FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
SEP 21 2011
SOUTHWEST DISTRICT
TAMPA

Sarasota County
Solid Waste Operations

Central County Solid Waste Disposal Complex Phase I Class I Landfill Closure and Landfill Gas Collection System Construction Quality Assurance Plans and Technical Specifications

October 2011

Prepared by
HDR Engineering, Inc.
2621 Cattlemen Road, Suite 106
Sarasota, Florida 34232
(941) 342-2700

HDR Project No. 131392

Dept. Of Environmental Protection

SEP 2 1 2011

Southwest District

HDR | ONE COMPANY *Many Solutions*℠

Transmittal

Attention: Mr. Steve Morgan Date: September 20, 2011 Job No: 153175

To: Florida Department of Environmental Protection
Southwest District
13051 N. Telecom Parkway
Temple Terrace, FL 33637

Phone: 813-632-7600

Dept. Of Environmental Protection

SEP 2 1 2011

Southwest District

Regarding: Central County Solid Waste Disposal Complex (CCSWDC)
Phase I Closure and Landfill Gas Collection System
Permit No. 130542-014-SF/01 - Specific Condition No. B.4.a

We are sending you: ☒ **Attached** ☐ **Under separate cover via _____ the following items**

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change Order ☒ Other See Below

Copies	Date	No.	Description
1			Binder with 11x17 Drawings, Conformed Specifications and CQA Plans
1			Set of Full Size Drawings

These are transmitted as checked below:

☒ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval
☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return _____ corrected prints
☐ For review/comment ☐ Other _____

☐ For bids due _____ ☐ Prints returned after loan to us

Remarks

Copy to File

Signed Jason Timmons, PE

If enclosures are not as noted, please notify us at once

September 20, 2011

Dept. Of Environmental Protection
SEP 21 2011
Southwest District

Mr. Steve Morgan
Florida Department of Environmental Protection
Southwest District
13051 N. Telecom Parkway
Temple Terrace, FL 33637

Re: Central County Solid Waste Disposal Complex (CCSWDC)
Phase I Closure and Landfill Gas Collection System
Permit No.: 130542-014-SF/01 - Specific Condition No. B.4.a

Dear Steve:

The purpose of this transmittal is to satisfy the requirements of Specific Condition No. B.4.a of the above-referenced permit to construct which requires the submittal of a complete set of plans, specifications, and CQA plan to be used for construction. Attached are a full-size set of construction drawings (Attachment A) and a set of conformed construction specifications (Attachment B), including the CQA plans for the project. Also attached are permit specifications with tracked changes (Attachment C) showing the revisions to the specifications during construction document preparation and the bidding process.

Several changes to the permit documents became necessary as a result of the construction document preparation and bidding process as outlined below:

Drawings:

The conformed construction drawings are provided in Attachment A for the Department's reference. Please note that the Landfill Gas Collection System Drawings are also included with the Construction Set. The Landfill Gas Collection System and components are a continuation of the first phase of construction completed and approved in 2010 in accordance with FDEP Permit No. 130542-009-SC/08. A summary of the Landfill Gas Collection System construction sheets are not provided given that the permit only requires submittal of a conformed set of construction drawings for the Phase I Closure portion of the project.

- Sheet G-02 – Deleted Note 19 since this information is provided in the specifications. No other substantial changes.
- Sheet C-01 – No substantial changes.

HDR Engineering, Inc.
5426 Bay Center Drive
Suite 400
Tampa, FL 33609-3444
Phone: (813) 282-2300
Fax: (813) 282-2430
www.hdrinc.com

- Sheet C-02 – No substantial changes.
- Sheet C-03 – Not used.
- Sheet C-04 – Modified to show intermediate cover and existing gas collection system only.
- Sheet C-05 - Revised to include a stormwater swale and structures on the south side of the Phase I Closure and perimeter road. The additional stormwater controls are necessary to ensure that stormwater flow from the EGC cover on the south side of Phase I does not flood the perimeter road during a large storm event. The details of the stormwater piping penetrations and stormwater structures for the Phase I Closure EGC are provided on Sheet C-10A on Details 1 and 4. The modification to include additional stormwater controls does not change or revise the TPO EGC design or anchor trenching submitted as part of the permit documents.

  In addition, locations and detail call outs for modifications to the leachate cleanout pump stations (LCP) located on the north toe of Phase I have been added to the sheet. The following proposed modifications to LCP-1 through LCP-5 are intended to improve operations and maintenance of the LCPs:

  1. Relocate the flow meter and check valve in the existing utility vault to above grade locations. This will allow easier access, monitoring, and repair of these components.
  2. Remove the existing utility vault and replace with a smaller vault to encapsulate the gate valve and connection to the 6-inch forcemain.
  3. Remove the gate valve and piping which would allow redirection of the pumped liquid to the stormater swale. This piping was used when Phase I was first constructed, but is no longer needed for operations.
  4. Construct an LCP concrete maintenance pad at each location to reduce sediment and water accumulation around the LCP. As part of the concrete maintenance pad, a drain will remove stormwater accumulated on the pad and discharge it to the leachate pump riser pipe.

  Details for the proposed LCP modifications are provided on Sheet C-12A of the conformed construction drawings attached.

  Finally, additional callouts and details added for the Phase I/II overliner to provide clarification to Contractors.

- Sheet C-05A – Added sheet as an overall summary of Phase I Closure and Landfill Gas Collection System components.

- Sheet C-06 – Revised hatching for clarity.
- Sheet C-07 – Revised sheet to reflect south slope stormwater modifications and associated features shown on Sheet C-05. Added landfill gas system to sheet for clarification. Added other stormwater structures as shown on previous sheets.
- Sheet C-08 – No substantial changes.
- Sheet C-09 – Replaced woven geotextile around stone with non-woven geotextile to match geocomposite geotextile from cover system.
- Sheet C-10 – Added Detail 5 to show existing overlay liner to new overlay liner tie-in. Added details for rain tarp anchoring at slope transitions.
- Sheet C-10A – Added sheet to provide stormwater details for south side slope swale and EGC piping. Also, added details for transition and tie-ins for slope/cover transition to provide clarity.
- Sheet C-11 – Added concrete mitered end at 36" HDPE down drain to protect slope at pipe penetration from erosion.
- Sheet C-12 – Added concrete mitered end at 36" HDPE down drain to protect slope at pipe penetration from erosion.
- Sheet C-12A – Added sheet to include proposed leachate pump station modifications on north slope as discussed for Sheet C-05 above.
- Sheet C-13 – No substantial changes.
- Sheet C-14 – No substantial changes.
- Sheet C-15 – The TPO anchor trench on south side of swale modified to accommodate paved road. Please note that a Type 1 anchor trench is not required at this location given the anchor trench at the bottom of the swale and short slope of swale to road.
- Sheet C-16 – Revised anchor trench at road as discussed for Sheet C-15.
- Sheet C-17 – Added rain tarp anchoring and tie in for slope transitions.
- Sheet C-18 – No substantial change.
- Sheet C-19 – Revised anchor trench at road as discussed for Sheet C-15. Removed gas well boot detail and moved to LFG drawing sheet. Also, added pipe elbow turndown at down drains to help contain flow in south swale and not over to road.
- Sheet C-20 – Added details to clarify LFG pipe and anchor trench penetration.
- Sheet C-21 – No substantial changes.
- Sheet C-22 – No substantial changes.

Specifications:

The conformed construction specifications and CQA Plans are provided in Attachment B for the Department's reference. In addition, the permit specifications and CQA Plan with tracked changes showing the revisions made during the construction document preparation and bidding process are provided in Attachment C. In general, the revisions were made to clarify or provide additional information to the Contractor for construction. The list below provides the revisions which were discussed with FDEP or maybe of particular interest for review. Other changes considered minor or typographic have not been listed below.

- Phase I Closure CQA Plan – Revised plan to reflect inclusion of the Landfill Gas Collection System.
- Phase I Closure CQA Plan – Included information regarding use of off-site soil sources.
- Phase I Closure CQA Plan – Corrected reference to performance of MQC tests by CQA inspectors for LLDPE and TPO (Section 4.1.2).
- Phase I Closure CQA Plan – Revised TPO CQA testing for Xenon Arc Weathering to allow for manufacturer's certification in lieu of testing. Please refer to discussion of revision for Specification 02771 below for this item.
- Phase I Closure CQA Plan – Updated survey section to match language of survey specification. Tolerances allowed were unchanged.
- Specification 01560 – Environmental Protection and Special Controls. Revised solid waste handling to provide additional information for waste handling for the project.
- Specification 02200 – Earthwork Landfills. Included additional ASTM reference methods.
- Specification 02200 – Earthwork Landfills. Added that the fines content for soils shall be a maximum of 50% passing the #200 sieve.
- Specification 02200 – Earthwork Landfills. Revised low ground pressure equipment specification to conform to the geosynthetic manufacturer's requirements in lieu of 10 psi or less.
- Specification 02200 – Earthwork Landfills. Added detail in Section 3.2 regarding stripped sod handling (handling requirements discussed with FDEP via email on July 12, 2011).
- Specification 02200 – Earthwork Landfills. Added Section 3.8 for earth fill under structures to include the leachate pump station modification including in the drawing revisions discussed above.
- Specification 02260 – Topsoiling and Finished Grading. No substantial changes.
- Specification 02270 – Soil Erosion and Sediment Control. No substantial changes.
- Specification 02485 – Sodding. Added additional requirements and information for sod maintenance requirements.

- Specification 02486 – Hydroseeding. Specification was removed since no hydroseeding will be allowed for the project.
- Specification 02771 – TPO Geomembrane. Updated ASTM Standards for most current references.
- Specification 02771 – TPO Geomembrane. Added color review requirements.
- Specification 02771 – TPO Geomembrane. Revised qualification of installer to reflect installation of geomembrane material, not TPO specifically. Requiring an installer to have 10,000,000 SF of TPO installation limited the qualified installers to roofing installation firms and would disqualify qualified installation firms familiar with landfill geomembrane installation.
- Specification 02771 – TPO Geomembrane. Added additional requirements for material storage.
- Specification 02771 – TPO Geomembrane. Updated Table 1 to reflect most current material property requirements per manufacturer recommendations. Only those requirements that were more stringent than permitted requirements were included.
- Specification 02771 – TPO Geomembrane. Revised destructive seam testing and destructive test failure sections to match the requirements and language provided in the LLDPE geomembrane and CQA Plan text (revision discussed with FDEP on December 1, 2010)
- Specification 02771 – TPO Geomembrane. HDR proposes that MQC and CQA testing for Xenon Arc Weathering be substituted for certifications of passing tests from the Manufacturer. The Xenon Arc Weathering test is a long-term weather test, similar to that of OIT for polyethylene materials. It is not practical to perform this test for actual construction materials and certification from the material manufacturer is considered adequate by HDR as documentation that the material meets the requirement.
- Specification 02775 – LLDPE Geomembrane. No substantial changes.
- Specification 02777 – Geocomposite – Final Cover. No substantial changes.
- Specification 02778 – Geotextiles. Added specifications and requirements for 8 oz non-woven geotextile.
- Specification 02778 – Geotextiles. Deleted specification and requirements for woven geotextile. No woven geotextile is proposed for the project.
- Specification 15079 – Pipe Corrugated Polyethylene. Added clarification to requirements for perforations and pipe socks for piping.

Please contact us as soon as possible if in your opinion any of these changes will require a permit modification.

Project Team:

The specific condition also requests the names of each of the parties on the project team as shown on Figure 1 of the Construction Quality Assurance Plan (CQAP). The project team for the Phase II construction is as follows:

Owner	Sarasota County, Florida
General Contractor	Thalle Construction Company, Inc.
Design Engineer	HDR Engineering, Inc.
CQA Engineer	HDR Engineering, Inc.
CQA Inspector	HDR Engineering, Inc.
CQA Testing Laboratory	Ardaman & Associates, Inc.
Geosynthetics Manufacturer	Agru, Skaps, Firestone or Carlisle (unconfirmed)
MQC Testing Laboratory	Unknown at this time.
Earthwork and Landfill Gas Contractor	Thalle Construction Company, Inc.
Geosynthetics Installer	Hallaton, Inc.
CQC Testing Laboratory	Unknown at this time.

Additional information or missing items above regarding the project team will be submitted as part of the Preconstruction Meeting Minutes or Periodic Progress Reports for the project.

Please do not hesitate to contact us if you have any questions regarding this information.

Sincerely,
HDR Engineering, Inc.

Dept. Of Environmental Protection
SEP 2 1 2011
Southwest District

Jason Timmons, PE
Solid Waste Project Manager

Richard Siemering
Solid Waste Department Manager

Attachments (3)

cc: Lois Rose, Sarasota County
Spencer Anderson, Sarasota County
Alex Boudreau, Sarasota County
Rich Siemering, HDR
Tom Yanoschak, HDR

Dept. Of Environmental Protection

SEP 2 1 2011

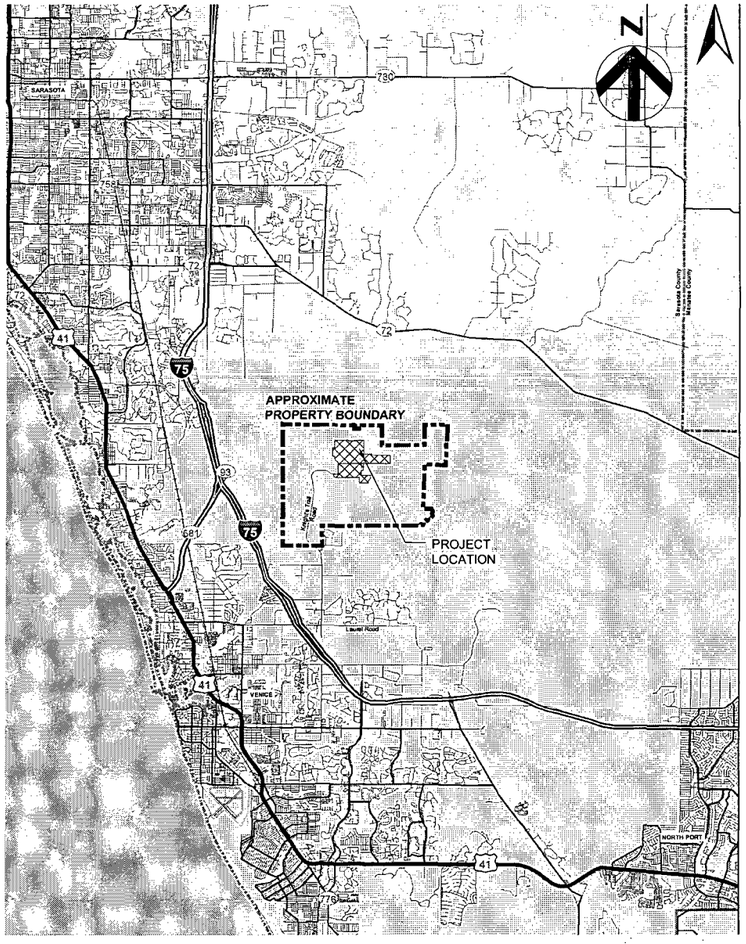
Southwest District

ATTACHMENT A

CONFORMED CONSTRUCTION DRAWINGS (11x17)

FULL SIZE SHEETS BOUND SEPARATELY

Sarasota County



sunshine state ONE CALL of florida

Always call 811 before you dig.
www.callsunshine.com

C:\pwworking\tpa\8297\00G-01.dwg, Plot, 9/20/2011 1:47:13 PM, BradJohn

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

ADDRESS: 4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT NO. 00096-130530-005

SARASOTA COUNTY, FLORIDA

CIP NO. 95206

BID NO. 111383CS

ISSUED FOR CONSTRUCTION

OCTOBER 2011

HDR

HDR Engineering, Inc.
2621 Cattlemen Road, Suite 106
Sarasota, FL 34232-62121
(941) 342-2700
CA00004213

INDEX OF DRAWINGS
PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM DRAWINGS

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G-02	GENERAL NOTES LEGEND AND ABBREVIATIONS
C-01	OVERALL SITE PLAN
C-02	BORROW AREA MAP
C-03	BORROW AREA MAP (2 OF 2)
C-04	INTERMEDIATE COVER GRADES AND EXISTING GAS COLLECTION SYSTEM
C-05	PHASE I FINAL BUILDOUT GRADING PLAN
C-05A	PHASE I CLOSURE FINAL SITE PLAN
C-06	PHASE I CLOSURE COVER KEY SHEET
C-07	PLAN AND PROFILE PHASE I ACCESS ROAD
C-08	FULL BUILDOUT SECTIONS
C-09	PHASE I CLOSURE DETAILS
C-10	PHASE I CLOSURE DETAILS
C-10A	PHASE I CLOSURE DETAILS
C-11	PHASE I CLOSURE DETAILS
C-12	PHASE I CLOSURE DETAILS
C-12A	PHASE I CLOSURE DETAILS
C-13	PHASE I TEMPORARY FINAL COVER LAYOUT AND ANCHOR TRENCH PLAN
C-14	PHASE I TEMPORARY FINAL COVER ANCHOR TRENCH SECTIONS AND DETAILS
C-15	PHASE I TEMPORARY FINAL COVER ANCHOR TRENCH SECTIONS AND DETAILS
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C-22	SEDIMENTATION AND EROSION CONTROL DETAILS
LFG-01	LANDFILL GAS GENERAL NOTES
LFG-02	PHASE I GAS SYSTEM LAYOUT – EXISTING CONDITIONS
LFG-03	PHASE I SEQUENCE 2 GAS SYSTEM LAYOUT
LFG-04	EXTRACTION WELL DETAILS AND WELL SCHEDULE
LFG-05	WELLHEAD AND CONFIGURATION DETAILS
LFG-5A	WELLHEAD AND CONFIGURATION DETAILS
LFG-06	GENERAL LFG DETAILS
LFG-07	VALVE PIT DETAILS
LFG-08	GENERAL LFG DETAILS

Dept. Of Environmental Protection

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Southwest District

CCSWDC BORROW FACILITY PHASE IV DRAWINGS

1	COVER SHEET
2	GENERAL NOTES
3	OVERALL SITE PLAN
4	SITE/DRAINAGE PLAN – BORROW AREA A
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6	SITE/DRAINAGE PLAN – BORROW AREA C
7	CROSS SECTIONS
8	EROSION AND SEDIMENT CONTROL

CCSWDC BORROW FACILITY PHASE V DRAWINGS

1	COVER SHEET
2	GENERAL NOTES
3	OVERALL SITE PLAN & KEY SHEET
4	SITE/DRAINAGE PLAN – BORROW AREA A
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6	SITE/DRAINAGE PLAN – BORROW AREA C
7	SITE/DRAINAGE PLAN – BORROW AREA D
8	CROSS SECTIONS
9	EROSION & SEDIMENT CONTROL

SHEET
G-01

ENGINEERING SYMBOLOGY

- EMBANKMENT SLOPE
- VEGETATION (SIZE)
- CO — CLEANOUT
- MH — MANHOLE
- MW — GROUNDWATER MONITORING WELL
- P — PIEZOMETER
- WATER SUPPLY WELL
- C-1/P2-1 — LEACHATE MONITORING POINT
- STW — STORMWATER MONITORING STATION
- GP — GAS PROBE
- UV — UTILITY VAULT
- PP — POWER POLE
- TP — TELEPHONE POLE
- FH — FIRE HYDRANT
- YH-X — YARD HYDRANT
- X 75.5 — EXISTING SPOT ELEVATION
- 75.8 — FINISHED SPOT ELEVATION
- HORIZONTAL CONTROL POINT OR BENCHMARK
- DOWNGUY
- SWAMP OR WETLANDS
- B4-R — SURFACE WATER MONITORING STATION

NOTES:

1. UTILITIES THAT ARE SUSPENDED ABOVE GRADE ARE DESIGNATED BY THE PREFIX "OH" (OVERHEAD).

- ---T--- TELEPHONE LINE
- ---E--- ELECTRIC LINE
- PIPELINE
- DRAINAGE FLOW
- NATURAL WATERWAY
- —X—X— CHAIN LINK FENCE
- —X—X— FIELD FENCE
- PROPERTY BOUNDARY
- CENTERLINE
- RB — ROCK BERM
- SILT FENCE
- LIMITS OF CONSTRUCTION
- WATERWAY
- LIMITS OF EASEMENT
- EASEMENT CENTERLINE
- CONSTRUCTION TRAFFIC ROUTE
- EXISTING ROADWAY
- PHASE LIMITS
- ANCHOR TRENCH – TYPE 1
- ANCHOR TRENCH – TYPE 2
- ANCHOR TRENCH – TYPE 3

- 30 — EXISTING ELEVATION CONTOUR
- 30 — PROPOSED ELEVATION CONTOUR
- LIMITS OF PROPOSED LINER
- APPROXIMATE LIMITS OF EXISTING LINER
- ASPHALT (PLAN OR SMALL-SCALE SECTION)
- ASPHALT (LARGE-SCALE SECTION)
- PROTECTIVE COVER SOIL
- INITIAL COVER
- INTERMEDIATE COVER
- STRUCTURAL FILL
- CONCRETE (PLAN AND/OR SECTION)
- CONCRETE MASONRY (PLAN AND/OR SECTION)
- SOLID WASTE (SECTION)
- FABRIC-FORMED CONCRETE (PLAN)
- FABRIC-FORMED CONCRETE (SECTION)
- GRANULAR FILL (SECTION)
- GRATING (PLAN)
- GROUT (SECTION)
- PRECAST CONCRETE (PLAN AND/OR SECTION)
- RIPRAP OR RUBBLE (PLAN AND/OR SECTION)
- DRAINAGE STONE (SECTION)
- PROTECTIVE COVER DRAINAGE LAYER (SECTION)
- VEGETATIVE COVER (SECTION)
- SOD (SECTION)
- WOOD – CONTINUOUS (SECTION)
- WOOD BLOCKING (SECTION)
- DRAINAGE GEOCOMPOSITE (SECTION)
- GEOTEXTILE (SECTION)
- 20 MIL POLYETHYLENE RAIN COVER
- 40 MIL GEOMEMBRANE (LLDPE TEXTURED/SMOOTH)
- 60 MIL GEOMEMBRANE (HDPE TEXTURED)
- 60 MIL TPO
- LEACHATE FORCEMAIN

GENERAL SYMBOLOGY

ARROW INDICATES DIRECTION OF PLAN NORTH

N

PLAN
1/4" = 1'-0"

PLAN TITLE

SECTION LETTER
FLAG INDICATES DIRECTION OF SECTION CUT
X / XXX
SHEET WHERE SECTION IS LOCATED *

SECTION CUT MARKER

SECTION LETTER
SECTION
3/8" = 1'-0"
SHEET WHERE SECTION VIEW IS FIRST CUT *

SECTION TITLE

DETAIL NUMBER
/ XXX
SHEET WHERE DETAIL IS LOCATED *

DETAIL MARKER

FOR REFERENCING DETAILS INCLUDED IN DRAWING SET.

XXXXXXXX

DETAIL MARKER

FOR REFERENCING DETAILS BOUND IN SPECIFICATIONS OR SEPARATE VOLUME.

DETAIL NUMBER
DETAIL
3" = 1'-0"
SHEET WHERE DETAIL WAS CALLED OUT

DETAIL TITLE

* FOR COMMON DETAILS AND SECTIONS OR DETAILS THAT ARE CUT OR CALLED OUT ON MULTIPLE SHEETS, THE SHEET NUMBER IS REPLACED BY A DASH (–).

ELEVATION NUMBER
ARROW INDICATES POINT OF VIEW
SHEET WHERE ELEVATION IS LOCATED *

SINGLE ELEVATION OR PHOTO MARKER

A / D / B / C
ELEVATION NUMBER
ARROW INDICATES POINT OF VIEW ELEVATION
INDICATES SHEET WHERE ELEVATION IS LOCATED

MULTIPLE ELEVATION OR PHOTO MARKER

ELEVATION IDENTIFICATION NUMBER
ELEVATION
3" = 1'-0"
SHEET WHERE POINT OF VIEW MARKER CAN BE FOUND *

ELEVATION TITLE

ABBREVIATIONS

APPROX – APPROXIMATE, APPROXIMATELY
BLDG – BUILDING
BTM – BOTTOM
CB – CATCH BASIN
CM – CONCRETE MONUMENT
CMP – CORRUGATED METAL PIPE
CONC – CONCRETE
CONT – CONTINUOUS
CORR – CORRUGATED
DET – DETAIL
DIA – DIAMETER
DIM – DIMENSION
DWG – DRAWING
EA – EACH
EDL – EDGE OF LINER
ETC – ET CETERA
ENCL – ENCLOSE, ENCLOSURE
EL – ELEVATION
EQUIP – EQUIPMENT
EXIST – EXISTING
FDEP – FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
FDOT – FLORIDA DEPARTMENT OF TRANSPORTATION
FES – FLARED END SECTION
FIN – FINISHED
FM – FORCE MAIN
GALV – GALVANIZED
GCL – GEOSYNTHETIC CLAY LINER
GFFR – GROUT FILLED FIBER REVETMENT
GR – GRADE
GDL – GEOSYNTHETIC DRAINAGE LINER
GM – GAS MONITORING LOCATION
GP – GAS PROBE
HDPE – HIGH DENSITY POLYETHYLENE
HP – HIGH POINT
ID – INSIDE DIAMETER
IE – INVERT ELEVATION
LF – LINEAL FEET
LFG – LANDFILL GAS
LLDPE – LINEAR LOW DENSITY POLYETHYLENE
LP – LOW POINT
MES – MITRED END SECTION
MAX – MAXIMUM
MFR – MANUFACTURER
MH – MANHOLE
MIN – MINIMUM
MISC – MISCELLANEOUS
MSL – (ABOVE) MEAN SEAL LEVEL
MT – MOUNT
MW – GROUNDWATER MONITORING WELL
N/A – NOT APPLICABLE
N/AVAIL – NOT AVAILABLE
NGVD – NATIONAL GEODETIC VERTICAL DATUM
NIC – NOT IN CONTRACT
No – NUMBER
NP – NONPERFORATED – PIEZOMETER
NTS – NOT TO SCALE
OC – ON CENTER
OD – OUTSIDE DIAMETER
OSHA – OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION
P – PIEZOMETER
PLS – PROFESSIONAL LAND SURVEYOR
PS – PUMP STATION
R – RADIUS
RCP – REINFORCED CONCRETE PIPE
REF – REFERENCE
REQD – REQUIRED
SL–SLOPE
SCH – SCHEDULE
SDR – STANDARD DIMENSION RATIO
SHT – SHEET
SIM – SIMILAR
SS – STAINLESS STEEL
STD – STANDARD
STL – STEEL
STW – STORMWATER MONITORING STATION
TPO – THERMOPLASTIC POLYOLEFIN
TYP – TYPICAL
USC&GS – UNITED STATES COASTAL AND GEODETIC SURVEY
USGS – UNITED STATES GEOLOGICAL SURVEY
WGT – WEIGHT
W.E. – WATER ELEVATION
WWTP – WASTE WATER TREATMENT PLANT

GENERAL NOTES

1. THIS IS A STANDARD SHEET SHOWING COMMON SYMBOLOGY. ALL SYMBOLS ARE NOT NECESSARILY USED ON THIS PROJECT. REFER TO THE LEGEND PROVIDED ON EACH SHEET FOR SPECIFIC SHEET SYMBOLOGY.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.
3. EXISTING TOPOGRAPHY WITHIN PHASES I THROUGH IV AREAS COMPILED BY KUCERA INTERNATIONAL INC. OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 2, 2010.
4. EXISTING TOPOGRAPHY WITHIN THE FUTURE USE AREAS COMPILED FROM THE CDM CONSTRUCTION PLANS DATED APRIL 1998 AND BY PBS&J LEACHATE FORCEMAIN AND PUMP STATION DRAWING SET DATED JULY 2005.
5. LOCATIONS OF EXISTING PIEZOMETERS, MONITORING WELLS AND STAFF GAUGES OBTAINED FROM SPECIFIC PURPOSE SURVEY BY SARASOTA COUNTY, MARCH 2008. VERIFY LOCATIONS IN FIELD.
6. EXISTING UNDERGROUND FACILITIES, STRUCTURES, AND UTILITIES HAVE BEEN LOCATED FROM THE BEST AVAILABLE SURVEY DATA AND RECORDS AND THEIR LOCATIONS MUST ONLY BE CONSIDERED AS APPROXIMATE. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THE EXACT LOCATION OF ALL EXISTING UTILITIES SHOWN ON THE PLANS AND ANY OTHER UTILITIES WHICH MAY NOT BE SHOWN ON THE PLANS. THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES IN THE AREA AT LEAST 72 HOURS PRIOR TO BEGINNING CONSTRUCTION. CALL FLORIDA SUNSHINE STATE ONE CALL CENTER AT 811. ALL COORDINATION AND REQUIRED UTILITY COMPANY TEMPORARY PROTECTION SHALL BE AT THE CONTRACTOR'S EXPENSE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE NO INTERRUPTION OF SERVICE AND REPLACEMENT OF DAMAGED UTILITIES.
7. THE CONTRACTOR SHALL RESTORE TO THE OWNER'S SATISFACTION ALL AREAS DISTURBED BY CONSTRUCTION; INCLUDING PERIMETER ROADWAY SURFACES, ROADWAY SHOULDERS AND DITCHES, DRAINAGE STRUCTURES AND OTHER EXISTING FEATURES.
8. HORIZONTAL DATUM IS BASED ON THE FLORIDA STATE PLANE COORDINATE SYSTEM–WEST ZONE (NAD 83). VERTICAL DATUM IS BASED ON THE NATIONAL GEODETIC VERTICAL DATUM (NGVD 29).
9. THE CONTRACTOR SHALL OBTAIN ALL PERMITS AND APPROVALS PRIOR TO COMMENCING WORK.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MEETING ALL CONDITIONS AND REQUIREMENTS OF ALL PERMITS AND ALL GOVERNING FEDERAL, STATE, AND LOCAL AGENCIES.
11. THESE PLANS ACCOMPANY AND ARE PART OF THE TECHNICAL SPECIFICATIONS. WHEN THESE DRAWINGS AND/OR TECHNICAL SPECIFICATIONS LACK SPECIFICITY, CONSULT THE DESIGN ENGINEER (HDR ENGINEERING, INC.).
12. ANY CONFLICTS BETWEEN THESE PLANS AND THE SPECIFICATION SHOULD BE BROUGHT TO THE ATTENTION OF THE DESIGN ENGINEER (HDR ENGINEERING, INC.).
13. THE CONTRACTOR IS RESPONSIBLE FOR DEWATERING (IF REQUIRED) ALL EXCAVATIONS, FILL AREAS, ETC. IN ORDER TO WORK IN DRY CONDITIONS. REFER TO THE SPECIFICATIONS FOR ADDITIONAL INFORMATION.
14. ATTENTION IS DIRECTED TO THE FACT THAT AN ACTIVE LANDFILL AND OTHER FACILITIES WILL BE IN OPERATION DURING THE CONSTRUCTION PERIOD. WASTE HAULING TRUCKS WILL BE ACTIVE DURING NORMAL BUSINESS HOURS. THE CONTRACTOR SHALL NOT BLOCK WASTE HAULING OR OTHER LANDFILL ACTIVITIES WITHOUT PRIOR WRITTEN APPROVAL FROM THE OWNER. IF NECESSARY, CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL TO MAINTAIN LANDFILL ACTIVITIES. THE CONTRACTOR IS ADVISED THAT SCALE RECORDS ARE AVAILABLE, UPON REQUEST FROM THE OWNER, WHICH INDICATE HISTORICAL DELIVERIES, BOTH DAILY AND HOURLY, OF WASTE TO THE LANDFILL.
15. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR SITE SAFETY ASSOCIATED WITH THE WORK UNDER THIS CONTRACT AND FOR COMPLIANCE WITH ALL FEDERAL, STATE AND LOCAL HEALTH AND SAFETY LAWS, CODES, REGULATIONS AND ORDINANCES INCLUDING BUT NOT LIMITED TO THOSE MANDATED BY OSHA AND THE FLORIDA TRENCH SAFETY ACT. CONTRACTOR SHALL ALSO COORDINATE A SITE SAFETY PLAN WITH COUNTY PERSONNEL. THE CONTRACTOR SHALL INCLUDE IN THE TOTAL BID PRICE ALL COSTS FOR COMPLIANCE WITH THESE REGULATIONS.
16. THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING AND MAINTAINING A SITE AND PERSONNEL SAFETY PROGRAM TO ADDRESS MONITORING OF THE WORK WITHIN AND ADJACENT TO THE EXISTING LANDFILL. REFER TO TECHNICAL SPECIFICATIONS FOR ENVIRONMENTAL CONTROL PROGRAM REQUIREMENTS FOR FURTHER INFORMATION.
17. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE LOCATION AND ELEVATION OF ALL EXISTING BENCHMARKS. FURTHER, THE CONTRACTOR WILL NEED TO EMPLOY A LICENSED SURVEYOR FOR EXTENDING BOTH HORIZONTAL AND VERTICAL CONTROLS AS NECESSARY TO PERFORM THE WORK UNDER THIS CONTRACT.
18. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE TO EXISTING FACILITIES, STRUCTURES, OR UTILITIES ABOVE OR BELOW GROUND, CAUSED BY CONSTRUCTION OPERATIONS WHICH HAVE BEEN PREVIOUSLY LOCATED BY THEIR RESPECTIVE OWNERS.
19. THE CONTRACTOR SHALL PROVIDE PROPER WARNING SIGNS, BARRICADES, TEMPORARY FENCING AND OTHER APPROPRIATE SAFETY DEVICES DURING THE EXECUTION OF THE WORK TO PROVIDE PUBLIC PROTECTION AND SAFETY.
20. THE CONTRACTOR SHALL PROVIDE ACCESS FOR TRAFFIC AT ALL TIMES DURING CONSTRUCTION.

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SHEET NAMING CONVENTION

G	GENERAL
V	SURVEYING/MAPPING
X	DEMOLITION
C	CIVIL
U	MULTI-DISCIPLINE
S	STRUCTURAL
A	ARCHITECTURAL
D	PROCESS
M	MECHANICAL (HVAC)
P	PLUMBING
E	ELECTRICAL
Y	INSTRUMENTATION
LFG	LANDFILL GAS

HDR Engineering, Inc.
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ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	10009S–130530–005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY, FLORIDA

GENERAL NOTES LEGEND AND ABBREVIATIONS

0 1" 2"

FILENAME 00G-02.DWG
SCALE AS SHOWN

SHEET G-02

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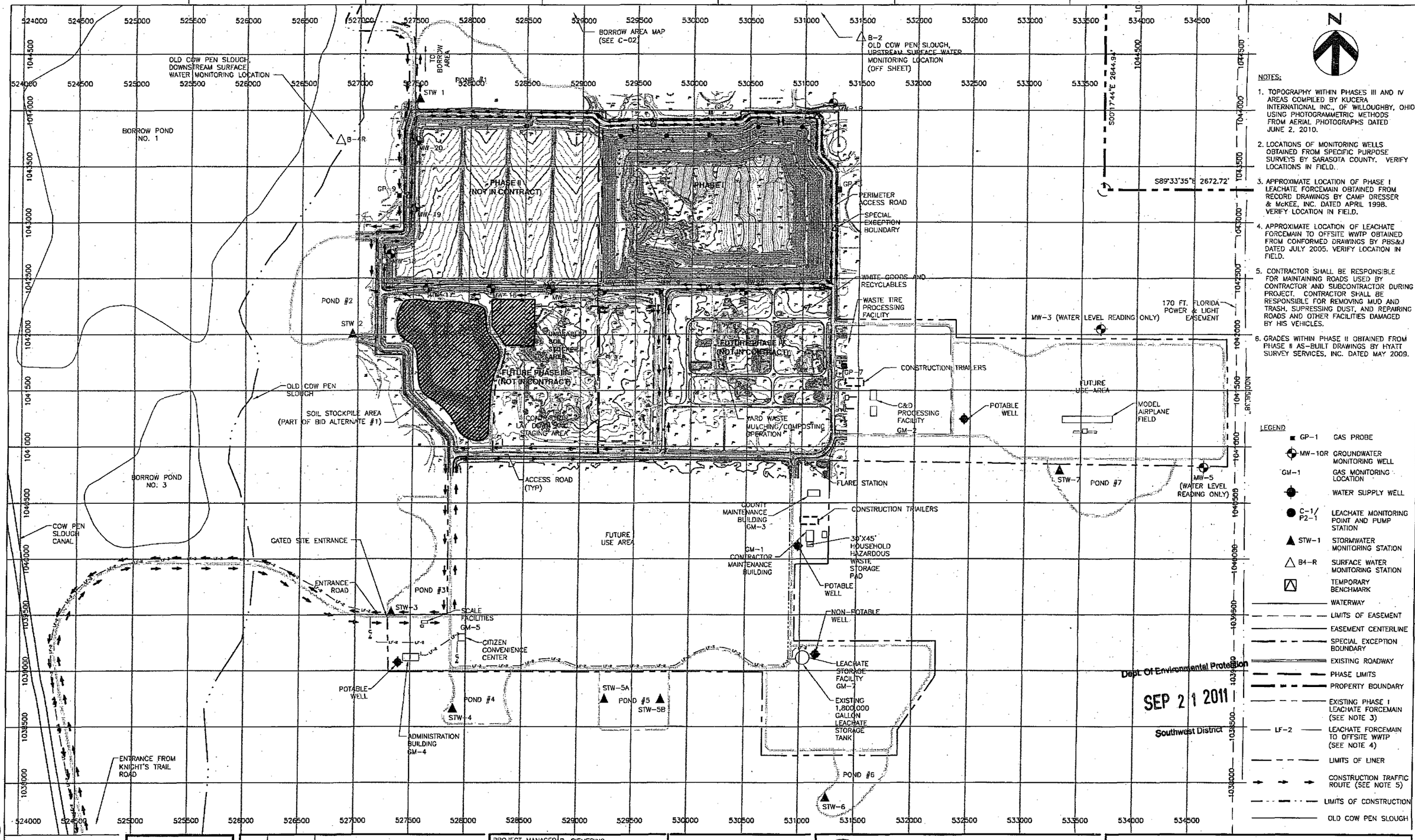

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ISSUE	DATE	DESCRIPTION
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REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

OVERALL SITE PLAN

0 1" 2"

FILENAME	00C-01.DWG
SCALE	1"=400'

SHEET C-01

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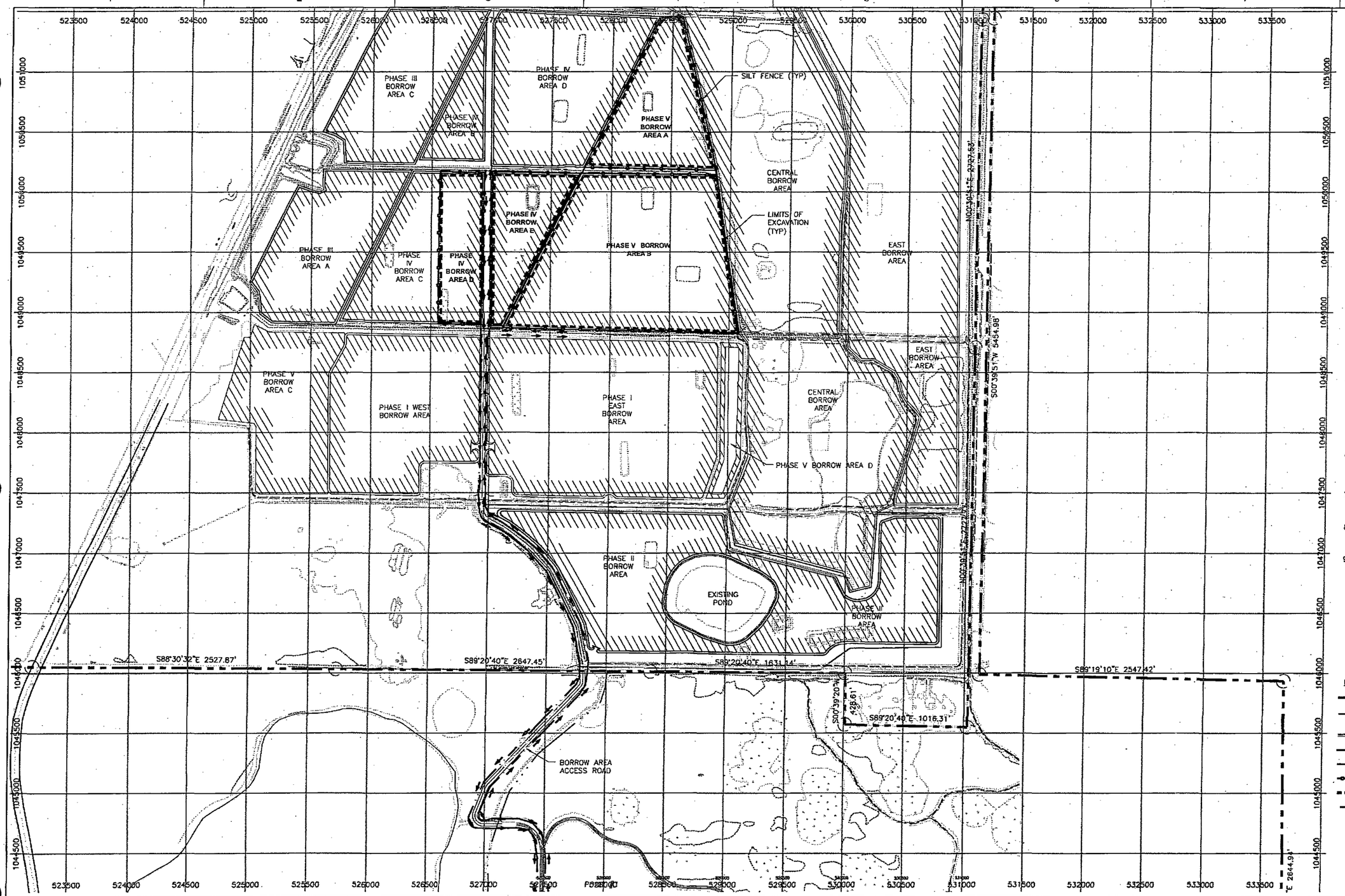

NOTES:

1. EXISTING TOPOGRAPHY WITHIN LANDFILL PHASES III AND IV AREAS COMPILED BY KUCERA INTERNATIONAL, INC. OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 2, 2010.
2. REFER TO PHASE IV AND V BORROW AREA DESIGN AND TOPOGRAPHIC INFORMATION OBTAINED FROM "CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX BORROW FACILITY–PHASE IV", DATED 9/2008 AND "CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX BORROW FACILITY–PHASE V" DATED 4/2009 BY PBS&J.
3. CONTRACTOR SHALL MAINTAIN AND OPERATE BORROW AREA IN ACCORDANCE WITH ALL PERMIT CONDITIONS AND OWNER REQUIREMENTS.
4. CONTRACTOR SHALL ONLY OPERATE IN AREAS OF BORROW PIT DESIGNATED BY OWNER.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ROADS USED BY CONTRACTOR AND SUBCONTRACTORS DURING PROJECT. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING MUD AND TRASH, SUPPRESSING DUST, AND REPAIRING ROADS AND OTHER FACILITIES DAMAGED BY HIS VEHICLES.
6. CONTRACTOR SHALL PERFORM PRE–CONSTRUCTION SURVEYS TO CONFIRM QUANTITIES AND DEPTH OF EXCAVATION.
7. CONTRACTOR SHALL REMOVE ALL SILT FENCING AT COMPLETION OF BORROW EXCAVATION ACTIVITIES.
8. CONTRACTOR SHALL RESTORE ACCESS ROADS TO PRE–CONSTRUCTION CONDITION AND GRADES.
9. CONTRACTOR SHALL COORDINATE SOIL BORROW HAUL ROUTES WITH COUNTY STAFF AND OTHER ON–SITE CONTRACTORS.

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LEGEND

- PROPERTY BOUNDARY
- SPECIAL EXCEPTION BOUNDARY
- EXISTING ROADWAY
- PHASE LIMITS
- LIMITS OF CONSTRUCTION
- SILT FENCE
- LIMITS OF EXCAVATION
- CONSTRUCTION TRAFFIC ROUTE (SEE NOTE 5)

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ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON

PROJECT NUMBER 00096–130530–005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

BORROW AREA MAP

0 1" 2"

FILENAME	00C–02.DWG
SCALE	1"=400'

SHEET C-02

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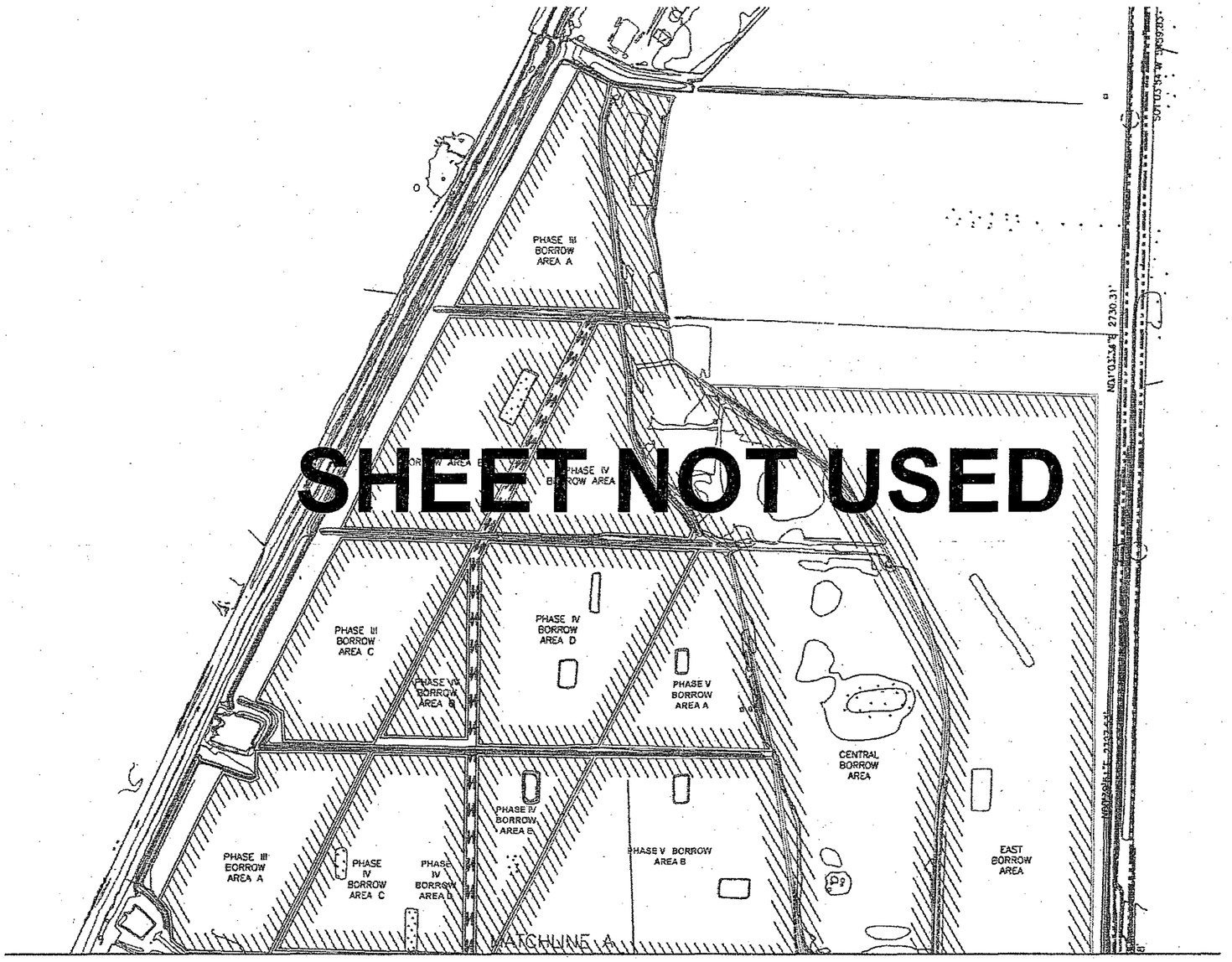

SHEET NOT USED

N

NOTES:

1. EXISTING TOPOGRAPHY WITHIN LANDFILL PHASES III AND IV AREAS COMPILED BY KUCERA INTERNATIONAL, INC. OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 1, 2009.
2. PHASE I AND II BORROW AREA DESIGN AND TOPOGRAPHIC INFORMATION OBTAINED FROM "CONSTRUCTION PLANS FOR CENTRAL COUNTY SOLID WASTE DISPOSAL CENTER ALBRITTON BORROW FACILITY, PHASE 2" BY PBS&J, JULY 2006
3. PHASE III BORROW AREA DESIGN AND TOPOGRAPHIC INFORMATION OBTAINED FROM "CONSTRUCTION PLANS FOR CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX BORROW FACILITY – PHASE III" BY PBS&J, OCTOBER 2007.
4. PHASE IV BORROW AREA DESIGN AND TOPOGRAPHIC INFORMATION OBTAINED FROM "CONSTRUCTION PLANS FOR CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX BORROW FACILITY – PHASE IV" BY PBS&J, SEPTEMBER 2008.
5. CONTRACTOR SHALL MAINTAIN AND OPERATE BORROW AREA IN ACCORDANCE WITH ALL PERMIT CONDITIONS AND OWNER REQUIREMENTS.
6. CONTRACTOR SHALL ONLY OPERATE IN AREAS OF BORROW PIT DESIGNATED BY OWNER.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ROADS USED BY CONTRACTOR AND SUBCONTRACTORS DURING PROJECT. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING MUD AND TRASH, SUPPRESSING DUST, AND REPAIRING ROADS AND OTHER FACILITIES DAMAGED BY HIS VEHICLES.

LEGEND

- PROPERTY BOUNDARY
- SPECIAL EXCEPTION BOUNDARY
- EXISTING ROADWAY
- PHASE LIMITS
- CONSTRUCTION TRAFFIC ROUTE (SEE NOTE 6)

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HDR Engineering, Inc.
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(941) 342-2700
CA0694213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	100098-130630-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

BORROW AREA MAP (2 OF 2)

0 1" 2"

FILENAME 00C-03.DWG

SCALE 1"=400'

SHEET C-03

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SEP 2 1 2011

Southwest District

N

NOTES:

1. TOPOGRAPHY WITHIN PHASES I, III, AND IV AREAS COMPILED BY KUCERA INTERNATIONAL INC., OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 2, 2010.
2. LOCATIONS OF MONITORING WELLS OBTAINED FROM SPECIFIC PURPOSE SURVEYS BY SARASOTA COUNTY. VERIFY LOCATIONS IN THE FIELD.
3. APPROXIMATE LOCATION OF PHASE I LEACHATE FORCEMAIN OBTAINED FROM RECORD DRAWINGS BY CAMP DRESSER & McKEE, INC. DATED APRIL 1998. VERIFY LOCATION IN FIELD.
4. PHASE I GRADES REPRESENT MAXIMUM PROPOSED GRADES AT TIME OF CLOSURE. ACTUAL GRADES AT TIME OF CLOSURE CONSTRUCTION WILL NOT EXCEED THE ELEVATIONS SHOWN.
5. CONTRACTOR SHALL CUT/FILL EXISTING GRADES TO ACHIEVE INTERMEDIATE COVER GRADES AS SHOWN ON THIS SHEET.
6. CONTRACTOR TO REMOVE EXISTING BOLLARDS AND STOCKPILE FOR REUSE AS DIRECTED BY OWNER AND ENGINEER.
7. LOCATIONS OF EXISTING GAS COLLECTION SYSTEM OBTAINED FROM SURVEY BY HYATT SURVEY SERVICES, INC. DATED AUGUST 2, 2010. VERIFY LOCATIONS IN FIELD.

LEGEND

- GP-1 GAS PROBE
- MW-10R GROUNDWATER MONITORING WELL
- GM-1 GAS MONITORING LOCATION
- WATER SUPPLY WELL
- STW-1 STORMWATER MONITORING STATION
- B4-R SURFACE WATER MONITORING STATION
- LEACHATE PUMP STATION
- TEMPORARY BENCH MARK
- WATERWAY
- LIMITS OF EASEMENT
- EASEMENT CENTERLINE
- SPECIAL EXCEPTION BOUNDARY
- EXISTING ROADWAY
- PHASE BOUNDARY
- CHAIN LINK FENCE
- APPROX. LOCATION OF PHASE I LEACHATE FORCEMAIN (SEE NOTE 3)
- OHE OVERHEAD ELECTIC LINE
- UG E UNDERGROUND ELECTRIC LINE
- GW-60 EXISTING LFG WELLS
- AIR AIR EXISTING FM FM LFG PIPE

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CA#00004213

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PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

INTERMEDIATE COVER GRADES AND EXISTING GAS COLLECTION SYSTEM

FILENAME	00C-04.DWG
SCALE	1"=100'

SHEET C-04

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Southwest District

N

POND #1

CELL 1

PHASE II (NIC)

PHASE III (NIC)

PHASE I

PHASE IV (NIC)

EXISTING PHASE I/II OVERLAY LINER

TRANSITION FINAL COVER (SIDESLOPE) TO PHASE I/II OVERLAY LINER SYSTEM

TRANSITION FINAL COVER (SIDESLOPE) TO PHASE I/II OVERLAY LINER SYSTEM

PROPOSED PHASE I/II OVERLAY LINER SYSTEM

SLOPE TO DRAIN

NEW PHASE I/II OVERLAY LINER

EXISTING OVERLAY LINER TO NEW OVERLAY LINER TIE-IN

LIMITS OF EXISTING PHASE I/II OVERLAY LINER SYSTEM

TRANSITION PHASE I/II OVERLAY LINER TO TEMPORARY FINAL COVER

DOWNDRAIN TRENCH (TYP) SOUTH SLOPE

ENERGY DISSIPATOR NORTH SLOPE (TYP)

STORMWATER DOWNDRAIN PIPE (TYP)

MEET AND MATCH EXISTING PAVEMENT (TYP)

EXISTING LEACHATE PUMP STATION (TYP)

PROPOSED LEACHATE PUMP STATION (TYP)

DOWNDRAIN TRENCH (TYP)

PROPOSED LEACHATE PUMP STATION ACCESS ROAD

FINAL COVER TIE-IN (TYP)

NO. 4 STONE (TYP)

PROPOSED OUTER SIDESLOPE CONTOURS REPRESENT TOP OF FINAL COVER (TYP.)

EXISTING STORMWATER PERIMETER SWALES

LIMITS OF CONSTRUCTION

TYPICAL DRAINAGE TERRACE

APPROXIMATE LOCATION OF EXISTING LEACHATE FORCEMAIN (TYP)

DOWNDRAIN AT TOP OF LANDFILL (TYP)

TERRACE/DOWNDRAIN INTERSECTION (TYP)

TRANSITION FINAL COVER (TOPSLOPE) TO PHASE I/II OVERLAY LINER SYSTEM

BERM ON TOP OF LANDFILL (TYP)

FINAL COVER PROFILE (TYP)

FINAL COVER PROFILE (TYP)

TERRACE/DOWNDRAIN INTERSECTION SOUTH SLOPE

ACCESS ROAD

LIMITS OF TPO

TRANSITION FINAL COVER (TOPSLOPE) TO TEMPORARY FINAL COVER

TOE CONNECTION TO DITCH INLET FOR INLET

TYP. I DITCH BOTTOM INLET WITH GRATE EL. 30.50

STORMWATER DOWNDRAIN DISCHARGE UNDER ROAD CROSSING (TYP OF 2)

24" RCP (E (N) 23.50) (E (S) 23.30)

36" RCP

RESHAPE SOUTH SWALE AS REQUIRED AND REMOVE EXISTING CROSSINGS AND STORMWATER PIPE

CONTRACTOR STAGING, STORAGE AND STOCKPILE AREA ACCESS ROAD

EXISTING PAVED ACCESS ROAD

LIMITS OF TPO

24" MES (IE 25.00)

EXISTING MONITORING WELLS (TO BE EXTENDED)

36" MES

24" MES (IE 23.50)

36" RCP

TOE DRAIN TIE-IN TO 24" DOWNDRAIN

8" DIA. ABS N-12 PERFORATED TOE DRAIN

ENERGY DISSIPATOR (TYP) EAST SLOPE

TRANSITION FINAL COVER (SIDESLOPE) TO TEMPORARY FINAL COVER

FABRIC FORMED CONCRETE LINING OR FDOT DITCH LINING (RIP RAP)

EXISTING 38"X60" ERCP (TO REMAIN)

EXISTING BOX CULVERT (TO REMAIN)

MATCH EXISTING (EL 21.40)

FDOT DITCH LINING (RIP RAP)

NOTES:

1. TOPOGRAPHY WITHIN PHASES III AND IV AREAS COMPILED BY KUCERA INTERNATIONAL INC., OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 2, 2010.
2. CONTOURS WITHIN PHASE I CLOSURE AREA REPRESENT PROPOSED TOP OF FINAL COVER.
3. OPERATIONAL AND FINAL WASTE GRADES SHALL NOT BE GREATER THAN 3:1.
4. APPROXIMATE LOCATION OF PHASE I LEACHATE FORCEMAIN OBTAINED FROM RECORD DRAWINGS BY CAMP DRESSER & McKEE, INC. DATED APRIL 1998. VERIFY LOCATION IN FIELD.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ROADS USED BY CONTRACTOR AND SUBCONTRACTORS DURING PROJECT. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING MUD AND TRASH, SUPPRESSING DUST, AND REPAIRING ROADS AND OTHER FACILITIES DAMAGED BY HIS VEHICLES.
6. LFG WELLS NOT SHOWN FOR CLARITY.

LEGEND

- EXISTING CONTOUR
- PROPOSED ELEVATION
- SPECIAL BOUNDARY
- EXISTING ROADWAY
- LIMITS OF CONSTRUCTION
- APPROX. LOCATION OF PHASE I LEACHATE FORCEMAIN (SEE NOTE 4)
- TOE DRAIN
- LP LOW POINT
- HP HIGH POINT
- TERRACE/DOWNDRAIN INTERSECTION
- PHASE I LEACHATE PUMP STATIONS
- CONSTRUCTION TRAFFIC ROUTE (SEE NOTE 5)
- STORMWATER FLOW DIRECTION
- FABRIC FORMED CONCRETE LINING
- VAULT BOX
- LEACHATE PUMP STATION STABILIZED ACCESS ROAD

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REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00095-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

FLORIDA

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

PHASE I FINAL BUILDOUT GRADING PLAN

0 1" 2"

FILENAME	00C-05.DWG
SCALE	1"=100'
SHEET	C-05

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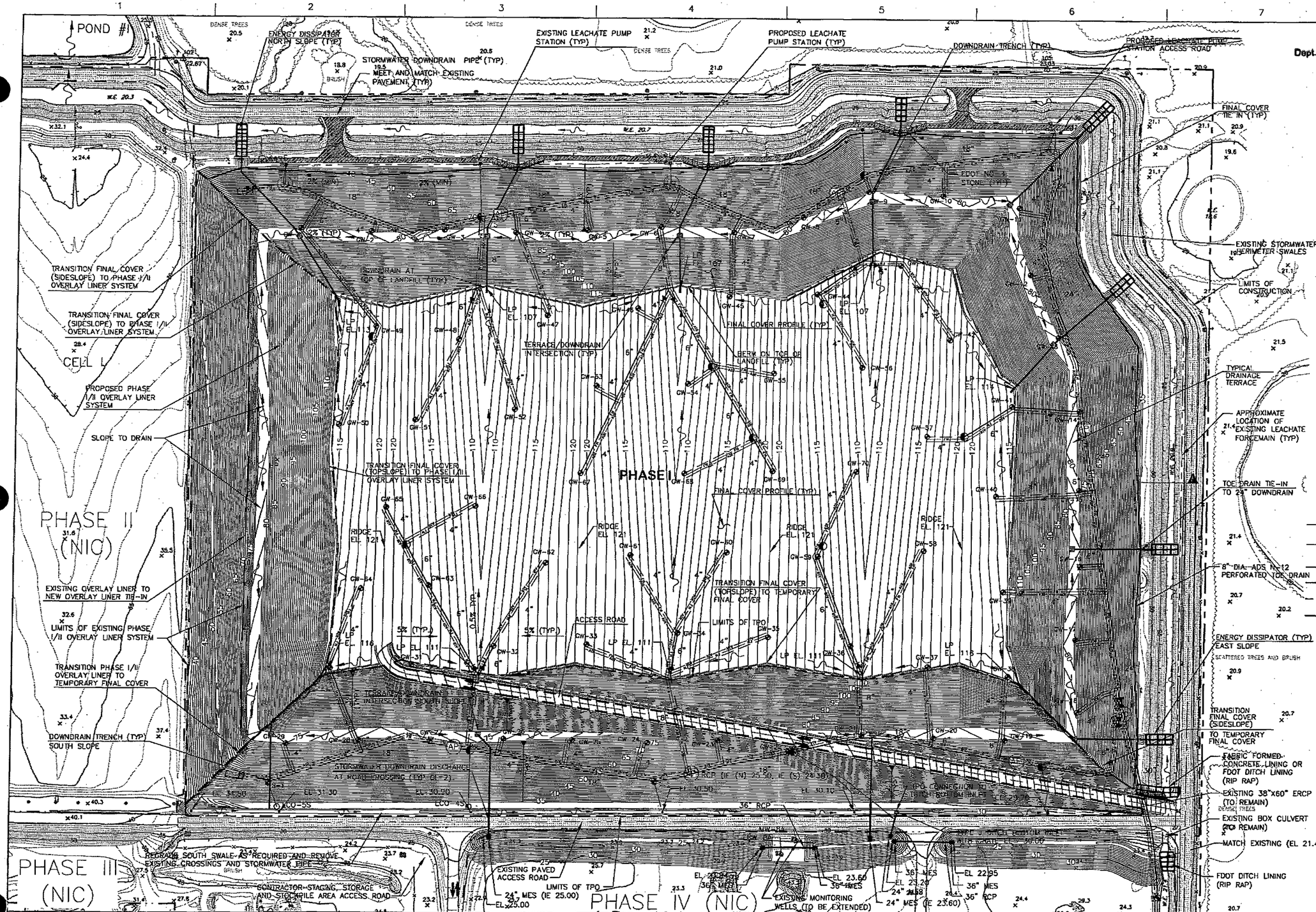

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

N

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2. CONTOURS WITHIN PHASE I CLOSURE AREA REPRESENT PROPOSED TOP OF FINAL COVER.
3. OPERATIONAL AND FINAL GRADES SHALL NOT BE GREATER THAN 3:1.
4. APPROXIMATE LOCATION OF PHASE I LEACHATE FORCEMAIN OBTAINED FROM RECORD DRAWINGS BY CAMP DRESSER & McKEE, INC. DATED APRIL 1998. VERIFY LOCATION IN FIELD.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ROADS USED BY CONTRACTOR AND SUBCONTRACTORS DURING PROJECT. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING MUD AND TRASH, SUPPRESSING DUST, AND REPAIRING ROADS AND OTHER FACILITIES DAMAGED BY HIS VEHICLES.

LEGEND

- S-1 — CONDENSATE SUMP
- GW-18 — LFG EXTRACTION WELL
- AP — ACCESS POINT
- KO — KNOCKOUT POT
- REMOTE WELLHEAD
- EXISTING LEACHATE CLEANOUT
- AIR — 2" HDPE SDR 9 AIR SUPPLY LINE
- FM — 4" HDPE SDR 9 CONDENSATE RETURN LINE
- 4" HDPE SDR 11 LATERAL
- 6" HDPE SDR 11 LATERAL
- 8" HDPE SDR 11 LATERAL
- HDPE SDR 17 HEADER
- EXISTING CONTOUR
- PROPOSED ELEVATION
- SPECIAL BOUNDARY
- EXISTING ROADWAY
- LIMITS OF CONSTRUCTION
- APPROX. LOCATION OF PHASE I LEACHATE FORCEMAIN (SEE NOTE 4)
- TOE DRAIN
- LP — LOW POINT
- HP — HIGH POINT
- TERRACE/DOWNDRAIN INTERSECTION
- PHASE I LEACHATE PUMP STATIONS
- CONSTRUCTION TRAFFIC ROUTE (SEE NOTE 5)
- STORMWATER FLOW DIRECTION
- FABRIC FORMED CONCRETE LINING
- VAULT BOX
- LEACHATE PUMP STATION STABILIZED ACCESS ROAD

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CA0000213

ISSUE	DATE	DESCRIPTION
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REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

PHASE I CLOSURE FINAL SITE PLAN

0 1" 2"

FILENAME	00C-05A.DWG
SCALE	1"=100'
SHEET	C-05A

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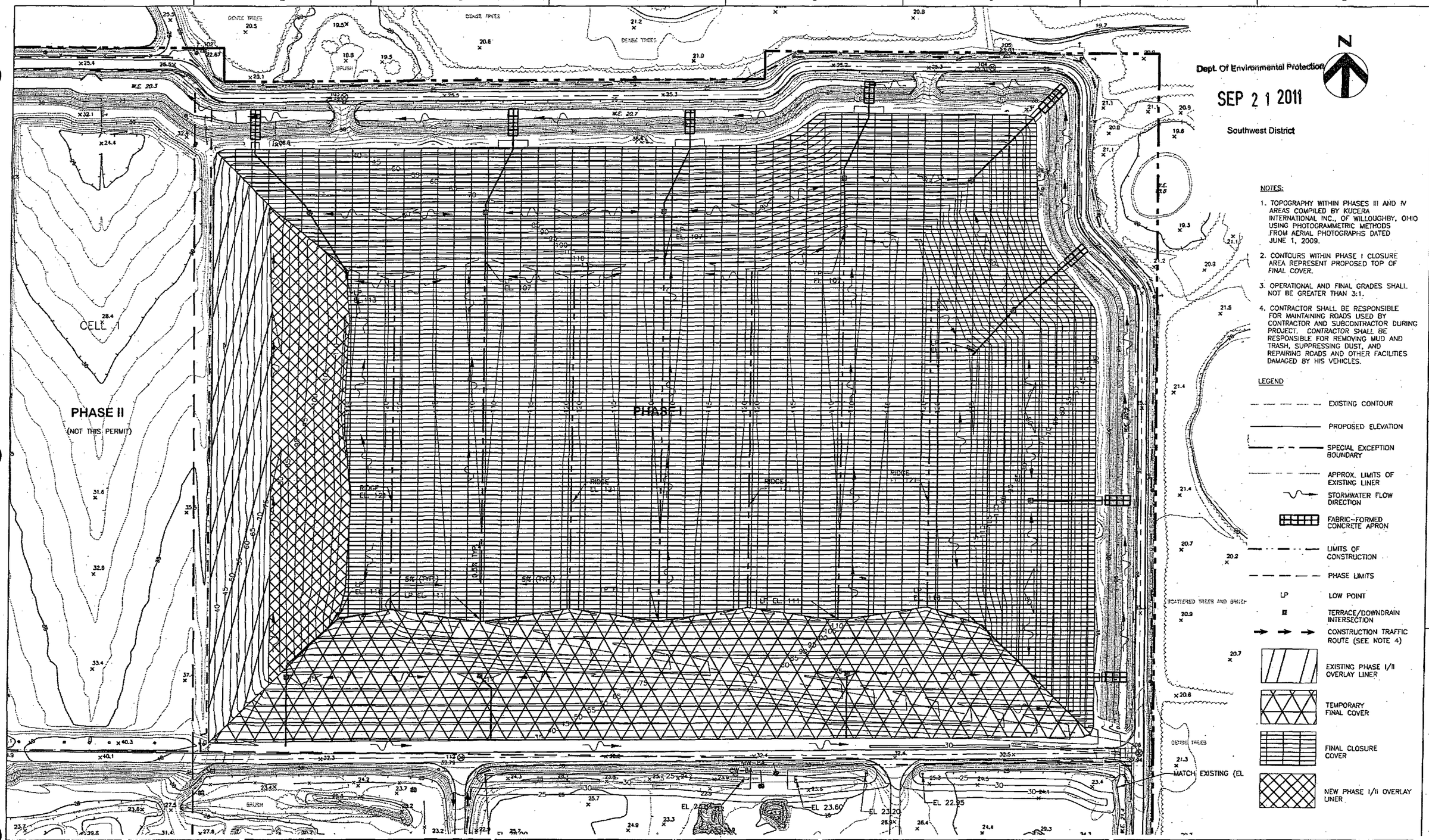


NOTES:

1. TOPOGRAPHY WITHIN PHASES III AND IV AREAS COMPILED BY KUCERA INTERNATIONAL INC., OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 1, 2009.
2. CONTOURS WITHIN PHASE I CLOSURE AREA REPRESENT PROPOSED TOP OF FINAL COVER.
3. OPERATIONAL AND FINAL GRADES SHALL NOT BE GREATER THAN 3:1.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ROADS USED BY CONTRACTOR AND SUBCONTRACTOR DURING PROJECT. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING MUD AND TRASH, SUPPRESSING DUST, AND REPAIRING ROADS AND OTHER FACILITIES DAMAGED BY HIS VEHICLES.

LEGEND

- EXISTING CONTOUR
- PROPOSED ELEVATION
- SPECIAL EXCEPTION BOUNDARY
- APPROX. LIMITS OF EXISTING LINER
- STORMWATER FLOW DIRECTION
- FABRIC-FORMED CONCRETE APRON
- LIMITS OF CONSTRUCTION
- PHASE LIMITS
- LP LOW POINT
- TERRACE/DOWNDRAIN INTERSECTION
- CONSTRUCTION TRAFFIC ROUTE (SEE NOTE 4)
- EXISTING PHASE I/II OVERLAY LINER
- TEMPORARY FINAL COVER
- FINAL CLOSURE COVER
- NEW PHASE I/II OVERLAY LINER

HDR

HDR Engineering, Inc.
2621 Cattlemen Rd., Ste. 196
Sarasota, FL 34232-6212
(941) 342-2700
CA00004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

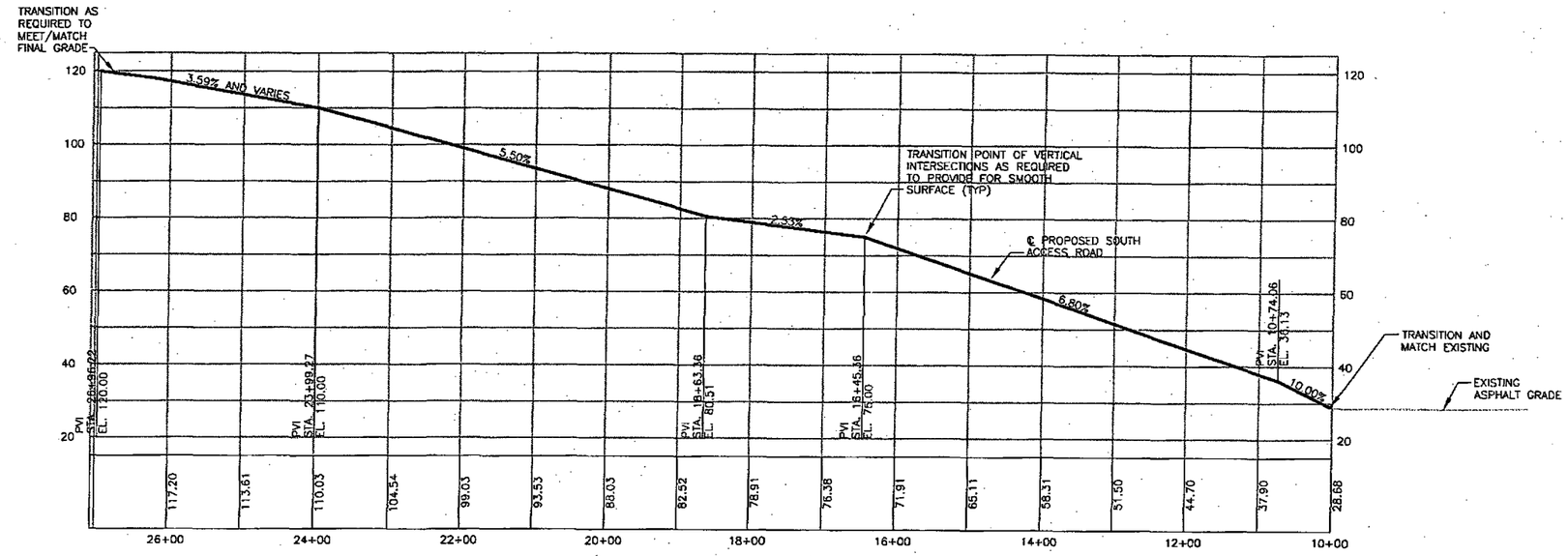
SARASOTA COUNTY FLORIDA

PHASE I CLOSURE COVER KEY SHEET

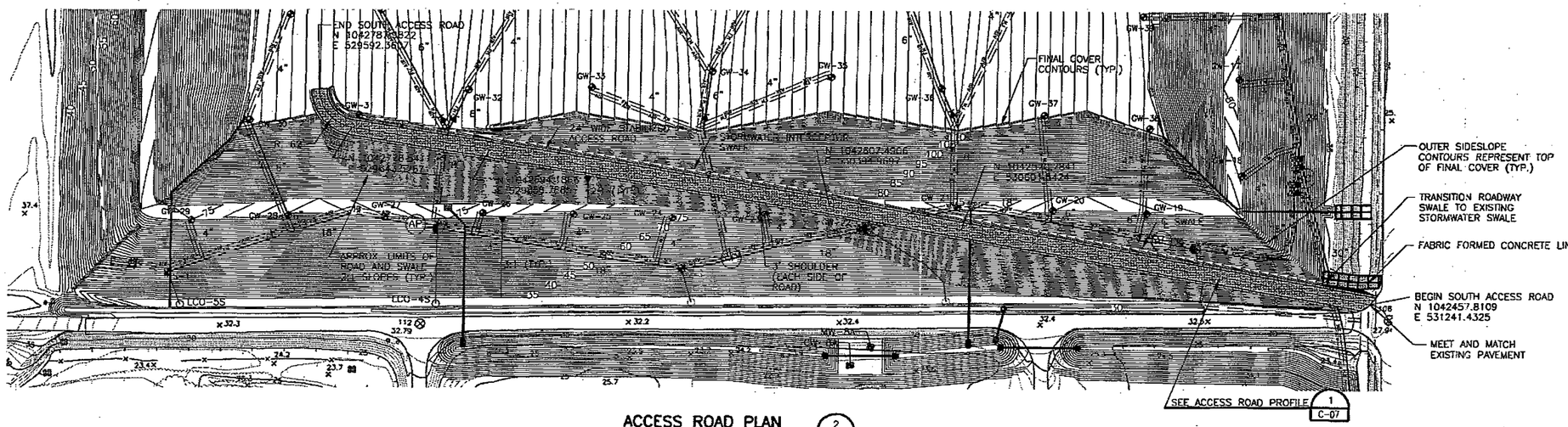
0 1" 2"

FILENAME	00C-09_KEY.DWG
SCALE	1"=100'
SHEET	C-06

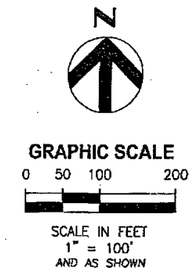
c:\pwworking\tpa\d0318297\00C-09_Key.DWG, Plot, 9/14/2011 11:36:51 AM, BradJohn



ACCESS ROAD PROFILE (1 / C-07)
1" = 100' HORIZ. 1" = 20' VERT.



ACCESS ROAD PLAN (2 / C-05)
SCALE 1" = 100' HORIZ.



NOTE

1. LANDFILL GAS COLLECTION SYSTEM AND STORMWATER FEATURES SHOWN TO PROVIDE CLARITY FOR CONSTRUCTION OF ROADWAY.

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ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY FLORIDA

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

PLAN AND PROFILE PHASE I ACCESS ROAD

0 1" 2"

FILENAME	00C-06.DWG
SCALE	AS SHOWN

SHEET C-07

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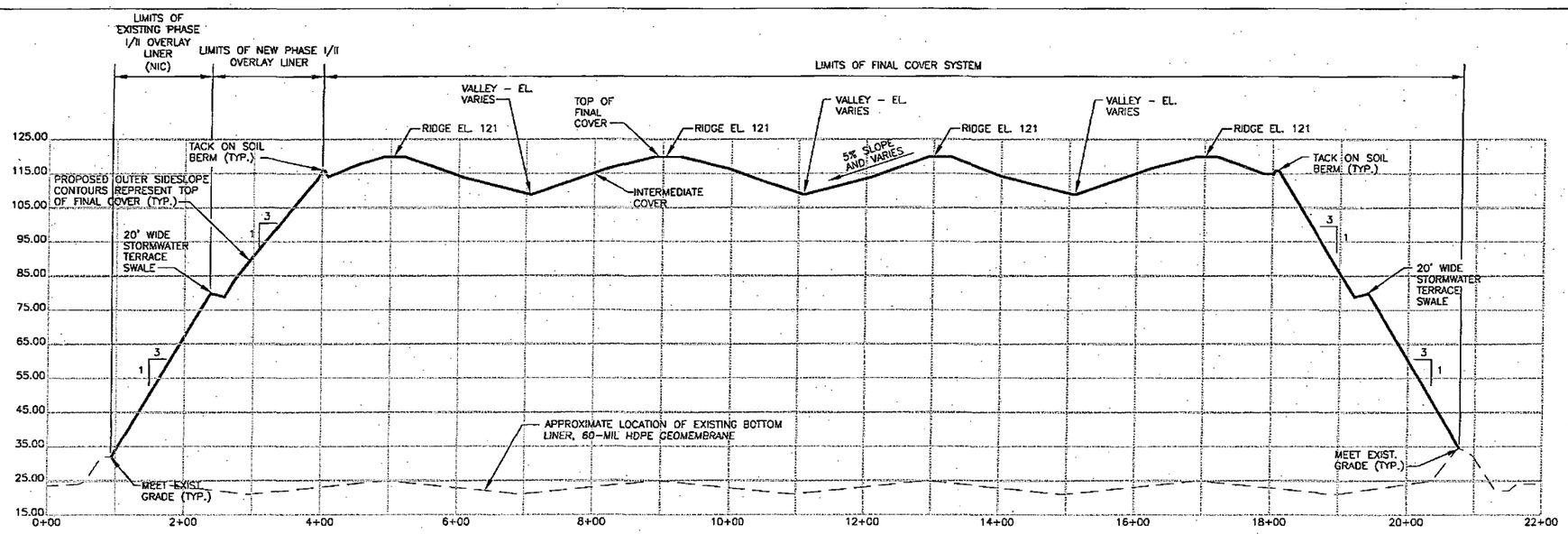
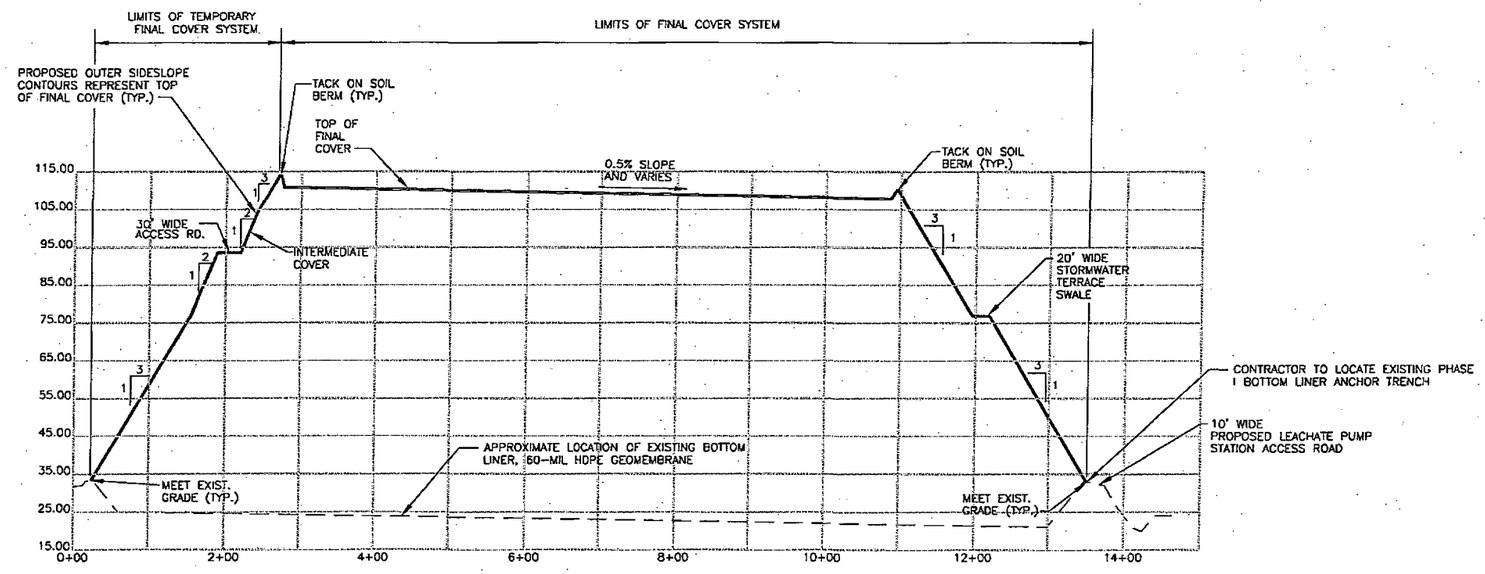


SECTION A
1" = 100' HORIZ. 1" = 10' VERT. A C-05



SECTION B
1" = 100' HORIZ. 1" = 10' VERT. B C-05

NOTES

1. FILLING GRADES AND ELEVATIONS ARE APPROXIMATE. SEE PERMITTED FILLING PLAN PREPARE BY HDR ENGINEERING, INC. DATED JANUARY 2008, FOR GRADES AND ELEVATIONS.
2. OPERATIONAL AND FINAL WASTE GRADES SHALL NOT BE GREATER THAN 3:1.
3. MAINTAIN OPERATION BERMS AT ALL ACTIVE WORKING FACES TO CONTAIN ALL STORMWATER COMMINGLED WITH WASTE.
4. MAINTAIN POSITIVE DRAINAGE AT ALL TIMES.

Dept. Of Environmental Protection
SEP 21 2011
Southwest District

HDR
HDR Engineering, Inc.
2621 Cattlemen Rd., Ste. 106
Sarasota, Fl 34232-6232
(941) 342-2799
CA00004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex
PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

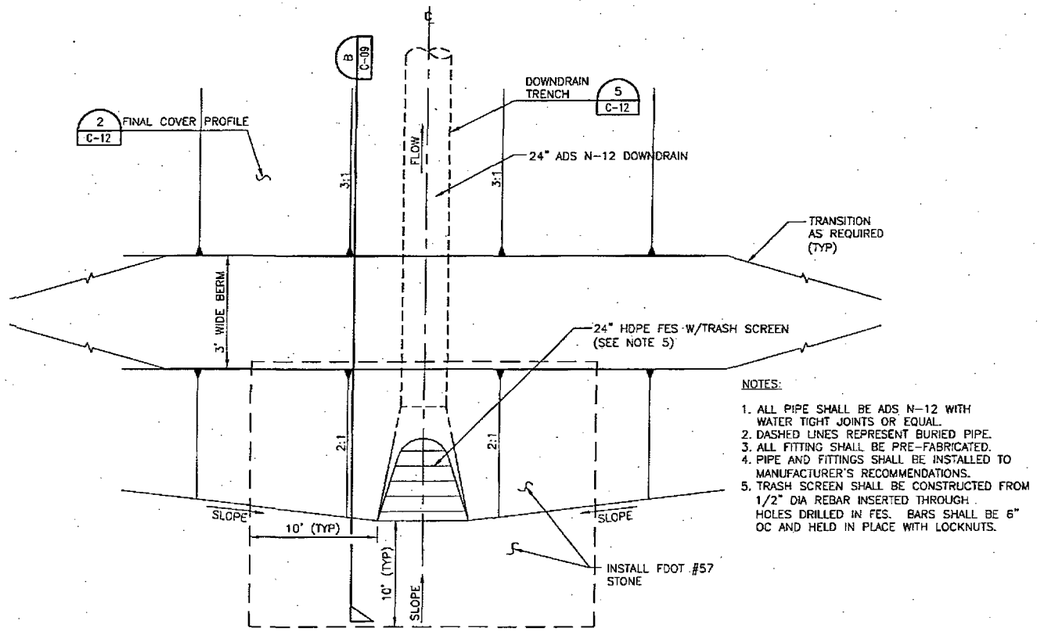
FULL BUILDOUT SECTIONS

0 1" 2"

FILENAME 00C-07.DWG
SCALE AS SHOWN

SHEET C-08

c:\pwworking\tpa\d0318297\00C-07.dwg, FULL BUILDOUT SECTIONS, 9/14/2011 11:37:06 AM, BradJohn



NOTES:

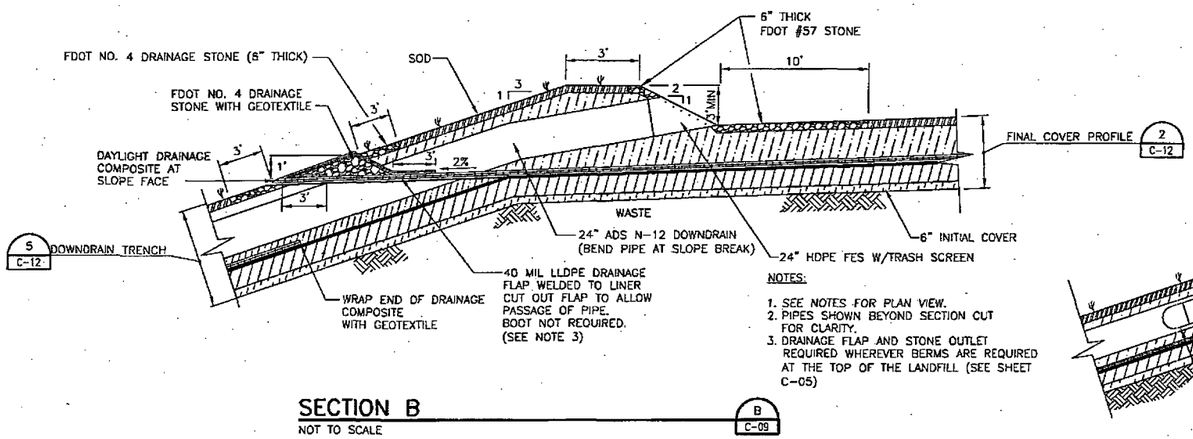
1. ALL PIPE SHALL BE ADS N-12 WITH WATER TIGHT JOINTS OR EQUAL.
2. DASHED LINES REPRESENT BURIED PIPE.
3. ALL FITTING SHALL BE PRE-FABRICATED.
4. PIPE AND FITTINGS SHALL BE INSTALLED TO MANUFACTURER'S RECOMMENDATIONS.
5. TRASH SCREEN SHALL BE CONSTRUCTED FROM 1/2" DIA REBAR INSERTED THROUGH HOLES DRILLED IN FES. BARS SHALL BE 6" OC AND HELD IN PLACE WITH LOCKNUTS.

PLAN VIEW

DOWNDRAIN AT TOP OF LANDFILL

1 C-05

NOT TO SCALE



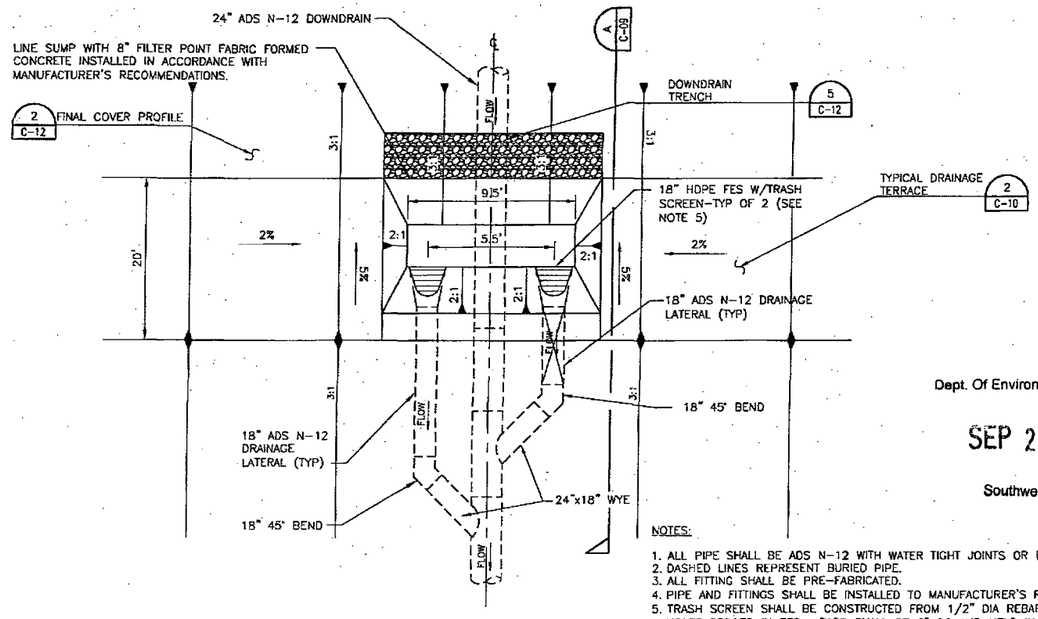
NOTES:

1. SEE NOTES FOR PLAN VIEW.
2. PIPES SHOWN BEYOND SECTION CUT FOR CLARITY.
3. DRAINAGE FLAP AND STONE OUTLET REQUIRED WHEREVER BERMS ARE REQUIRED AT THE TOP OF THE LANDFILL (SEE SHEET C-05)

SECTION B

B C-09

NOT TO SCALE



Dept. Of Environmental Protection

SEP 2 1 2011

Southwest District

NOTES:

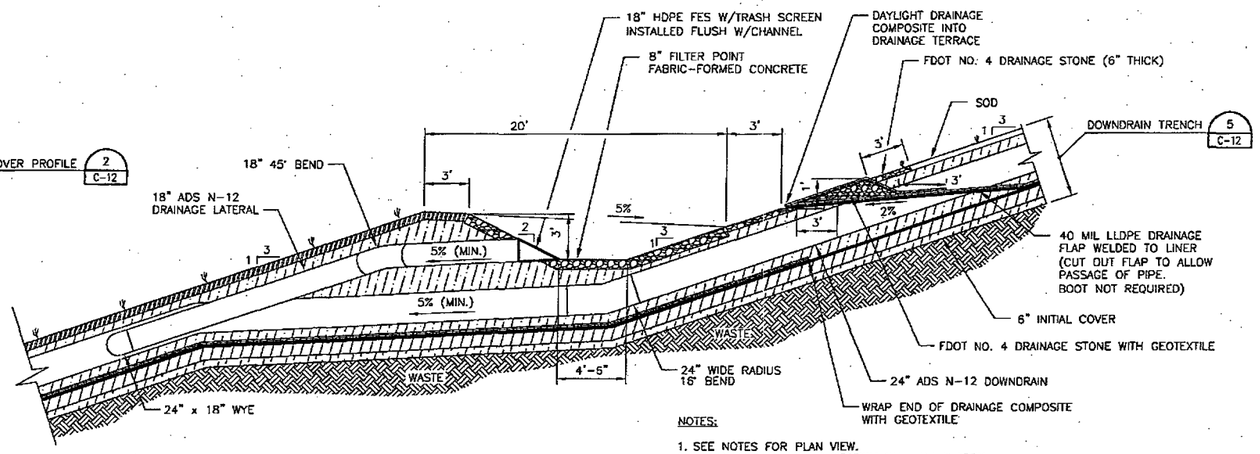
1. ALL PIPE SHALL BE ADS N-12 WITH WATER TIGHT JOINTS OR EQUAL.
2. DASHED LINES REPRESENT BURIED PIPE.
3. ALL FITTING SHALL BE PRE-FABRICATED.
4. PIPE AND FITTINGS SHALL BE INSTALLED TO MANUFACTURER'S RECOMMENDATIONS.
5. TRASH SCREEN SHALL BE CONSTRUCTED FROM 1/2" DIA REBAR INSERTED THROUGH HOLES DRILLED IN FES. BARS SHALL BE 6" OC AND HELD IN PLACE WITH LOCKNUTS.
6. SEE DETAIL 1, SHEET C-18 FOR TYPICAL TEMPORARY FINAL COVER INSTALLATION FOR SOUTH SLOPE.

PLAN VIEW

TERRACE / DOWNDRAIN INTERSECTION (NORTH AND EAST SLOPES)

2 C-05

NOT TO SCALE



NOTES:

1. SEE NOTES FOR PLAN VIEW.
2. PIPES SHOWN BEYOND SECTION CUT FOR CLARITY.
3. EXCAVATE WASTE AS NEEDED TO ALLOW PLACEMENT OF 24" DOWNDRAIN.

SECTION A

A C-09

NOT TO SCALE

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CA0004213

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PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

PHASE I CLOSURE DETAILS

0 1" 2"

FILENAME 00D-01.DWG

SCALE AS SHOWN

SHEET C-09

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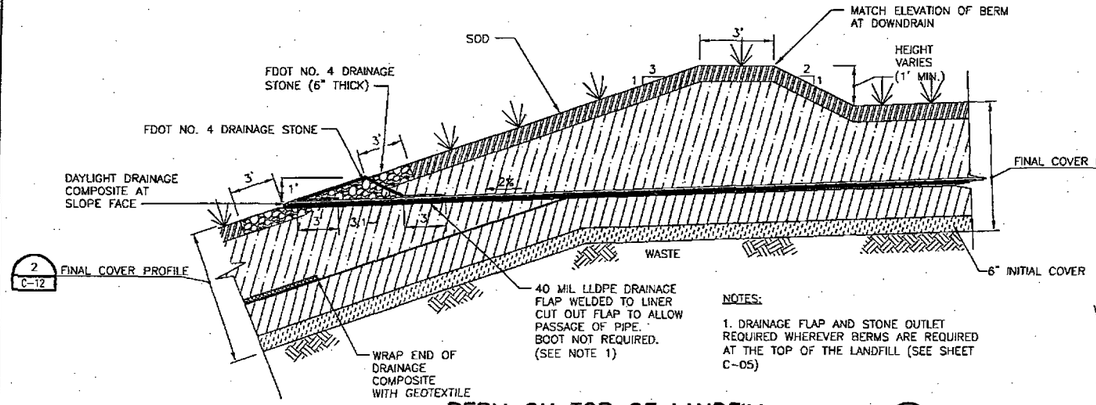
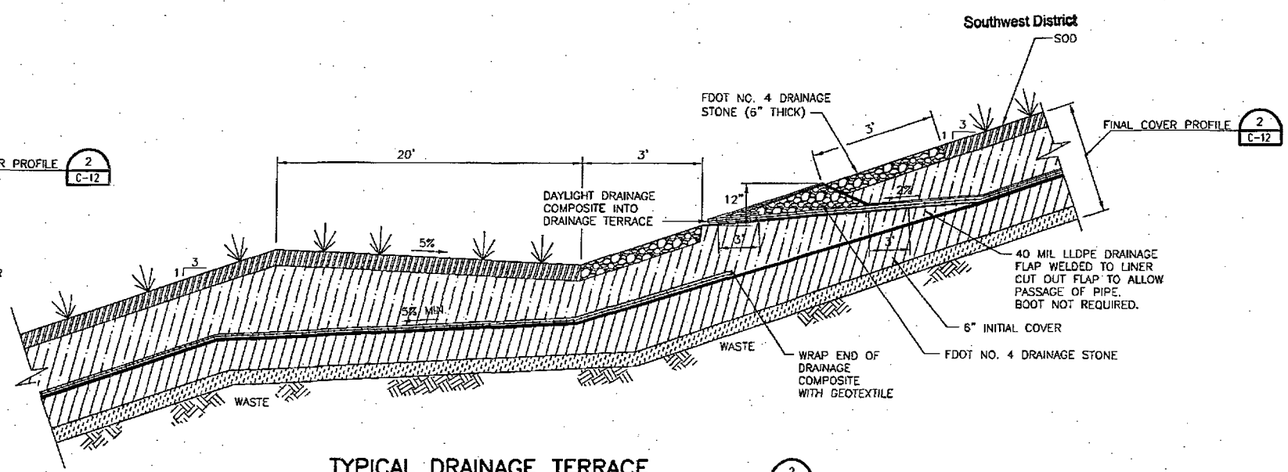


NOTES:

1. DRAINAGE FLAP AND STONE OUTLET REQUIRED WHEREVER BERMS ARE REQUIRED AT THE TOP OF THE LANDFILL (SEE SHEET C-05)

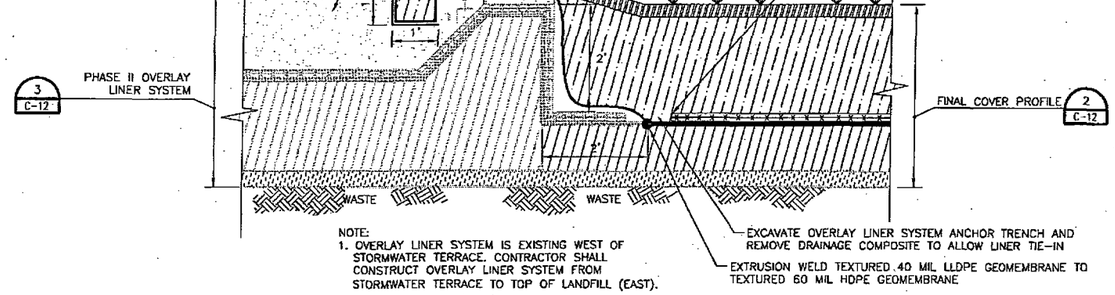
BERM ON TOP OF LANDFILL

NOT TO SCALE — 1 C-05



TYPICAL DRAINAGE TERRACE

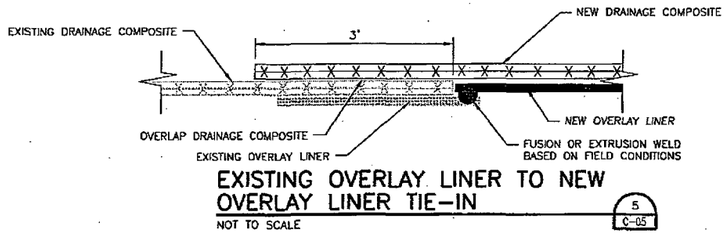
NOT TO SCALE — 2 C-05 C-09 C-18



NOTE:
1. OVERLAY LINER SYSTEM IS EXISTING WEST OF STORMWATER TERRACE. CONTRACTOR SHALL CONSTRUCT OVERLAY LINER SYSTEM FROM STORMWATER TERRACE TO TOP OF LANDFILL (EAST).

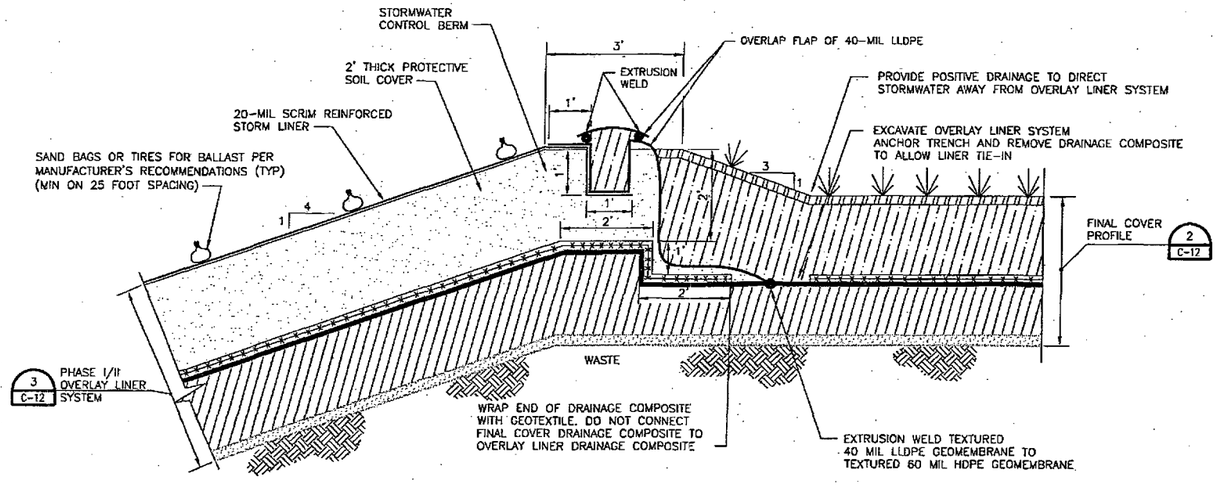
TRANSITION FINAL COVER (SIDE SLOPE) TO PHASE I/II OVERLAY LINER SYSTEM

NOT TO SCALE — 3 C-05



EXISTING OVERLAY LINER TO NEW OVERLAY LINER TIE-IN

NOT TO SCALE — 5 C-05



TRANSITION FINAL COVER (TOP SLOPE) TO PHASE I/II OVERLAY LINER SYSTEM

NOT TO SCALE — 4 C-05

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ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

PHASE I CLOSURE DETAILS

0 1" 2"

FILENAME	000-02.DWG
SCALE	AS SHOWN

SHEET C-10

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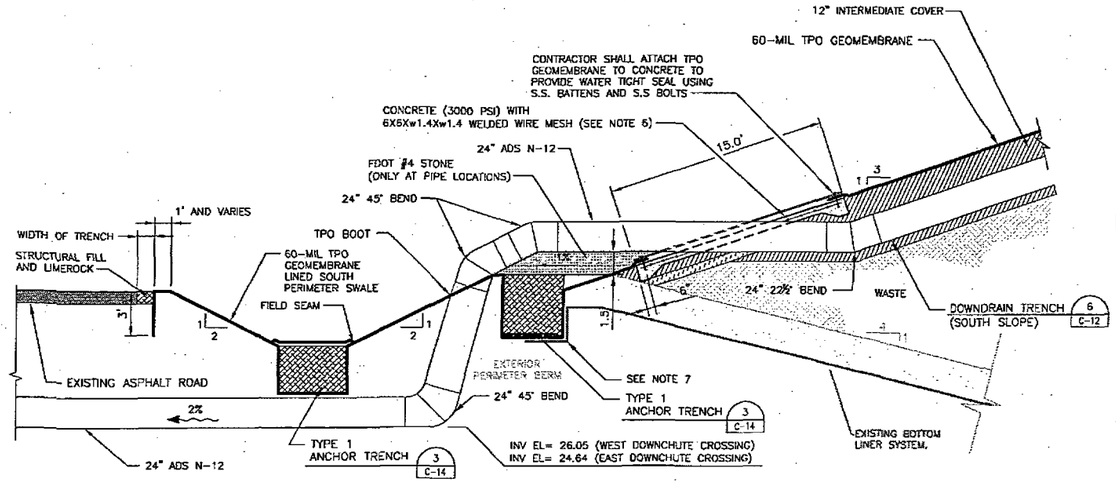


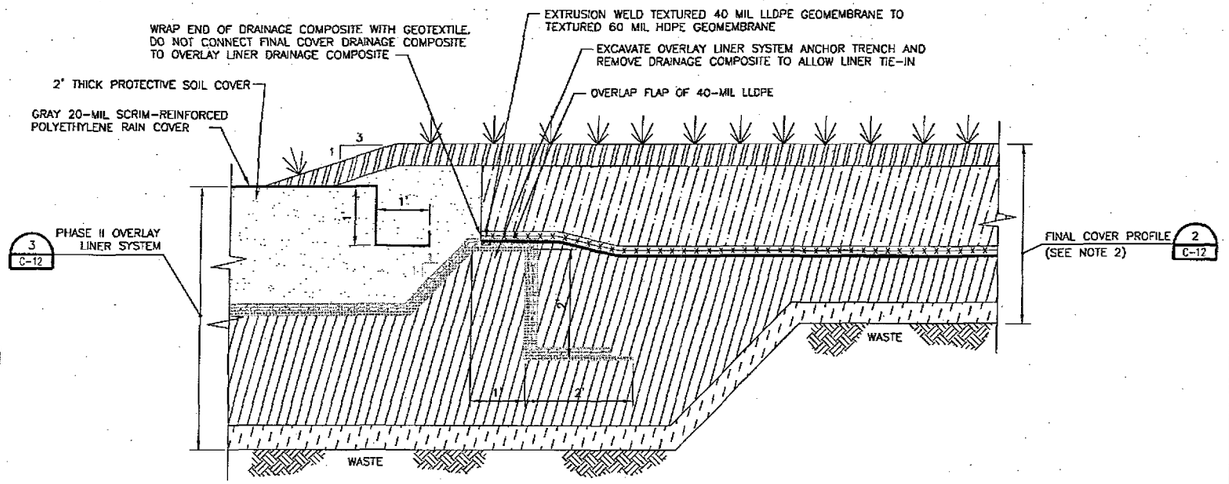
STORMWATER DOWNDRAIN DISCHARGE AT ROAD CROSSING

1 C-05 C-10A

NOT TO SCALE

NOTES:

1. ALL PIPE SHALL BE ADS N-12 WITH WATER TIGHT JOINTS OR EQUAL.
2. ALL PIPE FITTINGS SHALL BE PREFABRICATED AND SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
3. CAREFULLY EXPOSE EXISTING BOTTOM LINER AND PLACE TPO GEOMEMBRANE ON TOP.
4. DO NOT WELD TPO GEOMEMBRANE TO EXISTING BOTTOM LINER.
5. ANNULAR SPACE BETWEEN CONCRETE AND PIPE SHALL BE FILLED WITH WEATHER RESISTANT SEALANT OR APPROVED EQUAL.
6. CONCRETE PAD SHALL BE LENGTH SHOWN AND WIDTH BASED ON FDOT INDEX 273 FOR MITERED END SECTION FOR 24" PIPE.
7. CONTRACTOR TO LOCATE EXISTING PHASE I BOTTOM LINER ANCHOR TRENCH.

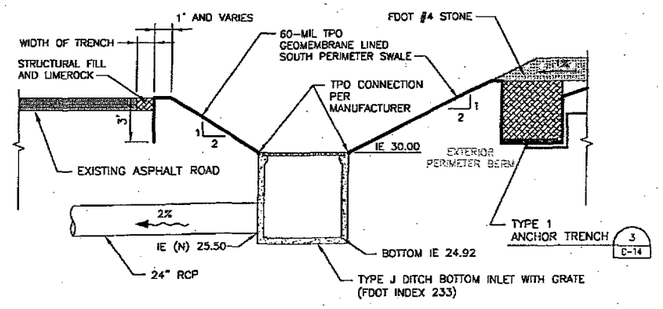


NOTE:
1. OVERLAY LINER SYSTEM IS EXISTING WEST OF STORMWATER TERRACE. CONTRACTOR SHALL CONSTRUCT OVERLAY LINER SYSTEM FROM STORMWATER TERRACE TO TOP OF LANDFILL (EAST).
2. THICKNESS OF INTERMEDIATE COVER VARIES. MINIMUM 1 FOOT.

TRANSITION FINAL COVER (SIDE SLOPE) TO PHASE I/II OVERLAY LINER SYSTEM

3 C-05

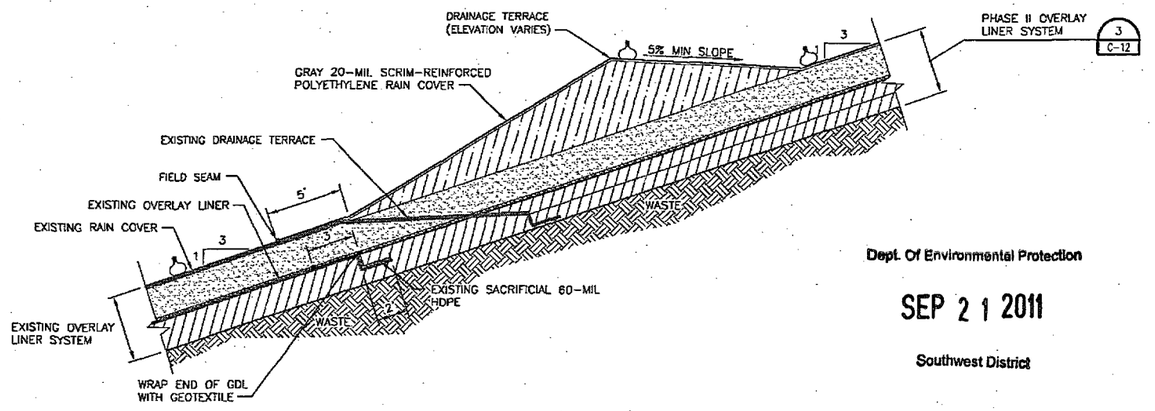
NOT TO SCALE



TPO CONNECTION TO DITCH BOTTOM INLET

4 C-05

NOT TO SCALE



TRANSITION EXISTING OVERLAY LINER TO PROPOSED OVERLAY LINER

2 C-05

NOT TO SCALE

Dept. Of Environmental Protection

SEP 2 1 2011

Southwest District

HDR Engineering, Inc.
2621 Cattlemen Rd., Ste. 106
Sarasota, FL 34232-6312
(941) 342-2750
CA00004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

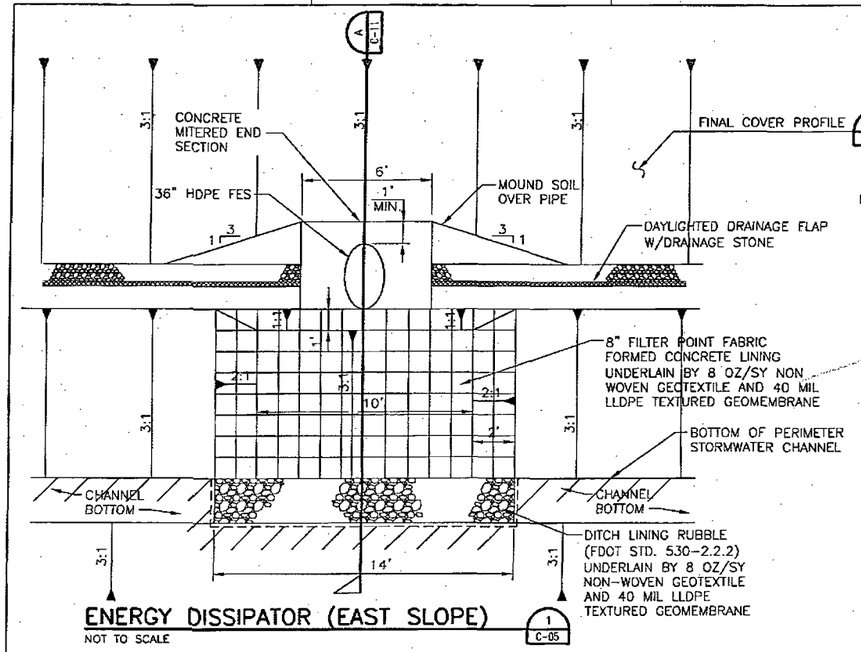
FLORIDA

PHASE I CLOSURE DETAILS

0 1" 2"

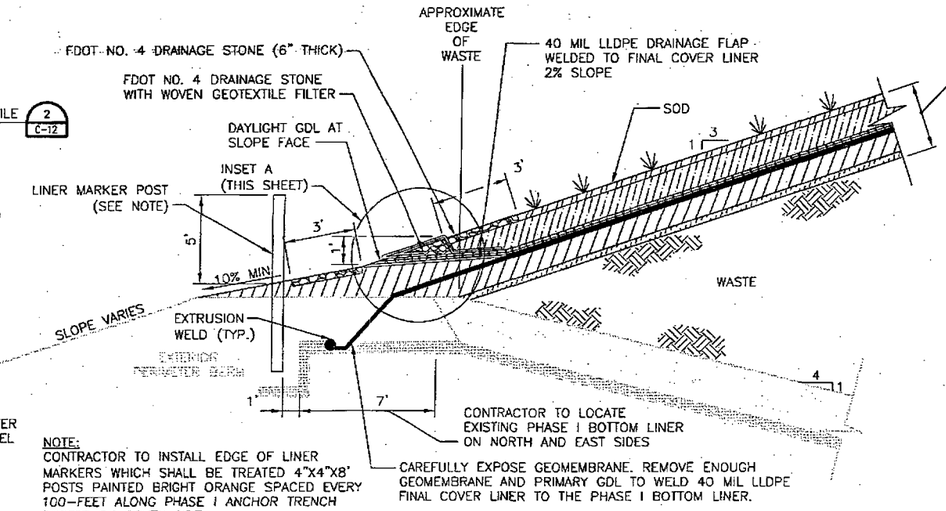
FILENAME	00D-02A.DWG
SCALE	AS SHOWN
SHEET	C-10A

c:\pwworking\tpa\d0318297\00D-02A.dwg, Plot, 9/14/2011 11:37:25 AM, Brad.John



ENERGY DISSIPATOR (EAST SLOPE)

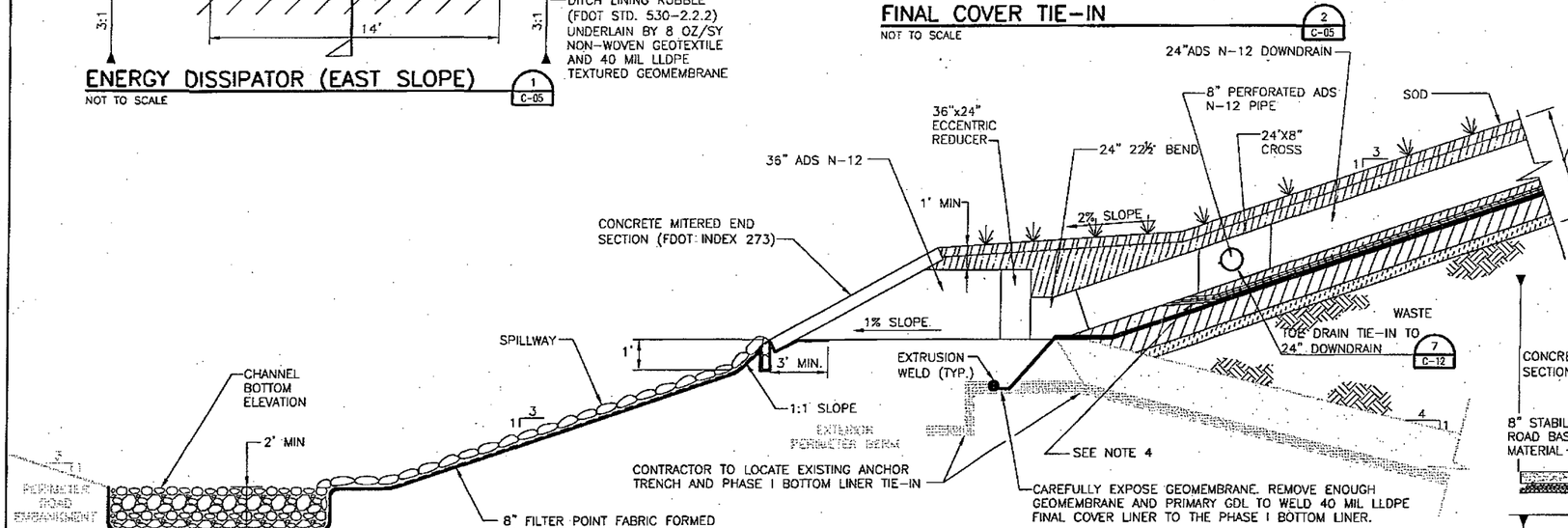
NOT TO SCALE



NOTE:
CONTRACTOR TO INSTALL EDGE OF LINER MARKERS WHICH SHALL BE TREATED 4"X4"X8' POSTS PAINTED BRIGHT ORANGE SPACED EVERY 100-FEET ALONG PHASE I ANCHOR TRENCH EXCEPT ON SOUTH SIDE.

FINAL COVER TIE-IN

NOT TO SCALE 2 C-05

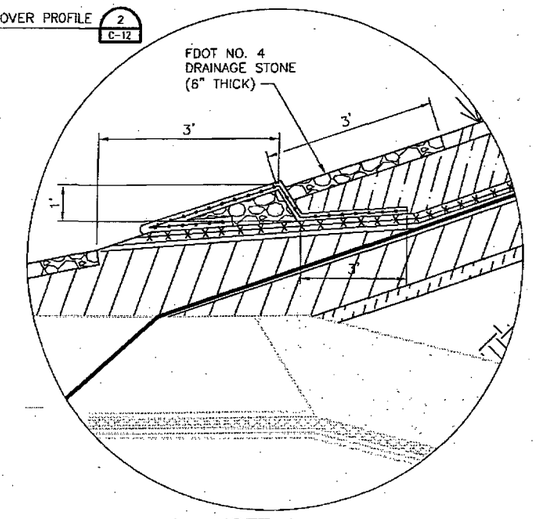


NOTES:

1. ALL PIPE SHALL BE ADS N-12 WITH WATER TIGHT JOINTS OR EQUAL.
2. ALL PIPE FITTINGS SHALL BE PREFABRICATED.
3. PIPE, FITTINGS, AND FABRIC FORMED CONCRETE LINING SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
4. DRAINAGE FLAP AND DRAINAGE STONE NOT SHOWN FOR CLARITY. SEE DETAIL 2 THIS SHEET FOR TYPICAL FLAP CONSTRUCTION AT TOE OF SLOPE.

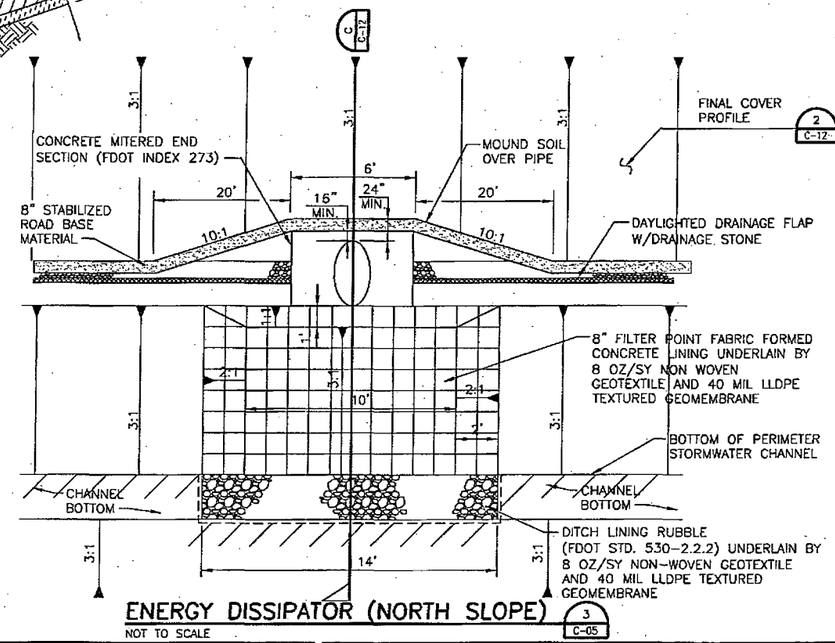
SECTION A

NOT TO SCALE A C-11



INSET A

SCALE: NOT TO SCALE



ENERGY DISSIPATOR (NORTH SLOPE)

NOT TO SCALE 3 C-05

Dept. Of Environmental Protection

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HDR Engineering, Inc.
2621 Cattleman Rd., Ste. 106
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(941) 342-2700
CA0000213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

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CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

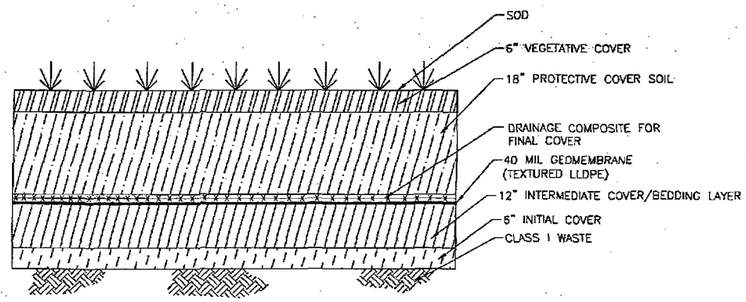
PHASE I CLOSURE DETAILS

0 1" 2"

FILENAME	00D-03.DWG
SCALE	AS SHOWN

SHEET C-11

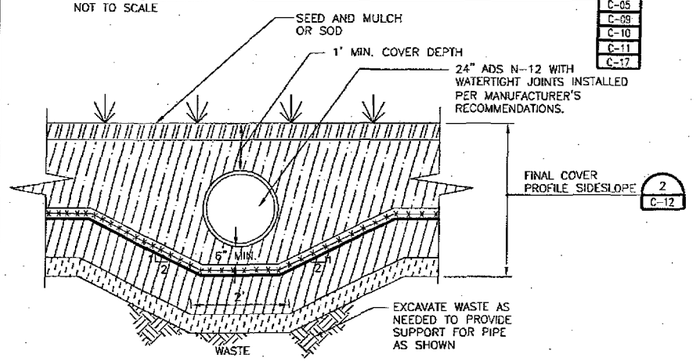
c:\pwworking\tpa\d0318297\00D-03.DWG, Plot, 9/14/2011 11:37:34 AM, BradJohn



FINAL COVER PROFILE

NOT TO SCALE

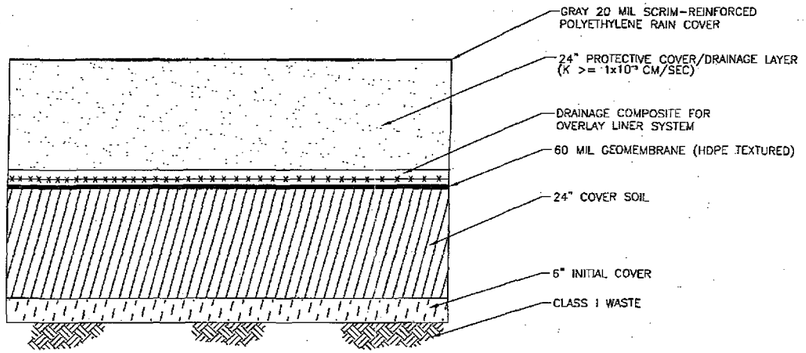
2 | C-05, C-09, C-10, C-11, C-17



DOWN DRAIN TRENCH (NORTH, EAST SLOPES)

NOT TO SCALE

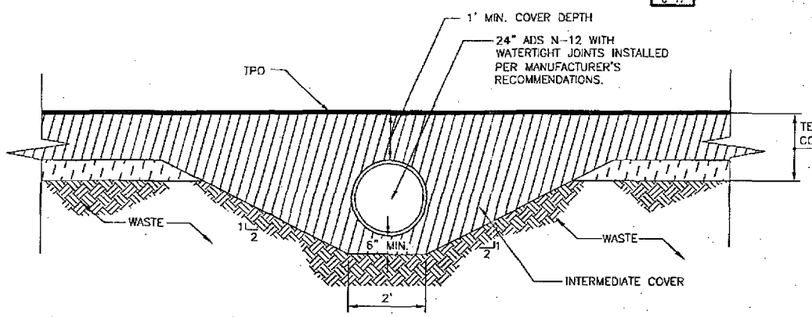
5 | C-05, C-09, C-11



PHASE I/II OVERLAY LINER SYSTEM

NOT TO SCALE

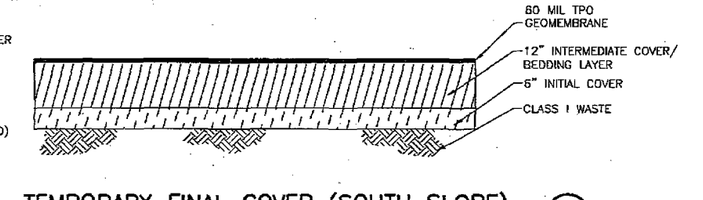
3 | C-05, C-10, C-17



DOWNDRAIN TRENCH (SOUTH SLOPE)

NOT TO SCALE

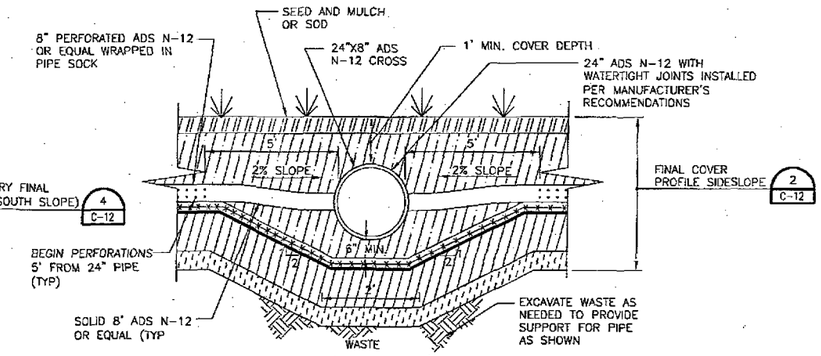
6 | C-05, C-18, C-19



TEMPORARY FINAL COVER (SOUTH SLOPE)

NOT TO SCALE

4 | C-14, C-15, C-17, C-18



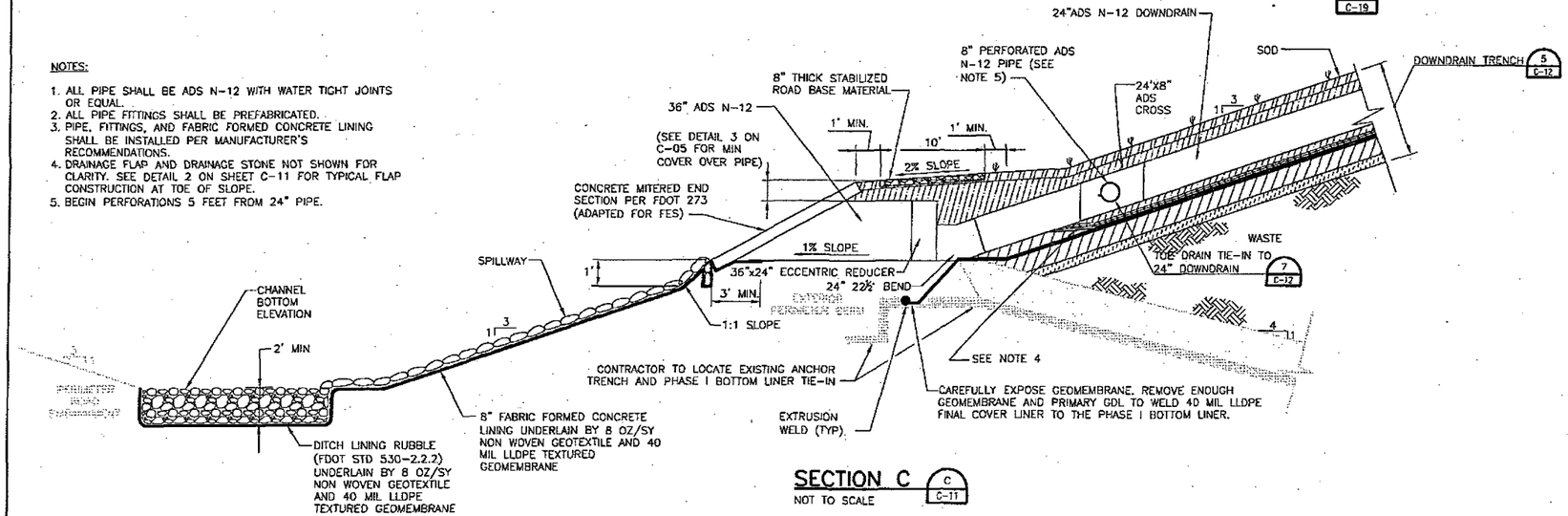
TOE DRAIN TIE-IN TO 24" DOWNDRAIN

NOT TO SCALE

7 | C-05, C-11

NOTES:

1. ALL PIPE SHALL BE ADS N-12 WITH WATER TIGHT JOINTS OR EQUAL.
2. ALL PIPE FITTINGS SHALL BE PREFABRICATED.
3. PIPE, FITTINGS, AND FABRIC FORMED CONCRETE LINING SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
4. DRAINAGE FLAP AND DRAINAGE STONE NOT SHOWN FOR CLARITY. SEE DETAIL 2 ON SHEET C-11 FOR TYPICAL FLAP CONSTRUCTION AT TOE OF SLOPE.
5. BEGIN PERFORATIONS 5 FEET FROM 24" PIPE.



SECTION C

NOT TO SCALE

C | C-11

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

HDR Engineering, Inc.
2621 Cattlemen Rd., Ste. 106
Sarasota, FL 34232-6212
(941) 342-2780
CA00004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

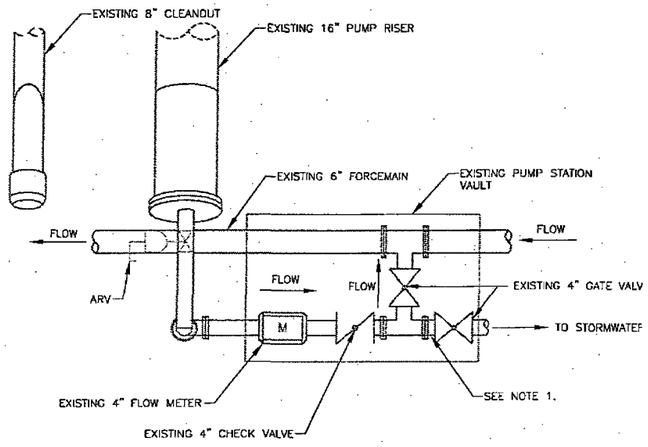
PHASE I CLOSURE DETAILS

0 1" 2"

FILENAME	00D-04.DWG
SCALE	AS SHOWN

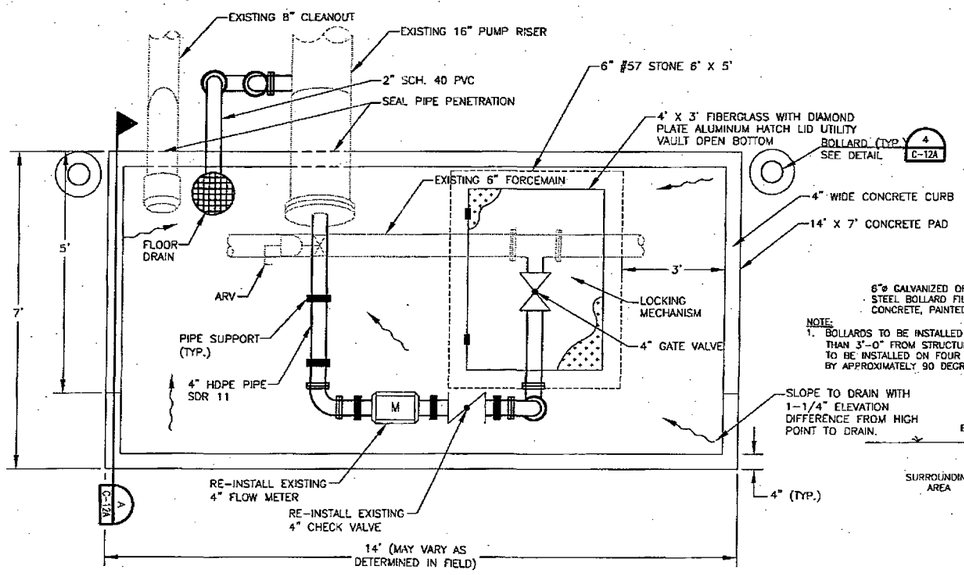
SHEET C-12

c:\pwworking\tpa\d0318297\00D-04.dwg, Plot, 9/14/2011 11:37:38 AM, Brad.John

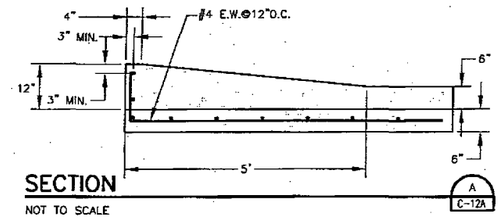


NOTE 1: CONTRACTOR SHALL REMOVE PIPING FROM VAULT TO STORMWATER.

PLAN VIEW

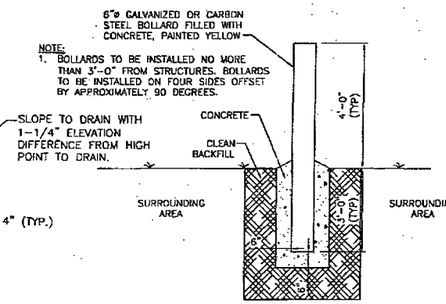


PLAN VIEW



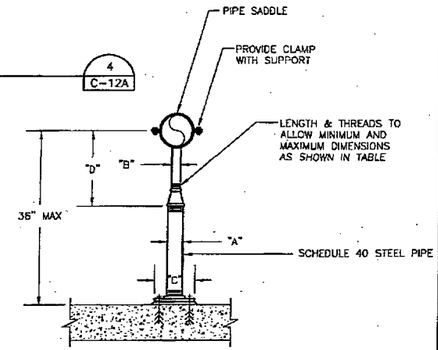
SECTION

NOT TO SCALE



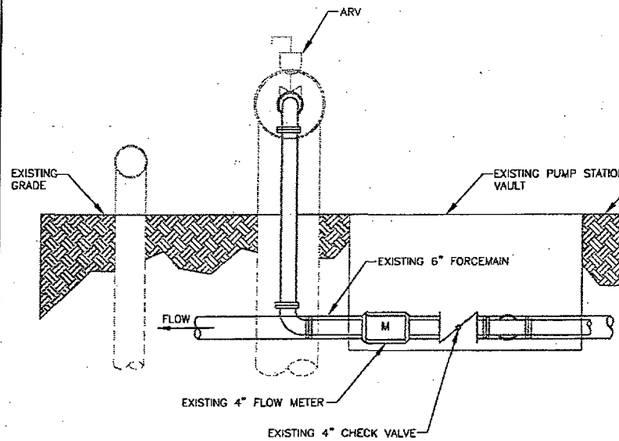
BOLLARD (TYP)

NOT TO SCALE 4 C-12A



PIPE SUPPORT DETAIL

NOT TO SCALE 3 C-12A



EXISTING LEACHATE PUMP STATION (TYP.) 1 C-05

NOT TO SCALE

PROPOSED LEACHATE PUMP STATION (TYP.) 2 C-05

NOT TO SCALE

FLOOR PIPE SUPPORT SCHEDULE
DIMENSIONS IN INCHES

PIPE SIZE	"A"	"B"	"C"	"D" MINIMUM	"D" MAXIMUM	ANCHORS DIA	ANCHORS EMBED
≤ 2 1/2	2 1/2	1 1/2	9	8	13	5/8	5
3	2 1/2	1 1/2	9	8 1/2	13 1/2	5/8	5
3 1/2	2 1/2	1 1/2	9	8 1/2	13 1/2	5/8	5
4	3	2 1/2	9	9 1/2	14	5/8	5
6	3	2 1/2	9	10 1/2	15 1/2	5/8	5
8	3	2 1/2	9	11 1/2	16 1/2	5/8	5
10	3	2 1/2	9	13 1/2	18 1/2	5/8	5
12	3	2 1/2	9	15	19 1/2	5/8	5
14	4	3	11	16 1/2	20 1/2	3/4	6 5/8
16	4	3	11	17 1/2	22 1/2	3/4	6 5/8
18	6	3 1/2	13 1/2	19 1/2	24	3/4	6 5/8
20	6	3 1/2	13 1/2	21	25 1/2	3/4	6 5/8
24	6	4	13 1/2	23 1/2	28 1/2	3/4	6 5/8
30	6	4	13 1/2	27	31 1/2	3/4	6 5/8
32	6	4	13 1/2	28 1/2	32 1/2	3/4	6 5/8
36	6	4	13 1/2	30 1/2	34 1/2	3/4	6 5/8

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PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

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SARASOTA COUNTY FLORIDA

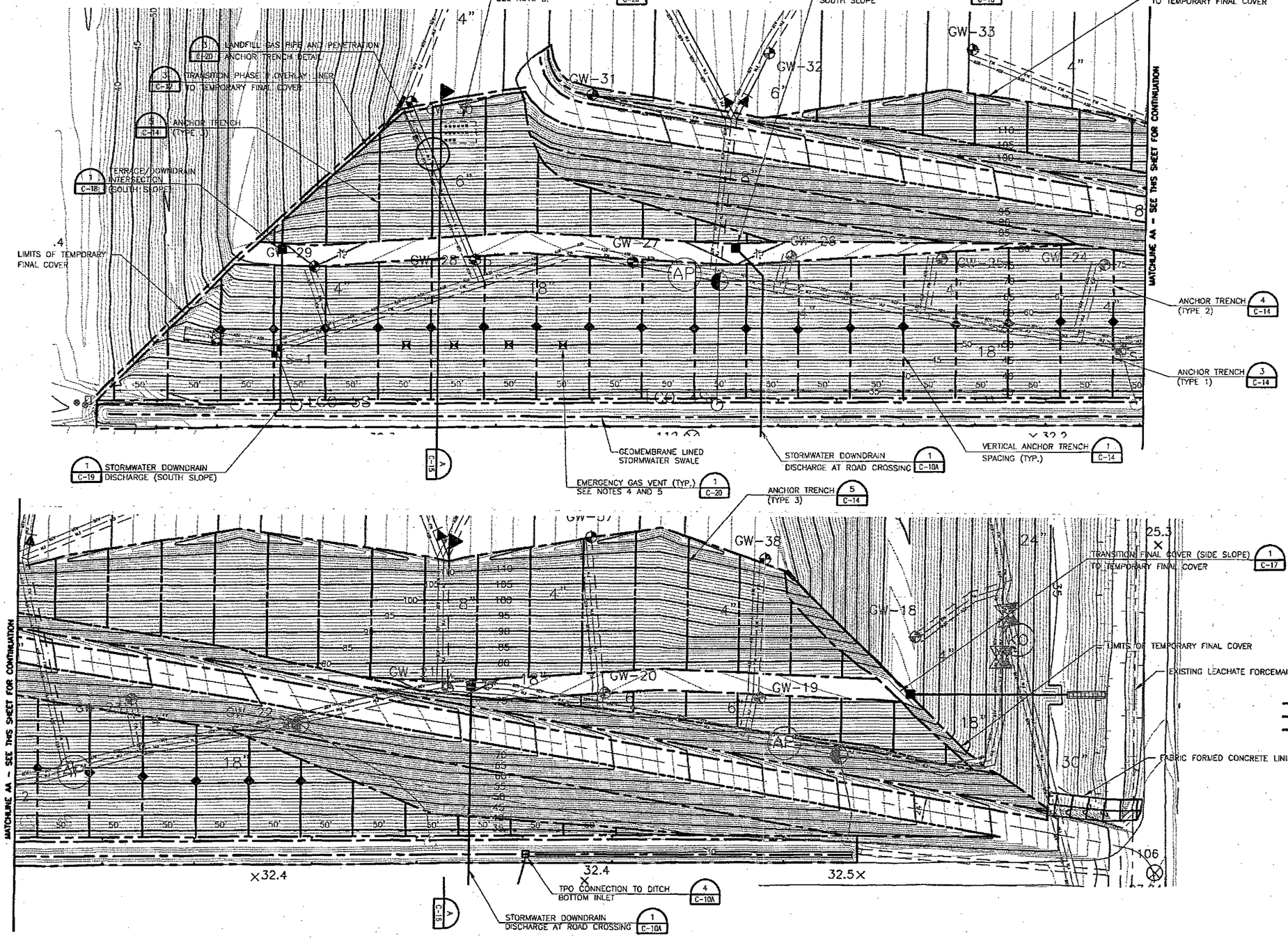
PHASE I CLOSURE DETAILS

0 1" 2"

FILENAME 00D-12A.DWG
SCALE AS SHOWN

SHEET C-12A

c:\pwworking\tpeld03182970\00D-12a.DWG, Plot, 9/14/2011 11:37:42 AM, BradJohn



NOTES:

1. TOPOGRAPHY WITHIN PHASES I THROUGH IV AREAS COMPILED BY KUCERA INTERNATIONAL, INC., OF WILLOUGHBY, OHIO USING *PHOTOGRAMMETRIC METHODS FROM* AERIAL PHOTOGRAPHS DATED JUNE 2, 2010.
2. LOCATION OF ANCHOR TRENCHES SHALL BE ADJUSTED IN THE FIELD BASED ON ACTUAL LOCATION OF GAS WELLS AND LFG ACCESS POINTS.
3. THE ANCHOR TRENCH LOCATIONS SHOWN ARE CONCEPTUAL AND SUBJECT TO CHANGE BASED ON CONTRACTORS APPROVED PANEL LAYOUT.
4. THE CONTRACTOR SHALL INSTALL EMERGENCY GAS VENTS FOR EACH PANEL. PLEASE NOTE THAT NOT ALL VENTS ARE SHOWN ON THIS DRAWING. A PANEL IS DEFINED AS A SECTION OF TPO BETWEEN ANCHOR TRENCHES.
5. THE EMERGENCY GAS VENTS ARE GENERALLY CLOSED WITH A CAM GROOVE FITTING WHICH WILL BE OPENED MANUALLY IN THE EVENT OF PRESSURE BUILD UP. THE ACTIVE GAS COLLECTION SYSTEM MAY BE CONNECTED TO THESE VENTS IF DEEMED NECESSARY IN THE FUTURE FOR CONTINUOUS GAS EXTRACTION.
6. FIFTEEN 60-MIL TPO GEOMEMBRANE TEST PANELS TO BE PROVIDED IN DESIGNATED LOCATION.

LEGEND

- GW-38 PROPOSED LFG WELLS
- GW-38 EXISTING LFG WELLS
- ℄ ANCHOR TRENCH (TYPE 3)
- ℄ ANCHOR TRENCH (TYPE 2)
- ℄ ANCHOR TRENCH (TYPE 1)
- EXISTING LFG ACCESS POINT
- PROPOSED LFG ACCESS POINT
- REMOTE WELLHEAD
- PROPOSED GAS VENT
- ANCHOR TRENCH TYPE TRANSITION POINT

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

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2601 Cattlemen Rd., Ste. 106
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CA0000213

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	R. SIEMERING
REVIEWED BY	M. ROBERTS
CIVIL DESIGN	K. PERERA
DRAWN BY	L. KARSHNER
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

PHASE I TEMPORARY FINAL COVER LAYOUT AND ANCHOR TRENCH PLAN

0 1" 2"

FILENAME	00D--05.DWG
SCALE	1"=50'

SHEET C-13

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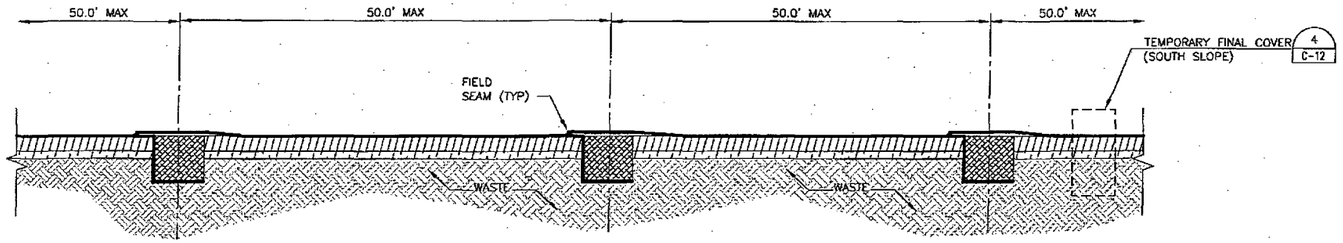
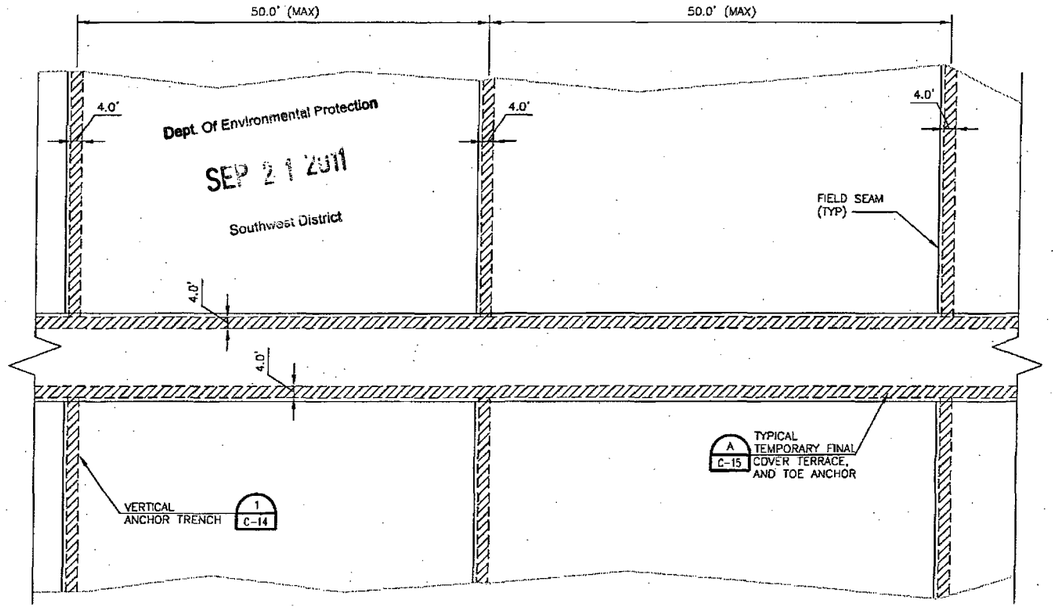


VERTICAL ANCHOR TRENCH SPACING
1 C-13 C-14

NOT TO SCALE

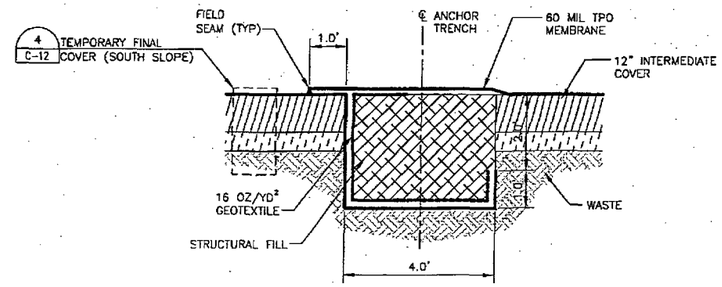
NOTES:

1. MAXIMUM CENTER TO CENTER DISTANCE OF VERTICAL ANCHOR TRENCHES SHALL NOT EXCEED 50 FT. ON 3:1 SIDESLOPES. HORIZONTAL ANCHOR TRENCHES SHOWN IN THE 2:1 SIDESLOPES SHALL NOT EXCEED 25 FT IN THE UPPER 1/3 OF SIDESLOPE AND 32 FT BELOW THE UPPER 1/3 OF THE SIDESLOPE.
2. THE CENTER TO CENTER DIMENSIONS SHOWN ARE CONCEPTUAL AND SUBJECT TO CHANGE BASED ON CONTRACTORS APPROVED PANEL LAYOUT.
3. DURING INSTALLATION OF TEMPORARY FINAL COVER (INCLUDING HORIZONTAL AND VERTICAL TRENCHES) THE CONTRACTOR SHALL MINIMIZE THE AMOUNT OF OPEN TRENCHES FOR ODOR AND STORMWATER CONTROL.
4. CONSTRUCTION ACTIVITIES SHALL BE SEQUENCED TO ALLOW GEOMEMBRANE TO BE PLACED IN THE ANCHOR TRENCH IMMEDIATELY FOLLOWING THE EXCAVATION OF THE ANCHOR TRENCH.
5. AS SOON AS CONSTRUCTION QUALITY ASSURANCE (CQA) PERSONNEL HAVE APPROVED THE DIMENSIONS, ALL OPEN TRENCHES SHALL BE BACKFILLED WITH SOIL AT THE END OF THE DAY.
6. CONTRACTOR SHALL USE CLEAN BACKFILL FOR ANCHORS. ANY SOLID WASTE REMOVED DURING EXCAVATION MUST BE PROPERLY DISPOSED OF IN ADJACENT ACTIVE LANDFILL CELL.
7. WEDGE WELD END OF GEOMEMBRANE PANEL TO BEGINNING OF NEW GEOMEMBRANE PANEL AND CONTINUE DOWNSLOPE. FLAP OF WEDGE WELD TO BE ON TOP IN THE DOWNSLOPE DIRECTION.
8. WELDS CONNECTING DOWNSLOPE SHEETS SHALL BE DOUBLE WEDGE WELDS, AND SHALL HAVE A MINIMUM 10 FT. VERTICAL OFFSET BETWEEN ADJACENT PANEL WELDS.
9. HOT ARC WELDS SHALL BE USED ONLY WHEN WEDGE WELDS ARE NOT FEASIBLE.
10. SEE SHEET 00C-13 FOR PLACEMENT OF TYPE 1, 2, AND 3 ANCHOR TRENCHES FOR VERTICAL ANCHOR TRENCHES.



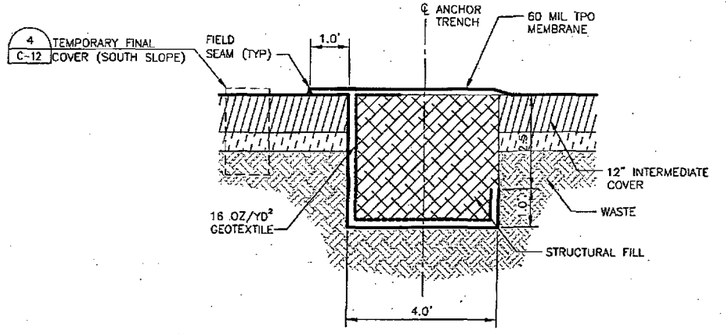
TYPICAL ANCHORING PLAN
2 C-14

NOT TO SCALE



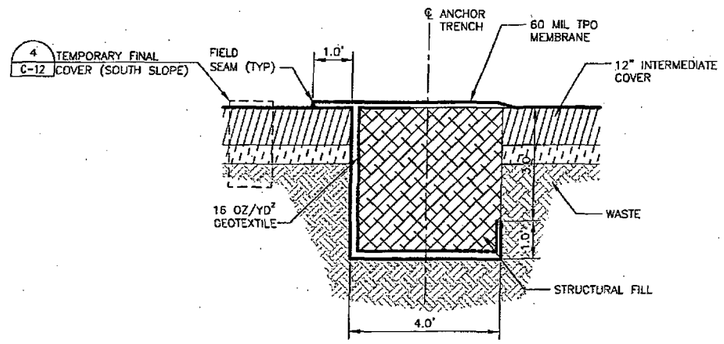
ANCHOR TRENCH (TYPE 1) – 3-FT DEPTH
3 C-13 C-15 C-16 C-17 C-18

NOT TO SCALE



ANCHOR TRENCH (TYPE 2) – 3.5-FT DEPTH
4 C-13

NOT TO SCALE



ANCHOR TRENCH (TYPE 3) – 4-FT DEPTH
5 C-13 C-16

NOT TO SCALE

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PROJECT MANAGER	R. SIEMERING
REVIEWED BY	M. ROBERTS
CIVIL DESIGN	K. PERERA
DRAWN BY	L. KARSHNER
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex
PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS
FLORIDA

PHASE I TEMPORARY FINAL COVER ANCHOR TRENCH SECTIONS AND DETAILS

0 1" 2"

FILENAME 00D-06.DWG
SCALE AS SHOWN

SHEET C-14

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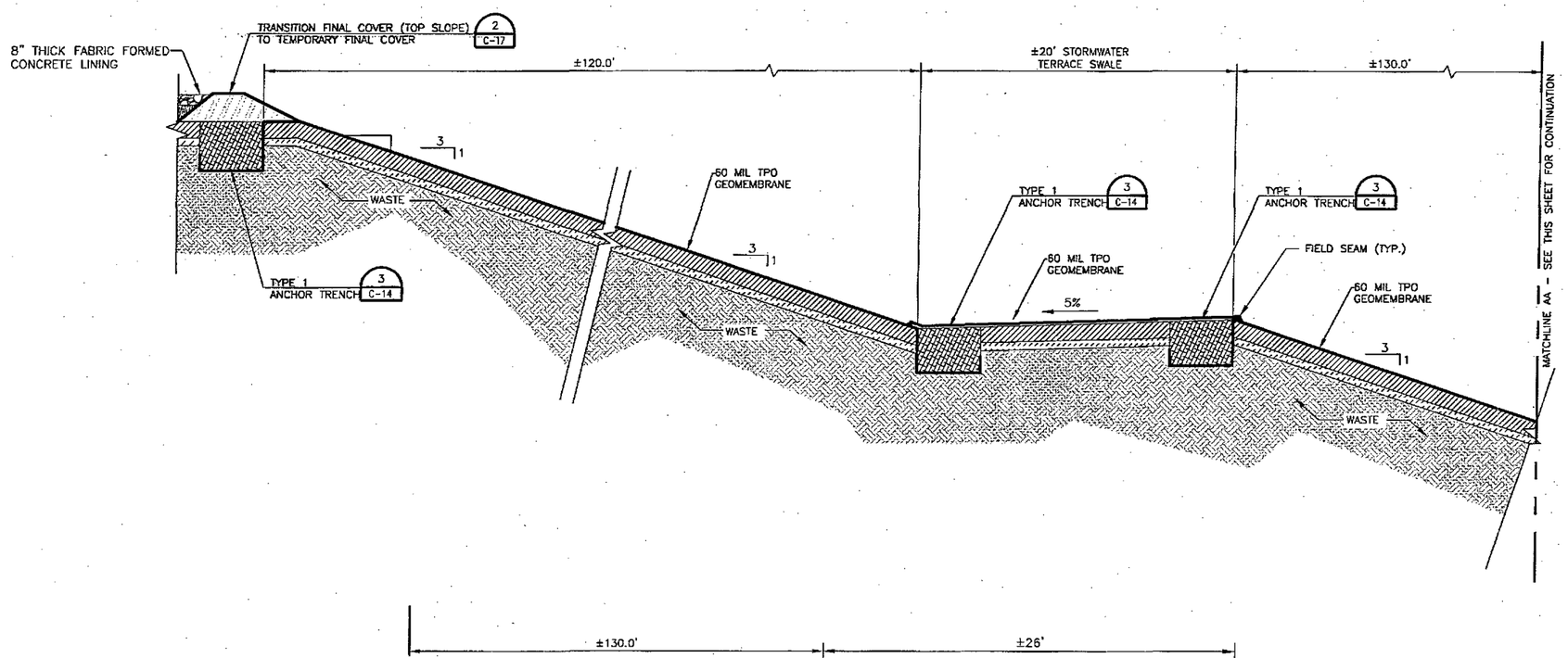
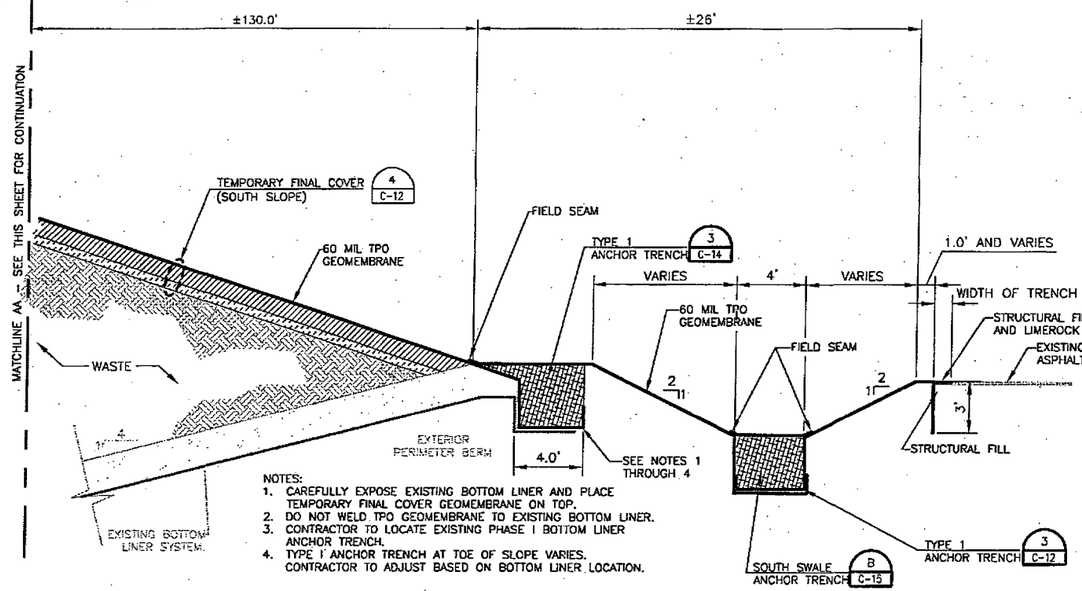


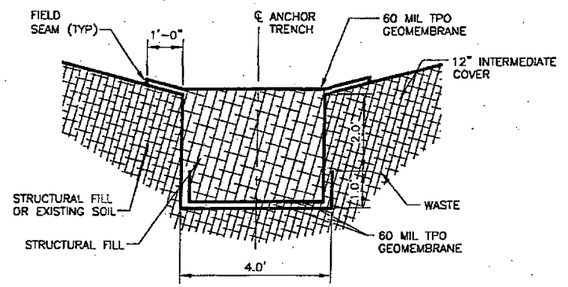


NOTES:
1. CAREFULLY EXPOSE EXISTING BOTTOM LINER AND PLACE TEMPORARY FINAL COVER GEOMEMBRANE ON TOP.
2. DO NOT WELD TPO GEOMEMBRANE TO EXISTING BOTTOM LINER.
3. CONTRACTOR TO LOCATE EXISTING PHASE I BOTTOM LINER ANCHOR TRENCH.
4. TYPE I ANCHOR TRENCH AT TOE OF SLOPE VARIES. CONTRACTOR TO ADJUST BASED ON BOTTOM LINER LOCATION.

TYPICAL TEMPORARY FINAL COVER TERRACE AND TOE ANCHOR

A C-13

NOT TO SCALE



SOUTH SWALE ANCHOR TRENCH

B C-15 C-16

NOT TO SCALE

Dept. Of Environmental Protection

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Southwest District

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ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	R. SIEMERING
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CIVIL DESIGN	K. PERERA
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SARASOTA COUNTY

Central County Solid Waste Disposal Complex

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SARASOTA COUNTY FLORIDA

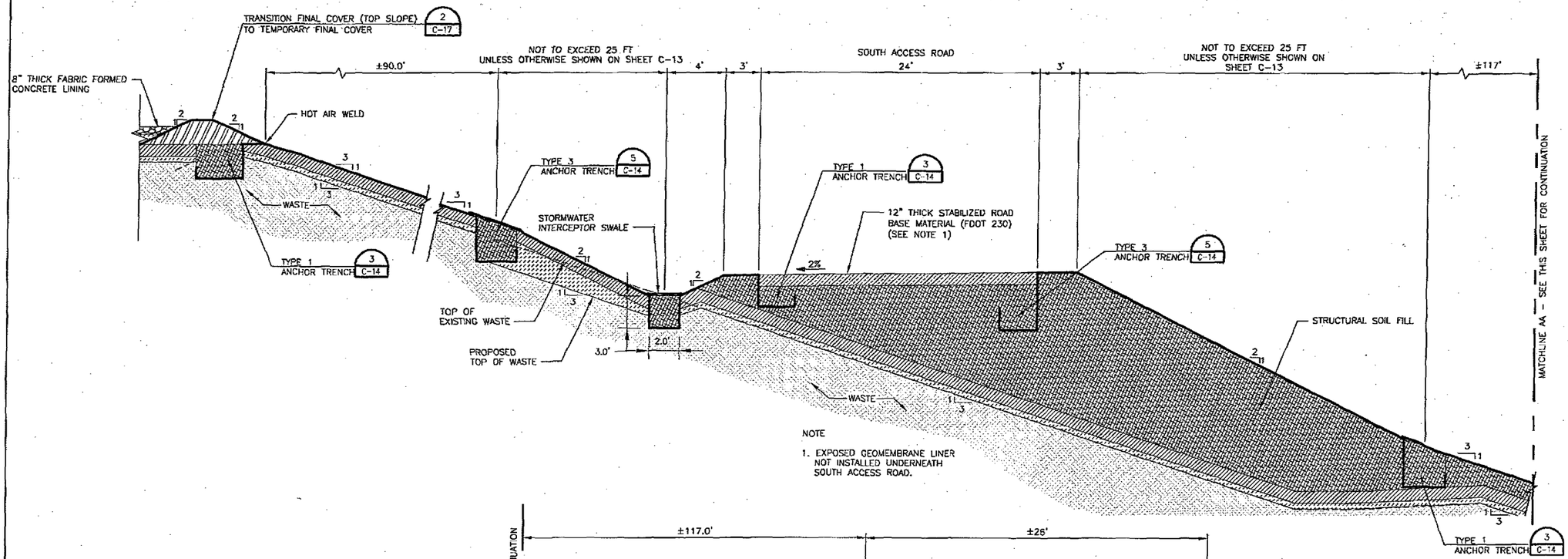
PHASE I TEMPORARY FINAL COVER ANCHOR TRENCH SECTIONS AND DETAILS

0 1" 2"

FILENAME	00D-07.DWG
SCALE	AS SHOWN

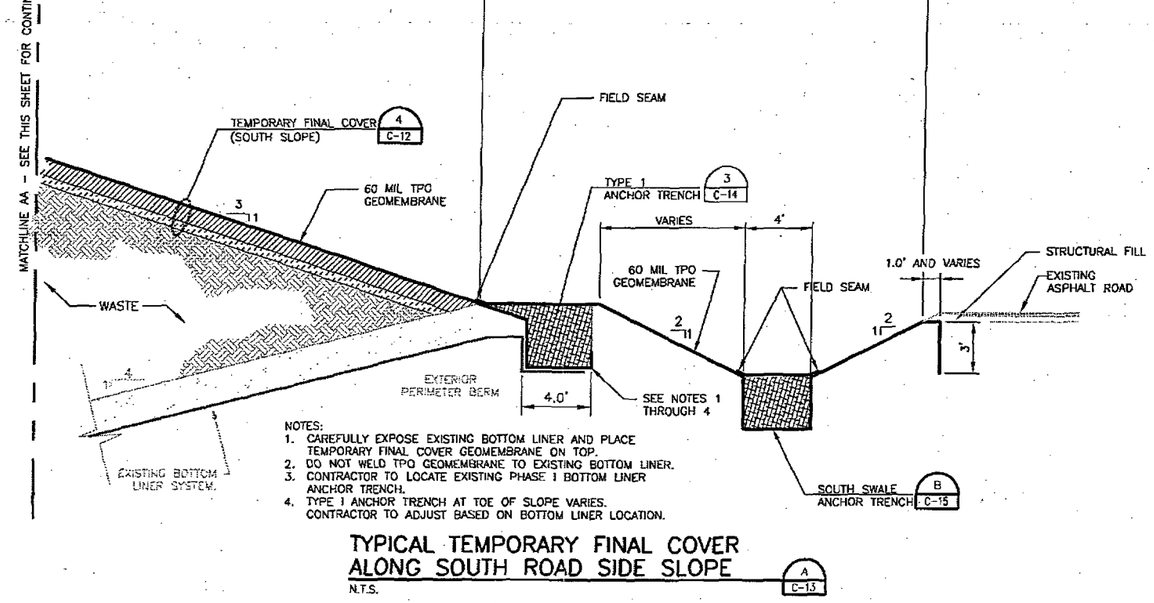
SHEET C-15

c:\pwworking\tpa\d0318297\00D-07.dwg, Plot, 9/14/2011 11:38:02 AM, BradJohn



NOTE

1. EXPOSED GEOMEMBRANE LINER NOT INSTALLED UNDERNEATH SOUTH ACCESS ROAD.



NOTES:

1. CAREFULLY EXPOSE EXISTING BOTTOM LINER AND PLACE TEMPORARY FINAL COVER GEOMEMBRANE ON TOP.
2. DO NOT WELD TPO GEOMEMBRANE TO EXISTING BOTTOM LINER.
3. CONTRACTOR TO LOCATE EXISTING PHASE 1 BOTTOM LINER ANCHOR TRENCH.
4. TYPE 1 ANCHOR TRENCH AT TOE OF SLOPE VARIES. CONTRACTOR TO ADJUST BASED ON BOTTOM LINER LOCATION.

TYPICAL TEMPORARY FINAL COVER ALONG SOUTH ROAD SIDE SLOPE

N.T.S. A C-13

Dept. Of Environmental Protection

SEP 21 2011

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PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

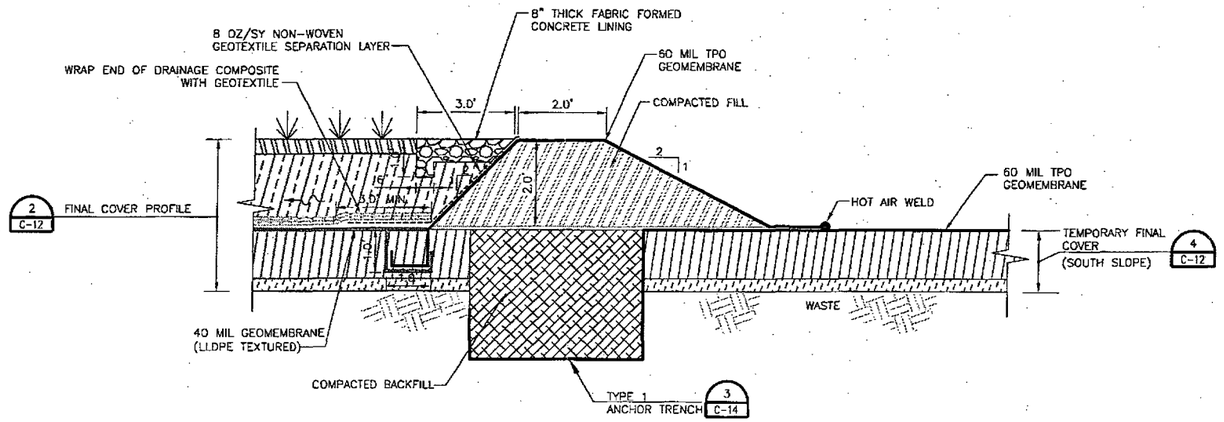
PHASE I TEMPORARY FINAL COVER ANCHOR TRENCH SECTIONS AND DETAILS

0 1" 2"

FILENAME	00D-08.DWG
SCALE	AS SHOWN

SHEET C-16

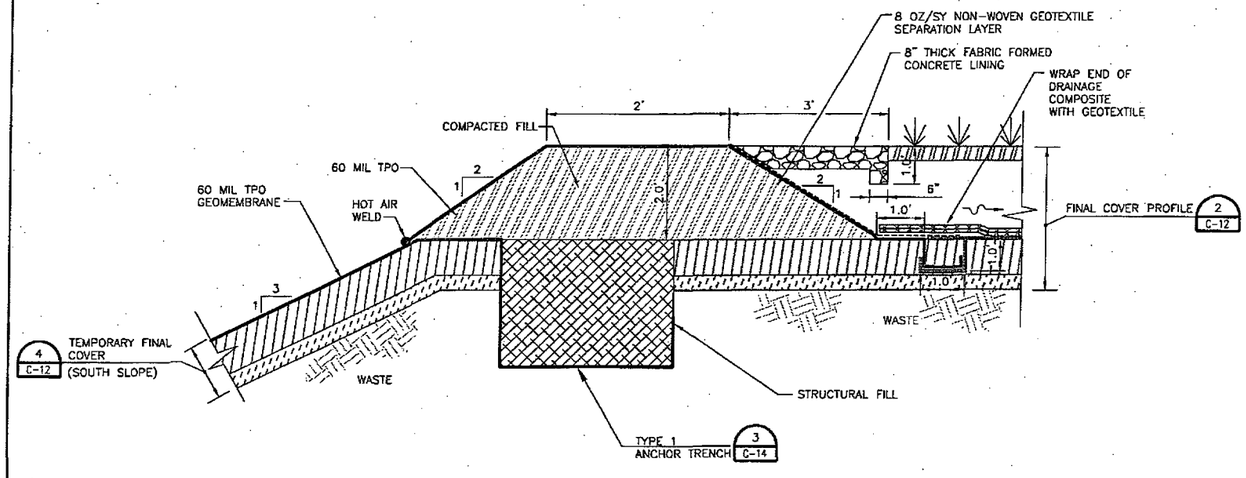
c:\pwworking\tpa\d0318227\00D-08.dwg, Plot, 9/14/2011 11:38:05 AM, BradJohn



TRANSITION FINAL COVER (SIDESLOPE) TO TEMPORARY FINAL COVER

NOT TO SCALE

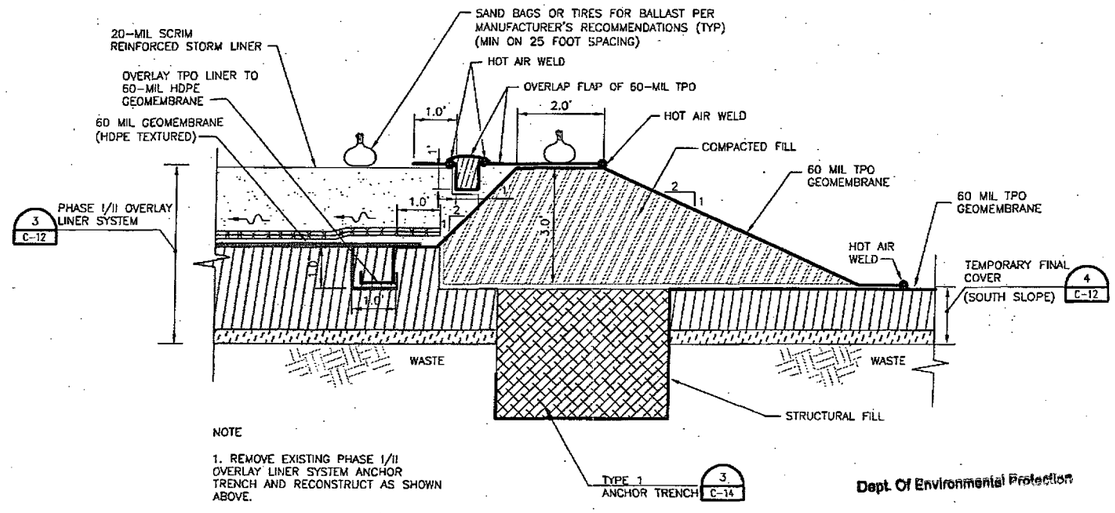
1 C-05 C-13



TRANSITION FINAL COVER (TOPSLOPE) TO TEMPORARY FINAL COVER

NOT TO SCALE

2 C-05 C-13 C-15



NOTE

1. REMOVE EXISTING PHASE I/II OVERLAY LINER SYSTEM ANCHOR TRENCH AND RECONSTRUCT AS SHOWN ABOVE.

TRANSITION PHASE I/II OVERLAY LINER TO TEMPORARY FINAL COVER

NOT TO SCALE

3 C-05 C-13

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

HDR Engineering, Inc.
2621 Cattleman Rd., Ste. 108
Sarasota, Fl 34232-6212
(941) 342-2700
CA0004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	M. ROBERTS
CIVIL DESIGN	K. PERERA
DRAWN BY	L. KARSHNER
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

PHASE I TEMPORARY FINAL COVER CLOSURE DETAILS

0 1" 2"

FILENAME	00D-09.DWG
SCALE	AS SHOWN

SHEET C-17

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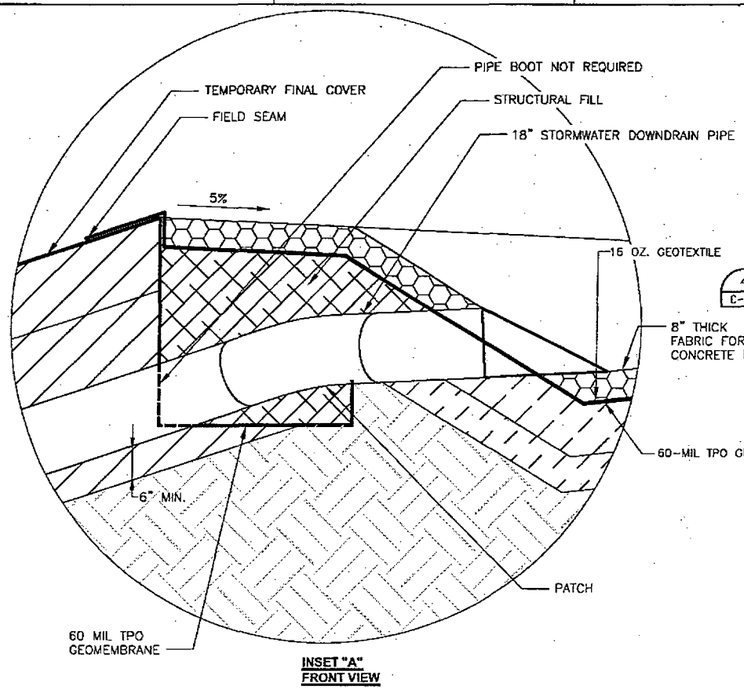
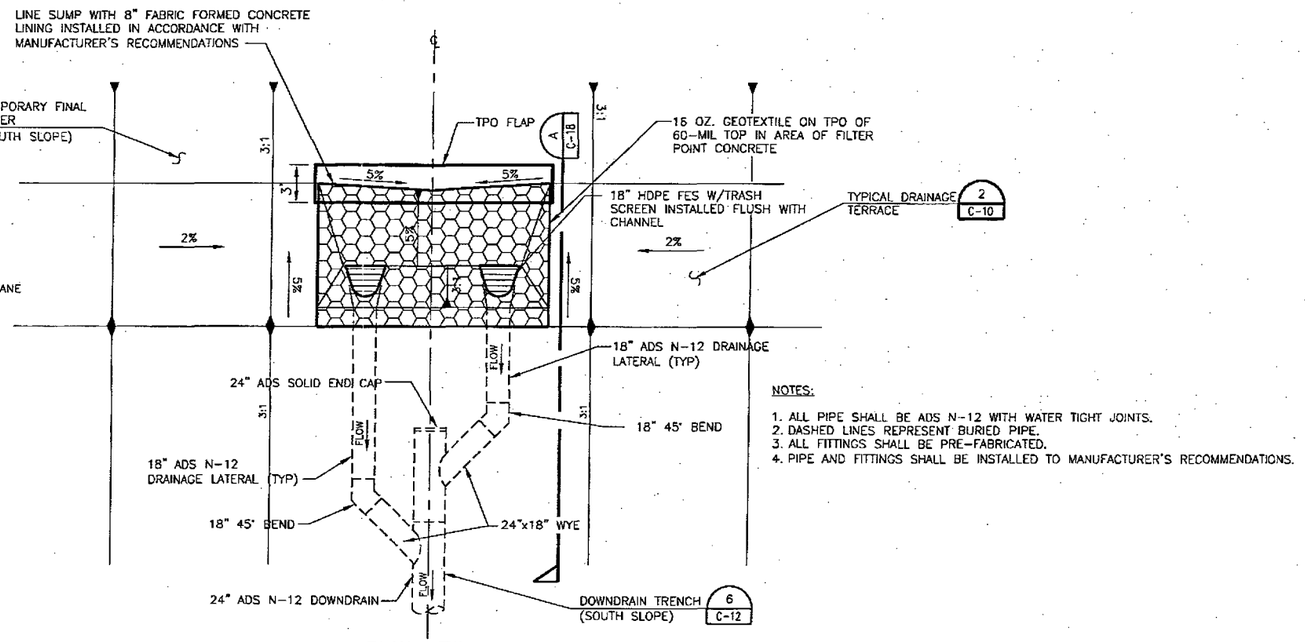


INSET "A" FRONT VIEW



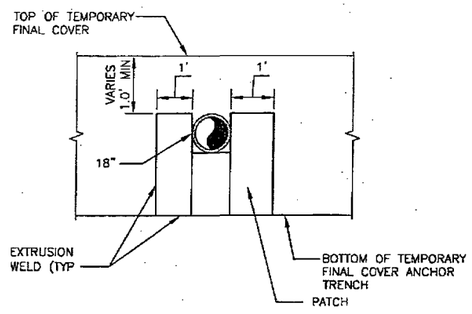
PLAN VIEW

NOTES:

1. ALL PIPE SHALL BE ADS N-12 WITH WATER TIGHT JOINTS.
2. DASHED LINES REPRESENT BURIED PIPE.
3. ALL FITTINGS SHALL BE PRE-FABRICATED.
4. PIPE AND FITTINGS SHALL BE INSTALLED TO MANUFACTURER'S RECOMMENDATIONS.

TERRACE/DOWNDRAIN INTERSECTION (SOUTH SLOPE)

NOT TO SCALE — 1 C-05 C-13



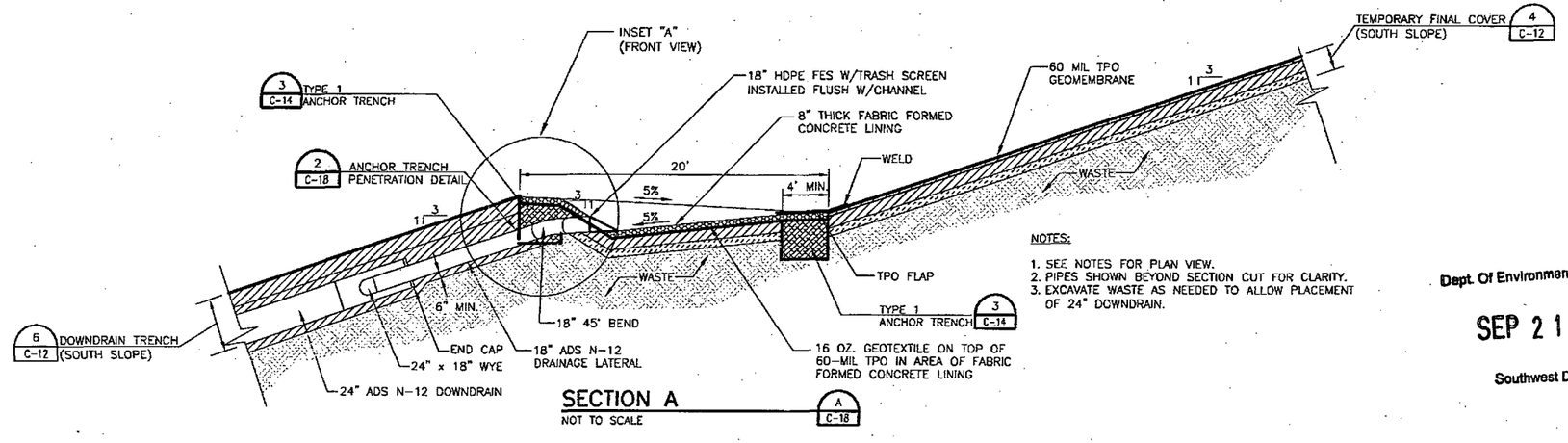
SIDE

NOTES:

1. CONTRACTOR TO USE CAUTION WHEN EXCAVATING AROUND EXISTING UNDERGROUND PIPING SYSTEM.
2. CUT GEOMEMBRANE AROUND EXISTING PIPE.
3. PLACE GEOMEMBRANE PATCH AROUND PIPE PENETRATION. OVERLAP MIN. 1' ON EACH SIDE AND EXTRUSION WELD ALL SEAMS.

TYPICAL TEMPORARY FINAL COVER ANCHOR TRENCH PENETRATION DETAIL

NOT TO SCALE — 2 C-18 C-19



SECTION A

NOT TO SCALE — A C-18

NOTES:

1. SEE NOTES FOR PLAN VIEW.
2. PIPES SHOWN BEYOND SECTION CUT FOR CLARITY.
3. EXCAVATE WASTE AS NEEDED TO ALLOW PLACEMENT OF 24" DOWNDRAIN.

Dept. Of Environmental Protection

SEP 2 1 2011

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CIVIL DESIGN	K. PERERA
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PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY — FLORIDA

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

PHASE I TEMPORARY FINAL COVER CLOSURE DETAILS

0 1" 2"

FILENAME 00D-10.DWG
SCALE AS SHOWN
SHEET C-18

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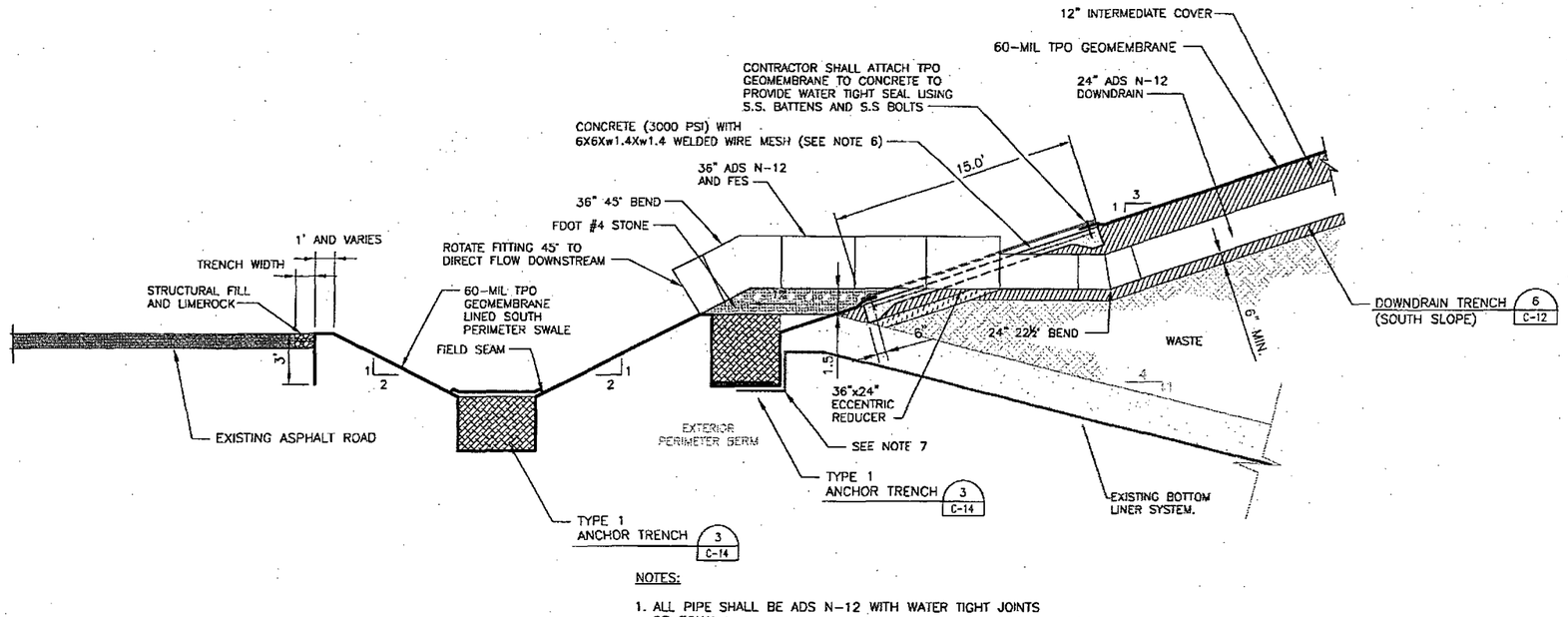

NOTES:

1. ALL PIPE SHALL BE ADS N-12 WITH WATER TIGHT JOINTS OR EQUAL.
2. ALL PIPE FITTINGS SHALL BE PREFABRICATED AND SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
3. CAREFULLY EXPOSE EXISTING BOTTOM LINER AND PLACE TPO GEOMEMBRANE ON TOP.
4. DO NOT WELD TPO GEOMEMBRANE TO EXISTING BOTTOM LINER.
5. ANNULAR SPACE BETWEEN CONCRETE AND PIPE SHALL BE FILLED WITH LINK SEAL OR APPROVED EQUAL.
6. CONCRETE PAD SHALL BE LENGTH SHOWN AND WIDTH BASED ON FDOT INDEX 273 FOR MITERED END SECTION FOR 36" PIPE.
7. CONTRACTOR TO LOCATE EXISTING PHASE I BOTTOM LINER ANCHOR TRENCH.

STORMWATER DOWNDRAIN DISCHARGE (SOUTH SLOPE) 1 C-13

NOT TO SCALE

Dept. Of Environmental Protection

SEP 2 1 2011

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SARASOTA COUNTY

Central County Solid Waste Disposal Complex

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SARASOTA COUNTY, FLORIDA

PHASE I TEMPORARY FINAL COVER CLOSURE DETAILS

0 1" 2"

FILENAME	00D-11.DWG
SCALE	AS SHOWN

SHEET C-19

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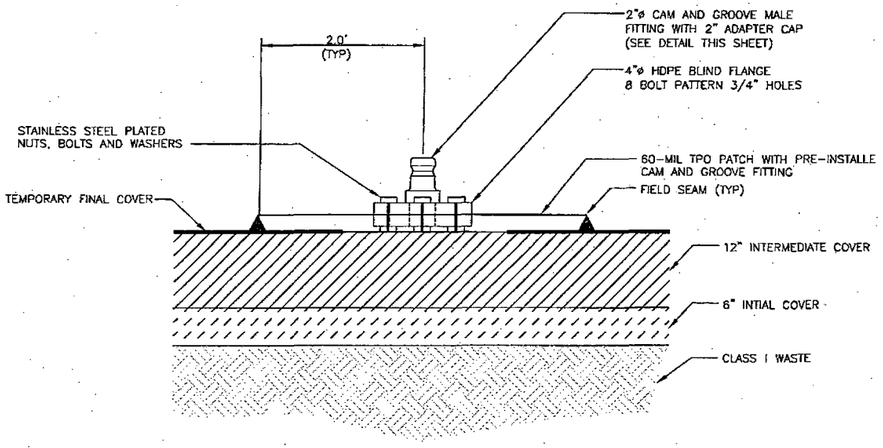
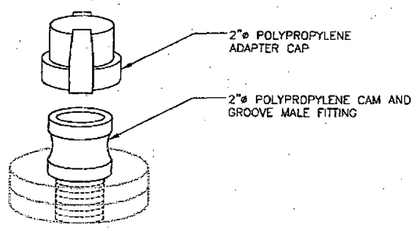


EMERGENCY GAS VENT

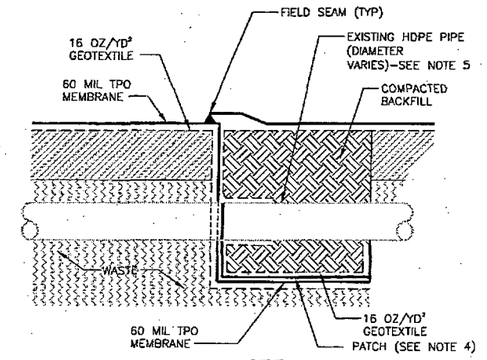
NOT TO SCALE

1 / C-13

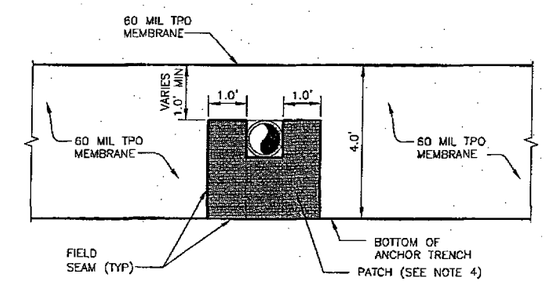


CAM AND GROOVE FITTING DETAIL

NOT TO SCALE



SIDE



FRONT

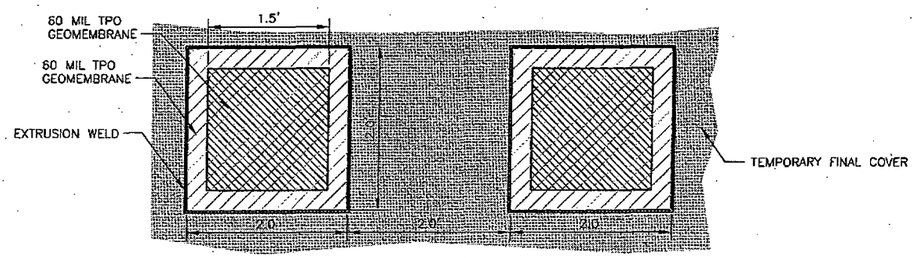
NOTES:

1. CONTRACTOR TO USE CAUTION WHEN EXCAVATING AROUND EXISTING UNDERGROUND PIPING SYSTEM.
2. CUT GEOMEMBRANE AROUND EXISTING PIPE.
3. PLACE GEOMEMBRANE PATCH AROUND PIPE PENETRATION, OVERLAP MIN 1' ON EACH SIDE AND FIELD SEAM AS SHOWN.
4. PATCH WILL CONSIST OF A 60 MIL TPO WELDED TO SEC AS SHOWN TO STRENGTHEN THE GEOMEMBRANE UNDERNEATH THE HEADER.
5. FOR LANDFILL GAS PIPING, PENETRATION WOULD BE REQUIRED FOR LATERAL OR HEADER, AIRLINE, AND FORCEMAIN, UP TO 3 PIPES AT EACH CROSSING.

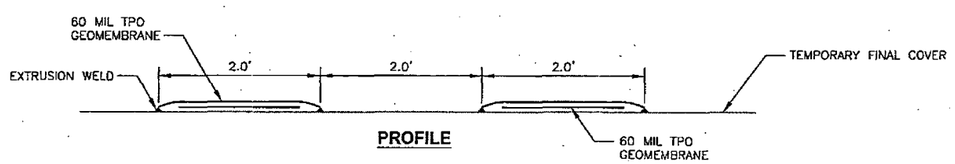
LANDFILL GAS PIPE AND ANCHOR TRENCH PENETRATION

N.T.S.

3 / C-13



PLAN



PROFILE

GEOMEMBRANE TEST PANELS

NOT TO SCALE

2 / C-13

Dept. Of Environmental Protection

SEP 2 1 2011

Southwest District

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HDR Engineering, Inc.
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CA#0004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	M. ROBERTS
CIVIL DESIGN	K. PERERA
DRAWN BY	L. KARSHNER
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

PHASE I TEMPORARY FINAL COVER CLOSURE DETAILS

0 1" 2"

FILENAME 00D-12.DWG

SCALE AS SHOWN

SHEET C-20

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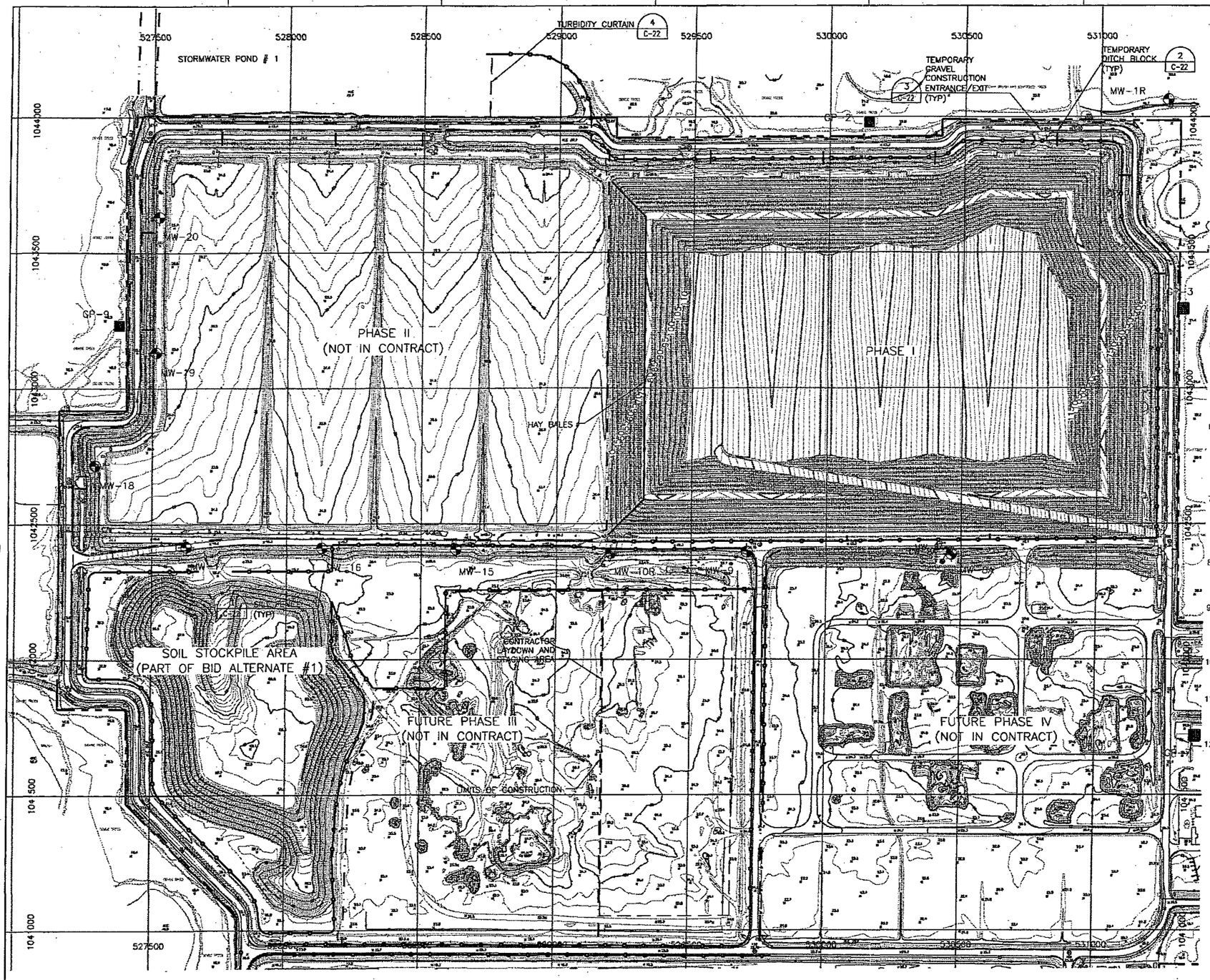

N

SEDIMENT AND EROSION CONTROL NOTES

1. SOIL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSTALLED IN STRICT ACCORDANCE WITH STANDARDS IN THE CONSTRUCTION DOCUMENTS AND APPLICABLE ENVIRONMENTAL REGULATIONS.
2. ALL STORM WATER MANAGEMENT AND EROSION CONTROL MEASURES SHALL BE INSTALLED AND MADE OPERATIONAL PRIOR TO COMMENCEMENT OF EARTHWORK ACTIVITIES.
3. CONTRACTOR, OWNER AND ENGINEER WILL EVALUATE THE EXISTING CONDITION OF THE PERIMETER DRAINAGE CHANNELS AT START OF WORK. CONTRACTOR WILL BE RESPONSIBLE FOR MAINTAINING THE CHANNEL AND PONDS AND RESTORING THEM TO THE ORIGINAL CONDITION AT START OF WORK PRIOR TO DEMOBILIZING.
4. EROSION CONTROL MEASURES SHALL BE INSTALLED AND MAINTAINED TO THE SATISFACTION OF THE ENGINEER. FAILURE TO DO SO WILL RESULT IN STOPPAGE OF ALL OTHER WORK UNTIL SAID MEASURES COMPLY WITH ACCEPTABLE STANDARDS.
5. STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS PRACTICABLE IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED, BUT IN NO CASE MORE THAN 6 WEEKS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED, UNLESS ACTIVITY IN THAT PORTION OF THE SITE WILL RESUME WITHIN 8 WEEKS.
6. ADDITIONAL TEMPORARY DITCHES AND/OR DIVERSIONS MAY BE REQUIRED TO PERFORM CONSTRUCTION. WHERE SUCH MEASURES ARE REQUIRED, THEY SHALL BE CONSTRUCTED SO AS TO DIRECT RUNOFF FROM DISTURBED AREAS TO APPROPRIATE TEMPORARY CONTROL FEATURES. NO ADDITIONAL PAYMENT SHALL BE MADE FOR ADDITIONAL MEASURES REQUIRED TO CONTROL EROSION.
7. ALL SEDIMENT CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE EVERY SEVEN CALENDAR DAYS AND AFTER ANY STORM EVENT OF GREATER THAN ONE-HALF INCH OF PRECIPITATION DURING ANY 24 HOUR PERIOD. ALL SEDIMENT CONTROL FEATURES SHALL BE MAINTAINED UNTIL FINAL STABILIZATION HAS BEEN OBTAINED.
8. RESTORE AND STABILIZE ALL DISTURBED AREAS INCLUDING STOCKPILES AND STORAGE AREAS. PERFORM PERMANENT SEEDING IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
9. BETWEEN SUBSTANTIAL COMPLETION AND FINAL COMPLETION OF THE WORK, THE CONTRACTOR SHALL REMOVE ALL SEDIMENT FROM THE EROSION CONTROL MEASURES THAT RECEIVED DRAINAGE DURING CONSTRUCTION UNLESS OTHERWISE DIRECTED BY OWNER.
10. ANY ERODED MATERIALS SHALL BE PROMPTLY REMOVED FROM ROADWAYS, DRIVES, WALKS, DITCHES, WATER COURSES, DRAINAGE CULVERTS, AND/OR STRUCTURES.
11. SILT FENCE, STRAW BALE BARRIERS, ETC. SHALL BE CHECKED REGULARLY FOR UNDERMINING OR DETERIORATION. CONTRACTOR SHALL REPLACE AS REQUIRED.
12. ALL TEMPORARY EROSION CONTROL AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED UPON SATISFACTORY COMPLETION OF WORK AND SITE STABILIZATION.

GENERAL NOTES

1. TOPOGRAPHY WITHIN PHASES I THROUGH IV AREAS COMPILED BY KUCERA INTERNATIONAL, INC. OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 2, 2010.
2. APPROXIMATE LOCATION OF PHASE I LEACHATE FORCEMAIN OBTAINED FROM RECORD DRAWINGS BY CAMP DRESSER & McKEE, INC. DATED APRIL 1998. VERIFY LOCATION IN FIELD.
3. CONTOURS WITHIN PHASE I CLOSURE AREA REPRESENT PROPOSED TOP OF FINAL COVER.

LEGEND

- GP-1 GAS PROBE
- MW-10R GROUNDWATER MONITORING WELL
- VEGETATION
- WATERWAY
- SPECIAL EXCEPTION BOUNDARY
- EXISTING ROADWAY
- PHASE BOUNDARY
- SILT FENCE
- EXISTING PHASE I LEACHATE FORCEMAIN (SEE GENERAL NOTE 2)
- LIMITS OF CONSTRUCTION
- HAY BALES

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

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ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	J. TIMMONS, R. SIEMERING
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

THOMAS M. YANOSCHAK, P. E.
CERTIFICATE NO. 44200

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

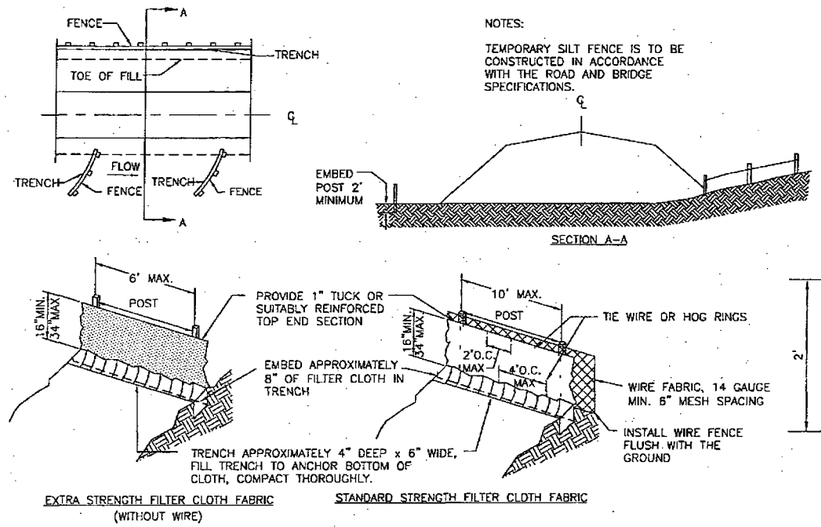
FLORIDA

SEDIMENTATION AND EROSION CONTROL PLAN

0 1" 2"

FILENAME	00D-13.DWG
SCALE	1"=200'
SHEET	C-21

c:\pwworking\tpal\d0318297\00D-13.dwg, Plot, 9/14/2011 11:38:31 AM, BradJohn



SILT FENCE

NOT TO SCALE

1 C-21

CONSTRUCTION SPECIFICATIONS

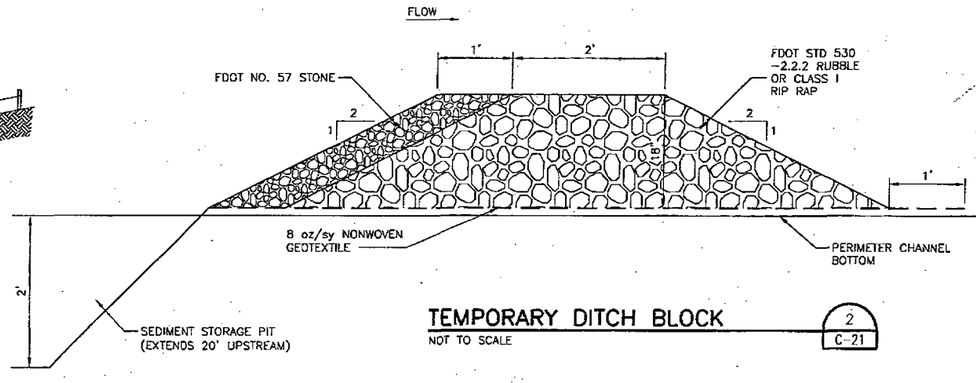
MATERIALS

1. SYNTHETIC FILTER FABRIC SHALL BE A PERVIOUS SHEET OF POLYPROPYLENE, NYLON PLOYESTER, OR ETHYLENE YARN AND SHALL BE CERTIFIED BY THE MANUFACTURER OR SUPPLIER AS CONFORMING TO THE FOLLOWING REQUIREMENTS:

PHYSICAL PROPERTY	TEST	REQUIREMENTS
FILTERING EFFICIENCY	ASTM D-5141	75% (MIN)
TENSILE STRENGTH AT 20% (MAX.) ELONGATION*	VTM-52	EXTRA STRENGTH- 50 LBS./LIN. IN. (MIN.) STANDARD STRENGTH- 30 LBS./LIN. IN. (MIN.)
FLOW RATE	ASTM D-5141	0.3 GAL./SQ. FT./MIN.
ULTRAVIOLET RADIATION	ASTM D-4355 AND G-28	90% (MIN.)

* REQUIREMENTS REDUCED BY 50% AFTER 6 MONTHS OF INSTALLATION.

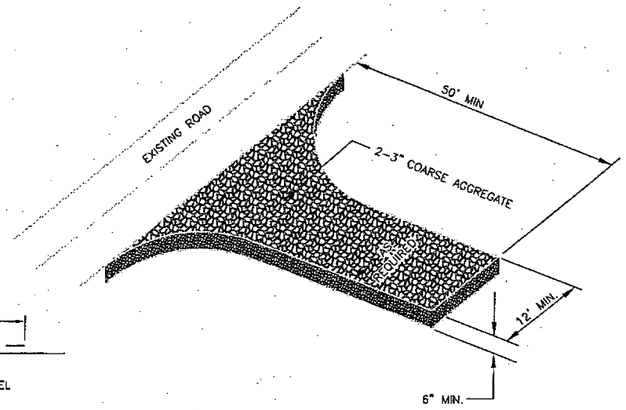
2. SYNTHETIC FILTER FABRIC SHALL CONTAIN ULTRAVIOLET RAY INHIBITORS AND STABILIZERS TO PROVIDE A MINIMUM OF 6 MONTHS OF EXPECTED USABLE CONSTRUCTION LIFE AT A TEMPERATURE RANGE OF 0 F TO 120 F.



TEMPORARY DITCH BLOCK

NOT TO SCALE

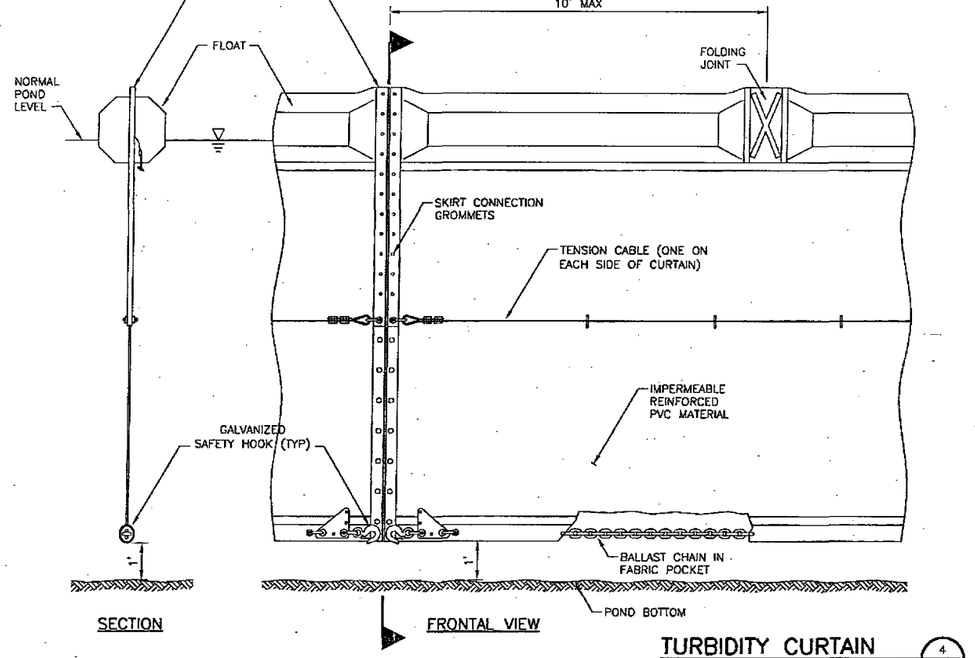
2 C-21



TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT

NOT TO SCALE

3 C-21



TURBIDITY CURTAIN

NOT TO SCALE

4 C-21

NOTES

1. CONTRACTOR SHALL INSPECT TURBIDITY CURTAIN ACCORDING TO INSPECTION SCHEDULE AND REPAIR ANY OBSERVED DAMAGE.
2. CONTRACTOR SHALL MEASURE SEDIMENT LEVELS IMMEDIATELY UPSTREAM OF CURTAIN AFTER ANY STORM EVENT OF GREATER THAN ONE-HALF INCH OF PRECIPITATION DURING ANY 24 HUOR PERIOD. SEDIMENT SHALL BE REMOVED OR CURTAIN MOVED FURTHER DOWNSTREAM IF SEDIMENT LEVEL REACHES BOTTOM OF CURTAIN.

TURBIDITY CURTAIN SPECIFICATIONS

CURTAIN MATERIAL: IMPERMEABLE REINFORCED PVC
MIN. TENSILE STRENGTH - 300 LB/IN
MIN. FABRIC WT. - 13 OZ/SY
TEAR STRENGTH - 80 LBS
TENSILE STRENGTH AFTER ABRASION - 200 LB/IN
RESISTANT TO MARINE GROWTH, ULTRA VIOLET LIGHT, AND MILDEW
ALL FABRIC SHALL BE HEAT SEALED.

FLOATS: SOLID, CLOSED-CELL, PLASTIC FOAM SEALED IN FABRIC POCKET. PROVIDE BUOYANT RATIO > 5
MAX. LENGTH 10'

BALLST CHAIN: NON-CORROSIVE
2 LB/IN WEIGHT

TENSION CABLE: GALVANIZED OR STAINLESS STEEL WIRE ROPE

MOORING: AS RECOMMENDED BY MANUFACTURER FOR PROPOSED APPLICATION

Dept. Of Environmental Protection

SEP 21 2011

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FLORIDA

SEDIMENTATION AND EROSION CONTROL DETAILS

0 1" 2"

FILENAME	00D-14.DWG
SCALE	AS SHOWN

SHEET C-22

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ENGINEERING SYMBOLOGY

HP	HIGH POINT
LP	LOW POINT
S-1	PROPOSED CONDENSATE SUMP
GW-49	PROPOSED LFG EXTRACTION WELL
AP	PROPOSED ACCESS POINT
KO	PROPOSED KNOCKOUT POT
U1	PROPOSED U-TRAP
	PROPOSED REMOTE WELLHEAD
	EXISTING LEACHATE SUMP
	EXISTING LEACHATE CLEANOUT
	PROPOSED AIRLINE/FORCE MAIN VALVE PIT
	PROPOSED HEADER ISOLATION VALVE PIT
	PROPOSED ECCENTRIC REDUCER
	PROPOSED STRAW BALE BARRIER
	PROPOSED TEMPORARY DITCH BLOCK
	EXISTING SOLAR FLARE
GP-7	EXISTING GAS PROBE
MW-14	EXISTING GROUNDWATER MONITORING WELL
	EXISTING WATER SUPPLY WELL
	PROPOSED ELECTRICAL HOUSING
	PROPOSED SILT FENCE
	PROPOSED 2" HDPE SDR 9 AIR SUPPLY LINE
	PROPOSED 4" HDPE SDR 9 CONDENSATE RETURN LINE
	PROPOSED 4" HDPE SDR 11 LATERAL
	PROPOSED 6" HDPE SDR 11 LATERAL
	PROPOSED 8" HDPE SDR 11 LATERAL
	PROPOSED HDPE SDR 17 HEADER
	EXISTING MAJOR/MINOR CONTOURS
40	PROPOSED MAJOR/MINOR CONTOURS
	PHASE LIMITS
	CELL LIMITS
	PROPERTY LINE
	EXISTING 6" LEACHATE FORCEMAIN
	PROPOSED CHAIN LINK FENCE
	EXISTING CHAIN LINK FENCE
	LIMITS OF CONSTRUCTION
UGE	PROPOSED UNDERGROUND ELECTRIC CONDUIT
UGT	PROPOSED UNDERGROUND TELEPHONE CONDUIT

DETAILS LEGEND OF PATTERNS

CLEAN BACKFILL

PIPE BEDDING (DEFINED AS FIELD COMPACTED AND LEVELED BACKFILL OR EQ.)

INTERMEDIATE COVER

WASTE

BENTONITE SEAL

EXISTING GROUND

STONE

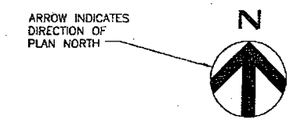
ONSITE SOIL

CONCRETE

ASPHALT

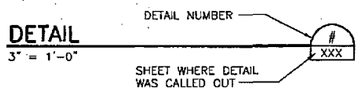
NOTE
SYMBOLOGY IS REPRESENTATIVE OF MAJOR LANDFILL GAS COMPONENTS.

GENERAL SYMBOLOGY



DETAIL MARKER

FOR REFERENCING DETAILS INCLUDED IN DRAWING SET.



DETAIL TITLE

GENERAL NOTES

SURVEY AND MAP REPORT:

1. TOPOGRAPHY WITHIN PHASES I THROUGH IV AREAS COMPILED BY KUCERA INTERNATIONAL INC., OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 2010.

SPECIFIC NOTES:

1. 2 WEEKS PRIOR TO INITIATING WORK, THE CONTRACTOR WILL SUBMIT FOR APPROVAL A SCHEDULE TO THE ENGINEER, FOR COMPLETION OF THE PROJECT.
2. ALL EXCAVATION AND DRILLING WITHIN THE LANDFILL LIMITS SHALL CEASE PRIOR TO 3:00 PM. ALL WASTE EXCAVATED SHALL BE DELIVERED TO THE ACTIVE FACE OF THE LANDFILL DAILY BY 5:00 PM. WASTE NOT TAKEN TO WORKING FACE SHALL BE CONVERED OR CONTAINERIZED. CHANGES IN WORK HOURS ARE BASED UPON OWNER'S APPROVAL.
3. HOURS FOR CONSTRUCTION: 7:00 AM TO 7:00 PM MONDAY THRU SATURDAY, NO WORK ALLOWED ON SUNDAY UNLESS OTHERWISE APPROVED BY OWNER AND PERMIT WITH A MAXIMUM OF 60 HOURS PER WEEK.
4. CONTRACTOR MAY CONTAINERIZE WASTE AND TARP OVERNIGHT BASED ON OWNER APPROVAL.

EROSION AND SEDIMENT CONTROL:

1. CONTRACTOR WILL ADD EROSION AND SEDIMENT CONTROL AS NECESSARY TO PREVENT SEDIMENTATION AND DAMAGE TO ADJACENT AREAS AND AS DIRECTED BY THE OWNER'S REPRESENTATIVE.
2. CONTRACTOR WILL INSPECT AND REPAIR, AS NECESSARY, ANY EROSION AND SEDIMENT CONTROL DAILY AND FOLLOWING EACH RAIN.
3. EROSION AND SEDIMENT CONTROL WILL BE INSTALLED PRIOR TO CONSTRUCTION AND SHALL BE MAINTAINED UNTIL PERMANENT GROUND COVER IS ESTABLISHED.
4. CONTRACTOR IS RESPONSIBLE FOR MONITORING DOWNSTREAM CONDITIONS THROUGHOUT THE CONSTRUCTION PERIOD AND CLEARING ANY DEBRIS AND SEDIMENT RESULTING FROM CONSTRUCTION.
5. EROSION CONTROL FENCING MUST MEET THE REQUIREMENT OF THE DEPARTMENT OF TRANSPORTATION, STATE OF FLORIDA STANDARD SPECIFICATIONS. EROSION CONTROL MEASURES WILL BE MAINTAINED AT ALL TIMES.
6. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES WILL BE INSTALLED IF DEEMED NECESSARY BY ON-SITE INSPECTION.

EARTHWORK:

1. EXCAVATION IS UNCLASSIFIED AND INCLUDES REMOVAL OF EARTH FILLS, RUBBLE, TRASH, AND OTHER MATERIALS ENCOUNTERED IN EXCAVATION AND GRADING OPERATIONS TO DEPTH AND EXTENT SHOWN ON DRAWINGS OR SPECIFIED. THE OWNER'S REPRESENTATIVE SHALL BE THE FINAL AUTHORITY AND SHALL MAKE THE FINAL DECISION DURING CONSTRUCTION AS TO THE DEPTH AND EXTENT TO WHICH MATERIALS MUST BE REMOVED AND REPLACED.
2. SURVEY BENCHMARKS, MONUMENTS AND OTHER REFERENCE POINTS WILL BE PROTECTED FROM DAMAGE AND DISPLACEMENT. IF DISTURBED OR DESTROYED, THEY WILL BE REPLACED AT THE CONTRACTOR'S EXPENSE.
3. CONTRACTOR SHALL KEEP DIRT, DUST, NOISE AND OTHER OBJECTIONABLE NUISANCES TO A MINIMUM.
4. ALL FILL AREAS ARE TO BE COMPACTED AS DEFINED IN THE SPECIFICATIONS AND DRAWINGS.
5. CUT AND FILL SLOPES FOR STRUCTURAL EMBANKMENTS SHALL NOT EXCEED 3 HORIZONTAL TO 1 VERTICAL.

UTILITIES:

1. THERE MAY BE OTHER UTILITIES NOT SHOWN ON THESE PLANS. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR LOCATIONS SHOWN AND IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE LOCATIONS OF ALL UTILITIES WITHIN THE LIMITS OF THE WORK PRIOR TO CONSTRUCTION. ALL DAMAGE MADE TO EXISTING UTILITIES SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES IN THE AREA AT LEAST 72 HOURS PRIOR TO BEGINNING CONSTRUCTION. CALL FLORIDA SUNSHINE STATE ONE CALL CENTER AT 1-800-432-4770. ALL COORDINATION AND REQUIRED UTILITY COMPANY TEMPORARY PROTECTION SHALL BE AT THE CONTRACTOR'S EXPENSE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE UNINTERRUPTION OF SERVICE AND REPLACEMENT OF DAMAGED UTILITIES.

AS-BUILT SURVEY DATA:

1. CONTRACTOR SHALL BE RESPONSIBLE FOR MINIMIZING LANDFILL GAS EMISSIONS FROM SURVEY TUBES (E.G. SEAL TOP OF SURVEY TUBES).
2. THE CONTRACTOR SHALL PROVIDE SURVEY DATA TO THE ENGINEER SHOWING THE LANDFILL GAS SYSTEM HAS BEEN PROPERLY CONSTRUCTED AND MEETS THE MINIMUM SLOPES REQUIRED AS SHOWN ON THE DRAWINGS.
3. THE SURVEY DATA SUBMITTED TO THE ENGINEER SHALL BE GROUND SURFACE ELEVATIONS AND TOP OF PIPE ELEVATIONS AT 50 FOOT INTERVALS ON CENTER AND AT EACH FITTING, LATERAL CONNECTION, VALVE, BENDS AND OTHER SIGNIFICANT FEATURES
4. ALL REQUESTED SURVEY DATA MUST BE PROVIDED TO OWNER'S REPRESENTATIVE IN FLORIDA STATE PLANE COORDINATES AND BE PERFORMED BY A STATE OF FLORIDA CERTIFIED SURVEYOR.

GENERAL NOTES:

1. THE CONTRACTOR IS ADVISED THAT NO ACTIVITIES MAY INTERFERE, DISRUPT, BLOCK, OR OTHERWISE CONFLICT WITH LANDFILL OPERATIONS. IF CONFLICTS ARE ANTICIPATED THEY SHALL BE COORDINATED AND APPROVED BY THE OWNER AND ENGINEER PRIOR TO DISRUPTION.
2. PROJECT SITE IS A SOLID WASTE LANDFILL, AS SUCH, CONDITIONS ARE SUBJECT TO CHANGE WITH TIME. CONTROLS, IN PARTICULAR VERTICAL CONTROL, SHOULD BE EXPECTED (AND ANTICIPATED) TO VARY FROM THOSE SHOWN ON THESE DRAWINGS DUE TO ONGOING SUBSIDENCE RESULTING FROM REFUSE DECOMPOSITION. RELATIVE ELEVATION DIFFERENCES IN EXISTING AND PROPOSED ELEVATIONS SHOWN ON THE DRAWINGS SHALL BE ADJUSTED ACCORDINGLY. LOCATION OF STRUCTURES SHALL BE PLACED IN ACCORDANCE WITH HORIZONTAL CONTROLS. VERTICAL PLACEMENT OF STRUCTURES SHALL BE IN ACCORDANCE WITH CONSTRUCTION DOCUMENTS, OR AS APPROVED BY THE ENGINEER.
3. CONSTRUCTION OF LANDFILL GAS COLLECTION SYSTEM WILL INVOLVE REFUSE EXCAVATION. THE CONTRACTOR SHALL MAKE ALL SAFETY AND ENVIRONMENTAL PRECAUTIONS TO PROTECT ITS WORKERS AND SUBCONTRACTORS, AT NO ADDITIONAL COST TO THE OWNER. ALL EXCAVATED WASTES SHALL BE PLACED AT THE WORKING FACE. CONTRACTOR IS ADVISED THAT THE POTENTIAL FOR ENCOUNTERING ASBESTOS CONTAINING MATERIAL EXISTS. SHOULD SUSPECT ASBESTOS-CONTAINING MATERIAL BE ENCOUNTERED, IT SHALL BE MAINTAINED IN A MOIST CONDITION DURING THE REMOVAL AND TRANSFER PROCESS TO MINIMIZE/PREVENT EMISSIONS FROM SUCH. DISTURBED REFUSE (INCLUDING ANY SUSPECT ASBESTOS-CONTAINING MATERIAL) WILL BE TRANSPORTED TO THE WORKING FACE OF THE CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX BY THE END OF EACH WORKING DAY FOR PROPER DISPOSAL AND BURIED WITH A MINIMUM OF SIX (6) INCHES OF SOIL COVER.
4. ANY AND ALL FINES IMPOSED ON THE OWNER BY ANY REGULATORY AGENCY DUE TO ACTIONS OF THE CONTRACTOR SHALL BE PAID BY THE CONTRACTOR.
5. INSPECTION: EXAMINE AREAS FOR CONDITIONS UNDER WHICH WORK IS TO BE PERFORMED. REPORT IN WRITING TO OWNER'S REPRESENTATIVE ALL CONDITIONS CONTRARY TO THOSE SHOWN ON THE DRAWINGS OR SPECIFIED HEREIN AND ALL OTHER CONDITIONS THAT WILL AFFECT SATISFACTORY EXECUTION OF WORK. DO NOT PROCEED WITH WORK UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED. STARTING WORK CONSTITUTES ACCEPTANCE OF THE CONDITIONS UNDER WHICH WORK IS TO BE PERFORMED. AFTER SUCH ACCEPTANCE, THE CONTRACTOR SHALL, AT CONTRACTORS EXPENSE, BE RESPONSIBLE FOR CORRECTING ALL UNSATISFACTORY AND DEFECTIVE WORK RESULTING FROM SUCH UNSATISFACTORY CONDITIONS.
6. PROTECTIONS: INSTALL TEMPORARY BARRIERS, FENCES, BARRICADES, LIGHTS, WARNING SIGNS AND OTHER DEVICES NECESSARY TO PROTECT STRUCTURES, UTILITIES, LANDSCAPING, EXCAVATIONS, AND OTHER ITEMS AS NECESSARY. PROTECT SURVEY BENCHMARKS AND MONUMENTS FROM DISPLACEMENT.
7. ALL WORK SHALL BE PERFORMED IN A QUALITY WORKMANLIKE MANNER.
8. DEVIATIONS FROM THESE PLANS AND SPECIFICATIONS WITHOUT PRIOR WRITTEN CONSENT OF THE ENGINEER OR OWNER MAY CAUSE THE WORK TO BE UNACCEPTABLE AND WILL BE ADJUSTED OR REPAIRED AT THE CONTRACTOR'S EXPENSE.
9. THE CONTRACTOR SHALL OBTAIN AND PAY FOR ALL NECESSARY LICENSES AND PERMITS ASSOCIATED WITH THE CONSTRUCTION OF THIS PROJECT UNLESS NOTIFIED OTHERWISE IN WRITING BY THE OWNER.
10. LATERAL PIPING ALIGNMENTS ARE APPROXIMATE. CONTRACTOR TO FIELD VERIFY TO ASSURE REQUIRED SLOPE AND DIRECTION OF GAS AND CONDENSATE FLOW.
11. SUGGESTED INSTALLATION SEQUENCE: THE FOLLOWING INSTALLATION SEQUENCE HAS BEEN ASSUMED IN THE ENGINEER CALCULATIONS.
    - (A.) DRILL ALL VERTICAL WELLS, INSTALLING AND COMPLETING WELL COMPONENTS AS PROCEEDING.
    - (B.) TRENCH LATERAL PIPING FROM THE WELLS TO CONNECTION POINT IN THE ACTIVE GAS COLLECTION SYSTEM.
    - (C.) CONNECT ALL LATERALS TO ACTIVE GAS COLLECTION SYSTEM.
    - (D.) INSTALL FORCEMAIN AND AIR LINE PIPING
    - (E.) INSTALL PNEUMATIC PUMPS AT WELLS DESIGNATED BY ENGINEER.
    - (F.) COMPLETE WELLHEAD INSTALLATION AND PNEUMATIC PUMP CONNECTIONS.
12. PRIOR TO INSTALLATION OF GAS COLLECTION SYSTEM, ENGINEER TO BE PROVIDED WITH THE FINAL GRADING PLAN TO CONFIRM LAYOUT AND MINIMUM SLOPES.
13. ALL WORK SHALL HAVE A WARRANTY AS SPECIFIED IN THE CONTRACT DOCUMENTS.
14. ALL BORE HOLES THAT ARE NOT COMPLETED AT THE END OF THE DAY ARE TO BE COVERED WITH A METAL WELL COVER CAPABLE OF PREVENTING ANY PERSONS FROM FALLING INTO THE HOLE. THE HOLE MUST THEN BE COVERED WITH A PIECE OF PLYWOOD TO SUBSTANTIALLY COVER THE ENTIRE HOLE. SOIL MUST BE PLACED ON TOP OF THE PLYWOOD TO COMPLETELY COVER THE PLYWOOD TO FURTHER PREVENT GAS EMISSIONS. SUBSTITUTE SAFETY MEASURES MAY BE USED IF APPROVED BY ENGINEER.
15. ALL HDPE PIPES SHALL BE PRESSURE TESTED AFTER FUSION FOR LEAKS. THE STANDARD PRESSURE TEST SHALL BE 10 PSI FOR 1 HOUR WITH A MAXIMUM OF 5% LOSS.
16. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL SURVEY TUBES AT THE END OF THE PROJECT, UNLESS INSTRUCTED OTHERWISE BY OWNER OR ENGINEER.
17. ACTUAL DIMENSIONS AND LOCATIONS MAY VARY BASED ON FIELD LOCATIONS.
18. TERMS "OWNER'S REPRESENTATIVE" AND "ENGINEER" ARE INTERCHANGEABLE.
19. CONTRACTOR TO PROVIDE SHOP DRAWINGS TO ENGINEER FOR APPROVAL.
20. THE CONTRACTOR IS ADVISED THAT THE LANDFILL CONTAINS A SYNTHETIC LINER AS PART OF THE SUBGRADE CONSTRUCTION. ALL COSTS ASSOCIATED WITH REPAIR RESULTING FROM DAMAGE TO THIS LINER SYSTEM SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. THESE COSTS SHALL INCLUDE, BUT ARE NOT LIMITED TO ENGINEER'S REVIEW, REPAIR OR REPLACEMENT BY A QUALIFIED LLDPE LINER INSTALLER, THIRD PARTY OBSERVATION, AND COUNTY REVIEW.
21. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ENGINEERING HOURS OVER THE 60 HOURS PER WEEK WORK SCHEDULE AT A RATE OF $100/HR.

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

HDR

HDR Engineering, Inc.
2521 Cattlemen Rd., Ste. 105
Sarasota, Fl 34232-6212
(941) 342-2700
CA#0004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

LANDFILL GAS GENERAL NOTES

0 1" 2"

FILENAME	00LFG-01.DWG
SCALE	AS SHOWN
SHEET	LFG-01

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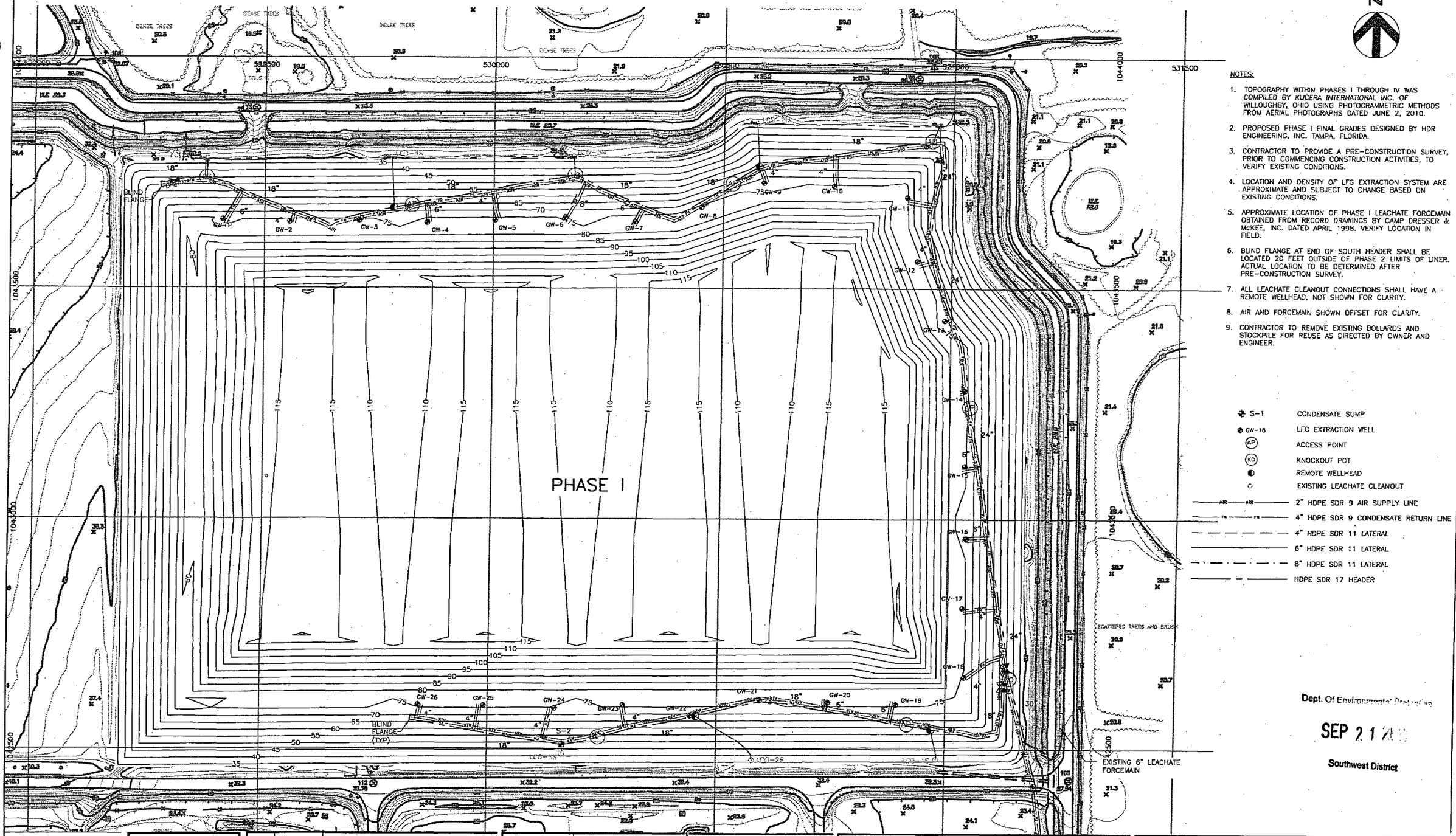

NOTES:

1. TOPOGRAPHY WITHIN PHASES I THROUGH IV WAS COMPILED BY KUCERA INTERNATIONAL INC. OF WILLOUGHBY, OHIO USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS DATED JUNE 2, 2010.
2. PROPOSED PHASE I FINAL GRADES DESIGNED BY HDR ENGINEERING, INC. TAMPA, FLORIDA.
3. CONTRACTOR TO PROVIDE A PRE-CONSTRUCTION SURVEY, PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, TO VERIFY EXISTING CONDITIONS.
4. LOCATION AND DENSITY OF LFG EXTRACTION SYSTEM ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON EXISTING CONDITIONS.
5. APPROXIMATE LOCATION OF PHASE I LEACHATE FORCEMAIN OBTAINED FROM RECORD DRAWINGS BY CAMP DRESSER & McKEE, INC. DATED APRIL 1998. VERIFY LOCATION IN FIELD.
6. BLIND FLANGE AT END OF SOUTH HEADER SHALL BE LOCATED 20 FEET OUTSIDE OF PHASE 2 LIMITS OF LINER. ACTUAL LOCATION TO BE DETERMINED AFTER PRE-CONSTRUCTION SURVEY.
7. ALL LEACHATE CLEANOUT CONNECTIONS SHALL HAVE A REMOTE WELLHEAD, NOT SHOWN FOR CLARITY.
8. AIR AND FORCEMAIN SHOWN OFFSET FOR CLARITY.
9. CONTRACTOR TO REMOVE EXISTING BOLLARDS AND STOCKPILE FOR REUSE AS DIRECTED BY OWNER AND ENGINEER.

- S-1 CONDENSATE SUMP
- GW-18 LFG EXTRACTION WELL
- AP ACCESS POINT
- KO KNOCKOUT POT
- REMOTE WELLHEAD
- EXISTING LEACHATE CLEANOUT
- AIR AIR 2" HDPE SDR 9 AIR SUPPLY LINE
- FR FR 4" HDPE SDR 9 CONDENSATE RETURN LINE
- 4" HDPE SDR 11 LATERAL
- 6" HDPE SDR 11 LATERAL
- 8" HDPE SDR 11 LATERAL
- HDPE SDR 17 HEADER

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

HDR
HDR Engineering, Inc.
2621 Cattlemen Rd., Ste. 106
Sarasota, Fl 34232-6212
(941) 342-2700
CA00004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

SARASOTA COUNTY FLORIDA

PHASE I GAS SYSTEM LAYOUT - EXISTING CONDITIONS

0 1" 2"

FILENAME	00C-08.DWG
SCALE	1"=100'

SHEET LFG-02

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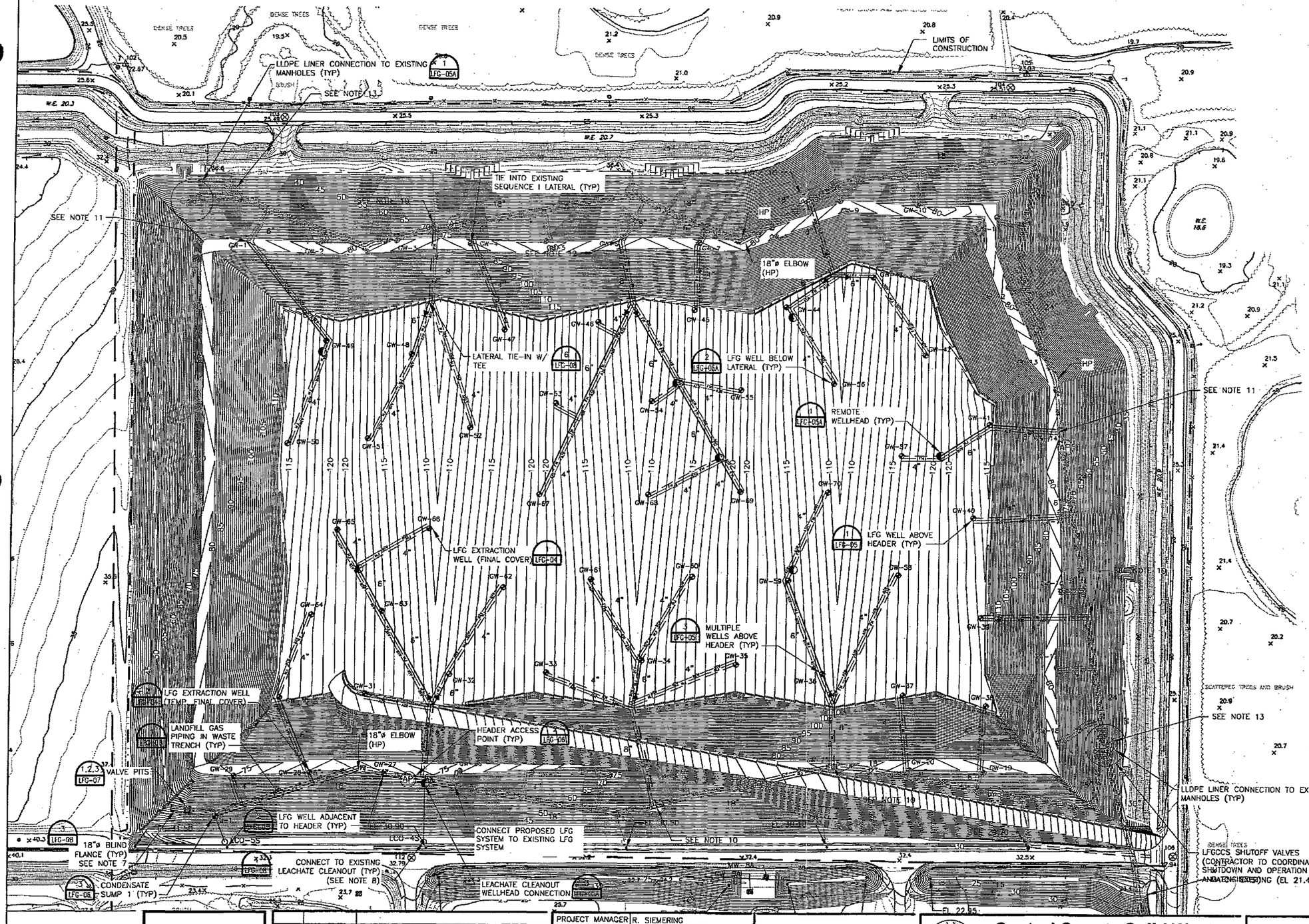

N

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3. CONTRACTOR TO PROVIDE A PRE-CONSTRUCTION SURVEY, PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, TO VERIFY EXISTING CONDITIONS.
4. LOCATION AND DENSITY OF LFG EXTRACTION SYSTEM ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON EXISTING CONDITIONS.
5. APPROXIMATE LOCATION OF PHASE I LEACHATE FORCEMAIN OBTAINED FROM RECORD DRAWINGS BY CAMP DRESSER & McKEE, INC. DATED APRIL 1998. VERIFY LOCATION IN FIELD.
6. HEADER PIPE SHALL BE HDPE SDR 17 AND LATERAL PIPES SHALL BE HDPE SDR 11.
7. BLIND FLANGE AT END OF SOUTH HEADER SHALL BE LOCATED 20 FEET OUTSIDE OF PHASE 2 LIMITS OF LINER. ACTUAL LOCATION TO BE DETERMINED AFTER PRE-CONSTRUCTION SURVEY.
8. ALL LEACHATE CLEANOUT CONNECTIONS SHALL HAVE A REMOTE WELLHEAD, NOT SHOWN FOR CLARITY.
9. AIR AND FORCEMAIN SHOWN OFFSET FOR CLARITY.
10. ELECTROFUSION COLLARS NEEDED FOR LATERAL/HEADER CONNECTIONS. (5 LOCATIONS)
11. CONTRACTOR TO REPLACE 6"X4"X4" TEE FOR LATERAL EXTENSION WITH A 6"X6"X4" TEE.
12. CONTRACTOR TO REPLACE 8"X6"X4" TEE FOR LATERAL EXTENSION WITH A 8"X6"X4" TEE.
13. CONTRACTOR TO EXTEND EXISTING MANHOLES TO MAINTAIN A MINIMUM OF 2 FEET FROM TOP OF MANHOLE DOWN TO TOP OF FINAL COVER (SOD).
14. IN THE EVENT OF LINER BALLOONING OWNER AND ENGINEER MAY DIRECT CONTRACTOR TO INSTALL ADDITIONAL GAS WELLS OR HORIZONTAL COLLECTORS AND NEGOTIATE COST WITH CONTRACTOR AS NEEDED.

LEGEND

S-1	CONDENSATE SUMP
GW-18	LFG EXTRACTION WELL
AP	ACCESS POINT
KO	KNOCKOUT POT
	REMOTE WELLHEAD
	EXISTING LEACHATE CLEANOUT
AIR AIR	2" HDPE SDR 9 AIR SUPPLY LINE
FR FR	4" HDPE SDR 9 CONDENSATE RETURN LINE
	4" HDPE SDR 11 LATERAL
	6" HDPE SDR 11 LATERAL
	8" HDPE SDR 11 LATERAL
	HDPE SDR 17 HEADER

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SEP 21 2011

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REVIEWED BY	C. KOENIG
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DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

PHASE I SEQUENCE 2 GAS SYSTEM LAYOUT

0 1" 2"

FILENAME	00C-12.DWG
SCALE	1"=100'
SHEET	LFG-03

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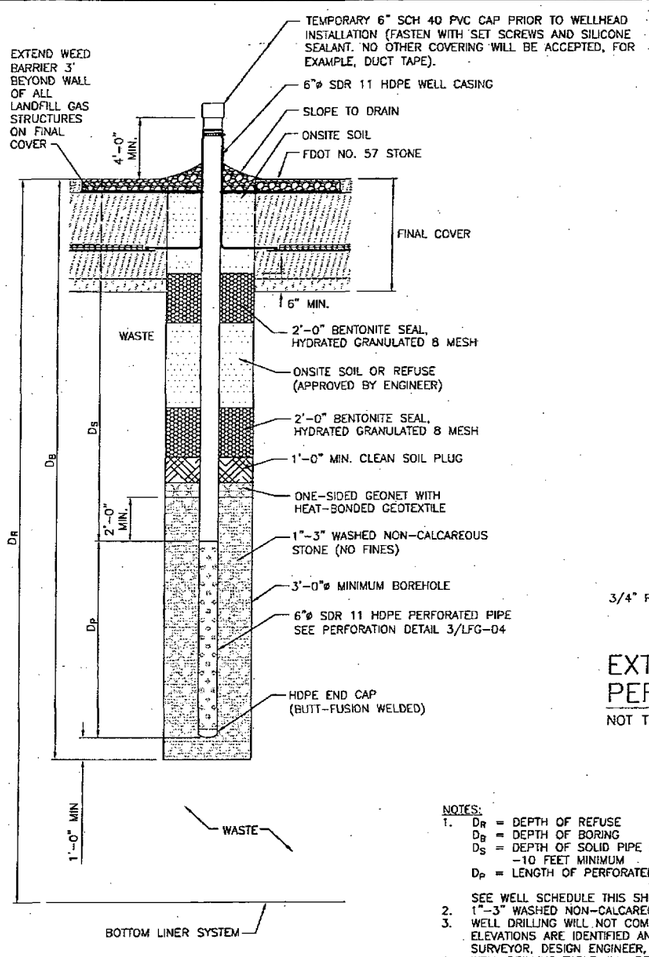


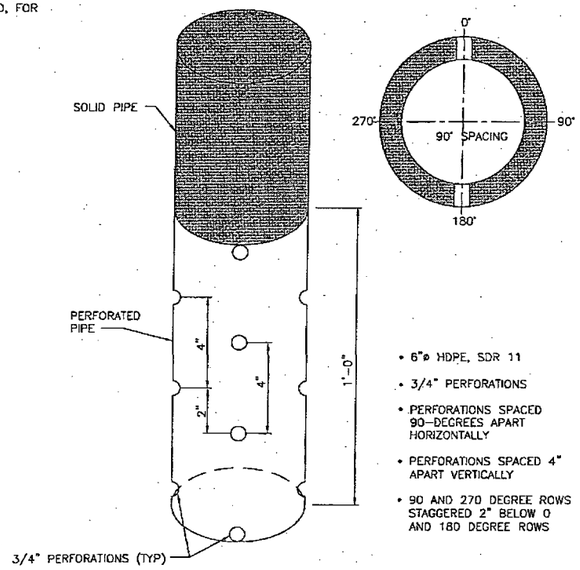
NOTES:
1. D_R = DEPTH OF REFUSE
   D_B = DEPTH OF BORING
   D_S = DEPTH OF SOLID PIPE (BELOW GRADE) −10 FEET MINIMUM
   D_P = LENGTH OF PERFORATED PIPE

   SEE WELL SCHEDULE THIS SHEET.
2. 1"-3" WASHED NON-CALCAREOUS STONE (NO FINES).
3. WELL DRILLING WILL NOT COMMENCE UNTIL EXISTING GRADE ELEVATIONS ARE IDENTIFIED AND VERIFIED BY PROJECT SURVEYOR, DESIGN ENGINEER, AND COA REPRESENTATIVE.
4. WELL DRILLING TABLE WILL BE MANAGED BY OWNER OR DESIGNATED REPRESENTATIVE TO ENSURE ONLY THE VERIFIED WELL DEPTHS ARE PRESENT, AND THAT DRILLER AND COA REPRESENTATIVE HAVE THE IDENTICAL INFORMATION PRIOR TO DRILLING.

LANDFILL GAS EXTRACTION WELL (FINAL COVER)

NOT TO SCALE

1 / LFG-03



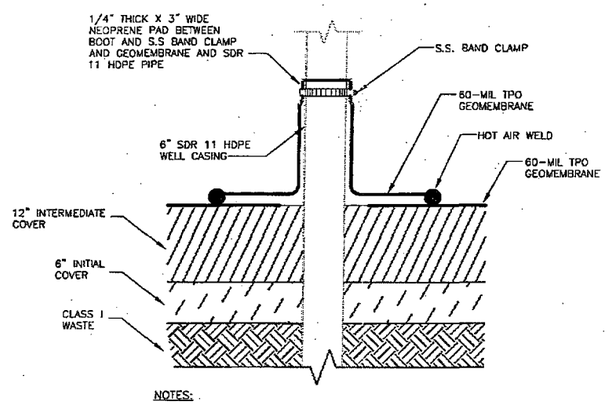
- 6"ø HDPE, SDR 11
- 3/4" PERFORATIONS
- PERFORATIONS SPACED 90-DEGREES APART HORIZONTALLY
- PERFORATIONS SPACED 4" APART VERTICALLY
- 90 AND 270 DEGREE ROWS STAGGERED 2" BELOW 0 AND 180 DEGREE ROWS

EXTRACTION WELL PERFORATION DETAIL

NOT TO SCALE

3 / LFG-04

WELL ID	NORTHING	EASTING	FG ELEVATION	BG ELEVATION	DEPTH OF WASTE (D_R)	BOREHOLE (D_B)	SOLID PIPE (D_S)	PERFORATED PIPE (D_P)	Grid Coordinates (Surveyed) Northing	Grid Coordinates (Surveyed) Easting	Surveyed Cover Elevation	Calculated Borehole Depth (D_B)	Calculated Perforated Length (D_P)
GW-27	1042588.88	529698.26	78.0	29.0	49.0	32.0	10.0	22.0					
GW-28	1042590.90	529546.85	79.0	31.0	48.0	32.0	10.0	22.0					
GW-29	1042583.90	529394.20	77.0	28.0	49.0	32.0	10.0	22.0					
GW-30	1042740.47	529484.07	117.0	30.0	87.0	58.0	10.0	48.0					
GW-31	1042747.90	529655.28	118.0	30.0	88.0	58.0	10.0	48.0					
GW-32	1042798.78	529835.56	113.0	29.0	84.0	56.0	10.0	46.0					
GW-33	1042791.98	530017.18	120.0	31.0	89.0	59.0	10.0	49.0					
GW-34	1042816.73	530205.71	111.0	29.0	82.0	54.0	10.0	44.0					
GW-35	1042809.04	530393.83	121.0	32.0	89.0	59.0	10.0	49.0					
GW-36	1042791.49	530567.31	112.0	28.0	84.0	56.0	10.0	46.0					
GW-37	1042749.48	530727.80	118.0	31.0	87.0	58.0	10.0	48.0					
GW-38	1042729.74	530894.99	117.0	30.0	87.0	58.0	10.0	48.0					
GW-39	1042904.29	530861.78	117.0	31.0	86.0	57.0	10.0	47.0					
GW-40	1043101.51	530882.82	117.0	31.0	86.0	57.0	10.0	47.0					
GW-41	1043287.03	530892.47	115.0	31.0	84.0	56.0	10.0	46.0					
GW-42	1043423.84	530781.90	119.0	29.0	90.0	60.0	10.0	50.0					
GW-43	1043577.01	530665.82	111.0	27.0	84.0	56.0	10.0	46.0					
GW-44	1043516.97	530484.19	115.0	26.0	89.0	59.0	10.0	49.0					
GW-45	1043610.85	530300.25	114.0	27.0	87.0	58.0	10.0	48.0					
GW-46	1043488.01	530110.70	113.0	26.0	87.0	58.0	10.0	48.0					
GW-47	1043470.08	529922.80	116.0	28.0	88.0	55.0	10.0	48.0					
GW-48	1043420.87	529739.69	111.0	26.0	85.0	56.0	10.0	46.0					
GW-49	1043411.11	529551.95	118.0	29.0	89.0	59.0	10.0	49.0					
GW-50	1043243.55	529493.43	115.0	28.0	87.0	58.0	10.0	48.0					
GW-51	1043253.76	529683.84	117.0	28.0	89.0	59.0	10.0	49.0					
GW-52	1043276.06	529857.54	112.0	27.0	85.0	56.0	10.0	46.0					
GW-53	1043325.43	530028.10	119.0	27.0	92.0	61.0	10.0	51.0					
GW-54	1043330.53	530217.36	109.0	26.0	83.0	55.0	10.0	45.0					
GW-55	1043353.23	530395.40	121.0	29.0	92.0	61.0	10.0	51.0					
GW-56	1043368.35	530580.19	109.0	26.0	83.0	55.0	10.0	45.0					
GW-57	1043224.57	530718.99	118.0	28.0	88.0	58.0	10.0	48.0					
GW-58	1042988.69	530713.97	117.0	28.0	89.0	59.0	10.0	49.0					
GW-59	1042976.22	530495.90	116.0	27.0	89.0	59.0	10.0	49.0					
GW-60	1042983.27	530304.05	118.0	30.0	88.0	57.0	10.0	47.0					
GW-61	1042977.11	530103.91	115.0	29.0	88.0	57.0	10.0	47.0					
GW-62	1042960.10	529928.06	118.0	31.0	87.0	58.0	10.0	48.0					
GW-63	1042912.19	529687.23	116.0	29.0	87.0	58.0	10.0	48.0					
GW-64	1042904.69	529545.79	119.0	31.0	88.0	58.0	10.0	48.0					
GW-65	1043072.88	529595.53	121.0	31.0	90.0	60.0	10.0	50.0					
GW-66	1043075.68	529779.37	110.0	28.0	82.0	54.0	10.0	44.0					
GW-67	1043145.00	529996.89	121.0	28.0	92.0	61.0	10.0	51.0					
GW-68	1043145.70	530212.83	110.0	28.0	84.0	56.0	10.0	46.0					
GW-69	1043151.72	530396.57	121.0	29.0	92.0	61.0	10.0	51.0					
GW-70	1043151.52	530571.89	110.0	28.0	84.0	56.0	10.0	46.0					
Total						2,483.0	440.0	2,023.0					



NOTES:

1. EXTRUSION WELD LINER AROUND PIPE FOR ACCESS POINTS AND SUMP.

LANDFILL GAS EXTRACTION WELL (TEMP FINAL COVER) DETAIL

NOT TO SCALE

2 / LFG-03

Dept. of Environmental Protection

SEP 21 2011

Southwest District

HDR
HDR Engineering, Inc.
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(941) 342-2700
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ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

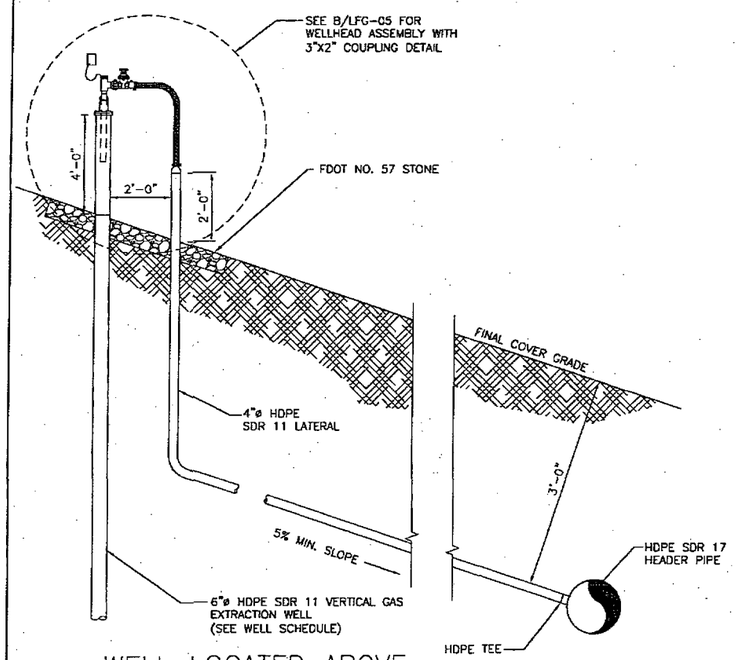
EXTRACTION WELL DETAILS AND WELL SCHEDULE

0 1" 2"

FILENAME	00D-15.DWG
SCALE	AS SHOWN

SHEET LFG-04

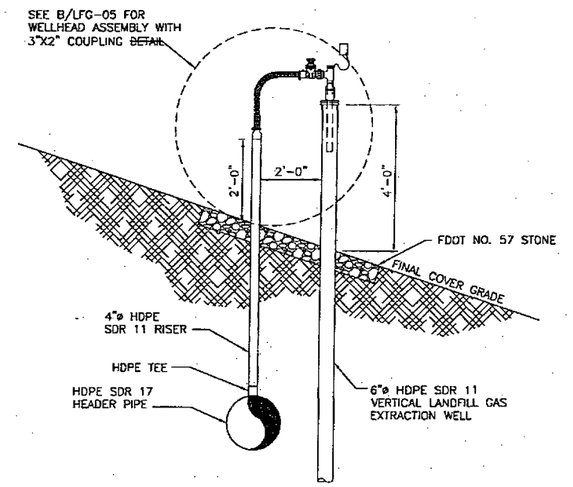
c:\pwworking\tpaid\0318297\00D-15.dwg, Plot, 9/14/2011 11:39:10 AM, Brad.John



WELL LOCATED ABOVE HEADER PIPE (TYPE #1)

1 LFG-03

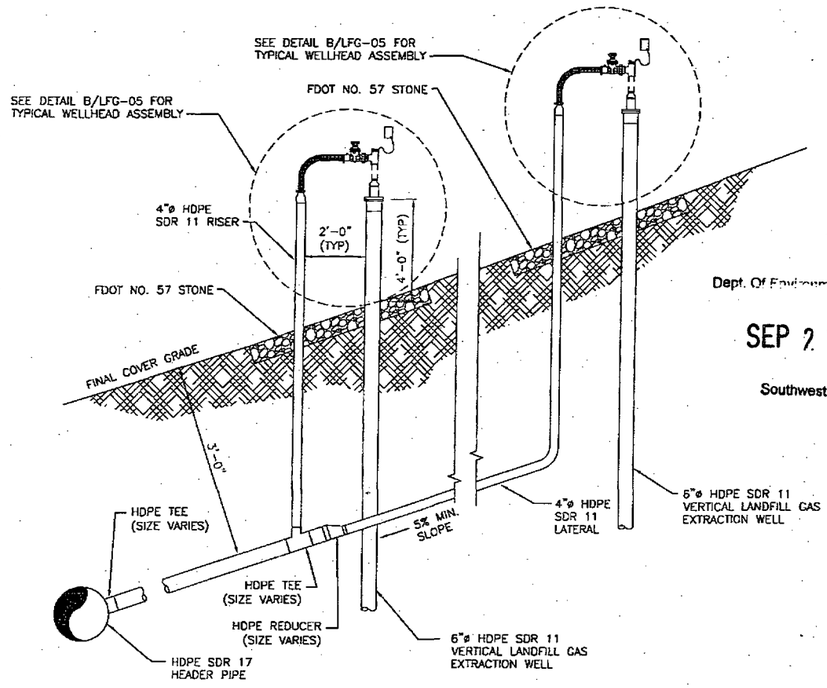
NOT TO SCALE



WELL LOCATED ADJACENT TO HEADER PIPE (TYPE #2)

2 LFG-03

NOT TO SCALE



MULTIPLE WELLS LOCATED ABOVE HEADER PIPE (TYPE #3)

3 LFG-03

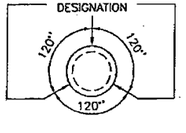
NOT TO SCALE

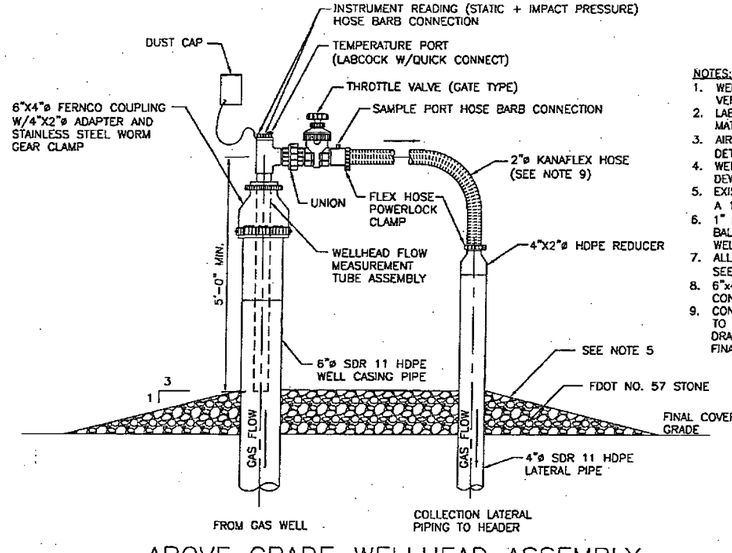
VERTICAL WELL HEAD CONFIGURATION SCHEDULE

TYPE #1				TYPE #2
GW-29	GW-40	GW-53	GW-65	GW-27
GW-31	GW-42	GW-55	GW-67	
GW-33	GW-45	GW-58	GW-69	
GW-35	GW-46	GW-60		
GW-37	GW-47	GW-61		
GW-38	GW-51	GW-62		
GW-39	GW-52	GW-64		

TYPE #3		TYPE #4	LCO
GW-28	GW-44	GW-50	LCO-4S
GW-30	GW-48	GW-54	LCO-5S
GW-32	GW-49	GW-56	
GW-34	GW-59	GW-57	
GW-36	GW-63	GW-66	
GW-41		GW-68	
GW-43		GW-70	

FOR INFORMATIONAL PURPOSES ONLY
SEE TYP WELL HEAD ASSEMBLIES FOR SIZES, DIMENSIONS AND SPECIFICS ON COMPONENTS. SEE ABOVE FOR WELL HEAD CONFIGURATION SCHEDULE.



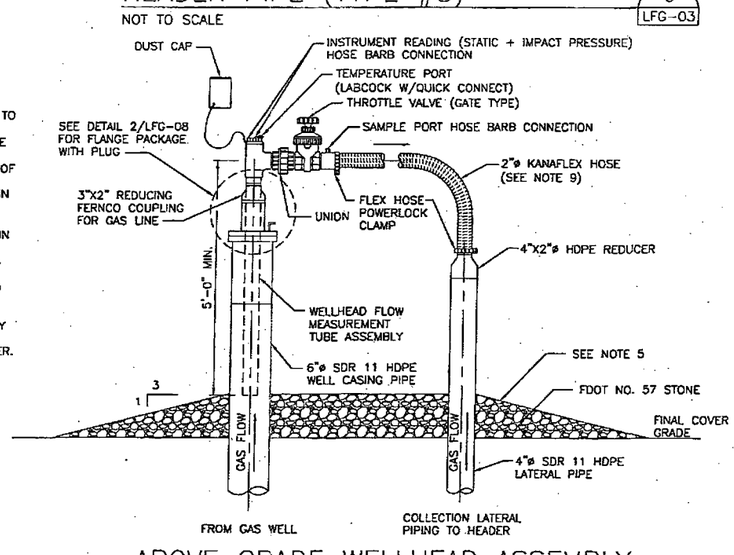


ABOVE GRADE WELLHEAD ASSEMBLY WITH 6"X4" COUPLING DETAIL

A LFG-05

NOT TO SCALE

NOTES:
1. WELLHEAD ASSEMBLY SHOWN REPRESENTS 2"ø LANDTEC VERTICAL ACCU-FLO WELLHEAD ASSEMBLY.
2. LABEL ALL WELL RISERS WITH IDENTIFICATION NUMBER TO MATCH EXISTING WELL RISERS
3. AIR AND FORCEMAIN LINES NOT SHOWN FOR CLARITY (SEE DETAIL 4/LFG-08).
4. WELLHEAD TO BE CONSTRUCTED TO ALLOW INSTALLATION OF DEWATERING PUMP.
5. EXISTING GRADE TO BE SLOPED FOR POSITIVE DRAINAGE IN A 1'-0"ø SURROUNDING SURFACE EXPRESSION.
6. 1" DIAMETER RISERS FOR FORCEMAIN AND AIRLINE WITH BALL VALVES ARE REQUIRED FOR ALL VERTICAL EXTRACTION WELLS.
7. ALL WELLS TO BE CONSTRUCTED WITH BOOT CONNECTION. SEE DETAILS 1 AND 2/LFG-04
8. 6"x4" COUPLING DETAIL A/LFG-05 CORRESPONDS TO LCO CONNECTIONS AND REMOTE WELLHEADS ONLY.
9. CONTRACTOR SHALL PROVIDE SUFFICIENT SLACK IN HOSE TO ALLOW FOR SETTLEMENT, HOWEVER HOSE MUST FREELY DRAIN TO THE LATERAL PIPE AND NOT HOLD WATER. THE FINAL HOSE LENGTH MUST BE APPROVED BY THE ENGINEER.



ABOVE GRADE WELLHEAD ASSEMBLY WITH 3"X2" COUPLING DETAIL

B LFG-05

NOT TO SCALE

Dept. Of Environmental Protection
SEP 21
Southwest District

HDR
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2621 Cattlemen Rd., Ste. 106
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(941) 342-2700
CA0000213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

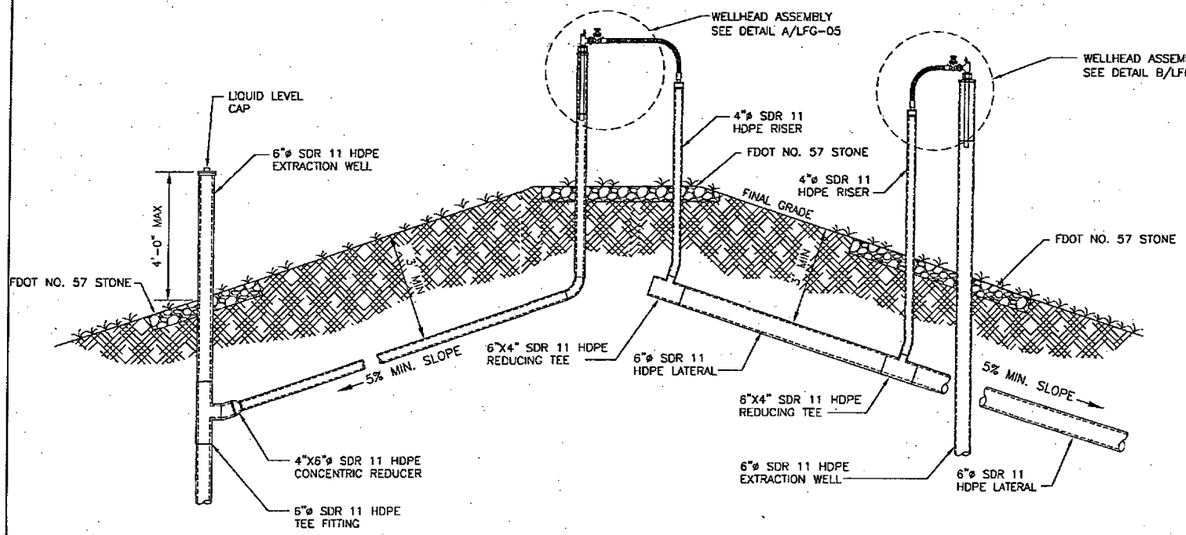
WELLHEAD AND CONFIGURATION DETAILS

0 1" 2"

FILENAME	00D-16.DWG
SCALE	AS SHOWN

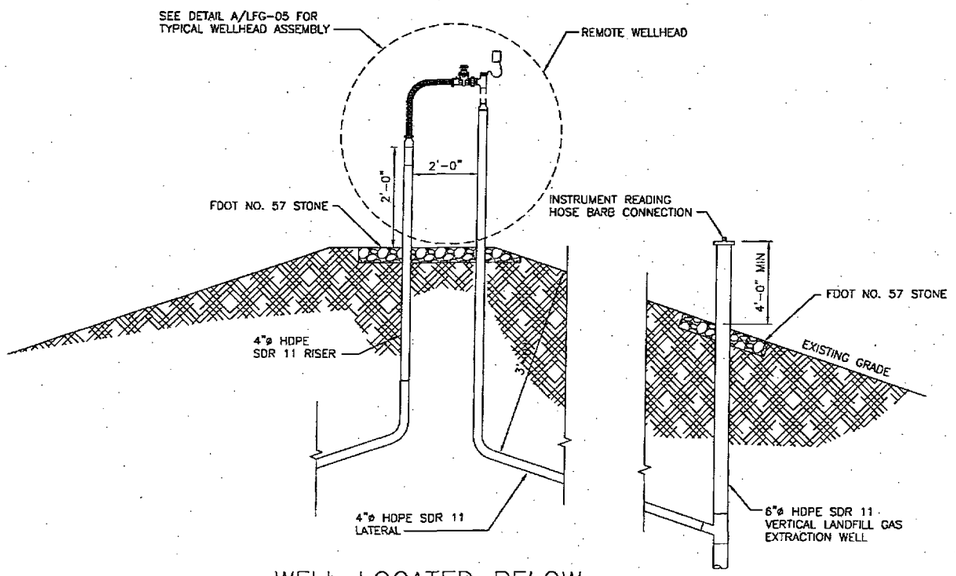
SHEET LFG-05

c:\pwworkingtpa\d0318297\00D-16.dwg, Plot, 9/14/2011 11:39:18 AM, Brad.John



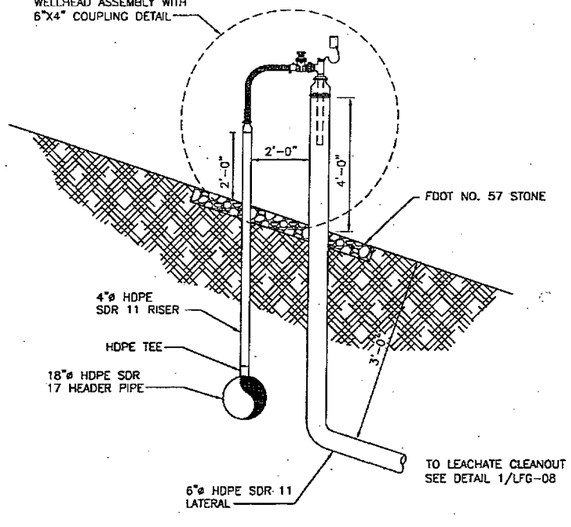
REMOTE WELLHEAD (1 / LFG-03)

NOT TO SCALE



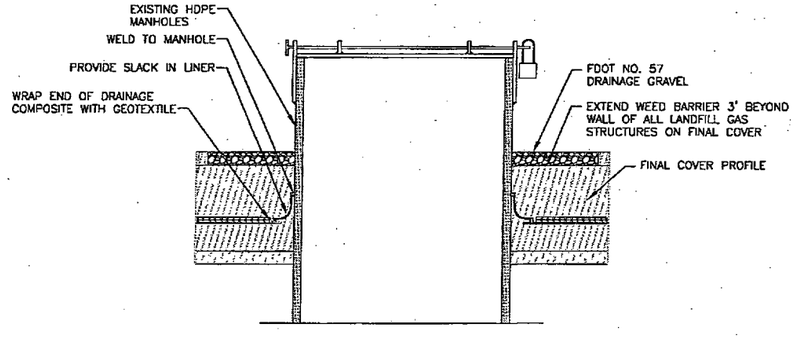
WELL LOCATED BELOW LATERAL (TYPE #4) (2 / LFG-03)

NOT TO SCALE



LEACHATE CLEANOUT CONNECTION (3 / LFG-03)

NOT TO SCALE



FINAL COVER LLDPE LINER CONNECTION TO EXISTING MANHOLES (TYP) (1 / LFG-03)

NOT TO SCALE

Dept. Of Environmental Protection

SEP 2 1 2011

Southwest District

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2621 Cattleman Rd., Ste. 196
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(941) 342-2700
CA#0054213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 54078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

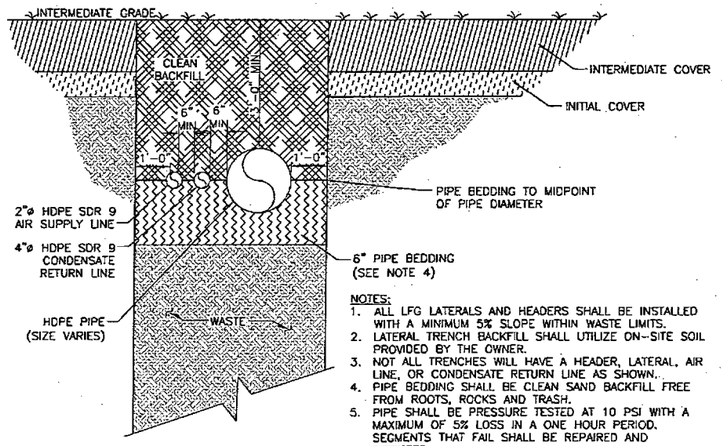
WELLHEAD AND CONFIGURATION DETAILS

0 1" 2"

FILENAME	00LFG-05A.DWG
SCALE	AS SHOWN

SHEET LFG-5A

c:\pwworking\ttpaid\03182970\00LFG-05A.dwg, Plot, 9/14/2011 11:39:25 AM, BradJohn

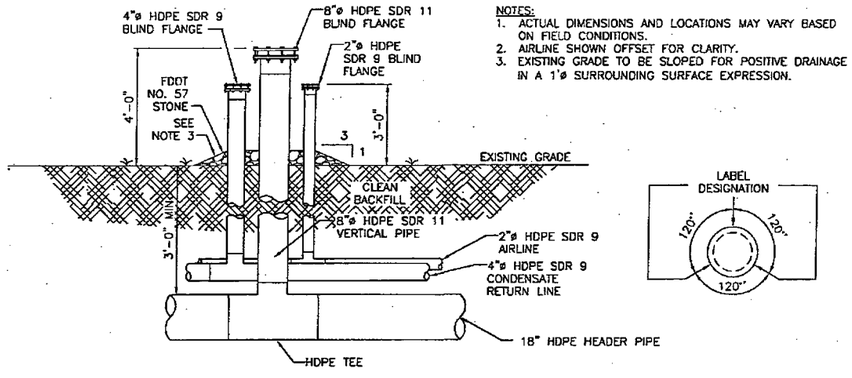


NOTES:
1. ALL LFG LATERALS AND HEADERS SHALL BE INSTALLED WITH A MINIMUM 5% SLOPE WITHIN WASTE LIMITS.
2. LATERAL TRENCH BACKFILL SHALL UTILIZE ON-SITE SOIL PROVIDED BY THE OWNER.
3. NOT ALL TRENCHES WILL HAVE A HEADER, LATERAL, AIR LINE, OR CONDENSATE RETURN LINE AS SHOWN.
4. PIPE BEDDING SHALL BE CLEAN SAND BACKFILL FREE FROM ROOTS, ROCKS AND TRASH.
5. PIPE SHALL BE PRESSURE TESTED AT 10 PSI WITH A MAXIMUM OF 5% LOSS IN A ONE HOUR PERIOD. SEGMENTS THAT FAIL SHALL BE REPAIRED AND RETESTED.

LANDFILL GAS PIPING IN WASTE TRENCH DETAIL

NOT TO SCALE

1 LFG-06

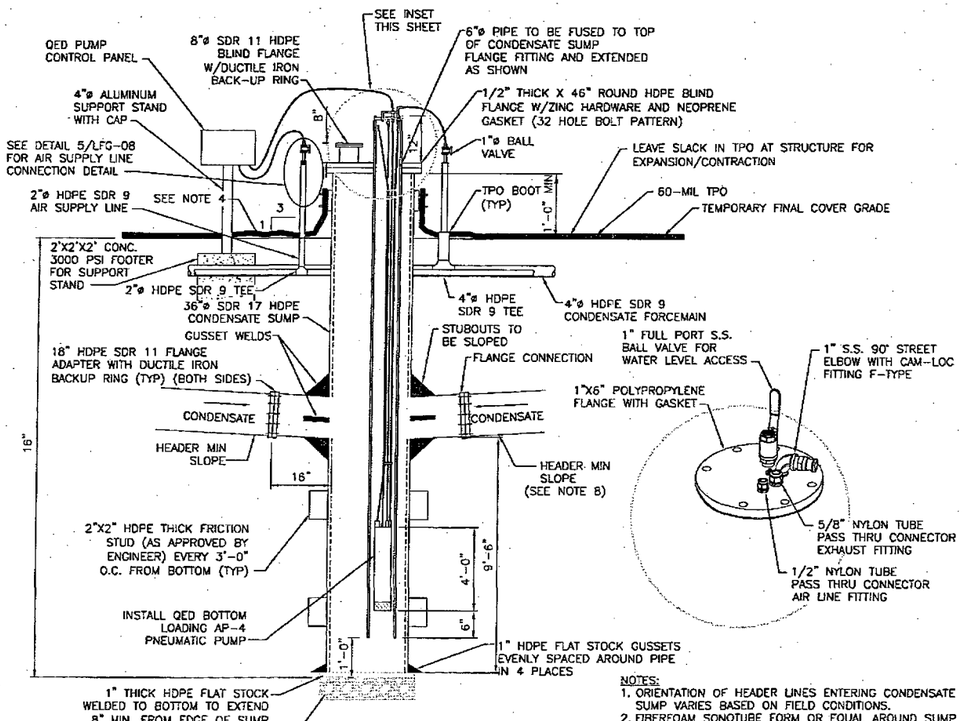


NOTES:
1. ACTUAL DIMENSIONS AND LOCATIONS MAY VARY BASED ON FIELD CONDITIONS.
2. AIRLINE SHOWN OFFSET FOR CLARITY.
3. EXISTING GRADE TO BE SLOPED FOR POSITIVE DRAINAGE IN A 1'ø SURROUNDING SURFACE EXPRESSION.

HEADER ACCESS POINT

NOT TO SCALE

2 LFG-03



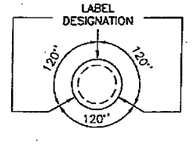
NOTES:
1. ORIENTATION OF HEADER LINES ENTERING CONDENSATE SUMP VARIES BASED ON FIELD CONDITIONS.
2. FIBERFOAM SONOTUBE FORM OR EQUAL AROUND SUMP FOR CONCRETE BALLAST TO BE CONSTRUCTED ON CONDENSATE SUMPS OUTSIDE OF WASTE.
3. LABEL ALL CONDENSATE SUMPS WITH IDENTIFICATION NUMBER TO MATCH EXISTING SUMPS.
4. EXISTING GRADE TO BE SLOPED FOR POSITIVE DRAINAGE IN A 1'ø SURROUNDING SURFACE EXPRESSION.
5. THE PNEUMATIC PUMP INSTALLATION SHALL ALSO INCLUDE A PUMP DATA MODULE.
6. SUMPS 1 – 36"ø SDR 17.
7. AIRLINE AND FORCEMAIN LINES SHOWN OFFSET FOR CLARITY. LINES LOCATED AT SPRINGLINE OF HEADER PIPE.
8. HEADER @ 5% SLOPE WITHIN LANDFILL FOOTPRINT.
9. ZINC HARDWARE AND NEOPRENE GASKET FOR FLANGES.
10. FLANGE ADAPTERS TO BE ADJUSTED BASED ON ANGLES FOR HEADER PIPE.
11. REPLACE CONTROL PANEL POST AT EXISTING CONDENSATE SUMP 2 WITH ROUND ALUMINUM SUPPORT STAND WITH TPO BOOT.

TOP VIEW

CONDENSATE SUMP DETAIL (TYP)

NOT TO SCALE

3 LFG-03



Dept. Of Environmental Protection
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Southwest District

Dept. Of Environmental Protection
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Southwest District

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CA#00004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

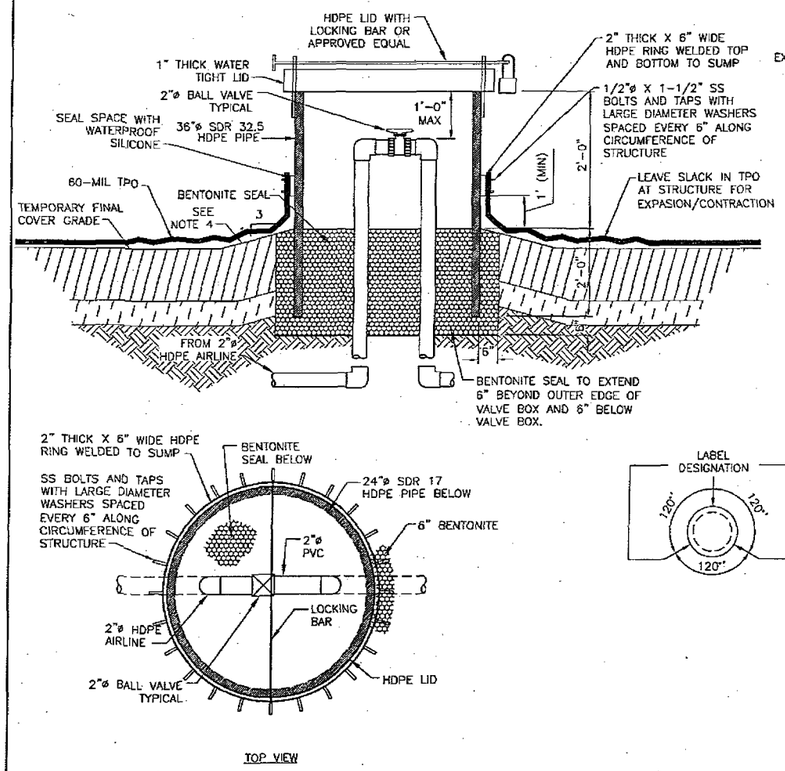
GENERAL LFG DETAILS

0 1" 2"

FILENAME	00D-17.DWG
SCALE	AS SHOWN

SHEET LFG-06

c:\pwworking\tpa\d0318\w000D-17.dwg, Plot, 9/14/2011 11:39:34 AM, BradJohn

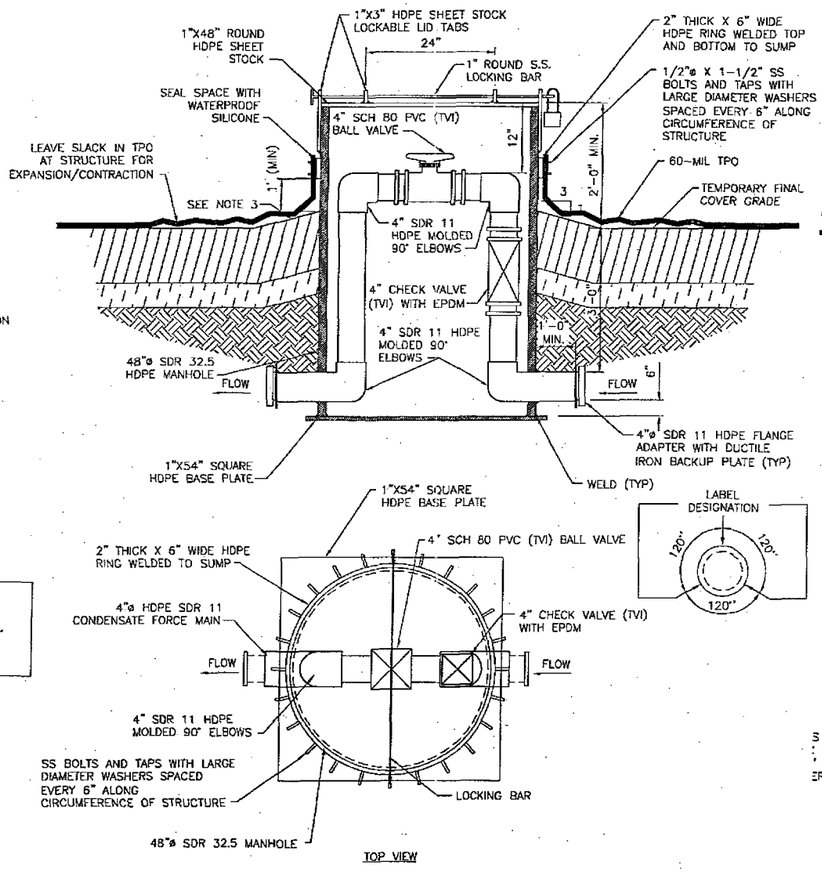


AIRLINE VALVE PIT

NOT TO SCALE

1 LFG-03

NOTES:
1. ALL FITTINGS SHALL BE HDPE SDR 9 UNLESS OTHERWISE NOTED.
2. VALVE BOX AND COVER SHALL BE 2'-0"ø MIN, WITH LID AND LOCKING DEVICE.
3. LABEL ALL VALVE PITS WITH IDENTIFICATION NUMBER TO MATCH EXISTING VALVE PITS.
4. EXISTING GRADE TO BE SLOPED FOR POSITIVE DRAINAGE IN A 1'ø SURROUNDING SURFACE EXPRESSION.

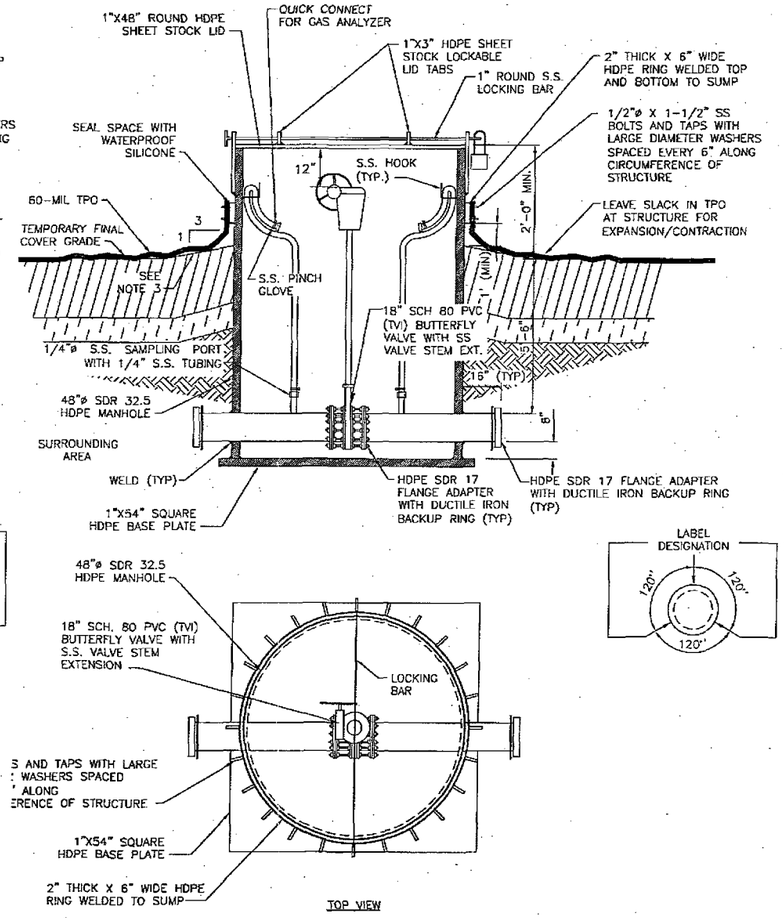


FORCE MAIN VALVE PIT

NOT TO SCALE

2 LFG-03

NOTES:
1. ACTUAL DIMENSIONS AND LOCATIONS MAY VARY BASED ON FIELD CONDITIONS.
2. LABEL ALL VALVE PITS WITH IDENTIFICATION NUMBER TO MATCH EXISTING VALVE PITS.
3. EXISTING GRADE TO BE SLOPED FOR POSITIVE DRAINAGE IN A 1'ø SURROUNDING SURFACE EXPRESSION.



HEADER LINE ISOLATION VALVE PIT

NOT TO SCALE

3 LFG-03

NOTES:
1. HOOK FOR SAMPLE PORT SHALL BE CONNECTED TO WALL OF VALVE PIT WITHIN REACH OF TOP OF VALVE PIT.
2. LABEL ALL VALVE PITS WITH IDENTIFICATION NUMBER MATCHING EXISTING VALVE PITS.
3. EXISTING GRADE TO BE SLOPED FOR POSITIVE DRAINAGE IN A 1'ø SURROUNDING SURFACE EXPRESSION.

Dept. Of Environmental Protection

SEP 21 2011

Southwest District

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CA#00004213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD C. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS FLORIDA

VALVE PIT DETAILS

0 1" 2"

FILENAME	00D-18.DWG
SCALE	AS SHOWN

SHEET LFG-07

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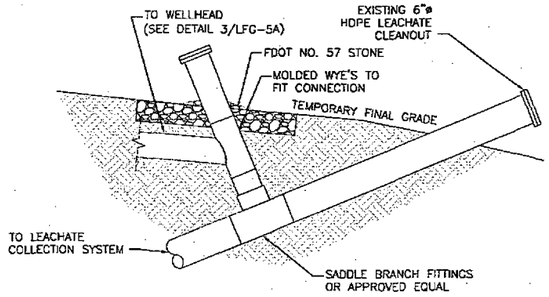
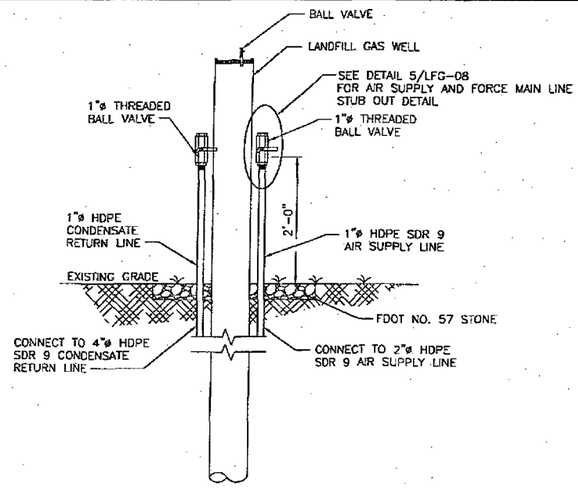


GAS COLLECTION FROM LEACHATE CLEANOUT CONNECTION (TYP)

NOT TO SCALE

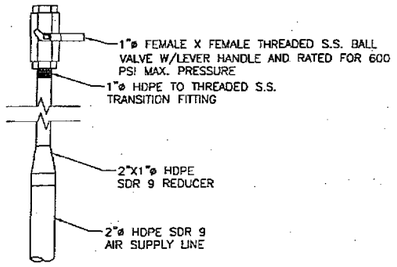
1 / LFG-03 / LFG-5A



WELL RISER DETAIL (TYP)

NOT TO SCALE

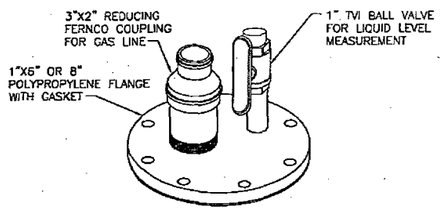
4 / LFG-05



AIR SUPPLY AND FORCE MAIN LINE CONNECTION DETAIL (TYP)

NOT TO SCALE

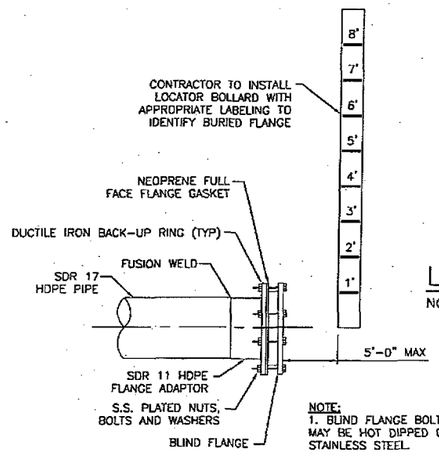
5 / LFG-08



VERTICAL WELL WITHOUT PUMP FLANGE PACKAGE

NOT TO SCALE

2 / LFG-05

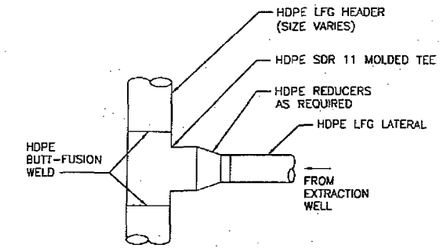


NOTE:
1. BLIND FLANGE BOLTS AND WASHERS MAY BE HOT DIPPED GALVANIZED OR STAINLESS STEEL.

BLIND FLANGE WITH LOCATOR BOLLARD DETAIL

NOT TO SCALE

3 / LFG-03



NOTES:
1. SHOP FABRICATED BRANCH SADDLE FITTINGS MAY BE USED AS APPROVED BY THE ENGINEER. FIELD FABRICATED BRANCH SADDLE FITTINGS WILL NOT BE ACCEPTED.
2. 1' MIN. OF SAND WILL BE PLACED BELOW EACH TEE. THE SAND WILL BE INSTALLED SO IT EXTENDS 3'-0" MIN. ON EACH SIDE OF THE TEE. SAND WILL BE SLIGHTLY MOISTENED AND HAND-TAMPED PROVIDING SUPPORT TO ALL POINTS OF THE TEE. CLEAN, GRADED SOIL WILL BE HAND-TAMPED ABOVE TEE (1'-0" MIN.) BEING CAREFUL TO ELIMINATE ALL VOIDS.

LATERAL TIE-IN W/TEE

NOT TO SCALE

6 / LFG-03

HDR
HDR Engineering, Inc.
2621 Cattlemen Rd., Ste. 106
Sarasota, FL 34232-6212
(941) 342-2700
CA0096213

ISSUE	DATE	DESCRIPTION
0	10/2011	ISSUED TO CONSTRUCTION

PROJECT MANAGER	R. SIEMERING
REVIEWED BY	C. KOENIG
CIVIL DESIGN	C. RESTREPO, T. YANOSCHACK
DRAWN BY	B. JOHNSON
PROJECT NUMBER	00096-130530-005

CLIFFORD G. KOENIG, P. E.
CERTIFICATE NO. 64078

SARASOTA COUNTY

Central County Solid Waste Disposal Complex

PHASE I CLASS I LANDFILL CLOSURE AND LANDFILL GAS COLLECTION SYSTEM CONSTRUCTION DRAWINGS

FLORIDA

GENERAL LFG DETAILS

0 1" 2"

FILENAME 00D-19.DWG
SCALE AS SHOWN

SHEET
LFG-08

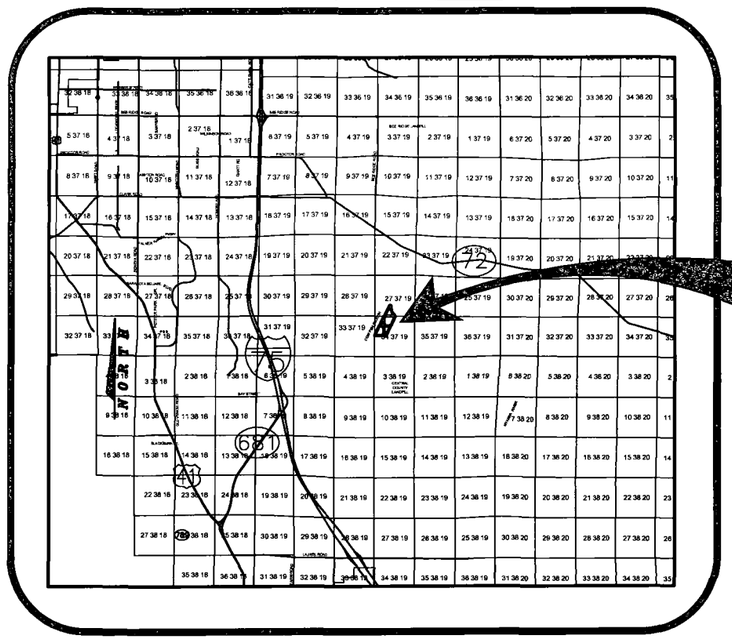
c:\pwworking\tpald0318297\00D-19.dwg, Plot, 9/14/2011 11:39:50 AM, BradJohn

CONSTRUCTION PLANS FOR

CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX BORROW FACILITY - PHASE IV

SECTION - 34 TOWNSHIP - 37S RANGE - 19E

VICINITY MAP



INDEX

SHT. NO.	TITLE
1	COVER SHEET
2	GENERAL NOTES
3	OVERALL SITE PLAN
4	SITE / DRAINAGE PLAN - BORROW AREA A
5	SITE / DRAINAGE PLAN - BORROW AREA B
6	SITE / DRAINAGE PLAN - BORROW AREA C
7	CROSS SECTIONS
8	EROSION AND SEDIMENT CONTROL

PREPARED FOR

SARASOTA COUNTY ENVIRONMENTAL SERVICES SOLID WASTE OPERATIONS

4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PREPARED BY

PBS&J

PRINCIPAL OFFICE
5300 WEST CYPRESS STREET
TAMPA, FLORIDA 33607
FBPR CERT. OF AUTH. # 24

PRODUCTION OFFICE
2803 FRUITVILLE ROAD SUITE 130
SARASOTA, FLORIDA 34237
PHONE: (941) 954-4036

PROFESSIONAL ENGINEER DATE
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

GENERAL NOTES:

1. ANY U.S.C. AND G.S. MONUMENT, PUBLIC LAND CORNER, PROPERTY MONUMENTATION, OR BENCH MARK WITHIN LIMITS OF CONSTRUCTION SHALL BE PROTECTED. IF IN DANGER OF DAMAGE, THE CONTRACTOR SHOULD NOTIFY THE OWNER'S REPRESENTATIVE IMMEDIATELY AS WELL AS:

   GEODETIC INFORMATION CENTER
   ATTN.: MARK MAINTENANCE CENTER
   ATTN.: N/CG-162 6001 EXECUTIVE BLVD.
   ROCKVILLE, MARYLAND 20852
   (301) 443-8319

2. THE CONTRACTOR SHALL PROVIDE AT LEAST 72 HOURS NOTICE TO RELEVANT UTILITIES IN ADVANCE OF CONSTRUCTION. CONTACT SUNSHINE STATE ONE UTILITIES NOTIFICATION CENTER AT 1-800-432-4770. THE CONTRACTOR SHALL PROVIDE UTILITY COMPANIES ADEQUATE TIME TO RELOCATE ANY UTILITIES IN CONFLICT WITH PROPOSED CONSTRUCTION.

3. ALL WORK SHALL COMPLY WITH REGULATION AND ORDINANCES OF THE VARIOUS GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE WORK.

4. THE INFORMATION PROVIDED IN THESE PLANS IS TO ASSIST THE CONTRACTOR IN ASSESSING THE NATURE AND EXTENT OF THE CONDITIONS WHICH MAY BE ENCOUNTERED DURING THE COURSE OF WORK. ALL CONTRACTORS ARE DIRECTED, PRIOR TO BIDDING, TO CONDUCT WHATEVER INVESTIGATIONS NECESSARY TO DETERMINE THE ACTUAL CONDITIONS THAT WILL BE ENCOUNTERED AND UPON WHICH THEIR BIDS WILL BE BASED.

5. ALL BACKFILL SHALL BE COMPACTED PER FDOT SPECIFICATIONS.

6. MATERIALS INTERFERING WITH CONSTRUCTION, AND ALL ABANDONED UTILITY LINES, PIPES, STRUCTURES AND ALL OTHER SUB TERRAIN OBJECTS TO BE REMOVED, SHALL BE DISPOSED OF AS DIRECTED BY THE OWNER'S REPRESENTATIVE.

7. MATERIALS AND CONSTRUCTION TO BE IN ACCORDANCE WITH THE FDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST EDITION USING ENGLISH SYSTEM.

8. GRADE THE SITE AND DITCHES TO THE FINISHED GRADES AND TYPICAL SECTIONS. IMMEDIATELY BEFORE REQUESTING FINAL INSPECTIONS, CHECK THE LINES AND DRESS TO THE PROPER CONTOURS. ALL AREAS ARE TO BE STABILIZED AND MAINTAINED UNTIL ACCEPTED BY THE OWNER.

9. THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE IMMEDIATELY WHEN CONFLICTS BETWEEN DRAWINGS AND ACTUAL CONDITIONS ARE DISCOVERED.

10. FIELD CONDITIONS MAY NECESSITATE SLIGHT ALIGNMENT AND GRADE DEVIATION TO AVOID OBSTACLES, AS ORDERED BY THE OWNER'S REPRESENTATIVE.

11. LOCATION, ELEVATION, AND DIMENSIONS OF THE EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES ARE SHOWN IN ACCORDANCE WITH THE BEST INFORMATION AVAILABLE AT TIME OF THE PREPARATION OF THESE PLANS BUT DO NOT PURPORT TO BE ABSOLUTELY CORRECT.

12. THE CONTRACTOR SHALL VERIFY THE LOCATION, ELEVATION, AND DIMENSIONS OF ALL EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES AFFECTING HIS WORK AND SHALL COMPLY WITH ALL STATE, COUNTY, AND LOCAL ORDINANCES.

13. *CONTRACTOR SHALL MAINTAIN A SET OF PLANS WITH CURRENT FIELD CHANGES MARKED THEREON AND SHALL DELIVER* THESE PLANS TO THE OWNER'S REPRESENTATIVE UPON COMPLETION OF CONSTRUCTION. FINAL PAYMENT SHALL NOT BE MADE UNTIL THIS REQUIREMENT IS SATISFIED.

14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY PERMITS NOT PROVIDED BY THE ENGINEER, OWNER, OR OWNER'S REPRESENTATIVE THESE PERMITS MAY INCLUDE ROAD CROSSING, ONSITE DEWATERING, BURNING PERMITS, NPDES, EARTHMOVING, AND ANY OTHER PERMITS FROM GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE PROJECT SITE.

15. THE CONTRACTOR SHALL ADHERE TO ALL CONDITIONS AND REQUIREMENTS OF ALL PERMITS WHICH HAVE BEEN OBTAINED. CONTRACTOR SHALL BE RESPONSIBLE FOR PAYMENT OF ANY FINES AND ADMINISTRATIVE COSTS INCURRED BY THE OWNER FOR PERMIT VIOLATIONS.

16. THE CONTRACTOR SHALL STABILIZE AND MAINTAIN ACCESS ROADS DURING CONTRUCTION AS NECESSARY FOR WORK ACCESS AND USE BY SARASOTA COUNTY STAFF FOR PROPERTY MANAGEMENT, SERVICE, AND FIRE PROTECTION. THESE ROADS SHALL BE RESTORED TO ORIGINAL CONDITION AFTER JOB COMPLETION IN AREAS DIRECTED BY THE OWNER'S REPRESENTATIVE.

17. THE OWNER'S SURVEYOR SHALL PROVIDE BENCH MARK AND COORDINATE CONTROL POINTS FOR THE CONTRACTOR. THE CONTRACTOR SHALL SUPPLY POINTS FOR LINE AND GRADE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COMPLETE STAKE-OUT OF THE PROJECT GRADE, SLOPE STAKING, MAINTENANCE OF STAKING, AND ANY RESTAKING THAT MAY BE REQUIRED TO COMPLETE THE PROJECT IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS. ANY AND ALL EXPENSES INCURRED FOR THE CONTRACTOR'S SURVEY WORK SHALL BE INCLUDED IN THE PRICE BID FOR APPLICABLE ITEMS. NO ADDITIONAL PAYMENT SHALL BE MADE FOR THIS WORK.

18. OVERALL CLEAN UP SHALL BE ACCOMPLISHED BY THE CONTRACTOR AS DIRECTED BY THE OWNER'S REPRESENTATIVE. ANY AND ALL EXPENSES INCURRED FOR THIS WORK SHALL BE INCLUDED IN THE UNIT PRICE BID FOR THE APPLICABLE LINE ITEMS. THE CONTRACTOR SHALL REMOVE ALL TRASH, DEBRIS, AND UNUSED MATERIALS ON A REGULAR BASIS TO KEEP WORK SITE CLEAN. MATERIALS REMOVED SHALL BE DISPOSED IN A LAWFUL MANNER.

19. THE CONTRACTOR SHALL ENDEAVOR TO PROTECT PRIVATE PROPERTY. ANY DAMAGE CAUSED BY THE CONTRACTOR IN THE PERFORMANCE OF HIS WORK SHALL BE CORRECTED TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE AT THE CONTRACTOR'S EXPENSE. PAYMENT SHALL NOT BE MADE FOR ANY RESTORATION WORK.

20. ANY DAMAGE TO STATE, COUNTY, OR LOCAL ROADS OR PROPERTY CAUSED BY THE CONTRACTOR'S HAULING OR EXCAVATION EQUIPMENT SHALL BE REPAIRED BY THE CONTRACTOR TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE OR FACILITY OWNER. PAYMENT SHALL NOT BE MADE FOR THIS WORK.

EROSION AND SEDIMENT CONTROL:

1. MAINTAIN WATER QUALITY STANDARDS PURSUANT TO SECTION 62-302 F.A.C.

2. THE CONTRACTOR SHALL INSTALL AND MAINTAIN EROSION CONTROL BARRIERS SUCH AS SILT SCREEN FENCING/FLOATING TURBIDITY BARRIERS, AS REQUIRED BY ACTUAL SITE CONDITIONS AND AS DIRECTED BY THE OWNER'S REPRESENTATIVE. THE MAINTENANCE OF EROSION CONTROL DEVICES AND THEIR COMPLETE REMOVAL ARE TO BE INCLUDED IN THE BID PRICE. THE SILT BARRIERS SHALL BE PLACED IN ACCORDANCE WITH THE REQUIREMENTS OF FDOT INDEX NO. 102 AND 103, OR AS DIRECTED BY THE OWNER'S REPRESENTATIVE. FAILURE TO INSTALL OR PROPERLY MAINTAIN THESE BARRIERS MAY RESULT IN ENFORCEMENT ACTIONS WHICH MAY INCLUDE CITATIONS, AS PROVIDED BY CHAPTERS 40D-A, AND 40D-40, F.A.C.

3. THE CONTRACTOR SHALL PROVIDE AND INSTALL HAY BALES AND/OR SILT SCREENS AND/OR SODDED BERMS TO PREVENT THE TRANSPORT OF SEDIMENT DOWNSTREAM INTO PRIVATE PROPERTY, OPEN DITCHES, SURFACE WATERS ETC. & MAINTAIN SUCH CONTROL DEVICES THROUGHOUT THE CONSTRUCTION.

4. EROSION AND SEDIMENT CONTROL DEVICES SHALL REMAIN IN PLACE AND SHALL NOT BE REMOVED UNTIL FINAL GRADING AND RESTORATION OF THE SITE HAS BEEN COMPLETED.

5. ALL AREAS DISTURBED DURING CONSTRUCTION SHALL BE RETURNED TO THE EXISTING GRADE, PROFILE, AND CROSS SECTION UNLESS OTHERWISE NOTED. MATCH EXISTING ELEVATIONS AT BOUNDARIES/LIMITS OF CONSTRUCTION ACTIVITIES.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF THE EXISTING DRAINAGE SYSTEM WITHIN THE LIMITS OF THE PROJECT AREA, FOR THE DURATION OF THE PROJECT. NO ADDITIONAL PAYMENT WILL BE MADE FOR THE WORK INVOLVED.

7. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A STORMWATER POLLUTION PREVENTION PLAN IN COMPLIANCE WITH NPDES STORMWATER PERMIT REQUIREMENTS.

8. THE CONTRACTOR SHALL SUBMIT A NOTICE OF INTENT OF CONSTRUCTION COMMENCEMENT AND NOTICE OF TERMINATION TO APPLICABLE AGENCIES AND MONITOR CONSTRUCTION IN ACCORDANCE WITH NPDES STORMWATER PERMIT REQUIREMENTS.

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

FRANK COGGINS
MANAGER SOLID WASTE OPERATIONS

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/
PBSJ
PRINCIPAL ADDRESS:
5300 W. CYPRESS SUITE 300
TAMPA, FL. 33607
FBPR CERT. OF AUTH. No. 24

PRODUCTION ADDRESS:
101 ARTHUR ANDERSEN
PARKWAY SUITE 260
SARASOTA, FLORIDA 34232
PHONE: (941) 378 - 0272

CLIENT:
SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
GENERAL NOTES

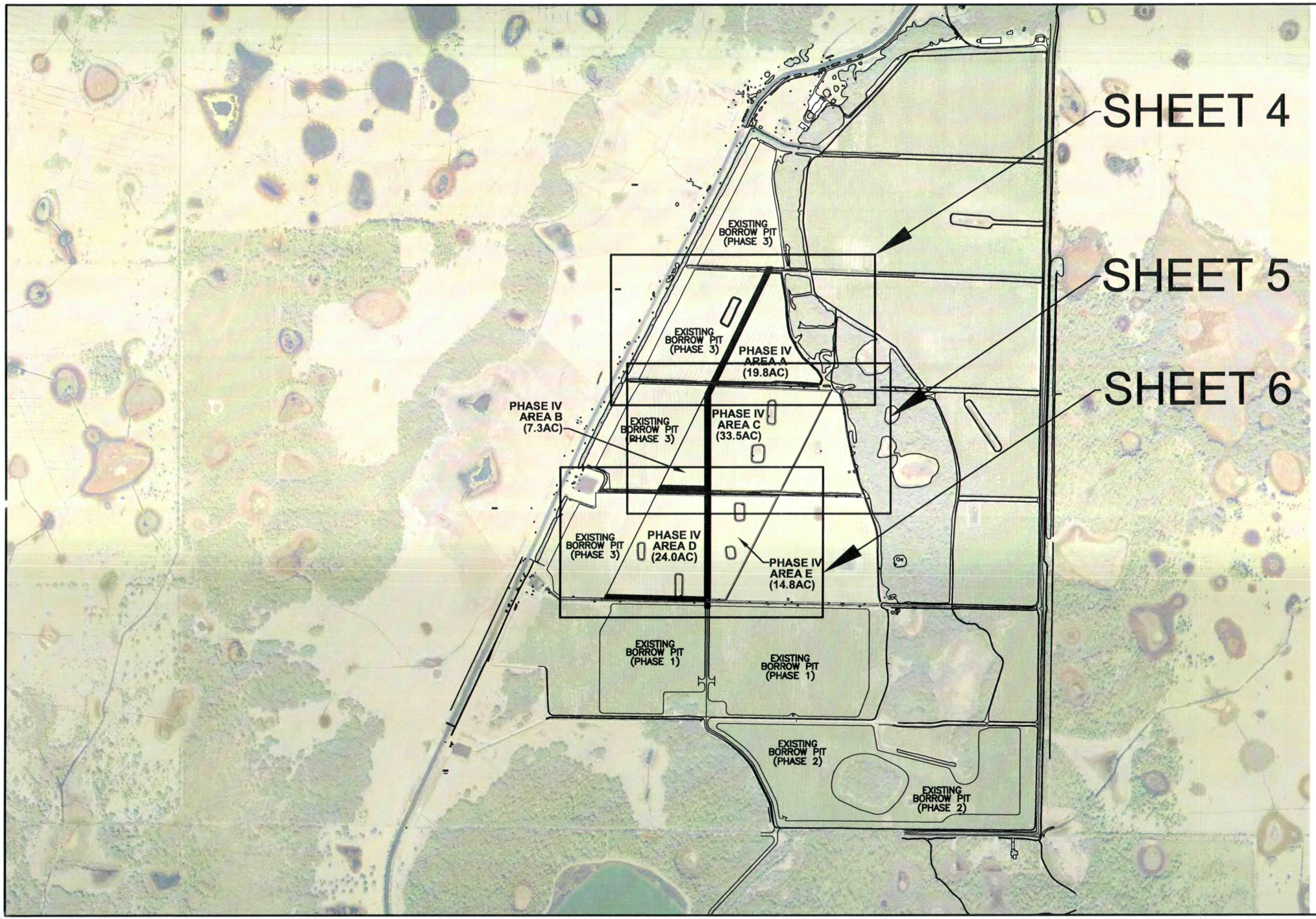
ORIGINAL: SEPTEMBER 08
REVISIONS:
1 _____ 2 _____ 3 _____ 4 _____ 5 _____
6 _____ 7 _____ 8 _____ 9 _____ 10 _____ 11 _____ 12 _____

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100004629
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: JE

SHEET 2



N
W E
S

0' 600' 1200'

11" X 17" SHEET: 1" = 1200'
24" X 36" SHEET: 1" = 600'

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/

PBSJ

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ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

SARASOTA COUNTY 1921

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
OVERALL SITE PLAN

ORIGINAL: SEPTEMBER 08
REVISIONS:
1
2
3
4
5
6
7
8
9
10
11
12

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100004629
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: JE

SHEET 3

LEGEND:

- EXISTING SPOT ELEVATION / PROPOSED SPOT ELEVATION
- EXISTING FENCE
- EXISTING/PROPOSED FLOW ARROW
- EXISTING CONTOUR
- EXISTING WATER
- EXISTING ROAD / TRAIL
- EXISTING TREES / BRUSH
- PROPOSED SILT FENCE
- PROPOSED ACTIVITY
- PROPOSED CROSS SECTION

N W E S

0' 100' 200'

11" X 17" SHEET: 1" = 200'
24" X 36" SHEET: 1" = 100'

EXISTING PHASE III BORROW AREA "D"

EXISTING PHASE III BORROW AREA "C"

PROPOSED PHASE IV BORROW AREA "A"

COW PEN SLOUGH

W/S 6.9

PROPOSED 20LF FLOATING TURBIDITY BARRIER

EXISTING 60LF 48" RCP. INVERTS AT EXISTING BOT

SLOPE 4:1 (TYP)

TOB

TOS

PROPOSED SILT FENCE SEE SHEET 8

EXISTING HAUL ROAD. CONTRACTOR RESPONSIBLE FOR MAINTAINING.

50.0'

PROPOSED 20LF FLOATING TURBIDITY BARRIER

EXISTING 60LF 48" RCP. INVERTS AT EXISTING BOT (PHASE III)

A A

B B

C C

F F

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

NOTE:
1. TOP OF BANK LINES DELINEATE LIMITS OF CONSTRUCTION.

2. IF DEWATERING IS NEEDED, CONTRACTOR SHALL ULTIMATELY DISCHARGE ANY DEWATERING ACTIVITIES INTO THE PHASE III BORROW PIT AFTER ALL MEASURES HAVE BEEN TAKEN TO REMOVE ALL COLLOIDAL PARTICALS FROM THE WATER.

Oct. 12, 2010 - 8:48am
User Name: 17381
Drawing Name: L:\Civil\03 SW\Landfill\CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX\BORROW AREA "A"\BORROW PHASE IV\DRAWINGS\Drawings

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PHONE: (941) 378 - 0272

CLIENT:
SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
SITE / DRAINAGE PLAN
BORROW AREA A

ORIGINAL: SEPTEMBER 08
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100004629
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: JE

SHEET 4

NOTE:
1. TOP OF BANK LINES DELINEATE LIMITS OF CONSTRUCTION.

2. IF DEWATERING IS NEEDED, CONTRACTOR SHALL ULTIMATELY DISCHARGE ANY DEWATERING ACTIVITIES INTO THE PHASE III BORROW PIT AFTER ALL MEASURES HAVE BEEN TAKEN TO REMOVE ALL COLLOIDAL PARTICALS FROM THE WATER.

LEGEND:

- EXISTING SPOT ELEVATION / PROPOSED SPOT ELEVATION
- EXISTING FENCE
- EXISTING/PROPOSED FLOW ARROW
- EXISTING CONTOUR
- EXISTING WATER
- EXISTING ROAD / TRAIL
- EXISTING TREES / BRUSH
- PROPOSED SILT FENCE
- PROPOSED ACTIVITY
- C C PROPOSED CROSS SECTION

PROPOSED 20LF FLOATING TURBIDITY BARRIER

EXISTING 60LF 48" RCP. INVERTS AT EXISTING BOT (PHASE III)

PROPOSED SILT FENCE SEE SHEET 8

EXISTING PHASE III BORROW AREA "B"

SLOPE 4:1

SLOPE 4:1

TOB

TOS

TOB

TOS

50.0'

EXISTING AGRICULTURAL IMPOUNDMENT AREA "A" (0.31 AC) SEE CROSS SECTION SHEET 7

W/S 12.9

PROPOSED PHASE IV BORROW AREA "C"

W/S 12.1

EXISTING AGRICULTURAL IMPOUNDMENT AREA "B" (0.45AC) SEE CROSS SECTION SHEET 7

PROPOSED PHASE IV BORROW AREA "B"

EXISTING HAUL ROAD. CONTRACTOR RESPONSIBLE FOR MAINTAINING.

EXISTING 60LF 48" RCP. INVERTS AT EXISTING BOT (PHASE III)

PROPOSED 20LF FLOATING TURBIDITY BARRIER

W/S 11.4

W/S 11.3

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

11" X 17" SHEET: 1" = 200'
24" X 36" SHEET: 1" = 100'

04-12-2010 - 05:01pm

User Name: 17201
Drawing Name: C:\SWK 03 SW\MISC\BORROW PHASE IV\BORROW PHASE IV.dwg

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/ PBSJ

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PRODUCTION ADDRESS:
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PARKWAY SUITE 260
SARASOTA, FLORIDA 34232
PHONE: (941) 378 - 0272

CLIENT:
SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
SITE / DRAINAGE PLAN
BORROW AREAS B & C

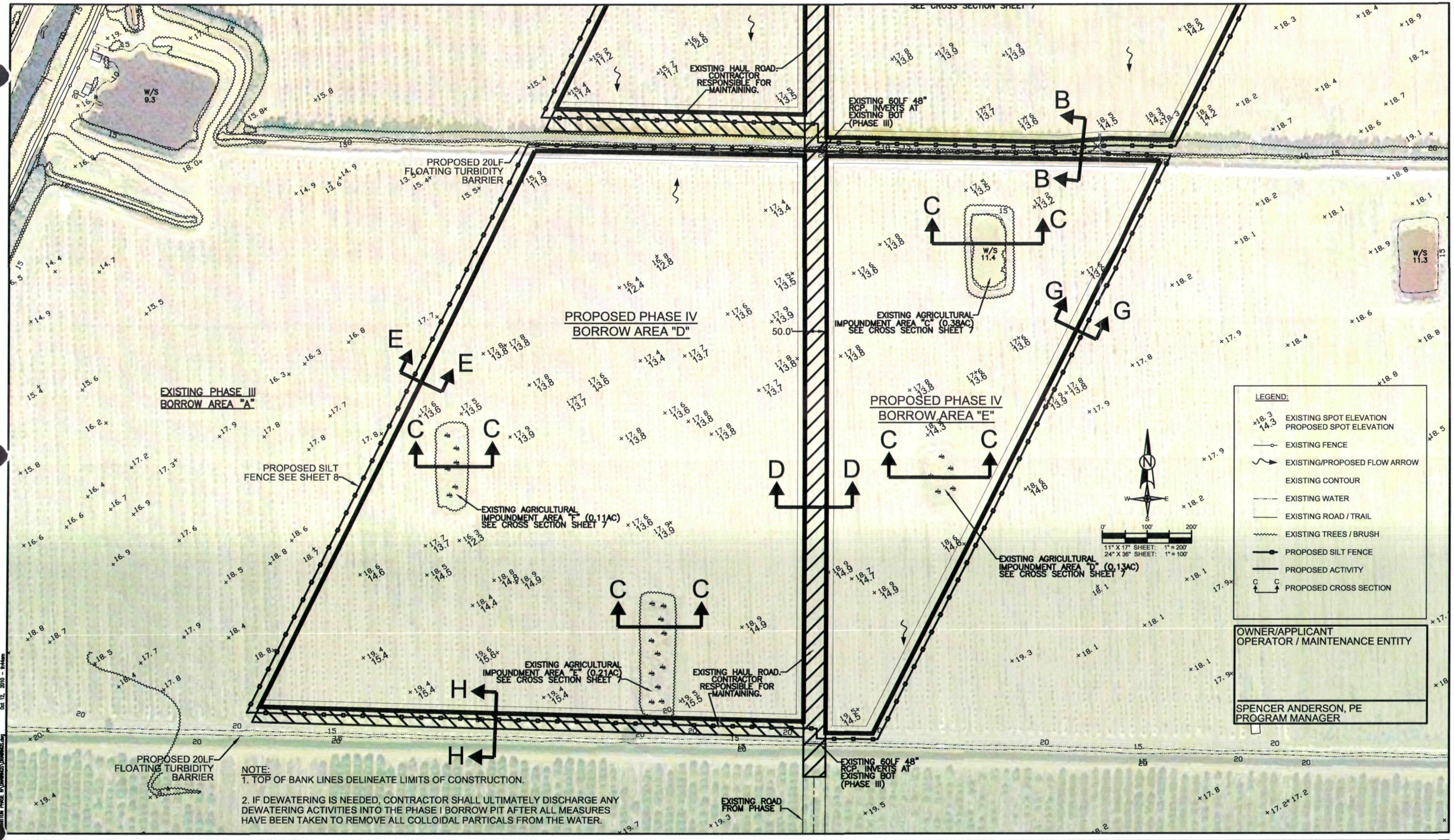
ORIGINAL: SEPTEMBER 08
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100004629
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: JE

SHEET 5



NOTE:
1. TOP OF BANK LINES DELINEATE LIMITS OF CONSTRUCTION.

2. IF DEWATERING IS NEEDED, CONTRACTOR SHALL ULTIMATELY DISCHARGE ANY DEWATERING ACTIVITIES INTO THE PHASE I BORROW PIT AFTER ALL MEASURES HAVE BEEN TAKEN TO REMOVE ALL COLLOIDAL PARTICALS FROM THE WATER.

Oct 12, 2010 - 8:44am
User Name: 17391
Drawing Name: L:\SWR_03_SP\ALIEN\...\SOUTH PHASE IV\DRAWINGS\DRAWINGS.dwg

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/
PBSJ
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TAMPA, FL. 33607
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SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
SITE / DRAINAGE PLAN
BORROW AREAS D & E

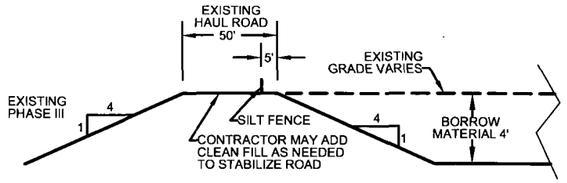
ORIGINAL: SEPTEMBER 08
REVISIONS:
1 _____ 6 _____
2 _____ 7 _____
3 _____ 8 _____
4 _____ 9 _____
5 _____ 10 _____
11 _____
12 _____

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

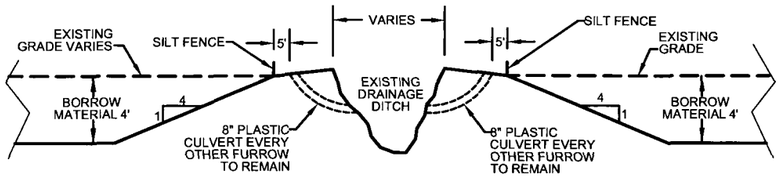
PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100004629
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: JE

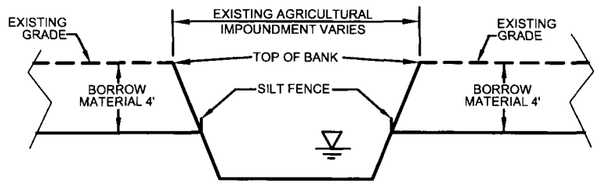
SHEET 6



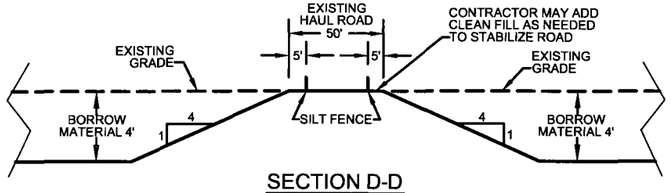
SECTION A-A
PROPOSED BORROW PIT
NTS



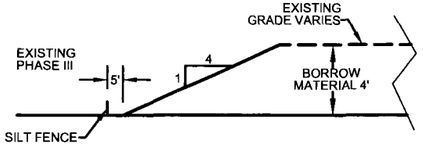
SECTION B-B
PROPOSED BORROW PIT
NTS



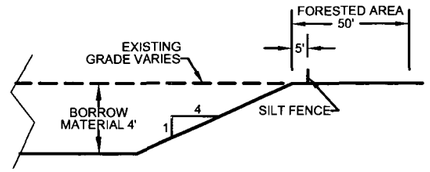
SECTION C-C
TYPICAL AGRICULTURAL
IMPOUNDMENT AREA CROSS SECTION
NTS



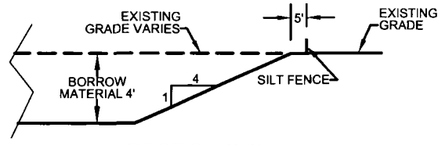
SECTION D-D
PROPOSED BORROW PIT
NTS



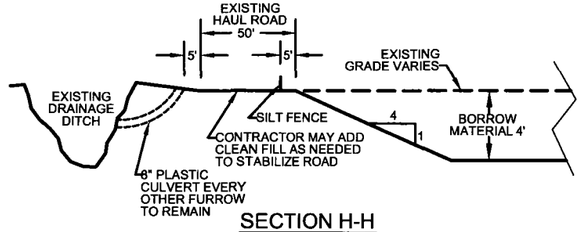
SECTION E-E
PROPOSED BORROW PIT
NTS



SECTION F-F
PROPOSED BORROW PIT
NTS



SECTION G-G
PROPOSED BORROW PIT
NTS



SECTION H-H
PROPOSED BORROW PIT
NTS

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/ PBSJ

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PHONE: (941) 378 - 0272

CLIENT:
SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
CROSS SECTIONS

ORIGINAL: SEPTEMBER 08
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

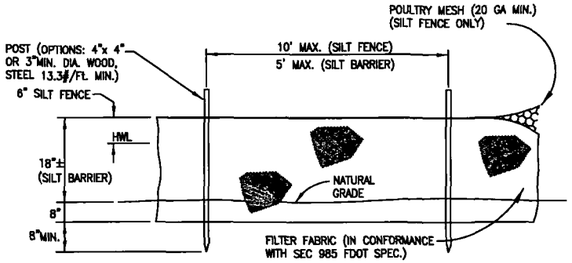
NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

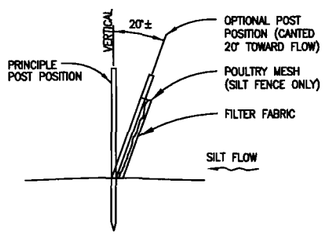
JOB NO.: 100004629
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: JE

SHEET 7

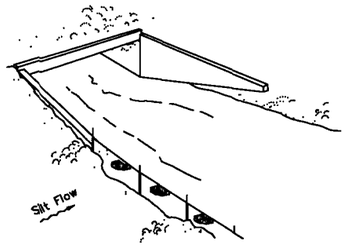
Mar 03, 2009 - 8:48am
Drawing Name: L:\Jobs\03 SWM\100004629\Engineering\Drawings\BORROW PHASE IV\BORROW CROSSSECTIONS.dwg



ELEVATION



SECTION

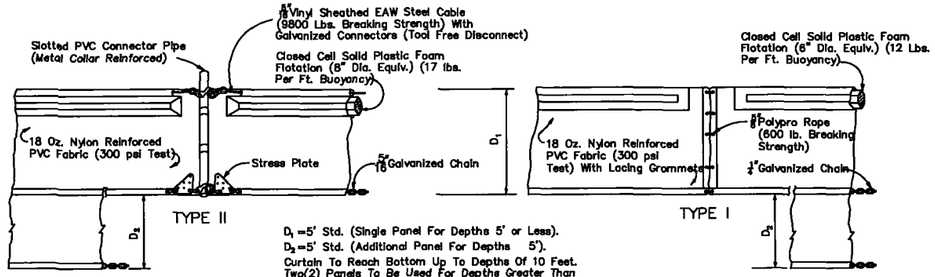


Type III Silt Fence

Note: Spacing for Type III Fence to be in accordance with Chart 1, Sheet 1 of 3 and ditch installations at drainage structures Sheet 2 of 3.
FDOT DESIGN STANDARDS, 2004, INDEX 102

Type III Silt Fence

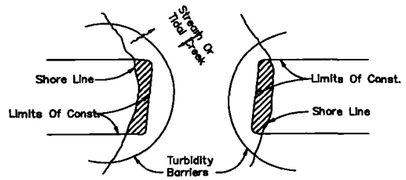
TYPICAL SILT FENCE
AND STAKED SILT BARRIER
N.T.S.

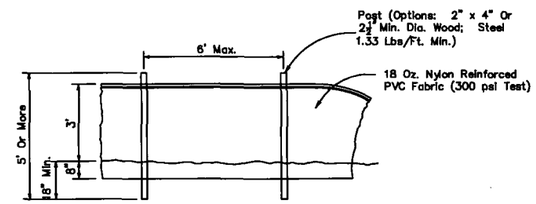


D_1 =5' Std. (Single Panel For Depths 5' or Less).
D_2 =5' Std. (Additional Panel For Depths 5').
Curtain To Reach Bottom Up To Depths Of 10 Feet.
Two(2) Panels To Be Used For Depths Greater Than
10 Feet Unless Special Depth Curtains Specifically Called
For In The Plans Or As Determined By The Engineer.

NOTICE: COMPONENTS OF TYPES I AND II MAY BE SIMILAR OR IDENTICAL TO PROPRIETARY DESIGNS. ANY INFRINGEMENT ON THE PROPRIETARY RIGHTS OF THE DESIGNER SHALL BE THE SOLE RESPONSIBILITY OF THE USER. SUBSTITUTIONS FOR TYPES I AND II SHALL BE AS APPROVED BY THE ENGINEER.

FLOATING TURBIDITY BARRIERS





STAKED TURBIDITY BARRIER

NOTES:
1. Turbidity barriers are to be used in all permanent bodies of water regardless of water depth.
2. Number and spacing of anchors dependent on current velocities.
3. Deployment of barrier around pile locations may vary to accommodate construction operations.
4. Navigation may require segmenting barrier during construction operations.
5. For additional information see Section 104 of the FDOT Standard Specifications,2004 .
6. Floating turbidity barriers are to be paid for under the contract unit price for Floating Turbidity Barrier, LF.
7. Staked turbidity barriers are to be paid for under the contract unit price for Staked Turbidity Barrier, LF.

NOTE:
Turbidity barriers for flowing streams and tidal creeks may be either floating, or staked types or any combinations of types that will suit site conditions and meet erosion control and water quality requirements. The barrier type(s) will be at the Contractors option unless otherwise specified in the plans, however payment will be under the pay item(s) established in the plans for Floating Turbidity Barrier and/or Staked Turbidity Barrier. Posts in staked turbidity barriers to be installed in vertical position unless otherwise directed by the Engineer.

TURBIDITY BARRIER APPLICATIONS

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/ PBSJ

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PHONE: (941) 378 - 0272

CLIENT:
SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
EROSION AND SEDIMENT CONTROL

ORIGINAL: SEPTEMBER 08
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100004629
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: JE

SHEET 8

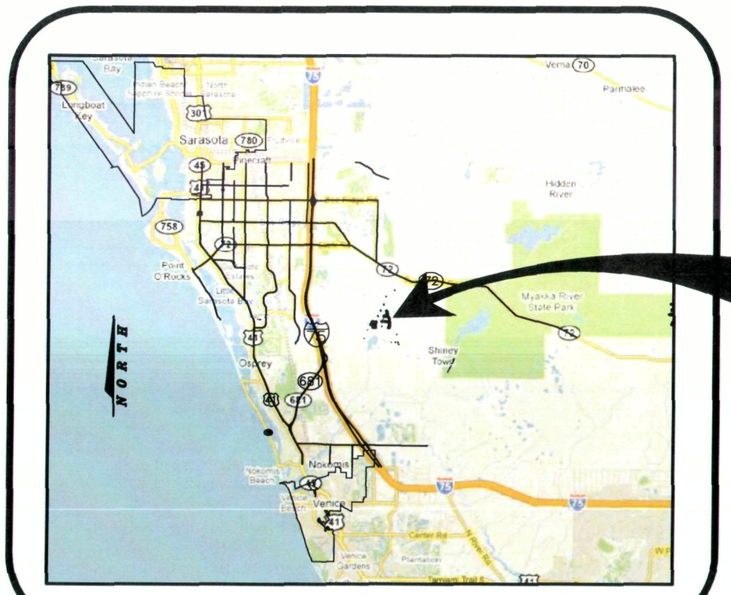
User Name: 17261
Drawing Name: L:\Work Groups\Environmental\Projects\Active\100004629 - Central County Solid Waste Disposal Complex\Borrow Facility - Phase IV\Construction Phase\Erosion and Sediment Control\Mar 03, 2009 - 8:49am

CONSTRUCTION PLANS FOR

CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX BORROW FACILITY - PHASE V

SECTION - 34 TOWNSHIP - 37S RANGE - 19E

VICINITY MAP



PROJECT LOCATION

SARASOTA COUNTY 1921

INDEX

SHT. NO.	TITLE
1	COVER SHEET
2	GENERAL NOTES
3	OVERALL SITE PLAN & KEY SHEET
4	SITE / DRAINAGE PLAN - BORROW AREA A
5	SITE / DRAINAGE PLAN - BORROW AREA B
6	SITE / DRAINAGE PLAN - BORROW AREA C
7	SITE / DRAINAGE PLAN - BORROW AREA D
8	CROSS SECTIONS
9	EROSION & SEDIMENT CONTROL

PREPARED FOR

SARASOTA COUNTY ENVIRONMENTAL SERVICES SOLID WASTE OPERATIONS

4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PREPARED BY

PBS&J

PRINCIPAL OFFICE
5300 WEST CYPRESS STREET
TAMPA, FLORIDA 33607
FBPR CERT. OF AUTH. # 24

PRODUCTION OFFICE
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SARASOTA, FLORIDA 34232
PHONE: (941) 378 - 0272

PROFESSIONAL ENGINEER DATE
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

GENERAL NOTES:

1. ANY U.S.C. AND G.S. MONUMENT, PUBLIC LAND CORNER, PROPERTY MONUMENTATION, OR BENCH MARK WITHIN LIMITS OF CONSTRUCTION SHALL BE PROTECTED. IF IN DANGER OF DAMAGE, THE CONTRACTOR SHOULD NOTIFY THE OWNER'S *REPRESENTATIVE IMMEDIATELY AS WELL AS:*

   GEODETIC INFORMATION CENTER
   ATTN.: MARK MAINTENANCE CENTER
   ATTN.: N/CG-162 6001 EXECUTIVE BLVD.
   ROCKVILLE, MARYLAND 20852
   (301) 443-8319

2. THE CONTRACTOR SHALL PROVIDE AT LEAST 72 HOURS NOTICE TO RELEVANT UTILITIES IN ADVANCE OF CONSTRUCTION. CONTACT SUNSHINE STATE ONE UTILITIES NOTIFICATION CENTER AT 1-800-432-4770. THE CONTRACTOR SHALL PROVIDE UTILITY COMPANIES ADEQUATE TIME TO RELOCATE ANY UTILITIES IN CONFLICT WITH PROPOSED CONSTRUCTION.

3. ALL WORK SHALL COMPLY WITH REGULATION AND ORDINANCES OF THE VARIOUS GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE WORK.

4. THE INFORMATION PROVIDED IN THESE PLANS IS TO ASSIST THE CONTRACTOR IN ASSESSING THE NATURE AND EXTENT OF THE CONDITIONS WHICH MAY BE ENCOUNTERED DURING THE COURSE OF WORK. ALL CONTRACTORS ARE DIRECTED, PRIOR TO BIDDING, TO CONDUCT WHATEVER INVESTIGATIONS NECESSARY TO DETERMINE THE ACTUAL CONDITIONS THAT WILL BE ENCOUNTERED AND UPON WHICH THEIR BIDS WILL BE BASED.

5. ALL BACKFILL SHALL BE COMPACTED PER FDOT SPECIFICATIONS.

6. MATERIALS INTERFERING WITH CONSTRUCTION, AND ALL ABANDONED UTILITY LINES, PIPES, STRUCTURES AND ALL OTHER SUB TERRAIN OBJECTS TO BE REMOVED, SHALL BE DISPOSED OF AS DIRECTED BY THE OWNER'S REPRESENTATIVE.

7. MATERIALS AND CONSTRUCTION TO BE IN ACCORDANCE WITH THE FDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST EDITION USING ENGLISH SYSTEM.

8. GRADE THE SITE AND DITCHES TO THE FINISHED GRADES AND TYPICAL SECTIONS. IMMEDIATELY BEFORE REQUESTING FINAL INSPECTIONS, CHECK THE LINES AND DRESS TO THE PROPER CONTOURS. ALL AREAS ARE TO BE STABILIZED AND MAINTAINED UNTIL ACCEPTED BY THE OWNER.

9. THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE IMMEDIATELY WHEN CONFLICTS BETWEEN DRAWINGS AND ACTUAL CONDITIONS ARE DISCOVERED.

10. FIELD CONDITIONS MAY NECESSITATE SLIGHT ALIGNMENT AND GRADE DEVIATION TO AVOID OBSTACLES, AS ORDERED BY THE OWNER'S REPRESENTATIVE.

11. LOCATION, ELEVATION, AND DIMENSIONS OF THE EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES ARE SHOWN IN ACCORDANCE WITH THE BEST INFORMATION AVAILABLE AT TIME OF THE PREPARATION OF THESE PLANS BUT DO NOT PURPORT TO BE ABSOLUTELY CORRECT.

12. THE CONTRACTOR SHALL VERIFY THE LOCATION, ELEVATION, AND DIMENSIONS OF ALL EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES AFFECTING HIS WORK AND SHALL COMPLY WITH ALL STATE, COUNTY, AND LOCAL ORDINANCES.

13. CONTRACTOR SHALL MAINTAIN A SET OF PLANS WITH CURRENT FIELD CHANGES MARKED THEREON AND SHALL DELIVER THESE PLANS TO THE OWNER'S REPRESENTATIVE UPON COMPLETION OF CONSTRUCTION. FINAL PAYMENT SHALL NOT BE MADE UNTIL THIS REQUIREMENT IS SATISFIED.

14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY PERMITS NOT PROVIDED BY THE ENGINEER, OWNER, OR OWNER'S REPRESENTATIVE THESE PERMITS MAY INCLUDE ROAD CROSSING, ONSITE DEWATERING, BURNING PERMITS, NPDES, EARTHMOVING, AND ANY OTHER PERMITS FROM GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE PROJECT SITE.

15. THE CONTRACTOR SHALL ADHERE TO ALL CONDITIONS AND REQUIREMENTS OF ALL PERMITS WHICH HAVE BEEN OBTAINED. CONTRACTOR SHALL BE RESPONSIBLE FOR PAYMENT OF ANY FINES AND ADMINISTRATIVE COSTS INCURRED BY THE OWNER FOR PERMIT VIOLATIONS.

16. THE CONTRACTOR SHALL STABILIZE AND MAINTAIN ACCESS ROADS DURING CONTRUCTION AS NECESSARY FOR WORK ACCESS AND USE BY SARASOTA COUNTY STAFF FOR PROPERTY MANAGEMENT, SERVICE, AND FIRE PROTECTION. THESE ROADS SHALL BE RESTORED TO ORIGINAL CONDITION AFTER JOB COMPLETION IN AREAS DIRECTED BY THE OWNER'S REPRESENTATIVE.

17. THE OWNER'S SURVEYOR SHALL PROVIDE BENCH MARK AND COORDINATE CONTROL POINTS FOR THE CONTRACTOR. THE CONTRACTOR SHALL SUPPLY POINTS FOR LINE AND GRADE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COMPLETE STAKE-OUT OF THE PROJECT GRADE, SLOPE STAKING, MAINTENANCE OF STAKING, AND ANY RESTAKING THAT MAY BE REQUIRED TO COMPLETE THE PROJECT IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS. ANY AND ALL EXPENSES INCURRED FOR THE CONTRACTOR'S SURVEY WORK SHALL BE INCLUDED IN THE PRICE BID FOR APPLICABLE ITEMS. NO ADDITIONAL PAYMENT SHALL BE MADE FOR THIS WORK.

18. OVERALL CLEAN UP SHALL BE ACCOMPLISHED BY THE CONTRACTOR AS DIRECTED BY THE OWNER'S REPRESENTATIVE. ANY AND ALL EXPENSES INCURRED FOR THIS WORK SHALL BE INCLUDED IN THE UNIT PRICE BID FOR THE APPLICABLE LINE ITEMS. THE CONTRACTOR SHALL REMOVE ALL TRASH, DEBRIS, AND UNUSED MATERIALS ON A REGULAR BASIS TO KEEP WORK SITE CLEAN. MATERIALS REMOVED SHALL BE DISPOSED IN A LAWFUL MANNER.

19. *THE CONTRACTOR SHALL ENDEAVOR TO PROTECT PRIVATE PROPERTY. ANY DAMAGE CAUSED BY THE CONTRACTOR IN THE* PERFORMANCE OF HIS WORK SHALL BE CORRECTED TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE AT THE CONTRACTOR'S EXPENSE. PAYMENT SHALL NOT BE MADE FOR ANY RESTORATION WORK.

20. ANY DAMAGE TO STATE, COUNTY, OR LOCAL ROADS OR PROPERTY CAUSED BY THE CONTRACTOR'S HAULING OR EXCAVATION EQUIPMENT SHALL BE REPAIRED BY THE CONTRACTOR TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE OR FACILITY OWNER. PAYMENT SHALL NOT BE MADE FOR THIS WORK.

EROSION AND SEDIMENT CONTROL:

1. MAINTAIN WATER QUALITY STANDARDS PURSUANT TO SECTION 62-302 F.A.C.

2. *THE CONTRACTOR SHALL INSTALL AND MAINTAIN EROSION CONTROL BARRIERS SUCH AS SILT SCREEN FENCING/FLOATING* TURBIDITY BARRIERS, AS REQUIRED BY ACTUAL SITE CONDITIONS AND AS DIRECTED BY THE OWNER'S REPRESENTATIVE. THE MAINTENANCE OF EROSION CONTROL DEVICES AND THEIR COMPLETE REMOVAL ARE TO BE INCLUDED IN THE BID PRICE. THE SILT BARRIERS SHALL BE PLACED IN ACCORDANCE WITH THE REQUIREMENTS OF FDOT INDEX NO. 102 AND 103, OR AS DIRECTED BY THE OWNER'S REPRESENTATIVE. FAILURE TO INSTALL OR PROPERLY MAINTAIN THESE BARRIERS MAY RESULT IN ENFORCEMENT ACTIONS WHICH MAY INCLUDE CITATIONS, AS PROVIDED BY CHAPTERS 40D-A, AND 40D-40, F.A.C.

3. *THE CONTRACTOR SHALL PROVIDE AND INSTALL HAY BALES AND/OR SILT SCREENS AND/OR SODDED BERMS TO PREVENT THE* TRANSPORT OF SEDIMENT DOWNSTREAM INTO PRIVATE PROPERTY, OPEN DITCHES, SURFACE WATERS ETC. & MAINTAIN SUCH CONTROL DEVICES THROUGHOUT THE CONSTRUCTION.

4. EROSION AND SEDIMENT CONTROL DEVICES SHALL REMAIN IN PLACE AND SHALL NOT BE REMOVED UNTIL FINAL GRADING AND RESTORATION OF THE SITE HAS BEEN COMPLETED.

5. ALL AREAS DISTURBED DURING CONSTRUCTION SHALL BE RETURNED TO THE EXISTING GRADE, PROFILE, AND CROSS SECTION UNLESS OTHERWISE NOTED. MATCH EXISTING ELEVATIONS AT BOUNDARIES/LIMITS OF CONSTRUCTION ACTIVITIES.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF THE EXISTING DRAINAGE SYSTEM WITHIN THE LIMITS OF THE PROJECT AREA, FOR THE DURATION OF THE PROJECT. NO ADDITIONAL PAYMENT WILL BE MADE FOR THE WORK INVOLVED.

7. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A STORMWATER POLLUTION PREVENTION PLAN IN COMPLIANCE WITH NPDES STORMWATER PERMIT REQUIREMENTS.

8. THE CONTRACTOR SHALL SUBMIT A NOTICE OF INTENT OF CONSTRUCTION COMMENCEMENT AND NOTICE OF TERMINATION TO APPLICABLE AGENCIES AND MONITOR CONSTRUCTION IN ACCORDANCE WITH NPDES STORMWATER PERMIT REQUIREMENTS.

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/ PBSJ

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CLIENT:
SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE V

TASK:
GENERAL NOTES

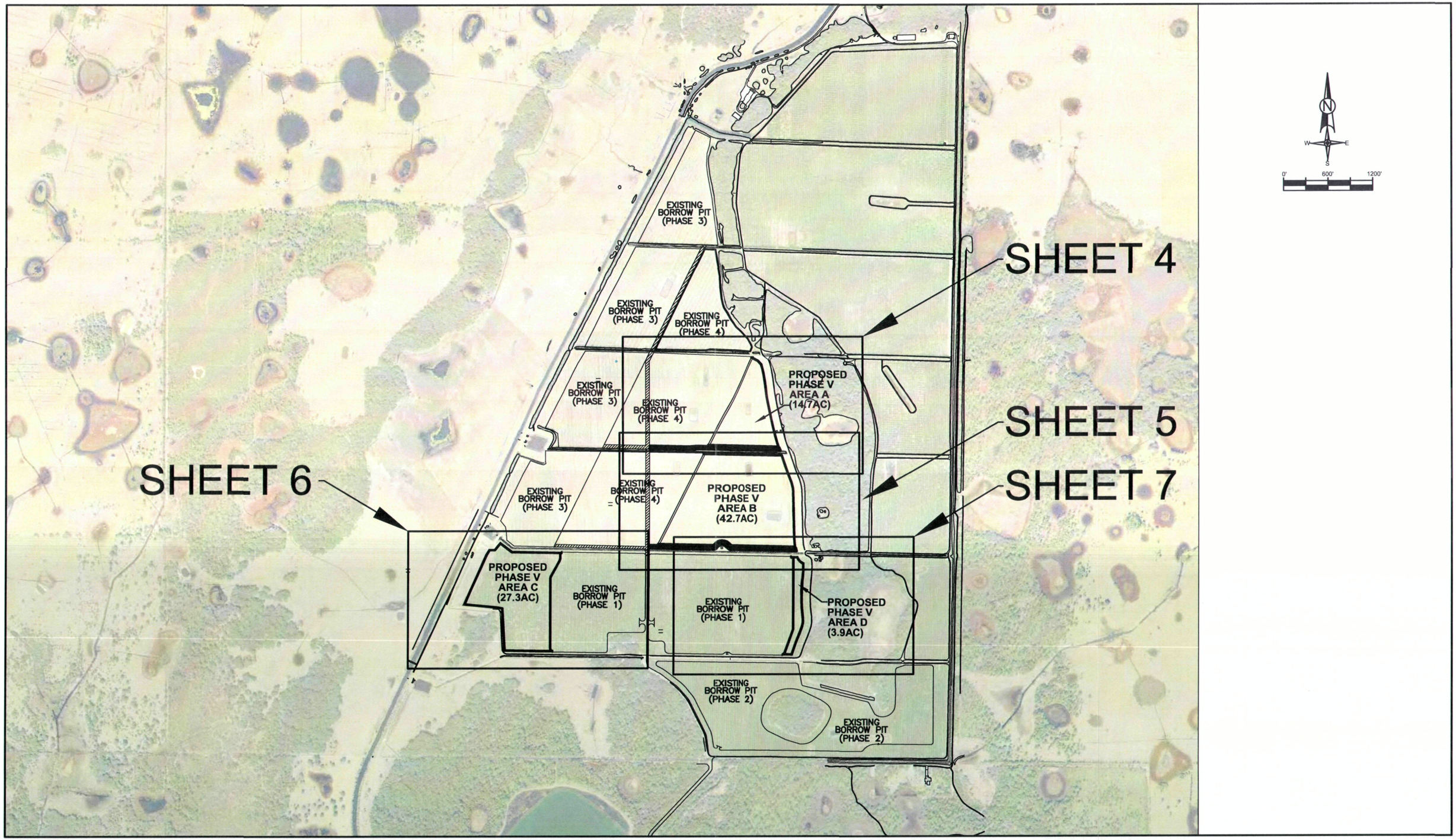
ORIGINAL: SEPTEMBER 08
REVISIONS:
1 _____ 2 _____ 3 _____ 4 _____ 5 _____
6 _____ 7 _____ 8 _____ 9 _____ 10 _____ 11 _____ 12 _____

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100007426
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: CS

SHEET 2



POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A
PBSJ

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SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE V

TASK:
OVERALL SITE PLAN & KEY SHEET

ORIGINAL: SEPTEMBER 08
REVISIONS:
1
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3
4
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11
12

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BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100007426
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: CS

SHEET 3

NOTE:
1. TOP OF BANK LINES DELINEATE LIMITS OF CONSTRUCTION.

2. IF DEWATERING IS NEEDED, CONTRACTOR SHALL ULTIMATELY DISCHARGE ANY DEWATERING ACTIVITIES INTO THE PHASE I BORROW PIT AFTER ALL MEASURES HAVE BEEN TAKEN TO REMOVE ALL COLLOIDAL PARTICALS.

LEGEND:
- EXISTING SPOT ELEVATION / PROPOSED SPOT ELEVATION
- EXISTING FENCE
- EXISTING/PROPOSED FLOW ARROW
- EXISTING CONTOUR
- EXISTING WATER
- EXISTING TREES / BRUSH
- EXISTING BORROW AREA
- PROPOSED ACTIVITY
- PROPOSED CROSS SECTION

PROPOSED 20LF FLOATING TURBIDITY BARRIER SEE DETAIL SHEET 9

EXISTING 60LF 48" RCP (PHASE III)

EXISTING PHASE III BORROW AREA "B"

EXISTING PHASE IV BORROW AREA "C"

PROPOSED SILT FENCE SEE SHEET 8

PROPOSED PHASE V BORROW AREA "A"

EXISTING AGRICULTURAL IMPOUNDMENT AREA "A" (0.21 AC) SEE CROSS SECTION SHEET 8

EXISTING HAUL ROAD, CONTRACTOR RESPONSIBLE FOR MAINTAINING

PROPOSED HAUL ROAD, CONTRACTOR RESPONSIBLE FOR MAINTAINING

EXISTING 60LF 48" RCP (PHASE III)

PROPOSED 20LF FLOATING TURBIDITY BARRIER SEE DETAIL SHEET 9

W/S 12.9

W/S 12.1

W/S 11.4

0' 100' 200'

OWNER/APPLICANT OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/
PBSJ
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SARASOTA COUNTY
ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE V

TASK:
SITE / DRAINAGE PLAN
BORROW AREA A

ORIGINAL: SEPTEMBER 08
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

NOT VALID FOR CONSTRUCTION UNLESS SIGNED IN THIS BLOCK

PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100007426
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: CS

SHEET 4

PROPOSED HAUL ROAD. CONTRACTOR RESPONSIBLE FOR MAINTAINING

PROPOSED 20LF FLOATING TURBIDITY BARRIER SEE DETAIL SHEET 9

EXISTING 60LF 48" RCP (PHASE III)

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

LEGEND:

- EXISTING SPOT ELEVATION / PROPOSED SPOT ELEVATION
- EXISTING FENCE
- EXISTING/PROPOSED FLOW ARROW
- EXISTING CONTOUR
- EXISTING WATER
- EXISTING TREES / BRUSH
- EXISTING BORROW AREA
- PROPOSED ACTIVITY
- PROPOSED CROSS SECTION

EXISTING PHASE IV BORROW AREA "E"

W/S 11.4

EXISTING HAUL ROAD. CONTRACTOR RESPONSIBLE FOR MAINTAINING

PROPOSED PHASE V BORROW AREA "B"

EXISTING AGRICULTURAL IMPOUNDMENT AREA "B" (0.42AC) SEE CROSS SECTION SHEET 8

W/S 11.3

EXISTING PHASE IV BORROW AREA "D"

W/S 12.5

EXISTING AGRICULTURAL IMPOUNDMENT AREA "C" (0.54AC) SEE CROSS SECTION SHEET 8

PROPOSED HAUL ROAD. CONTRACTOR RESPONSIBLE FOR MAINTAINING

EXISTING PUMP HOUSE

PROPOSED 20LF FLOATING TURBIDITY BARRIER

EXISTING 60LF 48" RCP (PHASE III)

EXISTING HAUL ROAD FROM PHASE I. CONTRACTOR RESPONSIBLE FOR MAINTAINING

NOTE:
1. TOP OF BANK LINES DELINEATE LIMITS OF CONSTRUCTION.

2. IF DEWATERING IS NEEDED, CONTRACTOR SHALL ULTIMATELY DISCHARGE ANY DEWATERING ACTIVITIES INTO THE PHASE I BORROW PIT AFTER ALL MEASURES HAVE BEEN TAKEN TO REMOVE ALL COLLOIDAL PARTICALS.

0' 100' 200'

POST, BUCKLEY, SCHUH & JERNIGAN, INC., D/B/A/
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TAMPA, FL. 33607
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CLIENT:
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ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE IV

TASK:
SITE / DRAINAGE PLAN
BORROW AREA B

ORIGINAL: SEPTEMBER 08
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

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PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100007628
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: GB

SHEET 5

NOTE:
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2. IF DEWATERING IS NEEDED, CONTRACTOR SHALL ULTIMATELY DISCHARGE ANY DEWATERING ACTIVITIES INTO THE PHASE I BORROW PIT AFTER ALL MEASURES HAVE BEEN TAKEN TO REMOVE ALL COLLOIDAL PARTICALS.

LEGEND:

- EXISTING SPOT ELEVATION / PROPOSED SPOT ELEVATION
- EXISTING FENCE
- EXISTING/PROPOSED FLOW ARROW
- EXISTING CONTOUR
- EXISTING WATER
- EXISTING TREES / BRUSH
- EXISTING BORROW AREA
- PROPOSED ACTIVITY
- PROPOSED CROSS SECTION

PROPOSED 20LF FLOATING TURBIDITY BARRIER

PROPOSED PHASE V
BORROW AREA "C"

EXISTING PHASE I
BORROW AREA

EXISTING AGRICULTURAL IMPOUNDMENT AREA "D" (0.28AC)
SEE CROSS SECTION SHEET 8

OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

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NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE V

TASK:
SITE / DRAINAGE PLAN
BORROW AREA C

ORIGINAL: SEPTEMBER 08
REVISIONS:
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FL. LICENSE #: 63933

JOB NO.: 100007426
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: CS
SHEET 6

PROPOSED HAUL ROAD. CONTRACTOR RESPONSIBLE FOR MAINTAINING

EXISTING PUMP HOUSE

PROPOSED 20LF FLOATING TURBIDITY BARRIER

EXISTING 60LF 48" RCP (PHASE III)

EXISTING HAUL ROAD FROM PHASE I. CONTRACTOR RESPONSIBLE FOR MAINTAINING

NOTE:
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OWNER/APPLICANT
OPERATOR / MAINTENANCE ENTITY

SPENCER ANDERSON, PE
PROGRAM MANAGER

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- EXISTING CONTOUR
- EXISTING WATER
- EXISTING TREES / BRUSH
- EXISTING BORROW AREA
- PROPOSED ACTIVITY
- PROPOSED CROSS SECTION

EXISTING PHASE I BORROW AREA

PROPOSED PHASE V BORROW AREA "D"

Dept. Of Environmental Protection
SEP 21 2011
Southwest District

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NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE V

TASK:
SITE / DRAINAGE PLAN
BORROW AREA D

ORIGINAL: SEPTEMBER 08
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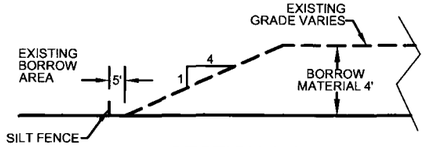
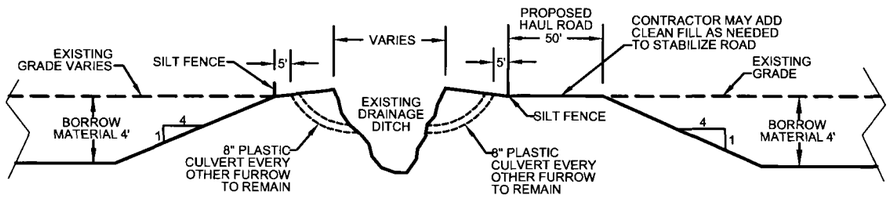
FL. LICENSE #: 63933

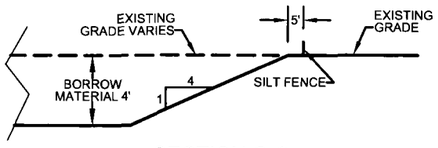
JOB NO.: 100007426
DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: CS
SHEET 7



SECTION A-A
PROPOSED BORROW PIT
NTS



SECTION B-B
PROPOSED BORROW PIT
NTS



SECTION C-C
PROPOSED BORROW PIT
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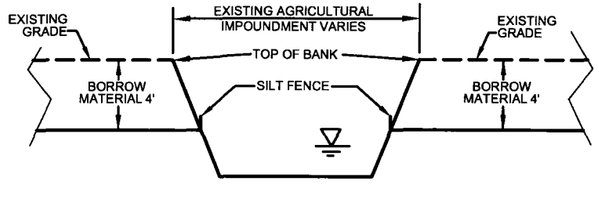

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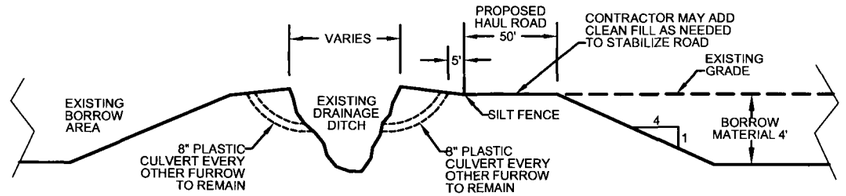
IMPOUNDMENT AREA CROSS SECTION
NTS



SECTION E-E
PROPOSED BORROW PIT
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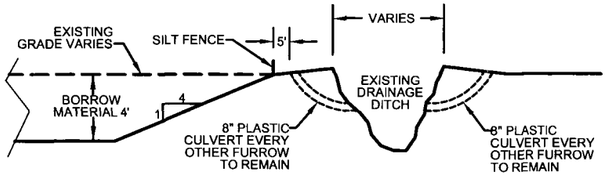
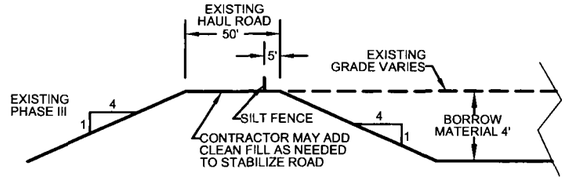


SECTION F-F
PROPOSED BORROW PIT
NTS



SECTION G-G
EXISTING HAUL ROAD
NTS

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PROGRAM MANAGER

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NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE V

TASK:
CROSS SECTIONS

ORIGINAL: SEPTEMBER 08
REVISIONS:
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PROFESSIONAL ENGINEER:
BRYAN ZOLLER, PE
FL. LICENSE #: 63933

JOB NO.: 100007426
DRAWN: BZ
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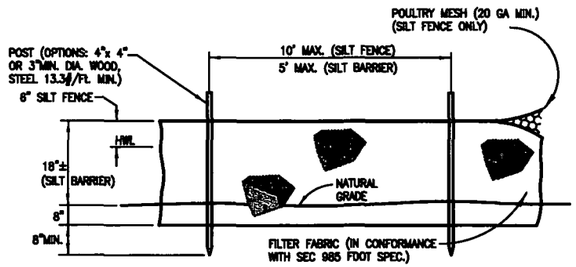
QC: CS

SHEET 8



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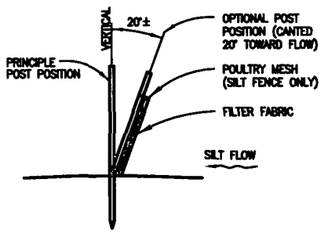

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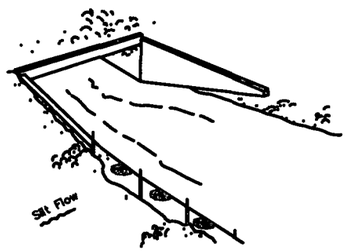


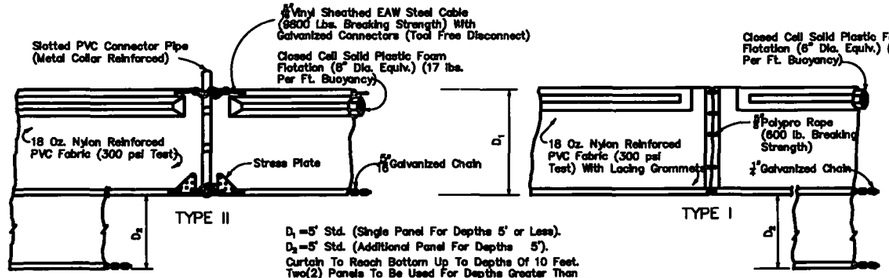
Type III Silt Fence

Note: Spacing for Type III Fence to be in accordance with Chart 1, Sheet 1 of 3 and ditch installations at drainage structures Sheet 2 of 3. FDOT DESIGN STANDARDS, 2004, INDEX 102

Type III Silt Fence

TYPICAL SILT FENCE AND STAKED SILT BARRIER

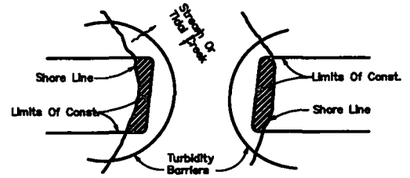
N.T.S.

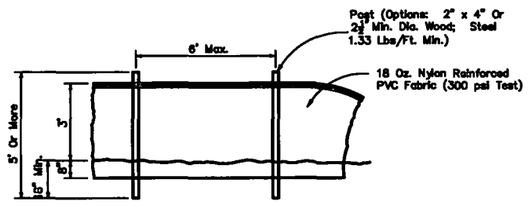


D_1 =5' Std. (Single Panel For Depths 5' or Less).
D_2 =5' Std. (Additional Panel For Depths 5').
Curtain To Reach Bottom Up To Depths Of 10 Feet. Two(2) Panels To Be Used For Depths Greater Than 10 Feet Unless Special Depth Curtains Specifically Called For In The Plans Or As Determined By The Engineer.

NOTICE: COMPONENTS OF TYPES I AND II MAY BE SIMILAR OR IDENTICAL TO PROPRIETARY DESIGNS. ANY INFRINGEMENT ON THE PROPRIETARY RIGHTS OF THE DESIGNER SHALL BE THE SOLE RESPONSIBILITY OF THE USER. SUBSTITUTIONS FOR TYPES I AND II SHALL BE AS APPROVED BY THE ENGINEER.

FLOATING TURBIDITY BARRIERS





STAKED TURBIDITY BARRIER

NOTES:
1. Turbidity barriers are to be used in all permanent bodies of water regardless of water depth.
2. Number and spacing of anchors dependent on current velocities.
3. Deployment of barrier around pile locations may vary to accommodate construction operations.
4. Navigation may require segmenting barrier during construction operations.
5. For additional information see Section 104 of the FDOT Standard Specifications,2004 .
6. Floating turbidity barriers are to be paid for under the contract unit price for Floating Turbidity Barrier, LF.
7. Staked turbidity barriers are to be paid for under the contract unit price for Staked Turbidity Barrier, LF.

NOTE:
Turbidity barriers for flowing streams and tidal creeks may be either floating, or staked types or any combinations of types that will suit site conditions and meet erosion control and water quality requirements. The barrier type(s) will be at the Contractors option unless otherwise specified in the plans, however payment will be under the pay item(s) established in the plans for Floating Turbidity Barrier and/or Staked Turbidity Barrier. Posts in staked turbidity barriers to be installed in vertical position unless otherwise directed by the Engineer.

TURBIDITY BARRIER APPLICATIONS

Dept. Of Environmental Protection

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Southwest District

OWNER/APPLICANT
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ENVIRONMENTAL SERVICES
SOLID WASTE OPERATIONS
4000 KNIGHTS TRAIL ROAD
NOKOMIS, FLORIDA 34275

PROJECT:
CENTRAL COUNTY SOLID
WASTE DISPOSAL COMPLEX
BORROW FACILITY - PHASE V

TASK:
EROSION & SEDIMENT CONTROL

ORIGINAL: SEPTEMBER 08
REVISIONS:
1 _____ 2 _____ 3 _____ 4 _____ 5 _____
6 _____ 7 _____ 8 _____ 9 _____ 10 _____ 11 _____ 12 _____

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FL. LICENSE #: 63933

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DRAWN: BZ
DESIGNED: BZ
CHECKED: JE
QC: CS

SHEET 9

ATTACHMENT B

CONFORMED CONSTRUCTION SPECIFICATIONS

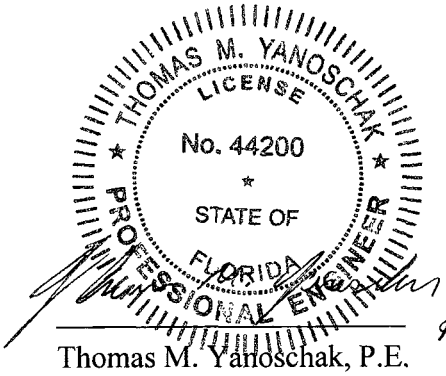
Sarasota County
Solid Waste Operations

Central County Solid Waste Disposal Complex Phase I Class I Landfill Closure and Landfill Gas Collection System Construction Quality Assurance Plans and Technical Specifications

October 2011

Prepared by
HDR Engineering, Inc.
2621 Cattlemen Road, Suite 106
Sarasota, Florida 34232-62121
(941) 342-2700

HDR Project No. 131392



9/19/11

Thomas M. Yanoschak, P.E.
Certificate No. 44200
HDR CA# 4213

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2. CENTRAL COUNTY SOLID WASTE DISPOSAL COMPLEX CLASS I LANDFILL EXPANSION CONSTRUCTION QUALITY ASSURANCE PLAN (PHASE II OVERLINER SYSTEM INSTALLED ON WEST SLOPE OF PHASE I)

Please note that two Construction Quality Assurance Plans are provided for this project due to separate permitting requirements for the Phase I Closure final cover/temporary final cover and the Phase II overliner system that is being installed on the west side slope of Phase I as shown in the Contract Drawings. Please refer to the appropriate CQA Plan listed above as appropriate for these portions of the Work.

PART B – TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

01040	COORDINATION
01050	SURVEY
01060	SPECIAL CONDITIONS
01290	MEASUREMENT AND PAYMENT
01340	SUBMITTALS
01410	TESTING LABORATORY SERVICES
01500	CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
01560	ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS
01600	PRODUCT DELIVERY, STORAGE, AND HANDLING
01640	PRODUCT SUBSTITUTIONS
01700	CONTRACT CLOSEOUT

DIVISION 2 - SITE WORK

02130	VERTICAL EXTRACTION WELLS
02200	EARTHWORK: LANDFILL
02221	TRENCHING, BACKFILLING, AND COMPACTING FOR LFG PIPING AND STRUCTURES
02221A	TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES AND STORMWATER STRUCTURES
02240	DRAINAGE SAND LAYER: OVERLAY LINER SYSTEM
02260	TOPSOILING AND FINISHED GRADING
02270	SOIL EROSION AND SEDIMENT CONTROL
02310	DEWATERING
02485	SODDING
02510	ROADWAY: LANDFILL ACCESS ROAD
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02515	PRECAST CONCRETE STRUCTURES
02575	ENVIRONMENTAL CONTROL PROGRAM REQUIREMENTS
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02777A DRAINAGE COMPOSITE: OVERLAY LINER SYSTEM
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02780 GEOSYNTHETIC RAIN COVER

DIVISION 3 - CONCRETE

03002 CONCRETE

DIVISION 10 - SPECIALTIES

10400 IDENTIFICATION DEVICES

DIVISION 11 - EQUIPMENT

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11060 PUMPING EQUIPMENT: BASIC REQUIREMENTS
11070 PUMPING EQUIPMENT: PNEUMATIC PUMPS

DIVISION 15 - MECHANICAL

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15067 PIPE: HIGH DENSITY POLYETHYLENE
15079 PIPE: CORRUGATED POLYETHYLENE
15100 VALVES: BASIC REQUIREMENTS
15104 BALL VALVES

PART A

Sarasota County
Solid Waste Operations

Central County Solid Waste Disposal Complex Phase I Class I Landfill Closure and Landfill Gas Collection System Construction Quality Assurance Plan

October 2010

Prepared by
HDR Engineering, Inc.
2621 Cattlemen Road, Suite 106
Sarasota, Florida 33609-344434232-62121
(941) 342-2700

HDR Project No. 0096-125174-002

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SECTION 1.0
INTRODUCTION

1.1 PURPOSE

This Construction Quality Assurance (CQA) Plan is a document that contains requirements for testing materials and monitoring construction of the Sarasota Central County Solid Waste Disposal Complex Phase I Class I Landfill Closure and Landfill Gas Collection System, including the responsibilities of CQA personnel, documentation control, and reporting procedures.

The plan was prepared to provide the Owner, Design Engineer, CQA Engineer, and the Contractor the means to govern the construction quality; to satisfy environmental protection requirements for current solid waste management regulations; and utilize state-of-the-art construction practices and testing procedures to adequately document proposed construction activities. The proposed construction, testing, and documentation procedures are also intended to provide the necessary safeguards and provisions accepted by the Owner upon completion. The roles of each party have been sufficiently defined and the level of responsibility explained. The proposed final cover system will be constructed in accordance with the design, the construction documented, and respective components approved and certified for acceptance.

More specifically, this CQA Plan addresses the soils and geosynthetics components of the final and temporary final cover system. Specific work elements include the following:

- Initial Cover
- Intermediate Cover
- Final Cover liner which consists, from bottom to top, of
    - 40-mil LLDPE liner (textured),
    - geocomposite drainage layer
- Protective cover
- Pipes and fittings
- Vegetative Layer
- Top Soil
- TPO Geomembrane for Temporary Final Cover
- Landfill Gas Collection System piping and components

The CQA Engineer has the primary responsibility of implementing and managing the CQA program described in this plan. When construction is complete, the CQA organization will prepare a construction certification report that will include information generated through the CQA program and will document the extent to which construction was performed in accordance with the contract documents.

The CQA Plan is intended to be a supporting document to improve the overall implementation of the work. The Contractor is instructed to bring discrepancies in the contract documents to the attention of the Design Engineer or CQA Engineer for resolution. The Design Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents. Unless otherwise determined by the Design Engineer, the more stringent requirement shall be the controlling resolution.

1.2 REFERENCE DOCUMENTS

In addition to the methods, procedures and requirements outlined in this CQA Plan refer to the following documents:

- Florida Department of Environmental Protection (FDEP) Chapter 62-701.400; 62-701.600
- Project Plans and Specifications
- Manufacturer's Quality Assurance Manuals (where applicable)
- Contractor's Construction Quality Control Plan
- EPA/600/R-93/182
- ASTM International - Current Edition

1.3 DEFINITIONS

This section provides definitions for terms used in this CQA Plan.

Contract Documents – All contractor submittals, construction plans, as-built plans, construction specifications, QA plan, safety plan and project schedule.

CQA Organization – The company and persons including CQA Engineer, CQA Inspector, and CQA Laboratories whose primary responsibility is to implement the CQA Plan.

CQA Plan – The document contained herein, entitled Central County Solid Waste Disposal Complex Phase I Closure Construction Quality Assurance Plan prepared for Sarasota County Solid Waste Operations by HDR Engineering, Inc.

Project Plans and Specifications - All project related plans and specifications including design modifications and as-built plans.

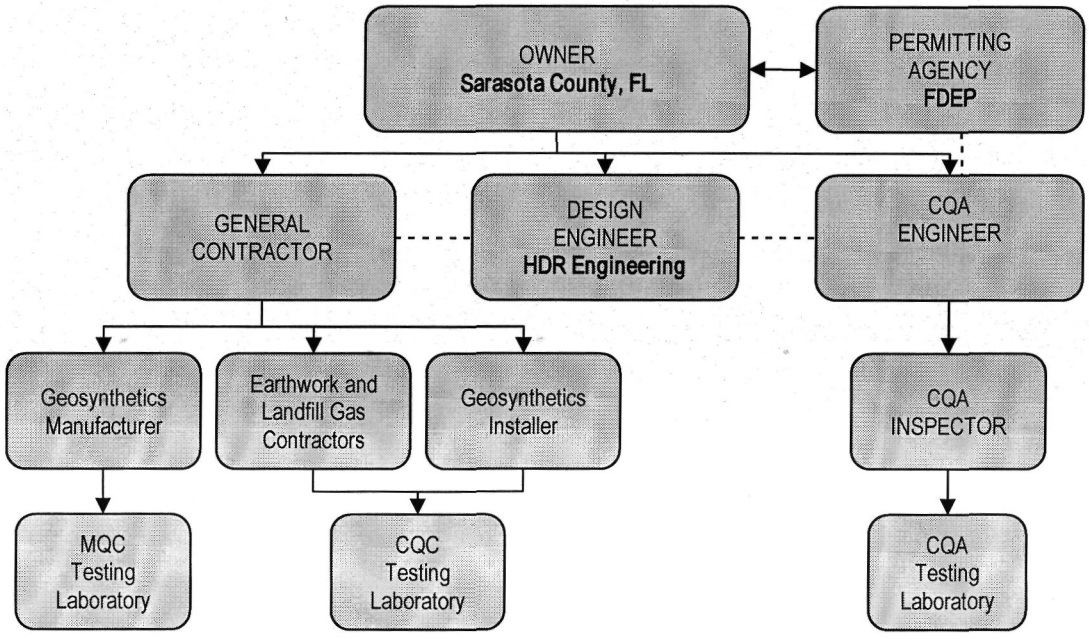
Quality Control - Actions taken by the geomembrane manufacturer and installer to ensure that the geosynthetic materials and workmanship meet the requirements of the Project Plans and Specifications.

Work - All tools, equipment, supervision, labor and material or supplies necessary to complete the project as specified herein and as shown on the Project Plans and Specifications.

SECTION 2.0
RESPONSIBILITY AND AUTHORITY

The principal organizations involved in permitting, designing and construction of the solid waste disposal facility include the permitting agency, facility owner/operator, Design Engineer, CQA organization, and Contractor. The principal organizations, their areas of responsibility and lines of authority as delineated for the CQA Plan are shown in the organization chart below and described fully in this section. This establishes the necessary lines of communication that will facilitate an effective decision making process during implementation of the CQA Plan.

Figure 1
CQA/CQC Organization Chart



2.1 PERMITTING AGENCY

The Florida Department of Environmental Protection (FDEP), as permitting agency, is authorized by law to issue a permit for the construction of landfill closure. It is the responsibility of the FDEP to review the facility owner/operator's permit application, including the site-specific CQA Plan, for compliance with FDEP's regulations and to make a decision to issue or deny a permit based on this review. The FDEP has the responsibility and authority to review and accept or reject any design revisions or requests for variance that are submitted by the facility owner/operator after the permit is issued. The FDEP also has the responsibility and authority to review all CQA documentation during or after construction to confirm that the approved CQA Plan was followed and that the construction was completed as specified in the design.

2.2 FACILITY OWNER/OPERATOR

Sarasota County, Florida ("Owner") is the facility owner/operator and is responsible for the design, construction, operation and closure of the solid waste disposal facility. This responsibility includes complying with the requirements of the FDEP in order to obtain a permit and assuring the FDEP, by the

submission of CQA documentation, that the facility was constructed as specified in the design. The Owner has the authority to select and dismiss organizations charged with design, CQA, and construction activities. The Owner also has the authority to accept or reject design plans and specifications, CQA Plans, reports and recommendations of the CQA Engineer, and the materials and workmanship of the contractor.

2.3 DESIGN ENGINEER

HDR Engineering, Inc. is the Design Engineer and is primarily responsible for designing the landfill closure for the solid waste disposal facility that fulfills the requirements from the Owner and the FDEP. Design activities shall not end until construction of the closure is completed. The Design Engineer may be requested to change some component designs if unexpected site conditions are encountered or changes in construction methodology occur that could adversely affect landfill construction. Implementation of the CQA Plan provides assurance that these unexpected changes or conditions will be detected, documented, and addressed during construction.

The Owner has the authority to delegate additional responsibility and authority to the Design Engineer by expressed consent (i.e., a contractual agreement). Additional responsibilities and authority may include formulating and implementing a site-specific CQA Plan, periodic review of CQA documentation, modifying construction site activity, and identifying corrective measures in cases where deviation from the specified design or failure to meet design criteria, plans, and specifications is detected by the CQA Engineer.

2.4 CONSTRUCTION QUALITY ASSURANCE ORGANIZATION

2.4.1 Construction Quality Assurance Engineer (CQA Engineer)

The CQA Engineer is a party, independent of the manufacturer and the contractor, with responsibility for implementing this CQA plan. The CQA Engineer is responsible to the Owner but will function independently of the Owner and Contractor. At a minimum, the CQA Engineer is a Florida Registered Professional Engineer who possesses adequate formal academic training in engineering and managerial experience to successfully oversee and implement construction quality assurance activities for solid waste disposal facilities. The CQA Engineer is responsible for the following:

- Reviewing design criteria, permit conditions, the Contractor's Construction Quality Control (CQC) plan, and project plans and specifications for clarity and completeness so that the CQA plan can be implemented.
- Educating CQA Inspectors on CQA requirements and procedures.
- Scheduling and coordinating CQA activities including sampling for conformance testing.
- Confirming that regular calibration of testing equipment is properly conducted and recorded.
- Reviewing and interpreting test data and reports.
- Rejecting defective work and verifying that corrective measures have been implemented.
- Certifying construction completion.
- Providing signed, sealed final report and record drawings to the FDEP after owner review and approval stating that the final cover and temporary final cover systems have been installed in substantial conformance with the Project Plans and Specifications.

2.4.2 Construction Quality Assurance Inspector (CQA Inspector)

In order to assist the CQA Engineer in providing full-time on-site oversight and monitoring services, a CQA Inspector will be named. The CQA Inspector is a person(s) or firm(s) independent of the Contractor and Geomembrane Installer and authorized by the CQA Engineer and Owner to manage and oversee the execution of the work. The CQA Inspector shall possess formal academic training in soils engineering, engineering geology or other closely associated discipline. All completed work is subject to approval of the CQA Engineer.

The following minimum qualifications must be met by the CQA Inspector:

- The CQA Inspector must have been in business for at least ten (10) continuous years of operation immediately prior to the date of this project.
- The CQA Inspector must have inspected and tested a minimum of five (5) liner projects consisting of at least 10,000,000 square feet of LLDPE, TPO and/or HDPE liner.
- The CQA Inspector shall provide one full-time Qualified Engineering Technician and other trained technicians to perform the required tests and inspections of the liner system.
- The Qualified Engineering Technician is qualified representative of the CQA Inspector, who is an engineering technician with a minimum of four years of directly related experience or a graduate engineer/geologist with one year of directly related experience.
- The CQA Inspector shall provide certified technicians to perform full time observation and documentation of activities related to the CQA of the liner system construction.
- The CQA Inspector must have registered full-time Professional Engineers on staff to sign, seal, and certify that the project was constructed in accordance with the contract documents.

The CQA Inspector's responsibilities include:

- Performing independent on-site inspection of the work in progress to assess compliance with the facility design, Project Plans and Specifications.
- Verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the standardized procedures defined by the CQA Plan.
- Reviewing design criteria, and Project Plans and Specifications for CQA requirements and procedures.
- Scheduling and coordinating inspection activities.
- Directing and supporting the inspection personnel in performing observations and tests by:
    - submitting test samples for analysis by the CQA laboratory,
    - confirming that regular calibration of testing equipment is properly conducted and recorded,
    - confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process,
    - recording and maintaining comprehensive documentation of the liner system construction, and
    - verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted in accordance with the CQA Plan and the Project Plans and Specifications.
- Providing to the CQA Engineer reports on the inspection results including:

- review and interpretation of all data sheets and reports,
- identification of work that the CQA Inspector believes should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval,
- rejection of defective work and verification that corrective measures are implemented, and
- verification that the Contractor's construction quality control plan is in accordance with the site-specific CQA Plan.

2.4.3 Construction Quality Assurance Laboratory (CQA Laboratory)

The CQA Laboratory will be independent of the geosynthetic manufacturer and installer. The CQA Laboratory will be qualified and responsible for material conformance testing for soil, geomembrane, geocomposite, and for destructive seam tests on the installed geomembrane. The CQA Engineer and CQA Inspector will be responsible for coordinating with the laboratory, sampling the geosynthetics or arranging for sampling at the manufacturing facility, and reviewing conformance testing.

- The CQA Laboratory shall possess testing equipment which is capable of testing the interface friction between the liner system components in accordance with ASTM standards.
- The CQA Laboratory shall possess testing equipment which is capable of testing LLDPE and TPO liner seams for peel and shear according to ASTM standards.
- The CQA Laboratory shall be familiar with ASTM, NSF and other applicable test standards. It shall have performed a minimum of 100 sets of peel and shear tests on seams of material the same type as specified.

2.5 CONSTRUCTION CONTRACTORS

2.5.1 Construction Contractor

It is the responsibility of the Contractor to construct the landfill final cover and temporary final cover system in strict accordance with design criteria, Project Plans and Specifications, using the required construction procedures and techniques. The chosen Contractor will be registered in accordance with applicable local, state, and federal requirements and will have prior landfill-related experience.

The Construction Contractor's responsibilities include but are not limited to:

- Constructing the final cover and temporary final cover system in strict accordance with the contract documents including Project Plans and Specifications using the necessary construction procedures and techniques.
- Formulating and implementing a Construction Quality Control (CQC) Plan in accord with requirements of the technical specification.
- Contracting with subcontractors, such as manufacturers and specialty installers, and coordinating their activities.
- Supplying required materials and supporting QC documentation either directly or through subcontractors.
- Discussing procedures for locating and protecting construction materials and for implementing methods for preventing damage of the materials from inclement weather or other adverse effects.

- Coordinating activities with the CQA Engineer and CQA Inspector and providing the CQA organization with all necessary documentation as detailed in this plan.
- Updating original construction drawings and specifications to reflect any deviation from the original plans and furnishing as-built record drawings and all required quality control documentation.
- Planning and monitoring construction site health and safety procedures.
- Approving shop drawings prior to submission to the CQA Engineer.
- Determining and verifying:
    - field measurement,
    - field construction criteria,
    - catalog numbers and similar data, and
    - conformance to Project Plans and Specifications.
- Coordinating each submittal with other submittals and with the requirements of work and of the Project Plans and Specifications
- Notifying the CQA Engineer in writing, at time of submission, of any variance in the submittals from the requirements of the Project Plans and Specifications. Any such deviations permitted by the Design Engineer will require modifications to the Project Plans and Specifications.

2.5.2 Site Supervisor

The Construction Contractor will be represented in the field by a Site Supervisor. The Site Supervisor is responsible for the following:

- Scheduling and coordinating work including subcontractors.
- Informing the CQA Inspector and CQA Engineer of any discrepancies between the Project Plans and Specifications and field conditions.
- Coordinating with the CQA Inspector and CQA Engineer.
- Attending project meetings.
- Maintaining a daily log of construction and quality control activities.
- Implementing and verifying CQC procedures.
- Submitting proposed alternative materials or construction methods for approval before acquisition and use.
- Construction.

2.5.3 Geomembrane Installation Contractor (Geomembrane Installer)

The Geomembrane Installer may be a general contractor, a subcontractor to the general construction contractor, or a specialty contractor hired directly by the Owner. The Geomembrane Installer has not been chosen at this time. The selected contractor will have experience in installing at least 10 million square feet of geosynthetics.

The Geomembrane Installer or their CQC Consultant will be responsible for the following:

- Coordinating with the general contractor and CQA Inspector.
- Handling, storing, placing, and installing manufactured materials.
- Implementing and verifying a manufacturer and installer QC plan.

2.5.4 Thermoplastic Polyolefin Geomembrane Installer

Thermoplastic Polyolefin (TPO) geomembrane installer will demonstrate 5 years continuous experience with a minimum 10,000,000 square feet of geomembranes. The installer will be trained and certified by at least one of the named manufacturers in this Specification (not necessarily the manufacturer supplying materials for this Project).

Geomembrane Installer Personnel Qualifications:

- Installation Superintendent shall have worked in a similar capacity on at least five geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
- The Master Welder shall have completed a minimum of 5,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
- Other welders shall have seamed a minimum of 1,000,000 square feet geomembrane.

SECTION 3.0
INTERMEDIATE AND PROTECTIVE SOIL COVER

This section contains procedures and tests, which must be implemented in order to ensure the soil components of the final and temporary final cover systems meet the design standards. This is a critical component of the Construction Quality Assurance Plan. All required tests and sampling procedures within this section shall be performed in accordance with generally accepted engineering procedures. Table 3-1 contains a listing of applicable test procedure standards for the intermediate and protective cover soils.

3.1 INTERMEDIATE SOIL COVER

3.1.1 Preconstruction

Soil materials to be used as intermediate cover shall consist of select borrow material meeting all requirements specified in Specification Section 02200, Earthwork. The borrow material for intermediate cover must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on drawings. In addition, soil provided by the Owner, from an off-site soil recovery project may be provided for use in the lower 6-inches of intermediate cover. The off-site soil must pass the material requirements of this plan and technical specifications. For all other soils from an off-site location, Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

Table 3- 1
Intermediate and Protective Cover Test Procedure Standards

STANDARD	TEST DESCRIPTION
ASTM D422	Method for Particle-Size Analysis of Soils
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12, 400 ft-lb/ft^2)
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
ASTM D2487	Test Method for Classification of Soils for Engineering Purposes (United Soil Classification System)
ASTM D2488	Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D3017	Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
ASTM D2216	Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D2937	Test Method for Density of In-Place Soils by Drive-Cylinder Method

Soil for the intermediate cover should be free of deleterious material (organics, sticks, roots, waste, etc.) and rock fragments, boulders or cobbles greater than three inches in size. Fines content of installed soil shall be a maximum of 50% (passing #200 sieve) and monitored as specified in the Project Plans and Specifications. Soil shall classify as SP, SW, SC, SM, SP-SM, or SP-SC in accordance with ASTM D2487 or ASTM D2488.

The intermediate cover layer shall be placed and compacted in accordance with specification section 02200, Earthwork, Part 3.6.E. The CQA Inspector shall test materials and monitor compliance with requirements of the Project Plans and Specifications. All observations and tests shall be conducted at locations selected by the CQA Inspector who has been assigned responsibility for verification and documentation of the element in question.

3.1.2 Construction

The following is an outline of the minimum construction requirements for the intermediate cover. For more detailed information, see the specification Sections 02200, Earthwork, 02775, LLDPE Geomembrane Liner System, and 02771 TPO Geomembrane .

- Strip vegetation from existing cover soils and dispose at a location designated by Owner.
- Verify that a minimum of 18 inches of cover soils exist after stripping operations. Add additional soil as needed to fill surface depressions and achieve a minimum thickness of 18 inches. Surface shall be smooth without irregularities unless shown on the drawings.
- Approval from CQA Inspector with regard to suitability of soils and acceptable subgrade.
- Atmospheric conditions observed and recorded by the CQA Inspector and appropriate actions taken when unsuitable weather conditions exist.
- Dust control continuous throughout the intermediate cover operations.
- Verify grade control is established to control thickness of material placed.
- Verify final grading completed in accordance with specification Section 02200, Earthwork.
- Intermediate cover compacted to specified requirements provided in Section 02200.
- Surface of intermediate cover soils proof-rolled in accordance with technical specification Section 02200 Part 3.2.F.
- Verify minimum thickness of the soils and geomembrane materials is achieved in accordance with the specifications.
- Provide as built survey of intermediate cover sealed by a professional land surveyor illustrating construction of all design features.
- Approval from CQA Inspector with regard to final surface smoothness and uniformity. Any objects protruding from the final surface or coarse fragments within the surface material that may damage the geomembrane will be removed.
- The required thickness of intermediate cover will be verified, as described in Specification 02200 – Earthwork, on an established grid system with not less than one verification point per 10,000 square feet of surface.

Table 3- 2
Intermediate Cover Conformance and Construction Testing

TEST DESCRIPTION	STANDARD	TEST FREQUENCY
Intermediate Cover		
Density, Nuclear Method	ASTM D2922	1 per 1,500 yd^3
Moisture Content, Nuclear Method	ASTM D3017	1 per 1,500 yd^3
Sand Cone or Drive Cylinder Method	ASTM D2937	1 per 20 nuclear tests
Oven Moisture Content Verification	ASTM D2216	1 per 20 nuclear tests
Moisture Density Relations	ASTM D698	1 per 20,000 yd^3 *
Sieve Analysis	ASTM D422	1 per 20,000 yd^3 *

* Increase frequency as needed to ensure each soil type is tested.

3.2 PROTECTIVE COVER

3.2.1 Preconstruction

Soil materials to be used as the 24-inch thick protective cover over the geomembrane (including 6-inch thick topsoil cover) shall consist of select borrow material meeting all requirements specified in Specification Section 02200, Earthwork. The borrow material for protective cover must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on the drawings. If cover soil comes from off-site location, the Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

Soil for the bottom 18 inches of protective cover should be free from deleterious material (organics, sticks, roots, etc.) and rock fragments, boulders or cobbles greater than three inches in size. The upper 6 inches of protective cover shall meet the same criteria except that the soil shall contain sufficient organics to promote vegetative growth.

The protective cover layer shall be placed and compacted in accordance with the specification Section 02200, Earthwork, Parts 3.1 G through M and 3.6.E. The CQA Inspector will observe that placement of the soil material is done in a manner to protect the geocomposite. The CQA Inspector shall test materials and monitor compliance with requirements of the Project Plans and Specifications. All observations and tests shall be conducted at locations selected by the CQA Inspector who has been assigned responsibility for verification and documentation of the element in question.

Table 3- 3
Protective Cover Conformance and Construction Testing

TEST DESCRIPTION	STANDARD	TEST FREQUENCY
Intermediate Cover		
Density, Nuclear Method	ASTM D2922	1 per 1,500 yd^3
Moisture Content, Nuclear Method	ASTM D3017	1 per 1,500 yd^3
Sand Cone or Drive Cylinder Method	ASTM D2937	1 per 20 nuclear tests
Oven Moisture Content Verification	ASTM D2216	1 per 20 nuclear tests
Moisture Density Relations	ASTM D698	1 per 20,000 yd^3 *
Sieve Analysis	ASTM D422	1 per 20,000 yd^3 *

* Increase frequency as needed to ensure each soil type is tested
Note: Testing is not required for topsoil layer

3.2.2 Construction

Protective cover should be stable for construction and maintenance traffic. Care will be exercised in placement so as not to shift, wrinkle or damage the underlying geosynthetic layers, and the placement methods will be documented by the Contractor and CQA Inspector.

The protective cover shall be placed under the direct supervision of the CQA Inspector. The Contractor shall utilize care to avoid damage to the geocomposite. No vehicular traffic will be permitted on the unprotected liner system except low ground pressure equipment necessary for the deployment and installation of liner system. The loose thickness of the initial lift of protective cover shall not be less than 12 inches and spread with low ground pressure equipment (maximum pressure 10psi). Fill shall be placed by equipment starting at the toe of slope and spreading toward the top of slope. Material shall not be placed over standing water or ice.

The following is an outline of the minimum construction requirements for the protective cover. For more detailed information, see specification section 02200, Earthwork:

- Approval from CQA Inspector with regard to suitability of soils.
- Atmospheric conditions observed and recorded by the CQA Inspector and appropriate actions taken when unsuitable weather conditions exist.
- Dust control continuous throughout protective cover operations.
- Verify the underlying geocomposite construction is complete before material installation.
- Verify grade control is established to control thickness of material placed.
- For placement of material over geosynthetics; monitor 12-inch minimum thickness of material below spreading equipment and the spreading equipment has a ground pressure rating equal to or less than 10psi. During placement of material, identify geocomposite damaged during material installation and establish that the damage is repaired.
- Monitor haul road thickness over geocomposite and verify that equipment hauling and placing material over geocomposite meets equipment specifications.

- Monitor placement of material over piping and verify that pipe is not damaged by occasionally uncovering piping.
- Monitor equipment speed over material.
- Verify lower 18 inches of protective cover compacted to specified requirements. Do not compact topsoil layer beyond tracking it in.
- Verify final grading completed in accordance with specification section 02200, Earthwork.
- Verify minimum thickness is achieved in accordance with specifications.
- Install sod in accordance with specifications.
- Approval from CQA Inspector with regard to final surface smoothness and uniformity.
- Provide as-built survey of protective cover sealed by a professional land surveyor illustrating construction of all design features.

The required thickness of protective cover will be verified, as described in Specification 02200 – Earthwork, on an established grid system with not less than one verification point per 10,000 square feet of surface.

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SECTION 4.0
GEOMEMBRANE LINER

This section covers the work necessary to construct and test the geomembrane lining system, which will consist of a 40 mil Linear Low Density Polyethylene (LLDPE) liner material (top, north and east slopes) in accordance with specification Section 02775, LLDPE Geomembrane Liner Systems and a 60 mil Thermoplastic Polyolefin (TPO) Geomembrane (south slope) in accordance with specification Section 02771, TPO Geomembrane. The geomembrane material and installation will be in accordance with specification Sections 02775 and 02771. The LLDPE and TPO liner materials shall be new, first quality products designed and manufactured specifically for the purposes of the Work and shall have satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes. All LLDPE geomembranes will be textured on both sides and shall be an unmodified LLDPE containing no plasticizers, fillers, chemical additives, or extenders. The only other compound ingredients to be added to the LLDPE geomembrane resin shall be anti-oxidants and heat stabilizers required for manufacturing. The LLDPE geomembranes shall be supplied as a single ply continuous sheet with no factory seams and in rolls with a minimum width of 22 feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams. The requirements for the TPO geomembrane will meet the minimum requirement as illustrated in specification Section 02771.

Extrusion resin used for fusion welding with extrudate to make field seams between geomembrane sheets and for repairs shall be LLDPE or TPO produced from, and the same as, the geomembrane sheet resin. Physical properties shall be the same as LLDPE or TPO geomembrane sheets.

The geomembrane liner shall conform to the testing requirements of GRI Standard GM17 - "*Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes*" (Geosynthetic Research Institute; Philadelphia, PA) and requirements of Section 02771 for TPO geomembrane.

4.1 PRECONSTRUCTION

4.1.1 Certification of CQA Plan Conformance

Prior to start of work, the Geosynthethics Manufacturer and the Geomembrane Installer, each, shall submit for approval by the CQA Inspector documented evidence of its ability and capacity to perform this Work. Each shall have successfully manufactured and/or installed a minimum of ten (10) million square feet of similar lining material in solid waste containment structures.

The Contractor shall submit written certification by the Geosynthetics Manufacturer that the lining materials conform to the requirements of the CQA Plan. The Contractor shall submit the name and qualifications of its project superintendent that will be on the project whenever lining materials are being handled and/or installed plus the names and qualifications of senior installation personnel on the project. All manufacturer and Geomembrane Installer qualifications shall be submitted in accordance with technical specification Sections 02775 and 02771 Part 1.2.B.

4.1.2 Geomembrane Installer's and Manufacturer's QC Program

The Geosynthetics Manufacturer and the Geomembrane Installer, each, shall submit a complete description of its quality control (QC) program, as applicable, for manufacturing, handling, installing, testing, repairing and providing a completed lining in accordance with requirements of the CQA Plan and contract documents. The description shall include, but not be limited to, polymer resin supplier, product identification, acceptance testing, fabrication and production testing, installation testing, documentation of changes, alterations and repairs, retests and acceptance.

The following quality control tests will be performed on the geomembrane.

Table 4- 1
MQC Conformance Testing for LLDPE Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D6693, Type IV, 2 ipm	Standard Test Method for Determining Tensile Properties of Non-reinforced Polypropylene and Non-reinforced Flexible Polypropylene Geomembranes	Every 20,000 lbs
ASTM D1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting	Every 45,000 lbs
ASTM D1505/D792	Standard Test Method for Density of Plastics by the Density-Gradient Technique	Every 200,000 lbs
ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer	One per rail car compartment
ASTM D1603	Standard Test Method for Carbon Black Content in Olefin Plastics	Every 20,000 lbs
ASTM D3895	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry	Every 200,000 lbs
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products	Every 45,000 lbs
ASTM D5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics	Every 45,000 lbs
ASTM D5994[1]	Standard Test Method for Measuring Core Thickness of Textured Geomembrane	Every roll
GRI GM12	Asperity Height	Every other roll

1. Textured Geomembrane Only.

Table 4- 2
MQC Conformance Testing for TPO Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D751	Thickness	Per roll
ASTM D4885	Tensile Properties	Once per day or 20,000 lb
ASTM D751	Tear Resistance	Once per day or 45,000 lb
Visual	Scrim Orientation	Every Lot or Every Scrim Roll

4.1.3 Geomembrane Installer's Installation Plan

The Installer shall submit installation drawings, the Manufacturer's written Field Installation Procedure Manual, and a schedule for performing/completing the Work. Installation drawings shall show a lining sheet layout with proposed size, number, position, and sequence of placing of all sheets and indicating the location of all field seams. Installation drawings shall also show complete details and/or methods for anchoring the lining at its perimeter, making field seams, and making anchors/seals to pipes and structures.

The Installer shall submit a complete description of welding procedures for making field seams and repairs. The welding procedures shall conform to the latest procedures recommended by the lining Manufacturer.

The Contractor and Geomembrane Installer shall submit for approval, by the CQA Inspector, certification that the surface(s) on which the lining will be placed is acceptable. Installation of the lining shall not commence until this certification is furnished to the CQA Inspector.

The Geomembrane Installer shall provide on-site technical supervision and assistance at all times during installation of the lining system. The Geomembrane Installer and Contractor, as applicable to each, shall submit for approval by the CQA Inspector written certification that the lining system was installed in accordance with the Manufacturer's recommendation, the CQA Plan, Project Plans, Specification Sections 02775 and 02771, and approved submittals.

The CQA Engineer will initiate a pre-installation meeting with the Geomembrane Installer, Contractor, and CQA Inspector prior to installation of the lining system. Topics for review/discussion shall include, as a minimum, Project Plans and Specifications, approved submittals, and training and qualification procedures for Contractor personnel.

Prior to installation of the lining system, the Geomembrane Installer shall instruct the workmen of the hazards of installation, such as handling sheets of lining material in high winds; use of equipment; application of solvents, adhesives and caulks; and walking on lining surfaces. Work gloves, safety glasses, hard hats, and smooth-soled shoes are minimum safety wear requirements when working on the geomembrane. Safety shoes must be worn when handling heavy objects.

The Owner shall have authority to order an immediate stoppage of work because of improper installation procedures, safety infractions, or for any reason which may result in a defective liner.

4.1.4 Contractor's Geomembrane Preconstruction Material Submittals

The Contractor will provide the CQA organization with the following items for review and testing:

- Results of interface friction testing for the geomembrane proposed for the project as outlined in this CQA Plan.
- Manufacturer's description (cut sheet) of the proposed geomembrane documenting it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geomembrane will meet specified interface friction angle.

- Written instructions for storage, handling, installation, seaming, and repair of the proposed geomembrane consistent with the technical specifications, project plans, and the manufacturer's recommendations.

Before shipment of the geomembrane, the CQA organization shall review all approved pre-construction submittals. Pre-construction submittals should be submitted a minimum of four weeks in advance to allow time for review and approval by the CQA organization.

The Contractor shall submit certifications that the LLDPE and TPO geomembrane material delivered to the site meets the requirements of the Specification and that the LLDPE and TPO geomembrane was received and accepted in undamaged condition from shipper.

4.1.5 CQA Conformance Testing

The geomembrane material will be sampled at the site by the CQA Inspector or at the manufacturing plant by a third party under the direction of the CQA organization. The sample will be taken across the entire roll width and will be 3 feet long. Samplers will mark the machine direction and the manufacturer's roll identification number on the sample. Samplers will also assign a conformance test number to the sample and mark the sample with that number. The samples will be forwarded to a CQA testing laboratory for the conformance testing. The CQA Inspector will review all conformance test results and report any nonconformance to the Owner and CQA Engineer.

The following conformance tests will be performed on the LLDPE geomembrane at the frequencies indicated in Table 4-3.

Table 4- 3
CQA Conformance Testing for LLDPE Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D6693	Standard Test Method for Determining Tensile Properties of Non-reinforced Polypropylene and Non-reinforced Flexible Polypropylene Geomembranes	Every 20,000 lbs
ASTM D6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.	Every 500 LF of seam
ASTM D5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method	One per project

Table 4- 4
CQA Conformance Testing for TPO Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D 4637	Thickness	1 test per 100,000 ft^2
ASTM D 4885	Tensile Strength at Break	1 test per 100,000 ft^2
ASTM D 4885	Elongation at Break	1 test per 100,000 ft^2
ASTM D 5884	Tear Strength	1 test per 100,000 ft^2

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D 4833	Puncture Resistance	1 test per 100,000 ft^2
ASTM G 155	Resistance to Xenon-Arc Weathering	Manufacturer's Certification Only
ASTM D 1149	Ozone Resistance	1 test per 100,000 ft^2
ASTM D5321	Interface Friction	One for each interface identified for the project by the Engineer

Laboratory interface friction tests shall be conducted in general accordance with ASTM D5321, on the following interfaces:

- Textured LLDPE liner and geocomposite
- Textured LLDPE liner and intermediate cover soil
- TPO geomembrane and 16 oz/sy geotextile

The CQA Laboratory will perform three (3) direct shear tests at the project specific effective normal stresses. These tests will be performed using the Contractor's proposed geosynthetic materials for above interfaces following award of the construction contract to the selected Contractor. Samples of intermediate cover soil and protective cover soil (if different than the intermediate cover soil material) proposed for the project will also be obtained for testing. A minimum interface friction angle based on the landfill design will be required to maintain stability. The project specific testing parameters for direct shear testing, including the effective normal stresses and minimum required interface friction angles, for the TPO and LLDPE materials are provided in technical specification Section 02771-2.2 Table 2 and Section 02775-2.3, respectively.

The Owner will pay for "Passing" tests. Costs of corrective action, costs of "Failing" tests and all associated costs of testing due to failing tests will be paid by the Owner and the cost reimbursed to the Owner by the Contractor. Materials not meeting the required shear strength will not be approved for use on this project.

4.2 CONSTRUCTION

4.2.1 Delivery, Storage and Handling

Materials will be delivered to the site after the required submittals have been furnished and approved. The delivered roll goods will be marked by the manufacturer to show at a minimum the following information:

- Name of manufacturer.
- Product type.
- Product thickness.
- Manufacturing batch code.
- Date of manufacture.
- Physical dimensions.
- Roll number.

Lining materials delivered to the site shall be inspected for damage, unloaded, and stored with a minimum of handling. Each roll shall be wrapped in an opaque and waterproof layer of plastic during shipment and storage. The plastic wrap shall not be removed until deployment. Materials shall not be stored directly on the ground. The storage area shall be such that all materials are protected from mud, soil, dirt and debris. The stacking of lining shall not be higher than two rolls.

Under no circumstances shall the lining be subjected to materials, sandbags, equipment or other items being dragged across its surface. Nor shall workmen and others slide down slopes atop the lining. All scuffed surfaces resulting from abuse of any kind caused by the Contractor in performance of the Work shall be repaired at the CQA Inspector's direction.

LLDPE or TPO geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed. LLDPE or TPO shall not be exposed to temperatures in excess of 60°C (140°F) or less if recommended by the Manufacturer.

No hooks, tongs or other sharp instruments shall be used for handling the LLDPE or TPO geomembrane. Rolls shall not be lifted by use of cables or chains in contact with the LLDPE or TPO geomembrane. LLDPE or TPO geomembrane shall not be dragged along the ground.

The Contractor shall be completely responsible for shipping, storage, handling, and installation of all lining materials in compliance with the CQA Plan.

4.2.2 Geomembrane Subsurface Preparation

Before geomembrane installation, the CQA Inspector will document that the intermediate cover installation is complete and CQC and CQA documentation verifies that subsurface has been prepared in accordance with specification Sections 02775 and 02771.

4.2.3 Geomembrane Placement and Seaming

Prior to installation of the geomembrane, a site inspection will be conducted by the CQA Inspector and the Contractor to verify measurements, structures and surface conditions to support the geomembrane.

The Contractor and Geomembrane Installer will provide written documentation to the CQA Inspector that surfaces to receive the geomembrane have been inspected and are acceptable for installation of the lining.

Before the work begins, the Contractor will inspect all lining materials for damage from transit. Materials that cannot be repaired will be rejected and removed from the work area and site.

During unwrapping of lining materials for use and placement, the Contractor will visually inspect all materials, particularly surfaces of lining sheets, for imperfections and faulty areas. All such defective places will be marked and repaired in accordance with approved methods.

The geomembrane will be installed as shown on the project plans and approved installation drawings. Placement of the geomembrane will be done such that good fit, without bridging, is provided on all covers and grade changes. Excessive slack will be avoided to minimize rippling during the soil cover operation. Geomembrane liner shall be handled and placed in a manner which minimizes wrinkles, scratches and crimps.

Sheets of geomembrane materials will be of lengths and widths and will be placed in a manner as to reduce field seaming to a minimum. The lining will be anchored in accordance with details shown on approved plans and drawings. The lining will be anchored and sealed to structures, pipes and other types of penetrations, (if any), in accordance with details shown on approved plans and drawings. All changes in approved installation drawings and procedures must be approved by the Design Engineer.

Extreme care will be taken during installation of the lining to be certain no damage is done to any part of the lining. Dragging of the geomembrane material on the prepared subgrade will be prohibited. Smoking will be prohibited for all personnel. All handling and installation procedures will be performed by workers wearing shoes with smooth soles. Shoes with soles that have patterns in relief shall be prohibited. No foot traffic will be allowed on the geomembrane except with approved shoes. No vehicular traffic will be allowed on the geomembrane except low ground pressure equipment necessary for the deployment and installation of the lining system. All motor driven equipment using fuel will have spark arrestors. No gasoline driven generators or cans of gas or solvent will be placed directly on the lining material. Under no circumstances will the lining be used as a work area to prepare patches or to store tools and supplies. If needed, a tarpaulin of approved material will be spread out as a work area.

During installation, the Contractor will be responsible for protecting the lining against adverse effects of high winds such as uplift. Sand bags will be used as required to hold the lining material in position during installation. Sand bags will be sufficiently close-knit to preclude fines from working through the bottom, sides or seams. Paper bags, whether or not lined with plastic, will not be permitted. Burlap bags, if used, must be lined with plastic. Bags that are split, torn, or otherwise losing their contents will be immediately removed from the work area and any spills immediately cleaned up. Metal or wire ties will not be used.

The geomembrane material will not be installed under adverse climatic conditions, unless the Contractor can demonstrate that his installation techniques adequately compensate for such adverse conditions and quality of workmanship is not compromised. Adverse climatic conditions occur when the air temperature measured 6 inches above the geomembrane surface is less than 41°F and decreasing, or more than 104°F; when it is raining; or when there is frost on the ground; or during conditions of excessive winds.

Geomembrane field seams will be lap seams as shown on approved plans and drawings. The lap seams will be formed by lapping the edges of geomembrane sheets a minimum of 3 inches unless otherwise specified in the approved plans and drawings. The contact surfaces of the sheets will be wiped clean to remove dirt, dust, moisture, and other foreign materials. Geomembrane shall not be welded when ambient temperatures are below 41°F or above 104°F without written consent of manufacturer and CQA Engineer or CQA Inspector. For fillet weld seams, bevel edge of geomembrane and clean oxidation from surfaces to receive extrudate by disk grinding or equivalent not more than one hour before seaming.

For the final cover system, lap seam intersections involving more than three thicknesses of lining material will be avoided, and all seam intersections will be offset at least 2 feet. No horizontal field seams will be allowed on the slope and sheets of lining material on the slopes will extend down slope to the perimeter anchor trench as shown on the drawings. For the temporary final cover system, wedge weld end of geomembrane panel to beginning of new geomembrane panel and continue downslope. Flap of wedge weld to be on top in the downslope direction as long as practically feasible. Welds connecting downslope

sheets shall be double wedge welds, and shall have a minimum of 10 feet vertical offset between adjacent panel welds. Wedge welds shall have a minimum of 3 inch overlap.

Geomembrane liners shall be welded using extrusion (LLDPE), hot air (TPO), single wedge or double wedge welding equipment (LLDPE and TPO). Extrusion welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the extrudate. Wedge welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the wedge. Geomembrane liners shall be welded continuously without fishmouths or breaks in the weld. Where fishmouths are unavoidable, the geomembrane sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle. The two edges of the slit shall be welded together provided that the overlap for this weld shall be a minimum of 6 inches. Areas of the slit that do not achieve an overlap of 6 inches, including the terminus of the slit, shall be provided with a patch.

Any necessary repairs to the geomembrane will be made with the lining material itself, using approved welding systems, equipment and techniques. The patch size will be 6 inches larger in all directions than the area to be patched. All corners of the patch will be rounded. Torn or permanently twisted geomembrane shall be replaced at no expense to the County.

All seams and seals of the geomembrane will be tightly bonded on completion of the work. Any lining surface showing injury due to scuffing or penetration by foreign objects or showing distress will be replaced or repaired as directed by the CQA Inspector.

Cleanup within the work area will be an ongoing responsibility of the Contractor. Particular care will be taken to insure that no trash, tools, and other unwanted materials are trapped beneath the lining. Care will be taken to insure that all scraps of lining material are removed from the work area prior to completion of the installation.

4.2.4 Emergency Gas Vents

Emergency gas vents will provide emergency pressure relief if the active gas collection system is shut down for an extended period of time or due to hotspots within the landfill. The active gas collection system serves as an integral part of the overall performance of the temporary final cover system, and the emergency gas vents are installed to provide backup relief if necessary. The emergency gas vents are designed to be directly connected to the active gas collection system if necessary to provide additional vacuum under the temporary final cover system. Typically, the emergency gas vents are capped until they are needed.

Each of the components of the emergency gas vents will be installed as specified in the Contract Documents. The vent installation observation will be performed during the construction of the cover system.

Post-construction inspection of the emergency gas vents will include the following:

- Observation to ensure that all system components have been installed as specified and according to the approved manufacturer's specifications and the engineering design.

4.2.5 Field Quality Control

Inspection and testing will involve the full time observation of the installation of the geomembrane, including the making and testing of lining seams and patches and periodic measurement of the liner material thickness to insure compliance.

Test welds will be made to verify that adequate conditions exist for field seaming to proceed. Each seamer and seaming equipment will produce a test seam at the beginning of each shift to determine the peel and tensile strength of the seam. The CQA Inspector may require a sample field seam be made at any time during seaming production to verify equipment/operator performance and seam integrity. In addition, if a seaming operation has been suspended for more than 1/2 hour or if a breakdown of the seaming equipment occurs, a test seam will be produced prior to resumption of seaming operations.

The trial weld sample must be a minimum of three feet long and one and a half feet wide, with the seam centered lengthwise. The CQA Inspector must observe all trial welding operations, quantitatively test each trial weld for peel and shear, and record the results. A minimum of two peel and two shear tests will be performed per trial seam. The trial weld shall be completed under the same conditions for which the panels will be welded. The trail weld must meet the requirements for peel and shear as stated in the following paragraph and the break must be a film tear bond (FTB) for a wedge weld.

During the field seaming operation, destructive samples will be removed from field seams by the Installer at locations selected by the CQA Inspector. Repairs to the field seams will be made in accordance with repair procedures specified in this CQA Plan. The samples will have a width of 12 inches plus the seam width and length of 48 inches. A minimum of one stratified sample per 500 feet of field seam will be made. All field seams will have a film tear bond in peel and shear and will meet the minimum pound per inch width seam strength specified in the specification Sections 02775 and 02271, LLDPE and TPO Geomembrane Liner Systems respectively. The bonded shear strength for fusion and extrusion welds must be greater than or equal to the appropriate values shown in the specifications. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam when necessary. The archived material will be kept at the CQA laboratory. Field testing shall include at least two peel tests per sample. CQA laboratory testing shall consist of five shear tests and five peel tests per sample. The Installer shall test the seam destructively at a frequency of one test per 500 linear feet of weld. Destructive seam-testing locations shall be cap-stripped and the cap completely seamed by extrusion welding to the geomembrane (LLDPE) or hot air welding for TPO geomembrane. Capped sections shall be non-destructively tested. Additional destructive test samples may be taken if deemed necessary by the CQA Inspector.

All field-tested specimens from a destructive-test location must be passing in both shear and peel for the seam to be considered as passing. Passing results, as specified in technical specification Sections 02771 and 02775, for both peel and shear for the seam must be received from the CQA laboratory to confirm the field testing and to accept the seam. The CQA testing laboratory will save all test samples including specimens tested until notified by the CQA Engineer relative to their disposal. All specimens which have failed under test will be shipped immediately by express delivery to the CQA Inspector for determination of corrective measures to be taken, which includes retest or repair of failed section.

For destructive samples which have failed the passing criterion, the Installer will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Installer may patch or cap strip the seam between the passed samples. If either fails, the Installer will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.

The Installer shall test all patch welds using one of the following nondestructive tests: vacuum tests, air lance (TPO hot air weld) or spark tests.

In the event capping of a field seam is required, the Installer will use a cover strip of the same thickness as the lining (and from the same roll, if available) and a minimum of 6 inch overlap away from the seam in all direction. It will be positioned over the center of the field seam and welded to the lining using a fillet weld each side.

All geomembrane sheets, seams, anchors, seals, and repairs will be visually inspected by the Installer for defects. Depending on seam welding equipment used, all seams and repairs will be tested continuously by a vacuum testing device, air pressure, or spark tests.

A visual inspection of the lining sheets, seams, anchors and seals will be made by the Installer and CQA Inspector as the installation progresses and again on completion of the installation. Defective and questionable areas will be clearly marked and repaired. Final approval of repairs will be given by the CQA Inspector.

If the fillet weld, extrusion lap weld, hot air weld, or single hot-wedge fusion lap weld is used to weld seams, the Installer will further test all seams and repairs in the geomembrane by vacuum box or by air lance test (hot air weld for TPO). All vacuum box testing will be done in the presence of the CQA Inspector. The area to be tested will be cleaned of all dust, debris, dirt and other foreign matter. A soap solution will be applied to the test area with a paint roller and the vacuum of 5 psi air pressure will be induced and held at least ten seconds to mark for repair any suspicious areas as evidenced by bubbles in the soap solution. All air lance testing will be performed in accordance with ASTM 3340.

If the double hot-wedge is used, the Installer will further test all seams in the geomembrane by using the air pressure test which consists of inserting a needle with gauge in the air space between welds. Air will be pumped into space at a pressure and held for a time as indicated in the specifications. If pressure does not drop more than the amount allowed in the specifications, then the seam is acceptable.

All costs of retesting of the geomembrane including reruns of field weld tests and all repairs will be at the Installer's expense.

The Installer shall assemble the quality control data required above into a final report of geomembrane installation. The report will contain all test data and a final layout of geomembrane liner which shows the location of all seams, patches and sample locations. In addition, the Installer shall submit resin tests, tests of sheet material, factory seam tests, daily seam test results, and daily results of production seam testing.

The Contractor will retain responsibility for the integrity of the geomembrane system until acceptance by the CQA Engineer. The geomembrane will be accepted by the CQA Engineer when:

- Written certification letters including as built record drawings, have been received by the CQA Engineer.
- Installation is completed.
- Documentation of completed installation, including all reports, is received and approved.
- Verification of adequacy of field seams and repairs, including associated testing, is complete.

Acceptance of the completed work will include receipt of all submittals and all work completed to the satisfaction of the CQA Engineer.

4.2.6 Geosynthetics Manufacturer's Warranty

The Geosynthetics Manufacturer's warranty shall be against manufacturing defects or workmanship and against deterioration due to ozone, ultraviolet or other normal weather aging. The warranty shall be limited to replacement of material only, and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals or unusual acts of God. The warranty shall state that the furnished material meets all requirements of specification Section 02775 or Section 02271 and the Contract Documents, is free from manufacturing defects and is able to withstand normal weathering for a period of five years, prorated. Written warranties addressing the LLDPE and TPO geomembrane material shall be furnished by the contractor and shall be made to Sarasota County.

4.2.7 Installer's Warranty

The Installer shall furnish a written guarantee that the entire lining work constructed by him to be free of defects in material and workmanship and installed pursuant to the CQA Plan for a period of two (2) years following the date of acceptance of the work by the CQA Engineer. During the 23rd month, a pre-guarantee expiration inspection will be conducted to identify any necessary repair work covered by the guarantee. The Installer shall agree to make any repairs or replacements made necessary by defects in materials or workmanship in the Work which become evident within said guarantee period. The Installer shall make repairs and/or replacements promptly, the Owner may do so, and the Installer shall be liable to the Owner for the cost of such repairs and/or replacements. The Installer's warranty shall state that the materials were properly installed, properly welded, seamed and jointed and will not fail within 2 years of installation under similar conditions. The warranty shall provide for complete repair/replacement for the warranty period. Written warranties addressing the LLDPE and TPO geomembrane material shall be furnished by the contractor and shall be made to Sarasota County.

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SECTION 5.0
GEOTEXTILE

The following section outlines the CQA required for the installation of geotextiles. Non-woven cushion, drainage, and woven separator geotextiles will be used to protect the geomembrane and segregate the soil from drainage stone.

5.1 PRE-CONSTRUCTION

5.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the following:

- Manufacturer's description (cut sheet) of the proposed geotextiles documenting it will meet or exceed specified requirements.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geotextiles.

Before shipment of the geotextile, the CQA organization shall review all pre-construction submittals.

The CQA Inspector will take conformance samples for testing in accordance with this CQA Plan and the specification Section 02778, Geotextiles.

Table 5-1
Manufacturer's Quality Control Testing for Geotextiles

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Non-Woven Drainage Geotextile	Mass Per Unit Area (oz/yd^2)	ASTM D5261	One per 90,000 ft^2
	Grab Tensile Strength (lbs)	ASTM D4632	One per 90,000 ft^2
	Grab Tensile Elongation (%)	ASTM D4632	One per 90,000 ft^2
	Puncture Strength (lbs)	ASTM D4833	One per 90,000 ft^2
	AOS, US sieve (mm)	ASTM D4751	One per 540,000 ft^2
	Permittivity, (sec^{-1})	ASTM D4491	One per 540,000 ft^2
	Trapezoidal Tear Strength, (lbs)	ASTM D4533	One per 90,000 ft^2
	Flow Rate (gpm/ft^2)	ASTM D4491	One per 540,000 ft^2
	UV Degradation, % retained @ 500 hrs	ASTM 4355	1 per formulation
Woven Separator Geotextile	Flow Rate (gpm/ft^2)	ASTM D4491	One per 540,000 ft^2
	UV Degradation, % retained @ 500 HRS	ASTM D4355	1 per formulation
	Permittivity, (sec^{-1})	ASTM D4491	One per 540,000 ft^2
	Trapezoidal Tear Strength, (lbs)	ASTM D4533	One per 90,000 ft^2
	Grab Tensile Strength, (lbs)	ASTM D4632	One per 90,000 ft^2
	Elongation, %	ASTM D4632	One per 90,000 ft^2
	AOS, U.S. Sieve (mm)	ASTM D4751	One per 540,000 ft^2
	Puncture Strength, (lbs)	ASTM D4833	One per 90,000 ft^2

5.1.2 CQA Conformance Testing

The CQA Organization will obtain geotextile conformance test samples of each type of material manufactured for the project. Samples will be obtained across the entire roll width and will be 3 feet long. Samplers will mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. Each sample will be sent to the CQA Laboratory for conformance testing. The CQA Inspector will review test results and report any nonconformance to the CQA Engineer.

The following conformance tests will be performed on the geotextile at the frequencies indicated in Table 5-2:

Table 5- 2
CQA Conformance Testing for Geotextiles

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geotextile	Puncture Strength (1bs)	ASTM D4833	One per 90,000 ft^2
	Flow Rate (gpm/ft^2)	ASTM D4491	One per 540,000 ft^2
	AOS, US sieve (mm)	ASTM D4751	One per 540,000 ft^2
	Grab Tensile Strength (lbs)	ASTM D4632	One per 90,000 ft^2
	Mass per Unit Area (oz/yd^2)*	ASTM D5261	One per 90,000 ft^2

* Non-woven geotextile only

5.2 CONSTRUCTION

5.2.1 Delivery, Storage and Handling

During delivery of geotextiles the CQA Inspector will monitor for the following:

- Equipment used to unload the rolls will not damage the geotextile.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by specification Section 02778, Geotextiles has been received.
- Each roll is marked or tagged with manufacturer's name, project identification, lot number, roll number, roll dimensions, and that this information is documented on a geosynthetic receipt form.
- Materials are stored in a location that is protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Damaged rolls may be rejected. If rejected, verify that rejected material is removed from the site or stored at a location separate from accepted rolls. Geotextile rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

5.2.2 Geotextile Subsurface Preparation

Before geotextile installation, the CQA Inspector will document that the surface where the geotextile will be installed is acceptable and CQC and CQA documentation verifies that its installation meets specified requirements.

5.2.3 Geotextile Placement and Seaming

During geotextile placement and seaming operations, the CQA Inspector will monitor for the following:

- All defects and defect corrective actions are performed in accordance with specification Section 02778, Geotextiles.
- Equipment used to install the geotextile does not damage it during deployment.
- Crews working on the geotextile do not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile.
- The geotextile is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and seamed in accordance with specification Section 02778, Geotextiles.
- The geotextile is not exposed to direct sunlight for more than the 14 days in accordance with technical specification Section 02778, Geotextiles.
- Final geotextile surface is free of harmful foreign objects.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan conditions.

5.2.4 Geotextile Repairs

Where repairs are necessary, the CQA Inspector will monitor for the following:

- Place a patch of the same type of geotextile which extends a minimum of 24 inches beyond the edge of the damage or defect.
- Fasten patches continuously using a sewn seam or other approved method.
- Align machine direction of the patch with the machine direction of the geotextile being repaired.
- Replace geotextile which cannot be repaired.

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SECTION 6.0
GEOCOMPOSITE

The following section outlines the CQA required for the installation of the single and double-sided geocomposite. The single sided geocomposite will be used as the drainage layer of the final cover system (top slope). The double sided geocomposite will be used as the drainage layer of the final cover system (north and east slopes).

6.1 PRECONSTRUCTION

All HDPE drainage composite shall be manufactured in accordance with specification Section 02777, Drainage Composite. The drainage composite manufacturer will provide the Contractor and the CQA Inspector with a written certification, signed by a responsible party, that the drainage composites actually delivered have properties which meet or exceed the guaranteed properties. The CQA Inspector will examine all manufacturer's certifications to ensure that the property values listed on the certifications meet or exceed the project specifications. Any deviations will be reported to the CQA Engineer.

6.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the CQA organization with the following items for review and testing:

- Manufacturer's description (cut sheet) of the proposed geocomposites documenting that it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geocomposites will meet specified interface residual strength.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geocomposites.

Before shipment of the geocomposite, the CQA organization will review pre-construction submittals.

Table 6- 1
Manufacturer's Quality Control Testing for Geonet / Geocomposite

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geonet	Specific Gravity/Density (g/cm3) (min)	ASTM D 1505	One per 50,000 ft^2 and every resin lot
	Thickness (mil)	ASTM D 5199	One per 50,000 ft^2 and every resin lot
	Carbon Black Content (% Minimum)	ASTM D 1603	One per 50,000 ft^2 and every resin lot
	Tensile Strength (MD), (lb/in)	ASTM D 5035	One per 50,000 ft^2 and every resin lot
MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geocomposite	Transmissivity (m^2/sec)	ASTM D4716	One per 540,000 ft^2
	Ply adhesion (lb/ft^2)	ASTM D7005	One per 50,000 ft^2

1. This is an index transmissivity value measured at stress = 1,000 psf; a gradient = 0.33; time = 100 hours, minimum 1 hour if data equivalent to 100 hours is provided; and boundary conditions = plate/geocomposite/plate

6.1.2 CQA Conformance Testing

The CQA Organization will obtain geocomposite conformance test samples of each type of material manufactured for the project. Samples will be obtained across the entire roll width and will be 3 feet long. Samplers will mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. Each sample will be sent to the CQA Laboratory for conformance testing in accordance with the project Specification Section 02777, Part 2.2.C. The CQA Inspector will review all test results and report any non-conformance to the CQA Engineer.

The following conformance tests will be performed on the geocomposite:

Table 6-2
CQA Conformance Testing for Geocomposite

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geocomposite	Transmissivity (m^2/s)*	ASTM D4716	One per 540,000 ft^2
	Ply Adhesion	ASTM D 7005	One per 50,000 ft^2
	Thickness (Geonet Core Only)	ASTM D5199	One per 50,000 ft^2
	Interface Friction	ASTM D5321	One per Project

NOTE: Geotextiles shall be tested in accordance with Specification Section 02778.
* See specifications for transmissivity testing criteria.

Laboratory interface friction tests shall be conducted in general accordance with ASTM D5321, on the following interfaces (double-sided geocomposite only):

- Textured LLDPE and geocomposite.
- Geocomposite and protective cover soil.

The CQA Laboratory will perform three (3) direct shear tests at the project specific effective normal stresses. These tests will be performed using the Contractor's proposed LLDPE and a sample of geocomposite obtained from the Geosynthetics Manufacturer following award of the construction contract to the selected Contractor. A sample of protective cover soil proposed for the project will also be obtained for testing. A minimum interface friction angle based on the landfill design will be required to maintain stability.

The Owner will pay for "Passing" tests. Costs of corrective action, costs of "Failing" tests and all associated costs of testing due to failing tests are the sole responsibility of the Contractor. Materials not meeting the required shear strength will not be approved for use on this project.

6.2 CONSTRUCTION

The following subsection describes the CQA inspection activities that are necessary during the geocomposite installation. Refer to the specification Section 02777, Drainage Composite, for project specific construction and test requirements.

The CQA Inspector shall observe the geocomposite placement to confirm that specifications Section 02777 is followed, including coverage of all specified areas and adequate material overlap or seaming

6.2.1 Delivery, Storage and Handling

During delivery of geocomposite the CQA Inspector will observe rolls for the following, and any deviation will be reported to the CQA Engineer:

- Equipment used to unload the rolls does not damage the material.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by specification Section 02777, Drainage Composite has been received.
- The drainage composite manufacturer has identified all rolls of drainage composite in accordance with specification Section 02777, Drainage Composite.

Drainage composite cleanliness is essential to its performance; therefore, the shipping and storage or drainage composite must be in strict accordance with specification Section 02777, Drainage Composite. The CQA Inspector will verify the following and report any deviations to the CQA Engineer.

- Materials are stored in a location that will protect the rolls from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.
- Drainage composites are free of dirt and dust just before installation. If the drainage composites are judged dirty or dusty, they will be washed by the drainage composite installer prior to installation. Washing operations will be observed by the CQA Inspector and improper washing operations will be reported to the CQA Engineer.
- When several layers of drainage composite are stacked, care is taken to ensure that stacked drainage composites are placed in the same direction. A stacked drainage composite will never be laid in a perpendicular direction to the underlying drainage composite (unless otherwise specified by the CQA Engineer.)

Damaged rolls may be rejected. If rejected, it must be verified that rejected material is removed from the site or stored at a location separate from accepted rolls. Geocomposite rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

6.2.2 Geocomposite Subsurface Preparation

Before geocomposite installation, the CQA Inspector will observe for the following:

- Lines and grades for the composite liner subgrade have been verified by the Contractor.
- Geomembrane installation is complete.

6.2.3 Geocomposite Placement and Seaming

During deployment and seaming operations, the CQA Inspector will observe for the following:

- All defects and defect corrective actions (panel rejected, patch installed, etc.) are recorded, and corrective actions are performed in accordance with the specifications.
- Equipment used to install geocomposite does not damage it during deployment.

- Crews working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite.
- The geocomposite is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and connected in accordance with Specification Section 02777, Drainage Composite.
- The geotextile component is not exposed to direct sunlight for more than the number of days recommended by the manufacturer.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

6.2.4 Geocomposite Repairs

Repair any holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 feet beyond the edges of the holes or tear. Use approved fasteners, spaced every 6 inches around the patch to fasten the patch to the original roll.

6.2.5 Placement of Soil Materials

All soil material placed over the drainage composite will be placed in accordance with specification Section 02200, Earthwork, so as to ensure the following:

- The drainage composite and underlying geomembrane are not damaged.
- Minimal slippage of the drainage composite on the underlying geomembrane occurs.
- No excess tensile stresses occur in the drainage composite.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

SECTION 7.0
CORRUGATED POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

7.1 PRECONSTRUCTION

All Advanced Drainage Systems (ADS) corrugated pipe and fittings for stormwater drainage shall be produced in accordance with specification Section 15079, Pipe – Corrugated Polyethylene.

7.1.1 Manufacturer's Quality Control

7.1.1.1 Prior to Shipment

Prior to shipment, the Contractor will provide the CQA Engineer and the CQA Inspector with a quality control certification for each lot/batch of ADS material provided. The quality control certificate will be signed by a responsible party employed by the Manufacturer, such as the production manager. The quality control certificate will include:

- lot/batch number and identification; and
- sampling procedures and results of quality control tests.

The CQA Inspector will verify that the quality control certificates have been provided at the specified frequency for all lots/batches of pipe and that each certificate identifies the pipe lot/batch related to it; and review the quality control certificates and verify that the certified properties meet the requirements of specification Section 15079.

7.1.1.2 Prior to Installation

Prior to the installation of ADS corrugated pipes, the Manufacturer will provide to the Contractor and the CQA Inspector the following:

- a properties sheet including, at a minimum, all specified properties, measured using test methods indicated in ASTM D3350;
- a list of quantities and descriptions of materials other than the base resin which comprise the pipe;
- the sampling procedure and results of testing; and
- a certification by the manufacturer that values given in the properties sheet are minimum values and are guaranteed by the Manufacturer.

The CQA Inspector will review these documents and verify that:

- the property values certified by the Manufacturer meet all requirements of ASTM D3350; and
- the measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.
- report any discrepancies with the above requirements to the CQA Engineer.

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SECTION 8.0
SURVEYING

Surveying of lines and grades is conducted on an ongoing basis during construction of the final and temporary final cover system. Close construction quality control (CQC) of the surveying is absolutely essential to ensure that slopes are properly constructed. The surveying conducted at the site shall be performed by the Contractor.

8.1 SURVEY CONTROL

Permanent benchmarks and baseline control points are to be established for the site at locations convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards.

8.2 SURVEYING PERSONNEL

The Contractor's survey crew will consist of a Senior Surveyor, and as many Surveying CQC Monitors as are required to satisfactorily undertake the requirements for the work. All Surveying CQC personnel will be experienced in the provision of these services, including detailed, accurate documentation.

All surveying will be performed under the direct supervision of a Registered Professional Engineer (PE) or Licensed Land Surveyor (PLS) licensed in the state in which the project is located. The Licensed Land Surveyor may be the Senior Surveyor.

8.3 PRECISION AND ACCURACY

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01 foot and with a setting accuracy of 20 seconds. (5.6×10^{-3} degrees).

8.4 LINES AND GRADES

The following surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include (as deemed appropriate by the CQA Engineer and CQA Inspector):

- One or more construction baselines.
- The edges of all surface breaks (ex. toes, crests, ridges and valleys).
- Surface of the intermediate cover.
- Surface of the final cover.
- All structures including gas wells.
- Inverts of drainage pipe inlets and outlets.
- Top/toe of all berms, roads, and channels.
- Location of edge of liner, anchor trenches tie-in seam to adjacent existing liner system (as applicable).
- Major patches of LLDPE liner.

Laser planes are highly recommended for achieving the correct lines and grades during construction of each surface.

8.5 FREQUENCY AND SPACING

All surveying will be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks during construction, as determined by the Senior Surveyor, CQA Inspector, or CQA Engineer, may be necessary to assist the Contractor in complying with the required grades.

The following spacings and locations will be provided by the CQC surveyor, as a minimum, for survey points:

- Surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than 50 feet.
- On slopes greater than 10 percent, a square grid not wider than 50 feet will be used, but, in any case, a line of survey points at the crest, midpoint, and toe of the slope will be taken.
- A line of survey points no farther than 50 feet apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope).
- A line of survey points not farther than 50 feet apart will be taken for all piping used for downdrains, in particular, at the end points.
- At a minimum, every 25 feet along the perimeter of the final cover liner system.

8.6 THICKNESS MEASUREMENTS

The CQC surveyor as a representative of the Contractor shall obtain thickness measurements of the intermediate cover and final cover at a maximum 50-foot grid points and at all grade break lines prior to placement of the geomembrane liner. The procedure for obtaining thickness measurements of the intermediate cover and final cover shall be agreed to by the CQA Inspector and CQA Engineer prior to construction. The CQC Surveyor shall review the survey information with the Contractor to ensure that the survey demonstrates compliance with the Project Plans and Specifications. The Contractor is responsible for identifying and reporting to the CQA Inspector any areas of non-compliance evidenced by the survey, and for repairing such areas. The CQA Inspector and Contractor shall review the elevation measurements of the intermediate cover prior to placement of the geomembrane liner.

8.7 TOLERANCES

The following are maximum tolerances for survey points:

- On surfaces, the maximum tolerances shall be 0.1 foot. When comparing survey points for surfaces to determine conformance with design, the surveyed elevation and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.
- On piping for downdrain lines, the maximum tolerances shall be 0.1 foot. When comparing survey points for surfaces to determine conformance with design, the surveyed elevation and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.
- For thickness verifications, no minor tolerances are acceptable.

8.8 DOCUMENTATION

All field survey notes will be retained by the Senior Surveyor. The results from the field surveys will be documented on a set of survey record (as-built) drawings by the Contractor for submittal to the CQA Inspector. The Contractor shall certify to the CQA Inspector and CQA Engineer that the results of the survey demonstrates compliance with the Contract Documents. Sealed surveys depicting the information gathered in Paragraph 8.5 shall be supplied to the CQA Engineer and CQA Inspector in sufficient quantities. The surveys shall depict the information in a topographic format and illustrate actual data points. For thickness verification a table shall be compiled by the CQC surveyor or contractor containing the following information for each point.

- Top of intermediate cover elevation.
- Intermediate cover thickness.
- Top of protective cover elevation.
- Protective cover thickness.

Any deviations in elevation or thickness outside the tolerances allowed by specification shall be corrected.

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SECTION 9.0
REPORTING REQUIREMENTS AND DOCUMENTATION

9.1 PROJECT MEETINGS

Conducting periodic project meetings is the responsibility of the Design Engineer who will make physical arrangements for meetings, record minutes and distribute copies to participants and those affected by decisions make at meetings. At a minimum the following meetings will be held.

- Pre-construction CQA meeting
- Problems or Work deficiency meetings

9.1.1 Preconstruction CQA Meeting

This meeting shall be attended by the Owner, Design Engineer, CQA Engineer, CQA Inspector, and Contractor. The topics should include but are not limited to:

- Providing each organization with all relevant CQA documents and supporting information.
- Familiarizing each organization with the site-specific CQA Plan and its role relative to the design criteria.
- Determining any changes to the CQA Plan that are needed to ensure that the facility will be constructed to meet or exceed the specified design.
- Reviewing the responsibilities of each organization.
- Reviewing lines of authority and communication for each organization.
- Discussing the established procedures or protocol for observations and tests including sampling strategies.
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and retesting.
- Reviewing methods for documenting and reporting inspection data.
- Reviewing methods for distributing and storing documents and reports.
- Reviewing work area security and safety protocol.
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events.
- Conducting a site walk-around to review construction material and inspection equipment storage locations.

The meeting shall be documented by a designated person, and minutes should be transmitted to all parties.

9.1.2 Weekly Progress Meetings

A progress meeting shall be held weekly at the work area at a time determined at the pre-construction meeting. The frequency of progress meetings may be reduced as the project proceeds if agreed to by the Owner, Contractor, and CQA Engineer. At a minimum, the meeting should be attended by the CQA Engineer, CQA Inspector, Contractor and the Owner.

The purpose of the meeting is to:

- Review the previous week's activities and accomplishments.

- Review status of progress schedule.
- Review the work location and activities for the week.
- Identify the contractor's personnel and equipment assignments for the week.
- Discuss any potential construction problems.

This meeting shall be documented by the CQA Engineer.

9.1.3 Problem or Work Deficiency Meetings

A special meeting shall be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting shall be attended by the Design Engineer, Owner, Contractor, CQA Engineer, and CQA Inspector. The purpose of the meeting is to define and resolve a problem or recurring work deficiency in the following manner:

- Define and discuss the problem or deficiency.
- Review alternative solutions.
- Implement a plan to resolve the problem or deficiency.

The meeting shall be documented by the CQA Engineer and transmitted to the Owner, Contractor, CQA Inspector and Design Engineer, if applicable.

9.2 DOCUMENTATION

Documentation is an essential element of the CQA Plan. The following documentation and record keeping of inspection activities will be required.

9.2.1 Daily Summary Report

A summary report shall be prepared daily by the CQA Inspector. This report will provide the chronologic framework for identifying and recording all other reports. At a minimum, the summary reports shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Date, project name, location, and other identification.
- Data on weather conditions.
- Reports on any meetings held and their results.
- Unit processes, and locations, of construction under way during the timeframe of the daily summary report.
- Equipment and personnel being worked in each unit process, including subcontractors.
- Descriptions of areas or units of work being inspected and documented.
- Description of off-site materials received, including any quality verification (vendor certification) documentation.
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration.
- Decisions made regarding approval of units of material or of work (blocks), and/or corrective actions to be taken in instances of substandard quality.

- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item.
- Supporting inspection data sheets.
- Signature of the CQA Inspector.

9.2.2 Inspection Data Sheets and Photographs

All observations, and field and/or laboratory tests, shall be recorded on an inspection data sheet. Required data to be addressed for most of the standardized test methods are included in the pertinent ASTM Standards.

At a minimum, the inspection data sheets shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Description or title of the inspection activity.
- Location of the inspection activity or location from which the same increment was obtained.
- Type of inspection activity; procedure used (reference to standard method when appropriate).
- Recorded observation or test data, with all necessary calculations.
- Results of the inspection activity; comparison with specification requirements.
- Personnel involved in the inspection activity.
- Signature of the appropriate inspection personnel and concurrence by the CQA Engineer.

Items above may be formulated into site-specific checklists and data sheets so that details are not overlooked.

Photographic supporting data sheets also may prove useful. Such data sheets could be cross-referenced or appended to inspection data sheets and/or problem identification and corrective measures reports. At a minimum, photographic reporting data sheets should include the following information:

- A unique identifying number on data sheets and photographs for cross-referencing and document control.
- The date, time, and location where the photograph was taken and weather conditions.
- The size, scale, and orientation of the subject matter photographed.
- Location and description of the work.
- The purpose of the photograph.
- Signature of the photographer and concurrence of the CQA Engineer.
- Photographic supporting data sheets may be in MS Word or PDF format.

These photographs will serve as a pictorial record of work progress, problems, and corrective measures. They should be kept in a permanent protective file in the order in which they were taken.

9.2.3 Problem Identification and Corrective Measures Reports

A problem is defined herein as material or workmanship that does not meet the specified design. Problem identification and corrective measures reports shall be cross-referenced to specific inspection data sheets where the problem was identified. At a minimum, they shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.

- Detailed description of the problem.
- Location of the problem.
- Probable cause.
- How and when the problem was located (reference to inspection data sheets).
- Estimation of how long problem has existed.
- Suggested corrective measure.
- Documentation of correction (reference to inspection data sheets).
- Final results.
- Suggested methods to prevent similar problems.
- Signature of the appropriate CQA inspection personnel and concurrence by the CQA Engineer.

Copies of the report shall be sent to the Design Engineer and the Owner for their comments and acceptance. These reports should not be submitted to the FDEP at that time unless they have been specifically requested. However, a summary of all data sheets and reports will be submitted to the FDEP upon completion of construction.

9.2.4 Acceptance of Completed Components

All daily inspection summary reports, inspection data sheets, and problem identification and corrective measures reports, shall be reviewed by the CQA Engineer.

9.2.5 Final Documentation

At the completion of the project, the Owner will submit a final construction certification report to the FDEP. This report will include all of the daily inspection summary reports, inspection data sheets, problem identification and corrective measures reports, photographic supporting data, acceptance reports, deviations from design and material specifications (with justifying documentation), and record drawings. This document shall be certified correct by the CQA Engineer and included as part of the CQA Plan documentation.

Sarasota County
Solid Waste Operations

Central County Solid Waste Disposal Complex
Class I Landfill Expansion
Construction Quality Assurance Plan

February 2007
Revised June 2007
Revised September 2010

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HDR Project No. 001916-43485-018

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SECTION 1.0
INTRODUCTION

1.1 PURPOSE

This Construction Quality Assurance (CQA) Plan is a document that contains requirements for testing materials and monitoring construction of the Sarasota Central County Solid Waste Disposal Complex Class I landfill expansion, including the responsibilities of CQA personnel, documentation control, and reporting procedures.

The plan was prepared to provide the Owner, Design Engineer, CQA Engineer, and the Contractor the means to govern the construction quality and to satisfy the environmental protection as required under current solid waste management regulations, utilizing state-of-the-art construction practices and testing to adequately document proposed construction activities. The proposed construction, testing, and documentation procedures are intended to not only satisfy the minimum regulatory requirements, but to provide the necessary safeguards and provisions to a level commensurate with the potential environmental liability to be accepted by the Owner upon completion. The roles of each party have been sufficiently defined and the level of responsibility explained such that the proposed liner system will be constructed in accordance with the design, the construction documented, and respective components approved and certified for acceptance.

More specifically, this CQA Plan addresses the soils and geosynthetics components of the liner system. Specific work elements include the following:

- Soil subgrade
- Composite liner which consists, from bottom to top, of
    - a geosynthetic clay liner,
    - secondary 60-mil geomembrane,
    - leak detection geocomposite drainage layer,
    - primary 60-mil geomembrane, and
    - leachate collection geocomposite drainage layer.
- Protective cover with perforated lateral collection piping.
- Lift Stations.
- Manholes, pipes, and fittings.
- Pumps.

The CQA organization has the primary responsibility of implementing and managing the CQA program described in this plan. When construction is complete, the CQA organization will prepare a construction certification report that will include information generated through the CQA program and will document the extent to which construction was performed in accordance with the contract documents.

The CQA Plan is intended to be a supporting document to improve the overall implementation of the work. The CQA Plan may be more or less specific than the Project Plans and Specifications, and conflicts may exist between the documents. The Contractor is instructed to bring discrepancies to the

attention of the Design Engineer or CQA Engineer for resolution. The Design Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents. Unless otherwise determined by the Design Engineer, the more stringent requirement shall be the controlling resolution.

1.2 REFERENCE DOCUMENTS

In addition to the methods, procedures and requirements outlined in this CQA Plan, refer to the following documents:

- Florida Department of Environmental Protection (FDEP) Chapter 62-701.400
- Project Plans and Specifications
- Manufacturer's Quality Assurance Manuals (where applicable)
- Contractor's Construction Quality Control Plan
- EPA/600/R-93/182
- ASTM International - Current Edition

1.3 DEFINITIONS

This section provides definitions for terms used in this CQA Plan.

Contract Documents – All contractor submittals, construction plans, as-built plans, construction specifications, QA plan, safety plan and project schedule.

CQA Organization – The company and persons including CQA Engineer, CQA Inspector, and CQA Laboratories whose primary responsibility is to implement the CQA Plan.

CQA Plan – The document contained herein, entitled Central County Solid Waste Disposal Complex Class I Landfill Expansion Construction Quality Assurance Plan prepared for Sarasota County Solid Waste Operations by HDR Engineering, Inc.

Project Plans and Specifications - All project related plans and specifications including design modifications and as-built plans.

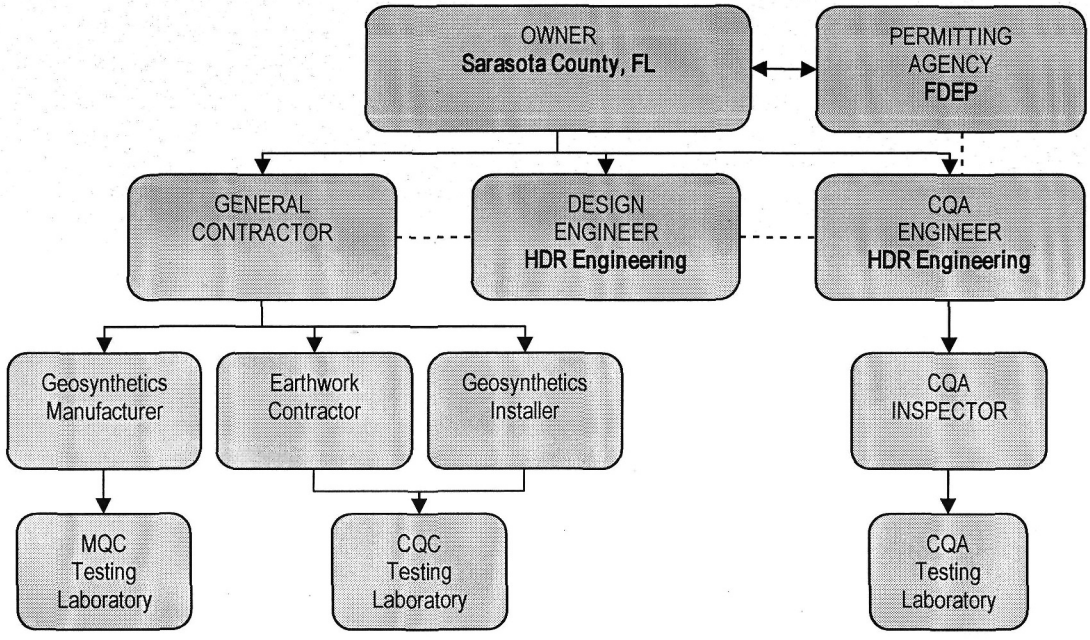
Quality Control - Actions taken by the geomembrane manufacturer and installer to ensure that the geosynthetic materials and workmanship meet the requirements of the Project Plans and Specifications.

Work - All tools, equipment, supervision, labor and material or supplies necessary to complete the project as specified herein and as shown on the Project Plans and Specifications.

SECTION 2.0
RESPONSIBILITY AND AUTHORITY

The principal organizations involved in permitting, designing and construction of the solid waste disposal facility include the permitting agency, facility owner/operator, Design Engineer, CQA organization, and Contractor. The principal organizations, their areas of responsibility and lines of authority as delineated for the CQA Plan are shown in the organization chart below and described fully in this section. This establishes the necessary lines of communication that will facilitate an effective decision making process during implementation of the CQA Plan.

Figure 1
CQA/CQC Organization Chart



2.1 PERMITTING AGENCY

The Florida Department of Environmental Protection (FDEP), as permitting agency, is authorized by law to issue a permit for the construction of landfill expansion. It is the responsibility of the FDEP to review the facility owner/operator's permit application, including the site-specific CQA Plan, for compliance with FDEP's regulations and to make a decision to issue or deny a permit based on this review. The FDEP has the responsibility and authority to review and accept or reject any design revisions or requests for variance that are submitted by the facility owner/operator after the permit is issued. The FDEP also has the responsibility and authority to review all CQA documentation during or after construction to confirm that the approved CQA Plan was followed and that the construction was completed as specified in the design.

2.2 FACILITY OWNER/OPERATOR

Sarasota County, Florida ("Owner") is the facility owner/operator and is responsible for the design, construction, operation and closure of the solid waste disposal facility. This responsibility includes complying with the requirements of the FDEP in order to obtain a permit and assuring the FDEP, by the submission of CQA documentation, that the facility was constructed as specified in the design. The Owner has the authority to select and dismiss organizations charged with design, CQA, and construction activities. The Owner also has the authority to accept or reject design plans and specifications, CQA Plans, reports and recommendations of the CQA Engineer, and the materials and workmanship of the contractor.

2.3 DESIGN ENGINEER

HDR Engineering, Inc. is the Design Engineer and is primarily responsible for designing a Subtitle D landfill expansion for the solid waste disposal facility that fulfills the requirements of the Owner and the FDEP. Design activities shall not end until construction of the expansion is completed. The Design Engineer may be requested to change some component designs if unexpected site conditions are encountered or changes in construction methodology occur that could adversely affect landfill construction. Implementation of the CQA Plan provides assurance that these unexpected changes or conditions will be detected, documented, and addressed during construction.

The Owner has the authority to delegate additional responsibility and authority to the Design Engineer by expressed consent (i.e., a contractual agreement). Additional responsibilities and authority include formulating and implementing a site-specific CQA Plan, periodic review of CQA documentation, modifying construction site activity, and identifying corrective measures in cases where deviation from the specified design or failure to meet design criteria, plans, and specifications is detected by the CQA Engineer.

2.4 CONSTRUCTION QUALITY ASSURANCE ORGANIZATION

2.4.1 Construction Quality Assurance Engineer (CQA Engineer)

HDR Engineering, Inc. is the CQA Engineer. The CQA Engineer is a party, independent of the manufacturer and the contractor, with responsibility for implementing this CQA plan. The CQA Engineer is responsible to the Owner but will function independently of the Owner and Contractor. At a minimum, the CQA Engineer is a Florida Registered Professional Engineer who possesses adequate formal academic training in engineering and managerial experience to successfully oversee and implement construction quality assurance activities for solid waste disposal facilities. The CQA Engineer is responsible for the following:

- Reviewing design criteria, permit conditions, the Contractor's CQC plan, and Project Plans and Specifications for clarity and completeness so that the CQA plan can be implemented.
- Educating CQA Inspectors on CQA requirements and procedures.
- Scheduling and coordinating CQA activities including sampling for conformance testing.

- Confirming that regular calibration of testing equipment is properly conducted and recorded.
- Reviewing and interpreting test data and reports.
- Rejecting defective work and verifying that corrective measures have been implemented.
- Certifying construction completion.
- Providing signed, sealed final report and record drawings to the FDEP stating that the liner system has been installed in substantial conformance with the Project Plans and Specifications for the liner system.

2.4.2 Construction Quality Assurance Inspector (CQA Inspector)

In order to assist the CQA Engineer in providing full-time on-site oversight and monitoring services, a CQA Inspector will be named. The CQA Inspector is a person(s) or firm(s) independent of the Contractor and Geomembrane Installer and authorized by the CQA Engineer and Owner to manage and oversee the execution of the work. The CQA Inspector shall possess formal academic training in soils engineering, engineering geology or other closely associated discipline. All completed work is subject to approval of the CQA Engineer.

The following minimum qualifications must be met by the CQA Inspector:

- The CQA Inspector must have been in business for at least ten (10) continuous years of operation immediately prior to the date of this project.
- The CQA Inspector must have inspected and tested a minimum of five (5) liner projects consisting of at least 10,000,000 square feet of HDPE liner.
- The CQA Inspector shall provide one full-time Qualified Engineering Technician and other trained technicians to perform the required tests and inspections of the liner system.
- The Qualified Engineering Technician is qualified representative of the CQA Inspector who is NICET Certified in Geotechnical Engineering Technology at Level 1 or higher, who is an engineering technician with a minimum of four years of directly related experience or a graduate engineer/geologist with one year of directly related experience.
- The CQA Inspector shall provide certified technicians to perform full time observation and documentation of activities related to the CQA of the liner system construction.
- The CQA Inspector must have registered full-time Professional Engineers on staff to sign, seal, and certify that the project was constructed in accordance with the contract documents.

The CQA Inspector's responsibilities include:

- Performing independent on-site inspection of the work in progress to assess compliance with the facility design, Project Plans and Specifications.
- Verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the standardized procedures defined by the CQA Plan.
- Reviewing design criteria, and Project Plans and Specifications for CQA requirements and procedures.
- Scheduling and coordinating inspection activities.

- Directing and supporting the inspection personnel in performing observations and tests by:
  - submitting test samples for analysis by the CQA laboratory,
  - confirming that regular calibration of testing equipment is properly conducted and recorded,
  - confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process,
  - recording and maintaining comprehensive documentation of the liner system construction, and
  - verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted in accordance with the CQA Plan and the Project Plans and Specifications.
- Providing to the CQA Engineer reports on the inspection results including:
  - review and interpretation of all data sheets and reports,
  - identification of work that the CQA Inspector believes should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval,
  - rejection of defective work and verification that corrective measures are implemented, and
  - verification that the Contractor's construction quality control plan is in accordance with the site-specific CQA Plan.

2.4.3 Construction Quality Assurance Laboratory (CQA Laboratory)

The CQA Laboratory will be independent of the geosynthetic manufacturer and installer. The CQA Laboratory will be qualified and responsible for material conformance testing for soil, geomembrane, GCL, geotextile, geocomposite, and for destructive seam tests on the installed geomembrane. The CQA Engineer and CQA Inspector will be responsible for coordinating with the laboratory, sampling the geosynthetics or arranging for sampling at the manufacturing facility, and reviewing conformance testing.

- The CQA Laboratory shall possess testing equipment which is capable of testing the interface friction between the liner system components in accordance with ASTM standards.
- The CQA Laboratory shall possess testing equipment which is capable of testing HDPE liner seams for peel and shear according to ASTM standards.
- The CQA Laboratory shall be familiar with ASTM, NSF and other applicable test standards. It shall have performed a minimum of 100 sets of peel and shear tests on seams of material the same type as specified.

2.5 CONSTRUCTION CONTRACTORS

2.5.1 Construction Contractor

It is the responsibility of the Contractor to construct the landfill system in strict accordance with design criteria, Project Plans and Specifications, using the required construction procedures and techniques. The chosen Contractor will be registered in accordance with applicable local, state, and federal requirements and will have prior landfill-related experience.

The Construction Contractor's responsibilities include but are not limited to:

- Constructing the solid waste disposal facility in strict accordance with the contract documents including Project Plans and Specifications using the necessary construction procedures and techniques.
- Formulating and implementing a Construction Quality Control (CQC) Plan in accord with requirements of the technical specification.
- Contracting with subcontractors, such as manufacturers and specialty installers, and coordinating their activities.
- Supplying required materials and supporting QC documentation either directly or through subcontractors.
- Discussing procedures for locating and protecting construction materials and for implementing methods for preventing damage of the materials from inclement weather or other adverse effects.
- Coordinating activities with the CQA Engineer and CQA Inspector and providing the CQA organization with all necessary documentation as detailed in this plan.
- Updating original construction drawings and specifications to reflect any deviation from the original plans and furnishing as-built record drawings and all required quality control documentation.
- Planning and monitoring construction site health and safety procedures.
- Approving shop drawings prior to submission to the CQA Engineer.
- Determining and verifying:
    - field measurement,
    - field construction criteria,
    - catalog numbers and similar data, and
    - conformance to Project Plans and Specifications.
- Coordinating each submittal with other submittals and with the requirements of work and of the Project Plans and Specifications
- Notifying the CQA Engineer in writing, at time of submission, of any variance in the submittals from the requirements of the Project Plans and Specifications. Any such deviations permitted by the Design Engineer will require modifications to the Project Plans and Specifications.

2.5.2 Site Supervisor

The Construction Contractor will be represented in the field by a Site Supervisor. The Site Supervisor is responsible for the following:

- Scheduling and coordinating work including subcontractors.
- Informing the CQA Inspector and CQA Engineer of any discrepancies between the Project Plans and Specifications and field conditions.
- Coordinating with the CQA Inspector and CQA Engineer.
- Attending project meetings.
- Maintaining a daily log of construction and quality control activities.
- Implementing and verifying CQC procedures.

- Submitting proposed alternative materials or construction methods for approval before acquisition and use.
- Construction.

2.5.3 Geomembrane Installation Contractor (Geomembrane Installer)

The Geomembrane Installer may be a general contractor, a subcontractor to the general construction contractor, or a specialty contractor hired directly by the Owner. The Geomembrane Installer has not been chosen at this time. The selected contractor will have experience in installing at least 10 million square feet of geosynthetics.

The Geomembrane Installer or their CQC Consultant will be responsible for the following:

- Coordinating with the general contractor and CQA Inspector.
- Handling, storing, placing, and installing manufactured materials.
- Implementing and verifying a manufacturer and installer QC plan.

SECTION 3.0
SUBGRADE AND DRAINAGE SAND LAYER – OVERLAY LINER

This section contains procedures and tests, which must be implemented in order to ensure the soil components of the base liner system meet the design standards. This is a critical component of the Construction Quality Assurance Plan. All required tests and sampling procedures within this section shall be performed in accordance with generally accepted engineering procedures.

3.1 SUBGRADE

3.1.1 Preconstruction

Soil material to be used as subgrade shall consist of select borrow material meeting all requirements specified in the contract documents. The borrow material for liner subgrade must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on drawings. If fill comes from off-site location, Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

Table 3- 1
Subgrade Test Procedure Standards

STANDARD	TEST DESCRIPTION
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3)
ASTM D 1556	Test Method for Water Content of Soil and Rock In-Place by the Sand-Cone Method
ASTM D422	Method for Particle-Size Analysis of Soils
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
ASTM D2487	Test Method for Classification of Soils for Engineering Purposes (United Soil Classification System)
ASTM D2488	Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D3017	Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
ASTM D2216	Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D2434	Method of Test for Permeability of Granular Soils (Constant Head)
ASTM D5321	Test Method Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
ASTM D6243	Test Method for Determining the Coefficient of Soil and GCL or Geosynthetic and GCL Friction by the Direct Shear Method
ASTM D3080	Method for Direct Shear Testing of Soil Under Consolidated Drained Conditions
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D2937	Test Method for Density of In-Place Soils by Drive-Cylinder Method

Soil for the subgrade should be free of deleterious material (sticks, roots, waste, etc.) and rock fragments, boulders or cobbles greater than three inches in size. Fines content of installed soil shall be a maximum of 20% (passing #200 sieve) and monitored as specified in the Project Plans and Specifications.

The CQA Inspector on-site shall test materials and monitor compliance with requirements of the Project Plans and Specifications. All observations and tests shall be conducted at locations selected by the CQA Inspector who has been assigned responsibility for verification and documentation of the element in question.

3.1.2 Construction

The following is an outline of the minimum construction requirements for the subgrade. For more detailed information see the specification Sections 02220, Earthwork and 02776, Geosynthetic Clay Liner (GCL).

- Approval from CQA Inspector with regard to suitability of soils and acceptable subgrade.
- Atmospheric conditions observed and recorded by the CQA Inspector and appropriate actions taken when unsuitable weather conditions exist.
- Subgrade soils proof-rolled in accordance with technical specification Section 02776 Part 3.1 F..
- Dust control continuous throughout the subgrade preparation operations.
- Final grading completed in accordance with specification Section 02220, Earthwork.
- Engineered fills compacted to specified requirements.
- Provide as built survey of subgrade sealed by a professional land surveyor illustrating construction of all design features.
- Approval from CQA Inspector with regard to final surface smoothness and uniformity. Any objects protruding from the final surface or coarse fragments within the surface material that may damage the geomembrane will be removed.

Table 3- 2
Subgrade Conformance and Construction Testing

TEST DESCRIPTION	STANDARD	TEST FREQUENCY
Subgrade		
Density, Nuclear Method	ASTM D2922	1 per 10,000 ft^2
Moisture Content, Nuclear Method	ASTM D3017	1 per 10,000 ft^2
Engineered Fill		
Density, Nuclear Method	ASTM D2922	1 per 1,500 yd^3
Moisture Content, Nuclear Method	ASTM D3017	1 per 1,100 yd^3
Sand Cone or Drive Cylinder Method	ASTM D1556/D2937	1 per 20 nuclear tests
Oven Moisture Content Verification	ASTM D2216	1 per 20 nuclear tests
Moisture/Density Relations	ASTM D1557	1 per 20,000 yd^3

3.2 DRAINAGE SAND LAYER – OVERLAY LINER

3.2.1 Preconstruction

Soil materials to be used as the 24-inch thick drainage sand layer shall consist of select borrow material meeting all requirements specified in Specification Section 02240, Drainage Sand Layer – Overlay Liner. The borrow material for drainage sand layer must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on the drawings. If cover soil comes from off-site location, the Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

The drainage sand layer shall be placed and compacted in accordance with the specification Section 02240. The Contractor will provide gradation and permeability testing of the granular material at the frequency specified in the specificationSection 02240. The CQA Inspector will observe that placement of the granular material is done in a manner to protect the geocomposite, and review the gradation and permeability test data provided by the Contractor. The CQA Inspector may conduct confirmation gradation and density testing in accordance with specification Section 02240.

Table 3- 3
Drainage Sand Layer Test Procedure Standards

STANDARD	TEST DESCRIPTION
ASTM C33	Standard Specification for Concrete Aggregate
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D4373	Standard Test Method for Rapid Determination of Carbonate Content of Soils
ASTM D5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

3.2.2 Construction

Drainage sand layer does not require compaction control; however, it should be stable for construction and maintenance traffic. Care will be exercised in placement so as not to shift, wrinkle or damage the underlying geosynthetic layers, and the placement methods will be documented.

The drainage sand layer shall be placed under the direct supervision of the CQA Inspector. The Contractor shall utilize care to avoid damage to the geocomposite. No vehicular traffic will be permitted on the unprotected liner system. The loose thickness of the initial lift of drainage sand layer shall not be less than 12 inches and spread with low ground pressure equipment (maximum pressure 8 psi). Fill shall be placed by equipment pushing from the bottom to top of slope. Material shall not be placed over standing water or ice.

The following is the general drainage sand layer construction sequence:

- Obtain sample of materials for visual reference if different.
- Review material submittals and pre-construction testing.
- Establish stockpile location, if required.
- Perform sampling, gradation, and permeability testing of material before installation at the frequencies established below to verify material quality.
- Verify the underlying geocomposite construction is complete before material installation.
- Verify grade control is established to control thickness of material placed.
- For placement of material over geosynthetics, monitor 12-inch minimum thickness of material below spreading equipment and the spreading equipment has a ground pressure rating equal to or less than 8psi. During placement of material, identify geocomposite damaged during material installation and establish that the damage is repaired.
- Monitor haul road thickness over geocomposite and verify that equipment hauling and placing material over geocomposite meets equipment specifications.
- Monitor placement of material over piping and verify that pipe is not damaged by occasionally uncovering piping.
- Monitor equipment speed over material.

All observation and test locations shall be conducted at locations selected by the CQA Inspector. Weather conditions shall be observed and recorded by the CQA Inspector and appropriate actions will be taken when unsuitable weather conditions exist.

The required thickness of drainage sand layer will be verified by survey methods on an established grid system with not less than one verification point per 5,000 square feet of surface.

Table 3- 4
Drainage Sand Layer Conformance and Construction Testing

TEST DESCRIPTION	STANDARD	TEST FREQUENCY
Protective Cover		
Gradation	ASTM D422	1 per 1,500 yd^3
Permeability	ASTM D2434	1 per 3,000 yd^3
Leachate Collection Stone		
Gradation	ASTM C33	1 per 1,500 yd^3
Permeability	ASTM D2434	1 per 3,000 yd^3

SECTION 4.0
GEOSYNTHETIC CLAY LAYER

The following section outlines the CQA required for the installation of the Geosynthetic Clay Layer (GCL).

4.1 PRECONSTRUCTION

4.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the CQA Inspector the following items for review and testing:

- Manufacturer's description (cut sheet) of the proposed GCL documenting that it will meet or exceed specified requirements.
- Available historical data documenting that the proposed GCL will meet specified interface peak strength.
- Written instructions for storage, handling, installation, seaming and repair of the proposed GCL.

Before shipment of the GCL, the CQA organization shall review all pre-construction submittals.

Before installation, the CQA Inspector shall take conformance samples for testing in accordance with this CQA plan and the specification Section 02776, Geosynthetic Clay Liner (GCL).

Table 4- 1
Manufacturer's Quality Control Testing for GCL

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geosynthetic Clay Layer	Bentonite Mass	ASTM D5993	1 per 40,000 ft^2 placed
	Index Flux and calculated hydraulic conductivity, at 10 psi confining pressure and 2 psi head	ASTM D5887	1 per 100,000 ft^2 placed
	Minimum Grab Tensile Strength	ASTM D4632	1 per 40,000 ft^2
	Typical Shear Strength	ASTM D6243	1 per project
	Minimum Free Swell	ASTM D5890	1 per 100,000 lbs
	Maximum Fluid Loss	ASTM D5891	1 per 100,000 lbs
	Minimum peel strength, MD	ASTM D6496	1 per 40,000 ft^2 placed
	Tensile strength, MD	ASTM D6768	1 per 40,000 ft^2 placed

4.1.2 CQA Conformance Testing

The GCL manufacturer will provide the Contractor and CQA Inspector with a written certification signed by a responsible party, that the GCL actually delivered has properties which meet or exceed the guaranteed properties.

The CQA Inspector will examine all manufacturer's certifications to ensure that the property values listed on the certification meet or exceed the project specifications. Any deviations will be reported to the CQA Engineer. Interface friction testing will be conducted in accordance with this CQA Plan and specification Section 02776, Geosynthetic Clay Liner (GCL).

This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable. Testing will include the interfaces between the following adjacent materials.

Table 4- 2
CQA Conformance Testing for GCL

MATERIAL	SPECIFICATION SECTION
Protective Cover	02240
Drainage Composite	02777
60 Mil Textured HDPE	02775
Drainage Composite	02777
60 Mil Textured HDPE	02775
Geosynthetic Clay Liner (GCL)	02776

The testing shall be performed as follows.

- Conduct one set of three direct-shear interface friction tests on each of the interfaces listed above. Normal stresses calculated to represent project conditions and presented in specification Section 02776 shall be used during hydration and shearing. Samples shall be allowed to hydrate for a minimum of 3 days prior to shear testing. The hydration fluid shall be leachate. Orient all geosynthetic materials such that the shear force is parallel to the down slope orientation of these components in the field.
- Verify that the materials meet the minimum friction angle required for each interface in the system as defined in the Project Plans and Specifications.
- Test interface friction between the GCL and adjacent materials in accordance with ASTM D6243, Procedure B. The rate of horizontal deformation shall be determined from the T50% time calculated during the consolidation phase of each test.
- Compact the subgrade soils within the moisture-density requirements of their respective specifications.

4.2 CONSTRUCTION

4.2.1 Delivery, Storage and Handling

During delivery of GCL the CQA Inspector will observe for the following:

- Equipment used to unload the materials does not damage the GCL.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by the Pspecification Section 02776 has been received.
- Each roll is marked or tagged with manufacturer's name; project identification; lot number; roll number; roll dimensions and that this information is documented on a geosynthetic receipt form.
- Materials are stored in a location that will protect the rolls from exposure to precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Damaged rolls may be rejected. If rejected, it must be verified that rejected material is removed from the site or stored at a location separate from accepted rolls. GCL rolls that do not have proper manufacturer's documentation must be stored at a separate location until all documentation has been received and approved.

4.2.2 GCL Subsurface Preparation

Before GCL installation, the CQA Inspector will observe for the following:

- Lines and grades have been verified by the Contractor and a subgrade acceptance form has been submitted.
- Soil subgrade surface has been prepared in accordance with specification Section 02776.

4.2.3 GCL Placement and Seaming

During GCL deployment and seaming operations, the CQA Inspector will observe for the following:

- All defects and defect corrective actions (panel rejected, patch installed, etc.) are recorded, and corrective actions are performed in accordance with specification Section 02776.
- Equipment used to install geocomposite does not damage it during handling, deployment, or due to leakage of hydrocarbons or other means.
- Crews working on the GCL do not smoke, wear shoes that could damage the GCL, or engage in activities that could damage the GCL.
- The GCL is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and seamed in accordance with tspecification Section 02776 and the proper amount of bentonite is applied to the seam overlap.
- The GCL is not exposed to precipitation.
- Final GCL surface is free of objects that could damage the overlying geomembrane.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

4.2.4 GCL Repairs

Where repairs are necessary the CQA Inspector will observe and document patching activities used to repair large holes, tears, and small defective areas. GCL that has been hydrated (above 100% per ASTM D4643) shall be removed and replaced.

SECTION 5.0
GEOMEMBRANE LINER

This section covers the work necessary to construct and test the double geomembrane lining system, which will consist of two 60 mil High Density Polyethylene (HDPE) liner materials in accordance with specification Section 02775, HDPE Geomembrane Liner Systems. The HDPE liner materials shall be new, first quality products designed and manufactured specifically for the purposes of the Work and shall have satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes. The geomembrane will be textured on both sides and shall be an unmodified HDPE containing no plasticizers, fillers, chemical additives, or extenders. The only other compound ingredients to be added to the geomembrane resin shall be anti-oxidants and heat stabilizers required for manufacturing. The geomembrane shall be supplied as a single ply continuous sheet with no factory seams and in rolls with a minimum width of 22 FT. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams.

Extrusion resin used for fusion welding with extrudate to make field seams between geomembrane sheets and for repairs shall be HDPE produced from, and the same as, the geomembrane sheet resin. Physical properties shall be same as HDPE geomembrane sheets.

The geomembrane liner shall conform to the testing requirements of GRI Standard GMI13 - "*Test Properties, Testing Frequency and Recommended Warrant for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes*" (Geosynthetic Research Institute; Philadelphia, PA) except as modified herein.

5.1 PRECONSTRUCTION

5.1.1 Certification of CQA Plan Conformance

Prior to start of work, the Geosynthethics Manufacturer and the Geomembrane Installer, each, shall submit for approval by the CQA Inspector documented evidence of its ability and capacity to perform this Work. Each shall have successfully manufactured and/or installed a minimum of ten (10) million square feet of similar lining material in solid waste containment structures.

The Contractor shall submit written certification by the Geosynthetics Manufacturer that the lining materials conform to the requirements of the CQA Plan. The Contractor shall submit the name and qualifications of its project superintendent that will be on the project whenever lining materials are being handled and/or installed plus the names and qualifications of senior installation personnel on the project. All manufacturer and Geomembrane Installer qualifications shall be submitted in accordance with technical specification Section 02775 Part 1.2 B.

5.1.2 Geomembrane Installer's and Manufacturer's QC Program

The Geosynthetics Manufacturer and the Geomembrane Installer, each, shall submit a complete description of its quality control (QC) program, as applicable, for manufacturing, handling, installing, testing, repairing and providing a completed lining in accordance with requirements of the CQA Plan and contract documents. The description shall include, but not be limited to, polymer resin supplier, product identification, acceptance testing, fabrication and production testing, installation testing, documentation of changes, alterations and repairs, retests and acceptance.

The following quality control tests will be performed on the geomembrane.

Table 5- 1
MQC Conformance Testing for Geomembranes

STANDARD	TEST DESCRIPTION
ASTM D638, Type IV	Test Method for Tensile Properties of Plastics
ASTM D1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
ASTM D1505/D792	Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1603	Standard Test Method for Carbon Black Content in Olefin Plastics
ASTM D3895	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
ASTM D5994	Standard Test Method for Measuring Core Thickness of Textured Geomembrane
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials
GRI GM12	Asperity Height

5.1.3 Geomembrane Installer's Installation Plan

The Installer shall submit installation drawings, the Manufacturer's written Field Installation Procedure Manual, and a schedule for performing/completing the Work. Installation drawings shall show a lining sheet layout with proposed size, number, position, and sequence of placing of all sheets and indicating the location of all field seams. Installation drawings shall also show complete details and/or methods for anchoring the lining at its perimeter, making field seams, and making anchors/seals to pipes and structures.

The Installer shall submit a complete description of welding procedures for making field seams and repairs. The welding procedures shall conform to the latest procedures recommended by the lining Manufacturer and to the CQA Plan.

The Contractor and Geomembrane Installer shall submit for approval by the CQA Inspector certification that the surface(s) on which the lining will be placed is acceptable. Installation of the lining shall not commence until this certification is furnished to the CQA Inspector.

The Geomembrane Installer shall provide on-site technical supervision and assistance at all times during installation of the lining system. The Geomembrane Installer and Contractor, as applicable to each, shall submit for approval by the CQA Inspector written certification that the lining system was installed in accordance with the Manufacturer's recommendation, the CQA Plan, Project Plans, specification Section 02775, and approved submittals.

The CQA Engineer will initiate a pre-installation meeting with the Geomembrane Installer, Contractor, and CQA Inspector prior to installation of the lining system. Topics for review/discussion shall include, as a minimum, Project Plans and Specifications, approved submittals, training and qualification procedures for Contractor personnel, and demonstration of making a field welded seam(s) including peel and shear tests.

Prior to installation of the lining system, the Geomembrane Installer shall instruct the workmen of the hazards of installation, such as handling sheets of lining material in high winds; use of equipment; application of solvents, adhesives and caulks; and walking on lining surfaces. Work gloves, safety glasses, hard hats, and smooth-soled shoes are minimum safety wear requirements when working on the geomembrane. Safety shoes must be worn when handling heavy objects.

The CQA Inspector shall have authority to order an immediate stoppage of work because of improper installation procedures, safety infractions, or for any reason which may result in a defective liner.

5.1.4 Contractor's Geomembrane Preconstruction Material Submittals

The Contractor will provide the CQA organization with the following items for review and testing:

- Geomembrane proposed for the project for slope stability verification testing as outlined in this CQA Plan.
- Manufacturer's description (cut sheet) of the proposed geomembrane documenting it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geomembrane will meet specified interface friction angle.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geomembrane.

Before shipment of the geomembrane, the CQA organization shall review all approved pre-construction submittals. Pre-construction submittals should be submitted a minimum of four weeks in advance to allow time for review and approval by the CQA organization.

The Contractor shall submit certifications that the HDPE geomembrane material delivered to the site meets the requirements of the Specification and that the HDPE geomembrane was received and accepted in undamaged condition from shipper.

5.1.5 CQA Conformance Testing

The geomembranematerial will be sampled at the site by the CQA Inspector or at the manufacturing plant by a third party under the direction of the CQA organization. The Ssample will be taken across the entire roll width and will be 3 feet long. Samplers will mark the machine direction and the manufacturer's roll identification number on the sample. Samplers will also assign a conformance test number to the sample and mark the sample with that number. The samples will be forwarded to a CQA testing laboratory for the conformance testing. The CQA Inspector will review all conformance test results and report any nonconformance to the Owner and CQA Engineer

The following conformance tests will be performed on the geomembrane.

Table 5- 2
CQA Conformance Testing for Geomembranes

STANDARD	TEST DESCRIPTION
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D4437	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

Laboratory interface friction tests shall be conducted in general accordance with ASTM D5321, on the following interfaces:

- Textured HDPE liner and geosynthetic clay liner.
- Textured HDPE liner and geocomposite.

The CQA Laboratory will perform three (3) direct shear tests at the project specific effective normal stresses. These tests will be performed using the Contractor's proposed HDPE and a sample of geosynthetics materials obtained from the Geosynthetics Manufacturer following award of the construction contract to the selected Contractor. A minimum interface friction angle based on the landfill design will be required to maintain stability.

The Owner will pay for "Passing" tests. Costs of corrective action, costs of "Failing" tests and all associated costs of testing due to failing tests are the sole responsibility of the Contractor. Materials not meeting the required shear strength will not be approved for use on this project.

Destructive seam tests will be taken at a minimum of 1 per 500 linear feet at locations selected by the CQA Inspector. The samples will be packaged in a manner that will not damage the test sample and will be sent to the CQA Testing Laboratory. Conformance testing will include seam strength and peel adhesion in accordance with ASTM D638 (using one-inch strips and a strain rate of two inches per minute), ASTM D4437, and the project technical specifications.

5.2 CONSTRUCTION

5.2.1 Delivery, Storage and Handling

Materials will be delivered to the site after the required submittals have been furnished and approved. The delivered roll goods will be marked by the manufacturer to show at a minimum the following information:

- Name of manufacturer.
- Product type.
- Product thickness.
- Manufacturing batch code.
- Date of manufacture.
- Physical dimensions.
- Roll number.

Lining materials delivered to the site shall be inspected for damage, unloaded, and stored with a minimum of handling. Each roll shall be wrapped in an opaque and waterproof layer of plastic during shipment and storage. The plastic wrap shall not be removed until deployment. Materials shall not be stored directly on the ground. The storage area shall be such that all materials are protected from mud, soil, dirt and debris. The stacking of lining shall not be higher than two rolls.

Under no circumstances shall the lining be subjected to materials, sandbags, equipment or other items being dragged across its surface. Nor shall workmen and others slide down slopes atop the lining. All scuffed surfaces resulting from abuse of any kind caused by the Contractor in performance of the Work shall be repaired at the CQA Inspector's direction.

HDPE geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed. HDPE shall not be exposed to temperatures in excess of 60°C (140°F) or less if recommended by the Manufacturer.

No hooks, tongs or other sharp instruments shall be used for handling the HDPE geomembrane. Rolls shall not be lifted by use of cables or chains in contact with the HDPE geomembrane. HDPE geomembrane shall not be dragged along the ground.

The Contractor shall be completely responsible for shipping, storage, handling, and installation of all lining materials in compliance with the CQA Plan.

5.2.2 Geomembrane Subsurface Preparation

Before geomembrane installation, the CQA Inspector will document that the GCL installation is complete and CQC and CQA documentation verifies that its installation meets specified requirements.

5.2.3 Geomembrane Placement and Seaming

Prior to installation of the geomembrane, a site inspection will be conducted by the CQA Inspector and the Contractor to verify measurements, structures and surface conditions to support the geomembrane.

The Contractor and Geomembrane Installer will provide written documentation to the CQA Inspector that surfaces to receive the geomembrane have been inspected and are acceptable for installation of the lining.

Before the work begins, the Contractor will inspect all lining materials for damage from transit. Materials that cannot be repaired will be rejected and removed from the work area and site.

During unwrapping of lining materials for use and placement, the Contractor will visually inspect all materials, particularly surfaces of lining sheets, for imperfections and faulty areas. All such defective places will be marked and repaired in accordance with approved methods.

The geomembrane will be installed as shown on the project plans and approved installation drawings. Placement of the geomembrane will be done such that good fit, without bridging, is provided on all covers and grade changes. Excessive slack will be avoided to minimize rippling during the soil cover operation. Geomembrane liner shall be handled and placed in a manner which minimizes wrinkles, scratches and crimps.

Sheets of geomembrane materials will be of such lengths and widths and will be placed in such a manner as to reduce field seaming to a minimum. The lining will be anchored in accordance with details shown on approved plans and drawings. The lining will be anchored and sealed to structures, pipes and other types of penetrations, (if any), in accordance with details shown on approved plans and drawings. All changes in approved installation drawings and procedures must be approved by the Design Engineer.

Extreme care will be taken during installation of the lining to be certain no damage is done to any part of the lining. Dragging of the geomembrane material on the subgrade will be prohibited. Smoking by installation personnel will be prohibited. All handling and installation procedures will be performed by workers wearing shoes with smooth soles. Shoes with soles that have patterns in relief shall be prohibited. No foot traffic will be allowed on the geomembrane except with approved shoes. No vehicular traffic will be allowed on the geomembrane. All motor driven equipment using fuel will have spark arrestors. No gasoline driven generators or cans of gas or solvent will be placed directly on the lining material. Under no circumstances will the lining be used as a work area to prepare patches or to store tools and supplies. If needed, a tarpaulin of approved material will be spread out as a work area.

During installation, the Contractor will be responsible for protecting the lining against adverse effects of high winds such as uplift. Sand bags will be used as required to hold the lining material in position during installation. Sand bags will be sufficiently close-knit to preclude fines from working through the bottom, sides or seams. Paper bags, whether or not lined with plastic, will not be permitted. Burlap bags, if used, must be lined with plastic. Bags that are split, torn, or otherwise losing their contents will be immediately removed from the work area and any spills immediately cleaned up. Metal or wire ties will not be used.

The geomembrane material will not be installed under adverse climatic conditions, unless the Contractor can demonstrate that his installation techniques adequately compensate for such adverse conditions and quality of workmanship is not compromised. Adverse climatic conditions occur when the air temperature measured 6 inches above the geomembrane surface is less than 32°F and decreasing, or more than 90°F; when the relative humidity is more than 80 percent; when it is raining; or when there is frost on the ground; or during conditions of excessive winds.

Geomembrane field seams will be lap seams as shown on approved plans and drawings. The lap seams will be formed by lapping the edges of geomembrane sheets a minimum of 3 inches. The contact surfaces of the sheets will be wiped clean to remove dirt, dust, moisture, and other foreign materials. Geomembrane shall not be welded when ambient temperatures are below 5°C or above 40°C without written consent of manufacturer and CQA Engineer or CQA Inspector. For fillet weld seams, bevel edge of geomembrane and clean oxidation from surfaces to receive extrudate by disk grinding or equivalent not more than one hour before seaming.

Lap seam intersections involving more than three thicknesses of lining material will be avoided, and all seam intersections will be offset at least 2 FT. No horizontal field seams will be allowed on the slope and sheets of lining material on the slopes will extend down slope out onto bottom a minimum of 5 FT from toe of slope.

Geomembrane liners shall be welded using either extrusion or double wedge welding equipment. Extrusion welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the extrudate. Double wedge welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the wedge. Each piece of welding equipment and each operator shall perform demonstration welds at the start of a shift, whenever equipment is switched on, if a seaming operation has been suspended for more than 1/2 hour or if a breakdown of the seaming equipment occurs, and at other times at the discretion of the CQA Inspector. These demonstration welds shall be tested using field test equipment, and at a minimum exhibit strength equivalent to a film tear bond.

Geomembrane liners shall be welded continuously without fishmouths or breaks in the weld. Where fishmouths are unavoidable, the geomembrane sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle. The two edges of the slit shall be welded together provided that the overlap for this weld shall be a minimum of 6 inches. Areas of the slit that do not achieve an overlap of 6 inches, including the terminus of the slit, shall be provided with a patch.

Any necessary repairs to the geomembrane will be made with the lining material itself, using approved fusion welding systems, equipment and techniques. The patch size will be 6 inches larger in all directions than the area to be patched. All corners of the patch will be rounded. Torn or permanently twisted geomembrane shall be replaced at no expense to the County.

All seams and seals of the geomembrane will be tightly bonded on completion of the work. Any lining surface showing injury due to scuffing or penetration by foreign objects or showing distress will be replaced or repaired as directed by the CQA Inspector.

Cleanup within the work area will be an ongoing responsibility of the Contractor. Particular care will be taken to insure that no trash, tools, and other unwanted materials are trapped beneath the lining. Care will be taken to insure that all scraps of lining material are removed from the work area prior to completion of the installation.

5.2.4 Field Quality Control

Inspection and testing will involve the full time observation of the installation of the geomembrane, including the making and testing of lining seams and patches and periodic measurement of the liner material thickness to insure compliance.

Test welds will be made to verify that adequate conditions exist for field seaming to proceed. Each seamer and seaming equipment will produce a test seam at the beginning of each shift to determine the peel and tensile strength of the seam. The CQA Inspector may require a sample field seam be made at any time during seaming production to verify equipment/operator performance and seam integrity. In addition, if a seaming operation has been suspended for more than 1/2 hour or if a breakdown of the seaming equipment occurs, a test seam will be produced prior to resumption of seaming operations.

The trial weld sample must be a minimum of three feet long and one and a half feet wide, with the seam centered lengthwise. The CQA Inspector must observe all trial welding operations, quantitatively test each trial weld for peel and shear, and record the results. A minimum of two peel and two shear tests will be performed per trial seam. The trial weld shall be completed under the same conditions for which the panels will be welded. The trail weld must meet the requirements for peel and shear as stated in the following paragraph and the break must be a film tear bond (FTB) for a wedge weld.

During the field seaming operation, destructive samples will be removed from field seams by the Installer at locations selected by the CQA Inspector. Repairs to the field seams will be made in accordance with repair procedures specified in this CQA Plan. The samples will have a width of 12 inches plus the seam width and length of 48 inches. A minimum of one stratified sample per 500 feet of field seam will be made. All field seams will have a film tear bond in peel and shear and will meet the minimum pound per inch width seam strength specified in the specification Section 02775, HDPE Geomembrane Liner Systems. At the very least, the seam peel strength must be greater than or equal to 90 ppi. The bonded shear strength for fusion and extrusion welds must be greater than or equal to 120 ppi and 115 ppi, respectively. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam when necessary. The archived material will be kept at the CQA laboratory. Field testing shall include at least two peel tests per sample. CQA laboratory testing shall consist of five shear tests and five peel tests per sample. The Installer shall test the seam destructively at a frequency of one test per 500 linear feet of weld and shall test 10 percent of all repaired areas. Destructive seam-testing locations shall be cap-stripped and the cap completely seamed by extrusion welding to the geomembrane. Capped sections shall be non-destructively tested. Additional destructive test samples may be taken if deemed necessary by the CQA Inspector.

All field-tested specimens from a destructive-test location must be passing in both shear and peel for the seam to be considered as passing. The CQA laboratory testing must confirm these field results. The CQA testing laboratory will save all test samples including specimens tested until notified by the CQA Engineer relative to their disposal. All specimens which have failed under test will be shipped immediately by express delivery to the CQA Inspector for determination of corrective measures to be taken, which includes retest or repair of failed section.

For destructive samples which have failed the passing criterion, the Installer will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Installer may patch or cap strip the seam between the passed samples. If either fails, the Installer will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.

The Installer shall test all patch welds using one of the following nondestructive tests: vacuum tests, or spark tests. The Installer shall also test patch welds destructively at a frequency of 10 percent or one test per welding personnel per day. This destructive testing may be accomplished using demonstration welds performed adjacent to the liner installation.

In the event capping of a field seam is required, the Installer will use a cover strip of the same thickness as the lining (and from the same roll, if available) and a minimum of 6 inch overlap away from the seam in all direction. It will be positioned over the center of the field seam and welded to the lining using a fillet weld each side.

All geomembrane sheets, seams, anchors, seals, and repairs will be visually inspected by the Installer for defects. Depending on seam welding equipment used, all seams and repairs will be tested continuously by a vacuum testing device, air pressure, or spark tests.

A visual inspection of the lining sheets, seams, anchors and seals will be made by the Installer as the installation progresses and again on completion of the installation. Defective and questionable areas will be clearly marked and repaired. Final approval of repairs will be given by the CQA Inspector.

If the fillet weld, extrusion lap weld or single hot-wedge fusion lap weld is used to weld seams, the Installer will further test all seams and repairs in the geomembrane by vacuum box. All vacuum box testing will be done in the presence of the CQA Inspector. The area to be tested will be cleaned of all dust, debris, dirt and other foreign matter. A soap solution will be applied to the test area with a paint roller and the vacuum of 5 psi air pressure will be induced and held at least fifteen seconds to mark for repair any suspicious areas as evidenced by bubbles in the soap solution.

If the double hot-wedge is used, the Installer will further test all seams in the geomembrane by using the air pressure test which consists of inserting a needle with gauge in the air space between welds. Air will be pumped into space to 25 psi and held for 5 minutes. If pressure does not drop more than 2 psi, then the seam is acceptable.

All costs of retesting of the geomembrane including reruns of field weld tests and all repairs will be at the Installer's expense.

The Installer shall assemble the quality control data required above into a final report of geomembrane installation. The report will contain all test data and a final layout of geomembrane liner which shows the location of all seams, patches and sample locations. In addition, the Installer shall submit resin tests, tests of sheet material, factory seam tests, daily seam test results, and daily results of production seam testing.

The Contractor will retain responsibility for the integrity of the geomembrane system until acceptance by the CQA Engineer. The geomembrane will be accepted by the CQA Engineer when:

- Written certification letters including as built record drawings, have been received by the CQA Engineer.
- Installation is completed.
- Documentation of completed installation, including all reports, is received and approved.
- Verification of adequacy of field seams and repairs, including associated testing, is complete.

Acceptance of the completed work will include receipt of all submittals and all work completed to the satisfaction of the CQA Engineer.

5.2.5 Geosynthetics Manufacturer's Warranty

The Geosynthetics Manufacturer's warranty shall be against manufacturing defects or workmanship and against deterioration due to ozone, ultraviolet or other normal weather aging. The warranty shall be limited to replacement of material only, and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals or unusual acts of God. The warranty shall state that the furnished material meets all requirements of specification Sectio 02775 and the Contract Documents, is free from manufacturing defects and is able to withstand normal weathering for a period of five years, prorated. Written warranties addressing the HDPE geomembrane material shall be furnished by the contractor and shall be made to Sarasota County.

5.2.6 Installer's Warranty

The Installer shall furnish a written guarantee that the entire lining work constructed by him to be free of defects in material and workmanship and installed pursuant to the CQA Plan for a period of two (2) years following the date of acceptance of the work by the CQA Engineer. During the 23rd month, a pre-guarantee expiration inspection will be conducted to identify any necessary repair work covered by the guarantee. The Installer shall agree to make any repairs or replacements made necessary by defects in materials or workmanship in the Work which become evident within said guarantee period. The Installer shall make repairs and/or replacements promptly, the Owner may do so, and the Installer shall be liable to the Owner for the cost of such repairs and/or replacements. The Installer's warranty shall state that the materials were properly installed, properly welded, seamed and jointed and will not fail within 2 years of installation under similar conditions. The warranty shall provide for complete repair/replacement for the warranty period. Written warranties addressing the HDPE geomembrane material shall be furnished by the contractor and shall be made to Sarasota County.

SECTION 6.0
GEOTEXTILE

The following section outlines the CQA required for the installation of geotextiles. Non-woven cushion, drainage, and woven separator geotextiles will be used to protect the geomembrane and segregate the leachate collection system and protective cover materials.

6.1 PRE-CONSTRUCTION

6.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the following:

- Manufacturer's description (cut sheet) of the proposed geotextiles documenting it will meet or exceed specified requirements.
- Available historical data documenting that the proposed cushion geotextile will meet specified interface residual strength.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geotextiles.

Before shipment of the geotextile, the CQA organization shall review all pre-construction submittals.

The CQA Inspector will take conformance samples for testing in accordance with this CQA Plan and the specification Section 02778, Geotextiles.

Table 6- 1
Manufacturer's Quality Control Testing for Geotextiles

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Non-Woven Cushion Geotextile	Mass Per Unit Area (oz/sy)	ASTM D5261	One per 90,000 ft^2
	UV Degradation, % retained @ 500 hrs	ASTM 4355	1 per formulation
	Grab Tensile Strength (lbs) [1]	ASTM D4632	One per 90,000 ft^2
	Grab Elongation (%) [1]	ASTM D4632	One per 90,000 ft^2
	Puncture Resistance (1bs)	ASTM D4833	One per 90,000 ft^2
	Trapezoidal Tear	ASTM D4533	One per 90,000 ft^2
Non-Woven Drainage Geotextile	Mass Per Unit Area	ASTM D5261	One per 90,000 ft^2
	Grab Tensile Strength (lbs)	ASTM D4632	One per 90,000 ft^2
	Puncture Strength	ASTM D4833	One per 90,000 ft^2
	AOS, US sieve (mm)	ASTM D4751	One per 540,000 ft^2

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
	Permittivity, (sec^{-1})	ASTM D4491	One per 540,000 ft^2
	Flow Rate, gpm/ft^2	ASTM D4491	One per 540,000 ft^2
	UV Degradation, % retained @ 500 hrs	ASTM 4355	1 per formulation
Woven Separator Geotextile	Water Flow Rate (gpm/sf)	ASTM D4491	One per 90,000 ft^2
	Ultraviolet Degradation, % retained @ 500 HRS	ASTM D4355	1 per formulation
	Permittivity, SEC-1	ASTM D4491	One per 540,000 ft^2
	Trapezoidal Tear, (lbs)	ASTM D4533	One per 90,000 ft^2
	Grab Tensile, (lbs)	ASTM D4632	One per 90,000 ft^2
	Elongation, %	ASTM D4632	One per 90,000 ft^2
	AOS, U.S. Sieve (max ARV)	ASTM D4751	One per 540,000 ft^2
	Puncture, LBS	ASTM D4833	One per 90,000 ft^2

6.1.2 CQA Conformance Testing

The CQA Organization may obtain geotextile conformance test samples of each type of material manufactured for the project. Samples will be obtained across the entire roll width and will be 3 feet long. Samplers will mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. Each sample will be sent to the CQA Laboratory for conformance testing. The CQA Inspector will review test results and report any nonconformance to the CQA Engineer.

The following conformance tests will be performed on the geotextile:

Table 6- 2
CQA Conformance Testing for Geotextiles

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD
Geotextile	Puncture Resistance (1bs)	ASTM D4833
	Water Flow Rate (gpm/sf)	ASTM D4491
	AOS	ASTM D4751
	Tear Strength	ASTM D4533
	Mass per Unit Area $(oz/ft)^2$	ASTM D5261

6.2 CONSTRUCTION

6.2.1 Delivery, Storage and Handling

During delivery of geotextiles the CQA Inspector will monitor for the following:

- Equipment used to unload the rolls will not damage the geotextile.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by specification Section 02778, Geotextiles has been received.
- Each roll is marked or tagged with manufacturer's name, project identification, lot number, roll number, roll dimensions, and that this information is documented on a geosynthetic receipt form.
- Materials are stored in a location that is protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Damaged rolls may be rejected. If rejected, verify that rejected material is removed from the site or stored at a location separate from accepted rolls. Geotextile rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

6.2.2 Geotextile Subsurface Preparation

Before geotextile installation, the CQA Inspector will document that the geomembrane installation is complete and CQC and CQA documentation verifies that its installation meets specified requirements.

6.2.3 Geotextile Placement and Seaming

During geotextile placement and seaming operations, the CQA Inspector will monitor for the following:

- All defects and defect corrective actions are recorded (panel rejected, patch installed, etc.), and corrective actions are performed in accordance with specification Section 02778, Geotextiles.
- Equipment used to install the geotextile does not damage it during deployment.
- Crews working on the geotextile do not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile.
- The geotextile is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and seamed in accordance with specification Section 02778, Geotextiles.
- The geotextile is not exposed to direct sunlight for more than the 14 days in accordance with technical specification Section 02778, Geotextiles.
- Final geotextile surface is free of harmful foreign objects.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan conditions.

6.2.4 Geotextile Repairs

Where repairs are necessary the CQA Inspector will monitor for the following:

- Place a patch of the same type of geotextile which extends a minimum of 24 inches beyond the edge of the damage or defect.
- Fasten patches continuously using a sewn seam or other approved method.

- Align machine direction of the patch with the machine direction of the geotextile being repaired.
- Replace geotextile which cannot be repaired.

SECTION 7.0
GEOCOMPOSITE

The leak detection layer and leachate collection layer will be composed of a double-sided geocomposite.

7.1 PRECONSTRUCTION

All HDPE drainage composite shall be manufactured in accordance with specification Section 02777, Drainage Composite. The drainage composite manufacturer will provide the Contractor and the CQA Inspector with a written certification, signed by a responsible party, that the drainage composites actually delivered have properties which meet or exceed the guaranteed properties. The CQA Inspector will examine all manufacturer's certifications to ensure that the property values listed on the certifications meet or exceed the project specifications. Any deviations will be reported to the CQA Engineer.

7.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the CQA organization with the following items for review and testing:

- Manufacturer's description (cut sheet) of the proposed geocomposites documenting that it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geocomposites will meet specified interface residual strength.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geocomposites.

Before shipment of the geocomposite, the CQA organization will review pre-construction submittals.

Table 7- 1
Manufacturer's Quality Control Testing for Geonet

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geonet	Specific Gravity/Density (g/cm3) (min)	ASTM D 1505	One per 100,000 ft^2 and every resin lot
	Mass per Unit Area (lbs/ft2)	ASTM D 5261	One per 50,000 ft^2 and every resin lot
	Carbon Black Content (% Minimum)	ASTM D 1603	One per 50,000 ft^2 and every resin lot
	Tensile Strength	ASTM D 5035	One per 50,000 ft^2 and every resin lot
	Transmissivity at 500 psf (m2/sec)	ASTM D 4716	One per 50,000 ft^2 and every resin lot

7.1.2 CQA Conformance Testing

The CQA Organization may obtain geocomposite conformance test samples of each type of material manufactured for the project. Samples will be obtained across the entire roll width and will be 3 feet long. Samplers will mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. Each sample will be sent to the CQA Laboratory for conformance testing in accordance with the project specifications (Section 02778, Part 2). The CQA Inspector will review all test results and report any non-conformance to the CQA Engineer.

The following conformance tests will be performed on the geocomposite:

Table 7- 2
CQA Conformance Testing for Geocomposite

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD
Geocomposite	Transmissivity (m^2/s)	ASTM D4716
	Ply Adhesion	ASTM F904
	Thickness	ASTM D5199

NOTE: Geotextiles shall be tested in accordance with Table 6.1 and 6.2.

7.2 CONSTRUCTION

The following subsection describes the CQA inspection activities that are necessary during the geocomposite installation. Refer to the specification Section 02777, Drainage Composite, for project specific construction and test requirements.

The CQA Inspector shall observe the geocomposite placement to confirm that specifications Section 02777 is followed, including coverage of all specified areas and adequate material overlap or seaming

7.2.1 Delivery, Storage and Handling

During delivery of geocomposite the CQA Inspector will observe rolls for the following, and any deviation will be reported to the CQA Engineer.:

- Equipment used to unload the rolls does not damage the material.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by specification Section 02777, Drainage Composite has been received.
- The drainage composite manufacturer has identified all rolls of drainage composite in accordance with specification Section 02777, Drainage Composite.

Drainage composite cleanliness is essential to its performance; therefore, the shipping and storage or drainage composite must be in strict accordance with specification Section 02777, Drainage Composite. The CQA Inspector will verify the following and report any deviations to the CQA Engineer.

- Materials are stored in a location that will protect the rolls from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.
- Drainage composites are free of dirt and dust just before installation. If the drainage composites are judged dirty or dusty, they will be washed by the drainage composite installer prior to installation. Washing operations will be observed by the CQA Inspector and improper washing operations will be reported to the CQA Engineer.
- When several layers of drainage composite are stacked, care is taken to ensure that stacked drainage composites are placed in the same direction. A stacked drainage composite will never be laid in a perpendicular direction to the underlying drainage composite (unless otherwise specified by the CQA Engineer.)

Damaged rolls may be rejected. If rejected, it must be verified that rejected material is removed from the site or stored at a location separate from accepted rolls. Geocomposite rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

7.2.2 Geocomposite Subsurface Preparation

Before geocomposite installation, the CQA Inspector will observe for the following:

- Lines and grades for the composite liner subgrade have been verified by the Contractor.
- Geomembrane installation is complete.

7.2.3 Geocomposite Placement and Seaming

During deployment and seaming operations, the CQA Inspector will observe for the following:

- All defects and defect corrective actions (panel rejected, patch installed, etc.) are recorded, and corrective actions are performed in accordance with the specifications.
- Equipment used to install geotextile does not damage it during deployment.
- Crews working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite.
- The geocomposite is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and connected in accordance with pecificationSection 02777, Drainage Composite.
- The geotextile component is not exposed to direct sunlight for more than the number of days recommended by the manufacturer.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

7.2.4 Geocomposite Repairs

Repair any holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 FT beyond the edges of the holes or tear. Use approved fasteners, spaced every 6 IN around the patch to fasten the patch to the original roll.7.2.5 Placement of Soil Materials

All soil materials places over the drainage composite will be placed in accordance with specification Section 02777, Drainage Composite, so as to ensure the following:

- The drainage composite and underlying geomembrane are not damaged.
- Minimal slippage of the drainage composite on the underlying geomembrane occurs.
- No excess tensile stresses occur in the drainage composite.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

SECTION 8.0
HIGH DENSITY POLYETHYLENE PIPE, MANHOLES AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

8.1 PRECONSTRUCTION

All HDPE manholes, pipe, and fittings shall be produced in accordance with specification Section 15067, Pipe - Polyethylene.

8.1.1 Manufacturer's Quality Control

8.1.1.1 Prior to Shipment

Prior to shipment, the Contractor will provide the CQA Engineer and the CQA Inspector with a quality control certification for each lot/batch of HDPE material provided. The quality control certificate will be signed by a responsible party employed by the Manufacturer, such as the production manager. The quality control certificate will include:

- lot/batch number and identification; and
- sampling procedures and results of quality control tests.

The CQA Inspector will verify that the quality control certificates have been provided at the specified frequency for all lots/batches of pipe and that each certificate identifies the pipe lot/batch related to it; and review the quality control certificates and verify that the certified properties meet the requirements of specification Section 15067.

8.1.1.2 Prior to Installation

Prior to the installation of HDPE manholes or pipes, the Manufacturer will provide to the Contractor and the CQA Inspector the following:

- a properties sheet including, at a minimum, all specified properties, measured using test methods indicated in specification Section 15067;
- a list of quantities and descriptions of materials other than the base resin which comprise the pipe;
- the sampling procedure and results of testing; and
- a certification by the manufacturer that values given in the properties sheet are minimum values and are guaranteed by the Manufacturer.

The CQA Inspector will review these documents and verify that:

- the property values certified by the Manufacturer meet all requirements of specification Section 15067; and
- the measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.
- report any discrepancies with the above requirements to the CQA Engineer.

SECTION 9.0
PUMPS AND VALVES

This section describes CQA procedures for leachate pumps and valves. Leachate pumps and valves will be installed in the lift station to pump and direct leachate to the leachate storage tanks. In addition, pumps and valves will be used in the leachate recirculation system.

9.1 PRECONSTRUCTION

9.1.1 Manufacturer's Quality Control

Prior to the installation of the pumps or valves, the Manufacturer will provide to the Contractor and the CQA Inspector the following:

- Manufacturer's description (cut sheet) including, at a minimum, all specified properties, measured using test methods indicated in the project technical specifications.
- A list of quantities and descriptions of materials which comprise the pumps and valves.
- The testing results.
- Certification by the Manufacturer that values given in the properties sheet are minimum values and are guaranteed by the Manufacturer.

The CQA Inspector will review these documents and verify that:

- Property values certified by the Manufacturer meet all of the project technical specifications.
- Measurements of properties by the Manufacturer are properly documented and the test methods used are acceptable.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any discrepancies with the above requirements.

9.1.2 CQA Conformance Testing

The CQA Inspector will conduct field testing of the system to verify that the pumps and valves are installed correctly and operating within the design criteria in specification Section 15100, Valves – Basic Requirements, and Section 15101, Gate Valves. The CQA Inspector will inform the CQA Engineer and Contractor if any leaks are detected or the system fails to operate as designed.

9.2 CONSTRUCTION

9.2.1 Nondestructive Testing of Joints

All non-perforated HDPE joints must be nondestructively tested. These pipe joints will be tested using the pressure test as provided in the project technical specifications. Other nondestructive test methods may be used only when:

- The Geomembrane Installer can prove its effectiveness.
- The method is approved by the HDPE pipe manufacturer.

- The method is approved by the CQA Engineer.

The CQA Engineer and the CQA Inspector will verify the effectiveness and validity of the alternative test method.

All leachate piping within the landfill footprint will be videotapes for blockages, belles, beans, and soil deposits. The CQA Inspector and CQA Engineer will review the videotape for deficiencies. Any deficiencies will be reported to the Contractor.

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SECTION 10.0
SURVEYING

Surveying of lines and grades is conducted on an ongoing basis during construction of the component liner and leachate collection systems. Close construction quality control (CQC) of the surveying is absolutely essential to ensure that slopes are properly constructed. The surveying conducted at the site shall be performed by the Contractor.

10.1 SURVEY CONTROL

Permanent benchmarks and baseline control points are to be established for the site at locations convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards.

10.2 SURVEYING PERSONNEL

The Contractor's survey crew will consist of a Senior Surveyor, and as many Surveying CQC Monitors as are required to satisfactorily undertake the requirements for the work. All Surveying CQC personnel will be experienced in the provision of these services, including detailed, accurate documentation.

All surveying will be performed under the direct supervision of a Registered Professional Engineer (PE) or Licensed Land Surveyor (PLS) licensed in the state in which the project is located. The Licensed Land Surveyor may be the Senior Surveyor.

10.3 PRECISION AND ACCURACY

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01 foot and with a setting accuracy of 20 seconds. (5.6×10^{-3} degrees).

10.4 LINES AND GRADES

The following surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include (as deemed appropriate by the CQA Engineer and CQA Inspector):

- One or more construction baselines.
- The edges of all surface breaks (ex. toes, crests, ridges and valleys).
- Surface of the subgrade.
- All structures.
- Surface of the soil liner component.
- Surface of the leachate collection layer (protective cover).
- Invert elevation of and location of leachate collection/header at each lateral intersection and endpoint, and every 50 feet between the intersections and endpoints.

- Force main piping and gravity main piping.
- Inverts of sumps and manholes.
- Top/toe of all berms, roads, and channels.
- Location of edge of liner, anchor trenches tie-in seam to adjacent existing liner system (as applicable).
- Major patches of HDPE liner.

Laser planes are highly recommended for achieving the correct lines and grades during construction of each surface.

10.5 FREQUENCY AND SPACING

All surveying will be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks during construction, as determined by the Senior Surveyor, CQA Inspector, or CQA Engineer, may be necessary to assist the Contractor in complying with the required grades.

The following spacings and locations will be provided by the CQC surveyor, as a minimum, for survey points:

- Surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than 100 feet.
- On slopes greater than 10 percent, a square grid not wider than 100 feet will be used, but, in any case, a line of survey points at the crest, midpoint, and toe of the slope will be taken.
- A line of survey points no farther than 100 feet apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope).
- A line of survey points not farther than 50 feet apart will be taken for all piping used for leachate collection/detection lines, in particular, at the lateral intersection and line end points.
- At a minimum, a line of survey points no farther than 50 feet apart will be taken for all cleanout risers.
- At a minimum, every 100 feet along the perimeter of the primary and secondary liner system.
- At a minimum, a line of survey points no farther than 50 feet apart will be taken for all piping used for the leachate collection/detection lines.

10.6 THICKNESS MEASUREMENTS

The CQC surveyor as a representative of the Contractor shall obtain elevations of the subgrade at a maximum 100-foot grid points and at all grade break lines prior to placement of the geosynthetic clay liner. The procedure for obtaining elevations of the subgrade shall be agreed to by the CQA Inspector and CQA Engineer prior to construction. The CQC Surveyor shall review the survey information with the Contractor to ensure that the survey demonstrates compliance with the Project Plans and Specifications. The Contractor is responsible for identifying and reporting to the CQA Inspector any areas of non-compliance evidenced by the survey, and for repairing such areas. The CQA Inspector and

Contractor shall review the elevation measurements of the subgrade prior to placement of the geosynthetic clay liner.

10.7 TOLERANCES

Except for liner components where no minus tolerances are acceptable, the following are maximum tolerances for survey points:

- On surfaces, the maximum tolerances shall be 0.1 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation.
- On piping for leachate collection/detection lines, the maximum tolerance shall be 0.02 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation.
- On cleanout risers, the tolerance shall be 0.1 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation.

10.8 DOCUMENTATION

All field survey notes will be retained by the Senior Surveyor. The results from the field surveys will be documented on a set of survey record (as-built) drawings by the Contractor for submittal to the CQA Inspector. The Contractor shall certify to the CQA Inspector and CQA Engineer that the results of the survey demonstrates compliance with the Contract Documents. Sealed surveys depicting the information gathered in Paragraph 10.5 shall be supplied to the CQA Engineer and CQA Inspector in sufficient quantities. The surveys shall depict the information in a topographic format and illustrate actual data points. For thickness verification a table shall be compiled by the CQC surveyor or contractor containing the following information for each point.

- Proposed subgrade elevation.
- Actual subgrade elevation.
- Subgrade deviation.
- Proposed final elevation.
- Actual final elevation.
- Thickness.
- Elevation deviation.

Any deviations in elevation or thickness outside the tolerances allowed by specification shall be corrected.

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SECTION 11.0
REPORTING REQUIREMENTS AND DOCUMENTATION

11.1 PROJECT MEETINGS

Conducting periodic project meetings is the responsibility of the Design Engineer who will make physical arrangements for meetings, record minutes and distribute copies to participants and those affected by decisions make at meetings. At a minimum the following meetings will be held.

- Pre-construction CQA meeting
- Problems or Work deficiency meetings

11.1.1 Preconstruction CQA Meeting

This meeting shall be attended by the Owner, Design Engineer, CQA Engineer, CQA Inspector, and Contractor. The topics should include but are not limited to:

- Providing each organization with all relevant CQA documents and supporting information.
- Familiarizing each organization with the site-specific CQA Plan and its role relative to the design criteria.
- Determining any changes to the CQA Plan that are needed to ensure that the facility will be constructed to meet or exceed the specified design.
- Reviewing the responsibilities of each organization.
- Reviewing lines of authority and communication for each organization.
- Discussing the established procedures or protocol for observations and tests including sampling strategies.
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and retesting.
- Reviewing methods for documenting and reporting inspection data.
- Reviewing methods for distributing and storing documents and reports.
- Reviewing work area security and safety protocol.
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events.
- Conducting a site walk-around to review construction material and inspection equipment storage locations.

The meeting shall be documented by a designated person, and minutes should be transmitted to all parties.

11.1.2 Weekly Progress Meetings

A progress meeting shall be held weekly at the work area at a time determined at the pre-construction meeting. At a minimum, the meeting should be attended by the CQA Engineer, CQA Inspector, Contractor and the Owner.

The purpose of the meeting is to:

- Review the previous week's activities and accomplishments.
- Review status of progress schedule.
- Review the work location and activities for the week.
- Identify the contractor's personnel and equipment assignments for the week.
- Discuss any potential construction problems.

This meeting shall be documented by the CQA Engineer.

11.1.3 Problem or Work Deficiency Meetings

A special meeting shall be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting shall be attended by the Design Engineer, Owner, Contractor, CQA Engineer, and CQA Inspector. The purpose of the meeting is to define and resolve a problem or recurring work deficiency in the following manner:

- Define and discuss the problem or deficiency.
- Review alternative solutions.
- Implement a plan to resolve the problem or deficiency.

The meeting shall be documented by the CQA Engineer and transmitted to the Owner, Contractor, CQA Inspector and Design Engineer, if applicable.

11.2 DOCUMENTATION

Documentation is an essential element of the CQA Plan. The following documentation and record keeping of inspection activities will be required.

11.2.1 Daily Summary Report

A summary report shall be prepared daily by the CQA Inspector. This report will provide the chronologic framework for identifying and recording all other reports. At a minimum, the summary reports shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Date, project name, location, and other identification.
- Data on weather conditions.
- Reports on any meetings held and their results.
- Unit processes, and locations, of construction under way during the timeframe of the daily summary report.
- Equipment and personnel being worked in each unit process, including subcontractors.
- Descriptions of areas or units of work being inspected and documented.
- Description of off-site materials received, including any quality verification (vendor certification) documentation.

- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration.
- Decisions made regarding approval of units of material or of work (blocks), and/or corrective actions to be taken in instances of substandard quality.
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item.
- Supporting inspection data sheets.
- Signature of the CQA Inspector.

11.2.2 Inspection Data Sheets and Photographs

All observations, and field and/or laboratory tests, shall be recorded on an inspection data sheet. Required data to be addressed for most of the standardized test methods are included in the pertinent ASTM Standards.

At a minimum, the inspection data sheets shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Description or title of the inspection activity.
- Location of the inspection activity or location from which the same increment was obtained.
- Type of inspection activity; procedure used (reference to standard method when appropriate).
- Recorded observation or test data, with all necessary calculations.
- Results of the inspection activity; comparison with specification requirements.
- Personnel involved in the inspection activity.
- Signature of the appropriate inspection personnel and concurrence by the CQA Engineer.

Items above may be formulated into site-specific checklists and data sheets so that details are not overlooked.

Photographic supporting data sheets also may prove useful. Such data sheets could be cross-referenced or appended to inspection data sheets and/or problem identification and corrective measures reports. At a minimum, photographic reporting data sheets should include the following information:

- A unique identifying number on data sheets and photographs for cross-referencing and document control.
- The date, time, and location where the photograph was taken and weather conditions.
- The size, scale, and orientation of the subject matter photographed.
- Location and description of the work.
- The purpose of the photograph.
- Signature of the photographer and concurrence of the CQA Engineer.

These photographs will serve as a pictorial record of work progress, problems, and corrective measures. They should be kept in a permanent protective file in the order in which they were taken.

11.2.3 Problem Identification and Corrective Measures Reports

A problem is defined herein as material or workmanship that does not meet the specified design. Problem identification and corrective measures reports shall be cross-referenced to specific inspection data sheets where the problem was identified. At a minimum, they shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Detailed description of the problem.
- Location of the problem.
- Probable cause.
- How and when the problem was located (reference to inspection data sheets).
- Estimation of how long problem has existed.
- Suggested corrective measure.
- Documentation of correction (reference to inspection data sheets).
- Final results.
- Suggested methods to prevent similar problems.
- Signature of the appropriate CQA inspection personnel and concurrence by the CQA Engineer.

Copies of the report shall be sent to the Design Engineer and the Owner for their comments and acceptance. These reports should not be submitted to the FDEP at that time unless they have been specifically requested. However, a summary of all data sheets and reports will be submitted to the FDEP upon completion of construction.

11.2.4 Acceptance of Completed Components

All daily inspection summary reports, inspection data sheets, and problem identification and corrective measures reports, shall be reviewed by the CQA Engineer.

11.2.5 Final Documentation

At the completion of the project, the Owner will submit a final construction certification report to the FDEP. This report will include all of the daily inspection summary reports, inspection data sheets, problem identification and corrective measures reports, photographic supporting data, acceptance reports, deviations from design and material specifications (with justifying documentation), and record drawings. This document shall be certified correct by the CQA Engineer and included as part of the CQA Plan documentation.

PART B

SECTION 01040
COORDINATION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Coordination of all Work associated with construction/installation in the landfill closure area generally related to:
   1. Earthwork.
   2. Liner System.
   3. Leachate Management System.
   4. Soil Erosion/Sedimentation and Stormwater Control Features as shown in the Drawings.
   5. Piping installation.
   6. Pipe fusion.
   7. Roads and crossings.
   8. Landfill Gas System installation.

B. Definitions:
   1. Owner: The Owner is Sarasota County, Florida, who owns and/or is responsible for the facility.
   2. Project Manager: The Project Manager is an official representative of the Owner.
   3. Engineer: The Engineer is responsible for the engineering design, drawings, plans, Contract Documents, and Project Specifications. The Engineer is HDR Engineering, Inc. Sarasota, FL.
   4. Contractor: The Contractor is responsible for all site work and Construction Quality Control (CQC) under the contract.
   5. Geosynthetics Manufacturer: The Geosynthetic(s) (e.g., geomembrane, geotextile, etc.) Manufacturer(s) is(are) responsible for the production, quality control, certification of properties, and installation guidelines of the geosynthetic component(s).
   6. Geosynthetics Installer: The Geosynthetics Installer(s) is(are) responsible for field handling, storing, placing, seaming, protection (against sun, wind, etc.), and other aspects of the geosynthetics installations. The Installer may also be responsible for transportation of these materials to the site.
   7. Construction Quality Assurance (CQA): CQA is defined as a planned system of activities employed by the Owner to assure that the facility is constructed in conformance with the Contract Drawings and Project Specifications. CQA is performed by the CQA Consultant and includes overview of the CQC activities of the Contractor, performing CQA testing, and preparation of a certification report incorporating both CQC and CQA data. The CQA program will be in accordance with the CQA Plan prepared for this project.
   8. Construction Quality Assurance Consultant: The CQA Consultant is a party, independent from the Owner, that is responsible for implementing the CQA Plan. The CQA Consultant's activities include observing the CQC Program, CQA testing, and documenting activities related to the CQC/CQA programs. The CQA Consultant is responsible for issuing a Construction Certification Report, sealed by a Professional Engineer registered in the state of Florida.
   9. Geosynthetics Construction Quality Assurance Laboratory: The Geosynthetics CQA Laboratory is a party, independent from the Owner, that is responsible for conducting tests on samples of geosynthetics used in the final and temporary cover systems.
   10. Soils Construction Quality Assurance Laboratory: The Soils CQA Laboratory is a party, independent from the Owner, that is responsible for conducting tests in the laboratory on samples of soil taken from the borrow source, stockpile, or site.

11. Construction Quality Control (CQC): CQC is defined as a planned system of activities employed by the Contractor to assure that the facility is constructed in conformance with the Contract Drawings and Project Specifications. CQC is performed by the CQC Consultant and includes performing CQC testing of facility components, assembly of manufacturer's product certifications, and monitoring of system construction techniques. The CQC program will be in accordance with the requirements of the Project Specifications.
12. Construction Quality Control Consultant: The CQC Consultant is a party, independent from the Contractor, that is responsible for the CQC program. The term CQC Consultant shall be used to designate the Engineer in charge of the quality control work. The personnel of the CQC Consultant also include Quality Control Monitors who are also located at the site for construction observation and monitoring. The CQC Consultant is responsible for the timely conveyance of CQC testing results to the CQA Consultant.
13. Geosynthetics Construction Quality Control Laboratory: The Geosynthetics CQC Laboratory is a party, independent from the Contractor, that is responsible for conducting tests on samples of geosynthetics used in the final and temporary cover systems.
14. Soils Construction Quality Control Laboratory: The Soils CQC Laboratory is a party, independent from the Contractor, that is responsible for conducting geotechnical tests on conformance samples of soils used in the final and temporary cover systems.

1.2 DESCRIPTION

A. Coordinate scheduling, submittals, and work of the various Sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating the sequencing of work, by others, in accordance with the Completion Time.

B. Coordinate the work with other Contractor's at the Central County Solid Waste Disposal Complex to avoid disruption of project schedules.

C. Coordinate the work with the CQC Consultant and CQA Consultant to avoid interruption of the CQC/CQA Programs.

1.3 MEETINGS

A. In addition to progress meetings specified in Section 01060, Special Conditions, hold coordination meetings and conferences with personnel and subcontractors to assure coordination of Work.

1.4 COORDINATION OF SUBMITTALS

A. Schedule and coordinate submittals specified in Section 01340.

B. Coordinate work of various Sections having interdependent responsibilities for completion, connecting to, and placing in service.

1.5 TESTING LABORATORY SERVICES

A. The Contractor is to provide the services of a Geosynthetic CQC Laboratory and a Soils CQC Laboratory to perform inspections, tests, and other services defined in these Project Specifications. CQA will be provided by the Owner at their expense. Refer to the CQA Plan for definition of the lines of communication.

B. CQC reports will be submitted in accordance with the Project Specifications to the CQA Consultant. They should provide observations, results of testing, and indicate compliance or non-compliance with specified standards and with Contract Documents.

C. Contractor's responsibilities:
   1. Deliver to CQA Consultant adequate samples of materials proposed to be used which require testing.
   2. Cooperate with CQA laboratory personnel, and provide access to work.

3. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.
4. Notify Engineer and CQA Consultant 24 hours prior to expected time for operations requiring inspection and testing services.
5. Coordinate and conduct all necessary surveys for location of both CQC and CQA field tests.

1.6 FIELD ENGINEERING

A. Verify locations of survey control points and interface points prior to starting Work. Promptly notify Engineer of any discrepancies encountered.

1.7 LIMITS OF CONSTRUCTION

A. Unless otherwise approved by the Owner, the Contractor shall restrict his operations to within the area defined by "Limits of Construction," "Contract Limits," etc. as noted on the Drawings.

1.8 SCHEDULING AND COORDINATION PERFORMED BY EACH CONTRACTOR

A. Contract Schedule. Within 15 days after award of contract, Contractor shall submit to Engineer three (3) copies of a Project Schedule. This Schedule shall be resource loaded and shall address construction tasks within allotted Contract Time. Schedule shall be of Critical Path Type and include an analysis of critical resources. A general guide for preparing such schedule is contained in "The Use of CPM in Construction, a Manual for Contractors," published by the AGC of America. Account for schedule of Subcontractors. Provide for proper sequence of construction considering various crafts, purchasing time, shop drawing submittal and approval, material delivery, equipment fabrication, and similar time-consuming factors. Show on schedule, as a minimum, notice to proceed, earliest starting, earliest completion, latest starting, latest completion, free float for each task, and total float for each task. The schedule shall include the full duration of the Contract as specified in the Contract Documents and Construction Contract Time for Performance. Contractor is to re-evaluate schedule monthly and submit with pay application to reflect true job progress and realistic projections. When schedule revision is required, submit a draft revised schedule to justify the changes with appropriate backup and state reason for revision request.

B. The accepted schedule shall include activities encompassing the entire Contract Time. If the Contractor's accepted schedule shows Float between the construction end date and the Contract end date, then the Float shall belong to the Project. Extensions of Contract Time shall be considered per General Provisions 7.10 and 7.14 only after utilizing all available schedule Float.

C. If the Contractor does not take necessary action to accomplish Work according to Approved Project Schedule, he may be directed by Owner to improve work progress. Such directive may require increased work forces, equipment, shifts, or other action as necessary, but will not be considered as a basis for a claim against the Owner for additional compensation or time. Should the Contractor refuse or neglect to take such action authorized, under provisions of this Contract, Owner may take necessary actions including, but not necessarily limited to, withholding of payment, temporary suspension of Work, and termination of Contract.

D. Exceeding the Approved Project Schedule, for any critical path item under the contractors control is grounds for termination.

E. Schedule of Anticipated Payment. Within 10 days of Approved Project Schedule receipt, each Contractor shall submit to Engineer an estimated monthly payment schedule for the project duration. Include a graph with a cumulative curve to show estimated value of work complete and stored materials less specified retainage overtime. During the course of work, update whenever variation is expected to be more than plus or minus 10 percent. Retain original or previous composite curves as dashed curves on all updates. Include a heavy plotted curve to show ACTUAL payment curve on all updates.

F. Within 10 days after award of Contract, submit for approval a critical path type schedule. Account for schedule of Subcontracts. Include proper sequence of construction, various crafts, purchasing time, Shop Drawing approval, material delivery, equipment fabrication, startup, demonstration, and similar time consuming factors. Show on schedule as a minimum, earliest starting, earliest completion, latest starting, latest finish, and free and total float for each task or item.

1.9 COMPLETION AND CONSTRUCTION SCHEDULES

A. Refer to Page BF-1 and Supplemental Conditions for construction durations and completion requirements.

B. Refer to Section 01700 – Contract Closeout for submittals required for Substantial Completion and Final Completion.

1.10 LIQUIDATED DAMAGES

A. Refer to Page BF-1 and Supplemental Conditions for liquidated damages.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01050
SURVEY

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall perform, or obtain other professional subcontractors to complete topographic surveys that meet the minimum standards of Chapter 61-G17 of the Florida Administrative Code, to document elevations, grades, locations, maintain survey control during construction, and perform related field engineering as specified in the Contract Documents.

B. The Contractor shall provide civil, structural, or other professional engineering services specified or required to execute the Contractor's construction methods as determined by the Contractor.

C. The Engineer shall provide to the Contractor all available surveys, monuments, and control information, collectively referred to as reference points, available for the Contractor's use for construction stakeout, provide construction controls, and to provide record drawings (as-builts) of the Work.

1.2 SURVEY REFERENCE POINTS

A. The Contractor shall locate reference points prior to starting the Work, and shall protect and preserve all permanent and temporary reference points during construction. The Owner shall provide control elevations and coordinates for the reference points to be used by the Contractor.
   1. The Contractor shall make no changes or relocate any reference point without prior written notice to the Owner and Engineer.
   2. The Contractor shall report to the Owner and Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations. The Contractor shall notify the Owner and/or the Florida State Geodetic Advisor (if applicable) of any changes to the reference point under their jurisdiction as directed in the Drawings.
   3. The Contractor, at no additional cost to the Owner, shall replace and resurvey reference points that have been lost or destroyed. The replaced reference point shall be surveyed by a Florida licensed and registered, professional land surveyor. Replacement will be based on original survey control.

B. Prior to any work, the Contractor shall immediately notify the Engineer of any discrepancies with the reference points from the coordinates and elevations provided.

C. The shall establish, as necessary, any additional temporary survey control reference points, in locations determined by the Contractor, to complete the Work. The Contractor shall be responsible for establishing and maintaining the Contractor's temporary survey control reference points during the entire duration of the Work. The Contractor's reference points shall not impede or impact the Owner's operations of the Facility.

1.3 RECORD SURVEY DRAWINGS

A. Survey record documents, submitted to the Engineer for progress review do not require the signature of a professional land surveyor; however, a final record drawing set shall be signed and sealed by a professional land surveyor registered in the State of Florida.

B. Submitted survey record documents for progress review shall include the following:
   1. As stages of the Work are completed, submit a site survey. The record drawing information shall be submitted on 22-inch by 34-inch sheets, as well as AutoCAD drawing files in AutoDesk Civil 3D 2008 (preferred) or Land Development Desktop format on CD-ROM.

2. AutoCAD drawing file requirements: Contour lines shall be continuous, unbroken polylines with a width of zero and an elevation (z-coordinate) assigned according to the elevation of the contour line. All spot elevations shall have horizontal controls with vertical z-coordinates. Contours shall be at 1 foot intervals, with index contours at every fifth interval. Objects in the drawing shall be drawn to scale.
3. All survey information submitted shall be on the State Coordinate System based on the monuments provided by the Owner.
4. All submitted record drawings shall have the control benchmarks and monuments shown on the drawings for the purposes of orientation, both horizontally and vertically.
5. If multiple sheets are required, each sheet shall include match lines. North arrows, drawings scale, and other site features are to be included.

1.4 SUBMITTALS

A. The Contractor shall submit the name and address of the surveyor to the Engineer.

B. Contractor shall submit documentation signed by a surveyor registered in the State of Florida, certifying that elevations and locations of improvements are in conformance with the Contract Documents, or if not in conformance, certifying variances from the Contract Documents.

C. Owner provided control points, permanent monuments, and reference points will be shown on all submitted surveys and electronic files.

D. The Contractor shall provide and submit to the Engineer for approval, a signed and sealed drawing, representing the horizontal and vertical limits, as follows

E. Preconstruction Survey – Prior to performing any earthwork, a preconstruction survey of the site must be provided to the Engineer for review. The preconstruction survey shall include:
1. Survey of the existing conditions within the limits of construction of the Phase I Closure and approved Borrow Areas.
2. Note all above grade structures, piping, and features including those features which may or will be impacted by the work including aboveground structures, such as wellheads, that will require extensions as a result of final cover installation and shall include the areal extent of existing sod that must be removed in order to enable the closure work to proceed.
3. Survey shall also include existing soil depth verifications as required in the specifications.
4. The preconstruction survey will be used as the baseline for determining soil fill quantities and payment of those items for the project.
5. The Preconstruction Survey will be compared to the Intermediate Cover Design to determine the areas requiring cut, fill and/or grading.
6. The preconstruction survey shall include proposed location of header pipe, lateral pipe, vertical wells, remote wellheads, access points, valve pits, sumps, Phase I overlay liner tie-in, anchor trench locations, downchutes, and existing leachate pump stations LCP-1 through LCP-5.

F. Intermediate Cover / LFG System Survey – An intermediate Cover / LFG system survey of the site must be provided to the Engineer for review. The intermediate Cover / LFG system survey shall include:
1. Following completion of the Preconstruction Survey and upon completion of the intermediate cover grading the Contractor shall submit an intermediate cover survey to the Engineer for review before construction of the landfill gas header and lateral pipes, vertical wells, remote wellheads, access points, valve pits, and sump in order to verify location, slope and grade of proposed locations. The Contractor will provide survey locations of the landfill gas header and lateral pipes, vertical wells, remote wellheads, access points, valve pits, and sump on the Intermediate cover survey when complete.
2. Survey will also include the first 24-inch soil cover layer (located beneath geosynthetic components) which is part of the Phase I/II Overlay Liner System located on the west slope of Phase I.

3. When complete and prior to geosynthetic installation, the Contractor will perform, certify and submit an intermediate cover / LFG system survey to demonstrate that intermediate cover is to design elevation and design thickness, overlay liner soil cover is to design elevation and thickness, and LFG system is installed to the required slopes and locations.

G. Geomembrane / Geocomposite Survey – The geomembrane / geocomposite survey shall include:
   1. Upon installation of the geosynthetic materials for the project, the Contractor shall survey the limits of liner for the final cover and Phase I/II Overlay Liner System and submit to the Engineer for approval.
   2. The limits of liner will be compared to the design limits shown in the Contract Drawings. Limits of liner are defined as the point at which the liner enters an anchor trench or is welded to an existing bottom liner.

H. Final Cover Survey – Following completion of intermediate cover grading and submittal/approval of the Intermediate Cover / LFG System and the Geomembrane / Geocomposite Surveys. The final cover survey shall include:
   1. Contractor will begin installation of the protective cover, stormwater downchute piping, vegetative cover components of the final cover system, and the drainage sand layer of the Phase I/II Overlay Liner System.
   2. The top of final cover (i.e. top of soil layer) will be surveyed when complete, but before sod is placed, to determine if the elevations are constructed to design elevation for the final cover.
   3. The drainage sand layer for the Phase I/II Overlay Liner System will also be surveyed when complete to determine if the design thickness is achieved.
   4. This survey will be used to compare to the Intermediate Cover Survey to determine quantity of final cover soil and drainage sand layer of the Phase I/II Overlay Liner System.

I. Final Survey – The final survey shall include:
   1. All features of the project installed as part of the construction project and all existing features within the limits of construction.
   2. The final survey will include, but is not limited to, the final cover grades, stormwater structures, piping, ditches, gas collection system components, roadways, limits of liner, underground piping and utilities, and all other features related to the Phase I closure project.

J. Record Drawings and Surveys – The Contractor shall, throughout the project, maintain a redline set of construction drawings noting deviations or actual installed conditions for the Phase I Closure. As part of Final Completion the Contractor must submit a complete set of final Record Drawings based on the red lines maintained throughout the project which identify the actual constructed conditions. These record drawings shall use the construction drawings as a base and show changes by cloud and strikethrough in electronic format. The record drawings shall incorporate the surveys listed above and any other changes made to the components into the set so to create a single Record Drawing Set for the project.

K. Substantial Completion cannot be granted until a draft set of Record Drawings in both hardcopy and AutoCADD electronic file formats are submitted to the Owner and Engineer for review.

L. Final Completion cannot be granted until the certified Record Drawings signed and sealed by a Florida licensed professional engineer or land surveyor and AutoCADD electronic files for the Record Drawings are submitted to and approved by the Owner and Engineer. The Record Drawings are critical to the Owner and must be accurate to receive approval by FDEP for operation of the facility.

M. Partial Surveys of Work – It is understood that the Contractor may elect to construct the Phase I Closure in sections and survey each section separately. Partial surveys must be submitted to the Engineer to determine that the section the contactor is requesting to continue working in meets the design requirements. The Contractor may not continue work until the partial survey is approved by the Engineer. Partial surveys are not required to be signed and sealed at the time of submittal, however, the partial surveys used to compile the complete survey for each survey listed above, must not deviate from the partial surveys previously submitted and approved. One complete overall and comprehensive survey of the Work must be certified for submittal and approval by the Owner and Engineer.

N. It is understood that during completion of the Work, the Contractor and Surveyor are working together and that all survey information submitted to the Engineer for approval has also been reviewed and approved by the Contractor as being representative of the work in accordance with the contract documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SURVEYING

A. The Contractor shall be responsible for the preservation of all benchmarks, reference points, stakes, and marks. If any benchmarks, reference points, stakes, or marks are disturbed by the Contractor, the Contractor shall not proceed with any Work until he has established such points, marks, lines, and elevations as may be necessary to complete the Work.

The accuracy of any method of staking shall be the responsibility of the Contractor. All professional services, as appropriate, for establishing vertical and horizontal control for the Work shall be the responsibility of the Contractor.

B. All topographic surveys shall meet the minimum standards of Chapter 61-G17 of the Florida Administrative Code.

C. The topographic information collected shall be taken on a 50 foot by 50 foot grid, at a minimum, one point directly above the same location on previous survey(s), as necessary to provide an accurate representation of the contour topography (i.e., spot elevations, grade breaks, ditches, mounds, etc.). For ditches and leachate or stormwater collection trenches, landfill gas piping, spot elevations shall be taken, at a minimum, every 50 linear feet, to include, at a minimum, the centerline of the ditch, the toe and top of ditch slopes, and any grade breaks.

D. The Contractor shall survey the limits of the geomembrane and place markers delineating the limits of geomembrane every 50 linear feet at the inside edge (closest to the landfill) of the anchor trench.

3.2 RECORD KEEPING

A. The surveyor shall maintain a complete, accurate log of all control and survey Work as it progresses. This log shall be available for periodic review by the Engineer.

B. Grade elevations and locations will be required at certain phases (or stages) of construction. The Contractor's Florida-registered land surveyor will provide and maintain record notes and a finished record drawing at the completion of each phase as listed in Paragraph 1.04 of this Section. Each phase must be accepted by the Engineer in writing before the start of the next phase. Record Drawings reflecting elevations and location information shall be submitted to the Engineer.

3.3 TOLERANCES

A. The survey instruments used for this Work should be sufficiently precise and accurate to meet the needs of this project. All survey instruments should be capable of reading to a precision of 0.01 foot and with a setting accuracy of 20 seconds (2.6 x 10-3 degrees). Documents and all surveys shall match the scale of contract drawings, with contours at one foot intervals.

B. On surfaces, the maximum tolerances shall be 0.1 foot. When comparing survey points for surfaces to determine conformance with design, the surveyed elevation and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.

C. On piping for downdrain lines, the maximum tolerances shall be 0.1 foot. When comparing survey points for surfaces to determine conformance with design, the surveyed elevation and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.

D. For thickness verifications, no minor tolerances are acceptable. The thicknesses indicated on the drawings are minimum thickness and cannot be less than the dimensions shown the drawings, unless otherwise indicted.

3.4 ACCEPTANCE OF WORK

A. Placement of Geomembrane shall not commence until the intermediate cover / LFG system survey has been completed and approved by the Engineer.

B. Placement of final cover and drainage sand layer shall not commence until the geomembrane / geocomposite survey has been completed and approved by the Engineer.

C. As-built surveys and red lines shall be submitted by the Contractor with each monthly pay application to document work performed. AutoCADD files in the formats specified by this section shall be submitted for review with the pay applications.

D. Three (3) draft copies of the complete Record Drawings shall be submitted for review at substantial completion. Substantial completion will not be granted until submittal of the draft Record Drawings in both hardcopy and AutoCADD electronic file format.

E. Six (6) signed and sealed certified sets of Record Drawings and AutoCADD electronic files shall be submitted for final acceptance of the project. The submittal of Record Drawings shall be a requirement for granting final completion of the project. Liquidated damages may be imposed in accordance with the Contract Documents if the certified Record Drawings are not submitted for final completion.

3.5 PARTIAL SURVEYS

A. Should sequence of construction selected by the Contractor be such that the Work is to be completed in phases (or stages) then, copies of the surveyor's official field notes for each phase (or stage) shall be submitted to the Engineer for approval. The field notes shall be signed and dated by the surveyor performing the survey. The field notes shall include the design elevation, the as-built information, and the differences in elevation. Upon completion of each layer of the liner system (i.e. all surveys as outlined in Part 1.04), a complete record drawing, reflecting the submitted field note information and meeting the requirements outlined for Record Drawings in this Section, shall be submitted to the Engineer for approval.

END OF SECTION

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SECTION 01060
SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 CONDITIONS SPECIFIC TO THIS PROJECT

A. CQC/CQA Duties: In general, the CQC Consultant will perform testing related to earthwork, pipe installation and geosynthetic materials, and will provide documentation to the CQA Consultant. The CQA Consultant will conduct separate destructive geosynthetic testing and provide geosynthetic documentation as per these documents. CQC and CQA documentation will be used by the CQA Consultant to prepare and submit final certification to FDEP. Refer to CQA Plan.

B. The Contractor is responsible for construction/maintenance of any additional access/haul roads as approved by the Owner.

C. The Contractor's as built survey shall cover all areas within the construction limits.

D. Contractor is to obtain soil fill material from the approved borrow area at the locations shown on the Drawings Stockpiling of soil fill material shall be within the limits of construction as shown on the Drawings. It is the Contractor's responsibility to coordinate operations with the Owner such that operations at the landfill are not adversely affected.

E. Construction Limits:
   1. Construction limits are depicted on the Drawings included but not limited to Phase I Closure Area and approved Borrow Areas.

F. Site Access:
   1. The only access to the site available to the Contractor is entering through the existing entrance using Knights Trail Road.

G. The Contractor's work shall be scheduled between 7:00 A.M. and 7:00 P.M. with a maximum of 10 hours per day and 6 days per week, Monday through Saturday. Should the Contractor require more work hours to maintain the contract schedule, a request shall be submitted in writing to the Engineer stating the reasons why and how many additional hours are needed. Also, the Contractor shall request in writing to the Engineer with a minimum of forty-eight (48) hours advance notice, of any plans for working on any weekend days or observed national holidays. Should the Engineer approve the request for additional hours, the Contractor shall reimburse the Owner for actual costs for resident inspection incurred during the additional hours approved. The hourly rate for these additional hours will be as provided in the contract documents.

H. Basis of Payment Survey:
   1. The Contractor shall employ a registered surveyor to survey the site prior to initiating construction and at the completion of construction. Some portions of the site will be surveyed several times to show different surfaces. Survey shall be completed in the same manner as will be employed during construction. Contractor shall review findings with Engineer and Owner. The Contractor shall provide the Engineer with sealed drawings and an AutoCAD file of each survey for review. Engineer and Owner may perform verifying survey if deemed necessary. If necessary, Owner will use findings to adjust pay items. Engineer will be sole basis for determination of adjustment.

1.2 PRECONSTRUCTION CONFERENCE

A. A preconstruction conference shall be held at the site after award of Contract. Engineer will notify the Contractor as to the date and time of the conference 2 weeks in advance of the proposed date. Contractor's Project Manager and Project Superintendent and Contractor's Subcontractor Representatives shall attend.

1.3 CONTRACTOR'S SUPERINTENDENT'S FIELD OFFICE TRAILER

A. Establish at site of Project.

B. Equipment: Telephone, telecopy, mailing address, and sanitary facilities.

C. Assure attendance at this office during the normal working day.

D. At this office, maintain complete field file of Shop Drawings, posted Contract Drawings and Specifications, and other files of field operations including provisions for maintaining "As Recorded Drawings."

E. Remove field office from site upon acceptance of the entire work by the Owner.

1.4 ENGINEER'S/CQA'S FIELD OFFICE TRAILER

A. Separate from Contractor's field office, Contractor shall provide one (1) field office trailer as described below for use of Engineer's staff and CQA Consultant's staff. This office and equipment to be purchased or leased, installed, and maintained by Contractor until completion of contract.

B. General Construction:
   1. New, or like new, mobile office trailer. Acceptability of like new office trailer to be determined solely by the Engineer.
   2. Baked enamel aluminum siding.
   3. 3-1/2 IN foil-backed fiberglass insulation throughout.
   4. Interior paneling.
   5. Vinyl tile flooring.
   6. 8 FT high acoustic tile ceiling.
   7. Two private office areas, one at each end of trailer and one reception-conference room area.
   8. Windows:
      a. Minimum two per room with one each on opposing walls.
      b. Combination screen-storm windows.
      c. Provide horizontal louver blinds on each window.
   9. Nominal 60 FT long and 12 FT wide.
   10. Two exterior doors (with cylinder deadbolt locks) with outer screens, exterior lights and exterior stairs and railings.
   11. Connect trailer to existing site utilities (telephone and power).
   12. Restroom with toilet and sink.
   13. Make necessary arrangements to connect trailer with County's potable water system.
   14. Provide temporary sanitary holding tank for wastewater discharge.

C. Electrical System:
   1. All fixtures, outlets, and wiring of Underwriters Laboratory (UL) approved devices.
   2. All circuits protected by circuit breakers; fuses are not acceptable.
   3. Electrical system shall meet requirements of the latest National Electric Code.
   4. System suitable for 220 V, 3 PH service.
   5. Any transformers or other devices required to match this supply to the mobile office shall be provided and connected.
   6. Provide a circuit breaker for the incoming service.
   7. Each interior room shall have at least four 110 V duplex electrical convenience outlets.

D. Central Combination Electric Heating, Air-Conditioning System:
   1. Fan-forced air.
   2. Thermostatically controlled.
   3. Individual room units are not acceptable.
   4. Freeze protect and insulate all piping.
   5. System sized to maintain 75 DegF constant temperature in each room.

E. Lighting System:
   1. Fluorescent type producing 100 footcandles at desk top height.
   2. Ample ceiling fixtures provided to ensure adequate lighting throughout.

F. Furnishings:
   1. Full width built-in desk at ends of both end offices, with a nominal depth of 30 IN and overhead book shelves 12 IN deep.
   2. Two desks 36 x 72 IN long with locking lap drawer.
   3. One plan table 39 x 72 x 36 IN wide, with one locking equipment drawer.
   4. Two 30 x 72 IN folding tables.
   5. One 48 x 60 IN liquid marking board with minimum four-color set of compatible markers.
   6. One 48 x 60 cork bulletin board.
   7. Two four-drawer letter size filing cabinets.
   8. Two cushioned swivel arm chairs.
   9. Twelve folding chairs.
   10. Two large size waste paper baskets.
   11. One 2.7 CF refrigerator or equal.
   12. Rain gauge.
   13. Outdoor thermometer.

G. Field Office Equipment:
   1. One copying machine.
   2. One telecopier.
   3. One three-hole punch, Master Products Series 25 or equal.
   4. One stapler, Swingline 113 or equal.
   5. Two Swingline Model 747 staplers.
   6. Two scotch tape dispensers.
   7. Four wire in and out baskets.
   8. One two-hole punch, Swingline Model 74200 or equal.
   9. One Eagle Zepher 84 date stamp.

H. Maintenance:
   1. Contractor shall provide all maintenance and upkeep of trailer and equipment. Equipment breakdowns shall be repaired promptly by Contractor.
   2. Janitorial service.
      a. Weekly:
         1) Floor sweeping using dust suppressing compound.
         2) Wet mopping with floor detergent.
      b. Inclement weather: Conduct weekly requirements on daily basis.
      c. Monthly: Wash windows and clean window blinds.
   3. Provide telephone service including four lines and two sets.
   4. Provide internet services to the trailer.
   5. Provide up to two 24-pack cases of bottled drinking water per week on an as needed basis.
   6. Pay all utilities costs.
   7. Provide pumping of wastewater holding tank on an as needed basis.
   8. Maintain at least until acceptance of the entire work by the Owner or until otherwise suspended by the Engineer.

I. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.

J. Remove field office from site upon acceptance of entire work by Owner.

1.5 DRAWINGS AND CONTRACT DOCUMENTS FOR CONTRACTOR USE

A. Refer to General Conditions.

B. Contractor shall pick up all "no-charge" documents within 10 days from date of Notice to Proceed.

C. Additional documents after "no-charge" documents will be furnished to Contractor at cost.

1.6 PROJECT PHOTOGRAPHS

A. During construction of the Work, the Contractor shall provide a photographic record of construction progress every other week to the Owner. For each submittal, electronic copy of the photos on a CD shall be sufficient. The Engineer shall reserve the right to select the views to be photographed. The photographs shall be of good quality as determined by the Engineer, and camera date stamped. Polaroid or similar instant type photographs will not be accepted, nor will video recordings. Provide each photograph with location and name of feature photographed.

B. Photographs shall be taken weekly or during the execution of individual Work items, whichever is more frequent, beginning prior the start of construction and continuing through the completion of the construction.

C. Photographs shall be taken to document each major Work item, including:
   1. Pre-construction conditions. For paved road conditions refer to Section 1.6.E;
   2. Mobilization and storage of materials;
   3. Installation of the gas extraction wells, including drilling, inspection of refuse, backfilling, installation of bentonite plug, pipe joining, well bore seal, and above ground completion;
   4. Installation of wellheads, sump, and access points;
   5. Installation of gas lateral and header piping, including pipe fusion;
   6. Connection of gas laterals to header;
   7. Tie-ins of air, forcemain, laterals, and header lines to existing LFG system;
   8. Tie-ins to existing leachate collection system (LCS);
   9. Backfilling of installed pipe;
   10. Installation of dewatering pumps;
   11. Installation of valve pits and valves;
   12. Pressure testing of LFG pipe;
   13. Borrow area excavation;
   14. Installation of intermediate cover, protective cover, final cover;
   15. Installation, connections to existing geosynthetics, and testing of geosynthetics;
   16. Existing bottom liner geosynthetics;
   17. Site cleaning and demobilization;
   18. Color aerial photos taken at each of the following:
      a. At 0 percent complete.
      b. At 2-month intervals after initial set.
      c. At 100 percent complete.

D. Photographically impose a site plan key map on each photograph in the upper right hand corner and show by arrow the subject and the direction from which the photograph was taken. Date all photographs.

E. Prior to commencing construction, Contractor is required to videotape the condition of all paved roads at the facility that will be used by his construction traffic (excluding Knights Trail Road to the scalehouse). The purpose of the videotape is to ascertain the condition of the paved roads at the facility prior to construction. The Contractor will be required to return the paved roads to like condition or better following the completion of construction. The videotape shall meet the following requirements:
   1. Videotape and audio shall be performed by a competent, professional camera operator who is fully experienced and qualified with the specified equipment.
   2. Contractor shall pay all costs associated with the videotaping.
   3. Contractor shall provide Owner with two (2) digital copies of the videotape and audio on high quality DVDs.
   4. Engineer shall review videotape prior to the commencement of construction and will have the authority to reject all or any portion of the videotape that does not adequately show the condition of the paved roads. Contractor shall redo rejected portions of videotapes.
   5. Video shall be bright, sharp, clear, have accurate colors, and shall be free from distortion or any other form of picture imperfection.

6. All recordings shall continuously display the time of day, month, day, and year of the recording.
7. Tape coverage shall be limited to one side of the road at a time and shall include all surface conditions with particular emphasis on the existence or non-existence of any faults, fractures, or defects. The tape shall be supported by appropriate audio description.
8. All recordings shall be permanently labeled and shall be properly identified by video number, Owner's name, date of taping, location of taping, and project name and number.
9. Each recording shall have a log of its contents. The log shall describe the various segments of coverage in terms of road designations, coverage beginning and end, directions of coverage, video unit counter numbers, engineering stationing when possible, and the date of the recording.
10. Recordings shall be performed during times of good visibility.
11. Recordings shall be performed from a wheeled vehicle at a rate of travel sufficient to adequately record the features of the road surface. The camera shall be firmly mounted to prevent an unsteady picture.

1.7 TESTING

A. Payment for Soil, Geosynthetics, Concrete and Other Testing:
   1. Contractor shall include the costs of all CQC testing designated as his responsibility in the specification and CQA plan within the CQC testing bid item. No other separate payment for testing will be made by Owner.
   2. Contractor shall reimburse Owner for re-testing of all CQA tests that fail.

1.8 ORDER OF CONSTRUCTION AND CONSTRUCTION SCHEDULE

A. Construction operations will be scheduled to allow the Owner uninterrupted operation of existing adjacent facilities. Coordinate connections with existing work to ensure timely completion of interfaced items.

B. The Contractor must provide the Owner and Engineer notification of commencement of the geosynthetics portion of the work at least 7 days prior to commencement of installation of geosythetics. This will allow the Owner and Engineer the time to finalize coordination of the inspection and CQA services for the geosynthetics installation.

C. The Contractor will have 90 days from commencement of installation, including any additional days awarded due to weather or other conditions requested by the Contractor and approved by the Owner and Engineer during the installation period, to complete installation of geosynthetics which requires CQA inspection and testing by the Owner. If the Contractor exceeds this interim milestone for geosynthetics installation, the Contractor will be responsible for all CQA inspection time incurred by the Owner. The Contractor will only be responsible for the cost of CQA tests which are required due to failures of material or seams as indicated in the specifications.

D. At no time shall Contractor or his employees modify operation of the existing facilities or start construction modifications without approval of the Owner except in emergency to prevent or minimize damage.

1.9 PROJECT MEETINGS

A. Construction Meetings:
   1. The Engineer will conduct construction meetings involving:
      a. Contractor's project manager.
      b. Contractor's project superintendent.
      c. Owner's designated representative(s).
      d. Engineer's designated representative(s).
      e. Contractor's subcontractors as appropriate to the work in progress.
      f. Owner's Construction Quality Control Consultant.
   2. Meetings to be conducted weekly at a minimum or more often as determined by Engineer.

3. The Engineer will take meeting minutes and submit copies of meeting minutes to participants and designated recipients identified at the Preconstruction Conference. Corrections, additions or deletions to the minutes shall be noted and addressed at the following meeting.
4. The Engineer will schedule meetings for most convenient time frame.
5. The Engineer will have available at each meeting full chronological files of all previous meeting minutes.
6. The Contractor shall have available at each meeting up-to-date record drawings.

B. Pre-Installation Conferences:
1. Coordinate and schedule with Resident Project Representative and Engineer for each material, product or system specified. Conferences to be held prior to initiating installation, but not more than two (2) weeks before scheduled initiation of installation.
   a. Conferences may be combined if installation schedule of multiple components occurs within the same two (2) week interval.
   b. Review manufacturers' recommendations and Contract Documents Specifications.
2. Contractor's Superintendent and the individual who will actually act as foreman of the installation crew (installer), if other than the Superintendent, shall attend.

1.10 SPECIAL CONSIDERATIONS

A. Contractor shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.

B. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.

C. Safety:
1. The Contractor alone shall be solely and completely responsible for conditions of the job site in connection with his work, including safety of all personas and property, preparatory to and during performance of the work. This requirement shall apply continuously and not be limited to normal working hours.
2. The Construction Documents and the construction hereby contemplated, are to be governed, at all times, by applicable provisions of local and state laws and regulations, and federal laws, including, but not limited to, the latest amendments of the following: Department of Labor, Bureau of Labor Standards Safety and Health Regulations for Construction, and Williams and Steiger Occupational Safety and Health Act of 1970, including rules and regulations pursuant thereto, applicable to the Work and performance of the Contract. (OSHA).
3. The duty of the Engineer to conduct construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.
4. No explosives are required for this project and are prohibited on Owner property.

D. Inspections by Federal and State Agencies: Authorized representative and agents of the state and federal government shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records.

E. Water:
1. Contractor is responsible for all water for completion of the Work. Water used on the project shall be fresh and of drinkable quality. The Contractor shall make arrangements to obtain fresh water for his drinking, normal use, and use in testing lines and equipment from the Owner.
2. Water for other uses such as dust control and moisture control of fill may be obtained from storm water basins as approved by the CQA Consultant. The Contractor shall obtain any required permits and permission from the Owner.

F. The Contractor shall provide sanitary facilities during construction. These facilities shall be made available for use by Owner, Engineer, CQA consultant and their representatives.

G. The Contractor shall provide telephone service during construction.

H. Order of Construction: The Contractor will schedule construction operations to allow the other contractors access to the site.

1.11 HISTORICAL AND ARCHAEOLOGICAL

A. If during the course of construction, evidence of deposits of historical or archeological interest is found, the Contractor shall cease operations affecting the find and shall notify Owner. No further disturbance of the deposits shall ensue until the Contractor has been notified by Owner that Contractor may proceed. Owner will issue a notice to proceed after appropriate authorities have surveyed the find and made a determination to Owner. Compensation to the Contractor, if any, for lost time or changes in construction resulting from the find, shall be determined in accordance with changed or extra work provisions of the Contract Documents. The site has been previously investigated and has no known history of historical or archaeological finds.

1.12 CLEANUP REQUIREMENTS

A. Cleanup operations shall be conducted daily.
   1. Contractor shall keep the work areas free at all times from accumulations of waste materials and rubbish.
   2. Volatile waste shall be properly stored in covered metal containers and removed daily.
   3. Wastes shall not be buried or burned on the site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the site and disposed of in a manner complying with local ordinances and anti-pollution laws.

B. Contractor shall make the necessary arrangements for proper off-site storage areas.

C. Contractor shall keep all equipment and materials within construction easements and protect private property from damage due to construction.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01290
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1) Procedures for measurement and payment of all Contract bid items for Construction of the Class I Landfill Phase I Closure and Landfill Gas Collection System at the Central County Solid Waste Disposal Complex (CCSWDC).

1.2 SCOPE OF WORK

A. All contract prices included in the Bid Form will be full compensation for all labor, materials, tools, equipment and incidental necessary to complete the Work as shown on the Drawings and specified in the Contract Documents to be performed under this contract.

B. Quantities provided on the Bid Form are estimated and are not guaranteed. The quantities are used solely for the purpose of comparison of Bids and determination of initial Contract Price.

C. The items listed below refer to and are the same pay items listed in the Bid Form. They constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, services, field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, water supplies, power, maintaining traffic, removal of waste, watchmen, and all other requirements of the General Conditions and Division 1 – General Requirements. Compensation for all such services, equipment and materials shall be included in the prices stipulated for the lump sum and unit pay items listed herein.

D. Each lump sum and unit bid price will be deemed to include an amount considered by the Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

E. Restoration is not a separate pay item but is considered to be an integral part of the work under the contract, and all contract bid prices include the cost of restoration necessitated by the work related to that bid item. Restoration includes existing structure and property, paving, stabilized roads, drainage piping and ditches, catch basins, head walls, yard culverts, driveways, lawns and ground areas, walkways, and irrigation systems which are altered, removed or damaged during construction. Cleanup is an integral part of restoration.

F. Removal and disposal of waste generated by the Contractor shall be included in the cost to perform the Work. No separate payment will be made to the Contractor for disposal of waste that is not part of the excavation of the landfill to construct the Work. The Contractor is notified that Sarasota County has contracted franchise haulers for the area, and the Contractor shall coordinate with the appropriate franchise hauler for the area for containers and disposal of job generated waste.

G. For purposes of measurement and payment, the term surface area is defined as the horizontal surface measured from a certified survey. The unit price bid for all items measured in surface area shall account for any necessary slope adjustments.

H. Costs associated with using the borrow area including clearing and grubbing, access road construction and maintenance, and seeding and stabilization shall be paid for in the cost of the individual line item cost for the material being excavated.

I. In several pay items below, the Contractor will be required to transport materials including soil and/or waste to the scales located at the Central County Solid Waste Disposal Complex to measure the quantity of material disposed. Vehicles used to transport these materials to the scales by the Contractor shall be capable of accessing scales with the following specifications:

1) Maximum Weight Capacity = 100,000 pounds
2) Maximum Width = 9 feet 6 inches (outside of tire to outside of tire across the truck width)
3) Maximum Width Above Tires = 10 feet 4 inches (width of guardrail approximately 6 inches from the scale deck)
4) No Height Restrictions.

The Contractor shall select either off-road or on-road vehicles that can access the scales with dimensions and specifications detailed above, coordinate with the County regarding the actual trucks proposed for the project, and confirm the suitability of the truck to be able to be weighed on the scales. A load count for basis of billing will not be accepted, only tonnages recorded through the scales for the pay items requiring tonnage across the scale for payment.

1.3 MEASUREMENT

A. All measurement shall be performed according to United States Standard units of measure and in accordance with the Contract Documents.

B. All measurements shall be based on actual units installed or neat line dimensions of work completed as stipulated by the Contract Documents.

C. Unless specified otherwise, all measurement and computations shall be based on survey completed by the Contractor per the Contract Documents.

D. Measurements of Area: Quantities shall be measured based on the surveyed surface area. Quantities shall be computed, in accordance with the unit of measure shown on the Bid Form, to either the nearest tenth of an acre, the nearest square yard or the nearest square foot. No adjustments shall be made for overlap of materials, penetrations, anchor trenches, geomembrane flaps, repairs or wasted materials. All quantities shall be measured to the lines shown on the Drawings unless otherwise specified.

E. Measurements of Volume by Survey: Quantities shall be measured based on survey taken before and after the work, unless otherwise noted by the individual measurement and payment description. Quantities shall be computed, in accordance with the unit of measure shown on the Bid Form, to either the nearest cubic foot or nearest cubic yard. The volume of prismoids shall be computed using digital terrain modeling (DTM). All quantities shall be measured to the lines and grades shown on the Drawings unless otherwise specified.

F. Measurements of Length: Quantities shall be measured based on survey length along the alignment of the feature being measured. Quantities shall be computed from the end points defined by the specification, through all elbows, tees, valves and fittings, to the nearest foot. Ditch, berm, and flume quantities shall be computed along the centerline between the end points defined by the Drawings. Vertical components of a length: for example a gas extraction well lateral vertical riser shall be included in the Contractor's unit cost for the horizontal length installed. Additional length of material for payment shall not be given for vertical components.

G. Measurement by Each: Quantities shall be measured based on each item whose installation or construction has been accepted by the Construction Manager.

H. Measurement by Lump Sum: Quantities shall be measured based on an estimated percent complete of the various components of the lump sum item established by the Contractor's Bidding Schedule and approved by the Project Representative. Progress estimates will be made by the Contractor on the day of the month established in the Preconstruction Meeting, and submitted to the Project Representative for review and approval.

1.4 PAYMENT

A. In accordance with unit prices shown on the Contractor's Bid Schedule on the Bid Form.

B. Payment for all items includes all costs for overhead and profit and for supplying all materials, labor, equipment, tools, permits and agreements, and performing all operations and any other incidentals necessary to complete the Work in accordance with the Contract Documents. Not withstanding the omission or mention of any incidental work, payment shall also constitute full compensation for all work incidental to completion of the items. Payment for bid item work also includes all costs for Division 0 and Division 1 requirements.

C. Payment for Each bid items will be in the amount of the scheduled value of each item that has been accepted by the Project Representative.

D. Payment for Lump Sum bid items will be in the amount of the scheduled value of each of the aggregate components comprising the Lump Sum item multiplied by the respective percent complete estimate.

E. Payment for any item of work for which there is no specific bid item shall be considered incidental to the construction and shall be included in the costs of other items of work involved in the project.

1.5 BID ITEMS FOR CCSWDC PHASE I CLOSURE

A. The line items below provide further description of the Work listed in the Bid Form. Some of the line items include approximate quantities as estimated by the Engineer. The Contractor understands that the quantities shown on the Bid Form under SF, SY, LF, AC, CF, and CY are approximate only and subject to increase or decrease. All unit price work shall be performed for the unit price bid regardless of actual quantities. Actual quantities will be determined upon completion of the Work. The price associated with each Lump Sum item shall be the full compensation paid for the Work described, regardless of the Engineer's or Contractor's estimated quantity. For Lump Sum items, no claim shall be made by the Contractor for deviations between the Contractor's estimated quantity and the actual quantity required to complete the Work described.

1) **BONDS, INSURANCE, AND MOBILIZATION:** This Work shall consist of securing the appropriate bonds and insurance policies for the Project, and performance of preparatory construction operations, including but not limited to, the movement of personnel and equipment to the Project site; safety equipment; furnishing and installing at the beginning of the project as well as removing and disposing at the conclusion of the project, project sign(s) as required by the Contract Documents; and other facilities to begin work on a substantial phase of the Contract. Payment for this item will be made on a Lump Sum basis, wherein no measurement will be made. The Lump Sum price proposed shall be full compensation for performing the Work specified and the furnishing of all materials, labor, tools, equipment, and incidentals necessary to mobilize and subsequently demobilize. The amount of this item shall be limited to a **maximum** of **four percent (4%)** of the Total Proposal price. Twenty-five percent (25%) of the lump sum price for this item will be withheld from payment until the final invoice to ensure proper demobilization.

2) **CONSTRUCTION QUALITY CONTROL (CQC), COMPLETE:** This Work shall consist of all soils and material testing work required by the Contract Documents. This Work includes, but is not limited to, the testing of borrow soil, soil fill, structural fill, aggregate materials, landfill gas piping, soil depth verifications, flexible membrane liners, geocomposite drainage layers, geotextiles, and concrete as defined in the Specifications and CQA Plan. The lump sum price shall be full compensation for performing the testing work required. Payment for this item shall be made on a lump sum basis, wherein no measurement will be made. Payments for this lump sum item will be made based on the value of materials furnished or services and work completed using estimates provided by Contractor and approved by the Owner's representative.

3) **SURVEYING AND CONTROL, COMPLETE:** This Work shall consist of all surveying and control work required by the Contract Documents for the Phase I Closure portion of the Work. Surveying shall be performed as described in Section 8.0 of the CQA Plan and the technical specifications. This Work includes establishment of appropriate local site benchmarks, baseline surveys, sampling tube locations, soil depth verifications, borrow area and stockpile layout. location of utilities, stakeout of elevation and positional information required to complete the construction, progress payment surveys, and obtaining all survey information required to compile Record (As-Built) Drawings as required by the Contract Documents. As-built drawings must be signed and sealed by a surveyor licensed in the State of Florida. This item also includes photography as outlined in Section 01060. The lump sum price proposed shall be full compensation for performing the surveying work required. Payment for this item shall be made on a lump sum basis, wherein no measurement will be made. Payments for this lump sum item will be made based on the following schedule. Full payment for each milestone will be made upon full completion of the item including submittal and approval by the Owner and Engineer of certified and complete surveys and record drawings. Surveys shall only be submitted by Contractor after previous surveys have been approved by Engineer.

a.	Preconstruction Survey	20%
b.	Intermediate Cover / LFG System Survey	40%
c.	Geomembrane / Geocomposite Survey	50%
d.	Final Cover Survey	60%
e.	Final Survey	80%
f.	Record Drawings and As-Built Surveys	100%

The following defines complete documents for the surveys notated above:

g. Preconstruction Survey – The preconstruction survey shall include a survey of the existing conditions within the limits of construction of the Phase I Closure and approved Borrow Areas. The survey shall note all above grade structures, piping, and features including those features which may or will be impacted by the work including aboveground structures, such as wellheads, that will require extensions as a result of final cover installation and shall include the areal extent of existing sod that must be removed in order to enable the closure work to proceed. The survey shall also include existing soil depth verifications as required in the specifications. The preconstruction survey will be used as the baseline for determining soil fill quantities and payment of those items for the project. The Preconstruction Survey will be compared to the Intermediate Cover Design to determine the areas requiring cut, fill and/or grading. The preconstruction survey shall include proposed location of header pipe, lateral pipe, vertical wells, remote wellheads, access points, valve pits, sumps, Phase I bottom liner tie-in and anchor trench location, downchutes, and existing leachate pump stations LCP-1 through LCP-5.

h. Intermediate Cover / LFG System Survey – Following completion of the Preconstruction Survey and upon completion of the intermediate cover grading the Contractor shall submit an intermediate cover survey to the Engineer for review before construction of the landfill gas header and lateral pipes, vertical wells, remote wellheads, access points, valve pits, and sump in order to verify location, slope and grade of proposed locations. The Contractor will provide survey locations of the landfill gas header and lateral pipes, vertical wells, remote wellheads, access points, valve pits, and sump on the Intermediate cover survey when complete. The Contractor will compare the Preconstruction Survey to the Intermediate Cover Design and grade the existing cover to the intermediate cover design grades. This survey will also include the first 24-inch soil cover layer (located beneath geosynthetic components) which is part of the Phase I/II Overlay Liner System located on the west slope of Phase I. When complete and prior to geosynthetic installation, the Contractor will perform, certify and submit a final intermediate cover / LFG system survey to demonstrate that intermediate cover is to design elevation and design thickness, overlay liner soil cover is to design elevation and thickness, and LFG system is installed to the required slopes and locations. This survey must be submitted and approved prior to installation of geosynthetics. Payment for intermediate grading will be based on this survey and thickness verifications.

i. Geomembrane / Geocomposite Survey – Upon installation of the geosynthetic materials for the project, the Contractor shall survey the limits of liner for the final cover and Phase I/II Overlay Liner System and submit to the Engineer for approval. The limits of liner will be compared to the design limits shown in the Contract Drawings. Limits of liner are defined as the point at which the liner enters an anchor trench or is welded to an existing bottom liner. Payment for the geomembrane / geosynthetic survey will be based on this survey.

j. Final Cover Survey – Following completion of intermediate cover grading and submittal/approval of the Intermediate Cover / LFG System and the Geomembrane / Geocomposite Surveys, the Contractor will begin installation of the protective cover, stormwater downchute piping, vegetative cover components of the final cover system and the drainage sand layer of the Phase I/II Overlay Liner System. The top of final cover (i.e. top of soil layer) will be surveyed when complete, but before sod is placed, to determine if the elevations are constructed to design elevation for the final cover. The drainage sand layer for the Phase I/II Overlay Liner System will also be surveyed when complete to determine if the design thickness is achieved. This survey will be used to compare to the Intermediate Cover Survey to determine quantity and payment of final cover soil and drainage sand layer of the Phase I/II Overlay Liner System.

k. Final Survey – The final survey will include all features of the project installed as part of the construction project and all existing features within the limits of construction. The final survey will include, but is not limited to, the final cover grades, stormwater structures, piping, ditches, gas collection system components, roadways, limits of liner, underground piping and utilities, and all other features related to the Phase I closure project.

l. Record Drawings and Surveys – The Contractor shall, throughout the project, maintain a redline set of construction drawings noting deviations or actual installed conditions for the Phase I Closure. As part of Final Completion the Contractor must submit a complete set of final Record Drawings based on the red lines maintained throughout the project which identify the actual constructed conditions. These record drawings shall use the construction drawings as a base and show changes by cloud and strikethrough in electronic format. The record drawings shall incorporate the surveys listed above and any other changes made to the components of the gas collection system into the set so to create a single Record Drawing Set for the project. A draft Record Drawing set, in both hardcopy and AutoCADD format in accordance with the specifications, must be submitted to the Owner and Engineer for review in order to grant Substantial Completion. Final Completion cannot be granted until the certified Record Drawings (hardcopy and AutoCADD format in accordance with the specifications) signed and sealed by a Florida licensed professional engineer or land surveyor is submitted to and approved by the Owner and Engineer. The Record Drawings are critical to the Owner and must be accurate to receive approval by FDEP for operation of the facility.

m. Partial Surveys of Work – It is understood that the Contractor may elect to construct the Phase I Closure in sections and survey each section separately. Partial surveys must be submitted to the Engineer to determine that the section the contactor is requesting to continue working in meets the design requirements. The Contractor may not continue work until the partial survey is approved. Partial surveys are not required to be signed and sealed at the time of submittal, however, the partial surveys used to compile the complete survey for each survey listed above, must not deviate from the partial survey submitted and the complete survey must be certified for submittal/approval. Payment for surveys will not be made until the complete, certified survey is submitted and approved. However, partial surveys may be used for payment of work items such as soil and piping upon review, agreement, and approval by the Owner, Engineer, CQA Inspector and Owner's Representative.

4) **FIELD OFFICE TRAILER, COMPLETE:** This Work shall consist of furnishing all necessary materials, equipment, labor, and appurtenances necessary to provide one (1) field office trailer for Engineer and CQA Consultant as specified in Section 01060 of the Contract Documents. This office shall be maintained by the Contractor during the Work. They shall be connected to on-site utilities including electricity, water, internet, and phone. Contractor shall remove the trailer from the site at the completion of the project and restore the area to pre-construction conditions. Payment for this item will be made on per day basis provided to the project starting from the day the trailer is fully operational to the day the trailer is no longer required for the project and the Owner and Engineer have vacated the trailer. The Owner and Engineer shall provide the Contractor with 10 working days notice of intent to vacate the trailer if the date is different than the date of final completion.

5) **SEDIMENTATION AND EROSION CONTROL, COMPLETE:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances required for sedimentation and erosion control at the site as required by the Contract Documents, applicable laws and regulations, and standards of practice. This Work includes but is not limited to furnishing, installing, and maintaining: silt fence, temporary or intermediate seeding and mulching, temporary stormwater channels and diversions, ditch blocks, sediment traps, turbidity curtains, and temporary construction entrances for the entire area of work including the Phase I Closure, stockpile areas, and borrow areas. This Work also includes removal of sediment from roads, stormwater channels, and stormwater ponds resulting from Contractor's Work and depositing it at the active face of the Phase II landfill. The lump sum price proposed shall be full compensation for performing sedimentation and erosion control work required. Payment for this bid item will be on a lump sum basis, wherein no measurement will be made. Payments for this lump sum item will be made

based on the value of materials furnished or services and work completed using estimates provided by Contractor and approved by Owner's representative.

6) **LOCATE EXISTING PHASE I ANCHOR TRENCH:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to locate the existing Phase I 60-MIL HDPE liner anchor trench at the toe of the Phase I landfill. Work shall include the excavation of soil and waste, and cleaning the exposed existing liner for fusing the proposed final cover liner system at locations as shown on the Contract Drawings and in accordance with the Contract Drawings and Technical Specifications. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view.

7) **REMOVING EXISTING SOD:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to remove the existing sod from the existing intermediate cover to obtain a suitable base for fill placement or geosynthetics installation. This item shall include stripping, loading, hauling, weighing at scalehouse (if material contains Class I waste) and unloading/dumping at Phase II working face if the material contains Class I waste, stockpiled adjacent to the Phase I/II landfill or at the Phase II working face (if material does not contain Class I waste), or as directed by the Owner. Separate payment will not be made for the soil quantity to bring the intermediate cover back to preconstruction survey elevation. Therefore, this bid item shall also include the soil required to bring the intermediate cover back to preconstruction survey elevations following sod removal. This shall include excavation, loading, hauling, placement and compaction of soil and preparation of surfaces. Separate payment shall not be made for soil replaced after sod removal to bring the soil cover to preconstruction elevations and cost for this material shall be included in the unit cost for this bid item. Payment will be made on a unit price basis per acre basis wherein measurement will be made based on the areas designated by the Owner and Engineer requiring sod removal on the Preconstruction Survey. Payment will be made only for areas pre-approved by Engineer for sod removal.

8) **INTERMEDIATE COVER, CUT TO FILL:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to cut excess intermediate cover soil from the existing intermediate cover and place in areas requiring fill to bring the existing intermediate cover to design grades as shown in the Drawings and as specified in the Contract Documents. This item shall also include use of other borrow materials provided by the Owner within the limits of the Phase I Closure for use by the Contractor. If there is intermediate cover soil in excess of what is required in fill areas or if the excess intermediate cover soil is considered unsuitable for reuse by Engineer or CQA Consultant due to the existence of waste or other materials, the excess or unsuitable soil shall be transported to the working face of the landfill and shall be paid under the bid item REMOVAL OF UNSUITABLE SOILS. Sequence and staging of Work is to be determined by the Contractor. This item shall include grading, excavation, loading, hauling, unloading/dumping of the material within the closure area, placement, spreading, compaction, and finish grading to achieve design grades. Payment will be made on a unit price basis per cubic yard wherein measurement will be made by comparing the Preconstruction Survey and Intermediate Cover / LFG System Survey to determine the quantity of cut to fill required.

9) **INTERMEDIATE COVER, FILL:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to provide intermediate cover soil from the permitted borrow area located adjacent to the site as shown on the Contract Drawings and place it in the Work. Contractor shall regrade existing intermediate cover within the closure area to achieve design grades before importing soil from the borrow area (see bid item INTERMEDIATE COVER, CUT TO FILL). This soil shall be used to establish the design intermediate cover grades as shown on the Contract

Drawings, construct the Access Road on the south slope of the Phase I area, install the soil for the TPO anchor trenches, as well as install the first 24" cover soil layer within the Phase I/II Overlay Liner area. Contractor shall only remove soil from locations within the borrow area as shown on the Contract Drawings. Contractor shall at all times be familiar with the conditions of the mining permit and shall abide by all requirements of the permit including excavating the borrow area only to permitted grades. Contractor shall be responsible for clearing, dewatering borrow area and disposing of drainage in an approved manner as well as maintaining haul roads from the borrow area to the Site while working in the borrow area. Contractor shall make all efforts to avoid excavation of unsuitable soils that do not meet the project specifications. This item shall include grading, excavation, loading, hauling, unloading/dumping of the material within the closure area, placement, spreading, compaction, and finish grading to achieve design grades. This item also includes the soil backfill required for the anchor trenches for the TPO Exposed geomembrane cover including excavation, loading, hauling, unloading/dumping, placement, compaction and finish grading in accordance with the earthwork specifications for the TPO anchor trench installation. Payment will be made on a unit price basis per cubic yard wherein measurement will be made by comparing the Preconstruction Survey and Intermediate Cover Survey to determine the quantity of fill required to complete the work. The anchor trench soil quantity installed will be measured based on surveyed length of each type of anchor trench installed and the design cross-section of each anchor trench type.

10) **REMOVAL OF UNSUITABLE SOIL:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to remove unsuitable existing intermediate cover soils from the closure area. The Contractor will be required to weigh the unsuitable soil at the scales near the entrance to the landfill using highway legal trucks and pay a processing fee of $10.08 per ton. The Contractor will be required to set up a pre-paid account at the landfill for payment purposes. Engineer and CQA Consultant shall determine the suitability of soils for use as intermediate cover. Unsuitable soils will be disposed at the active face of the Phase II landfill. Unsuitable soil hauled to the closure area by the Contractor from the borrow area, as determined by the Owner and Engineer, will be returned to the borrow area by the Contractor at no additional cost to the Owner. This item shall include excavation, loading, hauling to the scales at the entrance of the facility, processing fees, hauling from the scales to the active face, and unloading/dumping of the material at the active face. Payment will be made on a unit price basis per ton wherein measurement will be made by the tonnage disposed as measured at the scales.

11) **DISPOSAL OF EXCAVATED WASTE:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to remove municipal solid waste from the closure area and dispose of the waste at the active face of the Phase II landfill. Waste generated by the Contractor during the execution of the contract shall not be included within this bid item. Waste excavation may be required where overfill has occurred within the landfill, during drilling of gas wells, during access road grading, and/or during the excavation of trenches for piping or geosynthetic anchors. Engineer or CQA Consultant shall determine if soils excavated may be reused within the project or must be removed under this bid item due to contamination by waste. The Contractor will be required to weigh the waste at the scales near the entrance to the landfill using vehicles acceptable for use on paved roads and on the facility's truck scales and pay a processing fee of $10.08 per ton. The Contractor will be required to set up a prepaid account at the landfill for payment purposes. This item shall include loading waste excavated from the project, hauling to the scales at the entrance of the facility, processing fees, hauling from the scales to the active face, and unloading/dumping of the material at the active face. Payment will be made on a unit price basis per ton wherein measurement will be made by the tonnage disposed as measured at the scales.

12) **FINAL COVER, FILL:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to provide final cover soil including both protective cover and vegetative cover from the permitted borrow area located adjacent to the site as shown on the Contract Drawings and place it in the Work. This soil shall be used to establish the design final cover grades. This soil shall also be used to construct roadbeds, berms, and other structures shown on the Drawings. Contractor shall only remove soil from locations within the borrow area as shown on the Contract Drawings. Contractor shall at all times be familiar with the conditions of the mining permit and shall abide by all requirements of the permit including excavating the borrow area only to permitted grades. Contractor shall be responsible for clearing and dewatering borrow area and disposing of drainage in an approved manner as well as maintaining haul roads from the borrow area to the Site while working in the borrow area. Contractor shall make all efforts to avoid excavation of unsuitable soils that do not meet the project specifications. This bid item shall also include all Work required to restore the borrow area to conditions equal to, or better than, what existed prior to soil removal, as determined by the Owner. This item shall include grading, excavation, loading, hauling, unloading/dumping of the material within the closure area, placement, spreading, compaction, and finish grading to achieve design grades. Payment will be made on a unit price basis per cubic yard wherein measurement will be made by comparing the Intermediate Cover Survey and Final Cover Survey to determine the quantity of fill required to complete the work.

13) **DRAINAGE SAND LAYER - OVERLAY LINER:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to provide drainage sand layer for the Phase I/II Overlay Liner System including identification and testing of sources, hauling to the site, and forming rain gutters, where shown on the Contract Drawings and in accordance with the Technical Specifications and CQA Plan. The Contractor shall locate the source of material for this line item off the landfill property and the unit price shall include all transportation costs, borrow area permitting fees, material testing, and other incidentals related to this item. No payment will be made for drainage sand layer placed outside of the construction baseline shown on the Contract Drawings or where testing has indicated that the installed material does not meet the specified requirements or required depth without prior approval of the Engineer. Payment will be made on a unit price basis per square yard wherein measurement will be made in plan view from the Final Cover Survey of the plan view area of drainage sand installed.

14) **INTERMEDIATE COVER FINE GRADING FOR LINER PLACEMENT:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to complete preparation of the surface of the intermediate cover within the limits of liner for placement of the geomembrane liner system in accordance with the Specifications and as shown in the Contract Drawings. This Work includes, but is not limited to, fine grading, verification of surface competency, proof rolling as required to demonstrate competency for geomembrane liner placement, removal of unsuitable particles or debris in accordance with the specifications, and acceptance of subgrade by geomembrane installer and Owner. Payment will be made on a unit price basis per square yards wherein measurement will be made in plan view from the geomembrane/geocomposite survey.

15) **40-MIL TEXTURED LLDPE GEOMEMBRANE LINER:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to complete the installation of the textured LLDPE geomembrane where shown on the Contract Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, furnishing specified materials and documentation associated with manufacture of the materials, delivery, stockpiling, inventory, deployment, CQC testing, placement, protection , cleaning, patching, tie-ins with existing Work, boots and connections required for liner penetrations, stormwater flaps, anchor trenches, and seaming of geomembrane components. No payment will be made for LLDPE geomembrane placed

outside of the construction baseline shown on the Contract Drawings or where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square feet wherein measurement will be made in plan view within the limits of liner from the geomembrane/geocomposite survey. The measured quantity shall not include material in the anchor trenches, overlaps, wastage or other required material to complete the installation.

16) **60-MIL TEXTURED HDPE GEOMEMBRANE LINER:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to complete the installation of the textured HDPE geomembrane within the Phase I/II Overlay Liner area where shown on the Contract Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, furnishing specified materials and documentation associated with manufacture of the materials, delivery, stockpiling, inventory, deployment, CQC testing, placement, protection , cleaning, patching, tie-ins with existing Work, boots and connections required for liner penetrations, stormwater flaps, anchor trenches, and seaming of geomembrane components. No payment will be made for HDPE geomembrane placed outside of the construction baseline shown on the Drawings or where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square feet wherein measurement will be made in plan view within the limits of liner from the geomembrane/geocomposite survey. The measured quantity shall not include material in the anchor trenches, overlaps, wastage or other required material to complete the installation.

17) **GEOCOMPOSITE DRAINAGE LAYER – FINAL COVER:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the geocomposite drainage layer above the 40-mil LLDPE geomembrane components of the liner system where shown on the Contract Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, delivery, stockpiling, inventory, deployment, cleaning, securing, protecting, placing, seaming, repairing, tie-ins with existing Work, boots and connections required for liner penetrations, anchor trenches, and testing of the geocomposite layer. No payment will be made for geocomposite drainage layer placed outside of the construction baseline shown on the Contract Drawings or where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square foot wherein measurement will be made in plan view within the limits of liner from the geomembrane/geocomposite survey. The measured quantity shall not include material in the anchor trenches, overlaps, wastage or other required material to complete the installation.

18) **GEOCOMPOSITE DRAINAGE LAYER – OVERLAY LINER SYSTEM:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the geocomposite drainage layer above the 60-mil HDPE geomembrane components of the Phase I/II Overlay Liner System where shown on the Contract Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, delivery, stockpiling, inventory, deployment, cleaning, securing, protecting, placing, seaming, repairing, tie-ins with existing Work, boots and connections required for liner penetrations, anchor trenches, and testing of the geocomposite layer. No payment will be made for geocomposite drainage layer placed outside of the construction baseline shown on the Contract Drawings or where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square foot wherein measurement will be made in plan view within the limits of liner from the geomembrane/geocomposite survey. The measured quantity shall not include material in the anchor trenches, overlaps, wastage or other required material to complete the installation.

19) **60-MIL THERMOPLASTIC POLYOLEFIN (TPO) EXPOSED GEOMEMBRANE COVER LINER:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to complete the installation of the TPO Liner where shown on the Contract Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, furnishing specified materials and documentation associated with manufacture of the materials, delivery, stockpiling, inventory, deployment, CQC testing, placement, protection, cleaning, patching, tie-ins with existing Work, boots, test panels, and connections required for liner penetrations, stormwater flaps, stormwater structure connections, piping penetrations and connections, anchor trench excavation, anchor trench geotextile, emergency vents, gas vent well boots, and seaming of TPO and other components as shown on the drawings for TPO installation and provided in the specifications. In the event waste is removed during excavation of the TPO anchor trenches, the quantity of waste hauled and disposed will be paid from Pay Item 11 – Disposal of Excavated Waste. No payment will be made for TPO liner placed outside of the construction baseline shown on the Contract Drawings or where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square feet wherein measurement will be made in plan view within the limits of liner from the geomembrane/geocomposite survey. The measured quantity shall not include material in the anchor trenches, overlaps, wastage or other required materials or fittings to complete the installation of the TPO as described above. The cost for these items shall be included in the unit price.

20) **DRAINAGE GEOTEXTILE FILTER:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the drainage geotextile for the drainage flaps located at the face of the slope near the top of the landfill, near the terrace stormwater bench, at the toe of the landfill, under stone layers, and at other locations as shown on the drawings, in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, all material delivery, stockpiling, protection, placement, connections, tie-ins with existing Work, involving drainage geotextile. Payment will be made on a unit price basis per square foot wherein measurement will be made in plan view. The measured quantity shall not include material in the anchor trenches, overlaps, or other required material to complete the installation.

21) **DRAINAGE GRAVEL FDOT No. 4 STONE:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the drainage gravel No. 4 stone for the drainage flaps located at the face of the slope near the top of the landfill, near the terrace stormwater bench, at the toe of the landfill, and at other locations as shown on the Construction Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, all material delivery, stockpiling, protection, placement, connections, tie-ins with existing Work, involving drainage gravel. Payment will be made on a unit price basis per ton wherein measurement will be made from load tickets received from delivery of material. The installation of drainage gravel will not exceed the dimensions shown in the Contract Drawings. The installation of gravel will be monitored by the Owner or Engineer and the Contractor will be informed if excessive material is being used which appears to exceed the design quantity required. Any remaining drainage gravel that the Owner does not agree to accept from the Contractor must be removed from the site by the Contractor at no additional cost to the Owner. Payment will be made on a unit price basis per ton.

22) **DRAINAGE GRAVEL FDOT No. 57 STONE:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the No. 57 around all LFG appurtenances extending above final cover grades, and at other locations as shown on the Construction Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, all material delivery, stockpiling, protection, placement, connections, tie-ins with existing Work, involving No. 57 stone. Payment will be made on a unit price basis per ton wherein measurement will be made from

load tickets received from delivery of material. The installation of No. 57 stone will not exceed the dimensions shown in the Contract Drawings. The installation of No. 57 stone will be monitored by the Owner or Engineer and the Contractor will be informed if excessive material is being used which appears to exceed the design quantity required. Any remaining No. 57 stone that the Owner does not agree to accept from the Contractor must be removed from the site by the Contractor at no additional cost to the Owner. Payment will be made on a unit price basis per ton.

23) **DITCH LINING RUBBLE (RIP RAP):** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install ditch lining rubble within stormwater swales and at other locations as shown on the Construction Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, all material delivery, stockpiling, protection, placement, connections, tie-ins with existing Work, involving ditch lining rubble in accordance with FDOT Specification Section 530. Payment will be made on a unit price basis per ton wherein measurement will be made from load tickets received from delivery of material. The installation of ditch lining rubble will not exceed the dimensions shown in the Contract Drawings. The installation of ditch lining rubble will be monitored by the Owner or Engineer and the Contractor will be informed if excessive material is being used which appears to exceed the design quantity required. Any remaining ditch lining rubble that the Owner does not agree to accept from the Contractor must be removed from the site by the Contractor at no additional cost to the Owner. Payment will be made on a unit price basis per ton.

24) **WEED BARRIER:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the weed barrier underneath the drainage gravel around the drainage flaps located at the face of the slope near the top of the landfill, near the terrace stormwater bench, and at the toe of the landfill, under gravel /rock, under gravel around all LFG appurtenances extending above final cover grades, and at other locations as shown on the Contract Drawings and in accordance with the technical Specifications and CQA Plan. This Work shall include, but not be limited to, all material delivery, stockpiling, protection, placement, connections, tie-ins with existing Work, involving the weed barrier. Payment will be made on a unit price basis per square foot wherein measurement will be made in plan view from the As-Built surveys for areas utilizing weed barrier. Payment will be made on a unit price basis per square foot wherein measurement will be made in plan view. The measured quantity shall not include material in the anchor trenches, overlaps, or other required material to complete the installation.

25) **20-MIL RAIN COVER:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to complete the installation of the rain cover over the drainage sand layer of the Phase I /II Overlay Liner System as shown on the Contract Drawings and in accordance with the technical Specifications. This Work shall include, but not be limited to, furnishing specified materials, documentation, deployment, ballasting, protection, patching and seaming. No payment will be made for rain cover layer placed outside of the areas shown on the Drawings or where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square foot wherein measurement will be made in plan view by electronic survey.

26) **LANDTEC WELLHEADS WITH FLANGE AND FERNCO FITTINGS:** This work shall consist of furnishing all labor, materials and equipment necessary to furnish and install the 2-inch diameter vertical Landtec Wellheads for the vertical gas extraction wells and remote well heads shown in the Drawings including the Fernco couplings per the wellhead details in the Drawings, HDPE reducers, Kanaflex hose, steel clamps, connections, identification tags, liquid level caps for vertical extraction wells as part of remote wellhead systems, and other incidentals. Work includes all material and installation in compliance with the Drawings and Specifications from the 6-inch HDPE casing or pipe header to the HDPE lateral riser pipe. This work will include 37 wellheads for the vertical extraction wells and 7 remote wellheads, for a total of 44 wellheads. Payment for this item will be made per each unit installed and completed.

27) **DRILLING AND COMPLETION OF 36-INCH BORE VERTICAL ACTIVE WELL**: This work shall include furnishing all necessary materials, equipment, and labor to drill and install the 36-inch diameter HDPE casing, for the 44 wells, to depths shown on the Well Schedule. Work shall include boring, stone/bentonite/soil backfill, geocomposite ring, health and safety requirements, HDPE piping (solid and perforated), connections, fittings, and all other work required for a complete and accepted installation. Disposal of drilling spoils will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made per linear foot based on approved drilling records.

28) **WELL ABANDONMENT**: This work shall consist of furnishing all necessary materials, labor, equipment, and appurtenances necessary to relocate the boring equipment if the operation encounters material that cannot be penetrated. Abandoned locations shall be properly backfilled and covered. Engineer approval is required prior to abandonment. Payment for this item will be made per linear foot based on approved drilling records.

29) **2-INCH DIAMETER HDPE, SDR 9 AIRLINE (SAME TRENCH)**: This work shall consist of furnishing and installing all necessary materials, labor, equipment, and appurtenances necessary to install the 2-inch diameter HDPE SDR 9 airline in a common trench with the condensate forcemain and header pipe or lateral pipe including piping connections, fittings, quality control surveying, testing, incidentals, connection to existing landfill gas system and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view from the LFG system survey.

30) **4-INCH DIAMETER HDPE, SDR 9 FORCEMAIN (SAME TRENCH)**: This work shall consist of furnishing and installing all necessary materials, labor, equipment, and appurtenances necessary to install the 4-inch diameter HDPE SDR 9 forcemain in a common trench with the airline and header pipe or lateral pipe including piping connections, fittings, quality control surveying, testing, incidentals, connection to existing landfill gas system, and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view from the LFG system survey.

31) **4-INCH DIAMETER HDPE, SDR 11 LATERAL PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, and labor and services to install the 4-inch diameter HDPE SDR 11 lateral piping including excavation, pipe bedding, backfilling, soil compaction, fittings, piping, connections to existing landfill gas system, pipe location markings, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view from the LFG system survey.

32) **6-INCH DIAMETER HDPE, SDR 11 LEACHATE CLEANOUT PIPE CONNECTIONS:** This shall consist of furnishing and installing all necessary materials, equipment , and labor and services to install the 6-inch diameter HDPE SDR 11 leachate cleanout connection piping including excavation, pipe bedding, backfilling, soil compaction, fittings, piping, connections to existing leachate cleanout risers, pipe location markings, quality control surveying, testing incidentals and all other work required for a complete and acceptable connection according to the Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view from the LFG system survey.

33) **6-INCH DIAMETER HDPE, SDR 11 LATERAL PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, and labor and services to install the 6-inch diameter HDPE SDR 11 lateral piping including excavation, pipe bedding, backfilling, soil compaction, fittings, piping, connections to existing landfill gas system, pipe location markings, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view from the LFG system survey.

34) **8-INCH DIAMETER HDPE, SDR 11 LATERAL PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, and labor and services to install the 8-inch diameter HDPE SDR 11 lateral piping including excavation, pipe bedding, backfilling ,soil compaction, fittings, piping, connections to existing landfill gas system, pipe location markings, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view from the LFG system survey.

35) **18-INCH DIAMETER HDPE, SDR 17 HEADER PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, and labor and services to install the 18-inch diameter HDPE SDR 17 header piping including, pipe bedding, backfilling, soil compaction, fittings, piping, connections to existing landfill gas system, pipe location markings, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made on a unit price basis per linear foot wherein measurement will be made in plan view from the LFG system survey.

36) **HEADER/AIRLINE/CONDENSATE ACCESS POINT**: This work shall consist of furnishing all necessary materials, labor, equipment, and appurtenances necessary to install an access point as shown on the contract documents, specifications and design drawings. This line item cost must also include the cost for reducing tees, blind flange assembly, tees, protection components, location markings, quality control surveying, incidentals, and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Payment for this item will be made per each unit.

37) **36-INCH DIAMETER DIAMETER HDPE, SDR 17 SUMP**: This work shall consist of furnishing all necessary material, labor, equipment, and appurtenances necessary to furnish and install the condensate sump (Sump # 1) including excavation, backfilling, fittings, sump installation and connections, 1-inch check and ball valves, pump discharge stub, pump discharge hose, pump data modules, 8-inch blind flange, sample point, airlines from the pump data module to the pump discharge stub, pneumatic pump, testing, bollards, location markings, quality control survey, incidentals and all other work required for a complete and acceptable installations according to the Contract Drawings and Specifications for this project. This work shall also consist of furnishing all necessary materials, labor, equipment, and appurtenances necessary to furnish and install a QED bottom loading AP-4 pneumatic pump or equal in the condensate sump for a complete and acceptable installation according to the Contract Drawings and Specifications. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made per each unit.

38) **LANDTEC REMOTE WELLHEADS FOR LEACHATE CLEANOUT**: This work shall include furnishing all labor, materials and equipment necessary to furnish and install the 2-inch diameter Landtec Wellheads including the Fernco coupling, HDPE reducers, Kanaflex hose, steel clamps, connections, identification tags, quality control survey, and other incidentals located at the leachate cleanout connections. Work includes all material and installation in compliance with the Contract Drawings and Specifications. Payment for this item will be made per each unit.

39) **48-INCH DIAMETER HEADER ISOLATION VALVE BOX INSTALLATION**: This work shall consist of installing a 48-inch isolation valve box, provided by the Owner, including on-site transportation to the location of installation, excavation, bedding, backfilling, soil compaction, fittings, connections, pipe location markings, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made per each unit.

40) **36-INCH DIAMETER AIRLINE VALVE BOX INSTALLATION**: This work shall consist of installing a 36-inch airline valve box, provided by the Owner, including on-site transportation to the location of installation, excavation, bedding, bentonite seal, backfilling, soil compaction, fittings, valves, piping, connections, pipe location markings, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item (installation only) will be made per each unit.

41) **48-INCH DIAMETER CONDENSATE FORCEMAIN VALVE BOX INSTALLATION**: This work shall consist of installing a 48-inch condensate forcemain valve box, provided by the Owner, including on-site transportation, excavation, bedding, backfilling, soil compaction, fittings, piping, connections, pipe location markings, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item (installation only) will be made per each unit.

42) **MISCELLANEOUS FITTINGS, TEES, ELBOWS, ETC.**: This work shall consist of furnishing all necessary materials, labor, equipment, and appurtenances necessary to install HDPE and PE fittings for landfill gas and stormwater systems, including excavation, connections, incidentals, and all other work required for a complete and acceptable installation. All work shall be according to the Contract Drawings and Specifications for this project. Payment for this item will be made lump sum.

43) **EXTENSION OF EXISTING WELLHEADS AND OTHER GAS SYSTEM APPURTENANCES:** This work shall consist of furnishing all necessary materials, labor, equipment, and appurtenances necessary to extend the existing wellheads and other gas system appurtenances identified on the Contract Drawings to elevations that will be at a minimum of two (2) feet above the final cover finish grade. This work includes extension of 10 existing gas extraction wells including the airline and condensate forcemain risers. This work shall also include extension of three (3) existing header isolations valve pits, three (3) existing forcemain valve pits, and three (3) existing airline valve pits including extension of existing internal piping and valves stems as needed. The existing valve pits are located in the southeast corner of Phase I (6 valve pits) and the northwest corner of Phase I (3 valve pits). The existing valve pits are of the same configuration as the proposed valve pits shown in the Contract Drawings. Also, this work shall include extension of the existing header access points located on the north and east side slopes (3 locations) which include 8-inch, 4-inch and 2-inch HDPE riser pipes at each location in the same configuration shown for the proposed header access point in the Contract Drawings. The work shall also include extension of the existing U-trap pipes (3 locations) on the north slope which includes a 16-inch and 8-inch HDPE riser pipe at each location. This work includes health and safety procedures, cutting existing pipe or providing connections such as flanges or couples, supplying and installing extensions, surveying, and testing for a complete and acceptable installation according to the Drawings and Specifications. Payment for this item will be made lump sum based on percentage complete of the work as determined by the County and Engineer, however, in the event the full quantity of extensions described in the pay item are not necessary or completed, the Contractor shall submit to the County an estimate for reduction of the lump sum amount to account for the work not performed based on a schedule of values for this bid item submitted by the Contractor to the County at the Preconstruction Meeting or before the first pay application submittal.

44) **ACCESS ROAD STABILIZED BASE:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the stabilized access road base as shown on the Contract Drawings and in accordance with the technical Specifications. This work shall include, but not be limited to, subgrade preparation and proof rolling, removal and replacement of objectionable subgrade material, fine grading, limerock (furnishing, placing, mixing and compacting), finish grading of road shoulders, drainage ditch installation, traffic control, and coordination with Owner to avoid impacts to landfill operations. No payment will be made for stabilized road base where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square yard wherein measurement will be made in plan view from the final survey.

45) **8-INCH DIAMETER POLYETHYLENE TOE DRAIN PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, labor and services to construct the 8-inch diameter polyethylene toe drains including excavation, pipe sock filter fabric, pipe bedding, backfilling ,soil compaction, fittings, piping, gaskets, connections, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Payment for this item will be made per linear foot wherein measurement will be made in plan view from the final survey.

46) **18-INCH DIAMETER POLYETHYLENE DOWNDRAIN PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, labor and services to install the 18-inch diameter polyethylene downpipes including excavation, pipe bedding, backfilling ,soil compaction, fittings, piping, flared end sections, gaskets, connections, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made per linear foot wherein measurement will be made in plan view from the final survey.

47) **24-INCH DIAMETER POLYETHYLENE DOWNDRAIN PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, labor and services to install the 24-inch diameter polyethylene downpipes including excavation, pipe bedding, backfilling ,soil compaction, fittings, piping, gaskets, connections, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made per linear foot wherein measurement will be made in plan view from the final survey.

48) **36-INCH DIAMETER POLYETHYLENE DOWNDRAIN PIPE**: This work shall consist of furnishing and installing all necessary materials, equipment, labor and services to install the 36-inch diameter polyethylene downpipes including excavation, pipe bedding, backfilling ,soil compaction, fittings, piping, flared end sections, gaskets, connections, quality control surveying, testing, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Disposal of excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made per linear foot wherein measurement will be made in plan view from the final survey.

49) **FILTER POINT FABRIC-FORMED CONCRETE LINING:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the fabric-formed concrete lining as shown on the Contract Drawings and in accordance with the technical Specifications. This work shall include, but not be limited to, subgrade preparation, removal and replacement of objectionable subgrade material, fine grading, providing and placing fabric forms, pumping grout into forms, grout testing, anchor trenches, geotextile filter fabric, and seaming of forms. No payment will be made for fabric-formed concrete lining where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a unit price basis per square foot wherein measurement will be made in plan view from the final survey.

50) **LEACHATE CLEANOUT PUMP STATION MODIFICATIONS:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to modify the existing leachate cleanout pump stations as shown on the Drawings and in accordance with the technical Specifications. This work shall include, but not be limited to, utility vault, excavation and foundation preparation, dewatering, compaction to design grades, concrete, reinforcement, finishing concrete surface, pipe connections, piping and fittings within the leachate cleanout pump station, pipe supports, P-trap, and connections to existing cleanout risers. The lump sum proposed shall be full compensation for performing the Work required. Payment will be on a lump sum basis, wherein no measurement will be made. Payments for this lump sum item will be made based on the value of materials furnished or services and work completed using estimates provided by Contractor and approved by Owner's representative.

51) **CONCRETE FOR STORMWATER CONVEYANCE SYSTEMS**: This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install concrete pads at each stormwater down drains as shown on the Drawings for the North and East slopes of the Phase I Closure as well as one down drain on the south side. The Work for this item shall be performed in accordance with the Contract Drawings, Technical Specifications, and FDOT technical specifications for mitered end sections. This work shall include, but not be limited to form work, reinforcing steel, placement of concrete, and finish work, and removal of all formwork and appurtenances. This item will be measured on a per installed concrete structure basis for the down drains. Payments for this item will be made based on the value of materials furnished or services and work completed using estimates provided by Contractor and approved by Owner's representative for each concrete structure installed.

52) **SODDING:** This Work consists of furnishing all equipment, materials, labor, and appurtenances to provide sodding to those areas required to have sod for the final cover as shown in the Contract Drawings and those areas which have been disturbed by the Contractor and/or require repair as shown on the Contract Drawings and in accordance with the technical Specifications. Areas disturbed by the Contractor that are not required as part of the performance of the work, as determined by the Owner and Engineer, will not be included in the quantity for payment. This Work shall include, but not be limited to, fine grading and site preparation, soil testing, fertilizer and limestone application, supplying and installing sod, anchoring/netting of sod, watering, mowing, replanting, repair of erosion, and all other Work necessary to produce a uniform stand of grass. No payment will be made for sod that does not meet the acceptance criteria established in the Specifications. No payment will be made for sod placed outside of the limits of construction shown on the Contract Drawings without prior approval of the Engineer. Payment for sod shall not relieve Contractor of the need to maintain sod throughout warranty period. Payment will be made on a unit price basis per square yard wherein measurement will be made in plan view from the final cover survey.

53) **ASBESTOS REMOVAL AND DISPOSAL:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to remove asbestos encountered during construction activities and dispose of the material at the active face of the Phase II landfill. Specification 02130 – Vertical Extraction Wells (Paragraph 3.2.G Asbestos Handling) shall be followed for disposal of asbestos material. The Contractor will be required to weigh the asbestos waste at the scales near the entrance to the landfill using highway legal trucks and pay the current processing fee per ton for asbestos of $30.41 per ton of asbestos. The Contractor will be required to set up a prepaid account at the landfill for payment purposes. This item shall include health and safety procedures, excavation, loading, hauling to scales, processing fees, hauling from the scales to the active face, and unloading/dumping of the material at the active face. The need for asbestos removal and disposal are unknown at the time of bid, however, the Owner will provide the Contractor with the known locations of asbestos in Phase I with GPS locations. The Owner does not guarantee these locations nor does the Owner guarantee that the Contractor will not find asbestos in other locations not provided. This bid item is a contingency to establish a unit rate and a limited contract amount specific to asbestos removal if needed. Payment will be made on a unit price basis per ton wherein measurement will be made by the tonnage disposed as measured at the scales.

54) **SPARE PARTS:** This work shall consist of furnishing all required spare parts as specified in the Contract Specifications and Drawings. In general, this item includes, but is not limited to, spare parts listed in Specification 02130. Payment for this item will be made on a lump sum basis.

55) **SOUTH SIDE STORMWATER SWALE SOIL FILL:** This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to complete the south side stormwater swale and berms as shown in the Drawings and as specified in the Contract Documents. This Work includes, but is not limited to, removal of vegetation and disposal at a location designated by Owner and soil fill from the permitted borrow area located adjacent to the site as shown on the Contract Drawings and place it in the Work. Contractor shall only remove soil from locations within the borrow area as shown on the Contract Drawings. Contractor shall at all times be familiar with the conditions of the mining permit and shall abide by all requirements of the permit including excavating the borrow area only to permitted grades. Contractor shall be responsible for clearing, dewatering borrow area and disposing of drainage in an approved manner as well as maintaining haul roads from the borrow area to the Site while working in the borrow area. This item shall include grading, excavation, loading, hauling, unloading/dumping of the material, placement, spreading, compaction, and finish grading to achieve design grades. Payment will be made on a unit price basis per cubic yard wherein measurement will be made by comparing the Preconstruction Survey and Final Survey to determine the quantity of fill required to complete the work.

56) **24-INCH DIAMETER RCP FOR TYPE J STRUCTURE TO SOUTHSIDE STORMWATER SWALE:** This work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the 24-inch RCP pipe at road crossings as shown on the Drawings and in accordance with the technical specifications. This work shall include removal of existing asphalt paving and road base, excavation to design grades, disposal of soils, pipe bedding, 24-inch RCP pipe installation, backfilling, dewatering and proper disposal of dewatering liquid from Phase I area to leachate collection system in accordance with Specification Section 02310, soil compaction, and testing. No payment will be made for 24-inch RCP pipe installation where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made per linear foot wherein measurement will be made in plan view from the final survey.

57) **24-INCH DIAMETER MITERED END SECTIONS:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the 24-inch mitered end sections as shown on the Drawings and in accordance with the technical Specifications. This work shall include, but not be limited to, mitered end sections, foundation preparation, excavation, backfill and compaction to design grades, finish grading, and dewatering (as needed). Payment for this item will be made per each unit installed and completed.

58) **36-INCH DIAMETER RCP FOR SOUTHSIDE STORMWATER SWALE:** This work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the 36-inch RCP pipe at road crossings as shown on the Drawings and in accordance with the technical specifications. This work shall include removal of existing asphalt paving and road base, excavation to design grades, disposal of soils, pipe bedding, 36-inch RCP pipe installation, backfilling, dewatering and proper disposal of dewatering liquid from Phase I area to leachate collection system, soil compaction and testing. No payment will be made for 36-inch RCP pipe installation where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made per linear foot wherein measurement will be made in plan view from the final survey.

59) **36-INCH DIAMETER MITERED END SECTIONS:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the 36-inch mitered end sections as shown on the Drawings and in accordance with the technical Specifications. This work shall include, but not be limited to, mitered end sections, foundation preparation, excavation, backfill and compaction to design grades, finish grading, and dewatering. Payment for this item will be made per each unit.

60) **CONCRETE STRUCTURE (TYPE J) WITH GRATES FOR SOUTHSIDE STORMWATER SWALE:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to install the Type J ditch bottom inlet as shown on the Drawings and in accordance with the technical specifications. This work shall include, but not be limited to, Type J ditch bottom inlets, grates, foundation preparation, pipe seals, excavation, dewatering and proper disposal of dewatering liquid from Phase I area to leachate collection system, backfill and compaction to design grades, finish grading, and connection of concrete structure to TPO liner in south side stormwater swale. Payment for this item will be made per each unit.

61) **24-INCH DIAMETER HDPE DOWNDRAIN PIPE FROM NORTH BANK OF SOUTH SWALE TO SOUTHSIDE SWALE:** This work shall consist of furnishing and installing all necessary materials, equipment, labor and services to install the 24-inch diameter polyethylene downpipes at all road crossings as shown on the Drawings and in accordance with the technical specifications. This work shall include removal of existing asphalt pavement and road base, excavation to design grades, dewatering and proper disposal of dewatering liquid from Phase I area to leachate collection system, pipe bedding, pipe installation and testing, backfilling, soil compaction and testing, fittings, gaskets, connections, pipe boot to TPO geomembrane, quality control surveying, incidentals and all other work required for a complete and acceptable system according to the Contract Drawings and Specifications for this project. Excavated refuse will be paid under EXCAVATION AND REMOVAL OF WASTE. Payment for this item will be made per linear foot wherein measurement will be made in plan view from the final survey.

62) **REPAIR EXISTING PAVED ROAD AT PIPE CROSSINGS:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to repair the asphalt paving to existing conditions at all road crossings as shown on the Drawings and in accordance with the technical specifications. This work shall include, but not be limited to, subgrade preparation and proof rolling, removal and replacement of objectionable subgrade material, fine grading, stabilized subgrade, limerock base course, asphalt pavement, finish grading of road shoulders, traffic control, coordination with Owner to avoid impacts to landfill operations, quality control surveying, incidentals, and all other work required for a complete and acceptable system according to the drawings and technical specifications. No payment will be made for asphalt paving where testing has indicated that the installed material does not meet the specified requirements without prior approval of the Engineer. Payment will be made on a per road crossing basis.

63) **EXTEND EXISTING MONITORING WELLS FOR SOUTHSIDE SWALE:** This Work shall consist of furnishing all equipment, materials, labor, and appurtenances necessary to extend the existing monitoring wells identified on the Drawings to elevations that will be at a minimum of three (3) feet above finish grade. This work shall include, but not be limited to, removal of existing aluminum casing, concrete pad, and grout cement, cutting existing pipe, supplying and installing extensions, surveying, re-installation of 2-inch PVC cap, installation of grout cement, concrete pad, and aluminum casing. The Contractor shall reuse hardware from existing monitoring wells as appropriate. Payment for this item will be made per each unit.

64) **REMOVE EXISTING RCP PIPING FROM SOUTHSIDE SWALE:** This Work shall consist of removing the existing stormwater culverts from the swale located along the south side of the Phase I Closure. This work shall include removal of two existing RCP pipes as shown on the Drawings and stockpile of the pipe at a location adjacent to Phase I Closure project as directed by the Owner and Engineer. Payment for this item shall be on a lump sum basis as measured by the Engineer on a work completed basis.

65) **RELOCATION OF EXISTING PIPE BOLLARDS**: This work shall only be completed as determined by OWNER and ENGINEER. This work shall consist of furnishing all necessary materials, labor, equipment, paint, and appurtenances necessary to remove existing pipe bollards located within the Phase I closure area and reinstall them at the locations as directed by the Engineer. Payment for this item will be made per each unit.

66) **BORROW SOIL EXCAVATION AND STOCKPILING:** This work shall only be completed as determined by Owner and Engineer. This Work shall consist of furnishing all necessary materials, equipment, transportation, labor, and appurtenances necessary to stockpile soil from the permitted borrow area located adjacent to the site as shown on the Contract Drawings and place it in the soil stockpile located south of the landfill in locations designated by Owner. Contractor shall only remove soil from locations within the borrow area as shown on the Contract Drawings. Contractor shall at all times be familiar with the conditions of the mining permit and shall abide by all requirements of the permit including excavating the borrow area only to permitted grades. Contractor shall be responsible for clearing and dewatering borrow area and disposing of drainage in an approved manner as well as maintaining haul roads from the borrow area to the Site while working in the borrow area. This bid item shall also include all Work required to restore the borrow area to conditions equal to, or better than, what existed prior to soil removal, as determined by the Owner. This item shall include pre- and post-construction surveys of the stockpile area, excavation, loading, hauling, unloading/ dumping, placement, spreading, compaction, and finish grading to achieve uniform grades of 3:1(horizontal:vertical) or less within the stockpile area. Payment will be made on a unit price basis per cubic yard wherein measurement will be made by comparing the pre- and post-construction surveys of the stockpile area to determine the quantity of soil stockpiled.

67) **PNEUMATIC PUMPS**: This work shall only be completed as determined by Owner and Engineer. This work shall consist of furnishing all necessary materials, labor, equipment, and appurtenances necessary to furnish and install a QED bottom loading AP-4 pneumatic pump or approved equal in vertical gas wells as directed by the Engineer for a complete and acceptable installation according to the Drawings and Specifications. Contractor shall include up to 60 feet of cables and fittings for a complete installation in the selected vertical wells. The Contractor shall not purchase any pumps without the approval and direction of the Owner and Engineer. The pumps will be requested from the Contractor on an as needed basis depending on the conditions observed as the vertical gas extraction wells are installed and brought into operation. Pump installations shall require Owner and Engineer direction for placement and approval. Payment for this item will be made per each unit.

PART 2 - PRODUCTS (NOT USED)

PART 3 - GENERAL (NOT USED)

END OF SECTION

SECTION 01340
SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanics and administration of the submittal process for:
      a. Shop Drawings.
      b. Samples.
      c. Miscellaneous submittals.
      d. Operation and maintenance manuals.

B. Related Sections include but are not necessarily limited to:
   1. General Terms and Conditions.
   2. Division 1 - General Requirements.
   3. Sections in Divisions 2 through 16 identifying required submittals.

1.2 DEFINITIONS

A. Shop Drawings:
   1. All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
   2. Product data and Samples are to be submitted as Shop Drawing information.

B. Miscellaneous Submittals:
   1. Submittals other than Shop Drawings.
   2. Representative types of miscellaneous submittal items include but are not limited to:
      a. Construction schedule.
      b. soil compaction, and leak test reports.
      c. Manufacturer's installation certification letters.
      d. System performance test reports.
      e. Warranties.
      f. Service agreements.
      g. Construction photographs per Section 01060 – Special Conditions.
      h. Survey data.
      i. Cost breakdown (Schedule of Values).
      j. Health and safety plans.

1.3 SUBMITTAL SCHEDULE

1. Schedule of Shop Drawings:
   a. Contractor shall submit a schedule of anticipated shop drawings for Engineer's review and approval within 15 days of receipt of Notice to Proceed.
   b. Schedule shall account for multiple transmittals under any Specification Section where partial submittals will be transmitted.
   c. Review of Shop Drawings by the Engineer will not commence until after Notice to Proceed and receipt of an acceptable schedule of Shop Drawings.
2. Shop Drawings:
   a. Submittal and approval of all shop drawings is required prior to 50 percent completion.
3. Operation and Maintenance Manuals and Equipment Record Sheets:
   a. Initial submittal within 60 days after date Shop Drawings are approved.

1.4 TRANSMITTAL OF SUBMITTALS

A. Transmit all submittals to:

HDR Engineering, Inc.
5426 Bay Center Drive Suite 400
Tampa, Florida 33609-3444
Attn: Itza Rivera

B. Transmittal Form
1. Utilize the attached Submittal Form to transmit all Shop Drawings, Samples, Miscellaneous Submittals, and Operation & Maintenance Manuals.
   a. Check the appropriate box at the top of the form to indicate the type of submittal.

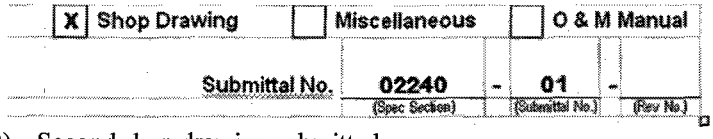
C. Shop Drawings:
1. For 8-1/2 x 11 IN size sheets, provide five (5) copies of each page of which three (3) copies will be retained by Engineer. Contractor shall submit additional copies if required for his use.
   a. The number of copies required by the Contractor will be defined at the Preconstruction Conference, but shall not exceed 5.
2. For drawings and information larger than 11 x 17 IN, submit same number of copies as required above.
   a. Utilize mailing tube; do not fold.

D. Miscellaneous Submittals
1. Submit minimum of five (5) copies or as specified in individual Specification Section.
2. Provide copy of letter of transmittal to Owner's Resident Project Representative.
   a. Exception for soils compaction and pressure test reports:
      1) Testing firm to transmit one copy directly to CQA representative and one copy directly to Engineer.

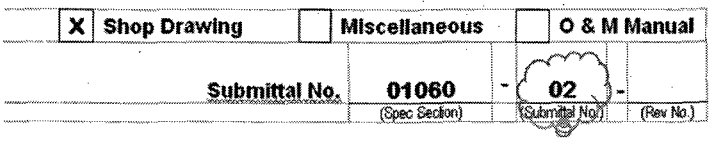
E. Operation and Maintenance Manuals
1. Submit one copy until approval is received. Once approved, submit two copies.

1.5 PREPARATION OF SUBMITTALS

A. Numbering of submittals:
1. The submittal number shall consist of the Specification Section number followed by a series number beginning at "01" and indicating the order of shop drawings as they are submitted by the Contractor, regardless of the type of submittal.
   a. Examples:
      1) First shop drawing submitted.



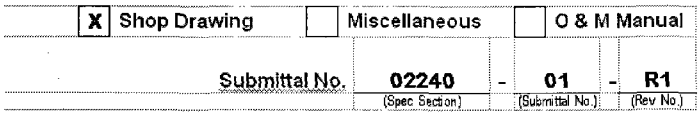
      2) Second shop drawing submitted.



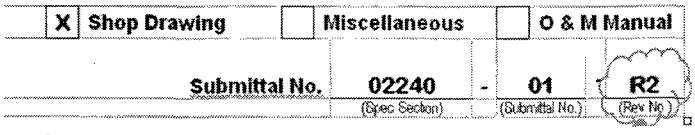
B. Resubmittals:
1. Utilize a new transmittal form for each resubmittal.
2. Do not increase the scope of any prior transmittal.
3. Account for all components of prior transmittal.

a. If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
   1) Do not include submittal information for items with prior "A" or "B" Action in transmittal.
b. Indicate "Outstanding-To Be Resubmitted at a Later Date" for any prior "C" or "D" Action item not included in resubmittal.

4. Obtain Engineer's prior approval to exclude items.
5. Number each resubmittal using the original submittal number with the addition of a suffix consisting of "R" with a series number identifying the resubmittal sequence for that specific shop drawing.
   a. Examples:
   1) First resubmittal.



   2) Second resubmittal.



C. Contractor Stamping
1. All submittals must be from Contractor and bear his approval stamp.
   a. Submittals will not be received from or returned to subcontractors.
2. Stamp Content
   a. Shop Drawing submittal stamp shall consist of the following or equivalent wording:

> "(Contractor's Name) has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval as stipulated under EJCDC General Conditions Paragraph 6.17D".

   b. Operation and Maintenance Manual submittal stamp may be Contractor's standard approval stamp.
   c. Contractor's signature and date shall be original ink signature.
3. Contractor's review and approval stamp shall be applied either to the letter of transmittal or a separate sheet preceding each independent item in the submittal.
   a. Letters of transmittal may be stamped only when the scope of the submittal is one item.
   b. Submittals containing multiple independent items shall be prepared with an index sheet for each item listing the discrete page numbers for each page of that item, which shall be stamped with the Contractor's review and approval stamp.
      1) Individual pages or sheets of independent items shall be numbered in a manner that permits Contractor's review and approval stamp to be associated with the entire contents of a particular item and vice-versa.
   c. In the event submittals are transmitted as a single item and found to include multiple independent items, the Owner and Engineer reserve the right to limit review to the single item listed, remove the other items from the submittal, and return them, not reviewed, to the Contractor for coordination, stamping and submittal under a new transmittal number that is not a re-submittal number.
      1) The items not listed in the transmittal letter will not be logged as received, or in any other manner acknowledged as submitted.
4. Electronic stamps
   a. Contractor may electronically embed Contractor's review and approval stamp to either the letter of transmittal or a separate index sheet preceding each independent item in the submittal.

b. Contractor's signature and date on electronically applied stamps shall be original ink signature.

D. Submittal Contents

1. Scope of any submittal and letter of transmittal.
   a. Limited to one Specification Section.
   b. Do not submit under any Specification Section entitled (in part) "Basic Requirements".
   c. Related submittals may be cross referenced as necessary.
2. Provide submittal information defining specific equipment or materials utilized on the project.
   a. Provide listing of each component or item in submittal capable of receiving an independent review action.
      1) Examples:

CONTRACTOR'S SECTION			Engineer's Action Taken*
Number of Copies	Description	Supplier / Manufacturer	
5	PVC Coated Conduit	Ocal	A
5	Flex Conduit	Anamet	A
5	Duct Spacers	Kraloy	B
5	PVC Conduit	National Pipe & Plastics	A
5	PVC Conduit Fittings	Kraloy	A
5	PVC Glue	Weld-On	A
5	Conduit Supports	Channel	C

CONTRACTOR'S SECTION			Engineer's Action Taken*
Number of Copies	Description	Supplier / Manufacturer	
5	Dwg 3077-RS1 Foundation Plan	Callaway Bldg Products	A
5	Dwg 3077-RS2 Slab Reinforcing	Callaway Bldg Products	A
5	Dwg 3077-RS3 Tank Foundation Reinforcement	Callaway Bldg Products	B

   b. Generalized product information, not clearly defining specific equipment or materials to be provided, will be rejected.
      1) Examples:

CONTRACTOR'S SECTION			Engineer's Action Taken*
Number of Copies	Description	Supplier / Manufacturer	
5	Electrical Submittals	Electric Sub	D

CONTRACTOR'S SECTION			Engineer's Action Taken*
Number of Copies	Description	Supplier / Manufacturer	
5	Layout Drawings		D

3. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Engineer.
   a. Identify for each item:
      1) Manufacturer and Manufacturer's drawing or data number.
      2) Contract Document tag number(s).
      3) Specification Article/Paragraph number if appropriate.
      4) Unique page numbers for each page of each separate item.
   b. Identify equipment or material use, tag number, drawing detail reference, weight, and other project specific information.
   c. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.

d. Submit items like equipment brochures, cuts of fixtures, product data sheets or catalog sheets on 8-1/2 x 11 IN pages. Indicate exact item or model and all options proposed. If information submitted does not clearly state the proposed equipment in the brochure or catalog, Engineer will return submittal to Contractor without review.
e. Include legible scale details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout drawings, parts catalogs, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data.
   1) Arrange data and performance information in format similar to that provided in Contract Documents.
   2) Provide, at minimum, the detail provided in the Contract Documents.

4. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet.
5. Calculations required in individual Specification Sections will be received for information purposes only, as evidence calculations have been performed by individuals meeting specified qualifications, and will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.
6. Provide clear space (3 IN SQ) for Engineer stamping of each component defined on the transmittal form.
7. Contractor shall not use red color for marks on transmittals.
   a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
   b. Outline Contractor marks on reproducible transparencies with a rectangular box.

E. Samples:
1. Identification:
   a. Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, Standard Specification Section or drawing detail reference, color, range, texture, finish and other pertinent data.
   b. If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.
2. Include application specific brochures, and installation instructions.
3. Provide Contractor's stamp of approval on samples or transmittal form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
4. Resubmit samples of rejected items.

F. Miscellaneous Submittals
1. Identify for each item the supplier or name of company that prepared or provided the document
2. Refer to Submittal Contents section above for additional detail.

G. Operation and Maintenance Manuals
1. Number transmittals for Operation and Maintenance Manuals with original root number of the approved Shop Drawing for the item.
2. Submit Operation and Maintenance Manuals printed on 8-1/2 x 11 IN size heavy first quality paper with standard three-hole punching and bound in stiff metal hinged binder constructed as a three-ring style.
   a. Provide binders with titles on front and on spine of binder.
   b. Tab each section of manuals for easy reference with plastic-coated dividers.
   c. Provide index for each manual.
   d. Provide plastic sheet lifters prior to first page and following last page.
3. Reduce drawings or diagrams bound in manuals to an 8-1/2 x 11 IN or 11 x 17 IN size.
   a. However, where reduction is not practical to ensure readability, fold larger drawings separately and place in vinyl envelopes which are bound into the binder.

b. Identify vinyl envelopes with drawing numbers.

4. Submittal contents:
   a. Submission of Operation and Maintenance Manuals is applicable but not necessarily limited to:
      1) Major equipment.
      2) Equipment used with electrical motor loads of 1/6 HP nameplate or greater.
      3) Specialized equipment including valves and instrumentation and control system components for HVAC and process systems such as meters, recorders, and transmitters.
      4) Valves greater than 12 IN DIA.
      5) Water control gates.
   b. Operation and maintenance manuals shall include, but not necessarily be limited to, the following detailed information, as applicable:
      1) Equipment function, normal operating characteristics, limiting operations.
      2) Assembly, disassembly, installation, alignment, adjustment, and checking instructions.
      3) Operating instructions for start-up, routine and normal operation, regulation and control, shutdown, and emergency conditions.
      4) Lubrication and maintenance instructions.
      5) Guide to "troubleshooting."
      6) Parts list and predicted life of parts subject to wear.
      7) Outline, cross-section, and assembly drawings; engineering data; and electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, word description of wiring diagrams and interconnection diagrams.
      8) Test data and performance curves.
      9) A list of recommended spare parts with a price list and a list of spare parts provided under these Specifications.
      10) Copies of installation instructions, parts lists or other documents packed with equipment when delivered.
      11) Instrumentation or tag numbers relating the equipment back to the Contract Documents.
      12) Include a filled-out copy of the Equipment Record Sheet, Exhibits C1 and C2 as the first page(s) of each Operation and Maintenance Manual.
         a) Complete maintenance requirements in detail. Simple reference to the Manual is not acceptable.
      13) For equipment items involving components or subunits, an Equipment Record Sheet for each operating component or subunit is required.

1.6 ENGINEER'S REVIEW ACTION

A. Shop Drawings and Samples:
   1. Items within submittals will be reviewed for overall design intent and will receive one of the following actions:
      a. A - FURNISH AS SUBMITTED.
      b. B - FURNISH AS NOTED.
      c. C - REVISE AND RESUBMIT.
      d. D - REJECTED.
      e. E - ENGINEER'S REVIEW NOT REQUIRED.
   2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
      a. Drawings not stamped by the Contractor or stamped with a stamp containing language other than that specified in the Contract Documents, will not be reviewed for technical content and will be returned without any action.
   3. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.

a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.

4. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
   a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
      1) One copy of the "C" or "D" drawings will be marked up and returned to the Contractor.
      2) Correct and resubmit items so marked.
   b. Items marked "A" or "B" will be fully distributed.
   c. If a portion of the items or system proposed is acceptable, however, the major part of the individual drawings or documents is incomplete or requires revision, the entire submittal may be given "C" or "D" Action.
      1) This is at the sole discretion of the Engineer.
      2) In this case, some drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."
      3) Distribution to the Owner and field will not be made (unless previously agreed to otherwise).
5. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.
6. Transmittals of submittals which the Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" Action in a prior submittal, will be returned with Action "E. Engineer's Review Not Required."
7. Samples may be retained for comparison purposes.
   a. Remove samples when directed. Include in bid all costs of furnishing and removing samples.
8. Approved samples submitted or constructed, constitute criteria for judging completed work.
   a. Finished work or items not equal to samples will be rejected.

B. Miscellaneous Submittals:
1. Items within transmittals will be reviewed for overall design intent and will receive one of the following actions:
   a. A – FILE AS SUBMITTED.
   b. B – FILE AS NOTED.
   c. C – REVISE AND RESUBMIT.
   d. D – REJECTED.
   e. E – ENGINEER'S REVIEW NOT REQUIRED.
2. Transmittals returned with Action "A" or "B" are considered acceptable. If for any reason a transmittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
3. Transmittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
   a. The portion of the items are acceptable, however, if the major part of the documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action. This is at the sole discretion of the Engineer. In this case, some submittals may contain relatively few or no comments or the statement, "Resubmit to maintain complete packages." Distribution to the Owner and field will not be made (unless previously agreed to otherwise).

b. Items marked "A" or "B" will be fully distributed.
c. If a portion of the items or system proposed is acceptable, however, the major part of the individual drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action. This is at the sole discretion of the Engineer. In this case, some drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package." Distribution to the Owner and field will not be made (unless previously agreed to otherwise).

4. Failure to include any specific information specified under the submittal paragraphs of the specifications will result in the transmittal being returned to the Contractor with "C" or "D" Action.
5. All costs, associated with the review of any Miscellaneous Submittals resubmitted more than twice shall be borne by the Contractor with said costs being deducted from any payments due to the Contractor.
6. Acceptable submittals will be retained with the transmittal form returned.

C. Operation and Maintenance Manuals:
1. Engineer will review and indicate one of the following review actions:
a. ACCEPTABLE.
b. FURNISH AS NOTED.
c. REVISE AND RESUBMIT.
d. REJECTED.
2. Acceptable submittals will be retained and the transmittal form returned with a request for a specified number of additional copies.
3. Deficient submittals will be returned along with the transmittal form which will be marked to indicate deficient areas.

D. Deficient submittals will be returned along with the transmittal form which will be marked to indicate deficient areas.

END OF SECTION

☐ Shop Drawing ☐ Miscellaneous ☐ O & M Manual

Submittal No. _____ - _____ - _____
(Spec Section) (Submittal No.) (Rev No.)

Project Name:	CCSWDC Phase I Class I Landfill Closure Construction
Project Owner:	**Sarasota County, FL**

Contractor:		Engineer:	**HDR Engineering, Inc.**
Address:		Address:	**5426 Bay Center Drive Suite 400** **Tampa, Florida 33609-3444**
Attn:		Attn:	**Itza Rivera**

CONTRACTOR'S SECTION

Number of Copies	Description	Supplier / Manufacturer	Engineer's Action Taken*

Contractor's Comments:

Name Date

ENGINEER'S SECTION

Date Received

*The Action Designated Above is in Accordance with the Following Legend:

Action:

- A Furnish as Submitted
- B Furnish as Noted
- C Revise and Resubmit
- D Rejected
- E Engineer's review not required.

Comments:

Shop Drawings:
- 1 See comments.
- 2 Not enough information for review.
- 3 Copies illegible.
- 4 Not enough copies submitted.
- 5 Wrong Specification Section Number.

Misc:
- 6 Submittal not required.
- 7 Supplemental Information; submittal retained for informational purposes only.
- 8 Information reviewed and approved on prior submittal.

O&M:
- 9 Organizational (index & tabbing).
- 10 Parts List & Ordering Instructions.
- 11 Operating Instructions.
- 12 Lubrication & Maintenance Instructions.
- 13 Troubleshooting Guide.
- 14 Test data & performance curves.

Engineer's Comments:

Name Date

Distribution:

☐ Owner ☐ Contractor ☐ Engineer ☐ Field ☐ Other

HDR

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SECTION 01410
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Contractor provided independent testing laboratory services; Contractor responsibilities; laboratory responsibilities; and laboratory limits of authority.

1.2 RELATED SECTIONS

A. Division 0 – Bid Requirements, Contract Forms, and Conditions of the Contract.

B. Division 1 – General Requirements.

C. Divisions 2 through 15, Sections requiring testing services apply to the work of this Section.

1.3 REFERENCES

A. American Council of Independent Laboratories, Inc. (ACIL):
   1. Recommended requirements for independent laboratory qualifications.

B. American Society for Testing and Materials (ASTM):
   1. D3740 - Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   2. E329 - Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

C. National Bureau of Standards (NBS).

1.4 GENERAL

A. Required inspection and testing services are to assist in determination of compliance of the Work. Required services do not relieve the Contractor of its responsibility for compliance with requirements of the Contract Documents.

B. Required services are not intended to limit the Contractor's own quality control procedures, but to establish the minimum testing level necessary to monitor compliance of construction materials and methods with Contract requirements.

C. Contractor shall retain independent testing laboratory to perform inspections, tests, and related actions as required by these Contract Documents. This may be the same party as the CQC Consultant, or a subcontractor to the CQC Consultant.

1.5 SUBMITTALS

A. Submit 3 copies of the following information within 14 calendar days of the Notice to Proceed:
   1. Independent Testing Laboratory:
      a. Name, address, and telephone number.
      b. Name of full-time Registered Engineer(s), if applicable.
      c. Name of responsible officer(s).
      d. Copy of facilities inspection report made by Materials Reference Laboratory of NBS during the most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.
      e. Copy of calibration results for testing equipment to be used or certification that testing equipment has been calibrated to NBS.

2. Schedule of inspections, tests, and similar services presented in tabular form:
   a. Reference to Specification Section and unit of work.
   b. Description of test.
   c. Identification of applicable standards and test methods.
   d. Number of test(s) required.
   e. Time schedule or time span for tests.
   f. Entity responsible for performing tests.
   g. Requirements for taking samples.
   h. Unique characteristics of each service.

B. Submit 3 copies of the following information within 14 calendar days of the completion of each service:
   1. Written report of each inspection, test, or similar service:
      a. Date issued.
      b. Independent laboratory name, address, and telephone number.
      c. Project Name and Project Number.
      d. Dates, times, and locations of samples and tests or inspections.
      e. Record of temperature and weather conditions.
      f. Names and signatures of individuals making the test or inspection.
      g. Designation of the work or product in relation to Specification Section.
      h. Complete inspection or test data.
      i. Type of test or inspection method.
      j. Results of test and compliance with the Contract Documents.
      k. Interpretation of test results,
      l. Recommendations on retesting, if applicable,

1.6 QUALIFICATIONS OF INDEPENDENT LABORATORY

A. Specializes in required services and complies with ACIL.

B. Meets requirements of ASTM D3740 and ASTM E329, if performing such services.

C. Authorized to operate in the State of Florida with qualified and licensed full-time Registered Engineer, if applicable.

D. Testing equipment calibrated at reasonable intervals with devices of an accuracy traceable to either NBS or accepted values of natural physical constants.

E. Acceptable to the CQA Consultant. CQA Consultant will have the right to disapprove of independent laboratory or agency which does not meet the criteria of this Section.

1.7 INDEPENDENT LABORATORY RESPONSIBILITIES

A. Test samples of materials submitted by Contractor.

B. Provide qualified personnel at site after due notice; cooperate with Engineer and Contractor in performance of services.

C. Perform specified inspections, sampling, and testing of products in accordance with specified standards.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Notify Engineer and Contractor immediately of observed irregularities or non-conformance of work or products.

1.8 LIMITATIONS OF AUTHORITY OF INDEPENDENT LABORATORY

A. Independent laboratory is not authorized to:
   1. Release, revoke, alter, or enlarge on requirements of the Contract Documents.
   2. Approve or accept any portion of the Work.
   3. Assume or perform any duties of the Contractor.
   4. Stop work.

1.9 CONTRACTOR'S RESPONSIBILITIES

A. Inspections, tests, and similar quality control services are the Contractor's responsibility; these services also include those specified to be performed by an independent laboratory and not directly by the Contractor.

B. Employ and pay an independent laboratory or other qualified agency to perform quality control services specified.

C. Cooperate with the independent laboratory(ies) performing required inspections, tests, and similar services. Notify the independent laboratory no less than 24 hours in advance of operations to permit assignment of personnel and scheduling of tests.

D. Provide such auxiliary services as are requested. These auxiliary services include, but are not limited to:
   1. Providing access to the work.
   2. Taking samples or assistance with taking samples.
   3. Delivery of samples to test laboratories.
   4. Security and protection of samples and test equipment at the Project site.

E. Contractor and each independent laboratory shall coordinate the sequence of their activities to minimize delay in progress of the Work.

F. Contractor and each independent laboratory shall coordinate their work to avoid removing or replacing work to accommodate inspections and tests. Contractor shall be responsible for scheduling times for inspections, tests, taking of samples, and similar activities.

G. Inspections and tests required by codes or ordinances, or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor.

1.10 RETEST RESPONSIBILITIES AND CONVENIENCE TESTING

A. Where results of inspections, tests, or similar services prove unsatisfactory and do not indicate compliance with requirements of the Contract Documents, repeats of the inspections, tests, or similar services shall be conducted following revision or replacement of the affected work.

B. Cost of repeat inspections, tests, or similar services shall be the Contractor's responsibility, regardless of responsibility of original inspection, test, or similar service.

C. Inspections, tests, or similar services performed exclusively for the Contractor's convenience and the costs of same shall be the sole responsibility of the Contractor.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SANITARY FACILITIES

A. Provide and maintain facilities and enclosures as required.

1.2 BARRIERS

A. Provide as required to prevent public entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

B. Restore all disturbed areas to original condition unless otherwise noted.

1.3 NOISE PROTECTION

A. Minimize noise by fitting equipment with appropriate mufflers or sound enclosures. The use of explosives or blasting operations is not approved.

1.4 PROTECTION OF EXISTING AND INSTALLED WORK

A. Provide temporary protection for existing and installed products. Control traffic in immediate area to minimize damage.

B. Prohibit traffic and storage on waterproofed, lawn, and landscaped areas.

C. Immediately report any damage to structures, roads, facilities, liner system or landfill gas system to CQA Consultant and Owner.

D. All paved roads shall be protected from damage due to equipment, trucks, and off-road vehicles. Any damage to existing paved roads due to the Contractors work activities such as hauling, earthwork, or material transport shall be repaired to pre-construction conditions by the Contractor at no additional cost to the Owner.

1.5 DUST CONTROL

A. Methods for controlling dust are to conform to Florida Department of Environmental Protection, Southwest Water Management District, and local regulations.

B. All costs associated with the provisions of dust control shall be included in the Contractor's Firm Base Bid Price. No additional payment shall be made to the Contractor for any work, materials, labor, equipment, and/or services necessary for or incidental to the provision of required dust control measures.

1.6 EROSION AND SEDIMENT CONTROL

A. Employ and utilize environmental protection methods in full observance of all state, federal, and local regulations.

B. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas to prevent erosion and sedimentation.

C. Provide temporary measures such as berms, dikes, and drains to prevent water flow and protect terrain in accordance with control measures shown on Drawings and following:
   1. Protect properties adjacent to the project site from sediment deposition by installing appropriate perimeter controls.

2. Sediment barriers and other measures intended to trap sediment on-site shall be constructed as the first step in site preparation operations and shall be made functional before any upslope disturbance takes place.
3. Restore all disturbed areas to original condition unless otherwise noted or directed by Owner.
4. Protect all side slopes and back slopes immediately upon completion of final grading.
5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.

D. Runoff Protection: Utilize methods in compliance with Florida Standards to effectively prevent erosion and control of sedimentation. Control methods shall include, but not necessarily be limited to, the following:
1. Retardation. Mechanically retard rate of runoff by construction of diversion ditches, terraces, and berms. Divert runoff to prevent damage to water courses.
2. Protect side and backslopes as soon as rough grading is complete.
3. Provide stabilization adequate to prevent erosion at the outlets of all drainage pipes and ditches from the site.

E. Stormwater Run-on Control: Contractor shall take all appropriate actions to avoid and prevent any stormwater from entering portions of any constructed Cells by providing appropriate diversions. These measures/actions shall include, but not be limited to, berms, swales, barriers, and/or culverts.

F. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures at no additional cost to Owner.

1.7 CLEANUP DURING CONSTRUCTION

A. Collect solid waste on a daily basis.

B. Provide disposal of degradable solid waste generated by the Contractor to an approved solid waste disposal site. Contractor must coordinate with the approved franchise waste hauler for the area of the CCSWDC and pay all container, hauling, and disposal fees as required by the approved franchise hauler.

C. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.

D. No building material wastes or unused building materials shall be buried, dumped, or disposed of on the site.

E. Waste excavated from the project area as part of the Work may be disposed at the CCSWDC. The Contractor shall be responsible for establishing a pre-paid account with the CCSWDC and will be charged a waste disposal processing fee for disposal of the waste. Hauling the excavated waste to the scales to be weighed and then to the Class I Landfill working face at the CCSWDC is part of the Contractor's work.

F. All exposed waste or waste to be taken to the working face of the landfill must be containerized or covered or taken to the scales and working face by no later than 5:00PM each day.

1.8 REMOVAL

A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to specified, or to original condition.

1.9 SAFETY AND SECURITY/PROVISIONS

A. Contractor shall take all reasonable precautions to preserve and protect the Owner's and other Contractors' property and employees during the construction period. Contractors shall develop and maintain safety and fire prevention and loss control programs appropriate for their activities throughout the construction period.

B. Contractor shall be responsible for all site safety within the limits of the Work and shall strictly abide by all Federal, state, and local laws, regulations, and ordinances, including but not limited to those applicable requirements administered by the Occupational Safety and Health Administration (OSHA).

C. Contractor shall be responsible to adequately secure the site at the end of each workday.

1.10 UTILITIES

A. Contractor is to provide water, sewer, electrical, telephone, or other services as required for the project. The Contractor is responsible for all fees associated with their usage of said services.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 01560
ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Addresses:
   1. Minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations

B. Land Protection:
   1. Except for any work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work within the Contract Documents.
   2. Manage and control all borrow areas, work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to the work site.
   3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover.
   4. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
   5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.
   6. Except for areas designated by the Contract Documents to be cleared and grubbed or stripped, the Contractor shall not deface, injure or destroy trees and vegetation, nor remove, cut, or disturb them without approval of the Engineer. Any damage caused by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense.

C. Surface Water Protection:
   1. Utilize, as necessary, erosion control methods to protect side and backslopes, and minimize the discharge of sediment to the surface water leaving the construction site as soon as rough grading is complete. These controls shall be maintained until the site is ready for final grading and landscaping or until they are no longer warranted and concurrence is received from the Engineer. Physically retard the rate and volume of run-on and runoff by:
      a. Implementing structural practices such as diversion swales, terraces, straw bales, silt fences, berms, storm drain inlet protection, rocked outlet protection, sediment traps, turbidity curtains, and temporary basins.
      b. Implementing vegetative practices such as temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffers, hydroseeding, anchored erosion control blankets, sodding, vegetated swales or a combination of these methods.

c. Providing Construction sites with graveled or rocked access entrance and exit drives and parking areas to reduce the tracking of sediment onto public or private roads.

2. Discharges from the construction site shall not contain pollutants at concentrations that produce objectionable films, colors, turbidity, deposits or noxious odors in the receiving stream or waterway.

D. Solid Waste Disposal:
   1. Collect solid waste on a daily basis.
   2. Provide disposal of degradable solid waste generated by the Contractor to an approved solid waste disposal site. Contractor must coordinate with the approved franchise waste hauler for the area of the CCSWDC and pay all container, hauling, and disposal fees as required by the approved franchise hauler.
   3. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
   4. No building material wastes or unused building materials shall be buried, dumped, or disposed of on the site.
   5. Waste excavated from the project area as part of the Work may be disposed at the CCSWDC. The Contractor shall be responsible for establishing a pre-paid account with the CCSWDC and will be charged a waste disposal processing fee for disposal of the waste. Hauling the excavated waste to the scales to be weighed and then to the Class I Landfill working face at the CCSWDC is part of the Contractor's work.
   6. All exposed waste or waste to be taken to the working face of the landfill must be containerized or covered or taken to the scales and working face by no later than 5:00PM each day.

E. Fuel and Chemical Handling:
   1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.
   2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides from entering drainage ways.
   3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other waste waters to enter a drainage way(s) or stream.
   4. The Contractor shall provide containment around fueling and chemical storage areas to ensure that spills in these areas do not reach waters of the state.

F. Control of Dust:
   1. The control of dust shall mean that no construction activity shall take place without applying all such reasonable measures as may be required to prevent particulate matter from becoming airborne so that it remains visible beyond the limits of construction. Reasonable measures may include paving, frequent road cleaning, planting vegetative groundcover, application of water or application of chemical dust suppressants. The use of chemical agents such as calcium chloride must be approved by the State of Florida DOT.
   2. Utilize methods and practices of construction to eliminate dust in full observance of agency regulations.
   3. The Engineer will determine the effectiveness of the dust control program and may request the Contractor to provide additional measures, at no additional cost to Owner.

G. Burning:
   1. Do not burn material on the site. If the Contractor elects to dispose of waste materials by burning, make arrangements for an off-site burning area and conform to all agency regulations.

H. Control of Noise:
   1. Control noise by fitting equipment with appropriate mufflers.

I. Completion of Work:
   1. Upon completion of work, leave area in a clean, natural looking condition.
   2. Ensure all signs of temporary construction and activities incidental to construction of required permanent work are removed.

J. Historical Protection:
   1. If during the course of construction, evidence of deposits of historical or archaeological interests is found, cease work affecting find and notify Engineer. Do not disturb deposits until written notice from Engineer is given to proceed.
   2. The Contractor will be compensated for lost time or changes in construction to avoid the find based upon normal change order procedures.

END OF SECTION

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SECTION 01600
PRODUCT DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Scheduling of product delivery.
   2. Packaging of products for delivery.
   3. Protection of products against damage from:
      a. Handling.
      b. Exposure to elements or harsh environments.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

C. Payment:
   1. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved shop drawings.
      a. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

1.2 DELIVERY

A. Scheduling:
   1. Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.

B. Packaging:
   1. Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.

C. Identification:
   1. Clearly and fully mark and identify as to manufacturer, item, and installation location.

D. Protection and Handling:
   1. Provide manufacturer's instructions for storage and handling.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 PROTECTION, STORAGE AND HANDLING

A. Manufacturer's Instruction:
   1. Protect all products or equipment in accordance with manufacturer's written directions.
      a. Store products or equipment in location to avoid physical damage to items while in storage.
      b. Handle products or equipment in accordance with manufacturer's recommendations and instructions.
   2. Protect equipment from exposure to elements and keep thoroughly dry.

3. Store pumps, motors, electrical equipment, and other equipment having antifriction or sleeve bearings in weathertight warehouses which are maintained at a temperature of at least 50 DegF.
4. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

3.2 FIELD QUALITY CONTROL

A. Inspect Deliveries:
   1. Inspect all products or equipment delivered to the site prior to unloading. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.

B. Monitor Storage Area:
   1. Monitor storage area to ensure suitable temperature and moisture conditions are maintained.

END OF SECTION

SECTION 01640
PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The procedure for requesting substitution approval for a product which is specified by descriptive or performance criteria or defined by reference to one or more of the following:
      a. Name of manufacturer.
      b. Name of vendor.
      c. Trade name.
      d. Catalog number.
   2. This Section does not address substitutions for major equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

C. Requests for Substitution - General:
   1. Base all bids on materials, equipment, and procedures specified.
   2. Certain types of equipment and kinds of material are described in specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog numbers, provided said products are capable of accomplishing the same tasks as the products specifically indicated.
   3. Other types of equipment and kinds of material may be acceptable.

1.2 QUALITY ASSURANCE

A. In making request for substitution or in using an approved product, Contractor represents:
   1. He has investigated proposed product, and has determined that it is adequate or superior in all respects to that specified, and that it will perform function for which it is intended.
   2. He will provide same guarantee for substitute item as for product specified.
   3. He will coordinate installation of accepted substitution into work, to include building modifications if necessary, making such changes as may be required for work to be complete in all respects.
   4. He waives all claims for additional costs related to substitution which subsequently arise.

1.3 DEFINITIONS

A. Product: Manufactured material or equipment.

1.4 PROCEDURE FOR REQUESTING SUBSTITUTION

A. Considered before bid opening:
   1. See Instructions, Terms, and Conditions, Article 15, Quality Guarantee.

B. Considered after award of Contract.
   1. Considered only if:
      a. Or-equals are unavailable due to strike, discontinued production of products meeting specified requirements, or other factors beyond control of Contractor; or,
      b. Contractor proposes a cost reduction incentive to the Owner.

C. Written requests through Contractor only.

D. Transmittal Mechanics:
   1. Follow the transmittal mechanics prescribed for Shop Drawings in Section 01340. Product substitution will be treated in a manner similar to "deviations," as described in Paragraph 1.5.D.4. of Section 01340. List the letter describing the deviation and justifications on the transmittal form in the space provided under the column with the heading "DESCRIPTION." Include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in Paragraph E below.

E. Transmittal Contents:
   1. Product identification:
      a. Manufacturer's name.
      b. Telephone number and representative contact name.
      c. Specification section or drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
   2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
   3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
      a. Size.
      b. Composition or materials of construction.
      c. Weight.
      d. Electrical or mechanical requirements.
   4. Product experience:
      a. Location of past projects utilizing product.
      b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.
      c. Available field data and reports associated with proposed product.
   5. Data relating to changes in construction schedule.
   6. Data relating to changes in cost.
   7. Samples:
      a. At request of Engineer.
      b. Full size if requested by Engineer.
      c. Held until substantial completion.
      d. Engineer not responsible for loss or damage to samples.

1.5 APPROVAL OR REJECTION

A. Written approval or rejection of substitution given by the Engineer.

B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.

C. In event substitution results in a change of Contract price or time, provisions in General Conditions will be applied for adjustment.

D. Substitutions will be rejected if:
   1. Submittal is not through the Contractor with his stamp of approval.
   2. Requests are not made in accordance with this Section.
   3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
   4. In the Engineer's opinion, substitution will not perform adequately the function consistent with the design intent.

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Description of procedures to be followed and related work required to accomplish an orderly transfer of Project deliverables from the Contractor to the Owner.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Proposal Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Sarasota County Government Bidding Requirements

1.2 DEFINITIONS

A. Punch List: The stated qualification accompanying either the Engineer's Certificate of Substantial Completion or the Certificate of Final Payment, or any list of construction items found to be deficient or incomplete through review of the Work by Engineer and communicated in writing to Contractor at any time during the Contract Period.

B. Record Drawings: Drawings showing changes made during actual construction. Changes must be shown in red marking. Contractor to provide Engineer with copy of record drawing CAD files.

C. Definition of Substantial Completion (refer to the General Conditions):
   1. In order to obtain a Certification of Closure for the landfill unit under construction, the CQA Consultant, on behalf of the Owner, must submit a comprehensive Certification Report to the regulating authority for approval. All CQC documentation maintained by the Contractor will be included in the Certification Report.
   2. Substantial Completion requires that, at a minimum, the Contractor has met the following criteria:
      a. That the CQC consultant has completed all required testing, has obtained and verified all test results.
      b. That the surveyor has completed all required surveys, has verified all lines and grades, and submitted a comprehensive, sealed survey document to the Contractor certifying that all conditions of the Contract regarding survey requirements have been met.
      c. That the Contractor has obtained, reviewed, and submitted all CQC documents (testing and survey) to the Engineer with a certification stating that the documents have been thoroughly reviewed by the Contractor and that all conditions of the Contract regarding documentation have been met. Interim preliminary or final testing or survey results transmitted to the Engineer during progression of the Work shall not be construed to represent submittal of information required above. The Contractor and surveyor shall compile all information obtained throughout construction for comprehensive submittal as stated above.

D. Definition of Final Acceptance: Completed including final inspections, correction of punch list items, and providing the Owner with all close-out documents required by the Contract. Refer to the General Conditions.

1.3 SUBMITTALS

A. Substantial Completion:
   1. Contractor to notify Engineer in writing that the Contractor considers the Work as a whole to be in Substantial Completion and request for a Substantial Completion inspection.

2. Three (3) draft copies of the complete Record Drawings shall be submitted for review at substantial completion.

3. A list of work, if any, not to be considered for Substantial Completion.

B. Final Acceptance:
   1. Contractor to notify Engineer in writing that the Contractor considers the entire Work to have progressed to final acceptance.
   2. Six (6) signed and sealed certified sets of Record Drawings shall be submitted for final acceptance of the project. The submittal of Record Drawings shall be a requirement for granting final completion of the project. Liquidated damages may be imposed in accordance with the Contract Documents if the certified Record Drawings are not submitted for final completion.
   3. When final acceptance and Substantial Completion are coincidental:
      a. Submittals required for Substantial Completion, and;
      b. Record Drawings;
      c. Lien waivers, if requested by Owner;
      d. Evidence of payments, if requested by Owner.
   4. When final acceptance does not coincide with Substantial Completion:
      a. Substantial Completion submittals for portions of the work not previously considered substantially complete, if any, and;
      b. Record Drawings;
      c. Lien waivers, if required by Owner;
      d. Evidence of payments, if required by Owner.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 SUBSTANTIAL COMPLETION, ADJUSTMENT AND RELEASE OF RETAINAGE

A. When the Work is found to be in a state of Substantial Completion with stated qualifications:
   1. Retainage will be reduced according to the schedule in the General Conditions.
   2. Or at Owner's sole discretion:
      a. Engineer: Determine the value of the punch list work using either the Project approved cost breakdown, schedule of values, or other method at his discretion.
      b. The value of incomplete work will be multiplied by 2 and retainage reduced to that amount.

B. No partial payments of the Substantial Completion retainage will be allowed.

C. The Substantial Completion retainage will be released with final payment.

3.2 INSPECTION FOR FINAL ACCEPTANCE AND PAYMENT

A. When the items of Work on the Punch List(s) have been completed, and Contractor considers the Work of the entire Project is complete, he shall submit written certification that:
   1. Contract Documents have been reviewed.
   2. Work has been inspected for compliance with Contract Documents.
   3. Work has been completed in accordance with Contract Documents.
   4. Equipment and systems have been tested in the presence of Owner's representative and are operational.
   5. Work has received final cleanup and restoration.
   6. Work is completed and ready for final inspection.

B. Engineer and Owner will make an inspection with the Contractor to verify the status of completion within 14 calendar days after receipt of such certification.

C. Should Engineer consider that the Work is incomplete or defective:
   1. Engineer: Notify the Contractor in writing within 7 calendar days, listing the incomplete or defective work.
   2. Contractor: Remedy the stated deficiencies, and send a second written certification to Engineer that the Work is complete.
   3. Engineer will reinspect the Work.

D. When Engineer finds the Work acceptable in accordance with the Contract Documents: Engineer requests Contractor to make closeout submittals.

E. Reinspection costs incurred by the Engineer will be billed to the Owner and deducted by the Owner from the final payment to the Contractor.

3.3 FINAL APPLICATION FOR PAYMENT

A. Complete demobilization prior to submitting final application for payment.

B. Submit final application for payment in accordance with procedures and requirements stated in the Conditions of the Contract.

C. Engineer will review application for final payment within 7 calendar days of receipt of application, and provide a recommendation to the Owner regarding payment.

3.4 LIQUIDATED DAMAGES

A. See requirements in Contract.

END OF SECTION

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SECTION 02130
VERTICAL EXTRACTION WELLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope of Work: The Contractor shall provide all labor, equipment, materials, and appurtenances necessary to drill, install and make ready landfill gas (LFG) extraction wells and wellheads as specified herein and as indicated on the Plans.

B. The perforated pipe, bentonite seals, stone, and soil backfill packs shall be set at depths shown on the Plans or as designated in the field by the Engineer. It is expected that combustible, asphixiant, and hazardous gases will be venting from boreholes drilled to install LFG extraction wells. The Contractor's bid price shall include provision for all equipment and procedures necessary to safely install wells under this condition. All work shall be performed by qualified workers in accordance with the best standards and practices available.

C. Upon completion of each extraction well, Contractor is responsible for the physical hauling and drop-off of all construction and drilling waste materials as directed by the Owner, at the landfill working face during normal operating hours. The Contractor is responsible for weighing the waste at the landfill scales using highway legal trucks and for paying disposal fees. Contactor shall establish a prepaid account with the landfill for disposal prior to the commencement of drilling.

D. Related Sections include but are not necessarily limited to:
   1. Section 15060 – Pipe and Pipe Fittings: Basic Requirements
   2. Section 15067 – Pipe: Polyethylene

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates
      b. C702, Standard Practice for Reducing Field Samples of Aggregate to Testing Size
      c. D2487, Standard Test Method for Classification of Soils for Engineering Purposes
      d. D2487, Standard Practice for Description for Soils (Visual-Manual Procedure)
      e. D2922, Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
      f. D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
      g. D1693 - Test Method for Environmental Stress Cracking of Ethylene Plastics.
      h. D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
      i. D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
      j. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter - Controlled Polyethylene Pipe and Tubing.
      k. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
      l. D3350 - Specification for Polyethylene Plastic Pipe and Fittings Material.
      m. D421, Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
      n. D422, Standard Test Method for Particle-Size Analysis of Soils.
      o. D4220, Standard Practices for Preserving and Transporting Soil Samples.

p. F480, Standard Specification for Thermoplastic Water Well Casing Pipe and Couplings Made in Standard Dimension Ratio (SDR).
q. F1248 - Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.

B. Qualifications:
1. The driller and installer of the landfill gas extraction wells shall have completed at least one hundred successful vertical landfill gas extraction wells of similar type and depth within the last 2 years.
2. All LFG collection wells shall be installed under the direction of a Civil Engineer, or Engineering Geologist, or Geologist if so required by local or state jurisdictions. All final LFG collection well drilling logs and construction diagrams shall be signed by a registered professional or person of responsible charge. Field supervision of drilling, logging and installation activities shall be performed by trained, experienced technical personnel.

C. Miscellaneous:
1. Contractor's personnel Health and Safety Plan shall be available for informational purposes.
2. Retain a professional experienced in installation of LFG wells to be responsible for observing and documenting information related to all installation activities.
3. Inspect well materials for cleanliness, deformations, and imperfections, and to ensure conformance with specifications prior to use.

1.3 SUBMITTALS

A. The Contractor shall prepare and submit to the Engineer, for review and approval, Certificates of Compliance on materials furnished, and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, and inspection of pipe and appurtenances furnished.

B. The Contractor shall submit a health and safety plan (HASP) for information purposes only and not for review to the Engineer before any construction starts.

C. The Contractor shall prepare and submit to the Engineer for review and approval Shop Drawings showing dimensions, materials, and manufacturer's information for backfill materials, pipe, pipe perforations, fittings, bentonite, and wellhead components.

D. One week prior to well drilling, Contractor shall submit an example well boring log and construction log. The example log shall be completed with all of the required descriptions and pertinent information required under Part 3.3 of this Section.

E. At least two weeks prior to construction, the Contractor shall submit to the Engineer for review and approval, results of the sieve analysis and calcium carbonate content for the stone backfill, samples of all well backfill materials (if requested), the name of the vendor(s) and source of materials furnished.

F. At the end of each day, Contractor shall provide the Engineer copies of the handwritten well boring and completion logs for each well drilled on that day. Information to be included on the well logs is listed in Part 3.3 of this Section.

G. Final boring logs, based on field information shall be typewritten and submitted with the Record Documents.

H. As-Built drawings shall be submitted to the Engineer including, northing, easting and elevation data for all required points of the gas collection system in the state plane coordinate system. Top of casing and ground surface elevation shall be surveyed for all well points.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers of HDPE casing, screen, protective casing and accessories are acceptable:
   1. CSR/Polypipe
   2. ISCO
   3. Lee Supply
   4. Ferguson Industrial Plastics
   5. Or acceptable others

2.2 MATERIALS

A. Well Casing as specified in Section 15060:
   1. 6 inch nominal diameter.
   2. ASTM D1248.
   3. High Density Polyethylene Pipe (HDPE) PE 3408 SDR 11 or approved equal with ASTM D3350 Cell Classification 345434C.

B. Well Screen:
   1. Same material and dimensions as casing.
   2. 3/4 inch diameter perforation
   3. Holes to be factory installed. No holes or slots to be installed in the field.
   4. 20 foot lengths or as needed. Field cutting will be allowed as long as cuts are clean, perpendicular to the pipe, and do not affect the integrity of the well screen.

C. HDPE Jointing:
   1. All joints shall be butt fused per ASTM D3261.
   2. Bottom cap of screen shall be butt fused per ASTM D3261.

D. Filter Pack as specified in Section 02221:
   1. Clean washed, non-calcareous gravel with no fines.
   2. 1-inch to 3-inch diameter size so as not to impair flow to perforations/slots.

E. Bentonite Seal:
   1. Pellet or chip form of sodium bentonite that shall consist of clay greater than 85% sodium montmorillonite, without additives.
   2. Bentonite shall be hydrated per manufacturer's instructions prior to backfilling with soil. Bentonite shall be hydrated in 6-inch lifts as per Paragraph 3.2.C.15 of this Section.
   3. Under no circumstances will the use of granular bentonite be permitted.

F. Backfill Material:
   1. Soil backfill material shall be granular material free of clay, sticks, roots organic material from the on-site borrow area.

G. Top and Bottom Cap:
   1. Bottom end cap shall be HDPE butt-fusion welded.
   2. Contractor shall supply temporary SCH 40 PVC cap on the top secured with at least three (3) set screws and silicone sealant as per Project Drawings and Specifications.

H. Wellhead materials
   1. Wellheads shall be 2-inch diameter Accu-flo wellheads by Landtec or approved equal.
   2. Vertical wellhead models shall be used for all wells

I. Sample ports
   1. Sample ports shall be 1-inch PVC ball valve to meet existing gas wells GWs or approved equal.

J. Well Identification
   1. Upon completion of well drilling, Contractor shall promptly label the well identification number on the well casing on three (3) sides self adhesive labels to match existing gas wells. Lettering by hand or by any other means shall not be permitted.

K. Spare Parts
   1. One well head
   2. 100' Kanaflex Hose
   3. 2 Dozen Power Clamps for Kanaflex Hose
   4. 2 Dozen Quick Connect Adaptors – Female
   5. 1 Dozen Thermometer Quick Connects – Female
   6. 4 Thermometers (to go with connect assembly)
   7. 6 Dozen Caps
   8. 4 Well Head Valve Handles

L. LFG Collection Wells:
   1. The Contractor shall install the landfill gas collection wells at the locations noted on the Project Drawings and/or where staked in the field, or as approved by the Owner or Engineer.
   2. The LFG well boring will be as noted in the drawings. The drilled boring shall be specified by the Engineer or Owner, and shall extend to approximately 75-percent of the depth of the waste mass but not be within 15 feet of the landfill base liner system elevations. In no instance will well bores be advanced and/or completed into the native soils beneath the landfill. Wells shall be constructed in accordance with the details shown on the Project Drawings and as noted in the Specifications.

M. Geocomposite:
   1. 6 oz geotextile bonded to geonet.

N. Pneumatic Pump:
   1. See Section 11070.
   2. Alternative item to be installed in select vertical gas wells to be determined by Owner and Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. All materials necessary to complete the installation of the gas extraction well shall be on-site prior to drilling start-up.

B. Contractor shall follow his Health and Safety Plan at all times.

C. The Contractor shall survey and stake the well locations prior to drilling. Well layout surveying shall be done by a Florida Licensed Professional Surveyor. Contractor shall notify the Engineer of any discrepancies between the elevations shown on the drawings and actual field measurement elevations, and any other conflicts that may be evident.

D. Contractor shall supply surveyed ground elevations to Engineer electronically in AutoCAD format so that the design depths may be confirmed at least one week prior to drilling.

E. Well locations must be approved and may be adjusted by the Engineer prior to beginning drilling. Final well schedule to be used for construction of the vertical wells will be provided by the Engineer after reviewing the survey provided by the Contractor.

3.2 INSTALLATION

A. General:
   1. All wells will be installed in the general locations shown in the Contract Drawings. The well schedule shows the estimated design depths of the wells along with the associated screen lengths. All field changes regarding the locations, depth, or dimensions specified in the

Contract Drawings shall be approved by the Engineer and documented in the record drawings by the Contractor.

2. The Contractor shall provide at all times a thoroughly experienced, competent driller during all operations at the drill site.
3. The Contractor must use dry drilling equipment.

B. Well Hole Construction:
   1. Drill wells using a minimum 36 in. OD core-grab bucket auger. Alternate drilling methods must be pre-approved by the Engineer.
   2. If a layer of sand or the liner is encountered while boring, drilling shall immediately cease and the Engineer shall be contacted immediately.
   3. All gas extraction well borings shall extend to the depth indicated in the plans. Under no circumstances, are the drilling depths from the well schedule on the Plans to be exceeded unless approved by the Engineer in advance.
      a. Wet Borings:
         1) The Engineer shall be notified of wet boring conditions.
         2) If water is encountered in a boring, the Contractor may be directed by the Engineer to drill beyond the point at which it was encountered. If wet conditions remain, at the direction of the Engineer, the boring may be terminated (after driller has attempted to advance boring for 3 hours) and the length of perforated pipe adjusted by the Engineer. If wet conditions cease (e.g. due to perched water layer), then drilling will continue to the design depth.
         3) If water is encountered in a boring at a shallow depth, the Engineer may decrease the well depth and length of perforated pipe, or relocate the well.
      b. Abandoned Borings
         1) If in the opinion of the Engineer, the borehole has not reached a sufficient depth to function as an effective extraction well, the Contractor shall abandon this borehole by backfilling it with cuttings removed during drilling. Soil shall be backfilled and compacted to ground surface. Contractor shall supply additional soil backfill to refill any settlement within the abandoned borehole, as approved by the Owner and Engineer.
         2) If cuttings are unsuitable as backfill (for example, box springs, tires, etc.) the Contractor shall use soil backfill material.
         3) Compensation for abandoned borings shall be at the unit price for boring refusal.
      c. As soon as drilling is completed, a safety screen shall be placed over the top of the bore. This screen shall stay in place until backfilling is within 4 feet of the surface. Safety screen size should be large enough to accommodate all backfill materials and any tools used during backfill yet not large enough for any human to accidentally fall through.
      d. All bore holes that are not completed at the end of the day are to be covered with a metal well cover capable of preventing any persons from falling into the hole. The hole must then be covered with a piece of plywood to substantially cover the entire hole. Soil must be placed on top of the plywood to completely cover the plywood to further prevent gas emissions. Substitute safety measure may be used if approved by the Engineer.

C. Well Installation:
   1. Contractor shall fabricate the well casings in accordance with Project Drawings and Specifications. The well casing shall be perforated in accordance with the Details and Specifications. Well casings shall be capped or blind-flanged at the surface connection prior to installation to prevent gas from escaping and to prevent backfill material from entering the pipe.
   2. No pressure tests are required for the collection well casings.
   3. Measure depth of boring. The bore for the well shall be straight and the well pipe shall be installed in the center of the borehole.
   4. Connect the well screen and a sufficient length of well casing including bottom plug or cap.
   5. Place 12 inches of gravel filter pack in the bottom of the boring prior to installing well casing.

6. Lower screen into the well with the casing. In no instance, drive or force into position. The Contractor shall take all necessary precautions to maintain the well pipe vertically plumb during the entire backfill operation of the borehole to the satisfaction of the Engineer.
7. If the pipe is installed out of plumb, as determined by the Engineer, the Contractor, at his own expense shall correct the alignment.
8. Join screen and riser sections for a single interval by butt fusion methods per ASTM D3261 for HDPE.
9. Extend casing to no more than 4 feet above final cover surface elevation.
10. At the end of each day, Contractor shall cap the ends of all joined pipes longer than 20 feet to prevent entry by animals and debris.
11. Continue placement of gravel filter pack into the annulus between the well screen and the borehole wall until the filter pack is 24 inches minimum above the top of the well screen. All filter pack materials shall be placed by methods approved by Engineer.
12. Take periodic depth soundings to monitor the level of the filter pack and detect any bridging. Soundings shall be taken at no more than 5-foot intervals.
13. Place 6 ounce non-woven geotextile bonded to geonet (geocomposite) or approved equal on top of the gravel filter.
14. Place a 1-foot minimum soil plug on top of the geonet.
15. After ensuring that the casing is centered in the borehole, place 2 foot minimum bentonite seal on the soil plug in maximum 6-inch lifts.
    a. Hydrate bentonite chips/pellet in the bore hole per supplier's recommendations for a minimum 1 hour after placement and prior to installing clean backfill. The bentonite must be thoroughly hydrated,
    b. Measure depth of bentonite seal after tamping each lift.
16. Fill borehole with clean backfill and install second bentonite seal as specified above in Step #15 and shown in the detail for the vertical extraction well. Fill the remainder of the bore hole to grade with cover soil with clean backfill by means pre-approved by the Engineer in maximum 18-inch lifts.
    a. Soil backfill shall be rodded in the boring to provide even distribution and compaction.
17. The grate over the borehole that is used to keep the well casing plumb shall not be removed until the borehole is backfilled to within 1 foot of ground surface and sufficiently compacted.
18. Collect and clean up drilling debris, cuttings around the work areas. Dispose in active landfill.
19. Mound shall be installed around the well riser to drain stormwater away from the well.
20. Contractor shall be responsible for any grading, leveling, towing and/or restoration that may be necessary for movement of the drill rig on the landfill property

D. Refuse Disposal:
1. Contractor shall dispose of cuttings at the working face of the landfill by the end of each working day. Contractor is responsible for weighing cuttings at landfill scale in highway legal trucks and paying tipping fees. Contractor shall be responsible for all other costs. Excavated refuse must be removed immediately during any rain event to prevent stormwater from contacting the refuse.

E. Temporary Cap:
1. The Contractor shall temporarily cap the riser pipe of the vertical extraction well immediately after well pipe installation to prevent venting of LFG into the atmosphere. The Contractor shall remove this cap during the installation of the wellheads. Lag screws may be necessary to secure the cap due to the internal gas pressure within the well.

F. Wellhead Installation:
1. Wellheads shall be installed in accordance with manufacturer's recommendations. Pipe sections of the wellhead shall be air-tight. Any leaks shall be repaired by Contractor at no additional cost to the Owner.
2. Install flexible hose so that hose has no sags, as show on the Plans. However, flexible hose shall not be taut. Provide enough slack to accommodate minor pipe settlement, as approved by the Engineer.
3. Wellhead to lateral connection shall be made with a 2 inch flexible hose fastened with stainless steel pipe clamps (or equal).

G. Asbestos Handling:
   1. If asbestos is encountered during drilling operations, the following waste handling procedures must be implemented:
      a. If any waste appearing to possibly contain asbestos is uncovered, all asbestos handling procedures will be immediately placed into effect.
      b. All persons within 25 feet of the drilling operations will be required to wear the appropriate respirators.
      c. The use of Tyvek suits will be optional. However, if Tyvek suits are not worn, all employee uniforms must be laundered and the launderers notified of possible contamination with asbestos. All Tyvek suits will be considered to be contaminated with asbestos and will be disposed of accordingly.
      d. A water truck equipped with the appropriate spraying equipment to keep the drill cuttings wet will be required at all times.
      e. An area of appropriate size will be prepared to contain the cuttings by one of the following methods.
         1) A waste container lined with 6 mil polyethylene will be placed as close as reasonably possible to the well being drilled. A small area next to the drill rig where drill cuttings will be handled will also be lined with 6 mil polyethylene and covered with clean soil to protect the polyethylene. A small earthen berm will be made to help contain the cuttings and facilitate loading into the container. The polyethylene and soil cover will be considered to be part of the waste.
         2) An area next to the drill rig that is appropriately sized to accommodate all of the drill cuttings will be surrounded by a small soil berm approximately 30" high. This area will then be lined with 6 mil polyethylene and covered with clean soil to protect the polyethylene. This area will be positioned in a way such that all handling of cuttings will be in the protected area. The polyethylene and soil will be considered to be part of the waste.
      f. All cuttings that are not already damp upon removal from the well bore will be immediately wetted.
      g. After wetting, all cuttings will be immediately placed into the container or moved to a different part of the storage area (if needed).
      h. All cuttings will be kept damp and covered.
      i. After the container is filled, the well is completed, or at the end of the workday, a representative sample will be taken of the waste. The waste sample will be tested by a certified testing laboratory for asbestos using the polarizing light microscopy method. While waiting for the test results, all waste will be kept damp and covered.
      j. If test results indicate greater than one (1) percent asbestos, the waste will be handled and disposed as asbestos waste. This will include keeping the waste wetted and covered as it is transported to another portion of the landfill. If asbestos waste is handled, all equipment that contacted the waste must be decontaminated in an acceptable manner prior to leaving the landfill site.
      k. If test results indicate less than one (1) percent asbestos, the waste will be tested as normal MSW and disposed of at the normal working face of the landfill.
      l. An alternative to sampling and testing the waste will be to assume that the waste contains asbestos and to handle and dispose of accordingly.
      m. The cost of all laboratory testing will be the responsibility of the Contractor. The exact drilling procedure that will be followed must be included in the Contractor's Health and Safety Plan. Additionally, both the selected testing laboratory and testing protocol (should asbestos be encountered during drilling) must be submitted by the Contractor in writing and approved by the Owner prior to beginning any well drilling activities.
      n. Contractor shall be responsible for safely transporting asbestos in highway legal trucks to landfill scales for weighing prior to disposal at active face. Contractor is responsible for paying all associated tipping fees.

H. Settlement
   1. Any settlement around the completed wells, or over abandoned boreholes, shall be backfilled within 3 weeks after placement of backfill from the level of the subsidence to 6 inches above existing grade with the appropriate cover materials.

I. Obstruction
   1. If there is a drilling obstruction encountered in the landfill that, despite the best reasonable efforts of the Contractor, cannot be penetrated, the Contractor shall request relief from the Owner or Engineer from completion of the well. The Owner or Engineer shall be the sole authority for deciding on one of the following:
      a. Additional drilling efforts are needed at no additional compensation.
      b. The hole shall be abandoned. The Contractor shall backfill the well to the predrilled condition or to the satisfaction of the OWNER or Engineer. The Contractor shall be compensated for the drilling and backfilling of the well, but not its completion.
      c. The well shall be accepted at the obstructed depth. The well shall be completed at this new depth. Compensation shall be for the modified footage of the well.

3.3 FIELD QUALITY CONTROL

A. Submit the following to the Engineer after each day's work.

B. Project Record Documents:
   1. Daily driller's report: During the drilling of the well, maintain daily driller's report that includes:
      a. Date
      b. Location
      c. Boring Identification Number
      d. Weather Conditions
      e. Daily Activities
      f. Equipment Used
      g. Materials Used
      h. Well construction (materials used, type, quantity, etc.)
      i. The number of feet drilled.
      j. The number of hours on the job (rig time, down time, stand-by, etc.).
      k. Names of contract personnel on the job.
      l. The foot of casing set.
      m. Other pertinent data as may be requested by the Engineer.
   2. Driller's log: During the drilling of the well, prepare and maintain a complete log that includes:
      a. Logger's Name
      b. Date
      c. Location
      d. Boring Identification Number
      e. Equipment Used
      f. Drill Crew
      g. Time
      h. The reference point for all depth measurements.
      i. The depth at which each soil to refuse change occurs.
      j. The thickness of each soil or refuse stratum.
      k. The depth at which the leachate is encountered, if applicable.
      l. Depth to refuse and depth of undisturbed soil.
      m. Visual description of refuse at 5-foot intervals:
         1) Type of waste encountered including the estimated percentage of the following components (by volume) on visual inspection:
            a) Plastic/Cardboard
            b) Plastic
            c) Yard waste
            d) Construction debris

e) Textiles
f) Tires
g) Sludge
h) Dirt

2) Temperature of excavated refuse.

n. Depth of location of any lost drilling material, tools, or any other unusual occurrences.
o. The total depth of completed extraction well.
p. The total depth of boring.
q. Well screen interval.
r. Solid pipe casing interval.
s. Length of above ground riser stick-up pipe.
t. Gravel filter pack depth interval.
u. Bentonite seal depth interval.

3. Typed final copies of the well logs shall be submitted with the Record Drawings. Handwritten logs will not be acceptable for submittal with the Record Drawings.

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SECTION 02200
EARTHWORK - LANDFILLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Earthwork, including intermediate cover, final cover system, cover soil layer for the Phase I/II overlay liner system, and anchor trench backfill material for exposed geomembrane closure area.

B. Additional Work under this Section includes excavation, backfilling, and compaction for the Leachate Cleanout Pump Pads.

C. Related Sections include but are not necessarily limited to:
   1. Section 02130 – Vertical Extraction Wells
   2. Section 02221 – Trenching, Backfilling, and Compacting for LFG Piping and Structures
   3. Section 02260 – Topsoiling and Finished Grading

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D422, Method for particle size analysis of soil
      b. D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f (2,700 kN-m/m)).
      d. D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
      e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      f. D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
      g. D2937, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
      h. D3017, Standard Test Method for Water Content of Soil and Rock in Place by Neclear Methods (Shallow Depth).
      i. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      j. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
      k. D6938, Standard Test Method for in-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods.
   2. Florida Erosion and Sediment Control Planning and Design Manual, current edition.
   3. Florida Department of Transportation Standard Specification for Road and Bridge Construction, current edition.
   4. Construction Quality Assurance (CQA) Plan.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Certifications.

3. Test reports:
   a. Soils inspection and testing results.

B. Samples:
   1. Submit samples and source of all soil materials proposed for use.
   2. Submit soil samples directly to CQA and CQC Laboratories with coordination and notification to the Engineer.

1.4 SOILS/GEOTECHNICAL

A. The Owner will provide for the on-site services of a CQA Inspector to selectively test materials and monitor compliance with the requirements of these Specifications.

B. The Contractor will afford these representatives access to the job site for the performance of their duties as described in the Contract Documents.

C. General Duties and Responsibilities of the Owner's CQA Inspector: Under the direction of a qualified registered engineer or geologist:
   1. Perform stockpile and in-place testing of all soil material used in the work in conformance with these Specifications and the CQA Plan.
   2. Inspect existing intermediate cover and excavations and evaluate/determine suitability of materials encountered. Determine extent of any overexcavation required to remove unsuitable materials under areas of construction.
   3. Document placement of fill materials and perform testing to confirm compliance with these Specifications.
   4. Evaluate the suitability of existing on-site materials for use in construction of embankments and fills.
   5. Measure quantity of unsuitable materials under contract provisions for authorized overexcavation and backfill.
   6. Review construction operations and monitor for compliance with Contract Documents.

D. Available Soil Information: Where provided, data on soil quantities or conditions is not intended as representations or warranties of the thickness of such conditions between borings or indicated sampling locations. It shall be expressly understood that neither the Owner nor the Engineer will be responsible for any interpretation or conclusion drawn therefrom by the Contractor. Data is made available for the convenience of the Contractor.

E. Additional or supplementary soil borings and/or test pits may be made by the Contractor at no additional cost to the Owner. The Contractor shall provide the Owner with a copy of any data obtained/developed during such work. Such additional work shall be performed in a timely manner in accordance with and not impacting or changing the project schedule set forth in the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All soils: Should be free of deleterious material (sticks, roots, waste, etc.) and rock fragments, boulders, or cobbles greater than 3 inches in size. Soils shall be obtained from the designated on-site borrow areas. Drainage sand layer for the overlay liner system shall be provided by the Contractor from an approved off-site borrow source (Refer to specification 02240)

B. Intermediate cover, final cover system, and cover soil layer of the Phase I / II overlay liner system shall be classified as SP, SW, SM, SC, SP-SM, or SP-SC materials in accordance with ASTM D2487. Fines content of installed soil shall be a maximum of 50% (passing #200 sieve).

C. The Contractor shall conduct his own quantity and quality investigations and testing to determine availability and suitability of all borrow materials, as allowed by the Owner.

D. All earth materials proposed for use in the Work shall be adequately characterized by the Contractor prior to the Work and testing to be completed by the CQA Inspector. Any soil samples submitted by the Contractor are assumed to be tested and approved for use by the Contractor.

E. The Contractor shall submit source test data for all borrow soils to the CQA Inspector for approval a minimum of 48 hours prior to its intended use.

F. Structural fill will be used to construct berms and anchor trench backfill for the TPO. The soil will be classified as ML, SM, SW, SC, SP-SM, SP-SC or CL in accordance with USCS and will have no particles or soil clods larger than 3 in. (75 mm). The minimum dry density of the structural fill material in the anchor trench will be 102.5 lb/cf. Any deviation from the minimum dry density may be accommodated with a revised anchor trench design that provides equivalent design performance. These adjustments shall be communicated clearly in the final CQA report that is submitted to DEP.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain bench marks, monitoring wells, existing structures, monuments or other established reference points and property corners.
      a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
   3. Verify location of utilities.
      a. Omission or inclusion of utility items does not constitute non-existence or definite location.
      b. Secure and examine local utility records for location data.
      c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
      d. Repair damages to utility items at own expense.
      e. In case of damage, notify Engineer at once so required protective measures may be taken.
   4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
      a. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
      b. All repairs to be made and paid for by Contractor and no additional cost to the Owner.
      c. All paved roads shall be protected from damage due to equipment, trucks, and off-road vehicles. Any damage to existing paved roads due to the Contractors work activities such as hauling, earthwork, or material transport shall be repaired to pre-construction conditions by the Contractor at no additional cost to the Owner.
   5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
   6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
   7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.
   8. Conduct operation with minimum interference to daily landfill operations.

B. Construct erosion and sedimentation controls prior to beginning earthwork.

C. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

D. Dispose of waste materials, legally, -at the active face of the Phase II landfill.

1. Any waste generated by the Contractor during the performance of the Work will be properly disposed of at a permitted facility.
2. Burning, as a means of waste disposal, is not permitted.
3. Contractor responsible for excavation, transportation, weighing at scale house, and paying all applicable processing fees.

E. Waste excavated for construction and installation of intermediate cover, TPO anchor trenches, toe drains, stormwater downchute pipes, gas well borings, and LFG piping shall be disposed of by the Contractor at the active face of the Phase II landfill. The Contractor will be charged a processing fee of $10.08 per ton for disposal of the waste and will be responsible for weighing the waste at the landfill scales in highway legal trucks. All costs associated with waste disposal shall be included in the Contractor's Firm Base Bid Price. No additional payment shall be made to the Contractor for any over-excavation not approved by Engineer or CQA Consultant.

F. Contractor shall be responsible for complete repair of any damage to any and all components of existing gas collection system caused by his actions during performance of landfill closure at no expense to Owner. Modification, relocations (horizontally and vertically), or other work to the existing gas collection system required, needed, or resulting from grade changes or other designed construction resulting from the landfill closure shall be brought to the attention of the Owner. Contractor shall notify Owner of any modifications to the gas collection system required for the performance of his work sufficiently ahead of time to allow the modifications to take place without impacting the construction schedule.

G. The final cover system is placed directly over the geocomposite, thus extreme caution shall be exercised by the Contractor to prevent damage to the liner system. The final cover system will be placed after construction of the landfill gas header and laterals is completed and approved.

H. Placement of the protective cover material of the final cover system shall be conducted only when the CQA Inspector or his representative is informed in advance of the intent to perform this work and is present at the site to observe the placement.

I. During placement of the final cover system, no construction equipment shall be allowed directly on the geomembrane or drainage composite, except low ground pressure equipment necessary for the deployment and installation of geomembrane liner. Any damage to these components shall be repaired immediately in accordance with the respective specifications. A 4-foot thick traffic surface consisting of protective cover material shall be constructed to support haul trucks traveling over the liner.

J. Stockpiles of materials for final cover system (including topsoil) shall be deposited in the closure area without vehicles traveling on the drainage composite. Soil shall then be pushed over the uncovered areas of the disposal unit with bulldozers. Advancement of soils over the liner system shall be achieved by pushing a minimum 12-inch thick loose lift ahead of the dozer blade.

K. Only low ground pressure dozers shall be used for spreading and grading of the final cover system (including topsoil) in accordance with the appropriate geosynthetic manufacturer's recommendations.

L. The final cover material shall be placed on slopes starting at the toe of the slope and spreading toward the top of the slope.

M. Final cover material shall only be spread when the liner is laying evenly over the intermediate cover of the landfill. Material shall not be spread over "standing waves" in the liner that form during periods of high temperature and direct sunlight. A standing wave is defined as a ripple in the liner in which the height of the ripple (as measured from the intermediate cover surface) exceeds the width of the ripple. If standing waves are occurring during peak temperature hours, the spreading operation shall be limited to mornings (before 10:00 am) and evenings (after 6:00 pm) or hours agreed upon by the Engineer and Contractor.

N. Any excavation in the final cover system will be performed with a backhoe bucket equipped with a protective sleeve over the bucket teeth or by another method approved by the Engineer. The Contractor shall exercise extreme care not to disturb or damage the drainage composite or liner. Any liner or drainage composite damaged shall be immediately repaired at no cost to the Owner and as directed by the Engineer.

3.2 SITE EXCAVATION AND GRADING

A. The work includes all operations in connection with excavation, borrow, construction of intermediate cover, final cover system (including vegetative cover layer), cover soil layer of the Phase I / II overlay liner system, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the project.

B. Excavation and Grading: Perform as required by the Contract Drawings.
   1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
      a. Stake all units, structures, piping, roads, and establish their elevations.
      b. Perform other layout work required.
      c. Replace permanent survey markers to original location if disturbed or destroyed.
   2. Preparation of ground surface for additional intermediate cover:
      a. Installation of the landfill gas header, laterals, sumps, and vertical extraction wells must be completed and approved before intermediate cover soil is placed.
      b. Before additional intermediate cover is placed, remove vegetation and unsuitable soils and scarify existing intermediate cover to a minimum depth of 6 IN in all proposed temporary final cover and final cover areas.
      c. Sod and soil stripped from the intermediate cover will be stockpiled in the soil stockpile area as directed by the Owner and Engineer if the material is clean and does not contain any Class I waste or leachate. If the sod/soil contains Class I waste or appears to contain leachate, the material must be handled as excavated waste, weighed at the scalehouse, and the Contractor will pay processing fee as established in the Contract documents for excavated waste disposal.
      d. The stockpiled, clean sod/soil maybe tested and if it is approved by the Engineer and meets the requirements for final cover soil, the material maybe used by the Contractor for final cover.
      e. Caution must be taken to avoid any damages to the existing landfill gas system. Any damages must be repaired at Contractor's own expense.
      f. Perform depth verifications on a minimum 100 ft x 100 ft minimum grid pattern to determine depth of existing intermediate cover and additional thickness required to achieve design depth or grades. If necessary, identify areas where waste excavation will be required to achieve minimum intermediate cover thickness without exceeding design grades.
   3. Protection of finish grade:
      a. During construction, shape and drain intermediate cover and protective cover layers of the final cover system, cover soil layer of the Phase I / II overlay liner system, berms and excavations.
      b. Maintain ditches and drains to provide drainage at all times.
      c. Protect graded areas against action of elements prior to acceptance of work.
      d. Reestablish grade where settlement or erosion occurs.

C. Borrow:
   1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
   2. Include cost of excavation and transportation of all borrow material in original Bid.
   3. Fill material to be approved by CQA Inspector prior to placement.
   4. Obtain borrow soil only from the borrow area designated by the Owner. Do not excavate beyond permitted grades of borrow area. Contractor is responsible for maintaining drainage within the portions of the borrow area he is working in.

D. Construct intermediate cover, final cover system, cover soil layer of the Phase I / II overlay liner system, access road, and berms as required by the Contract Drawings:
   1. Construct access road and berms at locations and to lines of grade indicated.
      a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
   2. Construct intermediate cover, final cover system, cover soil layer of the Phase I / II overlay liner system to minimum thicknesses shown on the Drawings measured perpendicular to the slope. Grade to smooth true lines approved by Engineer with no soft spots or uncompacted areas. Top of final cover elevations shall not exceed the design elevations shown on the Drawings.
   3. Provide approved fill material:
      a. Ensure that stones larger than 3 IN are not placed in upper 6 IN of intermediate cover, final cover system, cover soil layer of the Phase I / II overlay liner system, or berms.
      b. Do not place material in layers greater than 12 IN loose thickness.
      c. Place layers horizontally to geosynthetic surfaces and compact each layer prior to placing additional fill.
      d. Lift thickness shall be at the discretion of the CQA Inspector.
   4. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
      a. Control moisture for each layer necessary to meet requirements of compaction.
   5. The structural fill in the TPO anchor trenches and berms shall be placed and compacted in lifts to the lines and grades shown on the drawings. The compacted thickness of each lift shall be 6 IN. maximum (150 mm). Each lift shall be compacted to at least 95 percent of the standard proctor maximum dry density (ASTM D698) within ±4% of optimum moisture content. Each layer surface shall be scarified before placing subsequent lifts and compaction.

E. Upon reaching the required compacted thickness of intermediate cover layer of the final cover system and cover soil layer of the Phase I / II overlay liner system, proofroll intermediate cover and cover soil layers and obtain the CQA Inspector's review/recommendation and approval. If unsuitable materials are encountered, repair as directed and approved by the CQA Inspector to remove unsuitable materials. Excavation of 1 CY or greater should be preapproved by the CQA Inspector.

F. Proofrolling shall be conducted with a 10 ton drum roller approved by the CQA Inspector. An alternate approved by the CQA Inspector may be used in constricted areas.

G. Where intermediate cover and /or cover soil layer materials are determined to be unsuitable, such materials shall be removed to the lengths, widths, and depths directed by the CQA Inspector, and backfilled with suitable material unless further excavation or earthwork is required. Additional payment will be made for excavation and replacement of intermediate cover and / or cover soil layer in accordance with the Contract Documents except for material previously placed by Contractor that did not meet project specifications. The final cover and temporary final cover areas to receive additional intermediate cover shall be free of all vegetation, sticks, roots, rocks, and debris greater than 3 inches in size.

H. Dewatering (as required): Provide and maintain dewatering of all surface water and/or groundwater as required for excavation. Where groundwater is or is expected to be encountered during borrow area excavation, install a dewatering system to prevent softening and disturbance of excavation, allow borrow material to be excavated in the dry, and maintain a stable excavation. Soils and hydrogeologic information may be reviewed before beginning excavation to determine where groundwater is likely to be encountered during excavation. Employ a dewatering specialist for selecting/designing, monitoring, and operating the dewatering system as needed. Keep dewatering system in operation until borrow activities are completed. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction as approved by the Owner. Install groundwater monitoring points as necessary. Shut off dewatering system at such a rate so as to prevent a quick upsurge of water that might weaken the subgrade. Installation, start-up, monitoring maintenance, and shut-off of the dewatering system shall be at no additional cost to the Owner. Any dewatering from the Phase I disposal footprint (within the limits of liner/waste) will be considered leachate and cannot be discharged to the stormwater system, but must be disposed appropriately as directed by the Owner.

I. Do not place fill when the underlying material is frozen, wet, loose, or soft.

J. Moisture control:
   1. Moisture content of materials prior to, and during compaction, shall be uniform throughout each layer of material.
   2. Granular materials shall be thoroughly wetted during or immediately prior to compaction.
   3. Supplementary water shall be added as required to materials by sprinkling and mixing uniformly throughout layer.
   4. Materials too wet for placing shall be temporarily spread or aerated until moisture content is acceptable. If these materials cannot be processed in time to use, the Contractor shall find alternatives acceptable to the CQA Inspector.

3.3 ROCK EXCAVATION – NOT APPLICABLE

3.4 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.5 FIELD QUALITY CONTROL

A. Moisture density relations, to be established by the CQA Inspector are required for all materials to be compacted.

B. Extent of compaction testing will be as necessary to assure compliance with Specifications.

C. Give minimum of 24 HR advance notice to CQA Inspector when ready for compaction or subgrade testing and inspection.

D. Should any compaction density test, subgrade inspection, or other QA/QC problem be identified, the affected area shall be delineated and reworked by Contractor as necessary to achieve passing criteria.

E. Contractor shall pay for all costs associated with corrective work and retesting resulting from failed tests.

F. Proofroll intermediate cover soil layer of the final cover system and cover soil layer of the Phase I / II overlay liner system after reaching specified thicknesses and/or grades prior to geomembrane deployment by making 2 passes parallel to the slope or as directed by CQA Inspector. The proof-rolling shall be performed under the observation of the CQA Inspector. Intermediate and protective cover shall be compacted in accordance with Section 3.6.

3.6 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from CQA Inspector with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by CQA Inspector.

D. Stabilize subgrade with approved materials as directed by CQA Inspector.

E. Intermediate, final cover system, and cover soil layer of the Phase I / II overlay liner system shall be compacted to a minimum 90% standard proctor maximum dry density. The soils shall be wetted or dried as necessary so that the moisture content during compaction is near the optimum moisture content to consistently achieve target compaction, or as otherwise determined by Engineer.

F. Perform testing at a minimum frequency as shown below:

TEST DESCRPTION	TEST FREQUENCY
1. Additional Intermediate Cover, Final Cover, cover soil of Phase I/II overlay liner system, and Berm Fill	
Density, Nuclear Method	1 per 1,500 yd3, ASTM D2922
Moisture Content, Nuclear Method	1 per 1,500 yd^3, ASTM D3017
Sand Cone or Drive Cylinder Method	1 per 20 nuclear tests, ASTM D2937
Oven Moisture Content Verification	1 per 20 nuclear tests, ASTM D2216
Moisture Density Relations	1 per 20,000 yd^3, ASTM D698*
Sieve Analysis	1 per 20,000 yd^3, ASTM D422*
2. Structural Fill for TPO Anchor Trenches	
In-Situ Density, Nuclear Method	1 per 250 ft/lift, ASTM D2922
In-Situ Moisture Content, Nuclear Method	1 per 250 ft/lift, ASTM D3017
Oven Moisture Content Verification	1 per 2,000 yd^3, ASTM D2216
Standard Proctor of borrow soil	1 per 5,000 yd^3, ASTM D698*
Sieve Analysis of borrow soil	1 per 2,000 yd^3, ASTM D422*
Atterberg Limits of borrow soil	1 per 5,000 yd^3, ASTM D4318*
Classification of borrow soil	1 per 5,000 yd^3, ASTM D2487*

*Increase frequency as needed to ensure each soil type is tested.

3.7 FINISH GRADING

A. Grade all areas disturbed by construction operations.

B. Grade to smooth, uniformly sloping surfaces to existing elevations or to finish grades shown on drawings or as approved by Engineer.

C. Grading shall maintain minimum required protective cover and topsoil thicknesses of the final cover system and cover soil layer of the Phase I / II overlay liner system but not exceed the maximum top of final cover elevation of the final cover system as shown on the Drawings.

D. Evenly slope finished grade to drainage swales, terraces, and downdrain inlets as shown on drawings to provide drainage.

E. Ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.

F. Ensure rutting or raveling is not caused by installation equipment or weather.

3.8 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General: Section includes excavation, backfilling, and compaction for the Leachate Cleanout Pump Pads.

1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling and subgrade compaction.
2. Specifier: Verify with soils report or Soils Engineer that excavated material can be used for fill and backfill. Delete paragraph sentence if excavated material can not be used.
3. Obtain fill and backfill material necessary to produce grades required. Material and source to be approved by CQA Inspector. Excavated material approved by CQA Inspector may also be used for fill and backfill.
4. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
5. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
   1. General. Do not commence excavation for foundations for structures until:
      a. CQA Inspector approves:
         1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
         2) Density and moisture content of site area compacted fill material meets requirements of specifications.
         3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
         4) Surcharge or mass fill material has been removed from construction area or portions thereof.
      b. CQA Inspector grants approval to begin excavations.
   2. Dimensions:
      a. Excavate to elevations and dimensions indicated or specified.
      b. Allow additional space as required for construction operations and inspection of foundations.
   3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by CQA Inspector.
   4. Level off bottoms of excavations to receive foundations, floor slabs, or compacted fill. Remove loose materials and bring excavations into approved condition to receive concrete or fill material. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to 98% standard proctor maximum dry density before fill material can be placed thereon. Do not carry excavations lower than shown for foundations except as directed by CQA Inspector or CQA Engineer. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefore.
   5. Notify CQA Inspector and CQA Engineer as soon as excavation is completed in order that subgrades may be inspected. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-gradeand under retaining wall footings has been inspected and approved by the CQA Inspector as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon. CQA Inspector shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.

a. Place fill material, foundations, retaining wall footings, floor slabs-on-grade as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.

6. Dewatering: Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope. Groundwater shall be maintained at least 3 FT below the bottom of any excavation. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation. Employ dewatering specialist for selecting and operating dewatering system. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure. Any dewatering from the Phase I disposal footprint (within the limits of liner/waste) will be considered leachate and cannot be discharged to the stormwater system, but must be disposed appropriately as directed by the Owner.
7. Subgrade stabilization: If subgrade under foundations, fill material, floor slabs-on-grade is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by CQA Inspector. Provide compaction density of replacement material as stated in this specification section. Loose, wet, or soft materials, when approved by CQA Inspector, may be stabilized by a compacted working mat of well graded crushed stone. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids. Remove and replace frozen materials as directed by CQA Inspector. Method of stabilization shall be performed as directed by CQA Inspector. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the CQA Inspector.
8. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction. Do not place building floor slabs-on-grade pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.
9. Drainage: Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures. Maintain excavations where foundations, floor slabs, or fill material are to be placed free of water. Provide pumping required to keep excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify CQA Engineer and CQA Inspector. Any dewatering from the Phase I disposal footprint (within the limits of liner/waste) will be considered leachate and cannot be discharged to the stormwater system, but must be disposed appropriately as directed by the Owner.
10. Frost protection: Do not place foundations, slabs-on-grade, or fill material on frozen ground. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, or fill material can be placed immediately after excavation has been completed and approved. Protect excavation from frost if placing of concrete or fill is delayed.
    a. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
    b. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, and Piping:
1. Structural fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of structural fill unless otherwise indicated.

2. Fill and backfill placement: Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from CQA Inspector. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material by means of equipment of sufficient size and proper type to obtain specified density. Use hand operated equipment for filling and backfilling next to walls. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft. Use vibratory equipment to compact granular material; do not use water.
3. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
   a. As required to provide fill material to indicated finished grade.
   b. 5 FT.
   c. Distance equal to depth of compacted fill below bottom of foundations.
   d. As directed by CQA Inspector.

D. Filling and Backfilling Outside of Structures. This paragraph of these specifications applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving. Provide material as approved by CQA Inspector for filling and backfilling outside of structures.
1. Fill and backfill placement: Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from CQA Inspector. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material with equipment of proper type and size to obtain density specified. Use only hand operated equipment for filling and backfilling next to walls and retaining walls. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft. Use vibratory equipment for compacting granular material; do not use water.
2. Backfilling against walls:
   a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
   b. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
   c. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

3.9 SPECIAL REQUIREMENTS

A. Erosion Control:
1. Conduct work to minimize erosion of site.
2. Construct temporary ditch blocks in perimeter drainage channel of landfill and install turbidity curtain in Pond No. 1 to settle and detain eroded material.
3. Remove eroded material washed off site.
4. Clean streets daily of any spillage of dirt, rocks or debris from equipment entering or leaving site.

B. Provide as built survey of top of intermediate cover prior to geomembrane installation to verify the required thickness of intermediate cover is installed. Depth thickness determinations shall be obtained on a maximum 100 ft x 100 ft grid pattern. Depth verifications may be made by test pits, temporary depth markers, or probes. Additional intermediate cover shall be placed in areas where insufficient depth is determined prior to geomembrane deployment in that area. Temporary depth markers, if used, shall be removed prior to installing geomembrane.

C. Provide as built survey of top of final cover (i.e. top of topsoil layer) prior to sodding to verify the required thickness of protective cover and topsoil combined is installed. Depth thickness determinations shall be obtained on a maximum 100 ft x 100 ft grid pattern. Depth verifications may be made by test pits, or temporary depth markers with careful attention to avoid damage to the underlying geosynthetics. Additional protective cover and/or topsoil, as appropriate, shall be placed in areas where insufficient depth is determined prior to laying sod in that area. Temporary depth markers, if used, shall be removed prior to installing sod. Survey shall be sealed by a professional land surveyor.

3.10 REPAIRS AND RETESTING

A. At locations where the field testing indicates densities below the requirements of the project specifications, the failing area shall be reworked. For the structural fill soil where the field testing indicates the dry density is below the requirements, the area shall be scarified, moisture-conditioned, and recompacted.

B. The Contractor shall correct the deficiency to the satisfaction of the CQA officer. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQA officer will develop and present to the Engineer and/or project manager suggested solutions for approval

C. All retests recommended by the CQA officer must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency.

D. The CQA officer will also verify that installation requirements are met and that submittals are provided.

END OF SECTION

SECTION 02221
TRENCHING, BACKFILLING, AND COMPACTING FOR LFG PIPING AND STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope of Work: CONTRACTOR shall provide all labor, materials, soils, equipment and incidentals to excavate and trench designated areas, install pipe and appurtenances, install bedding and backfill material, compact backfill, regrade, and re-vegetate disturbed areas as shown on the Plans and described in the Section.

B. The work specified in this Section includes the trenching and trench backfilling activities associated with installation of the landfill gas (LFG) extraction wells, LFG lateral pipe, air supply and condensate forcemain; and any other Work requiring drilling, excavation, trenching, trench backfilling, grading, re-grading, or re-vegetating disturbed areas as shown on the plans and described in this Section.

C. Work under this Section includes trenching and grading activities inside of the limits of municipal solid waste (MSW).

D. No classification of type of excavated materials will be made for piping excavation and trenching except for excavation of waste for which there is a separate bid item. Soil excavation includes all soil regardless of type, character, composition, moisture, or condition thereof.

E. Related Sections include but are not necessarily limited to:
   1. Sarasota County Government Bidding Requirements.
   2. Section 02260 – Topsoiling and Finished Grading
   3. Section 02485 - Sodding

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway & Transportation Officials (AASHTO):
      a. T99, The Moisture-Density Relations of Soils Using a 5.5 LB Rammer and a 12 IN Drop.
      b. T180, Moisture-Density Relations of Soils Using a 10 LB Rammer and an 18 IN Drop.
   2. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m)).
      d. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      e. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      f. D4254, Minimum Index Density of Soils and Calculation of Relative Density.
   3. Florida Erosion and Sediment Control Planning and Design Manual, current edition.
   4. Florida Department of Transportation Standard Specification for Road and Bridge Construction, current edition.
   5. Construction Quality Assurance (CQA) Plan.

B. Safety

1. All work shall be performed in strict accordance with all local, State, U.S. Occupational Safety and Health Administration (OSHA) and other applicable Federal regulations regarding trenching operations and trench safety.
2. All Work shall be performed in strict accordance with the Health and Safety requirements set forth in the General Conditions of the Contract Documents.
3. Excavation may be made without sheeting and bracing within the limitations and requirements of the governmental agencies having jurisdiction. Failure of the ENGINEER to order the use of bracing or sheeting and shoring or direct changes to systems in place, shall not in any way or to any extent relieve the CONTRACTOR of any responsibility concerning the condition of excavations or of his obligations under the Contract. The CONTRACTOR shall be responsible for the condition of all excavations. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances that they may occur.
4. All excavation shall comply with the applicable requirements as stated in the following:
   a. OSHA excavation safety standards 29 CFR, 1926-650, subpart P.
   b. Trench safety guidelines as specified by the Landfill Gas Division of the Solid Waste Association of North America (SWANA).
5. CONTRACTOR shall monitor the ambient air concentrations within and around excavations and take appropriate safety measures as needed.
6. Tests will be conducted by the ENGINEER or OWNER in accordance with this Section. Test results will be recorded by the ENGINEER or OWNER.
7. Use adequate numbers of skilled workers who are trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
8. Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.
9. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the OWNER and ENGINEER.

1.3 DEFINITIONS

A. Excavation:
   1. All piping excavation and trenching will be defined as unclassified except for excavation of waste for which there is a separate bid item.

1.4 SUBMITTALS

A. Product technical data including:
   1. Acknowledgement that products submitted meet requirements of standards referenced.
   2. Manufacturer's installation instructions.

B. Trench Safety Plan and/or trench shoring drawings including current certification of trench shields (trench boxes) if required by OSHA regulations.

C. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.

D. Pipe slope calculations and survey notes for pre-construction layout.

E. Pipe survey notes for installed pipe pursuant to Part 3.10 of this Section and proposed stationing and pipeline identification procedures. Prior to the start of any pipe installation, CONTRACTOR shall supply an example layout drawing showing how the header and laterals will be marked with stations for the conformance surveys. The example layout and stations must be consistent with the requirements of Section 15060.

F. Contractor daily logs detailing length of trench excavated and backfilled, with reference to pipe stationing and details sufficient to properly describe the work completed to date.

G. Submit sieve analysis reports on all granular materials (one per source or pit run).

H. Submit test reports and fully document each with specific location or stationing information, date, and other pertinent information.

I. Submit Contractor's site-specific Health and Safety Plan for information purposes only and not review.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Material:
1. Material shall be in accordance with Contract Specification 02200 and as approved by ENGINEER.
2. Backfill at least 6 inches above the top of the installed pipe shall conform to Part 2.1 A and B of this specification.
3. Backfill and bedding material free of rock cobbles, roots, sod or other organic matter, frozen material, and stones larger than 1 inch in any dimension.
4. The CONTRACTOR shall obtain pipe bedding and soil backfill material from the County borrow area in areas designated in the Contract Drawings.

B. Bedding Materials:
1. Material shall be in accordance with Contract Specification 02200 and as approved by ENGINEER.
2. Pipe bedding material shall be appropriate for spreading with hand tools and compaction with a bucket auger to provide a level and stable surface for pipe placement.
3. Granular bedding materials:
   a. Clean dry coarse-grained sand shall be used for pipe bedding and backfill to midway to the top of the installed pipe.

C. Non-Calcareous Stone for Landfill Gas Extraction Wells
1. Stone backfill shall be hard, durable non-calcareous rock. Stone shall be washed as a component of the manufacturing process and be free of organics, lumps or balls of clay, and other deleterious materials.

Sieve Size	3 IN	2 IN	1 IN	¾ IN	3/8
Percent Passing by Weight	100	90	35	0	0

PART 3 - EXECUTION

3.1 PREPARATION

A. Work shall be performed so as to not block or hinder site access, except as authorized by the OWNER.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect utilities from damage.

D. Protect benchmarks, survey control points, monitoring wells, geomembrane (where present), existing structures and fences from excavating equipment and vehicular traffic.

E. Prior to trenching and pipe installation, CONTRACTOR shall stake out the entire proposed trench alignment within the limits of waste. The proposed alignment must be approved by the ENGINEER prior to the CONTRACTOR beginning excavation activities. This pipeline route staking need not be completed by a licensed surveyor, but the routes for both header and lateral pipes must meet the minimum pipe slopes listed in this Section and on the Plans.

F. Survey notes with proposed pipe slope calculations shall be submitted to the ENGINEER for approval prior to pipe installation. Notes of pre-construction survey shall identify conflicts between the proposed Work and existing features.

G. CONTRACTOR shall use appropriate survey/level instrumentation during excavation to ensure proper trench slope. Verification of installed pipe slope shall be as specified in Part 3.9.

3.2 PROCEDURES

A. Protection of Existing Utilities:
   1. Unless shown to be abandoned or removed, protect utility lines and other pipes shown on the Drawings or otherwise made known to the CONTRACTOR prior to excavating. CONTRACTOR is required to perform all utility clearances, including interviewing on-site personnel to inquire about existing utilities in areas of proposed excavations. If a utility is damaged by the CONTRACTOR, the utility shall be repaired or replaced at no additional cost to the OWNER.
   2. If utility lines are encountered that are not shown on the Construction Drawings or otherwise made known to the CONTRACTOR, promptly take necessary steps to assure that service is not interrupted.
   3. If service is interrupted as a result of work under this Section, ENGINEER shall be notified, and CONTRACTOR shall immediately restore service by repairing the damaged utility at no additional cost to the OWNER.
   4. If existing utilities are found to interfere with the facilities being constructed under this Section, immediately notify the OWNER and ENGINEER and request their instructions. Maintain a minimum 12" horizontal and vertical separation from existing utilities and the LFG transmission pipe.
   5. Do not proceed with permanent relocation of the work until written instructions are received from the OWNER/ENGINEER.
   6. Exposed utilities shall be properly supported at all times if undermined.

B. Protection of Persons and Property:
   1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
   2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
   3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

C. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors and to other work being performed on or near the site.

D. Maintain access to adjacent areas at all times.

3.3 EXCAVATION

A. CONTRACTOR should not excavate more trench daily within the landfill waste limits than can be completely backfilled after installation of the pipe the same day. The maximum allowable open trench that can be left overnight is 100 ft. In no case shall waste be exposed overnight in an excavation or trench.

B. CONTRACTOR shall dispose of excavated refuse at the active face of the landfill. The OWNER will charge CONTRACTOR a processing fee and CONTRACTOR shall be responsible for all costs. Excavated refuse shall be direct-loaded into highway legal transport vehicles and hauled by CONTRACTOR to the landfill scales for weighing prior to disposal at the active face of the landfill. At no time, shall excavated waste be stockpiled next to the excavations. All waste to be disposed at the landfill shall be brought to the scales by no later than 5:00PM each day.

C. Excavation for Appurtenances:
   1. 12 inches (minimum) clear distance between outer surface and embankment.

2. Excavate as shown on plans and details.
3. Trench width as shown on details .
4. Provide gas monitoring in trench as required by Health and Safety Plan.
5. Dispose of excavated refuse at landfill active face.

D. Trench Excavation:
1. Excavate trenches by open cut method to depth shown on Contract Drawings and necessary to accommodate work.
   a. Support existing utility lines where proposed work crosses at a lower elevation.
      1) Stabilize excavation to prevent undermining of existing utility.
2. Excavate as shown on plans and details.
3. Trench width as shown on details.
4. Provide gas monitoring in trench as required by Health and Safety Plan and 1.2.B.5 of this section.
5. Satisfactory Excavated Materials shall be transported to, and placed in stockpiles or fill areas within the limits of the Work designated by the OWNER and ENGINEER.
6. If unsatisfactory materials are encountered above or at the design depth of the excavation, excavate the unsatisfactory materials as directed by the OWNER and ENGINEER, and replace with satisfactory materials. Excavate and backfill in a manner and sequence that will provide proper drainage at all times.
7. Dispose of unsatisfactory excavated material, and surplus satisfactory excavated material, away from the work area as directed by the OWNER and ENGINEER.
8. Obtain material required for fill in excess of that produced within the grading limits of the Work from County borrow area at locations shown on the Contract Drawings.
9. Unauthorized Excavation:
   a. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific instruction from the OWNER and ENGINEER.
   b. Backfill and compact unauthorized excavations as specified for authorized excavations, unless otherwise directed by the OWNER and ENGINEER.
10. Stability of Excavations:
   a. Slope sides of excavations shall be cut back to 1.5H:1V or flatter, in accordance with 29 CFR 1926.
   b. Shore and brace excavations where slope cut backs are not practical because of space restrictions or stability of the materials being excavated.
   c. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
11. Shoring and Bracing:
   a. Provide all labor and materials for shoring and bracing as may be necessary for safety of personnel, protection of work, and compliance with requirements of governmental agencies having jurisdiction.
   b. Maintain shoring and bracing in excavations regardless of the time period excavations will be open.
   c. Remove shoring and bracing as excavation progresses.

E. Asbestos Handling:
1. If asbestos is encountered during excavation operations, the following waste handling procedures must be implemented:
   a. If any waste appearing to possibly contain asbestos is uncovered, all asbestos handling procedures will be immediately placed into effect.
   b. All persons within 25 feet of the excavation operations will be required to wear the appropriate respirators.
   c. The use of Tyvek suits will be optional. However, if Tyvek suits are not worn, all employee uniforms must be laundered and the launderers notified of possible contamination with asbestos. All Tyvek suits will be considered to be contaminated with asbestos and will be disposed of accordingly.

d. A water truck equipped with the appropriate spraying equipment to keep the excavation cuttings wet will be required at all times.
e. An area of appropriate size will be prepared to contain the cuttings by one of the following methods.
   1) A waste container lined with 6 mil polyethylene will be placed as close as reasonably possible to the excavation activities. A small area next to the excavation activities where excavated materials will be handled will also be lined with 6 mil polyethylene and covered with clean soil to protect the polyethylene. A small earthen berm will be made to help contain the materials and facilitate loading into the container. The polyethylene and soil cover will be considered to be part of the waste.
   2) An area next to the excavation activities that is appropriately sized to accommodate all of the excavated materials will be surrounded by a small soil berm approximately 30" high. This area will then be lined with 6 mil polyethylene and covered with clean soil to protect the polyethylene. This area will be positioned in a way such that all handling of cuttings will be in the protected area. The polyethylene and soil will be considered to be part of the waste.

3.4 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Over-Excavation:
   1. Backfill and compact to maximum attainable density.
   2. Backfill with granular bedding material as option.

B. Subgrade Stabilization:
   1. Stabilize the subgrade when directed by the Owner.
   2. Observe the following requirements when unstable trench bottom materials are encountered.
      a. Notify Owner when unstable materials are encountered.
         1) Define by drawing station locations and limits.
      b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
         1) Replace with subgrade stabilization with no additional compensation.

C. In-Place Intermediate Cover Soils
   1. Backfill and compact to maximum attainable density.

3.5 BACKFILLING METHODS

A. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements.

B. CONTRACTOR shall notify the ENGINEER prior to beginning backfilling. The ENGINEER shall inspect all pipe, fittings and connections prior to approving backfilling. If CONTRACTOR backfills pipe without inspection of the pipe while pipe is installed in the open trench, CONTRACTOR shall uncover all un-inspected buried pipe so that it may be properly inspected. This shall be done at no additional cost to the OWNER or ENGINEER.

C. Place bedding material in trench to the lines and grades shown on the Plans.

D. Backfilling procedures shall be modified as necessary as approved by the ENINGEER in order to not displace (either horizontally or vertically) piping installed in the trench during backfill or bedding placement.

E. CONTRACTOR shall re-grade and return to their original condition, as determined by the OWNER and the ENGINEER, all areas disturbed by CONTRACTOR's work. This includes, but is not limited to ruts caused by construction equipment, soil stockpile areas, and landfill benches and terraces used for access.

F. Common Backfill-trenches, utilities, appurtenances:
   1. Perform in accordance with the following:

a. The bedding shall be poured into place, not pushed, and shall be raked by hand and then compacted, using a mechanical compaction device such as walk-behind vibratory compactor, in a loose lift not to exceed six (6) inches (loose thickness) above the top of the pipe.
b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

G. Water flushing for consolidation is not permitted.

H. For all gas collection pipe trenches, a clean backfill shall be used or a material otherwise approved by the ENGINEER or the OWNER.

3.6 COMPACTION

A. General:
1. Place and assure bedding, backfill, and fill materials achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work.
2. In no case shall degree of compaction below "Minimum Compaction" specified be accepted.

B. Compaction Requirements: Unless noted otherwise on Drawings or more stringently by other sections of these Specifications, comply with following compaction criteria:
1. Header and Lateral Pipes
a. None required for pipe bedding material.
b. Tamp waste with track hoe bucket to consolidate waste to ENGINEER's satisfaction.
2. Road Crossings within the landfill footprint
a. None required for pipe bedding material.
b. Tamp waste with track hoe bucket to consolidate waste to ENGINEER's satisfaction.
3. Gas Extraction System Appurtenances
a. Tamp waste with track hoe bucket to consolidate to ENGINEER's satisfaction.
b. Compact to maximum attainable density if pipe rests on intermediate cover material.
c. None required for granular materials

3.7 FINISH GRADING

A. Grade all areas disturbed by construction operations.

B. Grade to smooth, uniformly sloping surfaces to existing elevations or to finish elevations shown on drawings.

C. Grading shall be to a tolerance of plus or minus 0.1 FT

D. Evenly slope finished grade away from structures as shown on drawings to provide drainage.

E. Ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.

F. Ensure rutting or raveling is not caused by installation equipment or weather.

3.8 DEWATERING

A. Water that enters excavations into refuse shall be considered landfill leachate and shall not be discharged to the ground or other means that are typical for stormwater. Water in trench excavations that come in contact with refuse shall be pumped into sealed tanks, hauled to the leachate collection system, and discharged into the appropriately as directed by the OWNER.

B. The CONTRACTOR shall at all times during construction provide and maintain proper equipment and facilities to remove water entering excavations. CONTRACTOR shall keep such excavations dry so as to obtain a satisfactory foundation condition for all work.

C. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottom, and soil changes detrimental to stability of subgrades and foundations. Subgrade soils which become soft, loose, "quick," or otherwise unsatisfactory for support of

structure as a result of inadequate dewatering or other construction methods shall be removed and replaced by crushed stone or gravel as required by the ENGINEER at the CONTRACTOR's expense. The bottom of excavations shall be firm and without standing water before placing structures or pipes. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

D. For excavations not in refuse, establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

E. Disposal of Water Removed by Dewatering System:
   1. Water conveyed away from excavations which has not contacted refuse materials shall be discharged to areas approved by the ENGINEER.
   2. Dispose of water by procedures approved by the ENGINEER in such a manner as to cause no inconvenience to the OWNER, the ENGINEER, or others involved in work about the site.
   3. Water conveyed away from excavations which has contacted refuse materials shall be pumped into spill-proof containers and discharged into the leachate treatment pond as directed by the OWNER.

F. If the pipe trench becomes watered-in after placement of pipe, but before backfilling, CONTRACTOR shall dewater the trench, demonstrate that the pipe Bedding and pipe slope remain satisfactory, and upon approval by the ENGINEER, backfill the pipe with clean dry soil in accordance with Part 2.01 of this Section.

3.9 ROAD CROSSING

A. CONTRACTOR shall schedule and coordinate all road crossings with the OWNER to minimize disruption of waste disposal operations.

3.10 FIELD QUALITY CONTROL

A. Pipe Survey
   1. CONTRACTOR shall verify that pipe slope meets the requirements specified in this Section and on the Plans at 25-foot intervals along LFG laterals and header and record such information in the project notes. Station numbering shall be used and marked on the pipe, as approved by the ENGINEER.
      a. CONTRACTOR shall measure each length of installed pipe and mark the 25-foot stations. Stationing of laterals shall begin with 0+00 at the well, ending at the tee at the tie-in to the header.
      b. Stationing of the header shall begin with 0+00 at a location approved by the ENGINEER. Station numbering for pipe installed each day shall be consecutive with pipe installed on previous days. The CONTRACTOR shall not restart station numbering at 0+00 for any header segment without advance approval from the ENGINEER.
      c. Survey equipment shall be used to measure the change in relative elevation between each 50-foot station prior to burial of any pipe.
      d. The surveyed elevations and calculated change in elevation and slope for each 25-foot section shall be recorded in the CONTRACTOR's project notes.
      e. A trench laser will not be considered acceptable survey equipment for the purpose of verifying pipe slope.
   2. The project notes detailing the required pipe slope confirmation shall be provided daily to the ENGINEER and shall be checked by the OWNER or ENGINEER prior to proceeding with backfilling.
   3. A conformance survey shall be conducted on all installed pipe prior to backfilling the trench.

a. The survey shall document the horizontal and vertical location of the top of the landfill gas header, laterals, air supply lines, and condensate forcemain pipes, , at minimum 25-foot intervals and at each change in pipe direction, grade break, change in pipe grade, fitting, connection, pipe crossover, and tie-in along the entire pipeline routes.
b. If a run of pipe is 100 feet or less in length, CONTRACTOR shall provide survey shots at a 20-foot interval or less. For a run of pipe of 50 feet or less, at least three survey shots of the top of the pipe must be used to document the pipe as-built conditions.
c. The survey shall also document the type of pipe, location (horizontal and vertical coordinate) of structures and appurtenances such as, but not limited to, valves, road crossing steel casing, pipe crossing, and tie-ins.
d. This conformance surveying shall be sealed by a licensed Florida Professional Land Surveyor as described in Section 01720, Project Record Documents.

B. Moisture density relations, to be established by the CQA Inspector are required for all materials to be compacted.

C. Extent of compaction testing will be as necessary to assure compliance with Specifications.

D. Give minimum of 24 HR advance notice to the CQA Inspector when ready for compaction or subgrade testing and inspection.

E. Should any compaction density test, subgrade inspection, or other QA/QC problem be identified, the affected area shall be delineated and reworked by CONTRACTOR as necessary to achieve the passing criteria.

F. CONTRACTOR shall pay for all costs associated with corrective work and retesting resulting from failed tests.

G. The proof-rolling shall be reformed under the observation of the CQA Inspector. Subgrade shall be compacted in accordance with Section 3.6.

3.11 MAINTENANCE

A. Protection of Newly Graded Areas:
1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.12 SEEDING AND SODDING

A. Provide temporary seeding and mulching in disturbed areas where further construction activities will not take place within 30 days..

B. Install sod within final closure area after installation of protective cover soils in accordance with Section 02485 – Sodding.

3.13 SPECIAL REQUIREMENTS

A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed offsite. Clean streets daily of any spillage of dirt, rocks, or debris from equipment entering or leaving site.

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SECTION 02221A

TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES AND STORMWATER STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work: CONTRACTOR shall provide all labor, materials, soils, equipment and incidentals to excavate and trench designated areas, install pipe and appurtenances, install bedding and backfill material, compact backfill, regrade, and re-vegetate disturbed areas as shown on the Plans and described in the Section. Work also includes grading and construction of southside stormwater swale.

B. The work specified in this Section includes the trenching and trench backfilling activities associated with installation of the stormwater structures, excavation, trenching, trench backfilling, grading, re-grading swale, or re-vegetating disturbed areas as shown on the plans and described in this Section.

C. Work under this Section includes trenching and grading activities outside of the limits of municipal solid waste (MSW).

D. No classification of type of excavated materials will be made for piping excavation and trenching. Soil excavation includes all soil regardless of type, character, composition, moisture, or condition thereof.

E. Related Sections include but are not necessarily limited to:
   1. Section 02485 – Sodding
   2. Section 02515 – Precast Concrete Structures

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International:
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f(2,700 kN-m/m)).
      d. D2321, Underground Installation of Thermoplastic Pipe for Sewers and other Gravity Flow Applications.
      e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System.
      f. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      g. D4254, Minimum Index Density of Soils and Calculation of Relative Density.
   2. Florida Department of Transportation Standard Specification for Road and Bridge Construction, current edition.
   3. Florida Erosion and Sediment Control Planning and Design Manual, current edition.
   4. Construction Quality Assurance (CQA) Plan.

B. Qualifications:
   1. Independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification.
   2. Registered professional engineer licensed in Florida for design of trench shoring systems or other trench safety plans.

C. Safety
   1. All work shall be performed in strict accordance with all local, State, U.S. Occupational Safety and Health Administration (OSHA) and other applicable Federal regulations regarding trenching operations and trench safety.
   2. All Work shall be performed in strict accordance with the Health and Safety requirements set forth in the General Conditions of the Contract Documents.
   3. Excavation may be made without sheeting and bracing within the limitations and requirements of the governmental agencies having jurisdiction. Failure of the ENGINEER to order the use of bracing or sheeting and shoring or direct changes to systems in place, shall not in any way or to any extent relieve the CONTRACTOR of any responsibility concerning the condition of excavations or of his obligations under the Contract. The CONTRACTOR shall be responsible for the condition of all excavations. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances that they may occur.
   4. All excavation shall comply with the applicable requirements as stated in the following:
      a. OSHA excavation safety standards 29 CFR, 1926-650, subpart P.
      b. Trench safety guidelines as specified by the Landfill Gas Division of the Solid Waste Association of North America (SWANA).
   5. CONTRACTOR shall monitor the ambient air concentrations within and around excavations and take appropriate safety measures as needed.
   6. Tests will be conducted by the ENGINEER or OWNER in accordance with this Section. Test results will be recorded by the ENGINEER or OWNER.
   7. Use adequate numbers of skilled workers who are trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   8. Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.
   9. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the OWNER and ENGINEER

1.3 DEFINITIONS

A. Excavation:
   1. All piping excavation and trenching will be defined as unclassified.

1.4 SUBMITTALS

A. Product technical data including:
   1. Acknowledgement that products submitted meet requirements of standards referenced.
   2. Manufacturer's installation instructions.

B. Trench Safety Plan and/or trench shoring drawings including current certification of trench shields (trench boxes) if required by OSHA regulations.

C. Submit sieve analysis reports on all granular materials.

D. Contractor daily logs detailing length of trench excavated and backfilled.

E. Submit Contractor's site-specific Health and Safety Plan for information purposes only and not for review.

F. CONTRACTOR shall reuse excavated soils from trenching for pipe bedding around installed pipe, unless directed otherwise by ENGINEER (For excavations outside the limits of waste only). Reused soils shall conform to Part 2.1A, and B of this Section.

1.5 PROJECT CONDITIONS

A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.

B. Provide full access to facility as designated by Owner to prevent serious interruption of travel.

C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.

D. Verify location of existing underground utilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Material:
   1. As approved by Engineer.
      a. Backfill and bedding material free of rock cobbles, roots, sod or other organic matter, and frozen material, and stones larger than 1 inch in any dimension.
      b. Moisture content at time of placement: 3 percent plus/minus of optimum moisture content as specified in accordance with ASTM D1557.
      c. For excavations outside the limits of waste, CONTRACTOR shall reuse excavated soils from trenching for backfilling around installed pipe, unless directed otherwise by ENGINEER.
      d. Beyond the reusable quantities of soil described above, the CONTRACTOR shall use pipe bedding and soil backfill material excavated from approved borrow areas on-site and meeting project requirements.

B. Bedding Materials:
   1. As approved by the CQA Inspector.
   2. Granular bedding materials:
      a. Meeting FDOT No. 57 stone, or as specified in the approved drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Remove and dispose of unsuitable materials as directed by CQA Engineer to site provided by Owner.

3.2 PREPARATION

A. Work shall be performed so as to not block or hinder site access, except as authorized by the OWNER.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect utilities from damage.

D. Protect benchmarks, survey control points, monitoring wells, geomembrane (where present), existing structures and fences from excavating equipment and vehicular traffic.

E. Prior to trenching and pipe installation, CONTRACTOR shall stake out the entire proposed trench alignment outside the limits of waste. The proposed alignment, elevations, and cover over pipe must be approved by the ENGINEER prior to the CONTRACTOR beginning excavation activities. This pipeline route staking need not be completed by a licensed surveyor, but the pipes must meet the minimum pipe slopes listed on the Plans.

F. Survey notes with proposed pipe locations shall be submitted to the ENGINEER for approval prior to pipe installation. Notes of pre-construction survey shall identify conflicts between the proposed Work and existing features including maintenance of required cover over pipe as required.

G. CONTRACTOR shall use appropriate survey/level instrumentation during excavation to ensure proper trench slope. Verification of installed pipe slope shall be as specified in Part 3.11.

3.3 PROCEDURES

A. Protection of Existing Utilities:
   1. Unless shown to be abandoned or removed, protect utility lines and other pipes shown on the Drawings or otherwise made known to the CONTRACTOR prior to excavating. CONTRACTOR is required to perform all utility clearances, including interviewing on-site personnel to inquire about existing utilities in areas of proposed excavations. If a utility is damaged by the CONTRACTOR, the utility shall be repaired or replaced at no additional cost to the OWNER.
   2. If utility lines are encountered that are not shown on the Construction Drawings or otherwise made known to the CONTRACTOR, promptly take necessary steps to assure that service is not interrupted.
   3. If service is interrupted as a result of work under this Section, ENGINEER shall be notified, and CONTRACTOR shall immediately restore service by repairing the damaged utility at no additional cost to the OWNER.
   4. If existing utilities are found to interfere with the facilities being constructed under this Section, immediately notify the OWNER and ENGINEER and request their instructions. Maintain a minimum 12" horizontal and vertical separation from existing utilities and the LFG transmission pipe.
   5. Do not proceed with permanent relocation of the work until written instructions are received from the OWNER/ENGINEER.
   6. Exposed utilities shall be properly supported at all times if undermined.

B. Protection of Persons and Property:
   1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
   2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
   3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

C. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors and to other work being performed on or near the site.

D. Maintain access to adjacent areas at all times.

3.4 EXCAVATION

A. Unclassified Excavation:
   1. Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by CQA Inspector.

B. Excavation for Appurtenances:
   1. 12 IN (minimum) clear distance between outer surface and embankment.

C. Trench Excavation:
   1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
      a. Tunnel work for crossing under crosswalks, driveways or existing utility lines with permission.
         1) Limit tunnels to 10 FT in length.
   2. Open trench outside buildings, units, and structures:
      a. No more than the distance between two manholes, structures, units, or 600 LF, whichever is less.
      b. Field adjust limitations as weather conditions dictate.

3. Any trench or portion of trench, which is opened and remains idle for 7 calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
4. Observe following trenching criteria:
   a. Trench size.
      1) Excavate width to accommodate free working space.
      2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	12 IN
more than 33 IN	24 IN

      3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
      4) Keep trenches free of water. Include cost of dewatering in original Bid.

D. Trenching for polyethylene pipe:
   1. Trenching should be done in accordance with ASTM D2321, Section 6 and/or ASTM D 2774.

3.5 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Over-Excavation:
   1. Backfill and compact to 95 percent of maximum dry density per ASTM D698.
   2. Backfill with granular bedding material as option.

B. Rock Excavation: NOT APPLICABLE

C. Subgrade Stabilization:
   1. Stabilize the subgrade when directed by the Owner.
   2. Observe the following requirements when unstable trench bottom materials are encountered.
      a. Notify Owner when unstable materials are encountered.
         1) Define by drawing station locations and limits.
      b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
         1) Replace with subgrade stabilization with no additional compensation.

3.6 BACKFILLING METHODS

A. Do not backfill until tests to be performed on system show system is in full compliance to specified requirements.

B. CONTRACTOR shall notify the ENGINEER prior to beginning backfilling. The ENGINEER shall inspect all pipe, fittings and connections prior to approving backfilling. If CONTRACTOR backfills pipe without inspection of the pipe while pipe is installed in the open trench, CONTRACTOR shall uncover all un-inspected buried pipe so that it may be properly inspected. This shall be done at no additional cost to the OWNER or ENGINEER.

C. Place bedding material in trench to the lines and grades shown on the Plans.

D. Backfilling procedures shall be modified as necessary as approved by the ENINGEER in order to not displace (either horizontally or vertically) piping installed in the trench during backfill or bedding placement.

E. CONTRACTOR shall re-grade and return to their original condition, as determined by the OWNER and the ENGINEER, all areas disturbed by CONTRACTOR's work. This includes, but is not limited to ruts caused by construction equipment, soil stockpile areas, and landfill benches and terraces used for access.

F. Common Backfill-trenches, utilities, appurtenances:
   1. Perform in accordance with the following:
      a. The bedding shall be poured into place, not pushed, and shall be raked by hand and then compacted, using a mechanical compaction device such as walk-behind vibratory compactor, in a loose lift not to exceed six (6) inches (loose thickness) above the top of the pipe.
      b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
      c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

G. Water flushing for consolidation is not permitted.

H. Polyethylene pipe backfill:
   1. Embedment materials should be Class I, Class II, or Class III materials as defined by ASTM D2321, Section 5. The use of Class IV and Class V materials for embedment is not acceptable. The embedment material shall have an installed density of at least 98% Standard Proctor Density through compaction or consolidation.
   2. The pipe bedding should be constructed in accordance with ASTM D2321, Section 5, Table 2.

3.7 COMPACTION

A. General:
   1. Place and assure bedding, backfill, and fill materials achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work.
   2. In no case shall degree of compaction below "Minimum Compaction" specified be accepted.

B. Compaction Requirements: Unless noted otherwise on Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria for areas outside of the construction baseline:

MINIMUM COMPACTIONS

LOCATION	SOIL TYPE	MINIMUM COMPACTION
1. Bedding Material:		
All Locations	Cohesive Soils	90 percent of max standard proctor density by ASTM D698
	Cohesionless Soils	75 percent of max relative density by ASTM D4253 and D4254
2. Carefully compacted backfill:		
Perimeter berms and perimeter road	Cohesive soils	95 percent of max dry density by ASTM D698
	Cohesionless soils	75 percent of max relative density by

ASTM D4253 and D4254

3. Common trench backfill:

Under pavements roadways surfaces, within highway right-of-ways	Cohesive soils	95 percent of max dry density by ASTM D698
	Cohesionless soils	75 percent of relative density by ASTM D4253 and D4254
Under turfed, sodded, plant seeded, non-traffic areas	Cohesive soils	85 percent of max dry density by ASTM D698
	Cohesionless soils	40 percent of relative density by ASTM D4253 and D4254

4. In accordance with ASTM D2486, "Classification of Soils for Engineering Purposes." See Figure 1 – Soil Classification Chart. Generally soil group symbols (refer to Spec Note under "9. Pipe Embedments") are described as follows:

Cohesive soils	GC, SC, ML, CL, MH, CH
Cohensionless soils	GW, GP, SW, SP.

Materials classified as GM and SM are identified as cohesionless only when fines have a plasticity index of 0

3.8 FINISH GRADING

A. Grade all areas disturbed by construction operations.

B. Grade to smooth, uniformly sloping surfaces to existing elevations or to finish elevations shown on drawings.

C. Grading shall be to a tolerance of plus or minus 0.1 FT

D. Evenly slope finished grade away from structures as shown on drawings to provided drainage.

E. Ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.

F. Ensure rutting or raveling is not caused by installation equipment or weather.

3.9 DEWATERING

A. All dewatering liquid removed from the Phase I Landfill area must be disposed of in the leachate collection system at the CCSWDC. The Contractor must coordinate with Owner and Engineer for disposal of dewatering liquid during construction and include the cost for dewatering equipment, operations, removal of solids from liquid, and disposal of dewatering liquid in the contract bid items for this Work.

B. The CONTRACTOR shall at all times during construction provide and maintain proper equipment and facilities to remove water entering excavations. CONTRACTOR shall keep such excavations dry so as to obtain a satisfactory foundation condition for all work.

C. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottom, and soil changes detrimental to stability of subgrades and foundations. Subgrade soils which become soft, loose, "quick," or otherwise unsatisfactory for support of structure as a result of inadequate dewatering or other construction methods shall be removed

and replaced by crushed stone or gravel as required by the ENGINEER at the CONTRACTOR's expense. The bottom of excavations shall be firm and without standing water before placing structures or pipes. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

D. For excavations not in refuse, establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

E. Disposal of Water Removed by Dewatering System:
   1. Water conveyed away from excavations which has not contacted refuse materials shall be discharged to areas approved by the ENGINEER.
   2. Dispose of water by procedures in accordance with Part 3.9A of this Section and as approved by the ENGINEER in such a manner as to cause no inconvenience to the OWNER, the ENGINEER, or others involved in work about the site.
   3. Water conveyed away from excavations which has contacted refuse materials shall be pumped into spill-proof containers and discharged into the leachate collection system at the CCSWDC in accordance with Part 3.9A of this Section as directed by the OWNER.

F. If the pipe trench becomes watered-in after placement of pipe, but before backfilling, CONTRACTOR shall dewater the trench, demonstrate that the pipe Bedding and pipe slope remain satisfactory, and upon approval by the ENGINEER, backfill the pipe with clean dry soil in accordance with Part 2.1 of this Section.

3.10 ROAD CROSSING

A. CONTRACTOR shall schedule and coordinate all road crossings with the OWNER to minimize disruption of waste disposal operations.

3.11 FIELD QUALITY CONTROL

A. Testing:
   1. Specifier: Make sure you know how you client wants to do testing. He may or may not have a Soils Engineer retained to do the necessary testing. Coordinate testing with Structural Engineer so that procedures are same for project. The following appears to be most normal method of handling testing.
   2. The Contractor shall perform testing of the materials.
   3. Give minimum of 24 HR advance notice to the CQA Inspector when ready for compaction or subgrade testing and inspection.
   4. Perform in-place moisture and density tests at a frequency of 1 test per 1 FT per 500 LF of trench.
   5. Tests shall be performed by a certified testing laboratory.
   6. Should any compaction density test, subgrade inspection, or other QA/QC problem be identified, the affected area shall be delineated and reworked by CONTRACTOR as necessary to achieve the passing criteria.
   7. CONTRACTOR shall pay for all costs associated with corrective work and retesting resulting from failed tests.
   8. Ensure excavations are safe for testing personnel.
   9. The proof-rolling shall be reformed under the observation of the CQA Inspector. Subgrade shall be compacted in accordance with Section 3.7.

B. Pipe and Stormwater Structures Survey
   1. A conformance survey shall be conducted on all installed pipe and stormwater structures prior to backfilling the trench.

a. The survey shall document the horizontal and vertical location of invert locations of all stormwater piping and structures, each change in pipe direction, grade break, change in pipe grade, fitting, connection, pipe crossover, and tie-in along the entire pipeline routes.
b. The survey shall also document the type of pipe, location (horizontal and vertical coordinate) of structures and appurtenances such as, but not limited to, mitered end sections, ditch bottom inlets, pipe crossing, and tie-ins.
c. This conformance surveying shall be sealed by a licensed Florida Professional Land Surveyor as described in Section 01050, Survey.

3.12 MAINTENANCE

A. Protection of Newly Graded Areas:
   1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
   2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.13 SODDING

A. Sod, fertilize, mulch and maintain all disturbed areas until satisfactory grass growth coverage and density is provided.

B. Contractor shall submit sodding plan for OWNER and ENGINEER prior to sodding.

C. Contractor shall sod areas of unnecessary disturbance at no cost to OWNER of areas with established grass.

3.14 SPECIAL REQUIREMENTS

A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed offsite. Clean streets daily of any spillage of dirt, rocks, or debris from equipment entering or leaving site.

END OF SECTION

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SECTION 02240
DRAINAGE SAND LAYER– OVERLAY LINER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Drainage Sand Layer used as part of the Phase I / II Overlay Liner System

B. Related Sections Include But Are Not Necessarily Limited To:
   1. Section 02200 – Earthwork.
   2. Section 02776 – HDPE Geomembrane Liner System.
   3. Section 02777A – Drainage Geocomposite – Overlay Liner System
   4. Section 02778 – Geotextiles.
   5. Central County Solid Waste Disposal Complex Class I Landfill Expansion Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Referenced Standards
   1. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregate
      b. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
      c. D422, Standard Test Method for Particle-Size Analysis of Soils.
      d. D2434, Standard Test Method for Permeability of Granular Soils (Constant Head).
      e. D4373, Standard Test Method for Rapid Determination of Carbonate Content of Soils.
      f. D5321 Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
   2. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.

1.3 SUBMITTALS

A. Shop Drawings
   1. Carbonate content test results.
   2. Permeability test results for all materials
   3. Gradation test results.

B. At least four weeks prior to construction of the drainage sand layer for the Phase I / II overlay liner system, submit a bulk sample of each material from each source to the CQC Laboratory for approval and the CQA Inspector for acceptance.

C. Submit all required laboratory test data as required by Subparts 2.1 and 3.2 for materials used in the construction.

D. Submit periodic surveys of each layer during construction for thickness verification as required by Part 3.2D of this specification.

1.4 JOB CONDITIONS

A. Take necessary precautions to protect the entire landfill liner system from damage due to any construction activity. Repair damages at own expense. Assess no cost to Owner or Engineer for any damages to liner system resulting from placement of soil or activities of equipment. No vehicular traffic will be allowed directly on the unprotected liner system, except for low ground pressure equipment necessary for the deployment and installation of overlying geosynthetic layers.

B. Protect and maintain benchmarks, monuments, or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.

1.5 TOLERANCES

A. Materials shall be placed to the lines and grades as shown on the Contract Drawings except that a 0.1 FT overbuild is allowed. Material placed beyond these limits shall be removed at Contractor's expense.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material: The CQC Laboratory shall submit source test data to the CQA Inspector from offsite borrow source prior to delivery to the site.
   1. Free of roots, sod or other organic matter, and frozen material. The material shall be of durable and noncarbonaceous origin.
   2. The drainage sand layer material used for the Phase I / II overlay liner system shall be washed, and reasonably free of clay lumps, soft and friable particles, salt, alkali, organic matter, adherent coatings, and other substances not defined which may possess undesirable characteristics.
   3. Drainage sand layer material for the Phase I / II overlay liner system will consist of 2 feet of sand.
   4. Non-calcareous: carbonate content per ASTM D4373 < 15% by weight.
   5. Drainage sand layer for the Phase I / II overlay liner system:
      a. Natural sand, or manmade sand, as approved by Engineer.
      b. 100% passing ¼ IN sieve and < 10% passing #200 sieve per ASTM D422.
      c. Permeability greater than or equal to 1.0×10^{-3} cm/sec per ASTM D2434.
   6. The Contractor shall provide representative analyses certifying that material and source meets the above specification to the CQA Inspector for approval at least 48 hours prior to the arrival of the material on the job site.

2.2 INTERFACE FRICTION TESTS:

A. Laboratory friction tests shall be conducted, on behalf of the Owner by the CQA Laboratory, with representative samples obtained by the CQA Inspector from the materials provided by the Contractor for use in the Work. The CQA Inspector is responsible for shipping materials to the testing laboratory. The initial set of testing and subsequent conformance tests (if any) shall be paid for by the Owner. If any interface doesn't meet the requirements, or if the Contractor changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the Contractor. Testing will include the interfaces between the following adjacent materials.

Material	Specification Section
Drainage Sand Layer – Overlay Liner	02240
Drainage Composite – Overlay Liner	02777A
60 Mil Textured HDPE Geomembrane	02776

B. The testing shall be performed in accordance with ASTM D5321.
   1. The materials shall be tested at normal stressed of 5,000, 10,000, and 20,000 psf. Displacement rates shall be in accordance with ASTM D5321 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope

orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA Inspector prior to performing the tests.

2. A minimum friction angle of 23 degrees is required for each interface in the system defined in Paragraph A.

C. This material is part of a system. The system shall meet the requirements before the component materials can be deemed acceptable.

PART 3 - EXECUTION

3.1 GENERAL

A. The drainage sand layer material for the Phase I / II overlay liner system is placed directly over the geosynthetics (drainage geocomposite- overlay liner), thus, extreme caution shall be exercised by the Contractor to prevent damage to the liner system materials.

B. Placement of this material shall be conducted only when the CQA Inspector or his representative is informed in advance of the intent to perform this work and is present at the site to observe the placement.

C. The Contractor shall exercise care in maintaining a true line and grade an all piping during placement and spreading of the material.

D. Materials shall be placed over the geosynthetics only after areas have been released by the Geomembrane Installer and the CQA Inspector. The materials shall be placed as specified below.

1. All materials shall be placed and spread with low ground pressure (LGP) equipment in accordance with the geosynthetic manufacturer's recommendations and as approved by the CQA Engineer to reduce potential damage to the geosynthetics. The geosynthetics surface shall be off limits to construction traffic. Hard turning of tracked equipment on the drainage sand layer must be avoided.
2. At least 12 IN of separation between the geosynthetics and all low ground pressure equipment shall be maintained.
3. Stockpiling of materials within the limits of Phase I shall be subject to advanced approval by the CQA Inspector. Any hauling equipment (dump trucks, etc.) operating within the Phase I limits (and including access ramps), shall have a minimum of 3 feet of separation between the vehicle wheels and the geosynthetics.
4. No vehicle shall access the completed Work unless it can be demonstrated that its weight, movement or activities will not damage the Work.
5. Drainage sand layer material for the Phase I / II overlay liner system shall not be placed over standing water or ice.
6. Drainage sand layer material for the Phase I / II overlay liner system shall not be compacted.

E. The materials shall be spread in a manner that minimizes development of folds in the geosynthetics. Any portions of the geosynthetics that develop crimp shall be repaired by the Contractor at no expense to the Owner.

1. If during spreading, excessive wrinkles develop, the Contractor shall adjust placement and spreading methods, or cease until the geosynthetics cool and wrinkles decrease in size.
2. Wrinkles that exceed approximately 6 IN in height and cannot be eliminated by amended placement and spreading methods shall be cut and repaired by the geosynthetics installer in a method approved by the CQA Inspector.

F. The drainage sand layer cover layer for the Phase I / II overlay liner system shall be spread over the drainage composite – overlay liner in a manner that minimizes development of folds in the underlying geosynthetics. Any portions of the geosynthetics that develop crimp and/or tear shall be repaired by the contractor at no expense to the Owner.

G. Any damage to the underlying soil or geomembrane liners or other geosynthetics shall be repaired in accordance with the applicable Section of these Specifications at Contractor's expense.

H. Stockpiling of materials within the limits of Phase I shall be subject to advanced approval by the CQA Inspector. Any hauling equipment (dump trucks, or non-LGP equipment.) operating within the cell limits (and including access ramps), shall have a minimum of 3 feet of separation between the vehicle wheels and the geosynthetics.

I. Any areas where unauthorized or tracked equipment has operated over the geosynthetic liner system shall be subject to investigation for potential geosynthetics damage. Such investigations may include removal of overlying materials in the affected areas and visual inspection of the geosynthetics. These activities shall be conducted under direction by the CQA Inspector at Contractor's expense.

J. Test areas to evaluate potential damage due to equipment operations may be required by the CQA Inspector to assess equipment to be used by the Contractor. The test area shall be outside the Phase I limits, use scrap materials not to be used in cell construction, and model construction conditions as closely as is practical.

3.2 QUALITY CONTROL

A. The Contractor shall perform testing of the materials.

B. Ensure CQA Inspector has at all times immediate access for the testing of all related work.

C. Perform CQC testing of all materials.
   1. Perform gradation tests at a frequency of 1 per 1,500 CY or portion thereof for:
      a. Drainage sand layer for the Phase I / II overlay liner system by ASTM D422.
   2. Perform permeability tests at a frequency of 1 per 3,000 CY or portion thereof for:
      a. Drainage sand layer for the Phase I / II overlay liner system by ASTM D 2434.
      b. Permeability samples shall be compacted to 95% of standard proctor before testing.

D. Confirm specified thickness by survey on a grid system with not less than one verification point per 5,000 square feet of surface.

E. Reject or modify material not meeting specifications.
   1. Provided the Contractor demonstrates that the materials exceed the permeability requirement, the Engineer may consider approval of materials with more than 10% passing the #100 sieve.

3.3 QUALITY ASSURANCE

A. The CQA Inspector is responsible for collecting and submitting test materials to the CQA laboratory for interface friction testing.

B. The CQA Inspector is responsible for observing and documenting placement of the drainage sand layer for the Phase I / II overlay liner system.

C. The CQA Inspector will review all testing submitted by the Contractor.

D. The CQA Inspector may conduct confirmation testing of drainage sand layer for the Phase I / II overlay liner system.

END OF SECTION

SECTION 02260
TOPSOILING AND FINISHED GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Topsoiling and finished grading.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 – Earthwork - Landfill.
   2. Section 02270 - Soil Erosion and Sediment Control.
   3. Section 02485 - Sodding.
   4. Section 02486 – Hydroseeding.

C. Location of Work: All areas within limits of grading unless otherwise shown on Drawings and all vegetated areas outside limits of grading which are disturbed in the course of the work and require the reestablishment of vegetation..

1.2 PROJECT CONDITIONS

A. Verify amount of topsoil available in designated stockpiles and borrow area and determine amount of additional topsoil, if necessary, to complete work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. Original surface soil typical of the area.
   2. Capable of supporting native plant growth.

2.2 TOLERANCES

A. Provide minimum of 6 inches (compacted) of topsoil. Final topsoil elevations shall not exceed final buildout elevations on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Correct, adjust and/or repair rough graded areas.
   1. Cut off mounds and ridges.
   2. Fill gullies and depressions.
   3. Perform other necessary repairs.
   4. Ensure underlying intermediate cover and protective cover minimum thicknesses are achieved and that all underlying materials have been tested and meet Specifications.

B. Loosen surface to depth of 2 IN, minimum.

C. Remove all stones and debris over 2 IN in any dimension.

3.2 PLACING TOPSOIL

A. Do not place when subgrade is wet or frozen enough to cause clodding.

B. Spread to compacted depth of 6 IN for all areas where required

C. Do not over compact topsoil. Compaction of topsoil shall only be performed with dozer tracks. Rollers and compactors will not be allowed.

D. If topsoil stockpiled is less than amount required for work, furnish additional topsoil from designated areas of borrow area in accordance with Bid Form.

E. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension and suitable for the installation of sod.

F. Provide finished surface smooth and true to required grades.

G. Restore stockpile area and borrow area to condition of rest of finished work.

3.3 ACCEPTANCE

A. Upon completion of topsoiling, perform depth survey as required in Section 02200.

B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

SECTION 02270
SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil erosion and sediment control.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 – Earthwork - Landfills.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Florida Erosion and Sediment Control Planning Handbook, or current edition.
   2. Florida Department of Transportation Standard Specifications for Roads and Structures Construction, Latest edition.

1.3 SITE CONDITIONS

A. The Owner has installed sediment control features for their current operations.

B. The Contractor may use these existing features with the Owner's prior approval, provided the Contractor maintains said features.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Stone: Manufacturer's certification that materials supplied meet project requirements.
   2. Silt Fence: Product information demonstrating materials supplied meet project requirements including installation instructions.
   3. Turbidity Curtain: Product information demonstrating materials supplied meet project requirements including installation instructions and layout diagrams.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stone for temporary ditch blocks and construction entrances constructed as per the Plans/Drawings.

B. Temporary Grass Seed.

C. Silt Fence: Premanufactured or constructed on site as per Plans/Drawings.

D. Turbidity Curtains: pre-manufactured and installed as per the Plans/Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to Disturbance:
   1. Install silt fence, ditches, channels, ditch blocks, temporary construction entrances, and turbidity curtains.
   2. Refer to the construction sequence on the plans for further detail.

3.2 DURING CONSTRUCTION PERIOD

A. Maintain silt fence, ditches, channels, ditch blocks, temporary construction entrances, and turbidity curtains:
   1. Inspect regularly especially after rainstorms.
   2. Repair or replace damaged or missing items.

B. After rough grading, sow temporary grass cover and mulch over all exposed earth areas not draining into sediment basin or trap.

C. Provide necessary swales, dikes and temporary culverts to control erosion. Contractor shall provide all erosion protection measures at no additional cost to the Owner to prevent off-site sediment/erosion. Although there are stormwater ponds on-site, the Contractor shall take all reasonable precautions to reduce sediment transport to the ponds.

D. Do not disturb existing vegetation (grass and trees) to the extent possible.

E. Excavate sediment out of basins and traps when capacity has been reduced by 40 percent.
   1. Remove sediment from silt fence to prevent overtopping.

F. Topsoil and Fine Grade Slopes and Swales, Etc.:
   1. Seed and mulch or sod as soon as areas become ready.

G. The erosion control features shown on the plans are performance based. If the feature does not adequately control erosion and sediment control to the satisfaction of the Project Manager, the Contractor will be required to install additional erosion and sediment control features. The Project Manager will work with the Contractor to determine the extent of the additional measures.

H. After fine grading, sod all areas receiving final cover.

I. Remove accumulated mud and soil from roadways on a daily basis.

3.3 NEAR COMPLETION OF CONSTRUCTION

A. Removed accumulated sediment from erosion and sediment control devises, including Pond 1as shown on the Contract Drawings.

B. Eliminate temporary basins, dikes, traps, turbidity curtain, etc.

C. Grade to finished or existing grades.

D. Fine grade all remaining earth areas, then seed and mulch or sod in accordance with the Plans/Drawings.

END OF SECTION

SECTION 02310
DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
   1. Work necessary for dewatering, as necessary, to complete the work.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. All work in this Section shall be done in accordance with the requirements of the Environmental Resource Permit and Water Use Permit (if required) as issued by the Florida Department of Environmental Protection (FDEP) Southwest District.

B. The General and Special Conditions of these specifications are a part of this section as if incorporated herein.

1.3 SUBMITTALS

A. Within 15 days of receiving the notice to proceed, the Contractor shall submit to the FDEP a dewatering plan. At a minimum, the plan shall include the following:
   1. Duration of dewatering for each area.
   2. Number and size of pumps.
   3. Method for measuring dewatering flow and quantity.
   4. Method of dewatering each area.
   5. Methods for routing/containing the discharge.
   6. Methods of isolating dewatering areas.
   7. Time dewatering structure will be in place.
   8. Proposed discharge points.

B. Five copies of the plan shall be submitted to the Engineer for record purposes only.

C. It shall be the responsibility of the Contractor to determine if a Water Use Permit will be required. Should a Water Use Permit be required, it shall be the Contractor's responsibility to provide the required application and documentation. If a Water Use Permit is required the Contractor shall submit five copies of the application to the Engineer for record purposes only.

1.4 QUALIFICATIONS OF WORKMEN

A. At least one person shall be provided who shall be present at all times during the execution of this portion of the work and who shall be thoroughly familiar with the dewatering system being installed, the referenced standards, the requirements of this work, and who shall direct all work performed under this section.

B. It shall be the responsibility of the Contractor to determine the water level at the time prior to beginning excavation and construction.

1.5 REFERENCE MATERIAL

A. Design of the dewatering system shall be the sole responsibility of the Contractor. The Contractor shall be responsible for performing whatever investigations they see necessary, prior to bidding, to design the dewatering system. Inaccuracies in this information shall not be the basis for a claim by the Contractor as it is the Contractor's responsibility to verify these data with their own investigations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEWATERING SYSTEM

A. The dewatering system shall be adequate to pre-drain the soils to be excavated to the extent that the piezometric water level in the construction area is a minimum of 3 feet below the bottom of the excavation, side slopes of excavations, or bottom of the footings at all times, or as otherwise required to obtain the specified compaction and installation conditions. Pipeline trenches must be dewatered at least 6 inches below the trench bottom.

B. The dewatering system shall include a method of measuring flow and total quantity removed.

C. In the event of layered soils, the hydrostatic head in the zone below the subgrade elevation shall be relieved to prevent uplift.

D. Unless otherwise noted and prior to any excavating below or within 2 feet above the groundwater level, a dewatering system shall be placed into operation to lower water levels to the extent specified previously, and then shall be operated continuously 24 hours per day, 7 days a week, throughout the duration of the contract to maintain and protect all work, until the work has been completed to the satisfaction of the Owner.

E. Where used, well points shall be installed in an approved manner and in sufficient numbers to provide the necessary removal of water as stated previously. Well points and header piping shall be installed in such a manner that traffic on public thoroughfares and site access roads will not be impeded.

F. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the specified work. The dewatering system shall stay in full operation until not less than 90% of the total building load is applied, as will be determined by the Engineer, or until excavations and trenches have been backfilled and compacted.

G. To prevent excessive noise, exhaust from all pumps and engines shall be silenced and muffled.

H. Wellpoint or surface water pump discharge shall be controlled to prevent erosion, undermining, and all other damage, and be piped to approved locations.

I. The Contractor is solely responsible for determining what approvals and permits are required to comply with any and all applicable regulations and permitting requirements relating to dewatering activities. The Contractor shall obtain all necessary approvals and permits, and comply with any and all applicable regulations and permitting requirements concerning all dewatering activities including pumpage and discharge. The Contactor is solely responsible for all costs associated with both proper and improper implementation of dewatering activities.

J. The Contractor shall perform all dewatering work in strict compliance with Section 02575, Environmental Control Program Requirements.

K. Excavations shall be kept free from water during the placing of concrete and for 36 hours thereafter or until concrete forms are removed.

L. The Contractor shall dewater in such a manner as to prevent damage to existing work. Any damage resulting from the dewatering activities of the Contractor shall be repaired or replaced, as approved by the Engineer, at no additional cost or time to the Owner.

M. As a result of potential arsenic concentrations in groundwater within the proximity of the Phase I landfill, water removed by dewatering (inside or outside the limits of waste) will be disposed of in the Phase I leachate collection system or hauled to the on-site leachate storage tank. This area does not include the borrow areas for soil located northwest of the facility. No separate payment will be made as part of the Contract for dewatering. The cost to either connect dewatering piping to the existing leachate collection system cleanouts or for loading the water to a tanker truck, hauling to the existing leachate storage tank located on site, and pumping the water into the leachate storage tank as needed to contain the dewatering effluent, shall be included in the unit pricing for installation of material that may require dewatering within the limits of construction. These items include, but may not be limited to, the stormwater culvert piping from the Phase I closure south to the stormwater ditch and other areas which may require excavation to install piping or structures. Contractor shall include the proposed procedures and handling of the dewatering water, as described in this section, in the required project Dewatering Plan that shall be submitted by the Contractor to the Owner and Engineer for submittal to the FDEP and for approval before implementing any dewatering operations.

N. The Contractor shall record flow and total quantity of dewatering water removed and disposed in the CCSWDC leachate collection system or leachate storage tank daily. The daily dewatering quantity records shall be submitted to the Owner and Engineer the last day of each month during dewatering activities or the length of contract as needed for processing. In addition, the Contractor shall provide the County at each progress meeting or at least weekly a summary of the total quantity of dewatering discharge pumped and discharged to the County's leachate collection system or leachate storage tank.

3.2 OBSERVATION WELLS

A. The Contractor shall install observation wells as may be required to record accurate water levels.

B. The Contractor shall be responsible for maintaining all observation wells and observing and recording the elevation of the piezometric water levels daily.

C. Wells damaged or destroyed shall be replaced at no additional cost to the Owner.

3.3 CLEANUP

A. Upon completion of dewatering work elsewhere on the Project, the Contractor shall remove all equipment and leave the project site in a neat, clean, and acceptable condition, satisfactory to the Owner. Wellpoint holes, observation wells, and excavations shall be adequately backfilled and compacted to prevent settlement.

END OF SECTION

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SECTION 02485
SODDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to provide for sodding.

1.2 RELATED WORK

A. The General and Supplementary Conditions of these specifications are a part of this section as if incorporated herein.

1.3 REFERENCES

A. The latest edition of the Florida Department of Transportation (DOT) Standard Specifications for Road Bridge Construction (Standard Specifications) shall be referred to for both specific and general standards for materials, construction, workmanship, and quality control as specified herein with exceptions, as noted herein.

B. The latest edition of DOT Roadway and Traffic Design Standards.

1.4 SUBMITTALS

A. Soil Analysis: The Contractor shall furnish a soil analysis for each borrow source or distinct on-site soil type used as topsoil for the final cover. The analysis shall be made by a qualified independent soil-testing agency, to be approved by the Engineer. The analysis shall state percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of the soils. The analysis shall state recommended quantities of nitrogen, phosphorus, and potash nutrients and any soil amendments to be added to produce satisfactory topsoil. The Contractor shall perform soil test 30 days prior to mobilizing for landscape construction.

PART 2 - PRODUCTS

2.1 FERTILIZER

A. Fertilizer for grassing shall conform to Section 982 of the Standard Specifications.

B. Fertilizer shall be granulated so that 80 percent is held on a 16-mesh screen, uniform in composition, dry, and free flowing. The Contractor shall test screen one bag of fertilizer per source and per shipment.

2.2 SODDING

A. The following sections of the Standard Specifications shall apply:
   1. Section 575-1, Description
   2. Section 981-2 and 981-4, Materials

2.3 WATER

A. Water for sodding shall conform to Section 983 of the Standard Specifications.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All areas within the limits of work and all areas disturbed by the Contractor's operations with the exception of stockpile and borrow areas shall be sodded unless otherwise indicated on the Contract Drawings.

B. The period of sod establishment shall begin immediately after the completion of sodding in an area and shall continue for a period of 1year after the completion of sodding on the entire project unless the desired sod cover is established in a shorter period of time and shortening of the sod-establishment period is authorized by the Engineer.

C. Areas to be sodded shall be graded to remove construction debris, litter, depressions, undulations, and irregularities in the surface before sodding and in accordance with the Contract Drawings. Grading activities shall be conducted such that the minimum required thickness of topsoil is maintained.

3.2 SODDING

A. Sodding shall be placed within the entire final closure area unless shown otherwise on the Drawings and in all graded and disturbed areas that have a 4 (horizontal) to 1 (vertical) slope or steeper (except borrow and stockpile areas) and other areas as shown on the Drawings.

B. The following sections of the Standard Specifications shall apply:
   1. Section 575-3, Construction Methods

C. Exceptions:
   1. Section 575-3.3, replace phrase "a suitable length of roadway" with "an area."
   2. Section 575-3.3, Placing Sod; do not plant dormant sod or if ground is frozen. Rolled sod shall be placed parallel to contours. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. The offsets of individual staggered strips shall not exceed 6 inches. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass. On areas where sod may slide due to the slope gradient, may be displaced by flowing water or may otherwise move, the sod must be pegged using suitable wooden pegs and netting or other approved means. The pegs should be driven through the sod strips into firm earth, at suitable intervals. Contractor will apply at least 1.00 inch of water to new sod within 24 of sod placement and as frequent thereof in order to maintain a healthy and uniform stand of grass. Water sod thoroughly with a fine spray. Roll sod within 24 hours of placement to ensure contact between sod and subgrade.
   3. Section 575-3.4, watering shall conform to requirements previously specified herein. Replace the word "Department" with the Word "County" in the last sentence. The cost of resodding shall be borne exclusively by the Contractor.
   4. Section 575-3.5, Maintenance shall be performed as specified herein.

D. Sod installed within drainage swales, terraces, and near drainage inlets shall be adequately anchored using pegs, netting, or other means to ensure that the sod is not displaced by the flow of water.

3.3 CLEANUP

A. All excess sod materials, stones, and other waste shall be removed from the site weekly and shall not be allowed to accumulate.

3.4 MAINTENANCE

A. Maintenance shall begin immediately following the last operation of sodding and continue until conclusion of the sod-establishment period specified herein. Maintenance shall include watering, mowing every two weeks (or as needed) during construction and until final acceptance of the project, resodding, repair of erosion, and all other work necessary to produce a uniform stand of grass.

B. Sod will be considered for final acceptance when the sod roots are firmly anchored to underlying soil and the permanent grass is healthy and growing on 97 percent of the area with no bare areas wider than 12 inches, as determined by the Engineer.

C. The Contractor shall maintain the sodded areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary. If the planted areas must be resodded, reshaped, or otherwise repaired, regardless of cause, the Contractor shall perform such work at the Contractor's expense. The Engineer, at any time, may require replanting of any areas in which the establishment of the grass stand does not appear to be developing satisfactorily at no additional cost to Owner.

D. Due to the presence of the final cover geomembrane liner, sod should not be affected by landfill gas, therefore, if areas appear to not establish due to landfill gas, the Contractor must determine the integrity of the geomembrane liner in that area and repair as required in accordance with the Contract Documents.

E. The period of sod establishment for areas that are resodded shall extend to 1 year after the completion of resodding unless otherwise authorized by Engineer.

END OF SECTION

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SECTION 02510
ROADWAY: LANDFILL ACCESS ROAD

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
   1. Work necessary to provide for the construction of all stabilized roadway.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The current editions of the Florida Department of Transportation (DOT) Standard Specifications for Road and Bridge Construction (Standard Specifications) and the Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified herein with exceptions as noted herein.
   2. Note that any reference in the Standard Specifications to the terms "Department" or "District Materials Engineer" shall be replaced by the term "Owner."

1.3 SUBMITTALS

A. Limerock material submittal shall include liquid limit, plastic index, gradation, certification regarding deleterious material, limerock bearing ratio (LBR), DOT pit number, and other information as required to indicate performance with the specifications.

B. Information regarding subgrade materials shall be submitted as required by the referenced DOT specifications and Section 02200—Earthwork - Landfills.

1.4 QUALITY CONTROL AND TESTING

A. Field densities for the stabilized base shall be performed along the centerline of construction every 200 feet or as directed by the Engineer and in accordance with the Standard Specifications.

B. The Engineer may require additional testing as deemed necessary. Interpretation of test results shall be exclusively the responsibility of the Engineer, and remedial work shall be performed by the Contractor, at no cost to the Owner. The Contractor shall provide labor to the Engineer for aid in performing tests and/or checking line and grade at no additional cost to the Owner.

C. Laboratory Maximum Dry Density of soil mixtures at optimum moisture shall be determined by ASTM D 1557 for subgrade and stabilized road base material.

D. Field density of subgrade and stabilized road base material shall be determined by ASTM D 1556 or Nuclear Method D 2922.

E. Bearing value of stabilized road base material shall be determined by the methods required for determining limerock bearing ratio (LBR) according to the DOT, Standard Specification FM 5-515.

F. Field density of stabilized road base material shall be 98 percent or greater of the Modified Proctor maximum dry density, ASTM D 1557.

G. The Owner shall retain an independent testing agency, as approved by the Engineer, to perform all tests. The Engineer shall have sole responsibility for interpretation of all test results. The cost of all retests due to failure to achieve specified requirements will be borne by the Contractor.

PART 2 - PRODUCTS

2.1 LIMEROCK FOR STABILIZED ROAD BASE

A. The following sections of the Standard Specifications shall apply:
   1. Section 911, Limerock Material for Base and Stabilized Base.

PART 3 - EXECUTION

3.1 EXCAVATION AND EMBANKMENT

A. The following sections of the Standard Specifications shall apply:
   1. Section 120-1, Description
   2. Section 120-3, Preliminary Soils Investigation
   3. Section 120-4, Removal of Unsuitable Materials and Existing Roads
   4. Section 120-6.5, Authorization for Use of Borrow
   5. Section 120-8, Embankment Construction (excluding Section 120-8.3)
   6. Section 120-9, Compaction Requirements
   7. Section 120-11, Maintenance and Protection of Work
   8. Section 120-12, Construction

B. Exceptions
   1. Section 120-4.1, Subsoil Excavation: Unsuitable soils shall be those in Classifications A-6, A-7, or A-8 in the American Association of State Highway and Transportation Officials (AASHTO) System.
   2. Section 120-9.2.1: Laboratory maximum dry density shall be determined by Modified Proctor, ASTM D 1557. Field densities shall be determined by ASTM D 1556 or Nuclear Method D 2922. All embankments shall be compacted to not less than 95 percent of the maximum dry density, as determined by modified Proctor, ASTM D 1557.
   3. Section 120-12.1 Construction Tolerances: No deviation greater than 0.1 foot above or below the design will be allowed.

3.2 LIMEROCK STABILIZED BASE

A. The following sections of the Standard Specifications shall apply:
   1. Section 230-1, Description

2. Section 230-2, Materials
3. Section 230-3, Equipment
4. Section 230-4, Preparation of Roadbed
5. Section 230-5, Incorporation of Stabilizing Material and Mixing In
6. Section 200-6, Compacting and Finishing Base

B. Exceptions
1. Contractor shall stabilize road bed to a minimum depth as shown on the drawings. No deviation greater than 0.1 foot above or below the design will be allowed.

3.3 LIMEROCK BEARING RATIO AND DENSITIES

A. Limerock base materials shall have an average Limerock Bearing Ratio (LBR) value of not less than 100. Stabilized subgrade and shoulders shall have a minimum Limerock Bearing Ratio (LBR) value of 40.

B. Field density of stabilized limerock base shall be a minimum of 98 percent of the Modified Proctor maximum dry density per ASTM D 1557 to a minimum depth as shown on the drawings.

END OF SECTION

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SECTION 02510A
ROADWAY: ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
   1. Work necessary to provide for the construction and repair of all asphalt roadways.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The current editions of the Florida Department of Transportation (DOT) Standard Specifications for Road and Bridge Construction (Standard Specifications) and the Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified herein with exceptions as noted herein.
   2. Note that any reference in the Standard Specifications to the terms "Department" or "District Materials Engineer" shall be replaced by the term "Owner."

1.3 SUBMITTALS

A. Asphaltic concrete material submittals for mix type SP-9.5 shall be as required in Section 334 of the Standard Specifications.

B. Prime coat requirements shall be as required in Section 330 of the Standard Specifications.

C. Limerock material submittal shall include liquid limit, plastic index, gradation, certification regarding deleterious material, limerock bearing ratio (LBR), DOT pit number, and other information as required to indicate performance with the specifications.

D. Information regarding subgrade materials shall be submitted as required by the referenced DOT specifications and Section 02221—Trenching, Backfilling, and Compacting for LFG piping and Structures.

1.4 QUALITY CONTROL AND TESTING

A. Field densities for the stabilization and limerock base shall be performed along the centerline of construction every 200 feet or as directed by the Engineer and in accordance with the Standard Specifications. Testing of the asphalt surface course shall be as required in Section 334-5.1 1 of the Standard Specifications.

B. Depth of stabilization and/or limerock shall be field-checked at each road crossing with a pipeline.

C. The Engineer may require additional testing as deemed necessary. Interpretation of test results shall be exclusively the responsibility of the Engineer, and remedial work shall be performed by the Contractor, at no cost to the Owner. The Contractor shall provide labor to the Engineer for aid in performing tests and/or checking line and grade at no additional cost to the Owner.

D. Laboratory Maximum Dry Density of soil mixtures at optimum moisture shall be determined by ASTM D 1557 for subgrade, stabilized subgrade, and limerock base course.

E. Field density of stabilized subgrade, soils or soil mixtures in fill or backfill, and limerock base course shall be determined by ASTM D 1556 or Nuclear Method D 2922.

F. Bearing value of stabilized subgrade shall be determined by the methods required for determining limerock bearing ratio (LBR) according to the DOT, Standard Specification FM 5-515.

G. Field density of stabilized subbase shall be 98 percent or greater of the Modified Proctor maximum dry density, ASTM D 1557.

H. The Owner shall retain an independent testing agency, as approved by the Engineer, to perform all tests. The Engineer shall have sole responsibility for interpretation of all test results. The cost of all retests due to failure to achieve specified requirements will be borne by the Contractor.

PART 2 - PRODUCTS

2.1 LIMEROCK BASE

A. The following sections of the Standard Specifications shall apply:
   1. Section 911, Limerock Material for Base and Stabilized Base.

2.2 MATERIALS FOR SUBGRADE STABILIZATION

A. The following sections of the Standard Specifications shall apply:
   1. Section 914-1, General
   2. Section 914-3, Materials for Type B Stabilization
   3. Section 914-4, Testing of Materials for Use as Stabilization

2.3 PRIME AND TACK COATS

A. The following sections of the Standard Specifications shall apply:
   1. Section 300-2

PART 3 - EXECUTION

3.1 EXCAVATION AND EMBANKMENT

A. The following sections of the Standard Specifications shall apply:
   1. Section 120-1, Description
   2. Section 120-3, Preliminary Soils Investigation
   3. Section 120-4, Removal of Unsuitable Materials and Existing Roads
   4. Section 120-6.5, Authorization for Use of Borrow
   5. Section 120-7, Materials for Embankment
   6. Section 120-8, Embankment Construction Section 120-9, Compaction Requirements
   7. Section 120-11, Maintenance and Protection of Work
   8. Section 120-12, Construction

B. Exceptions
   1. Section 120-4.1, Subsoil Excavation: Unsuitable soils shall be those in Classifications A-6, A-7, or A-8 in the American Association of State Highway and Transportation Officials (AASHTO) System.
   2. Section 120-4.2: Where removal of existing pavement is called for, it shall be removed to the full depth of the existing roadway and replaced with new limerock and paving or other treatment in accordance with these specifications, and at a minimum, to match the existing roadway.
   3. Section 120-9.2.1: Laboratory maximum dry density shall be determined by Modified Proctor, ASTM D 1557. Field densities shall be determined by ASTM D 1556 or Nuclear Method D 2922. All embankments shall be compacted to not less than 95 percent of the maximum dry density, as determined by modified Proctor, ASTM D 1557.
   4. Section 120-12.1 Construction Tolerances: No deviation greater than 0.1 foot above or below the design will be allowed.

3.2 STABILIZING

A. The following sections of the Standard Specifications shall apply:
   1. Section 160-1, Description
   2. Section 160-2, Stabilized Subgrade
   3. Section 160-3, Stabilized Subbase
   4. Section 160-4, Materials
   5. Section 160-5, Construction Methods
   6. Section 160-6, Stabilized Subbase (additional strengthening of upper portion)
   7. Section 160-7, Acceptance Program

B. Exceptions
   1. Contractor shall stabilize road bed to a minimum depth as shown on the drawings. No deviation greater than 0.1 foot above or below the design will be allowed.

3.3 LIMEROCK BEARING RATIO AND DENSITIES

A. Limerock base materials shall have an average Limerock Bearing Ratio (LBR) value of not less than 100. Stabilized subgrade and shoulders shall have a minimum Limerock Bearing Ratio (LBR) value of 40.

B. Field density of stabilized limerock base shall be a minimum of 98 percent of the Modified Proctor maximum dry density per ASTM D 1557 to a minimum depth as shown on the drawings.

3.4 LIMEROCK STABILIZED BASE

A. The following sections of the Standard Specifications shall apply:
   1. Section 230

B. Exceptions
   1. Density: The minimum density which will be acceptable for driving areas will be 98 percent of the maximum dry density as determined by Modified Proctor, ASTM D 1557.
   2. Contractor shall construct the base to the minimum depth shown on the drawings. No deviation greater than 0.1 foot above or below the design will be allowed.

3.5 TYPE SP-9.5 ASPHALTIC CONCRETE

A. The following sections of the Standard Specifications shall apply:
   1. Section 334

B. Exceptions
   1. The Engineer may waive acceptance criteria described in Section 334-5.
   2. Contractor shall construct the surface course to the minimum depth shown on the drawings. No deviation greater than 0.1 foot above or below the design will be allowed.

3.6 PAVEMENT REPAIR

A. All damage to pavement as a result of work under this contract shall be repaired in a manner approved by the Engineer and at the expense of the Contractor. Pavement shall be repaired to match the original surface material and original grade. However, the asphalt concrete thickness shall not be less than 3 inches. The repair shall include the preparation of the subgrade, the placing and compacting of the applicable base, the priming of limerock base, the placing and maintaining of the surface treatment, all as specified herein.

B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

END OF SECTION

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SECTION 02515
PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete structures and appurtenant items.
      a. Culverts and appurtenances.
      b. Reinforced Concrete Pipe

B. Related Sections include but are not necessarily limited to:
   1. Section 02221 - Trenching, Backfilling, and Compacting for LFG Piping and Structures.
   2. Section 02221A – Trenching, Backfilling, and Compacting for Utilities and Stormwater Structures.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M198, Standard Specification for Asbestos-Cement Underdrain Pipe.
   2. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A536, Standard Specification for Ductile Iron Castings.
      c. C150, Standard Specification for Portland Cement.
      d. C478, Precast Reinforced Concrete Manhole Sections.
      e. C923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
      f. D1227,Emulsified Asphalt Used As a Protective Coating for Roofing.
      g. D4022, Standard Specification for Coal Tar Roof Cement, Asbestos Containing.
   3. Occupational, Health and Safety Administration (OSHA).
   4. FDOT Specification 430 – Pipe Culverts
   5. FDOT Specification 449 – Precast Concrete Drainage Products

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Fabrication and/or layout drawings:
      a. Include detailed diagrams of structures showing components and dimensions.
      b. Itemize, on separate schedule, sectional breakdown of each structure with all components indicate elevation and position of all piping and appurtenances of each structure, and refer to drawing identification number or notation.
      c. Indicate knockout elevations for all piping entering each structure.
   3. As-Built Drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Black mastic joint compound:
      a. Kalktite 340.

b. Tufflex.
c. Plastico.

2. Premolded joint compound:
   a. Ram Nec.
   b. Kent Seal.
3. Fibered asphalt compound:
   a. Sonneborn Hydrocide 700B Semi-Mastic.

2.2 STRUCTURE COMPONENTS

A. Structure Components:
1. Reinforcement: ASTM C478.
2. H-20 load rated unless otherwise indicated in Drawings.
3. Minimum wall thickness: 5 IN.
4. Minimum base thickness: 6 IN for integral precast.
5. Provide the following components for each structure:
   a. Base (precast) with integral bottom section.
6. Provide 4,000 psi concrete.
7. Must conform to FDOT Class III RCP specifications.

B. Frames and Cover:
1. As shown on Drawings.

C. Special Coatings and Joint Treatment:
1. Joints of precast sections:
   a. Black mastic compound: ASTM D4022.
2. Must conform to FDOT Class III RCP specifications.

D. Concrete:
1. Constructed with Portland ASTM C150, Type I or II cement with a tricalcium aluminate content not to exceed 8 percent.
2. Mix aggregate shall be a minimum of 50 percent crushed limestone.
3. Provide 3000 psi non-shrink grout.
4. Must conform to FDOT Class III RCP specifications.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. General:
1. Construct cast-in-place concrete base slabs where shown on Drawings.

B. Build each structure to dimensions shown on plans and at such elevation that pipe sections built into wall of structure will be true extensions of line of pipe.

C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, trowel apply to clean surface black mastic joint compound to a minimum wet thickness of 1/4 IN immediately prior to mating the surfaces.

D. Seal all pipe penetrations. Form pipe openings smooth and well shaped. After installation, seal cracks with, non shrink grout. After grout cures, wire brush smooth.

E. Apply grout to bottom of structures and shape to provide drainage as shown on Drawings.

3.2 INSTALLATION/ERECTION

A. Structures
1. Install in 12" leveling bed of crushed rock or gravel.
2. Install plumb and to grade for entering and exiting piping.
3. Exercise care to protect entering and exiting piping.

B. Pipe
   1. Install as indicated on the drawings.
   2. Install to line and grade as indicated.
   3. Connection of pipe and fittings to be in accordance with the pipe specifications and drawings.
   4. For sealing joints and gap minimum requirements, refer to FDOT 430, and FDOT 449

END OF SECTION

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SECTION 02575
ENVIRONMENTAL CONTROL PROGRAM REQUIREMENTS

PART 1 - GENERAL

1.1 BACKGROUND

A. This Section has been prepared based on the limited environmental investigations performed at the proposed project site to date.

B. A site safety program shall be developed by the Contractor. The program will address:
   1. Personal safety requirements.

1.02 RELATED REQUIREMENTS

A. Section 01340 – Submittals.

B. Section 01500 – Construction Facilities and Temporary Controls.

C. Section 02200 – Earthwork.

C. Section 02221 – Trenching, Backfilling, and Compacting for Utilities.

1.3 DEFINITIONS

A. Health and Safety Inspector (provided by Contractor): On-site environmental safety inspector responsible for development and implementation of Contractor's site Health and Safety Plan, monitoring of site conditions and supervision of site personnel on health and safety issues. Health and Safety Inspector shall be appropriately certified.

1.4 ON-SITE HEALTH AND SAFETY

A. General: A Health and Safety Plan developed by the Contractor shall be used as basis for safety precautions to be undertaken during construction of those project work elements that involve potential exposure to toxic/hazardous landfill gas. The Health and Safety Inspector (HSI) will instruct all site personnel on the level of protection required. Protective clothing, respirators and other equipment may be required depending upon the potential exposure of workers to landfill gases. Upon start-up of Work, the Contractor shall have available, on-site, the items outlined in Paragraph 2.1 for use by all construction and on-site personnel if required.

B. All on-site personnel shall attend any required health and safety training provided by the HSI prior to initiation of work at the site.

C. The Health and Safety Plan shall identify the minimum frequency of the site visits to be made by the HSI. That frequency may not be less than quarterly.

1.5 MINIMUM QUALIFICATIONS

A. The Contractor shall have on staff, as a permanent employee, a qualified Health and Safety Inspector or shall subcontract with a qualified firm for such services. At a minimum, the Health and Safety Inspector (HSI) must have five (5) years of experience related to on-site monitoring and supervision of health and safety programs for construction related activities. The experience must include monitoring of atmospheric conditions for toxic gas, combustible gas, and oxygen deficiency. The Contractor shall provide written Certification to the Owner that his selected HSI meets this minimum qualification requirement. The Owner reserves the right to reject the HSI if the evidence submitted by, or investigation of, the HSI fails to satisfy the Owner that such HSI is properly qualified to carry out the obligations of the contract.

B. Contractor or his approved Health and Safety subcontractor shall provide all required equipment and services necessary for site monitoring and analysis in accordance with these Contract Documents.

1.6 SUBMITTALS

A. Submit Health and Safety Plan to the Engineer for informational purposes only and not for review prior to initiating any construction activity.

B. Submit certification of Health and Safety Plan inspector or subcontractor to Engineer.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND SUPPLIES

A. All equipment, tools, etc. which have been in contact with hazardous materials shall be decontaminated with a water and detergent washdown and thorough rinse with spray equipment prior to leaving the site.

B. Equipment and Supplies for Decontamination: The Contractor shall supply all equipment and supplies required for decontamination for the duration of the project. A listing of the required supplies and equipment shall be included in the Contractor's Health and Safety Plan.

C. Equipment and Supplies for On-site Personnel: The Contractor shall provide all equipment and supplies for on-site personnel as required in the Contractor's Health and Safety Plan.

PART 3 - EXECUTION

3.1 COORDINATION AND PROJECT PROCEDURES

A. Coordinate Environmental Program requirements specified in this Section with other work or requirements as shown on drawings or specified in other Sections of the Contract Documents.

B. Sequence of work and general construction procedures shall be as follows:
1. Contractor shall develop project Health and Safety Plan. Plan shall be submitted to Engineer for informational purposes only and not review before any further activities are commenced.
2. Conduct on-site safety training in accordance with approved Health and Safety Plan.
3. Prior to initiating excavation, HSI shall monitor the site for hazardous conditions.
4. Based on findings, HSI shall establish protocol for continued monitoring as needed.
5. As conditions warrant, the HSI shall be on-site or available as needed to monitor site conditions and to supervise personnel on health and safety issues.

END OF SECTION

SECTION 02771
TPO GEOMEMBRANE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the scrim reinforced Thermoplastic Polyolefin (TPO) geomembrane components used in the exposed geomembrane temporary cover. The scrim reinforced TPO is 60 mil UltraPly^{TM} TPO as manufactured by Firestone Building Products or equivalent.

B. Related Sections:
   1. Section 02200 –Earthwork - Landfill.
      Section 02778 - Geotextile.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. ASTM D751– Standard Test Methods for Coated Fabrics
      b. ASTM D6878– Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing
      c. ASTM D5261– Test Method for Measuring Mass per Unit Area of Geotextiles
      d. ASTM D4885– Standard Test Method for Determining Performance Strength of Geomembranes by the Wide Strip Tensile Method
      e. ASTM D5884– Standard Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes
      f. ASTM D2137 – Standard Test Methods for Rubber Property-Brittleness Point of Flexible Polymers and Coated Fabrics
      g. ASTM D1204– Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
      h. ASTM D1149– Standard Test Methods for Rubber Deterioration; Cracking in an Ozone Controlled Environment
      i. FTM 101 C– Test Method for Puncture Resistance and Elongation Test
      j. ASTM D471– Standard Test Method for Rubber Properties—Effect of Liquids (Water Absorption)
      k. ASTM G 151 – Practice for Exposing Non-Metallic Materials in Accelerated Test Devices that use Laboratory Light Sources
      l. ASTMTM G 155 – Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
   2. The Geosynthetic Research Institute (GRI).
      a. GRI/G 16 – Observation of Surface Cracking of Geomembranes

B. Qualifications:
   1. Each manufacturing and fabricating firm shall demonstrate 5 years continuous experience with a minimum of 10,000,000 SF of TPO geomembranes.
   2. Installer:
      a. Demonstrate 5 years continuous experience with a minimum 10,000,000 SF of geomembranes.
      b. Trained and certified by at least one of the named manufacturers in this Specification (not necessarily the manufacturer supplying materials for this Project).
      c. Geomembrane Installer Personnel Qualifications:
         1) Installation Superintendent shall have worked in a similar capacity on at least five geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.

2) The Master Welder shall have completed a minimum of 5,000,000 sf geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
3) Other welders shall have seamed a minimum of 1,000,000 sf geomembrane.

3. CQC Testing Laboratory shall demonstrate 3 years of continuous experience in similar geosynthetic materials testing.

C. Quality Assurance / Control:
1. The Owner or Engineer's representative will conduct independent testing to support construction quality assurance (CQA) program and to provide documentation of such to appropriate regulatory agencies.
2. Unless specifically superseded by these contract documents or approved plans submitted by the Contractor, the geosynthetic materials shall be manufactured, stored, placed, seamed, tested and protected as described in EPA/600/R-93/182 and EPA/530/SW-91/051.
a. This specifically includes:
1) Material Composition.
2) Manufacturing.
3) Handling and Packaging.
4) Shipment.
5) Storage (Manufacturer and Site).
6) Placement:
a) Seaming and Joining.
b) Destructive and Non Destructive Testing.
c) Protection, Backfilling and Covering.
7) Conformance Testing.
8) Anchoring and Anchor Trenches.
9) Access Roads/Ramps.

D. CQA Plan Implementation: Construction Quality Control will be performed in accordance with the CQA Plan prepared for this project. The Contractor and Geomembrane Installer should familiarize themselves with the CQA Plan.

E. Installer's construction quality control programs to include, but not be limited to, product acceptance testing, installation testing, including both nondestructive and destructive quality control field testing of the sheets and seams during installation of the geomembrane, proposed methods of testing geosynthetic joints and connections at appurtenances for continuity, documentation and changes, alterations, repairs, retests, and acceptance.

F. Geomembrane Installer's installation manual to include:
1. Ambient temperature at which the seams are made
2. Control of panel lift up by wind
3. Acceptable condition of the subsurface beneath the geomembrane
4. Quality and consistency of the welding material
5. Proper preparation of the liner surfaces to be joined
6. Cleanliness of the seam interface (e.g., the amount of airborne dust and debris present)
7. Proposed details for connecting the TPO liner to appurtenances, i.e. penetrations of the containment facilities.
8. A complete description of seaming by hot-air welding and hot-wedge welding.
9. Requirements of the Manufacturer's Installation Manual unless exceptions are noted and approved by the Engineer.

1.3 DEFINITIONS AND RESPONSIBILITIES

A. Geomembrane Manufacturer: Manufacturer of geomembranes producing geomembrane sheets from resin and additives. The manufacturer is responsible for producing geomembrane sheet which complies with these Specifications. These responsibilities include but are not limited to:
1. Acceptance of the resin and additives from chemical formulators. Testing of the raw resin and additives to ensure compliance with the manufacturer's specifications and with this Specification.

2. Formulation of the resin and additives into geomembrane sheeting using mixing and extrusion equipment.
3. Testing of the geomembrane sheet to ensure compliance with manufacturer's specification and this Specification.
4. Shipping of the geomembrane sheet to installer designated facilities.
5. Certification of the raw materials and finished geomembrane sheet to comply with this Specification.
6. Certification of installer's training, experience, and methods for welding and inspection of geomembrane installations in compliance with manufacturer's standards.

B. Geomembrane Installer. Installer of geomembranes are responsible for handling, fitting, welding, and testing of geomembrane sheets or blankets in the field. These responsibilities include but are not limited to:
1. Acceptance (in writing) of the geomembrane from the manufacturer.
2. Acceptance (in writing) of the surface which will serve as a base for the geomembrane. This acceptance shall precede installation of the geomembrane, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of geomembrane liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
3. Handling, welding, testing, and repair geomembrane liners in compliance with this Specification and the Geomembrane Installer's Installation Procedures Manual.
4. Performance of QC testing and record keeping as required by the approved Geomembrane Installer's Field Installation Procedures Manual.
5. Repair or replacement of defects in the geomembrane as required by the Installer's CQC Consultant or the CQA Inspector.

C. CQA Inspector:
1. Inspectors of TPO geomembrane are the individuals responsible for observing field installation of the geosynthetic materials and providing the Manufacturer, Installer, CQA Engineer, and Owner with verbal and written documentation of the compliance of the installation with this specification and with written procedures manuals prepared by the Manufacturer or Installer.

D. CQA Testing Laboratory shall:
1. Perform destructive testing of the TPO geomembrane.
2. Perform conformance testing of TPO geomembrane.

E. Installer's CQC Consultant: Responsible for observing field installation of the geomembrane and performance of material conformance and CQC testing to provide the Contractor with verbal and written documentation of the compliance of the installation with these Specifications.

F. CQA Engineer: Responsible for implementing CQA Plan including overview of material conformance testing, field installation of the geomembrane, and CQC activities, and to perform limited CQA conformance testing to provide Owner with verbal and written documentation of the compliance of the installation with these Specifications. The CQA Engineer will use the written results of the CQC program and the CQA program in the preparation of the facility Certification Document. The CQA Engineer reports to the Owner and is not part of this contract.

G. Refer to the accompanying CQA Plan for additional definitions.

1.4 SUBMITTALS

A. Shop Drawings:
1. Submit for Engineer's approval Shop Drawings, including:
   a. Manufacturer's certification that raw materials and sheet materials comply with required materials, mil thickness, and material properties.
      1) Original certificates are required.
   b. Manufacturer/Fabricator/Installer quality control requirements.
   c. Qualifications and experience of key personnel per 1.2 B of this section.

d. Manufacturer's written acceptance of Geomembrane Installer's qualifications for installation of the TPO geomembrane.
e. TPO Geomembrane layout plan with proposed size, number, position and sequencing of liner panels and showing the location and direction of all field or factory joints.
   1) Proposed details for connecting the geosynthetic materials to appurtenances.
   2) Proposed methods of welding, seaming or jointing geosynthetic materials.
   3) Proposed method of testing TPO geomembrane and other geosynthetic materials, joints and connections at appurtenances for continuity.
   4) Location and configuration of haul roads and access points.
   5) Proposed details for anchor trench if different than included in Contract Documents.

B. Miscellaneous:
1. Test results:
   a. Resin test, tests of sheet material and factory seam tests at frequency specified in respective quality control manuals.
      1) Results shall include or bracket the rolls delivered for use in the Work.
   b. Daily test seam results.
   c. Daily results of production seam testing.
2. Warranties as described below.
3. Submit written certifications that:
   a. Utilize certification forms approved for use on this project by the Owner and Engineer. Make appropriate number of copies, as required.
   b. The TPO geomembrane material delivered to site meets the requirements of this Specification.
   c. The TPO geomembrane was received and accepted in undamaged condition from shipper.
   d. The TPO geomembrane liner was installed in accordance with this Specification and with approved Shop Drawings.
   e. The TPO geomembrane joints were inspected, tested for strength and continuity, and passed all inspections and tests.
      1) All test and inspection data shall be incorporated into this certification.
4. Manufacturer/Installer's Field Installation Procedures Manual shall clearly identify any exceptions taken to the specified execution of the Work.
5. Record Drawings: Submit reproducible drawings of record showing changes from the approved installation drawings. The record drawings shall include the identity and location of each repair, cap strip, penetration, boot, and sample taken from the installed geosynthetic for testing. The record drawings shall show locations of each type of material, anchor trenches and the construction baseline.

C. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted. All submittals must be submitted prior to the Geomembrane Preconstruction Meeting and a minimum of four weeks prior to installation.

D. The acceptable color of the material will be a shade of green. The proposed color and a sample of material and color shall be submitted for acceptance and approval by the Owner and Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The TPO geomembrane should be protected from punctures, abrasions, vandalism, excessive heat or cold or other damaging conditions

B. The TPO geomembrane shall be delivered to the project site intact and free from any tears, abrasion, or damage. Store TPO geomembrane rolls in a dry area off the ground on 4 rails with each rail being a minimum of 3.5 inches wide, and protected from the direct heat of the sun, where possible, and accessories in original containers in a dry area protected from the elements.

C. Each roll shall be labeled with the manufacturers name, type, lot number, roll number, and roll dimensions (length, width, gross weight).

1. TPO geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed.
2. TPO geomembrane shall not be exposed to temperatures in excess of 60 Deg C (140 Deg F) or less if recommended by the Manufacturer.

D. No hooks, tongs or other sharp instruments shall be used for handling the TPO geomembrane.
1. Rolls shall not be lifted by use of cables or chains in contact with the TPO geomembrane.
2. TPO geomembrane shall not be dragged along the ground.

1.6 PROJECT CONDITIONS

A. When the weather is of such a nature as to endanger the integrity and quality of the installation, whether this is due to rain, high winds, cold temperatures, or other weather elements, the installation of the geomembrane shall be halted at the direction of, or with the concurrence of, the Owner until the weather conditions are satisfactory.

B. The contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces which hamper the efficient field seaming of geosynthetic panels or performance.

C. Maintain natural surface water drainage diversions around the work area and provide for the disposal of water which may collect in the work area directly from precipitation falling within the area or from inadequate diversion structures or practices.

D. All materials shall be placed and spread with low ground pressure equipment (10 psi ground pressure or less) as approved by the CQA Engineer to reduce potential damage to the geosynthetics. The geosynthetics surface shall be off limits to construction traffic. Hard turning of tracked equipment on the protective cover and stone must be avoided.
1. At least 12 inches of separation between the geosynthetics and all low ground pressure equipment shall be maintained.
2. Stockpiling of materials within the limits of the cell shall be subject to advanced approval by the CQA Inspector. Any hauling equipment (dump trucks, etc.) operating within the cell limits (and including access ramps), shall have a minimum of 4 feet of separation between the vehicle wheels and the geosynthetics.
3. No vehicle shall access the completed Work unless it can be demonstrated that its weight, movement or activities will not damage the Work.
4. When damage is suspected, uncover area, repair damage if required, and recover area at no cost to Owner.
5. Suspect areas may be identified by Owner or Engineer.

1.7 WARRANTIES

A. Written warranties addressing TPO geomembrane material and installation workmanship shall be furnished by the Contractor and shall be made to the Owner.

B. Submit material samples and warranties prior to shipment.

C. Suitability of geosynthetic liner system shall be subject to Owner's approval of warranty.
1. The Manufacturer's warranty shall be against manufacturing defects and workmanship and against deterioration due to ozone, ultra- violet exposure from direct sunlight, and other exposure to the elements, for a period of 20 years on a pro rata basis. The warranty shall be limited to replacement of material, and shall not cover installation of replacement geomembrane.
2. The Installer's warranty shall state that the materials were properly installed, properly (field and factory) welded, seamed and jointed and will not fail within two years of the date of final acceptance of the Work by the Owner.
   a. Warranty shall not be prorated.

D. Warranties shall provide for complete repair/replacement excluding installation costs at no additional cost to the Owner for the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND/OR GEOMEMBRANE INSTALLERS

A. Subject to compliance with the Contract Documents, the following manufacturers and installers are acceptable:
   1. TPO Geomembrane liners manufacturers:
      a. Firestone Building Products
      b. Carlisle SynTec
   2. TPO Geomembrane Liner Installers:
      a. Authorized installers of approved manufacturers.
      b. Other installers may qualify by providing references for a minimum of 10,000,000 SF of TPO liner installations.

2.2 MATERIALS

A. The membrane will be Firestone UltraPly TPO 60 mil geomembrane or equivalent.

B. Accessories will be as supplied or approved by geomembrane manufacturer.

C. Geomembrane meets or exceeds the property values listed in Table 1.

D. Interface testing of liner and geotextile will be submitted as specified in Table 2.

Table 1: Physical Properties

Description	Test Method	Property
UNAGED PROPERTIES:		
Thickness (min average)	ASTM D751 and D6878	0.060" (1.52 mm, 60 mil) Lowest individual -10%
Thickness Over Scrim	ASTM D 4637 (Optical Method) 0.060" Membrane	0.024" (0.609 mm) ± 10%
Mass per unit area (min)	ASTM D5261	0.3 lb/sf (1.42 Kg/m^2)
Breaking Strength (TD and MD) (min)	ASTM D 4885	150 ppi (26.3 kN/m)
Elongation at Reinforcement break (TD and MD) (min)	ASTM D 4885	30%
Tearing Strength (TD and MD) (min)	ASTM D 751 (8"x8" specimen)	86 lbf (382 N)
Brittleness Point (max)	ASTM D 2137	-50°F (-46°C)
Linear Dimension Change (max)	ASTM D 120 (6 hrs @70° C)	4 %
Ozone Resistance	ASTM D 1149	PASS (no cracks)
Factory Seam Strength (min)	ASTM D 4885	150 ppi (26.3 kN/m)
Puncture Resistance (min)	FTM 101C Method 2031	265 lbf (1174 N)
Water Absorption (max, mass)	ASTM D471 166 hrs at 158^0F	+/- 3%
HEAT AGED PROPERTIES:		
Breaking Strength (TD and MD) (min)	ASTM D 4885	150 ppi (26.3 kN/m)*
Elongation at Reinforcement Break (TD and MD) (min)	ASTM D 4885	30%*
Tearing Strength (TD and MD) (min)	ASTM D 5884 (8"x8" specimen)	86 lbf (382N)*
Weight Change (max) (Membrane)	ASTM D 471	1% (change in mass)
AGED PROPERTIES:		
Ozone Resistance	ASTM D 1149	PASS (No cracks)
Weather resistance (Retained Values)	ASTM G 151/ G 154	
Visual Inspection		PASS
Breaking Strength, (min)		90% retained
Elongation at Reinforcement Break (min)	ASTM D 4885	90% retained
Resistance to Xenon-Arc Weathering	ASTM G 151/ G155	Pass

*ASTM D 6878 requires retained values of 90% for original breaking strength and elongation and 60% for tearing strength

Table 2: Interface Friction Angles

PROPERTIES	QUALIFIERS	UNITS	VALUES	TEST METHOD
Engineering Properties				
Interface friction between geomembrane liner and geotextile material in the anchor trench	minimum	degrees	22[1]	ASTM D 5321[2]

(1) Perform testing using normal stress range of 144 lb/sf, 288 lb/sf and 432 lb/sf.

(2) Wet the geotextile/TPO geomembrane interface prior to testing: perform test using: (i) normal stress indicator above; and (ii) a strain rate calculated in accordance with ASTM D 3080, Sections 9.12 and 9.13, not to exceed 1 mm/min. (0.04 in./min.).

2.3 MANUFACTURING QUALITY CONTROL

A. Rolls:

1. The Manufacturer will continuously monitor the TPO geomembrane sheets during the manufacturing process for inclusions, bubbles, or other defects.
2. No TPO geomembrane will be accepted that exhibits any defects.
3. The Manufacturer will continuously monitor the TPO geomembrane thickness during the manufacturing process.
4. No TPO geomembrane will be accepted that fails to meet the specified minimum thickness.
5. The Manufacturer will sample and test the geomembrane, at a minimum, at the test frequencies specified in Table 3.
   a. Samples taken from stored rolls will be taken across the entire width of the roll and will not include the first wrapping or outer layer of the roll (about 3.3 feet).
   b. Samples taken at the time of manufacturing can be obtained from the start/end of the roll.
   c. Unless otherwise specified, samples will be 2 feet long by the roll width. The Manufacturer will mark the machine direction on the samples with an arrow.
   d. Manufacturer quality control data shall accompany the geomembrane shipment.

Table 3: Manufacturer Quality Control Requirements

Material Property	Method	Test Frequency
Thickness	ASTM D751	Per roll
Tensile Properties	ASTM D4885	Once per day or 20,000 lb
Tear Resistance	ASTM D751	Once per day or 45,000 lb
Scrim Orientation	Visual	Every Lot or Every Scrim Roll
Mass per Unit Area	ASTM D5261	Once per day or 200,000 lb
Tear Resistance	ASTM D5884	Once per day or 45,000 lb
Thickness over Scrim	ASTM D6878	45,000 lb or Every other lot

6. Any TPO geomembrane sample that does not comply with the Specifications will result in rejection of the roll from which the sample was obtained. Contractor will replace any rejected rolls at no additional cost to Owner.
7. If a TPO geomembrane sample fails to meet the quality control requirements of this Section, the Manufacturer will sample and test each roll manufactured, in the same resin batch, or at the same time, as the failing roll. Sampling and testing of rolls will continue until a pattern of acceptable test results is established.
8. Additional testing may be performed at the Manufacturer's discretion and expense, to more closely identify the non-complying rolls and/or to qualify individual rolls.

2.4 CONFORMANCE TESTING

A. At the Geomembrane Manufacturer's plant or upon delivery of the rolls of geomembrane at the site, the CQA Officer will verify that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify conformance to both the design specifications and the list of guaranteed properties. The minimum number of tests to be performed and test procedures will be as indicated in Table 4.

B. Samples will be taken across the entire width of the roll and will not include the first linear 3 ft. Unless otherwise specified, samples will be 3-ft long by the roll width. The CQA Officer will mark the machine direction on the samples with an arrow. The required minimum sampling frequencies are provided in Table 4.

C. The CQA Officer will examine the results from laboratory conformance testing and will report non-conformance to the Project Manager.

D. The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:
   1. Installer will replace the roll of geomembrane that is in nonconformance with the specifications with a roll that meets specifications;
   2. Installer will remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll.
   3. These two samples must both conform to specifications. If either of these samples fail, then every roll of geomembrane on site and every roll delivered subsequently must be tested by the Geosynthetics CQA Laboratory for conformance to the specifications. This additional conformance testing will be at the expense of the Installer.

E. The CQA Officer will document actions taken in conjunction with conformance test failures.

Table 4: Geomembrane Conformance Testing Requirements

TEST NAME	TEST METHOD	MINIMUM FREQUENCY OF TESTING
Thickness	ASTM D 4637	1 test per 100,000 ft^2
Tensile Strength at Break	ASTM D 4885	1 test per 100,000 ft^2
Elongation at Break	ASTM D 4885	1 test per 100,000 ft^2
Tear Strength	ASTM D 5884	1 test per 100,000 ft^2
Puncture Resistance	ASTM D 4833	1 test per 100,000 ft^2
Resistance to Xenon-Arc Weathering	ASTM G 155	Manufacturer's Certification Only
Ozone Resistance	ASTM D 1149	1 test per 100,000 ft^2

2.5 EQUIPMENT AND ACCESSORIES

A. Welding and Seaming Equipment:
   1. Equipped with gages showing temperatures at the nozzle or at the wedge (wedge welder).
   2. Maintained in adequate numbers to avoid delaying work.

3. Supplied by a power source capable of providing constant voltage under a combined-line load.
4. Electric generator shall not be placed on the TPO geomembrane.

B. Field Tensiometer:
1. Provide a tensiometer for on-site shear and peel testing of TPO geomembrane seams.
   a. Tensiometer shall be in good working order.
   b. Built to ASTM specifications.
   c. Accompanied by evidence of calibration of equipment and gages within the past six months.
2. Tension meter:
   a. Motor driven.
   b. Jaws capable of traveling a measure rate of 2 IN per minute.
   c. Equipped with a gauge that measures the force in unit pounds exerted between the jaws.
   d. Digital readout.

C. Punch Press:
1. Provide a punch press for the onsite preparation of specimens for testing.
2. Capable of cutting specimens in accordance with ASTM D4437.

D. Air Lance Test:
1. Provide equipment for air lance test per ASTM D4337.

E. Equipment necessary to perform "Pressurized Air Channel Evaluation of Dual Seamed Geomembranes" in accordance with ASTM D5820.

F. Gages:
1. Calibrated within past six months.
2. Specified test values reading near mid-range of the gage scale.

G. Equipment necessary to perform "Non-Destructive Testing of Geomembrane Seams Using The Spark Test" in accordance with ASTM D6365.

PART 3 - EXECUTION

3.1 GEOSYNTHETIC LINER SYSTEM

A. Geomembrane Subgrade:
1. Protect subgrade at all times from damage until such time as the placement of TPO geomembrane liner and other components of the geosynthetic liner system are complete.
2. The subgrade shall be prepared in a manner consistent with proper subgrade preparation techniques for the installation of TPO Geomembrane.
   a. The subgrade shall be properly compacted so as not to settle and cause excessive strains in the TPO Geomembrane or other synthetic liner materials.
   b. Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 inch.
   c. In addition, ensure that the subgrade has been rolled to provide a uniform surface.
   d. During installation, ensure that rutting or ravelling is not caused by installation equipment or weathering.

B. Anchor Trenches:
1. Geosynthetic materials placed on side slopes shall be anchored into trenches as detailed on the Contract Drawings.
2. Excavation, backfill and compaction shall be in accordance with Section 02200.

C. TPO Geomembrane:
1. General:
   a. Installer of TPO geomembranes is responsible for handling, fitting, welding, seaming, jointing and testing of geosynthetic materials sheets or blankets in the field in accordance with the Construction Quality Assurance (CQA) Plan.

b. These responsibilities include but are not limited to:
   1) Acceptance (in writing) of the geosynthetic materials sheets or blankets from the transporter.
   2) Acceptance (in writing) of the surface which will serve as a base for the TPO geomembrane.
      a) This acceptance shall precede installation of the TPO geomembrane.
      b) Shall state that the Installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of TPO geomembrane liners.
      c) Shall explicitly state any and all exceptions to acceptance.
   3) Handling, welding, seaming, jointing, testing and repair of TPO geomembrane liners and other geosynthetic materials in compliance with this Specification and with written procedures manuals prepared by the Manufacturer or Fabricator.
      a) Manual shall be submitted to the Engineer together with Shop Drawings showing the layout of TPO geomembrane within the facility.
         (1) Do not deviate from the procedures included in the manual.
      b) TPO Geomembrane shall not be placed upon frozen foundation, standing water or other conditions which will result in deterioration of the foundation.
      c) TPO Geomembrane liner materials shall be laid out according to plans previously approved by the Engineer.
      d) Adjacent rolls of TPO geomembrane shall overlap a minimum of 3 IN.
   4) Repair or replacement of defects in the geosynthetic materials as required by the Inspector or the Owner.
   5) Installer and Manufacturer may be the same firm.

2. Panel deployment:
   a. Subgrade Preparation:
      1) Prepare subgrade in a manner consistent with proper subgrade preparation techniques for the installation of TPO geomembrane liner.
      2) Properly compact the subgrade so as not to settle and cause excessive strains in the TPO geomembrane liner.
      3) Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.
      4) Subgrade soils proof-rolled with a ten (10) ton drum roller, two (2) passes parallel to slope or as directed by CQA Inspector. The subbase shall be compacted and proof-rolled under observation of the CQA Inspector to assure the maximum practical compaction under the existing field conditions has been achieved. See specification Section 02200 for project specific compaction requirement.
      5) Ensure rutting or raveling is not caused by installation equipment or weather.
      6) Ensure that lines and grades have been verified by the Contractor and a subgrade acceptance form has been submitted.
   b. Construct and backfill anchor trenches
   c. Deploy TPO geomembrane liner in a manner to ensure it is not damaged
   d. On slopes, anchor the TPO geomembrane liner securely and deploy it down the slope in a controlled manner.
   e. Weight the TPO geomembrane liner with sandbags or equivalent in the presence of wind.
   f. Minimize cutting the TPO geomembrane liner. Whenever possible, overlap instead of cutting material. If cutting is required, cut TPO geomembrane liner with a cutter or other approved device. Seal all cut edges, as recommended by Manufacturer.
   g. Only those panel/sheets that can be seamed in 1 day shall be deployed.
   h. Place panels with minimal handling.
      1) Protect panels from tear, puncture or abrasion.
   i. Equipment used to deploy the geomembrane shall not damage the TPO geomembrane.
   j. Minimize foot traffic.
      1) Do not allow personnel access to wet or slippery liners without adequate safety precautions.

2) Do not allow footwear that may damage the geomembrane.

k. Ballast with sandbags to prevent wind uplift as recommended by Manufacturer based on local climatic conditions.
   1) Remove and replace all wind damaged panels at no additional cost to Owner.
   2) If wind causes panels to be displaced, displaced panel may not be reused.

l. Install TPO geomembrane in stress free, tension free and relaxed condition.
   1) Account for temperature and weather-related impacts when deploying and covering.
   2) Stretching to fit and folding are not permitted.

m. Do not allow TPO geomembrane to bubble, fold, or create ripples as a result of deployment of drainage layer or protective soil cover placement.
   1) Except as noted on Contract Drawings no folds in TPO geomembrane will be allowed.

n. Any panel exhibiting stretching caused by placement, covering techniques, or wind shall be removed and may not be incorporated in the final construction.

o. Field seaming:
   1) Field seaming shall be done in accordance with seaming recommendations furnished by the geomembrane Manufacturer, referenced EPA documents, and this specification.
   2) Each piece of seaming equipment and each operator shall perform trial seams at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.
   3) Trial seams shall use the same seaming materials and methods to be used in the actual construction.
   4) Surfaces to be seamed shall be clean and dry at the time of seaming.
      a) Precipitation and ponding of water on the TPO geomembrane shall cause termination of seaming operations.
      b) TPO geomembrane shall not be seamed when ambient temperatures are below 41 DegF or above 104 DegF, without written consent of TPO geomembrane Manufacturer and Engineer.
   5) TPO geomembrane sheets shall be seamed continuously without fishmouths or breaks in the seam.
      a) Where fishmouths are unavoidable, the sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle.
      b) The two edges of the slit shall be seamed together provided that the overlap for this seam shall be a minimum of 6 IN.
      c) Areas of the slit which do not achieve an overlap of 6 IN, including the terminus of the slit, shall be provided with a patch as discussed below.
   6) All TPO geomembranes shall be seamed by thermal fusion methods as recommended by the TPO geomembrane Manufacturer.
      a) TPO geomembrane seaming shall be either hot-air or double wedge welded as approved by the Engineer.
   7) Manufacturer's seaming instructions shall specifically address seaming materials, temporary and permanent jointing, seaming temperatures including temperatures for seaming materials, seam finishing and curing.
   8) A copy of Manufacturer's seaming instructions shall be available on site at all times and shall not be deviated from without written approval of the Manufacturer and Engineer.
   9) All panels/sheets should be overlapped a minimum of 3 IN.
   10) Seaming shall not be conducted in the presence of standing water.
      a) The seamed area shall be cleaned of dust, dirt and foreign material prior to and during the seaming operation.
   11) Seaming shall extend to the outside edge of panels/sheets to be placed in anchor and/or drainage trenches.

12) Tack welds shall conform to manufacturer's seaming techniques and shall not damage underlying membrane.

p. Patching:
   1) Defects in and damage to TPO geomembrane sheets shall be repaired by seaming a patch over the defect.
      a) The patch material shall consist of an undamaged piece of TPO geomembrane cut to provide a minimum of 6 IN of overlap in all directions from the defect.
      b) Round corners shall be utilized on all patches. No bead or spot patching will be accepted.
      c) Torn or permanently twisted TPO geomembrane shall be replaced at no expense to the Owner.
   2) Test all patch seams non-destructively using the air lance tests .
      a) Test patch seams destructively if the seam is greater than 100 feet in contiguous length (i.e. a single seam greater than 100 feet).
      b) Perform a destructive test for every 100 feet of contiguous seam over 200 total feet of contiguous seam. For example if a patch seam is 340 feet, 2 destructive tests would be required for the seam.Smoking is not permitted while on the geomembrane.

q. Field Panel Identification: The Installer's CQC Consultant will document that the Geomembrane Installer labels each field panel with an "identification code" consistent with the approved panel layout plan. The location of the label and the color of marker used must be as agreed to in the QA/QC Preconstruction Meeting.

r. Exposed reinforcement from cut TPO edges must be sealed with a hot-air weld.

3.2 FIELD QUALITY CONTROL

A. The CQA inspector shall not be a part of the installation program and shall not serve as a substitute for performing the duties or certification required of the Manufacturer and Installer.
   1. The CQA inspector's responsibilities include, but are not limited to:
      a. Inspection of the material and the handling and field installation of the geomembranes. Inspection of all welds, repairs and quality control test results.
      b. All exceptions to material or installation shall be documented and furnished to the CQA firm in writing within 48 HRS of discovery.
      c. Inspection and Certification of TPO geomembrane integrity until completion of placement of protective soil cover.

B. Non-Destructive Testing:
   1. The Geosynthetics Installer will nondestructively test all field seams over their full length using a air lance test (TPO hot air weld), vaccum box (HDPE and LLDPE extrusion weld), or air pressure test (TPO, HDPE and LLDPE double fusion seams). Continuity testing will be carried out as the seaming work progresses, not at the completion of all field seaming. The Installer will complete any required repairs in accordance with specifications. The following procedures will apply to locations where seams cannot be nondestructively tested:
      a. If the seam is accessible to testing equipment prior to final installation, the seam will be nondestructively tested prior to final installation.
      b. If the seam cannot be tested prior to final installation, the seaming operations must be observed in their entirety by the CQA Officer for uniformity and completeness.
   2. Air Pressure Testing (For Double Fusion Seams Only):
      a. The following procedures are applicable to those processes that produce a double seam with an enclosed space.
      b. The equipment will comprise the following.
         1) An air pump (manual or motor driven), equipped with a pressure gauge, capable of generating and sustaining a pressure between 25 and 30 psi, mounted on a cushion to protect the geomembrane.
         2) A rubber hose with fittings and connections.
         3) A sharp hollow needle, or other approved pressure feed device.
      c. The following procedures will be followed.

1) Seal both ends of the seam to be tested.
2) Insert needle, or other approved pressure feed device, into the channel created by the fusion weld.
3) Insert a protective cushion between the air pump and the geomembrane.
4) Energize the air pump to a pressure between 25 and 30 psi, close valve, allow two minutes for pressure to stabilize, and sustain the pressure for not less than 5 minutes.
5) If loss of pressure exceeds 4 psi, or if the pressure does not stabilize, locate faulty area and repair in accordance with Section 3.3.
6) Cut opposite end to verify continuity of seam, remove needle, or other approved pressure feed device, and repair in accordance with Section 3.3.

3. Air Lance Testing
   a. Mechanical point stressing method (see ASTM D4437, article 4.5) or the air lance test method will be used to verify seam integrity for hot air seams and wedge seams without air channel. Since the mechanical point stressing method cannot evaluate the bond over its entire width, and since there is a potential for damaging the membrane with the sharp point of the probe, the air lance test method is recommended to verify seam integrity.

C. Trial Seams
   1. Trial seams shall be made prior to production seaming by all seamers and by all equipment to be used during production seaming. The trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period, seaming operation has been suspended for more than 1/2 hour, breakdown of the seaming equipment occurs or at least once each five hours, for each seaming apparatus used that day. Also, each seamer shall make at least one trial seam each day. Trial seams shall be made under the same conditions as actual seams. The trial seam sample shall be at least 5 ft long by 1 ft wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as specified.
   2. Two adjoining specimens, each 1-inch wide for peel and 2-inch wide for shear, shall be cut from the trial seam sample by the Geosynthetics Installer. Fully support the test specimen within the grips across the width of the specimen. The specimens shall be tested in shear and peel, using a field tensiometer, and the specimen shall fail by film tear bond rather than in the seam. The minimum requirements for the seams strengths shall be as specified in Table 5. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.

D. After completion of the above-described tests, the remaining portion of the trial seam sample can be discarded. If a trial seam sample fails a test, then a destructive test seam sample shall be taken from the seams completed by the seamer during the shift related to the considered trial seam. These samples shall be forwarded to the CQA Consultant and, if they fail the tests, the procedure indicated in Paragraph 3.3 of this section shall apply. The conditions of this paragraph shall be considered as met for a given seam if a destructive seam test sample has already been taken from the considered seam

E. Destructive Testing:

F. Destructive Seam Testing:
   1. A minimum of one destructive test per 500 LF of seam, and as many other samples as CQA firm determines appropriate, shall be obtained at locations specified by the CQA firm.
      a. Sample locations shall not be identified prior to seaming.
      b. The samples shall be a minimum of 12 IN wide by 48 IN long with the seam centered lengthwise.
      c. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to a CQA Testing Laboratory, and the remaining piece given to the CQA Engineer for quality assurance testing and/or permanent record.
      d. Each sample shall be numbered and recorded on the final panel layout record drawing, and cross-referenced to a field log which identifies:

1) Panel/sheet number.
2) Seam number.
3) Top sheet.
4) Date and time cut.
5) Ambient temperature.
6) Seaming unit designation.
7) Name of seamer.
8) Seaming apparatus temperature and pressures (where applicable).

2. A minimum of four 1 IN wide replicate specimens shall be cut from the Installer's sample.
   a. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.
   b. To be acceptable, all field test specimens must meet the specified seam strength requirements and all must fail as Film Tear Bond.
   c. If all field tests pass, 5 specimens shall be tested at the CQA Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D4437.
   d. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fifth sample must meet 80% required strength and fail at Film Tear Bond.
   e. Shear elongation and Peel separation shall not exceed values given in GRI GM19

Table 5: Seam Strength and Related Properties of Thermally Bonded TPO Geomembrane per ASTM D 4437/GM 19

Geomembrane Nominal Thickness	60 mils
Hot Wedge Seams[1]	
Shear strength[2], lb/in	150
Peel strength[2], lb/in	20
Hot-air Seams	
Shear strength[2], lb/in	150
Peel strength[2], lb/in	20

Notes:
1. Also for hot air seaming methods
2. Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values.

3. For destructive samples which have failed the passing criterion, the Contractor will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Contractor may patch or cap strip the seam between the passed samples. If either fails, the Contractor will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.
   a. In addition, all destructive seam sample holes shall be repaired the same day as cut.
   b. Certified test results on all field seams shall be submitted to and approved by the CQA Engineer prior to acceptance of the seam.

4. All repaired areas shall be non-destructively tested and destructively tested as described in Part 3.1B.2.p (2) of this specification.

5. Destructive testing shall be performed by a CQA Testing Laboratory not employed by the Installer.

6. A map showing the locations, number and type of all patches shall be prepared and provided to the Owner.

7. Documentation: The following documentation must be maintained at the project site for review by the CQA Engineer or Inspector.
   a. Geomembrane Installer's Documentation:
      1) Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, weather conditions, and equipment on site.
      2) Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
      3) Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.
      4) Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
      5) Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
      6) Seam/Panel Repair Log: provides a complete record of all repairs and vacuum box testing of repairs made to defective seams or panels.
      7) As-Built Drawing: maintain an as-built drawing updated on a weekly basis.

3.3 DEFECTS AND REPAIRS

A. All seams and non-seam areas of the geomembrane will be examined by the CQA Officer 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 examination. The geomembrane surface shall be swept or washed by the Geosynthetics Installer if surface contamination inhibits examination. The Geosynthetics Installer shall ensure that this examination of the geomembrane precedes any seaming of that section.

B. Each suspect location, both in seam and non-seam areas, shall be nondestructively tested using the methods described, as appropriate. Each location that fails nondestructive testing shall be marked by the CQA Consultant and repaired by the Geosynthetics Installer. Work shall not proceed with any materials that will cover repaired locations until laboratory test results with passing values are available.

C. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the CQA Consultant shall identify excessive geomembrane wrinkles. The Geosynthetics Installer shall cut and reseam all wrinkles so identified. The seams thus produced shall be tested like any other seams.

D. Repair Procedures:
   1. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetics Installer. Several repair procedures are specified below. The final decision as to the appropriate repair procedure shall be agreed upon between the CQA Consultant and the Geosynthetics Installer. The procedures available include:
      a. patching - used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
      b. abrading and reseaming - used to repair small sections of extruded seams;
      c. spot seaming - used to repair small tears, pinholes, or other minor, localized flaws;
      d. capping - used to repair long lengths of failed seams; and
      e. removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).
   2. In addition, the following shall be satisfied:
      a. surfaces of the geomembrane that are to be repaired shall be abraded no more than one hour prior to the repair;
      b. all surfaces must be clean and dry at the time of repair;
      c. all seaming equipment used in repair procedures must be approved by Engineer;
      d. the repair procedures, materials, and techniques shall be approved in advance, for the specific repair, by the CQA Consultant and Geosynthetics Installer;

e. patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.; and
f. the geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

E. Each repair shall be numbered and logged and shall be nondestructively tested using the methods described in this section, as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests will require the repair to be redone and retested until a passing test result is achieved. At the discretion of the CQA Consultant, destructive testing may be required on large caps at no additional cost to OWNER.

3.4 DOCUMENTATION

A. The following documentation must be maintained at the project site for review by the CQA Engineer or Inspector as the Geomembrane Installer's Documentation:
1. Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, weather conditions, and equipment on site.
2. Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
3. Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.
4. Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
5. Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
6. Seam/Panel Repair Log: provides a complete record of all repairs and air lance testing of repairs made to defective seams or panels.
7. As-Built Drawing: maintain an as-built drawing updated on a weekly basis.

3.5 GEOSYNTHETIC LINER SYSTEM ACCEPTANCE

A. Contractor shall retain all ownership and responsibility for the geosynthetic liner system until final acceptance by the Owner.
1. Owner will accept the geosynthetic liner system installation when the installation is finished and all required warranties, test results, and documentation from the Contractor, Manufacturer, Inspector and Installer have been received and approved, and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

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SECTION 02775
LLDPE GEOMEMBRANE LINER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing, installation, quality control, and testing of a LLDPE geomembrane liner with texture on both sides. LLDPE geomembrane liner will be used as part of the final cover system.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 – Earthwork: Landfill.
   2. Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Referenced Standards:
   1. ASTM International (ASTM).
      a. ASTM D1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
      b. ASTM D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
      c. ASTM D1505 Standard Test Method for the Density of Plastics by the Density-Gradient Technique.ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
      d. ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
      e. ASTM D3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
      f. ASTM D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
      g. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
      h. ASTM D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      i. ASTM D5321, Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
      j. ASTM D5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
      k. ASTM 5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
      l. ASTM D5820, Standard Practice for Pressured Air Channel Evaluation of Dual Seamed Geomembrane.
      m. ASTM D5994 Test Method for Measuring the Core Thickness of Textured Geomembranes.
      n. ASTM D6365 Non-Destructive Testing of Geomembrane Seams Using the Spark Test
      o. ASTM D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
      p. ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexibly Polypropylene Geomembranes.
   2. The Geosynthetic Research Institute (GRI).
      a. GRI GM12, Asperity Measurement of Textured Geomembranes Using a Depth Gage.
      b. GRI GM17 Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes.

c. GRI GM19, Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

B. Qualifications:
   1. Each manufacturing and fabricating firm shall demonstrate 5 years continuous experience with a minimum of 10,000,000 SF of LLDPE geomembranes.
   2. Installer:
      a. Demonstrate 5 years continuous experience with a minimum 10,000,000 SF of LLDPE geomembranes.
      b. Trained and certified by at least one of the named manufacturers in this Specification (not necessarily the manufacturer supplying materials for this Project).
      c. Geomembrane Installer Personnel Qualifications:
         1) Installation Superintendent shall have worked in a similar capacity on at least five geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
         2) The Master Welder shall have completed a minimum of 5,000,000 SF of LLDPE geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
         3) Other welders shall have seamed a minimum of 1,000,000 SF of LLDPE geomembrane.
   3. CQC Testing Laboratory shall demonstrate 3 years of continuous experience in similar geosynthetic materials testing.

C. Quality Assurance / Control:
   1. The Owner or Engineer's representative will conduct independent testing to support construction quality assurance program and to provide documentation of such to appropriate regulatory agencies.
   2. Unless specifically superseded by these contract documents or approved plans submitted by the Contractor, the geosynthetic materials shall be manufactured, stored, placed, seamed, tested and protected as described in EPA/600/R-93/182 and EPA/530/SW-91/051.
      a. This specifically includes:
         1) Material Composition.
         2) Manufacturing.
         3) Handling and Packaging.
         4) Shipment.
         5) Storage (Manufacturer and Site).
         6) Placement:
            a) Seaming and Joining.
            b) Destructive and Non Destructive Testing.
            c) Protection, Backfilling and Covering.
         7) Conformance Testing.
         8) Anchoring and Anchor Trenches.
         9) Access Roads/Ramps.

D. CQA Plan Implementation: Construction Quality Control will be performed in accordance with the CQA Plan prepared for this project. The Contractor and Geomembrane Installer should familiarize themselves with the CQA Plan.

E. Certifications:
   1. Certifications are required for various aspects of the project related to the LLDPE geomembrane liner system construction.
      a. Utilize certification forms approved for use on this project by the Owner and Engineer.

F. Installer's construction quality control programs to include, but not be limited to, product acceptance testing, installation testing, including both nondestructive and destructive quality control field testing of the sheets and seams during installation of the geomembrane, proposed methods of testing geosynthetic joints and connections at appurtenances for continuity, documentation and changes, alterations, repairs, retests, and acceptance.

G. Geomembrane Installer's installation manual to include:
   1) Ambient temperature at which the seams are made
   2) Control of panel lift up by wind
   3) Acceptable condition of the subsurface beneath the geomembrane
   4) Quality and consistency of the welding material
   5) Proper preparation of the liner surfaces to be joined
   6) Cleanliness of the seam interface (e.g., the amount of airborne dust and debris present)
   7) Proposed details for connecting the LLDPE liner to appurtenances, i.e. penetrations of the containment facilities.
   8) A complete description of seaming by extrusion welding and hot-wedge welding.
   9) Requirements of the Manufacturer's Installation Manual unless exceptions are noted and approved by the Engineer.

1.3 DEFINITIONS AND RESPONSIBILITIES

A. Geomembrane Manufacturer: Manufacturer of geomembranes producing geomembrane sheets from resin and additives. The manufacturer is responsible for producing geomembrane sheet which complies with these Specifications. These responsibilities include but are not limited to:
   1. Acceptance of the resin and additives from chemical formulators. Testing of the raw resin and additives to ensure compliance with the manufacturer's specifications and with this Specification.
   2. Formulation of the resin and additives into geomembrane sheeting using mixing and extrusion equipment.
   3. Testing of the geomembrane sheet to ensure compliance with manufacturer's specification and this Specification.
   4. Shipping of the geomembrane sheet to installer designated facilities.
   5. Certification of the raw materials and finished geomembrane sheet to comply with this Specification.
   6. Certification of installer's training, experience, and methods for welding and inspection of geomembrane installations in compliance with manufacturer's standards.

B. Geomembrane Installer. Installer of geomembranes are responsible for handling, fitting, welding, and testing of geomembrane sheets or blankets in the field. These responsibilities include but are not limited to:
   1. Acceptance (in writing) of the geomembrane from the manufacturer.
   2. Acceptance (in writing) of the surface which will serve as a base for the geomembrane. This acceptance shall precede installation of the geomembrane, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of geomembrane liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
   3. Handling, welding, testing, and repair geomembrane liners in compliance with this Specification and the Geomembrane Installer's Installation Procedures Manual.
   4. Performance of QC testing and record keeping as required by the approved Geomembrane Installer's Field Installation Procedures Manual.
   5. Repair or replacement of defects in the geomembrane as required by the Installer's CQC Consultant or the CQA Inspector.

C. CQA Inspector:
   1. Inspectors of LLDPE geomembrane are the individuals responsible for observing field installation of the geosynthetic materials and providing the Manufacturer, Installer, CQA Engineer, and Owner with verbal and written documentation of the compliance of the installation with this specification and with written procedures manuals prepared by the Manufacturer or Installer.

D. CQA Testing Laboratory shall:
   1. Perform destructive testing of the LLDPE geomembrane.
   2. Perform conformance testing of LLDPE geomembrane.

E. Installer's CQC Consultant: Responsible for observing field installation of the geomembrane and performance of material conformance and CQC testing to provide the Contractor with verbal and written documentation of the compliance of the installation with these Specifications.

F. CQA Engineer: Responsible for implementing CQA Plan including overviewing material conformance testing, field installation of the geomembrane, and CQC activities, and to perform limited CQA conformance testing to provide Owner with verbal and written documentation of the compliance of the installation with these Specifications. The CQA Engineer will use the written results of the CQC program and the CQA program in the preparation of the facility Certification Document. The CQA Engineer reports to the Owner and is not part of this contract.

G. Refer to the accompanying CQA Plan for additional definitions.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit for Engineer's approval Shop Drawings, including:
      a. Manufacturer's certification that raw materials and sheet materials comply with required materials, mil thickness, and material properties.
         1) Original certificates are required.
      b. Manufacturer/Fabricator/Installer quality control requirements.
      c. Qualifications and experience of key personnel per 1.2 B of this section.
      d. Manufacturer's written acceptance of Geomembrane Installer's qualifications for installation of the LLDPE geomembrane.
      e. LLDPE Geomembrane layout plan with proposed size, number, position and sequencing of liner panels and showing the location and direction of all field or factory joints.
         1) Proposed details for connecting the geosynthetic materials to appurtenances.
         2) Proposed methods of welding, seaming or jointing geosynthetic materials.
         3) Proposed method and sequencing for placement of drainage layer on top of the LLDPE geomembrane liner.
         4) Proposed method of testing LLDPE geomembrane and other geosynthetic materials, joints and connections at appurtenances for continuity.
         5) Location and configuration of haul roads and access points.
         6) Proposed details for anchor trench if different than included in Contract Documents.

B. Miscellaneous:
   1. Test results:
      a. Resin test, tests of sheet material and factory seam tests at frequency specified in respective quality control manuals.
         1) Results shall include or bracket the rolls delivered for use in the Work.
      b. Daily test seam results.
      c. Daily results of production seam testing.
   2. Warranties as described below.
   3. Submit written certifications that:
      a. Utilize certification forms approved for use on this project by the Owner and Engineer. Make appropriate number of copies, as required.
      b. The LLDPE geomembrane material delivered to site meets the requirements of this Specification.
      c. The LLDPE geomembrane was received and accepted in undamaged condition from shipper.
      d. The LLDPE geomembrane liner was installed in accordance with this Specification and with approved Shop Drawings.
      e. The LLDPE geomembrane joints were inspected, tested for strength and continuity, and passed all inspections and tests.
         1) All test and inspection data shall be incorporated into this certification.

f. The drainage composite and protective cover soil on top of the LLDPE geomembrane liner was placed properly and carefully.

4. Manufacturer/Installer's Field Installation Procedures Manual shall clearly identify any exceptions taken to the specified execution of the Work.
5. Record Drawings: Submit reproducible drawings of record showing changes from the approved installation drawings. The record drawings shall include the identity and location of each repair, cap strip, penetration, boot, and sample taken from the installed geosynthetic for testing. The record drawings shall show locations of each type of material, anchor trenches and the construction baseline.

C. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted. All submittals must be submitted prior to the Geomembrane Preconstruction Meeting and a minimum of four weeks prior to installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Unused or stockpiled LLDPE geomembrane shall be stored in accordance with the manufacturer's recommendations.

B. Each roll shall be labeled with the manufacturers name, type, lot number, roll number, and roll dimensions (length, width, gross weight).
1. LLDPE geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed.
2. LLDPE geomembrane shall not be exposed to temperatures in excess of 60 Deg C (140 Deg F) or less if recommended by the Manufacturer.

C. No hooks, tongs or other sharp instruments shall be used for handling the LLDPE geomembrane.
1. Rolls shall not be lifted by use of cables or chains in contact with the LLDPE geomembrane.
2. LLDPE geomembrane shall not be dragged along the ground.

1.6 PROJECT CONDITIONS

A. When the weather is of such a nature as to endanger the integrity and quality of the installation, whether this is due to rain, high winds, cold temperatures, or other weather elements, the installation of the geomembrane shall be halted at the direction of, or with the concurrence of, the Owner until the weather conditions are satisfactory.

B. The contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces which hamper the efficient field seaming of geosynthetic panels or performance.

C. Maintain natural surface water drainage diversions around the work area and provide for the disposal of water which may collect in the work area directly from precipitation falling within the area or from inadequate diversion structures or practices.

D. All materials shall be placed and spread with low ground pressure equipment (10 psi ground pressure or less) as approved by the CQA Engineer to reduce potential damage to the geosynthetics. The geosynthetics surface shall be off limits to construction traffic. Hard turning of tracked equipment on the protective cover and stone must be avoided.
1. At least 12 IN of separation between the geosynthetics and all low ground pressure equipment shall be maintained.
2. Stockpiling of materials within the limits of Phase I shall be subject to advanced approval by the CQA Inspector. Any hauling equipment (dump trucks, etc.) operating within the Phase I limits (and including access ramps), shall have a minimum of 4 feet of separation between the vehicle wheels and the geosynthetics.
3. No vehicle shall access the completed Work unless it can be demonstrated that its weight, movement or activities will not damage the Work.
4. When damage is suspected, uncover area, repair damage if required, and recover area at no cost to Owner.
5. Suspect areas may be identified by Owner or Engineer.

1.7 WARRANTIES

A. Written warranties addressing LLDPE geomembrane material and installation workmanship shall be furnished by the Contractor and shall be made to the Owner.

B. Submit material samples and warranties prior to shipment.

C. Suitability of geosynthetic liner system shall be subject to Owner's approval of warranty.
   1. The Manufacturer's warranty shall be against manufacturing defects and workmanship and against deterioration due to ozone, ultra- violet, and other exposure to the elements, for a period of 5 years on a pro rata basis. The warranty shall be limited to replacement of material, and shall not cover installation of replacement geomembrane.
   2. The Installer's warranty shall state that the materials were properly installed, properly (field and factory) welded, seamed and jointed and will not fail within two years of the date of final acceptance of the Work by the Owner.
      a. Warranty shall not be prorated.

D. Warranties shall provide for complete repair/replacement excluding installation costs at no additional cost to the Owner for the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND/OR GEOMEMBRANE INSTALLERS

A. Subject to compliance with the Contract Documents, the following manufacturers and installers are acceptable:
   1. LLDPE Geomembrane liners manufacturers:
      a. Agru/America, Inc.
      b. GSE, Inc.
      c. Poly-Flex Inc.
   2. LLDPE Geomembrane Liner Installers:
      a. Authorized installers of approved manufacturers.
      b. Other installers may qualify by providing references for a minimum of 10,000,000 SF of liner installations.

2.2 MATERIALS

A. LLDPE Geomembrane Liner:
   1. Consist of unreinforced polyethylene.
      a. Thickness: 40 mils.
      b. Manufactured from virgin, first quality resin designed and formulated specifically for liquid containment in hydraulic structures.
      c. Reclaimed polymer shall not be added to the resin; except use of polymer recycled during the manufacturing process shall be allowed provided that recycled polymer shall be clean and shall not exceed 10 percent by weight.
      d. No additives or fillers may be added to the resin prior to or during manufacture of the LLDPE geomembrane.
   2. Manufactured to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.
      a. Any such defects shall be cause for rejection of the material.
      b. Minor defects may be repaired in accordance with Manufacturer's recommendations if approved by the Engineer.
   3. Manufactured as seamless rolls.
      a. Minimum width: 22 FT as delivered to the site.
   4. Prior to shipment, the geomembrane manufacturer will provide the CQA Engineer and the Installer's CQC Consultant with a quality control certificate for each roll of geomembrane provided. The quality control certificate will be signed by a responsible party employed by the geomembrane manufacturer and will include:

a. Roll numbers and identification; and
b. The results of quality control tests performed under the MQC program.

5. The Installer's CQC Consultant and the CQA Inspector will verify that a control certificate has been received for each roll and that the certified roll properties meet the requirements of these Specifications.
6. LLDPE sheet with **texture** on both sides shall be used for top, north, and east sideslopes including drainage terrace.
7. The geomembrane liner material shall consist of **40 MIL NOMINAL LLDPE** and meet or exceed GRI GM17 and the following requirements:

PROPERTY	TEST METHOD	TEST VALUE TEXTURED LLDPE
a. Sheet Thickness, Mils	ASTM D5994 (textured)	
•Minimum Average		nominal ± 5%
•Lowest Individual 8 of 10		nominal ± 10%
•Lowest Individual 10 of 10		nominal ± 15%
b. Sheet Density (min. ave.)	ASTM D1505	≥ 0.92 g/cc
c. Melt Flow Index (g/10 min.)	ASTM D1238 Condition 190/2.16	≤ 1.00
d. Minimum Tensile Properties (each direction)	ASTM D6693 Type IV Dumb-bell	
• Break Stress	2 ipm	60 ppi
• Elongation at Break	G.L. = 2.0 in (51 mm)	250%
e. Min. Tear Resistance Initiation	ASTM D1004	22 lbs
f. Carbon Black Content	ASTM D1603 or ASTM D4218	2.0-3.0%
g. Carbon Black Dispersion	ASTM D5596	Category
• Minimum 9 of 10		1 or 2
• All 10 of 10		1, 2, or 3
h. Puncture Resistance, Minimum Average	ASTM D4833	44 lbs
i. Oxidative Induction Time, Minimum Average	ASTM D3895 200°, O_2, 1 atm	>100 min.
j. Asperity Height, Minimum Average	GRI GM12	
• Minimum Average		10 mil
• Lowest Individual 8 of 10		7 mil
• Lowest Individual 10 of 10		5 mil

8. Rolls may be rejected if they appear damaged upon delivery or if they have been rejected or returned from another project.

B. Geomembrane Manufacturing Quality Assurance (QA): The geomembrane liner shall be manufactured in accordance with a written quality assurance/quality control program (QC). This QA/QC program shall be submitted to the Engineer or Inspector, together with shop drawings showing the layout of geomembrane liner in the containment facility. After this QA/QC program has been approved by the Engineer or Inspector, the Manufacturer shall not deviate from the program without written approval of the Engineer or Inspector. All testing shall be performed by the manufacturer and results shall be submitted to CQA Inspector for review. The QA/QC program shall include:
   1. Routine testing of incoming resin prior to manufacture of geomembranes. This testing shall include tests for density, melt index, and oxidative induction time, at a frequency of not less than one per 200,000 LB.
   2. Routine testing of the manufactured sheet for physical parameters. This testing shall include tests for carbon black, tensile strength, and elongation properties, at a frequency of not less than one per 20,000 LB of manufactured geomembrane; tear and puncture resistance and carbon black dispersion at a frequency of not less than one per 45,000 LB of manufactured geomembrane. Thickness shall be monitored continuously through the manufacturing process, or measured physically at a frequency of not less than one per roll of manufactured geomembrane. For textured sheet only, asperity height shall be measured every other roll.
   3. Extrusion rod shall be manufactured from identical resin to that used in geomembrane manufacture. Manufactured extrusion rod shall be tested for carbon black, specific gravity and melt index at a frequency of not less than one test per batch.
   4. The Manufacturer shall reject resin shipments which do not conform with the density and melt index requirements of the approved QA/QC program. The Manufacturer shall reject manufactured geomembrane which does not conform to the sheet physical requirements of the approved QA/QC program
   5. The LLDPE textured geomembrane shall conform to the requirements prescribed in GRI Test Method GM17.

C. Manufacturing QC data shall accompany the geomembrane shipment.

D. Independent testing of geomembrane shall be conducted in accordance with the CQA Plan.

2.3 INTERFACE FRICTION TESTS

A. Laboratory friction tests shall be conducted, on behalf of the OWNER by the CQA Laboratory, with representative samples of the materials selected by the Contractor for use in the Work. The CQA Inspector is responsible for shipping materials to the testing laboratory. The initial set of testing and subsequent conformance tests (if any) shall be paid for by the Owner. If any interface doesn't meet the requirements, or if the Contractor changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the Contractor.
Testing will include the interfaces between the following adjacent materials.

B.	D. Specification Section
C. Material	
E. Intermediate Cover	F. 02200
G. 40 mil Textured LLDPE Geomembrane	H. 02775
I. Drainage Composite: Final Cover	J. 02777
K. Protective Cover	L. 02200
	M.

N. The testing shall be performed in accordance with ASTM D5321.

1. The materials shall be tested at normal stressed of 250, 500, and 1,000 psf. Displacement rates shall be in accordance with ASTM D5321 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA Inspector prior to performing the tests.

O. A minimum friction angle of 26 degrees is required for each interface in the system defined in Paragraph A.

P. Interface shear strength of the actual components which will be used in the liner system shall be tested with method ASTM D5321 or an equivalent test method. The interface shall be tested in a water-saturated state.

Q. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

R. Interface friction tests will be conducted by the Owner.

2.4 EQUIPMENT AND ACCESSORIES

A. Welding and Seaming Equipment:
   1. Equipped with gages showing temperatures at the nozzle (extrusion welder) or at the wedge (wedge welder).
   2. Maintained in adequate numbers to avoid delaying work.
   3. Supplied by a power source capable of providing constant voltage under a combined-line load.
   4. Electric generator shall not be placed on the LLDPE geomembrane.

B. Field Tensiometer:
   1. Provide a tensiometer for on-site shear and peel testing of LLDPE geomembrane seams.
      a. Tensiometer shall be in good working order.
      b. Built to ASTM specifications.
      c. Accompanied by evidence of calibration of equipment and gages within the past six months.
   2. Tension meter:
      a. Motor driven.
      b. Jaws capable of traveling a measure rate of 2 IN per minute.
      c. Equipped with a gauge that measures the force in unit pounds exerted between the jaws.
      d. Digital readout.

C. Punch Press:
   1. Provide a punch press for the onsite preparation of specimens for testing.
   2. Capable of cutting specimens in accordance with ASTM D4437.

D. Vacuum Box:
   1. Provide a vacuum box for onsite testing of LLDPE geomembrane seams in accordance with ASTM D5641.

E. Equipment necessary to perform "Pressurized Air Channel Evaluation of Dual Seamed Geomembranes" in accordance with ASTM D5820.

F. Gages:
   1. Calibrated within past six months.
   2. Specified test values reading near mid-range of the gage scale.

G. Equipment necessary to perform "Non-Destructive Testing of Geomembrane Seams Using The Spark Test" in accordance with ASTM D6365.

2.5 FABRICATION

A. The Manufacturer is responsible for producing geomembrane sheet that complies with this Specification. These responsibilities include but are not limited to:
   1. Resin and additive quality control:
      a. Acceptance of the resin and additives from chemical formulators.
      b. Testing of the raw resin and additives to ensure compliance with the Manufacturer's specifications and with this Specification.
   2. Formulation of the resin and additives into sheeting using mixing and extrusion equipment.
   3. Testing of the sheet material to ensure compliance with Manufacturer's specifications and this Specification.
   4. Shipping of the sheet material to Installer.
   5. Certification of the raw materials and finished sheet to comply with this Specification.
   6. Certification of Installer's training (unless Installer is certified by other acceptable manufacturer list herein), experience and methods for welding, seaming, joining and inspecting geosynthetic materials installations in compliance with Manufacturer's standards and with Quality Assurance requirements of this Specification Part 1.2.

PART 3 - EXECUTION

3.1 GEOSYNTHETIC LINER SYSTEM

A. Geomembrane Subgrade:
   1. Protect subgrade at all times from damage until such time as the placement of LLDPE geomembrane liner and other components of the geosynthetic liner system are complete.
   2. The subgrade shall be prepared in a manner consistent with proper subgrade preparation techniques for the installation of LLDPE Geomembrane.
      a. The subgrade shall be properly compacted so as not to settle and cause excessive strains in the LLDPE Geomembrane or other synthetic liner materials.
      b. Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 inch.
      c. In addition, ensure that the subgrade has been rolled to provide a uniform surface.
      d. During installation, ensure that rutting or ravelling is not caused by installation equipment or weathering.

B. Anchor Trenches:
   1. Geosynthetic materials placed on side slopes shall be anchored into trenches as detailed on the Contract Drawings.
   2. Excavation, backfill and compaction shall be in accordance with Section 02200.

C. LLDPE Geomembrane:
   1. General:
      a. Installer of LLDPE geomembranes is responsible for handling, fitting, welding, seaming, jointing and testing of geosynthetic materials sheets or blankets in the field in accordance with the Construction Quality Assurance (CQA) Plan.
      b. These responsibilities include but are not limited to:
         1) Acceptance (in writing) of the geosynthetic materials sheets or blankets from the transporter.
         2) Acceptance (in writing) of the surface which will serve as a base for the LLDPE geomembrane.
            a) This acceptance shall precede installation of the LLDPE geomembrane.
            b) Shall state that the Installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of LLDPE geomembrane liners.
            c) Shall explicitly state any and all exceptions to acceptance.

3) Handling, welding, seaming, jointing, testing and repair of LLDPE geomembrane liners and other geosynthetic materials in compliance with this Specification and with written procedures manuals prepared by the Manufacturer or Fabricator.
   a) Manual shall be submitted to the Engineer together with Shop Drawings showing the layout of LLDPE geomembrane within the facility.
      (1) Do not deviate from the procedures included in the manual.
   b) LLDPE Geomembrane shall not be placed upon frozen foundation, standing water or other conditions which will result in deterioration of the foundation.
   c) LLDPE Geomembrane liner materials shall be laid out according to plans previously approved by the Engineer.
   d) Adjacent rolls of LLDPE geomembrane shall overlap a minimum of 3 IN.
4) Repair or replacement of defects in the geosynthetic materials as required by the Inspector or the Owner.
5) Installer and Manufacturer may be the same firm.

2. Panel deployment:
   a. Subgrade Preparation:
      1) Prepare subgrade in a manner consistent with proper subgrade preparation techniques for the installation of LLDPE geomembrane liner.
      2) Properly compact the subgrade so as not to settle and cause excessive strains in the LLDPE geomembrane liner.
      3) Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.
      4) Subgrade soils proof-rolled with a ten (10) ton drum roller, two (2) passes parallel to slope or as directed by CQA Inspector. The subbase shall be compacted and proof-rolled under observation of the CQA Inspector to assure the maximum practical compaction under the existing field conditions has been achieved. See specification Section 02200 for project specific compaction requirement.
      5) Ensure rutting or raveling is not caused by installation equipment or weather.
      6) Ensure that lines and grades have been verified by the Contractor and a subgrade acceptance form has been submitted.
   b. Construct and backfill anchor trenches
   c. Deploy LLDPE geomembrane liner in a manner to ensure it is not damaged
   d. On slopes, anchor the LLDPE geomembrane liner securely and deploy it down the slope in a controlled manner.
   e. Weight the LLDPE geomembrane liner with sandbags or equivalent in the presence of wind.
   f. Minimize cutting the LLDPE geomembrane liner. Whenever possible, overlap instead of cutting material. If cutting is required, cut LLDPE geomembrane liner with a cutter or other approved device. Seal all cut edges, as recommended by Manufacturer.
   g. Only those panel/sheets that can be seamed in 1 day shall be deployed.
   h. Place panels with minimal handling.
      1) No horizontal seams on side slopes.
      2) Protect panels from tear, puncture or abrasion.
   i. Equipment used to deploy the geomembrane shall not damage the LLDPE geomembrane.
   j. Minimize foot traffic.
      1) Do not allow personnel access to wet or slippery liners without adequate safety precautions.
      2) Do not allow footwear that may damage the geomembrane.
   k. Ballast with sandbags to prevent wind uplift as recommended by Manufacturer based on local climatic conditions.
      1) Remove and replace all wind damaged panels at no additional cost to Owner.
      2) If wind causes panels to be displaced, displaced panel may not be reused.
   l. Install LLDPE geomembrane in stress free, tension free and relaxed condition.
      1) Account for temperature and weather-related impacts when deploying and covering.

2) Stretching to fit and folding are not permitted.

m. Do not allow LLDPE geomembrane to bubble, fold, or create ripples as a result of deployment of drainage layer or protective soil cover placement.
   1) Except as noted on Contract Drawings no folds in LLDPE geomembrane will be allowed.

n. Any panel exhibiting stretching caused by placement, covering techniques, or wind shall be removed and may not be incorporated in the final construction.

o. Field seaming:
   1) Field seaming shall be done in accordance with seaming recommendations furnished by the geomembrane Manufacturer, referenced EPA documents, and this specification.
   2) Each piece of seaming equipment and each operator shall perform trial seams at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.
   3) Trial seams shall use the same seaming materials and methods to be used in the actual construction.
   4) Surfaces to be seamed shall be clean and dry at the time of seaming.
      a) Precipitation and ponding of water on the LLDPE geomembrane shall cause termination of seaming operations.
      b) LLDPE geomembrane shall not be seamed when ambient temperatures are below 41 Deg F or above 104 Deg F, without written consent of LLDPE geomembrane Manufacturer and Engineer.
   5) LLDPE geomembrane sheets shall be seamed continuously without fishmouths or breaks in the seam.
      a) Where fishmouths are unavoidable, the sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle.
      b) The two edges of the slit shall be seamed together provided that the overlap for this seam shall be a minimum of 6 IN.
      c) Areas of the slit which do not achieve an overlap of 6 IN, including the terminus of the slit, shall be provided with a patch as discussed below.
   6) All LLDPE geomembranes shall be seamed by thermal fusion methods as recommended by the LLDPE geomembrane Manufacturer.
      a) LLDPE geomembrane seaming shall be either extrusion or double wedge welded as approved by the Engineer.
   7) Manufacturer's seaming instructions shall specifically address seaming materials, temporary and permanent jointing, seaming temperatures including temperatures for seaming materials, seam finishing and curing.
   8) A copy of Manufacturer's seaming instructions shall be available on site at all times and shall not be deviated from without written approval of the Manufacturer and Engineer.
   9) All panels/sheets should be overlapped a minimum of 3 IN.
      a) No horizontal seams will be permitted on the side slopes.
   10) Seaming shall not be conducted in the presence of standing water.
      a) The seamed area shall be cleaned of dust, dirt and foreign material prior to and during the seaming operation.
   11) Seaming shall extend to the outside edge of panels/sheets to be placed in anchor and/or drainage trenches.
   12) Tack welds shall conform with manufacturers seaming techniques and shall not damage underlying membrane.

p. Patching:
   1) Defects in and damage to LLDPE geomembrane sheets shall be repaired by seaming a patch over the defect.
      a) The patch material shall consist of an undamaged piece of LLDPE geomembrane cut to provide a minimum of 6 IN of overlap in all directions from the defect.

b) Round corners shall be utilized on all patches. No bead or spot patching will be accepted.
c) Torn or permanently twisted LLDPE geomembrane shall be replaced at no expense to the Owner.

2) Test all patch seams non-destructively using a vacuum box test
a) Test patch seams destructively if the seam is greater than 100 feet in contiguous length (i.e. a single seam greater than 100 feet).
b) Perform a destructive test for every 100 feet of contiguous seam over 200 total feet of contiguous seam. For example if a patch seam is 340 feet, 2 destructive tests would be required for the seam.

q. Smoking is not permitted while on the geomembrane.
r. No vehicles which may damage the material are allowed on the geomembrane.
s. Field Panel Identification: The Installer's CQC Consultant will document that the Geomembrane Installer labels each field panel with an "identification code" consistent with the approved panel layout plan. The location of the label and the color of marker used must be as agreed to in the QA/QC Preconstruction Meeting.

3.2 FIELD QUALITY CONTROL

A. The CQA Inspector shall not be a part of the installation program and shall not serve as a substitute for performing the duties or certification required of the Manufacturer and Installer.
1. The CQA Inspector's responsibilities include, but are not limited to:
a. Inspection of the material and the handling and field installation of the geomembranes. Inspection of all welds, repairs and quality control test results.
b. All exceptions to material or installation shall be documented and furnished to the CQA firm in writing within 48 HRS of discovery.
c. Inspection and Certification of LLDPE geomembrane integrity until completion of placement of protective soil cover.

B. Trial Seam Testing:
1. Trial seams shall be at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.
a. The location of trial seam shall be in an area proposed for the day's production seaming.
b. Equipment, methods and personnel shall be the same as proposed for the day's seaming.
2. Test four replicates (1 IN wide specimens) cut from trial seam.
a. To be acceptable, four of four replicate test specimens must meet specified seam strength requirements and all failures shall be Film Tear Bond.
b. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.
c. If the field trial seam tests fail to meet these requirements, the entire operation shall be repeated.
d. If the additional test seams fail, the seaming apparatus or seamer shall not be accepted or used for seaming until the deficiencies are corrected and two consecutive successful test seams are achieved.

C. Non-Destructive Seam Testing:
1. All field seams shall be non-destructively tested over their full length.
a. Seam testing shall be performed as the seaming work progresses, not at the completion of field seaming.
b. All testing shall be documented. Any seams which fail shall be repaired and documented.
2. Non-destructively test all field seams continuously using one of the following nondestructive seam tests:
a. Vacuum box (ASTM D5641). Test at 5psi for 10 seconds. Any loss in vacuum, as indicated by bubbling of soap solution, is a failing test.

b. Spark tests (ASTM D6365). Test at uniform rate between 6 and 9 meters per minute. A spark indicates a failing test.
c. Pressurized air channel test (ASTM D5820). For 40 mil geomembrane, test at between 24 and 30 psi for at least 5 minutes. A pressure drop of more than 4psi is a failing test.

3. All tests should be conducted in accordance with their corresponding ASTM method.

D. Destructive Seam Testing:

1. A minimum of one destructive test per 500 LF of seam, and as many other samples as CQA firm determines appropriate, shall be obtained at locations specified by the CQA firm.
   a. Sample locations shall not be identified prior to seaming.
   b. The samples shall be a minimum of 12 IN wide by 48 IN long with the seam centered lengthwise.
   c. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to a CQA Testing Laboratory, and the remaining piece given to the CQA Engineer for quality assurance testing and/or permanent record.
   d. Each sample shall be numbered and recorded on the final panel layout record drawing, and cross-referenced to a field log which identifies:
      1) Panel/sheet number.
      2) Seam number.
      3) Top sheet.
      4) Date and time cut.
      5) Ambient temperature.
      6) Seaming unit designation.
      7) Name of seamer.
      8) Seaming apparatus temperature and pressures (where applicable).
2. A minimum of four 1 IN wide replicate specimens shall be cut from the Installer's sample.
   a. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.
   b. To be acceptable, all field test specimens must meet the specified seam strength requirements and all must fail as Film Tear Bond.
   c. If all field tests pass, 5 specimens shall be tested at the CQA Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D6392.
   d. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fifth sample must meet 80% required strength and fail at Film Tear Bond.
   e. Shear elongation and Peel separation shall not exceed values given in GRI GM19
3. The minimum required seam strengths for 40 mil LLDPE are:

Description	Test Method	Seam Type	Required Value (lbs/in width)
LLDPE Peel	ASTM D6392	Extrusion	48
LLDPE Peel	ASTM D6392	Fusion	50
LLDPE Shear	ASTM D6392	All	60

4. For destructive samples which have failed the passing criterion, the Contractor will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Contractor may patch or cap strip the seam between the passed samples. If either fails, the Contractor will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.
   a. In addition, all destructive seam sample holes shall be repaired the same day as cut.
   b. Certified test results on all field seams shall be submitted to and approved by the CQA Engineer prior to acceptance of the seam.

5. All repaired areas shall be non-destructively tested and destructively tested as described in Part 3.1B.2.p (2) of this specification.
6. Destructive testing shall be performed by a CQA Testing Laboratory not employed by the Installer.
7. A map showing the locations, number and type of all patches shall be prepared and provided to the Owner.
8. Documentation: The following documentation must be maintained at the project site for review by the CQA Engineer or Inspector.
    a. Geomembrane Installer's Documentation:
        1) Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, weather conditions, and equipment on site.
        2) Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
        3) Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.
        4) Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
        5) Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
        6) Seam/Panel Repair Log: provides a complete record of all repairs and vacuum box testing of repairs made to defective seams or panels.
        7) As-Built Drawing: maintain an as-built drawing updated on a weekly basis.

3.3 GEOSYNTHETIC LINER SYSTEM ACCEPTANCE

A. Contractor shall retain all ownership and responsibility for the geosynthetic liner system until final acceptance by the Owner.
    1. Owner will accept the geosynthetic liner system installation when the installation is finished and all required warranties, test results, and documentation from the Contractor, Manufacturer, Inspector and Installer has been received and approved, and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

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SECTION 02776
HDPE GEOMEMBRANE LINER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing, installation, quality control, and testing of a textured HDPE geomembrane liner. HDPE geomembrane liner will be used as part of the Overlay Liner System overlay liner system for the Phase I / II connection.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 – Earthwork: Landfill.
   2. Section 02240 –Drainage Sand Layer - Overlay Liner System
   3. Section 02777A – Drainage Composite: Overlay Liner System
   4. Central County Solid Waste Disposal Complex Class I Landfill Expansion Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Referenced Standards:
   1. ASTM International (ASTM).
      a. ASTM D638, Standard Test Method for Tensile Properties of Plastics.
      b. ASTM D792, Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
      c. ASTM D1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
      d. ASTM D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
      e. ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
      f. ASTM D3015 Standard Practice for Microscopic Examination of Pigment Dispersion in Plastic Compounds. Refer to Subpart 2.2 for property to be tested.
      g. ASTM D3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
      h. ASTM D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
      i. ASTM D4437 Determining the Integrity of Field Seam Used in Joining Flexible Polymeric Sheets of Geomembrane
      j. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
      k. ASTM D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      l. ASTM D5321, Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
      m. ASTM D5397 Procedure to Perform a Single Point Notched Constant Tensile Load – Appendix (SP-NCTL) Test.
      n. ASTM D5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
      o. ASTM 5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
      p. ASTM D5721 Practice for Air-Oven Aging of Polyolefin Geomembranes.
      q. ASTM D5820, Standard Practice for Pressured Air Channel Evaluation of Dual Seamed Geomembrane.
      r. ASTM D5885 Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

s. ASTM D5994 Test Method for Measuring the Core Thickness of Textured Geomembranes.
t. ASTM D 6365 Non-Destructive Testing of Geomembrane Seams Using the Spark Test
u. ASTM D 6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion MethodsStandard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
v. ASTM D 6693 Standard Test Method for Determining Tensile Properties of nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes ASTM E-96-00, Procedure BW, Standard Test Methods for Water Vapor Transmission of Materials.

2. The Geosynthetic Research Institute (GRI).
   a. GRI GM6 Pressurized Air Channel Test for Dual Seam Geomembranes.
   b. GRI GM10 Specification for the Stress Crack Resistance of Geomembrane Sheet.
   c. GRI GM11 Accelerated Weathering of Geomembranes Using a Fluorescent UVA-Condensation Exposure Device.
   d. GRI GM12 Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gauge.
   e. GRI GM13 Standard Specification for Test Properties, Testing Frequency, and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembrane.
   f. GRI GM14 Selection Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes.

B. Qualifications:
   1. Each manufacturing and fabricating firm shall demonstrate 5 years continuous experience with a minimum of 10,000,000 SF of HDPE geomembranes.
   2. Installer:
      a. Demonstrate 5 years continuous experience with a minimum 10,000,000 SF of HDPE geomembranes.
      b. Certified by at least one of the named manufacturers in this Specification (not necessarily the manufacturer supplying materials for this Project).
      c. Geomembrane Installer Personnel Qualifications:
         1) Installation Superintendent shall have worked in a similar capacity on at least five HDPE geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
         2) The Master Welder shall have completed a minimum of 5,000,000 sf of HDPE geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
         3) Other welders shall have seamed a minimum of 1,000,000 sf of HDPE geomembrane.
   3. CQC Testing Laboratory shall demonstrate 3 years of continuous experience in similar geosynthetic materials testing.

C. Construction Quality Assurance / Control:
   1. The Owner or Engineer's representative will conduct independent testing to support Construction Quality Assurance (CQA) program and to provide documentation of such to appropriate regulatory agencies.
   2. Unless specifically superseded by these contract documents or approved plans submitted by the Contractor, the geosynthetic materials shall be manufactured, stored, placed, seamed, tested and protected as described in EPA/600/R-93/182 and EPA/530/SW-91/051.
      a. This specifically includes:
         1) Material Composition.
         2) Manufacturing.
         3) Handling and Packaging.
         4) Shipment.
         5) Storage (Manufacturer and Site).

6) Placement:
   a) Seaming and Joining.
   b) Destructive and Non Destructive Testing.
   c) Protection, Backfilling and Covering.
7) Conformance Testing.
8) Anchoring and Anchor Trenches.
9) Access Roads/Ramps.

D. CQA Plan Implementation: Construction Quality Control will be performed in accordance with the CQA Plan prepared for the Class I Landfill Expansion project. The Contractor and Geomembrane Installer should familiarize themselves with the CQA Plan.

E. Certifications:
   1. Certifications are required for various aspects of the project related to the HDPE geomembrane liner system construction.
      a. Utilize certification forms approved for use on this Projectproject by the Owner and Engineer.

F. Installer's Construction Quality Control (CQC) programs to include, but not be limited to, product acceptance testing, installation testing, including both nondestructive and destructive quality control field testing of the sheets and seams during installation of the geomembrane, proposed methods of testing geosynthetic joints and connections at appurtenances for continuity, documentation and changes, alterations, repairs, retests, and acceptance.

G. Geomembrane Installer's installation manual to include:
   1. Ambient temperature at which the seams are made
   2. Control of panel lift up by wind
   3. Acceptable condition of the subsurface beneath the geomembrane
   4. Quality and consistency of the welding material
   5. Proper preparation of the liner surfaces to be joined
   6. Cleanliness of the seam interface (e.g., the amount of airborne dust and debris present)
   7. Proposed details for connecting the HDPE liner to appurtenances, i.e. penetrations of the containment facilities
   8. A complete description of seaming by extrusion welding and hot-wedge welding
   9. Requirements of the Manufacturer's Installation Manual unless exceptions are noted and approved by the Engineer

1.3 DEFINITIONS AND RESPONSIBILITIES

A. Geomembrane Manufacturer: Manufacturer of geomembranes producing geomembrane sheets from resin and additives. The manufacturer is responsible for producing geomembrane sheet which complies with these Specifications and conducting Manufacturer's Quality Control (MQC) testing to document the material's compliance with these Specifications. These responsibilities include but are not limited to:
   1. Acceptance of the resin and additives from chemical formulators. Testing of the raw resin and additives to ensure compliance with the manufacturer's specifications and with this Specification.
   2. Formulation of the resin and additives into geomembrane sheeting using mixing and extrusion equipment.
   3. Testing of the geomembrane sheet to ensure compliance with manufacturer's specification and this Specification.
   4. Shipping of the geomembrane sheet to installer designated facilities and to the Project.
   5. Certification of the raw materials and finished geomembrane sheet to comply with this Specification.
   6. Certification of installer's training, experience, and methods for welding and inspection of geomembrane installations in compliance with manufacturer's standards.

B. Geomembrane Installer. Installer of geomembranes are responsible for handling, fitting, welding, and testing of geomembrane sheets in the field. These responsibilities include but are not limited to:
   1. Acceptance (in writing) of the geomembrane from the manufacturer.
   2. Acceptance (in writing) of the surface which will serve as a base for the geomembrane. This acceptance shall precede installation of the geomembrane, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions of the surface upon which the geomembrane is to be placed are acceptable for placement of geomembrane liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
   3. Handling, storage, welding, testing, and repair geomembrane liners in compliance with this Specification and the Geomembrane Installer's Installation Procedures Manual.
   4. Performance of QC testing and record keeping as required by the approved Geomembrane Installer's Field Installation Procedures Manual.
   5. Repair or replacement of defects in the geomembrane as required by the Installer's CQC Consultant or the CQA Inspector.

C. CQA Inspector:
   1. Inspectors of HDPE geomembrane are the individuals, independent of the geomembrane manufacturer, Installer, and Contractor, who is retained by the Owner and is responsible for observing field installation of the geosynthetic materials and providing the Manufacturer, Installer, CQA Engineer, and Owner with verbal and written documentation of the compliance of the installation with this specification and with written procedures manuals prepared by the Manufacturer or Installer.

D. CQA Testing Laboratory shall:
   1. Perform destructive testing of the HDPE geomembrane.
   2. Perform conformance testing of HDPE geomembrane in accordance with the Central County Solid Waste Disposal Complex (CCSWDC) Class I Landfill Expansion Construction Quality Assurance Plan. CQA conformance testing frequency shall be same as Manufacturer Quality Control (MQC) testing frequency unless otherwise noted in CQA Plan or this specification.

E. Installer's CQC Consultant: A firm or individuals, who is retained by the Installer and/or Contractor and is responsible for observing field installation of the geomembrane and performance of material conformance and CQC testing to provide the Contractor with verbal and written documentation of the compliance of the installation with these Specifications.

F. CQA Engineer: Responsible for implementing CQA Plan including overviewing material conformance testing, field installation of the geomembrane, and CQC activities, and to perform CQA conformance testing to provide Owner with verbal and written documentation of the compliance of the installation with these Specifications. The CQA Engineer will use the written results of the CQC program and the CQA program in the preparation of the Project Certification Document. The CQA Engineer reports to the Owner and is not part of this contract.

G. Refer to the accompanying CCSWDC Class I Landfill Expansion CQA Plan for additional definitions.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit for Engineer's approval Shop Drawings, including:
      a. Manufacturer's certification that raw materials and sheet materials comply with required materials, mil thickness, and material properties.
         1) Original certificates are required.
         2) A list of all geomembrane rolls to be actually delivered to the Project that correlates the resin lot numbers to geomembrane roll numbers produced from that resin lot.

3) Production dates of the geomembrane rolls will be provided and confirmation from the manufacturer that the geomembrane rolls meet the Project specifications.

b. Manufacturer/Fabricator/Installer quality control program requirements.
c. Qualifications and experience of key personnel per 1.2 B of this section.
d. Manufacturer's written acceptance of Geomembrane Installer's qualifications for installation of the HDPE geomembrane.
e. The manufacturer's/installer's recommendation for shipping, handling, and storage of materials.
f. Written description of recommended heavy equipment machines (to include model number and/or handling capacity) for use of the equipment and the handling of the geomembrane materials. If special
g. HDPE Geomembrane layout plan with proposed size, number, position and sequencing of liner panels and showing the location and direction of all field or factory joints.
   1) Proposed details for connecting the geosynthetic materials to appurtenances.
   2) Proposed methods of welding, seaming or jointing geosynthetic materials.
   3) Proposed method and sequencing for placement of drainage layer on top of the HDPE geomembrane liner.
   4) Proposed method of testing HDPE geomembrane and other geosynthetic materials, joints and connections at appurtenances for continuity.
   5) Location and configuration of haul roads and access points.
   6) Proposed details for anchor trench if different than included in Contract Documents.

B. Miscellaneous:
1. Test results:
   a. Resin test, tests of sheet material and factory seam tests at frequency specified in respective quality control manuals.
      1) Results shall include or bracket the rolls delivered for use in the Work.
   b. Daily test seaming logs.
   c. Seam pre-weld test results.
   d. Daily results of non-destructive and destructive seam testing.
2. Warranties as described in Section 1.7 of these Specifications.

3. Submit written certifications that:
   a. Utilize certification forms approved for use on this project by the Owner and Engineer. Make appropriate number of copies, as required.
   b. The HDPE geomembrane material delivered to site meets the requirements of this Specification.
   c. The HDPE geomembrane were received and accepted in undamaged condition from shipper.
   d. The HDPE geomembrane liner was installed in accordance with this Specification and with approved Shop Drawings.
   e. The HDPE geomembrane joints were inspected, tested for strength and continuity, and passed all inspections and tests.
      1) All test and inspection data shall be incorporated into this certification.
   f. The drainage layer, geotextiles and protective soil cover layer on top of the HDPE geomembrane liner was placed properly and carefully.
4. Manufacturer/Installer's Field Installation Procedures Manual shall clearly identify any exceptions taken to the specified execution of the Work; however, these Specfication should be considered as the minimum level of installation required to be acceptable for approval and compliance with the Project Documents.
5. Record Drawings: Submit reproducible drawings of record showing changes from the approved installation drawings. The record drawings shall include the identity and location of each repair, cap strip, penetration, boot, and test sample taken from the installed geosynthetic for testing. The record drawings shall show locations of each type of material, anchor trenches and the construction baseline.

C. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted. All submittals must be submitted prior to the Geomembrane Preconstruction Meeting and a minimum of four weeks prior to installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Unused or stockpiled HDPE geomembrane shall be stored in accordance with the manufacturer's recommendations.

B. Each roll shall be labeled with the manufacturers name, type, lot number, roll number, and roll dimensions (length, width, gross weight).
   1. HDPE geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed.
   2. HDPE geomembrane sheet surface temperatures in excess of 60 Deg C (140 Deg F), or less, if recommended by the Manufacturer shall not be exceeded.

C. No hooks, tongs or other sharp instruments shall be used for handling the HDPE geomembrane.
   1. Rolls shall not be lifted by use of cables or chains in contact with the HDPE geomembrane.
   2. HDPE geomembrane shall not be dragged along the ground.

1.6 PROJECT CONDITIONS

A. When the weather is of such a nature as to endanger the integrity and quality of the installation, whether this is due to rain, high winds, cold temperatures, or other weather elements, the installation of the geomembrane shall be halted at the direction of, or with the concurrence of, the Owner until the weather conditions are satisfactory.

B. Ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces which hamper the efficient field seaming of geosynthetic panels or performance.

C. Maintain surface water drainage diversions around the work area and provide for the disposal of water which may collect in the work area directly from precipitation falling within the area or from inadequate diversion structures or practices of the Contractor. The Contractor shall also maintain adequate dewatering controls for keeping groundwater tables below the Work areas.

D. All materials shall be placed and spread with low ground pressure equipment (8 psi ground pressure or less) as approved by the CQA Engineer to reduce potential damage to the geosynthetics. The geosynthetics surface shall be off limits to tracked or rubber tired construction equipment, with the exception of small low ground pressure ATV or multi-tired ATV traffic (John Deere 4x4 620i, or equal). Hard turning of tracked equipment on the protective cover and stone over the geomembrane must be avoided.
   1. At least 12 -inch of separation between the geosynthetics and all low ground pressure equipment shall be maintained.
   2. Stockpiling of materials within the limits of Phase I shall be subject to advanced approval by the CQA Inspector. Any hauling equipment (dump trucks, etc.) operating within the Phase I limits (and including access ramps), shall have a minimum of 3 feet of separation between the vehicle wheels and the geosynthetics.
   3. No vehicle shall access the completed Work unless it can be demonstrated that its weight, movement or activities will not damage the Work.
   4. When damage is suspected, uncover area, repair damage if required, and recover area at no cost to Owner.
   5. Suspect areas may be identified by Owner or Engineer.

1.7 WARRANTIES

A. Written warranties addressing HDPE geomembrane material and installation workmanship shall be furnished by the Contractor and shall be made to the Owner.

B. Submit material samples and warranties prior to shipment.

C. Suitability of geosynthetic liner system shall be subject to Owner's approval of warranty.
   1. The Manufacturer's warranty shall be against manufacturing defects and workmanship and against deterioration due to ozone, ultra- violet, and other exposure to the elements, for a period of 20 years on a pro rata basis. The warranty shall be limited to the manufacturer producing, testing, shipping, loading/unloading, and providing all labor, equipment, and associated costs necessary to delivery replacement of material to the project. The warranty shall specifically outline all exclusions and in general shall not cover installation of replacement geomembrane unless failure of the material is determined to be at fault. Installation costs for replacement geomembrane will be at no cost to the Owner if the material fails.
   2. The geomembrane supplied shall be capable of chemically compatible to prevent the leachate and LFG condensate produced by the solid waste (refuse) from reaching the underlying soil. The material supplied shall have a manufacturer's warranty that it will remain impermeable when exposed over five (5) years to a raw landfill leachate having the following range of values*:

LEACHATE & LFG CONDENSATE QUALITY

Component	Range of Values**	
pH	3.6	8.5
Hardness (Carbonate)	35	8,120
Alkalinity (Carbonate)	310	9,500
Calcium	240	2,570
Magnesium	64	410
Sodium	85	3,800
Iron (Total)	6	1,640
Chloride	96	2,350
Sulfate	40	1,220
Organic Nitrogen	2.4	550
Ammonia Nitrogen	0.2	845
Conductivity	100	1,200
BOD	7,050	32,400
COD	800	50,700
Suspended Solids	13	26,500

* Gewsein, Allen J., USEPA: EPA/530/SE-137, March 1975
** Values are in milligrams per liter except pH (pH units) and conductivity (Micromhos per cubic centimeter).

   3. The Installer's warranty shall state that the materials were properly installed, properly (field and/or factory) welded, seamed and jointed and the installed welds, seams, joints will not fail within two years of the date of final acceptance of the Work by the Owner.
      a. Warranty shall not be prorated.

D. Warranties shall provide for complete repair (for Installer's Warranty) / replacement for Manufacturer's Warranty) at no additional cost to the Owner for the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND/OR GEOMEMBRANE INSTALLERS

A. Subject to compliance with the Contract Documents, the following manufacturers and installers are acceptable:
   1. HDPE Geomembrane liners manufacturers:
      a. Agru/America, Inc.
      b. GSE, Inc.
      c. Poly-Flex Inc.

2. HDPE Geomembrane Liner Installers:
   a. Authorized installers of approved manufacturers.
   b. Other installers may qualify by providing references for a minimum of 10,000,000 SF of liner installations; however, the manufacturer shall be notified, and approval received from the manufacturer, that states no warranty issues will occur with selection of this installer.

2.2 MATERIALS

A. HDPE Geomembrane Liner:
1. Consist of unreinforced polyethylene.
   a. Thickness: 60 mils.
   b. Manufactured from virgin, first quality resin designed and formulated specifically for liquid containment in hydraulic structures.
   c. Reclaimed polymer shall not be added to the resin; except use of polymer recycled during the manufacturing process shall be allowed provided that recycled polymer shall be clean and shall not exceed 10 percent by weight.
2. Manufactured to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.
   a. Any such defects shall be cause for rejection of the material.
   b. Minor defects may be repaired in accordance with Manufacturer's recommendations if approved by the Engineer.
3. Manufactured as seamless rolls.
   a. Minimum width: 22 feet as delivered to the site.
4. Prior to shipment, the geomembrane manufacturer will provide the CQA Engineer and the Installer's CQC Consultant with a quality control certificate for each roll of geomembrane provided. The quality control certificate will be signed by a responsible party employed by the geomembrane manufacturer and will include:
   a. Roll numbers and identification; and
   b. The results of quality control tests performed under the MQC program.
5. The Installer's CQC Consultant and the CQA Inspector will verify that a control certificate has been received for each roll and that the certified roll properties meet the requirements of these Specifications.
6. HDPE sheet with **texture** on both sides shall be used for the Phase I / II overlay liner system including west drainage terrace.
7. The geomembrane liner material shall consist of **60 MIL NOMINAL HDPE** and meet or exceed GRI GM13 and the following requirements:

PROPERTY	TEST METHOD	TEST VALUE TEXTURED HDPE
a. Sheet Thickness, Mils	ASTM D5994	
• Minimum Average		nominal - 5%
• Lowest Individual 8 of 10		nominal - 10%
• Lowest Individual 10 of 10		nominal - 15%
b. Sheet Density (min. ave.)	ASTM D792 or D1505	≥ 0.940 g/cc
c. Melt Flow Index (g/10 min.)	ASTM D1238 Condition 190/2.16	≤ 1.00
d. Minimum Tensile Properties	ASTM D638, Type IV,	
• Yield Stress	Dumb-bell at 2 imp.	126 ppi
• Break Stress	(each direction)	90 ppi
• Elongation at Yield	Or ASTM D6693	12%
• Elongation at Break		100%

PROPERTY	TEST METHOD	TEST VALUE TEXTURED HDPE
(2-inch gage length)		
e. Min. Tear Resistance Initiation	ASTM D1004, Die C	42 lbs
f. Carbon Black	ASTM D1603 or ASTM D4218	2.0-3.0%
g. Carbon Black Dispersion • Minimum 8 of 10 • All 10 of 10	ASTM D5596	Category 1 or 2 1, 2, or 3
h. Puncture Resistance, Minimum Average	ASTM D4833	90 lbs
i. Oxidative Induction Time, Minimum Average	ASTM D3895 or ASTM D5885	100 min. 400 min.
j. Asperity Height, Minimum Average	GRI GM12	15 mil
k. Max. Water Vapor Transmission Rate	ASTM E96	0.24 g/m^2 per day
l. Stress Crack Resistance	ASTM D 5397 App A	300 hours

8. Rolls may be rejected if they appear damaged upon delivery or if they have been rejected or returned from another project.

B. Geomembrane Manufacturing Quality Assurance (QA): The geomembrane liner shall be manufactured in accordance with a written quality assurance/quality control program (QC). This QA/QC program shall be submitted to the Engineer or Inspector, together with shop drawings showing the layout of geomembrane liner in the containment facility. After this QA/QC program has been approved by the Engineer or Inspector, the Manufacturer shall not deviate from the program without written approval of the Engineer or Inspector. All testing shall be performed by the manufacturer and results shall be submitted to CQA Inspector for review. The QA/QC program shall include:
   1. Routine testing of incoming resin prior to manufacture of geomembranes. This testing shall include tests for density, melt index, environmental stress crack, oxidative-induction time and water vapor transmission at a frequency of not less than one per 200,000 LB.
   2. Routine QC testing of the manufactured sheet for physical parameters. This QC testing shall include tests for carbon black, asperity height, tensile strength, and elongation properties, at a frequency of not less than one per 20,000 LB (approximately every 10 rolls) of manufactured geomembrane; tear and puncture resistance at a frequency of not less than one per 45,000 LB (approximately every 25 rolls) of manufactured geomembrane. Thickness shall be monitored continuously through the manufacturing process, or measured physically at a frequency of not less than one per roll of manufactured geomembrane.
   3. Extrusion rod shall be manufactured from identical resin to that used in geomembrane manufacture. Manufactured extrusion rod shall be tested for carbon black, specific gravity and melt index at a frequency of not less than one test per batch.
   4. The Manufacturer shall reject resin shipments which do not conform with the density and melt index requirements of the approved QA/QC program. The Manufacturer shall reject manufactured geomembrane which does not conform to the sheet physical requirements of the approved QA/QC program.

5. The HDPE textured geomembrane shall conform to the requirements prescribed in GRI Test Method GM13 or these specification which ever is more stringent.

C. Manufacturing QC data shall accompany the geomembrane shipment.

D. Independent testing of geomembrane shall be conducted in accordance with the CCSWDC Class I Landfill Expansion CQA Plan.

2.3 INTERFACE FRICTION TESTS

A. Laboratory friction tests shall be conducted, on behalf of the OWNER by the CQA Laboratory, with representative samples of the materials selected by the Contractor for use in the Work. The CQA Inspector is responsible for shipping materials to the testing laboratory. The initial set of testing and subsequent conformance tests (if any) shall be paid for by the Owner. If any interface doesn't meet the requirements, or if the Contractor changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the Contractor. Testing will include the interfaces between the following adjacent materials.

Material	Specification Section
Cover Soil	02200
60 mil Textured HDPE Geomembrane	02776
Drainage Composite: Overlay Liner System	02777A
Drainage Sand Layer: Overlay Liner System	02240

B. The testing shall be performed in accordance with ASTM D5321.
1. The materials shall be tested at normal stressed of 5,000, 10,000, and 20,000 psf. Displacement rates shall be in accordance with ASTM D5321 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA Inspector prior to performing the tests.

C. A minimum friction angle of 23 degrees is required for each interface in the system defined in Paragraph A.

D. Interface shear strength of the actual components which will be used in the liner system shall be tested with method ASTM D5321 or an equivalent test method. The interface shall be tested in a water-saturated state.

E. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

F. Interface friction tests (initial CQA testing) will be conducted by the Owner.

2.4 EQUIPMENT AND ACCESSORIES

A. Welding and Seaming Equipment:
1. Equipped with gages showing temperatures at the nozzle (extrusion welder) or at the wedge (wedge welder).
2. Maintained in adequate numbers to avoid delaying work.
3. Supplied by a power source capable of providing constant voltage under a combined-line load.

4. Electric generator shall not be placed directly on the HDPE geomembrane unless protective boots or rubber tires are placed no generators and no damage to the geomembrane is observed. In addition, fuel cans will not be allowed to be stored directly on the geomembrane unless a spill container is provided outside of the fuel container.

B. Field Tensiometer:
   1. CQC will provide a tensiometer for on-site shear and peel testing of HDPE geomembrane seams.
      a. Tensiometer shall be in good working order.
      b. Built to ASTM specifications.
      c. Accompanied by evidence of calibration of equipment and gages within the past six months.
   2. Tension meter:
      a. Motor driven.
      b. Jaws capable of traveling a measure rate of 2 -inch per minute.
      c. Equipped with a gauge that measures the force in unit pounds exerted between the jaws.
      d. Digital readout.

C. Punch Press:
   1. Provide a punch press for the onsite preparation of specimens for testing.
   2. Capable of cutting specimens in accordance with ASTM D4437.

D. Vacuum Box:
   1. Provide a vacuum box for onsite testing of HDPE geomembrane seams in accordance with ASTM D5641.

E. Equipment necessary to perform "Pressurized Air Channel Evaluation of Dual Seamed Geomembranes" in accordance with ASTM D5820.

F. Gages:
   1. Calibrated within past six months.
   2. Specified test values reading near mid-range of the gage scale.

G. Equipment necessary to perform "Non-Destructive Testing of Geomembrane Seams Using The Spark Test" in accordance with ASTM D6365.

2.5 FABRICATION

A. The Manufacturer is responsible for producing geomembrane sheet that complies with this Specification. These responsibilities include but are not limited to:
   1. Resin and additive quality control:
      a. Acceptance of the resin and additives from chemical formulators.
      b. Testing of the raw resin and additives to ensure compliance with the Manufacturer's specifications and with this Specification.
   2. Formulation of the resin and additives into sheeting using mixing and extrusion equipment.
   3. Testing of the sheet material to ensure compliance with Manufacturer's specifications and this Specification.
   4. Shipping of the sheet material to Installer.
   5. Certification of the raw materials and finished sheet to comply with this Specification.
   6. Certification of Installer's training (unless Installer is certified by other acceptable manufacturer list herein), experience and methods for welding, seaming, joining and inspecting geosynthetic materials installations in compliance with Manufacturer's standards and with Quality Assurance requirements of this Specification Part 1.2.

PART 3 - EXECUTION

3.1 GEOSYNTHETIC LINER SYSTEM

A. Geomembrane Subgrade:

1. Protect subgrade at all times from damage until such time as the placement of HDPE geomembrane liner and other components of the geosynthetic liner system are complete.
2. The subgrade shall be prepared in a manner consistent with proper subgrade preparation techniques for the installation of HDPE Geomembrane.
   a. The subgrade shall be properly compacted so as not to settle and cause excessive strains in the HDPE Geomembrane or other synthetic liner materials.
   b. Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 inch.
   c. In addition, ensure that the subgrade has been rolled to provide a uniform surface.
   d. During installation, ensure that rutting or ravelling is not caused by installation equipment or weathering.

B. Anchor Trenches:
1. Geosynthetic materials placed on side slopes shall be anchored into trenches as detailed on the Contract Drawings.
2. Excavation, backfill and compaction shall be in accordance with Section 02200.

C. HDPE Geomembrane:
1. General:
   a. Installer of HDPE geomembranes is responsible for handling, fitting, welding, seaming, jointing and testing of geosynthetic materials sheets or blankets in the field in accordance with the CCSWDC Class I Expansion Construction Quality Assurance (CQA) Plan.
   b. These responsibilities include but are not limited to:
      1) Acceptance (in writing) of the geosynthetic materials sheets or blankets from the transporter.
      2) Acceptance (in writing) of the surface which will serve as a base for the HDPE geomembrane.
         a) This acceptance shall precede installation of the HDPE geomembrane.
         b) Shall state that the Installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all surface conditions acceptable for placement of HDPE geomembrane liners. Installer shall coordinate with the Contractor or surveyor to ensure the geomembrane surface is to the appropriate elevation.
         c) Shall explicitly state any and all exceptions to acceptance.
      3) Handling, welding, seaming, jointing, testing and repair of HDPE geomembrane liners and other geosynthetic materials in compliance with this Specification and with written procedures manuals prepared by the Manufacturer or Fabricator.
         a) Manual shall be submitted to the Engineer together with Shop Drawings showing the layout of HDPE geomembrane within the Project.
            (1) Do not deviate from the procedures included in the manual unless approved by the Owner/Engineer.
         b) HDPE Geomembrane shall not be placed upon frozen foundation, standing water or other conditions which will result in deterioration of the foundation.
         c) HDPE Geomembrane liner materials shall be laid out according to plans previously approved by the Engineer.
         d) Adjacent rolls of HDPE geomembrane shall overlap a minimum of 3 -inch.
      4) Repair or replacement of defects in the geosynthetic materials as required by the Inspector or the Owner.
      5) Installer and Manufacturer may be the same firm.
2. Panel deployment:
   a. Subgrade Preparation:
      1) Prepare subgrade in a manner consistent with proper subgrade preparation techniques for the installation of HDPE geomembrane liner.
      2) Properly compact the subgrade so as not to settle and cause excessive strains in the HDPE geomembrane liner.

3) Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 -inch.
4) Subgrade soils proof-rolled with a ten (10) ton drum roller, two (2) passes parallel to slope or as directed by CQA Inspector. The subbase shall be compacted and proof-rolled under observation of the CQA Inspector to assure the maximum practical compaction under the existing field conditions has been achieved. See specification Section 02200 for project specific compaction requirement.
5) Ensure rutting or raveling is not caused by installation equipment or weather.
6) Ensure that lines and grades have been verified by the Contractor and a subgrade acceptance form has been submitted.

b. Construct and backfill anchor trenches
c. Deploy HDPE geomembrane liner in a manner to ensure it is not damaged
d. On slopes, anchor the HDPE geomembrane liner securely and deploy it down the slope in a controlled manner.
e. Weight the HDPE geomembrane liner with sandbags or equivalent in the presence of wind.
f. Minimize cutting the HDPE geomembrane liner. Whenever possible, overlap instead of cutting material. If cutting is required, cut HDPE geomembrane liner with a cutter or other approved device. Seal all cut edges, as recommended by Manufacturer.
g. Only those panel/sheets that can be seamed in 1 day shall be deployed.
h. Place panels with minimal handling.
   1) No horizontal seams on side slopes.
   2) Protect panels from tear, puncture or abrasion.
i. Equipment used to deploy the geomembrane shall not damage the HDPE geomembrane.
   1) A rut is defined as a 1/4 -inch depression over a 10 FT straight-edged length.
j. No vehicular traffic, except low ground pressure equipment necessary for the deployment and installation of verlying geosynthetic layer, is permitted on unprotected HDPE geomembrane.
k. Minimize foot traffic.
   1) Do not allow personnel access to wet or slippery liners without adequate safety precautions.
   2) Do not allow footwear that may damage the geomembrane.
l. Ballast with sandbags to prevent wind uplift as recommended by Manufacturer based on local climatic conditions.
   1) Remove and replace all wind damaged panels at no additional cost to Owner.
   2) If wind causes panels to be displaced, displaced panel may not be reused.
m. Install HDPE geomembrane in stress free, tension free and relaxed condition.
   1) Account for temperature and weather-related impacts when deploying and covering.
   2) Stretching to fit and folding are not permitted.
n. Do not allow HDPE geomembrane to bubble, fold, or create ripples as a result of deployment of drainage layer or protective soil cover placement.
   1) Except as noted on Contract Drawings no folds in HDPE geomembrane will be allowed.
o. Any panel exhibiting stretching caused by placement, covering techniques, or wind shall be removed and may not be incorporated in the final construction.
p. Field seaming:
   1) Field seaming shall be done in accordance with seaming recommendations furnished by the geomembrane Manufacturer, referenced EPA documents, and this specification.
   2) Each piece of seaming equipment and each operator shall perform pre-weld trial seams at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.

3) Trial seams shall use the same seaming materials and methods to be used in the actual construction.
4) Surfaces to be seamed shall be clean and dry at the time of seaming.
   a) Precipitation and ponding of water on the HDPE geomembrane shall cause termination of seaming operations.
   b) HDPE geomembrane shall not be seamed when ambient temperatures are below 41 DegF or above 104 DegF, without written consent of HDPE geomembrane Manufacturer and Engineer.
5) HDPE geomembrane sheets shall be seamed continuously without fishmouths or breaks in the seam.
   a) Where fishmouths are unavoidable, the sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle.
   b) The two edges of the slit shall be seamed together provided that the overlap for this seam shall be a minimum of 6 -inch.
   c) Areas of the slit which do not achieve an overlap of 6 -inch, including the terminus of the slit, shall be provided with a patch as discussed below.
6) All HDPE geomembranes shall be seamed by thermal fusion methods as recommended by the HDPE geomembrane Manufacturer.
   a) HDPE geomembrane seaming shall be either extrusion or double wedge welded as approved by the Engineer.
7) Manufacturer's seaming instructions shall specifically address seaming materials, temporary and permanent jointing, seaming temperatures including temperatures for seaming materials, seam finishing and curing.
8) A copy of Manufacturer's seaming instructions shall be available on site at all times and shall not be deviated from without written approval of the Manufacturer and Engineer.
9) All panels/sheets should be overlapped a minimum of 3 -inch.
   a) No horizontal seams will be permitted on the side slopes.
10) Seaming shall not be conducted in the presence of standing water.
   a) The seamed area shall be cleaned of dust, dirt and foreign material prior to and during the seaming operation.
11) Seaming shall extend to the outside edge of panels/sheets to be placed in anchor and/or drainage trenches.
12) Tack welds shall conform with manufacturers seaming techniques and shall not damage underlying membrane.

q. Patching:
   1) Defects in and damage to HDPE geomembrane sheets shall be repaired by seaming a patch over the defect. All repairs will be numbered by the CQC consultant and shown on the as-builts.
      a) The patch material shall consist of an undamaged piece of HDPE geomembrane cut to provide a minimum of 6 -inch of overlap in all directions from the defect.
      b) Round corners shall be utilized on all patches. No bead or spot patching will be accepted.
      c) Torn or permanently twisted HDPE geomembrane shall be replaced at no expense to the Owner.
   2) Test all patch seams using one of the following nondestructive tests: vacuum tests or spark tests.
      a) Test patch seams destructively at a frequency of ten percent or a minimum of one test per seaming personnel per day.
      b) This destructive testing may be accomplished using demonstration seams performed adjacent to the liner installation.
r. Smoking is not permitted while on the geomembrane.

s. Field Panel Identification: The Installer's CQC Consultant will document that the Geomembrane Installer labels each field panel with an "identification code" consistent with the approved panel layout plan. The location of the label and the color of marker used must be as agreed to in the QA/QC Preconstruction Meeting.

3.2 FIELD QUALITY CONTROL

A. The CQA Inspector shall not be a part of the installation program and shall not serve as a substitute for performing the duties or certification required of the Manufacturer and Installer.
   1. The CQA Inspectors responsibilities include, but are not limited to:
      a. Inspection of the material and the handling and field installation of the geomembranes. Inspection of all welds, repairs and quality control test results.
      b. All exceptions to material or installation shall be documented and furnished to the CQA firm in writing within 48 HRS of discovery.
      c. Inspection and Certification of HDPE geomembrane integrity until completion of placement of protective soil cover.

B. Trial Seam Testing:
   1. Trial seams shall be at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.
      a. The location of trial seam shall be in an area proposed for the day's production seaming.
      b. Equipment, methods and personnel shall be the same as proposed for the day's seaming.
   2. Test four replicates (1 -inch wide specimens) cut from trial seam.
      a. To be acceptable, four of four replicate test specimens must meet specified seam strength requirements and all failures shall be Film Tear Bond.
      b. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 -inch per minute.
      c. If the field trial seam tests fail to meet these requirements, the entire operation shall be repeated.
      d. If the additional test seams fail, the seaming apparatus or seamer shall not be accepted or used for seaming until the deficiencies are corrected and two consecutive successful test seams are achieved.

C. Non-Destructive Seam Testing:
   1. All field seams shall be non-destructively tested over their full length.
      a. Seam testing shall be performed as the seaming work progresses, not at the completion of field seaming.
      b. All testing shall be documented. Any seams which fail shall be repaired and documented.
   2. Non-destructively test all field seams continuously using one of the following nondestructive seam tests:
      a. Vacuum box (ASTM D5641). Test at 6psi for 10 seconds. Any loss in vacuum, as indicated by bubbling of soap solution, is a failing test.
      b. Spark tests (ASTM D6365). Test at uniform rate between 6 and 9 meters per minute. A spark indicates a failing test.
      c. Pressurized air channel test (ASTM D5820). Test at 35 psi for at least 5 minutes. A pressure drop of more than 2psi is a failing test.
   3. All tests should be conducted in accordance with their corresponding ASTM method.

D. Destructive Seam Testing:
   1. A minimum of one destructive test per 500 LF of seam, and as many other samples as CQA firm determines appropriate, shall be obtained at locations specified by the CQA firm.
      a. Sample locations shall not be identified prior to seaming.
      b. The samples shall be a minimum of 12 -inch wide by 48 -inch long with the seam centered lengthwise.

c. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to a CQA Testing Laboratory, and the remaining piece given to the CQA Engineer for quality assurance testing and/or permanent record.
d. Each sample shall be numbered and recorded on the final panel layout record drawing, and cross-referenced to a field log which identifies:
   1) Panel/sheet number.
   2) Seam number.
   3) Top sheet.
   4) Date and time cut.
   5) Ambient temperature.
   6) Seaming unit designation.
   7) Name of seamer.
   8) Seaming apparatus temperature and pressures (where applicable).

2. A minimum of four 1 -inch wide replicate specimens shall be cut from the Installer's sample.
   a. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 -inch per minute.
   b. To be acceptable, all test specimens must meet the specified seam strength requirements and all must fail as Film Tear Bond.
   c. If all field tests pass, 5 specimens shall be tested at the CQA Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D6392.
   d. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirement and fifth sample must meet 80% required strength and fail at Film Tear Bond.
3. The minimum required seam strengths for 60 mil HDPE are:

Description	Test Method	Seam Type	Required Value (lbs/in width)
HDPE Peel	ASTM D6392	Extrusion	78
HDPE Peel	ASTM D6392	Fusion	91
HDPE Shear	ASTM D6392	Extrusion	120
HDPE Shear	ASTM D6392	Fusion	120

4. For destructive samples which have failed the seam strength criterion, the Contractor will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Contractor may patch or cap strip the seam between the passed samples. If either fails, the Contractor will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.

   a. In addition, all destructive seam sample holes shall be repaired the same day as cut.
   b. Certified test results on all field seams shall be submitted to and approved by the CQA Engineer prior to acceptance of the seam.
5. Ten percent of all repaired areas shall be destructively tested.
   a. All repaired areas shall be non-destructively tested.
6. Destructive testing shall be performed by a CQA Testing Laboratory not employed by the Installer.
7. A map showing the locations, number and type of all destructive samples, patches, repairs, and penetrations shall be prepared and provided to the Owner.
8. Documentation: The following documentation must be maintained at the project site for review by the CQA Engineer or Inspector.
   a. Geomembrane Installer's Documentation:
      1) Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, weather conditions, and equipment on site.

2) Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
3) Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.
4) Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
5) Seaming Pre-weld Log: provided a complete record of all pre-weld start-up test results.
6) Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
7) Seam/Panel Repair Log: provides a complete record of all repairs and vacuum box testing of repairs made to defective seams or panels.
8) As-Built Drawing: maintain an as-built drawing updated on a weekly basis.

3.3 GEOSYNTHETIC LINER SYSTEM ACCEPTANCE

A. Contractor shall retain all ownership and responsibility for the geosynthetic liner system until final acceptance by the Owner.
   1. Owner will accept the geosynthetic liner system installation when the installation is finished and all required warranties, test results, and documentation from the Contractor, Manufacturer, Inspector and Installer has been received and approved, and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

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SECTION 02777
DRAINAGE COMPOSITE – FINAL COVER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the bonded geotextile-geonet drainage composite used as part of the final cover system.

B. Related sections include but are not necessarily limited to:
   1. Section 02778 - Geotextiles.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D1238, Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
      b. D1505, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
      c. D1603, Standard Test Method for Carbon Black in Olefin Plastics.
      d. D1987 Test Method for Biological Clogging of Geotextile or Soil/Geotextile Filters.
      e. D4716, Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
      f. D4873, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
      g. D5199, Standard Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      h. D5321, Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
      i. D7005, Determining the Bond Strength (Ply Adhesion) of Geocomposites.
      j. D5035, Standard Test Method for Breaking Force and Elongation of Textile Fabrics (strip method).
   2. Geosynthetic Research Institute (GRI).
      a. GRI GC8 – Determination of the Allowable Flow Rate of a Drainage Geocomposite.

B. Qualifications:
   1. Each manufacturing and fabricating firm shall demonstrate five (5) years continuous experience, including a minimum of 5,000,000 SF of drainage composite production in the past three (3) years.
   2. Installer shall attend pre-installation conference.

1.3 DEFINITIONS

A. Manufacturer: Manufacturer producing drainage composites from geonet cores and geotextiles.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's documentation that raw materials and roll materials comply with required drainage composite physical properties.
   2. Manufacturer and Installer quality control manuals.
   3. Original test results for resins and roll material at frequency specified in respective quality control manuals.
      a. Include or bracket the rolls delivered for use in the Work.

4. Proposed details of anchor trench if different than included in Contract Documents.

B. Miscellaneous Submittals:
   1. Qualification documentation specified in Article 1.2.
   2. Transmissivity test.
   3. Interface friction test.

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store drainage composites in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage.
   1. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, drainage composite type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace, as directed by the Engineer, drainage composite or plastic wrapping damaged as a result of storage or handling.

E. Do not expose drainage composite to temperatures in excess of 71 DegC (160 DegF) or below 0 DegC (32 DegF) unless recommended by the Manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling the drainage composite.

G. Do not lift rolls by use of cables or chains in contact with the drainage composite.

H. Do not drag drainage composite along the ground or across textured geomembranes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. CETCO
   2. GSE Lining Technology.
   3. Polyflex Inc.
   4. Skaps Industries.
   5. Tenax Corp.

2.2 MATERIALS AND MANUFACTURE

A. Geonet Core:
   1. Use nonthermally degraded polyethylene polymer which is clean and free of any foreign contaminants.
   2. Manufactured geonet to conform to the property requirements listed in Table 1 and be free of defects including tears, nodules or other manufacturing defects which may affect its serviceability.

TABLE 1 - GEONET PROPERTIES

PROPERTY	TEST METHOD	REQUIRED VALUE	MIN. MQC TEST FREQUENCY
Specific Gravity/ Density (g/cm^3) (min)	ASTM D1505	>0.94 g/cc	1 per 50,000 ft^2 and every resin lot
Thickness (mil)	ASTM D5199	300 mil (min)	1 per 50,000 ft^2 and every resin lot
Carbon Black Content	ASTM D1603	2 percent	1 per 50,000 ft^2 and every resin lot
Tensile Strength	ASTM D5035	75 lbs/in MD	1 per 50,000 ft^2 and every resin lot

B. Geotextile:
   1. Cover geonet core on both sides or single side, as shown on Drawings, with a geotextile complying with requirements specified in Section 02778: Geotextiles, Drainage.

C. Drainage Composite:
   1. Create a composite by heat bonding geotextiles to the geonet.
   2. Transmissivity = $1.3x10^{-3}$ m^2/sec @ 100 hrs and 1,000 psf by ASTM D4716 (see Paragraph 2.3 A).
   3. Ply adhesion ASTM D7005 MARV of 1 lb/in.

D. Independent conformance testing shall be performed in accordance with CQA Plan.

2.3 SOURCE QUALITY CONTROL

A. Transmissivity Testing:
   1. Measure transmissivity using water at 68 DegF with a normal compressive load of 1,000 psf. and a hydraulic gradient of 0.33
   2. Attach geotextiles to the geonet in the same configuration as will be used in the field.
   3. Boundary conditions are soil interface on the upper geotextile and textured 40 mil LLDPE geomembrane against the lower geotextile.
   4. Maximum design normal load testing shall be conducted for a minimum period of 100 hours unless data equivalent to the 100-hour period is provided in which case the test shall be conducted for a minimum period of one hour.
   5. Testing frequency: 1 test for every 540,000 SF of installed product

B. Interface Friction Tests.
   1. Laboratory friction tests shall be conducted, on behalf of the Owner by the CQA Laboratory, with representative samples of the materials selected by the Contractor for use in the Work. The Contractor is responsible for shipping materials to the testing laboratory. The initial set of testing and subsequent conformance tests (if any) shall be paid for by the Owner. If any interface doesn't meet the requirements, or if the Contractor changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the Contractor. Testing will include the interfaces between the following adjacent materials.

Material	Specification Section
Protective Cover	02200
Drainage Composite – Final Cover	02777
40 mil Textured LLDPE Geomembrane	02775
Intermediate Cover	02200

   2. The testing shall be performed in accordance with ASTM D5321.
   3. The materials shall be tested at normal stressed of 250, 500, and 1,000 psf. Displacement rates shall be in accordance with ASTM D5321 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA Inspector prior to performing the tests.
   4. A minimum friction angle of 26 degrees is required for each interface in the system defined in Paragraph B.1.
   5. Interface shear strength of the actual components which will be used in the liner system shall be tested with method ASTM D5321 or an equivalent test method.
   6. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

7. Interface friction tests will be conducted by the CQA Testing Laboratory.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to placement of the drainage composite, clean the substrate of all soil, rock, and other materials which could damage the composite.

B. The geocomposite drainage media shall be placed only on geomembrane that has been approved by the Geomembrane Installer and accepted by the CQA Inspector.

3.2 INSTALLATION

A. Install geocomposite drain in accordance with manufacturer's written recommendations.

B. Deploy the drainage composite ensuring that the drainage composite and underlying materials are not damaged.
   1. Replace or repair faulty or damaged drainage composite as directed by Engineer.

C. Unroll drainage composite downslope keeping in slight tension to minimize wrinkles and folds.

D. Maintain free of dirt, mud, or any other foreign materials at all times during construction.
   1. Clean or replace rolls which are contaminated.

E. Place adequate ballast to prevent uplift by wind.

F. Overlap adjacent rolls a minimum of 6 IN.
   1. Overlap new drainage composite over existing as shown on the Drawings.
   2. Shingle all edges of geocomposite downslope

G. Use manufacturer's fasteners to join adjacent rolls.
   1. Metallic fasteners will not be allowed.
   2. Space fasteners a maximum of 5 FT along downslope roll overlaps and a maximum of 1 FT along cross slope roll overlaps.
   3. Use fasteners of contrasting color from the drainage composite to facilitate visual inspection.
   4. Do not weld drainage composite to geomembranes.
   5. Install geotextile cap strip wherever ends of geocomposite are exposed to soil intrusion.

H. See Section 02778, Geotextiles, for information on seaming the upper geotextile to the upper geotextile of the adjacent rolls.

I. Repairs holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 FT beyond the edges of the hole or tear.
   1. Use approved fasteners, spaced every 6 IN around the patch, to fasten the patch to the original roll.

3.3 FIELD QUALITY CONTROL

A. Prior to installation of the drainage composite, the Installer's CQC Consultant shall provide the Engineer quality control certificates signed by the manufacturer's quality assurance manager for every 540,000 SF of geocomposite drainage media to be installed illustrating satisfactory transmissivity tests among other attributes.

END OF SECTION

SECTION 02777A
DRAINAGE COMPOSITE - OVERLAY LINER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the bonded geotextile-geonet drainage composite used as part of the overlay liner system for the Phase I / II connection.

B. Related sections include but are not necessarily limited to:
   1. Section 02778 - Geotextiles.
   2. Central County Solid Waste Disposal Complex Class I Landfill Expansion Construction Quality Assurance Plan.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D1238, Flow Rates of Thermoplastics by Extrusion Plastometer.
      b. D1505, Density of Plastics by the Density-Gradient Technique.
      c. D1603, Carbon Black in Olefin Plastics.
      d. D1987 Test Method for Biological Clogging of Geotextile or Soil/Geotextile Filters.
      e. D4716, Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
      f. D4873, Identification, Storage and Handling of Geosynthetic Rolls.
      g. D5199, Standard Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      h. D7005, Determining the Bond Strength (Ply Adhesion) of Geocomposites.
   2. Geosynthetic Research Institute (GRI).
      a. GRI GC8 – Determination of the Allowable Flow Rate of a Drainage Geocomposite.

B. Qualifications:
   1. Each manufacturing and fabricating firm shall demonstrate 5 years continuous experience, including a minimum of 5,000,000 SF of drainage composite production in the past 3 years.
   2. Installer shall attend pre-installation conference.

1.3 DEFINITIONS

A. Manufacturer: Manufacturer producing drainage composites from geonet cores and geotextiles.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Shop Drawings:
      a. Manufacturer's documentation that raw materials and roll materials comply with required drainage composite physical properties.
      b. Manufacturer and Installer quality control manuals.
      c. Original test results for resins and roll material at frequency specified in respective quality control manuals. Include or bracket the rolls delivered for use in the Work.
      d. Proposed details of anchor trench if different than included in Contract Documents.

B. Miscellaneous Submittals:
   1. Qualification documentation specified in Article 1.2.
   2. Transmissivity test.
   3. Interface friction test.

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store drainage composites in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, drainage composite type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace, as directed by the Engineer, drainage composite or plastic wrapping damaged as a result of storage or handling.

E. Do not expose drainage composite to temperatures in excess of 71 DegC (160 DegF) or below 0 DegC (32 DegF) unless recommended by the Manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling the drainage composite.

G. Do not lift rolls by use of cables or chains in contact with the drainage composite.

H. Do not drag drainage composite along the ground or across textured geomembranes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. CETCO.
2. GSE Lining Technology.
3. Polyflex Inc.
4. Skaps Industries.
5. Tenax Corp.

2.2 MATERIALS AND MANUFACTURE

A. Geonet Core:
1. Use nonthermally degraded polyethylene polymer which is clean and free of any foreign contaminants.
2. Manufactured geonet to conform to the property requirements listed in Table 1 and be free of defects including tears, nodules or other manufacturing defects which may affect its serviceability.

TABLE 1 - GEONET PROPERTIES

PROPERTY	TEST METHOD	REQUIRED VALUE	MIN. MQC TEST FREQUENCY
Specific Gravity/ Density (g/cm^3) (min)	ASTM D1505	>0.94 g/cc	1 per 100,000 ft^2 and every resin lot
Mass per Unit Area (lbs/ft^2)	ASTM D5261		1 per 50,000 ft^2 and every resin lot
Carbon Black Content	ASTM D1603	2 percent	1 per 50,000 ft^2 and every resin lot
Tensile Strength	ASTM D5035		1 per 50,000 ft^2 and every resin lot

B. Geotextile:
1. Cover geonet core on both sides with a geotextile complying with requirements specified in Section 02778: Geotextiles, Drainage.

C. Drainage Composite:

1. Create a composite by heat bonding geotextiles to the geonet. The bond between the geotextile and the geonet shall exhibit a minimum peel strength of 1 LBS/IN when tested in accordance with ASTM D413
2. Transmissivity $1.8x10^{-3}m^2/sec$ @ 100 hrs and 20,000 psf by ASTM D4716.
3. Ply adhesion ASTM D7005 MARV of 1 lb/in.

2.3 SOURCE QUALITY CONTROL

A. Transmissivity Testing:
1. Measure transmissivity using water at 68 DegF with a normal compressive load of 20,000 psf and a hydraulic gradient of 0.02.
2. Attach geotextiles to the geonet in the same configuration as will be used in the field.
3. Boundary conditions are soil interface on the upper geotextile and HDPE geomembrane against the lower geotextile.
4. Maximum design normal load testing shall be conducted for a minimum period of 100 hours unless data equivalent to the 100-hour period is provided in which case the test shall be conducted for a minimum period of one hour. In the case of the design load from one lift of waste, the minimum period shall be one hour.
5. Testing frequency: 1 test for every 540,000 SF of installed product.

B. Interface Friction Tests.
1. Laboratory friction tests shall be conducted, on behalf of the OWNER by the CQA Laboratory, with representative samples of the materials selected by the Contractor for use in the Work. The Contractor is responsible for shipping materials to the testing laboratory. The initial set of testing and subsequent conformance tests (if any) shall be paid for by the Owner. If any interface doesn't meet the requirements, or if the Contractor changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the Contractor. Testing will include the interfaces between the following adjacent materials.

Material	Specification Section
Drainage Sand Layer – Overlay Liner	02240
Drainage Composite – Overlay Liner	02777A
60 mil Textured HDPE Geomembrane	02776
Cover Soil	02200

2. The testing shall be performed in accordance with ASTM D5321.
3. The materials shall be tested at normal stressed of 5,000, 10,000, and 20,000 psf. Displacement rates shall be in accordance with ASTM D5321 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA Inspector prior to performing the tests.
4. A minimum friction angle of 23 degrees is required for each interface in the system defined in Paragraph 2.3.B.1.
5. Interface shear strength of the actual components which will be used in the liner system shall be tested with method ASTM D5321 or an equivalent test method.
6. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.
7. Interface friction tests will be conducted by the CQA Testing Laboratory.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to placement of the drainage composite, clean the substrate of all soil, rock, and other materials which could damage the composite.

B. The geocomponent drainage media shall be placed only on geomembrane that has been approved by the Geomembrane Installer and accepted by the CQA Inspector.

3.2 INSTALLATION

A. Install geocomposite drain in accordance with manufacturer's written recommendations.

B. Deploy the drainage composite ensuring that the drainage composite and underlying materials are not damaged. Replace or repair faulty or damaged drainage composite as directed by Engineer.

C. Unroll drainage composite downslope keeping in slight tension to minimize wrinkles and folds.

D. Maintain free of dirt, mud, or any other foreign materials at all times during construction. Clean or replace rolls which are contaminated.

E. Place adequate ballast to prevent uplift by wind.

F. Overlap adjacent rolls a minimum of 6 IN. Overlap new drainage composite over existing as shown on the drawings.

G. Use manufacturer's fasteners to join adjacent rolls. Metallic fasteners will not be allowed. Space fasteners a maximum of 5 FT along downslope roll overlaps and a maximum of 1 FT along cross slope roll overlaps. Use fasteners of contrasting color from the drainage composite to facilitate visual inspection. Do not weld drainage composite to geomembranes.

H. See Section 02778, Geotextiles, for information on seaming the upper geotextile to the upper geotextile of the adjacent rolls.

I. Repairs holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 FT beyond the edges of the hole or tear. Use approved fasteners, spaced every 6 IN around the patch, to fasten the patch to the original roll.

3.3 FIELD QUALITY CONTROL

A. Prior to installation of the drainage composite, the Installer's CQC Consultant shall provide the Engineer quality control certificates signed by the manufacturer's quality assurance manager for every 540,000 SF of geocomposite drainage media to be installed illustrating satisfactory transmissivity tests among other attributes.

END OF SECTION

SECTION 02778
GEOTEXTILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-woven geotextile material for use in geocomposite drainage layer and other applications shown on the Drawings.

B. Related Sections:
   1. Section 02200 -Earthwork.
   2. Section 02777 - Drainage Composite – Final Cover.
   3. Section 02777A – Drainage Composite – Overlay Liner System.
   4. Central County Solid Waste Disposal Complex Phase I Closure Construction Quality Assurance Plan (applies to closure areas).
   5. Central County Solid Waste Disposal Complex Class I Landfill Expansion Construction Quality Assurance Plan (applies only to Overlay Liner System only).

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway Transportation Officials (AASHTO):
      a. M288, Standard Specification for Geotextile Specification for Highway Application.
   2. ASTM International (ASTM):
      a. D1987, Biological Clogging of Geotextile or Soil/Geotextile Filters.
      b. D3786, Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
      c. D4354, Sampling of Geosynthetics for Testing.
      d. D4355, Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
      e. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
      f. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
      g. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
      h. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
      i. D4759, Standard Practice for Determining the Specification Conformance of Geosynthetics.
      j. D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
      k. D4873, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
      l. D4884, Strength of Sewn or Thermally Bonded Seams of Geotextiles
      m. D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
      n. D6193, Standard Practice for Stitches and Seams.

B. Qualifications:
   1. Each manufacturing, fabricating firm shall demonstrate 5 years continuous experience, including a minimum of 10,000,000 SF of geotextile installation in the past three (3) years.
   2. Installing firm shall demonstrate that the site Superintendent or Foreman has had responsible charge for installation of a minimum of 1,000,000 SF of geotextile.
   3. Installer shall attend pre-installation conference.

1.3 DEFINITIONS

A. Manufacturer: Manufacturer producing geotextile sheets from resin and additives.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

C. MARV: Minimum Average Roll Value

1.4 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's documentation that raw materials and roll materials comply with required geotextile physical properties.
   2. Manufacturer and Installer quality control manuals.
   3. Original test results for resins, roll material and factory seam tests at frequency specified in respective quality control manuals.
      a. Results shall include or bracket the rolls delivered for use in the Work.
   4. Proposed details of anchoring and overlapping if different than included in Contract Documents.

B. Miscellaneous Submittals:
   1. For needle punched geotextiles, the Manufacturer shall certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers.
   2. Qualification documentation specified in Article 1.2.B

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store geotextiles in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage.
   1. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, geotextile type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace geotextile or plastic wrapping damaged as a result of storage or handling, as directed.

E. Do not expose geotextile to temperatures in excess of 71 Deg C (160 Deg F) or less than 0 Deg C (32 Deg F) unless recommended by the manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling geotextile.
   1. Do not lift rolls lifted by use of cables or chains in contact with the geotextile.
   2. Do not drag geotextile along the ground.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. GSE Lining Technology.
   2. Mirafi (TenCate Geosynthetics)
   3. Propex.
   4. SKAPS Industries.
   5. Tenax Corp.
   6. Or approved equal

2.2 MATERIALS AND MANUFACTURE

A. Geotextile:
   1. Non-woven and woven pervious sheet of polymeric material.
   2. Geotextile fibers:

a. Long-chain synthetic polymer composed of at least 85 percent by weight polyolefins, polyesters, or polyamides.
b. Filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.
c. Do not add reclaimed or recycled fibers or polymer to the formulation.

3. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages.
4. The geotextile physical properties shall equal or exceed the minimum average roll values listed below.
   a. Values shown are for the weaker principal direction unless both values are shown.
   b. Acceptance of geotextile shall be in accordance with ASTM D4759.

Non-woven Drainage Geotextile: Used in the geocomposite for drainage and other applications shown on Drawings.

PROPERTY	TEST METHOD	MARV	MIN. MQC TEST FREQUENCY
Mass per Unit Area, (oz/sy)	ASTM D5261	6	1 per 90,000 ft^2
Grab Tensile Strength (lbs)	ASTM D4632	170	1 per 90,000 ft^2
Puncture Strength (lbs)	ASTM D4833	90	1 per 90,000 ft^2
AOS, US sieve (mm)	ASTM D4751	70	1 per 540,000 ft^2
Permittivity, (sec^{-1})	ASTM D4491	1.5	1 per 540,000 ft^2
Flow Rate, gpm/ft^2	ASTM D4491	110	1 per 540,000 ft^2
Ultraviolet Degradation, % retained @ 500 HRS	ASTM D4355	70	1per formulation

Non-woven Drainage Geotextile: Used in underlayment and other applications.

PROPERTY	TEST METHOD	MARV	MIN. MQC TEST FREQUENCY
Mass per Unit Area (oz/sy)	ASTM D5261	8	1 per 90,000 ft^2
Grab Tensile Strength (lbs)	ASTM D4632	205	1 per 90,000 ft^2
Grab Tensile Elongation (%)	ASTM D4632	50	1 per 90,000 ft^2
Puncture Strength (lbs)	ASTM D4833	120	1 per 90,000 ft^2
Trapezoidal Tear Strength (lbs)	ASTM D4533	85	1 per 90,000 ft^2

Non-woven Drainage Geotextile: Used in the EGC anchor trenches.

PROPERTY	TEST METHOD	MARV	MIN. MQC TEST FREQUENCY
Mass per Unit Area (oz/sy)	ASTM D5261	16	1 per 90,000 ft^2
Grab Tensile Strength (lbs)	ASTM D4632	370	1 per 90,000 ft^2
Grab Tensile Elongation (%)	ASTM D4632	50	1 per 90,000 ft^2
Puncture Strength (lbs)	ASTM D4833	170	1 per 90,000 ft^2
Trapezoidal Tear Strength (lbs)	ASTM D4533	145	1 per 90,000 ft^2

B. Thread:
1. High-strength polyester, nylon, or other approved thread type.
2. Equivalent chemical compatibility and ultraviolet light stability as the geotextile.
3. Contrasting color with the geotextile.

PART 3 - EXECUTION

3.1 PREPARATION

A. Construct the surface underlying the geotextiles smooth and free of ruts or protrusions which could damage the geotextiles.

3.2 INSTALLATION

A. Install geotextiles in accordance with manufacturer's written recommendations except as follows.

B. Handling shall be in accordance with ASTM D4873.
   1. No equipment will be permitted to traffic in direct contact with the geotextile.

C. Lay geotextile smooth so as to be free of tensile stresses, folds, and wrinkles.

D. Seam Construction:
   1. Sew all geotextile seams except for geotextile used to wrap drainage stone or used for erosion control purposes. Adjacent panels may be overlapped without sewing as long as the seams do not come apart when material is placed over them.
   2. Broom clean existing geotextile and cut off to provide a clean area for seaming with the new geotextile.
   3. Sew seams continuously using an SSA flat seam with one (1) row of a two-thread 401 chain stitch unless otherwise recommended by the manufacturer.
   4. Minimum distance from the geotextile edge to the stitch line nearest to that edge: 2 IN unless otherwise recommended by the manufacturer.
   5. Tie off thread at the end of each seam to prevent unraveling.
   6. Construct seams on the top side of the geotextile to allow inspection.
   7. Sew skipped stitches or discontinuities with an extra line of stitching with 18 IN of overlap.
   8. Overlap adjacent panels a minimum of 6 IN.

E. Protect geotextiles from clogging, tears, and other damage during installation.

F. Geotextile Repair:
   1. Place a patch of the same type of geotextile which extends a minimum of 24 IN beyond the edge of the damage or defect.
   2. Fasten patches continuously using a sewn seam or other approved method.
   3. Align machine direction of the patch with the machine direction of the geotextile being repaired.
   4. Replace geotextile which cannot be repaired.

G. Use adequate ballast (e.g., sand bags) to prevent uplift by wind.

H. Do not use staples or pins to hold the geotextile in place.

I. Geotextile left uncovered for more than 14 days shall be removed and replaced at the contractors expense.

J. Damaged rolls may be rejected. If rejected, verify that rejected material is removed from the site or stored at a location separate from accepted rolls. Geotextile rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

K. The CQA Inspector shall observe that the equipment used to install the geotextile does not damage it during deployment.

L. Crews working on the geotextile shall not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile.

3.3 FIELD QUALITY CONTROL

A. The CQA Consultant shall confirm that the identification, storage, and handling of geotextiles is in accordance with ASTM D4873. Any deviation from this requirement will be reported to the Engineer.

B. The CQA Consultant will examine all manufacturer certifications to ensure that the property values listed on the certifications meet or exceed these specifications. Any deviations will be reported to the Engineer.

C. The CQA Consultant will observe placement of the geotextiles to confirm that the panel overlaps and seams are in accordance with these specifications. Any deviations will be reported to the Engineer.

END OF SECTION

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SECTION 02780
GEOSYNTHETIC RAIN COVER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials, tools, and equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of an impermeable, geosynthetic rain cover as shown on Drawings and specified in accordance with provisions of the Contract Documents.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 - Earthwork.
   2. Section 02221 - Trenching, Backfilling, and Compacting for LFG Piping and Structures.
   3. Central County Solid Waste Disposal Complex Class I Landfill Expansion Construction Quality Assurance Plan (applies only to Overlay Liner System only).

1.2 QUALITY ASSURANCE

A. Refer to the following standard references or specifications as applicable to this section of technical specifications:
   1. American Society for Testing and Materials (ASTM).
      a. ASTM D751 - Standard Test Method for Coated Fabrics.
      b. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
      c. ASTM D5199 - Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      d. ASTM D7003 - Standard Test Method for Strip Tensile Properties of Reinforced Geomembranes.
      e. ASTM D7004 - Standard Test Method for Grab Tensile Properties of Reinforced Geomembranes.
      f. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. The Contractor must provide installation instructions.

B. The Contractor must certify that the rain cover resin is first use; top grade quality only.

PART 2 - PRODUCTS

2.1 MATERIALS

A. 20-mil Scrim Reinforced Polyethylene Rain Cover
   1. The 20-mil scrim reinforced polyethylene rain cover shall consist of two sheets of high-strength polyethylene film laminated together with a third layer of molten polyethylene. A heavy scrim reinforcement shall be placed between these plies to enhance tear resistance and increase service life.
   2. Contractor must supply (in the Bid price) a high strength adhesive tape or equal for waterproofing and sealing the field seams and for performing repair work to the rain cover. Contractor shall minimize field seams.
   3. The scrim reinforced rain cover must meet the following specifications or approved equal, as determined by the Engineer.

PROPERTY	TEST METHOD	SCRIM-REINFORCED TEST VALUE
a. Thickness, nominal	ASTM D5199	20 mil
b. Weight		11.2 oz/yd^2
c. 1" Tensile Strength	ASTM D7003	75 lbf
d. Elongation at Break	ASTM D7003	750%
e. Grab Tensile Strength	ASTM D7004	102.9 lbf
f. Trapezoidal Tear Strength	ASTM D4533	102 lbf
g. Hydrostatic Resistance	ASTM D751	136 psi
h. Perm Rating	ASTM E96 Method A	0.052 U.S.Perms
i. Water Vapor Transmission	ASTM E96 Method A	0.023 g / 100 in^2 / day

B. General Requirements
   1. The rain cover must perform as specified for at least 3 years and a manufacturer's warranty must be supplied for at least 3 years.
   2. The material must be able to be moved by site personnel as needed. The material must be resilient to damage when moved and/or relocated by site personnel. If necessary, the material may be cut for removal/relocation; however, in this case, must be able to be easily reseamed by site personnel.
   3. Factory seams must utilize methods that will eliminate excess overlap.
   4. The rain cover must be impermeable, capable of repelling water with no absorption.
   5. The material must be anchored, when installed, through a system so as to preclude wind damage, traffic damage, and weather.

PART 3 - EXECUTION

3.1 METHODS

A. The Contractor shall deploy the GRC in a manner consistent with the manufacturer's specifications.

B. Anchoring methods shall be as per the manufacturer's specifications or as approved otherwise by the Engineer.

C. Any damage to the GRC during installation will be the Contractor's responsibility to repair/replace at no cost to the Owner.

D. Field seams shall be of the strongest available method for the approved material except as required for patches or similar limited area applications.

END OF SECTION

SECTION 03002
CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete and grout.
   2. Concrete mixes, proportioning, and source quality control for precast concrete.
   3. Filterpoint fabric-formed concrete lining for erosion control.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 116R, Cement and Concrete Terminology.
      b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      c. 212.3R, Chemical Admixtures for Concrete.
      d. 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
      e. 304.2R, Placing Concrete by Pumping Methods.
      f. 305R, Hot Weather Concreting.
      g. 306R, Cold Weather Concreting.
      h. 318, Building Code Requirements for Structural Concrete.
      i. 347R, Recommended Practice for Concrete Formwork.
   2. American Society for Testing and Materials (ASTM):
      a. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
      b. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (Including Supplementary Requirements S1).
      c. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
      d. C33, Standard Specification for Concrete Aggregates.
      e. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      f. C94, Standard Specification for Ready-Mixed Concrete.
      g. C138, Standard Method of Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
      h. C143, Standard Test Method for Slump of Hydraulic Cement Concrete.
      i. C150, Standard Specification for Portland Cement.
      j. C157, Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
      k. C171, Standard Specification for Sheet Materials for Curing Concrete.
      l. C172, Standard Practice for Sampling Freshly Mixed Concrete.
      m. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
      n. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
      o. C260, Standard Specification for Air Entraining Admixtures for Concrete.
      p. C289, Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).

q. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
r. C494, Standard Specification for Chemical Admixtures for Concrete.
s. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
t. D994, Standard Specification for Preformed Expansion Joint Filler for Bituminous Concrete.
u. D1056, Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber.
v. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
w. E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

3. Federal Specification (FS):
   a. CEGS 03300, Vegetable Fiber.
4. Florida Building Code, current edition.
5. Florida Department of Transportation, current edition:
   a. Index No. 272 and 273

B. Quality Control:
1. Concrete testing agency.
   a. Contractor to employ and pay for services of an independent testing laboratory to:
      1) Perform materials evaluation.
      2) Perform retests due to initial failing tests.
   b. See 3.4 "Field Quality Control" for Owner employment of testing laboratory.
   c. Concrete testing agency to meet requirements of ASTM E329 and be approved by Engineer.
2. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
   a. Approval of concrete mix design by Engineer does not relieve Contractor of his responsibility to provide concrete that meets the requirements of this Specification.
3. Adjust concrete mix designs when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
   a. Do not use revised concrete mixes until submitted to and approved by Engineer.
4. Contractor shall perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon.

C. Qualifications:
1. Ready mixed concrete batch plant certified by National Ready Mixed Concrete Association (NRMCA).
2. Formwork, shoring and reshoring for walls, slabs and beams except where cast on ground to be designed by a professional engineer currently registered in the state where the project is located.

1.3 DEFINITIONS

A. Per ACI 116R except as modified herein:
1. Concrete fill: Non-structural concrete.
2. Concrete Testing Agency: Testing agency employed to perform materials evaluation, design of concrete mixes or testing of concrete placed during construction.
3. Exposed concrete: Exposed to view after construction is complete.
4. Indicated: Indicated by Contract Documents.
5. Lean concrete: Concrete with low cement content.
6. Nonexposed concrete: Not exposed to view after construction is complete.
7. Required: Required by Contract Documents.
8. Specified strength: Specified compressive strength at 28 days.
9. Submitted: Submitted to Engineer.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Concrete mix designs proposed for use. Concrete mix design submittal to include:
      a. Sieve analysis and source of fine and coarse aggregates.
      b. Test for aggregate organic impurities.
      c. Test for deleterious aggregate per ASTM C289.
      d. Proportioning of all materials.
      e. Type of cement with mill certificate for cement.
      f. Type of fly ash with certificate of conformance to specification requirements.
      g. Slump.
      h. Air content.
      i. Brand, type, ASTM designation, and quantity of each admixture proposed for use.
      j. 28-day cylinder compressive test results of trial mixes per ACI 318 and as indicated herein.
      k. Standard deviation value for concrete production facility.
   3. Manufacturer and type of joint filler, joint sealant, curing agent and water stop.
   4. Manufacturer and type of bonding and patching mortar and bonding adhesive used at construction joints.
   5. Manufacturer and type of nonshrink grout.
   6. Reinforcing steel: Show grade, sizes, number, configuration, spacing, location and all fabrication and placement details.
      a. In sufficient detail to permit installation of reinforcing without having to make reference to Contract Drawings.
      b. Obtain approval of shop drawings by Engineer before fabrication.
      c. Mill certificates.
   7. Strength test results of newly placed concrete, including slump, air content and concrete temperature.
   8. Filterpoint Fabric-Formed Concrete:
      a. Technical data and performance
      b. Installation and panel configuration details
      c. Concrete mix design proposed for use. Refer to 1.4.A.2

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:
   1. Cement and fly ash:
      a. Store in moistureproof, weathertight enclosures.
      b. Do not use if caked or lumpy.
   2. Aggregate:
      a. Store to prevent segregation and contamination with other sizes or foreign materials.
      b. Obtain samples for testing from aggregates at point of batching.
      c. Do not use frozen or partially frozen aggregates.
      d. Do not use bottom 6 IN of stockpiles in contact with ground.
      e. Allow sand to drain until moisture content is uniform prior to use.
   3. Admixtures:
      a. Protect from contamination, evaporation, freezing, or damage.
      b. Maintain within temperature range recommended by manufacturer.
      c. Completely mix solutions and suspensions prior to use.
   4. Reinforcing steel:
      a. Support and store all rebars above ground.
   5. Filterpoint Fabric-Formed Concrete:
      a. Upon delivery, inspect the fabric and store to prevent damage or exposure to moisture or direct sunlight

B. Delivery:
   1. Concrete:
      a. Prepare a delivery ticket for each load for ready-mixed concrete.
      b. Truck operator shall hand ticket to Construction Administrator or Laboratory Technician at the time of delivery.
      c. Ticket to show:
         1) Mix identification mark.
         2) Quantity delivered.
         3) Amount of each material in batch.
         4) Outdoor temp in the shade.
         5) Time at which cement was added.
         6) Numerical sequence of the delivery.
         7) Approved amount of water (if any) added.
   2. Reinforcing steel: Ship to jobsite with attached plastic or metal tags with permanent mark numbers.
      a. Mark numbers to match shop drawing mark number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Nonshrink, nonmetallic grout:
      a. Sika "SikaGrout 212."
      b. Gifford Hill "Supreme Grout."
      c. Master Builders "Masterflow 713."
   2. Epoxy grout:
      a. Master Builders "Brutem MPG."
      b. Euclid Chemical Company, "High Strength Grout."
      c. Fosroc, "Conbextra EPHF".
   3. Expansion joint fillers:
      a. Permaglaze Co.
      b. Rubatex Corp.
      c. Williams Products, Inc.
   4. Waterstops, Preformed – Strip Type:
      a. Manufacturers:
         1) Greenstreak (Hydrotite).
         2) Adeka Ultra Seal (MC-2010M).
         3) De Neef (Swellseal Plus).
         4) Colloid Environmental Technology (Akwastop).
      b. Nonbentonite composition, hydrophilic.
      c. Solid cross section around pipe penetration.
      d. Hollow cross section at construction joints.
      e. Manufactured solely for the purpose of preventing water from traveling through construction joints.
   5. Waterstops, PVC:
      a. Greenstreak Plastic Products, Inc.
      b. W.R. Meadows, Inc.
      c. Burke Company.
   6. Form coating:
      a. Richmond "Rich Cote."
      b. Industrial Lubricants "Nox-Crete Form Coating."
      c. Protex "Pro-Cote."

7. Prefabricated forms:
   a. Simplex "Industrial Steel Frame Forms."
   b. Symons "Steel Ply."
   c. Universal "Uniform."
8. Synthetic fibers:
   a. Fibermesh.
   b. Grace Construction Products.
   c. Or approved equal.
9. Filterpoint Fabric-Formed Concrete:
   a. Fabriform®
   b. Hydrotex®
   c. Or approved equal.

2.2 MATERIALS

A. Portland Cement: Conform to ASTM C150 Type II.

B. Fly Ash:
   1. ASTM C618, Class F.
   2. Nonstaining.
      a. Hardened concrete containing fly ash to be uniform light gray color.
   3. Maximum loss on ignition: 4 percent.
   4. Compatible with other concrete ingredients.
   5. Obtain proposed fly ash from a source approved by the State Highway Department in the state where the Project is located for use in bridge concrete.

C. Admixtures:
   1. Air entraining admixtures: ASTM C260.
   2. Water reducing, retarding, and accelerating admixtures:
      a. ASTM C494 Type A through E.
      b. Conform to provisions of ACI 212.3R.
      c. Do not use retarding or accelerating admixtures unless specifically approved in writing by Engineer and at no cost to Owner.
      d. Follow manufacturer's instructions.
      e. Use chloride free admixtures only.
   3. Maximum total water soluble chloride ion content contributed from all ingredients of concrete including water, aggregates, cementitious materials and admixtures by weight percent of cement:
      a. 0.10 all concrete.
   4. Do not use calcium chloride.
   5. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.

D. Water: Potable, clean, free of oils, acids and organic matter.

E. Aggregates:
   1. Normal weight concrete: ASTM C33, except as modified below.
   2. Fine aggregate: Clean natural sand.
      a. No manufactured or artificial sand.
   3. Coarse aggregate: Crushed rock, natural gravel, or other inert granular material.
      a. Maximum amount of clay or shale particles: 1 percent.
   4. Gradation of coarse aggregate:
      a. All concrete: Size #57.

F. Concrete Grout:
   1. Nonshrink nonmetallic grout:
      a. Nonmetallic, noncorrosive, nonstaining, premixed with only water to be added.
      b. Grout to produce a positive but controlled expansion.
      c. Mass expansion not to be created by gas liberation.

d. Minimum compressive strength of nonshrink grout at 28 days: 6500 psi.

2. Epoxy grout:
   a. 3-component epoxy resin system.
      1) Two liquid epoxy components.
      2) One inert aggregate filler component.
   b. Each component packaged separately for mixing at jobsite.

G. Reinforcing Steel:
   1. Reinforcing bars: ASTM A615, Grade 60.

H. Forms:
   1. Prefabricated or job built.
   2. Wood forms:
      a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
      b. Built-in-place or prefabricated type panel.
      c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire area.
      d. When approved, plywood may be reused.
   3. Metal forms:
      a. Metal forms excluding aluminum may be used.
      b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
   4. Chamfer strips: Clear white pine, surface against concrete planed.
   5. Form ties: Removable end, permanently embedded body type with integral waterstop and cones on outer ends not requiring auxiliary spreaders.
      a. Cone diameter: 3/4 IN minimum to 1 IN maximum.
      b. Embedded portion 1 IN minimum back from concrete face.
      c. If not provided with threaded ends, constructed for breaking off ends without damage to concrete.
   6. Form release: Nonstaining and shall not prevent bonding of future finishes to concrete surface.

I. Waterstops, Pre-formed – Strip Type:
   1. Lap all types of waterstop to create water tight joints.
   2. Install on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of new concrete.
   3. Roughened joints shall be especially prepared during concrete placement to provide narrow, smooth surface for proper waterstop installation.
      a. Fill low areas under strip waterstops with a water swelling sealant recommended by waterstop manufacturer.
   4. Waterstop to be continuous with splices in accordance with manufacturer's instructions.
   5. Unless otherwise noted, use in joints against existing concrete and where indicated on Drawings.

J. Waterstops, PVC:
   1. Plastic: Corp of Engineers Specifications CRD-C572.
   2. Serrated with center bulb.
   3. Thickness: 3/8 IN.
   4. Length (general use): 6 IN unless indicated otherwise.
   5. Expansion joints:
      a. Length: 9 IN.
      b. Center bulb: 1 IN OD x ½ IN ID.
   6. Provide hog ring or grommets spaced at maximum 12 IN OC along the length of the water stop.
   7. Provide factory made waterstop fabrications at all changes of direction, intersections and transitions leaving only straight butt splices for the field.

K. Chairs, Runners, Bolsters, Spacers, and Hangers:
   1. Stainless steel, epoxy coated, or plastic coated metal.
      a. Plastic coated rebar support tips in contact with the forms only.

L. Membrane Curing Compound: ASTM C309, Type I-D.
   1. Resin based, dissipates upon exposure to UV light.
   2. Curing compound shall not prevent bonding of any future coverings, coatings or finishes.
   3. Curing compounds used in water treatment plant construction to be nontoxic and taste and odor free.

M. Expansion Joint Filler:
   1. Exterior driveways, curbs and sidewalks:
      a. Asphalt expansion joint filler.
      b. ASTM D994.
   2. Other use:
      a. Fiber expansion joint filler.
      b. ASTM D1751.

N. Synthetic Fiber Reinforcing:
   1. 100% virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured for use in concrete.
   2. Physical Characteristics:
      a. Specific gravity: 0.91.
      b. Tensile strength: 80 to 110 ksi.
      c. Modulus of Elasticity: 500 ksi.
      d. Fiber length: ¾ IN.

O. Filterpoint Fabriform:
   1. 8" filterpoint fabriform, double layer, joined in a mat configuration
   2. Fabric shall consist of 100% grade nylon yarn. Staple yarns shall not be allowed.
   3. Thickness: 4 IN

2.3 CONCRETE MIXES

A. General:
   1. All concrete to be ready mixed concrete conforming to ASTM C94 with all components and additives blended in at plant, unless otherwise approved.
   2. Provide concrete of specified quality capable of being placed without segregation and, when cured, of developing all properties required.
   3. All concrete to be normal weight concrete.
   4. Mix shall contain 1.5 lbs of fibers per cubic yard.
   5. Mix shall contain fly ash.
   6. For fabric-formed concrete lining use fluid aggregate concrete as recommended by manufacturer to allow pumpability.

B. Strength:
   1. Provide specified strength and type of concrete for each use in structure(s) as follows:

AREA	WEIGHT	SPECIFIED STRENGTH*
LCO pump pads	Normal weight	4000 psi
Fabric Formed Concrete	Normal weight	2500 psi
TPO Mitered End Section	Normal Weight	3000 psi

*Minimum 28-day compressive strength.

C. Air Entrainment: Provide air entrainment in all concrete resulting in a total air content percent by volume as follows:

MAX AGGREGATE SIZE	TOTAL AIR CONTENT PERCENT
1 IN or 3/4 IN	5% +/- 1 ½%

1. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.

D. Slump: 4 IN maximum, 1 IN minimum.
   1. Measured at point of discharge of the concrete into the concrete construction member.
   2. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
   3. Pumped concrete:
      a. Provide additional water at batch plant or at site to allow for slump loss due to pumping.
         1) For site addition, hold back water from batch plant quantity.
      b. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified above.
         1) Do not exceed approved mix design's water content.
   4. Determine slump per ASTM C143.

E. Selection of Proportions:
   1. General - Proportion ingredients to:
      a. Produce proper workability, durability, strength, and other required properties.
      b. Prevent segregation and collection of excessive free water on surface.
   2. Minimum cement contents and maximum water cement ratios for concrete to be as follows:

	TARGET CEMENT CONTENT, LB/CY		MAXIMUM WATER TO CEMENT RATIO BY WEIGHT
SPECIFIED STRENGTH	(Sacks/CY)	(Lbs/CY)	
3000	5 ½	517	0.47

   3. Fly ash:
      a. Substitute by weight of cement at rate of 1 LB fly ash for 1 LB of cement.
      b. Dosage to be between 15 and 25 percent of total cementitious product.
   4. Sand cement grout:
      a. Three parts sand.
      b. One part Portland cement.
      c. Entrained air: Six percent plus or minus one percent.
      d. Sufficient water for required workability.
      e. Minimum 28-day compressive strength: 3,000 psi.
   5. Normal weight concrete: Proportion mixture to provide desired characteristics using one of methods described below:
      a. Method 1 (Trial Mix): Per ACI 318, Chapter 5, except as modified herein.
         1) Air content within range specified above.
         2) Record and report temperature of trial mixes.
         3) Proportion trial mixes per ACI 211.1.
      b. Method 2 (Field Experience): Per ACI 318, Chapter 5, except as modified herein:
         1) Field test records must be acceptable to Engineer to use this method.
         2) Test records shall represent materials, proportions and conditions similar to those specified.
   6. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of paragraph 5.3 of ACI 318 using the standard deviation of the proposed concrete production facility as described in paragraph 5.3.1 of ACI 318.

PART 3 - EXECUTION

3.1 FORMING AND PLACING CONCRETE

A. General:
   1. Contractor is responsible for design and erection of formwork.
   2. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.
      a. Allowable tolerances: As recommended in ACI 347R.
   3. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs to drain.
      a. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform indicated depth.

B. Openings: Provide openings in formwork to accommodate work of other trades.
   1. Accurately place and securely support items built into forms.

C. Chamfer Strips: Place 3/4 IN chamfer strips in forms to produce 3/4 IN wide beveled edges on permanently exposed corners of members.

D. Reinforcement:
   1. Position, support and secure reinforcement against displacement.
   2. Locate and support with chairs, runners, bolsters, spacers and hangers, as required.
   3. Set wire ties so ends do not touch forms and are directed into concrete, not toward exposed concrete surfaces.
   4. Lap splice lengths: ACI 318 Class B top bar tension splices unless indicated otherwise on the Drawings.
   5. Extend reinforcement to within 2 IN of concrete perimeter edges.
      a. If perimeter edge is earth formed, extend reinforcement to within 3 IN of the edge.
   6. Unless otherwise indicated, provide minimum concrete cover as follows:
      a. Concrete deposited against earth: 3 IN.
      b. Formed surfaces exposed to weather or in contact with earth: 2 IN for reinforcing bars #6 or larger; 1-1/2 IN for reinforcing bars less than #6.
      c. Formed surfaces exposed to or located above any liquid: 2 IN.
      d. Interior surfaces: 1-1/2 IN for beams, girders and columns; 3/4 IN or bar diameter, whichever is greater, for slabs, walls and joists.
   7. Do not weld reinforcing bars.

E. Construction, Expansion, and Contraction Joints:
   1. Provide at locations indicated.
   2. Locate wall vertical construction joints at 35 FT maximum centers and wall horizontal construction joints at 10 FT maximum centers, unless otherwise specified.
   3. Locate construction joints in floor slabs and foundation base slabs so that concrete placements are approximately square and do not exceed 2500 SF unless otherwise specified.
   4. Locate construction joints in columns and walls:
      a. At the underside of beams, girders, haunches, drop panels, column capitals, and at floor panels.
      b. Haunches, drop panels, and column capitals are considered part of the supported floor or roof and shall be placed monolithically therewith.
      c. Column based need not be placed monolithically with the floor below.
   5. Install construction joints in beams, slabs, and girders perpendicular to the planes of their surfaces.
   6. At least 72 HRS shall elapse between placing of adjoining concrete construction.
   7. Thoroughly clean and remove all laitance, loose and foreign particles from construction joints.
   8. Before new concrete is placed, coat all construction joints with an approved bonding adhesive used and applied in accordance with manufacturer's instructions.

F. Embedments:
   1. Set and build in anchorage devices and other embedded items required for other work that is attached to, or supported by concrete.
   2. Use setting diagrams, templates and instructions for locating and setting.
   3. Secure waterstops in correct position.

G. Preparation:
   1. Clean and adjust forms prior to concrete placement.
   2. Tighten forms to prevent mortar leakage.
   3. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

H. Placing Concrete:
   1. Place concrete in compliance with ACI 304R and 304.2R.
   2. Place in a continuous operation within planned joints or sections.
   3. Begin placement when work of other trades affecting concrete is completed.
   4. Place concrete by methods which prevent aggregate segregation.
   5. Do not allow concrete to free fall more than 4 FT.
   6. Where free fall of concrete will exceed 4 FT, place concrete by means of tremie pipe or chute.

I. Consolidation:
   1. Unless otherwise noted in individual specification sections, consolidate all concrete using mechanical vibrators supplemented with hand rodding and tamping, so that concrete is worked around reinforcement and embedded items into all parts of forms.

J. Protection:
   1. Protect concrete from physical damage or reduced strength due to weather extremes.
   2. In cold weather comply with ACI 306R except as modified herein.
      a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice or snow.
      b. Minimum concrete temperature at the time of mixing:

OUTDOOR TEMPERATURE AT PLACEMENT (IN SHADE)	CONCRETE TEMPERATURE AT MIXING
Below 30 DegF	70 DegF
Between 30-45 DegF	60 DegF
Above 45 DegF	50 DegF

      c. Do not place heated concrete that is warmer than 80 DegF.
      d. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50 DegF for 7 days or 70 DegF for 3 days.
      e. Do not allow concrete to cool suddenly.
   3. In hot weather comply with ACI 305R except as modified herein.
      a. At air temperature of 90 DegF and above, keep concrete as cool as possible during placement and curing.
      b. Do not allow concrete temperature to exceed 90 DegF at placement.
      c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
      d. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 LBS/SF/HR as determined from ACI 305R, Figure 2.1.5.

K. Curing:
   1. Begin curing concrete as soon as free water has disappeared from exposed surfaces.
   2. Cure concrete by use of moisture retaining cover or by burlap kept continuously wet.
   3. Provide protection as required to prevent damage to concrete and to prevent moisture loss from concrete during curing period.
   4. Provide curing for minimum of 7 days.
   5. Form materials left in place may be considered as curing materials for surfaces in contact with the form materials except in periods of hot weather.

6. In hot weather follow curing procedures outlined in ACI 305R.
7. In cold weather follow curing procedures outlined in ACI 306R.
8. If forms are removed before 7 days have elapsed, finish curing of formed surfaces by one of above methods or by membrane curing compound for the remainder of the curing period.
9. Curing vertical surfaces with a curing compound: Cover vertical surfaces with a minimum of two coats of the curing compound.
    a. Allow the preceding coat to completely dry prior to applying the next coat.
    b. Apply the first coat of curing compound immediately after form removal.
    c. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
    d. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.

L. Form Removal:
1. Remove forms after concrete has hardened sufficiently to resist damage from removal operations or lack of support.
2. Where no reshoring is planned, leave forms and shoring used to support concrete until it has reached its specified 28-day compressive strength.

M. Fabric-Formed Concrete Lining:
1. Surfaces to be protected shall be prepared and graded before placing mat.
2. Prior to aggregate concrete injection, the dual wall fabric shall be positioned over a geotextile fabric as shown on the Contract Drawings.
3. Anchor mat as shown on the Contract Drawings.
4. Provide adequate allowance for contraction of the fabric as a result of aggregate concrete injection.
5. Panels of fabric may be factory assembled in predetermined sizes and joined together in the field by sewing or zipper closures attached to the upper and lower layers of the fabric.
6. If joining of panels is impractical, overlap fabric a minimum of two feet. In no case will simple butt joints between panels will be allowed.
7. Adjacent fabric panels shall be joined, before fine aggregate concrete injection.
8. The panels will be laid out with the mill widths running perpendicular to the slopes.
9. Concrete injection:
    a. Contractor responsible to insure concrete pumping equipment is capable of reaching mat locations
    b. Fine aggregate concrete shall be injected between the top and bottom layers of fabric through small slit cut in the upper layer of fabric.
    c. Wrap tightly injection pipe at point of injection and use burlap to minimize spillage.
    d. Insure complete filling of the revetment-forming fabric to the thickness specified by the manufacturer.

3.2 CONCRETE FINISHES

A. Tolerances:
1. Class B: 1/4 IN in 10 FT for all work.

B. Surfaces Exposed to View:
1. Provide a smooth finish for exposed concrete surfaces and surfaces that are to be covered with a coating or covering material applied directly to concrete.
2. Remove fins and projections, and patch voids, air pockets, and honeycomb areas with matching color cement grout.
3. Fill tie holes with nonshrink nonmetallic grout.

C. Surfaces Not Exposed to View:
1. Patch voids, air pockets and honeycomb areas with matching color cement grout.
2. Fill tie holes with nonshrink nonmetallic grout.

D. Slab Floated Finish:
1. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.

2. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operation.
3. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two different angles.
4. Cut down all high spots and fill all low spots during this procedure to produce a surface within Class B tolerance throughout.
5. Refloat slab immediately to a uniform sandy texture.

E. Broom Finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom across surface.

3.3 GROUT

A. Preparation:
1. Nonshrinking nonmetallic grout:
   a. Clean concrete surface to receive grout.
   b. Saturate concrete with water for 24 HRS prior to grouting.
2. Epoxy grout: Apply only to clean, dry, sound surface.

B. Application:
1. Nonshrinking nonmetallic grout:
   a. Mix in a mechanical mixer.
   b. Use no more water than necessary to produce flowable grout.
   c. Place in accordance with manufacturer's instructions.
   d. Completely fill all spaces and cavities below the bottom of baseplates.
   e. Provide forms where baseplates and bedplates do not confine grout.
   f. Where exposed to view, finish grout edges smooth.
   g. Do not extend grout above bottom of plate.
   h. Slope and finish edges flush at the baseplate, bedplate, member, or piece of equipment.
   i. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets.
   j. Wet cure grout for 7 days, minimum.
2. Epoxy grout:
   a. Mix and place in accordance with manufacturer's instructions.
   b. Completely fill all cavities and spaces around dowels and anchors without voids.
   c. Obtain manufacturer's field technical assistance as required to ensure proper placement.

3.4 FIELD QUALITY CONTROL

A. Contractor will employ and pay for services of a concrete testing laboratory to perform testing of concrete placed during construction.
1. Contractor to provide Owner with test results as soon as results are available.

B. Tests During Construction:
1. Strength test - procedure:
   a. Four cylinders, 6 IN DIA x 12 IN high, will be taken from each sample per ASTM C172 and C31.
   b. Cylinders will be tested per ASTM C39:
      1) One at 7 days.
      2) Two at 28 days.
      3) One held in reserve.
2. Strength test - frequency:
   a. Not less than one test each day concrete placed.
   b. Not less than one test for each 50 CY or major fraction thereof placed in one day.
   c. Not less than one test for each type of concrete poured.
   d. Not less than one test for each concrete structure exceeding 2 CY volume.
   e. Not less than one test for each delivery where water addition has been approved at the jobsite.
3. Slump test: Per ASTM C143.
   a. Determined for each strength test sample.

b. Additional slump tests may be taken.
4. Air content: Per ASTM C231, C173, and C138.
   a. Determined for each strength test sample.
5. Temperature: Determined for each strength test sample.

C. Evaluation of Tests:
1. Strength test results: Average of 28-day strength of two cylinders from each sample.
   a. If one cylinder manifests evidence of improper sampling, molding, handling, curing or testings, strength of remaining cylinder will be test result.
   b. If both cylinders show any of above defects, test will be discarded.

D. Acceptance of Concrete:
1. Strength level of each type of concrete shall be considered satisfactory if both of the following requirements are met:
   a. Average of all sets of three consecutive strength tests equals or exceeds the required specified 28-day compressive strength.
   b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.
2. If tests fail to indicate satisfactory strength level, perform additional tests and/or corrective measures as directed by Engineer.
   a. Perform additional tests and/or corrective measures at no additional cost to Owner.

E. Fabric formed concrete lining:
1. Foot traffic will not be permitted on the freshly pumped mat. Walk boards shall be used where necessary.
2. Excessive fine aggregate concrete which has been inadvertently spilled on the mat surface shall be cleaned up with a broom and shovel.
3. Use of water hose to remove spilled fine aggregate concrete from the surface of a freshly pumped mat will not be permitted.

3.5 SCHEDULES

A. Form Types:
1. Surfaces exposed to view:
   a. Prefabricated or job-built wood forms.
   b. Laid out in a regular and uniform pattern with long dimensions vertical and joints aligned.
   c. Produce finished surfaces free from offsets, ridges, waves, and concave or convex areas.
   d. Construct forms sufficiently tight to prevent leakage of mortar.
2. Surfaces not normally exposed to view:
   a. Wood or steel forms sufficiently tight to prevent leakage of mortar.

B. Grout:
1. Nonshrinking nonmetallic grout: General use.
2. Epoxy grout:
   a. Grouting of dowels and anchor bolts into existing concrete.
   b. Other uses indicated on Drawings.

C. Concrete:
1. Normal weight concrete: All locations.

D. Concrete Finishes:
1. Broom finish: Sidewalks and other exterior surfaces subject to foot traffic .
2. Exposed to view: All walls and exposed vertical edges.
3. Floated finish: All other locations.

END OF SECTION

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SECTION 10400
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items, and hazard and safety signs.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.

C. The Contractor is instructed to review the existing identification devices currently used at the CCSWDC and match the type and format of the existing identification systems to the best of their ability. This specification provides general guidelines for materials.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. A13.1, Scheme for Identification of Piping Systems.
      b. Z535.1, Safety Color Code.
      c. Z535.2, Environmental and Facility Safety Signs.
      d. Z535.3, Criteria for Safety Symbols.
      e. Z535.4, Product Safety Signs and Labels.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Occupational, Health and Safety Administration (OSHA):
      a. 1910.145, Specification for Accident Prevention Signs and Tags.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data:
      a. Catalog information for all identification systems.
      b. Acknowledgement that products submitted meet requirements of standards referenced.
   3. Identification register, listing all items in Part 3 to be identified, type of identification system to be used, lettering, location and color.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. W.H. Brady Co.
   2. Panduit.
   3. Seton.
   4. National Band and Tag Co.
   5. Carlton Industries, Inc.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MANUFACTURED UNITS

A. Type A1 - Round Metal Tags:
   1. Materials: Aluminum or stainless steel. Stainless steel shall be used in corrosive environments.
   2. Size:
      a. Diameter: 1-1/2 IN minimum.
      b. Thickness: 0.035 IN (20 gage) minimum.
   3. Fabrication:
      a. 3/16 IN minimum mounting hole.
      b. Legend stamped and filled with black coloring.
   4. Color: Natural.

B. Type A2 - Rectangle Metal Tags:
   1. Materials: Stainless steel.
   2. Size:
      a. 3-1/2 IN x 1-1/2 IN minimum.
      b. Thickness: 0.036 IN (20 gage) minimum.
   3. Fabrication:
      a. 3/16 IN minimum mounting hole.
      b. Legend stamped and filled with black coloring.
   4. Color: Natural.

C. Type A3 - Metal Tape Tags:
   1. Materials: Aluminum or stainless steel.
   2. Size:
      a. Width 1/2 IN minimum.
      b. Length as required by text.
   3. Fabrication:
      a. 3/16 IN minimum mounting hole.
      b. Legend Embossed.
   4. Color: Natural.

D. Type B1- Square Non-Metallic Tags:
   1. Materials: Fiberglass reinforced plastic.
   2. Size:
      a. Surface: 2 x 2 IN minimum.
      b. Thickness: 100 mils.
   3. Fabrication:
      a. 3/16 IN mounting hole with metal eyelet.
      b. Legend preprinted and permanently embedded and fade resistant.
   4. Color:
      a. Background: Manufacturer standard or as specified.
      b. Lettering: Black.

E. Type B2 - Non-Metallic Signs:
   1. Materials: Fiberglass reinforced or durable plastic.
   2. Size:
      a. Surface: As required by text.
      b. Thickness: 60 mils minimum.
   3. Fabrication:
      a. Rounded corners.
      b. Drilled holes in corners with grommets.
      c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
   4. Color:
      a. Background: Manufacturer standard or as specified.
      b. Lettering: Black.

5. Standards for OSHA signs: ANSI Z535.1, Z535.2, Z535.3, Z535.4, OSHA 1910.145.

F. Type C - Phenolic Name Plates:
1. Materials: Phenolic.
2. Size:
   a. Surface: As required by text.
   b. Thickness: 1/16 IN.
3. Fabrication:
   a. Two layers laminated.
   b. Legend engraved through top lamination into bottom lamination.
   c. Two drilled side holes, for screw mounting.
4. Color: Black top surface, white core, unless otherwise indicated.

G. Type D - Self-Adhesive Tape Tags and Signs:
1. Materials: Vinyl tape or vinyl cloth.
2. Size:
   a. Surface: As required by text.
   b. Thickness: 5 mils minimum.
3. Fabrication:
   a. Indoor/Outdoor grade.
   b. Weather and UV resistant inks.
   c. Permanent adhesive.
   d. Preprinted legend.
   e. Wire markers to be self-laminating.
4. Color: White with black lettering or as specified.
5. Standards for OSHA signs: ANSI Z535.1, Z535.2, Z535.3, Z535.4, OSHA 1910.145.

H. Type E - Heat Shrinkable Tape Tags:
1. Materials: Polyolefin.
2. Size: As required by text.
3. Fabrication: Legend preprinted.
4. Color: White background, black printing.

I. Type F - Underground Warning Tape:
1. Materials: Polyethylene.
2. Size:
   a. 6 IN wide (minimum).
   b. Thickness: 3.5 mils.
3. Fabrication:
   a. Legend: Preprinted and permanently imbedded.
   b. Message continuous printed.
   c. Tensile strength: 1750 psi.
4. Color: As specified.

J. Type G - Stenciling System:
1. Materials:
   a. Exterior type stenciling enamel.
   b. Either brushing grade or pressurized spray can form and grade.
2. Size: As required.
3. Fabrication: Legend as required.
4. Color: Black or white for best contrast.

2.3 ACCESSORIES

A. Fasteners:
1. Bead chain: #6 brass, aluminum or stainless steel.
2. Plastic strap: Nylon, urethane or polypropylene.
3. Screws: Self-tapping, stainless steel.
4. Adhesive, solvent activated.

2.4 MAINTENANCE MATERIALS

A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install identification devices at specified locations.

B. All identification devices to be printed by mechanical process, hand printing is not acceptable.

C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.

D. Attach tags with 1/8 IN round or flat head screws to equipment without sufficient surface or body area, or porous surfaces. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.

E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing. Several items of equipment mounted in housing to be individually tagged inside the compartment.

3.2 SCHEDULES

A. Process Systems:
   1. General:
      a. Provide arrows and markers on piping.
         1) At 20 FT maximum centers along continuous lines.
         2) At changes in direction (route) or obstructions.
         3) At valves, risers, "T" joints, machinery or equipment.
         4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
      b. Position markers on both sides of pipe with arrow markers pointing in flow direction. If flow is in both directions use double headed arrow markers.
      c. Apply tapes and stenciling in uniform manner parallel to piping.
   2. Trenches with piping:
      a. Tag type: Type F - Underground Warning Tape
      b. Location: Halfway between top of piping and finished grade.
      c. Letter height: 1-1/4 IN minimum.
      d. Natural gas or digester gas:
         1) Color: Yellow with black letters.
         2) Legend:
            a) First line: "CAUTION CAUTION CAUTION"
            b) Second line: "BURIED GAS LINE BELOW"
      e. Potable Water:
         1) Color: Blue with black letters.
         2) Legend:
            a) First line: "CAUTION CAUTION CAUTION"
            b) Second line: "BURIED WATER LINE BELOW"
      f. Storm and sanitary sewer lines:
         1) Color: Green with black letters.
         2) Legend:
            a) First line: "CAUTION CAUTION CAUTION"
            b) Second line: "BURIED SEWER LINE BELOW"
      g. (Non-potable) water piping, except 3 IN and smaller irrigation pipe:
         1) Color: Green with black letters.

2) Legend:
   a) First line: "CAUTION CAUTION CAUTION"
   b) Second line: "BURIED NON-POTABLE WATER LINE BELOW"

h. Chemical feed piping (e.g., chlorine solution, polymer solution, caustic solution, etc.):
   1) Color: Yellow with black letters.
   2) Legend:
      a) First line: "CAUTION CAUTION CAUTION"
      b) Second line: "BURIED CHEMICAL LINE BELOW"

i. Other piping (e.g., compressed air, irrigation, refrigerant, heating water, leachate, etc.):
   1) Color: Yellow with black letters.
   2) Legend:
      a) First line: "CAUTION CAUTION CAUTION"
      b) Second line: "BURIED PIPE LINE BELOW"

3. Yard valves, buried, with valve box and concrete pad:
   a. Tag type: Type A2 - Rectangle Metal Tags.
   b. Fastener: 3/16 IN x 7/8 IN plastic screw anchor with 1 IN #6 stainless steel pan head screw.
   c. Legend:
      1) Letter height: 1/4 IN minimum.
      2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
4. Valves and slide gates:
   a. Tag type:
      1) Outdoor locations: Type B1 - Square Non-Metallic Tags.
      2) Indoor non-corrosive:
         a) Type A1 - Round Metal Tags.
         b) Type B1 - Square Non-Metallic Tags.
      3) Indoor corrosive:
         a) Stainless steel Type A1 - Round Metal Tags.
         b) Type B1 - Square Non-Metallic Tags.
   b. Fastener:
      1) Type A1: Chain of the same material.
      2) Type B1: Stainless steel chain.
   c. Color: Per ANSI A13.1 corresponding to the piping system.
   d. Legend:
      1) Letter height: 1/4 IN minimum.
      2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
5. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):
   a. Tag type:
      1) Type B2 - Non-Metallic Signs.
      2) Type D - Self-Adhesive Tape Tags and Signs.
      3) Type G - Stenciling System.
   b. Fastener:
      1) Self.
      2) Screws.
      3) Adhesive.
   c. Legend:
      1) Letter height: 1/2 IN minimum.
      2) Equipment designation as indicated on the Drawings (e.g., "Primary Sludge Pump P-xxx").
6. Piping systems:
   a. Tag type:
      1) Outdoor locations: Type G - Stenciling System.
      2) Indoor locations:
         a) Type D - Self-Adhesive Tape Tags and Signs.
         b) Type G - Stenciling System.

b. Fastener: Self.
c. Color: Per ANSI A13.1.
d. Legend:
1) Letter height: Manufacturers standard for the pipe diameter.
2) Mark piping in accordance with ANSI A13.1.
3) Use piping designation as indicated on The Drawings.
4) Arrow: Single arrow.

B. Electrical Systems:
1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
a. Tag type: Type F - Underground Warning Tape.
b. Letter height: 1-1/4 IN minimum.
c. Location:
1) Where trench is 12 IN or more below finished grade: In trench 6 IN below finished grade.
2) Where trench is less than 12 IN below finished grade: In trench 3 IN below finished grade.
d. Electrical Power (e.g., low and medium voltage):
1) Color: Red with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION".
b) Second line: "BURIED ELECTRIC LINE BELOW".
e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
1) Color: Orange with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION".
b) Second line: "BURIED COMMUNICATION LINE BELOW".
2. Switchgear, switchboards and motor control centers:
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Main equipment legend:
1) Letter height:
a) First line: 1 IN minimum.
b) Subsequent lines: 3/8 IN minimum.
2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
3) Second line: Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx"). The source of power room number is only required when there are multiple electrical rooms, if the source is in another building, the building name or number shall be used.
4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
d. Main and feeder device legend:
1) Letter height: 3/8 IN minimum.
2) Description of load (e.g., "MAIN DISCONNECT", "PUMP Pxxx" or "PANELBOARD HPxxx").
3. Panelboards and transformers:
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height:
a) First line: 3/8 IN minimum.
b) Subsequent lines: 3/16 IN minimum.
2) First line: Equipment name (e.g., "PANELBOARD LPxxx" or "TRANSFORMER Txxx").
3) Second line (panelboards only): System voltage and phase (e.g., "208/120V, 3PH").

4. Transfer switches:
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height:
         a) First line: 3/8 IN minimum.
         b) Subsequent lines: 3/16 IN minimum.
      2) First line: Equipment name (e.g., "AUTOMATIC TRANSFER SWITCH ATSxxx").
5. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/4 IN minimum.
      2) First line: Description of load equipment is connected to (e.g., "PUMP Pxxx").
6. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/2 IN minimum.
      2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCPxxx").
7. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
   a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 3/16 IN minimum.
      2) Description or function of component (e.g., "M-xxx", "CR-xxx" or "TR-xxx").
8. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/4 IN minimum.
      2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
9. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
   a. Tag type: Type D - Self-Adhesive Tape Tags.
   b. Fastener: Self.
   c. Tag conductor at both ends.
   d. Legend:
      1) Letter height: 1/8 IN minimum.
      2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.
10. Conductors in handholes and manholes.
   a. Tag type: Type A3 - Metal Tape Tags.
   b. Fastener: Nylon strap.
   c. Tag conductor at both ends.
   d. Legend:
      1) Letter height: 1/8 IN minimum.
      2) Circuit number or wire number as scheduled on the Drawings.
11. Grounding conductors associated with grounding electrode system in accordance with the following:
   a. Tag type: Type D - Self-Adhesive Tape Tags.
   b. Fastener: Self.
   c. Legend:

1) Letter height: 1/8 IN minimum.
2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").

12. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:
    a. Tag type: Type D - Self-Adhesive Tape Signs.
    b. Fastener: Self.
    c. Legend: Per NFPA 70.

13. Entrances to electrical rooms:
    a. Tag type: Type B2 - Non-Metallic Signs.
    b. Fastener: Screw or adhesive.
    c. Size: 5 IN x 7 IN.
    d. Location: Each door to room.
    e. Legend:
        1) OSHA Danger Sign.
        2) Description of Danger: "HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY".

14. Equipment where more than one voltage source is present:
    a. Tag type:
        1) Type B2 - Non-Metallic Signs.
        2) Type D - Self-Adhesive Tape Signs.
    b. Fastener:
        1) Screw or adhesive.
        2) Self.
    c. Size: 1-3/4 IN x 2-1/2 IN.
    d. Location: Exterior face of enclosure or cubical.
    e. Legend:
        1) OSHA Danger Sign.
        2) Description of Danger: "MULTIPLE VOLTAGE SOURCES".

3.3 HAZARD AND SAFETY SIGNS

A. Provide hazard signs for each valve pit.
    1. Type B, D, or G as appropriate.
    2. Description of Danger: "CAUTION. CONFINED SPACE. HAZARDOUS ATMOSPHERE, ENTER BY PERMIT ONLY".

B. Provide 10 additional Hazard and Safety Signs:
    1. Type as directed by Owner.
    2. Inscription as directed by Owner.

END OF SECTION

SECTION 11005
EQUIPMENT: BASIC REQUIREMENTS.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements of this Section apply to all equipment provided on the Project including that found in Divisions 11 and 15 even if not specifically referenced in individual "Equipment" articles of those Specifications.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Gear Manufacturers Association (AGMA).
   3. ASTM International (ASTM):
      a. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   4. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910, OSHA Safety and Health Standards for General Industry (referred to herein as OSHA standards).

B. Miscellaneous:
   1. A single manufacturer of a "product" to be selected and utilized uniformly throughout Project even though:
      a. More than one manufacturer is listed for a given "product" in Specifications.
      b. No manufacturer is listed.

1.3 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:
   1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater, or:
   2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater, or:
   3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.

C. Equipment: One or more assemblies capable of performing a complete function. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection. Not limited to items listed under "Equipment" article within specifications.

D. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   1. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. General for all equipment:
      a. Data sheets that include manufacturer's name and complete product model number. Clearly identify all optional accessories that are included.
      b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
      c. Manufacturer's delivery, storage, handling, and installation instructions.

d. Equipment identification utilizing numbering system and name utilized in Drawings.
e. Equipment installation details:
    1) Location of anchorage.
    2) Type, size, and materials of construction of anchorage.
    3) Anchorage setting templates.
    4) Manufacturer's installation instructions.
f. Equipment area classification rating.
g. Shipping and operating weight.
h. Equipment physical characteristics:
    1) Dimensions (both horizontal and vertical).
    2) Materials of construction and construction details.
i. Equipment factory primer and paint data.
j. Manufacturer's recommended spare parts list.
k. Equipment lining and coatings.
l. Equipment utility requirements include air, natural gas, electricity, and water.
m. Ladders and platforms provided with equipment:
    1) Certification that all components comply fully with OSHA requirements.
    2) Full details of construction/fabrication.
    3) Scaled plan and sections showing relationship to equipment.

2. Mechanical and process equipment:
    a. Operating characteristics:
        1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
        2) Brake horsepower requirements.
        3) Copies of equipment data plates.
    b. Piping and duct connection size, type and location.
    c. Equipment bearing life certification.
    d. Equipment foundation data:
        1) Equipment center of gravity.
        2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
3. Electrical and control equipment:
    a. Electric motor information:
        1) Documentation that motors provided are manufacturer's energy efficient type and not standard efficiency motors.
            a) When standard efficiency motors are submitted, provide documentation why energy efficient motors are not available.
        2) Nameplate data as required by the NEC.
            a) Manufacturer's name.
            b) Rated voltage.
            c) Full load current.
            d) Rated frequency.
            e) Number of phases.
            f) Rated full load speed.
            g) Insulation system class and rated ambient temperature or rated temperature rise.
            h) Time rating: 5, 15, 30 or 60 minutes or continuous.
            i) Rated HP.
            j) Code letter or locked rotor current.
            k) NEMA design letter.
            l) Marked "Thermally Protected" where applicable.
        3) Motor service factor.
        4) Motor enclosure type.
        5) NEMA frame size.
        6) NEMA design code.
        7) Insulation type and temperature rise.

8) Motor locked rotor current.
9) Current, efficiency and power factor at 1/2, 3/4 and full load.

b. Electrical gear:
1) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.

c. Control panels:
1) Panel construction.
2) Point-to-point ladder diagrams.
3) Scaled panel face and subpanel layout.
4) Technical product data on panel components.
5) Panel and subpanel dimensions and weights.
6) Panel access openings.
7) Nameplate schedule.
8) Panel anchorage.

4. Year 2000 compliant equipment and software.
a. Certification that equipment and software is year 2000 compliant.

5. Systems schematics and data:
a. Provide system schematics where required in system specifications.
1) Acknowledge all system components being supplied as part of the system.
2) Utilize equipment, instrument and valving tag numbers defined in the contract documents for all components.
3) Provide technical data for each system component showing compliance with the Contract Document requirements.
4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.

6. For factory painted equipment, provide paint submittals.

B. Operation and Maintenance Manuals.

C. Miscellaneous Submittals:
1. Sample form letter for equipment field certification.
2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
4. Field noise testing reports if such testing is specified in narrow scope sections.
5. Field vibration testing reports if vibration testing is specified in narrow scope sections.
6. Notification, at least 1 week in advance, that motor testing will be conducted at factory.
7. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
8. Motor test reports.
9. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Motors:
a. Baldor.
b. General Electric.

c. Marathon Electric.
d. Reliance Electric.
e. Siemens.
f. Teco-Westinghouse.
g. U.S. Motors.
h. Franklin.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 MANUFACTURED UNITS

A. General:
1. Furnished equipment manufacturer's field quality control services and testing as specified in the individual equipment Specifications.
2. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
3. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
   a. Contract Drawings and Specifications.
   b. Related construction change documentation.
   c. Approved Shop Drawings.
   d. Approved Operation and Maintenance Manuals.
   e. Other pertinent information as required.

B. Equipment Monitoring and Testing Plans:
1. Approved in accordance with Shop Drawing submittal schedule.
2. Included as a minimum:
   a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
   b. List and description of testing and analysis equipment to be utilized.
   c. List of all equipment to be testing, including:
      1) Name and tag numbers identified in the Contract Documents.
      2) Manufacturer's serial numbers.
      3) Other pertinent manufacturer identification,

C. Instruments Used in Equipment and Connections Quality Control Testing:
1. Minimum calibration frequency:
   a. Field analog instruments: Not more than 6 months.
   b. Field digital instruments: Not more than 12 months.
   c. Laboratory instruments: Not more than 12 months.
   d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.

2.3 ACCESSORIES

A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
2. Interior applications:
   a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
   b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
   c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
3. Exterior applications:
   a. Construct from 16 GA stainless steel or aluminum.
   b. Construct to preclude entrance of rain, snow, or moisture.
   c. Roll to conform to shaft or coupling surface.
   d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:
   1. Cast-in-place anchorage:
      a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
      b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
      c. Provide two nuts for each bolt.
   2. Drilled anchorage:
      a. Threaded rods same as cast-in-place.

C. Data Plate:
   1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
   2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

D. Gages:
   1. Provide at the following locations:
      a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and process equipment.
      b. At locations identified on Drawings.
   2. Utilize tapping sleeves for mounting.

E. Lifting Eye Bolts or Lugs:
   1. Provide on all equipment 50 LBS or greater.
   2. Provide on other equipment or products as specified in the narrow specifications.

F. Platforms and Ladders:
   1. Design and fabricate in accordance with OSHA standards.
   2. Fabricate components from stainless steel grade 316.
   3. Provide platform surface: Non-skid grating, unless specified in narrow scope specification.

2.4 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option. Provide drain connection for 3/4 IN PVC tubing.

G. Machine the mounting feet of rotating equipment.

H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that can not be properly prepared and painted. When such back to back fabrication can not be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment.

2.5 SHOP OR FACTORY PAINT FINISHES

A. General Equipment:
   1. Provide factory-applied paint coating system(s) for all equipment components.

2.6 SOURCE QUALITY CONTROL

A. Motor Tests:
   1. Test motors in accordance with NEMA and IEEE standards.
   2. Provide routine test for all motors.
   3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
      a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
      b. The Contractor shall pay all costs, including shipping and handling, for all motors failing the tests.
      c. If two successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Utilize templates for anchorage placement for slab-mounted equipment.

C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain. Route clear of major traffic areas and as approved by Engineer.

D. DO NOT construct foundations until major equipment supports are approved.

E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings.

F. Construct subbases, either concrete, steel or cast iron, level in both directions. Particular care shall be taken at hold-down bolt locations so these areas are flat and level.

G. Machine Base:
   1. Mount machine bases of rotating equipment on subbases in manner that they are level in both directions according to machined surfaces on base. Use machinist level for this procedure.
   2. Level machine bases on subbases and align couplings between driver and driven unit using steel blocks and shims.
      a. Size blocks and shims to provide solid support at each anchor bolt location. Area size of blocks and shims shall be approximately 1-1/2 times area support surface at each anchor bolt point.
      b. Provide blocks and shims at each anchor bolt. Blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.
      c. After all leveling and alignment has been completed and before grouting, tighten anchor bolts to proper torque value.
      d. Do not use nuts below the machine base on anchor bolts for base leveling.

H. Couplings:
   1. Align in the annular and parallel positions.
      a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
      b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
   2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.

3. Check surfaces for runout before attempting to trim or align units.

I. Grouting:
   1. After machine base has been shimmed, leveled, couplings aligned and anchor bolts tightened to correct torque value, a dam or formwork shall be placed around base to contain grouting. Extend dam or formwork at least 1/2 IN above the top of leveling shims and blocks.
   2. Saturate top of roughened concrete subbase with water before grouting. Add grout until entire space under machine base is filled to the top of the base underside. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
   3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout. When the grout has fully hardened (after a minimum of 7 days) tighten all anchor bolts and recheck driver-driven unit for proper alignment.

3.2 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation. In each case, representative(s) shall be present during placement and startup of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
   1. Has been properly installed and lubricated.
   2. Is in accurate alignment.
   3. Is free from any undue stress imposed by connecting piping or anchor bolts.
   4. Has been operated under full load conditions and that it operated satisfactorily. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks. All or any time expended during installation check does not qualify as O&M training or instruction time when specified.

3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

A. Identify equipment and install hazard warning signs.

3.4 FIELD QUALITY CONTROL

A. Furnish equipment manufacturer services as specified in the individual equipment specifications.

B. Inspect wire and connections for physical damage and proper connection.

END OF SECTION

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SECTION 11059
LANDFILL GAS CONDENSATE SUMP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Construction and installation of landfill gas condensate sump.

B. Related Sections include but are not necessarily limited to:
   1. Section 11070 – Pumping Equipment: Pneumatic.
   2. Section 15060 – Pipe and Pipe Fittings: Basic Requirements.
   3. Section 15067 – Pipe: Polyethylene

C. Install the condensate sump in-line with the landfill gas header. The contractor may order the sump vault, pump, inlet line, level detector, pipe and fittings as combined package. Inlet line and level detectors shall be installed to maintain the level of condensate in the sump a maximum depth of not less than 6 inches below the lowest horizontal pipe invert.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM)
      a. D3350, Standard Specification for Polyethylene Plastics Pipes and Fittings Materials.

B. Qualifications:
   1. Supplied equipment in reference to this section shall have been proven in landfill type environment for no less than 2 years.
   2. A minimum of three references from landfill operators/owners must be provided for the equipment selected by the Contractor as a condition of approval by the Engineer.

C. Miscellaneous:
   1. Contractor's Health and Safety Plan.

1.3 SUBMITTALS

A. See Section 01340.

B. The Contractor shall submit the following documents to the Engineer for approval prior to constructing, assembling, or installing the sumps.
   1. The Manufacturer's installation procedures.
   2. Warranty Information.
   3. Drawings and specifications provided by the condensate pump Manufacturer.
   4. Operations and Maintenance (O&M) Manual.
   5. Air consumption, air pressure, and condensate flow rate curves.
   6. Factory test results.

C. Shop Drawings:
   1. Provide a list of materials of construction, including seals;
   2. Show detailed dimensions on drawings;
   3. Provide equipment foundation plan;
   4. Provide control panel drawings;
   5. Provide overall dimensions and clearance for selection of hatch opening.

D. A piping and instrumentation diagram showing the workings of the automatic pump system.

E. As-Built survey shall include sump location with northing and easting coordinates in the state plane coordinate system. Inlet and outlet invert elevations shall be included in survey and cover soil elevation above the invert survey points.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers of condensate sumps are acceptable:
   1. Landtec Landfill Control Technologies.
   2. EZ Products.
   3. Isco Industries
   4. Contractor fabrication allowed with approval of shop drawing.
   5. Approved Equal

B. Submit requests for substitution to Engineer in accordance with Section 01640.

2.2 MATERIALS

A. General:
   1. Landfill gas condensate sump shall be packaged type system and completely prefabricated prior to site delivery.
   2. All bolts, washers, nuts, screws, and steel tubing used in the construction and/or installation of the sump shall be zinc plated.
   3. Flange adapters provided with ductile iron backup ring.
   4. Backfill material shall be as specified by Section 02200.

B. Sump:
   1. Constructed of SDR 17 HDPE.
   2. Shall be liquid and gas tight and able to withstand a positive pressure of 5 psig for 8 hours.
   3. Sump shall contain sufficient volume to contain settling solids without impeding the operations of the pump.
   4. Provide separate 6-IN fabricated in-place (FIP) vacuum tight opening for pump installation compatible with system function as shown in the drawings.

C. Compressed Air Supply:
   1. Compressed air fittings shall be 1/4 IN NPT.
   2. Shall include Filter, Lubricator, Regulator, (FLR) meeting the requirements of the pump manufacturer.
   3. Compressed air system shall be rated for 150 psig.
   4. Contractor is responsible for calibrating and supplying oil for the filter, lubricator, and regulator.
   5. Compressed air lines within vault shall be ¼ IN stainless steel pipe.

D. Level Control:
   1. Floatless pneumatic level control, mechanical floats with pneumatic level switch, or Engineer approved equal.
   2. All materials shall be stainless steel.
   3. Pressure range of 40-100 psig.
   4. Temperature Range 35 – 200 Deg F.

E. Pumps:
   1. See Section 11070.

F. Filter:
   1. All compressed air entering the liquid pump system shall be dried and filtered prior to use in the instruments or pump.
   2. A 5-micron filter shall be used for removing particulates, oils and water.

3. A manual drain valve shall be mounted on the bottom of the bowl.
4. The filter shall be rated for a minimum inlet pressure of 150 psig.
5. The filter shall be located upstream of the air pressure regulator.

G. Compressed Air Pressure Regulator:
1. The compressed air pressure regulator shall be installed immediately downstream of the air filter. The regulator shall have an inlet pressure range and an outlet pressure range compatible with existing pneumatic pumps.
2. The regulator shall have a removable valve seat that can be removed without disassembling the regulator from the piping.
3. The regulator shall have an internal pressure relief port.

H. Air Relay:
1. A pilot operated pressure regulator located downstream of the pressure regulator shall be used for the air relay.
2. The air relay shall handle supply pressure to 150 psig.

I. Connections:
1. The compressed air connection to the system shall be rated for the maximum relief valve pressure setting of the compressed air system or 150 psig, whichever is greater.
2. All materials used in the pressure liquid discharge line shall be rated for 100 psig pressure with a safety factor of 3 (F.S.=3).
3. A 1 inch diameter HDPE-stainless steel transition fitting shall be welded to the 1 inch diameter liquid inlet to the sump.

J. Hardware:
1. All flange bolts and nuts for pump and pump control panel are to be Type 316 stainless steel. Hardware for condensate sump to be zinc plated, flange adapter with ductile iron backup ring.

K. Backfill Material
1. Material free of organic materials shall be used for backfill around the condensate liquid sump where indicated on the plans and in these specifications.
2. At a minimum, soil backfill and cover shall meet the engineering requirements for the site and shall be approved by the Engineer. In addition, soil backfill shall not have any large stones or other foreign materials present. Care shall be taken that the materials adjacent to the condensate sump are fine graded and that no objects are present that could damage the sump.

2.3 SOURCE QUALITY CONTROL

A. Factory Test:
1. The condensate sump system shall be pressure tested for leaks prior to delivery on site. A leak test report must be provided to Engineer before installation.

B. Field Quality Control:
1. Check sump storage tank, lines and block valve positions prior to operation.
2. Testing shall include the minimum operations:
   a. Pressure test the vessel and connecting pipes to verify that all connections are tight.
   b. Leak test the buried sump connection prior to setting and backfill.
   c. Check the compressed air lubricator to make sure that it is dispensing at the proper rate.
   d. Adjust the air pressure regulator.
   e. Proper electrical connections, grounding and thermal output of frost protection components.
3. Manufacturer's field service:
   a. Supplier's or manufacturer's representative for equipment specified herein shall be present at job site or location designated by Owner for minimum of one man-day, travel time excluded, for assistance during installation, start-up and training of Owner's personnel for operation. Include minimum of:
      1) 1/2 man-day for installation services

2) 1/2 man-day for instructional services

b. Supplier or manufacturer shall direct instructional services to specific system and equipment operation, maintenance and troubleshooting.

PART 3 - EXECUTION

3.1 PREPARATION

A. All materials necessary to complete the condensate sump installation shall be on-site prior to installation.

3.2 INSTALLATION

A. Installation shall be performed in accordance with the Manufacturer's instructions.

B. All lines shall be free and clear of debris prior to connecting. All pipes shall be connected using appropriate engineering methods.

C. The supply air shall be connected from the field to the vault using a flexible tubing meeting the manufacturer's recommendations.

D. The condensate discharge shall be installed using a HDPE to threaded epoxy coated steel transition fitting.

E. The Contractor shall ensure that kinking or excessive bend diameters of the pipe do not occur to any pipe during the installation process.

F. The unit is to be set within 1/4 percent tolerance of the elevation specifications.

G. The unit shall be set so that it is concentrically located in the excavation.

H. The condensate collection sump shall be isolated from any landfill refuse by a minimum of 6 inches of back fill.

I. The condensate liquid sump shall be installed in an area that does not allow accumulation or ponding of water. The vault assembly shall be at least 12 inches higher than surrounding grade.

3.3 CONNECTIONS

A. Prior to making connections, all lines shall be purged of debris.

B. The air pipe connection shall be made using either a 1/2 inch diameter SCH 40, blue nitrile or 316 SS pipe as recommended by pump vendor. A 316 SS union shall be connected to the pipe leading to the condensate liquid pump assembly.

C. The condensate liquid discharge pipe shall be connected to the condensate sump using good engineering practices. Materials and installation shall be as indicated on the piping plans.

D. The condensate liquid inlet shall be connected to the condensate sump using the pump vendor specified 5/8 inch nylon tube or approved equal.

3.4 ACCEPTANCE

A. Prior to acceptance the following verifications shall be made:
1. The unit is installed plumb and level.
2. The unit has been installed per manufacturer's recommendations.
3. All connections have been pressure tested per the manufacturer's recommendations.
4. The pipes and connections are clear and free of debris.
5. The level switch displacers are installed at elevations appropriate for the installation. As-built displacer elevations shall be recorded and submitted to the Engineer by the Contractor prior to project acceptance.
6. All required functional testing has been completed.

END OF SECTION

SECTION 11060
PUMPING EQUIPMENT: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pumping Equipment.

B. Related Sections include but are not necessarily limited to:
   1. Section 11005 - Equipment: Basic Requirements.
   2. Section 11070 – Pumping Equipment: Pneumatic.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Hydraulic Institute (HI):
      a. Standards for centrifugal, rotary and reciprocating pumps.

B. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

C. For variable speed pumping applications, the pump manufacturer is designated to have single source responsibility for coordination of the pump and VFD drive system.

1.3 DEFINITIONS

A. The abbreviations are defined as follows:
   1. IPS: Iron Pipe Size.
   2. NPSHR: Net Positive Suction Head Required.
   3. TDH: Total Differential Head.
   4. TEFC: Totally Enclosed Fan Cooled.
   5. VFD: Variable Frequency Drive.

B. Pump Service Category - Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005.
   2. Product technical data including:
      a. Performance data and curves with flow (gpm), head (FT), horsepower, efficiency, NPSH requirements, submergence requirement.
      b. Pump accessory data.
      c. Bearing supports, shafting details and lubrication provisions.
      d. Solids passage information.
   3. Certifications:
      a. Certified pump performance curves
   4. Test reports:
      a. Factory hydrostatic test.

B. Operation and Maintenance Manuals.

C. Miscellaneous:
   1. Certifications:
      a. Statement relative to installation and start-up per Paragraph 3.2A.4.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Pumps:
      a. See individual pump specification sections.
   2. Mechanical seals:
      a. Chesterton.
      b. Garlock.
      c. Or approved equal.

2.2 ACCESSORIES

A. See Section 11005.

B. Motors:
   1. See Section 11005.
   2. Sized to not overload at any point on the pump curve based on nameplate motor rating.

C. Each Unit:
   1. Lifting eye bolts or lugs.
   2. Plugged gage cock connection at suction and discharge nozzles (excluding submersibles).
   3. Tapped and plugged openings for casing and bearing housing vents and drains.
   4. Fittings for properly adding flushing lubricant.
   5. Pressure relief fittings for grease lubrication.

D. Packing Seal:
   1. Provide packing unless mechanical seal is specified in narrow-scope pump sections.
   2. Minimum of five rings graphite impregnated synthetic packing.
   3. Provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
   4. Provide split Teflon or bronze water seal ring.
   5. Adjustable split follower cast iron or bronze gland.

E. Mechanical Seals:
   1. Provide as specified in the narrow-scope pump sections.
   2. Provide rotating balanced O-ring type.
   3. Materials:
      a. Metal parts: 316 stainless steel.
      b. Seal faces: Unfilled carbon graphite versus silica-free Grade 99.5 ceramic.
      c. Elastomers: Viton.

2.3 FABRICATION

A. Pump Support:
   1. Design base to support weight of drive, shafting and pump.
   2. Comply with HI vibration limitations.
   3. Mount vertical pumps on single piece pedestal baseplate.
   4. Fabricate to withstand all operating loads transmitted from the pump and drive.

2.4 SOURCE QUALITY CONTROL

A. If specifically required in the individual pump specification sections, provide factory tests:
   1. All units:
      a. Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.
   2. Constant speed units:
      a. Head (FT) verses flow (gpm) pump curves:
         1) Efficiencies along curve.
         2) Brake horsepower along curve.

3. Results certified by a registered professional engineer.

B. Statically and dynamically balance each pump per HI standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 11005.

B. Submersible Units:
   1. Comply with pump manufacturers requirements.
   2. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange. Realign as necessary, install flange bolts and make equipment connection.

3.2 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by these Specifications.
   2. Supervise pre-start adjustments and installation checks.
   3. Conduct initial startup of equipment and perform operational checks.
   4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
   5. Instruct Owner's personnel for the specified minimum number of hours at jobsite on operation and maintenance of each of following pumping equipment:
      a. Section 11070 - Pumping Equipment: Pneumatic.

END OF SECTION

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SECTION 11070
PUMPING EQUIPMENT: PNEUMATIC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pneumatic pumps and accessories for Condensate Sump
   2. Pneumatic pumps and accessories for Landfill Gas Wells. (Alternate Bid Item)

B. Related Sections include but are not necessarily limited to:
   1. Section 01340 – Submittals.
   2. Section 11059 – Landfill Gas Condensate Sump
   3. Section 15060 – Pipe and Pipe Fittings: Basic Requirements
   4. Section 15067 – Pipe: Polyethylene

C. Pumps shall be air displacement pumps, internally controlled (controller-less) and designed for leachate and condensate systems. Pumps shall be bottom loading with inlet screen.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Requirements in Section 01340.
   2. Source quality control test reports.

B. Operation and Maintenance Manuals:
   1. See Section 01340.
   2. Contractor to provide 3 copies.

C. Warranty
   1. Warranty package will be submitted to Owner and Engineer for review and approval.
   2. All equipment specified in this section shall be warranted by Manufacturer for the period as specified in Section 2.2 and 2.3 starting from the date of Final Acceptance.

D. Quality Control
   1. Pump manufacturer must be active in the standard supply of pneumatic pumps, as specified, for a minimum of ten years
   2. Pump manufacturer must have factory representative or manufacturer's representative located within the State of Florida

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Pneumatic leachate pumps (LFG Wells – Alternate Bid Item) and condensate pump (Condensate Sump):
      a. QED Environmental Systems – Ann Arbor, MI
      b. Approved equal

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 PNEUMATIC PUMPS FOR LFG WELLS (ALTERNATE BID ITEM)

A. Short Bottom Loading AutoPump, QED Model AP-4 (Part No. 301881), or approved equal:

1. Controllerless pneumatic operation
2. Bottom loading intake
3. 3" extended stainless steel fluid intake screen
4. Stainless steel discharge check valve
5. FRP pump casing
6. Stainless steel support harness
7. 5-year parts & labor warranty (first 3 yrs. @ 100%; last 2 years @ 50%)
8. Stainless steel hose barb fittings for nylon tubing (1/2" OD air supply, 5/8" OD pump exhaust, 1-1/4" OD fluid discharge) with clamps and exhaust deflector (Part No. 301198).
9. Capable of minimum 4 gpm at 140 FT Total Dynamic Head (TDH)

B. AutoPump Accessories, QED or approved equal:
1. Downwell Jacketed Nylon 12 Tubing Bundle, Part No. 38883 (1/2" OD air supply tubing, 5/8" OD exhaust tubing, 1-1/4" OD fluid discharge tubing)
2. Downwell Support Rope, yellow braided, Part No. 205103)
3. 6" Machined Blind Flange Cap Assembly to include:
   a. Pass through compression fittings for Air Supply and Air Exhaust
   b. Pass through port for 2" gas line, including 3" x 2" flexible coupling
   c. Pump support rope eyelet
   d. Galvanized bolt kit, Part No. 40175, including eight (8) ¾" 10x4 bolts, sixteen (16) ¾" flat washers, and eight (8) ¾" hex nuts
4. Discharge Header and Valve Kit
   a. Discharge hose assembly, Part No. 40074, including 1" x 5' long hose terminating in a stainless steel female cam-lok fitting on both ends
   b. Discharge header valve kit, Part No. 40071, including PVC ball valve assembly and one-way flowing check valve that connects to the liquid force main. Also includes nylon male cam-lok fitting to mate with discharge hose on one end and 1" FPT for connection to the liquid header at other end.
5. Air Line Header and Valve Kit
   a. Brass ball valve assembly, Part No. 40070, that connects to the air header assembly.
   b. Includes brass female quick-connect to mate with filter/regulator hose on one end, and stainless steel reducing coupling ending in a 1" FPT for connection to the air supply header at the other end
6. Filter/Regulator, Part No. 40006, including 5' blue air hose with brass quick connect to mate to air line header ball valve, and 3' green hose pigtail with ½" PrestoLok for flange cap connection
7. Designed for maximum supply pressure of 125 psi.
8. Designed to regulate air pressure per pump supplier's recommendations
9. Shall include single stage 5 micron air filter with metal bowl and screw-fit drain plug
10. Pump Cycle Counter, Model 39196, with brass quick-connects.

2.3 PNEUMATIC PUMP FOR CONDENSATE SUMP

A. Customized Short Bottom Loading AutoPump, QED Model AP-4 (Part No. 302405), or approved equal:
1. Controllerless pneumatic operation
2. Bottom loading intake
3. 3" extended 316-stainless steel fluid intake screen
4. Upgraded 316-Stainless steel bottom check collar
5. Upgraded 316-Stainless steel discharge check valve
6. Upgraded 316-Stainless steel frame and support chain
7. FRP pump casing
8. Internal plastics upgraded to PVDF/UHMWPE
9. 5-year parts & labor warranty (first 3 yrs. @ 100%; last 2 years @ 50%)
10. Stainless steel hose barb fittings for nylon tubing (1/2" OD air supply, 5/8" OD pump exhaust, 1-1/4" OD fluid discharge) with clamps and exhaust deflector (Part No. 301198).
11. Capable of minimum 4 gpm at 140 FT Total Dynamic Head (TDH)

B. AutoPump Accessories, QED or approved equal:
   1. Downwell Jacketed Nylon 12 Tubing Bundle, Part No. 38883 (1/2" OD air supply tubing, 5/8" OD exhaust tubing, 1-1/4" OD fluid discharge tubing)
   2. Downwell Support Rope, yellow braided, Part No. 205103)
   3. 6" Machined Blind Flange Cap Assembly to include:
      a. Pass through compression fittings for Air Supply and Air Exhaust
      b. Fittings for Bubbler Tube and Reference Line Tube (for Data Module)
      c. Pump support rope eyelet
      d. 1-1/4" discharge barb underneath and stainless steel cam plug elbow above
      e. Galvanized bolt kit, Part No. 40175, including eight (8) ¾" 10x4 bolts, sixteen (16) ¾" flat washers, and eight (8) ¾" hex nuts
   4. Discharge Header and Valve Kit
      a. Discharge hose assembly, Part No. 40074, including 1" x 5' long hose terminating in a stainless steel female cam-lok fitting on both ends
      b. Discharge header valve kit, Part No. 40071, including PVC ball valve assembly and one-way flowing check valve that connects to the liquid force main. Also includes nylon male cam-lok fitting to mate with discharge hose on one end and 1" FPT for connection to the liquid header at other end.
   5. AutoPump Data Module, Part No. 300970, with Filter/Regulator, Pump Cycle Counter, 100" Magnehelic Gauge, and Vacuum References. Filter/Regulator portion:
      a. Designed for maximum supply pressure of 125 psi.
      b. Designed to regulate air pressure per pump supplier's recommendations
      c. Shall include single stage 5 micron air filter with metal bowl and screw-fit drain plug
   6. Bubbler Line and Reference Line Tubing, each line to be ¼" OD UV-Protected Nylon
   7. Air Line Header and Valve Kit
      a. Brass ball valve assembly, Part No. 40070, that connects to the air header assembly.
      b. Includes brass female quick-connect to mate with filter/regulator hose on one end, and stainless steel reducing coupling ending in a 1" FPT for connection to the air supply header at the other end
   8. Data Module Connection Kit, includes all fittings to connect the Data Module to the blind flange cap

2.4 SOURCE QUALITY CONTROL

A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory and provide to Engineer:
   1. Check for compliance with Specification.
   2. Test pump operation.

B. Factory test of head (FT) versus flow (gpm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pump in condensate sump and vertical LFG wells (alternate bid item – installed on landfill gas wells only if approved by Engineer) at location shown on the drawings per the pump manufacturer's recommendations.

B. Connect Air Supply Line to "Air Line Header and Valve Kit"

C. Connect "Discharge Header and Valve Kit" to forcemain line.

D. Air and Condensate Forcemain discharge hose lengths outside the sump shall be field determined and approved by the Engineer

3.2 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) for a minimum of two 8-hour days to:
   1. Inspect equipment covered by these Specifications.
   2. Supervise pre-start adjustments and installation checks.
   3. Conduct initial startup of equipment and perform operational checks.
   4. Provide a written statement from the manufacturer that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

END OF SECTION

SECTION 15060
PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope of Work: The CONTRACTOR shall supply all materials, equipment, and labor needed to install complete and make ready for use all pipe, pipe fittings, and valves as specified herein and as indicated on the Plans.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 – General Requirements
   2. Section 02130 – Vertical Extraction Wells
   3. Section 02221 – Trenching, Backfilling, and Compacting for LFG piping and Structures
   4. Section 11059 – Condensate Sump
   5. Section 15100– Valves – Basic Requirements
   6. Section 15067 – Pipe-Polyethylene
   7. Section 15079 – Pipe- Corrugated Polyethylene

1.2 QUALITY ASSURANCE

A. Referenced Standards:

B. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Use of the most recent version is required.
   1. American National Standards Institute (ANSI):
      a. B16.5, Pipe Flanges and Flanged Fittings.
      b. B31.8, Code for Pressure Piping, Appendix N
   2. ASTM International (ASTM):
      a. D1248 Specification for Polyethylene Plastics Molding and Extrusion Materials
      b. D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
      c. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter- Controlled Polyethylene Pipe and Tubing.
      d. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
      e. D3350, Specification for Polyethylene Plastics Pipe and Fittings Materials
      f. D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.
   3. Plastics Piping Institute (PPI)
      a. PPI TR-31/9-79, Technical Report

C. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS

A. SDR – Standard Dimension Ratio.

B. ESCR – Environmental Stress Crack Resistance.

C. HDPE – High Density Polyethylene Pipe

D. LFG – Landfill gas

1.4 SUBMITTALS

A. See Section 01340 for administration of submittals.

B. The Contractor shall prepare and submit to the Engineer, for review and approval prior to commencement of construction, certificates of compliance on materials furnished and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, inspection, maintenance and repair of each type of pipe, pipe fitting, and valve furnished.

C. Provide manufacturing test specification data listing resin type, cell classification, stock density, melt flow, flexural modulus, tensile strength, and coloration. Include results of tests with shipment of materials, with two (2) additional copies of test results furnished to Engineer.

D. The Contractor shall prepare and submit Shop Drawings to the Engineer for review and approval. The Shop Drawings shall show the following:
   1. Fabrication and/or layout drawings:
      a. Piping drawings (minimum scale 1 IN equals 10 FT) with information including:
         1) Pipe Dimensions, schedule, fittings, and supports.
         2) Invert or centerline elevations of piping crossings.
         3) Acknowledgement of bury depth and location requirements.
         4) Details of fittings, tapping locations, and related appurtenances.
         5) Acknowledge designated valve.
         6) Line slopes.
      b. Schedule of interconnections to existing piping and method of connection.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
      c. Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components. Attach technical product data on gaskets, pipe, fittings, and other components.

E. Test Report:
   1. Copies of pressure test results on all landfill gas piping systems and corrective actions taken if test failed.
   2. Notification of time and date of piping pressure tests.

F. As-Built Drawings:
   1. As work progresses and again when work is complete, submit "As-Recorded" drawings of piping systems including project items and pre-existing items. Identify complete location, elevation, and description of piping systems. Relate piping systems to identified structures and appurtenances.

G. Operation and Maintenance Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

C. Protect materials from direct exposure to rain or sunlight until installation.

D. Pipe Storage:
   1. Store or stack pipe to prevent damage from marring, crushing or puncture. Limit maximum stacking height to 6 feet or manufacturer's maximum recommended height, whichever is less.
   2. Store in accordance with manufacturer's recommendations.

E. Pipe handling:
   1. Protect pipe from excessive heat or harmful chemicals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers of PE pipe are acceptable for landfill gas applications:
   1. Driscoplex.
   2. CSR/Polypipe
   3. ISCO
   4. Lee Supply
   5. Ferguson Industrial Plastics
   6. Plexco

B. Submit requests for substitution to ENGINEER in accordance with Specification Section 01640.

2.2 HIGH DENSITY POLYETHYLENE (HDPE/PE 3408) PIPING AND FITTINGS

A. General:
   1. All HDPE pipe used must be in conformance with the documentation set forth in the construction drawings. The SDR of each specific pipe can be found on the drawings themselves or on the general notes page.
   2. Pipe shall be extruded from a Type III, Class C, Category 5, Grade P34 compound as described in ASTM D 1248. It shall be classified as cell 345434C according to ASTM D 3350 and have the material designation of PE 3408. The pipe shall be manufactured to meet the requirements of ASTM D 2513. Manufacturer's literature shall be adhered to when "manufacturer's recommendations" are specified. All pipe and fittings shall be provided by one of the manufacturers specified in Section 2.1 of this specification.

B. HDPE Fittings
   1. Fittings shall be manufactured from polyethylene compound having cell classification equal to or exceeding the compound used in the pipe.
   2. All fittings 12 inches and smaller shall be molded (excluding gas header pipe), unless approved by the ENGINEER. Extrusion welds on fittings will not be allowed. The ends of the fabricated fittings shall not be trimmed to match the pipe section to which they are going to be joined. All polyethylene fittings shall have the same or higher pressure rating as the pipe when installed in accordance with the latest technical specifications. All landfill gas tie-ins to the header may be shop fabricated branch saddle fittings. Field fabricated branch saddle fittings will not be accepted.
   3. Flanges for HDPE Pipe
      1) Flanges for HDPE pipe shall be convoluted ductile iron back-up rings with a minimum thickness of 1-inch.
      2) The studs, nuts and wasters for the flanges shall be 316 stainless steel hardware. Below grade flanges shall be wrapped in 5-mil polyethylene sheeting just after installation and prior to backfilling to help prevent corrosion.
      3) Flange gaskets shall be full-face Neoprene, or approved equal.
      4) Flanges and bolt patterns consistent with ANSI B16.5/AWWA C207/ASTM A536, as recommended by manufacturer.
   4. Valves
      a. Refer to valve specifications
   5. Reducers:
      a. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

C. All pipe and fittings must be supplied by the same manufacturer.

D. Identify each length of pipe clearly at intervals of 5 FT or less with the following markings:
   1. Manufacturer's name and trademark.

2. Nominal size of pipe,
3. Type of plastic (e.g. PE 3408)
4. Standard dimension ratio (SDR) Schedule (SCH) value
5. ASTM designations (i.e., ASTM D 2513)

E. Pipe Supports
1. All pipe supports shall conform to the details shown on the Plans and shall be located as shown on the Plans.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to Specifications, or for:
1. Fractures or cracks passing through pipe wall, except single crack not exceeding two (2) inches in length at either end of pipe which could be cut off and discarded. Pipes within one shipment will be rejected if defects exist in more than 5% of shipment or delivery.
2. Cracks sufficient to impair strength, durability, or serviceability of pipe.
3. Defects indicating improper proportioning, mixing, and molding.
4. Damaged ends, where such damage would prevent making satisfactory joints.

B. Acceptance of fittings, stubs, or other specifically fabricated pipe sections shall be based on visual observation by the Owner or Engineer at the Project site and documentation that they conform to these Specifications.

3.2 HPDE PIPE INSTALLATION

A. Perform trenching, backfilling, and compaction in accordance with Section 02221.

B. Install pipe as indicated on Drawings. Pipe installation shall comply with the requirements of ASTM D 2321, PPI TR31/9-79, and the manufacturer's recommendations.

C. Remove standing water in trench before installation.

D. Lengths of fused pipe to be handled as one segment shall not exceed 400 feet.

E. The Owner and Engineer shall be notified prior to any pipe being installed in the trench in order to have an opportunity to inspect the following items:
1. All butt and saddle fusions
2. Pipe integrity.
3. Trench excavation and bedding material for rocks and foreign material.
4. Proper trench slope.
5. Trench contour to ensure the pipe will have uniform and continuous support.
6. Proposed backfill sand and soil.

F. Any irregularities found by the Engineer during this inspection must be corrected before lowering the pipe into the trench. Pipe shall be allowed sufficient time to adjust to trench temperature prior to any testing, segment tie-ins, and/or backfilling.

G. Pipes and fittings shall be carefully lowered into trench to limit stress to pipes, fittings, and joints.

H. Pipe and fittings shall be installed so that there will be no deviation at the joints and so that inverts present a smooth surface. Pipe and fittings that do not fit together to form a tight fitting joint are not permitted.

I. Tie-ins shall be made out of the trench whenever possible. When tie-ins are to be made only in the trench, a bell hole shall be excavated large enough to ensure an adequate and safe work area.

J. The Contractor shall ensure that kinking or excessive bend diameters of the pipe do not occur during the installation process.

K. The Contractor shall insure that the pipe installed in the trench is firmly supported. The Contractor shall follow the minimum length and type of backfill specified in the Plans.

L. Cap pipe sections longer than single joint (usually 40 feet) on both ends during placement, except during fusing operations.

M. The Contractor shall cap all open pipe ends at the end of the work day.

N. All installed valves shall be tested in the presence of the Engineer. All repairs deemed necessary by the Engineer shall be made by the Contractor.

O. HDPE pipe and fittings shall be by the same manufacturer. The minimum strength of the fittings shall not be less than that of the pipe.

P. Changes in direction of HDPE Pipe:
   1. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade.

Q. The Contractor shall remove cuttings. Shavings shall not be left on the ground.

R. HDPE shall not be field threaded and such threaded joints shall not be used in gas distribution systems.

S. Except as indicted on construction drawings, landfill gas pipe fittings shall be butt fusion type, meeting the requirements of ASTM D-3261 and this specification. All fittings shall be pressure rated to match the system piping to which they are fused. At the point of fusion, the outside diameter and minimum wall thickness specifications of ASTM F-714 for the same size of pipe. The side slope riser fittings shall be factory fabricated and shall have a smooth interior surface.

T. All perforated pipes shall be perforated by the Manufacturer as shown on the Drawings.

U. Workmanship: Exterior and interior surfaces shall be smooth with no sharp projections. The surfaces shall be free of foreign inclusions and major surface defects. Polyethylene pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties. The product function shall be considered when judging external defects.

V. All installed HDPE pipe shall be marked in 25-foot intervals corresponding to the stationing required for slope confirmation and conformance surveying. Each joint shall be marked at header and lateral joints. For main pipeline, station numbering shall be continuous and sequential. Station numbering shall be referenced in daily logs to document pipe installation progress. Survey data shall be submitted in the state plane coordinate system. Top of pipe and cover soil elevation shall be included for all points unless piping is designed to be above grade.

3.3 HEAT FUSION OF HDPE PIPING:

A. HDPE pipe shall be joined by butt-fusion methods, having a uniform and monolithic pipe interior according to the fusion joining procedures as instructed by the manufacturer, except within the structures, as shown in the Construction Drawing.

B. Each individual performing fusion joining shall have at least one (1) year of experience in the use of the fusion procedure.

C. Join pipe sections at ground level to a maximum length of 400 feet, or a length recommended by the manufacturer such that maximum allowable stress, when pulling the pipe into position alongside the trench, is not exceeded. Use appropriate materials and equipment, as recommended by the HDPE pipe manufacturer, when pulling butt-fused pipe sections alongside the trench to prevent pipe damage.

D. For summertime installations it may be necessary to provide a slightly longer length of HDPE pipe when connections are to be made between two fixed points or structures to compensate for contraction of the pipe in a cooler trench bottom. The additional pipe length requirements shall be in accordance with the HDPE pipe manufacturer's instructions.

E. For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.

F. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade.

G. Do not subject pipe to strains that will overstress or buckle pipe or impose excessive stress on joints.

H. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment will be of the size to facilitate saddle fusion within the trench.

I. Before butt fusing pipe, each length shall be observed for presence of dirt, sand, mud, shavings, and other debris or animals. Remove all materials from the inside of the pipe.

J. At end of each working day, cover open ends of fused pipe. Cap to prevent entry by animals or debris.

K. Use compatible fusion techniques when polyethylene pipes of different melt indexes are fused together. Refer to manufacturer's specifications for compatible fusion.

3.4 FLANGED CONNECTIONS

A. For flanged connections in virgin soil, the Contractor shall wrap and tape the flanges and bolts in 5 mil polyethylene sheeting prior to backfilling to help protect the assembly from corrosion.

B. Flanges shall be joined with 316 stainless steel studs and nuts. Stud lengths shall accommodate the required distance between flanges including spacers, if necessary.

C. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint. Provide tightening torque in accordance with manufacturer's recommendations. CAUTION: Do not over-torque bolts.

D. For flanged connections within the limits of refuse, all below grade back-up rings, studs, nuts and wasters shall be thoroughly coated with a rubberized emulsion undercoating spray, or approved substitute.

E. The CONTRACTOR shall wrap and tape the flanges and bolts in 5 mil polyethylene sheeting prior to backfilling.

3.5 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Contractor to notify Owner or Engineer to shut down the flare station before proceeding to connect to existing gas system.

C. Undertake connections in fashion which will disturb existing gas system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to existing gas system.

E. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.6 VALVES

A. Refer to each valve specification.

3.7 SEGMENT TESTING

A. The HDPE laterals and connections to LFG header shall be subjected to pneumatic pressure tests as described herein to detect any leaks in the piping. Testing shall only be performed below grade (inside the trench). The Contractor shall accept the responsibility for locating, uncovering (if previously backfilled), and repairing any leaks detected during testing.

B. Polyethylene piping shall be butt welded together into testing segments. Segments shall be connected to a testing apparatus on one end and fitted with fusion-welded caps on all openings.

C. The segment to be tested shall be allowed time to reach constant and/or ambient temperature before initiating the test.

D. The test must be performed during a period when the pipe segment will be out of direct sunlight; i.e., early morning, late evening, or cloudy days. This will minimize the pressure changes which will occur during temperature fluctuations.

E. The pneumatic test pressure for LFG header pipe and laterals shall be 10 psig with a maximum of 5% loss. Failing pipe sections will be inspected for any visible leaks and re-tested. Engineer will determine protocol for any additional failures.

F. Pressure drop during the test shall not exceed five percent of the testing gauge pressure over a period of one hour. The pressure drop shall be corrected for temperature changes before determining pass or failure. (See Section 3.8 for test failures).

G. The Engineer shall be notified 1 week prior to commencement of the testing procedure and shall be present during the test.

H. All equipment for this testing procedure, including an adequately sized air compressor, fittings, caps/pipe plugs, etc. shall be furnished by the Contractor. Other necessary equipment includes a pressure gauge with a scale that spans the test pressure range with increments equal to 0.1 percent of the test pressure, an appropriate valve to facilitate an air compressor hose, and a ball valve to release pipe pressure at completion of test. Pipe reducers shall be utilized to adapt test flange to size of pipe being tested.

I. Pipe testing for retrofit of Phase I meter box shall be performed using hydraulic test per manufacturer's recommendations and as described above.

3.8 TEST FAILURE

A. The following steps shall be performed when a pipe segment fails the five percent/one hour test described in Section 3.7. F.
   1. The pipe and all fusions shall be inspected for cracks, pinholes, or perforations.
   2. All blocked risers and capped ends shall be inspected for leaks.
   3. Leaks shall be located and/or verified by applying a soapy water solution and observing soap bubble formation.

B. All pipe and fused joint leaks shall be repaired by cutting out the leaking area and re-fusing the pipe.

C. After all leaks are repaired, a retest shall be performed in accordance with Section 3.7.

3.9 TEST REPORTING

1. Each test (pass or failure) shall be reported in writing on a form approved by the Engineer.
   a. Test report to include, date, size of pipe, length, description, and stationing,
2. If failure occurs, Contractor shall note the following:
   a. Location of failure segment.
   b. Nature of leaks.
   c. Repairs performed
   d. Results of test.

END OF SECTION

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SECTION 15067
PIPE - HIGH DENSITY POLYETHYLENE (HDPE)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. High density polyethylene (HDPE) pipe, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Sarasota County Government Bidding Requirements.
   2. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. Polyethylene (PE) materials:
         1) D2104, (PE) Plastic Pipe, Schedule 40.
         2) D2239, (PE) Plastic Pipe (SDR-PR).
         3) D2447, (PE) Plastic Pipe, Schedule 40 and 80 Based on Outside Diameter.
         4) D2609, Plastic Inserts Fittings for (PE) Plastic Pipe.
         5) D2657 Heat Joining Polyolefin Pipe and Fittings.
         6) D2737, (PE) Plastic Tubing.
         7) D2837 Obtaining Hydrostatic Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
         8) D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
         9) D3350 (PE) Plastic Pipe and Fittings Materials
         10) F1055 Electrofusion Type PE Fittings for OD Controlled PE Pipe and Tubing.
      b. Installation:
         1) D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
         2) D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
   2. American Water Works Association (AWWA):
      a. Polyethylene (PE) materials:
         1) C901, Polyethylene (PE) Pressure Pipe Tubing and Fittings, 1/2 through 3 IN for Water.
         2) C906,Polyethylene (PE) Pressure Pipe and Fittings 4 IN through 63 IN for Water Distribution and Transmission.
   3. American National Standards Institute (ANSI).
      a. B36.10 standard dimensions of steel pipe (IPS).

1.3 SUBMITTALS

A. See Section 15060.

B. Pipe schedule identifying:
   1. Style, type, size.
   2. Quantity.
   3. Location to be used.

C. Perforation pattern(s).

D. Schedule of fittings.

E. Pipe data.

F. Installer certification.

G. Field quality control documents.

1.4 DEFINITIONS

A. SDR – Standard Dimension Ratio.

B. IPS – Iron Pipe Size.

C. CTS – Copper Tube Size.

D. DIPS – Ductile Iron Pipe Size.

E. ESCR – Environmental Stress Crack Resistance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers of PE pipe are acceptable:
   a. See Section 15060.

SDR	PRESSURE RATING (psi)
17	100
11	160
9	200

2.2 HIGH DENSITY POLYTHELYENE (HDPE) PIPING

A. General:
   1. Provide PE 3408 piping with fittings and appurtenances to locations shown on Drawings.
   2. Furnish materials in accordance with ASTM D2513 and full compliance to the following material specifications:
      a. Material description: ASTM D1248, Type III, Class C, Category 5, Grade P34.
      b. Cell classification: ASTM D3350, PE 345434C.
      c. ESCR: ASTM D1693, condition C, F_o>5,000 HRS.
      d. ESCR: ASTM D1693, condition A, B, C, F_o>5,000 HRS.
   3. Modulus of elasticity: ASTM D638, 110,000 psi.
   4. Hardness: ASTM D2240, 65 Shore D.
   5. SDR: 9.0, 11.0, and 17.0 as specified in the drawings.
   6. IPS for line size greater than 1 IN.
   7. CTS for line size less than or equal to 1 IN.

B. Fittings:
   1. ASTM D2513.
   2. SDR: 9.0, 11.0, and 17.0
   3. 1/2 to 3 IN: ASTM D2683.
   4. 4 to 10 IN: ASTM D3261.
   5. End connections:
      a. Socket fused ends for fittings 1 IN and under.
      b. Butt-fused ends for fitting 1-1/2 IN and greater.
   6. Use IPS reducers on the service mains.
   7. Use tapping tees or straight outlet service saddles to join service lines to the main.

8. Mitered or field fabricated fittings are not allowed.

C. Installation: Install pipe and fittings in accordance with ASTM 2513 and as recommended by the manufacturer.
   1. Provide for a maximum deflection of not more than 5 percent.
   2. HDPE pipe shall not be field threaded and such threaded joints shall not be used in gas distribution systems.

D. Deflection:
   1. See Section 15060.

E. HDPE to Steel Transition Fittings:
   1. When connecting plastic to steel use either Universal Maxi-Grip Coupling or weld-in transition fitting.
   2. Universal Maxi-Grip Coupling:
      a. Match coupling size with pipe size.
      b. For 1-1/4 IN IPS and 2 IN IPS Maxi-Grip provide sheer sleeve protector.
   3. Install according to Maxi-Grip Fitting Installation Procedures.
      a. Construction:
         1) 12 IN long steel nipple, swaged at one end and weld bevel of 37-1/2 on the other.
            a) Closed grooves machined on inside of diameter of the swaged section.
            b) Plastic pipe with a steel insert pushed into the swaged end shall form a joint stronger than the yield strength of the plastic pipe.
            c) Steel nipple shall be coated with heat fused epoxy.
         2) Firmly pack and bed the sleeve to its final grade with sand or sand/clay mixture.
            a) Manually backfill and tamp the bellhole to ensure the sleeve is centered around the pipe and the pipe and transition fitting are well supported.
      b. Installation:
         1) Connect the steel side of the transition fitting to steel pipe by welding.
            a) During installation, prevent plastic pipe portion of fitting from being overheated by wrapping wet cloths around plastic pipe portion of fitting before welding.
            b) After second weld pass, stop and allow joint to cool for at least 5 minutes then continue with final pass.
         2) During welding process, keep the cloths wet.
            a) Do not remove wet cloths until you can put your hand on the weld area.
         3) Before fusion of the plastic, place a protective sleeve over the steel section of the fitting.
            a) See the following table for protective sleeve size.
         4) Join the plastic side of the transmission fitting to the plastic pipe by heat fusion.
            a) Position protective sleeve to proper cantilever length as indicated on the following table.
         5) Firmly pack and bed the sleeve to its final grade with sand or sand/clay mixture.
            a) Manually backfill and tamp the bellhole to ensure the sleeve is centered around the pipe and the pipe and transmission fitting are well supported.

   4. Transition fitting and protective sleeve sizes:

TRANSITION FITTING	PROTECTIVE SLEEVE SIZES			
1 IN CTS	1-1/4 IN	1.8 IN	13.8 IN	10.8 IN
2 IN IPS	2 IN	4.7 IN	23 IN	19 IN
3 IN IPS	3 IN	6.0 IN	28 IN	23 IN
4 IN IPS	4 IN	7.0 IN	34 IN	29 IN

2.3 PIPE MARKING

A. During extrusion production, the HDPE pipe shall be continuously marked in accordance with AWWA 906 with durable printing including the following information:
   1. Nominal size.
   2. Dimension ratio.
   3. Pressure class.
   4. Manufacturer name or trademark and product series.
   5. Standard material code designation (ex: PE 3408).
   6. Plant identification.
   7. Production date.

2.4 PRESSURE PIPING (UNDERGROUND)

1. Materials: Furnish materials in full compliance with following requirements:
   a. Materials and workmanship in accordance with ASTM F714.
   b. Pipe type and size as shown on Drawings.
   c. Joints for polyethylene pipe shall be fusion type in accordance with AWWA C901.
   d. Installation: Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.
2. Uniformity: Ensure that all piping and fittings are integrated into components of the finished system. Utilize products of a single manufacturer.

2.5 PERFORATED PIPE

A. HDPE pipe requiring perforations shall conform to specified pattern size and spacing shown on the Drawings. The Contractor may not alter hole patterns or spacing shown on the drawings.

B. Perforations not authorized to be performed in the field

PART 3 - EXECUTION

3.1 IDENTIFICATION

A. Identify each length of pipe clearly at intervals of 5 FT or less. Include manufacturer's name and trademark.
   1. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications, and "NSF" approvals when applicable.

3.2 INSTALLATION

A. See Section 15060.

B. General:
   1. Install buried pipe as indicated on Drawings.
   2. The Contractor shall insure that kinking or excessive bend diameters of the pipe do not occur during the installation process.
   3. The Contractor shall insure that the pipe installed in the trench is firmly supported.
   4. The Contractor shall cap all open pipe ends at the end of the work day.
   5. All installed valves shall be tested in the presence of the Engineer.
      a. All repairs deemed necessary by the Engineer shall be made by the Contractor.
   6. Contractor shall remove any cave-in portions of the trench prior to placing sand bagging around the pipe.
   7. HDPE pipe and fittings shall be by the same manufacturer.
      a. The minimum strength of the fittings shall not be less than that of the pipe.
   8. Service taps shall be installed as shown on the Drawings.
   9. Changes in direction of PE Pipe:

a. Pipe may be cold-bent to minimum radius of 20 times the pipe diameter as it is installed.
b. If fittings or fusions are present in the bend, the minimum recommended cold bending radius is 125 times the outside diameter of the pipe.

10. Remove cutting and threading burrs.

C. Joining Procedures:
1. HDPE pipe joints shall be fused on the surface prior to installation into the trench.
   a. Alternative methods of fusing shall be approved by the Engineer.
   b. PE pipe 1 IN and under shall be socket fused.
   c. PE pipe joints 1-1/2 IN and over shall be buttfused.
2. Fusion joiner must be qualified by type of fusion (i.e., butt fusion, socket fusion or sidewall fusion) and fuse pipe only as qualified.
3. Each joint must be visually inspected inside and outside for damage, dirt, moisture, or any other abnormalities prior to fusing.
4. All joint fusion shall be performed in strict accordance with the manufacturer's specifications.
5. All fusion equipment must be approved by the manufacturer and operated by qualified and certified operators.
   a. Cost for testing and certifying personnel shall be born by the Contractor.

END OF SECTION

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SECTION 15079
PIPE - CORRUGATED POLYETHYLENE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This item shall consist of furnishing, fabricating, and installing corrugated polyethylene pipe of the types, classes, sizes, gauges, and dimensions as shown on the plans, at such places as are designated on the plans and profiles, or by the Engineer, in accordance with these specifications and in conformity with the lines and grades given.

B. Piping locations include, but may not be limited to:
   1. Slope drains.
   2. Toe drains.

1.2 SUBMITTALS

A. Verify on Shop Drawing dimensions, schedule of pipe, fittings, perforations, and miscellaneous appurtenances. When special fittings are necessary, verify locations of items and include complete details.

B. Render copies of any manufacturer's written instructions regarding material handling, delivery, storage, and installation.

C. As Work progresses and again when Work is complete, submit "As Recorded" Drawings of piping systems in project including project items and pre-existing items. Identify complete location, elevation, and description of piping systems. Relate piping systems to identified structures and appurtenances.

PART 2 - MATERIALS

2.1 GENERAL

A. Corrugated Polyethylene Pipe and Connections: This pipe and connections shall conform to the requirements of AASHTO M294-94.

B. All pipes shall be dual-walled pipe (water tight connections) and shall have a full circular cross-section, within an outer corrugated pipe wall and a smooth inner liner, ADS N-12 or approved equal.

C. Basic Materials: Pipe and fittings shall conform to the requirements of ASTM D3350, except the carbon black content shall not exceed 5 percent.

D. Coupling Bands: Flexible pipe shall be firmly joined by coupling bands. These bands shall be not more than two nominal sheet thicknesses lighter than the thickness of the pipe to be connected.
   1. Soil/Watertight couplers shall be used to connect individual pipe sections.
   2. Reinforced couplers shall be used where the possibility of separation is great. These couplers shall be constructed of a heavy cross-laminated polyethylene backing, rubberized mastic sealer, plastic straps with sheathing, and woven polypropylene reinforcing.

E. Perforations: where shown on the Drawings, provide AASHTO Class II perforations as appropriate for the size of pipe required.

F. Pipe Sock: where shown on the Drawings, provide geotextile pipe sock or wrap around perforated pipe.

1. Pipe sock or wrap around shall be supplied by the pipe manufacturer and shall be delivered to the site already installed on the pipe.
2. Pipe sock or wrap shall have the following minimum properties:
   a. 100% Nylon spunbond fabric
   b. Weight 0.85 oz/sy (ASTM D3776)
   c. Burst strength 28 lbs/in^2 (ASTM D3786)
   d. Equivalent opening size 50 (U.S. Army Corps of Engineers CW 02215)
   e. Water flow rate 163 gal/min/ft^2 (ASTM D4491)

PART 3 - EXECUTION

A. Equipment: All equipment necessary and required for the proper construction of piping shall be on the project, in first class working condition. The Contractor shall provide such mechanical tampers as required to obtain the compaction of the pipe bedding and backfill as specified.

B. Excavation: The Contractor shall perform all excavation to the depth and/or dimensions shown on the plans with special attention given to avoid damaging the underlying geosynthetic components of the final and temporary final cover system. Any damage to the final and temporary final cover system due to Contractor's action shall be repaired at Contractor's expense. The bedding for the pipe shall be so shaped that at least the lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Bedding shall be as shown on the plans.

C. Placing Pipe: The pipe shall be laid with the separate sections joined firmly together with coupling bands with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. The pipe shall be laid carefully and true to lines and grades on a bed which is uniformly firm throughout its entire length. Any pipe which is not in true alignment, or which shows any undue settlement after laid or is damaged, shall be taken up and relaid or replaced without extra compensation. Pipe shall not be laid on frozen ground.

D. Connections: Contractor shall follow manufacturer's recommendations in installing pipe connections.

E. Backfill: The trench shall be backfilled with protective cover material and compacted to the same density as specified in Section 02200. Maintain minimum cover as shown in the Drawings.

END OF SECTION

SECTION 15100
VALVES - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Valving, actuators, and valving appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 11005 - Equipment: Basic Requirements.
   4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B1.20.1, Pipe Threads, General Purpose.
      b. B16.34, Valves-Flanged, Threaded and Welding End.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
      c. D638, Standard Test Method for Tensile Properties of Plastics.
      d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load.
      e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
      f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
   3. American Water Works Association (AWWA):
      a. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
      b. C500, Gate Valves for Water and Sewerage Systems.
      c. C504, Rubber-Seated Butterfly Valves.
      d. C507, Ball Valves, 6 IN through 48 IN (150 MM through 1200 MM).
      e. C509, Resilient-Seated Gate Valves 3 through 12 NPS, for Water and Sewage Systems.
      f. C540, Power-Actuating Devices for Valves and Sluice Gates.
      g. C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
      h. C606, Grooved and Shouldered Joints.
   4. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
      b. MG 1, Motors and Generators.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Valve pressure and temperature rating.
      d. Valve material of construction.

e. Special linings.
f. Valve dimensions and weight.
g. Valve flow coefficient.
h. Installation, inspection, maintenance, operation, and repair of each valve furnished.

2. Test reports.

B. Operation and Maintenance Manuals

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to individual valve specification sections for acceptable manufacturers.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. Refer to individual valve specification sections.

2.3 VALVE ACTUATORS

A. Valve Actuators - General:
1. Provide actuators as shown on Drawings or specified.
2. Counter clockwise opening as viewed from the top.
3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 foot-pounds torque on the operating nut.
5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
6. Extension Stem:
a. Install where shown or specified.
b. For buried service, solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
c. For installation in manholes, stainless steel with handwheel, diameter not less than hand actuator shaft, with stainless steel wall supports and collars.
d. Pin all stem connections.
e. Center in valve box or grating opening band with guide bushing.

B. Buried Valve Actuators:
1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover.
2. Box base to enclose buried valve gear box or bonnet.
3. Provide 2 IN standard actuator nuts complying with Section 3.16 of AWWA C500.
4. Provide at least two teehandle keys for actuator nuts, with 5 FT extension between key and handle.
5. Extension Stem:
a. Provide for buried valves greater than 4 FT below finish grade.
b. Extend to within 6 IN of finish grade.
6. Provide concrete pad encasement of valve box for all buried valves unless shown otherwise.

C. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
2. Provide handwheels for gate and globe valves.
a. Size handwheels for valves in accordance with AWWA C500.
3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.

a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
b. Provide at least two levers for each type and size of valve furnished.

4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
5. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.

2.4 FABRICATION

A. End Connections:
1. Provide flanged type of end connections for valves unless otherwise shown on the Drawings.
2. Comply with the following standards:
a. Threaded: ANSI B1.20.1.
b. Flanged: ANSI B16.1 Class 125 unless otherwise noted or AWWA C207.
c. Grooved: Rigid joints per Table 5 of AWWA C606.

B. Refer to individual valve sections for specifications of each type of valve on Project.

C. Nuts, Bolts, and Washers:
1. To be 316 stainless steel.

D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.

E. Epoxy Interior Coating:
1. Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements:
1. Comply with painting and protective coatings as specified on the Drawings.

C. Setting Buried Valves:
1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
2. Set valves and valve boxes plumb.
3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
4. Install in closed position.
5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
6. After installation backfill up to top of box for a minimum distance of 4 FT on each side of box.

D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

E. For grooved coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.

F. For threaded valves, provide union on one side within 2 FT of valve to allow valve removal.

G. Install valves accessible for operation, inspection, and maintenance.

H. Flanges shall be joined with 316 stainless steel studs and nuts. Stud lengths shall accommodate the required distance between flanges including spacers, if necessary.

I. All below grade back-up rings, studs, nuts and washers shall be thoroughly coated with Polyken Technologies 1027 Primer, or rubberized emulsion undercoating spray, or approved substitute. There shall be no "holidays", or areas where the coating is not completely applied.

J. The Contractor shall wrap and tape the valve, flanges, and bolts in 5 mil polyethylene sheeting prior to backfilling.

3.2 ADJUSTING

A. Adjust valves, actuators and appurtenant equipment to ensure proper working order. Operate valve, open and close at system pressures.

END OF SECTION

SECTION 15104
BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ball valves.

B. Related Sections include but are not necessarily limited to:
   1. Sarasota County Government Bidding Requirements.
   2. Section 15067 - Pipe - Polyethylene
   3. Section 15100 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Gray Iron Castings for Valves Flanges, and Pipe Fittings.
      c. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   2. American National Standards Institute (ANSI):
      a. B16.34, Valves-Flanged, Threaded, and Welding End.
   3. American Water Works Association (AWWA):
      a. C507, Ball Valves 6 Inch through 48 Inch Diameter.
   4. Federal Specification:
      a. WW-V-35C, Valve, Ball.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100.

B. Operation and Maintenance Manuals: See Section 01340.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 METALLIC BALL VALVES

A. Acceptable Manufacturers:
   1. Apollo.
   2. Jamesbury.
   3. Watts.
   4. Stockham.
   5. Nibco.
   6. CF Fluid Controls, Inc.
   7. Or equal.

B. Materials:
   1. Body: Stainless Steel.
   2. Stem, stem gland nut: Stainless Steel.
   3. Ball: Stainless Steel.
   4. Seats, stuffing box ring, and thrust washer: Reinforced Teflon.
   5. Handle: Vinyl coated or zinc- or cadmium-plated steel.

C. Design Requirements:
   1. Rated for 400 psi and 250 DegF, WOG for threaded end applications and 1000 psi WOG and 150 psi saturated steam service for flanged end applications.
   2. Handles showing direction of opening.
   3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
   4. Stem with reinforced Teflon stuffing box ring and blowout-proof design.
   5. Renewable reinforced Teflon seats.
   6. Ball design which does not allow media contact with stem.
   7. Balancing stop for all applications.
   8. Bodies with mounting pad for applications requiring actuators.
   9. Stem extensions for piping systems with insulation
   10. Provide valves in pneumatic piping systems meeting OSHA requirements for automatic drains.

2.3 PVC BALL VALVES

A. Acceptable Manufacturers:
   1. Thermoplastic Valves, Inc.
   2. Or equal.

B. Materials:
   1. Body: PVC, PVDF.
   2. Stem, stem gland nut: PVC, PVDF.
   3. Ball: PVC, PVDF.
   4. Seats, stuffing box ring, and thrust washer: Reinforced Teflon.
   5. Handle: ABS.

C. Design Requirements:
   1. Rated at 150 psi at 75 DegF
   2. Handles showing direction of opening.
   3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
   4. Ball design which does not allow media contact with stem.

2.3 ACCESSORIES

A. Refer to Drawings for type of actuators.
   1. Furnish actuator integral with valve.

B. Refer to Section 15100 for actuator requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 15100.

END OF SECTION

Dept. Of Environmental Protection
SEP 2 1 2011
Southwest District

ATTACHMENT C

PERMIT SPECIFICATIONS AND CQA PLAN WITH TRACKED CHANGES

Sarasota County
Solid Waste Operations

Central County Solid Waste Disposal Complex Phase I Class I Landfill Closure and Landfill Gas Collection System Construction Quality Assurance Plan

~~July~~October 2010

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HDR Project No. 0096-125174-002

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SECTION 1.0
INTRODUCTION

1.1 PURPOSE

This Construction Quality Assurance (CQA) Plan is a document that contains requirements for testing materials and monitoring construction of the Sarasota Central County Solid Waste Disposal Complex Phase I Class I ~~landfill Phase I~~ Landfill Closure and Landfill Gas Collection System, including the responsibilities of CQA personnel, documentation control, and reporting procedures.

The plan was prepared to provide the Owner, Design Engineer, CQA Engineer, and the Contractor the means to govern the construction quality; to satisfy environmental protection requirements for current solid waste management regulations; and utilize state-of-the-art construction practices and testing procedures to adequately document proposed construction activities. The proposed construction, testing, and documentation procedures are also intended to provide the necessary safeguards and provisions accepted by the Owner upon completion. The roles of each party have been sufficiently defined and the level of responsibility explained. The proposed final cover system will be constructed in accordance with the design, the construction documented, and respective components approved and certified for acceptance.

More specifically, this CQA Plan addresses the soils and geosynthetics components of the final and temporary final cover system. Specific work elements include the following:

- Initial Cover
- Intermediate Cover
- Final Cover liner which consists, from bottom to top, of
    - 40-mil LLDPE liner (textured),
    - geocomposite drainage layer
- Protective cover
- Pipes and fittings
- Vegetative Layer
- Top Soil
- TPO Geomembrane for Temporary Final Cover
- Landfill Gas Collection System piping and components

The CQA Engineer has the primary responsibility of implementing and managing the CQA program described in this plan. When construction is complete, the CQA organization will prepare a construction certification report that will include information generated through the CQA program and will document the extent to which construction was performed in accordance with the contract documents.

The CQA Plan is intended to be a supporting document to improve the overall implementation of the work. The Contractor is instructed to bring discrepancies in the contract documents to the attention of the Design Engineer or CQA Engineer for resolution. The Design Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents. Unless otherwise determined by the Design Engineer, the more stringent requirement shall be the controlling resolution.

1.2 REFERENCE DOCUMENTS

In addition to the methods, procedures and requirements outlined in this CQA Plan refer to the following documents:

- Florida Department of Environmental Protection (FDEP) Chapter 62-701.400; 62-701.600
- Project Plans and Specifications
- Manufacturer's Quality Assurance Manuals (where applicable)
- Contractor's Construction Quality Control Plan .
- EPA/600/R-93/182
- ASTM International - Current Edition

1.3 DEFINITIONS

This section provides definitions for terms used in this CQA Plan.

Contract Documents – All contractor submittals, construction plans, as-built plans, construction specifications, QA plan, safety plan and project schedule.

CQA Organization – The company and persons including CQA Engineer, CQA Inspector, and CQA Laboratories whose primary responsibility is to implement the CQA Plan.

CQA Plan – The document contained herein, entitled Central County Solid Waste Disposal Complex Phase I Closure Construction Quality Assurance Plan prepared for Sarasota County Solid Waste Operations by HDR Engineering, Inc.

Project Plans and Specifications - All project related plans and specifications including design modifications and as-built plans.

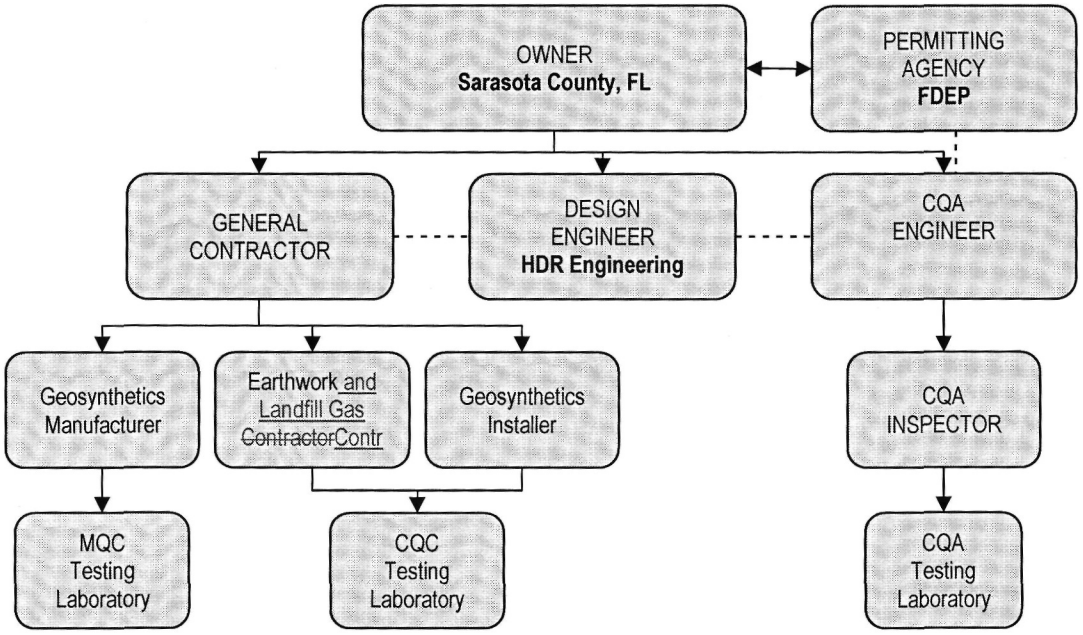
Quality Control - Actions taken by the geomembrane manufacturer and installer to ensure that the geosynthetic materials and workmanship meet the requirements of the Project Plans and Specifications.

Work - All tools, equipment, supervision, labor and material or supplies necessary to complete the project as specified herein and as shown on the Project Plans and Specifications.

SECTION 2.0
RESPONSIBILITY AND AUTHORITY

The principal organizations involved in permitting, designing and construction of the solid waste disposal facility include the permitting agency, facility owner/operator, Design Engineer, CQA organization, and Contractor. The principal organizations, their areas of responsibility and lines of authority as delineated for the CQA Plan are shown in the organization chart below and described fully in this section. This establishes the necessary lines of communication that will facilitate an effective decision making process during implementation of the CQA Plan.

Figure 1
CQA/CQC Organization Chart



2.1 PERMITTING AGENCY

The Florida Department of Environmental Protection (FDEP), as permitting agency, is authorized by law to issue a permit for the construction of landfill closure. It is the responsibility of the FDEP to review the facility owner/operator's permit application, including the site-specific CQA Plan, for compliance with FDEP's regulations and to make a decision to issue or deny a permit based on this review. The FDEP has the responsibility and authority to review and accept or reject any design revisions or requests for variance that are submitted by the facility owner/operator after the permit is issued. The FDEP also has the responsibility and authority to review all CQA documentation during or after construction to confirm that the approved CQA Plan was followed and that the construction was completed as specified in the design.

2.2 FACILITY OWNER/OPERATOR

Sarasota County, Florida ("Owner") is the facility owner/operator and is responsible for the design, construction, operation and closure of the solid waste disposal facility. This responsibility includes complying with the requirements of the FDEP in order to obtain a permit and assuring the FDEP, by the

submission of CQA documentation, that the facility was constructed as specified in the design. The Owner has the authority to select and dismiss organizations charged with design, CQA, and construction activities. The Owner also has the authority to accept or reject design plans and specifications, CQA Plans, reports and recommendations of the CQA Engineer, and the materials and workmanship of the contractor.

2.3 DESIGN ENGINEER

HDR Engineering, Inc. is the Design Engineer and is primarily responsible for designing the landfill closure for the solid waste disposal facility that fulfills the requirements from the Owner and the FDEP. Design activities shall not end until construction of the closure is completed. The Design Engineer may be requested to change some component designs if unexpected site conditions are encountered or changes in construction methodology occur that could adversely affect landfill construction. Implementation of the CQA Plan provides assurance that these unexpected changes or conditions will be detected, documented, and addressed during construction.

The Owner has the authority to delegate additional responsibility and authority to the Design Engineer by expressed consent (i.e., a contractual agreement). Additional responsibilities and authority may include formulating and implementing a site-specific CQA Plan, periodic review of CQA documentation, modifying construction site activity, and identifying corrective measures in cases where deviation from the specified design or failure to meet design criteria, plans, and specifications is detected by the CQA Engineer.

2.4 CONSTRUCTION QUALITY ASSURANCE ORGANIZATION

2.4.1 Construction Quality Assurance Engineer (CQA Engineer)

The CQA Engineer is a party, independent of the manufacturer and the contractor, with responsibility for implementing this CQA plan. The CQA Engineer is responsible to the Owner but will function independently of the Owner and Contractor. At a minimum, the CQA Engineer is a Florida Registered Professional Engineer who possesses adequate formal academic training in engineering and managerial experience to successfully oversee and implement construction quality assurance activities for solid waste disposal facilities. The CQA Engineer is responsible for the following:

- Reviewing design criteria, permit conditions, the Contractor's Construction Quality Control (CQC) plan, and project plans and specifications for clarity and completeness so that the CQA plan can be implemented.
- Educating CQA Inspectors on CQA requirements and procedures.
- Scheduling and coordinating CQA activities including sampling for conformance testing.
- Confirming that regular calibration of testing equipment is properly conducted and recorded.
- Reviewing and interpreting test data and reports.
- Rejecting defective work and verifying that corrective measures have been implemented.
- Certifying construction completion.
- Providing signed, sealed final report and record drawings to the FDEP after owner review and approval stating that the final cover and temporary final cover systems have been installed in substantial conformance with the Project Plans and Specifications.

2.4.2 Construction Quality Assurance Inspector (CQA Inspector)

In order to assist the CQA Engineer in providing full-time on-site oversight and monitoring services, a CQA Inspector will be named. The CQA Inspector is a person(s) or firm(s) independent of the Contractor and Geomembrane Installer and authorized by the CQA Engineer and Owner to manage and oversee the execution of the work. The CQA Inspector shall possess formal academic training in soils engineering, engineering geology or other closely associated discipline. All completed work is subject to approval of the CQA Engineer.

The following minimum qualifications must be met by the CQA Inspector:

- The CQA Inspector must have been in business for at least ten (10) continuous years of operation immediately prior to the date of this project.
- The CQA Inspector must have inspected and tested a minimum of five (5) liner projects consisting of at least 10,000,000 square feet of LLDPE, TPO and/or HDPE liner.
- The CQA Inspector shall provide one full-time Qualified Engineering Technician and other trained technicians to perform the required tests and inspections of the liner system.
- The Qualified Engineering Technician is qualified representative of the CQA Inspector, who is an engineering technician with a minimum of four years of directly related experience or a graduate engineer/geologist with one year of directly related experience.
- The CQA Inspector shall provide certified technicians to perform full time observation and documentation of activities related to the CQA of the liner system construction.
- The CQA Inspector must have registered full-time Professional Engineers on staff to sign, seal, and certify that the project was constructed in accordance with the contract documents.

The CQA Inspector's responsibilities include:

- Performing independent on-site inspection of the work in progress to assess compliance with the facility design, Project Plans and Specifications.
- Verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the standardized procedures defined by the CQA Plan.
- Reviewing design criteria, and Project Plans and Specifications for CQA requirements and procedures.
- Scheduling and coordinating inspection activities.
- Directing and supporting the inspection personnel in performing observations and tests by:
    - submitting test samples for analysis by the CQA laboratory,
    - confirming that regular calibration of testing equipment is properly conducted and recorded,
    - confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process,
    - recording and maintaining comprehensive documentation of the liner system construction, and
    - verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted in accordance with the CQA Plan and the Project Plans and Specifications.
- Providing to the CQA Engineer reports on the inspection results including:

- review and interpretation of all data sheets and reports,
- identification of work that the CQA Inspector believes should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval,
- rejection of defective work and verification that corrective measures are implemented, and
- verification that the Contractor's construction quality control plan is in accordance with the site-specific CQA Plan.

2.4.3 Construction Quality Assurance Laboratory (CQA Laboratory)

The CQA Laboratory will be independent of the geosynthetic manufacturer and installer. The CQA Laboratory will be qualified and responsible for material conformance testing for soil, geomembrane, geocomposite, and for destructive seam tests on the installed geomembrane. The CQA Engineer and CQA Inspector will be responsible for coordinating with the laboratory, sampling the geosynthetics or arranging for sampling at the manufacturing facility, and reviewing conformance testing.

- The CQA Laboratory shall possess testing equipment which is capable of testing the interface friction between the liner system components in accordance with ASTM standards.
- The CQA Laboratory shall possess testing equipment which is capable of testing LLDPE and TPO liner seams for peel and shear according to ASTM standards.
- The CQA Laboratory shall be familiar with ASTM, NSF and other applicable test standards. It shall have performed a minimum of 100 sets of peel and shear tests on seams of material the same type as specified.

2.5 CONSTRUCTION CONTRACTORS

2.5.1 Construction Contractor

It is the responsibility of the Contractor to construct the landfill final cover and temporary final cover system in strict accordance with design criteria, Project Plans and Specifications, using the required construction procedures and techniques. The chosen Contractor will be registered in accordance with applicable local, state, and federal requirements and will have prior landfill-related experience.

The Construction Contractor's responsibilities include but are not limited to:

- Constructing the final cover and temporary final cover system in strict accordance with the contract documents including Project Plans and Specifications using the necessary construction procedures and techniques.
- Formulating and implementing a Construction Quality Control (CQC) Plan in accord with requirements of the technical specification.
- Contracting with subcontractors, such as manufacturers and specialty installers, and coordinating their activities.
- Supplying required materials and supporting QC documentation either directly or through subcontractors.

- Discussing procedures for locating and protecting construction materials and for implementing methods for preventing damage of the materials from inclement weather or other adverse effects.
- Coordinating activities with the CQA Engineer and CQA Inspector and providing the CQA organization with all necessary documentation as detailed in this plan.
- Updating original construction drawings and specifications to reflect any deviation from the original plans and furnishing as-built record drawings and all required quality control documentation.
- Planning and monitoring construction site health and safety procedures.
- Approving shop drawings prior to submission to the CQA Engineer.
- Determining and verifying:
    - field measurement,
    - field construction criteria,
    - catalog numbers and similar data, and
    - conformance to Project Plans and Specifications.
- Coordinating each submittal with other submittals and with the requirements of work and of the Project Plans and Specifications
- Notifying the CQA Engineer in writing, at time of submission, of any variance in the submittals from the requirements of the Project Plans and Specifications. Any such deviations permitted by the Design Engineer will require modifications to the Project Plans and Specifications.

2.5.2 Site Supervisor

The Construction Contractor will be represented in the field by a Site Supervisor. The Site Supervisor is responsible for the following:

- Scheduling and coordinating work including subcontractors.
- Informing the CQA Inspector and CQA Engineer of any discrepancies between the Project Plans and Specifications and field conditions.
- Coordinating with the CQA Inspector and CQA Engineer.
- Attending project meetings.
- Maintaining a daily log of construction and quality control activities.
- Implementing and verifying CQC procedures.
- Submitting proposed alternative materials or construction methods for approval before acquisition and use.
- Construction.

2.5.3 Geomembrane Installation Contractor (Geomembrane Installer)

The Geomembrane Installer may be a general contractor, a subcontractor to the general construction contractor, or a specialty contractor hired directly by the Owner. The Geomembrane Installer has not been chosen at this time. The selected contractor will have experience in installing at least 10 million square feet of geosynthetics.

The Geomembrane Installer or their CQC Consultant will be responsible for the following:

- Coordinating with the general contractor and CQA Inspector.

- Handling, storing, placing, and installing manufactured materials.
- Implementing and verifying a manufacturer and installer QC plan.

2.5.4 Thermoplastic Polyolefin Geomembrane Installer

Thermoplastic Polyolefin (TPO) geomembrane installer will demonstrate 5 years continuous experience with a minimum ~~5~~10,000,000 square feet of ~~TPO~~ geomembranes. The installer will be trained and certified by at least one of the named manufacturers in this Specification (not necessarily the manufacturer supplying materials for this Project).

Geomembrane Installer Personnel Qualifications:

- Installation Superintendent shall have worked in a similar capacity on at least five geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
- The Master Welder shall have completed a minimum of 5,000,000 square feet of ~~TPO~~ geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
- Other welders shall have seamed a minimum of 1,000,000 square feet ~~of TPO~~ geomembrane.

SECTION 3.0
INTERMEDIATE AND PROTECTIVE SOIL COVER

This section contains procedures and tests, which must be implemented in order to ensure the soil components of the final and temporary final cover systems meet the design standards. This is a critical component of the Construction Quality Assurance Plan. All required tests and sampling procedures within this section shall be performed in accordance with generally accepted engineering procedures. Table 3-1 contains a listing of applicable test procedure standards for the intermediate and protective cover soils.

3.1 INTERMEDIATE SOIL COVER

3.1.1 Preconstruction

Soil materials to be used as intermediate cover shall consist of select borrow material meeting all requirements specified in Specification Section 02200, Earthwork. The borrow material for intermediate cover must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on drawings. ~~If fill comes from~~In addition, soil provided by the Owner, from an off-site soil recovery project may be provided for use in the lower 6-inches of intermediate cover. The off-site soil must pass the material requirements of this plan and technical specifications. For all other soils from an off-site location, Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

Table 3- 1
Intermediate and Protective Cover Test Procedure Standards

STANDARD	TEST DESCRIPTION
ASTM D422	Method for Particle-Size Analysis of Soils
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12, 400 ft-lb/ft^2)
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
ASTM D2487	Test Method for Classification of Soils for Engineering Purposes (United Soil Classification System)
ASTM D2488	Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D3017	Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
ASTM D2216	Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D2937	Test Method for Density of In-Place Soils by Drive-Cylinder Method

Soil for the intermediate cover should be free of deleterious material (organics, sticks, roots, waste, etc.) and rock fragments, boulders or cobbles greater than three inches in size. Fines content of installed soil shall be a maximum of 50% (passing #200 sieve) and monitored as specified in the Project Plans and Specifications. Soil shall classify as SP, SW, SC, SM, SP-SM, or SP-SC in accordance with ASTM D2487 or ASTM D2488.

The intermediate cover layer shall be placed and compacted in accordance with specification section 02200, Earthwork, Part 3.6.E. The CQA Inspector shall test materials and monitor compliance with requirements of the Project Plans and Specifications. All observations and tests shall be conducted at locations selected by the CQA Inspector who has been assigned responsibility for verification and documentation of the element in question.

3.1.2 Construction

The following is an outline of the minimum construction requirements for the intermediate cover. For more detailed information, see the specification Sections 02200, Earthwork, 02775, LLDPE Geomembrane Liner System, and 02771 TPO Geomembrane .

- Strip vegetation from existing cover soils and dispose at a location designated by Owner.
- Verify that a minimum of 18 inches of cover soils exist after stripping operations. Add additional soil as needed to fill surface depressions and achieve a minimum thickness of 18 inches. Surface shall be smooth without irregularities unless shown on the drawings.
- Approval from CQA Inspector with regard to suitability of soils and acceptable subgrade.
- Atmospheric conditions observed and recorded by the CQA Inspector and appropriate actions taken when unsuitable weather conditions exist.
- Dust control continuous throughout the intermediate cover operations.
- Verify grade control is established to control thickness of material placed.
- Verify final grading completed in accordance with specification Section 02200, Earthwork.
- Intermediate cover compacted to specified requirements provided in Section 02200.
- Surface of intermediate cover soils proof-rolled in accordance with technical specification Section 02200 Part 3.2.F.
- Verify minimum thickness of the soils and geomembrane materials is achieved in accordance with the specifications.
- Provide as built survey of intermediate cover sealed by a professional land surveyor illustrating construction of all design features.
- Approval from CQA Inspector with regard to final surface smoothness and uniformity. Any objects protruding from the final surface or coarse fragments within the surface material that may damage the geomembrane will be removed.
- The required thickness of intermediate cover will be verified, as described in Specification 02200 – Earthwork, on an established grid system with not less than one verification point per 10,000 square feet of surface.

Table 3- 2
Intermediate Cover Conformance and Construction Testing

TEST DESCRIPTION	STANDARD	TEST FREQUENCY
Intermediate Cover		
Density, Nuclear Method	ASTM D2922	1 per 1,500 yd^3
Moisture Content, Nuclear Method	*ASTM D3017*	*1 per 1,500 yd^3*
Sand Cone or Drive Cylinder Method	ASTM D2937	1 per 20 nuclear tests
Oven Moisture Content Verification	ASTM D2216	1 per 20 nuclear tests
Moisture Density Relations	ASTM D698	1 per 20,000 yd^3 *
Sieve Analysis	ASTM D422	1 per 20,000 yd^3 *

* Increase frequency as needed to ensure each soil type is tested.

3.2 PROTECTIVE COVER

3.2.1 Preconstruction

Soil materials to be used as the 24-inch thick protective cover over the geomembrane (including 6-inch thick topsoil cover) shall consist of select borrow material meeting all requirements specified in Specification Section 02200, Earthwork. The borrow material for protective cover must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on the drawings. If cover soil comes from off-site location, the Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

Soil for the bottom 18 inches of protective cover should be free from deleterious material (organics, sticks, roots, etc.) and rock fragments, boulders or cobbles greater than three inches in size. The upper 6 inches of protective cover shall meet the same criteria except that the soil shall contain sufficient organics to promote vegetative growth.

The protective cover layer shall be placed and compacted in accordance with the specification Section 02200, Earthwork, Parts 3.1 G through M and 3.6.E. The CQA Inspector will observe that placement of the soil material is done in a manner to protect the geocomposite. The CQA Inspector shall test materials and monitor compliance with requirements of the Project Plans and Specifications. All observations and tests shall be conducted at locations selected by the CQA Inspector who has been assigned responsibility for verification and documentation of the element in question.

Table 3- 3
Protective Cover Conformance and Construction Testing

TEST DESCRIPTION	STANDARD	TEST FREQUENCY
Intermediate Cover		
Density, Nuclear Method	ASTM D2922	1 per 1,500 yd^3
Moisture Content, Nuclear Method	ASTM D3017	1 per 1,500 yd^3
Sand Cone or Drive Cylinder Method	ASTM D2937	1 per 20 nuclear tests
Oven Moisture Content Verification	ASTM D2216	1 per 20 nuclear tests
Moisture Density Relations	ASTM D698	1 per 20,000 yd^3 *
Sieve Analysis	ASTM D422	1 per 20,000 yd^3 *

* Increase frequency as needed to ensure each soil type is tested
Note: Testing is not required for topsoil layer

3.2.2 Construction

Protective cover should be stable for construction and maintenance traffic. Care will be exercised in placement so as not to shift, wrinkle or damage the underlying geosynthetic layers, and the placement methods will be documented by the Contractor and CQA Inspector.

The protective cover shall be placed under the direct supervision of the CQA Inspector. The Contractor shall utilize care to avoid damage to the geocomposite. No vehicular traffic will be permitted on the unprotected liner system except low ground pressure equipment necessary for the deployment and installation of liner system. The loose thickness of the initial lift of protective cover shall not be less than 12 inches and spread with low ground pressure equipment (maximum pressure 10psi). Fill shall be placed by equipment starting at the toe of slope and spreading toward the top of slope. Material shall not be placed over standing water or ice.

The following is an outline of the minimum construction requirements for the protective cover. For more detailed information, see specification section 02200, Earthwork:

- Approval from CQA Inspector with regard to suitability of soils.
- Atmospheric conditions observed and recorded by the CQA Inspector and appropriate actions taken when unsuitable weather conditions exist.
- Dust control continuous throughout protective cover operations.
- Verify the underlying geocomposite construction is complete before material installation.
- Verify grade control is established to control thickness of material placed.
- For placement of material over geosynthetics, monitor 12-inch minimum thickness of material below spreading equipment and the spreading equipment has a ground pressure rating equal to or less than 10psi. During placement of material, identify geocomposite damaged during material installation and establish that the damage is repaired.
- Monitor haul road thickness over geocomposite and verify that equipment hauling and placing material over geocomposite meets equipment specifications.

- Monitor placement of material over piping and verify that pipe is not damaged by occasionally uncovering piping.
- Monitor equipment speed over material.
- Verify lower 18 inches of protective cover compacted to specified requirements. Do not compact topsoil layer beyond tracking it in.
- Verify final grading completed in accordance with specification section 02200, Earthwork.
- Verify minimum thickness is achieved in accordance with specifications.
- Install sod in accordance with specifications.
- Approval from CQA Inspector with regard to final surface smoothness and uniformity.
- Provide as-built survey of protective cover sealed by a professional land surveyor illustrating construction of all design features.

The required thickness of protective cover will be verified, as described in Specification 02200 – Earthwork, on an established grid system with not less than one verification point per 10,000 square feet of surface.

SECTION 4.0
GEOMEMBRANE LINER

This section covers the work necessary to construct and test the geomembrane lining system, which will consist of a 40 mil Linear Low Density Polyethylene (LLDPE) liner material (top, north and east slopes) in accordance with specification Section 02775, LLDPE Geomembrane Liner Systems and a 60 mil Thermoplastic Polyolefin (TPO) Geomembrane (south slope) in accordance with specification Section 02771, TPO Geomembrane. The geomembrane material and installation will be in accordance with specification Sections 02775 and 02771. The LLDPE and TPO liner materials shall be new, first quality products designed and manufactured specifically for the purposes of the Work and shall have satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes. All LLDPE geomembranes will be textured on both sides– and shall be an unmodified LLDPE containing no plasticizers, fillers, chemical additives, or extenders. The only other compound ingredients to be added to the LLDPE geomembrane resin shall be anti-oxidants and heat stabilizers required for manufacturing. The LLDPE geomembranes shall be supplied as a single ply continuous sheet with no factory seams and in rolls with a minimum width of 22 feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams. The requirements for the TPO geomembrane will meet the minimum requirement as illustrated in specification Section 02771.

Extrusion resin used for fusion welding with extrudate to make field seams between geomembrane sheets and for repairs shall be LLDPE or TPO produced from, and the same as, the geomembrane sheet resin. Physical properties shall be the same as LLDPE or TPO geomembrane sheets.

The geomembrane liner shall conform to the testing requirements of GRI Standard GM17 - "*Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes*" (Geosynthetic Research Institute; Philadelphia, PA) and requirements of Section 02771 for TPO geomembrane.

4.1 PRECONSTRUCTION

4.1.1 Certification of CQA Plan Conformance

Prior to start of work, the Geosynthethics Manufacturer and the Geomembrane Installer, each, shall submit for approval by the CQA Inspector documented evidence of its ability and capacity to perform this Work. Each shall have successfully manufactured and/or installed a minimum of ten (10) million square feet of similar lining material in solid waste containment structures.

The Contractor shall submit written certification by the Geosynthetics Manufacturer that the lining materials conform to the requirements of the CQA Plan. The Contractor shall submit the name and qualifications of its project superintendent that will be on the project whenever lining materials are being handled and/or installed plus the names and qualifications of senior installation personnel on the project. All manufacturer and Geomembrane Installer qualifications shall be submitted in accordance with technical specification Sections 02775 and 02771 Part 1.2.B.

4.1.2 Geomembrane Installer's and Manufacturer's QC Program

The Geosynthetics Manufacturer and the Geomembrane Installer, each, shall submit a complete description of its quality control (QC) program, as applicable, for manufacturing, handling, installing, testing, repairing and providing a completed lining in accordance with requirements of the CQA Plan and contract documents. The description shall include, but not be limited to, polymer resin supplier, product identification, acceptance testing, fabrication and production testing, installation testing, documentation of changes, alterations and repairs, retests and acceptance.

The following quality control tests will be performed on the geomembrane ~~by the CQA inspectors~~.

Table 4- 1
MQC Conformance Testing for LLDPE Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D6693, Type IV, 2 ipm	Standard Test Method for Determining Tensile Properties of Non-reinforced Polypropylene and Non-reinforced Flexible Polypropylene Geomembranes	Every 20,000 lbs
ASTM D1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting	Every 45,000 lbs
ASTM D1505/D792	Standard Test Method for Density of Plastics by the Density-Gradient Technique	Every 200,000 lbs
ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer	One per rail car compartment
ASTM D1603	Standard Test Method for Carbon Black Content in Olefin Plastics	Every 20,000 lbs
ASTM D3895	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry	Every 200,000 lbs
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products	Every 45,000 lbs
ASTM D5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics	Every 45,000 lbs
ASTM D5994[1]	Standard Test Method for Measuring Core Thickness of Textured Geomembrane	Every roll
GRI GM12	Asperity Height	Every other roll

1. Textured Geomembrane Only.

Table 4- 2
MQC Conformance Testing for TPO Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D751	Thickness	Per roll
ASTM D4885	Tensile Properties	Once per day or 20,000 lb
ASTM D751	Tear Resistance	Once per day or 45,000 lb
Visual	Scrim Orientation	Every Lot or Every Scrim Roll

4.1.3 Geomembrane Installer's Installation Plan

The Installer shall submit installation drawings, the Manufacturer's written Field Installation Procedure Manual, and a schedule for performing/completing the Work. Installation drawings shall show a lining sheet layout with proposed size, number, position, and sequence of placing of all sheets and indicating the location of all field seams. Installation drawings shall also show complete details and/or methods for anchoring the lining at its perimeter, making field seams, and making anchors/seals to pipes and structures.

The Installer shall submit a complete description of welding procedures for making field seams and repairs. The welding procedures shall conform to the latest procedures recommended by the lining Manufacturer~~.~~.

The Contractor and Geomembrane Installer shall submit for approval, by the CQA Inspector, certification that the surface(s) on which the lining will be placed is acceptable. Installation of the lining shall not commence until this certification is furnished to the CQA Inspector.

The Geomembrane Installer shall provide on-site technical supervision and assistance at all times during installation of the lining system. The Geomembrane Installer and Contractor, as applicable to each, shall submit for approval by the CQA Inspector written certification that the lining system was installed in accordance with the Manufacturer's recommendation, the CQA Plan, Project Plans, Specification Sections 02775 and 02771, and approved submittals.

The CQA Engineer will initiate a pre-installation meeting with the Geomembrane Installer, Contractor, and CQA Inspector prior to installation of the lining system. Topics for review/discussion shall include, as a minimum, Project Plans and Specifications, approved submittals, and training and qualification procedures for Contractor personnel.

Prior to installation of the lining system, the Geomembrane Installer shall instruct the workmen of the hazards of installation, such as handling sheets of lining material in high winds; use of equipment; application of solvents, adhesives and caulks; and walking on lining surfaces. Work gloves, safety glasses, hard hats, and smooth-soled shoes are minimum safety wear requirements when working on the geomembrane. Safety shoes must be worn when handling heavy objects.

The Owner shall have authority to order an immediate stoppage of work because of improper installation procedures, safety infractions, or for any reason which may result in a defective liner.

4.1.4 Contractor's Geomembrane Preconstruction Material Submittals

The Contractor will provide the CQA organization with the following items for review and testing:

- Results of interface friction testing for the geomembrane proposed for the project as outlined in this CQA Plan.
- Manufacturer's description (cut sheet) of the proposed geomembrane documenting it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geomembrane will meet specified interface friction angle.

- Written instructions for storage, handling, installation, seaming, and repair of the proposed geomembrane consistent with the technical specifications, project plans, and the manufacturer's recommendations.

Before shipment of the geomembrane, the CQA organization shall review all approved pre-construction submittals. Pre-construction submittals should be submitted a minimum of four weeks in advance to allow time for review and approval by the CQA organization.

The Contractor shall submit certifications that the LLDPE and TPO geomembrane material delivered to the site meets the requirements of the Specification and that the LLDPE and TPO geomembrane was received and accepted in undamaged condition from shipper.

4.1.5 CQA Conformance Testing

The geomembrane material will be sampled at the site by the CQA Inspector or at the manufacturing plant by a third party under the direction of the CQA organization. The sample will be taken across the entire roll width and will be 3 feet long. Samplers will mark the machine direction and the manufacturer's roll identification number on the sample. Samplers will also assign a conformance test number to the sample and mark the sample with that number. The samples will be forwarded to a CQA testing laboratory for the conformance testing. The CQA Inspector will review all conformance test results and report any nonconformance to the Owner and CQA Engineer.

The following conformance tests will be performed on the LLDPE geomembrane at the frequencies indicated in Table 4-3.

Table 4- 3
CQA Conformance Testing for LLDPE Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D6693	Standard Test Method for Determining Tensile Properties of Non-reinforced Polypropylene and Non-reinforced Flexible Polypropylene Geomembranes	Every 20,000 lbs
ASTM D6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.	Every 500 LF of seam
ASTM D5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method	One per project

Table 4- 4
CQA Conformance Testing for TPO Geomembranes

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D 4637	Thickness	1 test per 100,000 ft^2
ASTM D 4885	Tensile Strength at Break	1 test per 100,000 ft^2
ASTM D 4885	Elongation at Break	1 test per 100,000 ft^2
ASTM D 5884	Tear Strength	1 test per 100,000 ft^2

STANDARD	TEST DESCRIPTION	FREQUENCY OF TESTING
ASTM D 4833	Puncture Resistance	1 test per 100,000 ft^2
ASTM G 155	Resistance to Xenon-Arc Weathering	~~1 test per 100,000 ft^2~~ Manufacturer's Certification Only
ASTM D 1149	Ozone Resistance	1 test per 100,000 ft^2
ASTM D5321	Interface Friction	One for each interface identified for the project by the Engineer

Laboratory interface friction tests shall be conducted in general accordance with ASTM D5321, on the following interfaces:

- Textured LLDPE liner and geocomposite
- Textured LLDPE liner and intermediate cover soil
- TPO geomembrane and 16 oz/sy geotextile

The CQA Laboratory will perform three (3) direct shear tests at the project specific effective normal stresses. These tests will be performed using the Contractor's proposed geosynthetic materials for above interfaces following award of the construction contract to the selected Contractor. Samples of intermediate cover soil and protective cover soil (if different than the intermediate cover soil material) proposed for the project will also be obtained for testing. A minimum interface friction angle based on the landfill design will be required to maintain stability. The project specific testing parameters for direct shear testing, including the effective normal stresses and minimum required interface friction angles, for the TPO and LLDPE materials are provided in technical specification Section 02771-2.2 Table 2 and Section 02775-2.3, respectively.

The Owner will pay for "Passing" tests. Costs of corrective action, costs of "Failing" tests and all associated costs of testing due to failing tests will be paid by the Owner and the cost reimbursed to the Owner by the Contractor. Materials not meeting the required shear strength will not be approved for use on this project.

4.2 CONSTRUCTION

4.2.1 Delivery, Storage and Handling

Materials will be delivered to the site after the required submittals have been furnished and approved. The delivered roll goods will be marked by the manufacturer to show at a minimum the following information:

- Name of manufacturer.
- Product type.
- Product thickness.
- Manufacturing batch code.
- Date of manufacture.
- Physical dimensions.

- Roll number.

Lining materials delivered to the site shall be inspected for damage, unloaded, and stored with a minimum of handling. Each roll shall be wrapped in an opaque and waterproof layer of plastic during shipment and storage. The plastic wrap shall not be removed until deployment. Materials shall not be stored directly on the ground. The storage area shall be such that all materials are protected from mud, soil, dirt and debris. The stacking of lining shall not be higher than two rolls.

Under no circumstances shall the lining be subjected to materials, sandbags, equipment or other items being dragged across its surface. Nor shall workmen and others slide down slopes atop the lining. All scuffed surfaces resulting from abuse of any kind caused by the Contractor in performance of the Work shall be repaired at the CQA Inspector's direction.

LLDPE or TPO geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed. LLDPE or TPO shall not be exposed to temperatures in excess of 60°C (140°F) or less if recommended by the Manufacturer.

No hooks, tongs or other sharp instruments shall be used for handling the LLDPE or TPO geomembrane. Rolls shall not be lifted by use of cables or chains in contact with the LLDPE or TPO geomembrane. LLDPE or TPO geomembrane shall not be dragged along the ground.

The Contractor shall be completely responsible for shipping, storage, handling, and installation of all lining materials in compliance with the CQA Plan.

4.2.2 Geomembrane Subsurface Preparation

Before geomembrane installation, the CQA Inspector will document that the intermediate cover installation is complete and CQC and CQA documentation verifies that subsurface has been prepared in accordance with specification Sections 02775 and 02771.

4.2.3 Geomembrane Placement and Seaming

Prior to installation of the geomembrane, a site inspection will be conducted by the CQA Inspector and the Contractor to verify measurements, structures and surface conditions to support the geomembrane.

The Contractor and Geomembrane Installer will provide written documentation to the CQA Inspector that surfaces to receive the geomembrane have been inspected and are acceptable for installation of the lining.

Before the work begins, the Contractor will inspect all lining materials for damage from transit. Materials that cannot be repaired will be rejected and removed from the work area and site.

During unwrapping of lining materials for use and placement, the Contractor will visually inspect all materials, particularly surfaces of lining sheets, for imperfections and faulty areas. All such defective places will be marked and repaired in accordance with approved methods.

The geomembrane will be installed as shown on the project plans and approved installation drawings. Placement of the geomembrane will be done such that good fit, without bridging, is provided on all covers and grade changes. Excessive slack will be avoided to minimize rippling during the soil cover operation. Geomembrane liner shall be handled and placed in a manner which minimizes wrinkles, scratches and crimps.

Sheets of geomembrane materials will be of lengths and widths and will be placed in a manner as to reduce field seaming to a minimum. The lining will be anchored in accordance with details shown on approved plans and drawings. The lining will be anchored and sealed to structures, pipes and other types of penetrations, (if any), in accordance with details shown on approved plans and drawings. All changes in approved installation drawings and procedures must be approved by the Design Engineer.

Extreme care will be taken during installation of the lining to be certain no damage is done to any part of the lining. Dragging of the geomembrane material on the prepared subgrade will be prohibited. Smoking will be prohibited for all personnel. All handling and installation procedures will be performed by workers wearing shoes with smooth soles. Shoes with soles that have patterns in relief shall be prohibited. No foot traffic will be allowed on the geomembrane except with approved shoes. No vehicular traffic will be allowed on the geomembrane except low ground pressure equipment necessary for the deployment and installation of the lining system. All motor driven equipment using fuel will have spark arrestors. No gasoline driven generators or cans of gas or solvent will be placed directly on the lining material. Under no circumstances will the lining be used as a work area to prepare patches or to store tools and supplies. If needed, a tarpaulin of approved material will be spread out as a work area.

During installation, the Contractor will be responsible for protecting the lining against adverse effects of high winds such as uplift. Sand bags will be used as required to hold the lining material in position during installation. Sand bags will be sufficiently close-knit to preclude fines from working through the bottom, sides or seams. Paper bags, whether or not lined with plastic, will not be permitted. Burlap bags, if used, must be lined with plastic. Bags that are split, torn, or otherwise losing their contents will be immediately removed from the work area and any spills immediately cleaned up. Metal or wire ties will not be used.

The geomembrane material will not be installed under adverse climatic conditions, unless the Contractor can demonstrate that his installation techniques adequately compensate for such adverse conditions and quality of workmanship is not compromised. Adverse climatic conditions occur when the air temperature measured 6 inches above the geomembrane surface is less than 41°F and decreasing, or more than 104°F; when it is raining; or when there is frost on the ground; or during conditions of excessive winds.

Geomembrane field seams will be lap seams as shown on approved plans and drawings. The lap seams will be formed by lapping the edges of geomembrane sheets a minimum of 3 inches unless otherwise specified in the approved plans and drawings. The contact surfaces of the sheets will be wiped clean to remove dirt, dust, moisture, and other foreign materials. Geomembrane shall not be welded when ambient temperatures are below 41°F or above 104°F without written consent of manufacturer and CQA Engineer or CQA Inspector. For fillet weld seams, bevel edge of geomembrane and clean oxidation from surfaces to receive extrudate by disk grinding or equivalent not more than one hour before seaming.

For the final cover system, lap seam intersections involving more than three thicknesses of lining material will be avoided, and all seam intersections will be offset at least 2 feet. No horizontal field seams will be allowed on the slope and sheets of lining material on the slopes will extend down slope to the perimeter anchor trench as shown on the drawings. For the temporary final cover system, wedge weld end of geomembrane panel to beginning of new geomembrane panel and continue downslope. Flap of wedge weld to be on top in the downslope direction as long as practically feasible. Welds connecting downslope

sheets shall be double wedge welds, and shall have a minimum of 10 feet vertical offset between adjacent panel welds. Wedge welds shall have a minimum of 3 inch overlap.

Geomembrane liners shall be welded using extrusion (LLDPE), hot air (TPO), single wedge or double wedge welding equipment (LLDPE and TPO). Extrusion welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the extrudate. Wedge welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the wedge. Geomembrane liners shall be welded continuously without fishmouths or breaks in the weld. Where fishmouths are unavoidable, the geomembrane sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle. The two edges of the slit shall be welded together provided that the overlap for this weld shall be a minimum of 6 inches. Areas of the slit that do not achieve an overlap of 6 inches, including the terminus of the slit, shall be provided with a patch.

Any necessary repairs to the geomembrane will be made with the lining material itself, using approved welding systems, equipment and techniques. The patch size will be 6 inches larger in all directions than the area to be patched. All corners of the patch will be rounded. Torn or permanently twisted geomembrane shall be replaced at no expense to the County.

All seams and seals of the geomembrane will be tightly bonded on completion of the work. Any lining surface showing injury due to scuffing or penetration by foreign objects or showing distress will be replaced or repaired as directed by the CQA Inspector.

Cleanup within the work area will be an ongoing responsibility of the Contractor. Particular care will be taken to insure that no trash, tools, and other unwanted materials are trapped beneath the lining. Care will be taken to insure that all scraps of lining material are removed from the work area prior to completion of the installation.

4.2.4 Emergency Gas Vents

Emergency gas vents will provide emergency pressure relief if the active gas collection system is shut down for an extended period of time or due to hotspots within the landfill. The active gas collection system serves as an integral part of the overall performance of the temporary final cover system, and the emergency gas vents are installed to provide backup relief if necessary. The emergency gas vents are designed to be directly connected to the active gas collection system if necessary to provide additional vacuum under the temporary final cover system. Typically, the emergency gas vents are capped until they are needed.

Each of the components of the emergency gas vents will be installed as specified in the Contract Documents. The vent installation observation will be performed during the construction of the cover system.

Post-construction inspection of the emergency gas vents will include the following:

- Observation to ensure that all system components have been installed as specified and according to the approved manufacturer's specifications and the engineering design.

4.2.5 Field Quality Control

Inspection and testing will involve the full time observation of the installation of the geomembrane, including the making and testing of lining seams and patches and periodic measurement of the liner material thickness to insure compliance.

Test welds will be made to verify that adequate conditions exist for field seaming to proceed. Each seamer and seaming equipment will produce a test seam at the beginning of each shift to determine the peel and tensile strength of the seam. The CQA Inspector may require a sample field seam be made at any time during seaming production to verify equipment/operator performance and seam integrity. In addition, if a seaming operation has been suspended for more than 1/2 hour or if a breakdown of the seaming equipment occurs, a test seam will be produced prior to resumption of seaming operations.

The trial weld sample must be a minimum of three feet long and one and a half feet wide, with the seam centered lengthwise. The CQA Inspector must observe all trial welding operations, quantitatively test each trial weld for peel and shear, and record the results. A minimum of two peel and two shear tests will be performed per trial seam. The trial weld shall be completed under the same conditions for which the panels will be welded. The trail weld must meet the requirements for peel and shear as stated in the following paragraph and the break must be a film tear bond (FTB) for a wedge weld.

During the field seaming operation, destructive samples will be removed from field seams by the Installer at locations selected by the CQA Inspector. Repairs to the field seams will be made in accordance with repair procedures specified in this CQA Plan. The samples will have a width of 12 inches plus the seam width and length of 48 inches. A minimum of one stratified sample per 500 feet of field seam will be made. All field seams will have a film tear bond in peel and shear and will meet the minimum pound per inch width seam strength specified in the specification Sections 02775 and 02271, LLDPE and TPO Geomembrane Liner Systems respectively. The bonded shear strength for fusion and extrusion welds must be greater than or equal to the appropriate values shown in the specifications. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam when necessary. The archived material will be kept at the CQA laboratory. Field testing shall include at least two peel tests per sample. CQA laboratory testing shall consist of five shear tests and five peel tests per sample. The Installer shall test the seam destructively at a frequency of one test per 500 linear feet of weld. Destructive seam-testing locations shall be cap-stripped and the cap completely seamed by extrusion welding to the geomembrane (LLDPE) or hot air welding for TPO geomembrane. Capped sections shall be non-destructively tested. Additional destructive test samples may be taken if deemed necessary by the CQA Inspector.

All field-tested specimens from a destructive-test location must be passing in both shear and peel for the seam to be considered as passing. Passing results, as specified in technical specification Sections 02771 and 02775, for both peel and shear for the seam must be received from the CQA laboratory to confirm the field testing and to accept the seam. The CQA testing laboratory will save all test samples including specimens tested until notified by the CQA Engineer relative to their disposal. All specimens which have failed under test will be shipped immediately by express delivery to the CQA Inspector for determination of corrective measures to be taken, which includes retest or repair of failed section.

For destructive samples which have failed the passing criterion, the Installer will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Installer may patch or cap strip the seam between the passed samples. If either fails, the Installer will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.

The Installer shall test all patch welds using one of the following nondestructive tests: vacuum tests, air lance (TPO hot air weld) or spark tests.

In the event capping of a field seam is required, the Installer will use a cover strip of the same thickness as the lining (and from the same roll, if available) and a minimum of 6 inch overlap away from the seam in all direction. It will be positioned over the center of the field seam and welded to the lining using a fillet weld each side.

All geomembrane sheets, seams, anchors, seals, and repairs will be visually inspected by the Installer for defects. Depending on seam welding equipment used, all seams and repairs will be tested continuously by a vacuum testing device, air pressure, or spark tests.

A visual inspection of the lining sheets, seams, anchors and seals will be made by the Installer and CQA Inspector as the installation progresses and again on completion of the installation. Defective and questionable areas will be clearly marked and repaired. Final approval of repairs will be given by the CQA Inspector.

If the fillet weld, extrusion lap weld, hot air weld, or single hot-wedge fusion lap weld is used to weld seams, the Installer will further test all seams and repairs in the geomembrane by vacuum box or by air lance test (hot air weld for TPO). All vacuum box testing will be done in the presence of the CQA Inspector. The area to be tested will be cleaned of all dust, debris, dirt and other foreign matter. A soap solution will be applied to the test area with a paint roller and the vacuum of 5 psi air pressure will be induced and held at least ten seconds to mark for repair any suspicious areas as evidenced by bubbles in the soap solution. All air lance testing will be performed in accordance with ASTM 3340.

If the double hot-wedge is used, the Installer will further test all seams in the geomembrane by using the air pressure test which consists of inserting a needle with gauge in the air space between welds. Air will be pumped into space at a pressure and held for a time as indicated in the specifications. If pressure does not drop more than the amount allowed in the specifications, then the seam is acceptable.

All costs of retesting of the geomembrane including reruns of field weld tests and all repairs will be at the Installer's expense.

The Installer shall assemble the quality control data required above into a final report of geomembrane installation. The report will contain all test data and a final layout of geomembrane liner which shows the location of all seams, patches and sample locations. In addition, the Installer shall submit resin tests, tests of sheet material, factory seam tests, daily seam test results, and daily results of production seam testing.

The Contractor will retain responsibility for the integrity of the geomembrane system until acceptance by the CQA Engineer. The geomembrane will be accepted by the CQA Engineer when:

- Written certification letters including as built record drawings, have been received by the CQA Engineer.
- Installation is completed.
- Documentation of completed installation, including all reports, is received and approved.
- Verification of adequacy of field seams and repairs, including associated testing, is complete.

Acceptance of the completed work will include receipt of all submittals and all work completed to the satisfaction of the CQA Engineer.

4.2.6 Geosynthetics Manufacturer's Warranty

The Geosynthetics Manufacturer's warranty shall be against manufacturing defects or workmanship and against deterioration due to ozone, ultraviolet or other normal weather aging. The warranty shall be limited to replacement of material only, and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals or unusual acts of God. The warranty shall state that the furnished material meets all requirements of specification Section 02775 or Section 02271 and the Contract Documents, is free from manufacturing defects and is able to withstand normal weathering for a period of five years, prorated. Written warranties addressing the LLDPE and TPO geomembrane material shall be furnished by the contractor and shall be made to Sarasota County.

4.2.7 Installer's Warranty

The Installer shall furnish a written guarantee that the entire lining work constructed by him to be free of defects in material and workmanship and installed pursuant to the CQA Plan for a period of two (2) years following the date of acceptance of the work by the CQA Engineer. During the 23rd month, a pre-guarantee expiration inspection will be conducted to identify any necessary repair work covered by the guarantee. The Installer shall agree to make any repairs or replacements made necessary by defects in materials or workmanship in the Work which become evident within said guarantee period. The Installer shall make repairs and/or replacements promptly, the Owner may do so, and the Installer shall be liable to the Owner for the cost of such repairs and/or replacements. The Installer's warranty shall state that the materials were properly installed, properly welded, seamed and jointed and will not fail within 2 years of installation under similar conditions. The warranty shall provide for complete repair/replacement for the warranty period. Written warranties addressing the LLDPE and TPO geomembrane material shall be furnished by the contractor and shall be made to Sarasota County.

SECTION 5.0
GEOTEXTILE

The following section outlines the CQA required for the installation of geotextiles. Non-woven cushion, drainage, and woven separator geotextiles will be used to protect the geomembrane and segregate the soil from drainage stone.

5.1 PRE-CONSTRUCTION

5.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the following:

- Manufacturer's description (cut sheet) of the proposed geotextiles documenting it will meet or exceed specified requirements.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geotextiles.

Before shipment of the geotextile, the CQA organization shall review all pre-construction submittals.

The CQA Inspector will take conformance samples for testing in accordance with this CQA Plan and the specification Section 02778, Geotextiles.

Table 5-1
Manufacturer's Quality Control Testing for Geotextiles

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Non-Woven Drainage Geotextile	Mass Per Unit Area (oz/yd^2)	ASTM D5261	One per 90,000 ft^2
	Grab Tensile Strength (lbs)	ASTM D4632	One per 90,000 ft^2
	Grab Tensile Elongation (%)	ASTM D4632	One per 90,000 ft^2
	Puncture Strength (lbs)	ASTM D4833	One per 90,000 ft^2
	AOS, US sieve (mm)	ASTM D4751	One per 540,000 ft^2
	Permittivity, (sec^{-1})	ASTM D4491	One per 540,000 ft^2
	Trapezoidal Tear Strength, (lbs)	ASTM D4533	One per 90,000 ft^2
	Flow Rate (gpm/ft^2)	ASTM D4491	One per 540,000 ft^2
	UV Degradation, % retained @ 500 hrs	ASTM 4355	1 per formulation
Woven Separator Geotextile	Flow Rate (gpm/ft^2)	ASTM D4491	One per 540,000 ft^2
	UV Degradation, % retained @ 500 HRS	ASTM D4355	1 per formulation
	Permittivity, (sec^{-1})	ASTM D4491	One per 540,000 ft^2
	Trapezoidal Tear Strength, (lbs)	ASTM D4533	One per 90,000 ft^2
	Grab Tensile Strength, (lbs)	ASTM D4632	One per 90,000 ft^2
	Elongation, %	ASTM D4632	One per 90,000 ft^2
	AOS, U.S. Sieve (mm)	ASTM D4751	One per 540,000 ft^2
	Puncture Strength, (lbs)	ASTM D4833	One per 90,000 ft^2

5.1.2 CQA Conformance Testing

The CQA Organization will obtain geotextile conformance test samples of each type of material manufactured for the project. Samples will be obtained across the entire roll width and will be 3 feet long. Samplers will mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. Each sample will be sent to the CQA Laboratory for conformance testing. The CQA Inspector will review test results and report any nonconformance to the CQA Engineer.

The following conformance tests will be performed on the geotextile at the frequencies indicated in Table 5-2:

Table 5- 2
CQA Conformance Testing for Geotextiles

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geotextile	Puncture Strength (1bs)	ASTM D4833	One per 90,000 ft^2
	Flow Rate (gpm/ft^2)	ASTM D4491	One per 540,000 ft^2
	AOS, US sieve (mm)	ASTM D4751	One per 540,000 ft^2
	Grab Tensile Strength (lbs)	ASTM D4632	One per 90,000 ft^2
	Mass per Unit Area (oz/yd^2)*	ASTM D5261	One per 90,000 ft^2

* Non-woven geotextile only

5.2 CONSTRUCTION

5.2.1 Delivery, Storage and Handling

During delivery of geotextiles the CQA Inspector will monitor for the following:

- Equipment used to unload the rolls will not damage the geotextile.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by specification Section 02778, Geotextiles has been received.
- Each roll is marked or tagged with manufacturer's name, project identification, lot number, roll number, roll dimensions, and that this information is documented on a geosynthetic receipt form.
- Materials are stored in a location that is protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Damaged rolls may be rejected. If rejected, verify that rejected material is removed from the site or stored at a location separate from accepted rolls. Geotextile rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

5.2.2 Geotextile Subsurface Preparation

Before geotextile installation, the CQA Inspector will document that the surface where the geotextile will be installed is acceptable and CQC and CQA documentation verifies that its installation meets specified requirements.

5.2.3 Geotextile Placement and Seaming

During geotextile placement and seaming operations, the CQA Inspector will monitor for the following:

- All defects and defect corrective actions are performed in accordance with specification Section 02778, Geotextiles.
- Equipment used to install the geotextile does not damage it during deployment.
- Crews working on the geotextile do not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile.
- The geotextile is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and seamed in accordance with specification Section 02778, Geotextiles.
- The geotextile is not exposed to direct sunlight for more than the 14 days in accordance with technical specification Section 02778, Geotextiles.
- Final geotextile surface is free of harmful foreign objects.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan conditions.

5.2.4 Geotextile Repairs

Where repairs are necessary, the CQA Inspector will monitor for the following:

- Place a patch of the same type of geotextile which extends a minimum of 24 inches beyond the edge of the damage or defect.
- Fasten patches continuously using a sewn seam or other approved method.
- Align machine direction of the patch with the machine direction of the geotextile being repaired.
- Replace geotextile which cannot be repaired.

SECTION 6.0
GEOCOMPOSITE

The following section outlines the CQA required for the installation of the single and double-sided geocomposite. The single sided geocomposite will be used as the drainage layer of the final cover system (top slope). The double sided geocomposite will be used as the drainage layer of the final cover system (north and east slopes).

6.1 PRECONSTRUCTION

All HDPE drainage composite shall be manufactured in accordance with specification Section 02777, Drainage Composite. The drainage composite manufacturer will provide the Contractor and the CQA Inspector with a written certification, signed by a responsible party, that the drainage composites actually delivered have properties which meet or exceed the guaranteed properties. The CQA Inspector will examine all manufacturer's certifications to ensure that the property values listed on the certifications meet or exceed the project specifications. Any deviations will be reported to the CQA Engineer.

6.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the CQA organization with the following items for review and testing:

- Manufacturer's description (cut sheet) of the proposed geocomposites documenting that it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geocomposites will meet specified interface residual strength.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geocomposites.

Before shipment of the geocomposite, the CQA organization will review pre-construction submittals.

Table 6- 1
Manufacturer's Quality Control Testing for Geonet / Geocomposite

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geonet	Specific Gravity/Density (g/cm3) (min)	ASTM D 1505	One per 50,000 ft^2 and every resin lot
	Thickness (mil)	ASTM D 5199	One per 50,000 ft^2 and every resin lot
	Carbon Black Content (% Minimum)	ASTM D 1603	One per 50,000 ft^2 and every resin lot
	Tensile Strength (MD), (lb/in)	ASTM D 5035	One per 50,000 ft^2 and every resin lot
MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geocomposite	Transmissivity (m^2/sec)	ASTM D4716	One per 540,000 ft^2
	Ply adhesion (lb/ft^2)	ASTM D7005	One per 50,000 ft^2

1. This is an index transmissivity value measured at stress = 1,000 psf; a gradient = 0.33; time = 100 hours, minimum 1 hour if data equivalent to 100 hours is provided; and boundary conditions = plate/geocomposite/plate

6.1.2 CQA Conformance Testing

The CQA Organization will obtain geocomposite conformance test samples of each type of material manufactured for the project. Samples will be obtained across the entire roll width and will be 3 feet long. Samplers will mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. Each sample will be sent to the CQA Laboratory for conformance testing in accordance with the project Specification Section 02777, Part 2.2.C. The CQA Inspector will review all test results and report any non-conformance to the CQA Engineer.

The following conformance tests will be performed on the geocomposite:

Table 6-2
CQA Conformance Testing for Geocomposite

MATERIAL	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Geocomposite	Transmissivity (m^2/s)*	ASTM D4716	One per 540,000 ft^2
	Ply Adhesion	ASTM D 7005	One per 50,000 ft^2
	Thickness (Geonet Core Only)	ASTM D5199	One per 50,000 ft^2
	Interface Friction	ASTM D5321	One per Project

NOTE: Geotextiles shall be tested in accordance with Specification Section 02778.
* See specifications for transmissivity testing criteria.

Laboratory interface friction tests shall be conducted in general accordance with ASTM D5321, on the following interfaces (double-sided geocomposite only):

- Textured LLDPE and geocomposite.
- Geocomposite and protective cover soil.

The CQA Laboratory will perform three (3) direct shear tests at the project specific effective normal stresses. These tests will be performed using the Contractor's proposed LLDPE and a sample of geocomposite obtained from the Geosynthetics Manufacturer following award of the construction contract to the selected Contractor. A sample of protective cover soil proposed for the project will also be obtained for testing. A minimum interface friction angle based on the landfill design will be required to maintain stability.

The Owner will pay for "Passing" tests. Costs of corrective action, costs of "Failing" tests and all associated costs of testing due to failing tests are the sole responsibility of the Contractor. Materials not meeting the required shear strength will not be approved for use on this project.

6.2 CONSTRUCTION

The following subsection describes the CQA inspection activities that are necessary during the geocomposite installation. Refer to the specification Section 02777, Drainage Composite, for project specific construction and test requirements.

The CQA Inspector shall observe the geocomposite placement to confirm that specifications Section 02777 is followed, including coverage of all specified areas and adequate material overlap or seaming

6.2.1 Delivery, Storage and Handling

During delivery of geocomposite the CQA Inspector will observe rolls for the following, and any deviation will be reported to the CQA Engineer:

- Equipment used to unload the rolls does not damage the material.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by specification Section 02777, Drainage Composite has been received.
- The drainage composite manufacturer has identified all rolls of drainage composite in accordance with specification Section 02777, Drainage Composite.

Drainage composite cleanliness is essential to its performance; therefore, the shipping and storage or drainage composite must be in strict accordance with specification Section 02777, Drainage Composite. The CQA Inspector will verify the following and report any deviations to the CQA Engineer.

- Materials are stored in a location that will protect the rolls from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.
- Drainage composites are free of dirt and dust just before installation. If the drainage composites are judged dirty or dusty, they will be washed by the drainage composite installer prior to installation. Washing operations will be observed by the CQA Inspector and improper washing operations will be reported to the CQA Engineer.
- When several layers of drainage composite are stacked, care is taken to ensure that stacked drainage composites are placed in the same direction. A stacked drainage composite will never be laid in a perpendicular direction to the underlying drainage composite (unless otherwise specified by the CQA Engineer.)

Damaged rolls may be rejected. If rejected, it must be verified that rejected material is removed from the site or stored at a location separate from accepted rolls. Geocomposite rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

6.2.2 Geocomposite Subsurface Preparation

Before geocomposite installation, the CQA Inspector will observe for the following:

- Lines and grades for the composite liner subgrade have been verified by the Contractor.
- Geomembrane installation is complete.

6.2.3 Geocomposite Placement and Seaming

During deployment and seaming operations, the CQA Inspector will observe for the following:

- All defects and defect corrective actions (panel rejected, patch installed, etc.) are recorded, and corrective actions are performed in accordance with the specifications.
- Equipment used to install geocomposite does not damage it during deployment.
- Crews working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite.
- The geocomposite is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and connected in accordance with Specification Section 02777, Drainage Composite.
- The geotextile component is not exposed to direct sunlight for more than the number of days recommended by the manufacturer.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

6.2.4 Geocomposite Repairs

Repair any holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 feet beyond the edges of the holes or tear. Use approved fasteners, spaced every 6 inches around the patch to fasten the patch to the original roll.

6.2.5 Placement of Soil Materials

All soil material placed over the drainage composite will be placed in accordance with specification Section 02200, Earthwork, so as to ensure the following:

- The drainage composite and underlying geomembrane are not damaged.
- Minimal slippage of the drainage composite on the underlying geomembrane occurs.
- No excess tensile stresses occur in the drainage composite.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

SECTION 7.0
CORRUGATED POLYETHYLENE PIPE AND FITTINGS
CONSTRUCTION QUALITY ASSURANCE

7.1 PRECONSTRUCTION

All Advanced Drainage Systems (ADS) corrugated pipe and fittings for stormwater drainage shall be produced in accordance with specification Section 15079, Pipe – Corrugated Polyethylene.

7.1.1 Manufacturer's Quality Control

7.1.1.1 Prior to Shipment

Prior to shipment, the Contractor will provide the CQA Engineer and the CQA Inspector with a quality control certification for each lot/batch of ADS material provided. The quality control certificate will be signed by a responsible party employed by the Manufacturer, such as the production manager. The quality control certificate will include:

- lot/batch number and identification; and
- sampling procedures and results of quality control tests.

The CQA Inspector will verify that the quality control certificates have been provided at the specified frequency for all lots/batches of pipe and that each certificate identifies the pipe lot/batch related to it; and review the quality control certificates and verify that the certified properties meet the requirements of specification Section 15079.

7.1.1.2 Prior to Installation

Prior to the installation of ADS corrugated pipes, the Manufacturer will provide to the Contractor and the CQA Inspector the following:

- a properties sheet including, at a minimum, all specified properties, measured using test methods indicated in ASTM D3350;
- a list of quantities and descriptions of materials other than the base resin which comprise the pipe;
- the sampling procedure and results of testing; and
- a certification by the manufacturer that values given in the properties sheet are minimum values and are guaranteed by the Manufacturer.

The CQA Inspector will review these documents and verify that:

- the property values certified by the Manufacturer meet all requirements of ASTM D3350; and
- the measurements of properties by the Manufacturer are properly documented and that the test methods used are acceptable.
- report any discrepancies with the above requirements to the CQA Engineer.

SECTION 8.0
SURVEYING

Surveying of lines and grades is conducted on an ongoing basis during construction of the final and temporary final cover system. Close construction quality control (CQC) of the surveying is absolutely essential to ensure that slopes are properly constructed. The surveying conducted at the site shall be performed by the Contractor.

8.1 SURVEY CONTROL

Permanent benchmarks and baseline control points are to be established for the site at locations convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards.

8.2 SURVEYING PERSONNEL

The Contractor's survey crew will consist of a Senior Surveyor, and as many Surveying CQC Monitors as are required to satisfactorily undertake the requirements for the work. All Surveying CQC personnel will be experienced in the provision of these services, including detailed, accurate documentation.

All surveying will be performed under the direct supervision of a Registered Professional Engineer (PE) or Licensed Land Surveyor (PLS) licensed in the state in which the project is located. The Licensed Land Surveyor may be the Senior Surveyor.

8.3 PRECISION AND ACCURACY

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01 foot and with a setting accuracy of 20 seconds. (5.6×10^{-3} degrees).

8.4 LINES AND GRADES

The following surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include (as deemed appropriate by the CQA Engineer and CQA Inspector):

- One or more construction baselines.
- The edges of all surface breaks (ex. toes, crests, ridges and valleys).
- Surface of the intermediate cover.
- Surface of the final cover.
- All structures including gas wells.
- Inverts of drainage pipe inlets and outlets.
- Top/toe of all berms, roads, and channels.
- Location of edge of liner, anchor trenches tie-in seam to adjacent existing liner system (as applicable).
- Major patches of LLDPE liner.

Laser planes are highly recommended for achieving the correct lines and grades during construction of each surface.

8.5 FREQUENCY AND SPACING

All surveying will be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks during construction, as determined by the Senior Surveyor, CQA Inspector, or CQA Engineer, may be necessary to assist the Contractor in complying with the required grades.

The following spacings and locations will be provided by the CQC surveyor, as a minimum, for survey points:

- Surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than ~~100~~50 feet.
- On slopes greater than 10 percent, a square grid not wider than ~~100~~50 feet will be used, but, in any case, a line of survey points at the crest, midpoint, and toe of the slope will be taken.
- A line of survey points no farther than ~~100~~50 feet apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope).
- A line of survey points not farther than 50 feet apart will be taken for all piping used for downdrains, in particular, at the end points.
- At a minimum, every ~~100~~25 feet along the perimeter of the final cover liner system.

8.6 THICKNESS MEASUREMENTS

The CQC surveyor as a representative of the Contractor shall obtain thickness measurements of the intermediate cover and final cover at a maximum ~~100~~50-foot grid points and at all grade break lines prior to placement of the geomembrane liner. The procedure for obtaining thickness measurements of the intermediate cover and final cover shall be agreed to by the CQA Inspector and CQA Engineer prior to construction. The CQC Surveyor shall review the survey information with the Contractor to ensure that the survey demonstrates compliance with the Project Plans and Specifications. The Contractor is responsible for identifying and reporting to the CQA Inspector any areas of non-compliance evidenced by the survey, and for repairing such areas. The CQA Inspector and Contractor shall review the elevation measurements of the intermediate cover prior to placement of the geomembrane liner.

8.7 TOLERANCES

The following are maximum tolerances for survey points:

- On surfaces, the maximum tolerances shall be 0.1 foot. ~~This tolerance must be set~~When comparing survey points for surfaces to determine conformance with design, the ~~record~~surveyed elevation ~~of the surface below it~~ and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.
- On piping for downdrain lines, the maximum ~~tolerance~~tolerances shall be 0.1 foot. ~~This tolerance must be set~~When comparing survey points for surfaces to determine conformance with design, the ~~record~~surveyed elevation ~~of the surface below it~~ and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.
- For thickness verifications, no minor tolerances are acceptable.

8.8 DOCUMENTATION

All field survey notes will be retained by the Senior Surveyor. The results from the field surveys will be documented on a set of survey record (as-built) drawings by the Contractor for submittal to the CQA Inspector. The Contractor shall certify to the CQA Inspector and CQA Engineer that the results of the survey demonstrates compliance with the Contract Documents. Sealed surveys depicting the information gathered in Paragraph 8.5 shall be supplied to the CQA Engineer and CQA Inspector in sufficient quantities. The surveys shall depict the information in a topographic format and illustrate actual data points. For thickness verification a table shall be compiled by the CQC surveyor or contractor containing the following information for each point.

- Top of intermediate cover elevation.
- Intermediate cover thickness.
- Top of protective cover elevation.
- Protective cover thickness.

Any deviations in elevation or thickness outside the tolerances allowed by specification shall be corrected.

SECTION 9.0
REPORTING REQUIREMENTS AND DOCUMENTATION

9.1 PROJECT MEETINGS

Conducting periodic project meetings is the responsibility of the Design Engineer who will make physical arrangements for meetings, record minutes and distribute copies to participants and those affected by decisions make at meetings. At a minimum the following meetings will be held.

- Pre-construction CQA meeting
- Problems or Work deficiency meetings

9.1.1 Preconstruction CQA Meeting

This meeting shall be attended by the Owner, Design Engineer, CQA Engineer, CQA Inspector, and Contractor. The topics should include but are not limited to:

- Providing each organization with all relevant CQA documents and supporting information.
- Familiarizing each organization with the site-specific CQA Plan and its role relative to the design criteria.
- Determining any changes to the CQA Plan that are needed to ensure that the facility will be constructed to meet or exceed the specified design.
- Reviewing the responsibilities of each organization.
- Reviewing lines of authority and communication for each organization.
- Discussing the established procedures or protocol for observations and tests including sampling strategies.
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and retesting.
- Reviewing methods for documenting and reporting inspection data.
- Reviewing methods for distributing and storing documents and reports.
- Reviewing work area security and safety protocol.
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events.
- Conducting a site walk-around to review construction material and inspection equipment storage locations.

The meeting shall be documented by a designated person, and minutes should be transmitted to all parties.

9.1.2 Weekly Progress Meetings

A progress meeting shall be held weekly at the work area at a time determined at the pre-construction meeting. The frequency of progress meetings may be reduced as the project proceeds if agreed to by the Owner, Contractor, and CQA Engineer. At a minimum, the meeting should be attended by the CQA Engineer, CQA Inspector, Contractor and the Owner.

The purpose of the meeting is to:

- Review the previous week's activities and accomplishments.

- Review status of progress schedule.
- Review the work location and activities for the week.
- Identify the contractor's personnel and equipment assignments for the week.
- Discuss any potential construction problems.

This meeting shall be documented by the CQA Engineer.

9.1.3 Problem or Work Deficiency Meetings

A special meeting shall be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting shall be attended by the Design Engineer, Owner, Contractor, CQA Engineer, and CQA Inspector. The purpose of the meeting is to define and resolve a problem or recurring work deficiency in the following manner:

- Define and discuss the problem or deficiency.
- Review alternative solutions.
- Implement a plan to resolve the problem or deficiency.

The meeting shall be documented by the CQA Engineer and transmitted to the Owner, Contractor, CQA Inspector and Design Engineer, if applicable.

9.2 DOCUMENTATION

Documentation is an essential element of the CQA Plan. The following documentation and record keeping of inspection activities will be required.

9.2.1 Daily Summary Report

A summary report shall be prepared daily by the CQA Inspector. This report will provide the chronologic framework for identifying and recording all other reports. At a minimum, the summary reports shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Date, project name, location, and other identification.
- Data on weather conditions.
- Reports on any meetings held and their results.
- Unit processes, and locations, of construction under way during the timeframe of the daily summary report.
- Equipment and personnel being worked in each unit process, including subcontractors.
- Descriptions of areas or units of work being inspected and documented.
- Description of off-site materials received, including any quality verification (vendor certification) documentation.
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration.
- Decisions made regarding approval of units of material or of work (blocks), and/or corrective actions to be taken in instances of substandard quality.

- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item.
- Supporting inspection data sheets.
- Signature of the CQA Inspector.

9.2.2 Inspection Data Sheets and Photographs

All observations, and field and/or laboratory tests, shall be recorded on an inspection data sheet. Required data to be addressed for most of the standardized test methods are included in the pertinent ASTM Standards.

At a minimum, the inspection data sheets shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Description or title of the inspection activity.
- Location of the inspection activity or location from which the same increment was obtained.
- Type of inspection activity; procedure used (reference to standard method when appropriate).
- Recorded observation or test data, with all necessary calculations.
- Results of the inspection activity; comparison with specification requirements.
- Personnel involved in the inspection activity.
- Signature of the appropriate inspection personnel and concurrence by the CQA Engineer.

Items above may be formulated into site-specific checklists and data sheets so that details are not overlooked.

Photographic supporting data sheets also may prove useful. Such data sheets could be cross-referenced or appended to inspection data sheets and/or problem identification and corrective measures reports. At a minimum, photographic reporting data sheets should include the following information:

- A unique identifying number on data sheets and photographs for cross-referencing and document control.
- The date, time, and location where the photograph was taken and weather conditions.
- The size, scale, and orientation of the subject matter photographed.
- Location and description of the work.
- The purpose of the photograph.
- Signature of the photographer and concurrence of the CQA Engineer.
- Photographic supporting data sheets may be in MS Word or PDF format.

These photographs will serve as a pictorial record of work progress, problems, and corrective measures. They should be kept in a permanent protective file in the order in which they were taken.

9.2.3 Problem Identification and Corrective Measures Reports

A problem is defined herein as material or workmanship that does not meet the specified design. Problem identification and corrective measures reports shall be cross-referenced to specific inspection data sheets where the problem was identified. At a minimum, they shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.

- Detailed description of the problem.
- Location of the problem.
- Probable cause.
- How and when the problem was located (reference to inspection data sheets).
- Estimation of how long problem has existed.
- Suggested corrective measure.
- Documentation of correction (reference to inspection data sheets).
- Final results.
- Suggested methods to prevent similar problems.
- Signature of the appropriate CQA inspection personnel and concurrence by the CQA Engineer.

Copies of the report shall be sent to the Design Engineer and the Owner for their comments and acceptance. These reports should not be submitted to the FDEP at that time unless they have been specifically requested. However, a summary of all data sheets and reports will be submitted to the FDEP upon completion of construction.

9.2.4 Acceptance of Completed Components

All daily inspection summary reports, inspection data sheets, and problem identification and corrective measures reports, shall be reviewed by the CQA Engineer.

9.2.5 Final Documentation

At the completion of the project, the Owner will submit a final construction certification report to the FDEP. This report will include all of the daily inspection summary reports, inspection data sheets, problem identification and corrective measures reports, photographic supporting data, acceptance reports, deviations from design and material specifications (with justifying documentation), and record drawings. This document shall be certified correct by the CQA Engineer and included as part of the CQA Plan documentation.

SECTION 01560
ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Addresses:
   1. Minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1 - General Requirements.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations

B. Land Protection:
   1. Except for any work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work within the Contract Documents.
   2. Manage and control all borrow areas, work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to the work site.
   3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover.
   4. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
   5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.
   6. Except for areas designated by the Contract Documents to be cleared and grubbed or stripped, the Contractor shall not deface, injure or destroy trees and vegetation, nor remove, cut, or disturb them without approval of the Engineer. Any damage caused by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense.

C. Surface Water Protection:
   1. Utilize, as necessary, erosion control methods to protect side and backslopes, and minimize the discharge of sediment to the surface water leaving the construction site as soon as rough grading is complete. These controls shall be maintained until the site is ready for final grading and landscaping or until they are no longer warranted and concurrence is received from the Engineer. Physically retard the rate and volume of run-on and runoff by:
      a. Implementing structural practices such as diversion swales, terraces, straw bales, silt fences, berms, storm drain inlet protection, rocked outlet protection, sediment traps, turbidity curtains, and temporary basins.
      b. Implementing vegetative practices such as temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffers, hydroseeding, anchored erosion control blankets, sodding, vegetated swales or a combination of these methods.
      c. Providing Construction sites with graveled or rocked access entrance and exit drives and parking areas to reduce the tracking of sediment onto public or private roads.

2. Discharges from the construction site shall not contain pollutants at concentrations that produce objectionable films, colors, turbidity, deposits or noxious odors in the receiving stream or waterway.

D. Solid Waste Disposal:
   1. Collect solid waste on a daily basis.
   2. Provide disposal of degradable solid waste generated by the Contractor to an approved solid waste disposal site. Contractor must coordinate with the approved franchise waste hauler for the area of the CCSWDC and pay all container, hauling, and disposal fees as required by the approved franchise hauler.
   3. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
   4. No building material wastes or unused building materials shall be buried, dumped, or disposed of on the site.
   5. Waste excavated from the project area as part of the Work may be disposed at the CCSWDC. The Contractor shall be responsible for establishing a pre-paid account with the CCSWDC and will be charged a waste disposal processing fee for disposal of the waste. Hauling the excavated waste to the scales to be weighed and then to the Class I Landfill working face at the CCSWDC is part of the Contractor's work.
   6. All exposed waste or waste to be taken to the working face of the landfill must be containerized or covered or taken to the scales and working face by no later than 5:00PM each day.

E. Fuel and Chemical Handling:
   1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.
   2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides from entering drainage ways.
   3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other waste waters to enter a drainage way(s) or stream.
   4. The Contractor shall provide containment around fueling and chemical storage areas to ensure that spills in these areas do not reach waters of the state.

F. Control of Dust:
   1. The control of dust shall mean that no construction activity shall take place without applying all such reasonable measures as may be required to prevent particulate matter from becoming airborne so that it remains visible beyond the limits of construction. Reasonable measures may include paving, frequent road cleaning, planting vegetative groundcover, application of water or application of chemical dust suppressants. The use of chemical agents such as calcium chloride must be approved by the State of Florida DOT.
   2. Utilize methods and practices of construction to eliminate dust in full observance of agency regulations.
   3. The Engineer will determine the effectiveness of the dust control program and may request the Contractor to provide additional measures, at no additional cost to Owner.

G. Burning:
   1. Do not burn material on the site. If the Contractor elects to dispose of waste materials by burning, make arrangements for an off-site burning area and conform to all agency regulations.

H. Control of Noise:
   1. Control noise by fitting equipment with appropriate mufflers.

I. Completion of Work:
   1. Upon completion of work, leave area in a clean, natural looking condition.
   2. Ensure all signs of temporary construction and activities incidental to construction of required permanent work are removed.

J. Historical Protection:

1. If during the course of construction, evidence of deposits of historical or archaeological interests is found, cease work affecting find and notify Engineer. Do not disturb deposits until written notice from Engineer is given to proceed.
2. The Contractor will be compensated for lost time or changes in construction to avoid the find based upon normal change order procedures.

END OF SECTION

SECTION 02200
EARTHWORK - LANDFILLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Earthwork, including intermediate cover ~~and protective cover soil layers of the~~, final cover system, cover soil layer for the Phase I/II overlay liner system, and anchor trench backfill material for exposed geomembrane closure area.

B. Additional Work under this Section includes excavation, backfilling, and compaction for the Leachate Cleanout Pump Pads.

~~B.~~C. Related Sections include but are not necessarily limited to:
1. Section 02130 – Vertical Extraction Wells
2. Section 02221 – Trenching, Backfilling, and Compacting for LFG Piping and Structures
~~1.~~3. Section 02260 – Topsoiling and Finished Grading

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. ASTM International (ASTM):
   a. D422, Method for particle size analysis of soil
   b. D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
   c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f (2,700 kN-m/m)).
   d. D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
   ~~c.~~e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   ~~d.~~f. D2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
   ~~e.~~g. D2937, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
   ~~f.~~h. D3017, Standard Test Method for Water Content of Soil and Rock in Place by Neclear Methods (Shallow Depth~~)~~).
   i. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
   j. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
   ~~g.~~k. D6938, Standard Test Method for in-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods.
2. Florida Erosion and Sediment Control Planning and Design Manual, current edition.
3. Florida Department of Transportation Standard Specification for Road and Bridge Construction, current edition.
4. Construction Quality Assurance (CQA) Plan.

1.3 SUBMITTALS

A. Shop Drawings:
1. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
2. Certifications.
3. Test reports:
   a. Soils inspection and testing results.

B. Samples:
   1. Submit samples and source of all soil materials proposed for use.
   2. Submit soil samples directly to CQA ~~Laboratory with~~and CQC Laboratories with coordination and notification to the Engineer.

1.4 SOILS/GEOTECHNICAL

A. The Owner will provide for the on-site services of a CQA Inspector to selectively test materials and monitor compliance with the requirements of these Specifications.

B. The Contractor will afford these representatives access to the job site for the performance of their duties as described in the Contract Documents.

C. General Duties and Responsibilities of the Owner's CQA Inspector: Under the direction of a qualified registered engineer or geologist:
   1. Perform stockpile and in-place testing of all soil material used in the work in conformance with these Specifications and the CQA Plan.
   2. Inspect existing intermediate cover and excavations and evaluate/determine suitability of materials encountered. Determine extent of any overexcavation required to remove unsuitable materials under areas of construction.
   3. Document placement of fill materials and perform testing to confirm compliance with these Specifications.
   4. Evaluate the suitability of existing on-site materials for use in construction of embankments and fills.
   5. Measure quantity of unsuitable materials under contract provisions for authorized overexcavation and backfill.
   6. Review construction operations and monitor for compliance with Contract Documents.

D. Available Soil Information: Where provided, data on soil quantities or conditions is not intended as representations or warranties of the thickness of such conditions between borings or indicated sampling locations. It shall be expressly understood that neither the Owner nor the Engineer will be responsible for any interpretation or conclusion drawn therefrom by the Contractor. Data is made available for the convenience of the Contractor.

E. Additional or supplementary soil borings and/or test pits may be made by the Contractor at no additional cost to the Owner. The Contractor shall provide the Owner with a copy of any data obtained/developed during such work. Such additional work shall be performed in a timely manner in accordance with and not impacting or changing the project schedule set forth in the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All soils: Should be free of deleterious material (sticks, roots, waste, etc.) and rock fragments, boulders, or cobbles greater than 3 inches in size. Soils shall be obtained from the designated on-site borrow areas. Drainage sand layer for the overlay liner system shall be provided by the Contractor from an approved off-site borrow source (Refer to specification 02240)

B. Intermediate cover ~~and protective~~, final cover ~~soils~~system, and cover soil layer of the Phase I / II overlay liner system shall be classified as SP, SW, SM, SC, SP-SM, or SP-SC materials in accordance with ASTM D2487. Fines content of installed soil shall be a maximum of 50% (passing #200 sieve).

C. The Contractor shall conduct his own quantity and quality investigations and testing to determine availability and suitability of all borrow materials, as allowed by the Owner.

D. All earth materials proposed for use in the Work shall be adequately characterized by the Contractor prior to the Work and testing to be completed by the CQA Inspector. Any soil samples submitted by the Contractor are assumed to be tested and approved for use by the Contractor.

E. The Contractor shall submit source test data for all borrow soils to the CQA Inspector for approval a minimum of 48 hours prior to its intended use.

F. ~~F.~~ Structural fill will be used to construct berms and anchor trench backfill for the ~~EGC~~TPO. The soil will be classified as ML, SM, SW, SC, SP-SM, SP-SC or CL in accordance with USCS and will have no particles or soil clods larger than 3 in. (75 mm). The minimum dry density of the structural fill material in the anchor trench will be 102.5 lb/cf. Any deviation from the minimum dry density may be accommodated with a revised anchor trench design that provides equivalent design performance. These adjustments shall be communicated clearly in the final CQA report that is submitted to DEP.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain bench marks, monitoring wells, existing structures, monuments or other established reference points and property corners.
      a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
   3. Verify location of utilities.
      a. Omission or inclusion of utility items does not constitute non-existence or definite location.
      b. Secure and examine local utility records for location data.
      c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
      d. Repair damages to utility items at own expense.
      e. In case of damage, notify Engineer at once so required protective measures may be taken.
   4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
      a. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
      b. All repairs to be made and paid for by Contractor and no additional cost to the Owner.
      c. All paved roads shall be protected from damage due to equipment, trucks, and off-road vehicles. Any damage to existing paved roads due to the Contractors work activities such as hauling, earthwork, or material transport shall be repaired to pre-construction conditions by the Contractor at no additional cost to the Owner.
   5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
   6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
   7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.
   8. Conduct operation with minimum interference to daily landfill operations.

B. Construct erosion and sedimentation controls prior to beginning earthwork.

C. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

D. Dispose of waste materials, legally, ~~off-site~~ at the active face of the Phase II landfill.
   1. Any waste generated by the Contractor during the performance of the Work will be properly disposed of at a permitted facility.
   ~~1.~~2. Burning, as a means of waste disposal, is not permitted.
   3. Contractor responsible for excavation, transportation, weighing at scale house, and paying all applicable processing fees.

E. Waste excavated for construction and installation of ~~final~~intermediate cover, ~~EGC~~TPO anchor trenches ~~and temporary final cover~~, toe drains, stormwater downchute pipes, gas well borings, and LFG piping shall be disposed of by the Contractor at the active face of the Phase II landfill. The ~~tipping~~Contractor will be charged a processing fee of $10.08 per ton for ~~this relocated~~disposal of the waste ~~will be waived by the County. Contractor~~and will be ~~compensated~~responsible for weighing the waste ~~excavation and relocation~~at the landfill scales in ~~accordance~~highway legal trucks. All costs associated with ~~the~~ waste disposal shall be included in the Contractor's Firm Base Bid ~~Form.~~Price. No additional payment shall be made to the Contractor for any over-excavation not approved by Engineer or CQA Consultant.

F. Contractor shall be responsible for complete repair of any damage to any and all components of existing gas collection system caused by his actions during performance of landfill closure at no expense to Owner. Modification, relocations (horizontally and vertically), or other work to the existing gas collection system required, needed, or resulting from grade changes or other designed construction resulting from the landfill closure ~~will be provided by others.~~ shall be brought to the attention of the Owner. Contractor shall notify Owner of any modifications to the gas collection system required for the performance of his work sufficiently ahead of time to allow the modifications to take place without impacting the construction schedule.

G. The ~~protective~~final cover ~~material~~system is placed directly over the geocomposite, thus extreme caution shall be exercised by the Contractor to prevent damage to the liner system. The final cover system will be placed after construction of the landfill gas header and laterals is completed and approved.

H. Placement of the protective cover material of the final cover system shall be conducted only when the CQA Inspector or his representative is informed in ~~advanced~~advance of the intent to perform this work and is present at the site to observe the placement.

I. During ~~the~~ placement of ~~protective~~the final cover ~~soil~~system, no construction equipment shall be allowed directly on the geomembrane or drainage composite, except low ground pressure equipment necessary for the deployment and installation of geomembrane liner. Any damage to these components shall be repaired immediately in accordance with the respective specifications. A 4-foot thick traffic surface consisting of protective cover material shall be constructed to support haul trucks traveling over the liner.

J. Stockpiles of ~~protective~~materials for final cover ~~and~~system (including topsoil) shall be deposited in the closure area without vehicles traveling on the drainage composite. Soil shall then be pushed over the uncovered areas of the disposal unit with bulldozers. Advancement of soils over the liner system shall be achieved by pushing a minimum 12-inch thick loose lift ahead of the dozer blade.

K. Only low ground pressure dozers ~~(10 psi or less track pressure)~~ shall be used for spreading and grading of the ~~protective~~final cover ~~and~~system (including topsoil) in accordance with the appropriate geosynthetic manufacturer's recommendations.

L. The ~~protective~~final cover ~~and topsoil~~material shall be placed on slopes starting at the toe of the slope and spreading toward the top of the slope.

M. ~~Protective~~Final cover material shall only be spread when the liner is laying evenly over the intermediate cover of the landfill. Material shall not be spread over "standing waves" in the liner that form during periods of high temperature and direct sunlight. A standing wave is defined as a ripple in the liner in which the height of the ripple (as measured from the intermediate cover surface) exceeds the width of the ripple. If standing waves are occurring during peak temperature hours, the spreading operation shall be limited to mornings (before 10:00 am) and evenings (after 6:00 pm) or hours agreed upon by the Engineer and Contractor.

N. Any excavation in the ~~protective~~final cover system will be performed with a backhoe bucket equipped with a protective sleeve over the bucket teeth or by another method approved by the Engineer. The Contractor shall exercise extreme care not to disturb or damage the drainage composite or liner. Any liner or drainage composite damaged shall be immediately repaired at no cost to the Owner and as directed by the Engineer.

3.2 SITE EXCAVATION AND GRADING

A. The work includes all operations in connection with excavation, borrow, construction of intermediate cover ~~and protective cover~~, final cover system (including vegetative cover layer), cover soil layer of the Phase I / II overlay liner system, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the ~~proposed landfill closure~~project.

B. Excavation and Grading: Perform as required by the Contract Drawings.
   1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
      a. Stake all units, structures, piping, roads, ~~parking areas and walks~~ and establish their elevations.
      b. Perform other layout work required.
      c. Replace permanent survey markers to original location if disturbed or destroyed.
   2. Preparation of ground surface for additional intermediate cover:
      a. Installation of the landfill gas header, laterals, sumps, and vertical extraction wells must be completed and approved before intermediate cover soil is placed.
      ~~a.~~b. Before additional intermediate cover is placed, remove vegetation and unsuitable soils and scarify existing intermediate cover to a minimum depth of 6 IN in all proposed temporary final cover and final cover areas.
      c. Sod and soil stripped from the intermediate cover will be stockpiled in the soil stockpile area as directed by the Owner and Engineer if the material is clean and does not contain any Class I waste or leachate. If the sod/soil contains Class I waste or appears to contain leachate, the material must be handled as excavated waste, weighed at the scalehouse, and the Contractor will pay processing fee as established in the Contract documents for excavated waste disposal.
      d. The stockpiled, clean sod/soil maybe tested and if it is approved by the Engineer and meets the requirements for final cover soil, the material maybe used by the Contractor for final cover.
      e. Caution must be taken to avoid any damages to the existing landfill gas system. Any damages must be repaired at Contractor's own expense.
      f. Perform depth verifications on a minimum 100 ft x 100 ft minimum grid pattern to determine depth of existing intermediate cover and additional thickness required to achieve design depth or grades. If necessary, identify areas where waste excavation will be required to achieve minimum intermediate cover thickness without exceeding design grades.
   3. Protection of finish grade:
      a. During construction, shape and drain intermediate cover, and protective cover layers of the final cover system, cover soil layer of the Phase I / II overlay liner system, berms and excavations.
      b. Maintain ditches and drains to provide drainage at all times.
      c. Protect graded areas against action of elements prior to acceptance of work.

d. Reestablish grade where settlement or erosion occurs.

C. Borrow:
1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
2. Include cost of excavation and transportation of all borrow material in original Bid.
3. Fill material to be approved by CQA Inspector prior to placement.
4. Obtain borrow soil only from the borrow area designated by the Owner. Do not excavate beyond permitted grades of borrow area. Contractor is responsible for maintaining drainage within the portions of the borrow area he is working in.

D. Construct intermediate cover, ~~protective cover~~final cover system, cover soil layer of the Phase I / II overlay liner system, access road, and berms as required by the Contract Drawings:
1. Construct access road and berms at locations and to lines of grade indicated.
   a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
2. Construct intermediate cover ~~and protective cover~~, final cover system, cover soil layer of the Phase I / II overlay liner system to minimum thicknesses shown on the Drawings measured perpendicular to the slope. Grade to smooth true lines approved by Engineer with no soft spots or uncompacted areas. Top of final cover elevations shall not exceed the design elevations shown on the Drawings ~~but may be lower than the design elevations as long as minimum thicknesses and minimum/maximum slopes are maintained~~.
3. Provide approved fill material:
   a. Ensure that stones larger than 3 IN are not placed in upper 6 IN of intermediate cover, ~~protective cover~~ final cover system, cover soil layer of the Phase I / II overlay liner system, or berms.
   b. Do not place material in layers greater than 12 IN loose thickness.
   c. Place layers horizontally to geosynthetic surfaces and compact each layer prior to placing additional fill.
   d. Lift thickness shall be at the discretion of the CQA Inspector.
4. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required ~~toobtain~~to obtain specified density.
   a. Control moisture for each layer necessary to meet requirements of compaction.
5. The structural fill in the ~~EGC~~TPO anchor trenches and berms shall be placed and compacted in lifts to the lines and grades shown on the drawings. The compacted thickness of each lift shall be 6 IN. maximum (150 mm). Each lift shall be compacted to at least 95 percent of the standard proctor maximum dry density (ASTM D698) within ±4% of optimum moisture content. Each layer surface shall be scarified before placing subsequent lifts and compaction.

E. Upon reaching the required compacted thickness of intermediate cover layer of the final cover system and cover soil layer of the Phase I / II overlay liner system, proofroll intermediate cover ~~soils~~and cover soil layers and obtain the CQA ~~Inspector 's~~Inspector's review/recommendation and approval. If unsuitable materials are encountered, repair as directed and approved by the CQA Inspector to remove unsuitable materials. Excavation of 1 CY or greater should be preapproved by the CQA Inspector.

F. Proofrolling shall be conducted with a 10 ton drum roller approved by the CQA Inspector. An alternate approved by the CQA Inspector may be used in constricted areas.

G. Where intermediate cover and /or cover soil layer materials are determined to be unsuitable, such materials shall be removed to the lengths, widths, and depths directed by the CQA Inspector, and backfilled with suitable material unless further excavation or earthwork is required. Additional payment will be made for excavation and replacement of intermediate cover and / or cover soil layer in accordance with the Contract Documents except for material previously placed by Contractor that did not meet project specifications. The final cover and temporary final cover areas to receive additional intermediate cover shall be free of all vegetation, sticks, roots, rocks, and debris greater than 3 inches in size.

H. Dewatering (as required): Provide and maintain dewatering of all surface water and/or groundwater as required for excavation. Where groundwater is or is expected to be encountered during borrow area excavation, install a dewatering system to prevent softening and disturbance of excavation, allow borrow material to be excavated in the dry, and maintain a stable excavation. Soils and hydrogeologic information may be reviewed before beginning excavation to determine where ~~goundwater~~groundwater is likely to be encountered during excavation. Employ a dewatering specialist for selecting/designing, monitoring, and operating the dewatering system as needed. Keep dewatering system in operation until borrow activities are completed. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction as approved by the Owner. Install groundwater monitoring points as necessary. Shut off dewatering system at such a rate so as to prevent a quick upsurge of water that might weaken the subgrade. Installation, start-up, monitoring maintenance, and shut-off of the dewatering system shall be at no additional cost to the Owner. Any dewatering from the Phase I disposal footprint (within the limits of liner/waste) will be considered leachate and cannot be discharged to the stormwater system, but must be disposed appropriately as directed by the Owner.

I. Do not place fill when the underlying material is frozen, wet, loose, or soft.

J. Moisture control:
   1. Moisture content of materials prior to, and during compaction, shall be uniform throughout each layer of material.
   2. Granular materials shall be thoroughly wetted during or immediately prior to compaction.
   3. Supplementary water shall be added as required to materials by sprinkling and mixing uniformly throughout layer.
   4. Materials too wet for placing shall be temporarily spread or aerated until moisture content is acceptable. If these materials cannot be processed in time to use, the Contractor shall find alternatives acceptable to the CQA Inspector.

3.3 ROCK EXCAVATION – NOT APPLICABLE

3.4 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.5 FIELD QUALITY CONTROL

A. Moisture density relations, to be established by the CQA Inspector are required for all materials to be compacted.

B. Extent of compaction testing will be as necessary to assure compliance with Specifications.

C. Give minimum of 24 HR advance notice to CQA Inspector when ready for compaction or subgrade testing and inspection.

D. Should any compaction density test, subgrade inspection, or other QA/QC problem be identified, the affected area shall be delineated and reworked by Contractor as necessary to achieve passing criteria.

E. Contractor shall pay for all costs associated with corrective work and retesting resulting from failed tests.

F. Proofroll intermediate ~~coversoils~~cover soil layer of the final cover system and cover soil layer of the Phase I / II overlay liner system after reaching specified thicknesses and/or grades prior to geomembrane deployment by making 2 passes parallel to the slope or as directed by CQA Inspector. The proof-rolling shall be performed under the observation of the CQA Inspector. Intermediate and protective cover shall be compacted in accordance with Section 3.6.

3.6 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from CQA Inspector with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by CQA Inspector.

D. Stabilize subgrade with approved materials as directed by CQA Inspector.

E. Intermediate ~~and protective cover soils~~, final cover system, and cover soil layer of the Phase I / II overlay liner system shall be compacted to a minimum 90% standard proctor maximum dry density. The soils shall be wetted or dried as necessary so that the moisture content during compaction is near the optimum moisture content to consistently achieve target compaction, or as otherwise determined by Engineer.

F. Perform testing at a minimum frequency as shown below:

TEST DESCRPTION	TEST FREQUENCY
1. Additional Intermediate Cover, ~~Protective Cover~~Final Cover, cover soil of Phase I/II overlay liner system, and Berm Fill	
Density, Nuclear Method	1 per 1,500 yd3, ASTM D2922
Moisture Content, Nuclear Method	1 per 1,500 yd^3, ASTM D3017
Sand Cone or Drive Cylinder Method	1 per 20 nuclear tests, ASTM D2937
Oven Moisture Content Verification	1 per 20 nuclear tests, ASTM D2216
Moisture Density Relations	1 per 20,000 yd^3, ASTM D698*
Sieve Analysis	1 per 20,000 yd^3, ASTM D422*
2. Structural Fill for ~~EGC~~TPO Anchor Trenches	
In-Situ Density, Nuclear Method	1 per 250 ft/lift, ASTM D2922
In-Situ Moisture Content, Nuclear Method	1 per 250 ft/lift, ASTM D3017
Oven Moisture Content Verification	1 per 2,000 yd^3, ASTM D2216
Standard Proctor of borrow soil	1 per 5,000 yd^3, ASTM D698*
Sieve Analysis of borrow soil	1 per 2,000 yd^3, ASTM D422*
Atterberg Limits of borrow soil	1 per 5,000 yd^3, ASTM D4318*
Classification of borrow soil	1 per 5,000 yd^3, ASTM D2487*

*Increase frequency as needed to ensure each soil type is tested.

3.7 FINISH GRADING

A. Grade all areas disturbed by construction operations.

B. Grade to smooth, uniformly sloping surfaces to existing elevations or to finish grades shown on drawings or as approved by Engineer.

C. Grading shall maintain minimum required protective cover and topsoil thicknesses of the final cover system and cover soil layer of the Phase I / II overlay liner system but not exceed the maximum top of final cover ~~elevations~~elevation of the final cover system as shown on the Drawings.

D. Evenly slope finished grade to drainage swales, terraces, and downdrain inlets as shown on drawings to provide drainage.

E. Ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.

F. Ensure rutting or raveling is not caused by installation equipment or weather.

3.8 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES ~~NOT APPLICABLE~~

A. General: Section includes excavation, backfilling, and compaction for the Leachate Cleanout Pump Pads.
   1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling and subgrade compaction.
   2. Specifier: Verify with soils report or Soils Engineer that excavated material can be used for fill and backfill. Delete paragraph sentence if excavated material can not be used.
   3. Obtain fill and backfill material necessary to produce grades required. Material and source to be approved by CQA Inspector. Excavated material approved by CQA Inspector may also be used for fill and backfill.
   4. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
   5. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
   1. General. Do not commence excavation for foundations for structures until:
      a. CQA Inspector approves:
         1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
         2) Density and moisture content of site area compacted fill material meets requirements of specifications.
         3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
         4) Surcharge or mass fill material has been removed from construction area or portions thereof.
      b. CQA Inspector grants approval to begin excavations.
   2. Dimensions:
      a. Excavate to elevations and dimensions indicated or specified.
      b. Allow additional space as required for construction operations and inspection of foundations.
   3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by CQA Inspector.
   4. Level off bottoms of excavations to receive foundations, floor slabs, or compacted fill. Remove loose materials and bring excavations into approved condition to receive concrete or fill material. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to 98% standard proctor maximum dry density before fill material can be placed thereon. Do not carry excavations lower than shown for

foundations except as directed by CQA Inspector or CQA Engineer. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefore.

5. Notify CQA Inspector and CQA Engineer as soon as excavation is completed in order that subgrades may be inspected. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-gradeand under retaining wall footings has been inspected and approved by the CQA Inspector as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon. CQA Inspector shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
   a. Place fill material, foundations, retaining wall footings, floor slabs-on-grade as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
6. Dewatering: Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope. Groundwater shall be maintained at least 3 FT below the bottom of any excavation. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation. Employ dewatering specialist for selecting and operating dewatering system. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure. Any dewatering from the Phase I disposal footprint (within the limits of liner/waste) will be considered leachate and cannot be discharged to the stormwater system, but must be disposed appropriately as directed by the Owner.
7. Subgrade stabilization: If subgrade under foundations, fill material, floor slabs-on-grade is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by CQA Inspector. Provide compaction density of replacement material as stated in this specification section. Loose, wet, or soft materials, when approved by CQA Inspector, may be stabilized by a compacted working mat of well graded crushed stone. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids. Remove and replace frozen materials as directed by CQA Inspector. Method of stabilization shall be performed as directed by CQA Inspector. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the CQA Inspector.
8. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction. Do not place building floor slabs-on-grade pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.
9. Drainage: Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures. Maintain excavations where foundations, floor slabs, or fill material are to be placed free of water. Provide pumping required to keep excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify CQA Engineer and CQA Inspector. Any dewatering from the Phase I disposal footprint (within the limits of liner/waste) will be considered leachate and cannot be discharged to the stormwater system, but must be disposed appropriately as directed by the Owner.

10. Frost protection: Do not place foundations, slabs-on-grade, or fill material on frozen ground. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, or fill material can be placed immediately after excavation has been completed and approved. Protect excavation from frost if placing of concrete or fill is delayed.
    a. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
    b. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, and Piping:
    1. Structural fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of structural fill unless otherwise indicated.
    2. Fill and backfill placement: Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from CQA Inspector. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material by means of equipment of sufficient size and proper type to obtain specified density. Use hand operated equipment for filling and backfilling next to walls. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft. Use vibratory equipment to compact granular material; do not use water.
    3. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
        a. As required to provide fill material to indicated finished grade.
        b. 5 FT.
        c. Distance equal to depth of compacted fill below bottom of foundations.
        d. As directed by CQA Inspector.

D. Filling and Backfilling Outside of Structures. This paragraph of these specifications applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving. Provide material as approved by CQA Inspector for filling and backfilling outside of structures.
    1. Fill and backfill placement: Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from CQA Inspector. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material with equipment of proper type and size to obtain density specified. Use only hand operated equipment for filling and backfilling next to walls and retaining walls. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft. Use vibratory equipment for compacting granular material; do not use water.
    2. Backfilling against walls:
        a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
        b. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
        c. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

3.9 SPECIAL REQUIREMENTS

A. Erosion Control:

1. Conduct work to minimize erosion of site.
2. Construct temporary ditch blocks in perimeter drainage channel of landfill and install turbidity curtain in Pond No. 1 to settle and detain eroded material.
3. Remove eroded material washed off site.
4. Clean streets daily of any spillage of dirt, rocks or debris from equipment entering or leaving site.

B. Provide as built survey of top of intermediate cover prior to geomembrane installation to verify the required thickness of intermediate cover is installed. Depth thickness determinations shall be obtained on a maximum 100 ft x 100 ft grid pattern. Depth verifications may be made by ~~survey,~~ test pits, temporary depth markers, or probes. Additional intermediate cover shall be placed in areas where insufficient depth is determined prior to geomembrane deployment in that area. Temporary depth markers, if used, shall be removed prior to installing geomembrane. ~~Survey shall be sealed by a professional land surveyor.~~

~~1.~~C. Provide as built survey of top of final cover (i.e. top of topsoil layer) prior to sodding to verify the required thickness of protective cover and topsoil combined is installed. Depth thickness determinations shall be obtained on a maximum 100 ft x 100 ft grid pattern. Depth verifications may be made by ~~survey,~~ test pits, or temporary depth markers with careful attention to avoid damage to the underlying geosynthetics. Additional protective cover and/or topsoil, as appropriate, shall be placed in areas where insufficient depth is determined prior to laying sod in that area. Temporary depth markers, if used, shall be removed prior to installing sod. Survey shall be sealed by a professional land surveyor.

3.10 REPAIRS AND RETESTING

A. At locations where the field testing indicates densities below the requirements of the project specifications, the failing area shall be reworked. For the structural fill soil where the field testing indicates the dry density is below the requirements, the area shall be scarified, moisture-conditioned, and recompacted.

B. The ~~contractor~~Contractor shall correct the deficiency to the satisfaction of the CQA officer. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQA officer will develop and present to the Engineer and/or project manager suggested solutions for approval.

C. All retests recommended by the CQA officer must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency.

D. The CQA officer will also verify that installation requirements are met and that submittals are provided.

END OF SECTION

SECTION 02260
TOPSOILING AND FINISHED GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Topsoiling and finished grading.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 – Earthwork - Landfill.
   2. Section 02270 - Soil Erosion and Sediment Control.
   3. Section 02485 - Sodding.
   4. Section 02486 – Hydroseeding.

C. Location of Work: All areas within limits of grading unless otherwise shown on Drawings and all vegetated areas outside limits of grading which are disturbed in the course of the work and require the reestablishment of vegetation..

~~1.2 PROJECTCONDITIONS~~

1.2 PROJECT CONDITIONS

A. Verify amount of topsoil available in designated stockpiles and borrow area and determine amount of additional topsoil, if necessary, to complete work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. Original surface soil typical of the area.
   2. Capable of supporting native plant growth.

2.2 TOLERANCES

A. Provide minimum of 6 inches (compacted) of topsoil. Final topsoil elevations shall not exceed final buildout elevations on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Correct, adjust and/or repair rough graded areas.
   1. Cut off mounds and ridges.
   2. Fill gullies and depressions.
   3. Perform other necessary repairs.
   4. Ensure underlying intermediate cover and protective cover minimum thicknesses are achieved and that all underlying materials have been tested and meet Specifications.

B. Loosen surface to depth of 2 IN, minimum.

C. Remove all stones and debris over 2 IN in any dimension.

3.2 PLACING TOPSOIL

A. Do not place when subgrade is wet or frozen enough to cause clodding.

B. Spread to compacted depth of 6 IN for all areas where required

C. Do not over compact topsoil. Compaction of topsoil shall only be performed with dozer tracks. Rollers and compactors will not be allowed.

D. If topsoil stockpiled is less than amount required for work, furnish additional topsoil from designated areas of borrow area in accordance with Bid Form.

E. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension and suitable for the installation of sod.

F. Provide finished surface smooth and true to required grades.

G. Restore stockpile area and borrow area to condition of rest of finished work.

3.3 ACCEPTANCE

A. Upon completion of topsoiling, perform depth survey as required in Section 02200.

B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

SECTION 02270
SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil erosion and sediment control.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 – Earthwork - Landfills.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Florida Erosion and Sediment Control Planning Handbook, or current edition.
   2. Florida Department of Transportation Standard Specifications for Roads and Structures Construction, Latest edition.

1.3 SITE CONDITIONS

A. The Owner has installed sediment control features for their current operations.

B. The Contractor may use these existing features with the Owner's prior approval, provided the Contractor maintains said features.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Stone: Manufacturer's certification that materials supplied meet project requirements.
   2. Silt Fence: Product information demonstrating materials supplied meet project requirements including installation instructions.
   3. Turbidity Curtain: Product information demonstrating materials supplied meet project requirements including installation instructions and layout diagrams.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stone for temporary ditch blocks and construction entrances constructed as per the Plans/Drawings.

B. Temporary Grass Seed.

C. Silt Fence: Premanufactured or constructed on site as per Plans/Drawings.

D. Turbidity Curtains: pre-manufactured and installed as per the Plans/Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to Disturbance:
   1. Install silt fence, ditches, channels, ditch blocks, temporary construction entrances, and turbidity curtains.
   2. Refer to the construction sequence on the plans for further detail.

3.2 DURING CONSTRUCTION PERIOD

A. Maintain silt fence, ditches, channels, ditch blocks, temporary construction entrances, and turbidity curtains:
   1. Inspect regularly especially after rainstorms.
   2. Repair or replace damaged or missing items.

B. After rough grading, sow temporary grass cover and mulch over all exposed earth areas not draining into sediment basin or trap.

C. Provide necessary swales, dikes and temporary culverts to control erosion. Contractor shall provide all erosion protection measures at no additional cost to the Owner to prevent off-site sediment/erosion. Although there are stormwater ponds on-site, the Contractor shall take all reasonable precautions to reduce sediment transport to the ponds.

D. Do not disturb existing vegetation (grass and trees) to the extent possible.

E. Excavate sediment out of basins and traps when capacity has been reduced by 40 percent.
   1. Remove sediment from silt fence to prevent overtopping.

F. Topsoil and Fine Grade Slopes and Swales, Etc.:
   1. Seed and mulch or sod as soon as areas become ready.

G. The erosion control features shown on the plans are performance based. If the feature does not adequately control erosion and sediment control to the satisfaction of the ~~project manager~~Project Manager, the ~~contractor~~Contractor will be required to install additional erosion and sediment control features. The ~~project manager~~Project Manager will work with the ~~contractor~~Contractor to determine the extent of the additional measures.

H. After fine grading, sod all areas receiving final cover.

I. Remove accumulated mud and soil from roadways on a daily basis.

3.3 NEAR COMPLETION OF CONSTRUCTION

A. Removed accumulated sediment from erosion and sediment control devises, including Pond 1as shown on the Contract Drawings.

B. Eliminate temporary basins, dikes, traps, turbidity curtain, etc.

C. Grade to finished or existing grades.

D. Fine grade all remaining earth areas, then seed and mulch or sod in accordance with the Plans/Drawings.

END OF SECTION

SECTION 02485
SODDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to provide for sodding.

1.2 RELATED WORK

A. The General and Supplementary Conditions of these specifications are a part of this section as if incorporated herein. ~~Section 02486 presents requirements for seeding.~~

1.3 REFERENCES

A. ~~A.~~ The latest edition of the Florida Department of Transportation (DOT) Standard Specifications for Road Bridge Construction (Standard Specifications) shall be referred to for both specific and general standards for materials, construction, workmanship, and quality control as specified herein with exceptions, as noted herein.

B. ~~B.~~ The latest edition of DOT Roadway and Traffic Design Standards.

1.4 SUBMITTALS

A. ~~A.~~ Soil Analysis: The Contractor shall furnish a soil analysis for each borrow source or distinct on-site soil type used as topsoil for the final cover. The analysis shall be made by a qualified independent soil-testing agency, to be approved by the Engineer. The analysis shall state percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of the soils. The analysis shall state recommended quantities of nitrogen, phosphorus, and potash nutrients and any soil amendments to be added to produce satisfactory topsoil. The Contractor shall perform soil test 30 days prior to mobilizing for landscape construction.

PART 2 - PRODUCTS

2.1 FERTILIZER

A. ~~A.~~ Fertilizer for grassing shall conform to Section 982 of the Standard Specifications.

B. ~~B.~~ Fertilizer shall be granulated so that 80 percent is held on a 16-mesh screen, uniform in composition, dry, and free flowing. The Contractor shall test screen one bag of fertilizer per source and per shipment.

2.2 SODDING

A. The following sections of the Standard Specifications shall apply:
1. ~~A.~~ Section 575-1, Description
2. ~~B.~~ Section 981-2 and 981-4, Materials

2.3 WATER

A. Water for sodding shall conform to Section 983 of the Standard Specifications.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. ~~A.~~ All areas within the limits of work and all areas disturbed by the Contractor's operations with the exception of stockpile and borrow areas shall be sodded unless otherwise indicated on the Contract Drawings.

B. ~~B.~~ The period of sod establishment shall begin immediately after the completion of sodding in an area and shall continue for a period of ~~1 year~~1year after the completion of sodding on the entire project unless the desired sod cover is established in a shorter period of time and shortening of the sod-establishment period is authorized by the Engineer.

C. ~~C.~~ Areas to be sodded shall be graded to remove construction debris, litter, depressions, undulations, and irregularities in the surface before sodding and in accordance with the Contract Drawings. Grading activities shall be conducted such that the minimum required thickness of topsoil is maintained.

3.2 SODDING

A. ~~A.~~ Sodding shall be placed within the entire final closure area unless shown otherwise on the Drawings and in all graded and disturbed areas that have a 4 (horizontal) to 1 (vertical) slope or steeper (except borrow and stockpile areas) and other areas as shown on the Drawings.

B. ~~B.~~ The following sections of the Standard Specifications shall apply:

1. Section 575-3, Construction Methods

C. ~~C.~~ Exceptions:

1. Section 575-3.3, replace phrase "a suitable length of roadway" with "an area."
2. Section 575-3.3, Placing Sod; do not plant dormant sod or if ground is frozen. Rolled sod shall be placed parallel to contours. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. The offsets of individual staggered strips shall not exceed 6 inches. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass. On areas where sod may slide due to the slope gradient, may be displaced by flowing water or may otherwise move, the sod must be pegged using suitable wooden pegs and netting or other approved means. The pegs should be driven through the sod strips into firm earth, at suitable intervals. Contractor will apply at least 1.00 inch of water to new sod within 24 of sod placement and as frequent thereof in order to maintain a healthy and uniform stand of grass. Water sod thoroughly with a fine spray ~~immediately after planting~~. Roll sod within 24 hours of placement to ensure contact between sod and subgrade.
3. Section 575-3.4, watering shall conform to requirements previously specified herein. Replace the word "Department" with the Word "County" in the last sentence. The cost of resodding shall be borne exclusively by the Contractor.
4. Section 575-3.5, Maintenance shall be performed as specified herein.

D. ~~D.~~ Sod installed within drainage swales, terraces, and near drainage inlets shall be adequately anchored using pegs, netting, or other means to ensure that the sod is not displaced by the flow of water.

3.3 CLEANUP

A. All excess sod materials, stones, and other waste shall be removed from the site weekly and shall not be allowed to accumulate.

3.4 MAINTENANCE

A. Maintenance shall begin immediately following the last operation of sodding and continue until conclusion of the sod-establishment period specified herein. Maintenance shall include watering, mowing every two weeks (or as needed) during construction and until final acceptance of the project, resodding, repair of erosion, and all other work necessary to produce a uniform stand of grass.

B. Sod will be considered for final acceptance when the sod roots are firmly anchored to underlying soil and the permanent grass is healthy and growing on 97 percent of the area with no bare areas wider than 12 inches, as determined by the Engineer.

C. The Contractor shall maintain the sodded areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary. If the planted areas must be resodded, reshaped, or otherwise repaired, regardless of cause, the Contractor shall perform such work at the Contractor's expense. The Engineer, at any time, may require replanting of any areas in which the establishment of the grass stand does not appear to be developing satisfactorily at no additional cost to Owner.

D. Due to the presence of the final cover geomembrane liner, sod should not be affected by landfill gas, therefore, if areas appear to not establish due to landfill gas, the Contractor must determine the integrity of the geomembrane liner in that area and repair as required in accordance with the Contract Documents.

E. The period of sod establishment for areas that are resodded shall extend to 1 year after the completion of resodding unless otherwise authorized by Engineer.

END OF SECTION

SECTION 02771
TPO GEOMEMBRANE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the scrim reinforced Thermoplastic Polyolefin (TPO) geomembrane components used in the exposed geomembrane temporary cover. The scrim reinforced TPO is 60 mil UltraPly™ TPO as manufactured by Firestone Building Products or equivalent.

B. Related Sections:
1. Section 02200 – Earthwork - Landfill.
2. Section 02778 - Geotextile.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. ASTM International (ASTM):
a. ASTM D 1204 D751– Standard Test Methods for Coated Fabrics
b. ASTM D6878– Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing
c. ASTM D5261– Test Method for LinerMeasuring Mass per Unit Area of Geotextiles
d. ASTM D4885– Standard Test Method for Determining Performance Strength of Geomembranes by the Wide Strip Tensile Method
e. ASTM D5884– Standard Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes
f. ASTM D2137 – Standard Test Methods for Rubber Property-Brittleness Point of Flexible Polymers and Coated Fabrics
a.g. ASTM D1204– Standard Test Method for Linear Dimensional Changes of FlexibleNonrigid Thermoplastic Sheeting or Film at Elevated Temperature
b.h. ASTM D2136–D1149– Standard Test MethodMethods for Coated Fabrics Low-Temperature Bend TestRubber Deterioration; Cracking in an Ozone Controlled Environment
c. ASTM 4218 – Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique
d. ASTM D4437 – Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembrane
e. ASTM D 4833 – Test Method for Index FTM 101 C– Test Method for Puncture Resistance of Geotextiles, Geomembranes and Related Products
f. ASTM D5199 – Measuring Nominal Thickness of Geotextiles and Geomembranes.
g. ASTM D5721 – Practice for Air-Oven Aging of Polyolefin Geomembranes
h. ASTM D5884 – Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes
i. ASTM D5885 – Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimeter
j. ASTM D6636 – Test Method for Determination of Ply Adhesion Strength of Reinforced Geomembranes
k.i. ASTM D7004 – StandardElongation Test Method for Grab Tensile Properties of Reinforced Geomembranes
j. ASTM D471– Standard Test Method for Rubber Properties—Effect of Liquids (Water Absorption)
l.k. ASTM G 151 – Practice for Exposing Non-Metallic -Materials in Accelerated Test Devices that Useuse Laboratory Light Sources
m.l. ASTMASTMTM G 155 – Practice for Operating -Xenon Arc Light Apparatus for Exposure of Non-Metallic -Materials

~~n. ASTM D4885 Standard Test Method for Determining Performance of Geomembranes by the Wide Strip Tensile Method~~
~~o. ASTM D4437 Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Geomembranes~~

2. The Geosynthetic Research Institute (GRI).
   a. GRI/G 16 – Observation of Surface Cracking of Geomembranes

B. Qualifications:
   1. Each manufacturing and fabricating firm shall demonstrate 5 years continuous experience with a minimum of 10,000,000 SF of TPO geomembranes.
   2. Installer:
      a. Demonstrate 5 years continuous experience with a minimum 10,000,000 SF of ~~TPO~~ geomembranes.
      b. Trained and certified by at least one of the named manufacturers in this Specification (not necessarily the manufacturer supplying materials for this Project).
      c. Geomembrane Installer Personnel Qualifications:
         1) Installation Superintendent shall have worked in a similar capacity on at least five geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
         2) The Master Welder shall have completed a minimum of 5,000,000 sf ~~of TPO~~ geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
         3) Other welders shall have seamed a minimum of 1,000,000 sf ~~of TPO~~ geomembrane.
   3. ~~CQA~~CQC Testing Laboratory shall demonstrate 3 years of continuous experience in similar geosynthetic materials testing.

C. Quality Assurance / Control:
   1. The Owner or Engineer's representative will conduct independent testing to support construction quality assurance (CQA) program and to provide documentation of such to appropriate regulatory agencies.
   2. Unless specifically superseded by these contract documents or approved plans submitted by the Contractor, the geosynthetic materials shall be manufactured, stored, placed, seamed, tested and protected as described in EPA/600/R-93/182 and EPA/530/SW-91/051.
      a. This specifically includes:
         1) Material Composition.
         2) Manufacturing.
         3) Handling and Packaging.
         4) Shipment.
         5) Storage (Manufacturer and Site).
         6) Placement:
            a) Seaming and Joining.
            b) Destructive and Non Destructive Testing.
            c) Protection, Backfilling and Covering.
         7) Conformance Testing.
         8) Anchoring and Anchor Trenches.
         9) Access Roads/Ramps.

D. CQA Plan Implementation: Construction Quality ~~Assurance~~Control will be performed in accordance with the CQA Plan prepared for this project. The Contractor and Geomembrane Installer should familiarize themselves with the CQA Plan.

E. Installer's construction quality control programs to include, but not be limited to, product acceptance testing, installation testing, including both nondestructive and destructive quality control field testing of the sheets and seams during installation of the geomembrane, proposed methods of testing geosynthetic joints and connections at appurtenances for continuity, documentation and changes, alterations, repairs, retests, and acceptance.

F. Geomembrane Installer's installation manual to include:
~~1)~~1. Ambient temperature at which the seams are made
~~2)~~2. Control of panel lift up by wind
~~3)~~3. Acceptable condition of the subsurface beneath the geomembrane
~~4)~~4. Quality and consistency of the welding material
~~5)~~5. Proper preparation of the liner surfaces to be joined
~~6)~~6. Cleanliness of the seam interface (e.g., the amount of airborne dust and debris present)
~~7)~~7. Proposed details for connecting the TPO liner to appurtenances, i.e. penetrations of the containment facilities.
~~8)~~8. A complete description of seaming by hot-air welding and hot-wedge welding.
~~9)~~9. Requirements of the Manufacturer's Installation Manual unless exceptions are noted and approved by the Engineer.

1.3 DEFINITIONS AND RESPONSIBILITIES

A. Geomembrane Manufacturer: Manufacturer of geomembranes producing geomembrane sheets from resin and additives. The manufacturer is responsible for producing geomembrane sheet which complies with these Specifications. These responsibilities include but are not limited to:
1. Acceptance of the resin and additives from chemical formulators. Testing of the raw resin and additives to ensure compliance with the manufacturer's specifications and with this Specification.
2. Formulation of the resin and additives into geomembrane sheeting using mixing and extrusion equipment.
3. Testing of the geomembrane sheet to ensure compliance with manufacturer's specification and this Specification.
4. Shipping of the geomembrane sheet to installer designated facilities.
5. Certification of the raw materials and finished geomembrane sheet to comply with this Specification.
6. Certification of installer's training, experience, and methods for welding and inspection of geomembrane installations in compliance with manufacturer's standards.

B. Geomembrane Installer. Installer of geomembranes are responsible for handling, fitting, welding, and testing of geomembrane sheets or blankets in the field. These responsibilities include but are not limited to:
1. Acceptance (in writing) of the geomembrane from the manufacturer.
2. Acceptance (in writing) of the surface which will serve as a base for the geomembrane. This acceptance shall precede installation of the geomembrane, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of geomembrane liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
3. Handling, welding, testing, and repair geomembrane liners in compliance with this Specification and the Geomembrane Installer's Installation Procedures Manual.
4. Performance of QC testing and record keeping as required by the approved Geomembrane Installer's Field Installation Procedures Manual.
5. Repair or replacement of defects in the geomembrane as required by the Installer's CQC Consultant or the CQA Inspector.

C. CQA Inspector:

1. Inspectors of TPO geomembrane are the individuals responsible for observing field installation of the geosynthetic materials and providing the Manufacturer, Installer, CQA Engineer, and Owner with verbal and written documentation of the compliance of the installation with this specification and with written procedures manuals prepared by the Manufacturer or Installer.

D. CQA Testing Laboratory shall:
   1. Perform destructive testing of the TPO geomembrane.
   2. Perform conformance testing of TPO geomembrane.

E. Installer's CQC Consultant: Responsible for observing field installation of the geomembrane and performance of material conformance and CQC testing to provide the Contractor with verbal and written documentation of the compliance of the installation with these Specifications.

F. CQA Engineer: Responsible for implementing CQA Plan including overview of material conformance testing, field installation of the geomembrane, and CQC activities, and to perform limited CQA conformance testing to provide Owner with verbal and written documentation of the compliance of the installation with these Specifications. The CQA Engineer will use the written results of the CQC program and the CQA program in the preparation of the facility Certification Document. The CQA Engineer reports to the Owner and is not part of this contract.

G. Refer to the accompanying CQA Plan for additional definitions.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit for Engineer's approval Shop Drawings, including:
      a. Manufacturer's certification that raw materials and sheet materials comply with required materials, mil thickness, and material properties.
         1) Original certificates are required.
      b. Manufacturer/Fabricator/Installer quality control requirements.
      c. Qualifications and experience of key personnel per 1.2 B of this section.
      d. Manufacturer's written acceptance of Geomembrane Installer's qualifications for installation of the TPO geomembrane.
      e. TPO Geomembrane layout plan with proposed size, number, position and sequencing of liner panels and showing the location and direction of all field or factory joints.
         1) Proposed details for connecting the geosynthetic materials to appurtenances.
         2) Proposed methods of welding, seaming or jointing geosynthetic materials.
         3) Proposed method of testing TPO geomembrane and other geosynthetic materials, joints and connections at appurtenances for continuity.
         4) Location and configuration of haul roads and access points.
         5) Proposed details for anchor trench if different than included in Contract Documents.

B. Miscellaneous:
   1. Test results:
      a. Resin test, tests of sheet material and factory seam tests at frequency specified in respective quality control manuals.
         1) Results shall include or bracket the rolls delivered for use in the Work.
      b. Daily test seam results.
      c. Daily results of production seam testing.
   2. Warranties as described below.
   3. Submit written certifications that:
      a. Utilize certification forms approved for use on this project by the Owner and Engineer. Make appropriate number of copies, as required.
      b. The TPO geomembrane material delivered to site meets the requirements of this Specification.

c. The TPO geomembrane was received and accepted in undamaged condition from shipper.
d. The TPO geomembrane liner was installed in accordance with this Specification and with approved Shop Drawings.
e. The TPO geomembrane joints were inspected, tested for strength and continuity, and passed all inspections and tests.
1) All test and inspection data shall be incorporated into this certification.

4. Manufacturer/Installer's Field Installation Procedures Manual shall clearly identify any exceptions taken to the specified execution of the Work.
5. Record Drawings: Submit reproducible drawings of record showing changes from the approved installation drawings. The record drawings shall include the identity and location of each repair, cap strip, penetration, boot, and sample taken from the installed geosynthetic for testing. The record drawings shall show locations of each type of material, anchor trenches and the construction baseline.

C. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted. All submittals must be submitted prior to the Geomembrane Preconstruction Meeting and a minimum of four weeks prior to installation.

D. The acceptable color of the material will be a shade of green. The proposed color and a sample of material and color shall be submitted for acceptance and approval by the Owner and Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The TPO geomembrane should be protected from punctures, abrasions, vandalism, excessive heat or cold or other damaging conditions

B. The TPO geomembrane shall be delivered to the project site intact and free from any tears, abrasion, or damage. Store TPO geomembrane rolls in a dry area off the ground on 4 rails with each rail being a minimum of 3.5 inches wide, and protected from the direct heat of the sun, where possible, and accessories in original containers in a dry area protected from the elements.

C. Each roll shall be labeled with the manufacturers name, type, lot number, roll number, and roll dimensions (length, width, gross weight).
1. TPO geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed.
2. TPO geomembrane shall not be exposed to temperatures in excess of 60 Deg C (140 Deg F) or less if recommended by the Manufacturer.

D. No hooks, tongs or other sharp instruments shall be used for handling the TPO geomembrane.
1. Rolls shall not be lifted by use of cables or chains in contact with the TPO geomembrane.
2. TPO geomembrane shall not be dragged along the ground.

1.6 PROJECT CONDITIONS

A. When the weather is of such a nature as to endanger the integrity and quality of the installation, whether this is due to rain, high winds, cold temperatures, or other weather elements, the installation of the geomembrane shall be halted at the direction of, or with the concurrence of, the Owner until the weather conditions are satisfactory.

B. The contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces which hamper the efficient field seaming of geosynthetic panels or performance.

C. Maintain natural surface water drainage diversions around the work area and provide for the disposal of water which may collect in the work area directly from precipitation falling within the area or from inadequate diversion structures or practices.

D. All materials shall be placed and spread with low ground pressure equipment (10 psi ground pressure or less) as approved by the CQA Engineer to reduce potential damage to the geosynthetics. The geosynthetics surface shall be off limits to construction traffic. Hard turning of tracked equipment on the protective cover and stone must be avoided.
   1. At least 12 inches of separation between the geosynthetics and all low ground pressure equipment shall be maintained.
   2. Stockpiling of materials within the limits of the cell shall be subject to advanced approval by the CQA Inspector. Any hauling equipment (dump trucks, etc.) operating within the cell limits (and including access ramps), shall have a minimum of 4 feet of separation between the vehicle wheels and the geosynthetics.
   3. No vehicle shall access the completed Work unless it can be demonstrated that its weight, movement or activities will not damage the Work.
   4. When damage is suspected, uncover area, repair damage if required, and recover area at no cost to Owner.
   5. Suspect areas may be identified by Owner or Engineer.

1.7 WARRANTIES

A. Written warranties addressing TPO geomembrane material and installation workmanship shall be furnished by the Contractor and shall be made to the Owner.

B. Submit material samples and warranties prior to shipment.

C. Suitability of geosynthetic liner system shall be subject to Owner's approval of warranty.
   1. The Manufacturer's warranty shall be against manufacturing defects and workmanship and against deterioration due to ozone, ultra- violet exposure from direct sunlight, and other exposure to the elements, for a period of 20 years on a pro rata basis. The warranty shall be limited to replacement of material, and shall not cover installation of replacement geomembrane.
   2. The Installer's warranty shall state that the materials were properly installed, properly (field and factory) welded, seamed and jointed and will not fail within two years of the date of final acceptance of the Work by the Owner.
      a. Warranty shall not be prorated.

D. Warranties shall provide for complete repair/replacement excluding installation costs at no additional cost to the Owner for the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND/OR GEOMEMBRANE INSTALLERS

A. Subject to compliance with the Contract Documents, the following manufacturers and installers are acceptable:
   1. TPO Geomembrane liners manufacturers:
      a. Firestone Building Products
      b. Carlisle SynTec
   2. TPO Geomembrane Liner Installers:
      a. Authorized installers of approved manufacturers.
      b. Other installers may qualify by providing references for a minimum of 10,000,000 SF of TPO liner installations.

2.2 MATERIALS

A. The membrane will be Firestone UltraPly TPO 60 mil geomembrane or equivalent.

B. Accessories will be as supplied or approved by geomembrane manufacturer.

C. Geomembrane meets or exceeds the property values listed in Table 1.

D. Interface testing of liner and geotextile will be submitted as specified in Table 2.

Table 1: Physical Properties

~~Property~~Description	Test Method	~~Typical~~Property
UNAGED PROPERTIES:		
Thickness~~,~~ (min. ~~in (mm~~ average)	~~60 mil~~ASTM D751 and D6878	0.060" (1.52 mm~~) +~~, 60 mil) Lowest individual -10%
Thickness Over Scrim	ASTM D 4637 (Optical Method) 0.060" Membrane	0.024" (0.609 mm) ± 10%
Mass per unit area (min)	~~0.060" Membrane~~ASTM D5261	~~0.024" (0.609 mm) ± 10%~~0.3 lb/sf (1.42 Kg/m^2)
Breaking Strength (TD~~)~~ and MD) (min)	ASTM D 4885	150 ppi (26.3 kN/m)
Elongation at Reinforcement break (TD and MD) (min)	ASTM D 4885	30%
Tearing Strength (TD and MD) (min) (min)	ASTM D 751 (8"x8" specimen)	86 lbf (382 N)
Brittleness Point (max)	ASTM D 2137	-50°F (-46°C)
Linear Dimension Change (max)	ASTM D 120 (6 hrs @70° C)	4 ~~±0.15~~%
Ozone Resistance	ASTM D 1149	PASS (no cracks)
Factory Seam Strength (min)	ASTM D 4885	150 ppi (26.3 kN/m)
Puncture Resistance (min)	FTM 101C Method 2031	265 lbf (1174 N)
Water Absorption (max, mass)	ASTM D471 166 hrs at 158^{0}F	+/- 3%
HEAT AGED PROPERTIES:		
Breaking Strength (TD~~) 366 lbf (1628 N)*~~ and MD) (min)	ASTM D 4885	150 ppi (26.3 kN/m)*
Elongation at Reinforcement Break (TD and MD) (min)	ASTM D 4885	30%*
Tearing Strength (TD and MD) (min)	ASTM D ~~751~~5884 (8"x8" specimen)	86 lbf (382N)*
Weight Change (max) (Membrane)	ASTM D 471	1% (change in mass)
AGED PROPERTIES:		
Ozone Resistance	ASTM D 1149	PASS (No cracks)
Weather resistance (Retained Values)	ASTM G 151/ G 154	
Visual Inspection		PASS
Breaking Strength, ~~%~~ (min.)		90% retained
Elongation at Reinforcement Break ~~90% retained~~(min)	ASTM D 4885	90% retained
Resistance to Xenon-Arc Weathering	ASTM G 151/ G155	Pass

*ASTM D 6878 requires retained values of 90% ~~or~~for original breaking strength and elongation and 60% for tearing strength

Table 2: Interface Friction Angles

PROPERTIES	QUALIFIERS	UNITS	VALUES	TEST METHOD
Engineering Properties				
Interface friction between geomembrane liner and geotextile material in the anchor trench	minimum	degrees	22[1]	ASTM D 5321[2]

(1) Perform testing using normal stress range of 144 lb/sf, 288 lb/sf and 432 lb/sf.
(2) Wet the geotextile/TPO geomembrane interface prior to testing: perform test using: (i) normal stress indicator above; and (ii) a strain rate calculated in accordance with ASTM D 3080, Sections 9.12 and 9.13, not to exceed 1 mm/min. (0.04 in./min.).

2.3 MANUFACTURING QUALITY CONTROL

A. ~~A.~~ Rolls:

1. ~~1.~~ The Manufacturer will continuously monitor the TPO geomembrane sheets during the manufacturing process for inclusions, bubbles, or other defects.
2. ~~2.~~ No TPO geomembrane will be accepted that exhibits any defects.
3. ~~3.~~ The Manufacturer will continuously monitor the TPO geomembrane thickness during the manufacturing process.
4. ~~4.~~ No TPO geomembrane will be accepted that fails to meet the specified minimum thickness.
5. ~~5.~~ The Manufacturer will sample and test the geomembrane, at a minimum, at the test frequencies specified in Table 3.
   a. ~~a.~~ Samples taken from stored rolls will be taken across the entire width of the roll and will not include the first wrapping or outer layer of the roll (about 3.3 feet).
   b. ~~b.~~ Samples taken at the time of manufacturing can be obtained from the start/end of the roll.
   c. Unless otherwise specified, samples will be 2 feet long by the roll width. The Manufacturer will mark the machine direction on the samples with an arrow.
   d. Manufacturer quality control data shall accompany the geomembrane shipment.

Table 3: Manufacturer Quality Control Requirements

Material Property	Method	Test Frequency
Thickness	ASTM D751	Per roll
Tensile Properties	ASTM D4885	Once per day or 20,000 lb
Tear Resistance	ASTM D751	Once per day or 45,000 lb
Scrim Orientation	Visual	Every Lot or Every Scrim Roll
~~6.~~ Mass per Unit Area	ASTM D5261	Once per day or 200,000 lb
Tear Resistance	ASTM D5884	Once per day or 45,000 lb
Thickness over Scrim	ASTM D6878	45,000 lb or Every other lot

6. Any TPO geomembrane sample that does not comply with the Specifications will result in rejection of the roll from which the sample was obtained. Contractor will replace any rejected rolls at no additional cost to Owner.
7. ~~7.~~ If a TPO geomembrane sample fails to meet the quality control requirements of this Section, the Manufacturer will sample and test each roll manufactured, in the same resin batch, or at the same time, as the failing roll. Sampling and testing of rolls will continue until a pattern of acceptable test results is established.
8. ~~8.~~ Additional testing may be performed at the Manufacturer's discretion and expense, to more closely identify the non-complying rolls and/or to qualify individual rolls.

2.4 CONFORMANCE TESTING

A. At the Geomembrane Manufacturer's plant or upon delivery of the rolls of geomembrane at the site, the CQA Officer will verify that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify conformance to both the design specifications and the list of guaranteed properties. The minimum number of tests to be performed and test procedures will be as indicated in Table 4.

B. Samples will be taken across the entire width of the roll and will not include the first linear 3 ft. Unless otherwise specified, samples will be 3-ft long by the roll width. The CQA Officer will mark the machine direction on the samples with an arrow. The required minimum sampling frequencies are provided in Table 4.

C. The CQA Officer will examine the results from laboratory conformance testing and will report non-conformance to the Project Manager.

D. The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

1. ~~the~~ Installer will replace the roll of geomembrane that is in nonconformance with the specifications with a roll that meets specifications;
2. ~~the~~ Installer will remove conformance samples for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll.

3. These two samples must both conform to specifications. If either of these samples fail, then every roll of geomembrane on site and every roll delivered subsequently must be tested by the Geosynthetics CQA Laboratory for conformance to the specifications. This additional conformance testing will be at the expense of the Installer.

E. The CQA Officer will document actions taken in conjunction with conformance test failures.

Table 4: Geomembrane Conformance Testing Requirements

TEST NAME	TEST METHOD	MINIMUM FREQUENCY OF TESTING

Thickness	ASTM D 4637	1 test per 100,000 ft^2
Tensile Strength at Break	ASTM D 4885	1 test per 100,000 ft^2
Elongation at Break	ASTM D 4885	1 test per 100,000 ft^2
Tear Strength	ASTM D 5884	1 test per 100,000 ft^2
Puncture Resistance	ASTM D 4833	1 test per 100,000 ft^2
Resistance to Xenon-Arc Weathering	ASTM G 155	~~1 test per 100,000 ft^2~~ Manufacturer's Certification Only
Ozone Resistance	ASTM D 1149	1 test per 100,000 ft^2

2.5 EQUIPMENT AND ACCESSORIES

A. Welding and Seaming Equipment:
   1. Equipped with gages showing temperatures at the nozzle or at the wedge (wedge welder).
   2. Maintained in adequate numbers to avoid delaying work.
   3. Supplied by a power source capable of providing constant voltage under a combined-line load.
   4. Electric generator shall not be placed on the TPO geomembrane.

B. Field Tensiometer:
   1. Provide a tensiometer for on-site shear and peel testing of TPO geomembrane seams.
      a. Tensiometer shall be in good working order.
      b. Built to ASTM specifications.
      c. Accompanied by evidence of calibration of equipment and gages within the past six months.
   2. Tension meter:
      a. Motor driven.
      b. Jaws capable of traveling a measure rate of 2 IN per minute.
      c. Equipped with a gauge that measures the force in unit pounds exerted between the jaws.
      d. Digital readout.

C. Punch Press:
   1. Provide a punch press for the onsite preparation of specimens for testing.
   2. Capable of cutting specimens in accordance with ASTM D4437.

D. Air Lance Test:
   1. Provide equipment for air lance test per ASTM D4337.

E. Equipment necessary to perform "Pressurized Air Channel Evaluation of Dual Seamed Geomembranes" in accordance with ASTM D5820.

F. Gages:
   1. Calibrated within past six months.
   2. Specified test values reading near mid-range of the gage scale.

G. Equipment necessary to perform "Non-Destructive Testing of Geomembrane Seams Using The Spark Test" in accordance with ASTM D6365.

PART 3 - EXECUTION

3.1 GEOSYNTHETIC LINER SYSTEM

A. Geomembrane Subgrade:
   1. Protect subgrade at all times from damage until such time as the placement of TPO geomembrane liner and other components of the geosynthetic liner system are complete.
   2. The subgrade shall be prepared in a manner consistent with proper subgrade preparation techniques for the installation of TPO Geomembrane.
      a. The subgrade shall be properly compacted so as not to settle and cause excessive strains in the TPO Geomembrane or other synthetic liner materials.
      b. Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 inch.
      c. In addition, ensure that the subgrade has been rolled to provide a uniform surface.
      d. During installation, ensure that rutting or ravelling is not caused by installation equipment or weathering.

B. Anchor Trenches:
   1. Geosynthetic materials placed on side slopes shall be anchored into trenches as detailed on the Contract Drawings.
   2. Excavation, backfill and compaction shall be in accordance with Section 02200.

C. TPO Geomembrane:
   1. General:
      a. Installer of TPO geomembranes is responsible for handling, fitting, welding, seaming, jointing and testing of geosynthetic materials sheets or blankets in the field in accordance with the Construction Quality Assurance (CQA) Plan.
      b. These responsibilities include but are not limited to:
         1) Acceptance (in writing) of the geosynthetic materials sheets or blankets from the transporter.
         2) Acceptance (in writing) of the surface which will serve as a base for the TPO geomembrane.
            a) This acceptance shall precede installation of the TPO geomembrane.
            b) Shall state that the Installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of TPO geomembrane liners.
            c) Shall explicitly state any and all exceptions to acceptance.
         3) Handling, welding, seaming, jointing, testing and repair of TPO geomembrane liners and other geosynthetic materials in compliance with this Specification and with written procedures manuals prepared by the Manufacturer or Fabricator.
            a) Manual shall be submitted to the Engineer together with Shop Drawings showing the layout of TPO geomembrane within the facility.
               (1) Do not deviate from the procedures included in the manual.
            b) TPO Geomembrane shall not be placed upon frozen foundation, standing water or other conditions which will result in deterioration of the foundation.
            c) TPO Geomembrane liner materials shall be laid out according to plans previously approved by the Engineer.
            d) Adjacent rolls of TPO geomembrane shall overlap a minimum of 3 IN.
         4) Repair or replacement of defects in the geosynthetic materials as required by the Inspector or the Owner.
         5) Installer and Manufacturer may be the same firm.
   2. Panel deployment:
      a. Subgrade Preparation:
         1) ~~1)~~ Prepare subgrade in a manner consistent with proper subgrade preparation techniques for the installation of TPO geomembrane liner.
         2) ~~2)~~ Properly compact the subgrade so as not to settle and cause excessive strains in the TPO geomembrane liner.

3) ~~3)~~ Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.
4) ~~4)~~ Subgrade soils proof-rolled with a ten (10) ton drum roller, two (2) passes parallel to slope or as directed by CQA Inspector. The subbase shall be compacted and proof-rolled under observation of the CQA Inspector to assure the maximum practical compaction under the existing field conditions has been achieved. See specification Section 02200 for project specific compaction requirement.
5) ~~5)~~ Ensure rutting or raveling is not caused by installation equipment or weather.
6) ~~6)~~ Ensure that lines and grades have been verified by the Contractor and a subgrade acceptance form has been submitted.

b. Construct and backfill anchor trenches
c. Deploy TPO geomembrane liner in a manner to ensure it is not damaged
d. On slopes, anchor the TPO geomembrane liner securely and deploy it down the slope in a controlled manner.
e. Weight the TPO geomembrane liner with sandbags or equivalent in the presence of wind.
f. Minimize cutting the TPO geomembrane liner. Whenever possible, overlap instead of cutting material. If cutting is required, cut TPO geomembrane liner with a cutter or other approved device. Seal all cut edges, as recommended by Manufacturer.
g. Only those panel/sheets that can be seamed in 1 day shall be deployed.
h. Place panels with minimal handling.
   1) Protect panels from tear, puncture or abrasion.
i. Equipment used to deploy the geomembrane shall not damage the TPO geomembrane.
j. Minimize foot traffic.
   1) Do not allow personnel access to wet or slippery liners without adequate safety precautions.
   2) Do not allow footwear that may damage the geomembrane.
k. Ballast with sandbags to prevent wind uplift as recommended by Manufacturer based on local climatic conditions.
   1) Remove and replace all wind damaged panels at no additional cost to Owner.
   2) If wind causes panels to be displaced, displaced panel may not be reused.
l. Install TPO geomembrane in stress free, tension free and relaxed condition.
   1) Account for temperature and weather-related impacts when deploying and covering.
   2) Stretching to fit and folding are not permitted.
m. Do not allow TPO geomembrane to bubble, fold, or create ripples as a result of deployment of drainage layer or protective soil cover placement.
   1) Except as noted on Contract Drawings no folds in TPO geomembrane will be allowed.
n. Any panel exhibiting stretching caused by placement, covering techniques, or wind shall be removed and may not be incorporated in the final construction.
o. Field seaming:
   1) Field seaming shall be done in accordance with seaming recommendations furnished by the geomembrane Manufacturer, referenced EPA documents, and this specification.
   2) Each piece of seaming equipment and each operator shall perform trial seams at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.
   3) Trial seams shall use the same seaming materials and methods to be used in the actual construction.
   4) Surfaces to be seamed shall be clean and dry at the time of seaming.
      a) Precipitation and ponding of water on the TPO geomembrane shall cause termination of seaming operations.

b) TPO geomembrane shall not be seamed when ambient temperatures are below 41 DegF or above 104 DegF, without written consent of TPO geomembrane Manufacturer and Engineer.

5) TPO geomembrane sheets shall be seamed continuously without fishmouths or breaks in the seam.
   a) Where fishmouths are unavoidable, the sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle.
   b) The two edges of the slit shall be seamed together provided that the overlap for this seam shall be a minimum of 6 IN.
   c) Areas of the slit which do not achieve an overlap of 6 IN, including the terminus of the slit, shall be provided with a patch as discussed below.

6) All TPO geomembranes shall be seamed by thermal fusion methods as recommended by the TPO geomembrane Manufacturer.
   a) TPO geomembrane seaming shall be either hot-air or double wedge welded as approved by the Engineer.

7) Manufacturer's seaming instructions shall specifically address seaming materials, temporary and permanent jointing, seaming temperatures including temperatures for seaming materials, seam finishing and curing.

8) A copy of Manufacturer's seaming instructions shall be available on site at all times and shall not be deviated from without written approval of the Manufacturer and Engineer.

9) All panels/sheets should be overlapped a minimum of 3 IN.

10) Seaming shall not be conducted in the presence of standing water.
   a) The seamed area shall be cleaned of dust, dirt and foreign material prior to and during the seaming operation.

11) Seaming shall extend to the outside edge of panels/sheets to be placed in anchor and/or drainage trenches.

12) Tack welds shall conform to manufacturer's seaming techniques and shall not damage underlying membrane.

p. Patching:

1) Defects in and damage to TPO geomembrane sheets shall be repaired by seaming a patch over the defect.
   a) The patch material shall consist of an undamaged piece of TPO geomembrane cut to provide a minimum of 6 IN of overlap in all directions from the defect.
   b) Round corners shall be utilized on all patches. No bead or spot patching will be accepted.
   c) Torn or permanently twisted TPO geomembrane shall be replaced at no expense to the Owner.

2) Test all patch seams non-destructively using the air lance tests .
   a) Test patch seams destructively if the seam is greater than 100 feet in contiguous length (i.e. a single seam greater than 100 feet).
   ~~b)~~
   ~~c.~~b) Perform a destructive test for every 100 feet of contiguous seam over 200 total feet of contiguous seam. For example if a patch seam is 340 feet, 2 destructive tests would be required for the seam.Smoking is not permitted while on the geomembrane.

~~r.~~q. Field Panel Identification: The Installer's CQC Consultant will document that the Geomembrane Installer labels each field panel with an "identification code" consistent with the approved panel layout plan. The location of the label and the color of marker used must be as agreed to in the QA/QC Preconstruction Meeting.

~~s.~~r. Exposed reinforcement from cut TPO edges must be sealed with a hot-air weld.

3.2 FIELD QUALITY CONTROL

A. The CQA inspector shall not be a part of the installation program and shall not serve as a substitute for performing the duties or certification required of the Manufacturer and Installer.
   1. The CQA inspector's responsibilities include, but are not limited to:

a. Inspection of the material and the handling and field installation of the geomembranes. Inspection of all welds, repairs and quality control test results.
b. All exceptions to material or installation shall be documented and furnished to the CQA firm in writing within 48 HRS of discovery.
c. Inspection and Certification of TPO geomembrane integrity until completion of placement of protective soil cover.

B. Non-Destructive Testing:

1. ~~1.~~ The Geosynthetics Installer will nondestructively test all field seams over their full length using a air lance test (TPO hot air weld), vaccum box (HDPE and LLDPE extrusion weld), or air pressure test (TPO, HDPE and LLDPE double fusion seams). Continuity testing will be carried out as the seaming work progresses, not at the completion of all field seaming. The Installer will complete any required repairs in accordance with specifications. The following procedures will apply to locations where seams cannot be nondestructively tested:

a. ~~a.~~ If the seam is accessible to testing equipment prior to final installation, the seam will be nondestructively tested prior to final installation.

b. ~~b.~~ If the seam cannot be tested prior to final installation, the seaming operations must be observed in their entirety by the CQA Officer for uniformity and completeness.

2. ~~2.~~ Air Pressure Testing (For Double Fusion Seams Only):

a. ~~a.~~ The following procedures are applicable to those processes that produce a double seam with an enclosed space.

b. ~~b.~~ The equipment will comprise the following.

1) ~~i.~~ An air pump (manual or motor driven), equipped with a pressure gauge, capable of generating and sustaining a pressure between 25 and 30 psi, mounted on a cushion to protect the geomembrane.
2) ~~ii.~~ A rubber hose with fittings and connections.
3) ~~iii.~~ A sharp hollow needle, or other approved pressure feed device.

c. ~~c.~~ The following procedures will be followed.

1) ~~i.~~ Seal both ends of the seam to be tested.
2) ~~ii.~~ Insert needle, or other approved pressure feed device, into the channel created by the fusion weld.
3) ~~iii.~~ Insert a protective cushion between the air pump and the geomembrane.
4) ~~iv.~~ Energize the air pump to a pressure between 25 and 30 psi, close valve, allow two minutes for pressure to stabilize, and sustain the pressure for not less than 5 minutes.
5) ~~v.~~ If loss of pressure exceeds 4 psi, or if the pressure does not stabilize, locate faulty area and repair in accordance with Section 3.3.
6) ~~vi.~~ Cut opposite end to verify continuity of seam, remove needle, or other approved pressure feed device, and repair in accordance with Section 3.3.

3. ~~3.~~ Air Lance Testing

a. Mechanical point stressing method (see ASTM D4437, article 4.5) or the air lance test method will be used to verify seam integrity for hot air seams and wedge seams without air channel. Since the mechanical point stressing method cannot evaluate the bond over its entire width, and since there is a potential for damaging the membrane with the sharp point of the probe, the air lance test method is recommended to verify seam integrity.

C. Trial Seams

1. ~~1.~~ Trial seams shall be made prior to production seaming by all seamers and by all equipment to be used during production seaming. The trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period, seaming operation has been suspended for more than 1/2 hour, breakdown of the seaming equipment occurs or at least once each five hours, for each seaming apparatus used that day. Also, each seamer shall make at least one trial seam each day. Trial seams shall be made under the same conditions as actual seams. The trial seam sample shall be at least 5 ft long by 1 ft wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as specified.

2. ~~2.~~ Two adjoining specimens, each 1-inch wide for peel and 2-inch wide for shear, shall be cut from the trial seam sample by the Geosynthetics Installer. Fully support the test specimen within the grips across the width of the specimen. The specimens shall be tested in shear and peel, using a field tensiometer, and the specimen shall fail by film tear bond rather than in the seam. The minimum requirements for the seams strengths shall be as specified in Table 5. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.

D. ~~3.~~ After completion of the above-described tests, the remaining portion of the trial seam sample can be discarded. If a trial seam sample fails a test, then a destructive test seam sample shall be taken from the seams completed by the seamer during the shift related to the considered trial seam. These samples shall be forwarded to the CQA Consultant and, if they fail the tests, the procedure indicated in Paragraph 3.3 of this section shall apply. The conditions of this paragraph shall be considered as met for a given seam if a destructive seam test sample has already been taken from the considered seam

~~D.~~E. Destructive Testing:

~~1. Destructive test seams are to be made by each seaming crew, at the beginning of the seaming process and every four hours thereafter, or every time equipment is changed. Test seams will be made under the same conditions as the production welds (i.e., in contact with the geomembrane subsurface and similar ambient temperature). These seams are to be made of like materials provided for the purpose of testing and not cut from the seamed panels. Each seaming crew and the materials they are using must be traceable and identifiable to their test seams. The samples will be numbered, dated and identified as to the personnel making the seam, and the location made by appropriate notes on a print of the panel layout for the project. The completed field seam sample will measure at least fourteen inches wide and twenty four inch long.~~

~~2. The field test samples are to be tested for seam strength and peel adhesion using equipment suitable for this purpose. Shear and peel strength will be tested in accordance with ASTM D4437. The geomembrane Installer will provide a punch press or other suitable means for the on-site preparation of the specimens for testing. The geomembrane Installer will provide a tensiometer for the on-site shear and peel testing of the samples. The tensiometer will be in good working order, built to ASTM specifications and accompanied by evidence of recent calibration. All test failures shall be film tear bond failures.~~

~~3. To be acceptable, 4 out of 5 samples will pass shear and peel testing with strength values equal to those indicated in Table 5. If a test sample fails to meet the field seam design specification, then the seaming crew will make additional test samples, using the same tools, equipment, environmental conditions and materials and retest. All test failures shall be film tear bond failures.~~

F. Destructive Seam Testing:

1. A minimum of one destructive test per 500 LF of seam, and as many other samples as CQA firm determines appropriate, shall be obtained at locations specified by the CQA firm.
   a. Sample locations shall not be identified prior to seaming.
   b. The samples shall be a minimum of 12 IN wide by 48 IN long with the seam centered lengthwise.
   c. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to a CQA Testing Laboratory, and the remaining piece given to the CQA Engineer for quality assurance testing and/or permanent record.
   d. Each sample shall be numbered and recorded on the final panel layout record drawing, and cross-referenced to a field log which identifies:
      1) Panel/sheet number.
      2) Seam number.
      3) Top sheet.
      4) Date and time cut.
      5) Ambient temperature.
      6) Seaming unit designation.
      7) Name of seamer.
      8) Seaming apparatus temperature and pressures (where applicable).
2. A minimum of four 1 IN wide replicate specimens shall be cut from the Installer's sample.
   a. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.
   b. To be acceptable, all field test specimens must meet the specified seam strength requirements and all must fail as Film Tear Bond.
   c. If all field tests pass, 5 specimens shall be tested at the CQA Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D4437.
   d. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fifth sample must meet 80% required strength and fail at Film Tear Bond.
   e. Shear elongation and Peel separation shall not exceed values given in GRI GM19

Table 5: Seam Strength and Related Properties of Thermally Bonded TPO Geomembrane per ASTM D 4437/GM 19

Geomembrane Nominal Thickness	60 mils
Hot Wedge Seams[1]	
Shear strength[2], lb/in	150
Peel strength[2], lb/in	20
Hot-air Seams	
Shear strength[2], lb/in	150
Peel strength[2], lb/in	20

Notes:
1. Also for hot air seaming methods
2. Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values.

~~E. Procedures for Destructive Test Failure~~

~~The following procedures will apply whenever a sample fails a~~ For destructive ~~test, whether that test is conducted by the Geosynthetics CQA Laboratory, the Installer's laboratory, or by field tensiometer.~~

~~The Installer has two options.~~

- ~~The Installer can reconstruct (e.g., remove the old seam and reseam) the seam between any two passed destructive seam test locations.~~
- ~~The Installer can trace the seaming path to an intermediate location (at 10 ft (3 m) minimum from the point of the failed test in each direction) and take a small sample for an additional field test at each location. If these additional~~ samples ~~pass tensiometer testing, then full destructive laboratory samples are taken. If these destructive laboratory samples pass the tests, then the seam is reconstructed between these locations by capping. If either sample fails, the Installer~~which have failed the passing criterion, the Contractor will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Contractor may patch or cap strip the seam between the passed samples. If either fails, the Contractor will remove and replace the entire seam.

~~If a wedge type seam fails destructive testing and the Installer chooses to cap the seam, then the only~~ In all cases, acceptable ~~capping method is to reconstruct seam between any two passed destructive seam test locations. Applying topping is not an approved method of capping long lengths of seam.~~

3. ~~All acceptable~~ field seams must be bounded by two ~~locations from which destructive samples passing laboratory tests have been taken. In cases exceeding 150 ft (50 m) of reconstructed seam, a sample~~passed test locations. The decision of the CQA Engineer will be ~~taken from the zone in which the seam has been reconstructed. This sample must pass destructive testing or the procedure outlined in this section must be repeated.~~ final.

   a. ~~The CQA Officer will document~~In addition, all ~~actions taken in conjunction with~~ destructive seam sample holes shall be repaired the same day as cut.
   b. Certified test ~~failures~~results on all field seams shall be submitted to and approved by the CQA Engineer prior to acceptance of the seam.

4. All repaired areas shall be non-destructively tested and destructively tested as described in Part 3.1B.2.p (2) of this specification.

5. Destructive testing shall be performed by a CQA Testing Laboratory not employed by the Installer.

6. A map showing the locations, number and type of all patches shall be prepared and provided to the Owner.

7. Documentation: The following documentation must be maintained at the project site for review by the CQA Engineer or Inspector.
   a. Geomembrane Installer's Documentation:
      1) Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, weather conditions, and equipment on site.
      2) Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
      3) Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.
      4) Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
      5) Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.

6) Seam/Panel Repair Log: provides a complete record of all repairs and vacuum box testing of repairs made to defective seams or panels.
7) As-Built Drawing: maintain an as-built drawing updated on a weekly basis.

3.3 DEFECTS AND REPAIRS

A. All seams and non-seam areas of the geomembrane will be examined by the CQA Officer 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 examination. The geomembrane surface shall be swept or washed by the Geosynthetics Installer if surface contamination inhibits examination. The Geosynthetics Installer shall ensure that this examination of the geomembrane precedes any seaming of that section.

B. Each suspect location, both in seam and non-seam areas, shall be nondestructively tested using the methods described, as appropriate. Each location that fails nondestructive testing shall be marked by the CQA Consultant and repaired by the Geosynthetics Installer. Work shall not proceed with any materials that will cover repaired locations until laboratory test results with passing values are available.

C. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the CQA Consultant shall identify excessive geomembrane wrinkles. The Geosynthetics Installer shall cut and reseam all wrinkles so identified. The seams thus produced shall be tested like any other seams.

D. Repair Procedures:

1. ~~1.~~ Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetics Installer. Several repair procedures are specified below. The final decision as to the appropriate repair procedure shall be agreed upon between the CQA Consultant and the Geosynthetics Installer. The procedures available include:

   a. ~~i.~~ patching - used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter;
   b. ~~ii.~~ abrading and reseaming - used to repair small sections of extruded seams;
   c. ~~iii.~~ spot seaming - used to repair small tears, pinholes, or other minor, localized flaws;
   d. ~~iv.~~ capping - used to repair long lengths of failed seams; and
   e. ~~v.~~ removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).

2. ~~2.~~ In addition, the following shall be satisfied:

   a. ~~i.~~ surfaces of the geomembrane that are to be repaired shall be abraded no more than one hour prior to the repair;

   b. ~~ii.~~ all surfaces must be clean and dry at the time of repair;
   c. ~~iii.~~ all seaming equipment used in repair procedures must be approved by Engineer;
   d. ~~iv.~~ the repair procedures, materials, and techniques shall be approved in advance, for the specific repair, by the CQA Consultant and Geosynthetics Installer;
   e. ~~v.~~ patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.; and
   f. ~~vi.~~ the geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

E. Each repair shall be numbered and logged and shall be nondestructively tested using the methods described in this section, as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests will require the repair to be redone and retested until a passing test result is achieved. At the discretion of the CQA Consultant, destructive testing may be required on large caps at no additional cost to OWNER.

3.4 DOCUMENTATION

A. The following documentation must be maintained at the project site for review by the CQA Engineer or Inspector as the Geomembrane Installer's Documentation:

1. Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, weather conditions, and equipment on site.
2. Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
3. Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.
4. Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
5. Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
6. Seam/Panel Repair Log: provides a complete record of all repairs and air lance testing of repairs made to defective seams or panels.
7. As-Built Drawing: maintain an as-built drawing updated on a weekly basis.

3.5 GEOSYNTHETIC LINER SYSTEM ACCEPTANCE

A. Contractor shall retain all ownership and responsibility for the geosynthetic liner system until final acceptance by the Owner.
   1. Owner will accept the geosynthetic liner system installation when the installation is finished and all required warranties, test results, and documentation from the Contractor, Manufacturer, Inspector and Installer ~~has~~have been received and approved, and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

SECTION 02775
LLDPE GEOMEMBRANE LINER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing, installation, quality control, and testing of a LLDPE geomembrane liner with texture on both sides. LLDPE geomembrane liner will be used as part of the final cover system.

B. Related Sections include but are not necessarily limited to:
   1. Section 02200 – Earthwork: Landfill.
   2. Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Referenced Standards:
   1. ASTM International (ASTM).
      a. ASTM D1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
      b. ASTM D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
      c. ASTM D1505 Standard Test Method for the Density of Plastics by the Density-Gradient Technique.ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
      d. ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
      e. ASTM D3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
      f. ASTM D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
      g. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
      h. ASTM D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      i. ASTM D5321, Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
      j. ASTM D5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
      k. ASTM 5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
      l. ASTM D5820, Standard Practice for Pressured Air Channel Evaluation of Dual Seamed Geomembrane.
      m. ASTM D5994 Test Method for Measuring the Core Thickness of Textured Geomembranes.
      n. ASTM D6365 Non-Destructive Testing of Geomembrane Seams Using the Spark Test
      o. ASTM D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
      p. ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexibly Polypropylene Geomembranes.

   2. The Geosynthetic Research Institute (GRI).
      a. GRI GM12, Asperity Measurement of Textured Geomembranes Using a Depth Gage.

b. GRI GM17 Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes.
c. GRI GM19, Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

B. Qualifications:
1. Each manufacturing and fabricating firm shall demonstrate 5 years continuous experience with a minimum of 10,000,000 SF of LLDPE geomembranes.
2. Installer:
a. Demonstrate 5 years continuous experience with a minimum 10,000,000 SF of LLDPE geomembranes.
b. Trained and certified by at least one of the named manufacturers in this Specification (not necessarily the manufacturer supplying materials for this Project).
c. Geomembrane Installer Personnel Qualifications:
1) Installation Superintendent shall have worked in a similar capacity on at least five geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
2) The Master Welder shall have completed a minimum of 5,000,000 ~~sf~~SF of LLDPE geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
3) Other welders shall have seamed a minimum of 1,000,000 ~~sf~~SF of LLDPE geomembrane.
3. ~~CQA~~CQC Testing Laboratory shall demonstrate 3 years of continuous experience in similar geosynthetic materials testing.

C. Quality Assurance / Control:
1. The Owner or Engineer's representative will conduct independent testing to support construction quality assurance program and to provide documentation of such to appropriate regulatory agencies.
2. Unless specifically superseded by these contract documents or approved plans submitted by the Contractor, the geosynthetic materials shall be manufactured, stored, placed, seamed, tested and protected as described in EPA/600/R-93/182 and EPA/530/SW-91/051.
a. This specifically includes:
1) Material Composition.
2) Manufacturing.
3) Handling and Packaging.
4) Shipment.
5) Storage (Manufacturer and Site).
6) Placement:
a) Seaming and Joining.
b) Destructive and Non Destructive Testing.
c) Protection, Backfilling and Covering.
7) Conformance Testing.
8) Anchoring and Anchor Trenches.
9) Access Roads/Ramps.

D. CQA Plan Implementation: Construction Quality ~~Assurance~~Control will be performed in accordance with the CQA Plan prepared for this project. The Contractor and Geomembrane Installer should familiarize themselves with the CQA Plan.

E. Certifications:
1. Certifications are required for various aspects of the project related to the LLDPE geomembrane liner system construction.
a. Utilize certification forms approved for use on this project by the Owner and Engineer~~.~~.

F. Installer's construction quality control programs to include, but not be limited to, product acceptance testing, installation testing, including both nondestructive and destructive quality control field testing of the sheets and seams during installation of the geomembrane, proposed methods of testing geosynthetic joints and connections at appurtenances for continuity, documentation and changes, alterations, repairs, retests, and acceptance.

G. Geomembrane Installer's installation manual to include:
   1) Ambient temperature at which the seams are made
   2) Control of panel lift up by wind
   3) Acceptable condition of the subsurface beneath the geomembrane
   4) Quality and consistency of the welding material
   5) Proper preparation of the liner surfaces to be joined
   6) Cleanliness of the seam interface (e.g., the amount of airborne dust and debris present)
   7) Proposed details for connecting the LLDPE liner to appurtenances, i.e. penetrations of the containment facilities.
   8) A complete description of seaming by extrusion welding and hot-wedge welding.
   9) Requirements of the Manufacturer's Installation Manual unless exceptions are noted and approved by the Engineer.

1.3 DEFINITIONS AND RESPONSIBILITIES

A. Geomembrane Manufacturer: Manufacturer of geomembranes producing geomembrane sheets from resin and additives. The manufacturer is responsible for producing geomembrane sheet which complies with these Specifications. These responsibilities include but are not limited to:
   1. Acceptance of the resin and additives from chemical formulators. Testing of the raw resin and additives to ensure compliance with the manufacturer's specifications and with this Specification.
   2. Formulation of the resin and additives into geomembrane sheeting using mixing and extrusion equipment.
   3. Testing of the geomembrane sheet to ensure compliance with manufacturer's specification and this Specification.
   4. Shipping of the geomembrane sheet to installer designated facilities.
   5. Certification of the raw materials and finished geomembrane sheet to comply with this Specification.
   6. Certification of installer's training, experience, and methods for welding and inspection of geomembrane installations in compliance with manufacturer's standards.

B. Geomembrane Installer. Installer of geomembranes are responsible for handling, fitting, welding, and testing of geomembrane sheets or blankets in the field. These responsibilities include but are not limited to:
   1. Acceptance (in writing) of the geomembrane from the manufacturer.
   2. Acceptance (in writing) of the surface which will serve as a base for the geomembrane. This acceptance shall precede installation of the geomembrane, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of geomembrane liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
   3. Handling, welding, testing, and repair geomembrane liners in compliance with this Specification and the Geomembrane Installer's Installation Procedures Manual.
   4. Performance of QC testing and record keeping as required by the approved Geomembrane Installer's Field Installation Procedures Manual.
   5. Repair or replacement of defects in the geomembrane as required by the Installer's CQC Consultant or the CQA Inspector.

C. CQA Inspector:
   1. Inspectors of LLDPE geomembrane are the individuals responsible for observing field installation of the geosynthetic materials and providing the Manufacturer, Installer, CQA Engineer, and Owner with verbal and written documentation of the compliance of the installation with this specification and with written procedures manuals prepared by the Manufacturer or Installer.

D. CQA Testing Laboratory shall:
   1. Perform destructive testing of the LLDPE geomembrane.
   2. Perform conformance testing of LLDPE geomembrane.

E. Installer's CQC Consultant: Responsible for observing field installation of the geomembrane and performance of material conformance and CQC testing to provide the Contractor with verbal and written documentation of the compliance of the installation with these Specifications.

F. CQA Engineer: Responsible for implementing CQA Plan including overviewing material conformance testing, field installation of the geomembrane, and CQC activities, and to perform limited CQA conformance testing to provide Owner with verbal and written documentation of the compliance of the installation with these Specifications. The CQA Engineer will use the written results of the CQC program and the CQA program in the preparation of the facility Certification Document. The CQA Engineer reports to the Owner and is not part of this contract.

G. Refer to the accompanying CQA Plan for additional definitions.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit for Engineer's approval Shop Drawings, including:
      a. Manufacturer's certification that raw materials and sheet materials comply with required materials, mil thickness, and material properties.
         1) Original certificates are required.
      b. Manufacturer/Fabricator/Installer quality control requirements.
      c. Qualifications and experience of key personnel per 1.2 B of this section.
      d. Manufacturer's written acceptance of Geomembrane Installer's qualifications for installation of the LLDPE geomembrane.
      e. LLDPE Geomembrane layout plan with proposed size, number, position and sequencing of liner panels and showing the location and direction of all field or factory joints.
         1) Proposed details for connecting the geosynthetic materials to appurtenances.
         2) Proposed methods of welding, seaming or jointing geosynthetic materials.
         3) Proposed method and sequencing for placement of drainage layer on top of the LLDPE geomembrane liner.
         4) Proposed method of testing LLDPE geomembrane and other geosynthetic materials, joints and connections at appurtenances for continuity.
         5) Location and configuration of haul roads and access points.
         6) Proposed details for anchor trench if different than included in Contract Documents.

B. Miscellaneous:
   1. Test results:
      a. Resin test, tests of sheet material and factory seam tests at frequency specified in respective quality control manuals.
         1) Results shall include or bracket the rolls delivered for use in the Work.
      b. Daily test seam results.
      c. Daily results of production seam testing.
   2. Warranties as described below.
   3. Submit written certifications that:
      a. Utilize certification forms approved for use on this project by the Owner and Engineer. Make appropriate number of copies, as required.

b. The LLDPE geomembrane material delivered to site meets the requirements of this Specification.
c. The LLDPE geomembrane was received and accepted in undamaged condition from shipper.
d. The LLDPE geomembrane liner was installed in accordance with this Specification and with approved Shop Drawings.
e. The LLDPE geomembrane joints were inspected, tested for strength and continuity, and passed all inspections and tests.
1) All test and inspection data shall be incorporated into this certification.
f. The drainage composite and protective cover soil on top of the LLDPE geomembrane liner was placed properly and carefully.

4. Manufacturer/Installer's Field Installation Procedures Manual shall clearly identify any exceptions taken to the specified execution of the Work.
5. Record Drawings: Submit reproducible drawings of record showing changes from the approved installation drawings. The record drawings shall include the identity and location of each repair, cap strip, penetration, boot, and sample taken from the installed geosynthetic for testing. The record drawings shall show locations of each type of material, anchor trenches and the construction baseline.

C. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted. All submittals must be submitted prior to the Geomembrane Preconstruction Meeting and a minimum of four weeks prior to installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Unused or stockpiled LLDPE geomembrane shall be stored in accordance with the manufacturer's recommendations.

B. Each roll shall be labeled with the manufacturers name, type, lot number, roll number, and roll dimensions (length, width, gross weight).
1. LLDPE geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed.
2. LLDPE geomembrane shall not be exposed to temperatures in excess of 60 ~~DegC~~Deg C (140 ~~DegF~~Deg F) or less if recommended by the Manufacturer.

C. No hooks, tongs or other sharp instruments shall be used for handling the LLDPE geomembrane.
1. Rolls shall not be lifted by use of cables or chains in contact with the LLDPE geomembrane.
2. LLDPE geomembrane shall not be dragged along the ground.

1.6 PROJECT CONDITIONS

A. When the weather is of such a nature as to endanger the integrity and quality of the installation, whether this is due to rain, high winds, cold temperatures, or other weather elements, the installation of the geomembrane shall be halted at the direction of, or with the concurrence of, the Owner until the weather conditions are satisfactory.

B. The contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces which hamper the efficient field seaming of geosynthetic panels or performance.

C. Maintain natural surface water drainage diversions around the work area and provide for the disposal of water which may collect in the work area directly from precipitation falling within the area or from inadequate diversion structures or practices.

D. All materials shall be placed and spread with low ground pressure equipment (10 psi ground pressure or less) as approved by the CQA Engineer to reduce potential damage to the geosynthetics. The geosynthetics surface shall be off limits to construction traffic. Hard turning of tracked equipment on the protective cover and stone must be avoided.
1. At least 12 IN of separation between the geosynthetics and all low ground pressure equipment shall be maintained.

2. Stockpiling of materials within the limits of ~~the cell~~Phase I shall be subject to advanced approval by the CQA Inspector. Any hauling equipment (dump trucks, etc.) operating within the ~~cell~~Phase I limits (and including access ramps), shall have a minimum of 4 feet of separation between the vehicle wheels and the geosynthetics.
3. No vehicle shall access the completed Work unless it can be demonstrated that its weight, movement or activities will not damage the Work.
4. When damage is suspected, uncover area, repair damage if required, and recover area at no cost to Owner.
5. Suspect areas may be identified by Owner or Engineer.

1.7 WARRANTIES

A. Written warranties addressing LLDPE geomembrane material and installation workmanship shall be furnished by the Contractor and shall be made to the Owner.

B. Submit material samples and warranties prior to shipment.

C. Suitability of geosynthetic liner system shall be subject to Owner's approval of warranty.
1. The Manufacturer's warranty shall be against manufacturing defects and workmanship and against deterioration due to ozone, ultra- violet, and other exposure to the elements, for a period of 5 years on a pro rata basis. The warranty shall be limited to replacement of material, and shall not cover installation of replacement geomembrane.
2. The Installer's warranty shall state that the materials were properly installed, properly (field and factory) welded, seamed and jointed and will not fail within two years of the date of final acceptance of the Work by the Owner.
   a. Warranty shall not be prorated.

D. Warranties shall provide for complete repair/replacement excluding installation costs at no additional cost to the Owner for the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND/OR GEOMEMBRANE INSTALLERS

A. Subject to compliance with the Contract Documents, the following manufacturers and installers are acceptable:
1. LLDPE Geomembrane liners manufacturers:
   a. Agru/America, Inc.
   b. GSE, Inc.
   c. Poly-Flex Inc.
2. LLDPE Geomembrane Liner Installers:
   a. Authorized installers of approved manufacturers.
   b. Other installers may qualify by providing references for a minimum of 10,000,000 SF of liner installations.

2.2 MATERIALS

A. LLDPE Geomembrane Liner:
1. Consist of unreinforced polyethylene.
   a. Thickness: 40 mils.
   b. Manufactured from virgin, first quality resin designed and formulated specifically for liquid containment in hydraulic structures.
   c. Reclaimed polymer shall not be added to the resin; except use of polymer recycled during the manufacturing process shall be allowed provided that recycled polymer shall be clean and shall not exceed 10 percent by weight.
   d. No additives or fillers may be added to the resin prior to or during manufacture of the LLDPE geomembrane.
2. Manufactured to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.

a. Any such defects shall be cause for rejection of the material.
b. Minor defects may be repaired in accordance with Manufacturer's recommendations if approved by the Engineer.

3. Manufactured as seamless rolls.
   a. Minimum width: 22 FT as delivered to the site.
4. Prior to shipment, the geomembrane manufacturer will provide the CQA Engineer and the Installer's CQC Consultant with a quality control certificate for each roll of geomembrane provided. The quality control certificate will be signed by a responsible party employed by the geomembrane manufacturer and will include:
   a. Roll numbers and identification; and
   b. The results of quality control tests performed under the MQC program.
5. The Installer's CQC Consultant and the CQA Inspector will verify that a control certificate has been received for each roll and that the certified roll properties meet the requirements of these Specifications.
6. LLDPE sheet with **texture** on both sides shall be used for ~~all~~top, north, and east sideslopes including drainage terrace.
7. The geomembrane liner material shall consist of **40 MIL NOMINAL LLDPE** and meet or exceed GRI GM17 and the following requirements:

PROPERTY	TEST METHOD	TEST VALUE TEXTURED LLDPE
a. Sheet Thickness, Mils •Minimum Average •Lowest Individual 8 of 10 •Lowest Individual 10 of 10	ASTM D5994 (textured)	 nominal ± 5% nominal ± 10% nominal ± 15%
b. Sheet Density (min. ave.)	ASTM D1505	≥ 0.92 g/cc
c. Melt Flow Index (g/10 min.)	ASTM D1238 Condition 190/2.16	≤ 1.00
d. Minimum Tensile Properties (each direction) • Break Stress • Elongation at Break	ASTM D6693 Type IV Dumb-bell 2 ipm G.L. = 2.0 in (51 mm)	 60 ppi 250%
e. Min. Tear Resistance Initiation	ASTM D1004	22 lbs
f. Carbon Black Content	ASTM D1603 or ASTM D4218	2.0-3.0%
g. Carbon Black Dispersion • Minimum 9 of 10 • All 10 of 10	ASTM D5596	Category 1 or 2 1, 2, or 3
h. Puncture Resistance, Minimum Average	ASTM D4833	44 lbs
i. Oxidative Induction Time, Minimum Average	ASTM D3895 200°, O_2, 1 atm	>100 min.
j. Asperity Height,	GRI GM12	

PROPERTY	TEST METHOD	TEST VALUE TEXTURED LLDPE
Minimum Average		
• Minimum Average		10 mil
• Lowest Individual 8 of 10		7 mil
• Lowest Individual 10 of 10		5 mil

8. Rolls may be rejected if they appear damaged upon delivery or if they have been rejected or returned from another project.

B. Geomembrane Manufacturing Quality Assurance (QA): The geomembrane liner shall be manufactured in accordance with a written quality assurance/quality control program (QC). This QA/QC program shall be submitted to the Engineer or Inspector, together with shop drawings showing the layout of geomembrane liner in the containment facility. After this QA/QC program has been approved by the Engineer or Inspector, the Manufacturer shall not deviate from the program without written approval of the Engineer or Inspector. All testing shall be performed by the manufacturer and results shall be submitted to CQA Inspector for review. The QA/QC program shall include:
   1. Routine testing of incoming resin prior to manufacture of geomembranes. This testing shall include tests for density, melt index, and oxidative induction time, at a frequency of not less than one per 200,000 LB.
   2. Routine testing of the manufactured sheet for physical parameters. This testing shall include tests for carbon black, tensile strength, and elongation properties, at a frequency of not less than one per 20,000 LB of manufactured geomembrane; tear and puncture resistance and carbon black dispersion at a frequency of not less than one per 45,000 LB of manufactured geomembrane. Thickness shall be monitored continuously through the manufacturing process, or measured physically at a frequency of not less than one per roll of manufactured geomembrane. For textured sheet only, asperity height shall be measured every other roll.
   3. Extrusion rod shall be manufactured from identical resin to that used in geomembrane manufacture. Manufactured extrusion rod shall be tested for carbon black, specific gravity and melt index at a frequency of not less than one test per batch.
   4. The Manufacturer shall reject resin shipments which do not conform with the density and melt index requirements of the approved QA/QC program. The Manufacturer shall reject manufactured geomembrane which does not conform to the sheet physical requirements of the approved QA/QC program
   5. The LLDPE textured geomembrane shall conform to the requirements prescribed in GRI Test Method GM17.

C. Manufacturing QC data shall accompany the geomembrane shipment.

D. Independent testing of geomembrane shall be conducted in accordance with the CQA Plan.

2.3 INTERFACE FRICTION TESTS

A. Laboratory friction tests shall be conducted, on behalf of the OWNER by the CQA Laboratory, with representative samples of the materials selected by the Contractor for use in the Work. The CQA Inspector is responsible for shipping materials to the testing laboratory. The initial set of testing and subsequent conformance tests (if any) shall be paid for by the Owner. If any interface doesn't meet the requirements, or if the Contractor changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the Contractor.
Testing will include the interfaces between the following adjacent materials.

B.	D. Specification Section
C. Material	

E. Intermediate Cover	F. 02200
G. 40 mil Textured LLDPE Geomembrane	H. 02775
I. Drainage Composite: Final Cover	J. 02777
K. Protective Cover	L. 02200
	M.

~~B.~~N. The testing shall be performed in accordance with ASTM D5321.

1. The materials shall be tested at normal stressed of 250, 500, and 1,000 psf. Displacement rates shall be in accordance with ASTM D5321 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA Inspector prior to performing the tests.

~~C.~~O. A minimum friction angle of 26 degrees is required for each interface in the system defined in Paragraph A.

~~D.~~P. Interface shear strength of the actual components which will be used in the liner system shall be tested with method ASTM D5321 or an equivalent test method. The interface shall be tested in a water-saturated state.

~~E.~~Q. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

~~F.~~R. Interface friction tests will be conducted by the Owner.

2.4 EQUIPMENT AND ACCESSORIES

A. Welding and Seaming Equipment:
   1. Equipped with gages showing temperatures at the nozzle (extrusion welder) or at the wedge (wedge welder).
   2. Maintained in adequate numbers to avoid delaying work.
   3. Supplied by a power source capable of providing constant voltage under a combined-line load.
   4. Electric generator shall not be placed on the LLDPE geomembrane.

B. Field Tensiometer:
   1. Provide a tensiometer for on-site shear and peel testing of LLDPE geomembrane seams.
      a. Tensiometer shall be in good working order.
      b. Built to ASTM specifications.
      c. Accompanied by evidence of calibration of equipment and gages within the past six months.
   2. Tension meter:
      a. Motor driven.
      b. Jaws capable of traveling a measure rate of 2 IN per minute.
      c. Equipped with a gauge that measures the force in unit pounds exerted between the jaws.
      d. Digital readout.

C. Punch Press:
   1. Provide a punch press for the onsite preparation of specimens for testing.
   2. Capable of cutting specimens in accordance with ASTM D4437.

D. Vacuum Box:

1. Provide a vacuum box for onsite testing of LLDPE geomembrane seams in accordance with ASTM D5641.

E. Equipment necessary to perform "Pressurized Air Channel Evaluation of Dual Seamed Geomembranes" in accordance with ASTM D5820.

F. Gages:
   1. Calibrated within past six months.
   2. Specified test values reading near mid-range of the gage scale.

G. Equipment necessary to perform "Non-Destructive Testing of Geomembrane Seams Using The Spark Test" in accordance with ASTM D6365.

2.5 FABRICATION

A. The Manufacturer is responsible for producing geomembrane sheet that complies with this Specification. These responsibilities include but are not limited to:
   1. Resin and additive quality control:
      a. Acceptance of the resin and additives from chemical formulators.
      b. Testing of the raw resin and additives to ensure compliance with the Manufacturer's specifications and with this Specification.
   2. Formulation of the resin and additives into sheeting using mixing and extrusion equipment.
   3. Testing of the sheet material to ensure compliance with Manufacturer's specifications and this Specification.
   4. Shipping of the sheet material to Installer.
   5. Certification of the raw materials and finished sheet to comply with this Specification.
   6. Certification of Installer's training (unless Installer is certified by other acceptable manufacturer list herein), experience and methods for welding, seaming, joining and inspecting geosynthetic materials installations in compliance with Manufacturer's standards and with Quality Assurance requirements of this Specification Part 1.2.

PART 3 - EXECUTION

3.1 GEOSYNTHETIC LINER SYSTEM

A. Geomembrane Subgrade:
   1. Protect subgrade at all times from damage until such time as the placement of LLDPE geomembrane liner and other components of the geosynthetic liner system are complete.
   2. The subgrade shall be prepared in a manner consistent with proper subgrade preparation techniques for the installation of LLDPE Geomembrane.
      a. The subgrade shall be properly compacted so as not to settle and cause excessive strains in the LLDPE Geomembrane or other synthetic liner materials.
      b. Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 inch.
      c. In addition, ensure that the subgrade has been rolled to provide a uniform surface.
      d. During installation, ensure that rutting or ravelling is not caused by installation equipment or weathering.

B. Anchor Trenches:
   1. Geosynthetic materials placed on side slopes shall be anchored into trenches as detailed on the Contract Drawings.
   2. Excavation, backfill and compaction shall be in accordance with Section 02200.

C. LLDPE Geomembrane:
   1. General:
      a. Installer of LLDPE geomembranes is responsible for handling, fitting, welding, seaming, jointing and testing of geosynthetic materials sheets or blankets in the field in accordance with the Construction Quality Assurance (CQA) Plan.
      b. These responsibilities include but are not limited to:

1) Acceptance (in writing) of the geosynthetic materials sheets or blankets from the transporter.
2) Acceptance (in writing) of the surface which will serve as a base for the LLDPE geomembrane.
   a) This acceptance shall precede installation of the LLDPE geomembrane.
   b) Shall state that the Installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of LLDPE geomembrane liners.
   c) Shall explicitly state any and all exceptions to acceptance.
3) Handling, welding, seaming, jointing, testing and repair of LLDPE geomembrane liners and other geosynthetic materials in compliance with this Specification and with written procedures manuals prepared by the Manufacturer or Fabricator.
   a) Manual shall be submitted to the Engineer together with Shop Drawings showing the layout of LLDPE geomembrane within the facility.
      (1) Do not deviate from the procedures included in the manual.
   b) LLDPE Geomembrane shall not be placed upon frozen foundation, standing water or other conditions which will result in deterioration of the foundation.
   c) LLDPE Geomembrane liner materials shall be laid out according to plans previously approved by the Engineer.
   d) Adjacent rolls of LLDPE geomembrane shall overlap a minimum of 3 IN.
4) Repair or replacement of defects in the geosynthetic materials as required by the Inspector or the Owner.
5) Installer and Manufacturer may be the same firm.

2. Panel deployment:
   a. Subgrade Preparation:
      1) ~~1)~~ Prepare subgrade in a manner consistent with proper subgrade preparation techniques for the installation of LLDPE geomembrane liner.
      2) ~~2)~~ Properly compact the subgrade so as not to settle and cause excessive strains in the LLDPE geomembrane liner.
      3) ~~3)~~ Prior to installation, ensure a surface free of debris, roots, or angular stones larger than 1/2 IN.
      4) ~~4)~~ Subgrade soils proof-rolled with a ten (10) ton drum roller, two (2) passes parallel to slope or as directed by CQA Inspector. The subbase shall be compacted and proof-rolled under observation of the CQA Inspector to assure the maximum practical compaction under the existing field conditions has been achieved. See specification Section 02200 for project specific compaction requirement.
      5) ~~5)~~ Ensure rutting or raveling is not caused by installation equipment or weather.
      6) ~~6)~~ Ensure that lines and grades have been verified by the Contractor and a subgrade acceptance form has been submitted.
   b. Construct and backfill anchor trenches
   c. Deploy LLDPE geomembrane liner in a manner to ensure it is not damaged
   d. On slopes, anchor the LLDPE geomembrane liner securely and deploy it down the slope in a controlled manner.
   e. Weight the LLDPE geomembrane liner with sandbags or equivalent in the presence of wind.
   f. Minimize cutting the LLDPE geomembrane liner. Whenever possible, overlap instead of cutting material. If cutting is required, cut LLDPE geomembrane liner with a cutter or other approved device. Seal all cut edges, as recommended by Manufacturer.
   g. Only those panel/sheets that can be seamed in 1 day shall be deployed.
   h. Place panels with minimal handling.
      1) No horizontal seams on side slopes.
      2) Protect panels from tear, puncture or abrasion.
   i. Equipment used to deploy the geomembrane shall not damage the LLDPE geomembrane.
   j. Minimize foot traffic.

1) Do not allow personnel access to wet or slippery liners without adequate safety precautions.
2) Do not allow footwear that may damage the geomembrane.

k. Ballast with sandbags to prevent wind uplift as recommended by Manufacturer based on local climatic conditions.
1) Remove and replace all wind damaged panels at no additional cost to Owner.
2) If wind causes panels to be displaced, displaced panel may not be reused.

l. Install LLDPE geomembrane in stress free, tension free and relaxed condition.
1) Account for temperature and weather-related impacts when deploying and covering.
2) Stretching to fit and folding are not permitted.

m. Do not allow LLDPE geomembrane to bubble, fold, or create ripples as a result of deployment of drainage layer or protective soil cover placement.
1) Except as noted on Contract Drawings no folds in LLDPE geomembrane will be allowed.

n. Any panel exhibiting stretching caused by placement, covering techniques, or wind shall be removed and may not be incorporated in the final construction.

o. Field seaming:
1) Field seaming shall be done in accordance with seaming recommendations furnished by the geomembrane Manufacturer, referenced EPA documents, and this specification.
2) Each piece of seaming equipment and each operator shall perform trial seams at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.
3) Trial seams shall use the same seaming materials and methods to be used in the actual construction.
4) Surfaces to be seamed shall be clean and dry at the time of seaming.
a) Precipitation and ponding of water on the LLDPE geomembrane shall cause termination of seaming operations.
b) LLDPE geomembrane shall not be seamed when ambient temperatures are below 41 ~~DegF~~Deg F or above 104 ~~DegF~~Deg F, without written consent of LLDPE geomembrane Manufacturer and Engineer.
5) LLDPE geomembrane sheets shall be seamed continuously without fishmouths or breaks in the seam.
a) Where fishmouths are unavoidable, the sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle.
b) The two edges of the slit shall be seamed together provided that the overlap for this seam shall be a minimum of 6 IN.
c) Areas of the slit which do not achieve an overlap of 6 IN, including the terminus of the slit, shall be provided with a patch as discussed below.
6) All LLDPE geomembranes shall be seamed by thermal fusion methods as recommended by the LLDPE geomembrane Manufacturer.
a) LLDPE geomembrane seaming shall be either extrusion or double wedge welded as approved by the Engineer.
7) Manufacturer's seaming instructions shall specifically address seaming materials, temporary and permanent jointing, seaming temperatures including temperatures for seaming materials, seam finishing and curing.
8) A copy of Manufacturer's seaming instructions shall be available on site at all times and shall not be deviated from without written approval of the Manufacturer and Engineer.
9) All panels/sheets should be overlapped a minimum of 3 IN.
a) No horizontal seams will be permitted on the side slopes.
10) Seaming shall not be conducted in the presence of standing water.
a) The seamed area shall be cleaned of dust, dirt and foreign material prior to and during the seaming operation.

11) Seaming shall extend to the outside edge of panels/sheets to be placed in anchor and/or drainage trenches.
12) Tack welds shall conform with manufacturers seaming techniques and shall not damage underlying membrane.

p. Patching:
1) Defects in and damage to LLDPE geomembrane sheets shall be repaired by seaming a patch over the defect.
a) The patch material shall consist of an undamaged piece of LLDPE geomembrane cut to provide a minimum of 6 IN of overlap in all directions from the defect.
b) Round corners shall be utilized on all patches. No bead or spot patching will be accepted.
c) Torn or permanently twisted LLDPE geomembrane shall be replaced at no expense to the Owner.
2) Test all patch seams non-destructively using a vacuum box test
a) Test patch seams destructively if the seam is greater than 100 feet in contiguous length (i.e. a single seam greater than 100 feet).
~~b)~~
~~q.~~b) Perform a destructive test for every 100 feet of contiguous seam over 200 total feet of contiguous seam. For example if a patch seam is 340 feet, 2 destructive tests would be required for the seam.~~Smoking is not permitted while on the geomembrane.~~

q. Smoking is not permitted while on the geomembrane.
r. No vehicles which may damage the material are allowed on the geomembrane.
~~r.~~s. Field Panel Identification: The Installer's CQC Consultant will document that the Geomembrane Installer labels each field panel with an "identification code" consistent with the approved panel layout plan. The location of the label and the color of marker used must be as agreed to in the QA/QC Preconstruction Meeting.

3.2 FIELD QUALITY CONTROL

A. The CQA Inspector shall not be a part of the installation program and shall not serve as a substitute for performing the duties or certification required of the Manufacturer and Installer.
1. The CQA Inspector's responsibilities include, but are not limited to:
a. Inspection of the material and the handling and field installation of the geomembranes. Inspection of all welds, repairs and quality control test results.
b. All exceptions to material or installation shall be documented and furnished to the CQA firm in writing within 48 HRS of discovery.
c. Inspection and Certification of LLDPE geomembrane integrity until completion of placement of protective soil cover.

B. Trial Seam Testing:
1. Trial seams shall be at the start of a shift, whenever equipment has broken down or seaming is interrupted for more than 30 minutes, and at other times at the discretion of the Installer and Inspector.
a. The location of trial seam shall be in an area proposed for the day's production seaming.
b. Equipment, methods and personnel shall be the same as proposed for the day's seaming.
2. Test four replicates (1 IN wide specimens) cut from trial seam.
a. To be acceptable, four of four replicate test specimens must meet specified seam strength requirements and all failures shall be Film Tear Bond.
b. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.
c. If the field trial seam tests fail to meet these requirements, the entire operation shall be repeated.

d. If the additional test seams fail, the seaming apparatus or seamer shall not be accepted or used for seaming until the deficiencies are corrected and two consecutive successful test seams are achieved.

C. Non-Destructive Seam Testing:
   1. All field seams shall be non-destructively tested over their full length.
      a. Seam testing shall be performed as the seaming work progresses, not at the completion of field seaming.
      b. All testing shall be documented. Any seams which fail shall be repaired and documented.
   2. Non-destructively test all field seams continuously using one of the following nondestructive seam tests:
      a. Vacuum box (ASTM D5641). Test at 5psi for 10 seconds. Any loss in vacuum, as indicated by bubbling of soap solution, is a failing test.
      b. Spark tests (ASTM D6365). Test at uniform rate between 6 and 9 meters per minute. A spark indicates a failing test.
      c. Pressurized air channel test (ASTM D5820). For 40 mil geomembrane, test at between 24 and 30 psi for at least 5 minutes. A pressure drop of more than 4psi is a failing test.
   3. All tests should be conducted in accordance with their corresponding ASTM method.

D. Destructive Seam Testing:
   1. A minimum of one destructive test per 500 LF of seam, and as many other samples as CQA firm determines appropriate, shall be obtained at locations specified by the CQA firm.
      a. Sample locations shall not be identified prior to seaming.
      b. The samples shall be a minimum of 12 IN wide by 48 IN long with the seam centered lengthwise.
      c. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to ~~an~~ a CQA Testing Laboratory, and the remaining piece given to the CQA Engineer for quality assurance testing and/or permanent record.
      d. Each sample shall be numbered and recorded on the final panel layout record drawing, and cross-referenced to a field log which identifies:
         1) Panel/sheet number.
         2) Seam number.
         3) Top sheet.
         4) Date and time cut.
         5) Ambient temperature.
         6) Seaming unit designation.
         7) Name of seamer.
         8) Seaming apparatus temperature and pressures (where applicable).
   2. A minimum of four 1 IN wide replicate specimens shall be cut from the Installer's sample.
      a. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.
      b. To be acceptable, all field test specimens must meet the specified seam strength requirements and all must fail as Film Tear Bond.
      c. If all field tests pass, 5 specimens shall be tested at the CQA Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D6392.
      d. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fifth sample must meet 80% required strength and fail at Film Tear Bond.
      e. Shear elongation and Peel separation shall not exceed values given in GRI GM19

   3. The minimum required seam strengths for <u>40 mil LLDPE</u> are:

Required Value

Description	Test Method	Seam Type	(lbs/in width)
LLDPE Peel	ASTM D6392	Extrusion	48
LLDPE Peel	ASTM D6392	Fusion	50
LLDPE Shear	ASTM D6392	All	60

4. For destructive samples which have failed the passing criterion, the Contractor will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Contractor may patch or cap strip the seam between the passed samples. If either fails, the Contractor will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.

   a. In addition, all destructive seam sample holes shall be repaired the same day as cut.
   b. Certified test results on all field seams shall be submitted to and approved by the CQA Engineer prior to acceptance of the seam.
5. All repaired areas shall be non-destructively tested and destructively tested as described in Part 3.1B.2.p (2) of this specification.
6. Destructive testing shall be performed by ~~an~~ a CQA Testing Laboratory not employed by the Installer.
7. A map showing the locations, number and type of all patches shall be prepared and provided to the Owner.
8. Documentation: The following documentation must be maintained at the project site for review by the CQA Engineer or Inspector.
   a. Geomembrane Installer's Documentation:
      1) Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, weather conditions, and equipment on site.
      2) Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
      3) Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.
      4) Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
      5) Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
      6) Seam/Panel Repair Log: provides a complete record of all repairs and vacuum box testing of repairs made to defective seams or panels.
      7) As-Built Drawing: maintain an as-built drawing updated on a weekly basis.

3.3 GEOSYNTHETIC LINER SYSTEM ACCEPTANCE

A. Contractor shall retain all ownership and responsibility for the geosynthetic liner system until final acceptance by the Owner.
   1. Owner will accept the geosynthetic liner system installation when the installation is finished and all required warranties, test results, and documentation from the Contractor, Manufacturer, Inspector and Installer has been received and approved, and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

SECTION 02777
DRAINAGE COMPOSITE – FINAL COVER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the bonded geotextile-geonet drainage composite used as part of the final cover system.

~~A. Section Includes:~~
~~1. Bonded geotextile-geonet drainage composite.~~

B. Related sections include but are not necessarily limited to:
1. Section 02778 - Geotextiles.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. ASTM International (ASTM):
   a. D1238, Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
   b. D1505, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
   c. D1603, Standard Test Method for Carbon Black in Olefin Plastics.
   d. D1987 Test Method for Biological Clogging of Geotextile or Soil/Geotextile Filters.
   e. D4716, Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
   f. D4873, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
   g. D5199, Standard Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
   h. D5321, Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
   i. D7005, Determining the Bond Strength (Ply Adhesion) of Geocomposites.
   j. D5035, Standard Test Method for Breaking Force and Elongation of Textile Fabrics (strip method).

2. Geosynthetic Research Institute (GRI).
   a. GRI GC8 – Determination of the Allowable Flow Rate of a Drainage Geocomposite.

B. Qualifications:
1. Each manufacturing and fabricating firm shall demonstrate five (5) years continuous experience, including a minimum of 5,000,000 SF of drainage composite production in the past three (3) years.
2. Installer shall attend pre-installation conference.

1.3 DEFINITIONS

A. Manufacturer: Manufacturer producing drainage composites from geonet cores and geotextiles.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

1.4 SUBMITTALS

A. Shop Drawings:
1. Manufacturer's documentation that raw materials and roll materials comply with required drainage composite physical properties.
2. Manufacturer and Installer quality control manuals.

3. Original test results for resins and roll material at frequency specified in respective quality control manuals.
   a. Include or bracket the rolls delivered for use in the Work.
4. Proposed details of anchor trench if different than included in Contract Documents.

B. Miscellaneous Submittals:
1. Qualification documentation specified in Article 1.2.
2. Transmissivity test.
3. Interface friction test.

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store drainage composites in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage.
1. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, drainage composite type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace, as directed by the Engineer, drainage composite or plastic wrapping damaged as a result of storage or handling.

E. Do not expose drainage composite to temperatures in excess of 71 DegC (160 DegF) or below 0 DegC (32 DegF) unless recommended by the Manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling the drainage composite.

G. Do not lift rolls by use of cables or chains in contact with the drainage composite.

H. Do not drag drainage composite along the ground or across textured geomembranes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. CETCO
2. GSE Lining Technology.
3. Polyflex Inc.
4. Skaps Industries.
5. Tenax Corp.

2.2 MATERIALS AND MANUFACTURE

A. Geonet Core:
1. Use nonthermally degraded polyethylene polymer which is clean and free of any foreign contaminants.
2. Manufactured geonet to conform to the property requirements listed in Table 1 and be free of defects including tears, nodules or other manufacturing defects which may affect its serviceability.

TABLE 1 - GEONET PROPERTIES

PROPERTY	TEST METHOD	REQUIRED VALUE	MIN. MQC TEST FREQUENCY
Specific Gravity/ Density (g/cm^3) (min)	ASTM D1505	>0.94 g/cc	1 per 50,000 ft^2 and every resin lot
Thickness (mil)	ASTM D5199	300 mil (min)	1 per 50,000 ft^2 and every resin lot
Carbon Black Content	ASTM D1603	2 percent	1 per 50,000 ft^2 and every resin lot
Tensile Strength	ASTM D5035	75 lbs/in MD	1 per 50,000 ft^2 and every resin lot

B. Geotextile:
   1. Cover geonet core on both sides or single side, as shown on Drawings, with a geotextile complying with requirements specified in Section 02778: Geotextiles, Drainage.

C. Drainage Composite:
   1. Create a composite by heat bonding geotextiles to the geonet.
   2. Transmissivity = $1.3x10^{-3}$ m^2/sec @ 100 hrs and 1,000 psf by ASTM D4716 (see Paragraph 2.3 A).
   3. Ply adhesion ASTM D7005 MARV of 1 lb/in.

D. Independent conformance testing shall be performed in accordance with CQA Plan.

2.3 SOURCE QUALITY CONTROL

A. Transmissivity Testing:
   1. Measure transmissivity using water at 68 DegF with a normal compressive load of 1,000 psf. and a hydraulic gradient of 0.33
   2. Attach geotextiles to the geonet in the same configuration as will be used in the field.
   3. Boundary conditions are soil interface on the upper geotextile and textured 40 mil LLDPE geomembrane against the lower geotextile.
   4. Maximum design normal load testing shall be conducted for a minimum period of 100 hours unless data equivalent to the 100-hour period is provided in which case the test shall be conducted for a minimum period of one hour.
   5. Testing frequency: 1 test for every 540,000 SF of installed product

B. Interface Friction Tests.
   1. Laboratory friction tests shall be conducted, on behalf of the ~~OWNER~~Owner by the CQA Laboratory, with representative samples of the materials selected by the Contractor for use in the Work. The Contractor is responsible for shipping materials to the testing laboratory. The initial set of testing and subsequent conformance tests (if any) shall be paid for by the Owner. If any interface doesn't meet the requirements, or if the Contractor changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the Contractor. Testing will include the interfaces between the following adjacent materials.

Material	Specification Section
Protective Cover	02200
Drainage Composite – Final Cover	02777
40 ~~Mil~~mil Textured ~~HDPE~~ LLDPE Geomembrane	02775
Intermediate Cover	02200

   2. The testing shall be performed in accordance with ASTM D5321.

3. The materials shall be tested at normal stressed of 250, 500, and 1,000 psf. Displacement rates shall be in accordance with ASTM D5321 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA Inspector prior to performing the tests.
4. A minimum friction angle of 26 degrees is required for each interface in the system defined in Paragraph ~~A~~B.1.
5. Interface shear strength of the actual components which will be used in the liner system shall be tested with method ASTM D5321 or an equivalent test method.
6. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.
7. Interface friction tests will be conducted by the CQA Testing Laboratory.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to placement of the drainage composite, clean the substrate of all soil, rock, and other materials which could damage the composite.

B. The ~~geocomponent~~geocomposite drainage media shall be placed only on geomembrane that has been approved by the Geomembrane Installer and accepted by the CQA Inspector.

3.2 INSTALLATION

A. Install geocomposite drain in accordance with manufacturer's written recommendations.

B. Deploy the drainage composite ensuring that the drainage composite and underlying materials are not damaged.
   1. Replace or repair faulty or damaged drainage composite as directed by Engineer.

C. Unroll drainage composite downslope keeping in slight tension to minimize wrinkles and folds.

D. Maintain free of dirt, mud, or any other foreign materials at all times during construction.
   1. Clean or replace rolls which are contaminated.

E. Place adequate ballast to prevent uplift by wind.

F. Overlap adjacent rolls a minimum of 6 IN.
   1. Overlap new drainage composite over existing as shown on the Drawings.
   2. Shingle all edges of geocomposite downslope

G. Use manufacturer's fasteners to join adjacent rolls.
   1. Metallic fasteners will not be allowed.
   2. Space fasteners a maximum of 5 FT along downslope roll overlaps and a maximum of 1 FT along cross slope roll overlaps.
   3. Use fasteners of contrasting color from the drainage composite to facilitate visual inspection.
   4. Do not weld drainage composite to geomembranes.
   5. Install geotextile cap strip wherever ends of geocomposite are exposed to soil intrusion.

H. See Section 02778, Geotextiles, for information on seaming the upper geotextile to the upper geotextile of the adjacent rolls.

I. Repairs holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 FT beyond the edges of the hole or tear.
   1. Use approved fasteners, spaced every 6 IN around the patch, to fasten the patch to the original roll.

3.3 FIELD QUALITY CONTROL

A. Prior to installation of the drainage composite, the Installer's CQC Consultant shall provide the Engineer quality control certificates signed by the manufacturer's quality assurance manager for every 540,000 SF of geocomposite drainage media to be installed illustrating satisfactory transmissivity tests among other attributes.

END OF SECTION

SECTION 02778
GEOTEXTILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Non-woven geotextile material for use in geocomposite drainage layer and other applications shown on the Drawings~~.~~
~~2. Woven geotextile material for wrapping drainage stone.~~

B. Related Sections:
1. Section 02200 -Earthwork.
2. Section 02777 - Drainage ~~Geocomposite~~Composite – Final Cover.
3. Section 02777A – Drainage Composite – Overlay Liner System.
4. Central County Solid Waste Disposal Complex Phase I Closure Construction Quality Assurance Plan (applies to closure areas).
5. Central County Solid Waste Disposal Complex Class I Landfill Expansion Construction Quality Assurance Plan (applies only to Overlay Liner System only).

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Association of State Highway Transportation Officials (AASHTO):
   a. M288, Standard Specification for Geotextile Specification for Highway Application.
2. ASTM International (ASTM):
   a. D1987, Biological Clogging of Geotextile or Soil/Geotextile Filters.
   b. D3786, Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
   c. D4354, Sampling of Geosynthetics for Testing.
   d. D4355, Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
   e. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   f. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   g. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   h. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   i. D4759, Standard Practice for Determining the Specification Conformance of Geosynthetics.
   j. D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
   k. D4873, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
   l. D4884, Strength of Sewn or Thermally Bonded Seams of Geotextiles
   m. D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
   n. D6193, Standard Practice for Stitches and Seams.

B. Qualifications:
1. Each manufacturing, fabricating firm shall demonstrate 5 years continuous experience, including a minimum of 10,000,000 SF of geotextile installation in the past three (3) years.
2. Installing firm shall demonstrate that the site Superintendent or Foreman has had responsible charge for installation of a minimum of 1,000,000 SF of geotextile.
3. Installer shall attend pre-installation conference.

1.3 DEFINITIONS

A. Manufacturer: Manufacturer producing geotextile sheets from resin and additives.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

C. MARV: Minimum Average Roll Value

1.4 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's documentation that raw materials and roll materials comply with required geotextile physical properties.
   2. Manufacturer and Installer quality control manuals.
   3. Original test results for resins, roll material and factory seam tests at frequency specified in respective quality control manuals.
      a. Results shall include or bracket the rolls delivered for use in the Work.
   4. Proposed details of anchoring and overlapping if different than included in Contract Documents.

B. Miscellaneous Submittals:
   1. For needle punched geotextiles, the Manufacturer shall certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers.
   2. Qualification documentation specified in Article 1.2.B

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store geotextiles in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage.
   1. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, geotextile type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace geotextile or plastic wrapping damaged as a result of storage or handling, as directed.

E. Do not expose geotextile to temperatures in excess of 71 ~~DegC~~Deg C (160 ~~DegF~~Deg F) or less than 0 ~~DegC~~Deg C (32 ~~DegF~~Deg F) unless recommended by the manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling geotextile.
   1. Do not lift rolls lifted by use of cables or chains in contact with the geotextile.
   2. Do not drag geotextile along the ground.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. GSE Lining Technology.
   2. Mirafi (TenCate Geosynthetics)
   3. Propex.
   4. SKAPS Industries.
   5. Tenax Corp.
   6. Or approved equal

2.2 MATERIALS AND MANUFACTURE

A. Geotextile:
   1. Non-woven and woven pervious sheet of polymeric material.
   2. Geotextile fibers:
      a. Long-chain synthetic polymer composed of at least 85 percent by weight polyolefins, polyesters, or polyamides.

b. Filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.
c. Do not add reclaimed or recycled fibers or polymer to the formulation.

3. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages.
4. The geotextile physical properties shall equal or exceed the minimum average roll values listed below.
   a. Values shown are for the weaker principal direction unless both values are shown.
   b. Acceptance of geotextile shall be in accordance with ASTM D4759.

Non-woven Drainage Geotextile: Used in the geocomposite for drainage and other applications shown on Drawings.

PROPERTY	TEST METHOD	MARV	MIN. MQC TEST FREQUENCY
Mass per Unit Area, (oz/~~yd^2~~sy)	ASTM D5261	6	1 per 90,000 ft^2
Grab Tensile Strength (lbs)	ASTM D4632	170	1 per 90,000 ft^2
Puncture Strength (lbs)	ASTM D4833	90	1 per 90,000 ft^2
AOS, US sieve (mm)	ASTM D4751	70	1 per 540,000 ft^2
Permittivity, (sec^{-1})	ASTM D4491	1.5	1 per 540,000 ft^2
Flow Rate, gpm/ft^2	ASTM D4491	110	1 per 540,000 ft^2
Ultraviolet Degradation, % retained @ 500 HRS	ASTM D4355	70	1per formulation

Non-woven Drainage Geotextile: Used in underlayment and other applications.

PROPERTY	TEST METHOD	MARV	MIN. MQC TEST FREQUENCY
Mass per Unit Area (oz/sy)	ASTM D5261	8	1 per 90,000 ft^2
Grab Tensile Strength (lbs)	ASTM D4632	205	1 per 90,000 ft^2
Grab Tensile Elongation (%)	ASTM D4632	50	1 per 90,000 ft^2
Puncture Strength (lbs)	ASTM D4833	120	1 per 90,000 ft^2
Trapezoidal Tear Strength (lbs)	ASTM D4533	85	1 per 90,000 ft^2

Non-woven Drainage Geotextile: Used in the EGC anchor trenches.

PROPERTY	TEST METHOD	MARV	MIN. MQC TEST FREQUENCY
Mass per Unit Area (oz/sy)	ASTM D5261	16	1 per 90,000 ft^2
Grab Tensile Strength (~~lb~~lbs)	ASTM D4632	370	1 per 90,000 ft^2
Grab Tensile Elongation (%)	ASTM D4632	50	1 per 90,000 ft^2
Puncture Strength (~~lb~~lbs)	ASTM D4833	170	1 per 90,000 ft^2
Trapezoidal Tear Strength (~~lb~~lbs)	ASTM D4533	145	1 per 90,000 ft^2

~~Woven Geotextile: Used to wrap drainage stone.~~

~~PROPERTY~~	~~TEST METHOD~~	~~MARV~~	~~MIN. MQC TEST FREQUENCY~~
~~Grab Tensile Strength (lbs)~~	~~ASTM D4632~~	~~370x250~~	~~1 per 90,000 ft^2~~
~~Trapezoidal Tear Strength (lbs)~~	~~ASTM D4533~~	~~100x60~~	~~1 per 90,000 ft^2~~
~~Elongation, %~~	~~ASTM D4632~~	~~16x15~~	~~1 per 90,000 ft^2~~
~~Puncture Strength (lbs)~~	~~ASTM D4833~~	~~130~~	~~1 per 90,000 ft^2~~
~~AOS, US sieve (mm)~~	~~ASTM D4751~~	~~70~~	~~1 per 540,000 ft^2~~
~~Permittivity, (sec^{-1})~~	~~ASTM D4491~~	~~0.28~~	~~1 per 540,000 ft^2~~

~~Flow Rate, gpm/ft^2~~	~~ASTM D4491~~	~~18~~	~~1 per 540,000 ft^2~~
~~Ultraviolet Degradation, % retained @ 500 HRS~~	~~ASTM D4355~~	~~90~~	~~1 per formulation~~

B. Thread:
   1. High-strength polyester, nylon, or other approved thread type.
   2. Equivalent chemical compatibility and ultraviolet light stability as the geotextile.
   3. Contrasting color with the geotextile.

PART 3 - EXECUTION

3.1 PREPARATION

A. Construct the surface underlying the geotextiles smooth and free of ruts or protrusions which could damage the geotextiles.

3.2 INSTALLATION

A. Install geotextiles in accordance with manufacturer's written recommendations except as follows.

B. Handling shall be in accordance with ASTM D4873.
   1. No equipment will be permitted to traffic in direct contact with the geotextile.

C. Lay geotextile smooth so as to be free of tensile stresses, folds, and wrinkles.

D. Seam Construction:
   1. Sew all geotextile seams except for geotextile used to wrap drainage stone or used for erosion control purposes~~. For these exceptions.~~ Adjacent panels may be overlapped without sewing as long as the seams do not come apart when material is placed over them.
   2. Broom clean existing geotextile and cut off to provide a clean area for seaming with the new geotextile.
   3. Sew seams continuously using an SSA flat seam with one (1) row of a two-thread 401 chain stitch unless otherwise recommended by the manufacturer.
   4. Minimum distance from the geotextile edge to the stitch line nearest to that edge: 2 IN unless otherwise recommended by the manufacturer.
   5. Tie off thread at the end of each seam to prevent unraveling.
   6. Construct seams on the top side of the geotextile to allow inspection.
   7. Sew skipped stitches or discontinuities with an extra line of stitching with 18 IN of overlap.
   8. Overlap adjacent panels a minimum of 6 IN.

E. Protect geotextiles from clogging, tears, and other damage during installation.

F. Geotextile Repair:
   1. Place a patch of the same type of geotextile which extends a minimum of 24 IN beyond the edge of the damage or defect.
   2. Fasten patches continuously using a sewn seam or other approved method.
   3. Align machine direction of the patch with the machine direction of the geotextile being repaired.
   4. Replace geotextile which cannot be repaired.

G. Use adequate ballast (e.g., sand bags) to prevent uplift by wind.

H. Do not use staples or pins to hold the geotextile in place.

I. Geotextile left uncovered for more than 14 days shall be removed and replaced at the contractors expense.

J. Damaged rolls may be rejected. If rejected, verify that rejected material is removed from the site or stored at a location separate from accepted rolls. Geotextile rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

K. The CQA Inspector shall observe that the equipment used to install the geotextile does not damage it during deployment.

L. Crews working on the geotextile shall not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile.

3.3 FIELD QUALITY CONTROL

A. The CQA Consultant shall confirm that the identification, storage, and handling of geotextiles is in accordance with ASTM D4873. Any deviation from this requirement will be reported to the Engineer.

B. The CQA Consultant will examine all manufacturer certifications to ensure that the property values listed on the certifications meet or exceed these specifications. Any deviations will be reported to the Engineer.

C. The CQA Consultant will observe placement of the geotextiles to confirm that the panel overlaps and seams are in accordance with these specifications. Any deviations will be reported to the Engineer.

END OF SECTION

SECTION 15079
PIPE - CORRUGATED POLYETHYLENE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This item shall consist of furnishing, fabricating, and installing corrugated polyethylene pipe of the types, classes, sizes, gauges, and dimensions as shown on the plans, at such places as are designated on the plans and profiles, or by the Engineer, in accordance with these specifications and in conformity with the lines and grades given.

B. Piping locations include, but may not be limited to:
   1. Slope drains.
   2. Toe drains.

1.2 SUBMITTALS

A. Verify on Shop Drawing dimensions, schedule of pipe, fittings, perforations, and miscellaneous appurtenances. When special fittings are necessary, verify locations of items and include complete details.

B. Render copies of any manufacturer's written instructions regarding material handling, delivery, storage, and installation.

C. As Work progresses and again when Work is complete, submit "As Recorded" Drawings of piping systems in project including project items and pre-existing items. Identify complete location, elevation, and description of piping systems. Relate piping systems to identified structures and appurtenances.

PART 2 - MATERIALS

2.1 GENERAL

A. Corrugated Polyethylene Pipe and Connections: This pipe and connections shall conform to the requirements of AASHTO M294-94.

B. All pipes shall be dual-walled pipe (water tight connections) and shall have a full circular cross-section, within an outer corrugated pipe wall and a smooth inner liner, ADS N-12 or approved equal.

C. Basic Materials: Pipe and fittings shall conform to the requirements of ASTM D3350, except the carbon black content shall not exceed 5 percent.

D. Coupling Bands: Flexible pipe shall be firmly joined by coupling bands. These bands shall be not more than two nominal sheet thicknesses lighter than the thickness of the pipe to be connected.
   1. Soil/Watertight couplers shall be used to connect individual pipe sections.
   2. Reinforced couplers shall be used where the possibility of separation is great. These couplers shall be constructed of a heavy cross-laminated polyethylene backing, rubberized mastic sealer, plastic straps with sheathing, and woven polypropylene reinforcing.

E. Perforations: where shown on the Drawings, provide AASHTO Class II perforations as appropriate for the size of pipe required.

F. Pipe Sock: where shown on the Drawings, provide geotextile pipe sock or wrap around perforated pipe.
   1. Pipe sock or wrap around shall be supplied by the pipe manufacturer and shall be delivered to the site already installed on the pipe.
   2. Pipe sock or wrap shall have the following minimum properties:
      a. 100% Nylon spunbond fabric
      b. Weight 0.85 oz/sy (ASTM D3776)
      c. Burst strength 28 lbs/in^2 (ASTM D3786)
      d. Equivalent opening size 50 (U.S. Army Corps of Engineers CW 02215)
      e. Water flow rate 163 gal/min/ft^2 (ASTM D4491)

PART 3 - EXECUTION

~~3.1 GENERAL~~

A. Equipment: All equipment necessary and required for the proper construction of piping shall be on the project, in first class working condition. The Contractor shall provide such mechanical tampers as required to obtain the compaction of the pipe bedding and backfill as specified.

B. Excavation: The Contractor shall perform all excavation to the depth and/or dimensions shown on the plans with special attention given to avoid damaging the underlying geosynthetic components of the final and temporary final cover system. Any damage to the final and temporary final cover system due to Contractor's action shall be repaired at Contractor's expense. The bedding for the pipe shall be so shaped that at least the lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Bedding shall be as shown on the plans.

C. Placing Pipe: The pipe shall be laid with the separate sections joined firmly together with coupling bands with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. The pipe shall be laid carefully and true to lines and grades on a bed which is uniformly firm throughout its entire length. Any pipe which is not in true alignment, or which shows any undue settlement after laid or is damaged, shall be taken up and relaid or replaced without extra compensation. Pipe shall not be laid on frozen ground.

D. Connections: Contractor shall follow manufacturer's recommendations in installing pipe connections.

E. Backfill: The trench shall be backfilled with protective cover material and compacted to the same density as specified in Section 02200. Maintain minimum cover as shown in the Drawings.

END OF SECTION