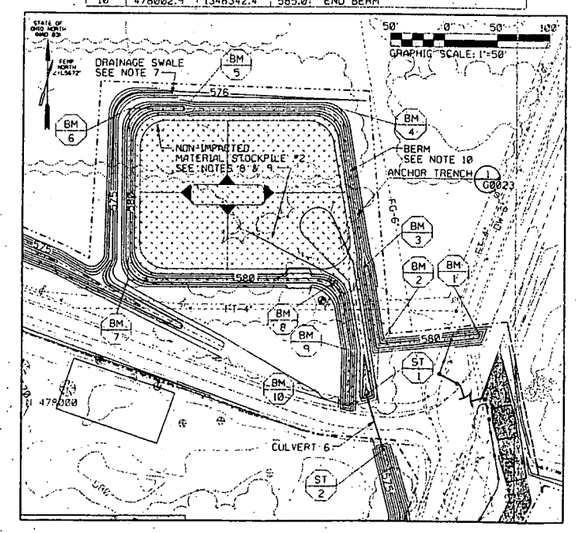


NOTE:
LOCATE SUPPORT RODS FIRMLY AGAINST SIDE OF PIPE IN VALLEY OF CORR. PLACE TOP SUPPORT ROD SNUG AGAINST TOP OF PIPE AND TIE WIRE TO SIDE SUPPORT RODS.

DETAIL 1 G0008 REF
PIPE SUPPORT
NTS

CULVERT SCHEDULE (ST)						
CULVERT NO.	POINT	NORTHING	EASTING	INVERT ELEV	DIA.	PIPE MATERIAL
6	1	478012.7	1348360.4	573.9	15"	CMP
	2	477961.5	1348376.7	573.3		

BERM SCHEDULE (BM)				
POINT	NORTHING	EASTING	ELEV	DESCRIPTION
1	478069.7	1348466.0	585.0	END BERM
2	478058.8	1348371.3	585.0	ANGLE POINT
3	478134.2	1348358.7	585.0	GRADE BREAK
4	478281.1	1348334.2	584.0	PI, R=25'
5	478281.1	1348185.3	585.0	GRADE BREAK
6	478281.1	1348133.9	585.0	PI, R=25'
7	478120.2	1348133.8	585.0	PI, R=25'
8	478120.2	1348332.0	585.0	PI, R=25'
9	478054.9	1348343.4	585.0	ANGLE POINT
10	478002.9	1348342.4	585.0	END BERM



NON-IMPACTED MATERIAL STOCKPILE #2

NOTES

1. FIELD ROUTE DITCH D2. MAINTAIN THE EXISTING CHANNEL PROTECTION (RIP-RAP). CUT MATERIAL IS TO BE DISPOSED OF AS AN IMPACTED MATERIAL. FILL MATERIAL WILL BE "BORROW" SOIL.
2. EXPOSE END OF EXISTING 18" CORR HDPE PIPE AS REQUIRED TO CONNECT NEW HDPE TO EXISTING PIPE. USE CONNECTING BAND OR TRANSITION COLLAR, OR OTHER METHOD AS RECOMMENDED BY THE MANUFACTURER TO MAKE CONNECTION. BACKFILL EXPOSED PORTION OF EXISTING PIPE.
3. SEE SHT G0012 FOR DETAILS AND INVERT ELEVATIONS OF DITCHES.
4. BEGIN DITCH AND GRADE TO INTERCEPT ALL FLOW FROM EXISTING STREAM.
5. MAINTAIN EXISTING TREES NEAR PADDYS RUN AND WEST OF 18 INCH STORM LINE TO THE EXTENT POSSIBLE.
6. INSTALL GEOTEXTILE PRIOR TO PLACEMENT OF DUMPED ROCK FILL.
7. CONSTRUCT 1' DEEP DRAINAGE SWALE ON NORTH AND WEST SIDES OF BERM. GRADE TO DRAIN INTO DITCH 12 AS SHOWN.
8. NON-IMPACTED MATERIAL STOCKPILE SHALL BE IN ACCORDANCE WITH SPECIFICATION 02200 FOR MAXIMUM HEIGHT AND SIDE SLOPES.
9. SURFACE OF NON-IMPACTED MATERIAL STOCKPILE AREA SHALL BE COVERED WITH A GEOMEMBRANE LINER PRIOR TO PLACEMENT OF NON-IMPACTED MATERIAL.
10. CONSTRUCT BERM TO THE LINES AND GRADES SHOWN WITH A 1.5' MIN. TOP WIDTH AND 2H:1V SIDE SLOPES.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00303	ENLARGEMENT RETENTION BASIN #1	G0009
92X-5900-G-00311	EROSION AND SEDIMENT CONTROL - SHEET 1 OF 2	G0012
92X-5900-G-00452	MISCELLANEOUS DETAILS - SHEET 3 OF 3	G0023

FOR INFORMATION ONLY

REV. NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
SITE PLAN - PADDYS RUN AREA

633

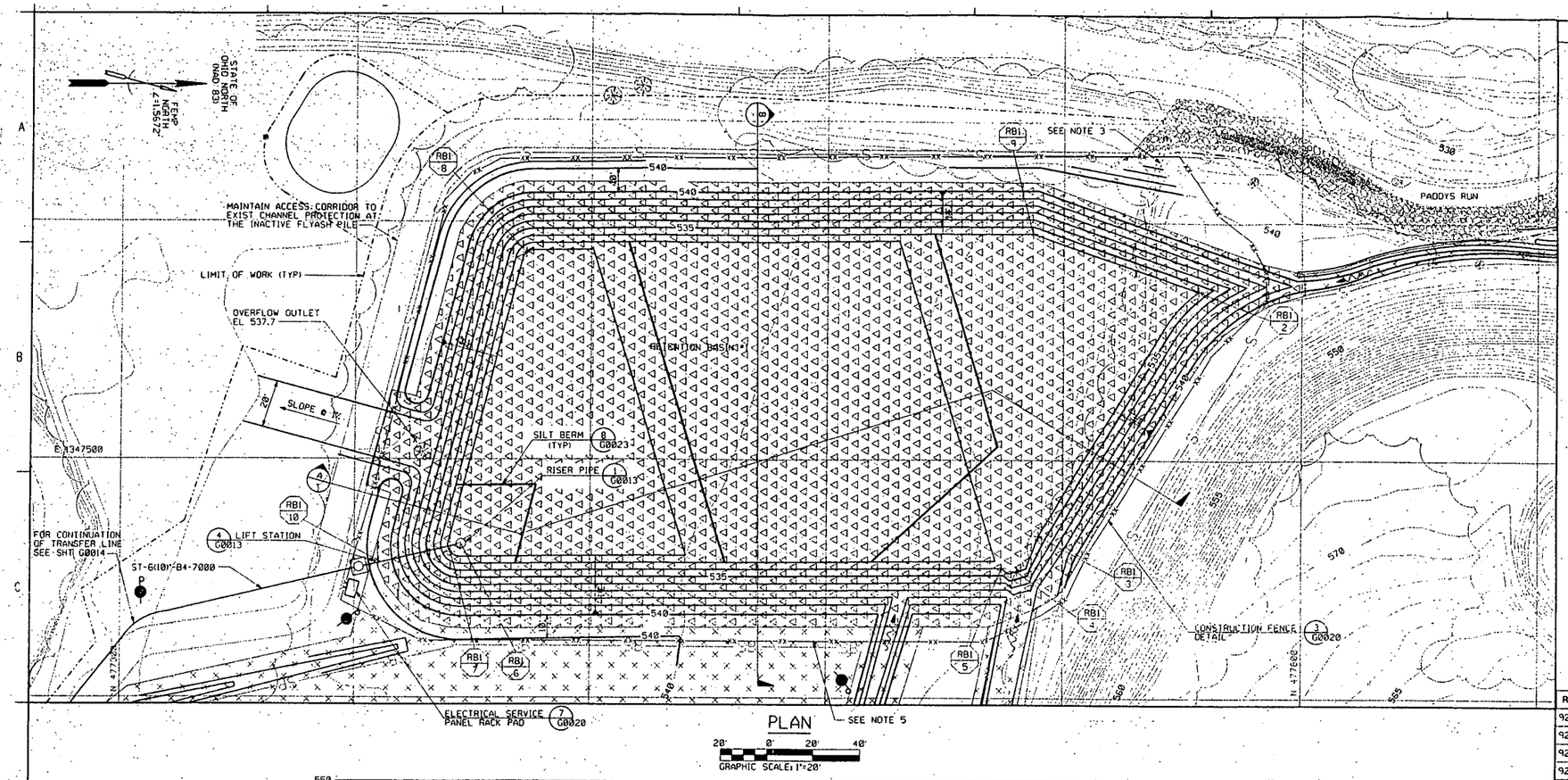
STATE OF OHIO FRANKLIN M. PARTOLL JR. NO E-67814 REGISTERED PROFESSIONAL ENGINEER 6/13/97

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	12/26/96		6/13/97	K. GERARD	01/18/97

PE UNIT/BLDG. NO	FLOOR	SCALE	CLASS
		AS SHOWN	

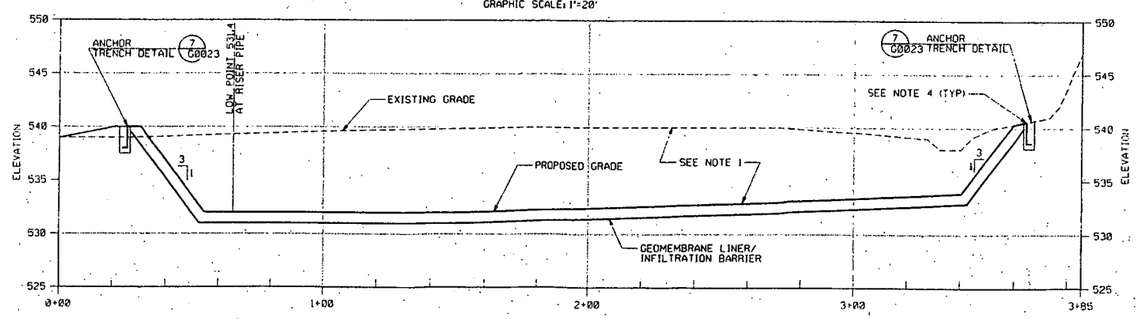
SUBMITTED FOR APPROVAL	FERNCO CPU APPROVAL	FERNCO PROJECT NO.
DATE 6/13/97	N/A	20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DWG PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00390	G0008	0

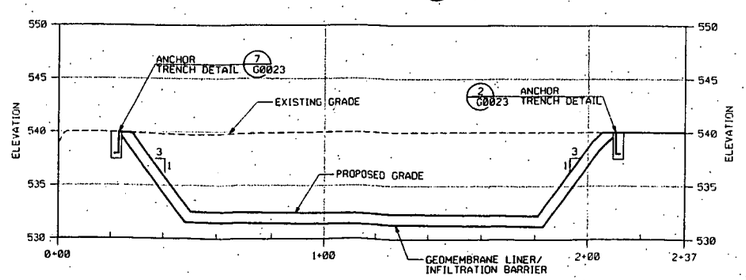


PLAN

GRAPHIC SCALE: 1"=20'



SECTION A



SECTION B

GRAPHIC SCALE: 1"=5' VERTICAL

GRAPHIC SCALE: 1"=20' HORIZONTAL

NOTES

1. TOP TWELVE INCHES OF MATERIAL FROM RETENTION BASIN #1 IS TO BE REMOVED AND DISPOSED OF AS IMPACTED MATERIAL IN THE IMPACTED MATERIAL STOCKPILE. REMAINING SOIL IS TO BE PLACED IN THE NON-IMPACTED MATERIAL STOCKPILES.
2. FOR UNDERGROUND UTILITIES IN AREA SEE SHT G0014.
3. REMOVE CULVERT AND BACKFILL TO EXISTING GRADE. COMPACT BACKFILL TO 95% STANDARD PROCTOR. COVER WITH ROCK. CULVERT TO BE DISPOSED IN THE IMPACTED MATERIAL STOCKPILE.
4. EXTEND GEOMEMBRANE LINER TO COVER ALL EXPOSED SANDS AND GRAVELS OF THE GMA.
5. IN AREAS WHERE CONSTRUCTION FENCE CROSSES GEOMEMBRANE FENCE POST SHALL BE NON-PENETRATING TYPE ANCHORAGE.

BOTTOM OF BASIN COORDINATES (RBI)

POINT	NORTHING	EASTING	DESCRIPTION
1	N/A	N/A	NOT USED
2	477756.3	1347429.3	CORNER BASIN
3	477689.6	1347532.4	CORNER BASIN
4	477680.5	1347547.3	CORNER BASIN
5	477673.9	1347546.0	CORNER BASIN
6	477445.0	1347535.9	RISER PIPE
7	477440.5	1347539.4	CORNER BASIN
8	477472.3	1347413.7	CORNER BASIN
9	477686.9	1347405.3	CORNER BASIN
10	477411.1	1347543.8	LIFT STATION

LEGEND

GEOMEMBRANE LINER

GEOMEMBRANE LINER/ INFILTRATION BARRIER

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00368	EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-G-00452	MISCELLANEOUS DETAILS - SHEET 3 OF 3	G0023

FOR INFORMATION ONLY

REV NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNIT REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
ENLARGEMENT RETENTION BASIN #1

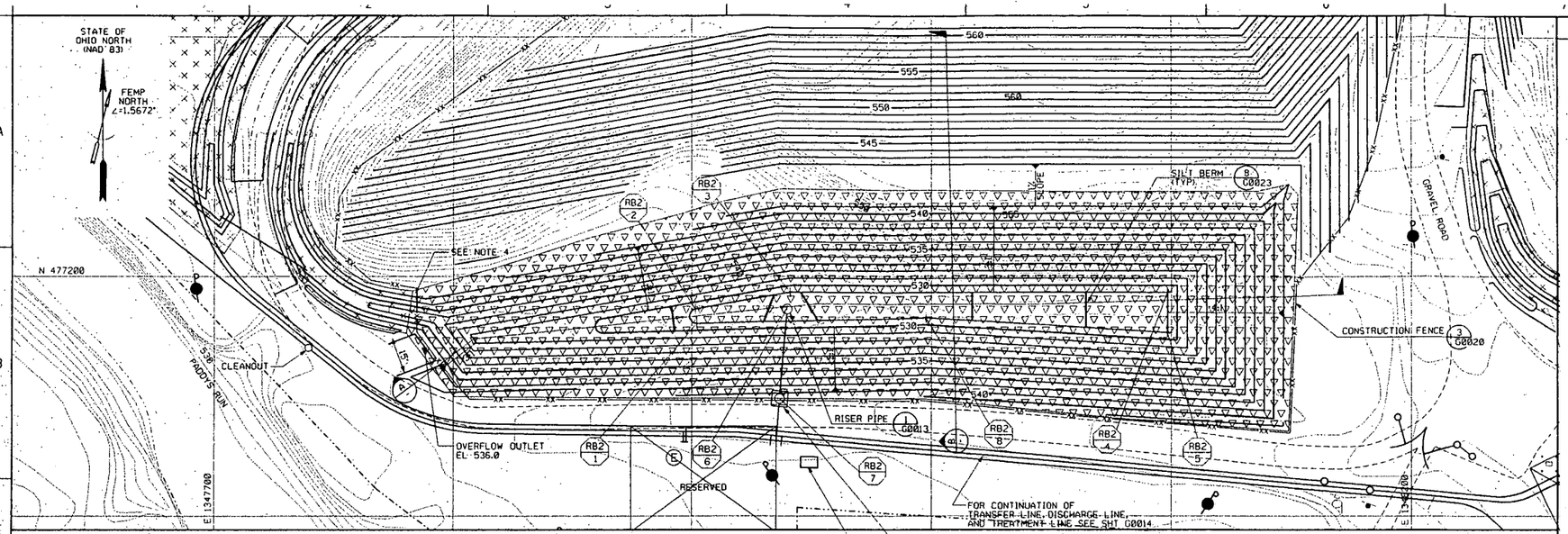
634

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	02/28/96		6/6/97	K. GERARD	1/18/97
PLANT/BLDG NO		FLOOR		SCALE 1"=20'	CLASS -
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL N/A		FERNCO PROJECT NO 20400	

DATE 6/13/97

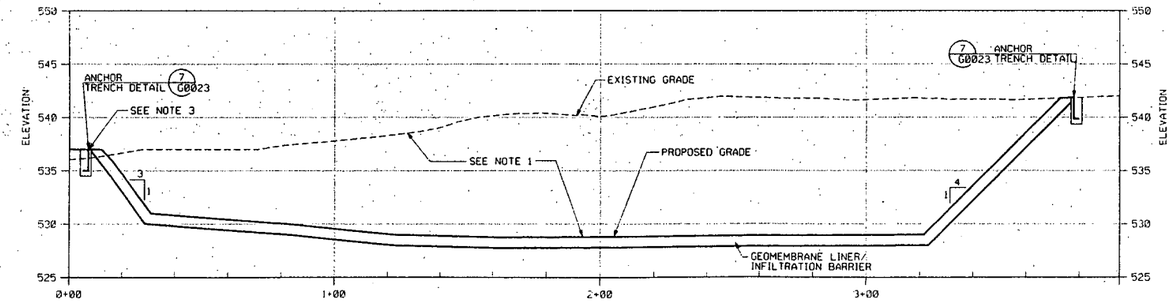
DOE PROJECT NO	TEMP PROJECT NO	DRAWING INDEX CODE NO	SHEET NO.	REV. NO
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00303	G0009	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165

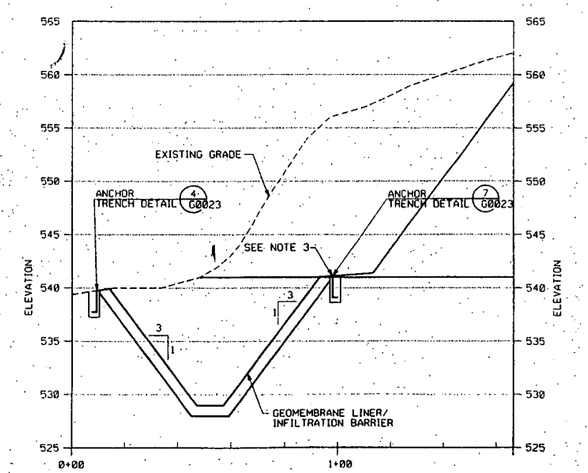


PLAN

GRAPHIC SCALE: 1"=20'



SECTION A



SECTION B

GRAPHIC SCALE: 1"=5' VERTICAL

GRAPHIC SCALE: 1"=20' HORIZONTAL

NOTES

1. TOP 12 INCHES OF MATERIAL FROM RETENTION BASIN #2 IS TO BE REMOVED AND DISPOSED OF AS IMPACTED MATERIAL IN THE IMPACTED MATERIAL STOCKPILE. REMAINING SOIL IS TO BE PLACED IN THE NON-IMPACTED MATERIAL STOCKPILES.
2. FOR UNDERGROUND UTILITIES IN AREA SEE SHT G0014.
3. EXTEND GEOMEMBRANE LINER TO COVER ALL EXPOSED SANDS AND GRAVELS OF THE GMA.
4. IN AREAS WHERE CONSTRUCTION FENCE CROSSES GEOMEMBRANE FENCE POST SHALL BE NON-PENETRATING TYPE ANCHORAGE.

LEGEND

GEOMEMBRANE LINER

GEOMEMBRANE LINER/ INFILTRATION BARRIER

BOTTOM OF BASIN COORDINATES (RB2)			
POINT	NORTHING	EASTING	DESCRIPTION
1	477180.5	1347902.7	BEGIN 3' RADIUS
2	477186.4	1347902.1	END 3' RADIUS
3	477193.5	1347941.3	CORNER BASIN
4	477193.4	1348099.0	CORNER BASIN
5	477176.0	1348099.0	CORNER BASIN
6	477186.4	1347940.1	RISER PIPE
7	477149.0	1347937.0	LIFT STATION
8	477182.9	1347998.3	CORNER BASIN

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00368	EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00389	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-G-00452	MISCELLANEOUS DETAILS - SHEET 3 OF 3	G0023

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A/E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNIT REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

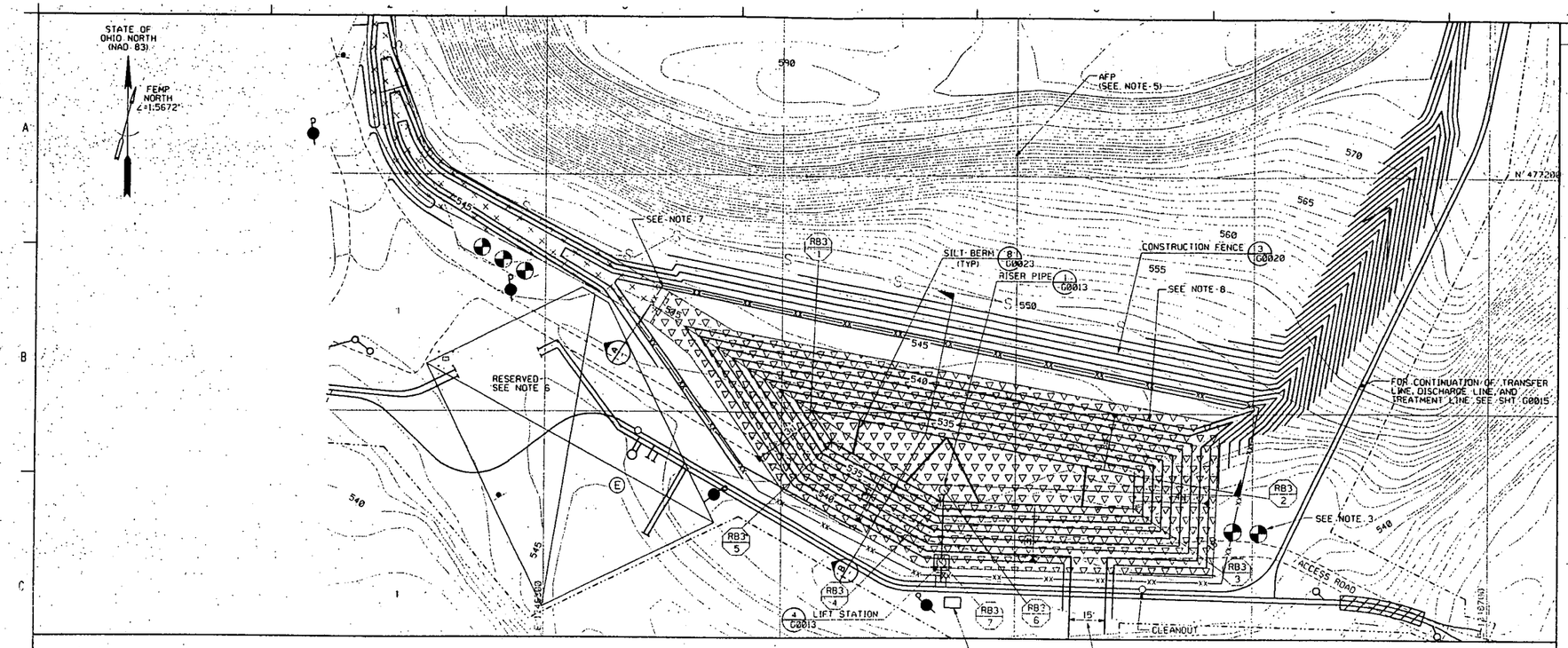
DRAWING TITLE
CIVIL
ENLARGEMENT RETENTION BASIN #2

635

STATE OF OHIO FRANKLIN M. PARTON JR. NO. E-57614 REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	02/28/96		6/13/97	K. GERARD	6/18/97
PLANT/BLDG. NO.		FOOR		SCALE: 1"=20'	CLASS.
SUBMITTED FOR APPROVAL		FERNCO CSU APPROVAL		FERNCO PROJECT NO.	
A/E	DATE 6/13/97	N/A	DATE	20400	

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00371	G0010	0



PLAN

20' 0' 20' 40'
GRAPHIC SCALE: 1"=20'

NOTES

1. TOP 12 INCHES OF MATERIAL FROM RETENTION BASIN #3 IS TO BE REMOVED AND DISPOSED OF AS IMPACTED MATERIAL IN THE IMPACTED MATERIAL STOCKPILE. REMAINING SOIL IS TO BE PLACED IN THE NON-IMPACTED MATERIAL STOCKPILES.
2. FOR UNDERGROUND UTILITIES IN AREA SEE SHEET G0015.
3. PROTECT ALL EXISTING MONITORING WELLS THAT ARE TO REMAIN.
4. EXTEND GEOMEMBRANE LINER TO COVER ALL EXPOSED SANDS AND GRAVELS OF THE GMA.
5. AFP SUBJECT TO LOCALIZED SLOUGHING/SLIDING DURING EXCAVATION OPERATIONS. EXERCISE EXTREME CAUTION WHEN WORKING NEAR THE TOE OF THE AFP.
6. AREAS RESERVED FOR FUTURE PROJECTS BY OTHERS EXCEPT FOR INSTALLATION OF OVERHEAD ELECTRIC AND UNDERGROUND UTILITIES. MAINTAIN AND ALLOW ACCESS TO THESE AREAS DURING CONSTRUCTION.
7. IN AREAS WHERE CONSTRUCTION FENCE CROSSES GEOMEMBRANE FENCE POST SHALL BE NON-PENETRATING TYPE ANCHORAGE.
8. ANCHOR TRENCH FOR GEOMEMBRANE LINER SHALL BE LOCATED AT ELEVATION 541.0 ON TOP OF RETENTION BASIN SIDE SLOPE.

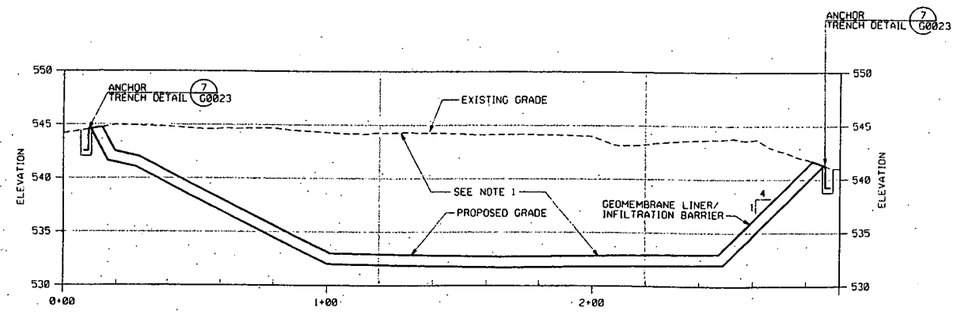
BOTTOM OF BASIN COORDINATES (RB3)

POINT	NORTHING	EASTING	DESCRIPTION
1	477101.1	1348412.9	CORNER BASIN
2	477074.0	1348550.6	CORNER BASIN
3	477060.2	1348550.1	CORNER BASIN
4	477062.6	1348468.7	CORNER BASIN
5	477087.6	1348422.3	CORNER BASIN
6	477067.6	1348470.0	RISER PIPE
7	477036.9	1348469.2	LIFT STATION

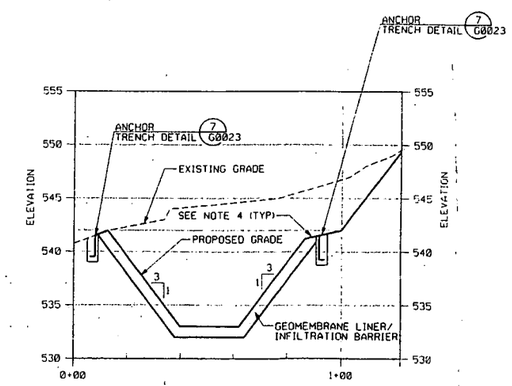
LEGEND

GEOMEMBRANE LINER

GEOMEMBRANE LINER/ INFILTRATION BARRIER



SECTION A



SECTION B

STATE OF OHIO FRANKLIN M. PARTON, JR. NO. E-57014 REGISTERED PROFESSIONAL ENGINEER 6/13/97

5' 0' 5' 10'
GRAPHIC SCALE: 1"=5' VERTICAL

20' 0' 20' 40'
GRAPHIC SCALE: 1"=20' HORIZONTAL

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00368	EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-G-00452	MISCELLANEOUS DETAILS - SHEET 3 OF 3	G0023

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNIT REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

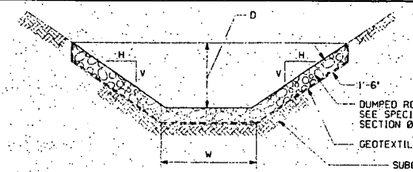
DRAWING TITLE
CIVIL
ENLARGEMENT RETENTION BASIN #3

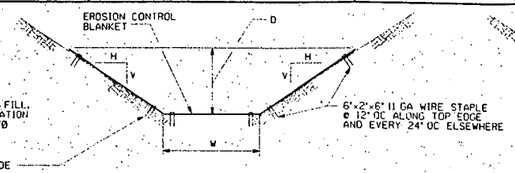
636

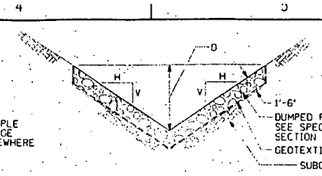
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	02/28/96		6/13/97	K. GERARD	1/18/97
PLANT/BLDG. NO.		FLOOR		SCALE 1"=20'	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL N/A		FERNCO PROJECT NO. 20400	
A-E	DATE 6/13/97		DATE		

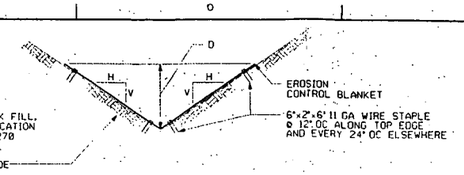
DOE PROJECT NO.	ITAP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00372	G0011	0

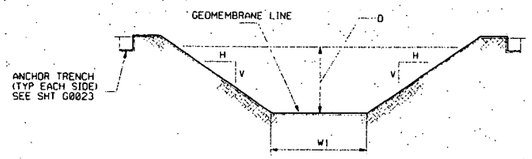
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165









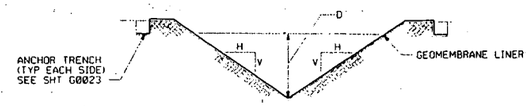


NOTE:

1. SEE DITCH SCHEDULE FOR CHANNEL LINING, DEPTH (D), BOTTOM WIDTH (W), HORIZONTAL (H) AND VERTICAL (V) COMPONENT OF DITCH SIDE SLOPE.

TYPICAL FLAT BOTTOM DITCH (FB) DETAIL

NTS — (1 / G0012) REF G0005 G0007

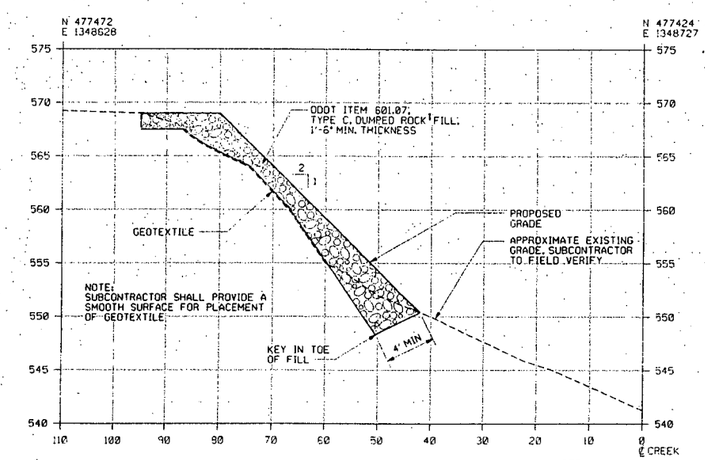


NOTE:

1. SEE DITCH SCHEDULE FOR CHANNEL LINING, DEPTH (D), HORIZONTAL (H) AND VERTICAL (V) COMPONENT OF DITCH SIDE SLOPE.

TYPICAL V-DITCH DETAIL

NTS — (2 / G0012) REF G0005 G0007 G0008

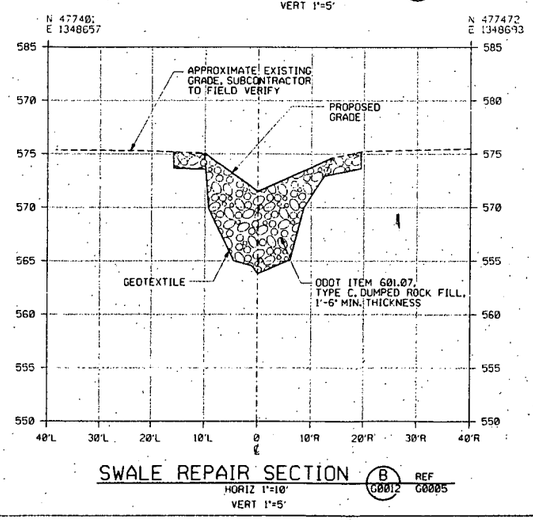


SWALE REPAIR SECTION

(A / G0012) REF G0005

HORIZ 1"=10'
VERT 1"=5'

NOTE:
SEE SHEET G0005 FOR PLAN VIEW EXTENT OF SWALE REPAIR.



SWALE REPAIR SECTION

(B / G0012) REF G0005

HORIZ 1"=10'
VERT 1"=5'

DITCH SCHEDULE

DITCH NO.	MIN. DEPTH (D) FT	BOTTOM WIDTH (W) FT	SIDE SLOPE HORIZONTAL (H)	SIDE SLOPE VERTICAL (V)	UPSTREAM INVERT (±)	DOWNSTREAM INVERT (±)	SLOPE (%)	DITCH LINING	DISPOSITION OF EXCAVATED MATERIAL (STOCKPILE)
D-1	1.5	N/A, V-DITCH	2.0	1.0	577.0	568.0	0.5 MIN 3.6 MAX	EROSION CONTROL BLANKET	IMPACTED
D-2A	1.5	N/A, V-DITCH	2.0	1.0	545.0	540.4	10.0 MAX	O.D.O.T. TYPE 'C' DUMPED ROCK FILL	IMPACTED
D-2B	1.5	N/A, V-DITCH	2.0	1.0	540.4	538.0	0.8	GEOMEMBRANE LINER	IMPACTED
D-3	1.5	BEGIN DITCH WITH W=4' TRANSITION TO W=8'	2.0	1.0	540.4	537.0	0.7	GEOMEMBRANE LINER	IMPACTED
D-4	1.0	2.0	2.0	1.0	540.0	537.0	0.9	GEOMEMBRANE LINER	IMPACTED
D-5	1.0	2.0	2.0	1.0	539.0	534.6	1.5	GEOMEMBRANE LINER	IMPACTED
D-6	1.0	2.0	2.0	1.0	538.0	534.6	1.4	GEOMEMBRANE LINER	IMPACTED
D-7	2.0	2.0	2.0	1.0	540.0	534.0	1.1 MIN 2.9 MAX	GEOMEMBRANE LINER	IMPACTED
D-8A	0.75	N/A, V-DITCH	2.0	1.0	573.33	569.0	0.8	EROSION CONTROL BLANKET	IMPACTED
D-8B	1.0	N/A, V-DITCH	2.0	1.0	569.0	544.0	10.0 MAX	O.D.O.T. TYPE 'C' DUMPED ROCK FILL	IMPACTED
D-9	2.0	4.0	2.0	1.0	549.0	542.0	1.1 MIN 6.7 MAX	GEOMEMBRANE LINER	IMPACTED
D-10A	1.0	N/A, V-DITCH	2.0	1.0	575.0	569.0	4.3	EROSION CONTROL BLANKET	IMPACTED
D-10B	1.0	N/A, V-DITCH	2.0	1.0	569.0	547.0	20.0	O.D.O.T. TYPE 'C' DUMPED ROCK FILL	IMPACTED
D-11	1.0	N/A, V-DITCH	2.0	1.0	572.0	566.0	2.6 MIN 4.0 MAX	EROSION CONTROL BLANKET	IMPACTED
D-12	1.5	2.0	2.0	1.0	573.0	565.0	0.8 MIN 1.8 MAX	EROSION CONTROL BLANKET	USE FOR DEVELOPMENT OF NON IMPACTED MATERIAL STOCKPILE #2. REMAINDER-IMPACTED
D-13	1.5	2.0	3.0	1.0	565.0	563.9	1.0 MIN 5.5 MAX	EROSION CONTROL BLANKET	TOP FOOT IMPACTED, BALANCE REMAINING IN WHEEL WASH AREA
D-14	1.5	2.0	3.0	1.0	MEET EXIST	563.9	0.8	EROSION CONTROL BLANKET	TOP FOOT IMPACTED, BALANCE REMAINING IN WHEEL WASH AREA
D-15	1.0	N/A, V-DITCH	2.0	1.0	575.0	568.5	2.5 MIN 3.0 MAX	EROSION CONTROL BLANKET	IMPACTED
BA1	2.0	N/A, V-DITCH	2.0	1.0	585.0	582.0	0.8	EROSION CONTROL BLANKET	USE AS INFILTRATION BARRIER OR KEEP WITHIN BORROW AREA
BA2	1.0	N/A, V-DITCH	2.0	1.0	578.0	575.0	0.8	EROSION CONTROL BLANKET	USE AS INFILTRATION BARRIER OR KEEP WITHIN BORROW AREA

GENERAL NOTES FOR EROSION AND SEDIMENT CONTROLS

1. RETENTION BASINS AND PERIMETER SEDIMENT CONTROLS SHALL BE IN PLACE AND FUNCTIONING PRIOR TO INITIATING EXCAVATION ACTIVITIES.
2. DISTURBED AREAS WHICH WILL REMAIN UNWORKED FOR A PERIOD OF 45 DAYS OR GREATER SHALL BE STABILIZED WITH SEED AND MULCH WITHIN SEVEN DAYS. SEE SPECIFICATION SECTION 02900.
3. UNLESS OTHERWISE INDICATED ON CONSTRUCTION DRAWINGS AND SPECIFICATIONS, ALL VEGETATIVE AND STRUCTURAL EROSION AND SEDIMENT CONTROL PRACTICES SHALL BE CONSTRUCTED AND MAINTAINED CONSISTENT WITH THE MINIMUM STANDARDS AND SPECIFICATIONS OF THE RAINWATER AND LAND DEVELOPMENT, OHIO'S STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT AND URBAN STREAM PROTECTION, 2ND EDITION, 1996, AND THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, CONSTRUCTION AND MATERIAL SPECIFICATIONS, JANUARY 1, 1995. RAINWATER MANUAL WILL TAKE PRECEDENCE OVER ODOT SPECS UNLESS DIRECTED OTHERWISE BY FDF.
4. ALL WOODED AREAS WITHIN LIMIT OF WORK SHALL BE CLEARED. TREES WILL BE CUT ONE FOOT ABOVE GROUND. THE TREES WILL BE CHIPPED AND STORED IN THE WOODCHIP STOCKPILE AREA.
5. STUMPS AND ENTIRE ROOT MASS ENCOUNTERED IN THE RETENTION BASIN WILL BE GROUND IN PLACE, MIXED WITH IMPACTED MATERIAL, AND TRANSPORTED TO THE IMPACTED MATERIAL STOCKPILE. SEE SPECIFICATIONS.
6. A COPY OF THE APPROVED SURFACE WATER MANAGEMENT PLAN SHALL BE MAINTAINED ON THE SITE AT ALL TIMES.
7. THE SUBCONTRACTOR IS RESPONSIBLE FOR INSTALLATION OF ANY ADDITIONAL TEMPORARY EROSION CONTROL MEASURES NECESSARY TO PREVENT EROSION AND SEDIMENTATION.
8. DISTURBED AREAS ARE TO DRAIN TO APPROVED SEDIMENT CONTROL MEASURES AT ALL TIMES DURING LAND DISTURBING ACTIVITIES THROUGHOUT THE DURATION OF THE CONTRACT.
9. INSPECT ALL EROSION AND SEDIMENT CONTROL MEASURES WEEKLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT OF (0.5"). ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
10. SEDIMENT CLEANOUT ELEVATIONS FOR EACH RETENTION BASIN ARE INDICATED ON THE DETAILS. THE SEDIMENT CLEANOUT ELEVATIONS SHALL BE INDICATED IN THE FIELD BY A FLOURESCENT ORANGE PAINTED RING ON THE RISER. ONCE ACCUMULATED SEDIMENTS REACH THE ESTABLISHED SEDIMENT CLEANOUT ELEVATIONS, THE SEDIMENTS SHALL BE REMOVED AND DISPOSED IN THE IMPACTED MATERIAL STOCKPILE.

GENERALIZED SEQUENCE OF CONSTRUCTION FOR EROSION AND SEDIMENT CONTROLS. (UNLESS OTHERWISE DIRECTED)

STEP 1. INSTALL SILT FENCE AND DIVERSION DITCHES/BERMS IN LOCATIONS INDICATED ON THE PLAN AND AS SHOWN IN THE DETAILS.

STEP 2. STRIP TOP TWELVE INCHES OF SOIL FROM AREAS DESIGNATED FOR RETENTION BASIN CONSTRUCTION AND PLACE IN THE IMPACTED MATERIAL STOCKPILE.

STEP 3. EXCAVATE RETENTION BASINS. PLACE EXCAVATED MATERIAL IN NON-IMPACTED MATERIAL STOCKPILE.

STEP 4. INSTALL RISERS, BARRELS, AND LIFT STATIONS.

STEP 5. CONSTRUCT GEOMEMBRANE LINER IN THE RETENTION BASINS.

STEP 6. DIVERT FLOW INTO THE RETENTION BASINS BY CONSTRUCTING COLLECTION DITCHES.

STEP 7. BEGIN OPERATION OF RETENTION BASINS AND LIFT STATIONS AND CONTINUE UNTIL COMPLETION OF EXCAVATION.

STATE OF OHIO — FRANKLIN M. PARTON, JR. — NO. E-67614 — REGISTERED PROFESSIONAL ENGINEER — 6/13/97

NOTES

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00390	SITE PLAN - PADDYS RUN AREA	G0008

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMH	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNIT REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
EROSION AND SEDIMENT CONTROL
SHEET 1 OF 2

637

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	11/18/96		6/12/97	K. GERARD	11/18/97

PLANT/BLDG. NO. — FLOOR — SCALE: NONE — CLASS

SUBMITTED FOR APPROVAL — DATE 6/13/97 — FERNCO CRU APPROVAL: N/A — DATE — FERNCO PROJECT NO.: 20400

DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO	SHEET NO.	REV. NO
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00311	G0012	0

PREPARED UNDER PARSONS PROJECT NUMBER SCEP/P0165

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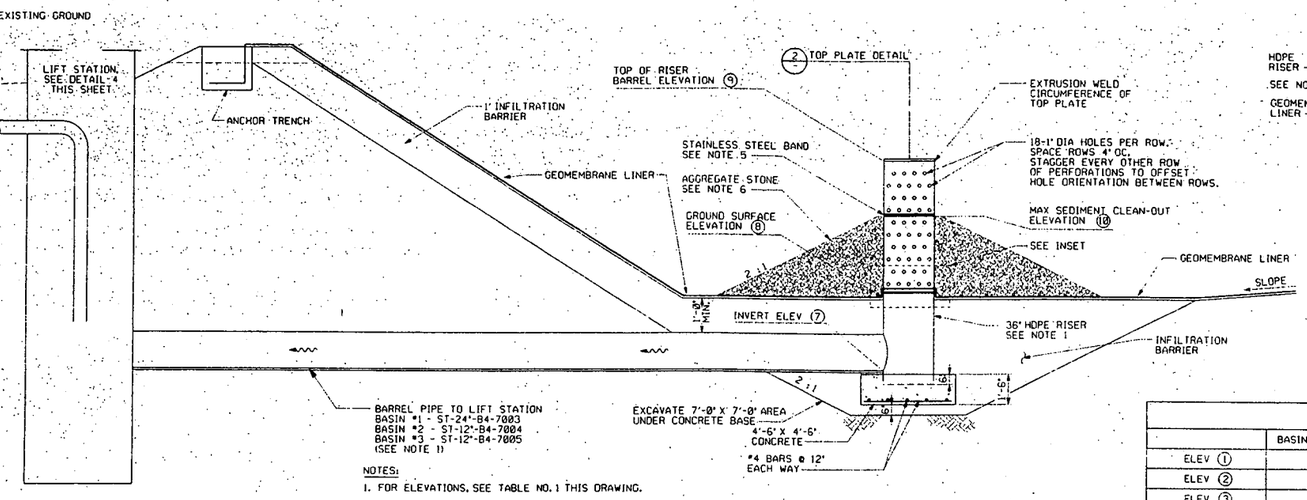


NOTES:

1. FOR ELEVATIONS, SEE TABLE NO. 1 THIS DRAWING.

SIDE VIEW

RISER PIPE DETAIL (1) G0013 — REF G0005, G0010, G0011
NTS

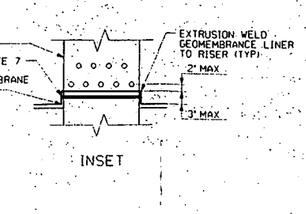
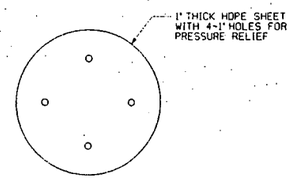


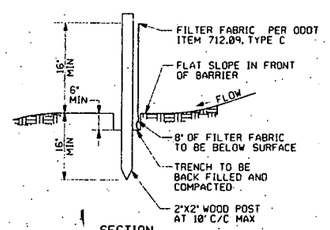
TABLE NO. 1			
	BASIN/LIFT STA 1	BASIN/LIFT STA 2	BASIN/LIFT STA 3
ELEV (1)	541.00	539.00	541.00
ELEV (2)	525.00	523.00	527.50
ELEV (3)	528.00	526.00	530.00
ELEV (4)	537.00	535.00	537.00
ELEV (5)	530.00	528.00	532.00
ELEV (6)	527.00	525.00	529.00
ELEV (7)	528.40	526.70	530.50
ELEV (8)	531.40	528.70	532.50
ELEV (9)	535.20	532.60	536.80
ELEV (10)	532.90	530.30	534.20
FORCE MAIN PIPE TO SWRB	6" CARRIER 10" CONTAINMENT	3" CARRIER 6" CONTAINMENT	3" CARRIER 6" CONTAINMENT

NOTES

1. BARREL AND RISER PIPES SHALL BE HDPE SDR-21.
2. VALVE AND PIPE ASSEMBLY ABOVE PUMP IS TO BE INSTALLED TO PERMIT UNOBSTRUCTED REMOVAL OF PUMP ON GUIDE CABLE ASSEMBLY.
3. HOOK ANCHORED TO CONCRETE WITH ½"X4" BOLTS. USE ¼" DIA GRADE 60 ALLOY CHAIN. RATED FOR LIFTING. SECURE TO PUMP AS PER MANUFACTURER'S INSTRUCTIONS.
4. CONNECT HDPE PIPE TO HDPE MANHOLE USING EXTRUSION WELD, BAND, ETC., AS RECOMMENDED BY THE HDPE MANHOLE MANUFACTURER.
5. INSTALL ½" STAINLESS STEEL BAND AROUND RISER AT SEDIMENT CLEANOUT ELEVATION. BAND SHALL BE PAINTED FLUORESCENT ORANGE. SUBCONTRACTOR SHALL REMOVE SEDIMENTS WHEN BUILD-UP REACHES BOTTOM OF PAINTED BAND.
6. PLACE AGGREGATE STONE UP TO MAXIMUM SEDIMENT CLEAN-OUT ELEVATION. STONE SHALL BE NO. 3 STONE WITH THE FRACTION SMALLER THAN ½" REMOVED IN ACCORDANCE WITH ODOT ITEM 703.01.
7. INSTALL ½" STAINLESS STEEL BAND AROUND RISER BELOW EXTRUSION WELD



TOP PLATE DETAIL (2) G0013
NTS

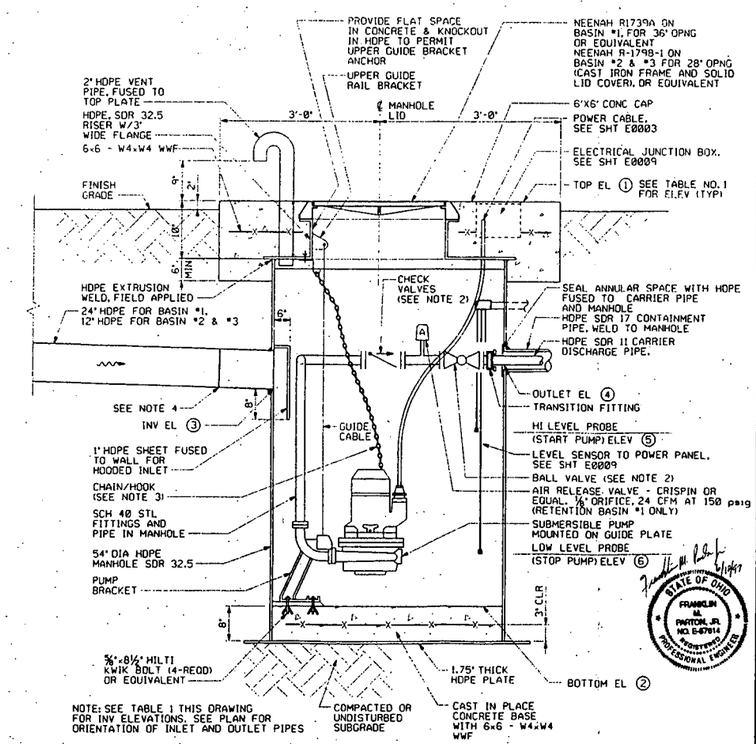


SECTION

NOTE:

1. DETAIL FOR JOINING SECTIONS OF SILT FENCE SHALL BE IN ACCORDANCE WITH RAINWATER AND LAND DEVELOPMENT, OHIO STANDARDS FOR STORMWATER MANAGEMENT, LAND DEVELOPMENT AND URBAN STREAM PROTECTION, 2ND EDITION, 1996.
2. REMOVE SEDIMENT AND RESTORE TO ORIGINAL CONDITION WHEN SEDIMENT DEPTH REACHES ONE-HALF FENCE HEIGHT, OR SOONER IF ACCUMULATED SEDIMENT PREVENTS PROPER PERFORMANCE OF SILT FENCE.

SILT FENCE DETAIL (3) G0013 — REF G0005
NTS



NOTE: SEE TABLE 1 THIS DRAWING FOR INV ELEVATIONS. SEE PLAN FOR ORIENTATION OF INLET AND OUTLET PIPES

LIFT STATION DETAIL (4) G0013 — REF G0009, G0010, G0011
NTS

STATE OF OHIO — FRANKLIN M. PARTON, JR. — REGISTERED PROFESSIONAL ENGINEER

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00303	ENLARGEMENT RETENSION BASIN #1	G0009
92X-5900-G-00371	ENLARGEMENT RETENSION BASIN #2	G0010
92X-5900-G-00372	ENLARGEMENT RETENSION BASIN #3	G0011
92X-5900-E-00377	SINGLE LINE DIAGRAMS/ELEVATIONS LIFT STATION NO. 1, 2 AND 3	E0003
92X-5900-E-00382	DETAILS - SHEET 1	E0009

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMM	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

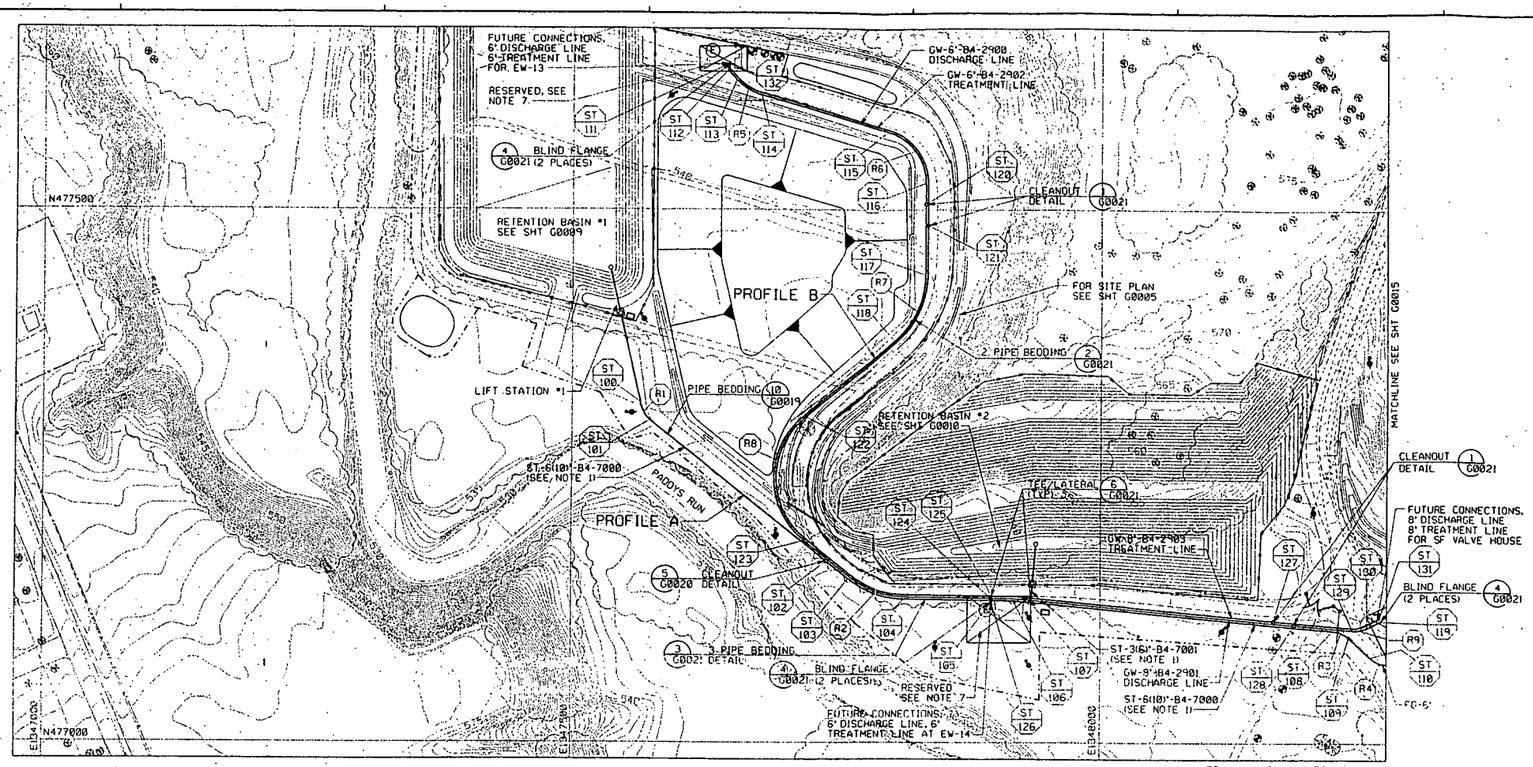
DRAWING TITLE
CIVIL
EROSION AND SEDIMENT CONTROL 638
SHEET 2 OF 2

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
K.L. RABBITT	10/15/96		6/13/97	K. GERARD	01/10/97
PLANT/BLDG NO.		FLOOR		SCALE: NONE	CLASS

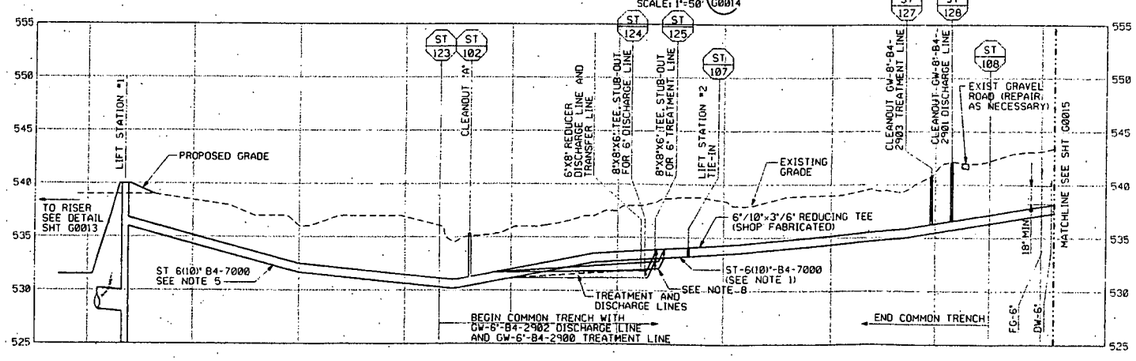
SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	FERNCO PROJECT NO.
DATE 6/13/97	N/A	20400

DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00368	G0013	0

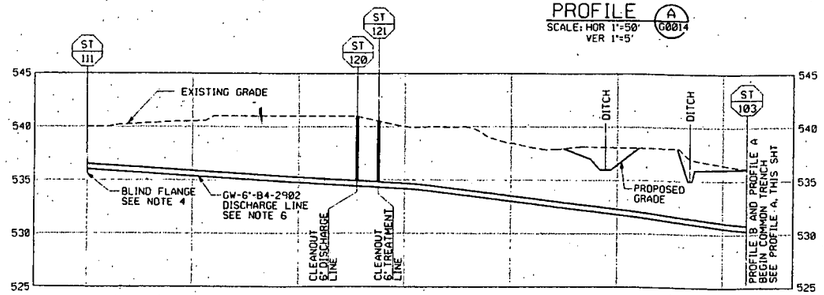
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165



PLAN 1 C0014
SCALE: 1"=50'



PROFILE A 4 C0014
SCALE: HOR 1"=50' VER 1"=5'



PROFILE B 5 C0014
SCALE: HOR 1"=50' VER 1"=5'

GRAPHIC SCALE: 1"=5' VERTICAL
GRAPHIC SCALE: 1"=50' HORIZONTAL

STATE OF OHIO FRANKLIN M. PARTON JR. NO. E-63014 REGISTERED PROFESSIONAL ENGINEER

GRAPHIC SCALE: 1"=5' VERTICAL
GRAPHIC SCALE: 1"=50' HORIZONTAL

CENTERLINE CURVE DATA				
CURVE	RADIUS	LENGTH	DELTA	TANGENT
R1	25.00'	19.64'	45°04'13"	10.37'
R2	90.00'	58.58'	37°18'37"	30.38'
R3	25.00'	17.02'	38°26'29"	8.72'
R4	25.00'	34.97'	80°07'29"	21.02'
R5	22.00'	24.42'	63°40'12"	13.66'
R6	80.00'	110.82'	79°25'04"	66.43'
R7	80.00'	70.94'	50°49'44"	38.01'
R8	75.00'	133.80'	102°15'50"	93.05'
R9	25.00'	13.60'	31°11'38"	6.98'

UNDERGROUND UTILITY COORDINATES (ST)			
POINT	NORTHING	EASTING	DESCRIPTION
100	477319.2	1347565.0	BEGIN RADIUS, R1
101	477302.4	1347574.2	END RADIUS, R1
102	477170.2	1347734.9	CLEANOUT 'A'
103	477153.8	1347760.6	BEGIN RADIUS, R2
104	477134.6	1347814.9	END RADIUS, R2
105	477131.0	1347897.1	BLIND FLANGE, ELEV. 535 ±
106	477133.0	1347918.7	ANGLE POINT, TRANSFER LINE
107	477131.5	1347935.5	REDUCING TEE
108	477105.7	1348218.7	BEGIN RADIUS, R3
109	477099.0	1348234.0	END RADIUS, R3
110	477080.8	1348253.4	BEGIN RADIUS, R4
111	477636.9	1347646.6	BLIND FLANGE, ELEV. 539 ±
112	477631.0	1347646.3	ANGLE POINT, DISCHARGE LINE
113	477621.8	1347654.8	BEGIN RADIUS, R5
114	477607.5	1347678.1	END RADIUS, R5
115	477573.8	1347798.0	BEGIN RADIUS, R6
116	477525.7	1347834.4	END RADIUS, R6
117	477439.2	1347834.4	BEGIN RADIUS, R7
118	477377.2	1347805.0	END RADIUS, R7
119	477114.8	1348263.5	BLIND FLANGE, ELEV. 540 ±
120	477505.7	1347834.4	CLEANOUT, DISCHARGE LINE
121	477485.7	1347836.4	CLEANOUT, TREATMENT LINE
122	477306.4	1347718.2	BEGIN RADIUS, R8
123	477189.7	1347718.8	END RADIUS, R8
124	477135.4	1347897.1	8"x8"x6" TEE, 8" DISCHARGE LINE
125	477137.3	1347898.2	8"x8"x6" TEE, 8" TREATMENT LINE
126	477131.0	1347898.1	BLIND FLANGE, ELEV. 535 ±
127	477114.7	1348164.1	CLEANOUT, TREATMENT LINE
128	477111.0	1348183.3	CLEANOUT, DISCHARGE LINE
129	477106.0	1348237.4	BEGIN RADIUS, R9
130	477108.5	1348250.6	END RADIUS, R9
131	477117.4	1348262.2	BLIND FLANGE, ELEV. 540 ±
132	477636.8	1347647.7	BLIND FLANGE, ELEV. 539 ±

NOTES

1. FOR TRANSFER LINE, USE HDPE SDR 11 FOR 3" AND 6" CARRIER PIPES AND SDR 21 FOR 6" AND 10" CONTAINMENT PIPES; ALL FITTINGS ARE TO BE MOLDED UNLESS NOTED OTHERWISE.
2. ALL HDPE VERTICAL ALIGNMENT IS TO BE MET USING A MINIMUM 20' RADIUS BEND OR IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATION. MAINTAIN 42" MINIMUM COVER OVER TOP OF PIPE.
3. THE LOCATION AND ELEVATION OF EXISTING UNDERGROUND UTILITIES ARE APPROXIMATE. FIELD VERIFY PRIOR TO CONSTRUCTION.
4. INSTALL BLIND FLANGE ON DISCHARGE AND TREATMENT LINES AT LOCATIONS SHOWN. AT EACH BLIND FLANGE INSTALL UTILITY MARKER. UTILITY MARKER SHALL BE A MIN. 3.0' WIDE, 6' LONG WITH A MIN. 3' INSTALLED ABOVE GRADE, YELLOW IN COLOR WITH THE WORDS DISCHARGE LINE OR TREATMENT LINE WRITTEN IN BLACK LETTERS. UTILITY MARKERS SHALL BE CARSONITE INTERNATIONAL, OR EQUAL AS A MINIMUM.
5. LOCATION GIVEN FOR ST-6(10)"-B4-7000 TRANSFER LINE. GW-DISCHARGE LINE AND GW-TREATMENT LINE ARE LOCATED IN SAME TRENCH, UNLESS OTHERWISE NOTED.
6. LOCATION GIVEN FOR GW-6"-B4-2902 DISCHARGE LINE. GW-6"-B4-2900 TREATMENT LINE IS LOCATED IN SAME TRENCH, UNLESS OTHERWISE NOTED.
7. AREAS RESERVED FOR FUTURE PROJECTS BY OTHERS EXCEPT FOR INSTALLATION OF OVERHEAD ELECTRIC AND UNDERGROUND UTILITIES. MAINTAIN AND ALLOW ACCESS TO THESE AREAS DURING CONSTRUCTION.
8. PIPE TO ALWAYS SLOPE FROM LOW POINTS TO AIR RELEASE VALVES AT THE HIGH POINTS. AVOID INTERMEDIATE HIGH POINTS. FIELD ADJUST AIR RELEASE VALVES TO INSURE THEY ARE AT THE HIGH POINT N THE LINE.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00303	ENLARGEMENT RETENTION BASIN #1	G0009
92X-5900-G-00371	ENLARGEMENT RETENTION BASIN #2	G0010
92X-5900-G-00368	EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00307	WATER LINE DETAILS	G0019
92X-5900-G-00309	MISCELLANEOUS DETAILS SHEET 1 OF 3	G0020
92X-5900-G-00308	MISCELLANEOUS DETAILS SHEET 2 OF 3	G0021

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

BATTELLE AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

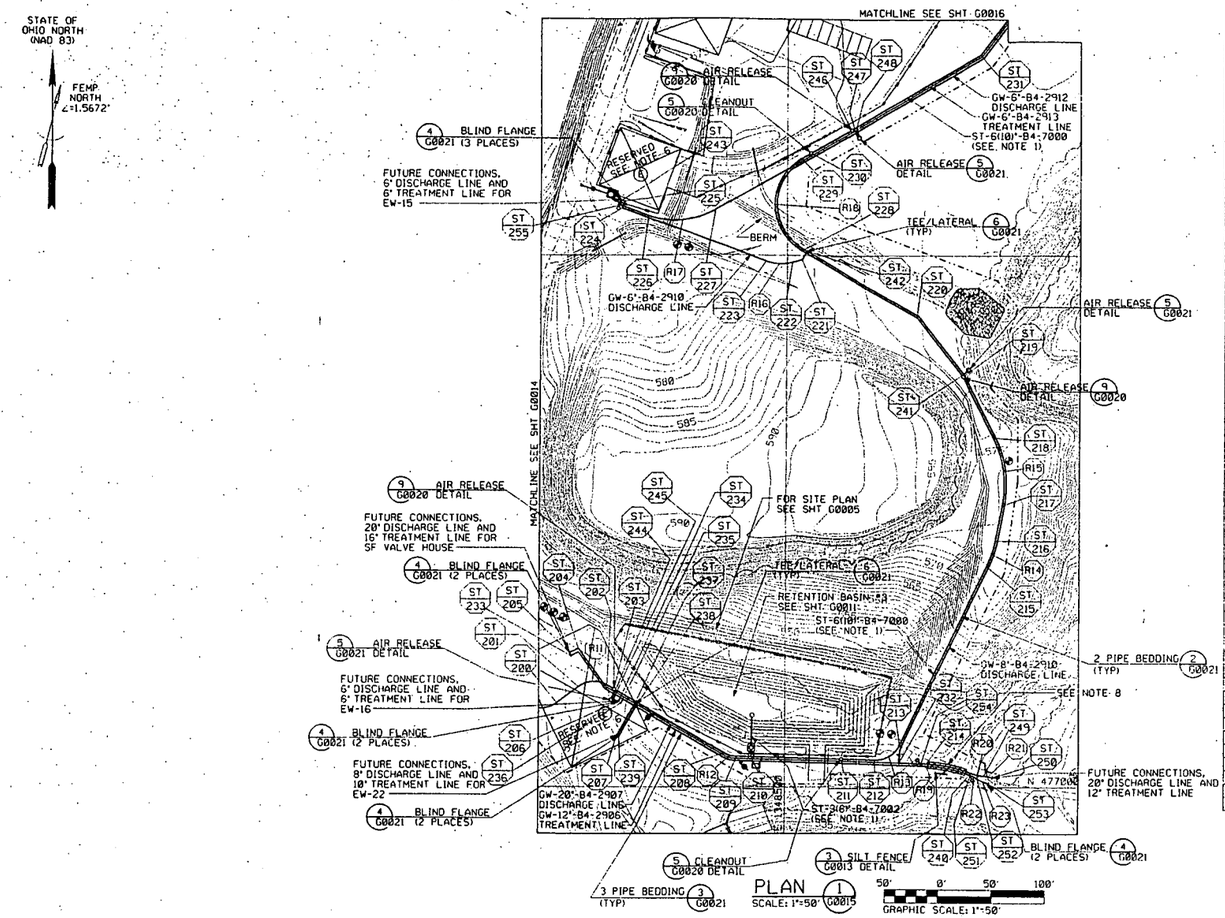
PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
TRANSFER LINE - PLAN AND PROFILE
SHEET 1 OF 3

639

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	06/12/96		6/10/97	K. GERARD	01/18/97
PLANT/BLDG. NO		PROGR		SCALE 1"=50'	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL N/A		FERNCO PROJECT NO. 20400	
DATE 6/13/97		DATE			

DOE PROJECT NO.	TEMP PROJECT NO	DRAWING INDEX CODE NO	SHEET NO.	REV NO
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00304	G0014	0

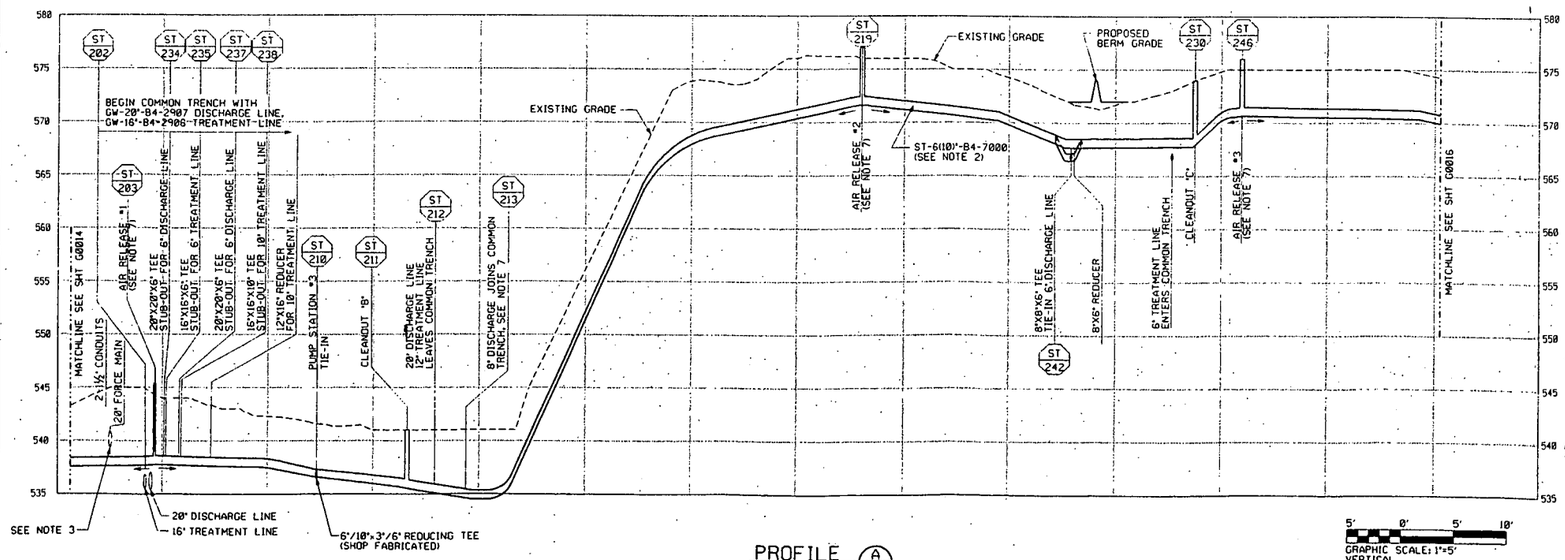


UNDERGROUND UTILITY COORDINATES (ST)			
POINT	NORTHING	EASTING	DESCRIPTION
200	477079.0	1348285.6	END RADIUS, R4
201	477094.3	1348305.8	BEGIN RADIUS, R11
202	477095.9	1348333.3	END RADIUS, R11
203	477092.0	1348340.1	AIR RELEASE #1
204	477130.1	1348305.7	ANGLE POINT, DISCHARGE LINE
205	477126.1	1348297.5	BLIND FLANGE, ELEV 540 ±
206	477080.6	1348344.1	BLIND FLANGE, ELEV 540 ±
207	477048.7	1348342.8	BLIND FLANGE, ELEV 540 ±
208	477032.3	1348443.9	BEGIN RADIUS, R12
209	477029.0	1348455.6	END RADIUS, R12
210	477028.6	1348469.0	REDUCING TEE, TRANSFER LINE
211	477026.2	1348554.3	CLEANOUT "B"
212	477025.3	1348587.2	BEGIN RADIUS, R13
213	477039.5	1348610.4	END RADIUS, R13
214	477021.9	1348636.0	BEGIN RADIUS, R19
215	477207.6	1348691.5	BEGIN RADIUS, R14
216	477231.8	1348699.5	END RADIUS, R14
217	477264.9	1348706.0	BEGIN RADIUS, R15
218	477328.8	1348697.3	END RADIUS, R15
219	477385.9	1348668.7	AIR RELEASE #2
220	477441.7	1348625.2	ANGLE POINT, TRANSFER LINE
221	477496.1	1348514.6	ANGLE POINT, DISCHARGE LINE
222	477493.6	1348505.5	BEGIN RADIUS, R16
223	477494.6	1348481.1	END RADIUS, R16
224	477544.4	1348345.3	ANGLE POINT, DISCHARGE LINE
225	477550.9	1348347.7	BLIND FLANGE, ELEV 569 ±
226	477537.3	1348370.5	BEGIN RADIUS, R17
227	477542.7	1348433.7	END RADIUS, R17
228	477504.5	1348514.5	BEGIN RADIUS, R18
229	477591.4	1348514.2	END RADIUS, R18
230	477596.4	1348522.8	CLEANOUT "C"
231	477689.4	1348684.3	ANGLE POINT, TRANSFER LINE
232	477022.7	1348618.0	20"X20"X6" TEE, DISCHARGE LINE
233	477123.4	1348298.8	BLIND FLANGE, ELEV 540 ±
234	477085.7	1348347.1	20"x20"x6" TEE, DISCHARGE LINE
235	477082.5	1348348.6	16"x16"x6" TEE, TREATMENT LINE
236	477079.1	1348346.6	BLIND FLANGE, ELEV 540 ±
237	477078.4	1348359.9	20"x20"x6" TEE, DISCHARGE LINE
238	477075.6	1348360.6	16"x16"x6" TEE, TREATMENT LINE
239	477047.7	1348344.5	BLIND FLANGE, ELEV 540 ±
240	477013.4	1348678.0	END RADIUS, R19-BEGIN RADIUS, R20
241	477388.7	1348669.1	8"x8"x1" TEE, DISCHARGE LINE
242	477504.2	1348519.2	8"x8"x6" TEE, DISCHARGE LINE
243	477551.8	1348345.1	BLIND FLANGE, ELEV 569 ±
244	477089.3	1348340.9	20"x20"x1" TEE, DISCHARGE LINE
245	477086.6	1348341.6	16"x16"x1" TEE, TREATMENT LINE
246	477618.8	1348561.8	AIR RELEASE #3
247	477616.4	1348565.6	6"x6"x1" TEE, TREATMENT LINE
248	477619.1	1348566.3	6"x6"x1" TEE, DISCHARGE LINE
249	477010.7	1348689.8	END RADIUS, R20-BEGIN RADIUS, R21
250	477009.3	1348697.9	END RADIUS, R21-BLIND FLANGE 535 ±
251	477011.5	1348677.4	BEGIN RADIUS, R22-CLEANOUT TEE
252	477008.2	1348684.0	END RADIUS, R22-BEGIN RADIUS, R23
253	477003.7	1348694.0	END RADIUS, R23-BLIND FLANGE 535 ±
254	477022.1	1348630.9	CLEANOUT TEE
255	477547.2	1348343.4	8"x8"x6" TEE

NOTES

1. FOR TRANSFER LINE, USE HDPE SDR 11 FOR 3" AND 6" CARRIER PIPES AND SDR 21 FOR 6" AND 10" CONTAINMENT PIPES. ALL FITTINGS ARE TO BE MOLDED UNLESS NOTED OTHERWISE.
2. ALL HDPE VERTICAL ALIGNMENT IS TO BE MET USING A MINIMUM 20' RADIUS BEND OR IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATION. MAINTAIN 42" MINIMUM COVER OVER TOP OF PIPE.
3. THE LOCATION AND ELEVATION OF EXISTING UNDERGROUND UTILITIES ARE APPROXIMATE. FIELD VERIFY PRIOR TO CONSTRUCTION.
4. INSTALL BLIND FLANGE ON DISCHARGE AND/OR TREATMENT LINES AT LOCATIONS SHOWN. AT EACH BLIND FLANGE INSTALL UTILITY MARKER. UTILITY MARKER SHALL BE A MIN. 3.5" WIDE, 2' LONG WITH 4 MIN. 3' INSTALLED ABOVE GRADE, YELLOW IN COLOR WITH THE WORDS DISCHARGE LINE OR TREATMENT LINE WRITTEN IN BLACK LETTERS. UTILITY MARKERS SHALL BE CARSONITE INTERNATIONAL, OR EQUAL AS A MINIMUM.
5. LOCATION GIVEN FOR ST-6"(10)"-B4-7000 TRANSFER LINE, GW-DISCHARGE LINE AND GW-TREATMENT LINE ARE LOCATED IN THE SAME TRENCH UNLESS OTHERWISE NOTED.
6. AREAS RESERVED FOR FUTURE PROJECTS BY OTHERS EXCEPT FOR INSTALLATION OF OVERHEAD ELECTRIC AND UNDERGROUND UTILITIES. MAINTAIN AND ALLOW ACCESS TO THESE AREAS DURING CONSTRUCTION.
7. PIPE TO ALWAYS SLOPE FROM LOW POINTS TO AIR RELEASE VALVES AT THE HIGH POINTS. AVOID INTERMEDIATE HIGH POINTS. FIELD ADJUST AIR RELEASE VALVES TO INSURE THEY ARE AT THE HIGH POINT IN THE LINE
8. PROVIDE CONCRETE ENCASEMENT ON PIPES FROM 5' EAST OF ST-232 TO 5' WEST OF ST-249. CONCRETE TO BE 6" MINIMUM THICKNESS ON ALL SIDES OF PIPES.

CENTERLINE CURVE DATA				
CURVE	RADIUS	LENGTH	DELTA	TANGENT
R11	25.00'	29.18'	66°52'56"	16.51'
R12	25.00'	12.32'	28°19'23"	6.28'
R13	25.00'	28.75'	65°52'46"	16.20'
R14	100.00'	25.57'	14°41'45"	12.86'
R15	100.00'	65.60'	37°32'55"	34.07'
R16	40.00'	24.82'	35°34'19"	12.84'
R17	75.00'	65.55'	50°4'18"	35.02'
R18	50.00'	105.16'	120°15'37"	87.06'
R19	125.00'	43.13'	19°46'47"	21.79'
R20	40.00'	12.09'	17°19'06"	6.10'
R21	40.00'	8.28'	11°51'31"	4.16'
R22	40.00'	7.41'	10°37'05"	3.72'
R23	40.00'	11.00'	15°46'32"	5.54'



RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00372	ENLARGEMENT, RETENTION BASIN #3	G0011
92X-5900-G-00368	EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00306	TRANSFER LINE - PLAN AND PROFILE - SHEET 3 OF 3	G0016
92X-5900-G-00307	WATER LINE DETAILS	G0019
92X-5900-G-00309	MISCELLANEOUS DETAILS SHEET 1 OF 2	G0020
92X-5900-G-00308	MISCELLANEOUS DETAILS SHEET 2 OF 3	G0021

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
TRANSFER LINE - PLAN AND PROFILE
SHEET 2 OF 3

640

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	06/12/96		6/4/97	K. GERARD	01/18/97

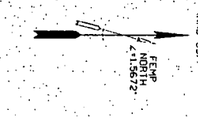
PLANT/BLDG. NO. | FLOOR | SCALE 1"=50' | CLASS

SUBMITTED FOR APPROVAL | FERMCO CRU APPROVAL N/A | FERMCO PROJECT NO. 20400

DOE PROJECT NO. | TEMP PROJECT NO. WBS 1.1.1.1.2.3.6 00-90701 | DATE 6/13/97 | DRAWING INDEX CODE NO. 92X-5900-G-00305 | SHEET NO. G0015 | REV. NO. 0

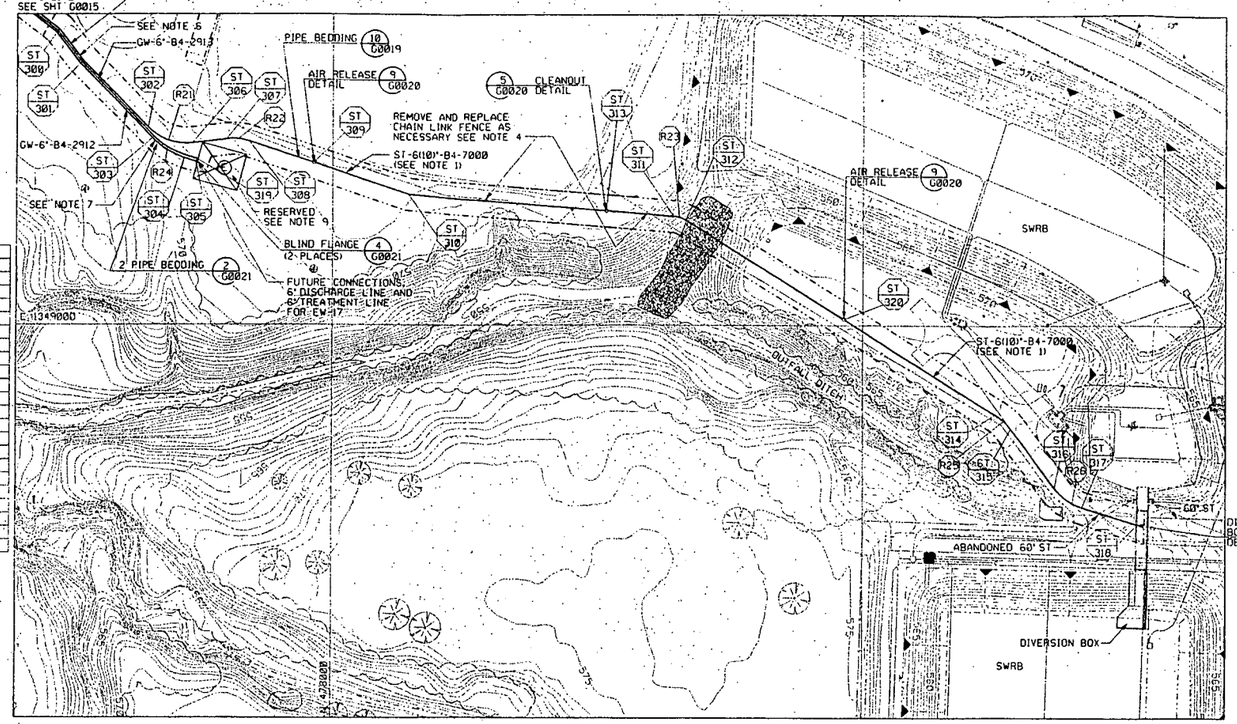
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165

STATE OF OHIO FRANKLIN M. PARTLOW, JR. NO. E-62814 REGISTERED PROFESSIONAL ENGINEER

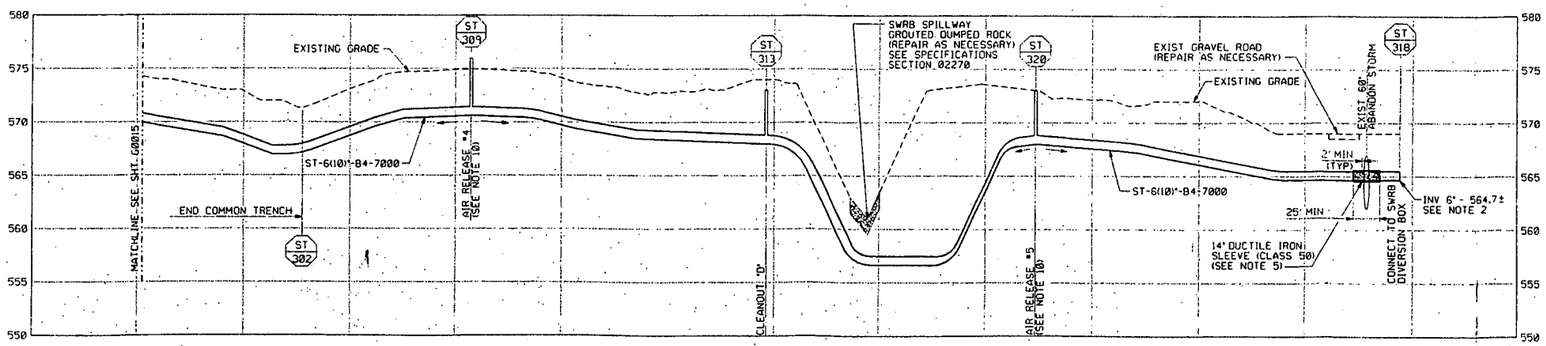


CENTERLINE CURVE DATA				
CURVE	RADIUS	LENGTH	DELTA	TANGENT
R21	50.00'	45.52'	52°01'22"	24.49'
R22	50.00'	21.77'	24°56'19"	11.06'
R23	25.00'	11.94'	27°21'20"	6.09'
R24	75.00'	35.50'	27°18'33"	18.18'
R25	50.00'	19.88'	22°50'44"	10.10'
R26	50.00'	31.79'	48°46'53"	22.67'

UNDERGROUND UTILITY COORDINATES (ST)			
POINT	NORTHING	EASTING	DESCRIPTION
300	477741.6	1348723.5	ANGLE POINT, TRANSFER LINE
301	477764.5	1348752.9	ANGLE POINT, TRANSFER LINE
302	477826.5	1348815.8	BEGIN RADIUS, R21
303	477830.5	1348825.6	BEGIN RADIUS, R24
304	477860.4	1348844.2	END RADIUS, R24
305	477871.4	1348847.8	BLIND FLANGE, ELEV. 568 ±
306	477867.9	1348830.4	END RADIUS, R21
307	477900.2	1348826.6	BEGIN RADIUS, R22
308	477921.7	1348828.7	END RADIUS, R22
309	477982.5	1348848.7	AIR RELEASE #4
310	478072.0	1348878.2	ANGLE POINT, TRANSFER LINE
311	478323.2	1348898.6	BEGIN RADIUS, R23
312	478334.4	1348902.4	END RADIUS, R23
313	478259.6	1348893.5	CLEANOUT "D"
314	478624.7	1349083.9	BEGIN RADIUS, R25
315	478639.3	1349097.1	END RADIUS, R25
316	478680.2	1349152.7	BEGIN RADIUS, R26
317	478705.7	1349170.8	END RADIUS, R26
318	478758.3	1349186.9	CONNECT TO SWRB DIVER. BOX
319	477872.3	1348872.3	BLIND FLANGE, ELEV 568 ±
320	478482.2	1348994.8	AIR RELEASE #5



PLAN 1 G0016
SCALE: 1"=50'



PROFILE A G0016
SCALE: HOR 1"=50' VER 1"=5'

5' 0' 5' 10'
GRAPHIC SCALE: 1"=5' VERTICAL

50' 0' 50' 100'
GRAPHIC SCALE: 1"=50' HORIZONTAL

STATE OF OHIO FRANKLIN M. PARTON JR. NO. E-67614 REGISTERED PROFESSIONAL ENGINEER
6/10/97

NOTES

1. FOR TRANSFER LINE, USE HDPE SDR 11 FOR 6" CARRIER PIPE AND SDR 21 FOR 10" CONTAINMENT PIPE. ALL FITTINGS ARE TO BE MOLDED UNLESS NOTED OTHERWISE.
2. ALL HDPE VERTICAL ALIGNMENT IS TO BE INSTALLED USING A MINIMUM 20' RADIUS BEND OR ACCORDANCE WITH MANUFACTURER'S RECOMENDATION. MAINTAIN 42" MINIMUM COVER OVER TOP OF PIPE.
3. THE LOCATION AND ELEVATION OF EXISTING UNDERGROUND UTILITIES ARE APPROXIMATE. FIELD VERIFY PRIOR TO CONSTRUCTION.
4. REMOVE AND REPLACE EXISTING CHAIN LINK FENCE AS REQUIRED FOR INSTALLATION OF TRANSFER LINE. COORDINATE FENCE REMOVAL AND REPLACEMENT WITH FDF.
5. REMOVE EXISTING ABANDONED 60" PIPE AS NECESSARY TO INSTALL 14" DUCTILE IRON SLEEVE. THE SUBCONTRACTOR SHALL GROUT AROUND THE OPENING IN THE ABANDONED 60" PIPE AND AT THE ENDS OF THE 14" SLEEVE.
6. LOCATION GIVEN FOR ST-6(10)"-B4-7000 TRANSFER LINE. GW-DISCHARGE LINE AND GW-TREATMENT LINE ARE LOCATED IN SAME TRENCH, UNLESS OTHERWISE NOTED.
7. LOCATION GIVEN FOR GW-6"-B4-2912 DISCHARGE LINE. GW-6"-B4-2913 TREATMENT LINE IS LOCATED IN SAME TRENCH.
8. INSTALL BLIND FLANGE ON DISCHARGE AND TREATMENT LINES AT LOCATIONS SHOWN. AT EACH BLIND FLANGE INSTALL UTILITY MARKER. UTILITY MARKER SHALL BE A MIN. 3.5' WIDE, 6' LONG WITH A MIN. 3' INSTALLED ABOVE GRADE, YELLOW IN COLOR, WITH WORDS "CAUTION, BURIED DISCHARGE LINE" OR "CAUTION, BURIED TREATMENT LINE" WRITTEN IN BLACK LETTERS. UTILITY MARKERS SHALL BE CARSONITE INTERNATIONAL, OR EQUAL AS A MINIMUM.
9. AREAS RESERVED FOR FUTURE PROJECTS BY OTHERS EXCEPT FOR INSTALLATION OF UNDERGROUND UTILITIES. MAINTAIN AND ALLOW ACCESS TO THESE AREAS DURING CONSTRUCTION.
10. PIPE TO ALWAYS SLOPE FROM LOW POINTS TO AIR RELEASE VALVES AT THE HIGH POINTS. AVOID INTERMEDIATE HIGH POINTS. FIELD ADJUST AIR RELEASE VALVES TO INSURE THEY ARE AT THE HIGH POINT IN THE LINE.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00307	WATER LINE DETAILS	G0019
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 2 OF 3	G0021

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E INITIALS	FERMCO INITIALS	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/10/97

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

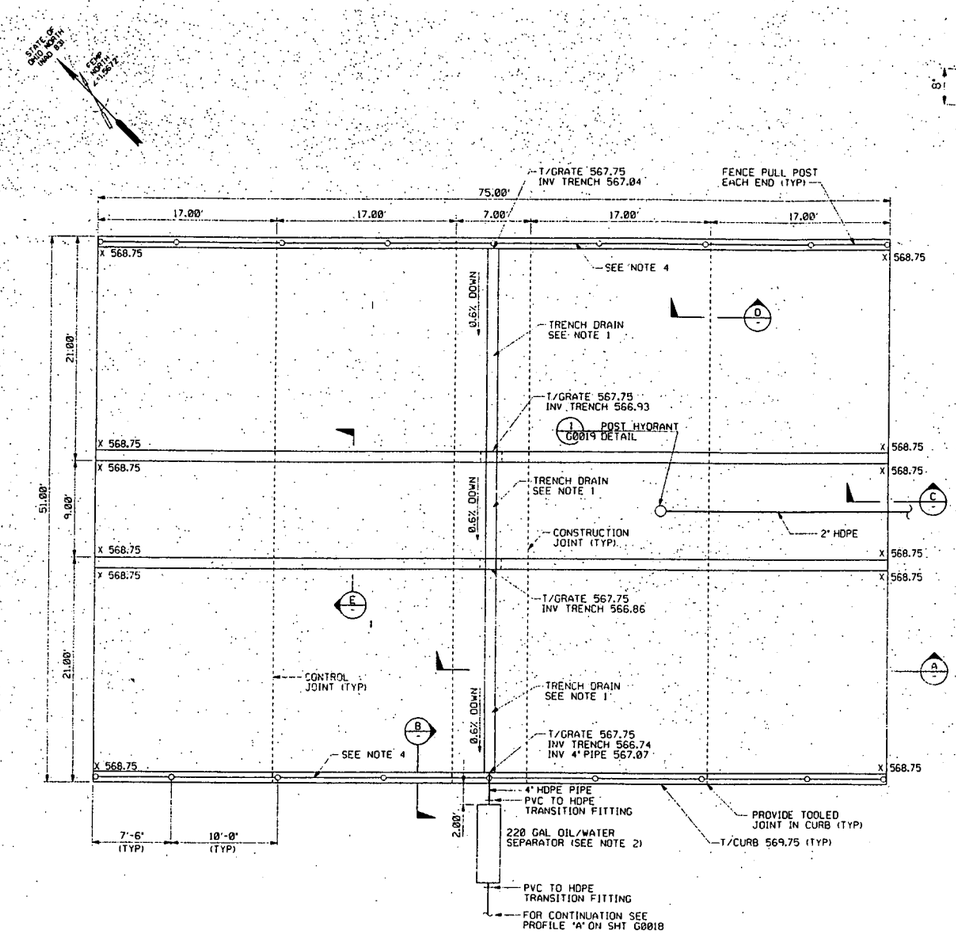
DRAWING TITLE
CIVIL
TRANSFER LINE - PLAN AND PROFILE
SHEET 3 OF 3

641

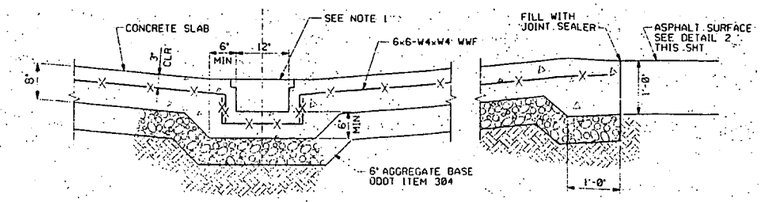
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	06/12/96		6/10/97	K. GERARD	01/18/97
PLANT/BLDG. NO		FLOOR		SCALE	CLASS
				1"=50'	
SUBMITTED FOR APPROVAL		FERMCO CRU APPROVAL		FERMCO PROJECT NO.	
		N/A		20400	

A-E PM DATE 6/13/97

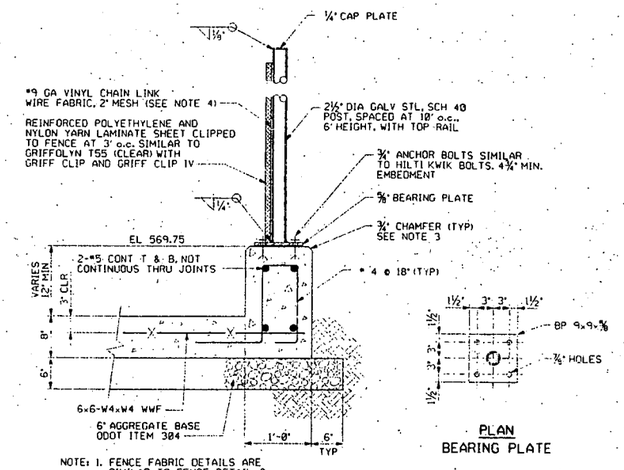
PREPARED UNDER PARSONS PROJECT ORDER NUMBER	CUP PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO	SHEET NO.	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00306	G0016	0



DETAIL 1 G0017 REF G0007
WASH PAD
SCALE: 1"=5'



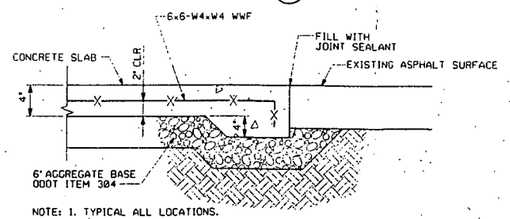
SECTION A
NTS



NOTE: 1. FENCE FABRIC DETAILS ARE SIMILAR TO FENCE DETAIL 2 ON SHT G0020.
2. TYPICAL ALL LOCATIONS.

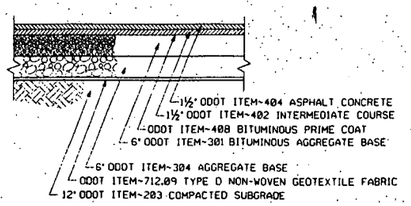
PLAN
BEARING PLATE

SECTION B
NTS

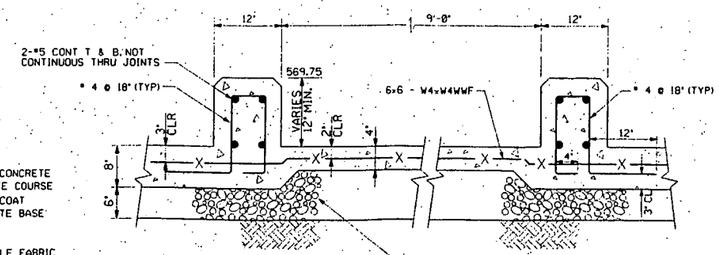


NOTE: 1. TYPICAL ALL LOCATIONS.

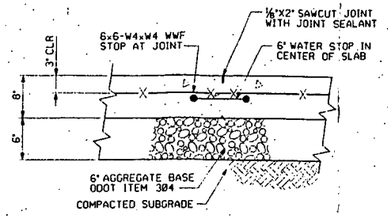
SECTION C
NTS



DETAIL 2 G0017 REF G0007
ASPHALTIC CONCRETE PAVING
NTS



SECTION E
NTS



SECTION D
NTS

NOTES

1. NEENAH R-4990-DX HEAVY DUTY DUCTILE IRON FRAME AND GRATE, OR EQUAL. SET FRAME PER MANUFACTURERS RECOMMENDATIONS.
2. 220 GALLON POLYMER CONCRETE OIL/WATER SEPARATOR SIMILAR TO ACO POLYMER PRODUCTS, INC. OIL SEPARATOR SYSTEM.
3. PROVIDE ¾" CHAMFER ON ALL EXTERIOR CORNERS OF CURBS AND CONCRETE.
4. PROVIDE 6'-0" HIGH SPLASH SHIELD ON TOP OF EXTERIOR CURBS.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00310	WHEEL WASH SUMP DISCHARGE - PROFILES AND DETAILS	G0018
92X-5900-G-00307	WATER LINE DETAILS	G0019
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNAS	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
WHEEL WASH PAD
STRUCTURAL DETAILS

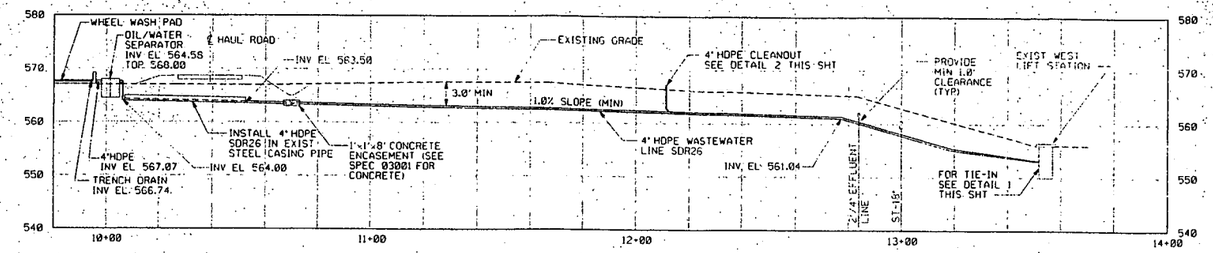
642

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	03/08/96		6/12/97	K. GERARD	1/18/97
PLANT/BLDG. NO		FLOOR		SCALE	CLASS
				NONE	
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL		FERNCO PROJECT NO.	
DATE 6/13/97		N/A		20400	

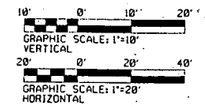
PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

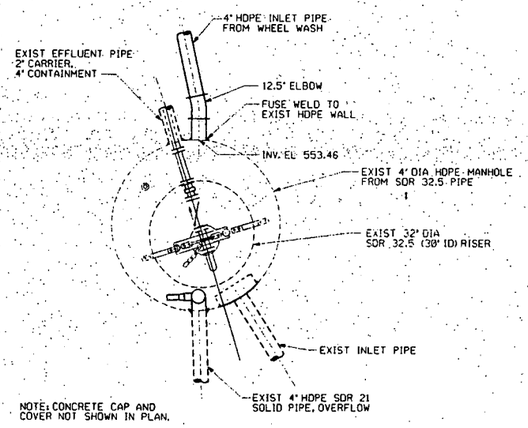
DOE PROJECT NO.	FY97 PROJECT NO.	DRAWING INDEX CODE NO	SHEET NO	REV. NO
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00312	G0017	0

STATE OF OHIO FRANKLIN M. PARTON, JR. NO. E-49914 REGISTERED PROFESSIONAL ENGINEER

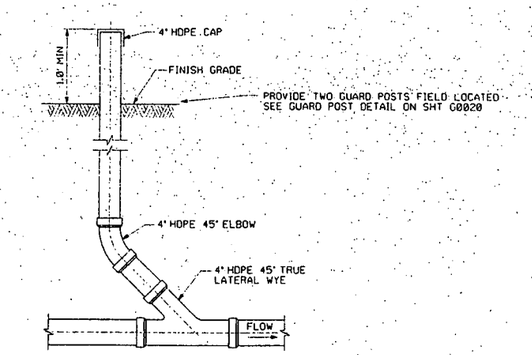


PROFILE (A) REF G0018 G0007 G0017
SCALE: HOR 1"=20' VER 1"=10'





DETAIL (1) REF G0018 G0007
PUMP MANHOLE TIE-IN
NTS



DETAIL (2) REF G0018 G0007
GRAVITY LINE CLEANOUT
NTS

NOTES :

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-G-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00312	WHEEL WASH PAD - STRUCTURAL DETAILS	G0017
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JHU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

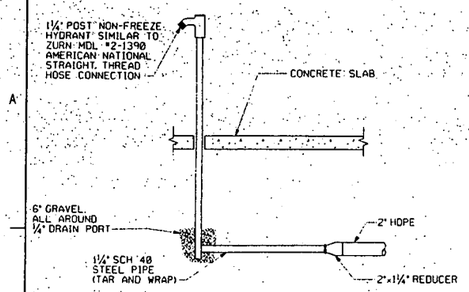
DRAWING TITLE
CIVIL
WHEEL WASH SUMP DISCHARGE
PROFILE AND DETAILS

643

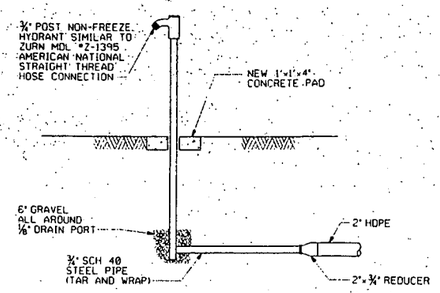
DRAWN BY D.R. FOX	DATE 11/15/96	LEAD ENGINEER	DATE 6/13/97	CHECKED BY K. GERARD	DATE 01/18/97
PLANT/BLDG. NO		FLOOR		SCALE AS SHOWN	CLASS
SUBMITTED FOR APPROVAL DATE 6/13/97		FERMCO CRU APPROVAL N/A DATE		FERMCO PROJECT NO. 20400	

STATE OF OHIO FRANKLIN M. PARTON, JR. NO. E-67814 REGISTERED PROFESSIONAL ENGINEER 6/13/97

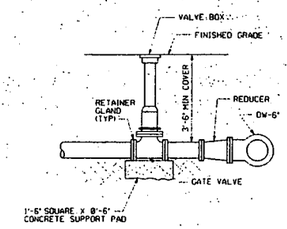
PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO	TEMP PROJECT NO	DRAWING INDEX CODE NO	SHEET NO	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00310	G0018	0



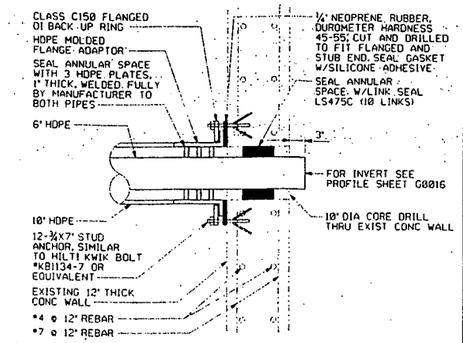
POST HYDRANT DETAIL (1 / G0019) REF G0007 G0017
NTS



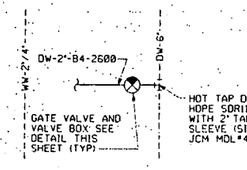
POST HYDRANT DETAIL (2 / G0019) REF G0006
NTS



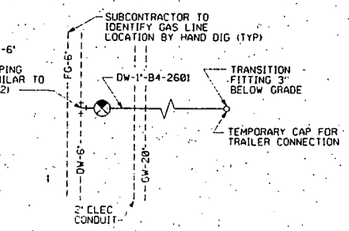
GATE VALVE DETAIL (3 / G0019) REF G0006
NTS



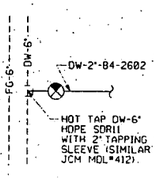
SWRB DIVERSION BOX TAP DETAIL (4 / G0019) REF G0016
NTS



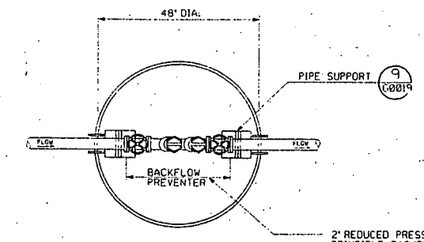
TIE-IN DETAIL (5 / G0019) REF G0006
NTS



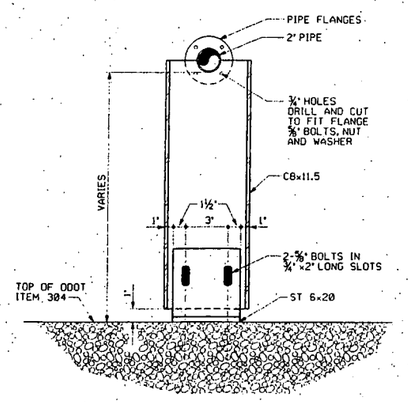
TIE-IN DETAIL (6 / G0019) REF G0006
NTS



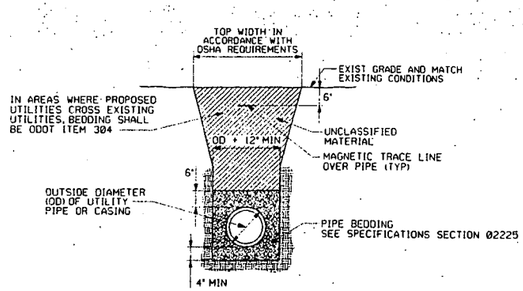
TIE-IN DETAIL (7 / G0019) REF G0006
NTS



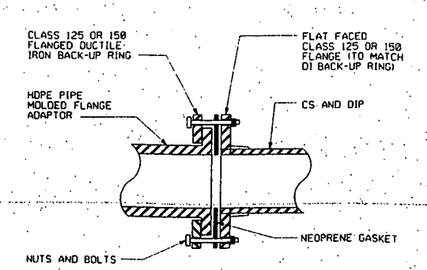
PLAN



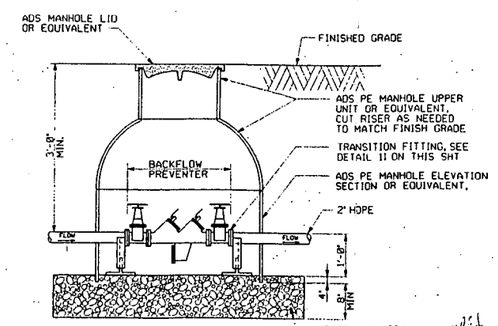
PIPE SUPPORT DETAIL (9 / -)
NTS



PIPE BEDDING DETAIL (10 / G0019) REF G0005 G0007 G0014 G0015 G0016
NTS



TYPICAL TRANSITION FITTING DETAIL (11 / G0019) REF G0021
NTS



SECTION

BACKFLOW PREVENTER DETAIL (8 / G0019) REF G0006
NTS

NOTES

1. INSPECT ALL BACKFLOW PREVENTERS ON A WEEKLY BASIS. THE BACKFLOW PREVENTER VAULT SHALL BE MAINTAINED IN A DRY CONDITION AT ALL TIMES TO MINIMIZE POTENTIAL CROSS CONTAMINATION. SUBCONTRACTOR SHALL PUMP VAULT AS NECESSARY. AT THE COMPLETION OF THE CONTRACT, INSPECTION AND MAINTENANCE RESPONSIBILITIES SHALL BE ASSUMED BY THE EXCAVATION SUBCONTRACTOR.
2. TEST COCKS SHALL BE PLUGGED.

RELATED DWG. NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00284	SITE PLAN	G0005
92X-5900-G-00284	SITE PLAN - SUPPORT AREA	G0006
92X-5900-G-00283	SITE PLAN - WHEEL WASH AREA	G0007
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00306	TRANSFER LINE - PLAN AND PROFILE - SHEET 3 OF 3	G0016
92X-5900-G-00312	WHEEL WASH PAD - PLAN AND DETAILS	G0017
92X-5900-G-00308	MISCELLANEOUS DETAILS - SHEET 2 OF 3	G0021

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMM	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

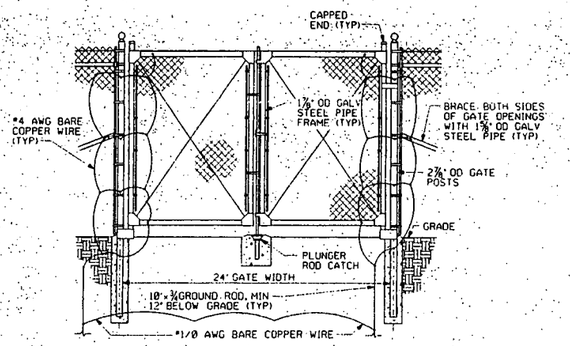
DRAWING TITLE
CIVIL
WATER LINE DETAILS

644

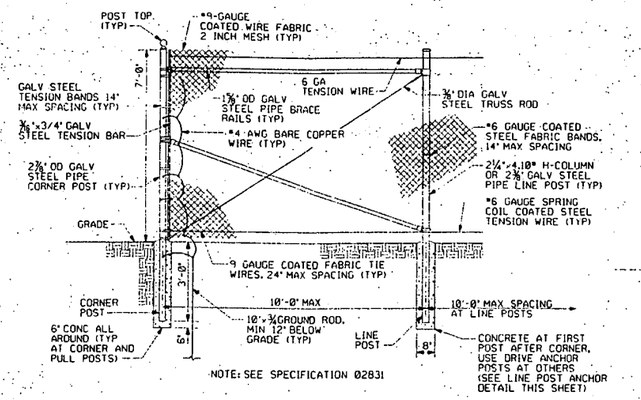
STATE OF OHIO — FRANKLIN M. PARTON, JR. NO. E-67914 — REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D.R.FOX	03/08/96		6/13/97	K. GERARD	1/18/97
PLANT/BLDG NO		FLOOR		SCALE: NONE	CLASS
SUBMITTED FOR APPROVAL: DATE 6/13/97		FERNCO CRU APPROVAL: N/A		FERNCO PROJECT NO.: 20400	

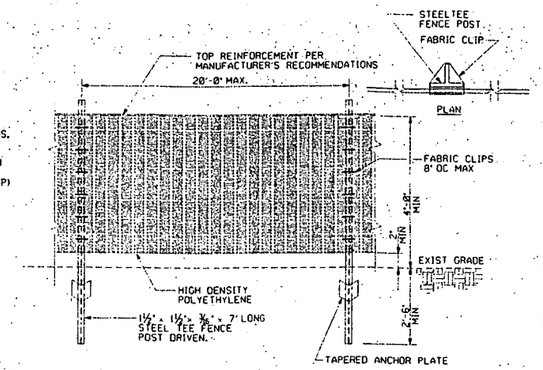
PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO	TEMP PROJECT NO.	DRAWING INDEX CODE NO	SHEET NO	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00307	G0019	0



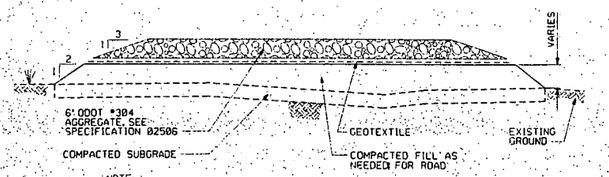
DOUBLE GATE DETAIL (1 / G0020) REF G0005 G0006
NTS



CHAINLINK FENCE DETAIL (2 / G0020) REF G0006
NTS



CONSTRUCTION FENCE DETAIL (3 / G0020) REF G0006 G0009 G0010 G0011
NTS

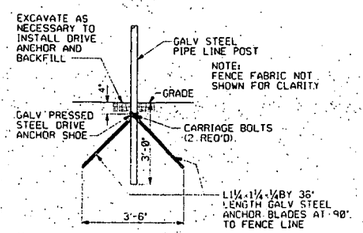


NOTE:
GRAVEL ACCESS ROAD SHALL BE 20' WIDE UNLESS NOTED OTHERWISE ON DRAWINGS. PROVIDE POSITIVE CROSS DRAINAGE.

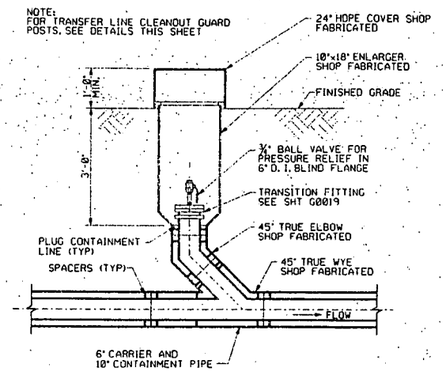
THE SUPPORT AREA GEOTEXTILE IS TO BE PLACED DIRECTLY ON GROUND WITH MINIMAL GRADING (NO CLEARING AND GRUBBING)

FOR GEOTEXTILE SEE SPECIFICATION SECTION 02506

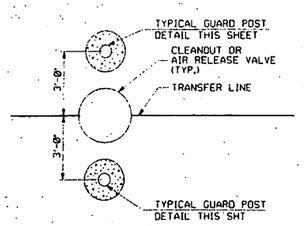
GRAVEL SURFACE DETAIL (4 / G0020) REF G0005 G0006 G0007
NTS



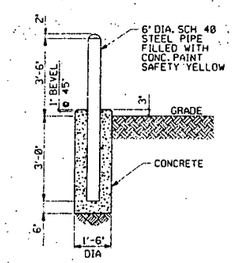
LINE POST DRIVE ANCHOR DETAIL
NTS



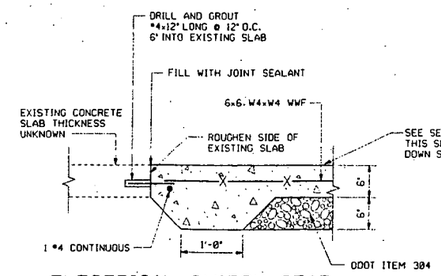
TRANSFER LINE CLEANOUT DETAIL (5 / G0020) REF G0014 G0015 G0016
NTS (SEE NOTE 1)



GUARD POST LAYOUT DETAIL (6 / G0020)
NTS

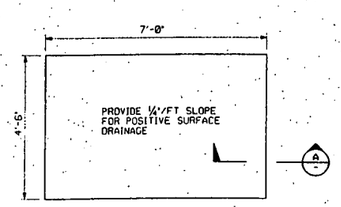


TYPICAL GUARD POST DETAIL
NTS

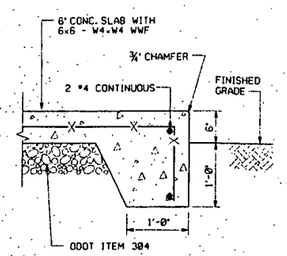


ELECTRICAL SWITCH GEAR PAD EXTENSION (8 / G0020) REF E0012
NTS

TRANSFER LINE AIR RELEASE VALVE DETAIL (9 / G0020) REF G0014 G0015 G0016
NTS



ELECTRICAL SERVICE PANEL RACK PAD DETAIL (7 / G0020) REF G0005 G0006 G0007 G0009 G0010 G0011
NTS



SECTION (A / -)
NTS

NOTES

1. AIR RELEASE VALVE AND CLEANOUT ASSEMBLIES SHALL BE SHOP FABRICATED AND TESTED. ALLOW FOR FIELD CONNECTION TO PIPELINE.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00284	SITE PLAN - SUPPORT AREA	G0006
92X-5900-G-00303	ENLARGEMENT RETENTION BASIN #1	G0009
92X-5900-G-00371	ENLARGEMENT RETENTION BASIN #2	G0010
92X-5900-G-00372	ENLARGEMENT RETENTION BASIN #3	G0011
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE SHEET 1 OF 3	G0014
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE SHEET 2 OF 3	G0015
92X-5900-G-00306	TRANSFER LINE - PLAN AND PROFILE SHEET 3 OF 3	G0016
92X-5900-G-00307	WATER LINE DETAILS	G0019
92X-5900-E-00409	ELECTRICAL - DETAILS - SHEET 4	E0012

FOR INFORMATION ONLY

REV. NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
MISCELLANEOUS DETAILS
SHEET 1 OF 3

645

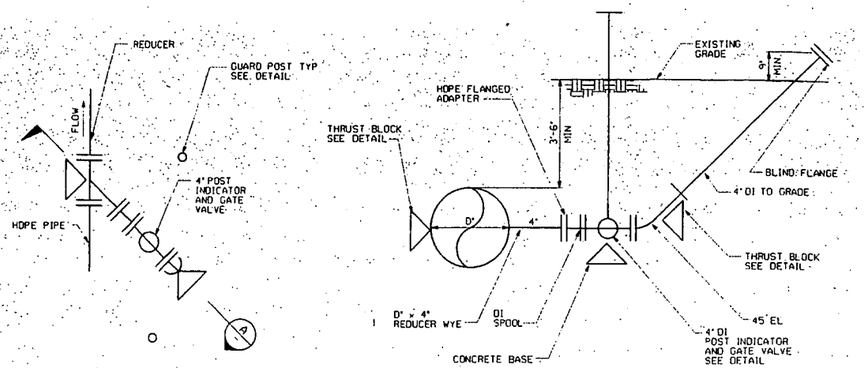
STATE OF OHIO — FRANKLIN M. PARTON, JR. — REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. LINDGREN	06/06/96		6/13/97	K. GERARD	1/20/97

PLANT/BLDG NO	FLOOR	SCALE	CLASS
		NONE	

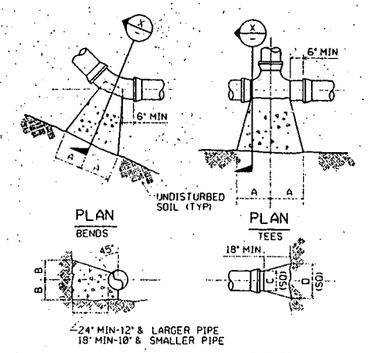
SUBMITTED FOR APPROVAL	FERMCO CRU APPROVAL	FERMCO PROJECT NO.
DATE 6/13/97	N/A	20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO	SHEET NO.	REV NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00309	G0020	0



PLAN

SECTION (A) NTS

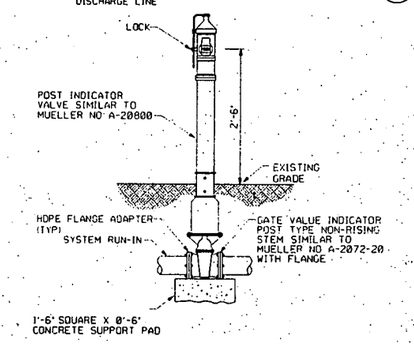


TYPE	SIZE	1/4 BENDS		1/8 BENDS		1/16 BENDS		TEES		PLUGS	
		A	B	A	B	A	B	A	B	C	D
2000 PSF SOIL	6"	16"	10"	9"	10"	6"	8"	10"	12"	10"	21"
	8"	22"	13"	12"	13"	8"	10"	13"	16"	12"	29"
	10"	26"	17"	14"	17"	10"	13"	16"	20"	14"	36"
	12"	29"	21"	16"	21"	11"	16"	18"	24"	16"	41"
	16"	38"	27"	-	-	-	-	24"	30"	-	-
	20"	42"	30"	-	-	-	-	27"	30"	-	-
	24"	48"	30"	-	-	-	-	36"	30"	-	-

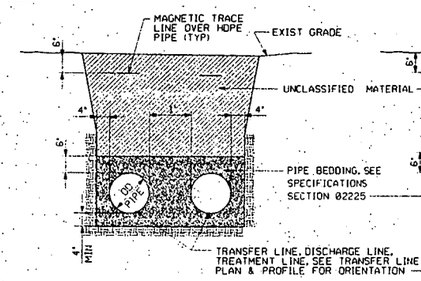
NOTE: BASED ON 150 PSI STATIC PRESSURE PLUS A.W.W.A. WATER HAMMER. ALL BEARING SURFACES TO BE CARRIED TO UNDISTURBED GROUND.

THRUST BLOCK DETAILS
NTS

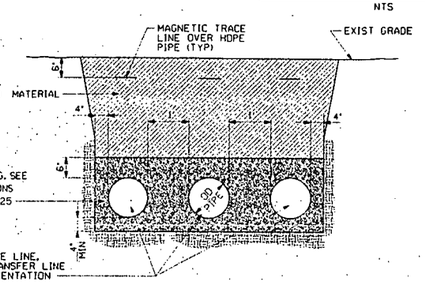
TYPICAL CLEANOUT DETAIL (1) REF G0021 G0014 G0015 G0016
TREATMENT LINE DISCHARGE LINE NTS



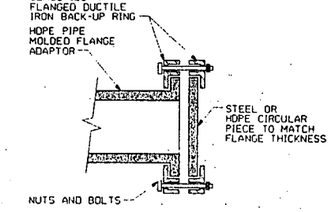
POST INDICATOR VALVE DETAIL
LINES SIZES 12" AND LESS NTS



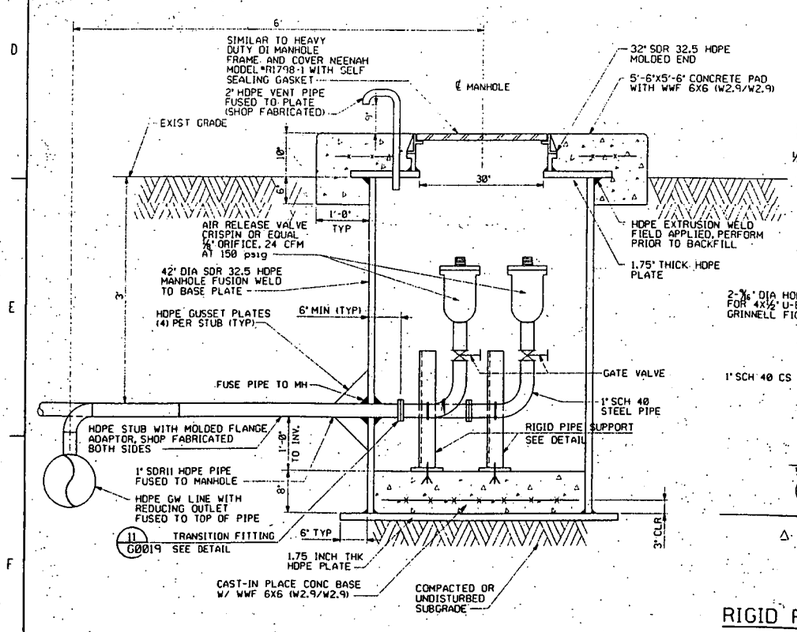
TYPICAL 2 PIPE BEDDING DETAIL (2) REF G0021 G0014 G0015 G0016
NTS



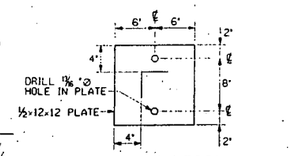
TYPICAL 3 PIPE BEDDING DETAIL (3) REF G0021 G0014 G0015 G0016
NTS



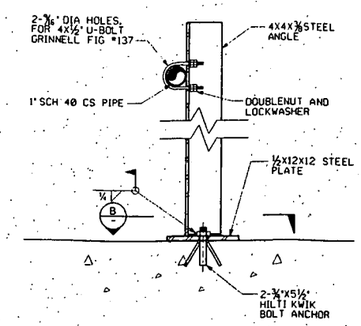
TYPICAL BLIND FLANGE DETAIL (4) REF G0021 G0014 G0015 G0016
END PIPE NTS



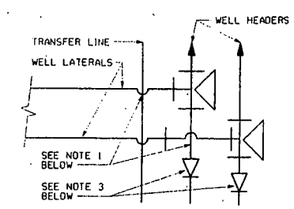
AIR RELEASE MANHOLE DETAIL (5) REF G0021 G0015
TREATMENT LINE DISCHARGE LINE



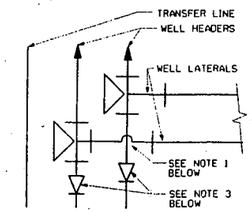
SECTION (B) NTS



RIGID PIPE SUPPORT DETAIL
NTS

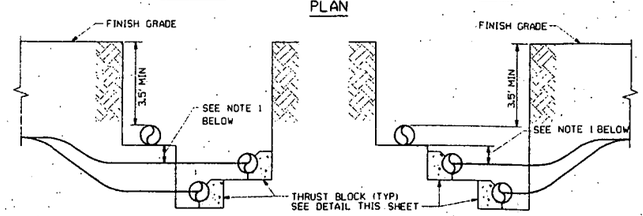


CROSSING



OFFSET

PLAN



ELEVATION

NOTE:

1. BEND LATERAL(S) AND HEADER TO PROVIDE 8' CLEARANCE. MINIMUM BEND RADIUS IS 20 DIAMETERS OR AS SPECIFIED BY PIPE MANUFACTURER.
2. COMMON TRENCH WITH 2 LATERIAL TEES SHOWN WITH THRUST BLOCK BEARING ON NATIVE SOIL. COMMON TRENCH WITH 1 LATERAL TEE WILL BE SIMILAR.
3. REDUCERS MAY BE REQUIRED UPSTREAM OF TEE. TEE SIZE SHALL MATCH DOWNSTREAM PIPE SIZE. SEE SHT G0014 AND SHT G0015.

TYPICAL TEE/ LATERAL DETAIL (6) REF G0021 G0014 G0015
NTS

STATE OF OHIO FRANKLIN M. PARTON, JR. NO. E-57614 REGISTERED PROFESSIONAL ENGINEER 9/13/97

NOTES

1. UNLESS OTHERWISE NOTED ALL CONCRETE SHALL BE 3000 PSI AS SPECIFIED IN THE SPECIFICATIONS.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00304	TRANSFER LINE - PLAN AND PROFILE - SHEET 1 OF 3	G0014
92X-5900-G-00305	TRANSFER LINE - PLAN AND PROFILE - SHEET 2 OF 3	G0015
92X-5900-G-00306	TRANSFER LINE - PLAN AND PROFILE - SHEET 3 OF 3	G0016
92X-5900-G-00309	MISCELLANEOUS DETAILS - SHEET 1 OF 3	G0020
92X-5900-G-00307	WATER LINE DETAILS	G0019

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
MISCELLANEOUS DETAILS
SHEET 2 OF 3

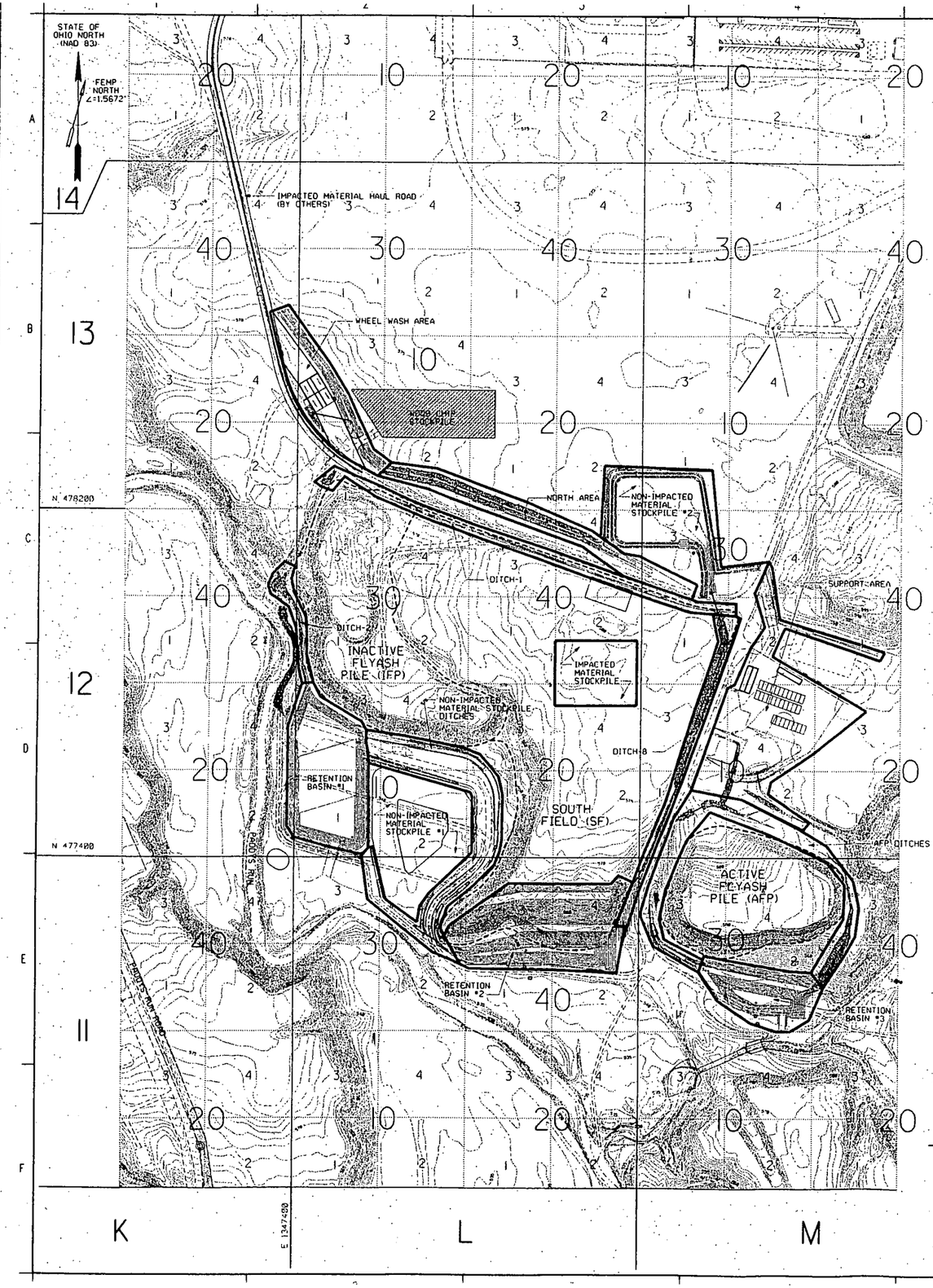
646

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. BROWN	03-28-97		6/13/97	K. GERARD	1/28/97

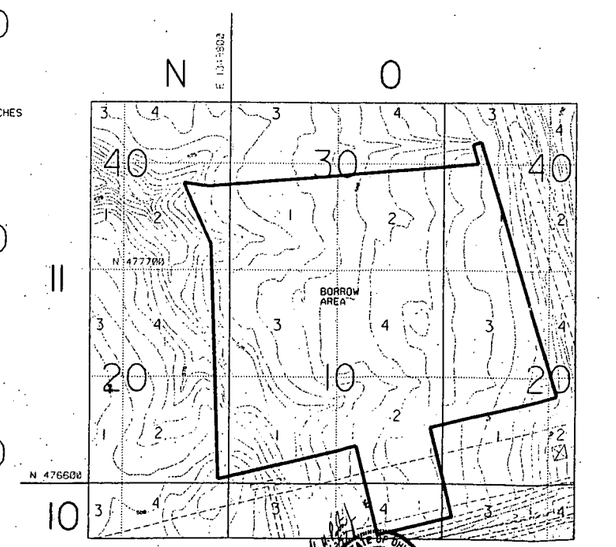
PLANT/BLDG NO. | FLOOR | SCALE NONE | CLASS

SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL NA | DATE 6/13/97

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO	TEMP PROJECT NO	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701		92X-5900-G-00308	G0021	0



AREA	DISPOSITION OF MATERIAL
WHEEL WASH AREA	BALANCE GRADING IN AREA WITH DITCHES 13 & 14
NORTH AREA	USE FOR DEVELOPMENT OF NON IMPACTED STOCKPILE #2 REMAINDER-IMPACTED
SUPPORT AREA (INCLUDING BERM NORTH OF AFP)	BALANCE GRADING IN AREA
DITCHES	SEE SHEET G0012
RETENTION BASIN 1	TOP FOOT - IMPACTED
	REMAINDER - NON IMPACTED
RETENTION BASIN 2 (ABOVE ELEV. 541	TOP FOOT - IMPACTED
	REMAINDER
RETENTION BASIN 2 (BELOW ELEV. 541	TOP FOOT - IMPACTED
	REMAINDER - NON IMPACTED
RETENTION BASIN 3	TOP FOOT - IMPACTED
	REMAINDER - NON IMPACTED
ROAD RE-GRADING (AT RETENTION BASIN 2)	EXCESS MATERIAL - IMPACTED
	FILL - NEAREST SOURCE OF NON IMPACTED MATERIAL
SWALE REPAIR AT AFP	IMPACTED
BORROW AREA	TOP FOOT - NON IMPACTED PLACE IN STOCKPILE AT BORROW AREA REMAINDER - INFILTRATION BARRIER



GRAPHIC SCALE: 1"=100'

NOTES

1. PERFORM MATERIAL DOCUMENTATION IN ACCORDANCE WITH SPECIFICATION SECTION 01450.
2. TRACK USING MATERIAL TRACKING LOCATION (MTL) SHOWN ON THIS DRAWING. USE GRID BOUNDARY (200' X 200') IF MTL BOUNDARIES ARE NOT APPLICABLE.

LEGEND

GRID BOUNDARY

MATERIAL TRACKING LOCATION (MTL) BOUNDARY

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
MATERIAL DOCUMENTATION PLAN

647

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. BROWN	02/11/97		6/13/97	F. PARTON	02/11/97

PLANT/BLDG NO.: 71000 | SCALE: 1"=100' | CLASS.

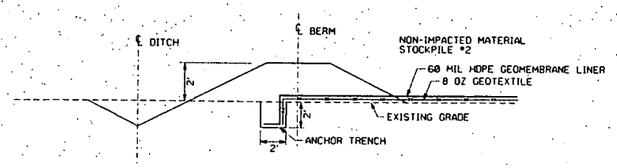
SUBMITTED FOR APPROVAL | FERMCO/KAISER APPROVAL

A-E PROJECT ENGINEER DATE 6/13/97 | DATE | 20400

DOE PROJECT NO. | TEMP PROJECT NO.: WBS 1.1.1.1.2.3.6 00-90701 | DRAWING INDEX CODE NO.: 92X-5900-G-00411 | SHEET NO.: G0022 | REV. NO.: 0

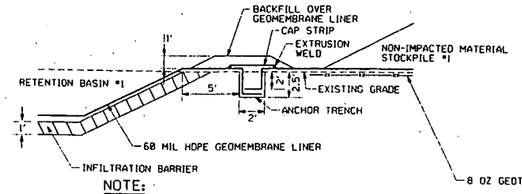
PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

STATE OF OHIO FRANKLIN M. PARTON, JR. NO. E-67614 REGISTERED PROFESSIONAL ENGINEER



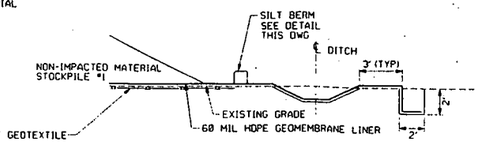
NOTE:
BACKFILL ANCHOR TRENCH WITH CL MATERIAL AND COMPACT TO 95% STANDARD PROCTOR (ASTM D698).

ANCHOR TRENCH DETAIL (1 / C0023) REF C0008
NON-IMPACTED MATERIAL STOCKPILE #2
NTS



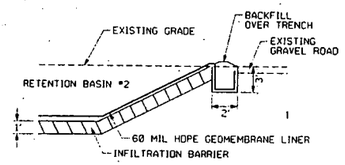
NOTE:
1. BACKFILL ANCHOR TRENCH WITH CL MATERIAL AND COMPACT TO 95% STANDARD PROCTOR (ASTM D698).
2. CAP STRIP SHALL BE THE SAME MATERIAL AS HDPE GEOMEMBRANE LINER.

ANCHOR TRENCH DETAIL (2 / C0023) REF C0009
RETENTION BASIN #1/
NON-IMPACTED MATERIAL STOCKPILE #1
NTS



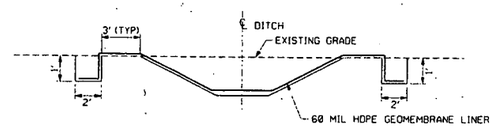
NOTE:
BACKFILL ANCHOR TRENCH WITH CL MATERIAL AND COMPACT TO 95% STANDARD PROCTOR (ASTM D698).

ANCHOR TRENCH DETAIL (3 / C0023) REF C0005
NON-IMPACTED MATERIAL STOCKPILE #1/DITCH
NTS



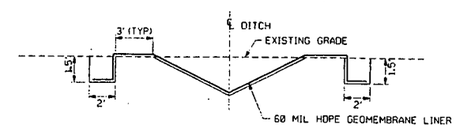
NOTE:
BACKFILL ANCHOR TRENCH WITH CL MATERIAL AND COMPACT TO 95% STANDARD PROCTOR (ASTM D698).

ANCHOR TRENCH DETAIL (4 / C0023) REF C0011
RETENTION BASIN #2/EXISTING ROAD
NTS



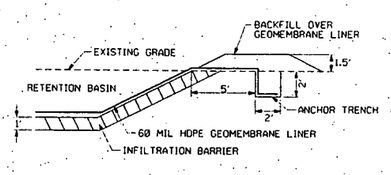
NOTE:
BACKFILL ANCHOR TRENCH WITH CL MATERIAL AND COMPACT TO 95% STANDARD PROCTOR (ASTM D698).

ANCHOR TRENCH DETAIL (5 / C0023) REF C0012
FLAT BOTTOM DITCH (TYP)
NTS



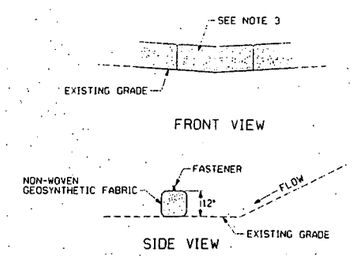
NOTE:
BACKFILL ANCHOR TRENCH WITH CL MATERIAL AND COMPACT TO 95% STANDARD PROCTOR (ASTM D698).

ANCHOR TRENCH DETAIL (6 / C0023) REF C0012
V - DITCH (TYP)
NTS



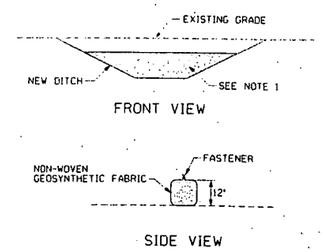
NOTE:
BACKFILL ANCHOR TRENCH WITH CL MATERIAL AND COMPACT TO 95% STANDARD PROCTOR (ASTM D698).

ANCHOR TRENCH DETAIL (7 / C0023) REF C0009, C0010, C0011
RETENTION BASIN (TYP)
NTS



NOTES:
1. LENGTH OF INDIVIDUAL SILT BERM MAY VARY AS REQUIRED FOR HANDLING
2. WHERE TWO ENDS OF SILT BERM MEET OVERLAP 1 FOOT MIN.
3. #57 STONE, ODOT ITEM 703.01

SILT BERM DETAIL (8 / C0023)
NTS



NOTES:
1. #57 STONE, ODOT ITEM 703.01

SEDIMENT BARRIER DETAIL (9 / C0023) REF C0005
NTS

NOTES

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00282	SITE PLAN	G0005
92X-5900-G-00390	SITE PLAN - PADDYS RUN AREA	G0008
92X-5900-G-00303	ENLARGEMENT RETENTION BASIN #1	G0009
92X-5900-G-00371	ENLARGEMENT RETENTION BASIN #2	G0010
92X-5900-G-00372	ENLARGEMENT RETENTION BASIN #3	G0011
92X-5900-G-00311	EROSION AND SEDIMENT CONTROL - SHEET 1 OF 2	G0012

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

RETAINS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

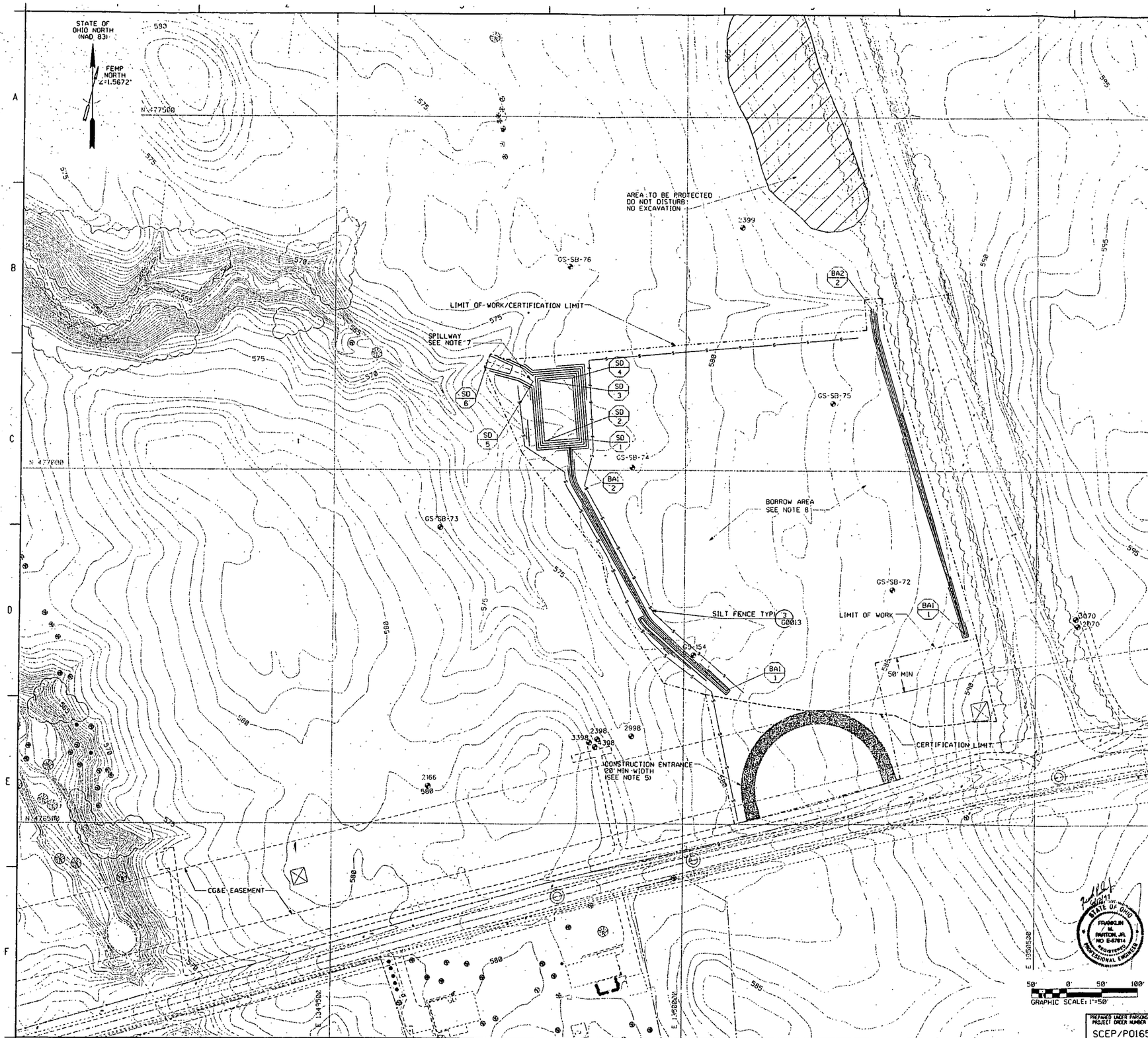
DRAWING TITLE
CIVIL
MISCELLANEOUS DETAILS
SHEET 3 OF 3

648

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D.R. FOX	05/22/97		6/13/97	TIM BROWN	6/6/97
PLANT/BLDG NO		FLOOR		SCALE: NONE	CLASS
SUBMITTED FOR APPROVAL: A-E DATE 6/13/97		FERMCO CRU APPROVAL: N/A DATE		FERMCO PROJECT NO. 20400	
DOE PROJECT NO	TSMP PROJECT NO: WBS 1.1.1.1.2.3.6 00-90701	DRAWING INDEX CODE NO: 92X-5900-G-00452		SHEET NO: G0023	REV. NO: 0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

STATE OF OHIO — FRANKLIN M. PARTON, JR. — NO. E-67814 — REGISTERED PROFESSIONAL ENGINEER — 6/13/97



NOTES

1. UTILITY LOCATIONS ARE APPROXIMATE. INSPECT THE WORK AREA PRIOR TO CONSTRUCTION AND STARTING WORK AND NOTIFY FDF OF ANY DISCREPANCIES IN WRITING.
2. STRIP TOP 6 INCHES OF TOPSOIL AND STOCKPILE ON SITE. PROVIDE EROSION AND SEDIMENT CONTROL FOR STOCKPILE.
3. EXCAVATE MAXIMUM OF 5' OF DEPTH FOR BORROW MATERIAL. MATERIAL EXCAVATED DEEPER THAN 5' OF DEPTH SHALL NOT BE USED UNLESS APPROVED BY FDF.
4. FOR SOIL BORING INFORMATION SEE GEOTECHNICAL DATA AND EVALUATION REPORT FOR EAST AND SOUTHFIELD BORROW AREAS, REVISION 0, DATED JUNE 1996.
5. PLACE NO.3 STONE, ODOT ITEM 703.01, AS SHOWN ON THE PLAN. ALL EXISTING WELLS ARE TO BE PROTECTED DURING CONSTRUCTION AND OPERATION.
6. SEE SHT G0012 FOR DETAILS AND INVERT ELEVATIONS OF DITCHES.
7. CONSTRUCT SPILLWAY WITH 12' WIDE BOTTOM WIDTH, 3H:1V SIDE SLOPES. LINE SPILLWAY WITH 8 oz. NON-WOVEN GEOTEXTILE. INSTALL 1.5' THICK MINIMUM DUMPED ROCK FILL ON TOP OF GEOTEXTILE TO FINISH GRADE. DUMPED ROCK FILL SHALL BE O.D.O.T. ITEM 601.07, TYPE 'C' DUMPED ROCK FILL.
8. BORROW AREA HAS BEEN PREVIOUSLY CERTIFIED BY FDF. CONSTRUCTION EQUIPMENT TO BE USED WITHIN BORROW AREA SHALL BE APPROVED BY FDF PRIOR TO ENTRANCE INTO CERTIFIED AREA. VEHICLES USED FOR HAULING BORROW MATERIAL TO CONSTRUCTION AREAS SHALL NOT CROSS INTO THE CERTIFICATION UNIT. BORROW MATERIAL SHALL BE LOADED INTO THE HAUL VEHICLES ACROSS THE CERTIFICATION LIMIT. CONSTRUCTION EQUIPMENT TO BE USED FOR LOADING THE HAUL VEHICLES SHALL NOT CROSS THE CERTIFICATION LIMIT WITH TIRES OR TRACKS.

DRAINAGE DITCHES (D). (SEE NOTE 6)

DITCH NO.	POINT	NORTHING	EASTING	DESCRIPTION/COMMENT
BA1	1	476689.2	1350061.0	BEGIN V-DITCH
BA1	2	477033.5	1349834.7	END V-DITCH
BA2	1	476769.3	1350398.2	BEGIN V-DITCH
BA2	2	477228.8	1350264.9	END V-DITCH

SEDIMENT TRAP (SD)

POINT	NORTHING	EASTING	ELEV	DESCRIPTION/COMMENT
1	477044.9	1349845.2	571.0	CORNER TRAP
2	477041.0	1349799.3	571.0	CORNER TRAP
3	477126.7	1349792.1	571.0	CORNER TRAP
4	477130.6	1349837.9	571.0	CORNER TRAP
5	477125.6	1349783.1	574.0	HP SPILLWAY
6	477153.3	1349717.8	572.5	END SPILLWAY

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-X-00321	LEGEND AND GENERAL NOTES	X0003
92X-5900-G-00368	EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00023	MISCELLANEOUS DETAILS SHEET 1 OF 3	G0023

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMH	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
CIVIL
SITE PLAN - BORROW AREA

649

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
D. REED	06/05/97		6/13/97		
PLANT/BLDG. NO		FLOOR		SCALE 1"=50'	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL N/A		FERNCO PROJECT NO. 20400	

APPROVED DATE 6/13/97

DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-G-00453	G0024	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
SCEP/P0165

PIPING VALVES

CONFIGURATIONS FOR VALVE TYPE

ANGLE STRAIGHT 3-WAY 4-WAY

VALVE TYPES (STRAIGHT CONFIG.)

- AIR RELEASE VALVE
- AIR AND VACUUM VALVE
- BACKPRESSURE REGULATOR
- BACKFLOW PREVENTER
- BALL
- BLOWDOWN
- BUTTERFLY/DAMPER
- CHECK, SWING TYPE
- CHECK, WAFER TYPE
- DELUGE
- DIAPHRAGM
- DIFFERENTIAL PRESSURE REGULATOR
- FLOAT
- FOOT
- GATE
- GLOBE
- HOSE
- KNIFE
- NEEDLE
- PINCH
- PRESSURE REGULATOR
- PLUG
- SAFETY RELIEF
- SLIDING GATE
- STOP CHECK
- VACUUM

PIPING SEGMENT BREAKS

- CONSTRUCTION REQUIREMENTS
- INSULATION REQUIREMENTS
- PIPING MATERIAL REQUIREMENTS
- UNDERGROUND ROUTING (SHADED AREA INDICATES DIRECTION OF UNDERGROUND)

PIPING FITTINGS

- BASKET STRAINER - SINGLE
- BASKET STRAINER - DUPLEX
- CAP
- CONCENTRIC REDUCER
- CONE STRAINER
- ECCENTRIC REDUCER
- EXPANSION FLANGE
- EXPANSION JOINT
- FILTER
- FLANGE
- FLEXIBLE HOSE
- HOSE CONNECTION
- HOSE QUICK COUPLING
- MECHANICAL COUPLING
- ORIFICE
- ORIFICE UNION
- PLUG
- REDUCING FLANGE
- STEAM TRAP
- SUMP STRAINER
- TEMPORARY STRAINER
- Y-STRAINER

PIPING SYMBOLOGY

- PRIMARY PIPING
- SECONDARY PIPING
- EXISTING PIPING
- FLEXIBLE HOSE
- FUTURE PIPING
- TIE-IN POINT

EQUIPMENT SYMBOLS

- AGITATOR (MIXER)
- CENTRIFUGAL BLOWER
- (AREA NAME) DEFINED BOUNDRY
- HORIZONTAL CENTRIFUGAL PUMP
- (SYSTEM NAME) PACKAGED SYSTEM BOUNDRY
- SUBMERSIBLE TURBINE PUMP
- SUMP PUMP WITH MOTOR

PIPING LINE NUMBER FORMAT

MEDIUM CODE
NOMINAL PIPE SIZE
NOMINAL CONTAINMENT PIPE SIZE (WHERE SHOWN)
MATERIAL CODE
LINE NUMBER
INSULATION CODE

GW-6(10)"-B4-2930-ET

MEDIUM FLOW DIRECTION

ABBREVIATIONS

AC	AIR TO CLOSE
AG	AGITATOR
AO	AIR TO OPEN
ARV	AIR RELEASE VALVE
AVV	AIR AND VACUUM VALVE
AWWT	ADVANCED WASTEWATER TREATMENT
BLW	BLOWER
BTU	BRITISH THERMAL UNIT
CFM	CUBIC FEET/MINUTE
CO	CLEAN OUT
CU FT	CUBIC FEET
ECC	ECCENTRIC
EF	EXHAUST FAN
FC	FAIL CLOSED
FO	FAIL OPEN
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GV	GRAVITY VENTILATOR
HDPE	HIGH DENSITY POLYETHYLENE
IA	INSTRUMENT AIR
KW	KILOWATT
LB/HR	POUNDS PER HOUR
MATL	MATERIAL
MED	MEDIUM
MS	MIST ELIMINATOR
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
PIV	POST INDICATOR VALVE
PMP	PUMP
RED	REDUCER
RH	RELATIVE HUMIDITY
SCFM	STANDARD CUBIC FEET/MINUTE
SFES	SOUTH FIELD EXTRACTION SYSTEM
SWRB	STORMWATER RETENTION BASIN
TBD	TO BE DETERMINED
TF	TOP FLAT
TNK	TANK
TYP	TYPICAL
UH	UNIT HEATER
1	SOLENOID VALVE COMMON PORT
2	SOLENOID VALVE NORM. OPEN PORT
3	SOLENOID VALVE NORM. CLOSED PORT
ID	INJECTION DEMONSTRATION
SPO	SOUTH PLUME OPTIMIZATION

PIPING SPECIFICATIONS

FLOWING MEDIUM	MED. CODE	MATL. CODE
BACK WASH	BW	T
BLOWER AIR	BA	A
CHILLED WATER	CHS, CHR	A
CHLORINE	CL	B1
CONDENSATE	LC	W, T
CONDENSER WATER	CWS, CWR	A
COOLING WATER	WS, WR	A
DRAIN	DR	A, T
DRINKING WATER	DW	W, B4, C1
FILTRATE EFFLUENT	FI	A
FLOCCULANT	FL	A
FLUSH WATER	FW	T
FORCE MAIN	FM	M
GROUND WATER	GW	A, B, B4, M
INSTRUMENT AIR	IA	T
MELTER OFF-GAS	OG	T
NITRIC ACID	AN	T1
PERCHED GND WATER	PGW	B
PHOSPHORIC ACID	PAPH	T1
PLANT AIR	PA	W
POLISHED WATER	PW	A
PROCESS WATER	TW, TWX1	A, B4
PROCESS WASTEWATER	CE	A
RAW WATER	RW	A
RECYCLE WATER	RC	T, B2
SCRUBBER RECYCLE	RSL	T
SLURRY	SL	T
SODIUM CARBONATE	SC	A
SODIUM HYDROXIDE	NA	T
SODIUM SILICATE	SS	A
STORM WATER	ST	A, A7, B4
SULFURIC ACID	SB	T1
SUMP DISCHARGE	SU	T
THICKENER OVERFLOW	TO	T
VACUUM	V	A
VENTILATION AIR	VE	T, A
WASTE WATER	WW	T, B4

MATL. CODE	DESCRIPTION
A	A53 SEAMLESS CARBON STEEL
A7	CORRUGATED METAL PIPE
B	PVC
B1	PVDF
B2	PVDF, 100PSI
B3	CPVC
B4	HDPE
B5	CORRUGATED HDPE
C1	CLASS 150, COPPER TUBING
L	FIBERGLASS REINFORCED PLASTIC
M	DUCTILE IRON
T	304L, STAINLESS STEEL
T1	316L, STAINLESS STEEL
W	A53, GR. A, GALVANIZED STEEL
INSUL. CODE	DESCRIPTION
ET	ELECTRIC TRACED AND INSULATED
IC	ANTI-CONDENSATION INSULATION
ST	STEAM TRACED AND INSULATED

INSTRUMENT ACTUATOR LABELS

- BALL FLOAT
- CAPACITY SENSOR
- DIAPHRAGM
- DISPLACING FLOAT
- DUAL ACTION PISTON
- DUAL SOLENOID
- MANUAL
- MOTOR
- PILOT
- SINGLE ACTION PISTON
- SINGLE SOLENOID
- SINGLE SOLENOID WITH RESET

INSTRUMENT DEVICE TAG TYPES

- XX 000 IN-LINE TAG WITH LEADER LINE
- XX 000 LOCAL MOUNTED DEVICE
- XX 000 FRONT OF PANEL MOUNTED DEVICE
- XX 000 FRONT OF PANEL MOUNTED DEVICE AUXILLARY LOCATION
- XX 000 REAR OF PANEL MOUNTED DEVICE
- XX 000 REAR OF PANEL MOUNTED DEVICE AUXILLARY LOCATION
- XX 000 SHARED DISPLAY COMPUTER CONTROL AND OPERATOR INTERFACE

EXAMPLE OF TAG CALLOUTS

FCV 123A

- INSTRUMENT TAG TYPE
- LETTERS OF INSTRUMENT IDENT.
- LOOP NUMBER SUFFIX
- LOOP NUMBER
- SPECIAL DESIGNATION

MISC. INSTRUMENTATION SYMBOLS

- INTERLOCK
- DIAPHRAGM SEAL
- IA INSTRUMENT AIR SUPPLY

INSTRUMENT IN-LINE DEVICES

- AVERAGING PITOT
- FLOW NOZZLE
- FLUME
- MAGNETIC FLOW METER
- ORIFICE PLATE
- POSITIVE DISPLACEMENT
- PROPELLER
- STRAIGHTING VANE
- SILENCER
- THERMOWELL
- TRAP
- ULTRASONIC FLOW METER
- FI 000 VARIABLE AREA FLOW METER
- VENTURI
- VORTEX SHEDDING FLOW METER
- WEIR

INSTRUMENT SIGNAL LINES

- CONNECT TO PROCESS
- MECHANICAL LINK
- ELECTRIC BINARY
- PNEUMATIC BINARY
- GUIDED ELECTROMAG OR SONIC
- SOFTWARE/DATA LINK
- CAPILLARY
- ELECTRIC
- PNEUMATIC
- HYDRAULIC
- UNGUIDED ELECTROMAG OR SONIC
- UNDEFINED

INSTRUMENT SPECIAL DESIGNATIONS

DESIGNATION	FUNCTION / ABBREVATION
C	CLOSED
DIF	DIFFERENTIAL
EX	EXISTING INSTRUMENTATION
H	HIGH
HH	HIGH HIGH
HL	HIGH LOW
HOA	HAND-OFF-AUTO
IA	IN-AUTO
I/I	CURRENT TO CURRENT
I/O	INPUT/OUTPUT
I/P	CURRENT TO PNEUMATIC TREANSDUCER
L	LOW
LL	LOW LOW
LOR	LOCAL-OFF-REMOTE
O	OPEN
OA	ON-OFF
OCA	OPEN-CLOSED-AUTO
R	RUNNING
Y	UNDETERMINED COMPUTING RELAY

LETTERS OF INSTRUMENT IDENTIFICATION

LETTER	1ST LETTER	2ND LETTER	3RD OR 4TH LETTER
	MEASURED OR INITIATING VARIABLE	MODIFIER	READ OUT OR PASSIVE FUNCTION
A	ANALYSIS	ALARM	ALARM
B	BURNER FLAME	----	----
C	CAMERA	CONTROLLER	CLOSED
D	DENSITY	DIFFERENTIAL	----
E	VOLTAGE	ELEMENT	ELEMENT
F	FLOW RATE	RATIO (FRACTION)	----
G	GAGING (DIM)	VIEWING DEVICE	GLASS
H	HAND (MANUAL)	----	----
I	CURRENT (ELEC)	INDICATE	INDICATE
J	POWER	SCAN	----
K	TIME	----	----
L	LEVEL	LIGHT	LOW
M	MOIST. OR HUMIDITY	----	----
N	----	----	----
O	OBSERVATION	ORIFICE	OPEN
P	PRESSURE OR VACUUM	----	POINT (TEST)
Q	QUANTITY OR EVENT	TOTALIZER	----
R	RESTRICTIVE	RECORDER	RECORDER
S	SPEED OR FREQUENCY	SAFETY/SWITCH	SWITCH
T	TEMPERATURE	TRANSMITTER	TRANSMITTER
U	USER'S GUIDE	----	MULTIFUNCTION
V	VISCOSITY	----	VENT, VALVE
W	WEIGHT OR FORCE	WELL	----
X	UNCLASSIFIED	---	UNCLASSIFIED
Y	RELAY	RELAY	----
Z	POSITION	----	----

FUNCTION LABELS

SYMBOLS	DESCRIPTION
Σ/n	AVERAGING
−	BIAS MINUS
+	BIAS PLUS
±	BIAS PLUS/MINUS
d/dt	DERIVATIVE
÷	DIVIDING
∫	INTERGAL
×	MULTIPLYING
K	PROPORTIONAL
x^n	RAISE TO POWER
RA	REVERSE ACTION
$\sqrt{x}$	ROOT EXTRACT
Σ	SUMMING

STATE OF OHIO — OSCAR W. CARLSON, JR. — 60390 — REGISTERED PROFESSIONAL ENGINEER

5-19-97

NOTES

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A/E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
MECHANICAL PROCESS
PIPING AND INSTRUMENTATION DIAGRAM
SYMBOLS AND LEGEND

650

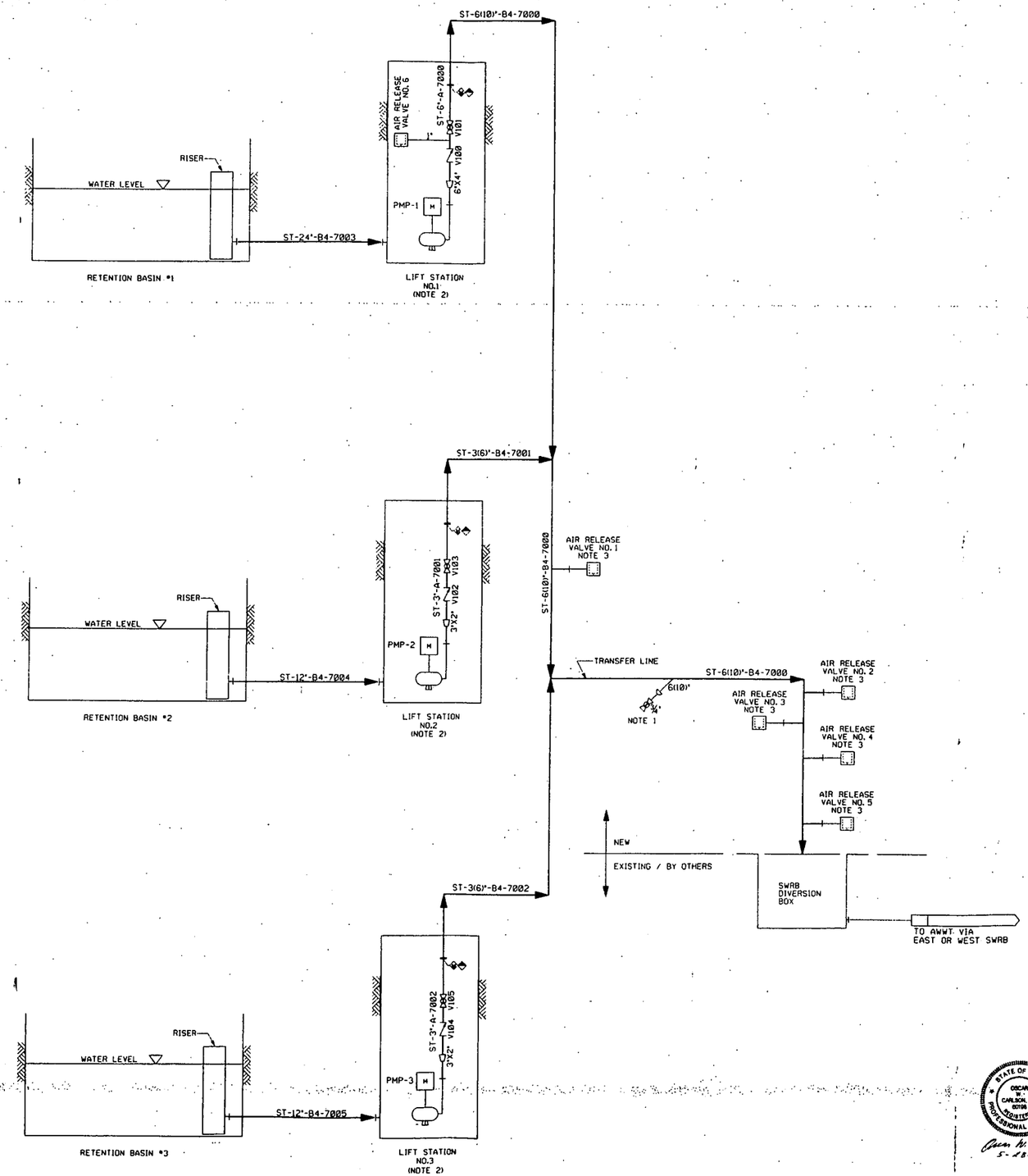
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
L. N. HAGAMAN	12/01/96	R. L. Parham	5/19/97	K. D. MORRIS	03/25/96

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	

SUBMITTED FOR APPROVAL	FERMCO CRU APPROVAL	FERMCO PROJECT NO.
DATE 6/13/97	N/A DATE	20400

DOE PROJECT NO.	FLMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-N-00295	N0001	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
SCEP/P0165



NOTES

1. TYPICAL DETAIL FOR CLEANOUT. THERE ARE 4 CLEANOUTS IN THE UNDERGROUND LINE TO SWRB. SEE CIVIL SHEET NO. G0020. VALVES V106-V109 ARE IN THE CLEANOUTS.
2. REFER TO SHEET NO: E0007 FOR LIFT STATION AUTOMATIC LEVEL CONTROLS.
3. SEE CIVIL SHEET NO. G0020 FOR DETAILS.

LAST VALVE No.	V109

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-N-00295	SYMBOLS AND LEGEND	N0001
92X-5900-E-00380	ELECTRICAL - ELEMENTARY DIAGRAMS	E0007
92X-5900-G-00309	CIVIL - MISCELLANEOUS DETAILS	G0020

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

RATIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
MECHANICAL PROCESS 650
PIPING AND INSTRUMENTATION DIAGRAM
WASTEWATER COLLECTION AND TRANSFER

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
P. A. WILSON	03/04/96	R.K. Carlson	5/28/97	K. D. MORRIS	03/25/96

PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS

SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL: N/A | FERNCO PROJECT NO.: 20400

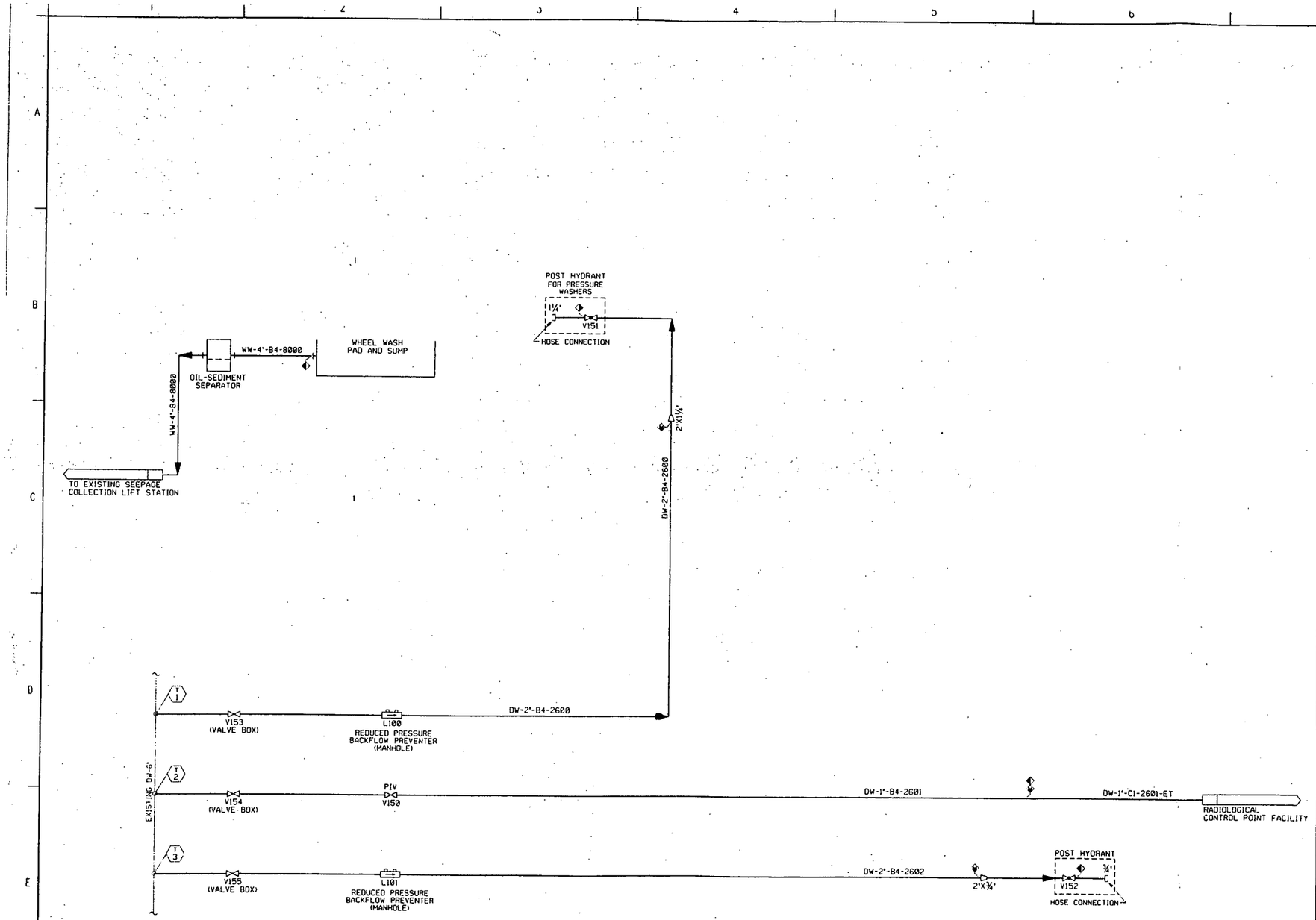
DATE 6/13/97

DOE PROJECT NO.	FLOW PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-N-00290	N0002	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

STATE OF OHIO — OSCAR W. CARLSON, JR. — REGISTERED PROFESSIONAL ENGINEER

Oscar W. Carlson, Jr. 5-28-97



NOTES

LAST VALVE No.	V155

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-N-00295	SYMBOLS AND LEGEND	N0001

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
MECHANICAL PROCESS
PIPING AND INSTRUMENTATION DIAGRAM
DRINKING WATER SYSTEM

652

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
P. A. WILSON	03/01/96	Rob Carlson	5/19/97	K. G. MORRIS	03/25/96
PLANT/BLDG. NO.		FLOOR		SCALE: NONE	CLASS
SUBMITTED FOR APPROVAL: DATE 6/13/97		FERMCO CRU APPROVAL: N/A		FERMCO PROJECT NO.: 20400	

STATE OF OHIO OSCAR G. CARLSON JR. 60194 REGISTERED PROFESSIONAL ENGINEER
5-19-97

DOE PROJECT NO.	FERMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-N-00291	N0003	0

SINGLE LINE DIAGRAM SYMBOLS

ARRESTER	YY-XXXX	'YY' INDICATES SPECIAL IDENTIFIER 'XXXX' INDICATES ID NO.
CIRCUIT BREAKER, LOW VOLTAGE	FFFF TTTT	'FFFF' INDICATES FRAME RATING AMPS (SHOWN ON SWITCHGEAR ONLY) 'TTTT' INDICATES TRIP RATING AMPS
FUSED SWITCH	FFFF	'FFFF' INDICATES FUSE SIZE
CURRENT TRANSFORMER	YY ZZZZ	'YY' INDICATES NO. OF CT(S) 'ZZZZ' INDICATES CT RATIO(S)
DISCONNECT SWITCH	FFFF	'FFFF' INDICATES FRAME RATING AMPS
FUSED DISCONNECT SWITCH	FFFF TTTT	'FFFF' INDICATES FRAME RATING AMPS 'TTTT' INDICATES TRIP RATING AMPS
FUSE	XXXX YY TTTT	'XXXX' INDICATES ID NO. 'YY' INDICATES SPECIAL IDENTIFIER 'TTTT' INDICATES TRIP RATING AMPS
LOAD, NON-MOTOR	ZZZ ZZZ	'ZZZ' INDICATES EQUIPMENT SIZE IN KVA OR KW
MOTOR	ZZZ HP	'ZZZ' INDICATES HORSEPOWER SIZE
MOTOR OVERLOAD RELAY		
MOTOR STARTER CONTACT	ZZ	'ZZ' INDICATES NEMA SIZE
SYMBOL, 3 PHASE DELTA		
SYMBOL, 3 PHASE WYE GROUNDED		
WELDING/POWER RECEPTACLE		
TRANSFORMER	XXXX ZZZZ	'XXXX' INDICATES ID NO. 'ZZZZ' INDICATES TRANSFORMER RATINGS - KVA, 1 OR 3 PHASE, VOLTAGE RATIO, IMPEDANCE
LIGHT		DESCRIPTION INDICATES WATTS AND VOLTAGE

PLOT PLAN SYMBOLS

480V POWER LINE (EXISTING)	
480V POWER LINE (NEW)	
13.2 kV POWER LINE	
EXISTING POWER POLE	
NEW POWER POLE	
GUY WIRE	
DUCT BANK	

ABBREVIATIONS

ACSR	ALUMINUM CONDUCTOR STEEL REINFORCED
MESS.	MESSENGER

ELEMENTARY DIAGRAM SYMBOLS

CIRCUIT BREAKER	TTTT	'TTTT' INDICATES TRIP RATING AMPS
CONTACT	YY-XXXX	NORMALLY OPEN, CLOSES WHEN COIL IS ENERGIZED. 'XXXX' INDICATES ID NO., 'YY' INDICATES SPECIAL IDENTIFIER
CONTACT	YY-XXXX	NORMALLY CLOSED, OPENS WHEN COIL IS ENERGIZED. 'XXXX' INDICATES ID NO., 'YY' INDICATES SPECIAL IDENTIFIER
CONTROL POWER XFMR	H1 480V H2 CPT X1 120V X2	
DISCONNECT SWITCH	FFFF	'FFFF' INDICATES FRAME RATING AMPS
FUSE	XXXX TTTT Y	'XXXX' INDICATES ID NO., 'TTTT' INDICATES TRIP RATING AMPS 'Y' INDICATES SPECIAL IDENTIFIER
GROUND		
MOTOR, 3 PHASE	T1 T2 T3 ZZZ HP	'ZZZ' INDICATES HP SIZE
OVERLOAD ELEMENT	OL	
PILOT LIGHT	XXXX YY	'XXXX' INDICATES ID NO., 'YY' INDICATES SPECIAL IDENTIFIER
RELAY	XXXX YY	'XXXX' INDICATES ID NO., 'YY' INDICATES SPECIAL IDENTIFIER
OVERLOAD CONTACT	OL	NORMALLY CLOSED, OPENS WHEN OVERLOAD RELAY(S) TRIP

WIRING BY SUBCONTRACTOR

WIRING BY CONSTRUCTION

SPECIAL IDENTIFIERS

FC	FUSED CUTOUT
LB	LOAD BREAK
M	MOTOR RELAY
R	RED LIGHT

SWITCHES

SELECTOR SWITCH (GENERAL)	XXXX YY ZZ (X0) (0X)	'XXXX' INDICATES ID NO. 'YY' INDICATES NAME OF CURRENT SWITCH POSITION, 'ZZ' INDICATES NAME OF OTHER SWITCH POSITION(S) 'X' INDICATES CLOSED CIRCUIT POSITION '0' INDICATES OPEN CIRCUIT POSITION (CONTACTS DIAGRAMMATICALLY SHOWN CLOSED)
TEMPERATURE SWITCH		NORMALLY CLOSED, OPENS ABOVE SET TEMPERATURE

NOTES

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00404	SINGLE LINE DIAGRAM WEST SIDE 13.2 kV FEEDERS	E0002
92X-5900-E-00377	SINGLE LINE DIAGRAMS/ ELEVATION LIFT STATION NO. 1, 2 & 3	E0003
92X-5900-E-00378	SINGLE LINE DIAGRAMS/ELEVATION WHEEL WASH FACILITY AND SUPPORT AREA	E0004
92X-5900-E-00379	ELEMENTARY DIAGRAMS	E0005
92X-5900-E-00380	OVERALL SITE POWER PLAN	E0007

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JWW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL SYMBOLS AND LEGEND

653

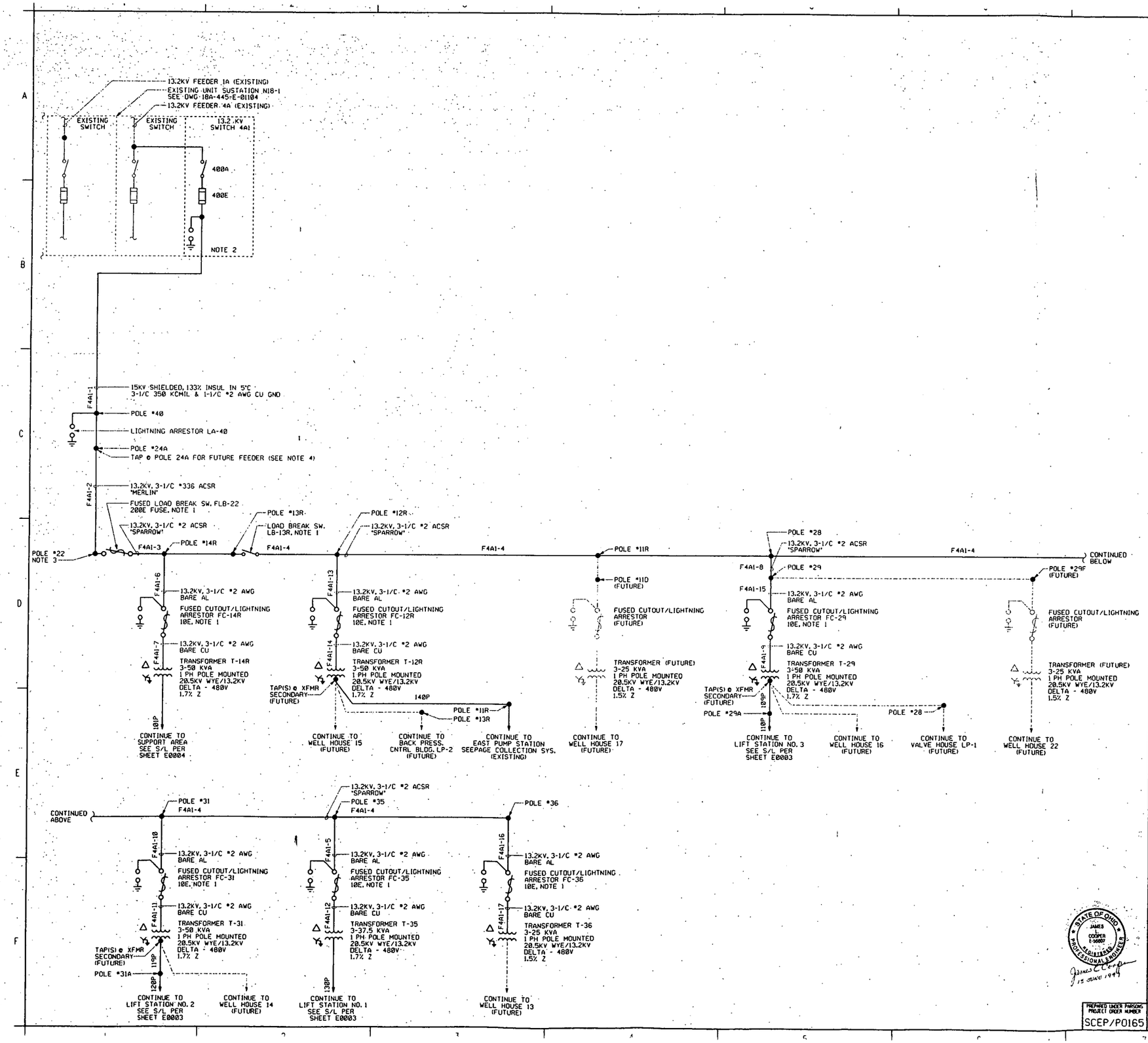
STATE OF OHIO — JAMES L. COOPER E-06807 — REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	01-15-97	James L. Cooper	10 June 97	J.L. COOPER	01-28-97
PLANT/BLDG. NO.		FLOOR		SCALE: NONE	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL: NA		FERNCO PROJECT NO: 20400	

DATE 6/13/97

DOE PROJECT NO.	FERNCO PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00405	E0001	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165



NOTES

1. ALL SWITCHES AND CUTOUTS ARE 13.2KV, 110KVBIL, 200A, 12KA SYMMETRICAL INTERRUPTING, UNLESS NOTED.
2. PRIMARY SWITCH AND CONNECTION KIT TO EXISTING SUBSTATION N18-1, AS SPECIFIED. CABLE AND BUS CONNECTIONS SHALL BE OF SUFFICIENT LENGTH TO ALLOW RECONNECTION IN THE FUTURE TO REVERSE LINE AND LOAD SIDE OF SWITCH. I.E. CABLE CONNECTION WILL BE TO LOAD SIDE: DOUBLE LUG FEEDERS WITH EXISTING LINE SIDE INCOMMING FEEDERS TO SUBSTATION N18-1 PRIMARY BUS.
3. INTERMEDIATE POLES PROVIDING SUPPORT ONLY OF OVERHEAD CONDUCTORS HAVE BEEN OMITTED FOR CLARITY.
4. FOR SOUTH PLUME INJECTION WATER SUPPLY. FOR SINGLE LINE SEE DWG #95X-5900-E-00455.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00377	SINGLE LINE DIAGRAMS / ELEVATIONS - LIFT STATION NO. 1, 2 & 3	E0003
92X-5900-E-00378	SINGLE LINE DIAGRAMS / ELEVATIONS - WHEEL WASH FACILITY & SUPPORT AREA	E0004
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-E-00406	CABLE AND CONDUIT SCHEDULES	E0008
92X-5900-E-00382	DETAILS - SHEET 1	E0009
92X-5900-E-00407	DETAILS - SHEET 2	E0010
92X-5900-E-00408	DETAILS - SHEET 3	E0011
92X-5900-E-00409	DETAILS - SHEET 4	E0012
92X-5900-E-00376	DETAILS - SHEET 5	E0013
18A-4445-E-01104	SWRB VALVE HOUSE SINGLE LINE	

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL
SINGLE LINE DIAGRAM
WEST SIDE 13.2 KV FEEDERS

654

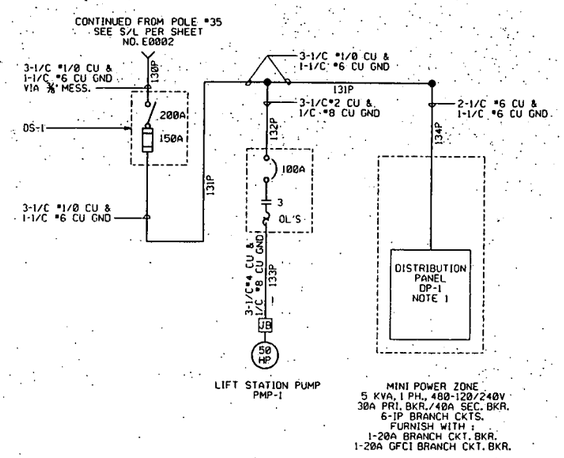
STATE OF OHIO — JAMES L. COOPER E-56087 — REGISTERED PROFESSIONAL ENGINEER — 13 JUNE 1997

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	01/03/97	James L. Cooper	June 97	JL. COOPER	01-28-97

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	

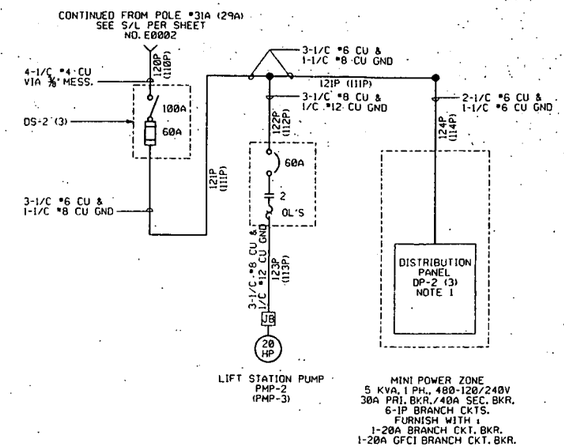
SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	FERNCO PROJECT NO
6/13/97	N/A	20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FERNP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00404	E0002	0



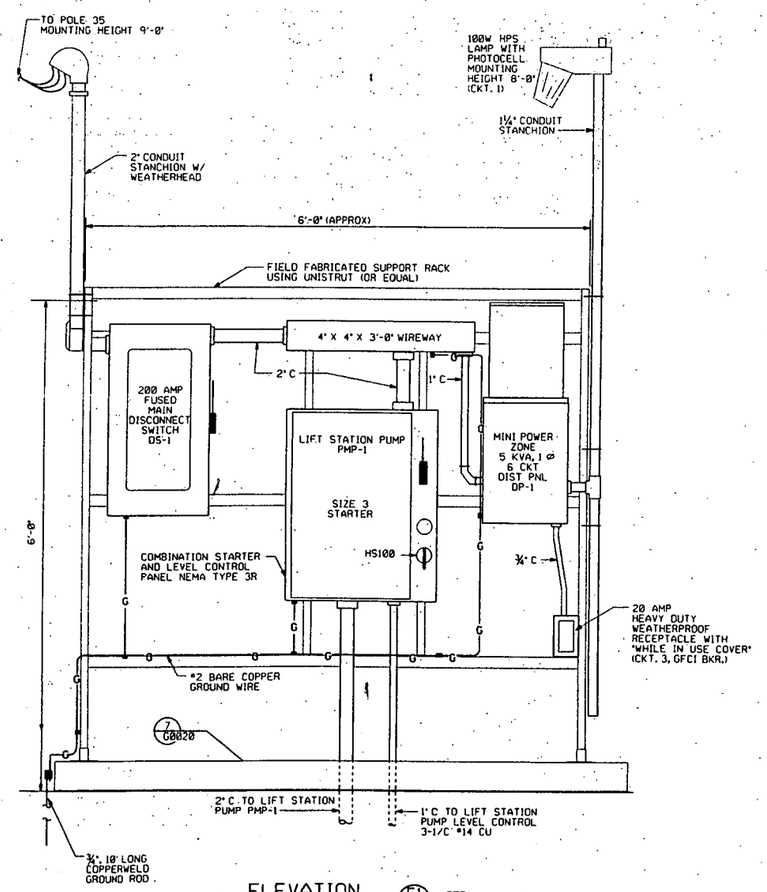
SINGLE LINE DIAGRAM

LIFT STATION NO. 1



SINGLE LINE DIAGRAM

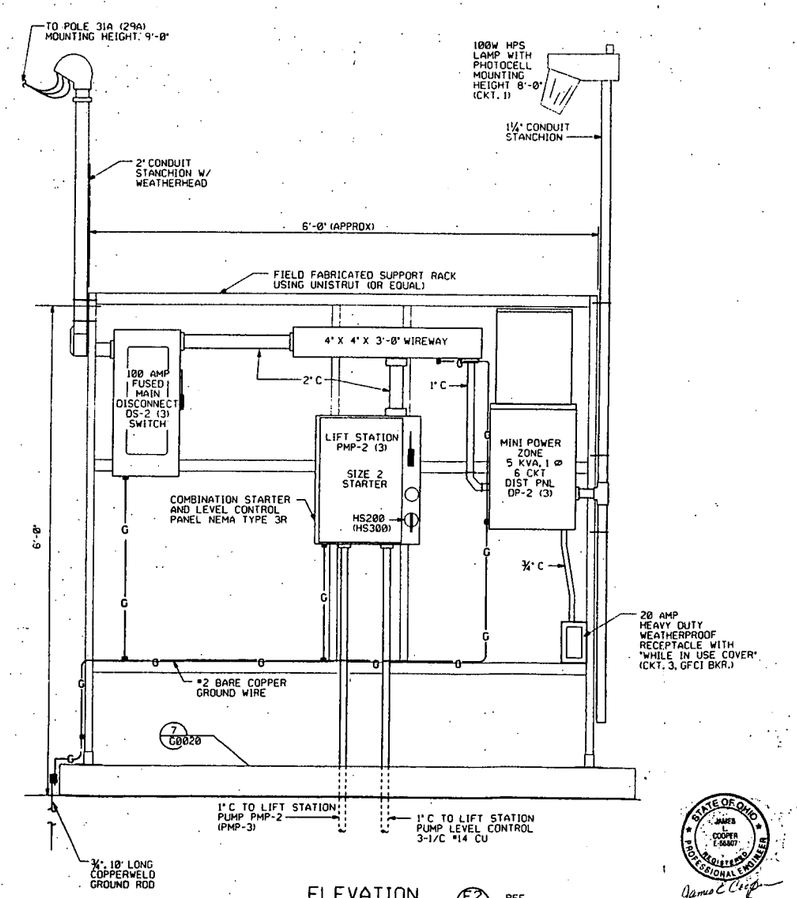
LIFT STATION NO. 2 (AND NO. 3)
(TYP.)



ELEVATION

SERVICE PANEL RACK @ LIFT STATION NO. 1
NTS

E1 E0003 REF E0005



ELEVATION

SERVICE PANEL RACK @ LIFT STATION NO. 2
(AND NO. 3)
NTS

E2 E0003 REF E0005

STATE OF OHIO
JAMES C. COOPER
E-56007
REGISTERED
PROFESSIONAL ENGINEER
James C. Cooper
15 JUNE 1997

NOTES

1. SEE SHEET NO. E0006 FOR PANEL SCHEDULES.
2. SEE SHEET NO. E0007 FOR ELEMENTARY DIAGRAMS.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00405	SYMBOLS AND LEGEND	E0001
92X-5900-E-00404	SINGLE LINE DIAGRAM - WEST SIDE 13.2 KV FEEDERS	E0002
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-E-00381	PANEL SCHEDULES	E0006
92X-5900-E-00380	ELEMENTARY DIAGRAMS	E0007
92X-5900-G-00368	CIVIL - MISCELLANEOUS DETAILS	G0020

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL
SINGLE LINE DIAGRAMS / ELEVATIONS
LIFT STATION NO. 1, 2, AND 3

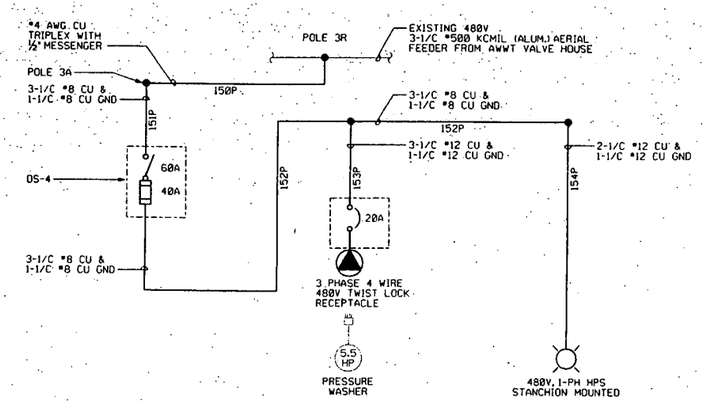
655

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	11/16/96	James C. Cooper	15 JUNE 97	J. L. COOPER	11/26/96

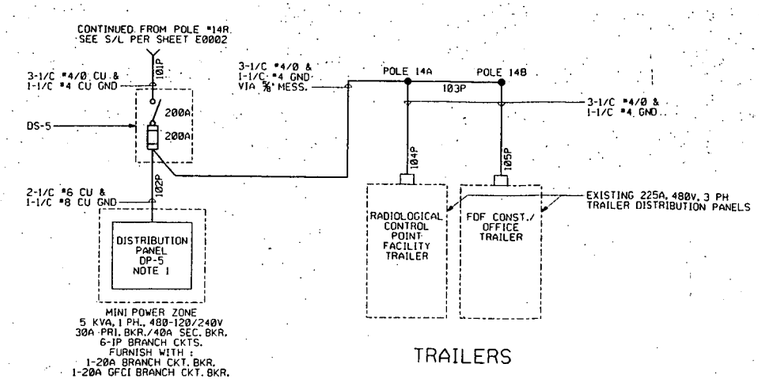
PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	FERNCO PROJECT NO.
A-E JMW DATE 6/13/97	N/A	20400

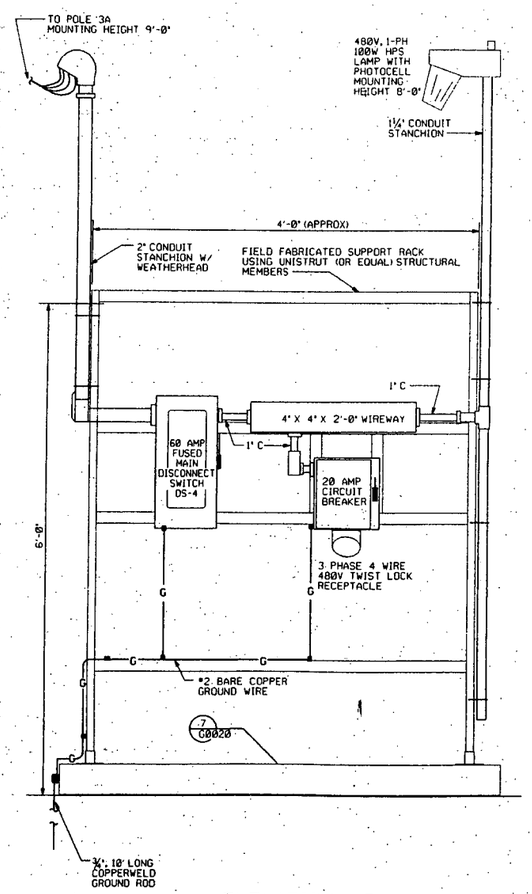
DOE PROJECT NO.	TEMP PROJECT NO.	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165	WBS 1.1.1.1.2.3.6 00-90701		92X-5900-E-00377	E0003	0



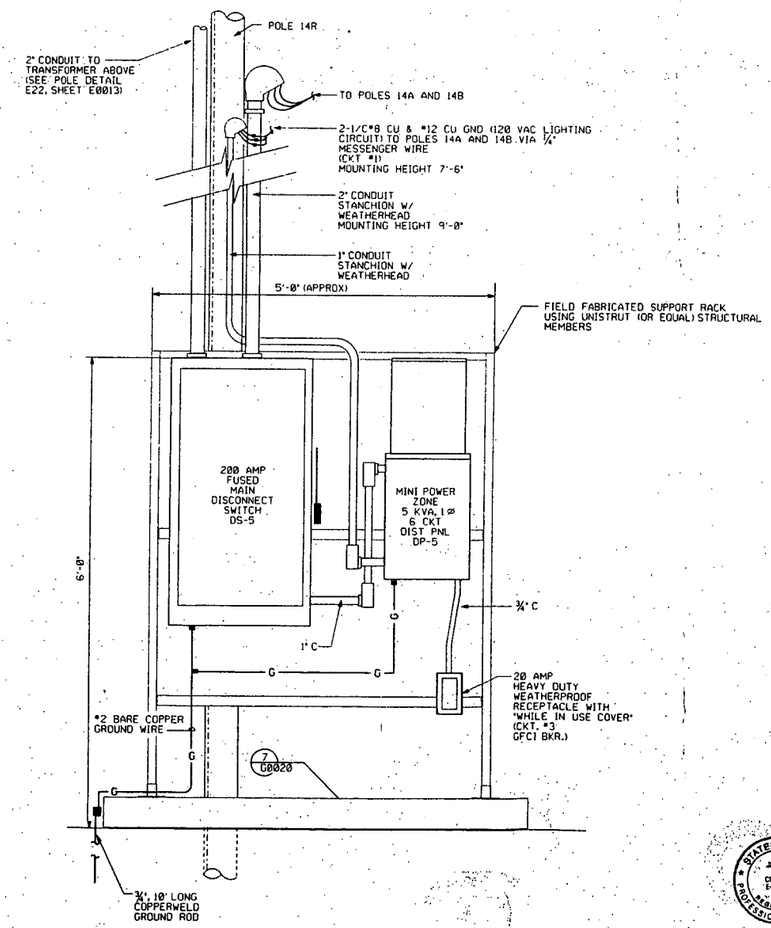
SINGLE LINE DIAGRAM
WHEEL WASH FACILITY



SINGLE LINE DIAGRAM
SUPPORT AREA



ELEVATION E3 (E0004) REF E0005
SERVICE PANEL RACK @ WHEEL WASH FACILITY
NTS



ELEVATION E4 (E0004) REF E0005
DISCONNECT SWITCH @ SUPPORT AREA TRAILERS
NTS

NOTES

1. SEE SHEET NO. E0006 FOR PANEL SCHEDULES.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00404	SINGLE LINE DIAGRAM - WEST SIDE 13.2 KV FEEDERS	E0002
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-E-00381	PANEL SCHEDULES	E0006
92X-5900-E-00406	CABLE AND CONDUIT SCHEDULES	E0008
92X-5900-E-00376	DETAILS - SHEET 5	E0013
92X-5900-G-00368	CIVIL - MISCELLANEOUS DETAILS	G0020

FOR INFORMATION ONLY

REV. NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	A.E.	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JWM	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL
SINGLE LINE DIAGRAMS / ELEVATIONS
WHEEL WASH FACILITY AND SUPPORT AREA

656

STATE OF OHIO — JAMES L. COOPER E-68007 — REGISTERED PROFESSIONAL ENGINEER
13 JUNE 1997

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	11/17/96	James L. Cooper	6/13/97	J. L. COOPER	11/26/96
PLANT/BLDG. NO.		FLOOR		SCALE: NONE	CLASS
SUBMITTED FOR APPROVAL		FERMCO CRU APPROVAL: N/A		FERMCO PROJECT NO: 20400	

DATE 6/13/97

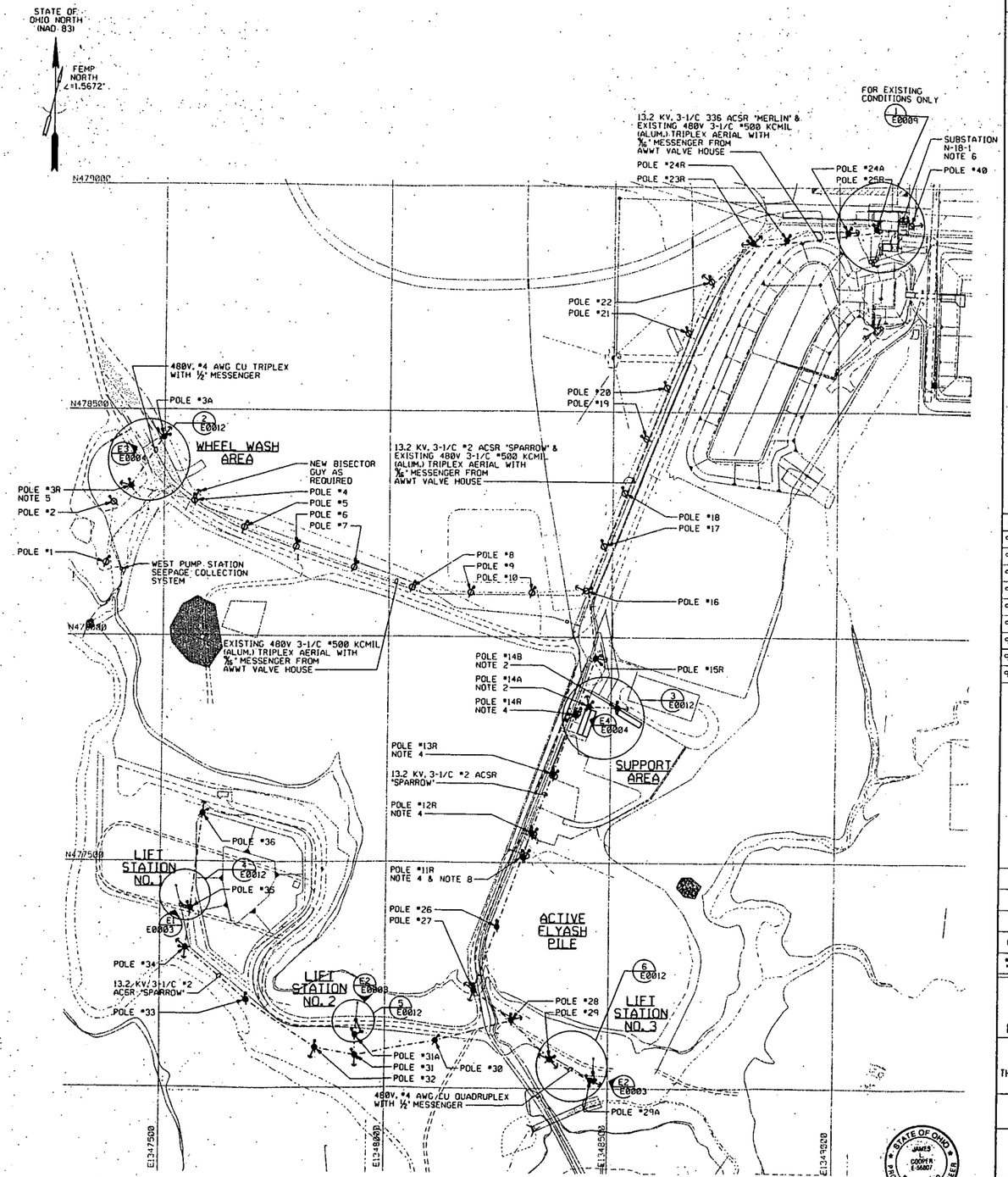
PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO	TEMP PROJECT NO	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701		92X-5900-E-00378	E0004	0

POWER POLE COORDINATES (NAD83)

POLE NO.	POLE HEIGHT	POLE STATUS	NORTH COORDINATES	EAST COORDINATES	ELEVATION NO.	SHEET NO.	GUYING LOCATIONS: STATIC LINE	13.2KV LINE	480V LINE	GUYING TYPE: BISSECTOR	DEADEND
1	45'	E	478,160.24	1,347,371.41	NOT IN CONTRACT						
2	45'	E	478,294.09	1,347,387.58	NOT IN CONTRACT						
3R	45'	RL	478,330.48	1,347,425.67	E21	E0013			X		X
3A	35'	N	478,438.16	1,347,498.61	E20	E0011			X		X
4	45'	E	478,298.08	1,347,567.58	NOT IN CONTRACT				X	X	
5	45'	E	478,240.08	1,347,679.57	NOT IN CONTRACT						
6	45'	E	478,198.08	1,347,794.57	NOT IN CONTRACT						
7	45'	E	478,153.08	1,347,922.58	NOT IN CONTRACT						
8	45'	E	478,109.08	1,348,053.57	NOT IN CONTRACT						
9	45'	E	478,098.07	1,348,185.57	NOT IN CONTRACT						
10	45'	E	478,098.07	1,348,322.57	NOT IN CONTRACT						
11R	55'	RL	477,513.27	1,348,307.75	E15	E0010			X		X
12R	55'	RL	477,566.91	1,348,327.04	E12	E0010			X		X
13R	55'	RL	477,696.77	1,348,373.73	E19	E0011					
14R	55'	RL	477,828.51	1,348,421.10	E22	E0013					
14A	35'	N	477,847.00	1,348,452.00	E23	E0013			X		X
14B	35'	N	477,844.00	1,348,514.00	E24	E0013			X		X
15R	55'	RL	477,953.30	1,348,465.96	E16	E0010	X	X		X	
16	45'	E	478,103.23	1,348,442.58	E8	E0009	X	X		X	
17	45'	E	478,202.15	1,348,481.80	E9	E0010					
18	45'	E	478,320.07	1,348,526.57	E9	E0010					
19	45'	E	478,440.76	1,348,575.23	E9	E0010					
20	45'	E	478,554.58	1,348,619.46	E9	E0010					
21	45'	E	478,676.29	1,348,667.11	E9	E0010					
22	45'	E	478,790.45	1,348,717.53	E25	E0013	X	X	X	X	
23R	60'	RP	478,876.07	1,348,809.57	E10	E0010	X	X	X		XX
24R	60'	RP	478,883.62	1,348,885.04	E28	E0013					
24A	60'	RP*	478,899.45	1,349,019.31	E28	E0013			X		X
25R	60'	RP	478,906.86	1,349,087.86	E11	E0010					
26	55'	N	477,358.00	1,348,251.92	E13	E0010					
27	55'	N	477,216.84	1,348,201.18	E26	E0013	X	X			XX
28	55'	N	477,151.13	1,348,285.74	E14	E0010	X	X			X
29	55'	N	477,065.25	1,348,372.33	E17	E0010	X	X	X		X
29A	35'	N	477,018.92	1,348,463.00	E20	E0011			X		X
30	55'	N	477,105.00	1,348,116.00	E13	E0010					
31	55'	N	477,072.00	1,347,934.00	E7	E0009	X	X	X	X	
31A	35'	N	477,117.00	1,347,934.00	E20	E0011					
32	55'	N	477,089.00	1,347,845.00	E16	E0010	X	X		X	
33	55'	N	477,195.00	1,347,693.00	E13	E0010					
34	55'	N	477,309.00	1,347,557.00	E16	E0010	X	X			XX
35	55'	N	477,397.00	1,347,568.00	E27	E0013					
36	55'	N	477,607.00	1,347,593.00	E17	E0010	X	X			X
40	60'	E	478,917.25	1,349,163.82	E18	E0011	X	X			X

'POLE STATUS' CODES

E = EXISTING POLE
N = NEW POLE IN NEW LOCATION, ASSIGNED POLE NUMBER
RL = NEW POLE/NEW LOCATION ASSIGNED EXISTING POLE NUMBER + 'R', OLD POLE REMOVED AFTER INSTALLATION OF NEW POLE
RP = NEW POLE REPLACING EXISTING POLE AT SAME LOCATION, ASSIGNED EXISTING POLE NUMBER + 'R'
RP* = NEW POLE REPLACING EXISTING POLE AT SAME LOCATION, ASSIGNED POLE NUMBER (EXISTING POLE NUMBER UNKNOWN)



NOTES

1. SLACK SPAN AERIAL CABLE FROM POLE TO SERVICE PANEL RACK.
2. INSTALL A 120VAC, 250 WATT HPS FLOODLIGHT WITH PHOTOCELL ON POLES 14A AND 14B. CONNECT TO DP-5, CKT. 1.
3. FOR POLE DETAILS, SEE SHEET E0009, E0010, E0011, E0012, & E0013.
4. EXISTING 45' POLES TO BE REMOVED AFTER NEW 13.2 kV POLE LINE IS CONSTRUCTED. NEW 55' CLASS II POLES WILL BE REASSIGNED SAME POLE NUMBER WITH 'R', IE, POLE 15 WILL BE REMOVED AND REPLACED BY POLE 15R.
5. PROVIDE NEW DEADEND GUY AS REQUIRED FOR NEW POLE 3R PLACEMENT.
6. SEE SHEET E0012 FOR CONNECTIONS TO EXISTING SUBSTATION N18-1 SWITCHES 4A1.
7. FOR MODIFICATION OF EXISTING POLE CONDUCTORS, SEE DETAIL 1 ON SHEET E0009.
8. DISCONNECT AND REMOVE EXISTING 480V TRIPLEX SERVICE FROM POLE #11 BACK TO POLE #16. MAINTAIN EXISTING 480V SERVICE TO WEST SEEPAGE COLLECTION PUMP (POLES 1-10 & 16-25).
9. MINIMUM CLEARANCES ; PHASE TO PHASE = 20", PHASE TO GROUND = 16'. 480V CONDUCTORS OVER ROADS = 23'. ALL CONDUCTORS OVER BUILDINGS = 8'. OTHERS CLEARANCES ON OVERHEAD SERVICE IN ACCORDANCE WITH ANSI C2, NATIONAL ELECTRICAL SAFETY CODE.
10. 13.2KV, 3-1/C #336 KCMIL ACSR "MERLIN" AND EXISTING 480V, 3-1/C #500 KCMIL(ALUM) TRIPLEX AERIAL WITH 7/8" MESSENGER FROM AWWT VALVE HOUSE, BETWEEN POLE #23R TO POLE #40.
11. SITE PHASING SHALL BE AS FOLLOWS:

NORTH/SOUTH POLE LINES
EAST WIRE - PHASE A
CENTER WIRE - PHASE B
WEST WIRE - PHASE C

EAST/WEST POLE LINES
NORTH WIRE - PHASE A
CENTER WIRE - PHASE B
SOUTH WIRE - PHASE C

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00405	SYMBOLS AND LEGEND	E0001
92X-5900-E-00377	SINGLE LINE DIAGRAM LIFT PUMP STATION NO. 1, 2, & 3	E0003
92X-5900-E-00378	SINGLE LINE DIAGRAM WHEEL WASH FACILITY & SUPPORT AREA	E0004
92X-5900-E-00382	DETAILS - SHEET 1	E0009
92X-5900-E-00407	DETAILS - SHEET 2	E0010
92X-5900-E-00408	DETAILS - SHEET 3	E0011
92X-5900-E-00409	DETAILS - SHEET 4	E0012
92X-5900-E-00376	DETAILS - SHEET 5	E0013

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A/E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL
OVERALL SITE POWER PLAN

657

STATE OF OHIO JAMES L. COOPER E-56807 REGISTERED PROFESSIONAL ENGINEER
James L. Cooper 13 June 1997

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	01/24/97	James L. Cooper	13-JUN-97	J. L. COOPER	01/28/97

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1" = 100'-0"	

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	FERNCO PROJECT NO
A.E. DATE 6/13/97	N/A	20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	CODE PROJECT NO.	FEMP PROJECT NO.	DATE	DRAWING INDEX CODE NO	SHEET NO.	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701		92X-5900-E-00379	E0005	0

PANEL DP-1

VOLTAGE : 120/240V
MAIN BKR : 40A
MOUNTING : RACK MOUNTED MINI POWER ZONE

REMARKS : 1. * INDICATES 6MA GFCI CLASS A, ** INDICATES 30MA GFCI CLASS B
LOCATION : LIFT STATION NO. 1. SEE SHEET NO. E0003 AND E0005

DIRECTORY	WATTS LOAD L1	WATTS LOAD L2	CKT NO	WIRE SIZE	BKR AMPS		BKR AMPS	WIRE SIZE	CKT NO	WATTS LOAD L1	WATTS LOAD L2	DIRECTORY
100 WATT HPS FLOODLIGHT	100		1	12	20	L1 L2 40 A MAIN	--	N/A	2	---		SPACE
RECEPTACLE		180	3	12	20		--	N/A	4		---	SPACE
SPACE	---		5	N/A	--		--	N/A	6	---		SPACE
SUB-TOTALS	100	180	NEUTRAL BUS							0	0	SUB-TOTALS
	L1	L2								L1	L2	

TOTAL WATTS L1 : 100 TOTAL WATTS L2 : 180 TOTAL WATTS : 280

PANEL DP-2

VOLTAGE : 120/240V
MAIN BKR : 40A
MOUNTING : RACK MOUNTED MINI POWER ZONE

REMARKS : 1. * INDICATES 6MA GFCI CLASS A, ** INDICATES 30MA GFCI CLASS B
LOCATION : LIFT STATION NO. 2. SEE SHEET NO. E0003 AND E0005

DIRECTORY	WATTS LOAD L1	WATTS LOAD L2	CKT NO	WIRE SIZE	BKR AMPS		BKR AMPS	WIRE SIZE	CKT NO	WATTS LOAD L1	WATTS LOAD L2	DIRECTORY
100 WATT HPS FLOODLIGHT	100		1	12	20	L1 L2 40 A MAIN	--	N/A	2	---		SPACE
RECEPTACLE		180	3	12	20		--	N/A	4		---	SPACE
SPACE	---		5	N/A	--		--	N/A	6	---		SPACE
SUB-TOTALS	100	180	NEUTRAL BUS							0	0	SUB-TOTALS
	L1	L2								L1	L2	

TOTAL WATTS L1 : 100 TOTAL WATTS L2 : 180 TOTAL WATTS : 280

PANEL DP-3

VOLTAGE : 120/240V
MAIN BKR : 40A
MOUNTING : RACK MOUNTED MINI POWER ZONE

REMARKS : 1. * INDICATES 6MA GFCI CLASS A, ** INDICATES 30MA GFCI CLASS B
LOCATION : LIFT STATION NO. 3. SEE SHEET NO. E0003 AND E0005

DIRECTORY	WATTS LOAD L1	WATTS LOAD L2	CKT NO	WIRE SIZE	BKR AMPS		BKR AMPS	WIRE SIZE	CKT NO	WATTS LOAD L1	WATTS LOAD L2	DIRECTORY
100 WATT HPS FLOODLIGHT	100		1	12	20	L1 L2 40 A MAIN	--	N/A	2	---		SPACE
RECEPTACLE		180	3	12	20		--	N/A	4		---	SPACE
SPACE	---		5	N/A	--		--	N/A	6	---		SPACE
SUB-TOTALS	100	180	NEUTRAL BUS							0	0	SUB-TOTALS
	L1	L2								L1	L2	

TOTAL WATTS L1 : 100 TOTAL WATTS L2 : 180 TOTAL WATTS : 280

PANEL DP-5

VOLTAGE : 120/240V
MAIN BKR : 40A
MOUNTING : RACK MOUNTED MINI POWER ZONE

REMARKS : 1. * INDICATES 6MA GFCI CLASS A, ** INDICATES 30MA GFCI CLASS B
LOCATION : SUPPORT AREA. SEE SHEET NO. E0004 AND E0005

DIRECTORY	WATTS LOAD L1	WATTS LOAD L2	CKT NO	WIRE SIZE	BKR AMPS		BKR AMPS	WIRE SIZE	CKT NO	WATTS LOAD L1	WATTS LOAD L2	DIRECTORY
2-250 WATT HPS FLOODLIGHTS	500		1	8	20	L1 L2 40 A MAIN	--	N/A	2	---		SPACE
RECEPTACLE		180	3	12	20		--	N/A	4		---	SPACE
SPACE	---		5	N/A	--		--	N/A	6	---		SPACE
SUB-TOTALS	500	180	NEUTRAL BUS							0	0	SUB-TOTALS
	L1	L2								L1	L2	

TOTAL WATTS L1 : 500 TOTAL WATTS L2 : 180 TOTAL WATTS : 680

NOTES

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00377	SINGLE LINE DIAGRAMS / ELEVATIONS - LIFT STATION NO. 1, 2, & 3	E0003
92X-5900-E-00378	SINGLE LINE DIAGRAMS / ELEVATIONS - WHEEL WASH FACILITY & SUPPORT AREA	E0004
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL PANEL SCHEDULES

658

STATE OF OHIO JAMES L. COOPER E-66857 REGISTERED PROFESSIONAL ENGINEER
13 June 1997

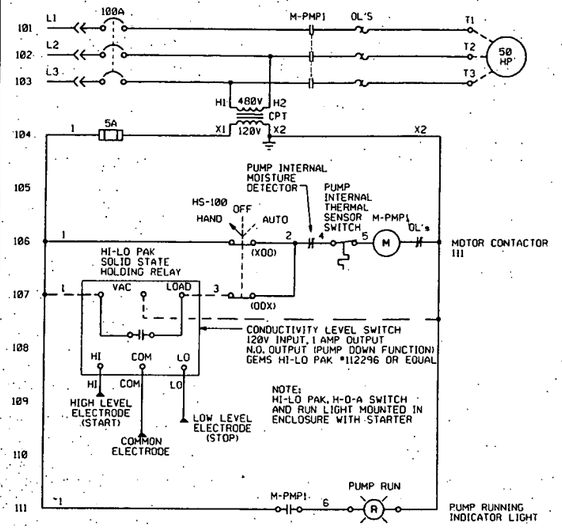
DRAWN BY	DATE	LEAD DRAFTER	DATE	CHECKED BY	DATE
T. COLLINS	11/17/96		13 JUN 1997	J. L. COOPER	11/26/96

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	

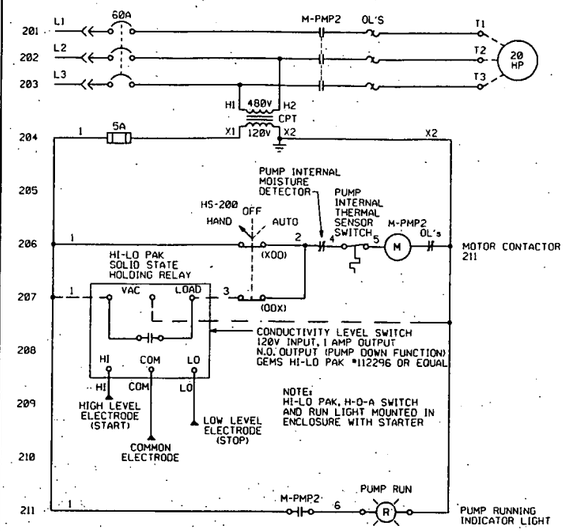
SUBMITTED FOR APPROVAL	FERNCO CBU APPROVAL	FERNCO PROJECT NO.
DATE 6/13/97	N/A	20400

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00381	E0006	0

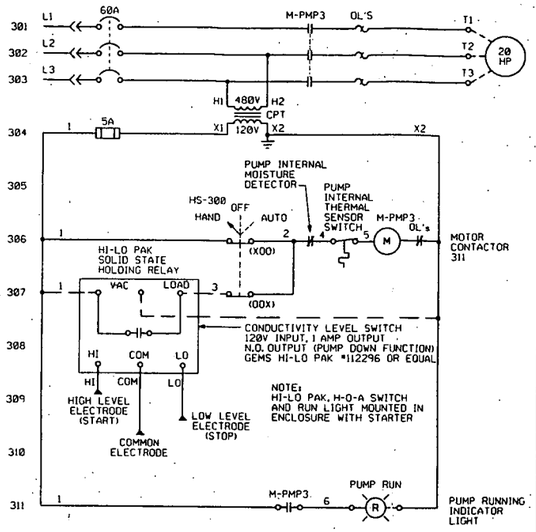
EQUIPMENT NAME : LIFT STATION NO. 1 PUMP PMP-1
EQUIPMENT NO. : PMP-1
S/L SHT. NO. : E0003, E0012
PLAN SHT. NO. : E0005
PREFIX WIRE NUMBERS WITH PMP1-



EQUIPMENT NAME : LIFT STATION NO. 2 PUMP PMP-2
EQUIPMENT NO. : PMP-2
S/L SHT. NO. : E0003, E0012
PLAN SHT. NO. : E0005
PREFIX WIRE NUMBERS WITH PMP2-



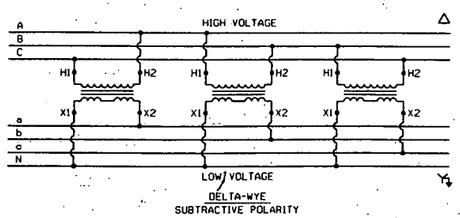
EQUIPMENT NAME : LIFT STATION NO. 3 PUMP PMP-3
EQUIPMENT NO. : PMP-3
S/L SHT. NO. : E0003, E0012
PLAN SHT. NO. : E0005
PREFIX WIRE NUMBERS WITH PMP3-



NOTES

POLE MOUNTED TRANSFORMER CONNECTION

EQUIPMENT NO. : ALL POLE MOUNTED TRANSFORMERS
S/L SHT. NO. : E0002
PLAN SHT. NO. : E0005



NOTE : INSTALLER SHALL CONFIRM DESIGNATIONS WITH VENDOR SUPPLIED INFORMATION.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00405	SYMBOLS AND LEGEND	E0001
92X-5900-E-00377	SINGLE LINE DIAGRAMS / ELEVATIONS - LIFT STATION NO. 1, 2, & 3	E0003
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JNW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL
ELEMENTARY DIAGRAMS

659

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	11/18/96	James L. Cooper	13 JUNE 1997	J. L. COOPER	11/26/96
PLANT/BLDG NO.		FLOOR		SCALE / CLASS	
				NONE	
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL		FERNCO PROJECT NO	
		N/A		20400	
APPROVED - DATE 6/13/97		DATE			

STATE OF OHIO JAMES L. COOPER E-56807 REGISTERED PROFESSIONAL ENGINEER
James L. Cooper 13 JUNE 1997

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FEMP PROJECT NO	DRAWING INDEX CODE NO	SHEET NO.	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00380	E0007	0

CABLE SCHEDULE

CABLE NO.	FROM	TO	CONDUCTOR NUMBER	CONDUCTOR SIZE	CONDUCTOR MATL.	CONDUCTOR INSUL	CONDUCTOR FUNCTION	WIRE TERMINATIONS 1	2	3	4	5	6	7	8	9	10	11	12	ROUTING	REF SHEET NO.	REMARKS
F4A1-1	LOAD SIDE OF SWITCH 4A1 IN UNIT SUBSTATION N18-1	POLE *40	3-1/C 1-1/C	350KCMIL *2 GND	CU	15KV 133%	13.2KV POWER	F4A1-1 -L1	F4A1-1 -L2	F4A1-1 -L3	F4A1-1 -GND									C100	E0012	INSTALL 15KV INSULATED COPPER CABLE FROM SWITCH *4A1 TO POLE *40
F4A1-2	POLE *40	FUSED LOAD BREAK SWITCH FLB-22 (POLE *22)	3-1/C	336KCMIL	ACSR	BARE	13.2KV POWER	F4A1-2 -L1	F4A1-2 -L2	F4A1-2 -L3										POLE *40 TO *22	E0002	AERIAL CONDUCTOR "MERLIN"
F4A1-3	FUSED LOAD BREAK SWITCH FLB-22 (POLE *22)	LOAD BREAK SWITCH LB-13R (POLE *13R)	3-1/C	*2 AWG	ACSR	BARE	13.2KV POWER	F4A1-3 -L1	F4A1-3 -L2	F4A1-3 -L3										POLE *22 TO *13R		AERIAL CONDUCTOR "SPARROW"
F4A1-4	LOAD BREAK SWITCH LB-13R (POLE *13R)	DEADEND TERMINATION @ POLE 36	3-1/C	*2 AWG	ACSR	BARE	13.2KV POWER	F4A1-4 -L1	F4A1-4 -L2	F4A1-4 -L3										POLE *13R TO *36		AERIAL CONDUCTOR "SPARROW"
F4A1-5	TAP F4A1-4 @ POLE *35	FUSED CUTOUT FC-35 (POLE *35)	3-1/C	*2 AWG	AL	BARE	13.2KV POWER	F4A1-5 -L1	F4A1-5 -L2	F4A1-5 -L3										POLE *35		
F4A1-6	TAP F4A1-3 @ POLE *14R	FUSED CUTOUT FC-14R (POLE *14R)	3-1/C	*2 AWG	AL	BARE	13.2KV POWER	F4A1-6 -L1	F4A1-6 -L2	F4A1-6 -L3										POLE *14R		
F4A1-7	FUSED CUTOUT FC-14R (POLE *14R)	TRANSFORMER T-14R (POLE *14R)	3-1/C	*2 AWG	CU	BARE	13.2KV POWER	F4A1-7 -L1	F4A1-7 -L2	F4A1-7 -L3										POLE *14R		
F4A1-8	TAP F4A1-4 @ POLE *28	DEADEND TERMINATION @ POLE *29	3-1/C	*2 AWG	ACSR	BARE	13.2KV POWER	F4A1-8 -L1	F4A1-8 -L2	F4A1-8 -L3										POLE *28 TO 29		AERIAL CONDUCTOR "SPARROW"
F4A1-9	FUSED CUTOUT FC-29 (POLE *29)	TRANSFORMER T-29 (POLE *29)	3-1/C	*2 AWG	CU	BARE	13.2KV POWER	F4A1-9 -L1	F4A1-9 -L2	F4A1-9 -L3										POLE *29		
F4A1-10	TAP F4A1-4 @ POLE *31	FUSED CUTOUT FC-31 (POLE *31)	3-1/C	*2 AWG	AL	BARE	13.2KV POWER	F4A1-10 -L1	F4A1-10 -L2	F4A1-10 -L3										POLE *31		
F4A1-11	FUSED CUTOUT FC-31 (POLE *31)	TRANSFORMER T-31 (POLE *31)	3-1/C	*2 AWG	CU	BARE	13.2KV POWER	F4A1-11 -L1	F4A1-11 -L2	F4A1-11 -L3										POLE *31		
F4A1-12	FUSED CUTOUT FC-35 (POLE *35)	TRANSFORMER T-35 (POLE *35)	3-1/C	*2 AWG	CU	BARE	13.2KV POWER	F4A1-12 -L1	F4A1-12 -L2	F4A1-12 -L3										POLE *35		
F4A1-13	TAP F4A1-4 @ POLE *12R	FUSED CUTOUT FC-12R (POLE *12R)	3-1/C	*2 AWG	AL	BARE	13.2KV POWER	F4A1-13 -L1	F4A1-13 -L2	F4A1-13 -L3										POLE *12R		
F4A1-14	FUSED CUTOUT FC-12R (POLE *12R)	TRANSFORMER T-12R (POLE *12R)	3-1/C	*2 AWG	CU	BARE	13.2KV POWER	F4A1-14 -L1	F4A1-14 -L2	F4A1-14 -L3										POLE *12R		
F4A1-15	DEADEND TERMINATION @ POLE *29	FUSED CUTOUT FC-29 (POLE *29)	3-1/C	*2 AWG	CU	BARE	13.2KV POWER	F4A1-15 -L1	F4A1-15 -L2	F4A1-15 -L3										POLE *29		
F4A1-16	DEADEND TERMINATION @ POLE *36	FUSED CUTOUT FC-36 (POLE *36)	3-1/C	*2 AWG	AL	BARE	13.2KV POWER	F4A1-16 -L1	F4A1-16 -L2	F4A1-16 -L3										POLE *36		
F4A1-17	FUSED CUTOUT FC-36 (POLE *36)	TRANSFORMER T-36 (POLE *36)	3-1/C	*2 AWG	CU	BARE	13.2KV POWER	F4A1-17 -L1	F4A1-17 -L2	F4A1-17 -L3										POLE *36		
101P	TRANSFORMER T-14R (POLE *14R)	400A MAIN DISC. SWITCH DS-5 @ SUPPORT AREA TRAILERS	3-1/C 1-1/C	*4/0 AWG *4 GND	CU	600V	480V POWER	T14R -L1	T14R -L2	T14R -L3	T14R -GND									VIA CONDUIT PER ELEVATION E4	E0004	
102P	400A MAIN DISCONNECT SWITCH DS-5	MINI POWER ZONE DP-5	2-1/C 1-1/C	*6 AWG *8 GND	CU	600V	480V POWER	DS5 -L1	DS5 -L2	DS5 -GND										VIA CONDUIT PER ELEVATION E4		
103P	400A MAIN DISCONNECT SWITCH DS-5	POLE *14B	3-1/C 1-1/C	*4/0 AWG *4 GND	CU	600V	480V POWER	DS5 -L1	DS5 -L2	DS5 -L3	DS5 -GND									POLE *14R, *14A, *14B		VIA ⅝" MESSENGER
104P	TAP 103P @ POLE *14A	RAD/DECON TRAILER 225A DISCONNECT SWITCH	3-1/C 1-1/C	*4/0 AWG *4 GND	CU	600V	480V POWER	DS5 -L1	DS5 -L2	DS5 -L3	DS5 -GND									POLE 14A		
105P	TAP 103P @ POLE *14B	FDF CONST. OFFICE TRAILER 225A DISCONNECT SWITCH	3-1/C 1-1/C	*4/0 AWG *4 GND	CU	600V	480V POWER	DS5 -L1	DS5 -L2	DS5 -L3	DS5 -GND									POLE 14B		
109P	TRANSFORMER T-29 (POLE *29)	DEADEND TERMINATION @ POLE *29A	4-1/C	*4 AWG	CU	600V	480V POWER	T29 -L1	T29 -L2	T29 -L3	T29 -GND									POLE *29 TO *29A	E0002	QUADRUPLEX VIA ½" MESSENGER
110P	TAP 109P @ POLE *29A	100A MAIN DISC. SWITCH DS-3 @ LIFT STATION NO. 3	3-1/C 1-1/C	*6 AWG *8 GND	CU	600V	480V POWER	T29 -L1	T29 -L2	T29 -L3	T29 -GND									VIA CONDUIT PER ELEVATION E2	E0003	VIA ⅜" MESSENGER
111P	100A MAIN DISC. SWITCH DS-3 @ LIFT STATION NO. 3	4'x4'x3'-0" WIREWAY	3-1/C 1-1/C	*6 AWG *8 GND	CU	600V	480V POWER	DS3 -L1	DS3 -L2	DS3 -L3	DS3 -GND											
112P	TAP 111P @ WIREWAY	LIFT STATION NO. 3 STARTER	3-1/C 1-1/C	*8 AWG *12 GND	CU	600V	480V POWER	DS3 -L1	DS3 -L2	DS3 -L3	DS3 -GND											
113P	LIFT STATION NO. 3 STARTER	LIFT STATION PUMP PMP-3	3-1/C 1-1/C	*8 AWG *12 GND	CU	600V	480V POWER	PMP3 -T1	PMP3 -T2	PMP3 -T3	PMP3 -GND									VIA U/G CONDUIT PER DETAIL 6	E0012	
114P	TAP 111P @ WIREWAY	MINI POWER ZONE DIST. PNL. DP-3	2-1/C 1-1/C	*6 AWG *6 GND	CU	600V	480V POWER	DS3 -L1	DS3 -L2	DS3 -GND										VIA CONDUIT PER ELEVATION E2	E0003	
119P	TRANSFORMER T-31 (POLE *31)	DEADEND TERMINATION @ POLE *31A	4-1/C	*4 AWG	CU	600V	480V POWER	T31 -L1	T31 -L2	T31 -L3	T31 -GND									POLE *31 TO *31A	E0002	QUADRUPLEX VIA ½" MESSENGER
120P	TAP 119P @ POLE *31A	100A MAIN DISC. SWITCH DS-2 @ LIFT STATION NO. 2	3-1/C 1-1/C	*6 AWG *8 GND	CU	600V	480V POWER	T31 -L1	T31 -L2	T31 -L3	T31 -GND									VIA CONDUIT PER ELEVATION E2	E0003	
121P	100A MAIN DISC. SWITCH DS-2 @ LIFT STATION NO. 2	4'x4'x3'-0" WIREWAY	3-1/C 1-1/C	*6 AWG *8 GND	CU	600V	480V POWER	DS2 -L1	DS2 -L2	DS2 -L3	DS2 -GND											
122P	TAP 121P @ WIREWAY	LIFT STATION NO. 2 STARTER	3-1/C 1-1/C	*8 AWG *12 GND	CU	600V	480V POWER	DS2 -L1	DS2 -L2	DS2 -L3	DS2 -GND											
123P	LIFT STATION NO. 2 STARTER	LIFT STATION PUMP PMP-2	3-1/C 1-1/C	*8 AWG *12 GND	CU	600V	480V POWER	PMP2 -T1	PMP2 -T2	PMP2 -T3	PMP2 -GND									VIA U/G CONDUIT PER DETAIL 5	E0012	
124P	TAP 121P @ WIREWAY	MINI POWER ZONE DIST. PNL. DP-2	2-1/C 1-1/C	*6 AWG *6 GND	CU	600V	480V POWER	DS2 -L1	DS2 -L2	DS2 -GND										VIA CONDUIT PER ELEVATION E2	E0003	
130P	TRANSFORMER T-35 (POLE *35)	100A MAIN DISC. SWITCH DS-1 @ LIFT STATION NO. 1	3-1/C 1-1/C	*1/0 AWG *6 GND	CU	600V	480V POWER	T35 -L1	T35 -L2	T35 -L3	T35 -GND									POLE *35 TO SWITCH		VIA ⅜" MESSENGER
131P	100A MAIN DISC. SWITCH DS-1 @ LIFT STATION NO. 1	4'x4'x3'-0" WIREWAY	3-1/C 1-1/C	*1/0 AWG *6 GND	CU	600V	480V POWER	DS1 -L1	DS1 -L2	DS1 -L3	DS1 -GND									VIA CONDUIT PER ELEVATION E1		
132P	TAP 131P @ WIREWAY	LIFT STATION NO. 1 STARTER	3-1/C 1-1/C	*2 AWG *8 GND	CU	600V	480V POWER	DS1 -L1	DS1 -L2	DS1 -L3	DS1 -GND									VIA CONDUIT PER ELEVATION E1		
133P	LIFT STATION NO. 1 STARTER	LIFT STATION PUMP PMP-1	3-1/C 1-1/C	*4 AWG *8 GND	CU	600V	480V POWER	PMP1 -T1	PMP1 -T2	PMP1 -T3	PMP1 -GND									VIA U/G CONDUIT PER DETAIL 4	E0012	
134P	TAP 131P @ WIREWAY	MINI POWER ZONE DIST. PNL. DP-1	2-1/C 1-1/C	*6 AWG *6 GND	CU	600V	480V POWER	DS1 -L1	DS1 -L2	DS1 -GND										VIA CONDUIT PER ELEVATION E1	E0003	
140P	TRANSFORMER T-12R (POLE *12R)	POLE *11R	4-1/C	*4 AWG	CU	600V	480V POWER	T12R -L1	T12R -L2	T12R -L3	T12R -GND									POLE *12R TO *11R	E0002	QUADRUPLEX VIA ½" MESSENGER
150P	TAP EXISTING 480V. 500 KCMIL @ POLE *3R	POLE *3A	3-1/C	*4 AWG	CU	600V	480V POWER	PP1 -IL1	PP1 -IL2	PP1 -IL3										POLE *3R TO * 3A	E0004	TRIPLEX VIA ½" MESSENGER
151P	TAP 150P @ POLE *3A	60A MAIN DISC. SWITCH DS-4 @ WHEEL WASH FACILITY	3-1/C 1-1/C	*8 AWG *8 GND	CU	600V	480V POWER	PP1 -IL1	PP1 -IL2	PP1 -IL3	PP1 -GND									VIA CONDUIT PER ELEVATION E3		
152P	60A MAIN DISC. SWITCH DS-4 @ WHEEL WASH FACILITY	4'x4'x2'-0" WIREWAY	3-1/C 1-1/C	*8 AWG *8 GND	CU	600V	480V POWER	DS4 -L1	DS4 -L2	DS4 -L3	DS4 -GND											
153P	TAP 152P @ WIREWAY	20A CIRCUIT BREAKER FOR TWIST LOCK RECEP.	3-1/C 1-1/C	*12 AWG *12 GND	CU	600V	480V POWER	DS4 -L1	DS4 -L2	DS4 -L3	DS4 -GND											
154P	TAP 152P @ WIREWAY	480V. 1PH. 100W. HPS LIGHT	2-1/C 1-1/C	*12 AWG *12 GND	CU	600V	480V POWER	DS4 -L1	DS4 -L2	DS4 -GND												

CONDUIT SCHEDULE

CONDUIT NO.	FROM	TO	COND SIZE	CONTAINS CABLE(S)	REMARKS
C100	SUBSTATION N-18-1, SWITCH 4A1 (TOP HAT)	POLE 40	5"	F4A1-1	RIGID STEEL

NOTES

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00404	SINGLE LINE DIAGRAM - WEST SIDE 13.2 KV FEEDERS	E0002
92X-5900-E-00377	SINGLE LINE DIAGRAMS / ELEVATIONS - LIFT STATION NO. 1, 2, & 3	E0003
92X-5900-E-00378	SINGLE LINE DIAGRAMS / ELEVATIONS - WHEEL WASH FACILITY & SUPPORT AREA	E0004
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005

FOR INFORMATION ONLY

REV NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL
CABLE AND CONDUIT SCHEDULES

660

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
I. COLLINS	01/09/97	James L. Cooper	13 June 97	J.L. COOPER	01-28-97

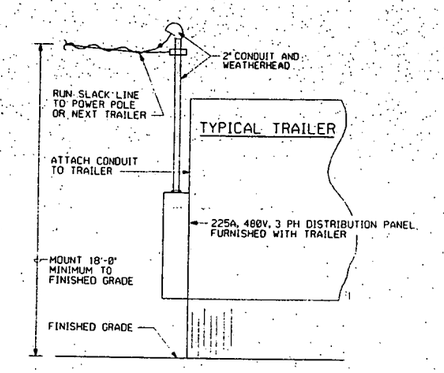
PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS

SUBMITTED FOR APPROVAL | DATE 6/13/97 | FERMCO CRU APPROVAL: N/A | DATE | FERMCO PROJECT NO: 20400

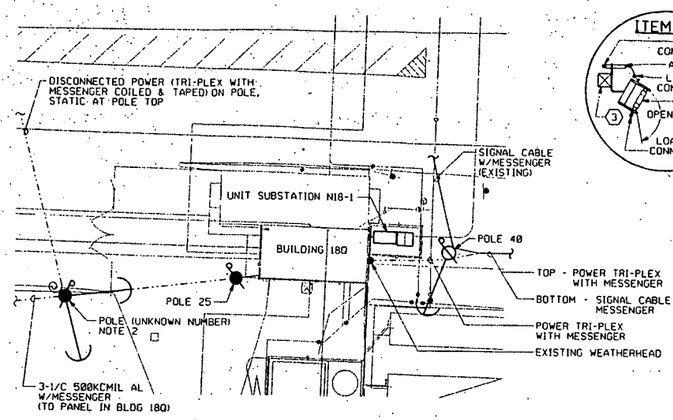
STATE OF OHIO — JAMES L. COOPER E-56807 — REGISTERED PROFESSIONAL ENGINEER — 13 JUNE 1997

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

DOE/PROJECT NO.	TOP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00406	E0008	0

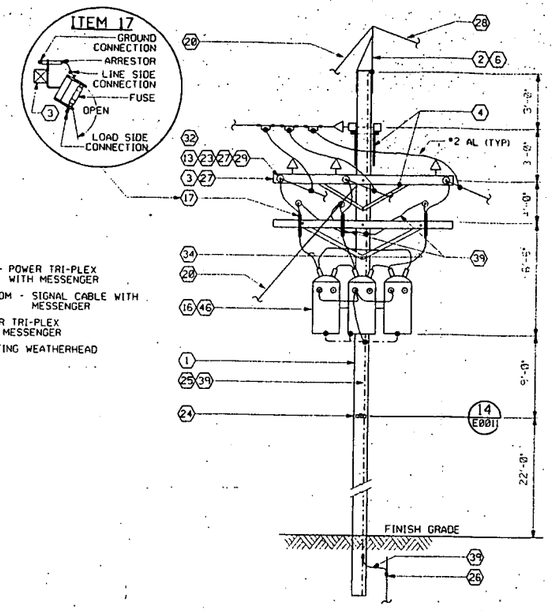


ELEVATION (E6) REF E0009 E0012
TRAILER MAST
NTS

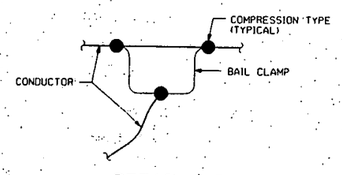


NOTE:
THIS DETAIL IS FOR THE PURPOSE OF SHOWING EXISTING CONDUCTORS ONLY.
FOR 13.2KV OVERHEAD CONDUCTORS SEE OVERALL SITE POWER PLAN AND POLE ELEVATIONS.

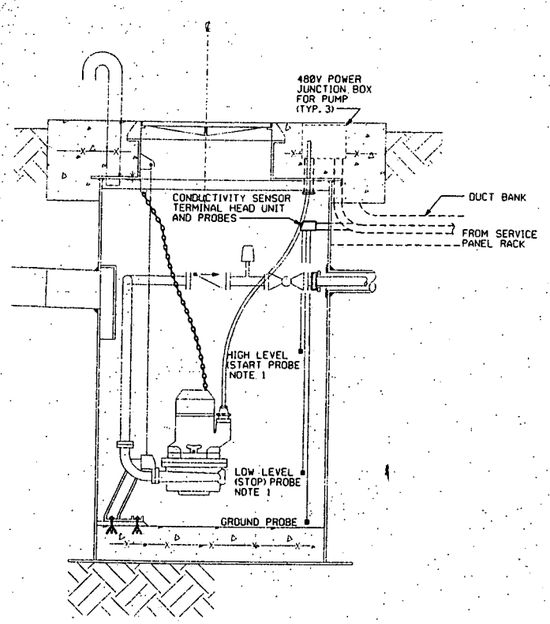
DETAIL (1) REF E0009 E0005
SUBSTATION AREA EXISTING
NTS



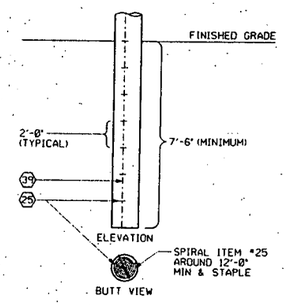
ELEVATION (E7) REF E0009 E0005
POLE 31
NTS



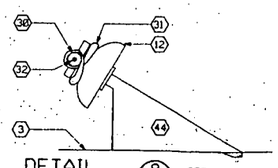
DETAIL (7)
BAIL CLAMP
NTS
TYPICAL FOR ALL TAP CONNECTIONS AS REQUIRED



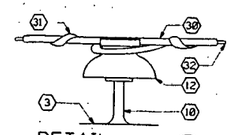
SECTION (C)
LIFT STATION MANHOLE
NTS



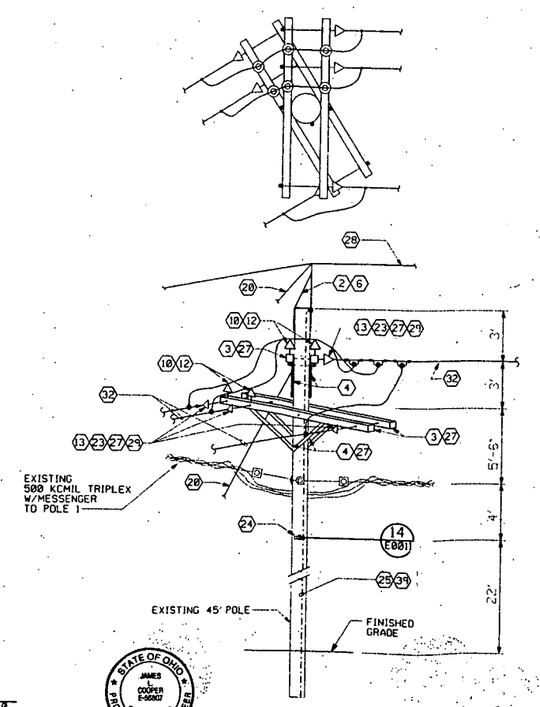
DETAIL (8) REF E0009 E0010 E0011 E0012 E0013
NTS
TYPICAL FOR ALL POLES



DETAIL (9) REF E0009 E0010 E0011 E0013
CROSSARM CORNER TYPE PINS
NTS
USE ON POLES AS REQUIRED



DETAIL (10) REF E0009 E0010 E0011 E0013
STRAIGHT ATTACHMENT TYPE PINS
NTS
USE ON POLES AS REQUIRED



ELEVATION (E8) REF E0009 E0005
POLE 16
NTS

STATE OF OHIO
JAMES L. COOPER
E-66002
REGISTERED PROFESSIONAL ENGINEER
James L. Cooper
13 JUNE 1997

NOTES

1. FOR HIGH AND LOW LEVEL PROBE SETTINGS AND PUMP STATION DETAILS, REFER TO CIVIL SHEET G0013.
2. BEFORE REMOVAL OF POLE (UNKNOWN NUMBER), REMOVE EXISTING DISCONNECTED POWER (TRIPLEX WITH MESSENGER) BACK TO 2ND POLE TO NORTH. COIL, TAPE, AND DEAD-END GUY (DETAIL 12, E0011) AT THAT POLE (2ND POLE TO NORTH). REMOVE STATIC LINE BACK TO 1ST POLE TO NORTH.
3. SEE SHEET E0011 FOR MATERIAL LIST.
4. SECONDARY CONDUCTORS ON POLE 35A ARE FUTURE, BY OTHERS.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-E-00407	DETAILS - SHEET 2	E0010
92X-5900-E-00408	DETAILS - SHEET 3	E0011
92X-5900-E-00409	DETAILS - SHEET 4	E0012
92X-5900-E-00376	DETAILS - SHEET 5	E0013
92X-5900-G-00368	CIVIL - MISCELLANEOUS DETAILS	G0013

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

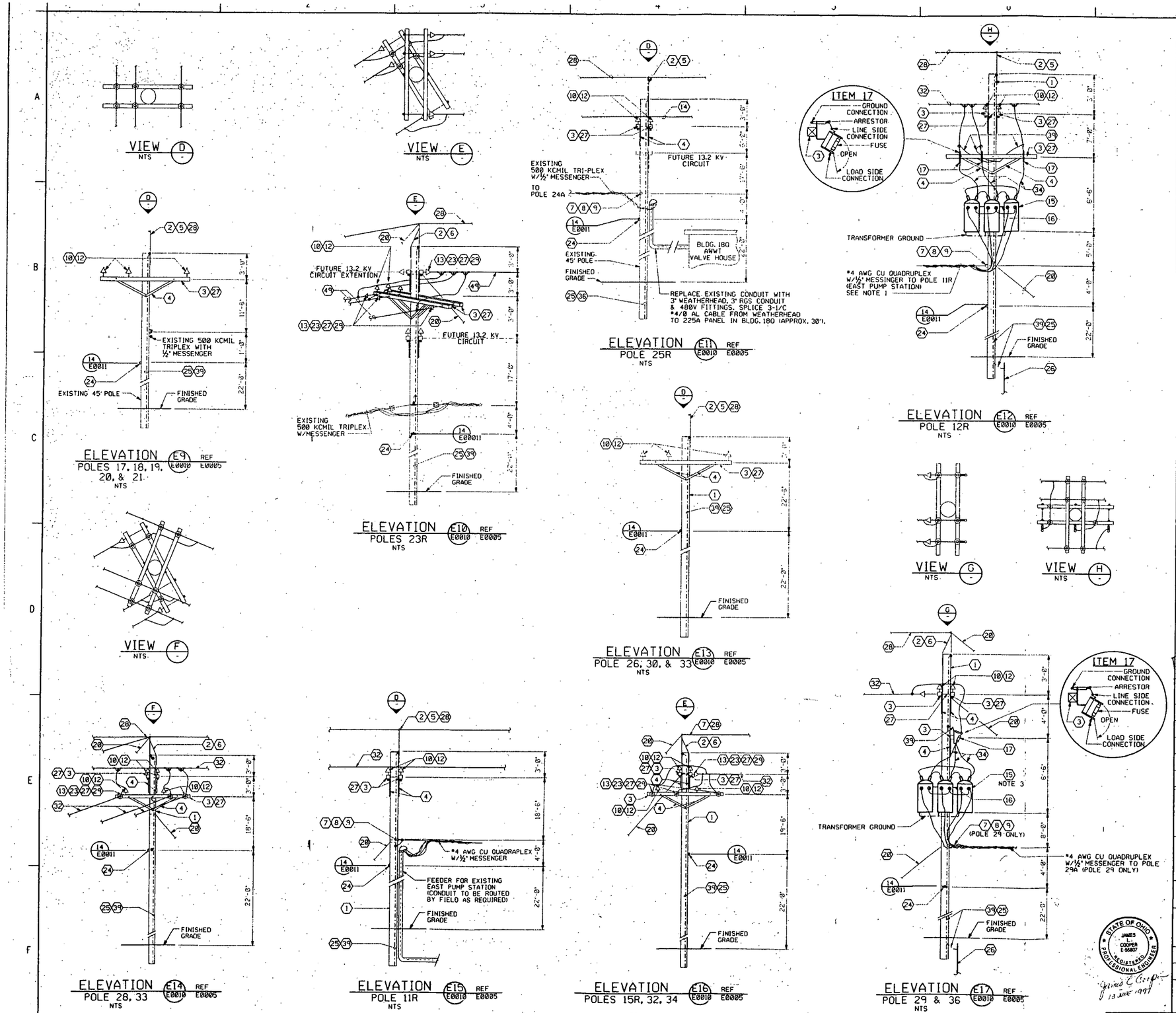
PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL DETAILS SHEET 1

661

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	11/19/96	J.L. COOPER	12 JUNE 97	J.L. COOPER	11/26/96
PLANT/BLDG. NO.				SCALE: AS NOTED	CLASS
SUBMITTED FOR APPROVAL: A-E DATE 6/13/97		FERNCO CRU APPROVAL: N/A DATE		FERNCO PROJECT NO. 20400	

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FERNCO PROJECT NO.	DRAWING INDEX CODE NO	SHEET NO	REV. NO
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00382	E0009	0



NOTES

1. EXTEND #4 AWG QUADRUPLEX CONDUCTORS FROM POLE #12R TRANSFORMER SECONDARY TO POLE #11R. FROM POLE #11R, EXTEND CONDUCTORS TO EXISTING PUMP AT POLE 11R; ENSURE MESSENGERS ARE CONNECTED TO GROUND AT POLE #12R ONLY.
2. SEE SHEET E0011 FOR MATERIAL LIST.
3. SEE SINGLE LINE DIAGRAM DRAWING 92X-5900-E-00404 FOR POLE 36 TRANSFORMER SIZING.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00404	SINGLE LINE DIAGRAM - WEST SIDE 13.2 KV FEEDERS	E0002
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-E-00382	DETAILS - SHEET 1	E0009
92X-5900-E-00408	DETAILS - SHEET 3	E0011

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JWW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS-MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL DETAILS SHEET 2

662

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	01/05/97	James L. Cooper	13 JUNE 97	J.L. COOPER	01/28/97

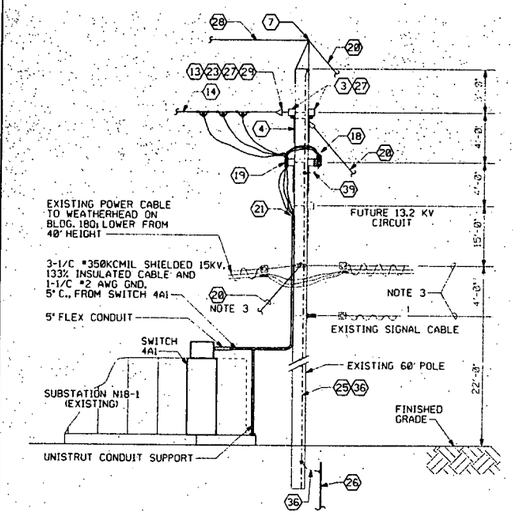
PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		AS NOTED	

SUBMITTED FOR APPROVAL	FERMCO CRU APPROVAL	FERMCO PROJECT NO.
A-E: 6/13/97 DATE	N/A	20400

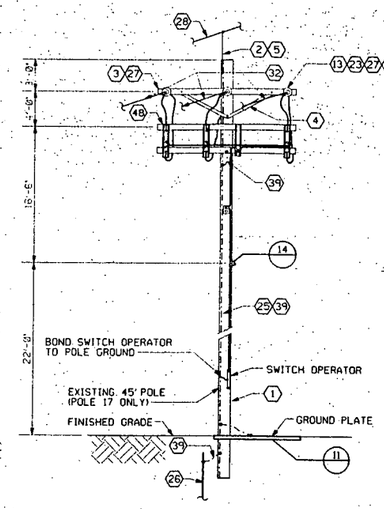
DOE PROJECT NO.	FTUP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00407	E0010	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

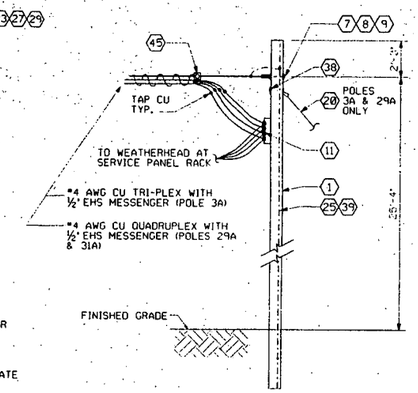
STATE OF OHIO — JAMES L. COOPER E-90807 — REGISTERED PROFESSIONAL ENGINEER — 13 JUNE 1997



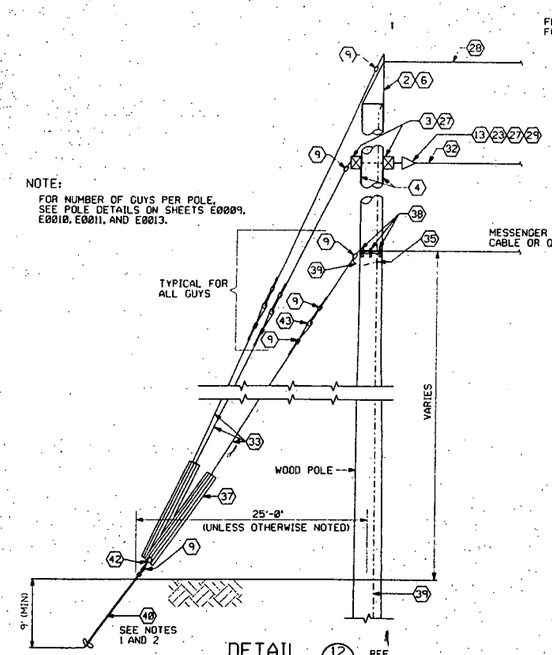
ELEVATION (E18) E0011 REF E0005
POLE 40
NTS



ELEVATION (E19) E0011 REF E0005
POLE 13R
NTS

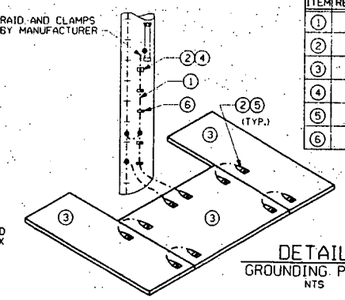


ELEVATION (E20) E0011 REF E0005
POLE 3A, 29A, 31A
NTS



DETAIL (12) E0011 REF E0009 E0010 E0012 E0013
GUY HARDWARE
NTS

NOTE:
FOR NUMBER OF GUYS PER POLE, SEE POLE DETAILS ON SHEETS E0009, E0010, E0011, AND E0013.

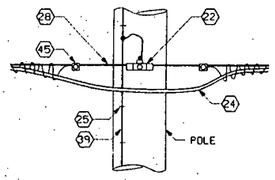


DETAIL (11)
GROUNDING PLATE
NTS

NOTE:
LOCATE GROUNDING PLATE TO PERMIT OPERATOR TO REMAIN ON PLATE AT ALL TIMES DURING OPENING OR CLOSING OF SWITCH. THIS ARRANGEMENT IS INTENDED AS A GUIDE ONLY. CONNECTIONS SHOULD BE MADE AS FIELD CONDITIONS PERMIT.

LIST OF MATERIAL

ITEM	REQ'D.	DESCRIPTION
1	20	2/0 COPPER CABLE (FT.)
2	12	CONNECTORS FOR 2/0 COPPER
3	3	GROUNDING PLATFORM PLATE
4	1	3/8" × 1" EVERDUR BOLT NUT & LOCK WASHER
5	10	3/8" × 1 1/2" EVERDUR BOLT NUT & LOCK WASHER
6	6	1 1/2" LONG COPPERCLAD STAPLES



DETAIL (14) E0011 REF E0010 E0013
NTS

MATERIAL LIST

1. POLE, CLASS 2, PRESSURE TREATED, SOUTHERN YELLOW PINE. TO BE INSTALLED PER PARSONS SPEC #16370. SEE NOTE 5.
2. GROUND WIRE CLAMP, USED TO ATTACH STATIC WIRE TO BAYONET.
3. CROSSARM, 3 1/2" × 4 1/2" × 8'-0", PRESSURE TREATED DOUGLAS FIR.
4. CROSSARM BRACE, 5'-3" LONG × 1'-6" DROP, HOT DIP GALVANIZED.
5. STATIC WIRE SUPPORT, STRAIGHT BAYONET TYPE.
6. STATIC WIRE SUPPORT, CORNER BAYONET TYPE.
7. THIMBLE, FOR STATIC WIRE OR MESSENGER WIRE DEAD-END.
8. EYE BOLT, OVAL EYE TYPE, FOR DEAD-END, 5/8" DIA., WITH ONE SQUARE NUT, ADDITIONAL NUTS, WASHERS, AND LENGTH AS REQUIRED.
9. GUY GRIP, FOR STATIC WIRE, PREFORMED WIRE TYPE.
10. HIGH VOLTAGE FORGED STEEL PIN, FOR PIN TYPE INSULATORS 1" LEAD THREAD, LONG SHANK, WITH WASHERS AND NUTS AS REQUIRED.
11. SECONDARY RACK FOR 4 WIRES, MEDIUM DUTY WITH INSULATORS.
12. INSULATORS, PIN TYPE, 14.4 KV, GLAZED PORCELAIN, 1" THREADS ANSI CLASS 55-5, "F" NECK.
13. INSULATOR, DEAD-END TYPE, 6 1/4" LONG, 4 3/8" DIA. ANSI CLASS 52-9, CLEVIS TYPE WITH STEEL HARDWARE.
14. AERIAL POWER CONDUCTOR #336 KCMIL, ACSR "MERLIN".
15. TRANSFORMER, POLE MOUNTED, THREE 50 KVA, 13.2KV-480V, 1 PHASE, W/ 2-2 1/2% TAPS ABOVE AND 2-2 1/2% TAPS BELOW, OIL-FILLED
16. EQUIPMENT MOUNT, FOR 3 POLE MOUNTED, TRANSFORMERS DOUBLE-BANDED ALUMINUM CLUSTER MOUNT W/ GND LUG.
17. FUSED CUTOUT ARRESTER COMBINATION UNIT, CUTOUT RATED 15KV, 200 AMPS, 12,000 AMPS IC, WITH CROSSARM MOUNTING HARDWARE. FOR ARRESTER, SEE ITEM 18, THIS MATERIAL LIST.
18. SURGE ARRESTER, DIRECT CONNECTED, 15KV, RISER POLE TYPE, METAL OXIDE VALVE W/CROSSARM MOUNTING HARDWARE.
19. TERMINATOR, 15 KV, SIZED TO FIT INSULATION DIAMETER.
20. FOR GUY INSTALLATION, SEE DETAIL 12 ON THIS DRAWING.
21. CABLE SUPPORT, CONDUIT TOP, OUTDOOR, WATERTIGHT, FILL WITH SEALING COMPOUND.
22. CLAMP, SUSPENSION, FOR 3/8" MESSENGER.
23. EYENUT, 5/8" BOLT DIA.
24. (FUTURE) COMMUNICATIONS CABLE, LASHED TO 3/8" MESSENGER. SEE NOTE 4.
25. STAPLE, COPPERCLAD, 1 1/2" LONG.
26. GROUND ROD, 3/4" DIAMETER × 10' LONG, COPPERWELD INSTALLED 12" MIN. BELOW FINISHED GRADE.
27. BOLTS, DOUBLE ARMING, SQUARE NUTS, 5/8" DIA. × LENGTH AS REQUIRED.
28. 3/8" DIAMETER, 7X8, STANDARD CONSTRUCTION, GALVANIZED STEEL STRAND.
29. DISTRIBUTION TYPE DEAD-END GRIP, FOR USE ON #2 AWG, ACSR CONDUCTOR.
30. ARMOR ROD, FOR USE ON #32, THIS MATERIAL LIST.
31. CONDUCTOR TIE ROD FOR ACSR CONDUCTOR TO "F" NECK PIN TYPE INSULATOR, SIZE TIE RODS TO FIT OVER ARMOR ROD ASSEMBLY.
32. AERIAL POWER CONDUCTOR, #2 AWG, ACSR, "SPARROW".
33. 5/8" DIA. GALVANIZED STEEL STRUCTURAL ROPE WITH A MINIMUM BREAKING STRENGTH OF 15 TONS.
34. #2 AWG BARE CU.
35. COMPRESSION GROUND FITTING.
36. #2 AWG, BARE SOLID COPPER GROUND CONDUCTOR.
37. GUY WIRE MARKER, HALF ROUND, 2" WIDE, 84" LONG, W/ REQ'D HARDWARE, UV RESISTANT.
38. GUY AND LOAD PLATE, W/ ANGLE THIMBLE EYE BOLT.
39. #4 AWG, BARE SOLID COPPER GROUND CONDUCTOR.
40. 12" DIA. HELICAL SCREW TYPE GUY ANCHOR WITH MINIMUM PULLOUT CAPACITY OF 23000 POUNDS.
41. NOT USED.
42. 1/2" THREADED ROD WITH NUTS, LENGTH AS REQUIRED.
43. GUY STRAIN INSULATOR, ANSI CLASS 54-4, FOR 5/8" GUY WIRE.
44. CROSSARM CORNER TYPE PIN, MALLABLE IRON, GALVANIZED 1" THREAD MOUNTING WITH HARDWARE.
45. LASHING WIRE CLIP, SIZE AS REQUIRED.
46. TRANSFORMER, POLE MOUNTED, THREE 37.5 KVA, 13.2KV - 480V, 1 PHASE, W/ 2 - 2 1/2% TAPS ABOVE AND 2 - 2 1/2% TAPS BELOW, OIL FILLED.
47. 600A, 15KV, 3-PH, 20 KAYMME POLE MOUNTED, MANUAL, GANG OPERATED (LOAD BREAK FUSED SWITCH) 806 FUSE.
48. 600A, 15KV, 3-PH, 20 KAYMME POLE MOUNTED, MANUAL, GANG OPERATED (LOAD BREAK SWITCH).
49. AERIAL POWER CONDUCTOR, 336 kcmil, ASCR, "MERLIN".

SAG AND TENSION TABLE

200-FT MAXIMUM SPAN - 28.5" INITIAL SAG AT 60 DEG F

CONDUCTOR ACSR BARE (KCM OR AWG)	ULTIMATE STRENGTH (LB)	CONDUCTOR AREA (SQ IN)	WEIGHT PER 1000 FOOT (LB)	15 DEG F LOADING			INITIAL STRINGING SAG AND TENSION										FINAL SAG AND TENSION					
							15 DEG F		30 DEG F		60 DEG F		90 DEG F		120 DEG F		15 DEG F		60 DEG F		120 DEG F	
				S	T	% ULT	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T
#2 (SPARROW)	2,850	0.0608	91.3	44.4	815	29.2	16.6	338	19.7	277	28.5	195	34.6	151	43.8	128	19.3	289	32.4	170	46.3	122

S = SAG IN INCHES
T = TENSION IN POUNDS
(6/1) = STRANDS
AVERAGE SPAN = 146.6 FT
RULING SPAN = 182 FT
MAXIMUM SPAN = 200 FT

HEAVY LOADING AREA, NESC C2

NOTES

1. INSTALL SOIL ANCHORS ACCORDING TO MANUFACTURER'S INSTRUCTIONS. DEPTH CALCULATION BASED ON SOIL DATA FOR MINIMUM BLOW COUNT OF 7. IF BLOW COUNT IS LESS THAN 7 THEN CONTACT FOF.
2. PRIOR TO INSTALLATION OF EARTH ANCHORS, VERIFY LOCATION OF NEARBY UNDERGROUND UTILITIES AND PUSH SMALL DIAMETER STEEL SOIL PROBE THROUGH AREA TO VERIFY THAT NO UNDERGROUND OBSTRUCTIONS ARE PRESENT.
3. ADJUST ELEVATIONS OF EXISTING POWER/SIGNAL CABLE(S) AND GUY TO THOSE SHOWN.
4. PLACE SIGNAL/COMMUNICATIONS CABLE SIX (6) FEET MINIMUM BELOW 13.2KV POWER LINE CONDUCTORS; FOUR (4) FEET MINIMUM BELOW 600V (OR LESS) POWER CONDUCTORS; AND TWO (2) FEET MINIMUM BELOW POLE-GUY ATTACHMENTS.
5. SEE SHEET NO. E0005 "POWER POLE COORDINATES - POLE HEIGHTS" FOR POLE LENGTHS.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-E-00382	DETAILS - SHEET 1	E0009
92X-5900-E-00407	DETAILS - SHEET 2	E0010
92X-5900-E-00409	DETAILS - SHEET 4	E0012
92X-5900-E-00376	DETAILS - SHEET 5	E0013

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL DETAILS SHEET 3

663

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	01/05/97	James E. Cooper	13 JUNE 1997	J.L. COOPER	01/20/97

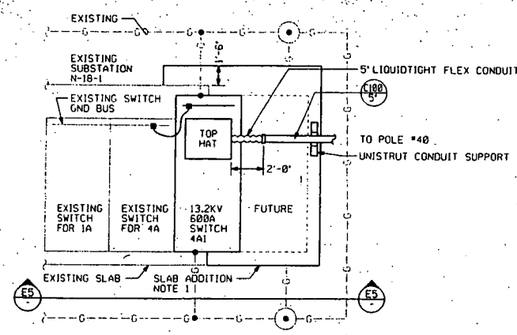
PLANT/BLDG NO: FLOOR — SCALE: AS NOTED — CLASS:

SUBMITTED FOR APPROVAL: A.E. 6/13/97 — FERNCO CRU APPROVAL: N/A — FERNCO PROJECT NO.: 20400

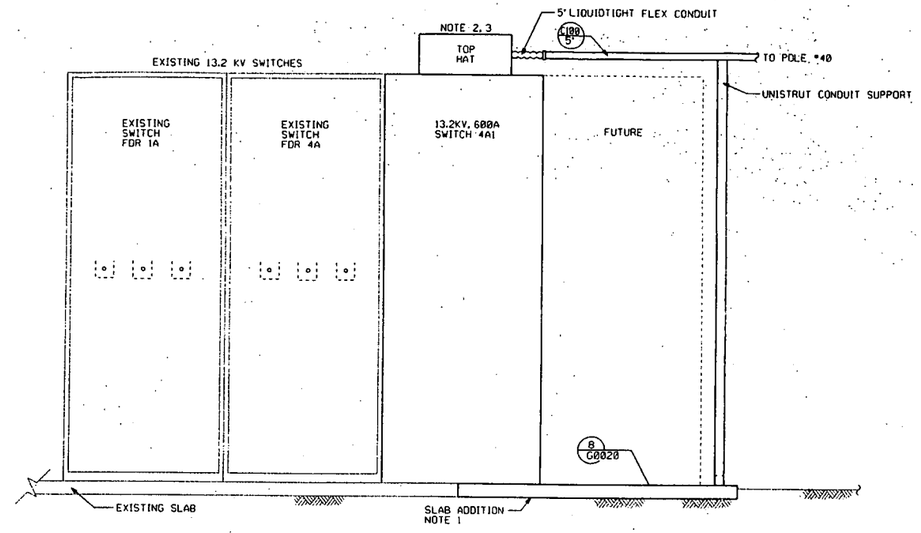
DATE

STATE OF OHIO — JAMES L. COOPER E-36007 — REGISTERED PROFESSIONAL ENGINEER — 13 JUNE 1997

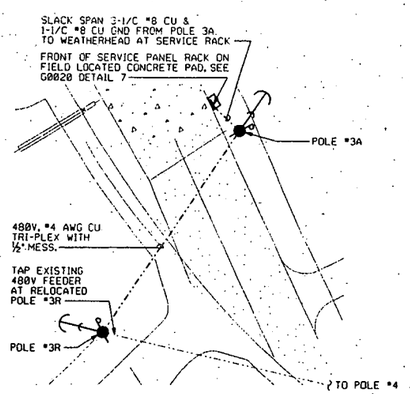
PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	TMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
SCEP/P0165		WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00408	E0011	0



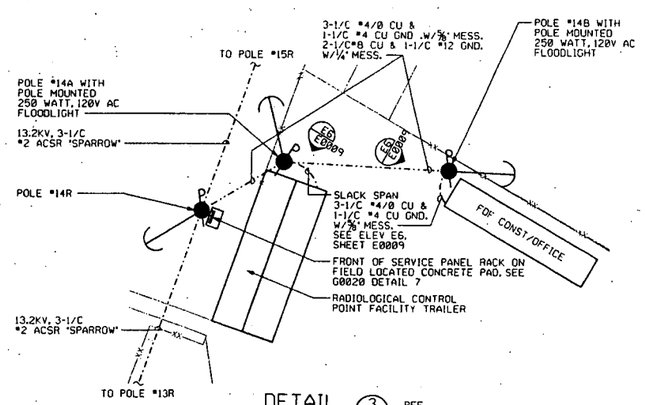
SWITCHGEAR PLAN
NTS



ELEVATION E5
NTS

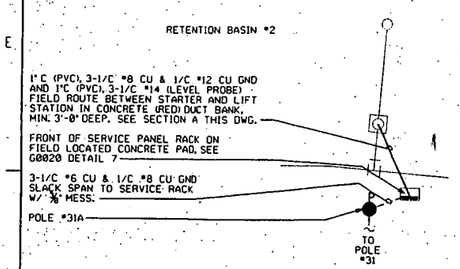


DETAIL 2 WHEEL WASH E0012 REF E0005
NTS



DETAIL 3 SUPPORT AREA E0012 REF E0005
NTS

DETAIL 4 LIFT STATION NO.1 E0012 REF E0005
NTS



DETAIL 5 LIFT STATION NO.2 E0012 REF E0005
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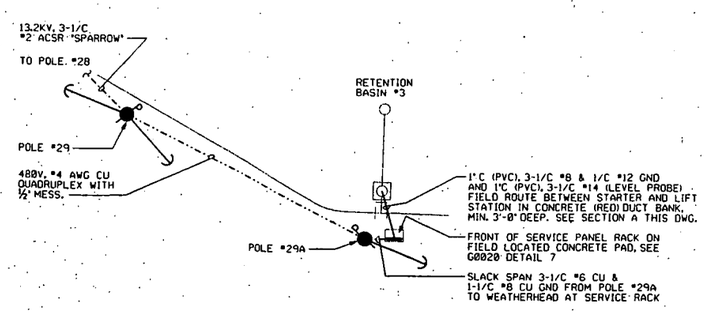
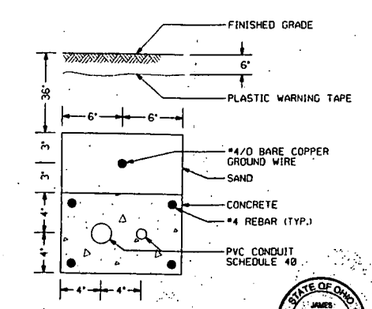


DETAIL 6 LIFT STATION NO.3 E0012 REF E0005
NTS



SECTION A
UNDERGROUND DUCTBANK
NTS

STATE OF OHIO JAMES L. COOPER E-39007 REGISTERED PROFESSIONAL ENGINEER
James L. Cooper 13 JUNE 1997

NOTES

1. EXTEND SLAB 6" THICK, 6" EAST TOWARD POLE *40 AND 1'-6" NORTH AS INDICATED. SEE G0020, DETAIL 8.
2. DIMENSION TO BE AT LEAST CABLE BENDING RADIUS PROVIDED BY CABLE MANUFACTURER. MINIMUM 1'-6". TOP HAT TO BE 1'-6" HIGH, 2' x 2'.
3. CONNECT LINE SIDE OF SWITCH TO LINE SIDE OF EXISTING SWITCH USING CONNECTION KIT FROM SIEMENS-ITE AS SPECIFIED. CONNECT PRIMARY CABLE TO LOAD SIDE OF SWITCH WITH MEDIUM VOLTAGE STRESS CONE TERMINATIONS. ALLOW SUFFICIENT CABLE FOR FUTURE CONNECTION TO LOAD SIDE OF SWITCH WITHOUT REMOVING CABLE FROM POLE *40.
4. FOR HIGH AND LOW LEVEL PROBE SETTINGS AND LIFT STATION DETAILS SEE CIVIL SHEET NO. G0013.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00405	SYMBOLS AND LEGEND	E0001
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-G-00368	CIVIL - EROSION AND SEDIMENT CONTROL - SHEET 2 OF 2	G0013
92X-5900-G-00389	CIVIL - MISCELLANEOUS DETAILS	G0020
92X-5900-E-00382	DETAILS - SHEET 1	E0009

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMW	N/A	6/13/97

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL DETAILS SHEET 4

664

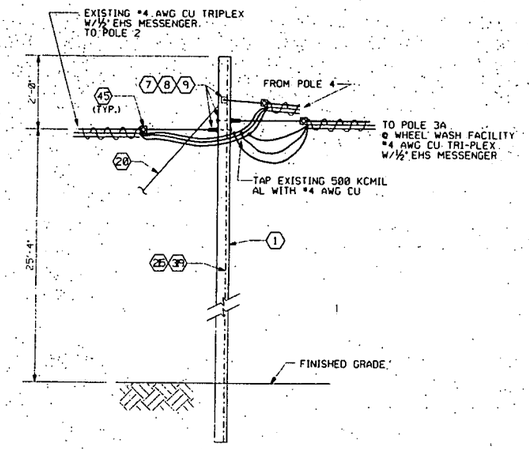
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	01/08/97	JLCooper	13 JUN 97	J. L. COOPER	01/28/97

PLANT/BLDG NO. | FLOOR | SCALE: NOT TO SCALE | CLASS

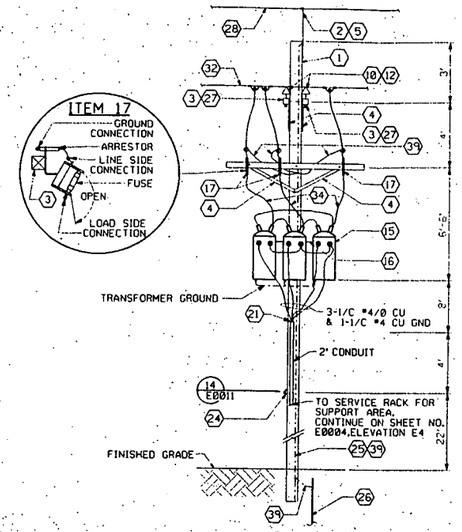
SUBMITTED FOR APPROVAL: DATE 6/13/97 | FERNCO CRU APPROVAL: N/A | DATE | FERNCO PROJECT NO. 20400

DOE PROJECT NO. | TOP PROJECT NO. WBS 1.1.1.1.2.3.6 00-90701 | DRAWING INDEX CODE NO. 92X-5900-E-00409 | SHEET NO. E0012 | REV. NO. 0

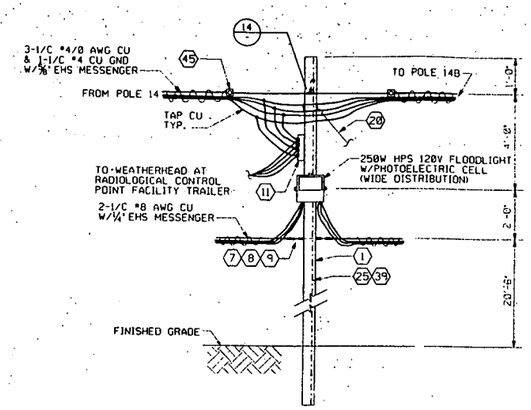
PREPARED UNDER PARSONS PROJECT ORDER NUMBER SCEP/P0165



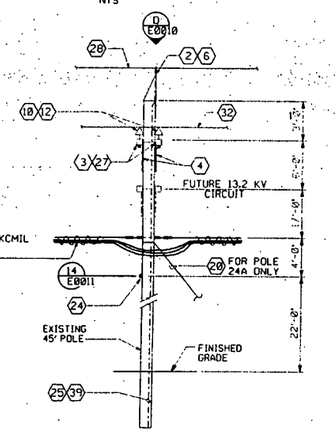
ELEVATION (E21) E0013 REF E0005
POLE 3R
NTS



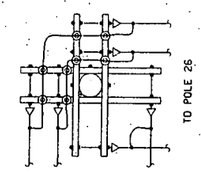
ELEVATION (E22) E0013 REF E0005
POLE 14R
NTS



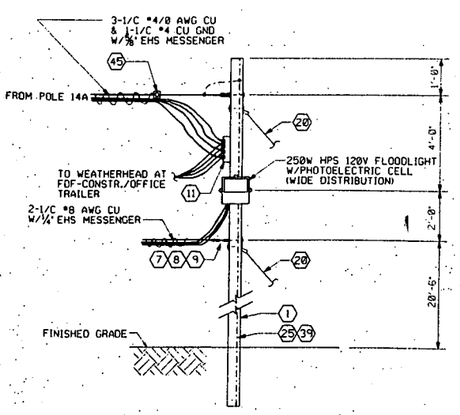
ELEVATION (E23) E0013 REF E0005
POLE 14A
NTS



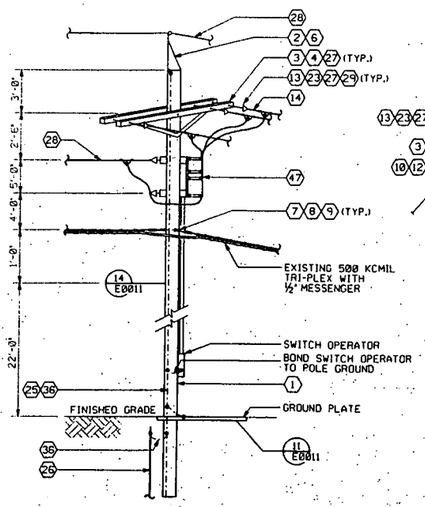
ELEVATION (E20) E0013 REF E0005
POLE 24R & 24A
NTS



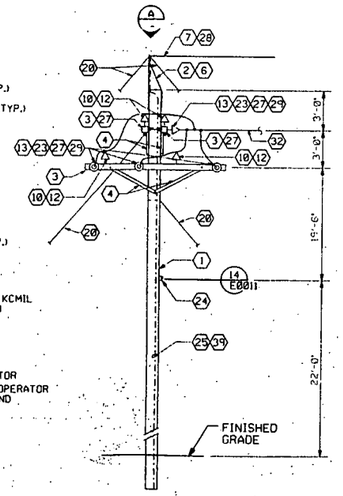
VIEW (A)
NTS



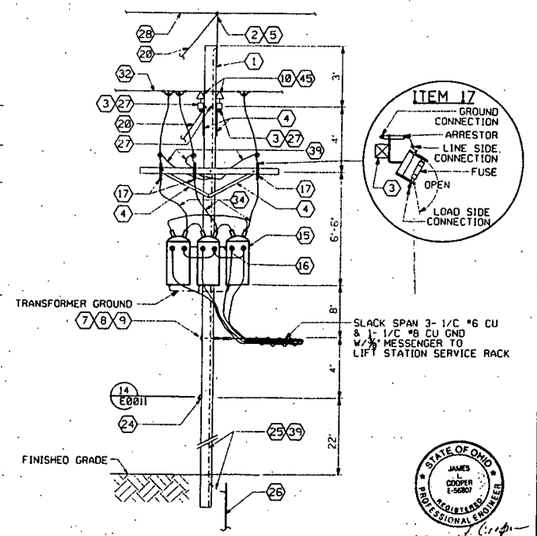
ELEVATION (E24) E0013 REF E0005
POLE 14B
NTS



ELEVATION (E25) E0013 REF E0005
POLE 22
NTS



ELEVATION (E26) E0013 REF E0005
POLE 27
NTS



ELEVATION (E27) E0013 REF E0005
POLE 35
NTS

NOTES

1. SEE SHEET E0011 FOR MATERIAL LIST.

RELATED DWG NO.	DRAWING TITLE	SHEET NO.
92X-5900-X-00320	DRAWING INDEX	X0002
92X-5900-E-00379	OVERALL SITE POWER PLAN	E0005
92X-5900-E-00382	DETAILS - SHEET 1	E0009
92X-5900-E-00408	DETAILS - SHEET 3	E0011

FOR INFORMATION ONLY

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
0	CERTIFIED FOR CONSTRUCTION	JMU	N/A	6/13/97

DETAILS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
WASTE UNITS REMEDIATION
SOUTHERN WASTE UNITS - SITE PREPARATION PACKAGE

DRAWING TITLE
ELECTRICAL DETAILS SHEET 5

665

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
T. COLLINS	01/05/97	James E. Cooper	13 June 1997	J. L. COOPER	01/28/97

PLANT/BLDG NO. | FLOOR | SCALE: AS NOTED | CLASS

SUBMITTED FOR APPROVAL | FERNCO ORU APPROVAL: N/A | FERNCO PROJECT NO.: 20400

A-E: JMU DATE 6/13/97

DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.2.3.6 00-90701	92X-5900-E-00376	E0013	0

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: SCEP/P0165

STATE OF OHIO — JAMES COOPER E-56807 — REGISTERED PROFESSIONAL ENGINEER

James E. Cooper 13 June 1997