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FINAL DESIGN
SPECIFICATION PACKAGE
ON-SITE DISPOSAL FACILITY

REVISION 0
MAY 1997

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

prepared by

GeoSyntec Consultants

1100 Lake Hearn Drive, NE, Suite 200
Atlanta, Georgia 30342

under

Fluor Daniel Fernald
Subcontract 95PS005028

No. 22

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SPECIFICATIONS PACKAGE
ON-SITE DISPOSAL FACILITY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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DIVISION 2: SITE WORK

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SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02100 **TITLE:** SURVEYING

Specifications By: (Cognizant Engineer)
Signature: Kara L. Olen — Date: 6/17/96
Printed Name and Title: Kara L. Olen, Project Engineer

Scope and Format Checked By: (Checker)
Signature: Rudolph Bonaparte — Date: 20 Jun 96
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Signature: J.F. Beezlt — Date: 24 Jun 96
Printed Name and Title: J.F. Beezlt, Principal

Overall Review By: (PDP)
Signature: J.F. Beezlt — Date: 24 Jun 96
Printed Name and Title: J.F. Beezlt, Principal

Approved by: (DTL)
Signature: K. W. Cargill — Date: 25 Jun 96
Printed Name and Title: Kenneth W. Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
F	Pre Final Design - EPA Submittal	25 Jun 96			
G	Final Design Package	9 Oct 96			
C	Response to Final Design Comts	14 May 97			

Section 02100

SECTION 02100

SURVEYING

PART 1 GENERAL

1.01 SCOPE

A. This section describes the requirements for surveying, including:
   1. Establishing temporary control and permanent benchmarks.
   2. Establishing a horizontal and vertical project control system based on the monuments established as part of this Section, and other approved existing reference monuments.
   3. Surveys for quantity determinations.
   4. Setting limits and boundaries of construction activities.
   5. Conducting topographic surveys as required to determine amount of work performed for periodic progress payments and final payment prior to Subcontract completion.
   6. Preparing and furnishing as-built drawings.

1.02 RELATED SECTIONS AND PLANS

A. Section 02110 - Clearing, Grubbing, and Stripping

B. Section 02200 - Earthwork

C. Section 02215 - Trenching and Backfilling

D. Section 02225 - Compacted Clay Liner and Cap

E. Section 02230 - Road Construction

F. Section 02240 - Protective and Contour Layers

G. Section 02250 - Vegetative Soil Layer

H. Section 02270 - Erosion and Sediment Control

I. Section 02271 - Riprap

J. Section 02280 - Biointrusion Barrier

K. Section 02605 - High Density Polyethylene (HDPE) Manholes Pipes and Fittings

L. Section 02710 - Granular Drainage Layer

M. Section 02712 - Granular Filter

N. Section 02721 - Culverts

O. Section 02770 - Geomembrane Liner and Cover

P. Section 02831 - Chain Link Fence and Gates

Q. Section 02920 - Topsoil

R. Section 13000 - Borrow Area Management

S. Section 13010 - Impacted Material Placement

T. Section 15000 - Mechanical

U. Construction Quality Assurance (CQA) Plan.

1.03 REFERENCES

A. National Geodetic Survey Standards.

1.04 QUALIFICATIONS

A. A Land Surveyor licensed in the State of Ohio shall provide oversight. Staking shall be in accordance with accepted surveying practices, provisions herein, and subject to Construction Manager approval.

B. Surveying work shall be under the direct supervision of a person who has a least five years of experience in construction staking. Any work performed in referencing or re-establishment of land or United States survey monuments shall be performed by a Ohio-licensed land surveyor.

1.05 SUBMITTALS

A. Submit the following to the Construction Manager for review within 15 calendar days from Notice to Proceed:
   1. Ohio surveyor's license; and
   2. manner of notation; notation shall be consistently applied to all project survey work; the stake marking format and the fieldbook notation shall be compatible.

B. Periodic deliverable data (deliver to Construction Manager, as completed during project):
   1. reduced and checked field notes;
   2. all drawings and sketches; and
   3. electronic file in DXF format or other electronic file approved by the Construction Manager;

C. One complete set of as-built (i.e., "record") survey drawings certified and stamped by Surveyor licensed in the State of Ohio shall be submitted to Construction Manager within 15 days of completion of the project. The Subcontractor shall also provide the Construction Manager with an electronic file in DXF format or other electronic file format approved by the Construction Manager upon final submittal of the record drawings. Three (3) copies of the certified survey record drawings will be required.

1.06 PROJECT RECORD DOCUMENTS

A. Maintain on site, a complete, accurate survey log documenting survey work as it progresses.

B. Maintain on-site, a plan clearly showing all site reference points, survey control points, and benchmarks.

C. Maintain on-site an accurate and current set of marked-up drawings showing "as-built" conditions.

D. Upon completion of each work item as specified in Part 3, prepare and/or update "as-built" drawing.

PART 2 PRODUCTS

2.01 MATERIALS AND SURVEY INSTRUMENTS

A. Provide materials as required to properly perform the surveys, including, but not limited to, instruments, tapes, rods, measures, mounts and tripods, stakes and hubs, nails, ribbons, other reference markers, and all else as required.

B. The survey instruments used for this work shall be precise and accurate to meet the needs of the projects. All survey instruments should be capable of reading to a precision of 0.001 ft and with a setting accuracy of $\pm$ 0.8 seconds.

PART 3 EXECUTION

3.01 GENERAL

A. Maintain accurate and complete notes of surveys:
   1. Handwritten survey notes and information shall be written with lead pencil(s) and entered in "write in rain" notebooks. A copy of the numbered, dated, and signed

field book pages shall be given to the Subcontractor daily for use in checking the work.

2. Electronically collected field survey information shall be collected and backup equipment shall be available in the event of equipment malfunction.
   a. Electronic format for printed output of data collector field survey notes shall be compatible with the approved fieldbook notation format.
   b. Electronic format for printed output of data collector field work shall be compatible with the Subcontractor's and Construction Manager's computer equipment and software for verifying and checking the work. A copy of the data disk shall be submitted to the Construction Manager weekly.

B. During construction of the OSDF, survey notes shall be retained by the Subcontractor and Surveyor. During construction of the OSDF, the Subcontractor and/or Surveyor shall submit surveys to the Construction Manager for review. Prior to the placement of successive soil or geosynthetic layers the Subcontractor shall submit a written statement certifying compliance of the preceding layer thickness and grades to the Construction Manager. Surveys will be required from the Subcontractor prior to approval for the placement for overlying materials by the Construction Manager.

C. The precision of horizontal and vertical controls shall meet or exceed Third-Order Class I and Third-Order accuracies, respectively, as defined by National Geodetic Survey Standards.

D. Conformance check surveys for elevation and for horizontal coordinates shall be to the nearest 0.01 ft and for angles shall be to the nearest 20 seconds.

E. Measurement and payment surveys for elevation and for horizontal distances shall be to the nearest 0.1 ft $\pm$ 0.05 ft.

F. Final "as-built" drawings shall be certified for procedure and accuracy of work and sealed by the Land Surveyor.

G. Perform construction layout surveys in advance of scheduled construction activities. At completion of a survey, provide a copy of the field notes, drawings, or sketches to the Construction Manager for review. The Subcontractor shall allow the CQC Consultant and/or Construction Manager one calendar day for review. The

Subcontractor is responsible for rework and/or construction delays caused by survey or staking errors.

H. Set slope stakes in accordance with accepted surveying practices.

I. Set grade stakes required for construction activities as the work progresses. Set fine grade stakes on all projects for which the plans show a definite grade line.

J. Upon completion of the work, the Subcontractor shall provide the Construction Manager with all original surveying field notes, layouts, computations, and electronic files in standard bound survey notebooks, binders containing electronic file information and two copies each of electronic files compatible with the Construction Manager's computer equipment and software.

K. Protect survey control points. Replace disturbed survey control points at no additional cost.

3.02 SPECIFIC FIELD REQUIREMENTS

A. Establish temporary control points, as necessary, to support construction work activities.

B. Survey Monuments, Accuracy, and Documentation:
   1. Record the following information in survey notebooks for each control point established and for all other surveying:
      a. designation of control point;
      b. state Planar North American Datum (NAD) 1983 Ohio South;
      c. elevation;
      d. date of establishment;
      e. description and sketch of the control point location; and
      f. control points shall be referenced to a minimum of three features that can be seen from the control point.
   2. Document survey work in the field notebooks using the format and procedures described below:
      a. title and consecutive number on the front cover;
      b. consecutively numbered pages;

c. table of contents, indicated by survey task, on the first numbered page;
d. legend indicating symbols used in survey notes;
e. names of survey team for each task;
f. notes on weather, equipment, etc.;
g. date and time on each page to indicate when work was recorded;
h. notes in a uniform character such that they can be interpreted and used by anyone with survey knowledge; and
i. description and/or sketches of the existing survey control used.

C. Preliminary Surveys:
1. Clearing Limit Staking: Stake clearing limits according to the minimum clearing limits identified on the Construction Drawings. Clearing limits stakes shall be flagged and marked "clearing limits".
2. Alignment and Existing Ground Staking: Following clearing operations and before stripping operations begin, preliminary locations of alignments and/or baseline of project features shall be established. Perform topographic surveys to describe original ground features before stripping or excavation begins. The distance between grid points shall not exceed 50 feet, and all breaks shall be noted.
3. Earthwork Staking: Staking for cut and fill limits shall establish the exterior limits of excavations and embankments. The maximum staking interval shall be 50 feet. Stakes shall be prominently noted with description of point, vertical distance to design elevation, and offset distance as applicable. A brightly flagged 4-foot lathe shall be provided with each stake. Flagging color will be designated by the Subcontractor.

D. Final Surveys:
1. Final topography shall be staked at nominal 50-foot intervals. Additionally, the following points shall be staked and noted as applicable.
a. Grade breaks.
b. Points of horizontal curvature and tangency.
c. Points of stationing equation.
2. Structures: Stake structure centerlines or building lines so that the orientation, position, limits, and foundation elevation(s) are positively identified. Mark stakes to reflect the design elevation and offset distance as applicable.

3. Ditches and Channels: Stake ditches, channels and culverts such that the layout remains undisturbed during construction.

3.03 SURVEYS FOR MEASUREMENT AND PAYMENT

A. Perform surveys to determine quantities of work and percent of completed work.

B. Calculate and certify quantities and submit survey results, calculations, and certification to the Construction Manager for review, evaluation, and payment.

3.04 BENCHMARKS

A. Install 3 permanent third order horizontal and vertical points benchmark in the locations indicated on Construction Drawings.
   1. Benchmark shall be referenced horizontally to the state planar North American Datum (NAD), 1983 Ohio and vertically in feet above sea level datum ("sea level datum" refers to the National Geodetic Vertical Datum [NGVD]).
   2. Construct benchmark monument as detailed on Construction Drawings. Each survey mark shall include a corrosion resistant metallic disk which indicates horizontal and vertical coordinates of the survey mark. Each permanent survey benchmark shall also contain a magnet or ferromagnetic rod to allow identification through magnetic detection method.
   3. Survey control standards for the benchmarks shall be in accordance with the following:
      a. for the first facility survey mark established from the known control point, minimum horizontal distance accuracy shall be one foot horizontal to 2,500 ft horizontal;
      b. for each facility survey mark established from the first facility survey mark, minimum horizontal accuracy shall be one foot horizontal distance to 5,000 ft horizontal; and
      c. for the first facility survey mark established from the known control point and for each facility survey mark established from the first facility survey mark, minimum vertical accuracy shall be one inch to 5,000 ft horizontal.

3.05 SURVEYS FOR CONFORMANCE CHECKS AND "AS-BUILT" DOCUMENTS

A. Survey the following surfaces to verify the lines and grades achieved during soil placement and compaction:
   1. for berms, ditches, roads, and other earthwork:
      a. original grade surface;
      b. compacted surface of cut slopes; and
      c. finished grade surface;
   2. for the compacted clay liner:
      a. prepared subgrade surface; and
      b. finished compacted clay liner surface;
   3. for the LDS, LCS, and cover drainage layer:
      a. top surface of preceding layer; and
      b. finished grade surface;
   4. for the biointrusion barrier, granular filter, vegetative soil, and topsoil layers;
      a. top surface of preceding layer; and
      b. finished grade surface; and
   5. for the compacted clay cap:
      a. prepared contouring layer surface; and
      b. finished compacted clay cap surface.

B. Perform conformance check "as-built" surveying immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. Provide the following minimum spacings and locations for survey points:
   1. surfaces with gradients less than 10 percent, survey on a square grid spaced not wider than 50 ft;
   2. on slopes greater than 10 percent, a square grid spaced not wider than 50 ft shall be used, but in any case, a line at the crest, midpoint, and toe of the slope shall be taken;
   3. a line of survey points spaced not more than 50 ft apart shall be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope);
   4. a line of survey points spaced not more than 50 ft apart shall be taken at the top of any pipes or other appurtenances to the liner; and
   5. at the corners and midpoints of the top and bottom of all sumps.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02110 **TITLE:** CLEARING AND GRUBBING

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title: J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neil Davies
Printed Name and Title: R. NEIL DAVIES, SENIOR PROJ. ENG. — Date 10/23/95

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 9 Feb 96 (Date)
Printed Name and Title: MARK H. GLEASON, Assistant Project Engineer

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ — 19 Feb 96 (Date)
Printed Name and Title: Kenneth W Cargill, Associate

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech — ~~24 Feb 96~~ 8 Apr 96 (Date)
Printed Name and Title: ~~Beech, Principal~~ Kenneth W Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	30% Submittal				
B	Preliminary Design for EPA Submittal	14 Dec 95	JFB	RNDavies	MP
C	Intermediate Design	27 Feb 96	MHG	MHG	KWC
D	Intermediate Design - EPA Submittal	8 Apr 96	[illegible]	—	—
F	Pre-final Design EPA Submittal	25 Jun 96	[illegible]	—	—
G	Final Design Package	7 Oct 96	—	—	[illegible]
C	Response to Final Design Cmts	14 May 97	—	—	[illegible]

Section 02110

SECTION 02110

CLEARING, GRUBBING, AND STRIPPING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes clearing, grubbing, and stripping from impacted and non-impacted areas, removing roadways, clay pipe subdrain system, abandoned utilities, borehole grout, and transporting and stockpiling these materials.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02270 - Erosion and Sediment Control

D. Section 13000 - Borrow Area Management

E. Section 13010 - Impacted Material Placement

F. Section 13040 - Control of Fugitive Emissions

G. Surface-Water Management and Erosion Control (SWMEC) Plan.

H. Impacted Materials Placement (IMP) Plan.

1.03 DEFINITIONS

A. Clearing consists of the removal of trees, bushes, vegetation, and other surface debris that are 18 inches above the ground surface.

B. Grubbing consists of the removal of stumps, roots, and vegetation to a depth of 3 feet below the existing ground surface or subgrade elevation, whichever is lower. Grubbing also includes removal of roadways, clay pipe subdrain system, abandoned utilities, and borehole grout associated with abandoned monitoring wells, boreholes,

piezometers, and lysimeters. Removal of roadways shall include removal of road coarses to subgrade elevation.

C. Stripping consists of the removal of the topsoil layer (6 inches minimum) including roots and organic matter, grass, and other material unsuitable for use as subgrade or compacted fill.

D. Impacted material is material requiring disposal in the On-Site Disposal Facility (OSDF). Impacted material is identified on the Construction Drawings, or in the field by the Construction Manager.

1.04 SUBMITTALS

A. Submit Subcontractor's Work Area Plan to the Construction Manager for review within 15 calendar days from Notice to Proceed. Location of the Subcontractor's work area shall be shown on the Construction Drawings. Subcontractor's Work Area Plan shall include the following as a minimum:
   1. location of construction laydown area;
   2. locations of stockpiles for material generated from clearing, grubbing, and stripping operations;
   3. locations of non-impacted ("clean") soil stockpile areas;
   4. location of impacted soil stockpile area; and
   5. layout and typical cross sections of roads within the Subcontractor work area.
   6. location of equipment service area;
   7. construction site access and haul road layout; and
   8. construction utilities layout including construction power and construction water.

PART 2 PRODUCTS

2.01 MATERIALS

Section not used.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment to perform the clearing, grubbing, and stripping activities associated with the work of this Section and with managing the Subcontractor's work area.

PART 3 EXECUTION

3.01 EROSION AND SEDIMENT CONTROL

A. Prior to implementing any of the work described in this Section, install surface-water management and erosion and sediment controls in the area to be disturbed as required by Section 02270 and the SWMEC Plan. Manage surface water and maintain erosion and sediment controls through completion of the Subcontract.

3.02 CLEARING AND GRUBBING

A. Perform clearing and grubbing to the limits as indicated on the Construction Drawings.

B. Perform clearing and grubbing as separate activities.

C. In those areas where only clearing is required, perform clearing in a manner that minimizes disturbance to the existing ground surface.

D. Chip cleared materials of a woody nature to a size that is suitable for use as mulch. Keep cleared material to be chipped as free of soil and other inorganic matter as possible. Cleared material smaller than 3 inches in diameter need not be chipped. Handle chipped material as non-impacted, unless otherwise directed by the Construction Manager.

E. Stockpile cleared material separately in Subcontractor's work area in accordance with the approved Subcontractor's Work Area Plan.

F. Stockpile grubbed material separately in Subcontractor's work area in accordance with the approved Subcontractor's Work Area Plan. Handle materials grubbed from areas designated for impacted soil removal as impacted and stockpile separately from materials grubbed outside the impacted soil removal areas. Provide sheeting (minimum 0.06 inch thick polyethylene) or equal to separate impacted grubbed material from the existing ground surface and to cover the impacted grubbed material to prevent rainfall infiltration. Use sandbags or other means acceptable to the Construction Manager to prevent wind uplift of the plastic sheeting.

G. After completion of grubbing, fill depressions with material meeting the requirements for compacted fill in Section 02200, lightly compact using hand-operated compaction equipment, tracking with a dozer, or other means, and grade to drain.

3.03 STRIPPING

A. Perform stripping within the clearing and grubbing area as indicated on the Construction Drawings. Transport stripped material to the Subcontractor's work area and stockpile separately in accordance with the approved Subcontractor's Work Area Plan. Handle stripping material from impacted areas as impacted material, unless otherwise directed by the Construction Manager. Stockpile non-impacted stripping material separately from impacted material. For non-impacted material, stockpile separately topsoil from roots, grass, and other organics. These latter materials may be stockpiled with non-impacted grubbing material.

B. If soil or weather conditions are unsuitable for stripping, due to precipitation or high wind as determined by the Construction Manager, cease stripping activities until permission to resume stripping activities is obtained from the Construction Manager.

C. Construct stockpiles for non-impacted and impacted stripping materials no steeper than 3H:1V (horizontal:vertical), grade to drain, seal by tracking perpendicular to the slope contours with a dozer, and dress daily during periods when stripping material is placed on, or borrowed from, stockpile. Temporarily cover impacted material stockpiles using plastic sheeting (minimum 0.006-inch thick polyethylene) or other material approved by the Construction Manager. Use sandbags or other means acceptable to the Construction Manager to prevent wind uplift of the plastic sheeting. Install erosion and sediment control measures at the stockpile areas in accordance with Section 02270 and the SWMEC.

D. Implement dust control measures in accordance with Section 13040.

3.04 DISPOSAL OF MATERIALS

A. The Construction Manager will define final disposal or end-use options for clearing, grubbing, and stripping materials that are non-impacted.

B. Materials from clearing, grubbing, and stripping defined in the Construction Drawings or by the Construction Manager as impacted will be evaluated by the Construction Manager to establish that they meet waste acceptance criteria (WAC) for the OSDF. The Construction Manager will direct the Subcontractor to separately stockpile any material not meeting the WAC for the OSDF. The Construction Manager will assume responsibility for management and disposal of this material.

C. Dispose of impacted material meeting the WAC from clearing, grubbing and stripping activities in the OSDF in accordance with Section 13010.

3.05 SURVEYING CONTROL

A. Survey the limits of cleared, grubbed, and stripped surfaces in accordance with Section 02100.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02200 **TITLE:** EARTHWORK

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neil Davis — 10/23/95 (Date)
Printed Name and Title R. NEIL DAVIS Senior Proj. Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 9 Feb 96 (Date)
Printed Name and Title MARK H GLEASON Assistant Project Engineer

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ — 19 Feb 96 (Date)
Printed Name and Title Kenneth W Cargill Associate

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech — 27 Feb 96 8 Apr 96 (Date)
Printed Name and Title ~~BEECH, PRINCIPAL~~ Kenneth W Cargill Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	30% Submittal				
~~B~~	~~Preliminary Design / EPA Submittal~~	~~14 Dec 95~~	~~NA~~	~~NA~~	~~NA~~
B	Report for EPA Submittal	14 Dec 95	NA	NA	NA
C	Intermediate Design	27 Feb 96	—	—	JFB
D	Intermediate Design - EPA Submittal	6 Apr 96			
F	Prefinal Design - EPA Submittal	25 Jun 96			
G	Final Design Package	9 Oct 96			
C	Response to Final Design Cmts	14 May 97			

Section 02200

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.01 SCOPE

A. This Section includes site preparation, excavation, surface water control, excavation dewatering, stockpiling, compacted fill, subgrade preparation and earthwork materials.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02110 - Clearing, Grubbing, and Stripping

C. Section 02215 - Trenching and Backfilling

D. Section 02225 - Compacted Clay Liner and Cap

E. Section 02230 - Road Construction

F. Section 02270 - Erosion and Sediment Control

G. Section 02605 - High Density Polyethylene (HDPE) Manholes, Pipes, and Fittings

H. Section 02930 - Vegetation

I. Section 13000 - Borrow Area Management

J. Section 13040 - Control of Fugitive Emissions

K. Construction Quality Assurance (CQA) Plan.

L. Surface-Water Management and Erosion Control (SWMEC) Plan.

M. Borrow Area Management and Restoration Plan.

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:
   1. ASTM D 698. Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop.
   2. ASTM D 2487. Standard Test Method for Classification of Soils for Engineering Purposes.

B. Reference Reports addressing OSDF and borrow area site subsurface conditions:
   1. "*Geotechnical Investigation Report, On-Site Disposal Facility*" [Parsons, 1995]. This report contains geotechnical data for the subsurface soils in the OSDF area.
   2. "*Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation Data Report, CERCLA/RCRA Unit 2*" [Science Applications International, 1995]. This report presents geotechnical data for the subsurface soils in the OSDF area.
   3. "*Geotechnical Data and Evaluation Report for East and South Field Borrow Areas*" [Parsons, 1996]. This report contains geotechnical data for the subsurface soils in the borrow area.
   4. "*Off-Site Borrow Materials Evaluation*" [Parsons, 1996b]. This report presents geotechnical data for potential off-site borrow sources for OSDF construction materials, including fine and coarse concrete aggregates, pea gravel, and riprap.

1.04 SUBMITTALS

A. Within 15 calendar days of Notice to Proceed, submit to the Construction Manager for review an Earthwork Work Plan. Earthwork Work Plan shall include, at a minimum:
   1. list of equipment proposed for the earthwork;
   2. excavation methods;
   3. dewatering methods and techniques;
   4. coordination of survey requirements for the earthwork;
   5. locations of soil stockpile areas;
   6. coordination of earthwork activities with surface-water management and erosion and sediment control measures;
   7. schedule for earthwork activities;
   8. borrow area requirements;
   9. coordination of fugitive emissions dust control;
   10. plan and measures to be taken during cold weather activities below 32 degrees Fahrenheit (F).

1.05 EXISTING CONDITIONS

A. Existing site surface and subsurface conditions, based on available site data, are indicated on the Construction Drawings and on the reference drawings and in the Reference Reports identified in the "References" Article of this Part.

B. In advance of earthwork in an area, verify the accuracy of existing conditions shown on the Construction Drawings. Immediately notify the Construction Manager in writing of deviations from the existing conditions indicated on the Construction Drawings.

C. The approximate locations of all known underground and above ground utility lines and structures are shown on the Construction Drawings and/or Reference Drawings. Immediately stop work and notify the Construction Manager if other utility lines or structures, not shown on the Construction Drawings and/or Reference Drawings, are encountered during the verification of existing conditions and execution of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Obtain fill for compacted fill from the On-Site Disposal Facility (OSDF) cell excavation included in this Subcontract and stockpiles. Obtain additional compacted fill material, if required, from the on-site borrow area indicated on the Construction Drawings. Operate the borrow area in accordance with Section 13000 and the Borrow Area Management and Restoration Plan.

B. Fill material shall be relatively free of debris, foreign objects, large rock fragments, organics, and other deleterious materials. Do not allow rock fragments larger than 3 inches. Fill material shall classify as GC, SC, SM, ML, CL, or CH according to the Unified Soil Classification System (per ASTM D 2487).

2.02 EQUIPMENT

A. Use compaction equipment to achieve the required minimum soil dry density within the range of acceptable moisture contents.

B. Use hand compaction equipment such as walk-behind padfoot compactor, hand tampers or vibratory plate compactor for compaction in areas inaccessible to large compaction equipment.

C. Use water tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths to provide the required in-place moisture content.

D. Use miscellaneous equipment such as scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment, and other equipment, as necessary for earthwork construction.

PART 3 EXECUTION

3.01 GENERAL

A. Perform construction activities in such a manner that equipment operating in the radiologically controlled areas (RCA) do not operate in non-RCA. Equipment operating in RCA shall be decontaminated before use in non-RCA.

3.02 SITE PREPARATION

A. Install construction safety fence around the construction areas and install construction signs at North Entrance Road crossings, plant road crossings, and construction accesses.

B. Install erosion and sediment controls in the relevant areas of construction as shown on the Construction Drawings and as required by Section 02270. Maintain the erosion and sediment controls for the duration of construction and until the contained areas are vegetated in accordance with Section 02930. Accumulated sediment behind silt fences shall be disposed in the OSDF.

C. Prior to any earthwork activity, perform clearing, grubbing, and stripping as indicated on the Construction Drawings and in accordance with Section 02110.

D. Construct haul roads and access corridors in accordance with the Construction Drawings and Section 02230.

E. Locate manholes, drop structures, monitoring wells, piezometers, lysimeters, utilities, and other subsurface structures in the work area. Protect and maintain or abandon these structures and utilities during the excavation and grading activities in accordance with the Construction Drawings and Reference Drawings.

3.03 SURFACE-WATER CONTROL

A. Prior to installation of surface water and erosion controls, ensure Construction Manager has reviewed the Surface-Water Management and Erosion Control Plan submitted as part of Section 02270.

B. Install surface-water and erosion controls in and around work areas to control runoff and erosion and to prevent surface-water runon into OSDF excavations in accordance with Section 02270. Perimeter controls may include shallow ditches, small berms, or localized regrading.

3.04 EXCAVATION

A. Excavate designated areas to the subgrade elevations or excavation limits shown on the Construction Drawings. Stockpile excavated material in the Subcontractor Work Area for use in subsequent construction as specified by this Section. Prepare the subgrade in accordance with this Section.

B. Excavate all material within the excavation limits, including any rock encountered, regardless of type, character, composition, and condition.

C. Blasting shall not be permitted.

D. Excavated material defined in the Construction Drawings or by the Construction Manager as impacted will be evaluated by the Construction Manager to establish that it meets waste acceptance criteria (WAC) for the OSDF. The Construction Manager will direct the Subcontractor to separately stockpile any material not meeting the OSDF WAC. The Construction Manager will assume responsibility for management and disposal of this material. Dispose of impacted excavated material meeting the OSDF WAC in the OSDF in accordance with Section 13010.

E. Minimize sluffing and caving of the excavation. Over-excavate and fill areas of the excavation that cave or sluff with compacted fill in accordance with this Section.

F. Over-excavate abandoned monitoring wells, borings, and lysimeters within the OSDF perimeter baseline as shown on the Construction Drawings to a minimum depth of 3 feet below subgrade elevation. Fill to subgrade elevation with compacted fill.

G. Do not remove soil from the site or dispose of soil included in this Subcontract except as approved in writing by the Construction Manager.

H. Perform activities in such a manner that hauling equipment transporting non-impacted material does not operate on impacted material haul roads. Decontaminate any equipment that operates on impacted material haul roads or in an impacted area prior to being used for earthwork activities in non-impacted areas.

3.05 EXCAVATION DEWATERING

A. Anticipate seepage of ground water into, and accumulation of surface-water runoff in excavations. Manage ground water and surface-water runoff in excavations in accordance with this Section.

B. Collect ground water that accumulates in the excavation in a toe drain, or other suitable sump, and pump to the Fernald Environmental Management Project (FEMP) Former Production area drain control system, the leachate transmission system or other locations directed by the Construction Manager.

C. Prevent surface water runon from adjacent areas from entering the excavation.

3.06 STOCKPILING

A. Stockpile excavated soils at the areas indicated on the Construction Drawings.

B. Construct stockpiles no steeper than 3H:1V (horizontal:vertical) grade to drain, seal by tracking perpendicular to the slope contours with a dozer, and dress daily during periods when fill is taken from the stockpile. Temporarily cover stockpiles using minimum 12-mil thick polyethylene plastic sheeting, temporary seeding or other approved material. Use sandbags or other means to prevent wind uplift of the plastic sheeting. Install erosion and sediment control measures around stockpile areas in accordance with Section 02270.

C. Stabilize stockpiles that will remain out of active use for a period greater than 6 months by revegetation in accordance with the requirements stated in Section 02930. Alternatively, cover stockpiles with minimum 12-mil thick polyethylene plastic sheeting. Use sandbags or other means to prevent wind uplift of the plastic sheeting.

3.07 SUBGRADE PREPARATION

A. Subgrade material shall consist of soil relatively free of debris, foreign objects, organics, and other deleterious materials.

B. Perform subgrade proofrolling by driving a loaded dump truck (minimum weight of 10 tons per axle and minimum loaded weight of 20 tons) or other pneumatic-tired vehicle, back and forth across the area to be prepared to confirm the firmness of subgrade surface. Overlap the passes such that one set of tires on each pass runs between the two sets of tire tracks from the previous pass. Except for road and access corridor alignment, soils shall not exhibit pumping or develop ruts more than 1 inch in depth. Along roads and access corridor alignments, soils shall not exhibit pumping or develop ruts more than 1/2 inch in depth. Unsuitable soils are soils exhibiting pumping or rutting exceeding the above specified limits.

C. In areas where unsuitable soils are encountered, remove and replace the soil to a minimum depth of 1 foot below the proposed subgrade elevation. Fill the area with compacted fill in accordance with the requirements of this Part. Compact the fill material to at least 95 percent standard Proctor maximum dry density (ASTM D 698). Compact the uppermost lift of compacted fill beneath road and access corridor alignments to at least 100 percent of the standard Proctor maximum dry density.

D. Subgrade for the compacted clay liner or cap shall be constructed, scarified as specified in Section 02225. At other locations where compacted fill is to be placed, prepare the subgrade by scarifying to a depth of 2 inches using the equipment identified in Part 2.

E. In excavations or other areas where water accumulates, implement measures to remove the water in accordance with this Section. Maintain the subgrade surface free of standing water and firm to meet the proofrolling requirements of this Article. Maintain dewatered areas in this condition until overlying construction is complete.

F. Manage surface-water runoff as described in Section 02270 and the Surface-Water Management and Erosion Control Plan.

3.08 COMPACTED FILL

A. Use fill that meets the requirements of Part 2 of this Section. Place the fill to the limits and grades shown on the Construction Drawings.

B. Place compacted fill material on surfaces which are relatively free of debris, branches, vegetation, mud, ice, or other deleterious material.

C. Place compacted fill material in loose lifts with a thickness of 8 inches ± 1 inch. In areas where compaction is to be performed using hand-operated equipment, place the fill material in loose lifts with a loose thickness of 4 inches ± 1 inch.

D. Remove rock particles with a maximum dimension larger than 3 inches.

E. Prior to placing a succeeding lift of material over a previously compacted lift, thoroughly scarify the previous lift to a depth of 2 inches by discing, raking, or tracking with a dozer. Moisture condition the preceding lift in accordance with this Article if the moisture content of the surface of the preceding lift is not within the range of acceptable moisture contents.

F. The trafficking of scarified surfaces by trucks or other equipment, except compaction equipment, is not permitted.

G. The maximum acceptable soil clod size after processing is 3 inches. Reduce clod size by discing, raking, or tracking with a dozer, using a soil stabilizer or other means. Soil clumps, consisting of an agglomeration of smaller clods, will not be considered a clod for purposes of this Article.

H. Except as specified in the Article "Subgrade Preparation" in this Section, compact fill material in each lift to at least 95 percent of its standard Proctor maximum dry density (ASTM D 698). Compact fill at a moisture content within ± 3 percentage points of the standard Proctor optimum moisture content (ASTM D 698).

I. Moisture condition the soil if the moisture content of the soil to be used as compacted fill is not within ± 3 percentage points of the optimum moisture content as determined by ASTM D 698. Use a water truck and spray nozzle for wetting. During wetting or drying, regularly disc, rake, or otherwise mix the material to thoroughly blend the moisture throughout the lift. Use discing, raking, or other appropriate methods to dry the material as required.

J. Do not place frozen fill nor place fill material on frozen subgrade or previously placed compacted fill.

K. Do not compact fill material at temperatures below 32°F, unless otherwise authorized in writing by the Construction Manager.

L. Do not place fill during periods of precipitation. Placement may occur during periods of misting or drizzle, but only if authorized by the Construction Manager.

M. Implement dust control measures in accordance with Section 13040.

3.09 CONSTRUCTION QUALITY REQUIREMENTS

A. CQC Consultant will perform soil conformance testing on compacted fill to establish compliance with this Section. Conformance testing to be performed and testing frequencies are given in the CQA Plan. Provide equipment and labor to assist the CQC Consultant in obtaining conformance samples from excavations, stockpiles, and borrow areas. Identify source(s) of fill material at least 10 calendar days prior to use.

B. CQC Consultant will perform soil performance testing on compacted fill lifts to evaluate compliance with this Section. Performance testing to be performed and testing frequencies are given in the CQA Plan.

C. If CQC Consultant's tests indicate that any portion of the compacted fill does not meet the requirements of this Section, CQC Consultant will delineate the extent of the nonconforming area. Rework the nonconforming area until it meets the requirements of this Section.

3.10 SURVEY CONTROL

A. Survey the limits and elevations of excavations, subgrade, and top of the compacted fill in accordance with Section 02100.

3.11 TOLERANCES

A. Perform the earthwork construction to within ± 0.3 ft of the grades indicated on the Construction Drawings except for subgrade for the compacted clay liner, access corridor, and roads for which earthwork construction shall be within ± 0.1 ft of the grades indicated unless otherwise indicated.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02215 **TITLE:** TRENCHING

Specifications By: (Cognizant Engineer)
Signature: Mark H. Gleason — Date: 9 Feb 96
Printed Name and Title: MARK H. GLEASON, Assistant Project Engineer

Scope and Format Checked By: (Checker)
Signature: K W C — Date: 19 Feb 96
Printed Name and Title: Kenneth W Cargill, Associate

Detailed Requirements Checked by: (Checker)
Signature: K W C — Date: 19 Feb 96
Printed Name and Title: Kenneth W Cargill, Associate

Overall Review By: (PDP)
Signature: Mark H. Gleason — Date: 20 Feb 96
Printed Name and Title: MARK H. GLEASON, ASSISTANT PROJECT ENGINEER

Approved by: (DTL)
Signature: J. F. Beerl — Date: 24 Feb 96
Printed Name and Title: J. F. BEERL, PRINCIPAL

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
C	Intermediate Design	24 Feb 96	—	—	JFB
F	Prefinal Design - EPA Submittal	25 Jun 96	✓	—	—
G	Final Design Package	9 Oct 96	—	—	✓
C	Response to Final Design Cmts	14 May 97	—	—	✓

Section 02215

SECTION 02215

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 SCOPE

A. This Section includes trenching, bedding and backfilling materials, and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02110 - Clearing, Grubbing, and Stripping

C. Section 02200 - Earthwork

D. Section 02270 - Erosion and Sediment Control

E. Section 02605 - High Density Polyethylene (HDPE) Manholes, Pipes, and Fittings

F. Section 02721 - Culverts

G. Section 02714 - Geotextiles

H. Section 02770 - Geomembrane Liner and Cap

I. Section 02772 - Geosynthetic Clay Liner and Cap

J. Section 02930 - Vegetation

K. Section 13040 - Control of Fugitive Emissions

L. Section 13010 - Impacted Material Placement

M. Construction Quality Assurance (CQA) Plan

N. Impacted Materials Placement Plan

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:
   1. ASTM C 136. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   2. ASTM D 698. Standard Test Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixture using a 5.5 Pound Rammer and a 12-inch Drop.
   3. ASTM D 2487. Standard Test Method for Classification of Soils for Engineering Purposes.
   4. ASTM E 946. Standard Test Method for Water Absorption of Bentonite by the Porous Plate Method.

B. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

C. Latest version of Occupational Safety and Health Administration (OSHA) Construction Standards.

D. Reference Reports addressing OSDF and borrow area site subsurface conditions:
   1. "*Geotechnical Investigation Report, On-Site Disposal Facility*" [Parsons, 1995].
   2. "*Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation Data Report, CERCLA/RCRA Unit 2*" [Science Applications International, 1995].
   3. "*Geotechnical Data and Evaluation Report for East and South Field Borrow Areas*" [Parsons, 1996a].
   4. "*Off-Site Borrow Materials - Geotechnical Evaluation Report*" prepared by Parsons, June 1996.

1.04 SUBMITTALS

A. Submit the following to the Construction Manager for review within 45 calendar days from Notice to Proceed:
   1. a list of equipment for trenching and backfilling;
   2. for each source of furnished fill material:
      a. the source of the fill;
      b. the results of tests conducted on each of three fill samples (taken from three different locations within the material stockpile such that the material is fully represented) in accordance with ASTM C 136 and ASTM D 2487.
      c. a 50-pound representative sample of the fill;

d. certification that the embedment fill meets the material requirements of this section; and

3. a specification sheet for the proposed bentonite powder or granules and a 5-pound representative sample of the material.

1.05 EXISTING CONDITIONS

A. Existing site surface and subsurface conditions, based on available site data, are indicated on the Construction Drawings and in the Reference Reports identified in the "References" Article of this Part.

B. In advance of trenching in an area, verify the accuracy of existing conditions shown on the Construction Drawings. Immediately notify the Construction Manager in writing of deviations from the existing conditions indicated on the Construction Drawings.

C. The approximate locations of all known underground and above ground utilities and structures are shown on the Construction Drawings. Immediately stop work and notify the Construction Manager if other utility lines or structures, not shown on the Construction Drawings are encountered during the verification of existing conditions and execution of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish embedment fill material consisting of homogeneous crushed or angular soil, relatively free of metal, roots, trees, stumps, concrete, construction debris, organic matter, or other deleterious material.

B. Furnish manhole embedment fill material classifying as GW, GP, SW, or SP in accordance with the Unified Soil Classification System (per ASTM D 2487), not gap graded, and having a gradation (per ASTM C 136) meeting the requirements for AASHTO No. 89 coarse aggregate presented in Section 703 of the Ohio DOT Specifications.

C. Furnish pipe embedment fill material for HDPE pipes, reinforced concrete pipe (RCP) culverts, aluminum coated corrugated metal pipe (ACCMP) culverts, polyvinyl chloride (PVC) pipes, and gravity drainage inlet structures meeting the requirements

of Section 703.06 of the Ohio DOT Specifications unless otherwise indicated on the Construction Drawings.

D. Furnish manhole granular filter material at the locations described in this Section meeting the requirements of Section 703.06 of the Ohio DOT Specifications.

E. Obtain trench backfill material for HDPE pipes, RCP culverts, ACCMP culverts, PVC pipes, and gravity drainage inlet structures, and manholes that meets the material requirements for compacted fill as specified in Section 02200.

F. Obtain trench backfill material for liner system anchor trenches from OSDF excavation that meet the material requirements for compacted clay liner material as specified in Section 02225.

G. Furnish bentonite powder or granules consisting of Wyoming-grade bentonite containing at least 85 percent sodium montmorillonite, and a water adsorption of at least 500 percent when tested in accordance with ASTM E 946.

H. Furnish a minimum 4-inch wide plastic underground warning tape with suitable warning legend and with integral magnetic locator wire to mark all HDPE and PVC pipes, electrical conduits, control cables, and any other underground utilities as shown on the Construction Drawings.

I. Furnish pipe line marker signs at the intervals shown on the Construction Drawings.

2.02 EQUIPMENT

A. Furnish, operate, and maintain all equipment necessary to perform the work of this Section.

PART 3 EXECUTION

3.01 GENERAL

A. Review Existing Site Utility Drawings and identify and stake existing utilities to locate existing utilities in vicinity of trench lines.

B. In areas of trenching and backfilling, maintain and protect existing above and below ground utilities.

C. Do not damage or disturb survey benchmarks, finished construction, and existing structures.

D. Do not damage or disturb above and below grade utilities that are to remain.

3.02 TRENCHING

A. Trench subsoils for placement of pipes, culverts, gravity inlet structures, anchor trenches, and HDPE manholes to the depths and minimum dimensions shown on the Construction Drawings. Manage excavated material in accordance with Section 02200.

B. Use sheeting and bracing where necessary to maintain the safety and stability of all slopes and trenches and to protect adjacent structures. Satisfy all applicable local, state, and federal requirements for slope and trench sheeting and bracing, including requirements of the Occupational Safety and Health Administration (OSHA) Construction Standards. Provide sheeting and bracing materials on site prior to the start of trenching. Adjust spacing and arrangement of sheeting and bracing as required by conditions encountered. Remove sheeting and bracing as backfill progresses. Fill any voids left from sheeting or bracing withdrawal with compacted fill or other approved material.

C. Protect and maintain the trench bottom. Remove rock fragments or raveled materials that collect on the trench bottom. Backfill any overexcavation with pipe embedment fill. Excavate any soft subgrade encountered at the trench bottom and backfill to subgrade elevation with embedment fill or compacted fill.

D. In fill areas, perform trenching only after compacted fill has reached an elevation of at least 2 feet above the elevation of the top of the pipe.

E. Limit the maximum length of open trench to 200 feet in advance and 200 feet behind pipe installation.

F. Dewater trenches (including anchor trenches during geosynthetics installation) and HDPE manhole and gravity drainage inlet structure excavations. Perform dewatering in accordance with Section 02200.

G. Stockpile excess material from trenching in accordance with Section 02200.

3.03 BACKFILLING

A. General
   1. Do not backfill with frozen or saturated material.
   2. Do not backfill over frozen, wet, or soft subgrade.
   3. Do not disturb or damage piping, geosynthetics or HDPE manholes in trenches and excavations during backfilling.
   4. Do not use heavy compaction equipment which exerts greater than 5 pounds per square inch ground pressure over piping or geosynthetics that is covered by less than 12 inches of backfill material.

B. Manhole Excavations
   1. For HDPE manholes, place and compact manhole embedment fill as follows.
      a. Place manhole embedment fill material in lifts to the elevation of the bottom of the HDPE manhole. Place material in 7-inch ±1-inch thick loose lifts.
      b. Compact the manhole embedment fill with a minimum of 4 passes of a vibratory plate compactor prior to placing manhole.
      c. Place HDPE manholes and manhole flotation anchor on the compacted manhole embedment fill.
      d. Place manhole embedment fill in the annulus between the HDPE manhole and the excavation, the minimum annulus width shall be 3.5 feet horizontally and 6 inches beneath the manholes, in 7-inch ±1-inch thick loose lifts.
      e. Compact with a minimum of 4 passes with a vibratory plate compactor to 3.5 feet below the manhole cover slab.
      f. Place manhole granular filter material above the manhole embedment fill to a thickness of 6 inches.
      g. Compact manhole granular filter material with a minimum of 4 passes of a vibratory plate compactor.
      h. Place compacted fill above the manhole granular filter material to the bottom of the manhole cover slab in accordance with Section 02200.

C. Placement of pipe embedment fill for pipes, culverts, and gravity inlet structures, except for electrical conduits (Section 16110):
   1. Place pipe embedment fill in 7-inch ±1-inch thick loose lifts to the elevation of the bottom of the pipe, culvert, or gravity drainage inlet structure.
   2. Compact pipe embedment fill with a minimum of 4 passes of a vibratory plate compactor prior to placing pipe.
   3. Place pipe, culvert, or gravity drainage inlet structures on top of the compacted pipe embedment fill.

4. For pipes or culverts 12 inches in diameter or less, place additional pipe embedment fill on the sides and gently hand tamp the fill around the sides as needed to insure that intimate contact between the pipe or culvert and the embedment fill is maintained below the spring line of the pipe. Continue placing pipe embedment fill until it is even with the top of the pipe. Compact the pipe embedment fill with a minimum of 4 passes of a vibratory plate compactor. Do not compact on top of the pipe unless a minimum of 12 inches of trench backfill separates the compactor from the top of the pipe.
5. For pipes or culverts greater than 12 inches in diameter, with the exception of the 36-inch diameter ACCMP culverts in the sedimentation basin outlet structure, place pipe embedment fill in 7-inch $\pm$1-inch thick loose lifts to the limits shown on the Construction Drawings. Compact each lift with a minimum of 4 passes of a vibratory hand compactor. Do not use pipe embedment fill for the 36-inch diameter ACCMP culvert in the Sedimentation Basin outlet structure.
6. For HDPE pipe trenches between HDPE manholes, and between HDPE manholes and the cell outlet, and horizontal monitoring well pipe trenches, construct a soil-bentonite plug in the trench to the limits shown in the Construction Drawings. Prepare soil-bentonite mixture consisting of pipe embedment fill at its natural moisture content mixed with minimum 10 percent (by dry weight basis) bentonite powder or granules by thoroughly mixing with a portable cement mixer or other suitable method. Place and compact the soil-bentonite mixture in the same manner as the pipe embedment fill.

D. Placement of backfill material for pipes, culverts, and gravity drainage inlet structures:
   1. After placement and compaction of embedment fill, place the first lift of backfill material in a 12-inch loose lift. Place subsequent lifts of trench backfill material in 8-inch $\pm$1-inch loose lifts.
   2. Compact each lift to 95 percent of the maximum standard Proctor dry unit weight and at a moisture content within $\pm$3 percent of the optimum moisture content as determined by ASTM D 698.

E. Trench backfill material for liner system anchor trench:
   1. Place the anchor trench backfill material in 8-inch thick ($\pm$1 inch) loose lifts if full size compaction equipment will be used, and in 4-inch thick ($\pm$1 inch) loose lifts if hand compaction equipment will be used.
   2. Compact the anchor trench backfill material to the minimum dry density and range of acceptable moisture contents required for compacted clay liner material in Section 02225.

F. Place underground warning tape in trench backfill 12 inches below finished grade and directly above all HDPE pipes, PVC pipes, and electrical conduits.

3.04 CONSTRUCTION QUALITY REQUIREMENTS

A. The CQC Consultant will perform conformance testing on the embedment fill and trench backfill materials to establish compliance with this Section and Sections 02200 and 02225, as applicable. The conformance testing to be performed and the testing frequencies are given in the CQA Plan.

B. The CQC Consultant will perform performance testing on compacted fill and backfill materials to establish compliance with this Section and Section 02200, as applicable. The performance testing to be performed and the testing frequencies are given in the CQA Plan.

3.05 SURVEY CONTROL

A. Survey the limits and elevations of the bottom of the liner system anchor trench in accordance with Section 02100.

3.06 TOLERANCES

A. Excavate the liner system anchor trench within 0 to +0.2 feet of the depth indicated on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02225 **TITLE:** COMPACTED CLAY LINER AND CAP

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title J.F. BEECH PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neil Davis — 10/23/95 (Date)
Printed Name and Title R. NEIL DAVIS Senior Proj. Eng.

Detailed Requirements Checked by: (Checker)
Signature Not Used for 30% Submittal — 10/24/95 (Date)
Printed Name and Title Patrick Rhodes / PATRICK RHODES STAFF ENGINEER

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title MARK H. GLEASON Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for 30% Submittal — 22 Feb 96 (Date)
Printed Name and Title J.F. Beech PRINCIPAL Kenneth W Cargill Associate 14 May 96

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
0A	30% Submittal				
B	Reprint for EPA Submittal	16Dec95	NA	NA	NA
C	Intermediate Design	22Feb96	—	—	JFB
F	Pre final Design EPA Submittal	25 Jun-96	—	—	
G	Final Design Package	9 Oct 96	—	—	—
C	Response to Final Design Cmts	14 May 97	—	—	—

SECTION 02225

COMPACTED CLAY LINER

PART 1 GENERAL

1.01 SCOPE

A. This section includes compacted clay liner and cap products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02240 - Protective Layer

D. Section 02772 - Geosynthetic Clay Liner

E. Section 13000 - Borrow Area Management

F. Section 13040 - Control of Fugitive Emissions

G. Construction Quality Assurance (CQA) Plan

H. Borrow Area Management and Restoration Plan

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:
   1. ASTM D 422. Standard Test Method for Particle-Size Analysis of Soils.
   2. ASTM D 698. Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using a 5.5 pound Rammer and a 12-in. drop.
   3. ASTM D 2487. Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   4. ASTM D 4318. Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

5. ASTM D 5084. Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter.
6. ASTM E 946. Standard Test Method for Water Absorption of Bentonite by the Porous Plate Method.

B. Reference Reports addressing OSDF and borrow area site subsurface conditions:
1. "*Geotechnical Investigation Report, On-Site Disposal Facility*" [Parsons, 1995]. This report contains geotechnical data for the subsurface soils in the OSDF area.
2. "*Disposal Facility Pre-Design Geotechnical Investigation, Soil Investigation, Soil Investigation Data Report, CERCLA/RCRA Unit 2*" [Science Applications International, 1995]. This report presents geotechnical data for the subsurface soils in the OSDF area.
3. "*Geotechnical Data and Evaluation Report for East and South Field Borrow Areas*" [Parsons, 1996a]. This report contains geotechnical data for the subsurface soils in the borrow area.

C. Test Pad Program Final Report, On-Site Disposal Facility, Volumes I-III, [GeoSyntec, 1996].

1.04 SUBMITTALS

A. Submit a list of the equipment to be used for compacted clay liner and cap construction to the Construction Manager for review within 30 calendar days from Notice to Proceed. The soil processing and compaction equipment proposed shall be as specified in Part 2 of this Section. If alternative equipment is proposed, provide a detailed demonstration that the proposed equipment is in all aspects functionally equivalent to the equipment described in Part 2. Also submit proposed method for removal of rock particles as specified in this section.

B. Submit to the Construction Manager for review within 30 calendar days from Notice to Proceed, a specification sheet for the proposed bentonite powder or granules and a 5-pound representative sample of the material.

PART 2 PRODUCTS

2.01 MATERIALS

A. Obtain material for compacted clay liner construction from the On-Site Disposal Facility (OSDF) excavation included in this Subcontract and stockpiles indicated on the Construction Drawings. Obtain additional clay liner and cap material, if required, from the on-site borrow area indicated on the Construction Drawings. Segregate granular lenses and other nonconforming soils in the excavation or borrow area and use only those materials meeting the material requirements of this Section. Minor granular lenses that when readily mixed with surrounding soil result in a material that meets the material requirements of this Part need not be segregated.

B. If borrow area is used, operate in accordance with Section 13000.

C. Identify sources of clay liner and cap materials at least 10 calendar days prior to use for conformance testing of soil by the CQC Consultant. Clay liner and cap material meeting the requirements specified in this section shall be used in the clay liner and clay cap construction.

D. Compacted clay liner and cap material shall meet the following requirements:
   1. be classified according to the Unified Soil Classification System (ASTM D 2487) as lean clay (CL) or fat clay (CH);
   2. have a plasticity index (ASTM D 4318) of at least 10 percent, but less then 40 percent;
   3. meet the following particle size requirements (ASTM D 422):
      a. 100 percent of the particles having a maximum dimension not greater than 2 inches (50 mm);
      b. not more than 10 percent of the particles, by weight, having a dimension greater than 0.75 inches (20 mm);
      c. not less than 50 percent of the particles, by weight, passing through the standard U.S. No. 200 standard sieve; and
      d. not less than 15 percent of the particles, by weight, having a maximum dimension not greater than 0.002 mm.
   4. have a hydraulic conductivity of not more than 1×10^{-7} centimeter per second (cm/s) when constructed in accordance with this Section and when tested in the laboratory in accordance with ASTM D 5084 at a confining pressure of 5 pounds per square inch (psi).

E. Obtain water for moisture conditioning clay liner or cap material from the on-site water source shown on the Construction Drawings.

F. Furnish bentonite powder or granules consisting of Wyoming-grade bentonite containing at least 85 percent sodium montmorillonite, and a water adsorption of at least 500 percent when tested in accordance with ASTM E 946.

G. Prepare soil-bentonite mix consisting of a minimum of 10 percent by weight bentonite powder or granules mixed with clay liner and cap material (by dry weight basis).

2.02 EQUIPMENT

A. Equipment for excavation shall be as specified in Section 02200.

B. Use hauling and placing equipment to place clay liner and cap material in uniform loose lift thicknesses as specified in Part 3 of this Section.

C. Use tank trucks, pressure distributors soil stabilizers, and other equipment designed to apply water uniformly and in controlled quantities to moisture condition clay liner material.

D. Use grading equipment to achieve uniform layers, sections, and smoothness of grade for compaction and drainage.

E. Use the following soil stabilizer equipment for processing clay liner and cap material:
   1. Caterpillar SS250 soil stabilizer with water spray bar; or
   2. HAMM RACO 250 soil stabilizer with water spray bar; or
   3. Equivalent soil stabilizer with water spray bar equipment approved in accordance with Part 1 of this Section.

F. Use the following soil stabilized equipment for processing clay liner and cap material:
   1. Caterpillar 815B; or
   2. Equivalent compaction in areas inaccessible to large compaction equipment.

G. Use hand compaction equipment such as a walk-behind pad-foot compactor or hand tamper for compaction in areas inaccessible to large compaction equipment.

H. Use the following equipment for sealing the compacted clay liner and cap lift surfaces:
   1. Caterpillar CS563; or
   2. equivalent self-propelled smooth drum roller approved in accordance with Part 1 of this Section.

PART 3 EXECUTION

3.01 GENERAL

A. Perform construction activities in such a manner that equipment operating in radiologically controlled areas (RCA) do not operate in non-RCAs. Equipment operating in RCAs shall be decontaminated before use in non-RCAs.

B. Dust control measures for compacted clay liner and clay cap construction activities shall be in accordance with Part 6, Statement of Work, of the Subcontract Documents.

C. Continuously remove visible rock particles with a maximum dimension larger than 2 inches during clay liner and cap material placement, processing, and compaction.

3.02 COMPACTED CLAY LINER PERFORMANCE CRITERIA

A. The moisture content and dry density of clay liner material placed shall be within the acceptable permeability zone (APZ) defined as those combinations of moisture content and dry density that meet the following three criteria: (i) moisture content that results in a degree of soil saturation of at least 90 percent; (ii) moisture content not greater than 3 percentage points wet of the standard Proctor optimum moisture content (ASTM D 698); and (iii) dry unit weight of at least 95 percent of the standard Proctor maximum dry unit weight (ASTM D 698). The CQC Consultant will provide the Subcontractor with specific moisture content ranges and associated dry unit weights that satisfy these criteria for each material used in compacted clay liner and cap construction.

B. The moisture content and dry density of clay cap material placed shall be within the acceptable permeability zone (APZ) defined as those combinations of moisture content and dry density that meet the following three criteria: (i) moisture content that results in a degree of soil saturation of at least 90 percent; (ii) moisture content not greater than 3 percentage points wet of the standard Proctor optimum moisture content (ASTM D 698); and (iii) dry unit weight of at least 95 percent of the standard Proctor maximum dry unit weight (ASTM D 698). The CQC Consultant will provide the Subcontractor with specific moisture content ranges and associated dry unit weights that satisfy these criteria for each material used in compacted clay cap construction.

3.03 MATERIAL PLACEMENT

A. Place rock particles removed from the clay liner and cap material in a stockpile in an area approved by the Construction Manager.

B. Do not place compacted clay liner and cap material until the CQC Consultant completes evaluation of that material and performance evaluation of previous work, including evaluation of Subcontractor's survey results for previous work.

C. Prepare subgrade in accordance with Section 02200 and survey in accordance with Section 02100 prior to scarification. Scarify the surface on which the first lift of clay liner material is to be placed to a depth of 2 inches using the soil stabilizer. Moisture content for the subgrade shall be as established for the compacted clay liner and cap performance criteria.

D. Prepare contouring layer in accordance with Section 02240 and survey in accordance with Section 02100 prior to beginning compacted clay cap construction. Scarify the surface on which the first lift of clay cap material is to be placed to a depth of 2 inches by tracking with a dozer. Moisture content for subgrade shall be as specified for compacted clay liner and cap performance criteria.

E. Construction compacted clay liner and cap to the grades and minimum thicknesses shown on the Construction Drawings. The thickness of the compacted clay liner and cap at any location shall be measured perpendicular to the plane of the slope at that location.

F. Prior to compacted clay liner or cap placement, ensure the surface on which the material is to be placed is relatively free of debris, branches, vegetation, mud, ice, or other deleterious material.

G. In areas where compaction is to be performed using the Caterpillar 815B, or equivalent equipment, place the clay liner and cap material in loose lifts with a thickness of 7 to 8 inches. In areas where compaction is to be performed using hand-operated equipment, place the clay liner and cap material in loose lifts with a loose thickness of 4 inches $\pm$ 1 inch. Loose lift thicknesses will be measured after spreading but before processing with the soil stabilizer.

H. Do not place a succeeding lift of material over any area until the CQC Consultant has completed performance testing of the preceding lift in that area.

I. Prior to compacting a succeeding lift of material over a previous lift, thoroughly scarify the previous lift to a depth of 2 inches using the soil stabilizer. Scarification may occur either before of after placement of the preceding lift. In either case, set the stabilizer mix depth appropriately to achieve the required depth of scarification. Moisture condition the preceding lift in accordance with this section. In scarifying lifts of the compacted clay cap, do not use a procedure that results in contamination of the soil stabilizer by impacted material of the contouring layer.

J. The trafficking of scarified surfaces by trucks or other equipment, except compaction equipment, is not permitted.

K. The maximum acceptable soil clod size after processing with the soil stabilizer is 3 inches. Reduce clod size using the soil stabilizer. Soil clumps, consisting of an agglomeration of smaller clods, will not be considered a clod for purposes of this section. After making each pass of the soil stabilizer, remove visible rock particles with a maximum dimension larger than 2 inches. A minimum of two passes of the soil stabilizer shall be required.

L. Moisture condition the loose lift of clay liner and cap material prior to compaction. Distribute the moisture through the loose lift using the soil stabilizer. Moisture condition, if necessary, as follows:
   1. If the clay liner and cap material is drier than required, process the material with the soil stabilizer to obtain a uniform consistency, distribute water uniformly into the soil to achieve the required moisture content, then process the material again with the soil stabilizer to obtain uniform mixing. The CQC Consultant will check the moisture content of the soil at the completion of these three steps and/or after compaction. Repeat the latter two steps if the measured moisture content is not within the acceptable range given in Part 3.01 of this section.
   2. If the clay liner and cap material is wetter than required, dry the material by processing with the soil stabilizer. The CQC Consultant will check the moisture content of the soil at the completion of processing or compaction. Repeat the processing if the measured moisture content is not within the acceptable range specified in this section.
   3. After making each pass of the soil stabilizer, remove visible rock particles with a maximum dimension larger than 2 inches.

M. Do not place frozen clay nor place clay on frozen ground.

N. Do not place compacted clay liner or cap material at temperatures below 32 degrees Fahrenheit (°F), unless otherwise authorized in writing by the Construction Manager. If cold weather (<32°F) clay material placement and/or compaction in implemented,

prepare and submit a written plan to the Construction Manager describing proposed cold weather placement and compaction procedures and the weather parameters for which cold weather operations are proposed. Include protection of work in accordance with the requirements of the succeeding item.

O. If compacted clay liner or cap material freezes after compaction, remove the frozen material, scarify the remaining unfrozen material, and replace material and compact in accordance with this section. Do not reuse the frozen material until it has thawed and been reprocessed to an acceptable moisture content. When freezing conditions are anticipated, prepare a written plan for review by the Construction Manager. The plan shall outline the measures to be taken for placement, compaction, and protection of clay liner and cap material. Protective measures may include the use of thermal blankets or a sacrificial soil layer.

P. Do not place clay liner or cap material during periods of precipitation. Placement may occur during periods of misting or drizzle, but only if approved by the Construction Manager.

Q. Prepare the last lift of the compacted clay liner or cap to meet the minimum thicknesses and grades indicated on the Construction drawings. Meet the construction tolerance requirements given in this part.

R. Prepare the surface of the last lift to be acceptable for placement of the overlying geosynthetic clay liner or cap in accordance with Section 02772.

3.04 MATERIAL COMPACTION

A. Compact loose lifts using a minimum of six passes of the compaction equipment. Provide as many additional passes as necessary to achieve performance criteria specified in this section.

B. For a dual-drum compactor with laterally-separated front and rear drums, a compaction pass is defined as one trip up and a staggered trip back to cover the uncompacted area between the drums (i.e., one full coverage).

C. Compact corners, around pipes, around liner penetration boxes, and other areas inaccessible to driven compaction equipment using hand operated equipment.

D. Avoid crusting and desiccation of the lift surface. In the event crusting or desiccation occurs, rework the soil in accordance with the "Protection of Work" Article of this section.

E. Construct the transition from an existing full-depth section of compacted clay liner or cap to the beginning of an adjacent section that is to be constructed subsequently by sloping (cutting back) the end of the full-depth section at 5:1 (horizontal:vertical) or flatter, scarifying the slope of the existing full-depth section at the transition, and then immediately begin placing the adjacent lifts of material.

F. Operate compaction equipment to prevent damage to, or disturbance of, leachate piping, liner penetration boxes, and geosynthetic materials.

3.05 CONSTRUCTION QUALITY REQUIREMENTS

A. The CQC Consultant will perform soil conformance testing on compacted clay liner and cap material to establish compliance with this section. The conformance testing to be performed and testing frequencies are given in the CQA Plan. Provide equipment such as shovels, hand augers, and backhoes and labor to assist the CQC Consultant in obtaining conformance samples from excavations, stockpile, and borrow areas. Identify source(s) of clay liner and cap materials at least 10 calendar days prior to use.

B. The CQC Consultant will perform soil performance testing on compacted lifts of clay liner and cap material to evaluate compliance with this section. The performance testing to be performed and testing frequencies are given in the CQA Plan.

C. If the CQC Consultant's tests indicate that any portion of the compacted clay liner and cap does not meet the requirements of this section, the CQC Consultant will delineate the extent of the nonconforming area. Rework the nonconforming area until acceptable test results are obtained by the CQC Consultant.

3.06 PERFORATIONS

A. Backfill perforations in the compacted clay liner and cap resulting from sand-cone tests, survey stakes, or other activities. The CQC Consultant will identify perforations requiring backfill. Perforations resulting from nuclear density tests will be filled by the CQC Consultant.

B. Prepare soil-bentonite mix for use in backfilling of perforations as specified. The mix shall consist of a minimum of 10 percent by weight bentonite powder or granules mixed with clay liner or cap material by dry weight basis.

C. Backfill perforations with soil-bentonite mix. Place soil-bentonite mix in these perforations in approximately 3-inch thick loose lifts and thoroughly compact.

D. Perforations in the compacted clay liner and cap resulting from nuclear density testing will be backfilled with bentonite powder or granules or the soil-bentonite mix furnished by the Subcontractor and compacted by hand tamping by the CQC Consultant.

3.07 SURVEY CONTROL

A. Survey the limits and elevations of the finished surface of the compacted clay liner and cap in accordance with Section 02100.

3.08 TOLERANCE

A. Construct the compacted clay liner and cap to within +0.1 feet of the thickness shown on the Construction drawings.

B. Construct the compacted clay liner and cap to within ±0.1 feet of the grades indicated on the Construction drawings.

3.09 PROTECTION OF WORK

A. Avoid crusting and desiccation cracking of compacted clay liner and cap. Regularly moisture condition the surface of the compacted clay liner and cap. If cracking is observed, scarify, moisture condition, and recompact the surface. Seal roll the surface of the clay to reduce evaporation, or alternatively protect exposed surfaces using light-colored or translucent membranes, such as Visqueen, that will inhibit drying of the clay.

B. Repair areas of crusting or desiccation cracking. Scarify the surface of such areas to a depth of 2 inches or to the depth of the desiccation, whichever is greater, and then moisture condition, process, and recompact the area in accordance with the full requirements of Part 3 of this section.

C. Seal roll the compacted clay liner or cap surface at the end of every working day and when precipitation is forecast.

D. Seal roll and make smooth the compacted clay liner or cap surface on which the geosynthetic clay liner is to be placed to facilitate intimate contact between the geosynthetic clay liner and the underlying compacted clay liner or cap surface.

E. Place a clay protection layer over the compacted clay liner or cap if construction of overlying layers or lifts is to be delayed more than 10 calendar days. Compact the

clay protection layer by tracking. The loose thickness of the protective layer shall be 8 inches (nominal).

F. Remove the compacted clay protection layer prior to placement of overlying lifts or the geosynthetic clay liner. The protection layer may be removed in sections in coordination with ongoing construction. Where the protection layer is removed, prepare the surface to receive an overlying lift or the geosynthetic clay liner and the finished surface as required by this section.

G. Protect the compacted clay liner from freezing as specified in this section.

H. Do not apply synthetic sealants or other chemical treatments to the compacted clay liner and cap material.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02230 **TITLE:** ROAD CONSTRUCTION

Specifications By: (Cognizant Engineer)
Signature: Mark H. Gleason — Date: 9 Feb 96
Printed Name and Title: Mark H. Gleason, Assistant Project Engineer

Scope and Format Checked By: (Checker)
Signature: B.B. Mazanti — Date: 20 Feb 96
Printed Name and Title: B. B. Mazanti, Consultant

Detailed Requirements Checked by: (Checker)
Signature: B.B. Mazanti — Date: 20 Feb 96
Printed Name and Title: B. B. Mazanti, Consultant

Overall Review By: (PDP)
Signature: Mark H. Gleason — Date: 20 Feb 96
Printed Name and Title: MARK H. GLEASON, Assistant Project Engineer

Approved by: (DTL)
Signature: T.E. Beck — Date: 21 Feb 96
Printed Name and Title: BECK, PRINCIPAL

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
C	Intermediate Design	21 Feb	—	—	JFB
F	Pre Final Design - EPA Submittal	25 Jun 96	[illegible]	—	—
G	Final Design Package	7 Oct 96	—	—	[illegible]
C	Response to Final Design Comments	14 May 97	—	—	[illegible]

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SECTION 02230

ROAD CONSTRUCTION

PART 1: GENERAL

1.01 SCOPE

A. This Section includes impacted material haul roads, construction haul roads, access corridors, and other roads associated with this Subcontract.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02110 - Clearing, Grubbing, and Stripping

C. Section 02200 - Earthwork

D. Section 02270 - Erosion and Sediment Control

E. Section 02714 - Geotextiles

F. Section 13040 - Control of Fugitive Emissions

G. Construction Quality Assurance (CQA) Plan

H. Surface-Water Management and Erosion Control Plan

1.03 REFERENCES

A. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

B. "Off-Site Borrow Materials Geotechnical Evaluation Report, Operable Unit 2, Project Order 154" (Revision 0), prepared by Parsons, June 1996.

1.04 SUBMITTALS

A. For each source of subbase material, base material, and asphalt concrete aggregate material, submit the following to the Construction Manager for review within 45 calendar days from Notice to Proceed:
   1. the source of the material;
   2. test results conducted on each of three samples of the material (taken from three different locations within the material stockpile such that the material is fully represented) which demonstrates the material meets the requirements of the Items from the Ohio DOT Specifications given in Part 2 of this Section.
   3. a 50-pound representative sample of the proposed material; and
   4. certification from the supplier that the material meets the material requirements of this Section.

B. For each source of asphalt concrete, submit the following to the Construction Manager within 45 calendar days from Notice to Proceed for review and approval:
   1. asphalt concrete mix design;
   2. the required mix temperature for placement; and
   3. certification, signed by both the Subcontractor and the asphalt concrete supplier, that the asphalt concrete meets the requirements of this Section.

PART 2: PRODUCTS

2.01 MATERIALS

A. Furnish subbase material consisting of homogenous crushed rock or angular soil free of organic matter or other deleterious materials, which meets the requirements of Item 310.02 and 703.04(2) of the Ohio DOT Specifications.

B. Furnish subbase material and base material consisting of crushed rock or angular soil free of organic matter or other deleterious materials, which meets the requirements of Item 304.02 and 703.04 of the Ohio DOT Specifications.

C. Furnish prime coat meeting the requirements of Item 408 of the Ohio DOT Specifications.

D. Furnish asphalt concrete meeting the requirements of Item 402.02 of the Ohio DOT Specifications.

E. Furnish a separator geotextile meeting the requirements of Section 02714.

F. Furnish compacted fill material meeting the requirements of Section 02200.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to construct roads in accordance with the requirements of this Section.

PART 3: EXECUTION

3.01 GENERAL

A. Implement dust control measures in accordance with Section 13040 during road construction.

B. Install erosion and sediment controls as necessary accordance with Section 02270.

C. Perform clearing, grubbing, and stripping as necessary accordance with Section 02110.

3.02 SUBGRADE PREPARATION

A. Prepare subgrade for road construction in accordance with Section 02200.

3.03 GEOTEXTILE PLACEMENT

A. Install the geotextile separator in accordance with the requirements of Section 02714.

3.04 SUBBASE AGGREGATE

A. Construct the subbase aggregate to the thicknesses, grades, and limits shown on the Construction Drawings.

B. Place the subbase material on top of the geotextile separator by end dumping onto previously placed subbase aggregate and carefully spreading using a track dozer. Do not operate equipment directly on the geotextile. Spread fill over the geotextile in accordance with Section 02714.

C. Place and compact the subbase layer in accordance with the requirements of Item 310.03 of the Ohio DOT Specifications. These requirements include construction of a test section.

3.05 BASE AGGREGATE

A. Construct the base layer to the thicknesses, grades, and limits shown on the Construction Drawings.

B. Place the base layer in accordance with requirements of Item 304.03 of the Ohio DOT Specifications.

C. Compact the base layer in accordance with the requirements of Item 304.04 of the Ohio DOT Specifications.

3.06 PRIME COAT

A. Install prime coat only in areas shown on the Construction Drawings.

B. Install prime coat in accordance with the requirements of Item 408 of the Ohio DOT Specifications.

3.07 ASPHALT CONCRETE SURFACE COARSE

A. Place asphalt concrete only in areas shown on the Construction Drawings.

B. Place and compact asphalt concrete in accordance with the requirements of Items 401 and 402 of the Ohio DOT Specifications.

3.08 CONSTRUCTION QUALITY REQUIREMENTS

A. CQC Consultant will perform conformance testing on road components to establish compliance with this Section. Conformance testing to be performed and testing frequencies are given in the CQA Plan.

3.09 SURVEY CONTROL

A. Survey the locations and elevations road construction in accordance with Section 02100 of these Specifications.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02240 **TITLE:** PROTECTIVE AND CONTOUR LAYERS

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature — 23 Oct 95 (Date)
Printed Name and Title Kenneth W Cargill, Associate

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 9 Feb 95 (Date)
Printed Name and Title MARK H. GLEASON, Assistant Project Engineer

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ — 19 Feb 96 (Date)
Printed Name and Title Kenneth W Cargill, Associate

Approved by: (DTL)
Signature Not Used for 30% Submittal — 8 Apr 96 (Date)
Printed Name and Title ~~BEECH, PRINCIPAL~~ Kenneth W Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
0A	30% Submittal				
B	Reprint for EPA Submittal	14 Dec 95	NA	NA	NA
C	Intermediate Design	9 Feb 96	[illegible]		JFB
D	Intermediate Design - EPA Submittal	8 Apr 96	[illegible]	—	—
F	Prefinal Design - EPA Submittal	26 Jun 96	[illegible]	—	—
G	Final Design Package	9 Oct 96	—	—	[illegible]
C	Response to Final Design Comments	14 May 97	—	—	[illegible]

Section 02240

SECTION 02240

PROTECTIVE AND CONTOURING LAYERS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes protective layer and contouring layer products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02710 - Granular Drainage Material

D. Section 02714 - Geotextiles

E. Section 02770 - Geomembrane Liner and Cap

F. Section 13010 - Impacted Material Placement

G. Section 13040 - Control of Fugitive Emissions

H. Construction Quality Assurance (CQA) Plan

I. Impacted Materials Placement Plan

1.03 SUBMITTALS

A. See Section 02710 for submittal requirements for granular drainage material that will be used for the granular protective layer shown on the Construction Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Obtain on-site till for the protective layer except where granular protective layer material is indicated on the Construction Drawings, and for the contouring layer. Utilize impacted material for these layers to the maximum extent possible. Use non-impacted till from the OSDF excavation, stockpiles, or on-site borrow area if impacted material is not available and only after written approval is obtained from the Construction Manager.

B. Obtain on-site till for the protective and contouring layers that meets the requirements of Section 13010.

C. Granular protective layer in the Impacted Runoff Catchment Area shall meet the requirements for leachate collection system granular drainage layer material given of Section 02710.

PART 3 EXECUTION

3.01 PLACEMENT

A. Construct the protective and contouring layers to the thicknesses, elevations, and limits shown on the Construction Drawings.

B. Place the protective layer (both granular and non-granular) above geotextile filter as shown on the Construction Drawings. Place and spread the protective layer in accordance with the requirements of Section 02714.

C. Do not use equipment to place, spread, or compact the protective layer that produces ground pressures on the underlying geotextile that exceed the requirements of Section 02714.

D. Remove rock particles in the protective and contouring layers with a maximum dimension larger than 3 inches.

E. Compact the protective and contouring layers in accordance with the performance requirements of Section 13010.

F. Requirements of the "Compacted Fill" Article of Section 02200 related to scarification, compaction, moisture conditioning, inclement weather work, and seal rolling apply to the contouring layer.

G. Implement dust control measures in accordance with Section 13040.

3.02 EQUIPMENT DECONTAMINATION

A. Decontaminate equipment used to place impacted protective layer and contouring layer materials in accordance with Section 13010.

3.03 CONSTRUCTION QUALITY REQUIREMENTS

A. CQC Consultant will perform conformance testing on granular protective layer material to establish compliance with this Section. Conformance testing to be performed and testing frequencies are given in the CQA Plan.

B. CQC Consultant will perform performance testing on compacted lifts of contouring layer material to establish compliance with this Section. Performance testing to be performed and testing frequencies are given in the quality assurance appendix of the Impacted Material Placement Plan.

3.04 SURVEY CONTROL

A. Survey the limits and elevations of the protective layer and the contouring layer in accordance with Section 02100 of these Specifications.

3.05 CONSTRUCTION TOLERANCES

A. Construct the protective and contouring layers to within +0.1 feet of the thickness shown on the Construction Drawings.

B. Construct the protective layer to within -0.1 to +0.2 feet of the elevations indicated on the Construction Drawings.

C. Construct the contouring layer to within $\pm$0.2 feet of the elevations indicated on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02250 **TITLE:** VEGETATIVE SOIL LAYER

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — Date 23 OCT 95
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neil Davis — Date 10/23/95
Printed Name and Title R. NEIL DAVIS Senior Proj. Eng.

Detailed Requirements Checked by: (Checker)
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Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — Date 20 Feb 96
Printed Name and Title MARK H. GLEASON Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech / Kenneth W Cargill — Date 8 Apr 96 / 21 Feb 96
Printed Name and Title ~~Beech, Manager~~ Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
0A	30% Submittal				
B	Report for EPA Submittal	4 Dec 95	NA	NH	NA
C	Intermediate Design				JFB
D	Intermediate Design - EPA Submittal	8 Apr 96			
F	Prefinal Design - EPA Submittal	25 Jun 96			
G	Final Design Package	9 Oct 96			
O	Response to Final Design Cmts	14 May 97			

Section 02250

SECTION 02250

VEGETATIVE SOIL LAYER

PART 1 GENERAL

1.01 SCOPE

A. This Section includes vegetative soil layer products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02200 - Earthwork

B. Section 02270 - Erosion and Sediment Control

C. Section 02920 - Topsoil

D. Section 02712 - Granular Filter

E. Section 13000 - Borrow Area Management

F. Section 13040 - Control of Fugitive Emissions

G. Construction Quality Assurance (CQA) Plan

H. Surface-Water Management and Erosion Control Plan

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:

1. ASTM D 422. Standard Method for Particle-Size Analysis of Soils (sieve only).
2. ASTM D 698. Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 5.5 pound Rammer and 12-inch Drop.
3. ASTM D 2487. Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. ASTM D 4318. Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

PART 2 PRODUCTS

2.01 MATERIALS

A. Obtain material for vegetative soil layer from the On-Site Disposal Facility (OSDF) cell excavation included in this Subcontract and stockpiles indicated on the Construction Drawings. Obtain additional vegetative soil layer material, if required, from the on-site borrow area indicated on the Construction Drawings.

B. Use on-site till for the vegetative soil layer. Use till relatively free of debris, foreign objects, large rock fragments, roots, and organics. Do not allow rock fragments larger than 3 inches in diameter (per ASTM D 422). Only use material classified according to the Unified Soil Classification System (per ASTM D 2487 and ASTM D 4318) as CL, SC, or GC.

C. Obtain water for moisture conditioning vegetative soil layer from the on-site potable water source shown on the Construction Drawings.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to transport, place, prepare, and compact the vegetative soil layer material.

PART 3 EXECUTION

3.01 PLACEMENT

A. Construct the vegetative soil layer to the thicknesses, elevations, and limits shown on the Construction Drawings and as specified in this Section.

B. Place the vegetative soil layer material in a loose lift having a thickness of 8 inches ± 1 inch. In any area where compaction is to be performed using hand-operated equipment, place the fill material with a loose thickness of 4 inches ± 1 inch. Loose lift thicknesses will be measured after spreading but before processing.

C. Remove rock particles with a maximum dimension larger than 3 inches.

D. Prior to placing a succeeding lift of material over a previous lift, thoroughly scarify the previous lift to a depth of 2 inches by discing, raking, or tracking with a dozer.

Moisture condition the preceding lift in accordance with the "Compaction" Article in this Part if the moisture content of the surface of the preceding lift is not within the range of acceptable moisture contents.

E. The trafficking of scarified surfaces by trucks or other equipment, except compaction equipment, is not permitted.

F. Do not place vegetative soil layer material during periods of precipitation. Placement may occur during periods of misting or drizzle, but only if authorized by the Construction Manager.

G. Do not place frozen vegetative soil layer material, nor place vegetative soil layer material on frozen ground.

H. Leave the entire area of exposed vegetative soil layer in a smooth, seal-rolled state to promote runoff at the end of each day when precipitation is forecast and/or at the completion of the compaction activities in that area.

3.02 COMPACTION

A. Compact each lift of vegetative soil layer to at least 92 percent of the maximum dry unit weight (ASTM D 698). Compact vegetative soil layer at a moisture content that allows this compaction criterion to be met.

B. Moisture condition the soil if the moisture content of the soil to be used as vegetative soil layer is not appropriate to achieve the compaction requirements. Use a water truck and spray nozzle for wetting. Use discing, raking, or other appropriate methods to dry the material as required. During wetting or drying, regularly disc, rake, or otherwise mix the material to thoroughly blend the moisture throughout the lift.

C. Compact vegetative soil layer material by tracking with a dozer, rolling with a static padfoot or sheepsfoot compactor, or by other means acceptable to the Construction Manager.

D. Do not compact vegetative soil layer material at temperatures below 32°F, unless otherwise authorized in writing by the Construction Manager.

E. If vegetative soil layer material freezes after compaction, remove the frozen material, scarify the remaining unfrozen material, and replace material and compact in accordance with this Section. Do not reuse frozen material until it has thawed and been reworked to an acceptable moisture content.

F. Implement dust control measures in accordance with Section 13040.

3.03 CONSTRUCTION QUALITY REQUIREMENT

A. CQC Consultant will perform conformance testing on the vegetative soil layer material to establish compliance with Part 2 of this Section. Conformance testing to be performed and the testing frequencies are given in the CQA Plan.

B. CQC Consultant will perform performance testing on the vegetative soil layer material to establish compliance with Part 3 of this Section. Performance testing to be performed and the testing frequencies are given in the CQA Plan.

3.04 SURVEY CONTROL

A. Survey the limits and elevation of the top of the vegetative soil layer in accordance with Section 02100.

3.05 TOLERANCE

A. Construct the vegetative soil layer to within ± 0.1 feet of the thickness shown on the Construction Drawings.

B. Construct the vegetative soil layer to within $+0.5$ feet of the grades indicated on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02270 **TITLE:** EROSION AND SEDIMENT CONTROL

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — Date 23 Oct 95
Printed Name and Title V.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neil Davies — Date 10/28/95
Printed Name and Title R. NEIL DAVIES Senior Proj. Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B.B. Mazanti — Date 2/22/96
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Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — Date 20 Feb 96
Printed Name and Title MARK H. GLEASON Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech — Date ~~21 Feb 96~~ 8 Apr 96
Printed Name and Title ~~BEECH, PRINCIPAL~~ Kenneth W Cargal Associate

Record of Revision (Number and initial all revisions)

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0A	30% Submittal				
B	Reprint for EPA Submittal	14 Dec 95	NA	NA	NA
C	Intermediate Design	21 Feb 96	—	—	JFB
D	Intermediate Design, EPA Submitted	8 Apr 96	—	—	—
G	Final Design Package	7 Oct 96	—	—	—
O	Response to Final Design Cmts	14 May 97	—	—	—

Section 02270

SECTION 02270

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes silt fence, erosion mat, straw bales, check dams and ditches, and temporary vegetation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02110 - Clearing, Grubbing, and Stripping

B. Section 02200 - Earthwork

C. Section 02271 - Riprap

D. Section 02930 - Vegetation

E. Surface-Water Management and Erosion Control (SWMEC) Plan

1.03 REFERENCES

A. Rainwater and Land Development, 2nd. ed., 1996, Ohio Department of Natural Resources [Rainwater and Land Development, 1996].

1.04 SUBMITTALS

A. For each product proposed for use, submit the following to the Construction Manager for review within 15 calendar days from Notice to Proceed:
   1. Manufacturer's product data and recommended methods of installation; and
   2. certification from supplier or Manufacturer that the products meet the material requirements of this Section.

B. Prepare and submit to the Construction Manager within 15 calendar days from Notice to Proceed, a Surface-Water Management and Erosion Control Plan that meets the requirements of the Surface-Water Management and Erosion Control Plan identified

Part 1 of this Section. Organize the Surface-Water Management and Erosion Control Plan to include, at a minimum:

1. descriptions of the surface-water management and erosion and sediment-control measures to be implemented throughout the duration of the Subcontract;
2. procedures for installing and maintaining surface-water management and erosion and sediment control measures:
3. drawings illustrating, in plan view, the location and sequencing of the surface-water management and erosion and sedimentation control measures;
4. details of the surface-water management and erosion and sediment control measures; and
5. calculations supporting the surface-water management and erosion and sediment control.

PART 2 PRODUCTS

2.01 SILT FENCE

A. Furnish silt fence with either woven or nonwoven fabric. Silt fence shall:
   1. be woven fabric consisting of slit films of polypropylene treated with ultraviolet light stabilizers;
   2. be nonwoven fabric consisting of long chain polymeric filaments or polyester yarns;
   3. be inert to chemicals commonly found in soils and to hydrocarbons;
   4. be resistant to mildew, rot, insects, and rodent attack; and
   5. have fabric and fence post properties and minimum dimensions in accordance with Rainwater and Land Development [1996].

2.02 EROSION MAT

A. Furnish erosion mat consisting of excelsior matting covered with plastic netting on both sides.

B. Furnish erosion mat that will resist degradation for a minimum 12 month period after installation.

C. Furnish erosion mat that will be capable of resisting shear stresses generated by water flowing across its upper surface of 0.4 pounds per square foot.

2.03 STRAW BALE

A. Furnish straw bales for sediment control made of tightly baled straw bound with at least two individual strands of poly-type twine. Bale dimensions shall be at least 1.5 feet by 2.5 feet long. Anchors for straw bales shall be wooden stakes that are a nominal 1.5 inches by 1.5 inches by 3 feet in length.

2.04 TEMPORARY VEGETATION

A. Temporary vegetation shall be furnished as specified in Section 02930.

2.05 OTHER MATERIALS

A. Materials for other erosion and sediment controls shall be as required in Rainwater and Land Development [1996].

PART 3 EXECUTION

3.01 INSTALLATION

A. Silt Fence
   1. Install silt fence in accordance with, and at the locations required by, the Surface-Water Management and Erosion Control Plan.
   2. Install silt fence in accordance with the requirements of Rainwater and Land Development [1996].

B. Erosion Mat
   1. Provide erosion mat at the locations indicated on the Construction Drawings. Begin erosion mat installation in an area within 48 hours after seeding operations have been completed in that area.
   2. Place erosion mat on a smooth surface that is relatively free of vegetation, trash, ruts, and rocks.
   3. Overlap adjacent erosion mats in a manner such that they are shingled in the direction of water flow.
   4. Install erosion mat and staples in accordance with manufacturer's recommendations.

C. Straw Bales:
   1. Sheet Flow Applications:
      a. Place bales in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.
      b. Install bales so that bindings are oriented around the sides rather than along the tops and bottoms of the bales to prevent deterioration of the bindings.
      c. Place bales directly on top of the ground surface in vegetated areas.
      d. Entrench and backfill bales on bare ground where there is no vegetation. Excavate the trench the width of a bale and the length of the proposed barrier to a minimum depth of 6 inches. Backfill the excavated soil against the barrier after the bales are staked and chinked.
      e. Securely anchor each bale with a minimum of two stakes driven through the bale. Drive the first stake in each bale toward the previously laid bale to force the bales together. Drive stakes deep enough into the ground to securely anchor the bales.
      f. Chink the gaps between bales by wedging with straw to prevent water from escaping between the bales. Install perpendicular bale checks at 100-feet maximum on-center along sloping areas where surface flow follows the bale line.
   2. Channel Flow Applications:
      a. Place bales in a single row, lengthwise, perpendicular to the channel, with ends of adjacent bales tightly abutting one another.
      b. Follow all steps for installing a bale barrier for sheet flow.
      c. Extend the length of the barrier so that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to ensure that sediment-laden runoff will flow either through or over the barrier but not around it.
      d. Temporary Vegetation: Establish temporary vegetation as specified in Section 02930.
      e. Other Erosion and Sediment Controls: Install other erosion and sediment controls as required by Rainwater and Land Development [1996].

3.02 ADDITIONAL PROVISIONS DURING CONSTRUCTION

A. Prevent the run-off of polluting substances such as silt, clay, fuels, oils, and contaminated soils into the water supplies and surface waters. Take special precautions in the use of construction equipment to prevent operations which promote erosion.

B. Remove accumulated silt and debris from behind the face of the silt fence when the silt deposits reach approximately one half the height of the fence. Replace silt fence fabric damaged during maintenance operations.

3.03 MAINTENANCE

A. Clean, maintain, repair, and replace erosion and sediment control products as needed throughout the duration of the Subcontract in accordance with the Surface-Water Management and Erosion Control (SWMEC) Plan.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02271 **TITLE:** RIPRAP

Specifications By: (Cognizant Engineer)
Signature J.F. Beech 24 Oct 95 Date
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature [signature] 10/23/95 Date
Printed Name and Title R NEAL DAVIES. Senior Project Engineer

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ [signature] 2/22/96 Date
Printed Name and Title B B. MAZANTI Consultant

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason 20 Feb 96 Date
Printed Name and Title Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech 21 Feb 96 Date
Printed Name and Title BEECH, PRINCIPAL

[signature] Kenneth W. Cargill 9 Oct 96 Associate

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B	Report for EPA Submittal	16 Dec 95	NA	NA	NA
C	Intermediate Design	21 Feb 96	—	—	JFB
F	Prefinal Design - EPA Submittal	25 Jun 96	[signature]		
G	Final Design Package	9 Oct 96	[signature]		[signature]
O	Response to Final Design Cmts	14 May 97	[signature]		[signature]

SECTION 02271

RIPRAP

PART 1 GENERAL

1.01 SCOPE

A. This Section includes riprap products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02270 - Erosion and Sediment Control

B. Section 02714 - Geotextiles

C. Construction Quality Assurance (CQA) Plan.

D. Surface-Water Management and Erosion Control (SWMEC) Plan.

1.03 REFERENCES

A. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

B. Latest version of American Society for Testing and Materials (ASTM) Standards.
   1. ASTM C 127. Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.

C. "Off-Site Borrow Materials Geotechnical Evaluation Report, Operable unit 2, Project Order 154" (Revision 0), Prepared by Parsons, June 1996.

1.04 SUBMITTALS

A. Submit the following to the Construction Manager within 30 calendar days from Notice to Proceed for review.
   1. the source of the riprap;
   2. the method used by the supplier to achieve the required gradation of the riprap material;

3. test results conducted on a representative riprap sample in accordance with ASTM C 127; and
4. certification from the supplier that the riprap meets the material requirements of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish stone used for riprap consisting of field stone, rough unhewn quarry stone, or excavated rock with angular or fractured faces.

B. Furnish stone used for riprap having a minimum bulk specific gravity of 2.60 and a maximum absorption of 0.83 percent when measured in accordance with ASTM C 127.

C. Furnish riprap conforming to requirements of Types C and D dumped rock fill as specified in Item 601 of the Ohio DOT Specifications.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place riprap to the thickness, elevations, and locations shown on the Construction Drawings.

B. Place riprap upon geotextile or prepared subgrade as shown on the Construction Drawings.

C. Carefully place riprap to avoid segregation or disturbance or damage of the underlying material. Place the material in such a manner as to produce a well graded mass of riprap with the minimum practicable percentage of voids. Distribute the larger pieces throughout the entire mass such that the finished riprap is free from objectionable pockets of small or large pieces. Hand placing, to a limited extent, may be required, but only to the extent necessary to obtain the results specified above.

D. Do not place riprap by dumping into chutes or by similar methods likely to cause segregation of various sizes.

E. Do not place riprap in a manner that causes damage to an underlying geotextile separator. Repair damaged geotextile in accordance with Section 02714.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02280 **TITLE:** BIOINTRUSION BARRIER

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title: J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neil Davies. — 10/28/95 (Date)
Printed Name and Title: R. NEIL DAVIES. Senior Proj. Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B Mazanti — 2/23/96 (Date)
Printed Name and Title: B. D. MAZANTI Consultant

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title: Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ — 8 Apr 96 (Date)
Printed Name and Title: ~~BEECH, PRINCIPAL~~ Kenneth W Cargill Associate

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SECTION 02280

BIOINTRUSION BARRIER

PART 1 GENERAL

1.01 SCOPE

A. This Section includes biointrusion barrier and choke stone products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02270 - Erosion and Sediment Control

C. Section 02710 - Granular Drainage Material

D. Section 02712 - Granular Filter

E. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards.
   1. ASTM C 136. Standard Test Method for Sieve Analysis of Fine and Course Aggregates.
   2. ASTM C 127. Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.

B. "Off-Site Borrow Materials Geotechnical Evaluation Report, Operable unit 2, Project Order 154" (Revision 0), Prepared by Parsons, June 1996.

1.04 SUBMITTALS

A. For each source of biointrusion barrier material, submit the following to the Construction Manager within 30 calendar days from Notice to Proceed for review:
   1. the source of the biointrusion barrier material;
   2. the method used by the supplier to achieve the required gradation of the biointrusion barrier material;

3. test results conducted on a representative biointrusion barrier sample in accordance with ASTM C 127; and
4. certification from the supplier that the biointrusion barrier material meets the material requirements of this Section.

B. For each source of choke stone, submit the following to the Construction Manager within 30 calendar days from Notice to Proceed for review:
1. the source of the choke stone;
2. test results conducted on each of three choke stone samples (taken from three different locations within the material stockpile such that material is fully represented) in accordance with ASTM C 136, and ASTM C 127;
3. a 50-pound representative sample of the material; and
4. certification from the supplier that the choke stone meets the material requirements of this Section.

C. After submitting the above, coordinate with the Construction Manager and CQC Consultant and arrange a visit to the proposed source for biointrusion barrier material. The Construction Manager and CQC Consultant may go to the source to visually observe the proposed material and the methods used to achieve the required material gradation. Arrange for a responsible party representing the source to be present during the visit.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish biointrusion barrier material consisting of field stone, rough unhewn quarry stone, or excavated rock with angular or fractured faces.

B. Furnish biointrusion barrier material relatively free of metal, roots, trees, stumps, concrete, construction debris, organic matter, or any other deleterious material. Furnish material that meets the following gradation requirements:
1. maximum dimension of 18 inches;
2. minimum of 85 percent of the material, by weight, larger than a 6-inch, but less than or equal to an 18-inch, square opening;
3. minimum of 50 percent of the material, by weight, larger than a 12-inch square opening;
4. material smaller than a 6-inch square opening consists of rock spalls and rock fines;

5. material smaller than a 1-inch square opening comprises less than 5 percent by total weight; and
6. the material has a particle size for which 15 percent of the particles are finer (d_{15}) in the range of 6 to 14 inches.

C. Furnish choke stone having a gradation (per ASTM C 136) that meets the following requirements:

Sieve	Total Percent Passing
4 in.	100
3 1/2 in.	90 to 100
2 1/2 in.	25 to 60
1 1/2 in.	0 to 15
3/4 in.	0 to 5

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to transport, place, spread, and compact biointrusion barrier and choke stone materials.

B. Also furnish steel drum (smooth or padded) vibratory compactor capable of delivering a dynamic force of 25,000 lbs (±15 percent).

PART 3 EXECUTION

3.01 MATERIAL PLACEMENT

A. Place biointrusion barrier material to the thickness, elevations, and locations shown on the Construction Drawings.

B. Carefully place biointrusion barrier material on top of the cover drainage layer as shown on the Construction Drawings. Avoid damage and disturbance of the underlying material. Maximum acceptable free-fall height of material during placement is 3 feet.

C. Place the biointrusion barrier material in such a manner as to produce a well-graded mass with the minimum practicable percentage of voids. Place so that the larger pieces are distributed throughout the entire mass. Hand placing, to a limited extent, may be required, but only to the extent necessary to obtain these results.

D. Place biointrusion barrier material from the toe of the slope and work upslope.

E. Do not place the biointrusion barrier material by dumping into chutes or by similar methods likely to cause segregation of various sizes.

F. Place the choke stone as a separate layer. Spread choke stone using a tracked dozer. Initially work the choke stone into the biointrusion barrier by multiple passes of the dozer. Work choke stone into at least the top 6 inches of the biointrusion barrier by at least four one-way passes of the vibratory compactor specified in Part 2.

3.02 SURVEY CONTROL

A. Survey the limits and elevations of the top of the biointrusion barrier (prior to placing choke stone) in accordance with Section 02100.

3.03 CONSTRUCTION TOLERANCE

A. Construct the biointrusion barrier to within -0.1 to +0.3 feet of the thickness shown on the Construction Drawings.

B. Construct the biointrusion barrier to within +0.5 feet of the elevations indicated on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02605 **TITLE:** HIGH DENSITY POLYETHYLENE (HDPE) MANHOLE

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title: J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neil Davies — 10/23/95 (Date)
Printed Name and Title: R. NEIL DAVIES, Senior Proj. Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B.B. Mazanti — 2/23/96 (Date)
Printed Name and Title: B. B. MAZANTI, Consultant

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title: Mark H. Gleason, Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech — 21 Feb 96 — 14 May 97 (Date)
Printed Name and Title: ~~J.F. BEECH, PRINCIPAL~~ Kenneth W. Cargill, Associate

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~~B~~ B	~~Report for EPA Submittal~~ Report for EPA Submittal	~~16 Dec 95~~ 16 Dec 95	~~MBS~~ MBS	~~MBS~~ MBS	~~AHA~~ AHA
B	Preliminary Design for EPA Submittal	16 Dec 95	JFB	BMM	JFB
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F	Prefinal Design - EPA Submittal	25 Jun 96	KC	—	—
G	Final Design Package	Oct 96	—	—	KC
C	Response to Final Design Cmts	14 May 97	—	—	KC

Section 02605

SECTION 02605

HIGH DENSITY POLYETHYLENE (HDPE) MANHOLES, PIPES, AND FITTINGS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes high density polyethylene (HDPE) manholes, pipes, fittings, supports, gussets, and appurtenances.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02215 - Trenching and Backfilling

D. Section 03100 - Concrete

E. Section 15000 - Mechanical

F. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) standards:

1. ASTM D 638. Test Method for Tensile Properties of Plastics.
2. ASTM D 790. Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
3. ASTM D 1238. Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
4. ASTM D 1248. Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
5. ASTM D 1505. Test Method for Density of Plastics by the Density-Gradient Technique.
6. ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.

7. ASTM D 1693. Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
8. ASTM D 2122. Method for Determining Dimensions of Thermoplastic Pipes and Fittings.
9. ASTM D 2657. Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
10. ASTM D 2837. Standard Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
11. ASTM D 3350. Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
12. ASTM F 714. Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
13. ASTM F 1055. Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

B. Latest version of the American National Standards Institute (ANSI) standards:
1. ANSI B16.1. Standard Specifications for Cast-Iron Pipe Flanges and Flange Fittings.

C. Latest version of the American Society of Mechanical Engineers (ASME) standard:
1. ASME B31.9 §937.1 through 937.3 Building Services Piping.

1.04 SUBMITTALS

A. Submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
1. detailed shop drawings of all HDPE manholes, pipes, support centralizers, fittings, supports, gussets, and appurtenances;
2. a list of materials to be furnished;
3. the names of the suppliers and the proposed dates of delivery of the materials to the site;
4. detailed procedures to be used for hydrostatic testing of the manholes, pipes, and fittings;
5. a list of completed facilities for which the Manufacturer has manufactured 7-ft diameter or larger HDPE manholes. Provide the following information for each facility:
   a. name, location, purpose of facility, and date of installation;
   b. names of owner, project manager, design engineer, and installer; and
   c. diameter and height of the manholes provided;

6. documentation demonstrating that the Manufacturer has adequate quality control procedures to ensure that fabrication of the HDPE manholes complies with the requirements of this Section;
7. origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used;
8. certification of minimum values and the corresponding test procedures for HDPE material properties listed in Tables 02605-1 and 02605-2; submit values that are specific to the resin used in manufacture.

B. Submit to the Construction Manager for review at least 30 calendar days prior to shipment, the following documentation on the resin used to manufacture the HDPE manholes, pipes, fittings, supports, and gussets.
   1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the HDPE products for this Subcontract.
   2. Results of tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the HDPE products assigned to the project.
   3. Certification that no reclaimed polymer is added to the resin during the manufacturing of the HDPE products to be used for this project.

C. Submit at least 30 calendar days prior to installation of any material covered by this Section, Manufacturer's written certification of compliance with these Specifications for that material. Include in this certification of compliance a final inspection and a written record of this inspection. The inspection shall include the following:
   1. HDPE manholes, including attached pipes, fittings, supports, gussets, and appurtenances;
      a. dimensional check;
      b. material quality check;
      c. weld quality; and
      d. leak check;
   2. HDPE pipes, fittings, and appurtenances:
      a. dimensional check; and
      b. material quality check.

D. Submit at least 14 calendar days prior to installation documentation of training and certification of personnel qualified for performing HDPE manhole installation and HDPE pipe joining operations.

PART 2 PRODUCTS

2.01 GENERAL

A. Design and proportion all parts to have adequate strength and stiffness and to be adapted for the purposes shown on the Construction Drawings.

B. Furnish each HDPE manhole completely assembled with all pipes, valves, fittings, supports, gussets, and appurtenances such that field work involves only installation and connection of external products.

C. Furnish each HDPE manhole with watertight construction of welds and pipe penetrations.

2.02 HDPE COMPOUND

A. Furnish HDPE manholes and flat stock manufactured from new, high performance, high molecular weight, HDPE resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P34), ASTM D 3350 (minimum cell classification as shown in Table 02605-1), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. Furnish material having minimum certifiable property values listed in Table 02605-1.

B. Furnish HDPE pipe and fittings manufactured from new, high performance, high molecular weight, HDPE resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P34), ASTM D 3350 (minimum cell classification as shown in Table 02605-2), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. Furnish material having minimum certifiable property values listed in Table 02605-2.

2.03 HDPE MANHOLE

A. Furnish manholes of the types, and to the dimensions, shown on the Construction Drawings.

B. Furnish manholes having exterior and interior surfaces that are smooth with no sharp projections, homogeneous throughout with respect to resin compound, and free of foreign inclusions and surface defects. Furnish HDPE manholes that are as uniform as commercially achievable in color, opacity, density, and other physical properties.

C. Shop fabricate manhole from HDPE pipe meeting the requirements of this Section. Shop fabricate 7-foot diameter manholes using HDPE Class 100 material conforming to ASTM F 894. Shop fabricate 48-inch diameter manholes using an HDPE Standard

Dimension Ratio (SDR) of 32.5 conforming to ASTM F 714. The primary containment of the permanent lift station shall be shop fabricated using Class 160 material and the secondary containment shall be shop fabricated using Class 250 material conforming to ASTM F 894.

D. Shop fabricate manhole pipe stub-outs with the same pipe SDR as the HDPE pipe specified in the Article "HDPE Pipes, Fittings, and Appurtenances" of this Section. Fabricate with a minimum stub-out length of 12 inches, or more if necessary for thermal butt fusion of external pipes.

E. Shop fabricate cover, base, gussets, and supports from minimum 1-inch thick HDPE flat stock.

F. Shop weld components of the HDPE manhole. Weld pipes and fittings to each other by thermal butt fusion. Weld other components, including gussets and supports, to the manhole by extrusion welding. Hot air welding is not acceptable. Do not join the pipe supports with the pipes unless specifically called for on the Construction Drawings.

G. Extrusion weld manhole cover and base at both inside and outside intersections with the riser section.

H. Extrusion weld stiffener rings to the permanent lift station primary containment. Perforate stiffener rings to provide 1 square inch of open area at bottom to allow flow of liquid to the annular space liquid level transmitter.

I. Provide manholes and the permanent lift station with adequate lugs for lifting and placement.

J. Perforate the equipment decontaminating facility manhole as indicated on the Construction Drawings.

K. Permit the CQC Consultant and/or Construction Manager to visit the manufacturing plant for project specific visits. If possible, such visits will be prior to, or during, the manufacturing of the manholes for this project.

2.04 HDPE PIPES, FITTINGS, AND APPURTENANCES

A. Unless otherwise shown on the Construction Drawings, furnish HDPE pipe and fittings that have a SDR of 11 and conform to ASTM F 714.

B. Furnish HDPE pipes in standard laying lengths not exceeding 50 feet.

C. Furnish HDPE pipes and fittings that are homogeneous throughout and free of visible cracks, holes (other than intentional manufactured perforations), foreign inclusions, or other deleterious effects, and are uniform in color, density, melt index, and other physical properties.

D. Furnish HDPE end caps at the end of pipes as shown on the Construction Drawings.

E. Furnish electrofusion couplings meeting the requirements of ASTM F 1055 and as recommended by the electrofusion coupling manufacturer.

F. Furnish HDPE pipe supports which cradle the pipe for a length of at least 1 pipe diameter and encircle the pipe 180 degrees of the pipe diameter. Furnish pipe supports conforming to the Construction Drawings.

G. Perforate pipe by factory drilling at locations shown on the Construction Drawings.

2.05 HDPE DUAL CONTAINMENT PIPING SYSTEM

A. Furnish dual containment piping system consisting of field or factory fabricated carrier and containment pipes and pre-fabricated fittings.

B. Furnish components of the dual containment piping system, including carrier piping, containment piping, fittings, and appurtenances meeting the requirements for HDPE pipes, fittings, and appurtenances given in this Section.

C. Furnish pipe and fittings with the carrier pipe/fitting ends extending 6 inches beyond the containment pipe/fitting ends. Provide pipe in nominal lengths of 20 to 50 feet, and allow for field adjustment of pipe length.

D. Furnish pre-fabricated dual containment fittings with the carrier fitting factory installed within the containment fitting, with all necessary support centralizers installed.

E. Fabricate all carrier to carrier containment to containment joints using thermal fusion procedures recommended by the Manufacturer and as required by this Section. Fabricate carrier to carrier joints and containment to containment joints independently of each other. Inspect carrier to carrier joints before final closure of the containment.

F. Furnish support centralizers to provide a continuous annular space between the carrier and the containment pipes in conformance with the recommendations of the

Manufacturer or with a maximum allowable spacing of 4 feet, whichever is less. Centralizers shall not inhibit flow of carrier pipe leakage in the containment pipe. Material for centralizers shall be as recommended by HDPE pipe manufacturer.

2.06 IDENTIFICATION

A. Identify each HDPE manhole using a manhole number, as indicated on the Construction Drawings. Mark the number on the interior and exterior of the manhole.

B. Mark the HDPE manhole with the Manufacturer's name, production code, date, and place of manufacture on the interior of the manhole.

C. Continuously indent print on the HDPE pipe, or space at intervals not exceeding 5 feet the following:
   1. name and/or trademark of the HDPE pipe manufacturer;
   2. nominal HDPE pipe size;
   3. standard dimension ratio (e.g., SDR-11);
   4. the letters PE followed by the polyethylene grade per ASTM D 1248, followed by the Hydrostatic Design Stress in 100's of psi (e.g., PE 3408);
   5. manufacturing Standard Reference (e.g., ASTM F 714); and
   6. a production code from which the date and place of manufacture can be determined.

2.07 MANHOLE FRAME AND COVER

A. Furnish manhole frame and access cover meeting the requirements of Section 15000.

2.08 MANUFACTURER TECHNICAL SUPPORT

A. Furnish on-site services of Manufacturer's technical representative as required for the installation of HDPE manholes.

2.09 EMBEDMENT FILL AND BACKFILL MATERIALS

A. Furnish pipe and manhole embedment fill materials in accordance with Section 02215.

B. Furnish trench backfill and compacted fill materials in accordance with Sections 02215 and 02200, respectively.

PART 3 EXECUTION

3.01

A. Perform HDPE manhole installation and pipe joining operations with trained and certified personnel.

3.02 HDPE MANHOLE HANDLING

A. Drain all entrapped water and prevent the entrance of water during shipment, storage, and handling.

B. Exercise care when transporting, handling, and placing the manhole, such that the HDPE manhole is not damaged. Handle manhole only by the lifting lugs specifically designed and installed by the Manufacturer for lifting. Protect finished surfaces.

C. Store HDPE manhole as recommended by Manufacturer.

3.03 HDPE MANHOLE INSTALLATION

A. Carefully examine HDPE manholes, fittings, supports, gussets, and appurtenances for cracks, damage or defects before installation. Remove defective materials from the site.

B. Install HDPE manholes, fittings, supports, gussets, and appurtenances in accordance with the Manufacturer's recommendations.

C. Inspect the HDPE manhole interior and HDPE pipe, fittings, supports, gussets, and appurtenances and remove any foreign material present before installation into the final position.

D. Perform excavation and backfilling for each manhole in accordance with Section 02215. Do not compact gravel around the decontamination facility manhole.

E. Perform a hydrostatic test of each installed manhole except the decontamination facility manhole in accordance with this Section.

3.04 HDPE PIPE, FITTINGS AND APPURTENANCES

A. Deliver HDPE pipe, fittings, and appurtenances to the site at least 10 calendar days prior to the planned installation date.

B. Provide proper handling and storage of the HDPE pipe, fittings, and appurtenances at the site. Protect materials from excessive heat or cold, dirt, moisture, cutting, or other damaging or deleterious conditions. Provide any additional storage procedures required by the Manufacturer.

C. Exercise care when transporting, handling, and placing HDPE pipe and fittings. Use rope, fabric, or nylon slings and straps when handling HDPE pipe. Do not position slings, straps, etc., at butt-fusion joints or at fittings.

D. The maximum allowable depth of cuts, gouges or scratches on the exterior surface of HDPE pipe or fittings is 10 percent of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges and scratches. Replace any HDPE pipe and fittings that become gouged, twisted, or crimped. Remove from the work area damaged pipes and fittings.

E. Whenever pipe laying is not actively in progress, close the open ends of all installed pipes using watertight plugs.

F. Perform trenching and backfilling of all installed pipe, fittings, and appurtenances in accordance with Section 02215.

G. Perform testing of all installed pipe, fittings, and appurtenances in accordance with this Section.

3.05 HDPE PIPE AND FITTINGS INSTALLATION

A. General:
1. Carefully examine HDPE pipe and fittings for cracks, damage or defects before installation. Do not use cracked, damaged, or defective material.
2. Inspect the interior of all pipe and fittings and remove any foreign material from the pipe interior before the pipe is moved into final position.
3. Perform field-cutting of pipes, where required, with a machine specifically designed for cutting pipe. Make cuts carefully without damage to pipe, so as to leave a smooth end at right angles to the axis of pipe. Taper cut ends and smooth sharp edges. Flame cutting is not allowed.
4. Do not lay pipe until the Construction Manager has verified the bedding conditions.
5. Install HDPE pipe and fittings in accordance with the Manufacturer's recommendations and the requirements of this Section.
6. Install pipe and fittings to the lines and grades shown on the Construction Drawings.

7. Place and compact pipe embedment fill and trench backfill material as shown on the Construction Drawings in accordance with Section 02215.
8. Provide all necessary adapters and/or fittings required when connecting different types and sizes of pipe or when connecting pipe made by different manufacturers.

B. Install pipe marker in accordance with Section 02215.

3.06 HDPE PIPE JOINTS, FITTINGS, AND APPURTENANCES CONNECTIONS

A. Qualify all personnel performing joining operations as specified in this Section.

B. Weather Conditions for Joining:
1. Do not join HDPE pipes and fittings at ambient temperatures below 40 degrees Fahrenheit (F) or above 104°F, unless authorized in writing by the Construction Manager. For cold (<40°F) or hot (>104°F) weather joining, use the additional procedures authorized in writing by the Construction Manager.
2. Measure ambient temperatures at fusion machine.
3. Do not join HDPE pipe and fittings during any precipitation, in the presence of heavy fog or dew, or in areas of ponded water.

C. Prior to joining, clean the joint area to be free of moisture, dust, dirt, debris of any kind, and foreign material.

D. Joining equipment shall be approved for the applicable field joining processes which are thermal butt fusion and eletrofusion. Fusion-welding apparatus shall be automated devices equipped with gauges giving the applicable temperatures and pressures.

E. Make trial but-fusion joints on spool pieces of HDPE pipe to verify that joining conditions are adequate. Conduct trial joints on the same material to be installed and under similar field conditions as production joints. Conduct trial joining at the beginning of each day for each fusion apparatus used that day. Also, each joiner shall make at least one trial joint each day. Conduct trial joining under the same conditions as the actual joining. Prepare trial joints that are at least 2 feet long (after seaming) with the joint at the midpoint.

F. Weld HDPE carrier and containment pipe with thermal butt-fusion joints or electrofusion adapters. Fabricate joints in compliance with ASTM D 2657, ASTM F 1055, the Manufacturer's recommendations, and the requirements of this Section.

G. Install flanged connections of HDPE pipe and fittings as shown on the Construction Drawings and as follows:
   1. Thermal butt-fuse HDPE flange connection (flange adapter) to HDPE pipe.
   2. Use Type 316 stainless steel lap joint flange. Outside diameter and drillings shall comply with American National Standards Institute (ANSI) B16.1.
   3. Use Type 316 stainless steel flange bolts, nuts and washers that meets the requirements of ANSI B16.1. Lubricate bolt threads prior to attaching nuts. Tighten bolts to a torque of 100 ±5 foot-pounds.

H. Bolt HDPE flange adapter and stainless steel lap joint flanges at the ambient temperature of the surrounding soil to prevent relaxation of the flange bolts and loosening of the joint due to thermal contraction of the polyethylene. Draw bolts up evenly and in line. Retighten bolts 1 and 4 hours after initial tightening.

3.07 FIELD TESTING AND INSPECTION

A. Notify the CQC Consultant a minimum of 24 hours in advance of any manhole or pipe testing or pipe inspection.

B. HDPE Manhole Hydrostatic Testing:
   1. Provide testing apparatus, including pumps, hoses, gauges, taps, plugs, drains, temporary connections, and fittings to perform testing in accordance with this Section.
   2. Hydrostatically test each HDPE manhole and primary containment after final pipe connections have been completed and after backfilling. Hydrostatically test each HDPE manhole, each primary containment vessel of each LDS manhole, and the primary containment of the permanent lift station using the following method.
      a. Perform each test in the presence of the CQC Consultant and in accordance with the detailed procedure approved under this Section.
      b. Temporarily seal any holes or gaps.
      c. Fill the HDPE manhole to 6 inches below its top with clean water.
      d. Monitor the level of water for a 4-hour period.
      e. Identify any leaks, remove the water, and make repairs to the HDPE manhole or primary containment. A leak is defined as any water level drop over the test period except for an anticipated drop due to material relaxation and expansion. The anticipated drop must be demonstrated in the approved test procedure submitted by the Subcontractor in accordance with this Section.
      f. Retest the HDPE manhole or primary containment until a passing test is achieved.

g. After completion of the test, remove temporary seals, pump the HDPE manhole or primary containment dry, and dispose of test water.

C. HDPE Pipe and Fittings Hydrostatic Testing:
1. Provide testing apparatus, including pumps, hoses, gauges, taps, plugs, drains, temporary connections, and fittings to perform testing in accordance with this Section.
2. HDPE pipe hydrostatic testing:
   a. Pressure test all installed HDPE solid wall, carrier, and containment pipe prior to placing fill over the pipes.
   b. Perform tests in the presence of the CQC Consultant and in accordance with the detailed test procedure submitted by the Subcontractor in accordance with this Section.
   c. Test HDPE solid wall and carrier pipe at 120 psi internal pressure for gravity pipe systems and at 130 psi internal pressure for force main system. Test pipes in accordance with ASME B31.9 §937.1 through §937.3.
   d. Test HDPE containment pipe at 15 psi internal pressure. Test containment pipe in accordance with ASME B31.9 §937.1 through §937.3.
   e. Test pipes at the required internal pressure for a minimum of one hour after the pressure in the pipe has stabilized. The test duration does not include the initial expansion phase after the pipe is first pressurized. The duration of the expansion phase shall be as recommended by the Manufacturer.
   f. Identify any leaks, remove the water, and make repairs to the pipe.
   g. Retest the pipe until acceptance criteria are achieved in accordance with the approved procedures for testing prior to placing backfill over the pipe.
   h. Test gauges shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry standards where possible.
   i. Acceptance criteria for hydrostatic testing is zero leakage for the stabilized pressure for the minimum duration of the test.

D. Subcontractor may substitute air testing in lieu of hydrostatic testing if authorized in writing by the Construction Manager. Submit detailed work plan for review and approval by the Construction Manager.

E. HDPE Pipe Inspection
1. Inspect fusion joints for evidence of excess or insufficient bead size, contamination, offset, or any other evidence of inadequate joining. The surface of the HDPE pipe shall be clean at the time of inspection. Wipe or wash the HDPE pipe surface if surface contamination inhibits inspection.
2. Repair any pipe sections where greater than 4 percent pipe diameter deflection from vertical is observed.

F. Defects and Repairs:
   1. Repair Procedures:
      a. Repair any portion of the HDPE pipe exhibiting a flaw, or poor quality fusion joint by removing bad joint or pipe section and replacing with a new pipe section.
      b. When making repairs, satisfy the following:
         (1) clean and dry all pipe surfaces immediately prior to repair;
         (2) only use approved fusion equipment; and
         (3) extend repairs at least 12 inches in all direction beyond the extent of the defect.
   2. Repair Verification:
      a. Inspect each repair using the methods described in the this Article. Repair areas that fail the inspection.

3.08 SURVEY CONTROL

A. Survey location and elevation of the manholes, pipes, and appurtenances in accordance with Section 02100.

B. Survey the top of HDPE containment pipe on no greater than 50-foot centers and at manhole inlets and outlets in accordance with Section 02100.

3.10 TOLERANCES

A. Install HDPE manholes and the permanent lift station to within ± 0.1 feet of the elevations indicated on the Construction Drawings.

B. Install HDPE manholes within 0.5 degrees of plumb.

C. Install all HDPE pipes to within ± 0.1 feet of bottom of pipe elevations of the containment pipes as indicated on the Construction Drawings.

D. Provide positive slope of gravity lines at all locations to within ± 10 percent of the values indicated on the Construction Drawings.

TABLE 02605-1

REQUIRED HDPE MANHOLES AND FLAT STOCK PROPERTIES ASTM D 3350 CELL CLASSIFICATION PROPERTIES AND RANGES

Properties	Cell Range	Qualifiers	Units	Specified Values	Test Method
Specific Gravity	3	minimum	N/A	0.94	ASTM D 1505
Melt Flow Index	3 to 5	maximum	g/10 min	<0.4	ASTM D 1238 (Condition E)
Flexural Modulus	5	minimum	lb/in^2	110,000	ASTM D 790
Tensile Strength	4 or 5	minimum	lb/in^2	3,000	ASTM D 638
Environmental Stress Crack	3	minimum	hrs	$F_{20} > 192$	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	minimum	lb/in^2	1,600	ASTM D 2837
UV Stabilizer	C	minimum	% Carbon Black	2	ASTM D 1603

TABLE 02605-2

REQUIRED HDPE PIPE AND FITTINGS PROPERTIES
ASTM D 3350 CELL CLASSIFICATION PROPERTIES AND RANGES

Properties	Cell Range	Qualifiers	Units	Specified Values	Test Method
Specific Gravity	3	minimum	N/A	0.94	ASTM D 1505
Melt Flow Index	4 or 5	maximum	g/10 min	<0.15	ASTM D 1238 (Condition E)
Flexural Modulus	5	minimum	lb/in^2	110,000	ASTM D 790
Tensile Strength	4 or 5	minimum	lb/in^2	3,000	ASTM D 638
Environmental Stress Crack	3	minimum	hrs	F_{20} > 192	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	minimum	lb/in^2	1,600	ASTM D 2837
UV Stabilizer	C	minimum	% Carbon Black	2	ASTM D 1603

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02710 **TITLE:** GRANULAR DRAINAGE LAYER

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neil Davies. — 10/23/95 (Date)
Printed Name and Title R NEIL DAVIES. Senior Project Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B B Mazanti — 2/23/96 (Date)
Printed Name and Title B. B. MAZANTI Consultant

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech — ~~23 Feb 1996~~ 8 Apr 96 (Date)
Printed Name and Title ~~BEECH, PRINCIPAL~~ Kenneth W Cargill Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	30% Submittal				
B	Reprint for EPA Submittal	6 Dec 95	NA	NA	NA
C	Intermediate Design	23 Feb 96	—	—	✓ 3
D	Intermediate Design EPA Submittal	8 Apr 96	✓	—	—
F	Prefinal Design, EPA Submittal	25 Jun 96	✓	—	—
G	Final Design Package	9 Oct 96	—	—	✓
H	Response to Final Design Cmts	14 May 97	—	—	✓

Section 02710

SECTION 02710

GRANULAR DRAINAGE MATERIAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes granular drainage material products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02210 - Surveying

B. Section 02280 - Biointrusion Barrier

C. Section 02714 - Geotextiles

D. Section 02772 - Geosynthetic Clay Liner

E. Section 13040 - Control of Fugitive Emissions

F. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:
   1. ASTM C 136. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   2. ASTM D 2434. Standard Test Method for Permeability of Granular Soils (Constant Head).
   3. ASTM D 2487. Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   4. ASTM D 3042. Standard Test Method for Insoluble Residue in Carbonate Aggregate.

B. "*Off-Site Borrow Materials - Geotechnical Evaluation Report, Operable Unit 2, Project Order 154*" (Revision 0) prepared by Parsons, June 1996.

1.04 SUBMITTALS

A. For each source of granular drainage material, submit the following to the Construction Manager within 45 calendar days from Notice to Proceed for review:
   1. the source of the granular drainage material;
   2. test results conducted on each of three granular drainage material samples taken from three different locations within the material stockpile such that the material is fully represented in accordance with ASTM C 136, ASTM D 2434, ASTM D 2487, and ASTM D 3042;
   3. a 50-pound representative sample of the granular drainage material; and
   4. certification from the supplier that the granular drainage material meets the material requirements of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish granular drainage material consisting of homogeneous crushed or angular material that is free of metal, roots, trees, stumps, concrete, construction debris, organic matter, or any other deleterious material.

B. Furnish granular drainage material for the leachate collection system (LCS) drainage layer, leachate detection system (LDS) drainage layer, the granular protective cover at the Impacted Runoff Catchment Area, and the cover drainage layer classified as GW or GP in accordance with the Unified Soil Classification System (per ASTM D 2487), and having a gradation (per ASTM C 136) that meets the following requirements:

Sieve	Total Percent Passing
3/4 in.	100
1/2 in.	90 to 100
3/8 in.	40 to 75
No. 4	5 to 25
No. 8	0 to 10
No. 16	0 to 5
No. 200	0 to 2

C. Furnish granular drainage material for the LCS drainage layer, LDS drainage layer, the granular protective cover at the Impacted Runoff Catchment Area, and cover drainage layer having a minimum hydraulic conductivity of 1×10^{-1} centimeters per

second (cm/s) based on laboratory permeability testing conducted in accordance with ASTM D 2434.

D. Furnish granular drainage material for the LCS and LDS drainage corridors classified as GW or GP in accordance with the Unified Soil Classification System (per ASTM D 2487), and having a gradation (per ASTM C 136) that meets the following requirements:

Sieve	Total Percent Passing
1-1/2 in.	100
1 in.	95 to 100
1/2 in.	25 to 60
No. 4	0 to 10
No. 8	0 to 5
No. 200	0 to 2

E. Furnish granular drainage material for the LCS drainage corridor and LDS drainage corridor having a minimum hydraulic conductivity of 10 cm/s based on laboratory permeability testing conducted in accordance with ASTM D 2434.

F. Furnish granular drainage material for the LCS and LDS drainage layers, and LCS and LDS drainage corridors having less than 5 percent loss of weight, when tested according to ASTM D 3042 at a pH of 4.

G. Furnish granular drainage material for the granular protective cover at the Impacted Runoff Catchment Area, and the cover drainage layer having less than 10 percent loss of weight when tested according to ASTM D 3042 at a pH of 4.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to transport, place, spread, and compact granular drainage materials.

PART 3 EXECUTION

3.01 MATERIAL PLACEMENT

A. Do not commence placement of the granular drainage material until the CQC Consultant has completed conformance evaluation of the granular drainage materials and performance evaluation of previous work, including evaluation of the Subcontractor's survey results for previous work.

B. Construct the granular drainage material layer to the thicknesses, and limits shown on the Construction Drawings.

C. Place the granular drainage material directly on top of the geotextile cushion, or supplemental geotextile cushion, as shown on the Construction Drawings. Place the granular drainage material by dumping onto previously placed granular drainage material and then carefully spread using low ground-pressure equipment meeting the ground pressure requirements of Part 3 of this Section.

D. Spread granular drainage material over the geotextile to cause the material to cascade over the geotextile rather than be shoved across the geotextile.

E. Do not drive equipment directly on the geotextile cushion or supplemental cushion. Only use equipment to place, spread, and compact the granular drainage material that meets the following ground pressure requirements:

Maximum Allowable Equipment Ground Pressure (psi)	Minimum Thickness of Granular Soil over Geotextile Cushion (in.)
<5	12
<10	18
<20	24
>20	36

F. Place the granular drainage material in one loose lift.

G. Compact the granular drainage material by tracking with low ground-pressure equipment. Use hand compactors in constricted locations and adjacent to structures.

H. Implement dust control measures in accordance with Section 13040.

3.02 CONSTRUCTION QUALITY REQUIREMENTS

A. The CQC Consultant will perform conformance testing on the granular drainage material to establish compliance with this Section. The conformance testing to be performed and the testing frequencies are given in the CQA Plan.

3.03 SURVEY CONTROL

A. Survey the limits and elevations of the top of the granular drainage material layers in accordance with Section 02100.

3.04 TOLERANCES

A. Construct the LDS drainage layer, LDS drainage corridor, LCS drainage layer, LCS drainage corridor, and the granular protective cover at the Impacted Runoff Catchment Area to within -0.1 to +0.2 feet of the elevations and to within +0.1 feet of the thicknesses shown on the Construction Drawings.

B. Construct the cover drainage layer to +0.2 feet of the elevations and to within +0.1 feet of the thicknesses shown on the Construction Drawings.

[END OF SECTION

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02712 **TITLE:** GRANULAR FILTER

Specifications By: (Cognizant Engineer)
Signature J.E. Beech — 23 Oct 95 (Date)
Printed Name and Title J.E. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R. Neal Davies — 10/23/95 (Date)
Printed Name and Title R. Neal Davies, Senior Project Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B.B. Mazanti — 2/22/96 (Date)
Printed Name and Title B. B. MAZANTI, Consultant

Overall Review By: (PDP)
Signature Not Used ~~for 30% Submittal~~ Marc H. Gleason — 20 Feb 96 (Date)
Printed Name and Title MARC H. GLEASON, Assistant Project Engineer

Approved by: (DTL)
Signature Not Used ~~for 30% Submittal~~ J.E. Beech — ~~23 Feb 96~~ 8 Apr 96 (Date)
Printed Name and Title ~~BEECH, PRINCIPAL~~ Kenneth W Cargill, Associate

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B	Reprint for EPA Submittal	14 Dec 95	WA	N/A	N/A
C	Intermediate Design	23 Feb 96	—	—	J.F.B
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F	Prefinal Design EPA Submittal	25 Jun 96	—	—	—
G	Final Design Package	9 Oct 96	—	—	—
O	Response to Final Design Cmts	14 May 97	—	—	—

Section 02712

SECTION 02712

GRANULAR FILTER MATERIAL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes granular filter products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02210 - Surveying

B. Section 02250 - Vegetative Soil Layer

C. Section 02280 - Biointrusion Barrier

D. Section 13040 - Control of Fugitive Emissions

E. Construction Quality Assurance (CQA) Plan.

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:
   1. ASTM C 136. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   2. ASTM D 2487. Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.04 SUBMITTALS

A. For each source of granular filter material, submit the following to the Construction Manager within 45 calendar days from Notice to Proceed for review:
   1. the source of the granular filter material;
   2. test results conducted on each of three granular filter material samples taken from three different locations within the material stockpile such that the granular filter material is fully represented in accordance with ASTM C 136, and ASTM D 2487;

3. a 50-pound representative sample of the granular filter material; and
4. certification from the supplier that the granular filter material meets the material requirements of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish granular filter material consisting of homogeneous angular or crushed material that is relatively free of metal, roots, trees, stumps, concrete, construction debris, organic matter, or any other deleterious material.

B. Furnish granular filter material classified as SW or SP in accordance with the Unified Soil Classification System (per ASTM D 2487), and having a gradation (per ASTM C 136) that meets the following requirements:

Sieve	Total Percent Passing
2 in.	100
3/4 in.	80 - 100
1/2 in.	70 - 85
No. 4	55 - 70
No. 8	50 - 65
No. 50	15 - 35
No. 60	0 - 30
No. 200	0 - 5

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to transport, place, spread, and compact granular filter materials.

PART 3 EXECUTION

3.01 PLACEMENT

A. Do not place granular filter material until CQC Consultant has completed conformance evaluation of the granular filter material and performance evaluation of previous work, including evaluation of the Subcontractor's survey results of previous work.

B. Construct the granular filter material to the thicknesses, and limits shown on the Construction Drawings.

C. Place the granular filter material directly on the biointrusion barrier and carefully spread it across the biointrusion barrier.

D. Place the granular filter material in a one loose lift.

E. Compact the granular filter material by tracking with a dozer or other suitable equipment. Use hand-operated compaction equipment in constricted locations and adjacent to structures.

F. Implement dust control measures in accordance with Section 13040.

3.02 CONSTRUCTION QUALITY REQUIREMENTS

A. The CQC Consultant will perform conformance testing on the granular filter material to establish compliance with this Section. The conformance testing to be performed and the testing frequencies are given in the CQA Plan.

3.03 SURVEY CONTROL

A. Survey the limits and elevations of the top of the granular filter material in accordance with Section 02100.

3.04 TOLERANCE

A. Construct the granular filter to within -0.1 to +0.2 feet of the elevations and to within +0.1 feet of the thicknesses shown on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02714 **TITLE:** GEOTEXTILE ~~FILTER AND CUSHION~~ JF73

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
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Scope and Format Checked By: (Checker)
Signature R. Neil Davies — 10/23/95 (Date)
Printed Name and Title: R. NEIL DAVIES, Senior Project Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ [illegible] Consultant — 2/22/96 (Date)
Printed Name and Title:

Overall Review By: (PDP)
Signature Not Used for ~~30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title: Mark H. Gleason, Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for 30% Submittal [illegible] — ~~23 Feb 96~~ 8 Apr 96 (Date)
Printed Name and Title: ~~J.F. BEECH, PRINCIPAL~~ Kenneth W Cargill, Associate

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ØA	30% Submittal				
B	Reprint for EPA Submittal	14 Feb 96	N/A	N/A	N/A
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D	Intermediate Design, EPA Submittal	8 Apr 96	[illegible]	—	—
F	Pre final Design, EPA Submittal	25 Jun 96	[illegible]	—	—
G	Final Design Package	7 Oct 96	—	—	[illegible]
E	Response to Final Design Cmts	14 May 97	—	—	[illegible]

SECTION 02714

GEOTEXTILES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes geotextile products and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02215 - Trenching and Backfilling

B. Section 02230 - Road Construction

C. Section 02240 - Protective and Contour Layers

D. Section 02271 - Riprap

E. Section 02710 - Granular Drainage Material

F. Section 02770 - Geomembrane Liner and Cap

G. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:

1. ASTM D 3786. Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabric-Diaphragm Bursting Strength Test Method.
2. ASTM D 4355. Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water.
3. ASTM D 4491. Standard Test Method for Water Permeability of Geotextiles by Permittivity.
4. ASTM D 4533. Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
5. ASTM D 4632. Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).

6. ASTM D 4751. Standard Test Method for Determining Apparent Opening Size of a Geotextile.

7. ASTM D 4833. Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
8. ASTM D 4873. Standard Guide for Identification, Storage, and Handling of Geotextiles.
9. ASTM D 5261. Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.

B. Federal Standard No. 751a - Stitches, Seams, and Stitching.

1.04 SUBMITTALS

A. Submit the following to the Construction Manager for review within 45 calendar days from Notice to Proceed.
1. Geotextile Manufacturer and product name.
2. Certification of minimum average roll values and the corresponding test procedures for all geotextile properties listed in Tables 02714-1 through 02714-5.
3. Projected geotextile delivery dates.

B. Submit to the Construction Manager for review at least 14 calendar days prior to geotextile placement, manufacturing quality control certificates for each roll of geotextile as specified in Part 2 of this Section.

PART 2 PRODUCTS

2.01 GEOTEXTILE

A. Furnish geotextile products with minimum average roll values (95 percent lower confidence limit) meeting or exceeding the required property values in Tables 02714-1 (for geotextile filters, sacrificial geotextile filters, and sacrificial geotextile cushions), 02714-2 to 02714-4 (for geotextile cushions and supplemental geotextile cushions), and 02714-5 (for geotextile separators).

B. Furnish geotextiles that are stock products.

C. Furnish geotextiles that are manufactured from first quality polymers, with not more than 20 percent reclaimed polymer used in production.

D. Furnish polymeric threads for stitching that are ultra-violet (UV) light stabilized to at least the same requirements as the geotextile to be sewn. Furnish polyester or polypropylene threads that have a minimum size of 2,000 denier.

2.02 MANUFACTURING QUALITY CONTROL

A. Sample and test the geotextile to demonstrate that the material conforms to the requirements of this Section.

B. Perform manufacturing quality control tests to demonstrate that the geotextiles properties conform to the values specified in Tables 02714-1 to 02714-5. Perform as a minimum, the following manufacturing quality control tests at a minimum frequency of once per 50,000 square feet:

Test	Procedure
Mass per unit area	ASTM D 5261
Grab strength	ASTM D 4632
Tear strength	ASTM D 4533
Puncture strength	ASTM D 4833
Burst strength	ASTM D 3786

C. Perform manufacturing quality control tests on the geotextile filter only, at a minimum frequency of once per 100,000 square feet, to demonstrate that its apparent opening size (ASTM D 4751) and permittivity (ASTM D 4491) conform to the values specified in Table 02714-1.

D. Submit quality control certificates signed by the geotextile Manufacturer quality control manager, and notarized. The certificates shall state that the geotextiles are continuously inspected and are needle-free. The quality control certificates shall also include:
   1. lot, batch, and roll number and identification; and
   2. results of manufacturing quality control tests including description of test methods used.

E. Do not supply any geotextile roll that does not comply with the manufacturing quality control requirements.

F. If a geotextile sample fails to meet the quality control requirements of this Section, sample and test rolls manufactured at the same time or in the same lot as the failing

roll. Continue to sample and test the rolls until the extent of the failing rolls are bracketed by passing rolls. Do not supply failing rolls.

2.03 PACKAGING AND LABELING

A. Supply geotextiles in rolls wrapped in relatively impermeable and opaque protective wrapping. Wrapping which becomes torn or damaged shall be repaired with similar materials.

B. Mark or tag geotextile rolls in accordance with ASTM D 4873 with the following information:
   1. manufacturer's name;
   2. product identification;
   3. lot or batch number;
   4. roll number; and
   5. roll dimensions.

C. Geotextile rolls not labeled in accordance with this Section or on which labels are illegible shall be rejected and replaced.

2.04 TRANSPORTATION

A. Deliver geotextiles to the site at least 14 calendar days prior to the planned deployment date to allow the CQC Consultant adequate time to perform conformance testing on the geotextile samples as described in the CQA Plan.

B. Store geotextile rolls on palates or other elevated structures. Do not store geotextile rolls directly on the ground.

C. Outdoor storage of rolls shall not exceed the manufacturer's recommendation or longer than 6 months, whichever is less.

2.05 HANDLING AND STORAGE

A. Protect geotextiles from sunlight, moisture, excessive heat or cold, puncture, mud, dirt, and dust or other damaging or deleterious conditions. Follow all geotextile manufacturer recommendations for handling and storage.

PART 3 EXECUTION

3.01 PLACEMENT

A. Do not commence geotextile installation until the CQC Consultant completes conformance evaluation of the geotextiles and performance evaluation of previous work, including evaluation of Subcontractor's survey results for previous work.

B. Handle geotextiles so as to ensure they are not damaged in any way.

C. Take necessary precautions to prevent damage to underlying layers including rutting during placement of the geotextiles.

D. After unwrapping the geotextiles from its opaque cover, do not leave them exposed for a period in excess of 10 calendar days.

E. If white colored geotextiles are used, take precautions against "snowblindness" of personnel.

F. Take care not to entrap stones, excessive dust, or moisture in the geotextiles during placement.

G. Anchor or weight geotextile with sandbags, or the equivalent, to prevent damage from wind. Install such sandbags during placement and maintain them until overlying material is placed.

H. Examine the geotextile surface after installation to ensure that no potentially harmful foreign objects are present. Remove any such objects and replace any damaged geotextiles.

3.02 SEAMS AND OVERLAPS

A. Continuously overlap a minimum of 6 inches and sew filter, cushion, and supplemental cushion geotextiles (i.e., spot sewing is not allowed) using a "single prayer" seam. Sew seams using Stitch Type 401 as per Federal Standard No. 751a.

B. Do not install horizontal seams on slopes that are steeper than 10 horizontal to 1 vertical. Seams shall be along, not across, the slopes.

C. Overlap separator geotextiles a minimum of 12 inches and spot sew at intervals as necessary to ensure that the overlap is maintained.

3.03 REPAIR

A. Repair any holes or tears in the geotextiles using a patch made from the same geotextile material. Extend geotextile patches a minimum of 1 foot beyond the damaged area. Sew geotextile patches into place no closer than 1 inch from any panel edge. Should any tear exceed 50 percent of the width of the roll, remove and replace that roll.

B. Remove any soil or other material that may have penetrated the torn geotextiles.

3.04 CREST ANCHORAGE SYSTEM

A. Install geotextile along with the other geosynthetic layers in the anchor trench at the crest of the slope as shown on the Construction Drawings. Temporarily anchor the geosynthetic layers using sandbags or other means until the commencement of trench backfilling.

B. Do not entrap soil, sand bags, or other materials between the geosynthetic layers.

C. Backfill the anchor trench with compacted clay once all the geosynthetic layers are installed in the anchor trench. Backfill to the limits shown on the Construction Drawings. Compact backfill in accordance with Section 02215.

D. Do not damage any geosynthetic layer when backfilling the anchor trench.

E. To the extent possible, do not place granular drainage material for the leak detection system or leachate collection system on the side slopes until after the anchor trenches are completely backfilled.

3.05 PLACEMENT OF SOIL AND AGGREGATE MATERIALS

A. Place soil materials on top of geotextiles in such a manner as to ensure that:
   1. the geotextiles and the underlying materials are not damaged; and
   2. slippage does not occur between the geotextile and the underlying layers during placement.

B. Spread soil on top of the geotextile to cause the soil to cascade over the geotextile rather than be shoved across the geotextile.

C. For geotextile cushions overlying the geomembrane, do not place granular drainage material at ambient temperatures below 40 degrees Fahrenheit (F) or above 104°F,

unless authorized in writing by the Construction Manager. For cold (<40°F) and hot (>104°F) weather placement operations, use the additional procedures authorized in writing by the Construction Manager.

D. Do not drive equipment directly on the geotextile. Only use equipment above a geotextile cushion overlying a geomembrane that meets the following ground pressure requirements:

Maximum Allowable Equipment Ground Pressure (pounds per square inch)	Minimum Thickness of Overlying Fill (inches)
<5	12
<10	18
<20	24
>20	36

E. Place aggregate over geotextile separators as shown on the Construction Drawings prior to trafficking.

F. Place soil over geotextile filters as shown on the Construction Drawings prior to trafficking.

3.06 CONSTRUCTION QUALITY REQUIREMENTS

A. Samples of the geotextile will be removed by the CQC Consultant after the material has been received at the site and sent to a geosynthetics laboratory for testing to ensure conformance with the requirements of this Section. Conformance testing and frequency will be as given in CQA Plan.

TABLE 02714-1

REQUIRED PROPERTY VALUES FOR GEOTEXTILE FILTER

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	7	ASTM D 5261
Filter Requirements				
Apparent opening size (O_{95})	maximum	mm	0.21	ASTM D 4751
Permittivity	minimum	sec^{-1}	0.5	ASTM D 4491
Mechanical Requirements				
Grab strength	minimum	lb	180	ASTM D 4632[1]
Tear strength	minimum	lb	75	ASTM D 4533[2]
Puncture strength	minimum	lb	75	ASTM D 4833[3]
Burst strength	minimum	psi	350	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02714-2

REQUIRED PROPERTY VALUES FOR GEOTEXTILE CUSHION IN FINAL COVER SYSTEM

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	8	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	200	ASTM D 4632[1]
Tear strength	minimum	lb	75	ASTM D 4533[2]
Puncture strength	minimum	lb	90	ASTM D 4833[3]
Burst strength	minimum	psi	350	ASTM D 3786
Durability				
Ultraviolet Resistance @ 500 hours	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02714-3

REQUIRED PROPERTY VALUES FOR GEOTEXTILE CUSHION IN LINER SYSTEM

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	10	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	225	ASTM D 4632[1]
Tear strength	minimum	lb	90	ASTM D 4533[2]
Puncture strength	minimum	lb	120	ASTM D 4833[3]
Burst strength	minimum	psi	450	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02714-4

REQUIRED PROPERTY VALUES FOR SUPPLEMENTAL GEOTEXTILE CUSHION IN LINER SYSTEM

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven needlepunched				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	16	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	350	ASTM D 4632[1]
Tear strength	minimum	lb	120	ASTM D 4533[2]
Puncture strength	minimum	lb	180	ASTM D 4833[3]
Burst strength	minimum	psi	700	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values.
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

TABLE 02714-5

REQUIRED PROPERTY VALUES FOR GEOTEXTILE SEPARATOR

PROPERTIES	QUALIFIER	UNITS	SPECIFIED[4] VALUES	TEST METHOD
Type				
nonwoven				(-)
Polymer composition	minimum	%	95 polypropylene or polyester by weight	(-)
Mass per unit area	minimum	oz/yd^2	6	ASTM D 5261
Mechanical Requirements				
Grab strength	minimum	lb	180	ASTM D 4632[1]
Tear strength	minimum	lb	75	ASTM D 4533[2]
Puncture strength	minimum	lb	75	ASTM D 4833[3]
Burst strength	minimum	psi	350	ASTM D 3786
Durability				
Ultraviolet Resistance	minimum	%	70	ASTM D 4355

Notes:

(1) Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
(2) Minimum value measured in machine and cross machine direction.
(3) Tension testing machine with a 1.75-inch diameter ring clamp, the steel ball being replaced with 0.31-inch diameter solid steel cylinder with flat tip centered within the ring clamp.
(4) All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
(5) mm = millimeter
% = percent
oz/yd^2 = ounce per square yard
sec = second
lb = pound
psi = pound per square inch

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02721 **TITLE:** ~~CORRUGATED METAL PIPE~~ CULVERTS, JFB

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — Date 20 Oct 95
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neal Davies — Date 10/23/95
Printed Name and Title R NEAL DAVIES Senior Project Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B B Mazanti — Date 20 Feb 96
Printed Name and Title B. B. MAZANTI Consultant

Overall Review By: (PDP)
Signature Not Used for ~~30% Submittal~~ Mark H. Gleason — Date 20 Feb 96
Printed Name and Title Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for 30% Submittal J.F. Beech — Date 14 May 97
Printed Name and Title ~~BEECH, PRINCIPAL~~ Kenneth W Cargill Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
PA	30% Submittal				
B	Reprint for EPA Submittal	14 Feb 96	NA	NA	NA
C	Intermediate Design	14 Feb 96	—	~~JFB~~ JFB	JFB
F	Prefinal ~~Design~~ Submittal, EPA Submittal	25 Jun 96	—	—	—
G	Final Design Package	9 Dec 96	—	—	—
O	Response to Final Design Cmts	14 May 97	—	—	—

SECTION 02721

CULVERTS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes culverts and related appurtenances, products, and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02215 - Trenching and Backfilling

C. Section 02270 - Erosion and Sediment Control

D. Construction Quality Assurance (CQA) Plan

E. Surface Water Management and Erosion Control (SWMEC) Plan

1.03 REFERENCES

A. Latest version of American Association of State Highway Transportation Officials (AASHTO) Standards.

1. AASHTO M 36. Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
2. AASHTO M 170. Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. AASHTO M 198. Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.
4. AASHTO M 273. Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less than 2 feet of Cover Subject to Highway Loadings.
5. AASHTO M 274. Standard Specification for Steel Sheet, Aluminum-Coated (Type 2) for Corrugated Steel Pipe.

B. Latest version of the State of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

1.04 SUBMITTALS

A. Submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
   1. culvert manufacturer's product data and recommended methods of storage, handling, and proposed installation;
   2. shop drawings showing the layout and details of joints, special connections, and fittings;
   3. culvert manufacturer's written certification that culverts and joint material meet the material requirements of this Section.

PART 2 PRODUCTS

2.01 GENERAL

A. Furnish reinforced concrete pipe (RCP) circular or box culverts and aluminum-coated corrugated metal pipe (ACCMP) culverts at the locations and with the dimensions shown on the Construction Drawings.

2.02 RCP CIRCULAR AND BOX CULVERTS

A. Furnish RCP circular culverts meeting the requirements of AASHTO M 170 for Class IV Reinforced Concrete Pipe with Wall B.

B. Furnish RCP box culverts meeting the requirements of AASHTO M 273 for Precast Reinforced Concrete Box Sections with Less Than 2 Feet of Cover Subjected to HS20 Loading.

2.03 ACCMP CULVERTS

A. Furnish ACCMP culverts meeting the requirements of AASHTO M 36 and AASHTO M 274 with 0.064-inch thick sheets and corrugations of 2.67 inches by 0.50 inches.

2.04 JOINTS

A. Seal RCP circular joints with Type A culvert gaskets meeting the requirements of AASHTO M 198.

B. Seal RCP box culvert joints with bituminous pipe joint filler meeting the requirements of Item 706.10 of the Ohio DOT Specifications.

C. Seal ACCMP culvert joints with coupling bands and rubber O-ring gaskets meeting the requirements of AASHTO M 36. Use coupling bands fabricated from the same base metal coating as the ACCMP culverts.

PART 3 EXECUTION

3.01 INSTALLATION

A. Examine culverts and joint materials before installation for workmanship. Do not install any culvert or joint material which shows poor workmanship.

B. Prior to culvert installation, complete trench excavation and install embedment fill in accordance with the requirements of Section 02215 unless otherwise shown on the Construction Drawings.

C. Install RCP circular and box and ACCMP culverts to the lines and grades shown on the Construction Drawings, to the survey tolerances specified in this Section.

D. Install joints for RCP circular and box culvert and ACCMP culverts in accordance with manufacturer's recommendations and at the locations shown on the Construction Drawings.

E. After placement of the culverts, perform backfilling as specified in Section 02215.

3.02 SURVEY CONTROL

A. Survey the final locations and invert elevations of the culverts in accordance with Section 02100.

3.03 TOLERANCE

A. Construct culverts to within ±0.1 feet of the invert elevations shown on the Construction Drawings, and to provide positive drainage at all times.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02770 **TITLE:** GEOMEMBRANE LINER AND COVER

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 OCT 95 (Date)
Printed Name and Title: J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neil Davies — 10/23/95 (Date)
Printed Name and Title: RNEIL DAVIES Senior Project Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B B Mazanti — 20 Feb 96 (Date)
Printed Name and Title: B. B. MAZANTI Consultant

Overall Review By: (PDP)
Signature Not Used for ~~30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title: MARK H. GLEASON Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for ~~30% Submittal~~ ~~J.F. Beech~~ Kenneth W Cargill — ~~23 Feb 96~~ 8 Apr 96 (Date)
Printed Name and Title: ~~BEECH, PRINCIPAL~~ Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	30% Submittal				
B	Reprint for EPA Submittal	16 Dec 95	NA	NA	NA
C	Intermediate Design	23 Feb 96	—	—	JFB
D	Intermediate Design EPA Submittal	8 Apr 96			
F	Pre final Design EPA Submittal	25 Jun 96			
G	Final Design Package	9 Oct 96			
C	Response to Final Design Cmts	14 May 97			

Section 02770

SECTION 02770

GEOMEMBRANE LINER AND CAP

PART 1 GENERAL

1.01 SCOPE

A. The Section includes geomembrane liner and cap products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02215 - Trenching and Backfilling

C. Section 02714 - Geotextiles

D. Section 02772 - Geosynthetic Clay Liner

E. Section 13005 - Liner Penetration Boxes

F. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) standards:

1. ASTM D 638. Standard Test Method for Tensile Properties of Plastics.
2. ASTM D 746. Standard Test Method for Brittleness, Temperature of Plastics and Elastomers by Impact.
3. ASTM D 792. Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
4. ASTM D 1004. Standard Test Method of Initial Tear Resistance of Plastic Film and Sheeting.
5. ASTM D 1204. Standard Plastics Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
6. ASTM D 1238. Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

7. ASTM D 1505. Standard Test Methods for Density of Plastics by Density-Gradient Technique.
8. ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.
9. ASTM D 4437. Standard Test Methods for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Geomembranes.
10. ASTM D 5397. Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
11. ASTM D 5596. Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.

B. Latest version of the Geosynthetic Research Institute (GRI) test procedures:
1. GM8 Standard Test Method for Measurement of the Core Thickness of Textured Geomembrane.

C. Latest version of National Sanitation Foundation (NSF) 54, Flexible Membrane Liners, Annex A.

1.04 WARRANTY

A. Furnish a 20-year written warranty against defects in materials. Warranty conditions concerning limits of liability will be evaluated by, and be acceptable to, the Construction Manager.

1.05 SUBMITTALS

A. Submit the following information to the Construction Manager for review within 45 calendar days from Notice to Proceed.
1. Geomembrane Manufacturer capabilities, including:
   a. daily production capacity available for this Subcontract;
   b. manufacturing quality control procedures; and
   c. list of material properties, including test method, to which are attached geomembrane liner samples.
2. A list of 10 completed facilities for which the Manufacturer has manufactured a minimum total of 10,000,000 square feet of polyethylene geomembrane. Provide the following information for each facility:
   a. name, location, purpose of facility, and date of installation;
   b. names of owner, project manager, design engineer, and installer; and
   c. thickness and surface area of geomembrane provided.
3. Origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used.

4. Certification of minimum average roll values (95 percent lower confidence limit) for physical and mechanical properties and the corresponding test procedures for the geomembrane properties listed in Table 02770-1. Minimum or maximum values and corresponding test procedures for environmental properties are listed in Table 02770-1. Submit values that are specific to the resin used in manufacture.
5. Certification that HDPE welding rod is compatible with the specifications and consists of the same resin as the geomembrane.
6. Manufacturer warranty as specified in this Part.

B. Submit to the Construction Manager for review within 45 calendar days from Notice to Proceed the following documentation on the resin used to manufacture the geomembranes:
   1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the geomembrane for this Subcontract.
   2. Results of tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the project.
   3. Certification that no reclaimed polymer is added to the resin during the manufacturing of the geomembrane to be used for this project.

C. Submit to the Construction Manager for review the following documentation on geomembrane roll production at least 14 calendar days prior to transporting any geomembrane to the site.
   1. Manufacturing certificates for each shift's production of geomembrane, signed by the Manufacturer quality control manager.
   2. Certificate shall include:
      a. roll numbers and identification;
      b. sampling procedures; and
      c. results of quality control tests, including descriptions of the test methods used (the Manufacturer quality control tests to be performed are given in Part 2 of this Section).

D. Submit to the Construction Manager for review the following information from the Installer at least 14 calendar days prior to mobilization of the Installer to the site.
   1. Layout drawings showing the installation layout identifying geomembrane panel configurations, dimensions, details, locations of seams, as well as any variance or additional details which deviate from the Construction Drawings. The layout drawings shall be adequate for use as a construction plan and shall include dimensions, details, etc. The layout drawings, as modified and/or approved by the Construction Manager, shall become part of the Subcontract.

2. Installation schedule.
3. Copy of Installer's letter of approval or license by the Manufacturer.
4. Installation capabilities, including:
   a. information on equipment proposed for this project;
   b. average daily production anticipated for this project; and
   c. quality control procedures to include quality control organization.
5. A list of 10 completed facilities for which the Installer has installed a minimum of 10,000,000 square feet of polyethylene geomembrane. The following information shall be provided for each facility:
   a. the name and purpose of the facility, its location, and dates of installation;
   b. the names of the owner, project manager, and geomembrane manufacturer;
   c. name and qualifications of the supervisor of the installation crew;
   d. thickness and surface area of installed geomembrane;
   e. type of seaming and type of seaming apparatus used; and
   f. duration of installation.
6. Resumes of the Installer Superintendent and quality control chief to be assigned to this project, including dates and duration of employment.
7. Resumes of all personnel who will perform seaming operations on this project, including dates and duration of employment.
8. Evidence that the installation crew has the following experience.
   a. The Superintendent shall have supervised the installation of a minimum of 5,000,000 square feet of polyethylene geomembrane.
   b. At least one seamer shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Seamers with such experience will be designated "master seamers" and shall provide direct supervision over less experienced seamers.
   c. All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet of seams shall be allowed to seam only under the direct supervision of the master seamer or Superintendent.

E. Submit to the Construction Manager for review at least 14 days prior to geomembrane placement, a Certificate of Calibration less than 12 months old for the field tensiometer. Tensiometer shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry recognized standards where possible.

F. Submit subgrade acceptance certificates, signed by the Installer, for each area to be covered by the geomembrane prior to that area being covered by geomembrane.

G. Within 14 calendar days of completion of the geomembrane installation, submit to the Construction Manager the executed installation warranty as specified in this Part.

PART 2 PRODUCTS

2.01 RESIN

A. Provide geomembrane manufactured from new, first-quality polyethylene resin. Do not add reclaimed polymer to the resin. The use of polymer recycled during the manufacturing process is permitted if performed with appropriate cleanliness and if the recycled polymer during the manufacturing process does not exceed 2 percent by weight of the total polymer weight.

B. Use high density polyethylene (HDPE) resin having the following properties:
   1. Specific Gravity: 0.935 minimum (ASTM D 792 Method A, or ASTM D 1505)
   2. Melt Index: 1.0 g/10 min., maximum (ASTM D 1238 Condition E)

2.02 GEOMEMBRANE PROPERTIES

A. Furnish 80-mil HDPE textured geomembrane having properties that comply with the required values shown in Table 02770-1.

B. In addition, furnish geomembrane that:
   1. Contains a maximum of 1 percent by weight of additives, fillers, or extenders not including carbon black.
   2. Does not have striations, pinholes, bubbles, blisters, nodules, undispersed raw materials, or any sign of contamination by foreign matter on the surface or in the interior.

2.03 MANUFACTURING QUALITY CONTROL

A. Resin:
   1. Sample and test resin at a minimum frequency of one test per rail car to demonstrate that the resin complies with the requirements of this Section. Perform tests on resin after the addition of additives to the virgin resin. Certify in writing that the resin meets the requirements of this Section.
   2. Do not use any noncomplying resin.

B. Rolls:

1. Continuously monitor for geomembrane defects during manufacture.
2. Do not supply geomembrane that exhibits any defects.
3. Regularly monitor for geomembrane thickness during manufacture.
4. Do not supply geomembrane that fails to meet the specified thickness.
5. Sample and test the geomembrane, to demonstrate that its properties conform to the values specified in Table 02770-1. Perform the following tests at a minimum of once every 40,000 square feet:

Test	Procedure	
thickness	GRI-GM8	
yield strength	ASTM D 638	Modified by NSF 54 Annex A
yield elongation	ASTM D 638	Modified by NSF 54 Annex A
tensile strength	ASTM D 638	Modified by NSF 54 Annex A
tensile elongation	ASTM D 638	Modified by NSF 54 Annex A
tear resistance	ASTM D 1004	
carbon black	ASTM D 1603	Modified by NSF 54 Annex A
carbon black dispersion	ASTM D 5596	

Perform the following tests at a minimum of once every 100,000 square feet:

Test	Procedure	
specific gravity	ASTM D 792	Method A or ASTM D 1505
melt index	ASTM 1238	Condition E

6. If a geomembrane sample fails to meet the quality control requirements of this Section, sample and test rolls manufactured, in the same resin batch, or at the same time, as the failing roll. Continue to sample and test the rolls until the extent of the failing rolls are bracketed by passing rolls. Do not supply any failing rolls.

7. The following tests shall be run a minimum of once per every 400,000 square feet. Provide written certification that the geomembrane meets the material requirements as per the following test procedures. Provide written certification that these tests have been performed on geomembrane samples obtained from rolls delivered to the site.

Test	Procedure
environmental stress crack	ASTM D 5397
low temperature brittleness	ASTM D 746, Procedure B
dimensional stability	ASTM D 1204

C. Permit the CQC Consultant and/or Construction Manager to visit the manufacturing plant for project specific visits. If possible, such visits will be prior to, or during, the manufacturing of the geomembrane rolls for the specific project.

2.04 LABELING

A. Label the geomembrane rolls with the following information.
1. thickness of the material;
2. length and width of the roll;
3. name of Manufacturer;
4. product identification;
5. lot number; and
6. roll number.

B. Geomembrane rolls not labeled in accordance with this Section or on which labels are illegible will be rejected and replaced.

2.05 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver geomembranes to the site at least 14 calendar days prior to the planned deployment date to allow the CQC Consultant adequate time to perform conformance testing on the geomembrane samples as described in the CQA Plan.

B. Provide proper handling and storage of the geomembrane at the site. Protect the geomembrane from excessive heat or cold, dirt, puncture, cutting, or other damaging or deleterious conditions. Provide any additional storage procedures required by the Manufacturer.

C. Store geomembrane rolls on palates or other elevated structures. Do not store geomembrane rolls directly on the ground surface. Do not store more than 3 rolls high.

PART 3 EXECUTION

3.01 GEOMEMBRANE DEPLOYMENT

A. General:
1. Do not deploy geomembrane until the layout drawings are approved by the Construction Manager.
2. Do not deploy a geomembrane panel in an area until the Construction Manager has been provided with a certificate of subgrade acceptance for that area.
3. Do not deploy geomembranes until CQC Consultant completes conformance evaluation of the geomembrane and performance evaluation of previous work, including evaluation of Subcontractor's survey results for previous work.
4. Deploy each geomembrane panel in accordance with the approved layout drawings.

B. Field Panel Identification:
1. A geomembrane field panel is a roll or a portion of roll cut in the field.
2. Give each field panel an identification code (number or letter-number). This identification code shall be agreed upon by the CQC Consultant and the Installer.

C. Field Panel Placement:
1. Place each geomembrane panel one at a time and seam each panel immediately after its placement.
2. Use temporary rubsheets as required to prevent displacement or damage to underlying geosynthetics. High spots in geomembrane-baked geosynthetic clay liners shall be covered by a temporary rubsheets during placement of geomembrane.
3. Do not place geomembrane panels when the ambient temperature is below 40° Fahrenheit (F), unless authorized in writing by the Construction Manager. For cold weather (<40°F) deployment, use the additional procedures authorized in writing by the Construction Manager.
4. Do not place geomembranes during any precipitation, in the presence of heavy fog or dew, in an area of ponded water, or in the presence of high wind.

5. Ensure that:
   a. No vehicular traffic drives directly on the geomembrane.
   b. Equipment used does not damage the geomembrane by handling, trafficking, or leakage of hydrocarbons (i.e., fuels).
   c. Personnel working on the geomembrane do not smoke, bring glass onto the geomembrane, or engage in other activities that could damage the geomembrane.
   d. The method used to unroll the panels does not scratch or crimp the geomembrane and does not damage lower geosynthetics or the supporting soil.
   e. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The method used to place the panels results in intimate contact with geosynthetic clay liner. Adjust or repair any area of geomembrane wrinkles where the wrinkle height, measured perpendicular to the slope during the hottest portion of the day, is more than 4 inches.
   f. The method used to place the panels does not cause the panels to lift up or trampoline during the coolest portion of the day.
   g. The geomembrane is anchored or weighted with sandbags, or the equivalent, to prevent damage or uplift from wind. Install sufficient anchoring or weighting to prevent uplift and maintain such system until overlying material is placed.
6. Replace any field panel or portion thereof that becomes damaged (torn, twisted, or crimped). Remove from the work area damaged panels or portions of damaged panels.

D. Do not install geomembrane between one hour before sunset and one hour after sunrise unless approved by the Construction Manager.

3.02 FIELD SEAMING

A. Personnel shall be experienced as specified in this Section. Do not perform seaming unless a "master seamer" and the CQC Consultant is on-site.

B. Orient seams parallel to the line of maximum slope (i.e., oriented down, not across, the slope). Minimize the number of seams in corners and at odd-shaped geometric locations. No horizontal seam shall be less than 10 feet from the toe of the slope, except where approved by the Construction Manager. Do not locate seams at an area of potential stress concentration.

C. Weather Conditions for Seaming:
   1. Do not seam geomembrane at ambient temperatures below 40°F or above 104°F, unless authorized in writing by the Construction Manager. For cold (<40°F) or hot (>104°F) weather seaming, use the additional procedures authorized in writing by the Construction Manager.
   2. Measure ambient temperatures between 0 to 6 inches above the geomembrane surface.
   3. In all cases the geomembrane seam areas shall be dry and protected from wind.

D. Overlapping and Temporary Bonding:
   1. Sufficiently overlap geomembrane panels for welding and to allow peel tests to be performed on the seam. Any seams that cannot be destructively tested because of insufficient overlap are failing seams.
   2. Control the temperature of the air at the nozzle of heat bonding apparatus such that the geomembrane is not damaged.

E. Seam Preparation:
   1. Prior to seaming, clean the seam area and ensure that area to be bonded is free of moisture, dust, dirt, debris of any kind, and foreign material.
   2. If seam overlap grinding is required, complete the process according to the Manufacturer's instructions within 20 minutes of the seaming operation. Do not grind to a depth that exceeds ten percent of the geomembrane thickness. Grinding marks shall not appear beyond 0.25 inch of the extrudate after it is placed.
   3. Align seams with the fewest possible number of wrinkles and "fishmouths".

F. General Seaming Requirements:
   1. Extend seams to the outside edge of panels to be placed in the anchor trench.
   2. If required, place a firm substrate such as a flat board or similar hard surface directly under the seam overlap to achieve proper support.
   3. Cut fishmouths or wrinkles at the seam overlaps along the ridge of the wrinkle to achieve a flat overlap. Seam the cut fishmouths or wrinkles and patch any portion where the overlap is less than 6 inches with an oval or round patch of geomembrane that extends a minimum of 6 inches beyond the cut in all directions.
   4. Place the electric generator used for power supply to the welding machines outside the area to be lined or mount it on soft tires such that no damage occurs to the geomembrane. Properly ground the electric generator. Place a smooth insulating plate or fabric beneath the hot welding apparatus after use.

G. Seaming Process:
   1. Approved processes for field seaming are extrusion welding and fusion welding. Use only geomembrane Manufacturer-approved equipment.
   2. Extrusion Equipment and Procedures:
      a. Maintain at least one spare operable seaming apparatus on site.
      b. Equip extrusion welding apparatus with gauges giving the temperature in the apparatus and at the nozzle.
      c. Prior to beginning a seam, purge the extruder until all heat-degraded extrudate has been removed from the barrel. Whenever the extruder is stopped, purge the barrel of all heat-degraded extrudate.
   3. Fusion Equipment and Procedures:
      a. Maintain at least one spare operable seaming apparatus on site.
      b. Fusion-welding apparatus shall be automated self-propelled devices equipped with gauges giving the applicable temperatures and pressures.
      c. Fusion-welding apparatus shall produce a double-track seam.
      d. Abrade the edges of cross seams to a smooth incline (top and bottom) prior to extrusion welding.

H. Trial Seams:
   1. Make trial seams on excess pieces of geomembrane to verify that seaming conditions are adequate. Conduct trial seams on the same material to be installed and under similar field conditions as production seams. Conduct trial seaming at the beginning of each seaming period, and at least once each five hours, for each seaming apparatus used that day prior to seaming. Also, each seamer shall make at least one trial seam each day, for each day that seaming is performed by that seamer. Conduct trial seaming under the same conditions as the actual seaming. Prepare trial seams that are at least 15 feet long by 1 foot wide (after seaming) with the seam centered lengthwise for fusion equipment and at least 3 feet long by 1 foot wide for extrusion equipment. Prepare seam overlap as indicated in the "Overlapping and Temporary Bonding" Article of this Part.
   2. Cut four specimens, each 1.0 inch wide, from the trial seam sample. Test two specimens in shear and two in peel, using a field tensiometer. The test specimens shall not fail in the seam. If a specimen fails, repeat the entire operation. If the additional specimen fails, do not accept the seaming apparatus or seamer until the deficiencies are corrected and two consecutive successful trial seams are achieved. A seamer may start production seaming prior to testing of the trial seams. In the event the trial seam fails, all production seams by the seamer are failed seams.

I. Nondestructive Seam Continuity Testing:
1. Nondestructively test for continuity field seams over their full length. Perform continuity testing as the seaming work progresses, not at the completion of field seaming. Complete any required repairs in accordance with the "Defects and Repairs" Article of this Part. Apply the following procedures:
   a. Use vacuum testing for extrusion welds.
   b. Use air pressure testing for double-track fusion seams.
2. Vacuum Testing:
   a. Use the following equipment:
      i. A vacuum box assembly consisting of a stiff housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.
      ii. A system for applying 5 pound per square inch (psi) gauge suction to the box.
      iii. A bucket of soapy solution and applicator.
   b. Follow these procedures:
      i. Energize the vacuum pump and reduce the tank pressure to 5 $\pm$1 psi gauge.
      ii. Wet an area of the geomembrane seam larger than the vacuum box with the soapy solution.
      iii. Place the box over the wetted area.
      iv. Close the bleed valve and open the vacuum valve.
      v. Ensure that a leak tight seal is created.
      vi. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 20 seconds.
      vii. If no bubbles appear after 20 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inch overlap, and repeat the process.
      viii. Mark all areas where soap bubbles appear with a marker that will not damage the geomembrane and repair in accordance with the "Defects and Repairs" Article of this Part.
3. Air Pressure Testing:
   a. Use the following equipment:
      i. An air pump (manual or motor driven) or air reservoir, equipped with a pressure gauge, capable of generating and sustaining a pressure between 25 and 30 pounds per square inch.
      ii. A rubber hose with fittings and connections.
      iii. A hollow needle, or other approved pressure feed device.

b. Follow these procedures:
   i. Seal both ends of the seam to be tested.
   ii. Insert needle, or other approved pressure feed device, into the tunnel created by the fusion weld.
   iii. Insert a protective cushion between the air pump and the geomembrane.
   iv. Energize the air pump to a pressure between 25 and 30 pounds per square inches, close valve, and sustain the pressure for not less than 5 minutes.
   v. If loss of pressure exceeds 3 pounds per square inches, or does not stabilize, locate faulty area and repair in accordance with the "Defects and Repairs" Article of this Part.
   vi. Cut opposite end of air channel from pressure gauge and observe release of pressure to ensure air channel is not blocked.
   vii. Remove needle, or other approved pressure feed device, and seal both ends in accordance with the "Defects and Repairs" Article of this Part.

J. Destructive Testing:
   1. Perform destructive seam tests to evaluate seam strength and integrity. Perform destructive testing as the seaming work progresses, not at the completion of field seaming.
   2. Sampling and Testing:
      a. Collect destructive test samples at a minimum average frequency of one test location per 500 feet of seam length and at additional locations of suspected nonperformance. The CQC Consultant will select test locations, including locations with evidence of excess geomembrane crystallinity, contamination, offset seams, or any other evidence of inadequate seaming.
      b. Cut samples at the locations designated by the CQC Consultant at the time the locations are designated. Number each sample and identify the sample number and location on the panel layout drawing. Immediately repair all holes in the geomembrane resulting from the destructive seam sampling in accordance with the repair procedures described in the "Defects and Repairs" Article of this Part. Test the continuity of the new seams in the repaired areas according to "Nondestructive Seam Continuity Testing" Article of this Part.

c. Cut two strips 1 inch wide and 12 inch long with the seam centered parallel to the width from either side of the sample location. Test the two 1-inch wide strips in the field tensiometer in the peel mode. The CQC Consultant may request an additional test in the shear mode. If these samples pass the field test, prepare a laboratory sample at least 1 foot wide by 3.5 feet long with the seam centered lengthwise. Cut the laboratory sample into three parts and distribute as follows:
   i. One portion 1 foot long to the Installer.
   ii. One portion 1.5 feet long to the CQC Consultant for testing.
   iii. One portion 1 foot long to the Construction Manager for archival storage.

3. In the event of failing field or laboratory test results, the Subcontractor may reconstruct the entire seam between two passing destructive tests; otherwise, the CQC Consultant will identify the extent of the nonconforming area following the procedures given in the CQA Plan. Obtain additional samples for testing as requested by the CQC Consultant.

K. Defects and Repairs:
1. Inspect the geomembrane before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. Sweep or wash the geomembrane surface if surface contamination inhibits inspection.
2. Test each suspect location, both in seam and non-seam areas, using the methods described in the "Nondestructive Seam Continuity Testing" Article of this Part. Repair each location that fails nondestructive testing.
3. Cut and reseam wrinkles not conforming with Part 2 of this Section. Test the seams thus produced like any other seam.
4. Repair Procedures:
   a. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test. Use the most appropriate of the available procedures:
      i. patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
      ii. abrading and reseaming, used to repair small sections of extruded seams;
      iii. spot seaming, used to repair minor, localized flaws;
      iv. capping, used to repair long lengths of failed seams;
      v. topping, used to repair areas of inadequate seams, which have an exposed edge less than 4 inches in length; and

vi. removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).

b. When making repairs, satisfy the following:
   i. abrade surfaces of the geomembrane that are to be repaired no more than 20 minutes prior to the repair;
   ii. clean and dry all geomembrane surfaces immediately prior to repair;
   iii. only use approved seaming equipment;
   iv. extend patches or caps at least 6 inches beyond the edge of the defect, and round corners of patches to a radius of at least 3 inches; and
   v. cut the geomembrane below large caps to avoid potential for water or gas collection between the two sheets.

5. Repair Verification:
   a. Test each repair using the methods described in the "Nondestructive Seam Continuity Testing" Article of this Part. Repairs that pass the nondestructive test are adequate unless the CQC Consultant elects to also perform destructive tests. Re-repair and retest failed tests.

3.03 CREST ANCHORAGE SYSTEM

A. Temporarily anchor each geomembrane panel in the anchor trench at the crest of the slope as soon as the panel is deployed or positioned.

B. Do not entrap soil, sand bags, or other materials between the geosynthetic layers.

C. Do not backfill the anchor trench until all geosynthetic layers are installed in the anchor trench. Backfill in accordance with the Construction Drawings and Section 02215.

D. Do not damage any geosynthetic layer when backfilling the anchor trench.

3.04 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

A. Take all necessary precautions to prevent damage to the geomembrane during the installation of other components of the liner system.

B. Do not drive equipment directly on the geomembrane. Only use equipment above the geomembrane that meets the following ground pressure requirements.

Maximum Allowable Equipment Ground Pressure (pounds per square inches)	Minimum Thickness of Overlying Material (inches)
<5	12
<10	18
<20	24
>20	36

C. Penetrations:

1. Install the geomembrane at liner penetrations, and connect the geomembrane to penetrating pipes and the liner penetration boxes in accordance with the Construction Drawings and Section 13005. Take extreme care while seaming around appurtenances as neither nondestructive nor destructive testing may be feasible in certain areas.

3.05 CONSTRUCTION QUALITY REQUIREMENTS

A. Samples of the geomembrane will be removed by the CQC Consultant after the material has been received at the site. The CQC Consultant will send the geosynthetics to a CQC laboratory for testing to ensure conformance with the requirements of this Section. Conformance testing and frequency will be as given in the CQA Plan.

B. The CQC Consultant will send geomembrane destructive seam samples to the CQC laboratory for testing to ensure that seam performance requirements are met. Performance testing and frequency will be as given in the CQA Plan.

3.06 SURVEY CONTROL

A. Survey the installed geomembrane liner in accordance with Section 02100.

TABLE 02770-1

REQUIRED HDPE TEXTURED GEOMEMBRANE PROPERTIES

Properties	Qualifiers	Units[1]	Specified Values		Test Method
			Liner	Cap	
Physical Properties					
Thickness	average	mils	80	60	GRI-GM8
	minimum	mils	76	58	GRI-GM8
Specific Gravity	minimum	N/A	0.940		ASTM D 792 Method A or ASTM D 1505
Carbon Black Content	range	%	2-3		ASTM D 1603
Carbon Black Dispersion	N/A	none	Category 1 or 2		ASTM D 5596
Melt Flow Index	maximum	g/10 min	1.0		ASTM D 1238 (Condition E)
Mechanical Properties					
Tensile Properties (each direction)					
1. Force Per Unit Width at Yield	minimum	lb/in	168	126	ASTM D 638 (Modified by NSF 54 Annex A)
2. Tensile Strength (force per unit width at break)	minimum	lb/in	120	90	ASTM D 638 (Modified by NSF 54 Annex A)
3. Elongation at Yield	minimum	%	12		ASTM D 638 (Modified by NSF 54 Annex A)
4. Elongation at Break	minimum	%	200		ASTM D 638 (Modified by NSF 54 Annex A)
Tear Resistance	minimum	lb	56	42	ASTM D 1004 Die C Puncture

TABLE 02770-1 (continued)

Properties	Qualifiers	Units[1]	Specified Values		Test Method
			Liner	Cap	
Environmental Properties					
Low Temperature Brittleness	maximum	°C	-60		ASTM D 746 Procedure B
Dimensional Stability (each direction)	maximum change	%	±2		ASTM D 1204 212°F, 15 min.
Environmental Stress Crack	minimum	hrs	500[2]		ASTM D 5397

Notes: 1. % = percent
g = grams
min = minutes
lb/in = pounds per inch
lb = pound
°C = degrees celsius
hrs = hours
2. Time-to-failure at a tensile stress of 30 percent of the tensile yield strength.

TABLE 02770-2

REQUIRED HDPE TEXTURED GEOMEMBRANE SEAM PROPERTIES

Properties	Qualifiers	Units[3]	Specified Values		Test Method
			Liner 80 mil	Cap 60 mil	
Shear Strength[1]					
fusion	minimum	lb/in	151	113	ASTM D 4437
extrusion	minimum	lb/in	151	113	ASTM D 4437
Peel Adhesion					
FTB[2]					
fusion	minimum	lb/in	99	78	ASTM D 4437
extrusion	minimum	lb/in	84	63	ASTM D 4437

Notes: 1. Also called "Bonded Seam Strength". Value is at material yield point.
2. FTB = Film Tear Bond. (Maximum 10 percent seam separation)
3. lb/in = pounds per inch

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02772 **TITLE:** GEOSYNTHETIC CLAY LINER AND CAP 14 May 97

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neil Davies — 10/23/95 (Date)
Printed Name and Title R NEIL DAVIES.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ — 20 Feb 96 (Date)
Printed Name and Title Kenneth W Cargill, Associate

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title MARK H. GLEASON, Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ — 8 Apr 96 / 27 Feb 96 (Date)
Printed Name and Title ~~BEECH, Principal~~ Kenneth W Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
~~A~~	30% Submittal				
B	Reprint for EPA Submittal	6 Dec 95	NA	NA	NA
C	Intermediate Design	27 Feb 96	—	—	JFB
D	Intermediate Design, EPA Submittal	8 Apr 96			
F	Prefinal Design, EPA Submittal	25 Jun 96			
G	Final Design Package	9 Oct 96			
C	Response to Final Design Cmts	14 May 97			

Section 02772

SECTION 02772

GEOSYNTHETIC CLAY LINER AND CAP

PART 1 GENERAL

1.01 SCOPE

A. This Section includes geosynthetic clay liner and cap products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02215 - Trenching and Backfilling

B. Section 02225 - Compacted Clay Liner and Cap

C. Section 02710 - Granular Drainage Material

D. Section 02714 - Geotextiles

E. Section 02770 - Geomembrane Liner and Cap

F. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest Version American Society of Testing and Materials (ASTM) Standards:

1. ASTM D 638. Standard Test Method for Tensile Properties of Plastics.
2. ASTM D 792. Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
3. ASTM D 1004. Standard Test Method of Initial Tear Resistance of Plastic Film and Sheeting.
4. ASTM D 1238. Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
5. ASTM D 1505. Standard Test Method for Density of Plastics by the Density Gradient Technique.
6. ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.
7. ASTM D 3786. Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.

8. ASTM D 4533. Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
9. ASTM D 4595. Standard Test Method for Tensile Properties of Geotextiles by Wide-Width Strip Method.
10. ASTM D 4632. Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
11. ASTM D 4643. Determination of Water (Moisture) Content of Soil by Microwave Oven Method
12. ASTM D 4833. Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
13. ASTM D 5261. Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.
14. ASTM D 5321. Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
15. ASTM D 5596. Standard Test Method for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
16. ASTM D 5890. Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.

B. Latest version of Geosynthetic Research Institute (GRI):
   1. GM8 Standard Test Method for Measurement of the Core Thickness of Textured Geomembrane.
   2. GCL-2 Standard Test Method for Measurement of Hydraulic Conductivity in Geosynthetic Clay Liners.

1.04 SUBMITTALS

A. Submit to the Construction Manager for review within 30 calendar days from Notice to Proceed the following information regarding the geosynthetic clay liner and cap proposed for use.
   1. Manufacturer and product name.
   2. Manufacturer's daily production capacity available for this project. Evidence that the Manufacturer has more than one year of experience in the manufacturing of geosynthetic clay liner and cap.
   3. Manufacturer's quality control procedures.
   4. Manufacturer's requirements for any geotextile component of the geosynthetic clay liner. At a minimum, mass per unit area, grab strength, and grab elongation are to be required.
   5. Certification that manufacturer's requirements for geotextile components are met.

6. Certification of minimum average roll values (95 percent lower confidence limit) and the corresponding test procedures for all geosynthetic clay liner and cap properties listed in Table 02772-1.
7. Manufacturer's recommended procedures for overlapping adjacent geosynthetic clay liner and cap panels.
8. Projected geosynthetic clay liner and cap delivery dates.

B. For each proposed geosynthetic clay liner and cap material, submit to the Construction Manager for review at least 42 calendar days prior to geosynthetic clay liner and cap placement the results of internal and interface shear strength tests and certification that the geosynthetic clay liner and cap has minimum internal and interface shear strength as specified in Part 2 of this Section.

C. Submit to the Construction Manager for review at least 14 days prior to geosynthetic clay liner and cap placement manufacturing quality control certificates for each roll of geosynthetic clay liner and cap as specified in Part 2 of this Section. Submit certificates signed by the Manufacturer quality control manager, and notarized. The quality control certificates shall include:
1. lot, batch, or roll numbers and identification;
2. sampling procedures; and
3. results of quality control tests.

PART 2 PRODUCTS

2.01 GEOSYNTHETIC CLAY LINER AND CAP

A. Furnish geosynthetic clay liner and cap with bentonite core and textured 40-mil HDPE geomembrane backing, or with internally-reinforced bentonite core and nonwoven geotextile and woven geotextile backings, as indicated on the Construction Drawings.

B. Furnish geosynthetic clay liner and cap having properties that comply with the required values shown in Table 02772-1.

C. Geosynthetic clay liner and cap consisting of a bentonite core with textured 40-mil HDPE geomembrane backing shall meet the following requirements:
1. Hydraulic conductivity of the bentonite component is equal to or less than 5 x 10^{-9} centimeters per second, when measured in a flexible wall permeameter in accordance with GRI-GCL-2 under an effective confining stress of 5 pounds per square inch.
2. Minimum roll width is 15 feet.

3. Minimum roll length is 100 feet.
4. Bentonite component is at least 90 percent sodium montmorillonite.
5. Bentonite component is glued to the HDPE geomembrane component and is applied at a minimum rate of 1.0 pound per square foot, measured at a water content of less than or equal to 25 percent. Glue is sufficient to prevent more than nominal dislodgement of bentonite during geosynthetic clay liner and cap transportation, handling, and installation. Use glue that does not affect geomembrane properties.
6. Geomembrane component of the geosynthetic clay liner and cap has the following characteristics:
   a. Provide geomembrane manufactured from new, first-quality polyethylene resin. Do not add reclaimed polymer to the resin. The use of polymer recycled during the manufacturing process is permitted it does not exceed 2 percent by weight of the total polymer weight.
   b. Use high density polyethylene (HDPE) resin having the following properties:
      i. Specific Gravity: 0.935 minimum (ASTM D 792 Method A, or ASTM D 1505)
      ii. Melt Index: 1.0 g/10 min., maximum (ASTM D 1238 Condition E)
   c. Furnish geomembrane having properties that comply with the required property values shown in Table 02772-1.
   d. In addition, furnish geomembrane that:
      i. Contains a maximum of 1 percent by weight of additives, fillers, or extenders (not including carbon black).
      ii. Does not have striations, pinholes (holes), bubbles, blisters, nodules, undispersed raw materials, or any sign of contamination by foreign matter on the surface or in the interior.

D. Geosynthetic clay liner and cap consisting of an internally-reinforced bentonite core with woven and nonwoven geotextile backings shall meet the following requirements:
1. Hydraulic conductivity is equal to or less than 5×10^{-9} centimeters per second, when measured in a flexible wall permeameter in accordance with ASTM D 5084 under an effective confining stress of 5 pounds per square inch.
2. Minimum roll width is 15 feet.
3. Minimum roll length is 100 feet.
4. Bentonite component is at least 90 percent sodium montmorillonite.
5. Bentonite component is applied at a minimum rate of 0.95 pounds per square foot, when measured at a water content of less than or equal to 25 percent.
6. Geotextile backings are woven and nonwoven materials, manufactured with polyproplene or polyester material, and conforming to the manufacturer's requirements.

7. Needlepunching is used to bind geotextile backings and bentonite core.
8. Bentonite is contained by the geotextiles in a manner that prevents more than nominal dislodgement of bentonite during geosynthetic clay liner and cap transportation, handling, and installation.

E. Furnish geosynthetic clay liner and cap that meets the shear strength requirements of this Part.
   1. Measure peak and large-displacement (2 inch displacement) shear strengths using 12-inch square direct shear box. Perform test in accordance with ASTM D 5321 and as specified below. Test for:
      a. Internal shear strength of representative samples of geosynthetic clay liner and cap.
      b. Interface shear strength of representative samples of geosynthetic clay liner and cap and geomembrane liner.
      c. Representative samples are defined as samples obtained from rolls destined for use on this project. Identify the source (roll number) of representative samples.
   2. Follow the specific procedures and conditions listed below.
      a. Place the materials to be tested with their machine directions aligned in the direction of shear in the shear box. For the internal shear strength test, use a test specimen configuration of (from bottom to top): rigid substrate with textured gripping surface, geosynthetic clay liner and cap, and rigid substrate with textured gripping surface. For the interface shear strength test, use a test specimen configuration of (from bottom to top): concrete bedding sand, geomembrane, geosynthetic clay liner and cap with woven geotextile in contact with geomembrane, and rigid substrate with textured gripping surface.
      b. Submerge the test specimen for at least a 7-day period prior to testing to allow the geosynthetic clay liner and cap to hydrate. Prior to the start of hydration, apply a normal (seating) stress of 3 pounds per square inch.
      c. After hydration, consolidate the materials for at least 48 hours at the specified normal stress.
      d. Use a shear rate of 0.004 inches per minute.
      e. Use textured gripping surfaces that apply a uniform transfer of shear stress to prevent non-uniform stressing of the geosynthetics.
      f. Perform the direct shear tests at normal stresses of 5, 20, and 45 pounds per square inch, and report the peak and large-displacement (2 inch displacement) shearing resistance for each test. Perform a duplicate test for at least one normal stress (20 points per square inch) for each test configuration.
      g. Use fresh specimens for each normal stress.

h. Repeat any tests for which the shear displacements do not occur within the desired material (internal strength) or along the desired interface (interface strength).

3. Report peak and large-displacement shear strengths for each of the respective tests in terms of secant friction angles (equal to inverse tangent of shear stress divided by normal stress). Furnish geosynthetic clay liner and cap with the following minimum shear strengths:

Normal Stress (psi)	Peak Shear Strength Secant Angle (degrees)	Large-Displacement Shear Strength Secant Angle (degrees)
5	17	12
20	17	7
45	17	6.5

2.02 MANUFACTURING QUALITY CONTROL

A. Sample and test the geosynthetic clay liner and cap to demonstrate that the material complies with the requirements of this Section.

B. Perform manufacturing quality control tests to demonstrate that geosynthetic clay liner and cap properties conform to the stated requirements. Perform the following tests at a minimum frequency of once per 40,000 square feet, except for hydraulic conductivity and direct shear which shall be performed at a minimum frequency of once per 100,000 square feet.

Test	Procedure	Frequency
bentonite content	ASTM D 5261	1/40,000 ft^2
bentonite moisture content	ASTM D 4643	1/100,000 lb
bentonite free swell	ASTM D 5890	1/100,000 lb
grab strength	ASTM D 4632	1/40,000 ft^2
grab elongation	ASTM D 4632	1/40,000 ft^2
bentonite hydraulic conductivity	GRI-GCL-2	1,100,000 ft^2
direct shear	ASTM D 5321	1,100,000 ft^2

C. Comply with the certification and submittal requirements of this Section.

D. If a geosynthetic clay liner and cap sample fails to meet the quality control requirements of this Section, sample and test rolls fabricated at the same time or in the same lot as the failing roll. Continue to sample and test the rolls until the extent of the failing rolls are bracketed by passing rolls. Do not supply any failing rolls.

2.03 PACKING AND SHIPPING

A. Supply geosynthetic clay liner and caps in rolls wrapped in impermeable and opaque protective covers.

B. Mark or tag geosynthetic clay liner and caps with the following information:
1. manufacturer's name;
2. product identification;
3. lot number;
4. roll number;
5. roll weight; and
6. roll dimensions.

C. Geosynthetic clay liner and cap rolls not labeled in accordance with this Section or on which labels are illegible will be rejected and replaced.

D. Deliver the geosynthetic clay liner and cap to the site at least 28 calendar days prior to the scheduled installation date to allow the CQC Consultant to obtain conformance samples and complete conformance testing as described in the CQA Plan.

2.04 STORAGE AND PROTECTION

A. Handle, store, and care for the geosynthetic clay liner and cap in a manner that does not cause hydration or damage.

B. Protect the geosynthetic clay liner and cap from moisture, excessive heat or cold, puncture, or other damaging or deleterious conditions. Store the geosynthetic clay liner and cap rolls on palates or other elevated structures. Do not store geosynthetic clay liner and cap rolls directly on the ground surface. Cover the geosynthetic clay liner and cap entirely with a tarp. Store geosynthetic clay liner and cap rolls out of direct sunlight. Follow any additional storage procedures required by the Manufacturer.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Provide certification in writing that the surface on which the geosynthetic clay liner and cap will be installed is acceptable as described below. Give this certification of acceptance to the Construction Manager prior to commencement of geosynthetic clay liner and cap installation in the area under consideration.

B. Maintain the prepared soil surface in accordance with Article 3.08 "Protection of Work" of Section 02225.

C. Do not place the geosynthetic clay liner and cap onto an area that has been softened by precipitation or that has cracked due to desiccation. Repair such areas in accordance with Section 02225.

3.02 CREST ANCHORAGE SYSTEM

A. Excavate the anchor trench prior to geosynthetic clay liner and cap placement. Excavate to the lines and grades shown on the Construction Drawings.

B. The anchor trench beneath the geosynthetic clay liner and cap shall be firm, clean, and dry.

C. Temporarily anchor the geosynthetic clay liner and cap in the anchor trench until all geosynthetic layers are installed in the anchor trench.

D. Install other geosynthetics in the anchor trench in accordance with Sections 02714 and 02770. Backfill the anchor trench in accordance with Section 02215. Place granular drainage materials over the geosynthetics in accordance with Section 02710.

3.03 PLACEMENT

A. Do not commence geosynthetic clay liner and cap placement until the CQC Consultant completes conformance evaluation of this material and performance evaluation of previous work, including Subcontractor's survey results for previous work.

B. Weight geosynthetic clay liner and cap with sandbags or other means to prevent uplift or movement in wind. Immediately remove and replace any damaged or leaking sandbags.

C. Cut the geosynthetic clay liner and cap using a utility blade. Do not damage underlying material during cutting and fully repair any such damage.

D. Do not entrap stones or other foreign objects under the geosynthetic clay liner and cap. Do not drag equipment across the exposed geosynthetic clay liner and cap.

E. Replace any geosynthetic clay liner and cap that is damaged by any means including foreign objects, or installation activities.

F. Install geosynthetic clay liner and cap that has a sodium montmorillonite core and a textured 40-mil HDPE geomembrane backing with the HDPE geomembrane backing down. Install geosynthetic clay liner and cap that is internally-reinforced with the nonwoven geotextile backing down.

G. Do not install the geosynthetic clay liner and cap on a wet subgrade or in standing water. Prevent hydration of the bentonite core prior to completion of construction of the liner system or final cover system, as appropriate.

H. Do not install the geosynthetic clay liner and cap during precipitation or other conditions that may cause hydration of the geosynthetic clay liner and cap.

I. Install the overlying geomembrane as soon as possible following geosynthetic clay liner and cap installation. Cover all geosynthetic clay liner and cap that is placed during a work day with overlying geomembrane. Cover and protect the edges of geosynthetic clay liner and cap from hydration due to stormwater runon.

J. Remove and replace geosynthetic clay liner and cap that becomes hydrated. Hydration is defined by a moisture content of 40 percent or greater when measured in accordance with ASTM D 4643.

K. Place earthen material for the liner and final cover systems on top of the geomembrane and other geosynthetics overlying the geosynthetic clay liner and cap as soon after installation of the geosynthetic clay liner and cap as possible.

3.04 OVERLAPS

A. On slopes steeper than 5 horizontal to 1 vertical, install geosynthetic clay liners continuously down the slope; that is, allow no horizontal seams on the slope.

B. Allow no horizontal seams on the base of the landfill within 5 feet of the toe of a slope.

C. Overlap geosynthetic clay liner and cap in strict accordance with the Manufacturer's recommended procedures. As a minimum, overlap adjacent panels at least 6 inches along the sides and 12 inches along the ends.

3.05 MATERIALS IN CONTACT WITH THE GEOSYNTHETIC CLAY LINER AND CAP

A. Perform installation of other components in a manner that prevents damage to the geosynthetic clay liner and cap.

B. Do not drive equipment directly on the geosynthetic clay liner and cap.

C. Install the geosynthetic clay liner and cap in appurtenant areas, and connect the geosynthetic clay liner and cap to appurtenances according to the Construction Drawings. Do not damage the geosynthetic clay liner and cap while working around the appurtenances.

3.06 REPAIR

A. Repair any holes or tears in the geosynthetic clay liner and cap by placing a geosynthetic clay liner and cap patch over the hole. On slopes greater than 5 percent, the patch shall overlap the edges of the hole or tear by a minimum of 2 feet in all directions. On slopes 5 percent or flatter, the patch shall overlap the edges of the hole or tear by a minimum of 1 foot in all directions. Secure the patch with a water-based adhesive approved by the manufacturer.

B. Remove any soil or other material that may have penetrated the torn geosynthetic clay liner and cap.

C. Do not nail or staple the patch.

3.07 CONSTRUCTION QUALITY REQUIREMENTS

A. Samples of the geosynthetic clay liner and cap will be removed by the CQC Consultant and sent to a geosynthetics CQC laboratory for testing to ensure conformance with the requirements of this Section. Conformance testing and frequency will be as given in the CQA Plan.

TABLE 02772-1

REQUIRED GEOSYNTHETIC CLAY LINER AND CAP PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS[6]	SPECIFIED[1] VALUES	TEST METHOD
GCL Properties				
Bentonite Content[2] (GCL)	minimum	lb/ft^2	1.0	ASTM D 5261
Bentonite Moisture Content	maximum	%	25	ASTM D 4643
Bentonite Free Swell	minimum	ml/2g	24	ASTM D 5890
Hydraulic Conductivity (Bentonite only)[3]	minimum	cm/s	5×10^{-9}	GRI GCL-2
Shear Strength (GCL)		See values in Part 2 of this Section.		
Textured HDPE Geomembrane Properties[4]				
Thickness	average minimum	mils mils	40 36	GRI GM 8 GRI GM 8
Specific Gravity	minimum	N/A	0.94	ASTM D 792 or ASTM 1505
Melt Flow Index	maximum	g/10 min	1.0	ASTM D 1238 (Condition E)
Elongation at Yield	minimum	%	13	ASTM D 638
Elongation at Break	minimum	%	100	ASTM D 638
Strength at Yield	minimum	lb/in	95	ASTM D 638
Strength at Break	minimum	lb/in	50	ASTM D 638
Tear Resistance	minimum	lb	12	ASTM D 1004 Die C puncture
Puncture Resistance	minimum	lb	25	ASTM D 4833
Carbon Black Content	range	%	2-3	ASTM D 1603
Carbon Black Dispersion	N/A	none	Category 1 or 2	ASTM D 5596
Geotextile Properties[4]				
Polymer Composition	minimum	%	95 polyester or polypropylene	

TABLE 02772-1 (continued)

Notes:
1. All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
2. Measured at a moisture content not exceeding 25 percent.
3. For GCL with geomembrane backing, perforate or cut backing to allow unimpeded and uniform flow through the backing.
4. Geosynthetic clay liners and caps not having these components and otherwise satisfying Part 2.01 of this Section, are exempt from meeting the specified values.
5. Not used.
6. lb/ft^2 = pounds per square foot
   cm/s = centimeter per second
   min = minutes
   g = grams
   % = percent
   lb = pound
   lb/in = pounds per inch
   ml/2g = milliliters per two grams

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02831 **TITLE:** CHAIN LINK FENCES AND GATES

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 (Date)
Printed Name and Title J.F. BEECH

Scope and Format Checked By: (Checker)
Signature R Neil Davies — 10/23/95 (Date)
Printed Name and Title R. NEIL DAVIES. Senior Project Engineer

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B B Mazanti — 20 Feb 96 (Date)
Printed Name and Title B. B. MAZANTI Consultant

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 (Date)
Printed Name and Title Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech — 22 Feb 96 — 14 May 97 (Date)
Printed Name and Title ~~BEECH PRINCIPAL~~ Kenneth W Cargill Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
0A	30% Submittal				
B	Request for EPA Submittal	14 Dec 95	NA	NA	NA
C	Intermediate Design	22 Feb 96	—	~~JFB~~ JFB	JFB
F	Prefinal Design, EPA Submittal	25 Jun 96	—	—	—
G	Final Design Package	30 Oct 96	—	—	—
E	Response to Final Design Cmts	14 May 97	—	—	—

SECTION 02831

CHAIN-LINK FENCES AND GATES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes chain-link fences and gates products and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 03100 - Concrete

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) Standards:
   1. ASTM A 121. Standard for Zinc-Coated (Galvanized) Steel Barbed Wire.
   2. ASTM A 123. Standard for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A 153. Zinc-Coated (Hot Dip) in Iron and Steel Hardware.
   4. ASTM A 392. Standard for Zinc-Coated Steel Chain-Link Fence Fabric.

1.04 SUBMITTALS

A. Submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
   1. manufacturer's product data and shop drawings showing details for fence, gates, hardware, footings, grounding, and installation; and
   2. specific size and wording for signs warning against unauthorized trespassing by unauthorized personnel.

PART 2 PRODUCTS

2.01 GENERAL

A. Furnish 6-foot high chain-link fencing as shown on the Construction Drawings. At gates, corners, and end posts, use vertical stretcher bars and horizontal and diagonal bracing rods which extend to the first adjacent line post. Use a fence with a top rail,

1 foot of three-strand barbed wire above the top rail, and a bottom tension wire as shown on the Construction Drawings.

B. Furnish gate posts spaced as indicated on the Construction Drawings.

2.02 FABRIC

A. Furnish 6-foot high chain-link fabric woven from 9-gauge steel wire galvanized in accordance with ASTM A 392 Class II in a 2-inch mesh. Use a wire with a minimum breaking strength of 1,200 pounds.

2.03 POSTS AND FITTINGS

A. Furnish hot-dip galvanized posts and rails conforming to ASTM A 123 with ASA Schedule 40 steel pipe sizes as follows:
1. line posts are 2.375-inch outside diameter (O.D.);
2. end, corner, and pull posts are 2.875-inch O.D.; and
3. top brace rails are 1.66-inch O.D.

B. Furnish cylindrical concrete footings with a minimum diameter of 9 inches, extending a minimum of 6 inches below the bottom of the posts. Use cast-in-place concrete as specified in Section 03100.

C. Furnish brace bands, tension bands, tie-rods, and turn-buckles manufactured from malleable iron or pressed steel and coated in accordance with ASTM A 153.

D. Furnish galvanized stretcher bars in one piece lengths equal to the full height of the chain-link fabric with a minimum cross section of 0.1875 inches by 0.75 inches and coated in accordance with ASTM A 153. Provide stretcher bars for gate posts, end posts, and corner posts.

E. Furnish 9-gauge steel tie wire and 7-gauge steel tension wire galvanized in accordance with ASTM A 123.

2.04 SUPPORTING ARMS AND BARBED WIRE

A. Furnish supporting arms:
1. coated in accordance with ASTM A 153;
2. oriented at 45 degrees to vertical; and
3. manufactured from malleable iron or pressed steel.

B. Furnish supporting arms with caps which securely fit to the tops of posts to exclude moisture and have openings to receive top rail.

C. Furnish three rows of barbed wire manufactured from two-strand, 12.5-gauge wire with 14-gauge, 4-point barbs spaced at 5 inches on center and galvanized in accordance with ASTM A 121, Class 3.

2.05 GATES

A. Furnish gates manufactured with:
1. 1.90-inch O.D. frames;
2. welded fittings;
3. braces and 0.375-inch truss rod fabrication; and
4. fabric and barbed wire in accordance with this Section.

B. Furnish gates which are the same height as the adjacent fence.

C. Furnish 2.875-inch O.D. gate posts for gates with up to 6-feet leaf widths. Use 4.0-inch O.D. gate posts for gates with 6-feet to 13-feet leaf widths. Provide gate posts with securely fitting caps to exclude moisture. Supply each gate with:
1. a locking bar and locking device;
2. non lift-off type malleable iron hinges; and
3. plunger-bar type latch.

2.06 SIGNS

A. Furnish baked enamel 18-gauge steel signs warning against trespassing by unauthorized personnel.

PART 3 EXECUTION

3.01 INSTALLATION OF FENCES AND GATES

A. Perform all final grading prior to installation of permanent fencing. Install fencing as shown on the Construction Drawings and follow the general lines and grades of the finished ground.

B. Installation:
1. Set posts plumb in concrete as shown on the Construction Drawings. Concrete shall meet the requirements of Section 03100. Posts shall be in a straight

alignment, with temporary bracing until concrete has set. Trowel finish and slope exposed tops of concrete footings to promote drainage away from the posts.

2. Install pull posts every 300 feet if no corner posts are encountered in that distance.
3. Install corner posts at changes in direction of 30 degrees or more, and pull posts at changes in direction of 15 degrees or more. Install pull posts at abrupt changes in grade.
4. Install supporting arms on each post.

C. Set post bracing as specified below after concrete in post bases has set.
   1. Install pull posts at gate posts, end posts, and at each side of corner posts; install so posts are plumb when diagonal rod is under tension.

D. Install top brace rails as specified below.
   1. Continuously run through barbed wire supporting arms.
   2. Install expansion couplings at each joint.

E. Install chain-link fabric as specified below:
   1. Stretch taut with equal tension on each side of line posts.
   2. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
   3. Use U-shaped tie wire, conforming to diameter of pipe to which fabric is being attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
   4. Fasten fabric to line posts with tie wire spaced at a maximum of 12 inches on center.
   5. Fasten fabric to top rail with tie wire spaced at a maximum of 24 inches on center.
   6. Join roll of fabric together by weaving a single strand into the end of the roll to form a continuous piece.
   7. Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. (Peen ends of bolts or score threads to prevent removal of nuts.)
   8. Attach tension wire and pull tension wire taut along the bottom of the fabric with ring-type fasteners spaced at a maximum of 24 inches on center.
   9. Attach tension wire to line posts with brace bands and pull taut.

F. Install stretcher bars as described below.
   1. Thread through or clamp to fabric at a maximum of 4 inches on center.
   2. Secure to posts with metal bands spaced 15 inches on center maximum.
   3. Install at each gate, pull and end posts, and both sides of corner post.

G. Install barbed wire as described below.
   1. Attach 3 rows to each barbed wire supporting arm. Pull wire taut and fasten securely to each arm.
   2. Install 3 rows above fabric and on extended gate and members of swing gate.

H. Install manual-swing gates as described below.
   1. Install plumb, level, and free swinging through full opening without interference.
   2. Install all hardware.
   3. Install keepers, ground set items and flush place in concrete to engage gate stop.

I. Install fence grounding as indicated on the Construction Drawings.

J. Repair any damaged coating in the shop or field by recoating with compatible and similar coating. Apply coating per manufacturer's recommendation.

K. Install signage at 4 feet above finished ground and spaced at a maximum of 50 feet on center.

3.02 TOLERANCE

A. Erect the chain-link fences and gates with a maximum variation from plumb of 0.25 inches.

B. Erect the chain-link fence with a maximum offset of 1 inch from true position.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02920 **TITLE:** TOPSOIL

Specifications By: (Cognizant Engineer)
Signature J. F. Beech — 23 Oct 95 Date
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neal Davies — 10/23/95 Date
Printed Name and Title R NEAL DAVIES Senior Project Eng

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B B Mazanti — 2/23/96 Date
Printed Name and Title B. B. MAZANTI Consultant

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 Date
Printed Name and Title Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ ~~J. F. Beech~~ K W Cargill — 23 Feb 96 BApr96 Date
Printed Name and Title ~~BEECH, PRINCIPAL~~ Kenneth W Cargill Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
~~0~~A	30% Submittal				
B	Report for EPA submitted	14Dec95	NA	NA	NA
C	Intermediate Design	23Feb96	—	—	FB
D	Intermediate Design, EPA Submittal	8Apr96			
F	Prefinal Design, EPA Submittal	25Jun96			
G	Final Design Package	9Oct96			
O	Response to Final Design Cmts	14May97			

Section 02920

SECTION 02920

TOPSOIL

PART 1 GENERAL

1.01 SCOPE

A. This Section includes topsoil products and placement.

1.02 RELATED SECTIONS AND PLANS

A. Section 02200 - Earthwork

B. Section 02250 - Vegetative Soil Layer

C. Section 02270 - Erlosion and Sediment Control

D. Section 02930 - Vegetation

E. Section 13000 - Borrow Area Management

F. Section 13040 - Control of Fugitive Emissions

G. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:
   1. ASTM D 422. Standard Method for Particle-Size Analysis of Soils.
   2. ASTM D 2487. Classification of Soils for Engineering Purposes (Unified Soil Classification System)
   3. ASTM D 2974. Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soil.
   4. ASTM D 4318. Standard Test Method for liquid Limit, Plastic Limit, and Plasticity Index of Soils.

B. Latest version of USEPA SW846: Test Methods for Evaluating Solid Waste:
   1. Method 6010 - Inductively Coupled Plasma-Atomic Emission Spectroscopy
   2. Method 8080 - Organochlorine Pesticides and Polychlorinated Biphenyls by Gas Chromatography
   3. Method 8260 - Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS):
   4. Method 8270 - Semi-Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS).

1.04 SUBMITTALS

A. For each off-site topsoil source, submit the following to the Construction Manager for review and approval within 30 calendar days from Notice to Proceed:
   1. the source of the topsoil;
   2. test results conducted on each of three topsoil samples (taken from three different locations within the borrow pit and/or borrow stockpile such that the topsoil is fully represented) in accordance with:
      a. ASTM D 422, ASTM D 2487, ASTM D 2974 Methods A and C, and ASTM D 4318;
      b. USEPA SW846-methods 6010, 8080, 8260, and 8270;
   3. A 50-pound representative sample of the topsoil; and
   4. certification from the supplier that the topsoil meets the material requirements of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Obtain topsoil from on-site borrow sources and on-site excavations to the extent such material is available. The CQC Consultant will perform conformance testing to identify material meeting the requirements of this Article. Do not use off-site sources for topsoil unless on-site material is not readily available, and then only with written approval from the Construction Manager. Furnish topsoil meeting the following material requirements.
   1. Material shall be a clay loam, classify as CL (per ASTM D 2487), and be loose and friable. For topsoil to be considered loamy, that fraction passing the U.S. Standard No. 10 sieve shall contain not more than 40 percent clay-sized fraction, as determined in accordance with ASTM D 422.
   2. Topsoil shall be relatively free of metal, debris, foreign objects, large rock fragments, and stumps.

3. Topsoil shall contain not less than 3 percent organic matter as determined by loss on ignition of samples oven dried to constant weight (per ASTM D 2974, Method A for moisture content determination and Method C for ash content determination). The topsoil may be amended as approved in writing by the Construction Manager if the organic content is less than three percent.

B. Obtain water for moisture conditioning topsoil from the on-site potable water source shown on the Construction Drawings.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to transport, place, prepare, and compact topsoil.

PART 3 EXECUTION

3.01 PLACEMENT

A. Do not commence placement of topsoil until CQC Consultant completes conformance evaluation of topsoil material and performance testing of previous work, including evaluation of the Subcontractor's survey results of previous work.

B. Prior to spreading the topsoil, scarify or otherwise loosen the top surface of the existing soil layer to a minimum depth of 1 inch. Scarify using a disc harrow, rake, or other suitable means.

C. Construct topsoil to the thickness, elevations, and limits shown on the Construction Drawings. Round breaks between slopes on the final cover system.

D. Place topsoil over approved areas, spread, and track lightly so that the equipment grouser marks are perpendicular to the direction of flow.

E. Place and spread topsoil to a depth sufficiently greater than required so that after light tracking and natural settlement, the completed work will conform to the thickness requirement of this Section.

F. Do not spread topsoil in water or while frozen or muddy. If soil or weather conditions are unsuitable, as determined by the Construction Manager, cease placing topsoil until permission to resume topsoil operations is obtained from the Construction Manager.

G. After topsoil has been placed and spread, remove stiff clods, lumps, roots, litter, and other foreign material. Remove stiff clods larger than 3 inches in diameter or reduce in size by raking, discing, or other processing.

H. Within 72 hours of the completion of the placement of topsoil in an area, vegetate the area in accordance with Section 02930.

I. Repair any erosion or washout of the topsoil layer prior to final acceptance of vegetation by the Construction Manager in accordance with Section 02930.

J. Implement dust control measures in accordance with Section 13040.

3.02 CONSTRUCTION QUALITY REQUIREMENTS

A. CQC Consultant will perform soil conformance testing on the topsoil material to establish compliance with this Section. Conformance testing to be performed and testing frequencies are given in the CQA Plan.

3.03 SURVEY CONTROL

A. Survey the limits and elevations of the top surface of the topsoil layer in accordance with Section 02100.

3.04 TOLERANCE

A. Construct the topsoil layer to within ± 0.1 feet of the thickness shown on the Construction Drawings.

B. Construct the topsoil layer to within $+0.5$ feet of the elevations indicated on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 02930 **TITLE:** VEGETATION

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 OCT 1995 (Date)
Printed Name and Title: J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neal Davies — 10/23/95 (Date)
Printed Name and Title: R NEAL DAVIES. Senior Project Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B B Mazanti — 2/23/96 (Date)
Printed Name and Title: B. B. MAZANTI, Consultant

Overall Review By: (PDP)
Signature Not Used for ~~30% Submittal~~ Mark H. Gleason — 20Feb96 (Date)
Printed Name and Title: Mark H. Gleason, Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for ~~30%~~ Submittal ~~J.F. Beech~~ ~~23 Feb 96~~ 8 Apr 96 (Date)
Printed Name and Title: ~~BEECH, PRINCIPAL~~ Kenneth W Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
~~A~~	30% Submittal				
B	Request for EPA Submittal	14 Dec 95	NA	NA	NA
C	Intermediate Design	23 Feb 96	—	—	JFB
D	Intermediate Design EPA Submittal	8 Apr 96		—	—
F	Prefinal Design, EPA Submittal	25 Jun 96		—	—
G	Final Design Package 2	9 Oct 96	—	—	
O	Response to Final Design Cmts	14 May 97		—	

SECTION 02930

VEGETATION

PART 1 GENERAL

1.01 SCOPE

A. This section includes seeding, mulching, fertilizing, liming, and maintaining seeded areas until vegetation is established and accepted.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02270 - Erosion and Sediment Control

D. Section 02920 - Topsoil

E. Section 13040 - Control of Fugitive Emissions

F. Construction Quality Assurance (CQA) Plan.

G. Surface-Water Management and Erosion Control (SWMEC) Plan.

1.03 REFERENCES

A. Construction Quality Assurance (CQA) Plan.

B. Surface-Water Management and Erosion Control Plan.

C. Latest version of American Association of State Highway and Transportation Officials (AASHTO) standards:
   1. AASHTO M140. Standard Specification for Emulsified Asphalt.
   2. AASHTO M208. Standard Specification for Cationic Emulsified Asphalt.

D. Latest version of the State of Ohio Department of Transportation Construction Manual and Specifications (Ohio DOT Specifications).

1.04 SUBMITTALS

A. Submit the following to the Construction Manager within 30 calendar days of Notice to Proceed for review:
   1. Proposed seed mixes, mulches, asphalt emulsion tackifier, and fertilizers.
   2. Manufacturer's product data and recommended methods of application for seed, mulches, lime, asphalt emulsion tackifier, and fertilizer.

B. Submit a manufacturer's certificate of compliance for each seed mix. These certificates shall include the seed mixture, guaranteed percentages of purity, weed content, germination of the seed, name of the seller, the test date for the seed, and the net weight and date of shipment. Do not sow seed until the Construction Manager has reviewed the certificates.

C. After review of the seed mixes by the Construction Manager, submit the following:
   1. a manufacturer's certificate stating the available nutrients contained in the proposed fertilizer;
   2. a manufacturer's certificate that the lime meets the requirements of this Section;
   3. a manufacturer's certificate that the wood cellulose mulch meets the requirements of this Section; and
   4. a manufacturer's certificate that the asphalt emulsion tackifier meets the requirements of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish seed labeled in accordance with US Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its date of expiration. Furnish seed from same or previous year's crop. Each variety of seed shall have a purity of not less than 90 percent, a percentage of germination not less than 80 percent, shall have a weedseed content of not more than 0.75 percent and contain no noxious weeds. The above percentages are by weight. Furnish seed mixtures having seed proportioned by weight in accordance with Tables 02930-1, 02930-2, and 02930-3.

B. Furnish mulch meeting the requirements stated below.

1. Furnish mulch consisting of straw or wood cellulose fiber unless otherwise directed by the Construction Manager. Furnish mulch that is free of clay, stones, foreign substances, plant parts of Canada Thistle and Johnson grass, and reasonably free of other weed seeds.
2. Furnish straw that does not contain sticks larger than 1/4-inch diameter or other materials that may prevent matting down during application. No straw shall be used within 48 hours after cutting. Use straw that is free from mold and other objectionable material and in an air-dry condition suitable for placing with mulch blower equipment. Ninety-five percent of the straw shall be 6 inches or more in length.
3. Mulch applied by spraying shall be a specially processed wood cellulose processed into a uniform fibrous physical state. Use wood cellulose fiber containing a green dye that will provide easy visual inspection for uniformity of the slurry spread. The wood cellulose fiber including dye, shall contain no growth or germination-inhibiting properties. The wood cellulose fiber shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed on the ground, the material shall allow absorption and percolation of moisture. The wood cellulose fiber shall meet the following requirements:

Quantity	Specification Limit
Particle Length	0.375 inch (maximum)
Particle Thickness	0.047 inch (maximum)
pH	4.0 to 8.5
Ash Content	1.6 percent (maximum)
Water Holding Capacity	90 percent (minimum)

Deliver the material in uniform packages bearing the name of the manufacturer, the net weight, and a statement of content.

C. Maintain straw mulching materials in place with an asphalt emulsion tackifier. Use asphalt emulsion for vegetative mulch conforming to AASHTO M140 or AASHTO M208. Asphalt emulsion tackifier shall be nontoxic to plants and shall be prepared so that it will not change in transportation or storage.

D. Use fertilizer that is dry or liquid commercial grade fertilizer uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists. Deliver fertilizer to the site in original, properly labeled, unopened, clean, containers each showing the manufacturer's guaranteed

analysis conforming to applicable fertilizer regulations and standards. Use fertilizer that is 10-10-10, 12-12-12, or as modified in writing by the Construction Manager based on testing of the topsoil by the CQC Consultant. Apply fertilizer to all areas receiving seed.

E. Use lime that is agricultural ground limestone with a minimum total neutralizing power of 90 percent. The lime shall have a material gradation of at least 40 percent passing the U.S. Standard Number 100 sieve, and at least 95 percent passing the U.S. Standard Number 8 sieve.

PART 3 EXECUTION

3.01 APPLICATION

A. Apply fertilizer, lime, seed, mulch, and asphalt emulsion tackifier to topsoil areas in the OSDF final cover system, to other disturbed areas adjacent to the OSDF requiring vegetative cover, to disturbed areas in the borrow area, and areas graded under this Subcontract unless otherwise indicated.

B. Application rates:
   1. Application rates for fertilizer, lime and seed as specified in this Section may be adjusted after the results of the site soil test results performed by the CQC Consultant are available.
   2. Base subcontract price on application rates for fertilizer, lime, seed, mulch, and asphalt emulsion tackifier specified in this Section. Subcontract price will be adjusted for any variations either decreasing or increasing the application rates for fertilizer or lime specified in this Section.

C. For areas to be seeded:
   1. Apply fertilizer at a uniform rate of 12 pounds per 1000 square feet or as otherwise directed by the Construction Manager.
   2. Apply the specified seed mix at the rates indicated on Tables 2930-01, 2930-02, and 02930-03.
   3. Do not apply mulch to the seeded OSDF final cover system indicated on the Construction Drawings to receive erosion mat. Install erosion mat in accordance with Section 02270.
   4. Spread straw mulch either by hand or by the blowing method at the rate of 2 airdried tons per acre within 24 hours of seeding.

5. Apply sprayed wood cellulose fiber, at a net dry weight of 750 pounds per acre. Mix the wood cellulose fiber with water at a ratio of 50 pounds of wood cellulose fiber per 100 gallons of water.
6. Apply agricultural lime at a rate of two tons per acre or as otherwise directed in writing by the Construction Manager.
7. Apply asphalt emulsion tackifier at a rate of 120 gallons per acre.

D. The application of fertilizer and lime may be performed hydraulically with pasture species or temporary seedings in one operation with hydroseeding. All structures and paved areas shall be cleared of unwanted deposits of the hydroseed mixture.

3.02 PLACEMENT

A. Do not commence vegetation until the CQC Consultant reviews the results of soil analyses.

B. Perform permanent seeding, fertilizing, liming, and mulching (if applicable) only during those periods indicated in Tables 02930-1 and 02930-2. Seeding of the OSDF final cover outside these periods shall consist of applying both temporary and permanent seeding. Hydroseed only on a calm day with winds below twenty miles per hour. Do not seed on frozen ground or when the temperature is 32°F or lower.

C. Notify the Construction Manager 24 hours prior to seeding or fertilizing.

D. In cut areas to be seeded, loosen the finished subgrade to a depth of 4 to 6 inches by discing or harrowing immediately prior to seeding.

E. In fill areas to be seeded, scarify areas to be hydroseeded and disc or harrow all other areas to a depth of 4 to 6 inches immediately prior to seeding.

F. Apply fertilizer and lime at the specified rate or hydraulically with seed. If not applied hydraulically, thoroughly harrow, disc, or rake the fertilizer and lime into the prepared surface to a minimum depth of 2 inches.

G. In areas receiving topsoil, seed within 72 hours of the completion of topsoil placement.

H. Prior to seeding, track the prepared surface with a bulldozer up and down the slope, and repair all gullies, washes, or disturbed areas that develop.

I. Apply seed at the rates indicated in Tables 02930-01, 02930-02, and 02930-03. Apply seed by drilling, broadcasting, or hydroseeding as described below.
   1. Seeding by drilling shall be done to a depth of 0.25 inches followed by cultipacking.
   2. Broadcasted seed shall be covered with 0.25 inches of topsoil using a light harrow or similar equipment.
   3. For hydroseeding:
      a. The spraying equipment and mixture shall be designed such that when the mixture is sprayed over an area, the fertilizer, seed, and mulch shall be equal in quantity to the specified rates.
      b. Prior to the start of work, furnish the Construction Manager with a certified statement as to the number of pounds of materials to be used per 100 gallons of water. The certified statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.
      c. Seed and/or fertilizer and lime shall be mixed together with water in the relative proportions specified so that these combined solids do not exceed 300 pounds per 100 gallons. Mixing shall be done within one hour of application.
      d. The water-seed-fertilizer-lime mixture shall be applied at a minimum rate of 1,000 gallons/acre.
      e. After hydroseeding on flat areas, the seedbed shall be immediately rolled with a roller weighing 40 to 65 pounds per foot of width unless an intervening precipitation causes such rolling to be detrimental to the seeded area.
      f. Upon completion of seeding operations, furnish the Construction Manger with a certified statement on the actual quantity of solution applied.

J. Install erosion mat on the OSDF final cover system to the limits indicated on the Construction Drawings and in accordance with Section 02270.

K. Repair all gullies, washes, or disturbed areas that develop subsequent to final dressing of the prepared surface.

L. At areas not receiving erosion mat, apply mulch materials on seeded areas within 24 hours after seeding. Mulch shall achieve a uniform distribution and depth so that no more than 10 percent of the soil surface is exposed. Spray asphalt emulsion tackifier on the mulch to hold it in place.

3.03 MAINTENANCE

A. Maintain the seeded areas in satisfactory condition until completion of the subcontract. Maintenance of the seeded areas includes repairing eroded areas, revegetating, watering, and mowing (if applicable). A satisfactory condition of seeded area is defined as a 10,000 square feet section of turf that has no bare spots larger than three square feet and not more than fifteen percent of total area with bare spots larger than 6-inches square.

B. The inspection will be performed by the Construction Manager who will determine whether repair of seeded areas or revegetation is required.

3.04 ACCEPTANCE

A. The vegetated areas shall be accepted at the end of the warranty period if a satisfactory condition as defined in this Section exists.

3.05 WARRANTY PERIOD

A. Vegetated areas shall be subject to a warranty period of not less than 2 full growing seasons from initial establishment of permanent vegetation over 100 percent of the areas seeded.

B. At the end of the warranty period, the Construction Manager will perform an inspection upon written request by the Subcontractor. As part of the inspection, the Construction Manager may collect soil samples from areas not demonstrating satisfactory vegetation conditions and forward them to the local Natural Resources Conservation Service (NRCS) for recommendations. Vegetated areas not demonstrating satisfactory condition of vegetation as outlined above, shall be repaired, reseeded, and maintained to meet all requirements as specified herein at the Subcontractor's expense.

C. After all necessary corrective work has been completed, the Construction Manager will certify in writing the final acceptance of the seeded areas.

TABLE 02930-01

SEED MIXES FOR PERMANENT VEGETATION
NATIVE SPECIES
(OSDF FINAL COVER SYSTEM ONLY)

Slope - Moisture Class	Planting Period	
	Apr - May[1]	
	Species[2]	lb/ac
Drainage Channels	Big Bluestem	10
	Switchgrass	5
All Other Areas	Big Bluestem	5
	Indiangrass	5
	Canada Wildrye	3
	Switchgrass	5

Notes:
1. Switchgrass should be frost seeded (Jan - Feb) by broadcasting into winter cover.
2. "Cave-in-rock" switchgrass variety recommended. Species other than switchgrass planted by drilling during April - May.

TABLE 02930-02

SEED MIXES FOR PERMANENT VEGETATION
PASTURE SPECIES
(EXCLUDING OSDF FINAL COVER SYSTEM)

Slope - Moisture Class	Planting Period	
	15 Mar - 31 May or 1 Aug - 30 Sep	
	Species	lb/ac
Drainage Channels	Reed Canarygrass	8
	Kentucky Bluegrass	10
	Alsike Clover	5
All Other Areas	Creeping Red Fescue	20
	Annual Ryegrass	10
	Kentucky Bluegrass	15
	Alsike Clover	5
	Flatpea	5

TABLE 02930-03

SEED MIXES FOR TEMPORARY SEEDING

Planting Period			
Warm Season (Jun - Aug)		Cool Season (Aug - Nov)	
Species	lb/ac	Species	lb/ac
Annual Ryegrass	40	Annual Ryegrass	40
Oats	64	Rye	80
Sudangrass	80	Perennial Ryegrass	20

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 03100 **TITLE:** CONCRETE FORMWORK

Specifications By: (Cognizant Engineer)
Signature: Mark H. Gleason — Date: 9 Feb 96
Printed Name and Title: MARK H. GLEASON, Assistant Project Engineer

Scope and Format Checked By: (Checker)
Signature: B.B. Mazanti — Date: 2/22/96
Printed Name and Title: B. B. MAZANTI, Consultant

Detailed Requirements Checked by: (Checker)
Signature: B.B. Mazanti — Date: 2/22/96
Printed Name and Title: B. B. MAZANTI, Consultant

Overall Review By: (PDP)
Signature: Mark H. Gleason — Date: 20 Feb 96
Printed Name and Title: Mark H. Gleason, Assistant Project Engineer

Approved by: (DTL)
Signature: J.F. Beech — Date: 23 Feb 96
Printed Name and Title: J.F. BEECH, PRINCIPAL

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
C	Intermediate Design	23 Feb 96	–	–	JFB
F	Prefinal Design, EPA Submitted	25 Jun 96			
G	Final Design Package	9 Oct 96			
O	Response to Final Design Cmts	14 May 97			

SECTION 03100

CONCRETE

PART 1 GENERAL

1.01 SCOPE

A. This Section includes concrete reinforcement, concrete forms, cast-in-place concrete, and pre-cast concrete.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02215 - Trenching and Backfilling

C. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest Version of American Concrete Institute (ACI) Standards:

1. ACI 301. Specifications for Structural Concrete.
2. ACI 304. Guide for Measuring, Mixing, Transporting, and Placing Concrete.
3. ACI 305. Hot-Weather Concreting.
4. ACI 306. Cold-Weather Concreting.
5. ACI 315. Details and Detailing of Concrete Reinforcement.
6. ACI 318. Building Code Requirements for Structural Concrete.
7. ACI 347. Guide to Formwork for Concrete.

B. Latest version of American Society for Testing Materials (ASTM) Standards:

1. ASTM A 185. Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement.
2. ASTM A 615. Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
3. ASTM C 33. Standard Specification for Concrete Aggregates.
4. ASTM C 39. Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C 94. Standard Specification for Ready-Mixed Concrete.

6. ASTM C 143. Standard Test Method for Slump of Hydraulic Cement Concrete.
7. ASTM C 150. Standard Specification for Portland Cement.
8. ASTM C 231. Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9. ASTM C 260. Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C 309. Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
11. ASTM C 494. Standard Specification for Chemical Admixtures for Concrete.
12. ASTM D 994. Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
13. ASTM C 1107. Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

C. Latest Version of American Association of State Highway Transportation Officials (AASHTO) Standards.
1. AASHTO M 199. Standard Specification for Pre-Cast Reinforced Concrete Manhole Sections.

1.04 SUBMITTALS

A. Submit the following to the Construction Manager within 45 calendar days from Notice to Proceed for review:
1. Complete bar schedule, bar details, and erection drawings conforming to ACI 315.
   a. Mark each bar with identification corresponding to type, grade, and size.
   b. Detail drawings indicating spacings, location, and quantities of reinforcing steel.
2. Design Mix
   a. Proposed concrete design mix for concrete specified herein.
   b. Name and address of transit mix concrete supplier. Provide batch ticket and history per ASTM C 94.
   c. Test results for the mix design showing compressive strength at 2, 7, and 28 calendar days in accordance with ASTM C 39.
3. Certification from the supplier that concrete materials and concrete mix meet the material requirements of this Section.
4. Shop drawings for gravity inlet structures.
5. Sample of preformed expansion joint filler for concrete.

PART 2 PRODUCTS

2.01 MATERIALS

A. Forms
1. Design concrete formwork for vertical loads and lateral pressures in accordance with the standards prescribed in ACI 347.
2. Furnish plywood forms that are grade marked B-B Plyform.
3. Furnish minimum 16 gauge steel forms.
4. Furnish factory fabricated snap-off metal form ties of adequate design to minimize form deflection and preclude concrete spalling upon removal.
5. Furnish a bond breaker or form release agent made from non-staining colorless mineral oil or similar liquid product that imparts a waterproof film to prevent adhesion of concrete to formwork and will not impair natural bonding characteristics of subsequent coatings.

B. Concrete Reinforcement
1. Furnish concrete reinforcement as shown on the Construction Drawings or as otherwise specified.
2. Furnish reinforcing steel bars meeting the requirements of ASTM A 615, Grade 60, modified in accordance with ACI 318.
3. Furnish welded steel wire fabric meeting the requirements of ASTM A 185.
4. Furnish bolsters, chairs, and accessories meeting the requirement of ACI 315.

C. Cast-In-Place Concrete
1. Furnish Type II Portland Cement conforming to ASTM C 150.
2. Furnish concrete aggregate complying with the provisions of ASTM C 33.
3. Furnish water for concrete mix that meets the requirements of ASTM C 94.
4. Furnish concrete mix with:
   a. a compressive strength of 4,000 psi at 28 when tested in accordance with ASTM C 39;
   b. a water/cement ratio (maximum) of 0.45;
   c. a maximum aggregate size of 1 inch;
   d. a slump of 4 inch ($\pm$1 inch) when tested in accordance with ASTM C 143.
   e. a minimum cement content of six 90-pound bags cement per cubic yard concrete; and
   f. a total air content of 5 percent ($\pm$1.5 percent) when tested in accordance with ASTM C 231.

5. Furnish admixtures for the concrete conforming to ASTM C 260 for air entraining agent and to ASTM C 494, Type A, for water reducing admixtures for concrete.
6. Furnish polyethylene sheet for vapor barriers with a 6-mil minimum thickness between all concrete and ground interfaces and overlap vapor barriers a minimum of 6 inches, and seal joints with tape designed for use with the above specified material.
7. Furnish a pre-molded bituminous expansion joint filler. Construct the joint filler to the full depth of the slab and to a thickness of 1/2 inch at all joints between slab and vertical walls, columns, etc., unless otherwise indicated on the Construction Drawings. Set expansion joint material conforming to ASTM D 994 with a 1/2-inch deep removable strip at top.
8. Furnish a curing compound conforming to the requirements of ASTM C 309 and that does not impair natural bonding characteristics of subsequent coatings.

D. Furnish pre-cast concrete structures conforming to AASHTO M 199.

E. Grout
   1. Non-Shrinking Grout
      a. Mix and place as recommended by the manufacturer.
      b. Furnish flowable nonmetallic grout, manufactured by one of the following:
         (1) Five Star Grout, U.S. Grout Corporation;
         (2) Masterflow 713 Grout, Master Builder's Company; or
         (3) Sauereisen F-100, Sauereisen Cements Company.

F. Bonding Agent
   1. Furnish moisture insensitive, epoxy-resin bonding agent as manufactured by one of the following:
      a. Expoxite; W.R. Grace;
      b. Euco Epoxy; Euclid Chemical Company; or
      c. Weld-crete, Larson Products.
   2. Use where indicated or specified.
   3. Use in conformance with manufacturer's instructions.

G. Reinforcement Bar Tags
   1. Reinforcement bar tags made of durable material and marked with permanent markings, not less than one tag per bundle. Use tags that show grade, size, number of pieces, and mark or length of bars.

PART 3 EXECUTION

3.01 PREPARATION

A. Erect formwork and bracing to achieve design requirements in accordance with requirements of ACI 301 and ACI 347.
   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. Form Release Agent:
   1. Apply form release agent on formwork in accordance with manufacturer's instructions.
   2. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
   3. Keep surfaces coated prior to placement of concrete.

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

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

3.02 PLACING AND FASTENING

A. Arrange and place reinforcing steel as shown on the Construction Drawings.

B. Secure reinforcement against displacement during placing of concrete. Do not deviate from required position.

3.03 ERECTION/INSTALLATION/APPLICATION

A. Maintain concrete cover around reinforcing according to the requirements of ACI 301, ACI 318, and as shown on the Construction Drawings.

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

C. Coordinate forming and setting openings, slots, recesses, sleeves, bolts, anchors, and other inserts with other concrete activities.

D. Install concrete accessories straight, level, and plumb, or as called out on the Construction Drawings.

E. Place concrete continuously between forms or other limits indicated on the Construction Drawings. Place concrete in accordance with ACI 301 and ACI 318, and ensure that reinforcement and forms are not disturbed during concrete placement.

3.04 PROTECTION

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

B. Provide finishes as defined in ACI 301.

C. Provide broom finish on all exposed slabs.

3.05 CONCRETE PLACEMENT

A. Notify the Construction Manager and the CQC Consultant at least 24 hours in advance of concrete placement.

B. Do not place concrete until foundations, forms, vapor barrier, reinforcing steel, pipes, conduits, sleeves, hangers, anchors, inserts and other work required to be built into concrete has been inspected and approved by the CQC Consultant.

C. Place concrete in accordance with the Construction Drawings, the requirements of the local building code, and in compliance with practices and recommendations of ACI-304. Place the concrete in a continuous operation to prevent the formation of seams.

Vibrate the concrete in place without dislocation or damage to the reinforcement and built-in items.

D. Mix and place concrete only when the temperature is within the limits of ACI 305/306, unless otherwise approved by the Construction Manager.

E. Prepare construction joints by roughening, brushing clean, and maintaining moisture for 24 hours (or apply bonding agent on clean prepared concrete joint in accordance with Manufacturer's instructions) prior to placement of concrete against construction joint. Joint the concrete fully around pipes.

F. Spread/broadcast red concrete dye on top of all electrical duct banks.

3.06 PRE-CAST CONCRETE INSTALLATION

A. Place and position the pre-cast concrete structure on a 6-in. thick embedment fill material in accordance with Section 02215.

B. Repair minor damage to the pre-cast concrete, such as spalls or chips, using an epoxy bonding agent and grout, as identified in this Section. Major damage that occurs during installation, as determined by the Construction Manager, is cause for rejection.

C. After installation, cut off the lifting devices and seal openings with grout.

D. Install the pre-cast concrete structures to the limits and grades indicated on the Construction Drawings.

3.07 CONSTRUCTION QUALITY REQUIREMENTS

A. Samples of concrete will be taken by the CQC Consultant during the concrete placement. Testing will be carried out in accordance with the CQA Plan.

3.08 SURVEY

A. Survey the location and elevations of the concrete structures in accordance with Section 02100.

3.09 TOLERANCE

A. Install precast and cast-in-place concrete structures to within ± 0.1 feet of the elevations indicated on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 13000 **TITLE:** BORROW AREA OPERATIONS

Specifications By: (Cognizant Engineer)
Signature J.F. Beck — Date 26 Feb 96
Printed Name and Title J.F. BECK, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature Kara L Olen — Date 26 Feb 96
Printed Name and Title Kara L. Olen, Asst Proj Engr.

Detailed Requirements Checked by: (Checker)
Signature Kara L Olen — Date 26 Feb 96
Printed Name and Title Kara L. Olen, Asst. Proj Engr.

Overall Review By: (PDP)
Signature K W Cargill — Date 26 Feb 96
Printed Name and Title Kenneth W Cargill, Associate

Approved by: (DTL)
Signature J.F. Beck K W Cargill — Date 14 May 97 / 26 Feb 96
Printed Name and Title BECK PRINCIPAL Kenneth W Cargill, Associate

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Rev. No.	Reason	Date	By	Checked	Approval
C	Intermediate Design	26 Feb 96	—	—	JFB
F	Prefinal Design, EPA Submittal	25 Jun 96	KL	—	—
G	Final Design Package	26 Feb 96	—	—	KL
C	Response to Final Design Comts	14 May 97	—	—	JFB

Section 13000

SECTION 13000

BORROW AREA MANAGEMENT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes on-site soil borrow area management, including maintenance and restoration.

1.02 RELATED SECTIONS AND PLANS

A. Section 02110 - Clearing, Grubbing and Stripping

B. Section 02200 - Earthwork

C. Section 02230 - Road Construction

D. Section 02270 - Erosion and Sediment Control

E. Section 02721 - Culverts

F. Section 02930 - Vegetation

G. Section 13040 - Control of Fugitive Emissions

H. Borrow Area Management and Restoration

I. Surface-Water Management and Erosion Control Plan

1.03 SUBMITTALS

A. Submit the following to the Construction Manger within 30 calendar days from Notice to Proceed for review and approval:
   1. a list of equipment to be utilized in borrow area management, including the anticipated percentages of time such equipment will be utilized for that purpose;
   2. Borrow Area Management and Restoration Plan meeting the requirements of this Part; and

3. documentation, explanation, and supporting information for any Subcontractor proposed deviations from the Borrow Area Management and Restoration reference plan.

B. Prepare and submit a Borrow Area Management and Restoration Plan that meets the requirements of the Borrow Area Management and Restoration reference plan identified in this Section. Organize the Borrow Area Management and Restoration Plan to include, at a minimum:
   1. procedures for implementing surface-water management controls and erosion and sediment controls, including sedimentation basins (if applicable);
   2. locations for haul roads within the borrow area and proposed surfacing on such haul roads;
   3. location of haul road(s) from borrow area to the On-Site Disposal Facility (OSDF) construction area covered by the Subcontract;
   4. location of road crossing and proposed traffic control measures;
   5. locations for stockpiling cleared, grubbed, and stripped materials;
   6. locations for stockpiling materials suitable for compacted clay liner and cap construction, compacted fill construction, topsoil, and those materials unsuitable for such purposes;
   7. proposed method for differentiating and managing borrow materials suitable for different uses, including compacted clay liner and cap, compacted fill, vegetative soil layer, and topsoil;
   8. plan for incremental development and restoration of the borrow area;
   9. plan for maintaining and cleaning the sedimentation basin and final decommissioning of the sedimentation basin; and
   10. plan for complying with all requirements of this Section and relevant requirements of other Sections of these Specifications.

PART 2 PRODUCTS

2.01 MATERIALS

Not used.

2.02 EQUIPMENT

A. Furnish, operate, and maintain equipment necessary to develop, manage, and restore the borrow area.

PART 3 EXECUTION

3.01 GENERAL

A. Perform borrow area management in accordance with this Section, the Construction Drawings, and the Borrow Area Management and Restoration Plan prepared by the Subcontractor and approved by the Construction Manager

B. Implement dust control measures in accordance with Section 13040.

3.02 EROSION AND SEDIMENT CONTROL

A. Implement and maintain surface-water management controls and erosion and sediment controls in accordance with the Construction Drawings and Section 02270.

3.03 BORROW AREA MANAGEMENT

A. Manage the borrow area within limits indicated on the Construction Drawings.

B. Perform clearing, grubbing, and stripping in the borrow area in accordance with Section 02110.

C. Perform borrow area management in accordance with the Borrow Area Management and Restoration Plan.

D. Install culverts associated with the borrow area as shown on the Construction Drawings and in accordance with Section 02721.

E. Construct borrow area haul road corridor in accordance with the Construction Drawings and Section 02230.

F. Implement dust control measures in accordance with Section 13040.

G. Revegetate the borrow area in accordance with Section 02930.

3.04 QUALITY CONTROL REQUIREMENTS

A. The CQC Consultant will perform conformance testing of materials Subcontractor proposes to excavate from the borrow area. Identify these materials at least 10 calendar days prior to the anticipated excavation date to provide the CQC Consultant time to perform conformance testing. Use the conformance test results to differentiate

borrow materials. Conformance testing to be performed and testing frequencies are given in the CQA Plan. CQC Consultant may perform conformance testing at a greater frequency if necessary to differentiate borrow materials.

B. Throughout borrow operations, provide equipment and labor as needed to assist the CQC Consultant in obtaining material conformance samples from future borrow locations.

3.05 TRAFFIC CONTROLS - BORROW AREA

A. Traffic shall not exceed the site speed limit of 15 mph.

B. Loaded equipment has the right-of-way over empty equipment.

C. Treat unmarked intersections as four-way intersections.

D. Use flagmen to direct traffic at intersections and congested work areas.

E. At North Entrance Road, South Entrance Road, and Plant Road Crossings, traffic from these roads has the right of way. Provide traffic signs, and flagmen at haul road crossings of these roads during borrow area management.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 13005 TITLE: LINER PENETRATION ~~CONSTRUCTION~~ BOXES ONLY

Specifications By: (Cognizant Engineer)
Signature _____ Date 26 Feb 96
Printed Name J.F. Beech
and Title BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature _____ Date 26Feb96
Printed Name Kenneth W Cargill
and Title Associate

Detailed Requirements Checked by: (Checker)
Signature _____ Date 26Feb96
Printed Name Kenneth W Cargill
and Title Associate

Overall Review By: (PDP)
Signature _____ Date 26Feb96
Printed Name Kenneth W Cargill
and Title Associate

Approved by: (DTL)
Signature _____ Date 26Feb96
Printed Name BEECH PRINCIPAL
and Title _____ 9Oct96
Kenneth W Cargill Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
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F	Prefinal Design, EPA Submitted	25 Jan 96			
G	Final Design Package	9 Oct 96			
O	Response to Final Design Cmts	14 May 97			

SECTION 13005

LINER PENETRATION BOXES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes liner penetration box product fabrication and installation.

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02215 - Trenching and Backfilling

D. Section 02225 - Compacted Clay Liner and Cap

E. Section 02605 - High Density Polyethylene (HDPE) Manholes, Pipes, and Fittings

F. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) standards:

1. ASTM D 1248. Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
2. ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.
3. ASTM D 1693. Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
4. ASTM D 2657. Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
5. ASTM D 3350. Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
6. ASTM F 905. Standard Practice for Qualification of Polyethylene Saddle Fusion Joints.

7. ASTM F 1055. Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

B. Latest version of the American Petroleum Institute (API) standard:
   1. API 13B. Standard Procedure for Field Testing Drilling Fluids; Marsh Funnel Viscosity Test

1.04 SUBMITTALS

A. Submit the following to the Construction Manager for review within 45 calendar days from Notice to Proceed:
   1. Name and qualifications of Fabricator of liner penetration boxes, including Fabricator quality control procedures.
   2. a list of completed facilities for which the Manufacturer has manufactured appurtenances from flat stock. Provide the following information for each facility:
      a. name, location, purpose of facility, and date of installation;
      b. names of owner, project manager, design engineer, and installer; and
      c. size of appurtenances provided;
   3. Name and qualifications of Manufacturer of HDPE flat stock used to fabricate liner penetration boxes.
   4. Origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used to manufacturer flat stock.
   5. Proposed fabrication dates for liner penetration boxes.
   6. Qualification procedure for Fabricator's welder(s).
   7. Installation procedure for electrofusion pipe couplings.

B. Submit to the Construction Manager for review within 45 calendar days from Notice to Proceed the following documentation on the resin used to manufacture the liner penetration boxes:
   1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the HDPE flat stock.
   2. Results of tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the HDPE flat stock.
   3. Certification that no reclaimed polymer is added to the resin during the manufacturing of the products to be used for this project.

C. Submit the following to the Construction Manager for review not less than 45 calendar days prior to the start of liner penetration box fabrication:

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1. Detailed shop drawings of liner penetration boxes Type I, Type II, Type III, and Type IV showing:
   a. box component dimensions;
   b. location of welds;
   c. weld types; and
   d. material tolerances.
2. Proposed detailed procedure for continuously welding all contact surfaces between liner penetration box components.
3. Detailed handling and storing instructions.

D. Submit the following to the Construction Manager for review not less than 14 calendar days of liner penetration box shipment to the site:
   1. results of Fabricator quality control tests required by this section; and
   2. written detailed installation procedures for the liner penetration box.

E. Notify the Construction Manager a minimum of 48 hours prior to the start of liner penetration box installation.

PART 2 PRODUCTS

2.01 HDPE FLAT STOCK

A. Furnish HDPE flat stock manufactured from new, high performance, high molecular weight, HDPE resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P 34), ASTM D 3350 (minimum Cell Classification PE 335434C), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. The resin shall be pre-compounded. In-plant blending of non-compounded resins is not permitted.

B. Furnish only smooth HDPE flat stock with no sharp projections, homogeneous throughout with respect to resin compound, and with surfaces free of foreign inclusions and surface defects. Furnish HDPE flat stock that is as uniform as commercially practical in color, opacity, density, and other physical properties.

2.02 HDPE PIPE

A. Furnish HDPE pipe meeting the requirements of Section 02605.

2.03 LINER PENETRATION BOXES

A. Fabricate liner penetration boxes to the dimensions and tolerances shown on the approved shop drawings submitted under the "Submittals" Article of this Section.

B. Fabricate liner penetration box outlets from HDPE pipe. Do not use flat stock.

C. Weld liner penetration box components in accordance with the approved welding procedures submitted under the "Submittals" Article of this Section.

D. Furnish 1.25-inch IPS NPT air pressure test ports with plugs and O-rings.

2.04 EQUIPMENT

A. Provide all equipment necessary to install and test liner penetration boxes in accordance with the requirements of this Section.

2.05 FABRICATOR QUALITY CONTROL

A. Conduct welder prequalification test each day before production welding in accordance with the procedure submitted as specified in this Section. Archive test specimens for 90 calendar days from date of shipment.

B. Pressure test each completed liner penetration box prior to shipping. Perform pressure testing consisting of injection of 15 psi air through the air pressure test port. Monitor the air pressure for 30 minutes, and apply soapy solution to all welds to facilitate detection of leaks. Measured air pressure shall remain constant over the testing period except for changes which can be explained due to material relaxation and expansion. Grind out any leaking seams and reweld. Repeat test. Reject any box with a pressure loss in which the leak cannot be found and repaired. Test gauges shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry recognized standards where possible.

C. Permit the CQC Consultant and/or Construction Manager to visit the fabrication plant for project specific visits. If possible, such visits will be prior to, or during, the fabrication and/or Fabricator quality control testing of the liner penetration boxes.

2.06 BENTONITE

A. Furnish bentonite powder and granules conforming to the requirements of Section 02215.

B. Prepare a flowable bentonite slurry with potable water having a minimum bentonite content of 10 percent by weight. Bentonite slurry shall have a Marsh funnel viscosity of 40 to 50 seconds measured in accordance with API 13B.

C. Prepare soil-bentonite mix in accordance with Section 02215.

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavate subgrade, compacted fill, and compacted clay liner to the lines and grade required for placement of liner penetration boxes. Minimize overexcavation and disturbance of the compacted clay liner.

B. Perform excavation in accordance with Section 02200.

C. Dewater excavation in accordance with the requirements of Section 02200.

3.02 BOX INSTALLATION

A. Hand grade compacted clay liner surface on which liner penetration box is to be installed. Make surface smooth to obtain close contact between compacted clay liner and liner penetration box. Recompact material in accordance with Section 02225 and regrade if poor contact occurs between the bottom of the box and the compacted clay liner surface.

B. Apply bentonite powder at a rate of 1 lb/ft^2 to the compacted clay liners over the footprint of the box.

C. Install the liner penetration boxes at the locations shown on the Construction Drawings.

D. Weld liner penetration box to the section of LCS, redundant LCS, or LDS pipe, as appropriate between the liner penetration box and LCS or LDS manhole using an

electrofusion coupling as shown on the Construction Drawings and in accordance with ASTM F 1055.

E. Backfill around LCS, redundant LCS, and LDS pipes in accordance with Sections 02215 and 02225 using soil-bentonite mix.

F. Backfill around liner penetration boxes using soil-bentonite mixture and compact in accordance with the requirements of Section 02225. Fill any interface between the compacted clay and liner penetration box with bentonite powder or granules.

G. Air pressure test liner penetration boxes in accordance with the requirements of Part 3 of this Section.

H. Fill chamber of each liner penetration box with bentonite slurry.

I. Install geomembrane over each liner penetration box as soon as air pressure testing, surveying, and bentonite filling are complete.

3.03 AIR PRESSURE TEST

A. Pressure test each liner penetration box after all associated earthwork and compacted clay liner installation is complete and prior to geosynthetics installation over the boxes. Use the air pressure testing procedure given in Part 2 of this Section.

B. In the event an unexplainable pressure loss occurs excavate the liner penetration box and investigate for leaks. Replace any liner penetration box with a pressure leak in which the leak cannot be found and repaired.

C. The Fabricator shall make repairs to the box. The repairs can be made in the field or in the shop.

D. Seal test openings with HDPE extrudate.

3.04 SURVEY CONTROL

A. Survey the locations and elevations of the liner penetration boxes in accordance with Section 02100 and as indicated on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 13010 **TITLE:** IMPACTED MATERIAL PLACEMENT

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — Date 23 Oct 95
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neil Davies — Date 10/23/95
Printed Name and Title R NEIL DAVIES Senior Project Eng.

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B B Mazanti — Date 2/22/96
Printed Name and Title B. B. MAZANTI Consultant

Overall Review By: (PDP)
Signature Not Used for 30% Submittal Mark H. Gleason — Date 20 Feb 96
Printed Name and Title Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for 30% Submittal J.F. Beech — Date 23 Feb 96
Printed Name and Title BEECH, PRINCIPAL
Kenneth W Cargill Associate 2 Dec 96

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B	Report for EIA Submittal	14 Dec 95	NA	NA	NA
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F	Preferred Design EIA Submittal	25 Jun 96			
G	Final Design Package	9 Dec 96			
C1	Response to Final Design Comts	14 May 97			

Section 13010

SECTION 13010

IMPACTED MATERIAL PLACEMENT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the placement of impacted material in the On-Site Disposal Facility (OSDF).

1.02 RELATED SECTIONS AND PLANS

A. Section 02100 - Surveying

B. Section 02200 - Earthwork

C. Section 02240 - Protective and Contour Layers

D. Section 02270 - Erosion and Sediment Control

E. Section 13040 - Control of Fugitive Emissions

F. Section 15000 - Mechanical

G. Impacted Materials Placement (IMP) Plan, with Appendix A, Impacted Materials Placement Quality Assurance (IMPQA) Plan

H. Surface-Water Management and Erosion Control (SWMEC) Plan

I. Air Monitoring Plan

1.03 REFERENCES

A. Systems Plan.

1.04 SUBMITTALS

A. Submit to the Construction Manager for review within 30 calendar days from Notice to Proceed:
   1. a list of the equipment to be utilized for impacted material placement activities and leachate management activities;
   2. a written procedure for decontamination of equipment used for impacted material placement;
   3. Impacted Materials Placement Plan meeting the requirements of this Section;
   4. Systems Plan meeting the requirements of this Section;
   5. documentation, explanation, and supporting information for any Subcontractor proposed alternative methods for the Impacted Materials Placement Plan and/or Systems Plan; and
   6. descriptions and product names of surfactants, foams and/or crusting agents proposed for use.

B. Prepare and submit an Impacted Materials Placement Plan that meets the requirements of the Impacted Materials Placement Plan identified in Part 1 of this Section. Organize the Impacted Materials Placement Plan to include, as a minimum:
   1. procedures for loading, transporting, and temporarily stockpiling impacted materials;
   2. procedures for controlling the receipt of Construction Manager approved impacted materials to ensure that only Construction Manager approved impacted materials meeting the WAC are accepted;
   3. methods of categorization of impacted materials to differentiate requirements for placement in the OSDF;
   4. general impacted material placement procedures to include:
      a. inclement weather operations;
      b. spreading, grading, and compaction; and
      c. maintenance of surface conditions and drainage;
   5. specific impacted material placement procedures for soils and soil-like materials to include spreading, grading, and compaction of:
      a. protective layer; and
      b. select impacted material layers.
   6. specific impacted material placement procedures for special material categories;
   7. procedures for managing impacted runoff and fugitive emissions during impacted material placement; and
   8. Subcontractor quality control activities during impacted material placement.

C. Prepare and submit a Systems Plan that meets the requirements of the Systems Plan identified in Part 1 of this Section. Organize the Systems Plan to include, at a minimum:
   1. procedures for operating the leachate management system, to include:
      a. operational procedures for both normal and storm conditions;
      b. inspection and maintenance procedures; and
      c. emergency procedure for spills;
   2. procedures for the inspection and maintenance of the support facilities, utilities, and fencing;
   3. procedures for the inspection and maintenance of haul and access roads; and
   4. recordkeeping and documentation procedures for all activities conducted under the Systems Plan.

PART 2 PRODUCTS

2.01 MATERIALS

A. Obtain material for protective and contouring layer conforming to Section 02240 and the Impacted Material Placement Plan.

B. Obtain material for select impacted layer conforming to the Impacted Materials Placement Plan from the impacted material stockpiles shown on the Construction Drawings.

C. Obtain seasonal cover soil from either impacted or non-impacted sources as defined below.
   1. Impacted seasonal cover soil shall conform to impacted non-granular protective layer material in accordance with Section 02240.
   2. Non-impacted seasonal cover soil shall conform to fill material in accordance with Section 02200.

D. Categorize all impacted material for OSDF disposal in accordance with the categorization framework in the approved Impacted Materials Placement Plan.

E. Use surfactants, crusting agents, and foams for control of fugitive emissions that are approved by the Construction Manager.

2.02 EQUIPMENT

A. Provide equipment for impacted material loading, transporting, placing, spreading, grading, and compacting.

B. Provide any special equipment required for staging and placement of building demolition debris and other special impacted materials.

C. Provide small equipment and tools (e.g., sump pumps, shovels, etc.) necessary for efficient impacted material placement and control of precipitation runon and runoff from haul and access roads and active cell areas.

PART 3 EXECUTION

3.01 GENERAL

A. Perform construction activities in such a manner that equipment operating in the radiologically controlled (RC) areas do not operate in non-RC areas. Equipment operating in RC shall be decontaminated before use in non-RC areas.

B. Perform leachate management operations in accordance with this Section, the Construction Drawings, approved Impacted Materials Placement Plan, approved Surface-Water Management and Erosion Control (SWMEC) Plan, and approved Systems Plan.

C. Implement fugitive emission control measures in accordance with Section 13040.

3.02 PLACEMENT

A. Do not commence placement of an impacted material layer until the CQC Consultant has completed any required conformance evaluation of that layer and any performance testing of previous work, including evaluation of the Subcontractor's survey results of previous work.

B. Place and compact impacted materials in the OSDF in accordance with the approved Impacted Materials Placement Plan.

C. Manage leachate in each OSDF cell during impacted material placement operations in accordance with the approved Systems Plan.

D. Construct a seasonal closure in the active cells at the end of each construction season using approved seasonal cover soils and maintain the seasonal closure through the winter shutdown.

E. Construct a seasonal closure over all areas of impacted material within active cells placed in this Subcontract.

F. Seasonal closure slopes shall not exceed 3(horizontal): 1(vertical).

G. Construct the seasonal closure in a manner that does not adversely impact leachate management, control of surface-water runoff and runon, and control of fugitive emissions.

H. Place the seasonal closure soil in one lift and compact as required for compacted fill in Section 02200 to a minimum thickness of 6 inches. Seal-roll the surface of the seasonal closure soil in accordance with Section 02200.

I. Treat completed seasonal closure with approved surfactant, crusting agent, or foam. Follow manufacturer's recommendations and procedures when using approved surfactant, crusting agent, or foam.

J. Install and maintain erosion and sediment controls through the winter shutdown in accordance with Section 02270.

K. Follow all requirements of the Air Monitoring Plan and Systems Plan.

L. Manage precipitation runoff and runon in accordance with Section 02270.

M. Contain runoff in cell and manage as leachate in accordance with Section 13020.

3.03 TRAFFIC CONTROLS - IMPACTED MATERIALS

A. Traffic shall not exceed the site speed limit of 15 mph.

B. Loaded equipment has the right-of-way over empty equipment.

C. Treat unmarked intersections as four-way intersections.

D. Use flagmen to direct traffic at intersections and congested work areas.

E. At any public road crossing, traffic from the public road has the right of way. Provide traffic signs, and flagmen at haul road crossings of the public road during impacted materials activities.

3.04 EQUIPMENT DECONTAMINATION

A. Decontaminate equipment used to haul and place impacted material prior to moving the equipment from areas designated for impacted material handling and placement to areas designated as non-impacted (clean) construction areas.

B. Gross decontaminate equipment, as necessary, in the OSDF cell in which waste is being placed. . Perform final equipment decontamination at the Equipment Decontamination Facility shown on the Construction Drawings.

3.05 CONSTRUCTION QUALITY REQUIREMENTS

A. CQC Consultant will perform conformance evaluation and testing of impacted materials brought to the OSDF for disposal in accordance with the Impacted Materials Placement Quality Assurance Plan.

B. CQC Consultant will perform performance testing of impacted materials brought to the OSDF for disposal in accordance with the Impacted Materials Placement Quality Assurance Plan.

3.06 SURVEY CONTROL

A. Survey the protective and select material layers of impacted material placed in the cells as required by the Impacted Materials Placement Plan. Survey shall include coordinates and elevations on a 50-ft grid and at grade breaks.

B. Perform surveying in accordance with Section 02100.

3.07 TOLERANCES

A. Tolerances for the protective layer are given in Section 02240.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 13020 **TITLE:** CONSTRUCTION-PHASE LEACHATE MANAGEMENT

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — Date 23 Oct 95
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neil Davies. — Date 10/23/95
Printed Name and Title R NEIL DAVIES. Senior Project Eng

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B D Mazanti — Date 2/22/96
Printed Name and Title B. D. MAZANTI Consultant

Overall Review By: (PDP)
Signature Not Used for ~~30% Submittal~~ Mark H. Gleason — Date 20 Feb 96
Printed Name and Title Mark H. Gleason Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for ~~30%~~ Submittal J.F. Beech — Date 23 Feb 96
Printed Name and Title BEECH, PRINCIPAL

Kenneth W Cargill — 9 Oct 96
Kenneth W Cargill Associate

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B	Request for EPA Submittal	14 Dec 95	NA	NA	NA
C	Intermediate Design	23 Feb 96	—	—	JPB
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G	Final Design Package	9 Oct 96	—	—	—
C	Response to Final Design Cmts	14 May 97	—	—	—

SECTION 13020

CONSTRUCTION PHASE LEACHATE MANAGEMENT

PART 1 GENERAL

1.01 SCOPE

A. The Section includes leachate management for the Subcontractor duration.

1.02 RELATED SECTIONS AND PLANS

A. Section 02605 - High Density Polyethylene (HDPE) Manholes, Pipe, and Fittings

B. Section 13010 - Impacted Material Placement

C. Section 13030 - Seasonal Closure

D. Impacted Materials Placement Plan

E. Surface-Water Management and Erosion Control (SWMEC) Plan

F. Systems Plan (Reference Version)

1.03 SUBMITTALS

A. Submit the following to the Construction Manager for review within 30 days from Notice to Proceed:
   1. list of all equipment to be utilized for leachate management activities;
   2. written procedures for decontamination of equipment used for leachate management;
   3. Systems Plan meeting the requirements of this Part; and
   4. documentation, explanation, and supporting information for any Subcontractor proposed deviations from the Systems Plan identified in this Section.

B. Prepare and submit a Systems Plan that meets the requirements of the Systems Plan identified in this Section. Organize the Systems Plan to include, at a minimum:
   1. procedures for operating the leachate management system, to include:
      a. operational procedures for both normal and storm conditions;
      b. inspection and maintenance procedures; and
      c. emergency procedure for spills;
   2. procedures for the final cover system inspection and maintenance;
   3. procedures for the inspection and maintenance of the seasonal closure system;
   4. procedures for the inspection and maintenance of the support facilities, utilities, and site security;
   5. procedures for the inspection and maintenance of access roads; and
   6. recordkeeping and documentation procedures for all activities conducted under the Systems Plan.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 LEACHATE MANAGEMENT

A. Implement leachate management requirements in accordance with the approved Impacted Materials Placement Plan, approved Surface-Water Management and Erosion Control (SWMEC) Plan, and approved Systems Plan and as shown on the Construction Drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

JFB

SPECIFICATION SECTION: 13030 **TITLE:** SEASONAL ~~AND INTERIM CELL~~ CLOSURE

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — Date 23 Oct 95
Printed Name and Title J.F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neil Davies — Date 10/23/95
Printed Name and Title R NEIL DAVIES Senior Project Eng

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ B.B. Mazanti — Date 2/22/96
Printed Name and Title B.B. MAZANTI Consultant

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — Date 20 Feb 96
Printed Name and Title MARK H. GLEASON Assistant Project Engineer

Approved by: (DTL)
Signature ~~Not Used for 30% Submittal~~ J.F. Beech — Date 23 Feb 96
Printed Name and Title BEECH, PRINCIPAL

Kenneth W Cargill — Date 9 Oct 96
Associate

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B	Report for EPA Submitted	14 Dec 95	NA	~~NA~~	NA
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SECTION 13030

SEASONAL CLOSURE

PART 1 GENERAL

1.01 SCOPE

A. This Section includes material and placement of seasonal closure for the On-Site Disposal Facility (OSDF).

1.02 RELATED SECTIONS AND PLANS

A. Section 02200 - Earthwork

B. Section 02240 - Protective and Contouring Layers

C. Section 02270 - Erosion and Sediment Control

D. Section 13010 - Impacted Material Placement

E. Section 13020 - Construction Phase Leachate Management

F. Section 13040 - Control of Fugitive Emissions

G. Impacted Materials Placement Plan

H. Systems Plan

I. Construction Quality Assurance (CQA) Plan

J. Surface-Water Management and Erosion Control Plan

1.03 SUBMITTALS

A. Provide the proposed on-site source of the seasonal cover soil to the Construction Manager for review no later than 30 days prior to the installation of seasonal closure.

PART 2 PRODUCTS

2.01 MATERIAL

A. Furnish seasonal cover soil from either impacted or non-impacted sources as defined below.
   1. Impacted seasonal cover soil shall conform to contouring layer material in accordance with Section 02240.
   2. Non-impacted seasonal cover soil shall conform to compacted fill in accordance with Section 02200.

PART 3 EXECUTION

3.01 PLACEMENT

A. Construct a seasonal closure in the active cells at the end of each construction season using seasonal cover soils and maintain the seasonal closure through the winter shutdown.

B. Construct the seasonal closure over all areas of impacted material within active cells which have not been covered with the contouring layer as required in Section 02240.

C. Seasonal closure slopes shall not exceed 3 horizontal to 1 vertical.

D. Construct the seasonal closure in a manner that does not adversely impact leachate management, control of surface-water runoff and runon, and control of fugitive emissions.

E. Place the seasonal closure soil in one lift and compact as required for compacted fill in Section 02200 to a minimum thickness of 6 inches. Seal-roll the surface of the seasonal closure soil in accordance with Section 02200.

F. Install and maintain erosion and sediment controls for seasonal closure areas in accordance with Section 02270.

G. Contain runoff from seasonal cover in cell and manage as leachate in accordance with Section 13020.

H. Implement fugitive emission controls in accordance with Section 13040.

I. Perform equipment decontamination, as necessary, in accordance with Section 13010.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 13040 **TITLE:** CONTROL OF FUGITIVE EMISSIONS

Specifications By: (Cognizant Engineer)
Signature J.F. Beech — 23 Oct 95 Date
Printed Name and Title J. F. BEECH, PRINCIPAL

Scope and Format Checked By: (Checker)
Signature R Neil Davies. — 10/23/95 Date
Printed Name and Title R NEIL DAVIES. Senior Project Eng

Detailed Requirements Checked by: (Checker)
Signature ~~Not Used for 30% Submittal~~ — 19 Feb 96 Date
Printed Name and Title Kenneth W Cargill, Associate

Overall Review By: (PDP)
Signature ~~Not Used for 30% Submittal~~ Mark H. Gleason — 20 Feb 96 Date
Printed Name and Title MARK H. GLEASON, Assistant Project Engineer

Approved by: (DTL)
Signature Not Used for 30% Submittal J.F. Beech — 24 Feb 96 Date
Printed Name and Title Kenneth W. Cargill, Associate — 9 Oct 96

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
OA	30% Submittal				
B	Preliminary Design for EPA Submittal	16 Dec 95	VRB	RNL	NA
C	Intermediate Design	24 Feb 96	—	—	OFB
F	Prefinal Design, EPA Submittal	25 Jun 96	[illegible]	—	—
G	Final Design Package	9 Oct 96	—	—	[illegible]
O	Response to Final Design Cmts	14 May 97	—	—	[illegible]

Section 13040

SECTION 13040

CONTROL OF FUGITIVE EMISSIONS

PART 1 GENERAL

1.01 SCOPE

A. This Section includes control of fugitive emissions.

1.02 RELATED SECTIONS AND PLANS

A. Section 02110 - Clearing, Grubbing, and Stripping

B. Section 02200 - Earthwork

C. Section 02225 - Compacted Clay Liner and Cap

D. Section 02230 - Road Construction

E. Section 02240 - Protective and Contouring Layers

F. Section 02250 - Vegetative Soil Layer

G. Section 02710 - Granular Drainage Material

H. Section 02712 - Granular Filter Material

I. Section 02920 - Topsoil

J. Section 13000 - Borrow Area Management

K. Section 13010 - Impacted Material Placement

L. Section 13030 - Seasonal Closure

M. Air Monitoring Plan

N. Impacted Materials Placement Plan

1.03 SUBMITTALS

A. Submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
   1. product information and material safety data sheets (MSDS) for any surfactants, crusting agents, or foams proposed for fugitive emission control; and
   2. Fugitive Emissions Control Plan for impacted and non-impacted material placement liner and cap construction borrow area operation and other construction activities included in this subcontract as specified in this Section.

B. Fugitive Emissions Control Plan shall be consistent with the requirements of the Impacted Material Placement Plan and the Air Monitoring Plan. Include the following information in the Plan:
   1. Subcontractor's proposed plan for monitoring dust generation levels resulting from his work; include monitoring equipment, procedures, frequencies, and action levels;
   2. a list of specific types and quantities of equipment to be used for dust control;
   3. the days and hours of operation of dust control equipment during construction activities;
   4. the days and hours of operation of dust control equipment during non-work periods on an as-needed basis, including but not limited to, between shifts, weekends, and holidays;
   5. provisions for contact person to be on-call 24 hours/day seven (7) days/week to respond to a dust alert; and
   6. provisions for dust suppression to begin two (2) hours after notification during non-work periods.

PART 2 PRODUCTS

2.01 WATER

A. Obtain water for fugitive emission control from sources indicated on the Construction Drawings or as directed by the Construction Manager.

2.02 SURFACTANTS, CRUSTING AGENTS, AND FOAMS

A. Use surfactants, crusting agents, and foams for control of fugitive emissions that are approved by the Construction Manager based on the Subcontractor submittal identified in Part 1 of this Section.

PART 3 EXECUTION

3.01 GENERAL

A. Control the release of all fugitive emissions in the construction areas. Fugitive emissions include dust, radiological and chemical emissions, asbestos, and other material emissions as determined by the Construction Manager.

B. Acceptable fugitive emissions levels shall be as identified in the Air Monitoring Plan.

C. FERMCO will perform fugitive emission monitoring at the site. If unacceptable fugitive emission levels are detected, immediately implement mitigative measures including wetting, with or without surfactants, foaming, temporary cover, temporary stop work orders, or other measures acceptable to the Construction Manager.

D. In addition to fugitive emission monitoring by FERMCO, the Subcontractor is responsible for monitoring for dust at construction areas including the borrow area and construction haul roads. Control dust during all construction activities by spraying surfaces with water or other approved agents. No visible dust emissions will be allowed. Subcontractor shall be responsible for providing dust controls during entire duration of Subcontract including between shifts, weekends, and holidays.

E. The Construction Manager may prohibit the use of water for fugitive emission control during freezing weather. In this event, propose alternate emission control methods for the Construction Manager's review and approval.

3.02 FOAM AND SURFACTANT APPLICATION

A. Follow Manufacturer's recommendations and procedures when using foams and adding surfactants to water.

3.03 WATER APPLICATION

A. Furnish required equipment, additives, accessories, and incidentals wherever and as often as necessary to reduce dust levels.

B. Apply water using pressure distributors, pipelines equipped with a spray distribution system, or hoses with nozzles that will ensure a uniform application of water. Apply water in a manner that prevents ponding and/or runoff from the area(s) being watered.

C. Equip all devices used for the application of water with a positive means of shutoff, an anti-siphon valve, and a means to control pressure, volume or spray pattern to prevent further dust generation during the application process.

3.04 RADON MITIGATION

A. Minimize the release of radon by covering radon emitting materials with:
   1. clean soil;
   2. impacted material approved by the Construction Manager; and/or
   3. foams or other approved products.

B. The Construction Manager will identify radon emitting materials requiring coverage under the provisions of this Article.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 15000 TITLE: MECHANICAL

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-26-96
Printed Name and Title: LAWRENCE W. FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D. Jacobson — Date: 26 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Detailed Requirement: Checked by: (Checker)
Signature: Brian D. Jacobson — Date:
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: [signature] — Date: 26 Feb 96
Printed Name and Title: Kenneth W Cargill

Approved by: (DTL)
Signature: J.F. Beech — Date: 26 Feb 96
Printed Name and Title: BEECH PRINCIPAL

[signature] 9 Oct 96
Kenneth W Cargill
Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	Intermediate Design	26 Feb 96	—	—	JFB
D	Intermediate Design, EPA Submittal	8 Apr 96	[signature]		
F	Prefinal Design, EPA Submittal	25 Jun 96	[signature]		
G	Final Design Package	9 Oct 96	[signature]		[signature]
C	Response to Final Design Comments	14 May 97	—		[signature]

SECTION 15000

MECHANICAL

PART 1: GENERAL

1.01 SCOPE

A. This section includes material and equipment for:
   1. Permanent lift station electrically actuated isolation valve, lift station control panel, associated instrumentation, sealed 12 VDC battery, battery charger, alarm light, alarm sirens.
   2. Leachate collection and leak detection manhole manual valves, control panel and associated instrumentation, sealed 12 VDC battery, alarm lights.
   3. Access covers for the leak detection and leachate collection manholes, permanent lift station, and LCS, LDS, and redunded LCS cleanouts.
   4. Leachate transmission system vent pipe and vent pipe support.
   5. Leachate transmission system auxiliary connection.
   6. Temporary gravity line flow control valve.
   7. Equipment decontamination facility sump pump, manual valves.
   8. Access covers for the equipment decontamination facility, and all other work indicated on Construction Drawings or as specified herein.

B. Additional work included in this section is the testing/startup and necessary support for testing/startup activities of the following:
   1. Leak detection and leachate collection manhole manual sampling valves, manual monitoring valves and manual isolation valves.
   2. Permanent lift station electrically actuated isolation valve, lift station alarms and level control panel, associated instrumentation, sealed 12 VDC battery, battery charger, alarm light, and alarm sirens.
   3. Leak detection manhole and leachate collection manhole control panels, associated instrumentation, and alarm lights.
   4. Temporary gravity line flow control valve.
   5. Equipment decontamination facility manual valves and pump.

1.02 RELATED SECTIONS AND PLANS

A. Section 02605 - High Density Polyethylene (HDPE) Manholes, Pipe, and Fittings

B. Section 16000 - Electrical

C. Section 02710 - Granular Drainage Layer

D. Section 02714 - Geotextiles

E. Section 02770 - Geomembrane Liner and Cover

F. Construction Quality Assurance (CQA) Plan

1.03 REFERENCES

A. Materials and methods shall conform to applicable requirements of documents listed below. In case of conflict between this Section and the listed documents, the requirements of this Section shall prevail.

B. Latest version of American National Standards Institute (ANSI) standards:
   1. ANSI A13.1 Standard Specification for Piping and Piping Systems.
   2. ANSI A74 Standard Specification for Cast Iron Soil Pipe and Fittings.

C. Latest version of American Petroleum Institute (API) standards:
   1. API 1104 Standard Specification for Welding of Pipeline and Related Facilities.

D. Latest version of American Society of Mechanical Engineers (ASME) standards:
   1. ASME B2.1. Standard Specification for Pipe Threads.
   2. ASME B16.1. Standard Specification for Cast Iron Pipe Flanges and Flanged Fittings.
   3. ASME B31.9. Standard Specification for Building Service Piping.

E. Latest version of American Society for Testing Materials (ASTM) standards:
   1. ASTM F 477. Standard Test Method for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

F. National Electrical Manufacturers' Association (NEMA):
   1. NEMA ICS 6-93 Industrial control and Systems-Enclosures

G. American Institute of Steel Construction (AISC):
   1. Manual of Steel Construction, Ninth Edition

H. Latest version of Ohio Department of Transportation Construction and Material Specifications (Ohio DOT Specifications).

1.04 SUBMITTALS

A. Submit shop drawings with the type of construction materials, manufacturer and catalog or model number, electrical characteristics, etc. for products in this Section to the Construction Manager for review at least 30 days from Notice to Proceed.

B. Submit to the Construction Manager for review at least 30 days from Notice to Proceed shop drawings that include dimensions, ratings, mounting requirements, clearances, components interface, wiring diagrams and other information required for evaluation and complete installation.

C. Submit "Record" copies of all shop drawings to the Construction Manager before final inspection and acceptance.

D. After completion of the work, furnish and deliver 4 copies of complete operating instructions, installation and maintenance instructions, and spare parts bulletins.

PART 2 PRODUCTS

2.01 LEACHATE COLLECTION AND LEAK DETECTION MANHOLE EQUIPMENT

A. Furnish control panels to house leak detection and level alarm equipment.

B. Furnish control panel enclosure exposure rated National Electrical Manufacturer's Association (NEMA) ICS 6, Type 3R, constructed of 14 gauge G-90 galvanized steel, with all surfaces phosphatized, finished inside and outside with ANSI 61 gray polyester powder finish, with an outer door and inner panel face door and the following features:
   1. Provide the panel with a full width drip shield formed into the top cap to prevent standing water from dripping into the interior when door is opened.
   2. Furnish The panel drip shield and formed edges of the enclosure to provide a seating surface for the full door gasket.
   3. Equip the outer door and inner panel face door with two galvanized hinges with stainless steel hinge pins.

4. Equip the panel outer door with two padlock-capable draw-pull latches.
5. Provide the panel with removable steel component mounting panel plate finished in white enamel and drilled and tapped for component mounting.

C. Furnish power to the control system from a 12 VDC source supplied by a pole mounted 53 watt solar collector with a NEMA ICS 6, Type 3R sealed control module and 115 Amp/hour sealed lead acid battery in a NEMA ICS 6, Type 3R enclosure. Mount solar collector on pole facing due south at the angle recommended by the manufacturer.

D. Include the following as standard features for the control panel.
   1. Terminal strip to allow for easy connection of external components.
   2. Two (2) Programmable Level Controller/Level Indicators mounted in a cutout on the inner panel face door, with the following:
      a. Digital level indication readout accurate to ± 0.1-inch of water.
      b. Minimum of 2 alarm relay contacts rated at 5 amps at 120 VAC.
      c. Minimum of 2 alarm signal inputs rated at 4-20mA/250 Ohms, 0-10 Volts.
      d. Full span accuracy of 0.20 percent.
      e. Input signal smoothing for 120 second.
   3. On-Off spring return to OFF, single pole, single throw switch, NEMA Type 3R, rated 0.5 Amp, 24 VDC, mounted on inner panel door face for alarm light testing.
   4. Three (3), single pole, Class 8700, industrial control relays, NEMA Type 600, with normally open contacts, rated at 24 VDC, 5 Amp, with 12 VDC coil.
   5. One (1), single pole, Class 9050 timing relay, NEMA Type PM, rated at 24 VDC, with timing range of at least 2 hours.

E. Furnish submersible level transmitter with the following:
   1. Solid state semiconductor sensor.
   2. Housing of 316 stainless steel .
   3. Range of 0-14 feet of water, 0-6 psi with 4-20 mA output.
   4. Full span accuracy of ±0.50 percent.
   5. Fifty (50) feet of lead wire.

F. Furnish alarm light with an intensity of 50 candelas, pipe mount, amber color, strobe type, with a flash rate of 60 flashes per minute, rated at 12 VDC, weatherproof marine type.

2.02 LEACHATE COLLECTION AND LEAK DETECTION MANHOLE CONTROL PANEL FUNCTIONAL OPERATION

A. For each OSDF cell, with the cell number herein indicated by the "*" symbol, when the leachate collection system manhole level transmitter LT-*02 transmits a Hi-Hi level signal to the Programmable Level Controller/Level Indicator LIC-*02, the LIC Hi-Hi-level contact closes, energizing relay *Y2 (Hi-Hi Level), which energizes relay *TY4 (Alarm Light Timer), which then energizes relay *Y3 (Alarm Light) and the alarm light LA-*01 begins flashing and continues operation for at least 2 hours after the level transmitter ceases sending a Hi-Hi level signal unless alarm light timer is manually reset.

B. For each OSDF cell, with the cell number herein indicated by the "*" symbol, when the leak detection system manhole level transmitter LT-*01 transmits a Hi-Hi level signal to the Programmable Level Controller/Level Indicator LIC-*01, the LIC Hi-Hi-level contact closes, energizing relay *Y1 (Hi-Hi Level), which energizes relay *TY4 (Alarm Light Timer) which then energizes relay *Y3 (Alarm Light) and the alarm light LA-*01 begins flashing and continues operation for at least 2 hours after the level transmitter ceases sending a Hi-Hi level signal unless alarm light timer is manually reset.

2.03 LEACHATE COLLECTION AND LEAK DETECTION MANHOLE VALVES

A. Furnish leachate collection manhole monitoring valves consisting of 1/2 inch polyvinyl chloride (PVC) ball valves with NPT threaded connectors, Teflon backed ethylene propylene diene (EPDM) seats and EPDM seals, rated at 30°F to 120°F, 150 psig, and mounted on an HDPE service saddle fitting with a noncorroding threaded insert on the leachate collection and redundant leachate collection system containment pipes for monitoring leakage from the carrier pipe.

B. Furnish leachate collection manhole sampling valves consisting of 1/2 inch PVC ball valves with NPT threaded connectors, Teflon backed EPDM seats and EPDM seals, rated at 30°F. to 120°F, 150 psig, and mounted on an HDPE service saddle fitting with a noncorroding threaded insert on the leachate collection and redundant leachate collection system carrier pipes for sampling leachate.

C. Furnish leachate collection manhole check valve from APCO Valve and Primer Corp., Series 906GEIF (or equal), consisting of 6-inch flanged Type 316 stainless steel double door check valve with EPDM seat, low torque Type 316 stainless steel torsion spring, Type 316 stainless steel doors, hinge pin and stop pin. Doors shall require less than 9 inches of water head to begin to open, rated at 30°F to 120°F, 125 psig, and

mounted in the leachate collection system carrier pipe with any required spacers for proper valve operation. Mount the check valve downstream of the butterfly valve.

D. Furnish leachate collection manhole manual butterfly valves consisting of 6-inch flanged PVC wafer style, lever action, Type 75, butterfly valve with PVC disc, EPDM seats, EPDM seals rated at 30°F to 120°F, 100 psig, and mounted in the leachate collection and redundant leachate collection system carrier pipes with any required spacers for proper valve operation.

E. Furnish leak detection manhole monitoring valve consisting of 1/2 inch PVC ball valve with NPT threaded connectors, Teflon backed EPDM seats and EPDM seals, rated at 30°F. to 120°F, 150 psig, and mounted on an HDPE service saddle fitting with a noncorroding threaded insert on the leak detection containment pipe for monitoring leakage from the carrier pipe.

F. Furnish leak detection manhole check valve from Red Valve Co., Series 37 (or equal) consisting of a 3-inch flanged EPDM in-line check valve rated at 30°F to 120°F, 100 psig, and mounted in a flanged SDR 13.5 spool piece before installation in the leak detection system manhole outlet piping.

2.04 TEMPORARY GRAVITY LINE FLOW CONTROL VALVE

A. Furnish temporary gravity line manual butterfly valve from CSR Polypipe, Assembly 8771 (or equal) consisting of 6-inch/10-inch HDPE dual contained fusion type butterfly valve with Type 316 stainless steel disk and stem, and EPDM seats. Include 7-feet stem extension with 3/4-inch type 316 stainless steel shaft, 1 1/2-inch HDPE guide sleeve with stabilizer fins. Manufacture HDPE components from resin satisfying the requirement for Article 2.02 "HDPE Compound" of Section 02605. Valve shall be installed by fusion personnel in accordance with Article 3.05 "HDPE Pipe Joints, Fittings, and Appurtenances Connections" of Section 02605.

2.05 PERMANENT LIFT STATION EQUIPMENT

A. Furnish the control panel to house level detection, level alarm and isolation equipment.

B. Furnish control panel enclosure exposure rated NEMA ICS 6, Type 3R, constructed of 14 gauge, G-90 galvanized steel, with all surfaces phosphatized, finished inside and outside with ANSI 61 gray polyester powder finish, with an outer door and inner panel face door and the following features.

1. Provide the panel with a full width drip shield formed into the top cap to prevent standing water from dripping into the interior when door is opened.

2. Furnish the panel drip shield and formed edges of the enclosure to provide a seating surface for the full door gasket.
3. Equip the outer door and inner panel face door with two galvanized hinges with stainless steel hinge pins.
4. Equip the panel outer door with two padlock-capable draw-pull latches.
5. Provide the panel with removable steel component mounting panel plate finished in white enamel and drilled and tapped for component mounting.

C. Furnish power to the control system from a 120 volt, 60 hertz, 1 phase power feed.

D. Include the following as standard features for the control panel.
1. Heater with adjustable thermostat to promote even distribution of heat and elimination of hot spots and condensation. Heater element shall be mounted in a space between the subpanel and the back of the enclosure and provide a minimum of 50 watts of heating capacity at 120 VAC.
2. Terminal Strip: to provide easy connection of external components.
3. One (1) Programmable Level Controller/Level Indicator mounted in a cutout on the inner panel face door, with the following:
   a. Digital level indication readout accurate to ± 0.1-inch of water.
   b. Minimum of 4 alarm relay contacts rated at 5 amps at 120 VAC.
   c. Minimum of 4 alarm signal inputs rated at 4-20mA/250 Ohms, 0-10 Volts.
   d. Full Span accuracy of ±0.20 percent.
   e. Input signal smoothing for 120 second .
4. One (1) Honeywell UDC 3000 Versa-Pro Universal Digital Programmable Level Controller/Level Indicator mounted in a cutout on the inner panel face door, with the following:
   a. Digital level indication readout accurate to ± 0.1-inch of water.
   b. Minimum of 2 alarm relay contacts rated at 5 amps at 120 VAC.
   c. Minimum of 2 alarm signal inputs rated at 4-20mA/250 Ohms, 0-10 Volts.
   d. Full Span accuracy of ±0.20 percent.
5. On-off spring return to OFF, single pole, single throw switch, NEMA Type 3R, rated at 5 Amps, 24 VDC mounted on inner panel door face for alarm testing.
6. One (1) 5 pole, Class 8501 industrial control relay, NEMA Type A 600, rated 600 volt, 10 Amp, with 120 VAC coil with 2 normally open contacts and 3 normally closed contacts
7. One (1) 115-VAC to 12-VDC, 100 mA rectifier for level control panel normal 12-VDC supply power.
8. One (1) single pole Class 9050 timing relay, NEMA type PM, rated at 12 VDC with timing ranges of at least 2 hours.

9. The following Class 8700 industrial control relays, NEMA Type 600, rated at 24 VDC, 5 Amp, with 12 VDC coil as follows:
   a. Two (2) 2-pole with 1 normally open contact and 1 normally closed contact.
   b. One (1) 2-pole with 2 normally open contacts.
   c. One (1) 4-pole with 1 normally open contact and 3 normally closed contacts.

E. Furnish submersible level transmitter with the following:
   1. Solid state semiconductor sensor.
   2. Housing of 316 stainless steel .
   3. Range of 0-14 feet of water, 0-6 psi with 4-20 mA output
   4. Full span accuracy of $\pm$0.50 percent.
   5. Fifty (50) feet of lead wire.

F. Furnish alarm light pipe mount, amber color, strobe type, with a flash rate of 60 flashes per minute, an intensity of 50 candelas, rated at 12 VDC, weatherproof marine type.

G. Furnish industrial siren, motor driven, UL Listed, heavy duty, weatherproof rated at 120 VAC, 110 dB at 100 yards.

H. Furnish industrial siren, UL Listed, heavy duty, weatherproof rated at 12-VDC, 40 dB at 25 feet.

I. Furnish sealed lead acid battery, maintenance free, valve regulated rated at 12-VDC, 50 Watt, 40 Amp/hr with a NEMA ICS 6 Type 3R enclosure.

J. Furnish 12-VDC solid state battery charger rated at 120 VAC input, 12-VDC output, 30/2 Amp fully automatic with analog ammeter.

2.06 PERMANENT LIFT STATION CONTROL PANEL FUNCTIONAL OPERATION

A. The permanent lift station level control panel normal power supply is from a 120-VAC breaker to a 115-VAC to 12-VDC rectifier (PS-110). The rectifier (PS-110) supplies 12-VDC power to the LICs and control relays. Relay 10Y5 is normally energized and the relay coil (120 VAC) is fed from the same breaker as the rectifier. With 10Y5 energized its normally open contacts 1-2 and 3-4 are closed supplying 12-VDC power to the level control system.

B. If the 120-VAC breaker trips or if 120-VAC power is lost, relay 10Y5 deenergizes, the normally open contacts 1-2 and 3-4 open, and the normally closed contacts 5-6 and 7-8 close supplying 12-VDC backup power from a 12-VDC sealed battery (PS-111)

mounted in the control panel. Also relay 10Y5 contact 9-10 closes which energizes timing relay 10TY4 which energizes the 12-VDC alarm light (LA-110) and 12-VDC (LA-111B) alarm siren.

C. When 120-VAC power is restored, relay 10Y5 energizes, the normally open contacts 1-2 and 3-4 close, and the normally closed contacts 5-6 and 7-8 open, isolating the 12-VDC backup power (PS-111) and restoring the normal 12-VDC power from the rectifier (PS-110) for the control panel.

D. If the 12-VDC control power fuse (10-1) blows, relay 10Y6 deenergizes, the normally closed contacts 1-2 and 3-4 close supplying 12-VDC backup power from a 12-VDC sealed battery (PS-111) mounted in the control panel. Relay 10Y6 contact 7-8 opens to isolate the relay from the 12-VDC backup power. Also relay 10Y6 contact 5-6 closes which energizes timing relay 10TY4 which energizes the 12-VDC alarm light (LA-110) and 12-VDC (LA-111B) alarm siren.

E. When normal 12-VDC power (PS-110) is restored, relay 10Y6 energizes, the normally closed contacts 1-2 and 3-4 open isolating the 12-VDC backup power and restoring the normal 12-VDC power from the rectifier (PS-110) for the control panel.

F. When the permanent lift station level transmitter transmits a Hi-Hi level signal to the Programmable Level Indicator/Controller, LIC-110, the Hi-Hi level contact closes, energizing relay 10Y1 which closes the permanent lift station inlet motor operated valve (V-001) and energizes relay 10TY4 (alarm time relay) which energizes relay 10Y2 (alarm light and alarm siren relay) and the 12-VDC alarm light (LA-110) begins flashing and the 120-VAC alarm siren (LA-111A) sounds and both continue operation for at least 2 hours after the level transmitter ceases sending a Hi-Hi level signal unless the alarm timer is manually reset.

G. When the permanent lift station annular space level transmitter transmits a Hi-Hi level signal to the Programmable Level Indicator/Controller, LIC-111, the Hi-Hi level contact closes, energizing relay 10Y3 which closes the permanent lift station inlet motor operated valve (V-001) and energizes relay 10TY4 (alarm time relay) which energizers relay 10Y2 (alarm light and alarm siren relay) and the 12-VDC alarm light (LA-110) begins flashing and the 120-VAC alarm siren (LA-111A) sounds and both continue operation for at least 2 hours after the level transmitter ceases sending a Hi-Hi level signal unless the alarm timer is manually reset.

H. The High 2 level, High 1 Level, and Low level contacts in the Programmable Level Indicator/Controller (LIC-110) will be available for permanent lift station pumps control. The wiring and programming of those setpoints are given in Section 15160 and as indicated on the Construction Drawings.

2.07 PERMANENT LIFT STATION MANHOLE LEACHATE TRANSMISSION SYSTEM HEADER ISOLATION VALVE

A. Furnish the permanent lift station manhole leachate transmission system header isolation valve consisting of a 6-inch flanged safe block PVC ball valve with EPDM valve seals, Teflon backed EPDM seats, rated at 30°F to 120°F, 150 psig with a BV Series electric actuator rated at 120 VAC. The electric valve actuator shall fail closed upon loss of electric power by means of a return spring or a backup battery pack. Furnish electric value actuator with reversing type, capacitor run motor design, thermally protected with a permanently lubricated gear train in a NEMS ICS6, Type 4 enclosure. Provide actuator with manual override, visual position indicator, and bolt circle to match header isolation valve.

2.08 FRAME AND COVERS

A. Frame and access covers shall be single leaf of the size indicated on the Construction Drawings. Metal curb, complete with counter flashing and 1-inch rigid insulation shall be 14 gauge, Type 316 stainless steel. The 12-inch curb shall be formed with a 3-1/2-inch flange which includes holes at 6 inches on center for attachment to the concrete slab with expansion anchors. Metal cover, complete with 1-inch insulation covered by metal liner, and inside handle, shall be 14 gauge, Type 316 stainless steel.

B. Frame and access cover shall be assembled with spring hinges entirely contained within cover to prevent outside tampering. All hardware shall be cadmium plated. Cover shall be equipped with automatic hold open arm, complete with grip handle, which provides easy one-hand release. Spring latch, providing inside and outside operation, shall include provision of locking from the outside. Cover shall provide for venting of the manhole and prevent infiltration of surface-water runoff from entering the manhole.

C. Frame and access cover for temporary gravity line cleanout shall be as indicated on the Construction Drawings.

2.09 LTS VENT PIPE AND VENT PIPE SUPPORT

A. LTS Vent Pipe
1. Design, fabrication, and erection of structural steel shall be in accordance with American Institute of Steel Construction (AISC) Manual of Steel Construction, Ninth Edition.
2. Pipe shall be seamless, Type 316 stainless steel, Schedule 40, and ASTM 53, beveled ends.
3. Fittings shall be seamless Type 316 stainless steel buttweld ASTM A-403.
4. All welding electrodes shall be AWS D1.1 Class E316. Visually inspect all welds.
5. Vent pipe shall have Type 304 stainless steel insect screen with a 18 x 18 mesh constructed of 0.009-inch diameter wire.
6. Vent pipe shall be equipped with a 4 inch quick connect hose coupling with chain connected locking dust plug manufactured of Type 316 stainless steel.

B. LTS Vent Pipe Support
1. Support shall be able to resist loads of 1,000 pounds vertical and horizontal, have 3 legs, be fabricated from Type 316 stainless steel, and be connected to the manhole cover slab.

2.10 AUXILIARY CONNECTION

A. Auxiliary connection shall be constructed of Type 316 stainless steel.

B. Quick connect shall be a 3-inch disconnect with Buna-N seals, rated at 30°F to 120°F, 100 psig, NPT threads.

2.11 FLANGE GASKETS

A. Furnish low torque type flange gaskets in accordance with ASTM F 477.

2.12 EQUIPMENT DECONTAMINATION FACILITY SUMP PUMP

A. The equipment decontamination facility sump pump shall be Type C, submersible pump, close-coupled to electric 120/240 VAC, 1 phase motor, with built-in float switch.

B. The equipment decontamination facility sump pump shall be capable of a discharge flow rate of 20 GPM at a total dynamic head of 25 feet.

C. The equipment decontamination facility sump pump casing, suction flange and discharge flange shall be carbon steel. The pump impeller shall be bronze.

D. The equipment decontamination facility sump pump shall function to a maximum operating temperature of 150°F.

E. The equipment decontamination facility sump pump shall be Multiquip, Inc. ST-2005T, or equal.

F. The equipment decontamination facility sump pump shall be equipped with a 50-ft long submersible cord.

G. Install the equipment decontamination facility sump pump, discharge valve, piping, and wiring in accordance with manufacturer's instructions and as detailed on the Construction Drawings.

2.13 EQUIPMENT DECONTAMINATION FACILITY VALVES

A. The equipment decontamination facility check valve shall be a 1½ inch flanged PVC swing check valve with EPDM seats rated at 30°F to 120°F, 150 psig mounted in the pump discharge piping at the connection to the dual contained piping.

B. The equipment decontamination facility gate valve shall be a 1 1/2-inch flanged PVC gate valve with EPDM seals, polypropylene plug, rated at 30°F to 120°F, 150 psig mounted in the pump discharge piping upstream of the check valve.

2.14 EQUIPMENT DECONTAMINATION FACILITY DISCHARGE PIPING

A. The equipment decontamination facility discharge piping shall be a 1½ inch leakproof Type 316 flexible stainless steel hose with liquid tight fittings to mate with flanged equipment as shown on the Construction Drawings.

2.15 EQUIPMENT DECONTAMINATION FACILITY WIND/OVERSPRAY SHIELD

A. Provide 3/8-inch thick and 36 inches in width by 72 inches in height fiberglass reinforced polyester sheets. Provide watertight seal between joints.

B. Use 2" x 6" pressure-treated boards as wood nailers and 4" x 4" pressure-treated support posts as shown on the Construction Drawings.

2.16 EQUIPMENT DECONTAMINATION FACILITY FROST-PROOF YARD HYDRANTS

A. Provide frost-proof yard hydrants with 3/4 inch brass hose threaded outlet. Provide hydrant with 5 foot total length, 1-inch diameter pipe and shutoff valve with pipe column drain, and level controlled flow regulator.

2.17 EQUIPMENT DECONTAMINATION FACILITY WOOD SUPPORTS

A. Provide pressure treated wood in accordance with Section 710.14 of the Ohio DOT Specifications. Provide ground contact rated material for wood supports.

2.18 EQUIPMENT DECONTAMINATION FACILITY GEOSYNTHETICS

A. Geotextile shall meet the material requirements for geotextile cushion in Specification Section 02714.

B. Geomembrane shall meet the material requirements of Section 02770.

2.19 EQUIPMENT DECONTAMINATION FACILITY LINER PENETRATION

A. Provide 1/2-inch wide Type 316 stainless steel clamps with heavy duty worm drive gear which can withstand 150 pounds of tightening torque.

B. Provide silicone sealant which adheres to HDPE.

C. Provide 1-inch wide by 1/8-inch thick by 6-inch diameter Viton seals.

2.20 EQUIPMENT DECONTAMINATION FACILITY ROAD BED

A. Construct equipment decontamination facility roadbed from used railroad ties.

B. Use 2" x 6" pressure-treated boards over the road bed as shown on the Construction Drawings.

2.21 EQUIPMENT DECONTAMINATION FACILITY GRAVEL

A. Gravel used below the facility road bed and in the facility sump shall meet the material requirements for drainage corridor gravel in Section 02710.

2.22 WATER LINE

A. Water line shall be 2-inch diameter PVC.

B. Valves shall be 2-inch PVC.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all materials included in this Section in compliance with the manufacturer's written installation instructions.

B. Fabricate the control systems as shown on the approved shop drawings. Install controls and perform all necessary field electrical work to connect the local and remote control devices.

C. Control panel signal and control circuit wiring shall conform to the following:
   1. Run all wires in plastic wireways except field wiring, wiring run between mating blocks in adjacent sections, wiring from components on a swing-out panel to components on a part of the fixed structure, and wiring run to panel-mounted components.
   2. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. Tie these bundles with nylon wire ties, and secure to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.
   3. Tie wiring run to control devices on the front panels together at short intervals (6 inches maximum) with nylon wire ties and secured to the inside face of the panel using adhesive mounts.
   4. Run wiring to rear terminals on panel-mount instruments in plastic wireways secured to horizontal brackets run above or below the instruments in approximately the same plane as the rear of the instruments.
   5. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings.

6. Tag instrument signal circuit conductors with unique multiple digit numbers consistent with Section 16050 of these specifications.
7. Tag black and white wires from the circuit breaker panel board including the 1- or 2-digit number of the branch circuit breaker.

D. Installation, calibration, testing and start-up instructions are as follows:
   1. Provide the installation personnel with a final reviewed copy of the shop drawings and data. Install all external wiring in conformance with Section 16110 of these specifications. All systems shall be installed, connected, calibrated, and tested as described below.
      a. Install the instrument process sensing lines in a similar manner to the installation of conduit specified under Section 16110. Run individual tubes parallel and near the surfaces from which they are supported. Use supports at intervals of not more than 3 feet of rigid tubing.
      b. Form bends with the proper tool and to uniform radii. Bends shall be made without deforming or thinning the walls of the tubing. Use plastic clips to hold individual plastic tubes parallel. Square-cut ends of tubing and clean before insertion in the fittings. Provide bulkhead fittings at all panels requiring pipe and/or tubing entries.
      c. The Subcontractor shall have a technical field representative instruct the installation personnel on any and all installation requirements. Thereafter, the technical field representative shall be readily available by telephone to answer questions and supply clarification when needed by the installation personnel.
      d. After all installation and connection work has been completed, the technical field representative shall check it for correctness, verifying polarity of electric power and signal connections, making sure all process connections are free of leaks, and all other similar details. The technical field representative shall certify in writing to the Subcontractor that for each loop or system checked out, all discrepancies have been corrected by the installation personnel.

E. Attach access covers to concrete slab with expansion anchors. Provide a watertight connection between the access cover and the concrete slab.

F. Install geotextile cushion and sacrificial geotextile cushion in accordance with Section 02714. Construction quality requirements shall be in accordance with Section 02714.

G. Install geomembrane in accordance with Section 02770. Construction quality requirements shall be in accordance with Section 02770.

H. Excavate trench for water line to a minimum depth of 3 feet. Backfill trench with trench spoils and compact in lifts no greater than 12 inches with hand operated compactor.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16000 TITLE: ELECTRICAL

Specifications By: (Cognizant Engineer)
Signature: Lawrence W. Fly — Date: 2-23-96
Printed Name and Title: LAWRENCE W. FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Detailed Requirements Checked by: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: K T Cargill — Date: 25 Feb 96
Printed Name and Title: Kennett W Cargill, Associate

Approved by: (PTL)
Signature: J. F. Beetz — Date: 26 Feb 96
Printed Name and Title: BEETZ, PRINCIPAL

K T Cargill 9 Oct 96
Kenneth W Cargill
Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	Intermediate Design	26 Feb 96	—	—	JFB
D	Intermediate Design, EPA Submittal	8 Apr 96	K	—	—
F	Pre final Design, EPA Submittal	25 Jun 96	K	—	—
G	Final Design Package	7 Oct 96	—	—	K
C	Response to Final Design Cmts	14 May 97	—	—	K

SECTION 16000

ELECTRICAL

PART 1: GENERAL

1.01 SECTION INCLUDES

1.02 SCOPE

A. All materials and appliances, obviously a part of the electrical system and necessary to its proper operation, but not specifically mentioned in this Section or shown on the Construction Drawings, shall be furnished and installed without additional charge.

B. All materials and equipment necessary for the proper installation and operation of the work included under this Section shall be purchased, procured, installed and wired and tested as required by these Specifications. The scope shall include, but not necessarily be limited to 120/240VAC, 1 phase, 3 wire system wiring to electrical equipment such as distribution panelboards, dry type transformers, control devices and all other components required for a complete electrical system. The wiring shall include raceways, cables, junction and pull boxes; wireways and all other required components for a complete installation.

C. The work shall include, but not limited to:
   1. Power wiring, including power circuit connections for pump motors.
   2. Solar collector units and solar control panels.
   3. Leaving the electrical system in proper operation conditions.
   4. Testing and start-up of all electrical equipment of these Specification.

1.03 RELATED SECTIONS

A. Section 15000 - Mechanical.

1.04 SUBMITTALS

A. Submit the following to the Construction Manager for review and approval within 30 calendar days of Notice to Proceed.
   1. Submit a listing of all the materials indicated below, with the type of material, manufacturer and catalog or model number for each. This will include: junction boxes, pull boxes, wireways, raceways, wire, cables, wiring devices, plates, nameplates, and alarm devices.
   2. Submit shop drawings of dry type transformers, panelboards control panels, and cabinets.

B. Include dimensions, weight, ratings, mounting requirements, clearances, components interface, wiring diagrams and other information required for proper evaluation and complete installation on shop drawings.

C. The approval of systems, equipment and shop drawings is a general approval subject to the contract drawings, specifications and verification of all measurements at the job site. Approval does not relieve the Subcontractor from the responsibility of shop drawing errors. Carefully check and correct all shop drawings prior to submission for approval.

D. Submit "Record" copies of all shop drawings to the Construction Manager before final inspection and acceptance.

E. Order no material or start shop work until the Construction Manager's review of shop drawings has been completed.

1.05 ELECTRICAL SHOP DRAWINGS

A. Construction drawings are generally diagrammatic and show the arrangement and location of fixtures, equipment and conduit. Carefully investigate the structural and finish conditions affecting the work and arrange the work accordingly.

B. The right is reserved to relocate up to 10 feet, equipment indicated on construction drawings prior to rough-in without increase in contract cost.

C. Make all connections to equipment in accordance with approved shop drawings.

D. Where exact locations are required by equipment for stubbing-up and terminating conduit, the Subcontractor shall coordinate with shop drawings and any other data

required to locate the conduit before the work is started and any concrete is poured.

1.06 RECORD DRAWINGS

A. Provide and maintain at the site a set of prints on which the actual installation of all work under this section shall be accurately shown, indicating any variation from contract drawings. Changes in circuitry shall be clearly and completely indicated as the work progresses.

B. These progress prints shall be available for inspection by the Construction Manager and shall be used to determine the progress of electrical work.

C. At the completion of the work, prepare a new set of record drawings of the work actually noted on the marked-up prints including the dimensioned location of all underground conduit.

D. Furnish record drawings to the Construction Manager for approval and transmission.

1.07 SUBSTITUTIONS

A. Where equipment is identified by manufacturer and catalog number, it shall be construed as the base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Subcontractor may submit for approval, similar equipment of other manufacturers as substitution. It is the Subcontractor's responsibility to prove that proposed equipment is equal to that specified. The decision of the Construction Manager as to whether the submitted equipment is acceptable shall be final and binding.

B. All changes necessary to accommodate the substituted equipment shall be made at the Subcontractor's expense, and shall be as approved by the Construction Manager. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested.

1.08 GUARANTEE

Guarantee to correct all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of project acceptance by the Construction Manager.

1.09 SYSTEMS MANUAL

After completion of the work, furnish and deliver four (4) copies of a complete electrical equipment systems manual to the Construction Manager's Representative. Include in each manual one (1) copy each of all approved shop drawings, catalog pages, instruction sheets, operating instructions, installation and maintenance instructions, spare parts bulletin, and a wiring diagram for each system.

1.10 STANDARDS

A. Furnish all materials and equipment under this section and comply with the applicable standards of the entities listed below:

1. American National Standards Institute - ANSI
2. American Society for Testing Materials - ASTM
3. American Standard Association - ASA
4. Institute of Electrical and Electronic Engineers - IEEE
5. Insulated Cable Engineers Assoc. - ICEA
6. National Electrical Code - NEC
7. National Electrical Manufacturers' Association - NEMA
8. Occupational Safety & Health Act - OSHA
9. Underwriters' Laboratories, Inc. - UL
10. Factory Mutual - FM
11. Electrical Testing Laboratories, Inc. - ETL
12. National Electric Safety Code - NESC

1.11 ABBREVIATIONS AND DEFINITIONS

When the following abbreviations and definitions are used in relation to the work for Division 16, they shall have the following meanings:

ITEM	MEANING
Accepted	Reviewed with no exceptions taken to submittal material. See "Submittal" below.
ANSI	American National Standards Institute
Approved	Inspected and accepted by the CQC Consultant or Construction Manager's Rep.
ASTM	American Society for Testing and Materials.
Boxes	Outlet, Junction, or Pull Boxes.
Code	All codes currently enforced at project location.

ITEM	MEANING
Compression	Compressed using a leverage powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
EMT	Electrical Metallic Tubing.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane
Fully Operational	Tested and approved and operating to the satisfaction of the CQC Consultant or Construction Manager, manufacturer, and contract documents.
Furnish	Deliver to the jobsite
Install	To enter permanently into the project and make fully operational
Mfr.	Manufacturer
NEC	National Electrical Code, National Fire Protection Association Publication #70 (latest adopted edition with amendments)
NESC	National Electrical Safety Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Noted	Shown or specified in the contract documents
PVC	Polyvinyl Chloride
Provide	Furnish and install
RGS	Rigid Galvanized Steel
Required	As required by code, Construction Manager, or contract documents for the particular installation to be fully operational
Shop Drawing	Document prepared by Subcontractor, supplier, fabricator, or similar party which fully illustrates and details the equipment and intended installation relative to this specified project
Shown	As indicated on the Drawings or details
Submittal	Material for CQC Consultant's or Construction Manager's review which may contain catalog cuts, shop drawings, wiring diagrams, etc., of the actual material being furnished.
UL	Underwriters' Laboratories, Inc.
Wiring	Raceway, conductors, and connections

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16100 TITLE: BASIC MATERIAL AND METHODS

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-23-96
Printed Name and Title: LAWRENCE W. FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D JACOBSON, STAFF ENGINEER

Detailed Requirements Checked by: (Checker)
Signature: Brian D Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: K T Cargill — Date: 25 Feb 96
Printed Name and Title: Kenneth W Cargill, Associate

Approved by: (PDTL)
Signature: J.F. Beck — Date: 26 Feb 96
Printed Name and Title: J.F. Beck, BECHTEL PRINCIPAL

K T Cargill 9 Oct 96
Kenneth W Cargill
Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	Intermediate Design	26 Feb 96	—	—	JFB
D	Intermediate Design, EPA Submittal	8 Apr 96	KC	—	—
F	Pre-final Design, EPA Submittal	25 Jun 96	KC	—	—
G	Final Design Package	4 Oct 96	—	—	KC
C	Response to Final Design Cmts	14 May 97	—	—	KC

SECTION 16100

BASIC MATERIALS

PART 1: GENERAL

1.01 SCOPE

A. This Section contains the general requirements for materials and installation methods which apply to all sections of Division 16.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02215 - Trenching and Backfilling

C. Section 03100 - Concrete

D. Section 16120 - Conductors and Terminations

1.03 SUBMITTALS

Submit to the Construction Manager for review at least 30 days from Notice to Proceed the following:

A. Product information submittals shall be required for the following:
   1. Raceways;
   2. Wires and Cables;
   3. Connectors and Terminations;
   4. Power Service Equipment;
   5. Transformers;
   6. Panelboards;
   7. Lighting Fixtures and Ballasts;
   8. Overhead Power Poles;
   9. Pullbox;
   10. Solar Collector Unit and Solar Control Panel; and
   11. Equipment Name Plates.

B. Shop Drawings for:
   1. Panelboards;
   2. Control panels; and
   3. Equipment Name Plates.

PART 2: PRODUCTS

2.01 GENERAL

A. Materials and equipment installed, including lighting fixtures, shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled.

2.02 NAMEPLATES

A. Provide permanently attached nameplates constructed of three-layer plastic laminated material engraved through white surface material to black sublayer. Lettering shall be 5/16 inch bold style. Nameplates shall indicate the equipment designation, voltage, number of phases, and the name of the piece of equipment that provides the source of power.

2.03 SUPPORTING DEVICES

A. Support channel shall be galvanized or painted steel.

B. Support hardware and accessories shall be corrosion resistant.

C. Supports shall be of all welded construction.

PART 3: INSTALLATION

3.01 CUTTING CONSTRUCTION

A. Construction materials damaged or cut shall be repaired or replaced with materials of like kind and quality as original materials.

3.02 EXCAVATIONS/TRENCHING AND BACKFILLING

A. Excavations shall not disturb drainage walls, footings, or other existing structures, utilities, and equipment.

B. Excavation shall be as specified in Section 02200.

C. Trenching and backfilling shall be as specified in Section 02215.

D. Concrete shall be as specified in Section 03100.

3.03 PAINTING

A. All exterior and interior steel surfaces shall be properly cleaned and finished with gray ASA-61 paint over a rust-inhibiting phosphatized coating. The finish paint shall be suitable for field painting. Items furnished under Division 16 that are scratched or marred in shipment or installation shall be refinished.

3.04 EQUIPMENT CONNECTION

A. Electrical connections necessary to serve such equipment of this Section shall be provided complete. Provide required control connections to all equipment so that the equipment is fully operational upon completion of the project. Whenever the Construction Drawings show an equipment connection, the code-required disconnect switch shall be provided.

B. All materials and equipment shall be installed in conformance with the manufacturer's installation instructions and UL requirements.

3.05 WIRE NUMBERING

A. All field wiring, external to pre-manufactured panels and equipment, shall be numbered. The numbering shall be sequential beginning with 1 and continuing to 99. If a panel requires more then 99 wire numbers start again at 1 preceded by an alpha character starting with A.

B. A finished wire number schedule shall be submitted complete with conduit numbers and a functional description of the wires.

C. Wire markers shall be installed in accordance with Section 16120.

3.06 EQUIPMENT SUPPORTS

A. Installation of structural steel framing, concrete pads, etc., shall be complete before installing supporting devices.

B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structures in accordance with manufacturer's recommendations as indicated.

C. Use expansion anchors for support on concrete surfaces.

D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

E. Do not drill structural steel members for installing support devices.

F. 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.

G. Install freestanding electrical equipment on concrete pads.

H. Install surface mounted cabinets and enclosures with four anchors (minimum). Provide steel channel supports to stand cabinets and enclosures 1 inch from the wall.

3.07 TESTING DURING INSTALLATION

A. All wires shall be tested for continuity. Wire insulation shall be megger tested between each conductor and ground. A 1,000-volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 100 megohms.

B. Resistance reading between shield and ground shall be measured and recorded for shielded cables in accordance with manufacturer's recommendations and shall transfer the resistance reading to record drawings.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16110 TITLE: RACEWAYS

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-23-96
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Scope and Format Checked By: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
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Detailed Requirements Checked by: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
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Overall Review By: (PDP)
Signature: [signature] — Date: 25 Feb 96
Printed Name and Title: Kenneth W Cargill

Approved by: (TL)
Signature: T.E. Beall — Date: 26 Feb 96
Printed Name and Title: BEALL, PRINCIPAL

Kenneth W Cargill 9 Oct 96
Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	Intermediate Design	26 Feb 96	—	—	TEB
F	Prefinal Design EPA Submittal	25 Jun 96	[signature]	[signature]	
G	Final Design Package	9 Oct 96	[signature]	[signature]	[signature]
O	Response to Final Design Cmts	14 May 97	[signature]	[signature]	[signature]

Section 16110

SECTION 16110

RACEWAYS

PART 1: GENERAL

1.01 SCOPE

This section includes all raceway systems that shall be installed complete and in conformance with National Electrical Code (NEC) and National Electrical Safety Code (NESC).

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All materials and equipment shall be new and shall meet or exceed the applicable standards listed above. All materials and equipment shall have a product with a date of manufacture of under one year.

B. All materials and equipment shall be from manufacturers whose products have been in service for at least three years.

C. Include brackets, attachments, mounting hardware and other accessories needed for complete installation.

D. Select only one manufacturer for any specific class of material equipment.

E. Use all materials in this project which are Underwriter's Laboratories, Inc. (UL) listed or labeled as may be applicable.

2.02 CONDUIT AND FITTINGS

A. Acceptable types of conduits and raceways are as follows:
   1. Non-metallic conduit (PVC).
   2. Liquid-tight flexible metal conduit.
   3. Rigid, heavy wall, galvanized steel conduit (RGS).

4. Wireways shall be provided as follows:
   a. Metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated shall be provided. Where types and grades are not indicated, provide proper selection determined by specifications, and applicable portions of NEC. Minimum size shall be 3/4-inch diameter. All raceway type shall be UL labeled.
   b. RGS conduit shall be provided, zinc-coated, threaded type, hot-dip galvanized inside and outside and after cutting. RGS shall be used on all outdoor exposed conduit runs.
   c. Liquid-tight flexible metal conduit shall be constructed of single strip, continuous, interlocked and double wrapped steel; hot dipped galvanized; coated with liquid-tight jacket. This conduit shall be used for connections to pumps on valves, outdoors, or in the permanent lift station.
   d. RGS conduits shall be Allied, Republic Steel, Triangle-PWC or Wheatland. Liquid-tight conduit shall be Anaconda type UA sealtight or Electri-Flex type LA.

B. Provide Metal conduit fittings in accordance with the following:
   1. Rigid metal conduit fittings shall be cast malleable iron, galvanized or cadmium plated.
   2. Rigid heavy wall galvanized steel and IMC fittings shall be of the threaded type. Bushings shall be of the insulated type. Use Myer's hub connectors on all outdoor or damp locations.
   3. Conduit fittings and bodies shall be Appleton, O.Z., Steel City, Raco, Crouse-Hinds, Efcor or Thomas and Betts and conforming to ANSI C801.
   4. Liquid-tight flexible metal conduit fittings shall be insulated throat cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings 3/4 inch minimum conforming to UL 360.

C. Provide nonmetallic conduit in accordance with the following:
   1. Provide nonmetallic conduit, ducts and fittings of types, sizes and weights for each service indicated on the Construction Drawings.
   2. Electrical plastic heavy wall conduit shall be Schedule 40, 90° C, constructed of polyvinyl chloride, for direct burial, or concrete encasement, 1 inch minimum size.

D. Provide nonmetallic conduit fittings and accessories in accordance with the following:
   1. PVC conduit and tubing fittings shall be manufactured to mate and match to conduit or tubing type and materials as required.
   2. PVC conduit shall be Carlon or Triangle-PWC.
   3. PVC conduits shall not be supported using metallic encirclements; break encirclements using nylon nuts and bolts.

E. Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements. Conduit bodies shall be constructed with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.

F. Provide electrical wireways shall be provided for each type of service as indicated. Assemble couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other components and accessories as required for a complete system.

PART 3: INSTALLATION

3.01 INSTALLATION OF CONDUITS

A. Fasten metal conduits, enclosures, and raceways together to provide electrical continuity and firm mechanical assembly.

B. Avoid use of dissimilar metals throughout system to eliminate electrolysis; where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

C. Provide all empty conduits with one (1) No. 10 AWG galvanized wire or nylon equivalent in sufficient length and properly bent at each end to prevent the wire from slipping into the conduit or duct. Conduits to be left empty shall be tested with a ball mandrel. Labels shall be provided to pull cord at each end of the empty conduit identifying the location at the other end.

D. Schedule 40 PVC conduit may be installed underground or below slabs on grade only. The use of schedule 40 PVC elbows or conduit stub-ups shall not be permitted with the exception of grounding system conduit runs.

E. Make all conduit runs straight and true, offsets and bends shall be uniform and symmetrical. Bends shall be of the long sweep type. Install all conduit stub-ups plumb and flush to mounting surface.

F. Clean all conduits immediately after installation with a wire brush that is 1/2 inch larger than the bore of the conduits. All conduits shall be capped with "steel pennies" or plastic "Push Penny" plugs immediately after installation and cleaning. Duct tape is not an acceptable method of capping conduits. If obstructions are found, the conduits shall be replaced.

G. Metallic conduits routed below grade shall either be wrapped or have a bitumastic coating.

H. All outdoor conduits shall be RGS or PVC conduit.

I. The use of running threads is prohibited.

J. Secure all RGS and intermediate metal conduits entering sheet metal boxes (i.e., junction boxes, pull boxes, panelboards, etc.) in place with one (1) galvanized steel bonding type locknut and one (1) insulated grounding type metallic bushing or two (2) galvanized steel bushing type locknuts and one (1) plastic bushing. Use insulated trout type Myer's Hub in outdoor or damp locations where box does not provide a threaded fitting.

K. All conduits shall be securely fastened within 36 inches of each outlet box, junction box, cabinet, or fitting. One support shall be provided not over 12 inches from each change in direction.

L. Flexible raceway connection shall be provided for permanent lift station electrically actuated isolation valve.

M. Fittings shall be suitable for providing conduit terminations with a liquid-tight seal.

N. Assemble metal enclosures, and raceways and connect to electrical boxes, fittings and cabinets to provide effective electrical continuity and rigid mechanical assembly.

3.02 RACEWAYS UNDERGROUND

A. Underground raceways shall be RGS with a 40 mil PVC jacket.

B. Arrange and slope raceways entering manholes to drain away from manholes.

C. Provide marker tape over all underground raceways. Marker tape shall read "Caution - Electric Line Buried Below" as manufactured by Terra Tape or approved equal. Marker tape shall be installed 12 inches below grade.

D. Install underground raceways a minimum of 36 inches below final grade unless otherwise noted on the Construction Drawings or as required by the Engineer. Abrasions on the raceways shall be repaired with PVC-base paint.

E. Provide backfill around underground raceways. Use clean sand 12 inches above and below raceways. Backfill shall meet the requirements of Section 02215 (i.e., Trenching) and shall be free of rocks greater than 1 inch in diameter. Space raceways a minimum of 3 inches apart.

3.03 RACEWAYS THAT STUB UP THROUGH CONCRETE SLAB

A. Install at such depth that the exposed raceway is vertical and no curved section of the elbow is visible.

3.04 SEALING OF RACEWAY PENETRATIONS

A. Provide a watertight seal around all raceways on concrete slab surfaces above grade in a method that is acceptable to Construction Manager.

3.05 SEALING OF RACEWAYS

A. Provide a watertight seal in the interior of all raceways that pass through weatherproof panel walls. Seal on the end inside building, using raceway sealing fittings manufactured for this purpose. Seal poured-type fittings with a non-hardening compound manufactured for such service.

3.06 PULL CORDS

A. Provide a nylon pull cord in spare raceways which are greater than 25 feet in length.

3.07 RACEWAY SIZE

A. Raceways not sized on the Construction Drawings shall be sized per NEC Table 3A. Size 3/4-inch minimum.

3.08 EXPANSION FITTINGS

A. Provide raceways crossing expansion joints with an expansion fitting with bonding jumper.

3.09 CONDUIT MARKERS

A. Conduits shall have stainless steel indented marker plates, Panduit Corporation, Catalog No. MMP350-C or approved equal, held in place with stainless steel ties, Catalog No. MLT4S-CP or approved equal. Characters shall be 3/16-inch high minimum, indented with indenter marker press, Catalog No. IMP187, or approved equal.

3.10 CONDUIT CLEANING

A. Thoroughly swab conduits to remove foreign material before pulling cables.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16120 **TITLE:** CONDUCTORS AND TERMINATIONS

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-23-96
Printed Name and Title: LAWRENCE W FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Detailed Requirements Checked by: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: [signature] — Date: 25 Feb 96
Printed Name and Title: Kenneth W Cargill, Associate

Approved by: (TL)
Signature: [signature] — Date: 26 Feb 96
Printed Name and Title: BEELK, PRINCIPAL

[signature] 9 Oct 96
Kenneth W Cargill
Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
A	Intermediate Design	26 Feb	—	—	JTB
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G	Final Design Package	9 Oct 96	—	—	[signature]
C	Response to Final Design Cmts	14 May 97	—	—	[signature]

SECTION 16120

CONDUCTORS AND TERMINATIONS

PART 1: GENERAL

1.01 SCOPE

A. This section includes conductors, splices, and terminations, that shall be supplied complete and in conformance with National Electrical Code (NEC) and National Electrical Safety Code (NESC).

PART 2: PRODUCTS

2.01 CONDUCTORS AND CONNECTORS

A. All conductors shall be 98% conductivity soft drawn annealed copper as manufactured by Cablec, ITT Royal Electric, Southwire, Carol, American Insulated Wire Corp. No. 12 and 14 American Wire Gauge (AWG) conductors may have a solid conductor material. All conductors larger than No. 10 AWG shall have a stranded conductor material. All wire shall be 90°C rated, with 98 percent conductivity.

B. Insulation shall be 600 volt of the following type:
   1. Branch Circuits - THWN
   2. Panel/Main Feeders - XHHW-2
   3. Signal/Control Systems - THHN/THWN
   4. Grounding - THWN

C. Color coded conductors as follows:
   1. Color coding for 240/120-volt, single phase systems:
      a. Grounded neutral white
      b. Grounding conductor green or bare
      c. Ungrounded conductor black
      d. Ungrounded conductor red

D. Remove and replace all conductors and cables not properly color coded.

E. Conductors up to No. 8 AWG shall have continuous color coded outer jacket. Conductors larger than No. 8 AWG shall be identified at all outlet boxes, junction and pull boxes by means of colored plastic tape applied to the wire. Tape shall be quarter lapped and two inches in length.

F. Use no conductor smaller than No. 12 AWG for power and no conductor smaller than No. 14 AWG shall be used for control.

G. Use No. 10 AWG minimum for receptacle branch circuit homeruns exceeding 100 feet for 120 volts.

2.02 SPLICES

A. Above grade splices shall be solderless type only. Preinsulated "twist-on" type shall be limited to size No. 10 and smaller. Bolt or compression-set type with application of preformed insulated cover, heat shrinkable tubing, or plastic insulated tape acceptable for all sizes.

B. Place below grade splices in handholes and make watertight with Scotchcast epoxy resin type splicing kits or similar.

2.03 TERMINATIONS

A. Use terminations which are compression-set, bolted, or screw type lug or direct to bolted or screw type terminal.

B. Utilize conductors No. 12 and smaller with eye or forked tongue type compression-set terminator when termination is to a bolt or screw set type terminal block or terminal cabinet.

C. Furnish terminations suitable for cable size and type employed.

D. Furnish wire and cable connectors for No. 8 AWG and larger of the bolted pressure type as manufactured by O.Z. Gedney Company. Insulate connections with vinyl mastic pads Scotch Series 2100, or insulating compound, then tape with 3 wraps of Scotch 33 vinyl plastic tape.

E. Fasten No. 1/0 AWG cable and larger with using multi-crimp (3 crimps minimum) long barrel two (2) hold compression type lugs, then insulate and protect as noted above. Do not use single indent compression lugs.

F. Connect all motor leads with Thomas & Betts 600 V motor pigtail connectors, with re-usable insulating boots.

2.04 CABLE TIES

Cable ties shall be nylon or equivalent, locking type.

2.05 WIRE MARKERS

Wire markers shall be imprinted tubular plastic type.

PART 3: INSTALLATION

3.01 GENERAL

A. Install all conductors in raceway unless shown on Construction Drawings or specifically authorized by the Construction Manager. Install all splices and terminations in enclosures as required or shown.

B. Use continuous conductors from outlet to outlet and no splices shall be permitted.

C. Identify wires at each end using wire markers impervious to oil, water and dust as manufactured by Brady, and Thomas & Betts.

D. Install conductors in a manner which will not damage their insulation. The bending radius for jacketed cables shall not be less than seven times the outside diameter of the cable. Conduit and wireway runs shall be thoroughly swabbed and complete before any conductors are installed. Use recommended pulling compound as required.

E. Neatly group and tie together all feeder, branch circuit or control wiring passing through pull boxes, and/or being made up in panels, and terminal cabinets using "Ty-Raps" manufactured by Thomas & Betts (T & B) at approximately 6 inch intervals, provide "Ty-Raps" at 36 inch intervals along cable tray runs. Neatly tie together feeders running in trenches using the same type of "Ty-Raps" above except spaced at three foot intervals.

3.02 CONDUCTOR SIZE

A. Furnish No. 12 AWG minimum conductors for power and lighting circuits.

3.03 RACEWAY SIZES

A. Raceways (when shown) are sized for copper, type THW, unless shown otherwise. Size all raceways per code unless specifically shown to be larger on Construction Drawings. See Section 16110 of these Specifications.

3.04 TAPING

A. Taping, if used, shall be half-lapped synthetic tape.

3.05 CONDUCTORS IN PANELS AND SWITCHBOARDS

A. Neatly group and form conductors in panels and terminal cabinets in a manner to "fan" into terminals with regular spacing.

3.06 WIRE NUMBERING

A. Provide wire numbering in accordance with Section 16100 of these Specifications.

B. Attach wire markers at each termination point within 2 inches of wire termination. Marker nomenclature shall be visible without moving the marker.

3.07 CABLE LUBRICANTS

A. Use cable lubricants that are specifically recommended by the cable manufacturer for assisting in pulling cables. Cable lubricants shall be soapstone, graphite, or talc. Lubricant shall not be deleterious to the cable.

3.08 CABLE PULLING

A. Do not exceed the maximum pulling tension recommended by the cable manufacturer.

3.09 TERMINATIONS

A. Provide terminations with materials and methods as recommended by the termination manufacturer.

3.10 CONSTRUCTION QUALITY REQUIREMENT

A. The CQC Consultant will perform general monitoring on a minimum of 10 percent of wire terminations to assure proper lug size; acceptable crimps (per manufacturer's instructions and acceptance criteria); wire identification; wires landed at correct points; equipment and wires not damaged; and wires properly supported in panels.

B. The CQC Consultant will observe cable pulling to assure correct wire size and type, correct routing, bending radius/pull tension per manufacturer's recommendations and verify that cable is properly identified and shows no indication of damage.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16130 **TITLE:** OUTLET, JUNCTION AND PULL BOXES

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-23-96
Printed Name and Title: LAWRENCE W. FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Detailed Requirements Checked by: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: [signature] — Date: 25 Feb 96
Printed Name and Title: Kenneth W Cargill, Associate

Approved by: (TL)
Signature: J.F. Beech — Date: 26 Feb 96
Printed Name and Title: BEECH, PRINCIPAL

[signature] Kenneth W Cargill, Associate 9 Oct 96

Record of Revision (Number and initial all revisions)

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F	Refined Design, EPA Submittal	26 Jun 96	[signature]	—	—
G	Final Design Packages	9 Oct 96	—	—	[signature]
C	Response to Final Design Cmts	14 May 97	[signature]	—	[signature]

Section 16130

SECTION 16130

OUTLET, JUNCTIONS, AND PULL BOXES

PART 1: GENERAL

1.01 SCOPE

A. This section includes outlet, junction, and pull boxes as required to enclose devices, to permit pulling conductors, and for wire splices and branches.

PART 2: PRODUCTS

2.01 MATERIAL

A. Above grade outlet and junction boxes shall be cast or malleable iron or shall be cast of corrosion resistant alloy, complete with conduit hubs, compatible with raceways to which they are connected. Fabricate pull boxes of heavy gauge steel and hot dipped galvanized complete with malleable iron hubs. Label all boxes for damp or wet locations as applicable.

B. Below grade boxes (handholes) shall be constructed of precast concrete with size, configuration, cover, grates, and reinforcing as required by the particular installation. Manufacturer: Utility Vault or Renton Concrete Products. Where not exposed to earth, boxes shall comply with Section 2.01A of these Specifications.

PART 3: INSTALLATION

3.01 ANCHORING

A. All boxes shall be firmly anchored directly to panel rack. Boxes must be attached such that they will not "rock" or "shift" when devices are operated.

3.02 ELECTRICAL OUTLETS

A. Device Height: Measure from the finished slab or ground surface to the center line, unless otherwise shown on the Drawings.

3.03 CONNECTION TO EQUIPMENT

A. For equipment furnished under this Section or other Sections of these Specifications, or by others, provide outlet boxes of sizes and at locations necessary to serve such equipment and provide final connections to all equipment. Outlet boxes are required if equipment has pigtail wires for external connection, does not have space to accommodate circuit wiring, or requires a wire with insulation rating different from circuit wiring used. Study equipment details to assure proper coordination.

3.04 BLANK COVERS

A. Provide blank covers or plates over all boxes that do not contain devices or are not covered by equipment.

3.05 JUNCTION OR PULL BOXES

A. Install pull and junction boxes as shown, or as necessary to facilitate pulling of wire and to limit the number of bends within code requirements. Boxes shall be permanently accessible and shall be placed only at locations shown on the Drawings or approved by the Construction Manager.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16400 **TITLE:** OVERHEAD SERVICE

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-23-96
Printed Name and Title: LAWRENCE W FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D Jacobson — Date: 24 Feb 96
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Detailed Requirements Checked by: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: K F W C — Date: 25 Feb 96
Printed Name and Title: Kenneth W Cargill, Associate

Approved by: (PTL)
Signature: J. F. Beech — Date: 26 Feb 96
Printed Name and Title: BEECH

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Kenneth W Cargill
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26 Feb 96

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F	Prefinal Design, EPA Submittal	25 Jun 96	KC	—	—
G	Final Design Package	9 Oct 96	—	—	KC
C	Response to Final Design Comts	14 May 97	—	—	KC

SECTION 16400

OVERHEAD SERVICE

PART 1: GENERAL

1.01 SCOPE

A. This Section includes the general requirements for overhead electrical distribution service in accordance with National Electrical Safety Code.

PART 2: PRODUCTS

2.01 WOOD POLES

A. Furnish poles of Southern Pine cut from live stock and conforming to American National Standards Institute (ANSI) Standard 5.1, Specifications and Dimensions for Wood Poles. All poles shall be air seasoned and butt treated in accordance with the American Wood Preservers' Association (AWPA) Standard C7. Each pole shall be branded or marked as described in ANSI 5.1 as follows:

1. The brand or mark shall be placed squarely on the face of the pole and at 10 feet from the butt. The face brand shall designate the supplier's code or trademark; plant location and year of treatment; species and preservative code; and class and length of pole.
2. The pole roof and gain shall be brush coated with pentachlorophenol-petroleum solution conforming to AWPA Standards p8 and p9. The top of each pole shall have a one-way roof cut sloping 30 degrees (120 degrees with pole axis), and the cut surface shall face at right angles to the pole face.

B. Poles shall be class 2 or 3.

C. The minimum setting depth for poles shall be 4 feet, 0 inches for 20 foot poles and 5 feet, 6 inches for 30 foot poles.

2.02 POLE LINE HARDWARE

A. All pole line hardware shall be heavy galvanized steel.

PART 3: INSTALLATION

3.01 GENERAL

A. Installation shall be per ANSI C2, National Electrical Safety Code.

B. Dig holes for wood poles using an auger type machine. Hole diameter shall be large enough to allow use of tamping bar or other compaction equipment.

C. Place backfill around poles in six-inch lifts and thoroughly compact by hand tamping. Place surplus excavated material around the pole in a cone approximately one foot in height.

D. Plumb all poles to true vertical.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16450 **TITLE:** GROUNDING

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-23-96
Printed Name and Title: LAWRENCE W. FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Detailed Requirements Checked by: (Checker)
Signature: Brian D Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: [illegible] — Date: 25 Feb 96
Printed Name and Title: Kenneth W Cargill, Associate

Approved by: (TL)
Signature: J.E. Beech — Date: 26 Feb 96
Printed Name and Title: BEECH, PRINCIPAL

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A	Intermediate Design	26 Feb 96	—	-	JFB
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G	Final Design Package	9 Oct 96	—	—	[illegible]
O	Response to Final Design Cmts	14 May 97	—	—	[illegible]

SECTION 16450

GROUNDING

PART 1: GENERAL

1.01 SCOPE

A. This section includes grounding systems for service neutral power ground and for equipment grounds and bonding as required by the National Electrical Safety Code.

PART 2: PRODUCTS

2.01 GROUNDING CONDUCTORS AND CONNECTORS

A. Grounding will be copper only, sized per code. Bare or green insulated in sizes No. 10 AWG (American Wire Gauge) or larger. Green insulated for size No. 12 AWG.

B. Overhead distribution poles, down guy wire will be copper only, sized per code. Bare size No. 4 AWG or larger.

2.02 GROUND RODS

A. Furnish 3/4-inch-diameter x 10.0-foot-long copper clad steel ground rods.

PART 3: INSTALLATION

3.01 GROUNDING

A. Ground electrical systems and equipment as required by National Electrical Safety Code and per Construction Drawings.

3.02 GROUND RODS

A. Provide ground rods as shown and/or required and the grounding conductor shall be connected to each rod.

3.03 SIZE OF GROUND WIRE

A. Where is exposed to physical damage, ground wire shall be protected with rigid non-ferrous conduit as permitted by applicable National Electrical Safety Code.

3.04 GROUND CONDUCTOR

A. Provide grounding conductor in all conduit runs.

3.05 CONNECTION TO POWER GROUND BUS

A. Furnish and install connections in accordance with codes, including but not limited to:
   1. Raceway system
   2. Panelboards
   3. Service neutral
   4. "Separately derived service" (transformer or emergency power supply)
   5. Electrically operated equipment and devices
   6. Surge arrestors.

B. No device or equipment shall be connected for electrical service which has a neutral conductor connected to a grounding conductor or to the frame within the device or equipment.

3.06 METHOD OF CONNECTIONS

A. Ground connections and ground cable splices shall be made by thermal welding or copper compression-set type connectors U. L. listed for grounding purposes. Grounding lugs, where provided as standard manufacturer's items on equipment furnished, may be used.

3.07 EXPANSION FITTINGS

A. In conduit runs requiring an expansion fitting, a bonding jumper shall be installed around the fitting to maintain continuous ground continuity.

[END OF SECTION]

SPECIFICATION COVER SHEET

SPECIFICATION SECTION: 16500 **TITLE:** LIGHTING

Specifications By: (Cognizant Engineer)
Signature: Lawrence W Fly — Date: 2-23-96
Printed Name and Title: LAWRENCE W FLY, PROJECT MANAGER

Scope and Format Checked By: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
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Detailed Requirements Checked by: (Checker)
Signature: Brian D. Jacobson — Date: 24 Feb 96
Printed Name and Title: BRIAN D. JACOBSON, STAFF ENGINEER

Overall Review By: (PDP)
Signature: Kenneth W Cargill — Date: 25 Feb 96
Printed Name and Title: Kenneth W Cargill

Approved by: (TL)
Signature: J.F. Beech — Date: 26 Feb 96
Printed Name and Title: BEECH, PRINCIPAL

Kenneth W Cargill 9 Oct 96
Associate

Record of Revision (Number and initial all revisions)

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C	Response to Final Design Cmts	14 May 97	[illegible]	[illegible]	[illegible]

Section 16500

SECTION 16500

LIGHTING

PART 1: GENERAL

1.01 SCOPE

A. This section includes the lighting system which shall be installed complete and fully operational and shall conform with National Electrical Code and Underwriters' Laboratories, Inc. (UL) listing requirements.

1.02 FIXTURE SCHEDULE NUMBERS

A. Fixture schedule numbers are a design series reference (not a catalog number) and do not necessarily represent the number, size, voltage, wattage, type of lamp, ballast, mounting hardware, or special requirements as specified below or as required by the particular installation(s). The Subcontractor shall verify these requirements and order fixtures as required to give a complete and fully operational installation per the Specifications and Construction Drawings and per the National Electrical Code..

1.03 FIXTURE VOLTAGE

A. Match fixture voltage and voltage of circuit serving the fixture.

1.04 SUBMITTALS

A. Original manufacturer's product descriptions, neatly and clearly marked, shall be submitted to indicate that fixtures and ballasts fully comply with Specifications and Construction Drawings.

PART 2: PRODUCTS

2.01 LIGHT TRANSMITTING COMPONENTS

A. Light transmitting components shall not yellow with age.

2.02 SPECIAL PARTS

A. Provide adapters, plates, brackets, and anchors where required to suitably mount lighting fixtures.

2.03 OUTDOOR LIGHTING POLES

A. Provide wood poles per Section 16400 and installed per Construction Drawings.

2.04 OUTDOOR LIGHTING FIXTURE

A. Provide dusk-to-dawn packaged outdoor lighting fixture, die cast aluminum with 24" aluminum mast arm, 120 Volt AC, 70 watt high pressure sodium lamp and ballast with photoelectric control packaged complete with fixture, lamp, arm, hook up wire, photo control and mounting hardware.

PART 3: INSTALLATION

3.01 POLE-MOUNTED OUTDOOR OVERHEAD LIGHT FIXTURES

A. Pole mounted light fixtures shall be installed in accordance with manufacturer's instructions and Construction Drawings.

[END OF SECTION]