October 29, 2013

Rec'd Digitally

AFIN: 60-00438

PMT#: 0163-S1-R3

RECEIVED
By Barbara J. Mathews at 12:35 pm, Oct 30, 2013

DOC ID#: 65169

TO: BL> file

SW

D

Solid Waste Division
Arkansas Department Environmental Quality
5301 Northshore Drive
North Little Rock, AR 72118-5317

Attention: Mr. Bryan Leamons, P.E., Engineer Supervisor
P: (501) 682-0601
E: leamons@adeq.state.ar.us

Subject: Notification of Construction – Cell 5
Waste Management Two Pine Class 1 Landfill
Permit No. 0163-S1-R3; AFIN: 60-00438

Dear Mr. Leamons:

Terracon Consultants, Inc. (Terracon) is providing this notification of construction on behalf of the Waste Management Two Pine Landfill (Facility), located near Jacksonville, Arkansas. The Facility is constructing Cell 5 at the existing Class 1 Landfill. Terracon and the Facility are notifying the Arkansas Department of Environmental Quality (ADEQ) of the proposed construction schedule in accordance with Reg.22.428(f) of Regulation 22. The earthwork contractor anticipates beginning construction on November 4, 2013, depending on the weather. Below is the proposed schedule of construction events.

RESPONSIBLE PARTIES	DATES
Earthwork Contractor (Browning Construction Company)	11/4/13 – 2/28/14
CQA Services (Terracon Consultants, Inc.)	11/4/13 – 2/28/14
Surveying (Shepherd Engineering)	11/4/13 – 2/28/14
Geosynthetics Installer (Environmental Specialties International, ESI)	1/27/14 – 2/28/14

Note: This schedule is tentative and may change due to weather delays.

The earthwork contractor has completed over 500,000 square feet of clay liner during the last three years. Therefore, Terracon requests that the ADEQ waive the test fill requirements of Reg.22.428(c)(11). A construction certification report documenting construction activities will be submitted to the ADEQ upon completion of construction.

If you have any questions or comments regarding this notification, please feel free to contact me at bnfureigh@terracon.com or 501-847-9292 at your convenience.

Sincerely,
Terracon Consultants, Inc.

Brad N. Fureigh, P.E.
Project Engineer

F. Owen Carpenter, P.E., P.G.
Engineering Department Manager

Attachment: Construction Plans and Specifications

Cc: David Conrad, WM Market Area Engineering Manager

N:\Projects\2013\35137172\Cell 5 Bid Documents\ADEQ Notification bnf 10.29.13.doc

Attachment

Cell 5 Construction Plans and Specifications

CONSTRUCTION DRAWINGS

FOR THE

TWO PINE CLASS 1 LANDFILL FACILITY
PROPOSED CELL 5
PERMIT NO. 0163-S1-R3; AFIN: 60-00438

SEPTEMBER 2013

PROJECT NO. - 062-015-3513172

PREPARED FOR

WASTE MANAGEMENT
TWO PINE LANDFILL
100 TWO PINE DRIVE
NORTH LITTLE ROCK, ARKANSAS 72117
(501) 982-7336

VICINITY MAP
N.T.S.

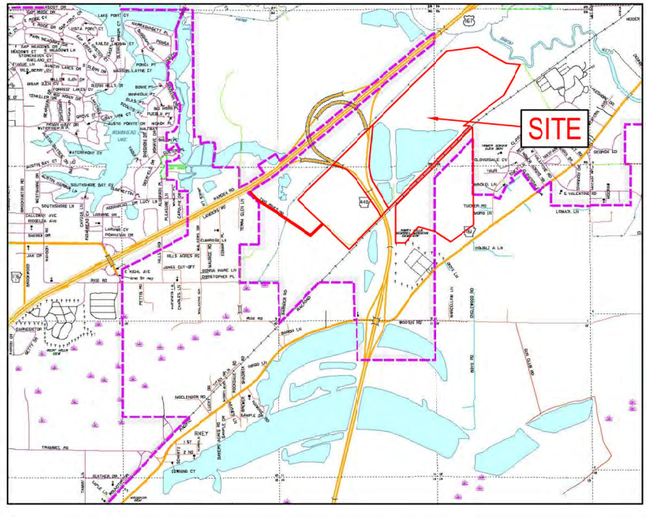
PREPARED BY

TERRACON CONSULTANTS, INC. CERTIFICATE OF AUTHORIZATION No.223 ARKANSAS

STATE OF ARKANSAS 10-4-2013 REGISTERED PROFESSIONAL ENGINEER No.14977 BRAD N. FUREIGH

Terracon
Consulting Engineers and Scientists

25809 I-30 SCUTH BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (501) 847-9210



SITE LOCATION MAP
N.T.S.

811
Know what's below.
Call before you dig.

INDEX OF DRAWINGS

DRAWING NO.	TITLE
	COVER SHEET
1	INDEX SHEET
2	EXISTING SITE FEATURES
3	PROPOSED BOTTOM OF ENGINEERED BUFFER GRADING
4	PROPOSED TOP OF SUBGRADE/ENGINEERED BUFFER GRADING
5	PROPOSED TOP OF CLAY LINER GRADING
6	PROPOSED TOP OF PROTECTIVE COVER GRADING AND CHIMNEY DRAIN PLAN
7	PROPOSED BORROW AREA GRADING
8	EROSION CONTROL PLAN
9	CELL CONSTRUCTION DETAILS
10	LEACHATE COLLECTION SYSTEM DETAILS
11	LEACHATE COLLECTION SYSTEM DETAILS
12	MISCELLANEOUS DETAILS
13	CROSS SECTION - CELL 5

ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

ADEQ	ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY
CB	CATCH BASIN
DIA	DIAMETER
DWG	DRAWING
ELEV	ELEVATION
EXIST	EXISTING
FT	FEET
HDPE	HIGH DENSITY POLYETHYLENE
HORZ	HORIZONTAL
ID	INSIDE DIAMETER
IN	INCHES
INV	INVERT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MSL	MEAN SEA LEVEL
NOM	NOMINAL
NSPS	NEW SOURCE PERFORMANCE STANDARDS
NTS	NOT TO SCALE
OD	OUTSIDE DIAMETER
PL	PROPERTY LINE
SDR	STANDARD DIMENSION RATIO
TYP	TYPICAL
VERT	VERTICAL
NPDES	NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

SYMBOLS

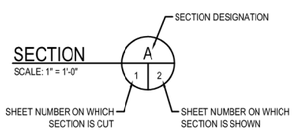
- PROPERTY LINE
- EXISTING FENCE
- PROPOSED SILT FENCE
- EXISTING BUILDING
- EXISTING GRAVEL ROAD
- EXISTING ASPHALT
- DRAINAGE WAY
- 323 EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- 323 PROPOSED INDEX CONTOUR (COLOR WILL VARY BY LAYER)
- PROPOSED INTERMEDIATE CONTOUR (COLOR WILL VARY BY LAYER)
- OHE OVERHEAD ELECTRIC
- 3"P 3"P 3"x6" LEACHATE FORCEMAIN
- 2"P 2"P 2"x6" LEACHATE FORCEMAIN
- PROPOSED LEACHATE FORCEMAIN
- LANDFILL GAS LINE
- PROPOSED ACCESS ROAD (GRAVEL)
- WATERLINE
- WS=1194.6 WATER SURFACE ELEVATION
- X 325.8' EXISTING SPOT ELEVATION
- BM-10 PERMANENT SURVEY BENCHMARK
- N 1000 / E 1000 SITE GRID MARKER
- LGW-7 GROUNDWATER MONITORING WELL
- GP-14R GAS MONITORING PROBE
- POWER POLE
- DRAINAGE CULVERT
- VEGETATION
- GEOMEMBRANE
- GEOTEXTILE
- GEOCOMPOSITE
- GCL (GEOSYNTHETIC CLAY LINER)
- PLYWOOD
- SUBGRADE
- ENGINEERED BUFFER
- ON-SITE SELECT FILL
- COMPACTED CLAY LINER
- PROTECTIVE SOIL LAYER
- GRAVEL / RIP-RAP
- CONCRETE
- WASTE
- INTERMEDIATE/INTERIM COVER
- TCP SOIL

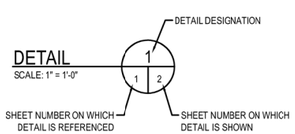
GENERAL NOTES

NOTES:

1. EXISTING CONTOURS AND SITE CONDITIONS SHOWN ON THESE PLANS ARE BASED ON AN AERIAL TOPOGRAPHIC SURVEY DATED JANUARY 19, 2013, AND WERE PROVIDED BY SOUTHERN RESOURCES MAPPING CORPORATION.
2. SURVEY CONTROL POINTS AND CONSTRUCTION CONTROL POINTS LISTED ON THESE DRAWINGS ARE BASED ON STATE PLANE COORDINATES (NAD 83 ARKANSAS SOUTH).
3. PERMANENT BENCH MARKS ARE SHOWN ON APPROPRIATE DRAWINGS AND SHOULD BE FIELD VERIFIED.
4. REFER TO PROJECT SPECIFICATIONS, DATED SEPTEMBER 2013 FOR ALL WORK SHOWN ON THESE DRAWINGS.
5. THE EROSION CONTROL FEATURES REQUIRED BY THESE PLANS ARE THE MINIMUM FEATURES REQUIRED. ADDITIONAL FEATURES MAY BE REQUIRED TO CONTROL EROSION.
6. SLOPES AND GRADES ARE IN UNITS OF FT/FT, UNLESS OTHERWISE SPECIFIED.
7. THE MATERIAL QUANTITIES SHOWN ON THESE PLANS ARE ESTIMATES ONLY.
8. CONTRACTOR SHALL NOT INTERRUPT OWNER'S DAILY OPERATION OF THE LANDFILL WITH CONSTRUCTION ACTIVITIES.
9. CONTRACTOR SHALL TAKE EXTRA CARE NOT TO DISTURB EXISTING ENVIRONMENTAL MONITORING STRUCTURES (GROUNDWATER WELLS, GAS MONITORING PROBES, ETC).
10. ENTRANCE TO THE CELL 5 AREA SHALL BE THROUGH THE SITE MAIN ENTRANCE AND USING ON-SITE ROADS, OR SPECIFICALLY DIRECTED BY WASTE MANAGEMENT.
11. CONTRACTOR SHALL BE RESPONSIBLE FOR BRINGING TO THE OWNER'S ATTENTION ANY CONSTRUCTION ELEMENT THAT HAS NOT BEEN ADDRESSED IN THESE DRAWINGS OR SEEN TO BE DIFFERENT FROM THE LIKE ELEMENT DESCRIBED IN THESE DRAWINGS.
12. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL OF ALL CONSTRUCTION RELATED DEBRIS FROM THE CELL 6B AREA AT THE TIME OF COMPLETION OF THE PROJECT.
13. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING LOCATION OF UTILITIES PRIOR TO WORKING IN PROJECT AREA. CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO THE UTILITIES CAUSED BY CONSTRUCTION OPERATIONS.

SITE/DETAIL KEY





CONTACT INFORMATION

OWNER:
WASTE MANAGEMENT OF ARKANSAS, INC.
ATTENTION: DAVID CONRAD
ENGINEERING MANAGER - ARKANSAS FACILITIES
100 TWO PINE DRIVE
NORTH LITTLE ROCK, ARKANSAS 72117

ENGINEER:
TERRACON CONSULTANTS, INC.
ATTENTION: BRAD N. FUREIGH, P.E. - PROJECT ENGINEER
25809 I-30 SOUTH
BRYANT, ARKANSAS 72022
PHONE: (501) 847-9292
FAX: (501) 847-9210

REGULATORY AUTHORITY:
ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY
SOLID WASTE MANAGEMENT DIVISION
ATTENTION: SOLID WASTE MANAGEMENT DIVISION CHIEF
5301 NORTHSHORE DRIVE
NORTH LITTLE ROCK, ARKANSAS 72118-5317
PHONE: (501) 682-0600
FAX: (501) 682-0611

811 Know what's below. Call before you dig.

REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION — TERRACON CONSULTANTS, INC. — No.223 — ARKANSAS

STATE OF ARKANSAS — 10-31-2013 — REGISTERED PROFESSIONAL ENGINEER — No.14977 — BRAD N. FUREIGH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH — BRYANT, ARKANSAS 72022
PH. (501) 847-9292 — FAX. (501) 847-9210

WM

INDEX SHEET
CELL 5 CONSTRUCTION DRAWINGS
WASTE MANAGEMENT
CLASS 1 LANDFILL FACILITY
NORTH LITTLE ROCK — ARKANSAS

DRAWING 1

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	N.T.S.
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	1 OF 13

NOTE:
EXISTING CONTOURS SHOWN ON THIS DRAWING ARE FROM AN AERIAL SURVEY PERFORMED BY SOUTHERN RESOURCES MAPPING CORPORATION ON JANUARY 19, 2013.

LEGEND:

- PROPERTY BOUNDARY
- WASTE DISPOSAL BOUNDARY
- CELL BOUNDARIES
- LR-5 LEACHATE RISER PIPE
- MW-04A GROUNDWATER MONITORING WELL
- GMP-08 GAS MONITORING PROBE

PERMANENT SITE MONUMENTS

NUMBER	NORTHING	EASTING	ELEVATION
BM -2	163136.51	1268157.75	244.40
BM -3	162673.74	1267676.71	249.75
BM -4	162362.01	1267225.00	253.98
BM -5	163089.25	1266826.56	264.98

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Consulting Engineers and Scientists
25809 I-30 SOUTH, BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (501) 847-9210

WM

EXISTING SITE FEATURES

CELL 5 CONSTRUCTION DRAWINGS

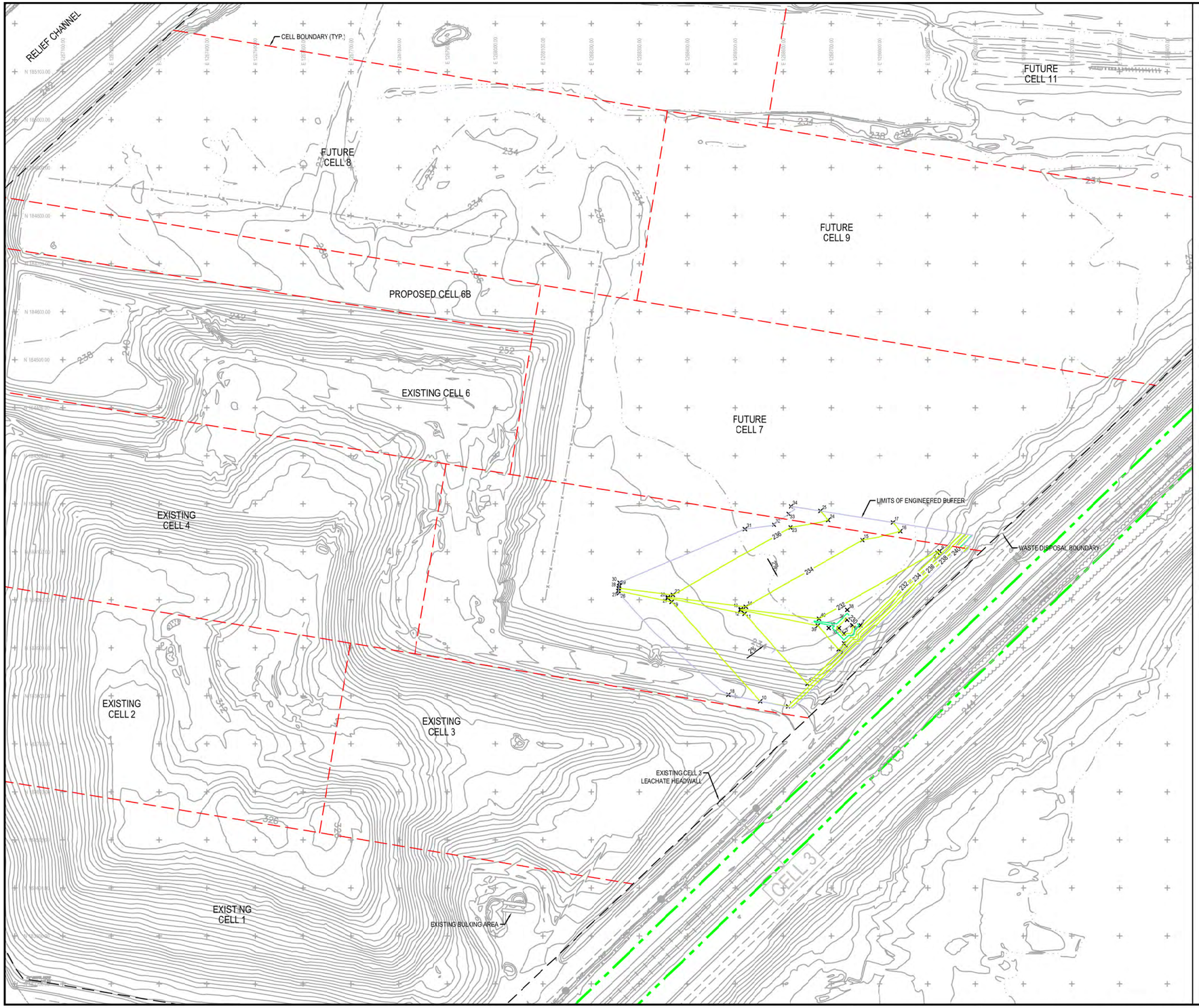
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK ARKANSAS

DRAWING 2

DESIGNED BY:	RSC
DRAWN BY:	RSC
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	2 OF 13



CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	1268609.78	183778.09	236.0	ENG. BJFFER
2	1268649.38	183824.93	234.0	ENG. BJFFER
3	1268715.00	183897.06	232.0	ENG. BJFFER
4	1268726.13	183909.30	231.7	ENG. BJFFER
5	1268726.42	183929.88	226.8	ENG. BJFFER
6	1268744.09	183947.06	226.8	ENG. BJFFER
7	1268761.26	183946.82	230.9	ENG. BJFFER
8	1268920.87	184097.75	231.9	ENG. BJFFER
9	1268924.91	184101.43	232.0	ENG. BJFFER
10	1268551.76	183788.77	236.0	ENG. BJFFER
11	1268519.49	183970.97	234.0	ENG. BJFFER
12	1268511.79	183978.65	232.0	ENG. BJFFER
13	1268512.12	183980.68	232.0	ENG. BJFFER
14	1268521.93	183985.51	234.0	ENG. BJFFER
15	1268764.88	184124.74	234.0	ENG. BJFFER
16	1268843.81	184143.09	234.0	ENG. BJFFER
17	1268827.75	184151.17	234.0	ENG. BJFFER
18	1268485.82	183802.29	236.8	ENG. BJFFER
19	1268367.65	183995.77	236.0	ENG. BJFFER
20	1268359.95	184003.45	234.0	ENG. BJFFER
21	1268360.29	184005.48	234.0	ENG. BJFFER
22	1268370.10	184010.31	236.0	ENG. BJFFER
23	1268615.03	184150.68	236.0	ENG. BJFFER
24	1268693.49	184156.19	236.0	ENG. BJFFER
25	1268676.67	184185.11	236.0	ENG. BJFFER
26	1268257.17	184013.81	237.5	ENG. BJFFER
27	1268256.29	184018.44	236.0	ENG. BJFFER
28	1268257.08	184024.27	236.0	ENG. BJFFER
29	1268257.68	184028.67	237.5	ENG. BJFFER
30	1268258.63	184035.66	237.6	ENG. BJFFER
31	1268520.06	184147.36	236.9	ENG. BJFFER
32	1268580.63	184156.63	236.5	ENG. BJFFER
33	1268610.96	184178.87	237.1	ENG. BJFFER
34	1268616.24	184194.69	236.8	ENG. BJFFER
35	1268715.51	183941.10	226.8	ENG. BJFFER
36	1268733.18	183958.28	226.8	ENG. BJFFER
37	1268694.75	183941.39	231.7	ENG. BJFFER
38	1268733.48	183979.10	231.7	ENG. BJFFER
39	1268671.33	183946.17	232.0	ENG. BJFFER
40	1268673.77	183960.71	232.0	ENG. BJFFER

N

SCALE IN FEET

NOTES:

1. ENGINEERED BUFFER WILL BE PLACED IN CELL BOTTOM AND SIDE SLOPE IMMEDIATELY UNDER THE CLAY LINER.
2. CONTRACTOR IS RESPONSIBLE FOR ALL DEWATERING, MUCKING-OUT, AND REMOVAL OF UNSUITABLE MATERIALS IN CONSTRUCTION AREAS.
3. CONTRACTOR SHALL PLACE ALL STRUCTURAL FILL MATERIAL AND ENGINEERED BUFFER MATERIAL IN APPROPRIATE LIFTS AND MOISTURE CONDITION AND COMPACT TO PROJECT SPECIFICATIONS.

TYPICAL SECTION THROUGH BOTTOM LINER W/ ENGINEERED BUFFER

PERMANENT SITE MONUMENTS

NUMBER	NORTHING	EASTING	ELEVATION
BM -2	183136.51	1268157.75	244.40
BM -3	182673.74	1267676.71	249.75
BM -4	182362.01	1267225.00	253.98
BM -5	183089.25	1266826.56	264.98

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PH. (501) 847-9292 FAX. (501) 847-9210

WM

PROPOSED BOTTOM OF ENGINEERED BUFFER GRADING

CELL 5 CONSTRUCTION DRAWINGS

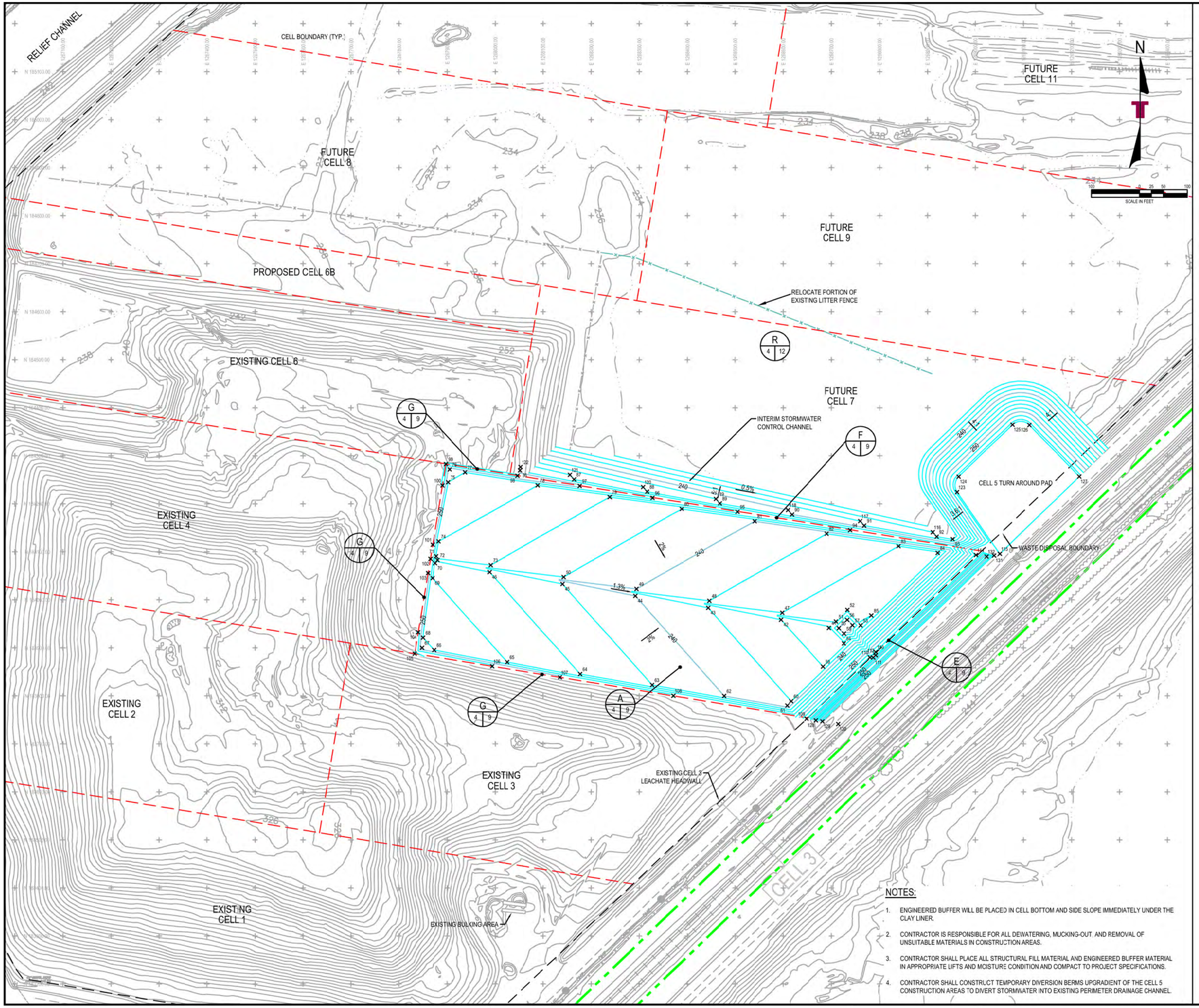
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK ARKANSAS

DRAWING 3

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	3 OF 13

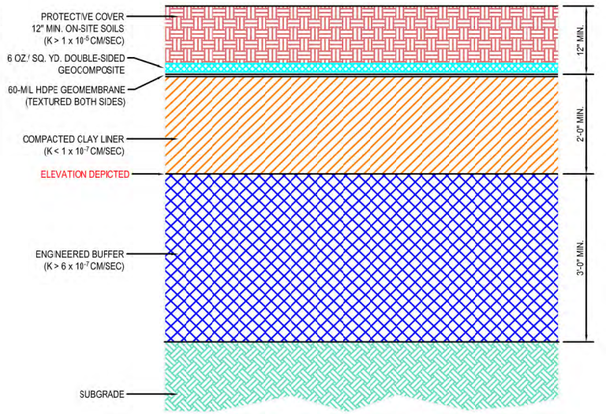


CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
41	183941.39	1268694.75	234.70	SUBGRADE
42	183958.57	1268595.41	236.00	SUBGRADE
43	183983.37	1268443.57	238.00	SUBGRADE
44	184008.17	1268291.74	240.00	SUBGRADE
45	184032.97	1268139.90	242.00	SUBGRADE
46	184057.77	1267988.06	244.00	SUBGRADE
47	183973.11	1268597.84	236.00	SUBGRADE
48	183997.91	1268445.99	238.00	SUBGRADE
49	184022.71	1268294.14	240.00	SUBGRADE
50	184047.52	1268142.29	242.00	SUBGRADE
51	183954.89	1268709.38	234.53	SUBGRADE
52	183979.10	1268733.48	234.72	SUBGRADE
53	183946.82	1268761.26	233.85	SUBGRADE
54	183909.30	1268726.13	234.66	SUBGRADE
55	183941.10	1268715.51	229.81	SUBGRADE
56	183958.28	1268733.18	229.81	SUBGRADE
57	183947.06	1268744.09	229.81	SUBGRADE
58	183929.88	1268726.42	229.81	SUBGRADE
59	183860.99	1268682.20	236.00	TOE BERM
50	183788.87	1268616.57	238.00	TOE BERM
51	183779.86	1268608.37	238.25	TOE BERM
52	183799.84	1268477.03	240.00	TOE BERM
53	183822.66	1268326.95	242.00	TOE BERM
54	183845.48	1268176.88	244.00	TOE BERM
55	183870.45	1268024.89	246.00	TOE BERM
56	183895.63	1267872.73	248.00	TOE BERM
57	183900.23	1267848.00	248.32	TOE BERM
58	183921.28	1267849.91	248.00	TOE BERM
59	184045.24	1267869.43	246.00	TOE BERM
70	184076.31	1267874.52	245.50	TOE BERM
71	184090.86	1267876.90	245.50	TOE BERM
72	184082.92	1267879.79	243.33	TOE BERM
73	184072.32	1267990.44	244.00	TOE BERM
74	184121.90	1267881.95	246.00	TOE BERM
75	184245.08	1267901.78	248.00	TOE BERM
76	184271.60	1267905.26	248.42	TOE BERM
77	184265.49	1267937.39	248.00	TOE BERM
78	184238.43	1268088.61	246.00	TOE BERM
79	184214.07	1268237.87	244.00	TOE BERM
80	184189.32	1268388.18	242.00	TOE BERM
81	184163.64	1268540.10	240.00	TOE BERM
82	184137.71	1268689.96	238.00	TOE BERM
83	184111.78	1268839.81	236.00	TOE BERM
84	184097.75	1268920.87	234.92	TOE BERM
85	183967.45	1268783.09	234.00	TOE BERM
86	184269.63	1268051.51	247.48	TOE BERM

CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
87	184250.81	1268164.01	246.00	TOE BERM
88	184225.32	1268316.46	244.00	TOE BERM
89	184200.83	1268468.02	242.00	TOE BERM
90	184177.74	1268618.30	240.00	TOE BERM
91	184154.65	1268768.59	238.00	TOE BERM
92	184131.56	1268918.88	236.00	TOE BERM
93	184126.41	1268952.37	235.55	TOE BERM
94	184145.19	1268739.23	244.00	CL BERM
95	184183.47	1268504.91	246.00	CL BERM
96	184212.39	1268327.80	248.00	CL BERM
97	184237.19	1268175.97	250.00	CL BERM
98	184258.39	1268046.20	252.00	CL BERM
99	184282.72	1267897.26	252.00	CL BERM
100	184238.21	1267889.99	252.00	CL BERM
101	184114.88	1267869.84	250.00	CL BERM
102	184085.33	1267865.02	249.52	CL BERM
103	184055.78	1267860.19	250.00	CL BERM
104	183932.46	1267840.05	252.00	CL BERM
105	183887.95	1267832.78	254.15	CL BERM
106	183861.71	1267993.43	252.00	CL BERM
107	183838.68	1268134.41	250.00	CL BERM
108	183800.23	1268371.09	248.00	CL BERM
109	183752.25	1268647.87	253.99	CREST
110	183880.06	1268780.29	254.23	CREST
111	183879.85	1268787.05	254.24	CREST
112	183884.62	1268792.00	254.25	CREST
113	183891.39	1268792.03	254.20	CREST
114	184093.39	1269001.31	254.65	CREST
115	184095.88	1269050.44	255.00	EDGE OF PVMNT.
116	184140.93	1268910.59	236.00	OVERBUILD
117	184164.02	1268760.29	238.00	OVERBUILD
118	184187.11	1268609.99	240.00	OVERBUILD
119	184210.20	1268459.68	242.00	OVERBUILD
120	184234.84	1268307.99	244.00	OVERBUILD
121	184260.37	1268155.42	246.00	OVERBUILD
122	184276.66	1268052.62	247.36	OVERBUILD
123	184224.32	1268961.66	255.00	EDGE OF PVMNT.
124	184256.51	1268964.86	255.00	EDGE OF PVMNT.
125	184364.78	1269076.94	255.00	EDGE OF PVMNT.
126	184364.17	1269112.29	255.00	EDGE OF PVMNT.
127	184256.80	1269216.01	255.00	EDGE OF PVMNT.
128	183749.07	1268667.39	245.61	CL CHANNEL
129	183746.85	1268680.94	254.03	EDGE OF PVMNT.
130	183741.42	1268714.19	254.05	EDGE OF PVMNT.
131	184092.26	1269038.82	254.77	EDGE OF PVMNT.
132	184090.17	1269023.37	248.00	CL CHANNEL



TYPICAL SECTION THROUGH BOTTOM LINER W/ ENGINEERED BUFFER

NOTES:

1. ENGINEERED BUFFER WILL BE PLACED IN CELL BOTTOM AND SIDE SLOPE IMMEDIATELY UNDER THE CLAY LINER.
2. CONTRACTOR IS RESPONSIBLE FOR ALL DEWATERING, MUCKING-OUT, AND REMOVAL OF UNSUITABLE MATERIALS IN CONSTRUCTION AREAS.
3. CONTRACTOR SHALL PLACE ALL STRUCTURAL FILL MATERIAL AND ENGINEERED BUFFER MATERIAL IN APPROPRIATE LIFTS AND MOISTURE CONDITION AND COMPACT TO PROJECT SPECIFICATIONS.
4. CONTRACTOR SHALL CONSTRUCT TEMPORARY DIVERSION BERMS UPGRADIENT OF THE CELL 5 CONSTRUCTION AREAS TO DIVERT STORMWATER INTO EXISTING PERIMETER DRAINAGE CHANNEL.

PERMANENT SITE MONUMENTS

NUMBER	NORTHING	EASTING	ELEVATION
BM -2	183136.51	1268157.75	244.40
BM -3	182673.74	1267676.71	249.75
BM -4	182362.01	1267225.00	253.98
BM -5	183089.25	1266826.56	264.98

811 Know what's below. Call before you dig.

REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION — TERRACON CONSULTANTS, INC. No.223 — ARKANSAS

STATE OF ARKANSAS — 10/31/2013 — REGISTERED PROFESSIONAL ENGINEER — No. 14977 — BRAD N. FURENCH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (511) 847-9210

WM

PROPOSED TOP OF SUBGRADE/ENGINEERED BUFFER GRADING

CELL 5 CONSTRUCTION DRAWINGS

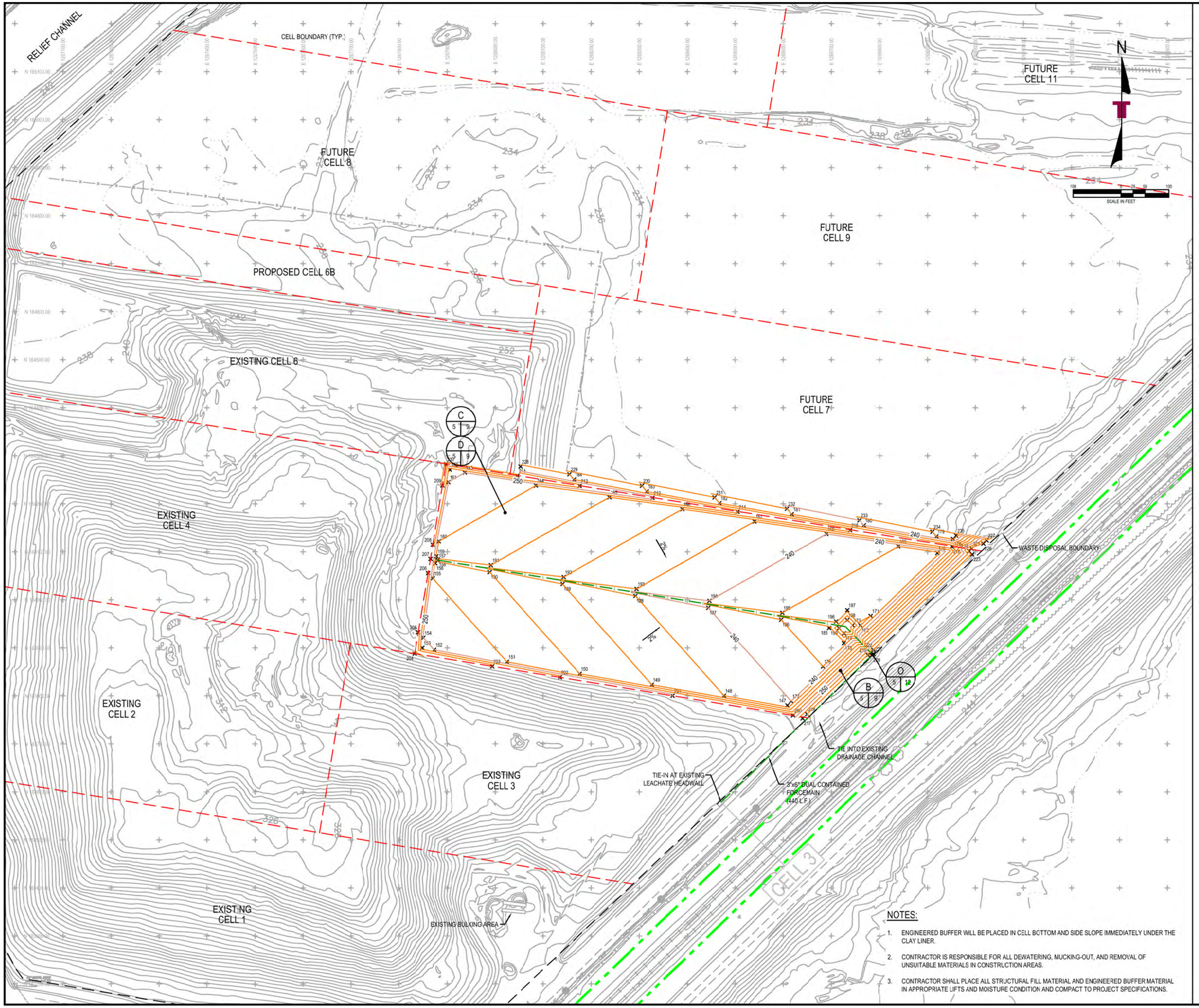
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK ARKANSAS

DRAWING 4

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	4 OF 13



NOTES:

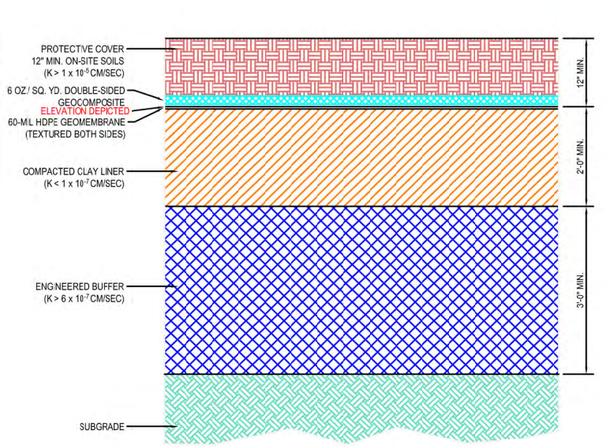
1. ENGINEERED BUFFER WILL BE PLACED IN CELL BOTTOM AND SIDE SLOPE IMMEDIATELY UNDER THE CLAY LINER.
2. CONTRACTOR IS RESPONSIBLE FOR ALL DEWATERING, MUCKING-OUT, AND REMOVAL OF UNSUITABLE MATERIALS IN CONSTRUCTION AREAS.
3. CONTRACTOR SHALL PLACE ALL STRUCTURAL FILL MATERIAL AND ENGINEERED BUFFER MATERIAL IN APPROPRIATE LIFTS AND MOISTURE CONDITION AND COMPACT TO PROJECT SPECIFICATIONS.

CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
147	183780.33	1268608.50	240.24	TOE BERM
148	183800.39	1268476.60	242.00	TOE BERM
149	183823.25	1268326.32	244.00	TOE BERM
150	183846.11	1268176.05	246.00	TOE BERM
151	183871.01	1268024.45	248.00	TOE BERM
152	183896.10	1267872.73	250.00	TOE BERM
153	183900.10	1267848.59	250.32	TOE BERM
154	183920.88	1267850.34	250.00	TOE BERM
155	184044.89	1267869.86	248.00	TOE BERM
156	184076.25	1267875.00	247.49	TOE BERM
157	184081.85	1267880.12	245.32	TOE BERM
158	184083.83	1267880.44	245.32	TOE BERM
159	184090.76	1267877.37	247.49	TOE BERM
160	184122.08	1267882.46	248.00	TOE BERM
161	184245.25	1267902.28	250.00	TOE BERM
162	184270.78	1267905.84	250.42	TOE BERM
163	184265.09	1267936.91	250.00	TOE BERM
164	184238.13	1268084.57	248.00	TOE BERM
165	184213.66	1268237.37	246.00	TOE BERM
166	184188.86	1268389.20	244.00	TOE BERM
167	184163.24	1268539.61	242.00	TOE BERM
168	184137.31	1268689.46	240.00	TOE BERM
169	184111.37	1268839.32	238.00	TOE BERM
170	184097.38	1268920.16	236.92	TOE BERM
171	183966.49	1268781.62	236.00	TOE BERM
172	183946.83	1268760.62	235.86	TOE BERM
173	183947.06	1268744.44	232.00	TOE BERM
174	183930.34	1268726.43	231.81	TOE BERM
175	183909.77	1268726.14	236.66	TOE BERM
176	183861.32	1268682.10	238.00	TOE BERM
177	183789.15	1268616.52	240.00	TOE BERM
178	184126.81	1268953.05	237.54	TOE BERM
179	184132.15	1268918.30	238.00	TOE BERM
180	184155.24	1268767.58	240.00	TOE BERM
181	184178.34	1268617.66	242.00	TOE BERM
182	184201.43	1268467.34	244.00	TOE BERM
183	184225.87	1268315.83	246.00	TOE BERM
184	184250.74	1268163.93	248.00	TOE BERM
185	183941.38	1268695.23	236.70	CLAY
186	183958.55	1268595.62	238.00	CLAY
187	183983.35	1268443.78	240.00	CLAY
188	184008.15	1268291.95	242.00	CLAY
189	184032.95	1268140.11	244.00	CLAY
190	184057.75	1267988.27	246.00	CLAY
191	184072.262	1267990.65	246	CLAY

CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
192	184047.46	1268142.49	244.00	CLAY
193	184022.66	1268294.32	242.00	CLAY
194	183997.86	1268446.15	240.00	CLAY
195	183973.06	1268597.99	238.00	CLAY
196	183954.80	1268709.78	236.53	CLAY
197	183978.61	1268733.47	236.71	CLAY
198	183957.82	1268733.18	231.81	CLAY
199	183941.09	1268715.97	231.81	CLAY
200	183759.30	1268620.44	248.04	CL BERM
201	183800.31	1268369.36	250.00	CL BERM
202	183838.68	1268134.41	252.00	CL BERM
203	183861.45	1267993.38	254.00	CL BERM
204	183887.95	1267832.78	256.15	CL BERM
205	183932.46	1267840.35	254.00	CL BERM
206	184055.78	1267860.20	252.00	CL BERM
207	184085.33	1267865.32	251.52	CL BERM
208	184114.88	1267869.85	252.00	CL BERM
209	184238.21	1267889.99	254.00	CL BERM
210	184282.72	1267897.26	254.00	CL BERM
211	184258.39	1268046.20	254.00	CL BERM
212	184237.19	1268175.97	252.00	CL BERM
213	184212.39	1268327.80	250.00	CL BERM
214	184183.46	1268504.33	248.00	CL BERM
215	184145.19	1268739.25	246.00	CL BERM
216	184110.58	1268951.17	244.19	CL BERM
217	183753.12	1268639.55	253.99	CREST
218	183762.06	1268648.32	254.00	CREST
219	183884.85	1268776.14	254.17	CREST
220	183884.70	1268784.33	254.17	CREST
221	183887.45	1268787.24	254.19	CREST
222	183895.71	1268787.39	254.19	CREST
223	184094.52	1268993.37	254.62	CREST
224	184101.69	1268986.36	254.63	CREST
225	184106.89	1268992.35	254.64	CREST
226	184117.03	1269016.70	254.67	CREST
227	184123.74	1269023.55	254.68	CREST
228	184277.60	1268052.81	249.34	OVERBUILD
229	184261.51	1268154.36	248.00	OVERBUILD
230	184237.57	1268305.43	246.00	OVERBUILD
231	184213.26	1268456.82	244.00	OVERBUILD
232	184189.68	1268607.57	242.00	OVERBUILD
233	184165.74	1268758.54	240.00	OVERBUILD
234	184141.80	1268909.72	238.00	OVERBUILD
235	184133.908	1268959.51	237.3408	OVERBUILD



TYPICAL SECTION THROUGH BOTTOM LINER W/ ENGINEERED BUFFER

PERMANENT SITE MONUMENTS

NUMBER	NORTHING	EASTING	ELEVATION
BM -2	183136.51	1268157.75	244.40
BM -3	182673.74	1267676.71	249.75
BM -4	182362.01	1267225.00	253.98
BM -5	183089.25	1266826.56	264.98

811 Know what's below. Call before you dig.

REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION — TERRACON CONSULTANTS, INC. — No.223 — ARKANSAS

STATE OF ARKANSAS — 10/31/2013 — REGISTERED PROFESSIONAL ENGINEER — No. 14977 — BRAD N. FUREIGH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH — BRYANT, ARKANSAS 72022
PH. (501) 847-9292 — FAX. (501) 847-9210

WM

PROPOSED TOP OF CLAY LINER GRADING

CELL 5 CONSTRUCTION DRAWINGS

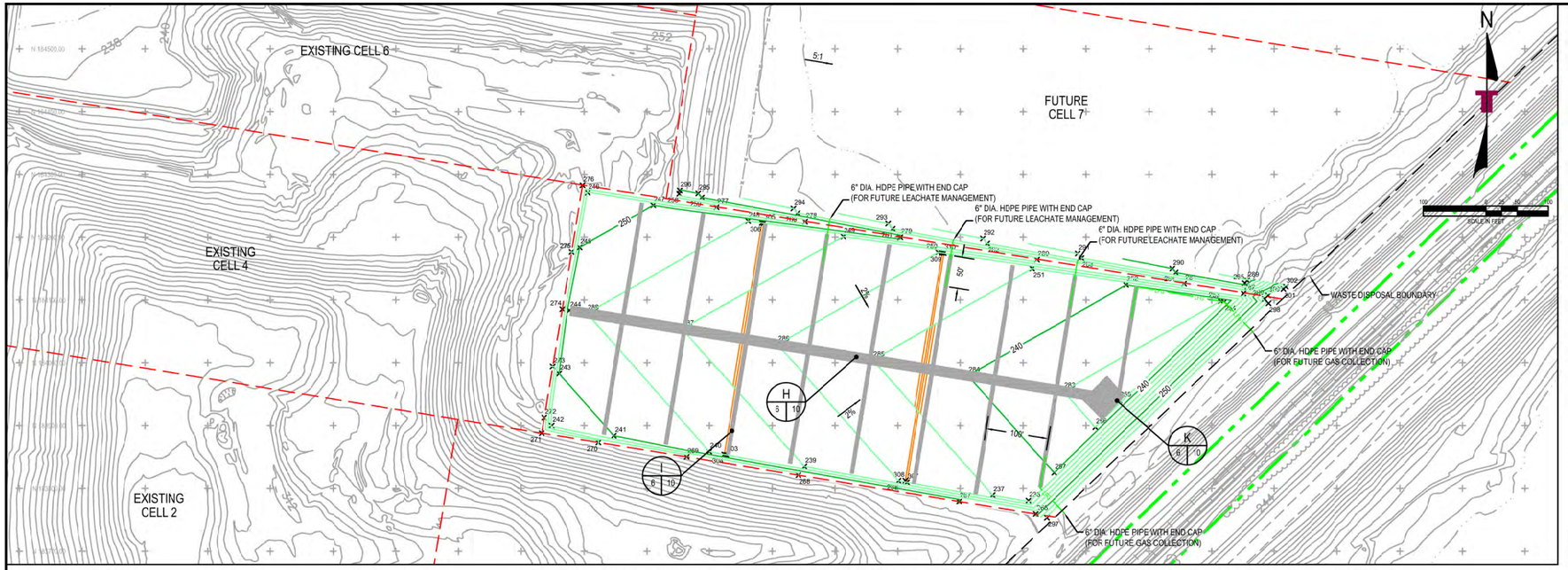
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

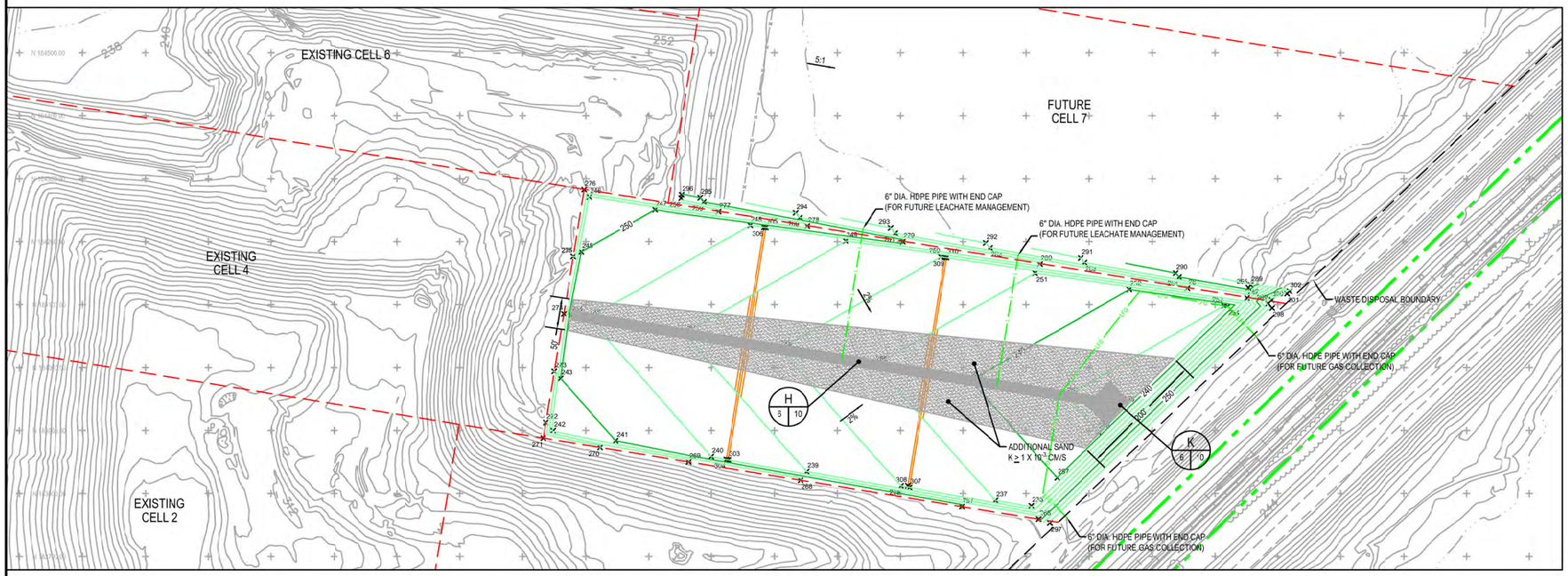
NORTH LITTLE ROCK — ARKANSAS

DRAWING 5

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	5 OF 13



OPTION 1 - LATERAL GRAVEL CHIMNEY DRAINS



OPTION 2 - ADDITIONAL SAND

CONTROL POINT TABLE

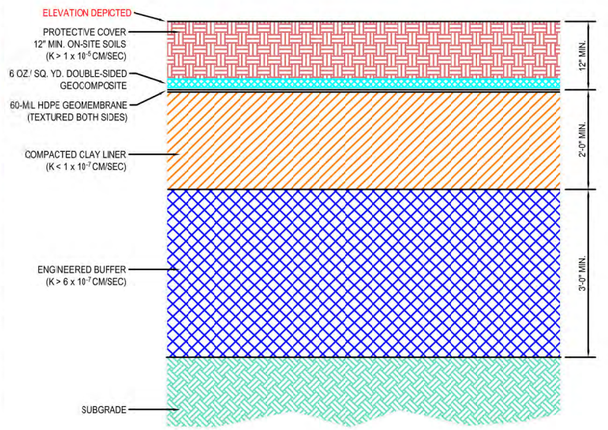
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
236	183780.53	1268608.43	241.23	TOE BERM
237	183789.27	1268551.00	242.00	TOE BERM
238	183812.09	1268400.92	244.00	TOE BERM
239	183834.91	1268250.83	246.00	TOE BERM
240	183858.71	1268099.89	248.00	TOE BERM
241	183883.89	1267947.73	250.00	TOE BERM
242	183900.11	1267848.55	251.31	TOE BERM
243	183982.89	1267859.90	250.00	TOE BERM
244	184083.45	1267876.32	248.37	TOE BERM
245	184183.82	1267892.72	250.00	TOE BERM
246	184270.87	1267905.78	251.42	TOE BERM
247	184250.98	1268009.90	250.00	TOE BERM
248	184225.88	1268161.20	248.00	TOE BERM
249	184201.12	1268313.12	246.00	TOE BERM
250	184176.07	1268464.51	244.00	TOE BERM
251	184150.13	1268614.36	242.00	TOE BERM
252	184124.20	1268764.22	240.00	TOE BERM
253	184098.27	1268914.07	238.00	TOE BERM
254	184097.27	1268919.82	237.92	TOE BERM
255	183940.16	1268753.54	236.82	TOE BERM
256	183897.42	1268714.70	238.00	TOE BERM
257	183825.15	1268649.00	240.00	TOE BERM
258	184269.22	1268051.46	250.48	TOE BERM
259	184263.26	1268087.92	250.00	TOE BERM
260	184238.46	1268239.75	248.00	TOE BERM
261	184213.66	1268391.59	246.00	TOE BERM
262	184190.08	1268542.36	244.00	TOE BERM
263	184166.97	1268692.71	242.00	TOE BERM
264	184143.87	1268843.07	240.00	TOE BERM
265	184126.98	1268953.00	238.54	TOE BERM
266	183759.33	1268620.25	249.05	CL BERM
267	183779.27	1268498.13	250.00	CL BERM
268	183821.27	1268241.02	252.00	CL BERM
269	183850.19	1268063.92	254.00	CL BERM
270	183873.22	1267922.93	256.15	CL BERM
271	183887.95	1267832.78	257.15	CL BERM
272	183912.70	1267836.82	256.00	CL BERM
273	183994.14	1267850.13	254	CL BERM

CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
274	184085.33	1267865.02	252.52	CL BERM
275	184176.52	1267879.91	254.00	CL BERM
276	184282.72	1267897.26	255.00	CL BERM
277	184247.79	1268111.08	254.00	CL BERM
278	184224.79	1268251.88	252.00	CL BERM
279	184199.99	1268403.72	250.00	CL BERM
280	184164.33	1268622.09	248.00	CL BERM
281	184126.05	1268856.41	246.00	CL BERM
282	184110.61	1268950.57	245.19	CL BERM
283	183954.82	1268663.78	238.00	PRO. COVER
284	183979.62	1268511.55	240.00	PRO. COVER
285	184004.42	1268360.11	242.00	PRO. COVER
286	184029.22	1268208.28	244.00	PRO. COVER
287	184054.03	1268056.45	246.00	PRO. COVER
288	184078.83	1267904.62	248.00	PRO. COVER
289	184131.15	1268956.79	238.42	OVERBUILD
290	184150.05	1268837.50	240.00	OVERBUILD
291	184173.99	1268686.43	242.00	OVERBUILD
292	184197.93	1268535.36	244.00	OVERBUILD
293	184221.88	1268384.29	246.00	OVERBUILD
294	184245.82	1268233.21	248.00	OVERBUILD
295	184269.76	1268082.14	250.00	OVERBUILD
296	184274.48	1268052.33	250.39	OVERBUILD
297	183753.31	1268637.46	254.49	CREST
298	184094.71	1268991.18	255.12	CREST
299	184101.89	1268984.77	255.13	CREST
300	184107.40	1268990.48	255.14	CREST
301	184117.54	1269014.83	255.16	CREST
302	184121.33	1269018.76	255.17	CREST
303	183853.44	1268126.23	248.00	TEMP. BERM
304	183854.03	1268123.28	248.00	TEMP. BERM
305	184222.49	1268186.35	248.00	TEMP. BERM
306	184222.90	1268183.37	248.00	TEMP. BERM
307	183809.69	1268414.33	244.00	TEMP. BERM
308	183812.30	1268411.72	244.00	TEMP. BERM
309	184175.14	1268470.83	244.00	TEMP. BERM
310	184174.711	1268473.8	244.00	TEMP. BERM

NOTES:

1. ENGINEERED BUFFER WILL BE PLACED IN CEL. BOTTOM AND SIDE SLOPE IMMEDIATELY UNDER THE CLAY LINER.
2. CONTRACTOR IS RESPONSIBLE FOR ALL DEWATERING, MUCKING-OUT, AND REMOVAL OF UNSUITABLE MATERIALS IN CONSTRUCTION AREAS.
3. CONTRACTOR SHALL PLACE ALL STRUCTURAL FILL MATERIAL AND ENGINEERED BUFFER MATERIAL IN APPROPRIATE LIFTS AND MOISTURE CONDITION AND COMPACT TO PROJECT SPECIFICATIONS.
4. SEGMENTS OF THE LEACHATE MANAGEMENT PIPE WITHIN THE CHIMNEY DRAIN GRAVEL AND SELECT SAND LAYER SHALL BE PERFORATED. THE PERFORATED LEACHATE MANAGEMENT PIPES SHALL EXTEND INTO THE CHIMNEY DRAINS A MINIMUM OF 50 FEET.



TYPICAL SECTION THROUGH BOTTOM LINER W/ ENGINEERED BUFFER

PERMANENT SITE MONUMENTS

NUMBER	NORTHING	EASTING	ELEVATION
BM -2	183136.51	1268157.75	244.40
BM -3	182673.74	1267676.71	249.75
BM -4	182362.01	1267225.00	253.98
BM -5	183089.25	1266826.56	264.98

811 Know what's below. Call before you dig.

REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION — TERRACON CONSULTANTS, INC. — No.223 — ARKANSAS

STATE OF ARKANSAS — 12 ★★★ 2013 — REGISTERED PROFESSIONAL ENGINEER — No.14977 — BRAD N. FURCIGH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH — BRYANT, ARKANSAS 72022
PH. (501) 847-9292 — FAX. (501) 847-9210

WM

PROPOSED TOP OF PROTECTIVE COVER GRADING AND CHIMNEY DRAIN

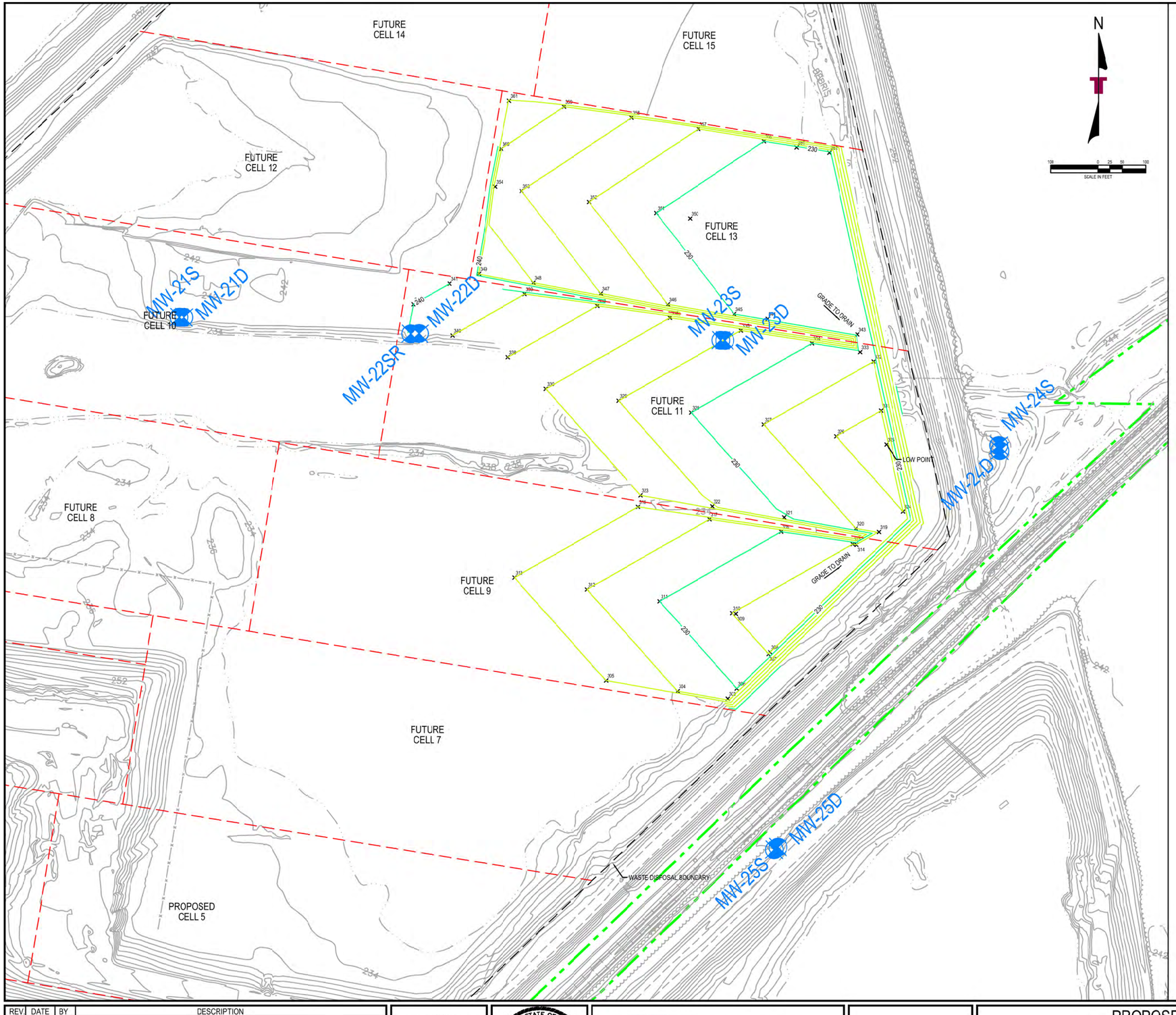
CELL 5 CONSTRUCTION DRAWINGS

WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK — ARKANSAS

DRAWING 6	
DESIGNED BY:	RSC
DRAWN BY:	RSC
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	6 OF 13



CONTROL POINT TABLE

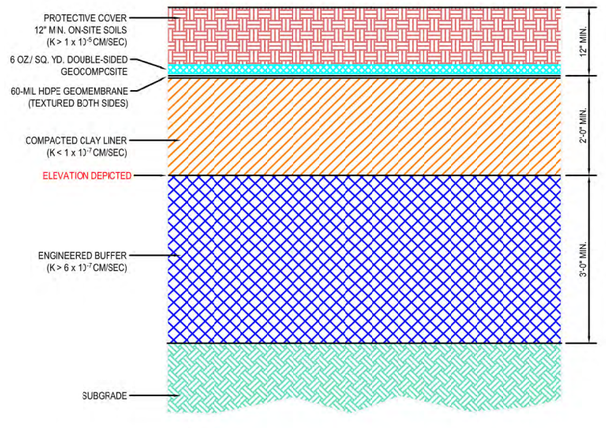
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
303	184481.86	1269296.89	230.61	BORROW GRADING
304	184497.64	1269191.17	232.00	BORROW GRADING
305	184519.90	1269041.60	234.00	BORROW GRADING
306	184503.12	1269316.10	230.00	BORROW GRADING
307	184575.32	1269381.72	228.00	BORROW GRADING
308	184579.28	1269385.37	227.90	BORROW GRADING
309	184659.21	1269314.32	227.89	BORROW GRADING
310	184660.58	1269305.94	228.00	BORROW GRADING
311	184685.38	1269154.11	230.00	BORROW GRADING
312	184710.18	1269002.27	232.00	BORROW GRADING
313	184734.98	1268850.44	234.00	BORROW GRADING
314	184803.64	1269566.33	227.90	BORROW GRADING
315	184805.14	1269558.17	228.00	BORROW GRADING
316	184831.07	1269408.32	230.00	BORROW GRADING
317	184857.01	1269258.46	232.00	BORROW GRADING
318	184882.94	1269108.61	234.00	BORROW GRADING
319	184830.41	1269613.04	227.36	BORROW GRADING
320	184837.81	1269564.88	228.00	BORROW GRADING
321	184860.91	1269414.56	230.00	BORROW GRADING
322	184884.00	1269264.24	232.00	BORROW GRADING
323	184907.10	1269113.92	234.00	BORROW GRADING
324	184873.11	1269663.30	226.00	BORROW GRADING
325	185013.19	1269628.57	224.62	BORROW GRADING
326	185030.34	1269523.56	226.00	BORROW GRADING
327	185055.14	1269371.72	228.00	BORROW GRADING
328	185079.94	1269219.89	230.00	BORROW GRADING
329	185104.74	1269068.05	232.00	BORROW GRADING
330	185129.54	1268916.22	234.00	BORROW GRADING
331	185084.11	1269617.38	226.00	BORROW GRADING
332	185186.656	1269601.2	228	BORROW GRADING

CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
333	185206.34	1269574.14	228.63	BORROW GRADING
334	185224.74	1269472.54	230.00	BORROW GRADING
335	185251.59	1269324.29	232.00	BORROW GRADING
336	185278.28	1269175.76	234.00	BORROW GRADING
337	185303.08	1269023.93	236.00	BORROW GRADING
338	185195.74	1268836.63	236.00	BORROW GRADING
339	185327.81	1268871.97	238.00	BORROW GRADING
340	185240.97	1268721.60	237.99	BORROW GRADING
341	185349.56	1268714.82	240.00	BORROW GRADING
342	185306.46	1268639.60	240.00	BORROW GRADING
343	185243.44	1269568.21	229.00	BORROW GRADING
344	185276.02	1269379.83	229.00	BORROW GRADING
345	185285.96	1269310.54	230.00	BORROW GRADING
346	185306.26	1269171.67	232.00	BORROW GRADING
347	185328.94	1269030.94	234.00	BORROW GRADING
348	185351.63	1268890.22	236.00	BORROW GRADING
349	185370.05	1268775.99	237.62	BORROW GRADING
350	185485.57	1269217.88	229.00	BORROW GRADING
351	185497.08	1269147.38	230.00	BORROW GRADING
352	185520.11	1269006.39	232.00	BORROW GRADING
353	185543.14	1268865.40	234.00	BORROW GRADING
354	185552.23	1268809.74	234.79	BORROW GRADING
355	185634.26	1269440.43	229.00	BORROW GRADING
356	185647.16	1269372.01	230.00	BORROW GRADING
357	185672.96	1269235.17	232.00	BORROW GRADING
358	185696.75	1269095.31	234.00	BORROW GRADING
359	185719.47	1268953.86	236.00	BORROW GRADING
360	185631.22	1268822.67	236.00	BORROW GRADING
361	185731.89	1268839.15	237.54	BORROW GRADING
362	185623.527	1269509.24	229	BORROW GRADING

NOTES:

CONTRACTOR SHALL PROTECT EXISTING MONITORING WELLS DURING BORROW AREA EXCAVATION AND REPLACE OR REPAIR ANY WELLS THAT ARE DAMAGED. BORROW AREA GRADING MAY BE ADJUSTED AS NEEDED TO PROTECT EXISTING MONITORING WELLS.



TYPICAL SECTION THROUGH BOTTOM LINER W/ ENGINEERED BUFFER

PERMANENT SITE MONUMENTS			
NUMBER	NORTHING	EASTING	ELEVATION
BM -2	183136.51	1269157.75	244.40
BM -3	182673.74	1267676.71	249.75
BM -4	182362.01	1267225.00	253.98
BM -5	183089.25	1266826.56	264.98

811 Know what's below. Call before you dig.

REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION TERRACON CONSULTANTS, INC. No.223 ARKANSAS

STATE OF ARKANSAS 10/31/2013 REGISTERED PROFESSIONAL ENGINEER No.14977 BRAD N. FURENCH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (501) 847-9210

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PROPOSED BORROW AREA GRADING

CELL 5 CONSTRUCTION DRAWINGS

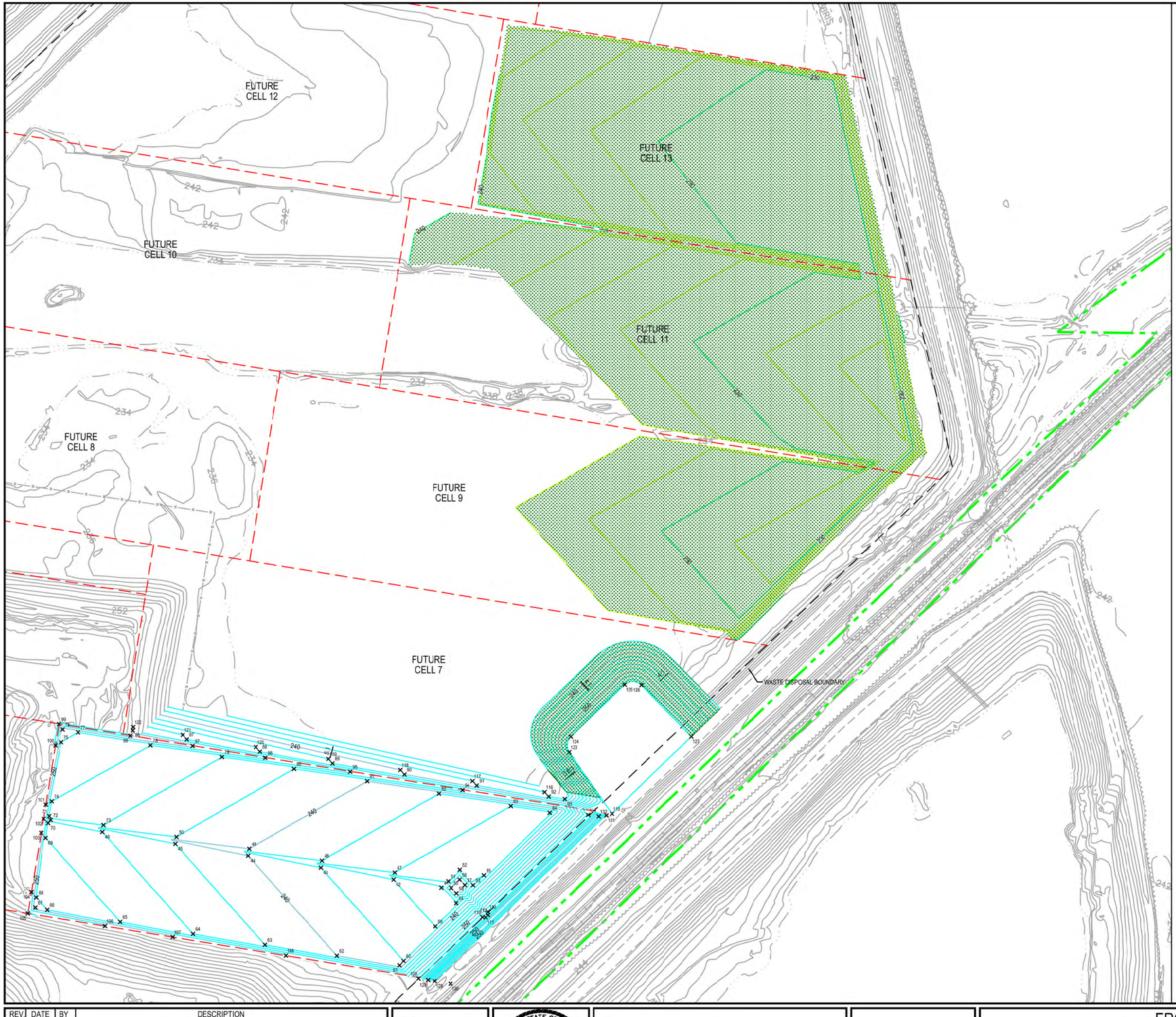
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK ARKANSAS

DRAWING 7

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-214-3513172
ACAD NO.	3513172-Main
SHEET NO.:	7 OF 13



N

SCALE IN FEET

NOTE:
EXISTING CONTOURS SHOWN ON THIS DRAWING ARE FROM AN AERIAL SURVEY PERFORMED BY SOUTHERN RESOURCES MAPPING CORPORATION ON JANUARY 19, 2013.

LEGEND:

- AREAS TO BE SEEDED
- PROPERTY BOUNDARY
- WASTE DISPOSAL BOUNDARY
- CELL BOUNDARIES

PERMANENT SITE MONUMENTS

NUMBER	NORTHING	EASTING	ELEVATION
BM -2	183136.51	1268157.75	244.40
BM -3	182673.74	1267676.71	249.75
BM -4	182362.01	1267225.00	253.98
BM -5	183089.25	1266826.56	264.98

811 Know what's below. Call before you dig.

REV.	DATE	BY	DESCRIPTION

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STATE OF ARKANSAS — 10/31/2013 — REGISTERED PROFESSIONAL ENGINEER — No. 14977 — BRAD N. FURENCH

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EROSION CONTROL PLAN

CELL 5 CONSTRUCTION DRAWINGS

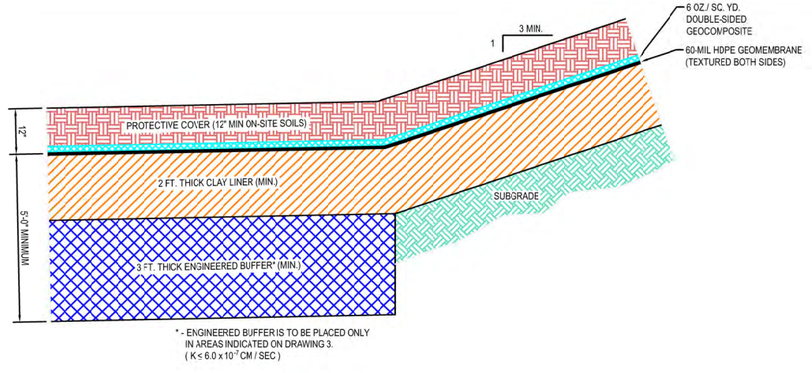
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK — ARKANSAS

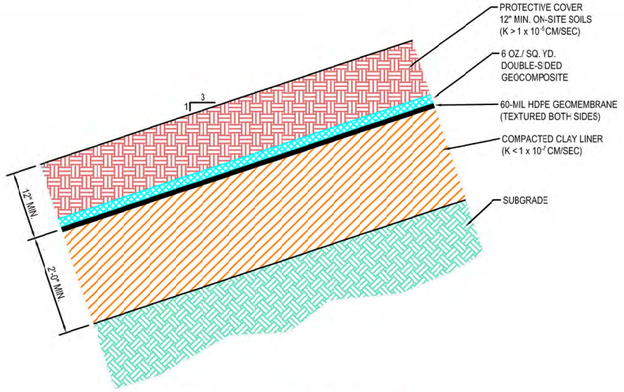
DRAWING 8

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	8 OF 13



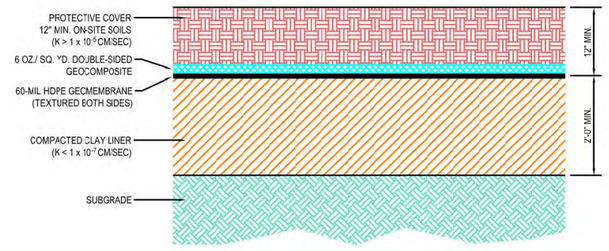
BASE LINER SYSTEM

DETAIL A — SCALE: N.T.S. — 4 | 9



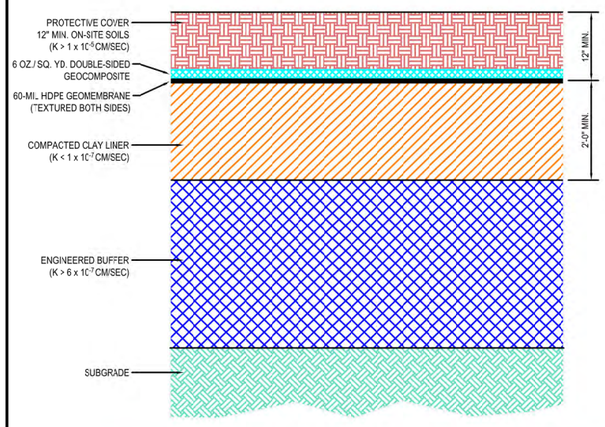
SECTION THROUGH LINER ON SIDE SLOPE

DETAIL B — SCALE: N.T.S. — 5 | 9



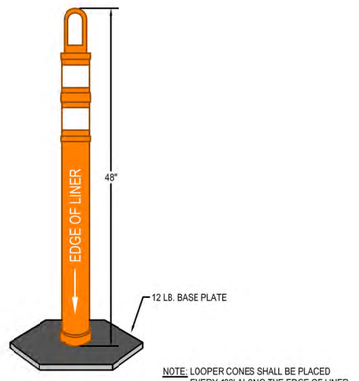
SECTION THROUGH LINER ON BOTTOM OF CELL

DETAIL C — SCALE: N.T.S. — 5 | 9



SECTION THROUGH LINER ON BOTTOM OF CELL WITH ENGINEERED BUFFER

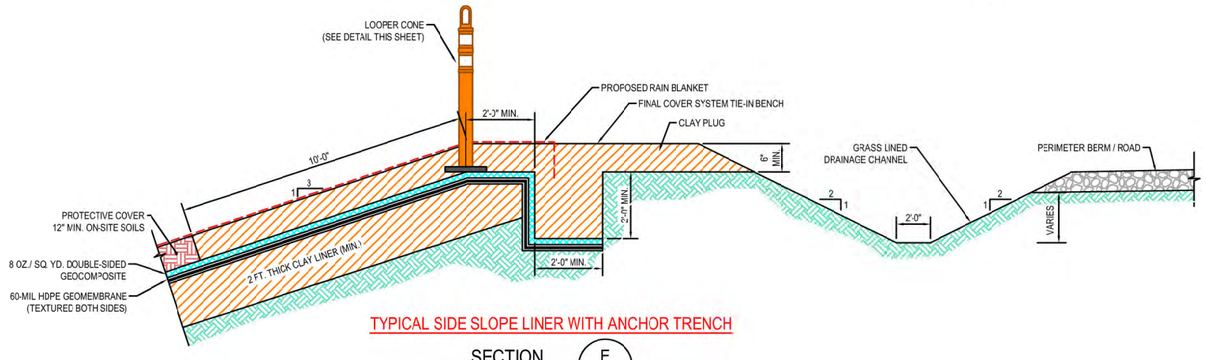
DETAIL D — SCALE: N.T.S. — 5 | 9



NOTE: LOOPER CONES SHALL BE PLACED EVERY 100' ALONG THE EDGE OF LINER.

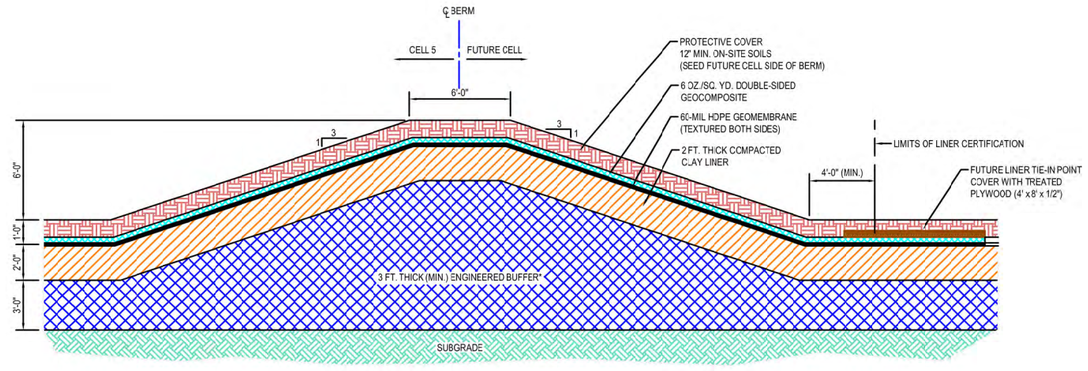
LOOPER CONE

SECTION E1 — SCALE: N.T.S. — 9 | 9



TYPICAL SIDE SLOPE LINER WITH ANCHOR TRENCH

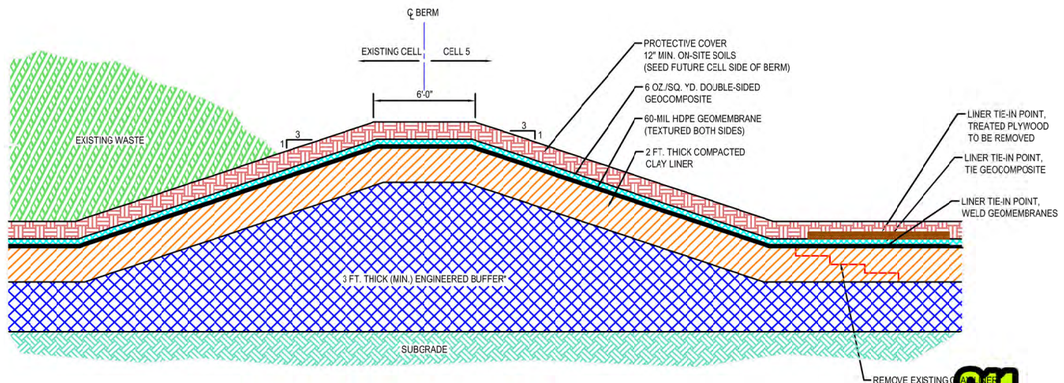
SECTION E — SCALE: N.T.S. — 4 | 9



TYPICAL LINER OVER-BUILD AREA

SECTION F — SCALE: N.T.S. — 4 | 9

* - ENGINEERED BUFFER IS TO BE PLACED ONLY IN AREAS INDICATED ON DRAWING 3. (K < 6.0 x 10-7 CM / SEC)



LINER TIE-IN AT EXISTING OVER-BUILD AREA

SECTION G — SCALE: N.T.S. — 4 | 9

* - ENGINEERED BUFFER IS TO BE PLACED ONLY IN AREAS INDICATED ON DRAWING 3. (K < 6.0 x 10-7 CM / SEC)

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Consulting Engineers and Scientists
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CELL CONSTRUCTION DETAILS

CELL 5 CONSTRUCTION DRAWINGS

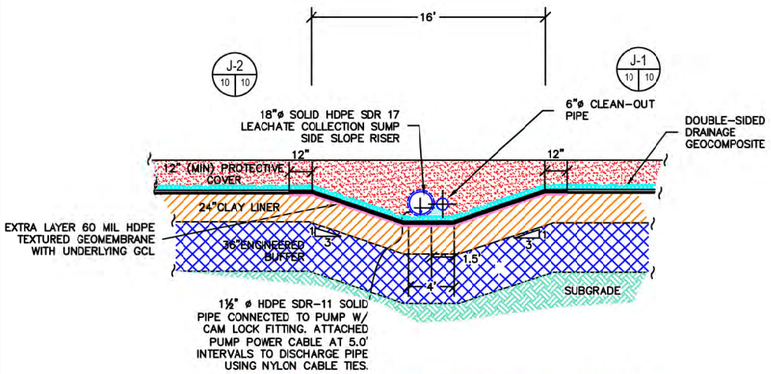
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK — ARKANSAS

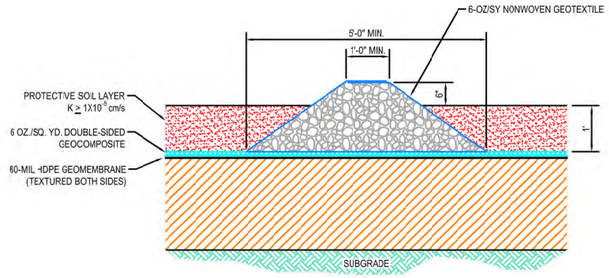
DRAWING 9

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	N.T.S.
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	9 OF 13



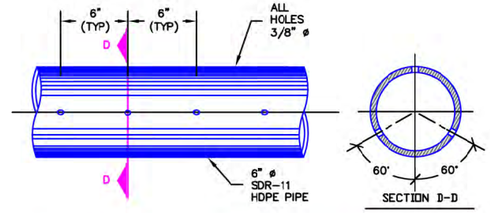
LEACHATE COLLECTION SUMP & RISER TRENCH - SECTION A-A'

DETAIL L (10 | 10)
SCALE: N.T.S.



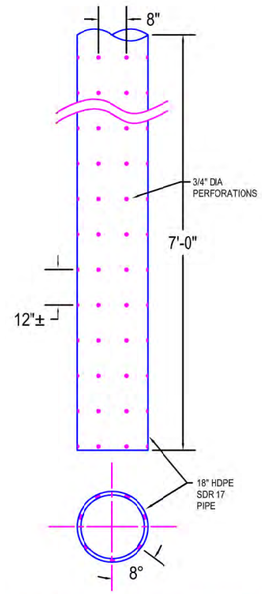
DETAIL - CHIMNEY DRAIN AND ALTERNATE BOTTOM LINER

DETAIL (6 | 10)
SCALE: N.T.S.



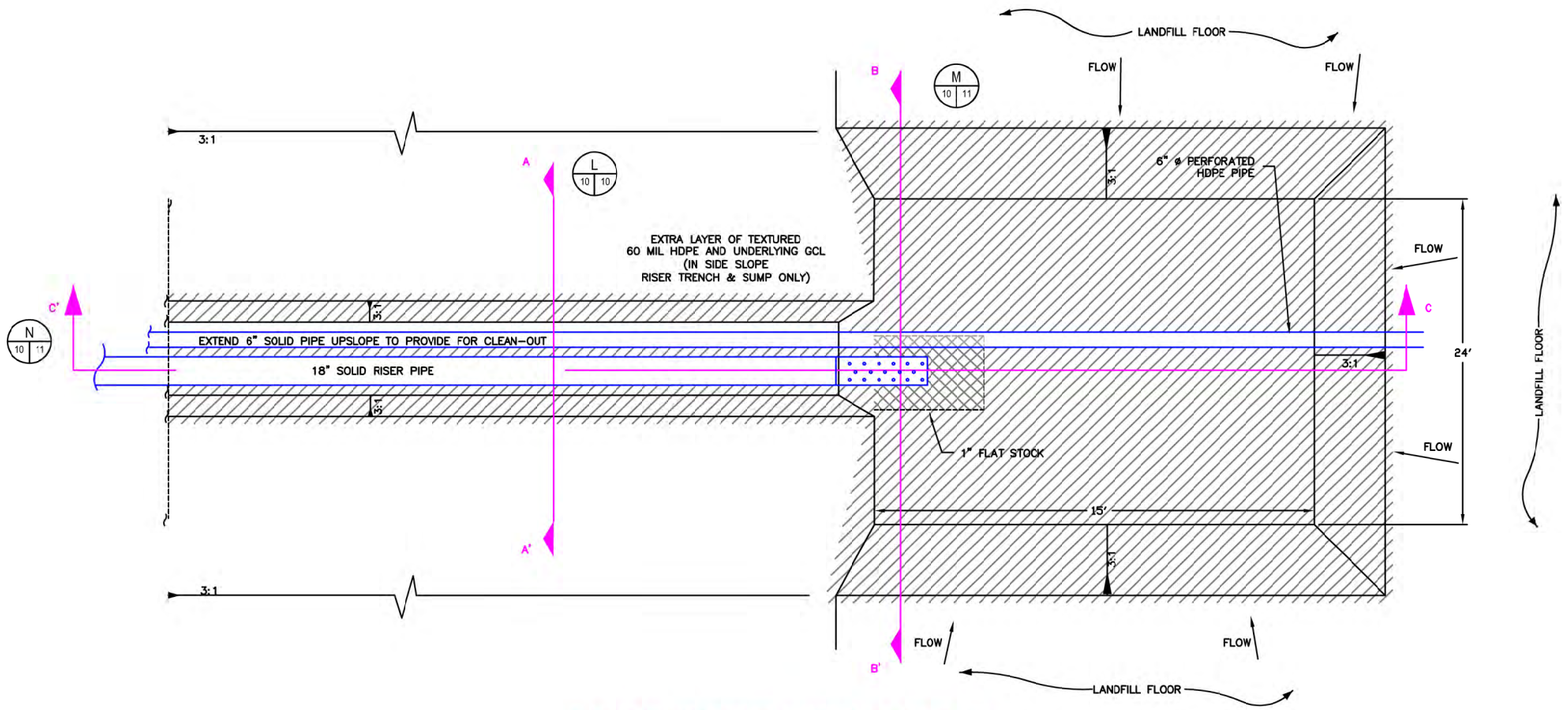
6-INCH SDR-11 PERFORATED HDPE COLLECTION TRENCH PIPE

DETAIL J-1 (10 | 10)
SCALE: N.T.S.



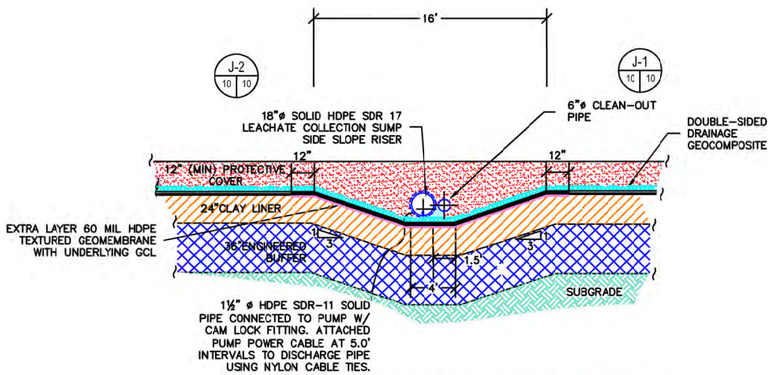
18" LEACHATE RISER PIPE PERFORATION LOCATION DETAIL

DETAIL J-2 (10 | 10)
SCALE: N.T.S.



LEACHATE COLLECTION SUMP & RISER TRENCH - PLAN VIEW

DETAIL K (6 | 10)
SCALE: N.T.S.



LEACHATE COLLECTION SUMP & RISER TRENCH - SECTION A-A'

DETAIL L (10 | 10)
SCALE: N.T.S.

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CERTIFICATE OF AUTHORIZATION — TERRACON CONSULTANTS INC. — No.223 — ARKANSAS

STATE OF ARKANSAS — 10/31/2013 — REGISTERED PROFESSIONAL ENGINEER — No. 14977 — BRAD N. FURENCH

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Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, ARKANSAS 72022
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LEACHATE COLLECTION SYSTEM DETAILS

CELL 5 CONSTRUCTION DRAWINGS

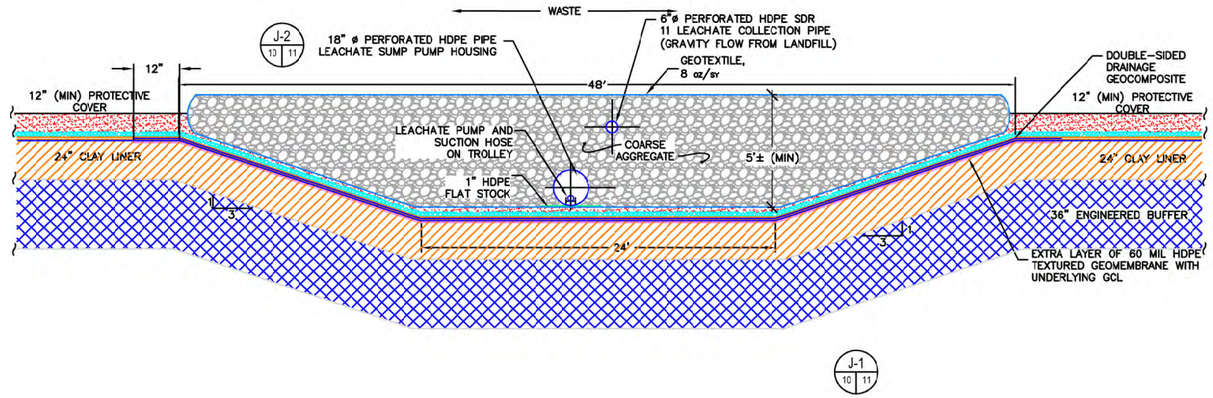
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

NORTH LITTLE ROCK ARKANSAS

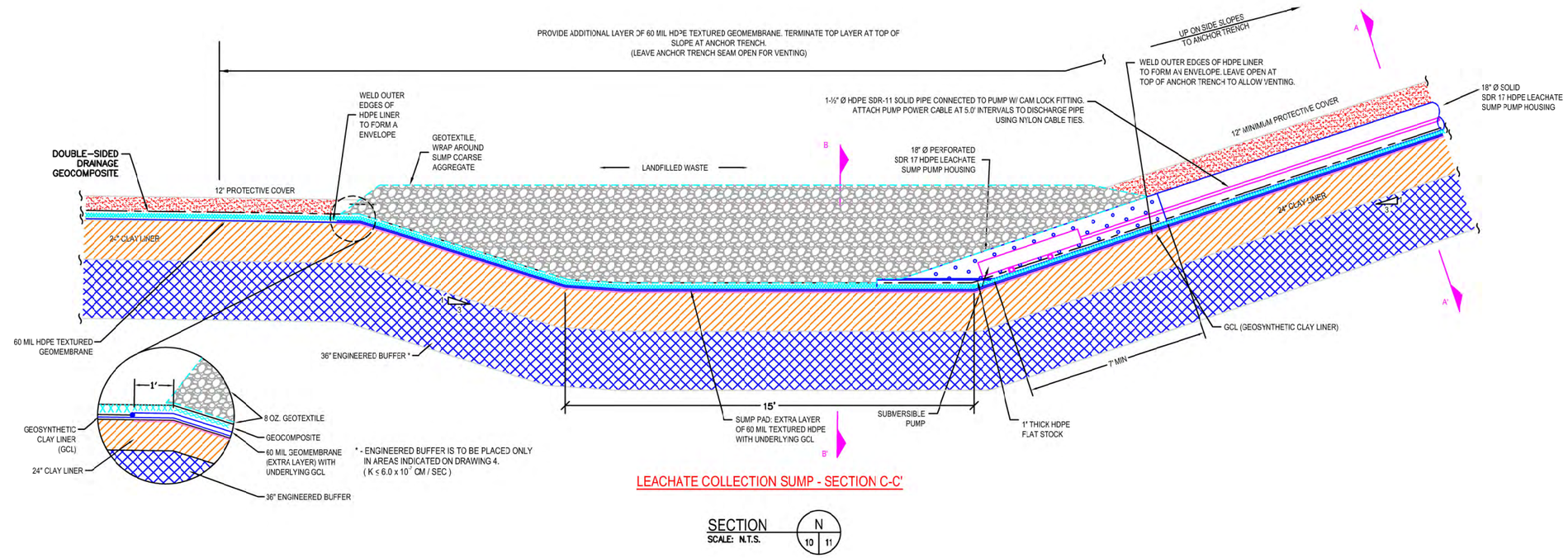
DRAWING 10

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	N.T.S.
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	10 OF 13



LEACHATE COLLECTION SUMP - SECTION B-B'

SECTION M (10 | 11)
SCALE: N.T.S.



LEACHATE COLLECTION SUMP - SECTION C-C'

SECTION N (10 | 11)
SCALE: N.T.S.

Know what's below. Call before you dig.

REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION — TERRACON CONSULTANTS, INC. — No.223 — ARKANSAS

STATE OF ARKANSAS — 10/31/2013 — REGISTERED PROFESSIONAL ENGINEER — No. 14977 — BRAD N. FURRIGH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (501) 847-9210

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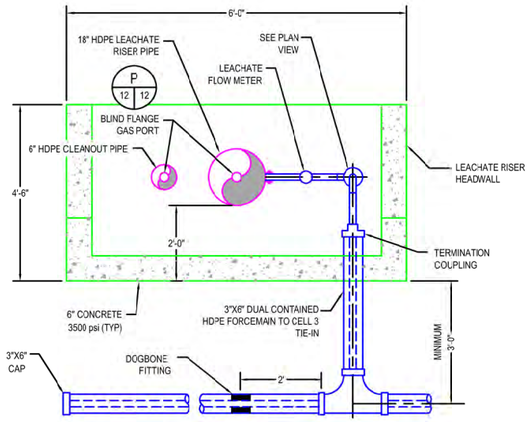
LEACHATE COLLECTION SYSTEM DETAILS

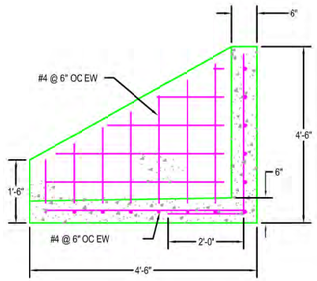
CELL 5 CONSTRUCTION DRAWINGS
WASTE MANAGEMENT
CLASS 1 LANDFILL FACILITY
NORTH LITTLE ROCK ARKANSAS

DRAWING 11

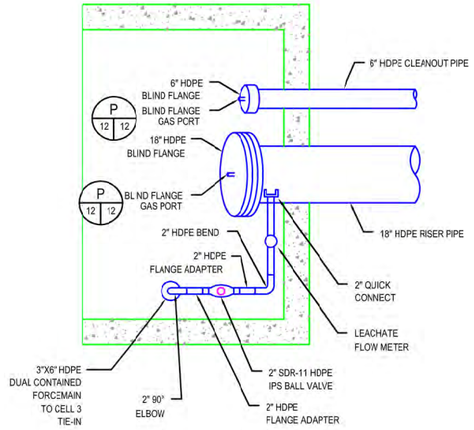
DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	N.T.S.
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	11 OF 13



FRONT VIEW



SIDE VIEW



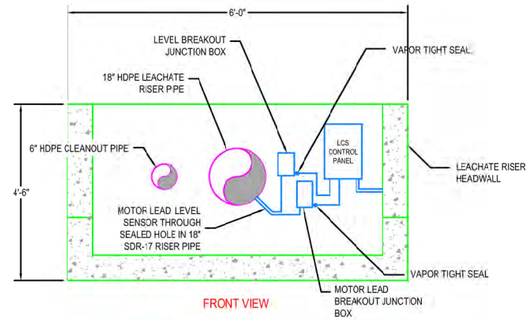
PLAN VIEW

TYPICAL HEADWALL & LEACHATE RISER PIPE DETAIL

DETAIL O 5 12
SCALE: N.T.S.

NOTES:

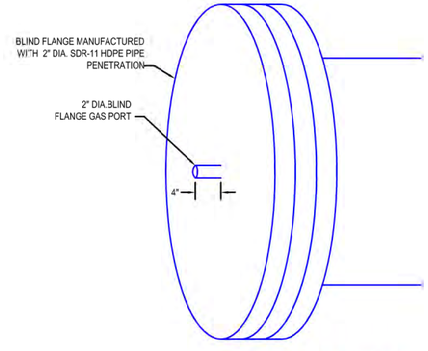
1. LOCATE END OF PIPE WITH 4"X4" WOODEN STAKE PAINTED ORANGE WITH NYLON ROPE LEADING TO END OF PIPE.
2. INSTALL 14 GAUGE COPPER SOLID GREEN TRACER WIRE WITH DUAL CONTAINED HDPE PIPE.
3. SEE DETAIL ON THIS SHEET FOR WIRING.
4. CONNECT GAS PORTS ON 6" CLEANOUT PIPE AND 18" RISER PIPE WITH 2' KANAFLEX HOSE AND POWERLOCK CLAMPS.



FRONT VIEW

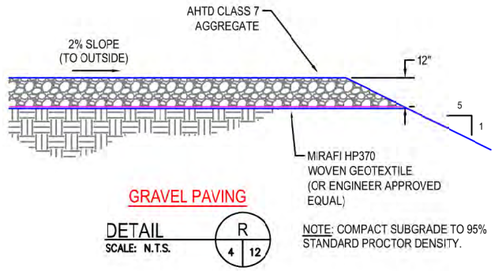
TYPICAL HEADWALL WIRING

DETAIL P 12 12
SCALE: N.T.S.



BLIND FLANGE GAS PORT

DETAIL P 12 12
SCALE: N.T.S.



GRAVEL PAVING

DETAIL R 4 12
SCALE: N.T.S.

NOTE: COMPACT SUBGRADE TO 95% STANDARD PROCTOR DENSITY.

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REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION TERRACON CONSULTANTS, INC. No.223 ARKANSAS

STATE OF ARKANSAS 10/7/2013 REGISTERED PROFESSIONAL ENGINEER No. 14977 BRAD N. FURESH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (501) 847-9210

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MISCELLANEOUS DETAILS

CELL 5 CONSTRUCTION DRAWINGS

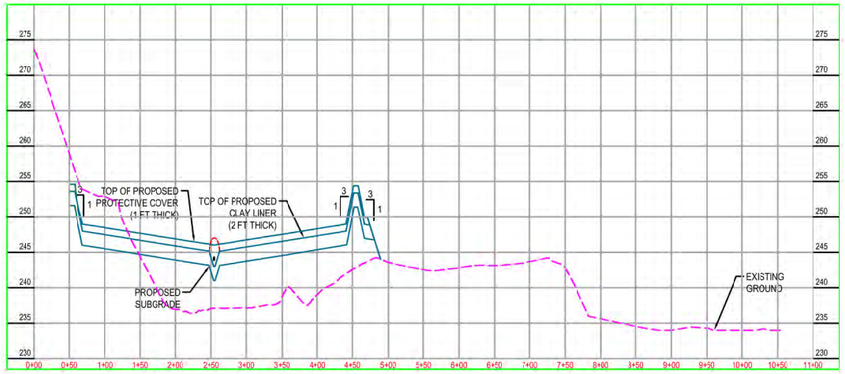
WASTE MANAGEMENT

CLASS 1 LANDFILL FACILITY

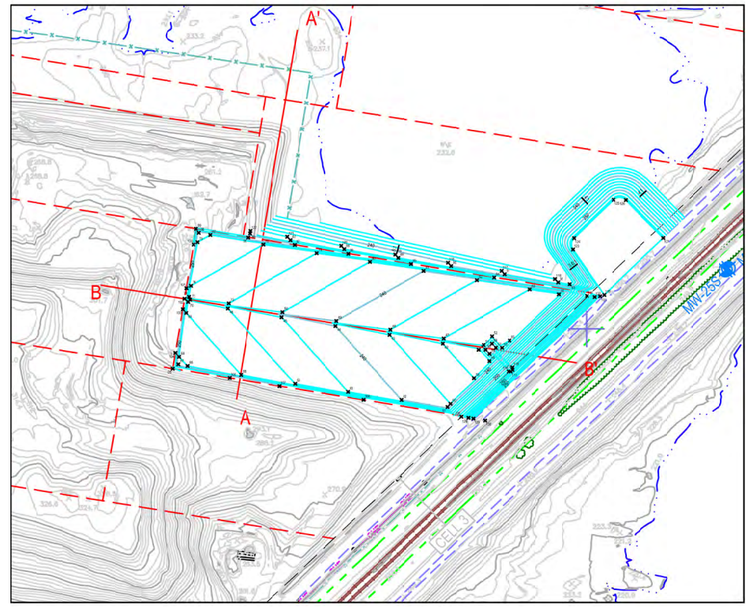
NORTH LITTLE ROCK ARKANSAS

DRAWING 12

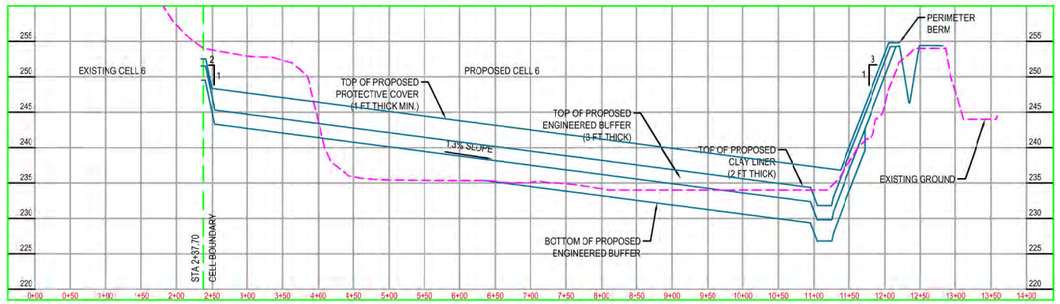
DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	N.T.S.
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	12 OF 13



SECTION A-A'
SCALE: AS SHOWN



CROSS SECTION KEY MAP
SCALE: N.T.S.



SECTION B-B'
SCALE: AS SHOWN

Know what's below.
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REV.	DATE	BY	DESCRIPTION

CERTIFICATE OF AUTHORIZATION
TERRACON CONSULTANTS, INC.
No.223
ARKANSAS

STATE OF ARKANSAS
10/31/2013
REGISTERED PROFESSIONAL ENGINEER
No. 14977
BRAD N. FUREIGH

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, ARKANSAS 72022
PH. (501) 847-9292 FAX. (501) 847-9210

WM

CROSS SECTION - CELL 5
CELL 5 CONSTRUCTION DRAWINGS
WASTE MANAGEMENT
CLASS 1 LANDFILL FACILITY
NORTH LITTLE ROCK ARKANSAS

DRAWING 13

DESIGNED BY:	RSG
DRAWN BY:	RSG
APPVD. BY:	BNF
SCALE:	AS SHOWN
DATE:	9-12-13
JOB NO.	062-014-3513172
ACAD NO.	3513172-Main
SHEET NO.:	13 OF 13

Technical Specifications

Two Pine Class 1 Landfill
Cell 5 Construction
North Little Rock, Arkansas
Permit No. 0163-S1-R3; AFIN 63-00438

September 2013
Project No. 35137172

Prepared for:
Waste Management of Arkansas, Inc.
100 Two Pine Drive
North Little Rock, Arkansas 72117
(501) 982-7336

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

Offices Nationwide Established in 1965
Employee-Owned terracon.com
Terracon
Geotechnical Environmental Construction Materials Facilities

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS – CONTINUED

DIVISION 1
GENERAL REQUIREMENTS

SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

- Description of Payment Items
- Work Covered by Contract Documents.
- Work by Others.
- Work Sequence.
- Existing Site Conditions.
- Contractor's Use of Premises.
- Erosion and Sediment Controls.
- Temporary and Permanent Seeding.
- Interim Stormwater Run-on and Run-off Controls.

1.02 DESCRIPTION OF PAYMENT ITEMS

A. The Earthwork Contractor shall be responsible for the work as described in this document and as indicated in the construction drawings. Payment for work will be made as indicated in the pay items listed below. Any work, which the Earthwork Contractor believes not to be covered by one of these pay items shall be addressed in the bid, submitted to the Owner.

The Earthwork Contractor shall take all necessary actions needed to meet the proposed schedule, taking into account weather as could be expected for the project area and season. Unless otherwise approved by the Owner, construction activities at the site and material deliveries to the Facility shall be limited to hours approved by the Owner.

1.03 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work consists of, in general, construction of landfill waste area with a leachate collection system (chimney drain or sand wedge), stormwater control structures, perimeter ditch and road improvements at the Waste Management Two Pine Landfill facility located near North Little Rock, Arkansas.

B. The following bid items correspond to the drawing sets entitled *Construction Drawings for the Two Pine Class 1 Landfill Facility, Proposed Cell 5 and Proposed Site Improvements.*

1. **Mobilization/Demobilization –** The Earthwork Contractor shall mobilize all equipment, materials, personnel, etc. to the site and demobilize after completion of construction, leaving allocated work areas, including borrow sources, haul roads and stockpiles, in a satisfactory condition. The Owner is not responsible for assisting the Contractor with unloading or loading of any materials or equipment. In addition to unloading geosynthetic liner materials, the Contractor shall be responsible for storing and protecting the materials from weather. Assume one mobilization for the project.

   The Lump Sum Price for Mobilization and Demobilization shall be payment in full for all labor, equipment, material and other incidentals to the site, as well as Contractor provided utilities and ongoing related expenses, considered normal for administration of the work. Fifty (50) percent of the Lump Sum price bid will be paid with the first payment request following satisfactory evidence of mobilization of sufficient labor, equipment and material to adequately progress the work of this contract. The remaining fifty (50) percent of the Lump Sum price bid will be paid with the Final Payment request after satisfactory substantial completion of the Project. The total price paid for this item in the first installment shall not exceed six (6) percent of the original Contract amount for the Contract. Assume one mobilization for the project.

2. **Stripping and Stockpiling of Topsoil –** The Contractor shall be responsible for clearing and stripping of vegetation, topsoil or otherwise unsuitable organic materials within the construction area or designated borrow area in accordance with the Contract Drawings and Technical Specifications. Topsoil can be stockpiled for reuse adjacent to the working area.

   No additional allowances shall be permitted for unauthorized excavation beyond the limits as set forth by the Contract Drawings or Technical Specifications, unless approved prior to removal.

   The unit price shall include all labor, material, equipment, and other incidentals, such as, excavating, moving, placing and segregating, stockpiling, stockpile grading and maintenance, disposal of debris, and erosion and sedimentation control materials and practices as required to

comply with the Contract Drawings and Technical Specifications (unless specifically identified as a pay item). Payment for this task shall be on a lump sum basis for the unit price provided in the bid form.

3. **Cell 5 Subgrade** – The Earthwork Contractor shall excavate, haul, place, grade, and compact subgrade in accordance with the Contract Drawings and Technical Specifications within the limits of the Cell 5 liner system. Fill material outside the cell limits, including the Cell 5 access road and turn-around pad, is also included in this bid item. Approximately 34,280 cubic yards of cut from Cell 5 can be used as fill material for Cell 5. An additional 106,170 cubic yards (approximate) of material will be required from the designated borrow source to complete subgrade. The Contractor shall be responsible for verifying these quantities, as they are only provided as estimates.

   The volume of compacted fill materials shall be calculated by grid methods based on topographic surveys of the ground surface before and after excavation within the limits of Construction. Volumes will be calculated as in-place with no adjustment factor. No additional allowances shall be permitted for unauthorized filling beyond the limits of Subgrade within the cell or finished grade outside of the cell as set forth by the Drawings or Specifications.

   The Contract Unit Price for Subgrade shall be for placed and compacted fill, including all labor, material, equipment, and other incidentals, such as, excavating, moving, placing and segregating, stockpiling, stockpile grading and maintenance, dewatering, and erosion and sedimentation control materials and practices as required to comply with the Drawings and Specifications (unless specifically identified as a pay item). Payment for this task shall be on a lump sum basis for the unit price provided in the bid form.

4. **Engineered Buffer Layer** – The Earthwork Contractor shall excavate from onsite borrow source or from mass excavation, haul, place, and compact the 36-inch thick recompacted engineered buffer layer above the subgrade of Cell 5 in accordance with the Contract Drawings and Technical Specifications. Hydraulic conductivity values must be less than or equal to 6.0×10^{-7} cm/sec as determined by ASTM D5084.

   The volume of recompacted soil liner shall be calculated by a topographic survey of the plan area of approved recompacted soil liner. The plan area and minimum design thickness shall be used to determine the

volume of recompacted soil liner constructed. Volumes will be calculated as in-place with no adjustment factor. No additional allowances shall be permitted for unauthorized filling beyond the limits of the cell as set forth by the Contract Drawings or Technical Specifications.

The Contract Unit Price for the Engineered Buffer Layer shall be for placed and compacted buffer material, including all labor, material, equipment, and other incidentals, such as, excavating, moving, placing and segregating, stockpiling, stockpile grading and maintenance, dewatering, and erosion and sedimentation control materials and practices as required to comply with the Contract Drawings and Technical Specifications (unless specifically identified as a pay item). Payment for this task shall be on a lump sum basis for the unit price provided in the bid form.

5. **Compacted Clay Liner** – The Earthwork Contractor shall excavate from onsite borrow source or from mass excavation, haul, place, and compact the 24-inch thick recompacted clay liner above the subgrade/engineered buffer layer (where appropriate) of Cell 5 in accordance with the Contract Drawings and Technical Specifications. Hydraulic conductivity values must be less than or equal to 1.0×10^{-7} cm/sec as determined by ASTM D5084.

   The volume of recompacted soil liner shall be calculated by a topographic survey of the plan area of approved recompacted soil liner. The plan area and minimum design thickness shall be used to determine the volume of recompacted soil liner constructed. Volumes will be calculated as in-place with no adjustment factor. No additional allowances shall be permitted for unauthorized filling beyond the limits of the cell as set forth by the Contract Drawings or Technical Specifications.

   The Contract Unit Price for the Clay Liner shall be for placed and compacted clay liner material, including all labor, material, equipment, and other incidentals, such as, excavating, moving, placing and segregating, stockpiling, stockpile grading and maintenance, dewatering, and erosion and sedimentation control materials and practices as required to comply with the Contract Drawings and Technical Specifications (unless specifically identified as a pay item). Payment for this task shall be on a lump sum basis for the unit price provided in the bid form.

6. **Liner Tie-In Preparation** – The Earthwork Contractor shall remove protective cover soils to reveal a minimum 5-foot width of 60-mil HDPE geomembrane for tie-in with existing landfill Cells 3, 4, and 6. The Contractor shall provide smooth, continuous transitions between previously-existing and newly-installed liner. The Contractor shall also maintain a clean tie-in that is suitable for geosynthetics installation.

   The length of Cell 5 tie-in shall be calculated by a survey of the constructed and approved tie-in length. Length will be planimetric with no adjustment for slopes.

   The Contract Unit Price for Cell 5 tie-in shall be full compensation for approved tie-in, including all labor, material, equipment, and other incidentals, such as, excavating, grading, maintenance, and erosion and sedimentation control materials and practices as required to comply with the Contract Drawings and Technical Specifications (unless specifically identified as a pay item). Final payment shall be based on the actual in-place length calculated from a physical survey as shown on approved Record Drawings.

7. **Geosynthetic Anchor Trench** – The Earthwork Contractor shall excavate, backfill, and compact the geosynthetics anchor trench to the lines and grades shown on the Contract Drawings and in accordance with the Technical Specifications. The construction of the anchor trench shall be coordinated with the Geosynthetics Installer.

   The length of the geosynthetic anchor trench excavated, backfilled, compacted and approved as indicated on the Drawings and Specifications shall be calculated. The quantity for the calculation shall be the planimetric measured linear distance of in-place, approved anchor trench. No additional allowances shall be permitted for unauthorized trenches beyond the depths or limits of anchor trench as set forth on the Contract Drawings or Technical Specifications. The Surveyor of Record shall determine the actual length of anchor trench installed as directed by this Specification and shall show the anchor trench on Record Drawings.

   The Contract Unit Price for anchor trench shall be full compensation for anchor trench, including all excavation, backfill, compaction, labor, material, equipment, and other incidentals. Final payment shall be based on the actual length of anchor trench installed as shown on approved Record Drawings.

8. **Leachate Collection System** – The Earthwork Contractor is responsible for the installation of leachate collection system which will include one of the following Options:

Option 1: Chimney Drains – requires approximately 3,810 linear feet of chimney drain consisting of aggregate and filter fabric (non-woven geotextile provided by Owner; installed by Contractor) and approximately 14,670 cubic yards of on-site soil protective cover ($k \geq 1.0 \times 10^{-5}$ cm/sec). The Contractor shall be responsible for the purchase, hauling and placing of chimney drain collection system aggregate as required by the Contract Drawings and Technical Specifications. The collection system aggregate shall be classified as either a well graded or poorly graded gravel (GW or GP) in accordance with the Unified Soil Classification System. Stockpiling must be coordinated with the Owner as construction progresses.

The Surveyor of Record shall determine the actual length of chimney drain collection system installed as directed by this Specifications and shall show the location of the collection system on the As-built Record Drawings.

Option 2: Sand Wedge – requires installation of approximately 2,990 cubic yards of sand ($k \geq 1.0 \times 10^{-3}$ cm/sec), roughly 12,230 cubic yards of on-site soils ($k \geq 1.0 \times 10^{-5}$ cm/sec), and 835 linear feet of aggregate and non-woven geotextile for the center collection trench, in accordance with the Contract Drawings and Technical Specifications. The Contractor shall be responsible for the purchase, hauling and placing of sand and aggregate material as required by the Contract Drawings and Technical Specifications. The collection system aggregate shall be classified as either a well graded or poorly graded gravel (GW or GP) in accordance with the Unified Soil Classification System. Stockpiling must be coordinated with the Owner as construction progresses.

The Surveyor of Record shall determine the actual volume of "sand wedge" material and on-site soil protective cover material installed as directed by this Specifications and shall show the location of the collection system on the As-built Record Drawings.

The Contract Unit Price for installing the leachate collection system shall include all labor, equipment and other incidentals as required to comply with the Contract Drawings and Technical Specifications. Payment for

this task shall be on a lump sum basis for the unit price provided in the bid form.

9. **Rain Blanket Anchor Trench** – The Earthwork Contractor shall trench, backfill, and compact the rain blanket anchor trench to the lines and grades shown on the Contract Drawings and in accordance with the Technical Specifications. The construction of the rain blanket anchor trench shall be coordinated with the Geosynthetics Installer.

   The Contract Price for the rain blanket anchor trench shall be full compensation, including all excavation, backfill, compaction, labor, material, equipment, and other incidentals. Payment for this task shall be on a lump sum basis for the price provided in the bid form. Full payment will be made upon completion and Owner acceptance of task.

10. **Overbuild Materials** – The Earthwork Contractor shall be responsible for the purchase and placement of treated plywood material on the Cell 5 Overbuild area (future liner tie-in location) as shown on the Contract Drawings. Payment for this task shall be on a lump sum basis. Final payment shall be based on the actual length of overbuild material installed as shown on approved Record Drawings.

11. **Stormwater Control** – The Earthwork Contractor shall be responsible for providing all necessary equipment and labor to control and pump stormwater within the limits of the construction area for the duration of the project. The Work includes all steps necessary to maintain compliance with the Owners NPDES Stormwater Permit ARG160011. The Contractor shall manage (including fuelling) the existing blue Gorman-Rupp stormwater pump provided by the Owner. The Owner will provide necessary maintenance accept for instances where the product has not been properly used; if it has been disassembled, modified, abused or tampered with; if the electrical cord has been cut or spliced; if the pump discharge has been reduced in size; or any other instance of neglect.

    The Lump Sum Price for Stormwater Control shall be payment in full for all labor, equipment, material and other incidentals to the site, as well as Contractor provided utilities and ongoing related expenses. Payment will be made based on the percentage of the project that has been completed at the time of payment request.

12. **Stormwater Diversion –** The Earthwork Contractor shall haul, place and compact soil berm for stormwater diversion on the north slope existing

Cell 3 and the east slope of active Cells 4 and 6, as shown on the Contract Drawings. The Contractor shall furnish all incidentals required for the construction of the stormwater diversion berm(s).

The length of in-place diversion shall be determined by the measured length of completed and approved diversion as measured along its centerline. No additional allowances shall be permitted for shrinkage, swelling, or unauthorized diversion placed beyond the limits as set forth on the Contract Drawings.

The Contract Unit Price for the stormwater diversion shall be full compensation for placed and compacted soil, including all labor, material, equipment, and other incidentals, such as, excavating, moving, placing and segregating, stockpiling, stockpile grading and maintenance, dewatering, and erosion and sedimentation control materials and practices as required to comply with the Contract Drawings and Technical Specifications (unless specifically identified as a pay item).

Final payment shall be based on the actual length of diversion berm installed as shown on approved Record Drawings.

13. **35' Wide Access Road and Turn-around Pad** – Earthwork quantities for this task are included in the Cell 5 Subgrade task (Bid Item 3). The Contractor shall be responsible for verifying all quantities, as they are only provided as estimates. The Earthwork Contractor shall supply and install gravel paving on the access road and turn around pad in accordance with the Contract Drawings and Technical Specifications. The Contractor shall furnish all incidentals required for the construction of gravel paving including woven geotextile. It is also the responsibility of the contractor to supply all labor, equipment, and material necessary to maintain Landfill access roads during construction of Cell 5. The Contractor shall be responsible for repairing Landfill roads back to preconstruction conditions upon completion of cell construction.

The Contract Price for gravel paving shall be full compensation for gravel paving, including all labor, material, equipment, and other incidentals, such as haul road construction and maintenance, dewatering, stockpile grading and maintenance, and erosion and sedimentation control materials and practices as required to comply with the Contract Drawings and Technical Specifications (unless specifically identified as a pay item). Payment for this task shall be on a percent complete basis for the lump sum price provided in the bid form.

14. **36" Diameter ADS Culvert** – The Earthwork Contractor shall purchase and install approximately 140 linear feet of 36" diameter ADS N-12 culvert (or approved equal) for drainage under Cell 5 access road as indicated on the Construction Drawings. The contractor shall provide appropriate pipe bedding, haunching and compacted backfill in accordance with manufacturer's specifications. The Contract Unit Price for the 36" diameter ADS culvert shall be full compensation for excavation and backfill, labor, material, equipment, and other incidentals. Full payment will be made upon completion of task.

15. **Excavate Perimeter Ditch** - The Earthwork Contractor shall excavate, compact, and fine grade approximately 530 linear feet of perimeter ditch to the lines and grades shown on the Construction Drawings. The Contract Unit Price for perimeter ditch excavation shall include all labor, material, equipment, and other incidentals, such as maintenance until project completion. Payment for this task shall be on a lump sum basis for the unit price provided in the bid form.

16. **Edge of Liner Markers** – The Earthwork Contractor shall purchase and install 48" Looper Cones with 12-pound base plates at the edge of liner on 100' intervals as indicated on the Construction Drawings. Each Looper Cone shall be labeled "Edge of Liner" as indicated by the Construction Drawings. The Contract Unit Price for Edge of Liner Markers shall be full compensation for excavation, labor, material, equipment, and other incidentals. Full payment will be made upon completion of task.

17. **6' Chain Link Litter Fence Relocation** – The Earthwork Contractor shall be responsible for providing all equipment, labor and material necessary to remove and re-install the existing chain link fence located adjacent to existing Cells 4 and 6, as shown on the Contract Drawings.

    Payment for this task shall be on a percent complete basis for the lump sum price provided in the bid form.

18. **Rip Rap** – The Earthwork Contractor shall purchase, haul, and stockpile or place 100 tons of Rip Rap as directed by the Owner. This item includes additional Rip Rap not shown on the Contract Drawings.

Payment for this task shall be on a lump sum basis for the unit price provided in the bid form. Full payment will be made upon completion of task.

19. **AHTD Class 7 Aggregate** – The Earthwork Contractor shall purchase, haul, and stockpile or place 200 tons of AHDT Class 7 aggregate as directed by the Owner. This item includes additional aggregate not shown on the Contract Drawings.

    Payment for this task shall be on a lump sum basis for the unit price provided in the bid form. Full payment will be made upon completion of task.

20. **Construction Layout Surveying** – The Earthwork Contractor shall be responsible for providing surveying for construction layout and cut/fill quantity calculations.

    Payment for this task shall be on a lump sum basis for the unit price provided in the bid form and shall include all costs associated with surveying by the contractor.

21. **Quality Control Surveying** – The Earthwork Contractor shall be responsible for providing a third party Arkansas licensed professional surveyor to perform CQA Certification Surveying and As-built Record Drawings as required by Arkansas Regulation 22. As-built drawing(s) are required to be submitted to the CQA Engineer within 5 working days of completing protective cover installation.

    Payment for this task shall be on a lump sum basis for the unit price provided in the bid form and shall include all costs associated with surveying by the contractor.

22. **Seeding & Mulching** – The Contractor shall be responsible for providing seeding and mulching for approximately 22.6 acres in accordance with the Contract Drawings and Technical Specifications.

    The Contract Unit Price for seeding and mulching shall be full compensation for all labor, material, equipment, and other incidentals, required to comply with the Contract Drawings and Technical Specifications (unless specifically identified as a pay item). Final payment shall be based upon the area of completed and approved seeding and mulching as determined by the Surveyor of Record from a

physical survey around the seeded areas as shown on an approved Record Drawing.

23. **Performance and Payment Bond –** A performance and payment bond may be required and shall be no less than the contract amount in accordance with the Agreement. This shall be a lump sum item.

1.05 WORK SEQUENCE

Sequencing of the Work shall be the responsibility of the Contractor as long as the requirements of these specifications are met, the Contractor's progress is according to the schedule approved by the Engineer and Owner, and compliance with Contract Times stated in the Agreement are met.

1.06 EXISTING SITE CONDITIONS

The Waste Management Class 1 Landfill is an active disposal facility. Construction operations shall not disturb normal landfill operations.

1.07 CONTRACTOR'S USE OF PREMISES

A. All of the Contractor's operations on the Owner's premises, including the storage of materials, shall be confined to areas approved by the Owner or Engineer.

B. Contractor's personnel shall abide by the Owner's regulations concerning site entry and exit. The Contractor shall use of a flagman whenever crossing railroad to gain access to borrow area. Flagman responsibilities will include directing traffic and keeping tracks clean and free of debris.

C. The Owner and Engineer will not assume responsibility for damages to facilities on the site due to negligence or carelessness on the part of the Contractor. The Owner and Engineer will not be liable for loss or damage of Contractor's tools equipment or materials due to theft, vandalism or any other causes whatsoever.

1.08 EROSION AND SEDIMENT CONTROLS

Temporary measures to control soil erosion and sediment transport within the construction limits shall be constructed.

1.09 TEMPORARY AND PERMANENT SEEDING

A stand of grass shall be established on all areas disturbed by construction within the construction limits.

1.10 INTERIM STORMWATER RUN-ON AND RUN-OFF CONTROLS

A. Stormwater management system improvements as shown on the Drawings shall be constructed.

B. Related Sections:

1. Section 02200 - Earthwork

2. Section 02223 - Trenching, Backfilling, and Compacting

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

NOTE:
At all times this landfill facility must remain in compliance with laws and regulations governing the operation and construction of such a facility. Accordingly, the CONTRACTOR must at all times sequence their work and implement the necessary temporary facilities or activities to maintain the proper operation and compliance of this facility. Furthermore, all of the CONTRACTOR's activities must be completed while focusing on the proper management of stormwater, landfill leachate and dust control. The Drawings provide the overall scope of work. It is the CONTRACTOR's responsibility to review and understand the necessary tasks required to complete the work. The CONTRACTOR may need to implement steps not necessarily shown on the Drawings in order to maintain landfill operations and landfill compliance. The CONTRACTOR is responsible for all bid items noted on the Bid Sheet and must complete all the work shown on the Drawings while maintaining the landfill operation and environmental compliance.

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 DESCRIPTION OF WORK

A. The project is specified as the Proposed Cell 5 Construction and Site Improvements at the Two Pine Class 1 Landfill in North Little Rock, Arkansas.

B. Payment shall be made on a Lump Sum basis and only be made for Work as specifically described in these Specifications and the Contract Documents. All other work shall be considered incidental to the Work. No payment shall be made for defective work or work beyond the lines and grades of the required Work.

C. Payment shall only be made for approved, in-place materials and Work, unless specifically permitted otherwise by these Specifications.

PART 2 PRODUCTS

A. Products are defined herein specific to the various aspects of construction. Products are considered to include those purchased and delivered to the site as well as those constructed on the site.

PART 3 EXECUTION

3.01 UNIT PRICE SCHEDULE

A. See Section II, Exhibit A – Attachment 2, Schedule of Values (Bid Sheet).

3.02 CONTRACT PAY ITEMS

A. See Section III, Specification 01010 – Summary of Work.

3.03 INCIDENTALS

A. Some items are considered incidental to the Work and shall not be measured or paid. Items not specifically listed as a pay item are considered incidental.

END OF SECTION

SECTION 01039
COORDINATION AND MEETINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Coordination

B. Pre-construction conference

C. Progress Meetings

1.02 COORDINATION

A. Contractor Shall

1. Coordinate scheduling, submittals, and Work of the various sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
2. Coordinate work of various sections having independent responsibilities for fabrication, installation, connection to, and placing in service, such equipment.
3. Coordinate space requirements and installation of structural work which are indicated diagrammatically on Drawings.
4. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion.
5. After occupancy of premises by Owner, coordinate access to site for correction of defective Work and Work not in accordance with Specifications, to minimize disruption of Owner's activities.

1.03 PRECONSTRUCTION CONFERENCE

A. Engineer will schedule a pre-construction conference.

B. Agenda:

1. Distribution of Specifications.
2. Finalize estimated progress schedule, Shop Drawing Schedule and schedule of values.

3. Designation of personnel representing the parties in Contract, and the Engineer.
4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
5. Scheduling.

1.04 PROGRESS MEETINGS

A. Contractor shall:

1. Schedule and administer meetings throughout progress of the Work at intervals specified by the Owner.
2. Make arrangements for meeting, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within two days to Engineer, Owner, participants, and those affected by decisions made.

B. Attendance Required: Contractor, Owner, Engineer, and others as appropriate to agenda topics for each meeting.

C. Agenda:

1. Review minutes of previous meetings.
2. Review of Work in progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned schedules.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected progress.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Safety issues relating to Work.
14. Other business relating to Work.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

END OF SECTION

SECTION 01040
COORDINATION

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall coordinate material supply, construction, and inspection to assure efficient and orderly completion of the Work:

B. The Contractor shall notify the Owner in writing when coordination of the Owner's or other contractors' activities is required.

1.02 PROJECT PERSONNEL

A. The Engineer is:
Brad N. Fureigh, P.E.
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292 email: bnfureigh@terracon.com

B. The Owner is:
David Conrad
Waste Management
100 Two Pine Drive
North Little Rock, Arkansas 72117
(501) 982-7336 email: dconrad@wm.com

C. The Technical/Quality Assurance Representative is:
To Be Determined

END OF SECTION

SECTION 01050
FIELD ENGINEERING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the contract including General Conditions, Supplementary Conditions and other Exhibits included in Section II apply to work of this section. This section applies to work of all sections of the Specifications.

1.02 OWNER'S RESPONSIBILITY

A. The Owner will provide reference dimensions for the Contractor's use in determining and controlling horizontal dimensions and vertical elevations of improvements as follows:

Baseline control and benchmark data as shown on Drawings.

1.03 CONTRACTOR'S RESPONSIBILITY

A. Protect all control points, property pins, right-of-way markers, and elevation bench marks. Replace points disturbed or damaged by Contractor at no additional cost to Owner.

B. Provide additional engineering control surveys as deemed necessary for Contractor's benefit. Employ qualified and approved surveyor, engineer, or engineering technician for field surveys.

C. Provide detailed construction layout staking as required for proper construction of site improvements.

D. Where work requires the removal of property pins, or right-of-way monuments or markers; employ an approved Arkansas Professional Land Surveyor to reference points before they are disturbed and to reset points in their original position and condition after the work in that area is complete.

1.04 CONSTRUCTION LAYOUT STAKING

A. The specifications of this subsection shall be applicable in the event that Contractor employs the Engineer to furnish detailed construction layout staking.

B. Notification and request for Services:

1. Properly coordinate requests for staking services with construction activities so as to preclude inefficient scheduling of staking crews.

2. Notify Engineer a minimum of 48 hours in advance of the date that specific services are desired.

3. Stipulate the particular stakes or marks required giving the specific location and/or limiting stations, offsets and other pertinent information.

4. Requests for services shall be for a minimum of 1,500 linear feet of line.

C. Control Staking:

1. Control stakes which are referenced points for all construction, work shall be conspicuously and visibly marked with flagging tape, paint, or other suitable means.

2. Contractor shall protect all control points and shall replace points disturbed or damaged by Contractor at his expense.

3. Control stakes which are located in the work area and which require removal in order to properly execute work will be referenced and removed at no cost to Contractor.

D. Flagging for Clearing:

1. For utilities, road right-of-way or other proposed improvements presently located in wooded areas, Engineer will flag proposed centerline or one side of right-of-way to be cleared.

2. After clearing and grubbing is completed, the remainder of construction will be staked.

E. Road Alignment and Grade Staking:

1. Contractor is responsible for constructing the proper road cross-section as shown on the Drawings.

2. One set of initial alignment and cut and fill stakes shall be set along one right-of-way for rough grading purposes. Stakes at 100 foot intervals and at other critical

points shall indicate cut and/or fill to finished centerline elevation.

3. One set of final hubs shall be set on 100 foot stations along one side of the road and shall indicate finish gravel course alignment and cut and/or fill to top of gravel.

F. Restaking and Checking:

1. Contractor responsible for verifying location and elevation of all reference stakes and all markings noted thereon.

2. At Contractor's request, Engineer shall check validity of any questionable stake. Any stakes found to be in error will be reset at no charge to the Contractor.

3. Engineer not responsible for any standby or "down" time as a result of such checking and/or resetting.

4. All stakes or reference marks described in this section shall be set one time only. Upon written request by Contractor, Engineer will perform restaking at Contractor's expense.

END OF SECTION

SECTION 01051
CONTROL OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. This section includes the control of Work, including:

1. Plans and working drawings;
2. Conformity with plans and specifications;
3. Construction stakes, lines, and grades;
4. Load restrictions;
5. Maintenance of traffic; and
6. Maintenance during construction.

1.02 PLANS AND WORKING DRAWINGS

A. Plans will show such details of all structures, lines, grades, location, and design of all structures and pipelines as are necessary to give the comprehensive idea of the proposed construction. The Contractor shall keep one set of the most current plans available on the project at all times.

B. The plans will be supplemented by such working drawings as are necessary to adequately control the Work.

1.03 CONFORMITY WITH PLANS AND SPECIFICATIONS

A. All Work performed and all materials furnished shall be in conformity with the lines, grades, details, dimensions, and material requirements including tolerances as indicated on the drawings or in the specifications.

B. In the event the Engineer finds the materials, the finished product in which the materials are used, or the Work performed are not in conformity with the drawings and specifications or within tolerances specified on the drawings or in the specifications, and the Engineer finds that this has resulted in an inferior or unsatisfactory product, the Work or materials shall be removed and replaced or otherwise corrected by, and at the expense of the Contractor.

C. In the event the Engineer finds the materials, the finished product in which the materials are used, or the Work performed are not in conformity with the drawings and specifications or within tolerances specified on the drawings or in the specifications, but that reasonably acceptable Work has been produced, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials.

1.04 CONSTRUCTION STAKES, LINES AND GRADES

A. The Contractor shall be responsible to provide his own construction control stakes to establish lines, slopes, and grades as necessary for layout and completion of the Work. All survey work performed for layout of the site and final grade checks shall be performed by a licensed surveyor of the State of Arkansas. The Surveyor shall have construction experience with projects of similar type and nature to this project.

1.05 LOAD RESTRICTIONS

A. The Contractor shall comply with all legal load restrictions in the hauling of materials on public highways beyond the limits of the project. The Contractor shall be responsible for all damage done by his hauling equipment and his construction activities.

1.06 MAINTENANCE OF TRAFFIC

A. All public and private roads used for haul roads shall be maintained to provide an adequate and safe driving condition for all public and private traffic.

1.07 MAINTENANCE DURING CONSTRUCTION

A. The Contractor shall maintain the Work during construction and until the project is accepted. The maintenance shall constitute continuous and effective work performed day to day with adequate equipment and forces such that all structures are kept in satisfactory condition at all times.

B. The Contractor shall provide all necessary drainage control and diversion structures, and sufficient pumping equipment and manpower to keep the construction area well drained and free of standing water that may adversely impact construction procedures and schedules.

1.08 FUEL STORAGE, WASTE PRODUCTS, TRASH AND DEBRIS

A. The Contractor shall observe all federal, state, and local requirements and regulations regarding the transportation, storage, and containment of fuels.

B. The Contractor shall be responsible for proper containment and labeling of containers, handling and disposal of all waste products and trash from all machinery, vehicles, and any other items used during the Work.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY

Section includes submittal procedures and types of submittals required prior to the beginning of certain phases of the Work, prior to the incorporation of products in the Work, and during the progress of the Work.

1.02 INITIAL SUBMITTALS

A. Submit the following to the Engineer for review not more than fourteen calendar days after the Effective Date of the Agreement:

1. Preliminary Schedule of Values.
2. Initial Construction Progress Schedule (specified in this Section).
3. Preliminary Schedule of Shop Drawing and Sample Submittals (specified in this Section).
4. Proposed Products List (specified in this Section).

1.03 PROGRESS SUBMITTALS

A. Submit the following to the Engineer for review during the progress of the Work:

1. Applications for Payment.
2. Individual processing submittals and change orders.
3. Independent quality control inspection and testing information.
4. Project Record Documents.
5. Equipment manufacturer's instructions and certificates.
6. All other miscellaneous submittals not mentioned herein and as specified in other individual specification Sections.

1.04 SUBMITTAL PROCEDURES

A. Timing of Submittals

1. Make submittals in advance of scheduled dates for installation, as specified in individual specification sections, to allow for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing deliveries. Preferred timing for the submittals will be discussed during the Preconstruction Meeting.

2. Contractor shall be responsible for delays occasioned by incomplete submittals.

B. Submittals shall be complete, and shall be combined into one package for each Section of the specifications, unless otherwise specified.

C. Sequentially number the transmittal forms.

D. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification section number, as appropriate.

E. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

F. Schedule submittals to expedite the project, and deliver to Engineer. Coordinate submission of related items.

G. Identify variations from Contract Documents and product or system limitations, which may be detrimental to successful performance of the completed Work.

H. Provide a four-inch square blank space for Engineer's review stamp.

I. Revise and resubmit submittals in the same quantity as required for the original submittal. Identify all changes made since previous submittal.

J. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

K. Maintain one copy of each submittal in Project Record Documents.

1.05 CONSTRUCTION PROGRESS SCHEDULE

A. Submit initial Construction Progress Schedule (first revision of schedule submitted with the Bid) in duplicate within the time specified in subsection 1.02 of this Section.

B. Submit revised Schedule with each Application for Payment, identifying changes since previous version.

C. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration. Schedule shall be in accordance with the required work sequence and completion dates specified in Section 01010 and elsewhere in the Contract Documents.

D. Indicate estimated percentage of completion for each item of Work at each submission.

E. Indicate submittal dates required for shop drawings, product data, samples, product delivery, and quality control test reports.

F. The Schedule shall be revised as required throughout the project to indicate anticipated and actual duration and sequence of activities. Copies of revised Schedules shall be provided promptly to the Engineer for review and comment.

1.06 PROPOSED PRODUCTS LIST

A. Within the time specified in subsection 1.02 of this Section, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

C. Indicate on the list the product delivery dates, including those furnished by the Owner.

1.07 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Within the time specified in subsection 1.02 of this Section, submit a preliminary Schedule of Shop Drawings and Samples in accordance. Include the following:

1. The dates for Contractor's submittals.
2. The dates submittals will be required for Owner-furnished products, if applicable.
3. The dates approved submittals will be required from the Engineer.
4. A list of all long lead items (equipment, materials, etc.).

B. Shop Drawings and Product Data Submittals

1. Submit the number of copies, which Contractor requires, plus three copies, which will be retained by Engineer.
2. Mark each copy of product data submittals to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to this Project.

C. Sample Submittals

1. Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
2. Include identification on each sample, with full project information.
3. Submit the number of samples specified in the individual specification Sections. The Engineer will retain one sample.

D. After review, distribute in accordance with subsection 1.03 above.

1.08 MANUFACTURERS' INSTRUCTIONS

A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Shop Drawings and Product Data in subsection 1.07.A above.

B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.09 MANUFACTURERS' CERTIFICATES

A. When specified in individual specification Sections, submit manufacturers' certificates to Engineer for review, in quantities specified for Shop Drawings and Product Data in subsection 1.07.A above.

B. Indicate material or product conforms to or exceeds specified requirements Submit supporting reference data, affidavits, and certificates as appropriate.

C. Certificates shall be based on test results acceptable to the Engineer.

1.10 INSPECTION AND TEST CERTIFICATES

A. Submit to Engineer for review, inspection and test certificates required for demonstrating proof or compliance of materials with specification requirements.

B. Each certificate shall be signed by an official authorized to certify on behalf of the manufacturing company and shall indicate the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply.

C. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the test to which the report applies.

D. Certification will not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specified requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01400
QUALITY CONTROL AND ASSURANCE SERVICES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Owner will employ and pay for the services of the Technical Representative to perform construction monitoring and testing services to assure the Owner that the Work is completed according to the Specifications and Drawings.

B. Contractor shall cooperate with the Technical Representative to facilitate the execution of its required services.

C. Employment of the Technical Representative shall in no way relieve Contractor's obligations to perform the Work and supply materials in accordance with the Contract Documents.

D. The Contractor shall provide any additional testing and services required to control construction quality at no additional cost to the Owner. Quality control testing and services do not include activities performed by the Technical Representative.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTRACTOR'S RESPONSIBILITIES

The Contractor shall:

A. Cooperate with the Technical Representative and its personnel and provide access to Work and to Supplier's operations.

B. Secure and deliver to the Technical Representative adequate quantities of representative samples of materials proposed to be used which require testing.

C. Furnish copies of Supplier's test reports as required.

D. Furnish incidental labor and facilities:

1. To provide access to Work to be tested;
2. To obtain and handle samples at the Project site or at the source of the product to be tested;
3. To facilitate inspections and tests; and
4. For storage and curing of test samples.

E. Coordinate activities to accommodate services with a minimum delay. Notify

Technical Representative 48 hours in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. When tests or inspections cannot be performed after such notice, reimbursing Owner for laboratory personnel and travel expenses incurred due to Contractor's negligence;

F. Employ and pay for the services of a separate, qualified independent testing laboratory to perform additional inspections, sampling and testing required:

1. For the Contractor's convenience;
2. As required by the Specifications or approved Quality Control Plans; or
3. When initial tests indicate Work does not comply with Contract Documents.

G. Promptly notify the Technical Representative of observed irregularities or deficiencies of Work or products;

H. Promptly submit a copy of a written report of each test to Technical Representative. Each report shall include:

1. Date issued;
2. Project title and number;
3. Testing laboratory name, address and telephone number;
4. Name and signature of laboratory inspector;
5. Date and time of sampling or inspection;
6. Record temperature and weather conditions;
7. Date of test;
8. Identification of product and specification section;
9. Location of sample or test in the Project;
10. Type of inspect or test;
11. Results of tests and compliance with Contract Documents; and
12. Interpretation of test results, when requested by Technical Representative.

I. Be responsible for retesting where results of inspections and tests prove unsatisfactory and indicates noncompliance with requirements.

3.02 REPAIR AND PROTECTION

Unless specified otherwise, the Contractor shall protect construction exposed for testing and shall repair construction damaged by sampling, testing or inspection.

END OF SECTION

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Mobilization.
2. Temporary Utilities.
3. Barriers and enclosures.
4. Protection of existing utilities and installed Work.
5. Site security.
6. Access roads and parking.
7. Temporary Controls: construction cleaning; noise; water; soil erosion and sediment; pollution; and, dust.
8. Traffic control and haul routes.
9. Project identification and signs.
10. Field offices and sheds.
11. Removal of temporary utilities, facilities and controls.

1.02 MOBLIZATION

A. Mobilize to the site and be prepared to initiate the construction activities within 15 days after receiving Notice to Proceed from the Owner.

B. Mobilization shall not be attempted unless the Contractor has:

1. Obtained all permits, licenses and OSHA training certificates necessary to perform the Work, where required.

2. Received approval from the Owner for the location of temporary structures and storage areas.

3. Submitted initial documents to the Engineer as listed in subsection 1.02 A of Section 01300.

C. Mobilization includes, but is not necessarily limited to: transportation of personnel, equipment and operating supplies to the site; establishment of offices, buildings, all necessary temporary utilities; installation and relocation of necessary facilities at the site; and, other preparatory work at the site.

1.03 TEMPORARY UTILITIES

A. Connect to existing power service to provide required temporary electrical utilities to the project area. Contractor shall pay all costs for connection of service and costs for power service. A licensed electrical contractor shall install temporary electrical utilities.

B. Provide and maintain adequate lighting for construction operations and field offices.

C. Provide and pay for adequate drinking water for construction operations.

D. Provide adequate fire protection at the site as required by local fire codes and standards.

E. Provide adequate temporary sanitary facilities in compliance with laws and regulations. Arrange for proper maintenance of such facilities. Pay all costs for installation and maintenance of the facilities.

F. Provide, maintain and pay for telephone service to Contractor's offices.

G. Provide, maintain and pay for any other temporary utility that is necessary to accomplish the Work.

1.04 BARRIERS AND ENCLOSURES

A. Provide barriers to prevent unauthorized entry to construction areas to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades, covered walkways and other temporary construction required by governing authorities for public rights-of-ways.

C. All temporary construction shall be in accordance with applicable federal, state and local laws and building codes.

D. Provide protection for plant life designated to remain. Trim tree branches if necessary for access and only if permitted by the Owner. Replace damaged plant life, or repair as follows:

1. Damaged branches shall be properly pruned and all wounds covered with approved tree paint.

2. Repair work shall be done on a daily basis without exception.

E. Protect non-covered vehicular traffic, stored materials, site and structures from damage.

1.05 PROTECTION OF EXISTING UTILITIES

A. Contact and cooperate with the Owner and utility companies to locate all utilities (including pipelines, cables, power poles and other structures) on the construction site prior to beginning the Work.

B. All utilities shall be protected from damage during construction, unless otherwise indicated to be removed or abandoned.

C. Comply with requirements of the utility owners for clearances and access for all construction within and adjacent to the utility right-of-way.

D. If damaged, the utilities shall be repaired as required by the Owner at the Contractor's expense.

E. If a utility is encountered which is not shown on the Drawings or otherwise made known to the Contractor prior to beginning the Work, promptly take necessary steps to assure that the utility is not damaged, and give written notice to the Owner or Engineer and to the utility owner. The Owner and Engineer will then review the conditions and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence of the utility.

1.06 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where required in individual specification sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

1.07 SECURITY

Provide security and facilities to protect Work from unauthorized entry, vandalism or theft.

1.08 ACCESS ROADS AND PARKING

A. Construct and maintain temporary roads accessing existing roads to serve construction area.

B. Extend and relocate, as Work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Designated existing on-site roads may be used for construction traffic, unless otherwise directed by the Owner or Engineer.

D. Construct temporary gravel surface parking areas in areas approved by the Owner to accommodate construction personnel.

E. When site space is not adequate, provide additional off-site parking.

F. Repair existing roads damaged by operation of construction equipment, as determined by the Engineer.

1.09 CONSTRUCTION CLEANING

A. Maintain areas free of trash and rubbish. Maintain site in a clean and orderly condition.

B. No trash or rubbish containers will be supplied by Owner. Supply all containers required for storage and removal of trash, rubbish and debris resulting from the Work included in this project.

C. Remove trash and rubbish from the construction area periodically and dispose in active waste area.

1.10 NOISE CONTROL

Contractor's vehicles and equipment shall be such as to minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and state, county and local ordinance requirements, and in no case will noise levels be permitted which interfere with the work of the Owner or others.

1.11 WATER CONTROL

Provide and maintain water control as specified in Section 01563.

1.12 SOIL EROSION AND SEDIMENT CONTROL

Provide and maintain soil erosion and sediment control as specified in Section 01565.

1.13 POLLUTION CONTROL

A. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.

B. Provide equipment and personnel, perform emergency measures required to contain significant spillage on-site, as determined necessary by the Engineer and Owner. Collect all oil and other fluids discharged during vehicle maintenance operation in drums and dispose of properly.

C. Take special measures to prevent harmful substances from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers. Conform to Owner's existing NPDES permit for the facility.

D. Provide systems for control of atmospheric pollutants. Prevent toxic concentrations of chemicals, and prevent harmful dispersal of pollutants in the atmosphere.

E. All Contractors' equipment used during construction shall conform to all current federal, state and local laws and regulations.

1.14 DUST CONTROL

A. Maintain all excavations, embankments, stockpiles, roads, and all other work areas within or outside the project boundaries free from visible airborne dust that would cause a hazard or nuisance to others.

B. Approved temporary methods of stabilization, consisting of sprinkling with clean water, or similar methods, will be required to control dust. Sprinkling must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times.

1.15 TRAFFIC CONTROL

A. Coordinate movement of construction equipment and hauling vehicles with Owner to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.

B. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

1.16 HAUL ROUTES

A. Consult with authority having jurisdiction in establishing public thoroughfares to be used for haul routes and site access.

B. Confine construction traffic to designated haul routes.

1.17 FIELD OFFICES AND SHEDS

A. Office: Weather-tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture.

1.18 REMOVAL OF TEMPORARY UTILITIES, FACILITIES AND CONTROLS

A. Remove temporary above-grade and buried utilities, equipment, facilities and materials prior to final inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01563
CONTROL OF WATER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Controlling surface water runoff.

B. Dewatering trenches, excavations, and other elements.

C. Controlling water of every origin.

1.02 SUBMITTALS

Submit in accordance with Section 01300 -Submittals

PART 2 PRODUCTS

Provide structures, machinery, appliances, and equipment designed and manufactured to control water.

PART 3 EXECUTION

3.01 GENERAL

A. Dewatering Procedures: The Contractor shall construct, maintain, and operate channels, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work.

B. Dewater and dispose of water in a manner that will not cause injury to public and private property.

C. Do not cause a nuisance to the Owner's operations.

D. Keep sufficient pumping equipment and machinery on hand at all times for emergencies, including electric power failures.

E. Keep experienced personnel available at all times to operate pumping equipment, machinery and appliances.

F. Do not shut down dewatering systems between shifts, on holidays and weekends, nor during Work stoppages, unless authorized by Owner or Engineer.

END OF SECTION

SECTION 01565
TEMPORARY SOIL EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

Section includes construction of temporary measures to control soil erosion and sediment transport within the construction limits.

1.02 REFERENCES

A. "Erosion and Sediment Control Handbook", published by McGraw-Hill Book Company.

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

1. ASTM D 488, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

1.03 SUBMITTALS

Submit product data and specifications for approval as required by the Engineer prior to use.

1.04 QUALITY ASSURANCE

Comply with the requirements of governmental authorities having jurisdiction.

1.05 PROJECT REQUIREMENTS

A. Obtain all required permits prior to commencement of Work in areas requiring erosion control measures.

B. The use of temporary control measures shall be coordinated with the permanent erosion control features specified elsewhere to the extent practical, to assure effective and continuous erosion control.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mulch: Hay, straw, wood chips, or other suitable material reasonably clean of noxious weeds and deleterious material.

B. Grasses: Rye grass, cereal grasses, or other quick-growing species suitable to the area and as a temporary cover, which will not compete with the grasses specified for permanent cover.

C. Silt Fencing: "Envirofence" by Mirafi, "Propex Silt Stop" by Amoco, or equivalent. Posts shall be as shown on the Drawings.

D. Check Dams shall be constructed of locally available sound crushed stone; size conforming to ASTM D 448, size number 1.

PART 3 EXECUTIONS

3.01 GENERAL

A. All Work under this contract shall be performed in such a manner that objectionable erosion shall not be created in watercourses through or adjacent to the project area.

B. The Contractor shall be responsible for the selection of appropriate temporary erosion control measures to suit the intended construction methods. The Contractor shall submit a scheme of control measures for each potentially impacted area prior to construction for approval by the Engineer.

C. Notify the Engineer and Owner in the event of conflict between these specification requirements and pollution control laws, rules or regulations of other federal, state, or local agencies.

3.02 EROSION AND SEDIMENT CONTROL

A. The Engineer shall have the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, and fill operations and to direct the Contractor to provide immediate, permanent or temporary sediment control measures to minimize damage to adjacent property and to minimize effects on adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

B. Incorporate all permanent erosion control features (including seeding) into the project at the earliest practical time. Temporary control measures shall be those that are needed prior to installation of permanent control features; or that is needed temporarily to control erosion that develops during normal construction activities, but are not associated with permanent control features on the project.

C. Where erosion is likely to be a problem, clearing and grubbing operation should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter, if the project conditions permit; otherwise temporary erosion control measures may be required between successive construction stages.

3.03 INSTALLATION AND MAINTENANCE OF SILT FENCING

A. Install in accordance with details shown on the Drawings and as specified in paragraphs B through E below. In slope areas greater than 30 percent slope, install two parallel silt fences.

B. Install posts at a maximum spacing of six feet, and to depth of approximately 18 inches, or as otherwise approved by the Engineer and Owner.

C. Excavate six-inch wide by six-inch deep trench along line of posts and upslope from barrier.

D. Fasten fabric to upstream side of posts using heavy-duty wire staples (at least one-inch long), tie wires or hog rings. Eight inches of the fabric shall extend into the trench.

E. Backfill trench and compact soil over the fabric.

F. Remove sediment deposits when deposits reach approximately one-half the height of the barrier. Sediment shall be placed in areas approved by the Engineer and spread uniformly over the ground surface.

G. Replace fabric when it has deteriorated, is torn, loose or no longer effectively performs.

H. Replace any silt fence, which has been overtopped with two new parallel fences.

3.04 APPLICATION OF TEMPORARY GRASS AND MULCH

A. Comply with Section 02930.

B. Temporary seeding shall be applied to areas lacking vegetation if no construction activities will be performed in the area for more than 30 days. Temporary seed mixtures shall be applied to such areas within 21 days of temporarily suspending work in the area.

3.05 CONSTRUCTION AND MAINTENANCE OF CHECK DAMS

A. Construct across creeks within the project limits as shown on the Drawings.

B. Inspect after each rainfall event. Make required repairs if the check dams have deteriorated to the extent that their effectiveness is reduced.

C. Remove sediment deposits when deposits reach approximately one-half the height of the dams. Sediments shall be placed in areas approved by the Engineer and spread uniformly over the ground surface.

D. Check dams shall be removed after completion of construction activities. Coarse aggregate shall be deposited on-site where approved by the Engineer.

3.06 INSTALLATION AND MAINTENANCE OF OTHER EROSION CONTROL MEASURES

A. Install according to manufacturer's recommendations and standard local practice.

B. Maintenance of the installations shall be performed as required for proper erosion and sediment control until the Work is accepted by the Owner.

3.07 REMOVAL OF SILT FENCING

A. Silt fencing shall be removed when approved by the Engineer and Owner, after a sufficient stand of grass has been established on all disturbed areas.

B. Any sediment deposits remaining after the silt fence is removed shall be dressed to conform to the existing grade, prepared, and seeded.

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Addresses:

1. Products;
2. Transportation and handling;
3. Storage and protection;
4. Product options; and
5. Substitutions.

1.02 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

1.03 TRANSPORTATION AND HANDLING

A. Contractor shall transport and handle products in accordance with manufacturer's instructions.

B. Contractor shall promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

C. Contractor shall provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, and damage.

1.04 STORAGE AND PROTECTION

A. Contractor shall store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Contractor shall store sensitive products in weather-tight, climate controlled enclosures.

B. For exterior storage of fabricated products, materials shall be placed on sloped supports, above ground.

C. Contractor shall provide off-site storage and protection when site does not permit on-site storage or protection.

D. Contractor shall cover products subject to deterioration with impervious sheet covering. Contractor shall provide ventilation to avoid condensation.

E. Contractor shall store loose granular materials on solid flat surfaces in a well-drained area. Contractor shall make every effort to prevent mixing with foreign matter.

F. Contractor shall provide equipment and personnel to store products by methods to prevent damage.

G. Contractor shall arrange storage of products to permit access for inspection. Contractor shall periodically inspect storage areas to assure products are undamaged and are maintained under specified conditions.

1.05 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications; no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

1.06 SUBSTITUTIONS

A. Engineer will consider requests for Substitutions only within 15 days after Effective Date of Agreement.

B. Subsequent Substitutions will be considered only when a product becomes unavailable through no fault of the Contractor. Improper planning will not be considered as a reason to increase Contract Price as a result of product substitution.

C. A request constitutes a representation that the Contractor:

1. Will provide the same warranty for the Substitution as for the specified product.

2. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
3. Waives claims for additional costs or time extension which may subsequently become apparent.
4. Will reimburse Owner for review or redesign services associated with re-approval by Engineer and Engineer's consultants and regulatory agencies.

D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

E. Substitution Submittal Procedure:

1. Contractor will submit copies of each request for Substitution for consideration. Contractor shall limit each request to one proposed Substitution.
2. Contractor shall submit the number of copies required for all submittals, as specified in Section 01300.
3. Contractor shall submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.

1.07 MANUFACTURER'S INSTRUCTIONS

A. Installation of equipment and materials shall comply with manufacturer's instructions. Contractor shall obtain and distribute printed copies of such instructions to parties involved in installation, including two copies to Owner.

1. Contractor shall maintain one set of complete instructions at job site during installation and until completion of work.

B. Contractor shall handle, store, install, connect, clean, condition, and adjust materials and equipment in accordance with manufacturer's written instructions and in conformance with specifications.

1. If job conditions or specified requirements conflict with manufacturer's instructions, Contractor shall consult with Owner or Engineer for further instructions.
2. Contractor shall not proceed with work without written instructions.

1.08 INSTALLATION, INSTRUCTIONAL, AND POST START-UP SERVICES

A. Installation Services:

1. Where installation services are called for in Specifications, Contractor shall provide competent and experienced technical representatives of manufacturers of equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.
2. After equipment is installed, representatives shall perform initial equipment and system adjustment and calibration to conform to Specifications and manufacturer's requirements and instructions.
3. Contractor shall provide "Certificate of Installation Services" stating proper adjustments have been made to equipment or system and equipment or system ready for start-up and operation.

B. Instructional Services:

1. Where training is called for in Specifications, Contractor shall provide competent and experienced technical representative of supplier to provide detailed instructions to Owner's personnel for operation of equipment. Training services shall include maintenance of instrumentation, maintenance of process equipment and operation of process equipment in classroom and on-site equipment instruction, as stated in Specifications.
2. Contractor shall coordinate pre-startup training periods with Owner and supplier's representatives.
   a. Contractor shall notify Owner at least 48 hours before training sessions are to begin so Owner can make arrangements with operating personnel.
   b. Contractor shall reschedule canceled training sessions 48 hours in advance.
   c. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify Owner 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to Owner for time lost by Owner's operating personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed one hour for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late up to one hour, after one hour training will be rescheduled.

3. Similar types of equipment differing in model, size or manufacturer shall require equal service time as stated in specific Specification section.
4. Contractor shall complete pre-startup training 14 days prior to system operations demonstrations.
5. O&M data shall constitute basis of instruction.
   a. Contractor shall review data contents with personnel in full detail to explain aspects of operations and maintenance.
6. Contractor shall provide "Certificate of Instructional Services," co-signed by Owner and supplier's representative, verifying training accomplished to satisfaction of all parties.

1.09 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

A. Contractor shall furnish, in accordance with manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. Special tools are those specially designed or adapted for use on parts of equipment, and not customarily and routinely carried by maintenance mechanics.

B. Special tools and lubricating equipment (when applicable) will be delivered to Owner when unit placed into operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.

C. Tools and lubricating equipment shall be of quality compatible to equipment manufacturer has furnished.

1.10 LUBRICATION

A. Where lubrication is required for proper operation of equipment, Contractor shall incorporate necessary and proper provisions in equipment in accordance with manufacturer's requirements. Where possible, lubrication shall be automated and positive.

B. Where oil is used, reservoir shall be of sufficient capacity to supply unit for 24-hour period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01655
STARTING OF SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Starting systems;
2. Demonstration and instructions; and
3. Testing, adjusting, and balancing.

1.02 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible manufacturers' representatives in accordance with manufacturers' instructions.

G. When specified in individual specification sections, require manufacturers to provide authorized representatives to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Section 01400 that equipment or system has been properly installed and is functioning correctly.

1.03 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of final inspection.

B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at equipment location.

C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manuals with Owners' personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.04 TESTING, ADJUSTING, AND BALANCING

A. Contractor shall appoint, employ, and pay for services of manufacturers' representatives or an independent firm to perform testing, adjusting and balancing.

B. Reports shall be submitted by manufacturers' representatives or independent firm to the Engineer indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with the requirements of the Contract Documents.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

END OF SECTION

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 DESCRIPTION

A. Owner will have the right to the access of all records, such as correspondence and claims that are maintained on site or any other locations by Contractor.

B. Contractor shall maintain at site for Owner one record copy of:

1. Drawings;
2. Specifications;
3. Addenda;
4. Change orders and other modifications to Contract;
5. Field orders, written instructions, or clarifications;
6. Approved submittals;
7. Field test records;
8. All associated permits; and
9. Certificates of inspection and approvals.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Contractor shall maintain documents in clean, dry, legible condition and in good order. Contractor shall not use record documents for construction purposes.

B. Contractor shall provide secure space for storage of samples and maintain same in good order.

C. Contractor shall make documents and samples available at all times for inspection by Owner.

D. Failure to properly maintain record documents may be reason to delay a portion of progress payments until records comply with Contract Documents.

1.03 RECORD DOCUMENTS

A. Contractor shall maintain a record set of drawings and specifications legibly changed to transfer approved modifications in completed work that differ from Contract Documents.

B. Contractor shall label each document "PROJECT RECORD" in neat, large printed letters.

C. Contractor shall record information concurrently with construction progress.

1. Contractor shall not cancel any work until required information is recorded.
2. Contractor shall record changes made by Written Amendment, Field Order, Change Order, or Work Directive Change.

D. Drawings

1. Using data accumulated during the project, the third party surveyor shall submit a set of As-Built Record Drawings for inclusion in the Construction Documentation Report.
2. Submit separate document indicating changes made to specifications during work.

1.04 SUBMITTALS

A. At substantial completion Contractor shall:

1. Deliver one set of marked up record drawings to Owner; and
2. Deliver documents described in Paragraph 1.01.B to Owner.

B. Submittals shall include a transmittal letter in duplicate, containing:

1. Date;
2. Project title and number;
3. Contractor's name and address;
4. Title of record document; and
5. Signature of Contractor or authorized representative.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

END OF SECTION

DIVISION 2
SITE WORK

SECTION 02110
CLEARING AND GRUBBING

PART1 GENERAL

1.01 SUMMARY

A. Section includes clearing and grubbing of vegetation, stripping of topsoil, and disposal of vegetation.

1.02 QUALITY ASSURANCE

A. Site clearing shall be performed in a manner that does not disturb existing structures, utilities, monitoring wells, or other facilities not indicated to be removed or abandoned.

B. Conform to applicable local codes for disposal of cleared and grubbed vegetation.

C. Coordinate clearing work with utility companies.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

A. Remove exposed trees, brush, logs, grass, and other vegetative material resting on or protruding through the ground surface in those areas identified for clearing on the Drawings.

B. Remove roots of all vegetation (including tree stumps) to a minimum depth of one foot below existing grade, or the proposed subgrade elevation, whichever is lower.

3.03 TOPSOIL STRIPPING

A. Excavate topsoil from areas to receive fill.

B. Stockpile topsoil in an area on-site where approved by the Owner or Engineer for later placement on surface to be seeded. Implement temporary erosion and sediment control measures specified in Section 01565.

3.04 DISPOSAL OF WOOD AND BRUSH

A. All wood and brush shall be disposed of within 15 days after cutting or felling unless otherwise approved. Coordinate disposal with owner.

END OF SECTION

SECTION 02200
EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes general earthwork for grading of the site, excavation, subgrade fill, general fill, fill placement for access roads, berms, underground pipelines, and stormwater facilities.

B. Related Sections:

1. Section 02220 - Excavation and Backfilling

1.02 REFERENCES

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

1. ASTM D 422, Standard Method for Particle-Size Analysis of Soils.

2. ASTM D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

3. ASTM D 1140, Standard Test Method for Amounts of Material in Soils Finer than the Number 200 Sieve.

4. ASTM D 1557, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using Ten-Pound (4.54 kg) Hammer and 18-Inch (457 mm) Drop.

5. ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.

6. ASTM D 2487, Standard Test Method for Classification of Soils for Engineering Purposes.

7. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

8. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

9. ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 DEFINITIONS

A. Excavation: Consists of the removal of material encountered to subgrade elevations and the reuse disposal of materials removed.

B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below base course.

C. Borrow: Soil material obtained from borrow areas when sufficient approved soil material is not available from excavations.

D. Unauthorized Excavation: Consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Engineer. Unauthorized excavation shall be at the Contractor's expense.

1.04 QUALITY ASSURANCE/QUALITY CONTROL

Owner will retain the services of an inspection and testing firm to determine conformance of the materials and constructed work with the specifications.

1.05 PROJECT CONDITIONS

A. Provide temporary controls as specified in Sections 01563 and 01565.

B. The Contractor is solely responsible for excavation slope stability. Excavation work shall be in compliance with applicable OSHA regulations and State regulations.

PART 2 PRODUCTS

2.01 GENERAL

Provide all labor, materials, and equipment necessary to accomplish the Work specified in this section.

2.02 SOIL MATERIALS

A. General Fill: On-site soil or borrow material free of large rock, debris, waste, frozen material, vegetation, and other deleterious matter with a maximum particle size of six inches.

B. Prepared Subgrade: In areas to be filled, unless otherwise noted, upper eight inches of in-situ soil, scarified and recompacted to density of subsequent layer of fill/backfill material.

2.03 OTHER MATERIALS

Provide other materials, not specifically described herein but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

2.04 WATER FOR COMPACTION

Furnish as required. Contractor will have to obtain a source from Owner.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties.

3.02 DEWATERING

A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site surrounding areas.

B. Protect subgrade soils from softening and damage by rain or water accumulation.

3.03 EXCAVATION

A. Perform excavation of every type of material encountered within the limits of the Work to the lines, grades, and elevations indicated on the Drawings and specified herein.

B. Satisfactory Excavated Materials shall be transported to, and place in, fill or embankment areas within the limits of Work.

C. Unsatisfactory Excavated Materials

1. Unsatisfactory material excavation shall include excavation and disposal of soft or compressible soils, old spoil material, or any other materials judged by the Engineer to be unsuitable for foundations or the placement of compacted soils.

2. Excavate to a distance below grade as directed by the Engineer, and replace with satisfactory materials.

3. The Contractor shall include excavation of unsatisfactory materials, and replacement by satisfactory materials, as parts of the Work of this Section.

4. Dewatering shall be provided in areas of undercutting to a depth of at least two feet below the bottom of the excavation and shall be maintained until compacted earth fill is placed to at least three feet above the original water level or original ground level, whichever is higher.

D. Surplus Materials or unsatisfactory excavated materials, and surplus satisfactory excavated material, shall be disposed of on-site in designated areas.

3.04 DITCHES AND GUTTERS

A. Cut accurately to the cross sections, grades and elevations shown on the Drawings.

B. Maintain excavation from detrimental quantities of debris until completion of work.

C. Dispose of excavated materials as shown on the Drawings or as directed by the Engineer; except do not, in any case, deposit materials less than three feet from the edge of a ditch.

3.05 UNAUTHORIZED EXCAVATION

Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific instruction from the Engineer.

3.06 STABILITY OF EXCAVATIONS

Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

3.07 APPROVAL OF SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. When Engineer determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Engineer.

3.08 STORAGE OF SOIL MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.

B. Stockpile soil material away from edge of excavations. Do not store within drip line of remaining trees or coordinate with owner.

3.09 GENERAL BACKFILLING

A. Backfill excavations promptly, but not before completing the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Testing, inspecting, and approval of underground utilities.

4. Removal of trash and debris from excavation.
5. Removal of temporary shoring, bracing, and sheeting.
6. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.10 FILL

A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactorily soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.

B. Place fill material in not more than eight to nine-inch loose layers to required elevations for each location listed below.

3.11 MOISTURE CONTROL

A. Unless otherwise noted, uniformly moisten or aerate subgrade and each subsequent fill or backfill layer to obtain compaction of 95% of the standard proctor.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.

3. Stockpile or spread and dry removed wet satisfactory soil material.

3.12 COMPACTION

A. Place backfill and fill materials in layers not more than eight to nine inches in loose depth for material compacted by heavy compaction equipment, and not more than four inches loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations.

C. Unless otherwise noted, scarify and recompact upper six inches of subgrade to density not less than required for the subsequent layer of fill/backfill material.

D. Percentage of Maximum Dry Density Requirements: Unless otherwise noted, compact soil to not less than the following percentages of maximum dry density according to ASTM D 698:

1. All areas: compact each layer of backfill or fill material at 95 percent maximum dry density.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and evaluations indicated.

1. Provide a smooth transition between existing adjacent grades and new grades.

2. Cut off soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within plus or minus 0.10-foot tolerances:

3.14 TOPSOIL

After rough grading is completed and reviewed by Engineer, spread topsoil over specified areas as shown on the Drawings to a minimum compacted thickness of twelve inches.

3.15 FIELD QUALITY CONTROL

A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

1. Perform field in-place density tests by the nuclear method according to ASTM D 2922.

B. When testing agency reports that subgrades, fills, or backfill are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

3.16 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.

   1. Scarify or remove and replace material to depth directed by the Engineer; reshape and recompact to optimum moisture content or the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

D. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

END OF SECTION

SECTION 02210
FILL COMPACTION FOR
EARTHWORK STRUCTURES OTHER THAN CLAY LINER

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of earthwork structures as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. The work of this Section shall include, but not necessarily be limited to: separating, hauling, stockpiling, backfilling, compacting, and grading of soils. The work of this Section may pertain in whole or in part to construction of the following: perimeter berm, roads, sedimentation basin, leachate tank area, maintenance area, parking areas, fuel station and access bench. The work of this Section also includes dewatering and protection. The Contractor shall be prepared to construct the structural fill in conjunction with other construction activities and subcontractors at the site.

C. Notwithstanding the prequalification of any material sources for the structural fill, the Contractor shall be entirely responsible for meeting the requirements of this Section.

1.02 REFERENCES

A. *Construction Quality Assurance Plan,* Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.

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

1. ASTM D 422, Standard Test Method for Particle-Size Analysis of Soils.

2. ASTM D 698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

3. ASTM D 1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

4. ASTM D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

5. ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.

6. ASTM D 2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

7. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

8. ASTM D 2937, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.

9. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

10. ASTM D 4220, Standard Practices for Preserving and Transporting Soil Samples.

11. ASTM D 4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 SUBMITTALS

A. The Contractor shall discuss with the Owner and the CQA Consultant the proposed methods of construction, including stripping, dewatering, excavation, filling, compaction, and backfilling for the various portions of the work. The review shall be for method only. The Contractor shall remain responsible for the adequacy and safety of the methods.

B. For each soil type specified in Part 2 of this Section, the Contractor shall submit to the Owner and the CQA Consultant the following information and samples a minimum of 14 days prior to starting construction:

1. the proposed material source;

2. the results of grain-size analyses conducted on the proposed material in accordance with ASTM D 422;

3. for fine-grained materials, the results of liquid and plastic limit tests conducted on the proposed material in accordance with ASTM D 4318;

4. the results of a moisture-density relation test (ASTM D 698); and

5. a 50-lb sample of each of the proposed soils or authorization to access the proposed source(s) for sampling.

C. The Contractor shall notify the Owner and the CQA Consultant in writing at least seven days in advance of intention to perform the work of this Section.

D. If work is interrupted for reasons other than inclement weather, the Contractor shall notify the Owner and the CQA Consultant immediately and provide a plan and schedule for resumption of the work.

E. The Contractor shall abide by all qualification requirements of the CQA Plan.

1.04 CONSTRUCTION QUALITY ASSURANCE

A. The construction of the structural fill shall be performed in accordance with the requirements of this section and the CQA Plan.

B. The construction of the structural fill shall be monitored by the CQA Consultant as outlined in the CQA Plan.

C. The Contractor shall be aware of the activities outlined in the CQA Plan and account for these CQA activities in the construction schedule.

1.05 PROTECTION

A. The Contractor shall contact utility companies and locate, mark and protect all existing utilities before commencement of construction.

B. The Contractor shall protect trees, shrubs, lawns, rock outcroppings and other features remaining as part of final landscaping.

C. The Contractor shall protect benchmarks, survey markers, fences, roads, sidewalks, paving, curbs and other existing structures from damage due to the Contractor's activities.

D. The Contractor shall repair damage caused by the construction operations.

E. Erosion control must be maintained. Erosion control measures shall be as noted on the grading plan or as directed by the Company.

PART 2 PRODUCTS

2.01 MATERIALS

A. All laboratory testing to evaluate the suitability or conformance of soil materials for the structural fill shall be carried out in accordance with the test methods indicated in Part 1.04 of this Section.

B. Structural fill shall consist of relatively homogeneous, natural soils that are free of debris, foreign objects, large rock fragments, roots, and organics. No materials larger than three in. shall be allowed. If structural fill is to be placed above geosynthetics, no materials larger than one in. shall be allowed within one ft of the geosynthetics. The structural fill shall be classified according to the Unified Soil Classification System (USCS) as SP, SW, SM, SC, ML, CL, CH, or MH material.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any work described in this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section and the CQA Plan.

B. Inspection:

1. Prior to implementing any of the work in this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the work specified in this Section may properly commence without adverse impact.

2. If the Contractor has any concerns regarding the installed work of other Sections, the Owner should be immediately notified in writing within 48 hours of the site inspection. Failure to notify the Owner or continuance with structural fill placement shall be construed as Contractor's acceptance of the related work of all other Sections.

3.02 SITE PREPARATION

A. The Contractor shall develop access to the construction area in accordance with the requirements of the Drawings and any supplemental Specifications.

B. The Contractor shall install silt fences immediately down-slope of each area to be disturbed prior to the beginning of work in that area. The Contractor shall maintain the silt fences for the duration of construction. Accumulated sediment behind the silt fences shall be disposed of on-site by the Contractor in a manner approved by the Owner.

C. All brush, vegetation, rubbish, and other objectionable material shall be removed from the construction area and disposed of in an area designated by the Owner.

D. All topsoil shall be removed from the construction area and stockpiled.

E. Diversion ditches, either permanent or temporary, shall be constructed in accordance with the Drawings. The Contractor shall be responsible for constructing diversion ditches as required to divert potential run-on around the construction area. The construction of temporary ditches not shown on the Drawings shall not be undertaken until the Contractor's plan for constructing the ditches is approved by the Owner.

3.03 EXCAVATION AND STOCKPILING

A. Excavated materials to be used as structural fill shall be stockpiled in designated areas segregated from soils not suitable for use as fill, clearing debris, or other objectionable materials. Stockpile areas shall be designated by the Owner.

B. Stockpiles of structural fill shall have side slopes no steeper than 3H:1V (3 horizontal:1 vertical) unless approved otherwise by the Owner. The stockpiles of structural fill shall be graded to drain, sealed by tracking parallel to the slope with a dozer or other means approved by the Owner, and dressed daily during periods when structural fill is taken from the stockpile. The Contractor may cover structural fill stockpiles with plastic sheeting or other material approved by the Owner in order to preserve the moisture content of the structural fill.

C. Stockpiles that shall remain out of active use for a period greater than seven months shall either be covered as described in Part 3.03.C of this Section or stabilized by seeding and fertilizing in accordance with the requirements given in Section 02930.

D. Surplus excavated soils shall not be removed from the site or disposed of by the Contractor unless such removal or disposal is approved by the Owner.

3.04 STRUCTURAL FILL

A. The structural fill used during this construction shall be constructed to the lines and grades shown on the Drawings using the appropriate material.

B. The structural fill shall meet the requirements of Part 2.01 of this Section.

C. The structural fill shall be placed in a loose lift that results in a compacted lift thickness of no greater than 12 inches.

D. The Contractor shall be responsible for installation of suitable material that meets the projects specifications for classification, moisture content and density. The Contractor shall not proceed to the next lift until the current lift has been tested and approved by the CQA representative. The Contractor will be held responsible for proceeding to the next lift without prior approval from the CQA Firm.

E. Each lift shall be compacted to at least 95 percent of the maximum dry unit weight as measured according to ASTM D 698. The dry unit weight and moisture content shall be measured in place in accordance with ASTM D 2922 (Method B) and ASTM D 3017, respectively.

F. If the moisture content of the structural fill is not suitable for proper compaction, the structural fill shall be moisture conditioned and reworked, as appropriate. Wetting shall be accomplished using a water truck and spray nozzle, unless the CQA Consultant approves an alternative method. During wetting or drying, the structural fill shall be regularly disced or otherwise mixed so that uniform moisture conditions in the appropriate range are obtained. In the event the moisture content is at optimum $\pm$ 1 percent and the compaction requirement of 95 percent can not be achieved, the lift thickness shall be reduced.

G. The Contractor shall not place frozen structural fill, nor shall structural fill be placed on frozen ground.

H. If the structural fill freezes during construction, the Contractor shall remove the frozen structural fill, scarify the remaining unfrozen fill, and then place and compact new structural fill in accordance with these Specifications and any supplemental Specifications. The frozen structural fill shall not be reused until it has thawed, been disced, and then reworked to an acceptable uniform moisture content.

3.05 SURVEY CONTROL

A. The Contractor shall survey the location and elevation of the structural fill, access road, drainage ditches, and drainage swales.

B. The Owner may supply surveying for quality assurance purposes and Record Drawings.

3.06 PROTECTION OF WORK

A. The Contractor shall use all means necessary to protect all materials and all partially-completed and completed work specified in this Section and prior work of other Sections.

B. At the end of each day, the Contractor shall verify that the entire work area was left in a state that promotes surface drainage off and away from the area and from finished work. If threatening weather conditions are forecast, compacted surfaces shall be seal-rolled to protect finished work.

C. In the event of damage to prior work or work completed as specified in this Section, the Contractor shall submit a repair plan to the Owner and CQA Consultant(s). The repair plan shall describe the areas requiring repair, and the Contractor shall make all repairs and replacements necessary to the approval of the Owner and CQA Consultant(s) and at no additional cost to the Owner.

3.07 PUMPING AND DRAINAGE

A. At all times during construction, the Contractor shall provide and maintain proper equipment and facilities to remove all water entering excavations and keep such excavations dry so as to obtain a satisfactory condition for progress of work.

B. Drainage shall be disposed of only in an area approved by the Owner. Drainage shall be disposed of in a manner which prevents flow or seepage back into the excavated area.

END OF SECTION

SECTION 02220
EXCAVATION AND BACKFILLING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes excavation, backfilling and compaction for installation of landfill liner system components.

B. Related Sections:

1. Section 02200 - Earthwork
2. Section 02226 - Protective Cover Layer
3. Section 02227 - Washed Gravel

C. Definitions:

1. Excavation: Consists of the removal of material encountered to subgrade elevations.
2. Unauthorized Excavation: Consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Engineer. Unauthorized excavation shall be at the Contractor's expense.
3. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below proposed structure or facility.
4. Borrow: Soil materials obtained from borrow areas when sufficient approved soil material is not available from excavations.
5. Unsuitable Material: Topsoil, peat, organic soils, lignite, debris, rubble, and soft, loose or saturated soils, as determined by the Owner.
6. Lift: Constructed portion of backfill layer comprised of suitable material placed in specified compacted thickness.

1.02 REFERENCES

A. *Construction Quality Assurance Plan,* Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.

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

1. ASTM D 422, Standard Method for Particle-Size Analysis of Soils.
2. ASTM D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
3. ASTM D 1140, Standard Test Method for Amounts of Material in Soils Finer than the Number 200 Sieve.
4. ASTM D 1557, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using Ten-Pound (4.54 kg) Hammer and 18-Inch (457 mm) Drop.
5. ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
6. ASTM D 2487, Standard Test Method for Classification of Soils for Engineering Purposes.
7. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
9. ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Test Results: The testing laboratory shall submit written reports of all specified tests, showing conformance of the materials and constructed work with the specifications. Submit test results within three days after samples are obtained.

C. Submit as-built survey maps of each specified fill layer.

1.04 QUALITY ASSURANCE/QUALITY CONTROL

A. Testing shall be done in accordance with the most current version of the *Construction Quality Assurance Plan,* Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.

B. Testing work be performed with the specifications, in accordance with Section 01400.

C. Use special testing frequency at discretion of Owner or Engineer when visual observations of construction performance indicate potential problem. Additional testing for suspected areas should be considered when:

1. Rollers slip during rolling operation.
2. Lift thickness is greater than specified.
3. Fill materials are at improper or variable moisture content.
4. The number of roller passes is less than specified number.
5. Compaction equipment have dirt-clogged rollers.
6. Compaction equipment may not be using optimum ballast.
7. Fill materials differ substantially from those specified.
8. Degree of compaction is doubtful.
9. Directed by Owner or Engineer.

D. During construction, testing frequency may also be increased in following situations:

1. Adverse weather conditions.
2. Breakdown of equipment.
3. At start or finish of grading.
4. Material fails to meet specifications.
5. Work area is reduced.

1.05 PROJECT CONDITIONS

A. Work shall be performed in a manner that does not disturb existing environmental monitoring wells or other site facilities not indicated to be removed within the construction limits.

B. Provide temporary controls as specified in Section 01563.

C. The Contractor is solely responsible for excavation slope stability. Excavation work shall be in compliance with applicable OSHA regulations.

PART 2 PRODUCTS

2.01 GENERAL

A. Proposed materials shall be approved for use on this project by the Engineer as specified, prior to use of the material in the construction.

B. Fill material to be reasonably well-graded soils derived from on-site and borrow sources.

C. Soil materials on-site, in-place, and/or in stockpiles are available for use the construction operations. These materials are to be used subject to acceptance by the Engineer.

2.02 GENERAL FILL

A. Material shall meet the standards as defined in Section 02210, subsection 2.02.

B. Place in areas as shown on Drawings, including geomembrane anchor trenches and waste cell separator berms.

2.03 PROTECTIVE COVER LAYER

A. Material to conform to the requirements of Section 02226.

B. Protective Cover material shall be placed on landfill base and side-slopes as shown on the Drawings.

2.04 WASHED GRAVEL

A. Material to conform to the requirements of Section 02227.

B. Shall be installed within the leachate collection pipe trench surrounding the leachate collection pipe, as shown on the Drawings.

2.05 PIPE BEDDING MATERIAL

A. Material to conform to the requirements of Section 02223, subsection 2.02.

B. Shall be installed within the leachate collection pipe trench on the landfill bottom, surrounding the leachate collection pipe, as shown on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to beginning excavation work, Contractor shall review and satisfy himself with the adequacy and accuracy of the control surveys and data established by the Owner for the purpose of computing payment quantities. Contractor may make such measurements and surveys as deemed necessary to confirm the Owner's control surveys. The Engineer will resolve any variances or discrepancies. When control surveys and data have been established to both parties' satisfaction, the Contractor shall indicate his acceptance by signing a copy of the Owner's field survey notes, which shall be maintained at the job site by the Engineer throughout the Work.

B. Flag and protect all known utilities and environmental monitoring stations.

3.02 EXCAVATION

A. Excavation consists of open-cut excavation and removal of all types of material encountered when establishing required subgrade and finished grade.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade or finished elevations without specific direction of Engineer or Owner. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at the Contractor's expense. Backfill and compact unauthorized excavations with material of subsequent layer and meet specified density of that layer.

C. Excavate areas as indicated on the Drawings in a safe manner and in conformance with all local, state, and federal regulations.

D. Separate excavated materials into stockpiles as shown on the Drawings and as directed by the Engineer. Maintain stockpiles in free-draining condition.

E. Grade final surfaces to the lines and elevations shown on the Drawings with a tolerance of 0.1 foot.

F. Final surfaces shall be free of loose material, clods, and other debris including grading stakes and hubs.

G. Grade top perimeter of excavation to prevent surface water from draining into excavation area.

H. Upon completion of excavation, notify Engineer before proceeding with backfilling operations.

I. Provide minimum trench depth indicated below to maintain a minimum cover over the top of the installed item below the finish grade:

1. Areas subject to vehicular traffic: 36 inches

2. Areas not subject to vehicular traffic: 18 inches

3. All areas: Electrical cables: 42 inches

   Electrical ducts: 36 inches

4. Where utilities are under a concrete structure slab or pavement, the minimum depth need only be sufficient to completely encase the conduit or pipe sleeve, provided it will not interfere with the structural integrity of the slab or pavement.

5. Where the minimum cover is not provided, encase the pipes in concrete as indicated on Drawings. Provide concrete with a minimum 28-day compressive strength of 2,500 pounds per square inch.

3.03 REMOVAL OF WATER

Provide and operate equipment adequate to keep all excavations free of water as specified in Section 01563.

3.04 PREPARATION

A. Prior to placement of fill materials, examine all surfaces and subgrades to receive fill to identify the existence of soft areas caused by ponding water or unsuitable

soils. Proof-roll area with a large rubber-tired vehicle of sufficient weight to reveal unstable areas. Remove all unsuitable soils and backfill with subsequent materials and compact to density as specified for that material layer.

B. Scarify top six to eight inches of subgrade, moisture condition, and unless otherwise noted, compact to moisture content and minimum density not less than the subsequent layer of fill/backfill material.

C. Survey Engineer - approved prepared subgrade area for record drawings in conformance with Section 01400. Acceptable tolerances on survey coordinates shall be +0.1 foot to -0.0 foot on elevations and coordinates, unless otherwise specified.

D. Maintain benchmarks and other elevation control points; re-establish, if disturbed or destroyed, at no additional cost to the Owner.

3.05 BACKFILLING

A. Notify Engineer at least 48 hours prior to placing any fill material.

B. Place fill material in accordance with procedures required to achieve specified performance standards outlined in each referenced section.

C. Hauling and spreading equipment will not be considered as compaction equipment unless Contractor has demonstrated suitability on test pad.

D. Contractor is responsible for maintaining proper lift thickness to achieve compaction as stated below. Place and compact fill materials in maximum uncompacted lift thickness and to minimum density indicated.

E. Material not meeting specified density shall be additionally compacted to meet specifications, or removed. Material not within specified moisture content range shall be scarified, moisture conditioned, and recompacted to meet the specifications, or removed.

TABLE 02220-1
GENERAL COMPACTION REQUIREMENTS

Material	Maximum Lift Thickness (inches)	Minimum Compaction (%)	Moisture Requirements
General Fill	9 inches	95 Standard Proctor	±5% of OMC

3.06 FIELD QUALITY CONTROL

A. Tests specified below shall be performed by the CQA Soil testing firm during placement of fill.

B. Testing of General Fill:

Compaction/Density tests, (using ASTM D 2922) and Moisture Content (using ASTM D 3017): Minimum of one test per 10,000 square feet area for each compacted lift or minimum of six tests per lift, and at every material change.

C. Testing of Protective Cover as per Section 02226.

D. Compacted fill, which does not meet density specifications shall be scarified, the moisture content adjusted, and the area recompacted and re-tested at Contractor's expense.

E. Surveying shall be performed to monitor as-built soil layer elevations. Measure on a 50-foot maximum grid pattern at the following locations:

1. Prepared Subgrade; and
2. Protective Cover.

F. Provide topographic survey drawings of the as-built surfaces to Engineer for review and approval before proceeding with subsequent construction. Survey maps shall be prepared by an Arkansas Registered Professional Land Surveyor.

3.07 STOCKPILING

A. Locate stockpiles as shown on Drawings, or as directed by the Engineer. Do not exceed 50 feet height of piles unless permitted by the Engineer or Owner. Place, grade, and shape stockpiles for proper drainage. Stockpiles shall not exceed slopes of 3 horizontal to 1 vertical.

B. Provide erosion control fences and barriers to prevent loss of material or movement outside the stockpile limits, as necessary.

END OF SECTION

SECTION 02223
TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.01 SUMMARY

A. This Section addresses excavation, backfill and compaction for installation of underground pipelines and anchor trenches for geosynthetics installations.

B. Related Sections:

1. Section 02200 – Earthwork

2. Section 02715 - Leachate Collection System Piping (HDPE)

1.02 REFERENCES

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

1. ASTM D 422, Standard Method for Particle-Size Analysis of Soils.
2. ASTM D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
3. ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
4. ASTM D 2487, Standard Test Method for Classification of Soils for Engineering Purposes.
5. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

A. Submittals shall be submitted under the provisions in Section 01300.

B. Test Results:

1. The testing laboratory shall submit written reports of all specified tests, showing conformance of the materials and constructed work with the specifications; and

2. The test results shall be submitted within three days after samples are obtained.

1.04 QUALITY ASSURANCE/QUALITY CONTROL

A. Owner will retain the services of an independent inspection and testing firm(s) to determine conformance of the materials and constructed work with the specifications, in accordance with the General Conditions.

1.05 PROJECT CONDITIONS

A. Work shall be performed in a manner that does not disturb existing environmental monitoring wells or other site facilities not indicated to be removed within the construction limits.

B. Contractor shall provide temporary controls to prevent erosion as specified in the General Conditions.

C. The Contractor is solely responsible for excavation slope stability. Excavation work shall be in compliance with applicable OSHA regulations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Proposed materials shall be approved for use on this project by the Engineer as specified, prior to use of the material in the construction.

2.02 PIPE BEDDING MATERIAL, HAUNCHING MATERIAL, AND INITIAL TRENCH BACKFILL

A. Pipe bedding material shall be sand or fine gravel, having characteristics consistent with SW, SP, GW or GP soils as defined by the Unified Soil Classification System (ASTM D 2487).

B. Shall be substantially free of sharp edges or corners, and debris. Maximum particle size shall be 3/8-inch or less.

C. Testing of Soil:

1. Soil Type (ASTM D 2487): Minimum of one test for each visible change in material.

2.03 FINAL TRENCH BACKFILL

A. Soil used for final backfill in all pipe trenches may be soil excavated from trench except if it is an organic or silt (MH, ML) soil. The soil shall be substantially free of organic matter or other perishable matter, rocks larger than two inches in maximum dimension, pavement material, litter, and topsoil.

B. For pipe trenches beneath areas which will carry vehicular traffic, trench backfill shall consist of same material as pavement surface coarse material.

2.04 GEOCOMPOSITE ANCHOR TRENCH BACKFILL

A. General fill material to be placed in Geocomposite anchor trenches.

B. Material shall conform to the requirements as specified in Section 02279.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Testing of Geosynthetic Anchor Trench Backfill:

1. Compaction/Density tests, using ASTM D 2922: Minimum of one test for each six inch completed lift of backfill placed and for every 100 feet of trench, or fraction thereof.

B. Materials not meeting density specification requirement shall be scarified, recompacted and retested at Contractor's expense.

C. The Engineer may require additional tests to establish gradation, maximum density, and in-place density as required by working conditions, at the Contractor's expense.

3.02 PREPARATION

A. Contractor shall establish required lines and levels, and check contours and datum.

B. Contractor shall remove and replace or compact in-situ soils or compacted fill material softened by surface water as required by the Engineer.

C. Unsuitable materials shall be removed from within the trench.

D. Contractor shall provide and operate equipment adequate to keep all excavations free of water as specified in the General Conditions.

E. Contractor shall maintain benchmarks and other elevation control points; re-establish, if disturbed or destroyed, at no additional cost to the Owner.

3.03 TRENCH EXCAVATION

A. Trenches shall be excavated to the dimensions shown on the Drawings, and as indicated in the following paragraphs.

B. For pipe installation across existing pavement, cut edge of pavement in a uniform straight alignment on each side of excavation at a distance of approximately twelve inches beyond top of excavation. Maintain pavement cuts in good order until pipe installation and pavement patching operations are completed.

C. If existing material below the trench bottom grade is unsuitable for properly laying pipe, as determined by the Engineer, excavate and remove the unsuitable material to a depth of approximately four inches and replace the same with Pipe Bedding Material

(meeting the qualifications of subsection 2.02 of this Section) properly compacted to produce a firm and even bearing surface.

D. Removal of materials beyond the indicated subgrade elevations, without authorization by the Engineer, shall be classified as unauthorized excavation and shall be backfilled and compacted at no additional cost to the Owner.

E. Contractor shall remove water from the excavations as required for installation of piping, and placement of backfill and geotextile (if applicable), in accordance with these specifications and the details shown on the Drawings.

F. Contractor shall notify Engineer before proceeding with installation of fill material or piping.

G. Cover:

1. Contractor shall provide minimum trench depth indicated below to maintain a minimum cover over the top of the installed item below the finish grade:

a.	Areas subject to vehicular traffic:	24 inches
b.	Areas not subject to vehicular traffic:	12 inches
c.	All areas:	
	i. Electrical cables:	42 inches
	ii. Electrical ducts:	36 inches

2. Where utilities are under a concrete structure slab or pavement, the minimum depth need only be sufficient to completely encase the conduit or pipe sleeve, provided it will not interfere with the structural integrity of the slab or pavement.

3.04 PIPE INSTALLATION

A. Engineer must approve pipe bedding prior to placement of piping.

B. Installation of all pipe and appurtenances shall be subject to the review of the Engineer.

C. Contractor shall install piping as shown on the Drawings and as specified in Section 02715.

3.05 BACKFILLING AND COMPACTING FOR PIPING

A. This subsection includes backfilling only for piping outside the limits of the landfill.

B. Contractor shall not completely backfill trenches until the piping system as installed conforms to the specifications.

C. Contractor shall place haunching material around the pipe up to at least the pipe spring line. Haunching material shall be placed on both sides of the pipe at the same time and to approximately the same elevation. Contractor shall compact using manually-guided compaction equipment, being careful not to damage the pipe.

D. Contractor shall place initial trench backfill over the pipe (if applicable), in layers not exceeding four inches loose thickness, up to approximately 12 inches above the top of the pipe. Each layer shall be thoroughly compacted using manually-guided compaction equipment.

E. Final Trench Backfill shall be placed in layers not exceeding eight inches loose thickness up to final grade. For pipe crossing roads or adjacent to roads, backfill shall be compacted to achieve at least 95 percent of the material's maximum dry density as determined by ASTM D 698. The upper twelve inches of backfill below pavement subgrade shall be compacted to at least 95 percent maximum dry density.

F. Compaction of Final Trench Backfill shall be performed in a manner that does not damage the pipe. Pipe that is damaged shall be replaced at the Contractor's expense.

G. The minimum depth of compacted trench backfill or fill over pipelines shall be as indicated in subsection 3.03 above, or as otherwise shown on the Drawings. Construction traffic shall not be allowed to cross installed pipelines prior to placement of aggregate subbase for the pavement or crushed stone fill (as applicable), unless concrete cover (concrete arch) is provided over the pipe.

3.06 BACKFILL FOR LEACHATE RISER PIPE TRENCH

A. Place pipe bedding material within trench as shown on the Drawings. Material shall not be compacted.

3.07 BACKFILL AND COMPACTING FOR GEOSYNTHETIC ANCHOR TRENCH

A. Contractor shall place general fill material within geosynthetic anchor trench as shown on the Drawings.

B. Material shall be placed in loose lifts of nine inches.

C. Contractor shall compact fill with power tamper or wheel roll with proper moisture conditioning to meet 95 percent of the maximum dry density of the material at a maximum of six inch lifts, being careful not to damage geosynthetic material.

END OF SECTION

SECTION 02226
PROTECTIVE COVER LAYER

PART 1 GENERAL

1.01 SUMMARY

A. Section includes description of soil protective cover layer over leachate collection blanket layer on landfill floor and above geomembrane liner and geocomposite drainage net on side-slopes and floor of landfill cell.

B. Related Sections

1. Section 02220 - Excavation and Backfilling
2. Section 02277 – Geomembrane
3. Section 02278 - Geotextile and Geocomposite

1.02 REFERENCES

A. *Construction Quality Assurance Plan, Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.*

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

1. ASTM D 422, Standard Method for Particle-Size Analysis of Soils.
2. ASTM D 2434, Standard Test Method for Permeability of Granular Soils (Constant Head).
3. ASTM D 2487, Standard Test Method for Classification of Soils for Engineering Purposes.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Test Results: The Contractor shall submit the following information and samples to the Company or the CQA Representative a minimum of 14 days prior to starting construction of the protective cover layer:

1. The proposed material source (if on-site, give specific location).

2. The results of a particle-size analysis on the proposed material, conducted in accordance with ASTM D 422.

3. The results of tests conducted in accordance with ASTM D 4373 to determine calcium carbonate content of the proposed material.

4. A 30-lb sample of the proposed material.

C. Submit as-built survey drawing of installed protective cover layer as shown on Drawings. As-built drawings must be signed and sealed by an Arkansas Registered Professional Land Surveyor.

PART 2 PRODUCTS

2.01 MATERIAL FOR PROTECTIVE COVER LAYER

A. Landfill Floor

1. All laboratory testing to evaluate the suitability or conformance of materials for the protective cover and barrier protective layer shall be carried out in accordance with the test methods indicated in Section 1.02.

2. The protective cover shall consist of relatively homogeneous material that is free of debris, foreign objects, large rock fragments, roots, and organic. The hydraulic conductivity of the protective cover shall be $K \geq 1 \times 10^{-5}$ cm/sec.

3. Soil testing will be provided by Owner through the Soils CQA Monitor and the Soils CQA Testing Laboratory.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section the Contractor shall become thoroughly familiar with the site, the site conditions and all portions of the work falling within this Section.

B. Inspection:

1. Prior to implementing any of the work in this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.

2. If the Contractor has any concerns regarding the installed work of other Sections, he/she should immediately notify the Company or Company's Project Manager in writing within 48 hours of the site visit. Failure to notify the Company or Company's Project Manager in writing or construction of the sump and leachate collection pipe gravel will be construed as Contractor's acceptance *of* the related work of all other Sections.

3.02 INSTALLATION

A. Place material only when underlying leachate drainage layer material, leachate collection system and geosynthetics are completed. The protective cover material shall be placed directly on top of the geosynthetic material.

B. Place to the lines and grades shown on the Drawings.

C. Place material in single uniform lifts of no less than 12 inches. Do not operate any equipment closer than 12 inches to underlying geosynthetics.

D. The protective cover layer shall be finish grade to a tolerance of +0.1 foot of the specified elevations, and shall meet the minimum thickness requirement.

E. Placement of the material will be performed using a low ground-pressure dozer. The tracked equipment shall operate only over previously placed material or granular drainage layer. The Contractor shall not operate equipment directly on geomembrane, geotextile, geonet, or geocomposite.

F. The equipment used to place protective cover, sand or gravel shall not exert ground pressures exceeding the following:

Allowable Equipment Ground Pressure (psi)	Thickness of Layer Above Geotextile or Geonet (in.)
<5	12
<10	18
<20	24
>20	48

G. Perform survey of approved protective cover layer for as-built drawing of landfill cell in accordance with Section 01400.

H. Equipment used to place and grade protective cover shall not contain unnecessary accessories (e.g. dozers shall not contain rippers while placing and grading protective cover).

3.03 QUALITY ASSURANCE/QUALITY CONTROL

A. The protective cover layer material shall be tested as outlined in Table 02226-1 below.

TABLE 02226-1
PROTECTIVE COVER LAYER MATERIAL
PRE-CONSTRUCTION AND CONSTRUCTION TESTING REQUIREMENTS

TEST	ASTM METHOD	PASSING CRITERIA
Pre-construction Testing: Minimum of one test per source		
Classification	D 2487	GW, GP, SW, SP, SM, ML
Permeability	D 2434	1×10^{-5} cm/sec or greater
Construction Testing: Minimum of one test per source		
Classification	D 2487	GW, GP, SW, SP, SM, ML
Permeability	D 2434	1×10^{-5} cm/sec or greater

3.04 PRODUCT PROTECTION

A. After the protective cover layer has been placed, the Contractor shall maintain it free of ruts, depressions, and damage resulting from the hauling and handling of any material, equipment, tools, etc.

B. The Contractor shall use all means necessary to protect all prior work and materials and completed work of other Sections.

C. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary, to the approval of the Owner or the CQA Representative and at no additional cost to Owner.

3.03 SURVEY CONTROL

A. The contractor shall be responsible for all layout work. Once the Protective Cover Layer is completed and CQA verified, the Contractor shall be responsible for certification surveying and documentation of protective cover thickness. Final elevations of the top of Protective Cover surface shall be 0 to +0.1 ft. compared to the grades shown on the Construction Drawings.

END OF SECTION

SECTION 02227
WASHED GRAVEL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes description of granular material placed in leachate collection trench and sump in landfill cell floor.

B. Related Sections:

1. Section 02220 - Excavation and Backfilling
2. Section 02226 - Protective Cover Layer
3. Section 02715 - Leachate System Piping

1.02 REFERENCES

A. *Construction Quality Assurance Plan,* Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.

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

1. ASTM D 422, Standard Method for Particle-Size Analysis of Soils.
2. ASTM D 2487, Standard Test Method for Classification of Soils for Engineering Purposes.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Test Results: The testing laboratory shall submit written reports of all specified tests, showing conformance of the materials and constructed work with the specifications. Submit test results within three days after samples are obtained.

PART 2 PRODUCTS

2.01 WASHED GRAVEL

A. Washed Gravel material shall be classified as a GP or GW in accordance with the Unified Soil Classification System (USCS) and ASTM D 422.

B. Material shall be obtained from off-site sources and shall be relatively homogeneous, natural granular soils which are free of debris, foreign objects, large rock fragments, roots, and organics.

C. The material shall be washed gravel with a maximum of 5% passing the 3/8-inch sieve. The maximum particle size shall be three inches in diameter.

PART 3 EXECUTION

3.01 GENERAL

A. Place material only when underlying composite liner system is completed.

B. Place to the lines and grades shown on the Drawings.

C. Place material in single uniform lifts.

D. Do not compact material.

3.02 QUALITY ASSURANCE/QUALITY CONTROL

A. Washed Gravel shall be tested as outlined in Table 02227-1 below.

TABLE 02227-1
WASHED GRAVEL
PRE-CONSTRUCTION AND CONSTRUCTION TESTING REQUIREMENTS

TEST	ASTM METHOD	PASSING CRITERIA
Pre-construction Testing: Minimum of one test per source		
Grain Size Analysis	D 422	Minimum 95% larger than pipe perforations (typically 3/8" sieve) Less than 5% passing a number 200 sieve. Maximum particle size of 3 inches
Calcium Carbonate		Maximum 15%
USCS Classification	D2487	GW or GP
Permeability	D 2434	1×10^{-2} cm/sec
Construction Testing: Minimum of one test per source		
Grain Size Analysis	D 422	Minimum 95% larger than pipe perforations (typically 3/8" sieve) Less than 5% passing a number 200 sieve. Maximum particle size of 3 inches
Permeability	D 2434	1×10^{-2} cm/sec

END OF SECTION

SECTION 02228
SUBGRADE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of the subgrade as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. The Contractor shall be prepared to coordinate the construction of the subgrade with other construction activities and subcontractors at the site.

C. Notwithstanding the prequalification of any material sources for the subgrade, the Contractor shall be entirely responsible for meeting the requirements of this Section.

D. The work of this Section shall include, but not necessarily be limited to, the construction of the subgrade component of the liner system.

1.02 RELATED SECTIONS

A. Section 02200 – Excavation and Subgrade Preparation

B. Section 02229 – Engineered Buffer Layer

C. Section 02277 – Geomembrane

D. Section 02278 – Geotextile and Geocomposite

1.03 REFERENCES

A. *Construction Quality Assurance Plan, Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.*

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

1. ASTM D 422 — Standard Test Method for Particle-Size Analysis of Soils.
2. ASTM D 698 — Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
3. ASTM D 1140 — Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve.

4. ASTM D 1556 — Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
5. ASTM D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
6. ASTM D 2216 — Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
7. ASTM D 2487 — Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
8. ASTM D 2922 — Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
9. ASTM D 2937 — Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
10. ASTM D 3017 — Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
11. ASTM D 4220 — Standard Practices for Preserving and Transporting Soil Samples.
12. ASTM D 4318 — Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
13. ASTM D 5084 — Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible-Wall Permeameter.
14. ASTM D 5093 — Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring.

1.04 SUBMITTALS

A. The Contractor shall notify the Owner and CQA Consultant in a minimum of 3 days prior to starting construction of the subgrade. The notice shall state the source of the material to be used, the equipment to be used, the date and time that placement operations shall start, and the name of the person in the field who shall be in charge of the construction of the subgrade.

B. If work is interrupted for reasons other than inclement weather, the Contractor shall notify the Owner and CQA Consultant immediately and provide a plan and schedule for resumption of the work.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The construction of the subgrade shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. The Contractor shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

PART 2 - PRODUCT

2.01 MATERIAL FOR SUBGRADE

A. All laboratory testing to evaluate the suitability or conformance of soil materials for the subgrade shall be carried out in accordance with the test methods indicated in Part 1.04 of this Section.

B. The subgrade shall consist of relatively homogeneous, natural soils which are substantially free of debris, foreign objects, large rock fragments, roots, and organics. The soils selected shall not be gap-graded or susceptible to piping. Any material which is found by the CQA Consultant to be unsuitable shall be removed from the work area by the Contractor.

C. Soil testing shall be provided by the Owner through the CQA Consultant.

PART 3 - EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any work of this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section and the CQA Plan.

3.02 SUBGRADE PLACEMENT

A. The Contractor shall construct the subgrade to the grades, slopes, and elevations shown on the Drawings and as specified in this Section.

B. No frozen or partially thawed subgrade material shall be placed, spread or compacted.

C. No compacted subgrade material shall be placed or spread while the surface on which the material is to be placed is frozen or thawing, during unfavorable weather conditions, or during periods of precipitation.

D. The subgrade surface shall be made smooth and free from ruts or indentations at the end of every working day when precipitation is forecast and/or at the completion of the compaction operations in that area.

E. The entire area shall be left in a manner to promote runoff at the end of each day.

F. The final surface of the subgrade shall be compacted using a smooth drum or pneumatic wheel compactor.

G. The subgrade material shall be placed in loose lifts which result in a maximum compacted lift thickness of 6 inches.

H. The subgrade material shall be compacted to at least 95 percent of the maximum dry unit weight as measured according to ASTM D 698. In all cases the moisture content shall be maintained as close to optimum moisture, as measured according to ASTM D 698, in order to meet the compaction requirements. The dry unit weight and moisture content shall be measured in place in accordance with ASTM D 2922 (Method B) and ASTM D 3017, respectively, at the frequencies presented in the CQA Plan.

I. The subgrade must have sufficient compaction and strength to enable the placement and compaction of the clay liner. The subgrade also must be stable to prevent large differential settlement that would be conducive to damage of the liner system or the pooling of leachate.

J. The Contractor shall not proceed to the next lift until the current lift has been tested and approved by the CQA representative. The Contractor will be held responsible for proceeding to the next lift without prior approval from the CQA Firm.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Frequency:

1. The frequency of quality control testing is outlined below. The Contractor shall take this testing frequency into account in planning his construction schedule.

   a. The minimum testing frequencies for material evaluation and construction quality evaluation shall be as presented in the CQA Plan.

   b. Sampling locations shall be selected by the CQA Consultant. If necessary, the location of routine in-place moisture content and dry density tests shall be determined using a non-biased sampling plan.

   c. A special testing frequency shall be used at the discretion of the Owner and/or the

CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas shall be considered when:

i. the rollers slip during rolling operation;

ii. the lift thickness is greater than specified;

iii. the subgrade soil is at improper and/or variable moisture content;

iv. fewer than the specified number of roller passes are made;

v. dirt-clogged rollers are used to compact the material;

vi. the rollers do not have optimum ballast; or

vii. the degree of compaction is doubtful.

d. During construction, the frequency of testing may also be increased in the following situations:

i. adverse weather conditions;

ii. breakdown of equipment;

iii. at the start and finish of grading;

iv. if the material fails to meet specifications; or

v. the work area is reduced.

B. Defective Areas:

1. If a defective area is discovered in the subgrade, the CQA Consultant shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant shall define the limits and nature of the defect.

2. After determining the extent and nature of a defect, the CQA Consultant shall notify the Contractor and schedule appropriate retests when the work deficiency has been corrected.

3. The Contractor shall correct the deficiency to the satisfaction of the CQA Consultant. The cost of corrective actions shall be borne by the Contractor.

4. All retests recommended by the CQA Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the

deficiency. The CQA Consultant shall also verify that all installation requirements are met and that all submittals are provided.

3.04 SURVEY CONTROL

A. The contractor shall be responsible for all layout work. Once the subgrade is completed and CQA verified, the Contractor shall be responsible for providing certification surveying of the top of subgrade at 50 ft. intervals. Final elevations of the top of subgrade surface shall be 0 to +0.1 ft. compared to the grades shown on the Construction Drawings.

3.05 PRODUCT PROTECTION

A. The Contractor shall use all means necessary to protect all prior work, including all materials and completed work specified in this and other Sections.

B. In the event of damage to prior work or work completed as specified in this section, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Owner and CQA Consultant and at no additional cost to the Owner.

END OF SECTION

SECTION 02229
ENGINEERED BUFFER LAYER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of the Engineered Buffer Layer as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. The Contractor shall be prepared to coordinate the construction of the Engineered Buffer Layer with other construction activities and subcontractors at the site.

C. Notwithstanding the prequalification of any material sources for the Engineered Buffer Layer, the Contractor shall be entirely responsible for meeting the requirements of this Section.

D. The work of this Section shall include, but not necessarily be limited to, the construction of the Engineered Buffer Layer component of the lining system.

1.02 RELATED SECTIONS

A. Section 02200 – Excavation and Subgrade Preparation

B. Section 02228 – Subgrade

C. Section 02230 – Clay Liner

D. Section 02277 – Geomembrane

E. Section 02278 – Geotextile and Geocomposite

1.03 REFERENCES

A. *Construction Quality Assurance Plan,* Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.

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

1. ASTM D 422 Standard Test Method for Particle-Size Analysis of Soils.
2. ASTM D 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

3. ASTM D 1140 — Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve.
4. ASTM D 1556 — Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
5. ASTM D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
6. ASTM D 2216 — Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
7. ASTM D 2487 — Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
8. ASTM D 2922 — Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
9. ASTM D 2937 — Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
10. ASTM D 3017 — Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
11. ASTM D 4220 — Standard Practices for Preserving and Transporting Soil Samples.
12. ASTM D 4318 — Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
13. ASTM D 5084 — Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible-Wall Permeameter.
14. ASTM D 5093 — Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring.

1.04 SUBMITTALS

A. The Contractor shall notify the Owner and CQA Consultant in a minimum of 3 days prior to starting construction of the Engineered Buffer Layer. The notice shall state the source of the material to be used, the equipment to be used, the date and time that placement operations shall start, and the name of the person in the field who shall be in charge of the construction of the Engineered Buffer Layer.

B. If work is interrupted for reasons other than inclement weather, the Contractor shall notify the Owner and CQA Consultant immediately and provide a plan and schedule for resumption of the work.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The construction of the Engineered Buffer Layer shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. The Contractor shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

PART 2 - PRODUCT

2.01 MATERIAL FOR ENGINEERED BUFFER LAYER

A. All laboratory testing to evaluate the suitability or conformance of soil materials for the Engineered Buffer Layer shall be carried out in accordance with the test methods indicated in Part 1.03 of this Section.

B. The Engineered Buffer Layer shall consist of relatively homogeneous, natural soils which are substantially free of debris, foreign objects, large rock fragments, roots, and organics. More than 30% passing a number 200 sieve and less than 20% greater than a number 4 sieve. No particles larger than one inch shall be allowed. The soil shall be classified according to the Unified Soil Classification System (USCS) as CL, CH, or SC material with a PI greater than 10. Regardless of the classification requirements, the material shall meet the requirements of Part 2.01-D of this Section. The soils selected shall not be gap-graded or susceptible to piping. Materials which do not meet all the requirements of this Section shall be segregated at the source and not be permitted at the work area. Any material which is found by the CQA Consultant to be unsuitable shall be removed from the work area by the Contractor at no extra cost to the Owner.

C. The Engineered Buffer Layer shall have a plasticity index (PI) in excess of ten, and the percent passing the No. 200 sieve shall be greater than 30 percent.

D. The Engineered Buffer Layer shall have an in-situ (i.e., after compaction) hydraulic conductivity less than 6.0×10^{-7} cm/sec as measured in the laboratory.

E. Soil testing shall be provided by the Owner through the CQA Consultant.

1. The Engineered Buffer Layer shall be constructed using an adequate compactive effort. The Contractor shall demonstrate that adequate compactive effort shall be applied by providing the following data:

   a. at least five compaction curves (i.e., moisture-density relation tests), provided the prepared material does not vary in dry unit weight by more than five pcf; and

   b. at least three additional compaction curves each time the soil varies in dry unit

weight by more than five pcf.

PART 3 - EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any work of this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section and the CQA Plan.

B. Inspection:

1. Prior to implementing any work of this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all such work is complete to the point where the installation of this Section may properly commence without adverse impact.

2. If the Contractor has any concerns regarding the installed work of other Sections or the site, the Contractor shall notify the CQA Consultant and Owner in writing within 48 hours of the site inspection. Failure to notify the CQA Consultant and Owner of installation of the Engineered Buffer Layer shall be construed as the Contractor's acceptance of the related work of all other Sections.

3.02 ENGINEERED BUFFER LAYER PLACEMENT

A. The Contractor shall construct the Engineered Buffer Layer to the grades, slopes, and elevations shown on the Drawings and as specified in this Section.

B. No frozen or partially thawed Engineered Buffer Layer material shall be placed, spread or compacted.

C. No Engineered Buffer Layer material shall be placed or spread while the surface on which the material is to be placed is frozen or thawing, during unfavorable weather conditions, or during periods of precipitation.

D. The Engineered Buffer Layer surface shall be made smooth and free from ruts or indentations at the end of every working day when precipitation is forecast and/or at the completion of the compaction operations in that area.

E. The entire area shall be left in a manner to promote runoff at the end of each day.

F. The final surface of the Engineered Buffer Layer shall be compacted using a smooth drum or pneumatic wheel compactor. The equipment shall operate only over previously placed Engineered Buffer Layer material.

G. The Engineered Buffer Layer material shall be placed in loose lifts which result in a compacted lift thickness of 6 to 12 inches. The total thickness of the Engineered Buffer Layer shall not be less than the minimum thickness shown on the Drawings.

H. The Contractor shall not proceed to the next lift until the current lift has been tested and approved by the CQA representative. The Contractor will be held responsible for proceeding to the next lift without prior approval from the CQA Firm.

I. The Engineered Buffer Layer material shall be compacted to at least 90 percent of the maximum dry unit weight as measured according to ASTM D 698. In all cases the moisture content shall be maintained at 0 to +6 percent of the optimum moisture content as measured according to ASTM D 698. The dry unit weight and moisture content shall be measured in place in accordance with ASTM D 2922 (Method B) and ASTM D 3017, respectively, at the frequencies presented in the CQA Plan.

J. The Engineered Buffer Layer shall be sampled and tested for in-situ hydraulic conductivity (i.e. after compaction) at the frequencies and procedures outlined in the CQA Plan.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Frequency:

1. The frequency of quality control testing is outlined below. The Contractor shall take this testing frequency into account in planning his construction schedule.

   a. The minimum testing frequencies for material evaluation and construction quality evaluation shall be as presented in the CQA Plan.

   b. Sampling locations shall be selected by the CQA Consultant. If necessary, the location of routine in-place moisture content and dry density tests shall be determined using a non-biased sampling plan.

   c. Undisturbed Engineered Buffer Layer material samples for laboratory hydraulic conductivity testing shall be taken with the assistance of the Contractor such that the sample tube is inserted vertically into the Engineered Buffer Layer with a continuous smooth stroke from the construction equipment used to drive the sampler.

   d. A special testing frequency shall be used at the discretion of the Owner and/or the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas shall be considered when:

i. the rollers slip during rolling operation;

ii. the lift thickness is greater than specified;

iii. the Engineered Buffer Layer soil is at improper and/or variable moisture content;

iv. fewer than the specified number of roller passes are made;

v. dirt-clogged rollers are used to compact the material;

vi. the rollers do not have optimum ballast; or

vii. the degree of compaction is doubtful.

e. During construction, the frequency of testing may also be increased in the following situations:

i. adverse weather conditions;

ii. breakdown of equipment;

iii. at the start and finish of grading;

iv. if the material fails to meet specifications; or

v. the work area is reduced.

B. Perforations:

1. Perforations in the Engineered Buffer Layer that must be filled shall include, but not be limited to, the following:

a. nuclear density test probe locations; and

b. hydraulic conductivity sampling locations.

2. Perforations in the Engineered Buffer Layer shall be backfilled with similar clay material and compacted to achieve a hydraulic conductivity less than 6×10^{-7} cm/s. Alternatively, bentonite chips or pellets may be used.

C. Defective Areas:

1. If a defective area is discovered in the Engineered Buffer Layer, the CQA Consultant shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant shall define the limits and nature of the defect.

2. After determining the extent and nature of a defect, the CQA Consultant shall notify the Contractor and schedule appropriate retests when the work deficiency has been corrected.

3. The Contractor shall correct the deficiency to the satisfaction of the CQA Consultant. The cost of corrective actions shall be borne by the Contractor.

4. All retests recommended by the CQA Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The CQA Consultant shall also verify that all installation requirements are met and that all submittals are provided.

3.04 SURVEY CONTROL

A. The contractor shall be responsible for all layout work. The contractor shall be responsible for all layout work. Once the Engineered Buffer is completed and CQA verified, the Contractor shall be responsible for providing certification surveying of the top of Engineered Buffer at 50 ft. intervals. Final elevations of the top of subgrade surface shall be 0 to +0.1 ft. compared to the grades shown on the Construction Drawings.

3.05 PRODUCT PROTECTION

A. The Contractor shall use all means necessary to protect all prior work, including all materials and completed work specified in this and other Sections.

B. In the event of damage to prior work or work completed as specified in this section, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Owner and CQA Consultant and at no additional cost to the Owner.

END OF SECTION

SECTION 02230
COMPACTED CLAY

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of the compacted clay as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. The Contractor shall be prepared to coordinate the construction of the compacted clay with other construction activities and subcontractors at the site.

C. Notwithstanding the prequalification of any material sources for the compacted clay, the Contractor shall be entirely responsible for meeting the requirements of this Section.

D. The work of this Section shall include, but not necessarily be limited to, the construction of the composite liner clay component of the lining system.

1.02 RELATED SECTIONS

A. Section 02200 – Excavation and Subgrade Preparation

B. Section 02229 – Engineered Buffer Layer

C. Section 02277 – Geomembrane

D. Section 02278 – Geotextile and Geocomposite

1.03 REFERENCES

A. *Construction Quality Assurance Plan, Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.*

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

1. ASTM D 422 — Standard Test Method for Particle-Size Analysis of Soils.
2. ASTM D 698 — Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
3. ASTM D 1140 — Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve.

4. ASTM D 1556 — Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
5. ASTM D 1557 — Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
6. ASTM D 2216 — Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
7. ASTM D 2487 — Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
8. ASTM D 2922 — Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
9. ASTM D 2937 — Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
10. ASTM D 3017 — Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
11. ASTM D 4220 — Standard Practices for Preserving and Transporting Soil Samples.
12. ASTM D 4318 — Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
13. ASTM D 5084 — Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible-Wall Permeameter.
14. ASTM D 5093 — Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring.

1.04 SUBMITTALS

A. The Contractor shall notify the Owner and CQA Consultant in a minimum of 3 days prior to starting construction of the compacted clay. The notice shall state the source of the material to be used, the equipment to be used, the date and time that placement operations shall start, and the name of the person in the field who shall be in charge of the construction of the compacted clay.

B. If work is interrupted for reasons other than inclement weather, the Contractor shall notify the Owner and CQA Consultant immediately and provide a plan and schedule for resumption of the work.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. The construction of the compacted clay shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. The Contractor shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

PART 2 - PRODUCT

2.01 MATERIAL FOR COMPACTED CLAY

A. All laboratory testing to evaluate the suitability or conformance of soil materials for the compacted clay shall be carried out in accordance with the test methods indicated in Part 1.04 of this Section.

B. The compacted clay shall consist of relatively homogeneous, natural soils which are substantially free of debris, foreign objects, large rock fragments, roots, and organics. More than 30% passing a number 200 sieve and less than 20% greater than a number 4 sieve. No particles larger than one inch shall be allowed. The soil shall be classified according to the Unified Soil Classification System (USCS) as CL, CH, or SC material with a PI greater than 10. Regardless of the classification requirements, the material shall meet the requirements of Part 2.01-D of this Section. The soils selected shall not be gap-graded or susceptible to piping. Materials which do not meet all the requirements of this Section shall be segregated at the source and not be permitted at the work area. Any material which is found by the CQA Consultant to be unsuitable shall be removed from the work area by the Contractor at no extra cost to the Owner.

C. The compacted clay shall have a plasticity index (PI) in excess of seven, and the percent passing the No. 200 sieve shall be greater than 30 percent.

D. The compacted clay shall have an in-situ (i.e., after compaction) hydraulic conductivity less than 1.0×10^{-7} cm/sec as measured in the laboratory.

E. Soil testing shall be provided by the Owner through the CQA Consultant.

F. A test pad shall be constructed for each source of compacted clay to verify that the proposed material and procedures shall result in a product complying with this Section. Test pad construction shall be as detailed in Part 3 of this Section.

G. The requirements for a test pad detailed in Part 3 of this Section may not be performed if the following conditions are met:

1. The proposed materials for the compacted clay:
   a. is classified as CL, CH, or SC;
   b. more than 30% passing through the No. 200 sieve;
   c. less than 20% retained on a number 4 sieve;
   d. has a LL of at least 25; and
   e. has a PI of at least 10.

2. The compacted clay shall be constructed using an adequate compactive effort. The Contractor shall demonstrate that adequate compactive effort shall be applied by providing the following data:
   a. at least five compaction curves (i.e., moisture-density relation tests), provided the prepared material does not vary in dry unit weight by more than five pcf; and
   b. at least three additional compaction curves each time the soil varies in dry unit weight by more than five pcf.

PART 3 - TEST PAD

3.01 REGULATORY REQUIREMENTS

A. Unless the requirements of Part 2.01-G of this Section are met, a test pad shall be constructed and tested prior to construction of the full-scale compacted clay.

B. A test pad shall be constructed each time:

1. the dry unit weight of the proposed material changes by at least five pcf, based on a moisture-density relation test results;

2. construction equipment is changed; or

3. construction practices are changed.

3.02 TEST PAD MATERIALS

A. The soil materials to be used for construction of the test pad shall be approved by the Engineer, and it shall be verified by the CQA Consultant that the materials conform to all design specifications. The test pad materials shall meet the requirements of Part 2.01 of this Section. Soil clods shall be broken up so that no clods exceed three inches in maximum size.

3.03 TEST PAD CONSTRUCTION

A. Subgrade Preparation:

1. The area within the limits of the test pad shall be cleared and grubbed of all trees, debris, stumps, and any other vegetation. After clearing and grubbing, the area shall be stripped of topsoil and/or organic materials.

2. The surface of the subgrade shall be proof-rolled to eliminate soft zones, irregularities, and abrupt changes in grade. The finished subgrade surface shall be sloped to promote drainage. No standing water or excessive moisture shall be allowed to accumulate on the surface of the subgrade. The surface of the subgrade shall be examined by the CQA Consultant prior to commencement of construction of the test pad. The CQA Consultant shall document the condition of the subgrade.

B. Configuration:

1. The test pad shall be constructed with a width at least four times wider than the widest piece of construction equipment, not counting side slopes.

2. The test pad shall be long enough to allow the construction equipment to achieve normal operating speed before reaching the area within the test pad that shall be used for testing, but not less than approximately 100 ft long.

3. The test pad shall consist of at least four lifts of soil. Each lift shall be of uniform thickness, however different lifts may vary in thickness. The total thickness of the test pad shall be a minimum of two ft.

C. Test Pad Placement

1. The test pad shall be constructed using equipment similar to that intended for use in full-scale construction. Each lift of the test pad shall be compacted using a wedge foot compactor, such as a Caterpillar 815C or 825C.

2. First Lift:

   a. the Contractor shall, by trial and error, determine the loosely-placed soil lift thickness which shall result in a maximum compacted lift thickness of approximately nine in. (225 mm), and upon determining this, place the first lift of soil;

   b. the soil moisture content shall be adjusted by the Contractor, as required, to 0 to

+4.0 percent above the optimum moisture content as determined by ASTM D 698 (Note: the moisture content for compaction to meet a density criterion shall normally be lower than the moisture content for compaction to meet a permeability criterion, depending on the PI of the soil);

c. the soil shall be compacted with two one-way passes, using the same compaction equipment intended for the construction of the full-scale compacted clay;

d. the CQA Consultant shall perform in-situ density tests using the nuclear device, and collect samples for hydraulic conductivity tests as outlined in Part 3.03-C.4.d. of this Section and the CQA Plan;

e. all holes made as a result of sampling or testing shall be repaired in accordance with procedures outlined in the CQA Plan;

f. the lift shall be recompacted (second sequence) by applying two additional one-way passes with the same equipment;

g. the testing, sampling, and repair outlined above shall be repeated at locations adjacent to the first set of tests;

h. the lift shall be recompacted (third sequence) by applying two additional one-way passes with the same equipment;

i. the testing, sampling, and repair outlined above shall be repeated at locations adjacent to the first two sets of tests; and

j. additional sequences of compaction, testing, sampling, and repair shall be carried out until the specified criteria for compaction and permeability are attained.

3. Subsequent Lifts

a. the Contractor shall place a soil lift which shall result in a compacted lift thickness of the target lift thickness;

b. the Contractor shall ensure that a good bond exists between two consecutive lifts, and the CQA Consultant shall verify that the two lifts are intermixed; and

c. additional sequences of compaction, testing, sampling, and repair shall be carried out until the specified criteria for compaction are attained.

4. Final Surface Preparation

    a. After compaction of the final lift, the surface of the test pad shall be rolled with a smooth drum or pneumatic wheel compactor so as to be free of irregularities, loose soil, and abrupt changes in grade;

    b. All stones projecting more than 0.4 in. from the surface shall be removed;

    c. One-half of the prepared soil surface shall be protected against drying. The protective material shall be placed immediately after the completion of surface preparation. Monitoring and documentation of the condition of the surface (e.g., desiccation cracking) shall be performed by the CQA Consultant on the uncovered section of the test pad; and

    d. The CQA Consultant shall conduct in-situ hydraulic conductivity testing on the protected portion of the test pad. The in-situ hydraulic conductivity test shall consist of one of the following test methods:

        i. sealed double-ring infiltrometer (SDRI), per ASTM D 5093; or

        ii. Shelby-tube (carved block) samples for laboratory testing, per ASTM D 5084, using a 12-in. (300-mm) diameter tube, with a minimum of three tests required.

PART 4 - EXECUTION

4.01 FAMILIARIZATION

A. Prior to implementing any work of this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section and the CQA Plan.

B. Inspection:

1. Prior to implementing any work of this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all such work is complete to the point where the installation of this Section may properly commence without adverse impact.

2. If the Contractor has any concerns regarding the installed work of other Sections or the site, the Contractor shall notify the CQA Consultant and Owner in writing within 48 hours of the site inspection. Failure to notify the CQA Consultant and Owner of installation of the compacted clay shall be construed as the Contractor's acceptance of the related work of all other Sections.

4.02 COMPACTED CLAY PLACEMENT

A. The Contractor shall construct the compacted clay to the grades, slopes, and elevations shown on the Drawings and as specified in this Section.

B. No frozen or partially thawed compacted clay material shall be placed, spread or compacted.

C. No compacted clay material shall be placed or spread while the surface on which the material is to be placed is frozen or thawing, during unfavorable weather conditions, or during periods of precipitation.

D. The compacted clay surface shall be made smooth and free from ruts or indentations at the end of every working day when precipitation is forecast and/or at the completion of the compaction operations in that area.

E. The entire area shall be left in a manner to promote runoff at the end of each day.

F. The compacted clay shall be compacted using the equivalent equipment to that used for construction of the Test Pad. The final surface of the compacted clay shall be compacted using a smooth drum or pneumatic wheel compactor. The equipment shall operate only over previously placed compacted clay material.

G. The compacted clay material shall be placed in loose lifts which result in a maximum compacted lift thickness of 6 in. The total thickness of the compacted clay layer shall not be less than the minimum thickness shown on the Drawings.

H. The Contractor shall not proceed to the next lift until the current lift has been tested and approved by the CQA representative. The Contractor will be held responsible for proceeding to the next lift without prior approval from the CQA Firm.

I. The compacted clay material shall be compacted to at least 95 percent of the maximum dry unit weight as measured according to ASTM D 698. In all cases the moisture content shall be maintained at 0 to +6 percent of the optimum moisture content as measured according to ASTM D 698. The dry unit weight and moisture content shall be measured in place in accordance with ASTM D 2922 (Method B) and ASTM D 3017, respectively, at the frequencies presented in the CQA Plan.

J. The compacted clay shall be sampled and tested for in-situ hydraulic conductivity (i.e. after compaction) at the frequencies and procedures outlined in the CQA Plan.

4.03 FIELD QUALITY CONTROL AND TESTING

A. Frequency:

1. The frequency of quality control testing is outlined below. The Contractor shall take this testing frequency into account in planning his construction schedule.

   a. The minimum testing frequencies for material evaluation and construction quality evaluation shall be as presented in the CQA Plan.

   b. Sampling locations shall be selected by the CQA Consultant. If necessary, the location of routine in-place moisture content and dry density tests shall be determined using a non-biased sampling plan.

   c. Undisturbed compacted clay material samples for laboratory hydraulic conductivity testing shall be taken with the assistance of the Contractor such that the sample tube is inserted vertically into the compacted clay with a continuous smooth stroke from the construction equipment used to drive the sampler.

   d. A special testing frequency shall be used at the discretion of the Owner and/or the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas shall be considered when:

      i. the rollers slip during rolling operation;

      ii. the lift thickness is greater than specified;

      iii. the compacted clay soil is at improper and/or variable moisture content;

      iv. fewer than the specified number of roller passes are made;

      v. dirt-clogged rollers are used to compact the material;

      vi. the rollers do not have optimum ballast; or

      vii. the degree of compaction is doubtful.

   e. During construction, the frequency of testing may also be increased in the following situations:

      i. adverse weather conditions;

      ii. breakdown of equipment;

      iii. at the start and finish of grading;

      iv. if the material fails to meet specifications; or

      v. the work area is reduced.

B. Perforations:

1. Perforations in the compacted clay that must be filled shall include, but not be limited to, the following:
   a. nuclear density test probe locations;
   b. hydraulic conductivity sampling locations; and
   c. test pit locations.

2. Perforations in the compacted clay shall be backfilled with similar clay material and compacted to achieve a hydraulic conductivity less than 1×10^{-7} cm/s. Alternatively, bentonite chips or pellets may be used.

C. Defective Areas:

1. If a defective area is discovered in the compacted clay, the CQA Consultant shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Consultant shall define the limits and nature of the defect.

2. After determining the extent and nature of a defect, the CQA Consultant shall notify the Contractor and schedule appropriate retests when the work deficiency has been corrected.

3. The Contractor shall correct the deficiency to the satisfaction of the CQA Consultant. The cost of corrective actions shall be borne by the Contractor.

4. All retests recommended by the CQA Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The CQA Consultant shall also verify that all installation requirements are met and that all submittals are provided.

4.04 SURVEY CONTROL

A. The contractor shall be responsible for all layout work. Once the Compacted Clay Liner is completed and CQA verified, the Contractor shall be responsible for providing certification surveying of the top of Compacted Clay Liner at 50 ft. intervals. Final elevations of the top of Compacted Clay surface shall be 0 to +0.1 ft. compared to the grades shown on the Construction Drawings.

4.05 PRODUCT PROTECTION

A. The Contractor shall use all means necessary to protect all prior work, including all materials and completed work specified in this and other Sections.

B. In the event of damage to prior work or work completed as specified in this section, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Owner and CQA Consultant and at no additional cost to the Owner.

END OF SECTION

SECTION 02270
RIPRAP

PART 1 GENERAL

1.01 SUMMARY

A. Section includes description of riprap stone and geotextile material, placed in stormwater outlet locations or areas requiring slope protection, as shown on the Drawings.

B. Related Sections

1. Section 02200 - Earthwork

2. Section 02720 - Stormwater Drainage Systems

1.02 REFERENCES

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

1. ASTM C 535, Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Test Results: The testing laboratory shall submit written reports of all specified tests, showing conformance of the materials and constructed work with the specifications. Submit test results within three days after samples are obtained.

PART 2 PRODUCTS

2.01 RIPRAP

A. The stone shall be hard, sound, and durable. It shall be free from seams, cracks, and other defects tending to destroy its resistance to weather.

B. The stone shall have less than 45 percent wear in accordance with the Los Angeles abrasion test and shall not weigh less than 140 pounds per cubic feet.

C. The stone shall have at least 50 percent by weight consisting of pieces measuring between seven inches and ten inches in any direction.

D. Dust or fines less than 1/2 inches in maximum cross section accumulated from quarrying or loading operations shall not exceed five percent by weight.

E. Nominal 12 inches graded down.

2.02 GEOTEXTILE FILTER

A. Geotextile Filter used with riprap shall be needlepunch non-woven geotextile, woven geotextile with monofilament yarn or woven geotextile with monofilament and fibrillated yarn meeting the following requirements:

1. Min. permittivity ASTM D4491: 0.2 sec.

2. Survivability (AASHTO M288-9G): Class 2 - woven monofilaments, Class 1 -all other geotextiles.

3. Max. AOS ASTM D4751: 0.25mm.

4. U.V. retardant required.

PART 3 EXECUTION

3.01 GENERAL

A. Riprap shall be provided at all locations shown on the Drawings or as directed by the Engineer. Prior to placing the riprap, install geotextile filter on the prepared subgrade as shown on the Drawings.

B. Key upper geotextile after placement of riprap on slopes. Prepare subgrade to the lines and grades as specified. Provide intimate contact of geotextile with smooth slope. Fill depressions or holes to avoid development of a geotextile bridge.

C. Riprap shall be placed from the bottom up on the geotextile filter in such manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids and shall be constructed to the lines and grades shown. Maximum drop height of stones should not exceed one foot.

D. The larger stones shall be well distributed and the entire mass of stones in their final position shall be roughly graded to conform to the gradation specified. The

finished riprap layer shall be free from objectionable pockets of small stones and clusters of larger stones.

E. Placing riprap layers will not be permitted. Placing of riprap by dumping into chutes or by similar methods likely to cause segregation of the various sizes will not be permitted. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry or other source; controlled dumping of successive loads during final placing or by other methods of placement which will produce the specified results. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to obtain a reasonably well graded distribution of stone sizes as specified above.

F. Riprap shall be maintained in a satisfactory condition, as determined by the Engineer, until completion of the project. Damage before completion from any cause shall be repaired or replaced at no cost to the Owner.

G. Articulated concrete mats or other flexible revetment systems may be used in place of stone riprap as approved by the engineer.

END OF SECTION

SECTION 02276
GEOSYNTHETIC CLAY LINER (GCL)

PART 1 GENERAL

1.01 SCOPE

A. This specification covers the technical requirements for the furnishing and installation of the geosynthetic clay liner described herein. All materials used shall meet the requirements of this specification, and all work shall be performed in accordance with the procedures provided herein and the contract drawings.

1.02 DEFINITIONS

A. For the purposes of this specification, the following terms are defined below:

1. *Geosynthetic Clay Liner (GCL). A manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetics.*
2. *Geomembrane. An essentially impermeable geosynthetic composed of one or more geosynthetic sheets.*
3. *Geotextile. Any permeable geosynthetic comprised solely of textiles.*
4. *Minimum Average Roll Value. For geosynthetics, the value calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.*
5. *Overlap. Where two adjacent GCL panels contact, the distance measuring perpendicular from the overlying edge of one panel to the underlying edge of the other.*
6. *Typical Value. The mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with one specific property.*

1.03 UNIT PRICES

A. Measurement will be made of the total surface area in square feet covered by the GCL as shown on the contract drawings. Final quantities will be based on as-built conditions. Allowance will be made for GCL in anchor and drainage trenches but no allowance will be made for waste, overlap, or materials used for the convenience of

the Contractor. GCL installed and accepted will be paid for at the respective contract unit price in the bidding schedule.

1.04 SUBMITTALS

A. With the bid, the Contractor shall furnish the following information:

1. Conceptual description of the proposed plan for placement of the GCL panels over the area of installation;

2. GCL manufacturer's MQC Plan for documenting compliance to Sections 2.1 and 2.2 of these specifications;

3. GCL manufacturer's historical data for reinforced GCL of a) 10,000-hour creep shear testing per Section 2.1 D and b) seam flow data at 2 psi confining pressure per Section 2.1 E; and

4. A copy of GCL manufacturer's ISO quality Certificate of Registration.

B. At the Engineer's or Owner's request the Contractor shall furnish:

1. A representative sample of the GCLs; and

2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million square feet (100,000 square meters) in size.

C. Upon shipment, the Contractor shall furnish the GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.

D. As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and CQA Inspector (see Section 1.7) for each area that is covered by the GCL.

1.05 QUALIFICATIONS

A. GCL Manufacturer must have produced at least 10 million square feet (1 million square meters) of GCL, with at least 8 million square feet (800,000 square meters) installed.

B. The GCL Installer must either have installed at least 1 million square feet (100,000 square meters) of GCL, or must provide to the Engineer satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

1.06 CONSTRUCTION QUALITY ASSURANCE (CQA)

A. The Owner and Engineer shall provide a third-party inspector for CQA of the GCL installation. The inspector shall be an individual or company who is independent from the manufacturer and installer, who shall be responsible for monitoring and documenting activities, related to the CQA of the GCL, throughout installation. The inspector shall have provided CQA services for the installation of the proposed or similar GCL for at least 5 completed projects totaling not less than 1 million square feet (100,000 square meters).

B. Testing of the GCL, as necessary to support the CQA effort, shall be performed by a third party laboratory retained by the Contractor and independent from the GCL manufacturer and installer. The laboratory shall have provided GCL CQA testing of the proposed or similar GCL for at least 5 completed projects totaling not less than 1 million square feet (100,000 square meters).

C. CQA shall be provided in accordance with the *CQA Manual* provided by the engineer.

PART 2 PRODUCTS

A. The GCLs shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and shall comply with all of the criteria listed in this Section. Prior to using an alternate GCL, the Contractor must furnish independent test results demonstrating that the proposed alternate material meets all requirements of this specification. The Contractor also must obtain prior approval of the alternative GCL by the Project Engineer.

B. Reinforced GCL must be used on slopes as designated by the Engineer. Unreinforced GCL may be used on slopes not exceeding 10H:1V.

2.01 MATERIALS

A. Acceptable reinforced GCL products are Bentomat® ST, as manufactured by CETCO, 1350 West Shure Drive, Arlington Heights, Illinois 60004 USA (847-392-5800), or an engineer-approved equal.

B. Areas requiring reinforced GCL will be furnished with Bentomat® ST. The delineation of these areas shall be agreed by the Installer and the Engineer prior to installation.

C. The reinforced GCL and its components shall have the properties shown in **Table 02226-1**.

D. The reinforced GCL shall have 10,000 hour test data for large-scale constant-load (creep) shear testing under hydrated conditions. The displacement shall be 0.11 in. (2.7 mm) or less at a constant shear load of 250 psf (12 kPa) and a normal load of 500 psf (24 kPa).

E. The reinforced GCL shall have seam test data from an independent laboratory showing that the seam flow with a grooved cut in the nonwoven geotextile is less than 1×10^{-8} $m^3/m^2/s$ at 2 psi hydraulic pressure.

F. The minimum acceptable dimensions of full-size GCL panels shall be 150 feet (45.7 m) in length. Short rolls [(those manufactured to a length greater than 70 feet (21 m) but less than a full-length roll)] may be supplied at a rate no greater than 3 per truckload or 3 rolls every 36,000 square feet (3,500 square meters) of GCL, whichever is less.

G. A 6-inch (150 mm) overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

2.02 CONFORMANCE TESTING

A. Samples shall be taken at the following frequency: a minimum of one test per 100,000 square feet and minimum of one test per lot.

B. Each sample shall be identified by manufacturer's name, product identification, lot number, roll dimensions, and roll number. The machine direction shall be noted on the samples with a waterproof marker.

C. As a minimum, the following conformance tests shall be performed:

a. Bentonite Mass/Area sq. - ASTM D 5993

b. Tensile Strength - ASTM D 6768

c. Index Flux and Hydraulic Conductivity - ASTM D 5887

2.03 PRODUCT QUALITY DOCUMENTATION

A. The GCL manufacturer shall provide the Contractor or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

1. Certificates of analysis for the bentonite clay used in GCL production demonstrating compliance with the parameters swell index and fluid loss shown in tables TR404-st and TR404-200r;

2. Manufacturer's test data for finished GCL product(s) of bentonite mass/area, GCL tensile strength and GCL peel strength (reinforced only) demonstrating compliance with the index parameters shown in **Table 02226-1**; and

3. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

B. Manufacturer's test data for finished GCL product(s) including GCL index flux, permeability and hydrated internal shear strength data demonstrating compliance with the performance parameters shown in **Table 02226-1** is available upon request of the manufacturer.

Table 02276-1
REINFORCED GCL BENTOMAT® ST CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000ft^2 (4,000m^2)	0.75lb/ft^2 (3.6kg/m^2)
GCL Grab Strength[3]	ASTM D 6768	200,000ft^2 (20,000m^2)	30lbs/in (53 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000ft^2 (4,000m^2)	3.5lbs/in (6.1 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Weekly	1 x $10^{-8}$$m^3$/$m^2$/sec max.
GCL Permeability[4]	ASTM D 5887	Weekly	5 x 10^{-9}cm/sec max.
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500psf (24kPa) typical@ 200 psf

Bentomat ST is a reinforced GCL consisting of a layer of sodium bentonite between a woven and a nonwoven geotextiles, which are needle punched together.

Notes

1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.

2 Bentonite mass/area reported at 0 percent moisture content.

3 All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.

4 Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5x10-9 cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.

5 Peak values measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design. *CETCO has developed an edge enhancement system that eliminates the need to use additional granular sodium bentonite within the overlap area of the seams. We call this edge enhancement, SuperGroove™, and it comes standard on both longitudinal edges of Bentomat® ST. It should be noted that SuperGroove™ does not appear on the end-of-roll overlaps and recommend the continued use of supplemental bentonite for all end-of-roll seams.*

2.04 PRODUCT LABELING

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand product code);

2. Lot number and roll number; and

3. Roll length, width and weight.

2.05 PACKAGING

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

2.06 ACCESSORY BENTONITE

A. The granular bentonite sealing clay used for overlap seaming, penetration

sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer. Seaming of GCLs shall be conducted in accordance with the manufacturer's guidelines for each particular GCL.

PART 3 EXECUTION

3.01 SHIPPING AND HANDLING

A. The manufacturer assumes responsibility for initial loading the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor, Installer or other designated party.

B. A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

C. The party responsible for unloading the GCL should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

3.02 STORAGE

A. Storage of the GCL rolls shall be the responsibility of the installer. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well drained.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

D. The integrity and legibility of the labels shall be preserved during storage.

3.03 EARTHWORK

A. Any earthen surface upon which the GCL is installed shall be prepared and compacted in accordance with the project specifications and drawings. The

surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation;
2. Construction Debris;
3. Sticks;
4. Sharp rocks;
5. Void spaces;
6. Ice;
7. Abrupt elevation changes;
8. Standing water;
9. Cracks larger than one-quarter inch (6 mm) in width; and
10. Any other foreign matter that could contact the GCL.

B. Subgrade surfaces consisting of granular soils or gravel may not be acceptable due to their large void fraction and puncture potential. *In high head applications, such as ponds and wastewater lagoons, subgrade soils should possess a particle size distribution such that at least 80 percent of the soil is finer than a #60 sieve (0.250 mm).*

C. Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12 mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.

D. On a continuing basis, the project CQA inspector shall certify acceptance of the subgrade before GCL placement.

E. It shall be the installer's responsibility thereafter to indicate to the Engineer any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.

F. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated or an equivalent runout shall be utilized in accordance with the project plans and specifications and as approved by the CQA Inspector. When utilizing an anchor trench design, the trench shall be excavated and approved by the CQA Inspector prior to GCL placement. No loose soil shall be allowed at the

bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

3.04 GCL PLACEMENT

A. Unreinforced GCL shall be placed on the flatter areas of the site; reinforced GCL shall be placed on the more steeply sloped areas. The Installer and Project engineer shall review and agree upon which GCL shall be placed on these areas prior to installation.

B. GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the Engineer's recommendations.

C. Equipment, which could damage the GCL, shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

D. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

E. The GCL panels shall be placed parallel to the direction of the slope.

F. All GCL panels should lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

G. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project Engineer, CQA inspector, and GCL supplier should be consulted for specific guidance if premature hydration occurs.

3.05 ANCHORAGE

A. As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope or an equivalent runout design shall be utilized. When utilizing an anchor trench design, the front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil

should be removed from the floor of the trench. The GCL should cover the entire trench floor but does not extend up the rear trench wall.

3.06 SEAMING

A. The GCL seams are constructed by overlapping their adjacent edges. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.

B. The minimum dimension of the longitudinal overlap should be 6 inches (150 mm). If the GCL is manufactured with a grooved cut in the nonwoven geotextile that allows bentonite to freely extrude into the longitudinal overlap then no supplemental bentonite is required for this overlap. If the GCL does not have a grooved cut in the nonwoven geotextile longitudinal overlap, then bentonite-enhanced seams are required as described below. End-of-roll overlapped seams should be constructed with a minimum overlap of 24 inches (600 mm). End-of-roll overlapped seams for all reinforced GCL seams require bentonite-enhanced seams as described below.

C. Bentonite-enhanced seams are constructed between the overlapping adjacent panels as follows. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the 6-inch (150-mm) line. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m). A similar bead of granular sodium bentonite is applied at the end-of-roll overlap.

3.07 DETAIL WORK

A. The GCL shall be sealed around penetrations and embedded structures embedded in accordance with the design drawings and the GCL Manufacturer.

B. Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.08 DAMAGE REPAIR

A. If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a

minimum overlap of 12 inches (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

3.09 COVER PLACEMENT

A. Cover soils shall be free of angular stones or other foreign matter that could damage the GCL. Cover soils should be approved the project Engineer with respect to particle size, uniformity and chemical compatibility. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.

B. Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1foot (300 mm) of cover should be maintained between the equipment tires/tracks and the GCL at all times during the covering process. This thickness recommendation does not apply to frequently trafficked areas or roadways, for which a minimum thickness of 2 feet (600 mm) is required.

C. Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. Cover soil shall be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

D. Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used to facilitate the installation of any geosynthetic material placed over the GCL. The GCL supplier or CQA engineer should be contacted with specific recommendations on the appropriate procedures in this situation.

E. When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

END OF SECTION

SECTION 02277
GEOMEMBRANE

PART 1 GENERAL

1.01 SUMMARY

Section includes furnishing and installing geomembrane as part of landfill liner and cover system construction, which will be done by others.

1.02 REFERENCES

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

1. ASTM D 6693, Standard Test Method for Tensile Properties of Plastics.
2. ASTM D 746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
3. ASTM D 1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
4. ASTM D 1204, Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
5. ASTM D 1238, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastomer.
6. ASTM D 1505, Standard “Test Method for Density of Plastics by the Density-Gradient Technique.
7. ASTM D 1603, Standard Test Method for Carbon Black in Olefin Plastics.
8. ASTM D 4437, Standard Practice for Determining the Integrity of Field Seams Used in joining Flexible Polymeric Sheet Geomembranes.
9. ASTM D 5596, Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
10. ASTM D 5994, Standard Test Method for Measuring Nominal Thickness of Textured Geomembrane.
11. ASTM D 4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

B. FTM Standard Number 101C, Method 2065, Puncture Resistance and Elongation Test (1/8 inch Radius Probe Method).

C. GRI Test Method GM6, "Pressurized Air Channel Test for Dual Seamed Geomembranes".

D. GRI Test Method GM13 “Standard Specification for HDPE Geomembranes”.

E. GRI Test Method GM19 “Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes”.

1.03 SUBMITTALS

A. Submit the following to the CQA Firm, for review and approval, no later than 14 calendar days prior to scheduled shipment of geomembrane:

1. Documentation of manufacturers' qualifications as specified in subsection 1.04.A of this Section.

2. Manufacturer's quality control program manual, or descriptive documentation.

3. List of material properties and samples of the material.

4. Manufacturers' certification that the products to be furnished will comply with all product specifications in this section.

5. Documentation of installers' qualifications, as specified below and in subsection 1.04.E of this Section.

a. Submit a list of at least ten completed facilities. For each installation, provide: name and type of facility; its location; the date of installation; name and telephone number of Owner, Design Engineer, Manufacturer, Fabricator, if applicable; name and telephone number of contact at the facility; thickness of geomembrane and surface area of the installed geomembrane; and type of seaming, patching, and tacking equipment.

b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and all technicians to be assigned to this project.

B. Shop Drawings

1. Submit copies of shop drawings for approval as soon as possible after award of contract. Shop drawings shall show a proposed installation panel layout identifying seams and details. The layout diagram shall indicate the location of pre-assembled panels.

2. Placement of geomembrane will not be allowed to proceed until CQA Firm has received and approved the shop drawings. Any proposed deviation from these documents shall be submitted in writing to the CQA Firm a minimum of one to two working days prior to the scheduled start of geomembrane installation and will be accepted/rejected by the CQA Firm prior to start of installation activities.

C. Submit the following to the CQA Firm for review and approval no later than one calendar day prior to shipment of the products:

1. Origin and quality control certificates from the supplier of the resin used to manufacture the geomembrane, and certification that the properties of the resin meet the requirements for the project.

2. The manufacturers' quality control certifications, including results of source quality control testing of the products, as specified in subsection 2.01 of this Section, to verify that the materials supplied for the project are in compliance with all product specifications in this Section. The certifications shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. Certifications shall include lot and roll numbers, and corresponding shipping information.

D. No geomembrane shall be deployed until the certifications and quality control certificates are submitted to and approved by the CQA Firm. Should geomembrane material be deployed prior to CQA Firm's approval, it shall be at sole risk of the Geomembrane Installer and Contractor, and if the material does not meet project specifications, it shall be removed from the project at the expense of the Contractor.

E. Additional Submittals (In-Progress and at Completion):

1. Quality Control test results (refer to subsection (2.01.A.4).

2. Manufacturer's warranty (refer to subsection 1.06).

3. Liner installation guarantee (refer to subsection 1.07).

4. Inventory of geomembrane rolls received on-site (refer to subsection 1.05.C).
5. Daily written acceptance of subgrade surface (refer to subsection 3.01.C).
6. Low temperature-seaming procedures, if applicable (refer to subsection 3.03.A).
7. Pre-qualification test seam samples (refer to subsection 3.05.A.3).
8. Non-destructive field seam test results (refer to subsection 3.05.13.1).
9. Destructive field seam test results (refer to subsection 3.05.C.5).
10. As-built survey drawing, as discussed in subsection 3.06.

1.04 QUALITY CONTROL/QUALITY ASSURANCE

A. Owner will retain the services of independent inspection and testing firms (Geosynthetics Quality Assurance Firm and Geosynthetics Quality Assurance Laboratory) to perform quality control and to check conformance of the materials and field seaming with the specification.

B. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.

C. Furnish all labor, materials, equipment, services, incidentals and other items necessary for the placement and installation of geomembrane as shown on the Contract Drawings and as specified herein.

D. Manufacturer's Qualifications: The manufacturer shall be a specialist in the manufacture of geomembrane of the type and shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 10,000,000 square feet of the specified type of geomembrane during the last five years.

E. Installer's Qualifications

1. The Geomembrane Installer shall be the manufacturer or an approved contractor trained and licensed to install the manufacturers geomembrane.

2. The Geomembrane Installer shall be a specialist in the installation of geomembranes of the type specified and shall have at least five years experience in the installation of such geomembranes.

3. Installation shall be performed under the constant direction of a single Field Installation Supervisor who shall remain on site and be in responsible charge, throughout the liner installation, for liner layout, seaming, patching, testing, repairs, and all other activities by the Installer.

4. Seaming shall be performed under the direction of a Master Seamer (who may also be the Installation Supervisor or Crew Foreman). The Master Seamer shall have experience in the same type of geomembrane specified, using the same type of seaming apparatus specified in the current project. This Installation Supervisor and/or Master Seamer shall be present whenever seaming is performed.

5. All seaming, patching, other welding operations, and testing shall be performed by qualified technicians trained by the Geomembrane Installer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall clearly state the manufacturer's name, product identification, lot number, material thickness, roll number, roll dimensions, and roll weight.

B. Geomembrane shall be protected from mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

C. Provide all labor and equipment required to assist the CQA Firm in the observation of materials delivered to the site. Generate, update and submit to the CQA Firm an inventory of geomembrane rolls received on-site from the manufacturer/distributor. The inventory shall include all the information appearing on the label of each roll.

D. Rolls shall be stored on a prepared surface (not wooden pallets) and shall not be stacked more than two rolls high.

1.06 MATERIAL WARRANTY

A. Membrane manufacturer shall warrant the membrane material against manufacturing defects and material degradation in the outdoor exposure for a period of 20 years from the date of installation.

B. The manufacturer shall provide new material to replace, on a prorated basis over the remaining life of the membrane, any material, which fails from the above causes within the warranty period.

C. The manufacturer shall furnish the CQA Firm with a written warranty covering the requirements of this paragraph.

1.07 LINER INSTALLATION GUARANTEE

A. Guarantee the membrane installation against defects in installation and workmanship for one year commencing with the date of final acceptance.

B. The guarantee shall include the services of qualified service technicians and all material required for the repairs at no expense to the Owner.

1.08 GEOMEMBRANE PRE-CONSTRUCTION MEETING

A. A Geomembrane Pre-Construction Meeting shall be held at the site prior to installation of the geomembrane. As a minimum, the meeting shall be attended by the Geomembrane Installer, Project Manager, CQA Firm and/or his representative, and Contractor.

B. Topics for this meeting shall include:

1. Responsibilities of each party.
2. Lines of authority and communication.
3. Methods for documenting and reporting, and for distributing documents and reports.
4. Procedures for packaging and storing archive samples.
5. Review of time schedule for all installation and testing.
6. Review of panel layout and numbering systems for panels and seams.
7. Preparation of the as-built panel and seam drawing.

C. The meeting shall be documented by a person designated at the beginning of the meeting, and minutes shall be transmitted to all parties.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Manufacturing Quality Control

1. Every effort shall be made to minimize the number of lots of geomembrane needed to complete the work.

2. The following test methods shall be used by the manufacturer for the quality control/quality assurance of the geomembrane prior to delivery.

   a. Density - ASTM D 1505/D 792 (min. one test per 200,000 lbs);

   b. Carbon Black Content - ASTM D 1603 or 4218 (min. one test per 20,000 lbs);

   c. Carbon Black Dispersion - ASTM D 5596 (min. one test per 45,000 lbs);

   d. Thickness - ASTM D 5994 (min. one test per roll);

   e. Tensile Properties - ASTM D 6693 (min. one test per 20,000 lbs); and

   f. Puncture Resistance - ASTM D 4833 (min. one test per 45,000 lbs).

3. Results of environmental stress crack resistance test (ASTM D 5397 - single point). At a minimum, test value shall be 200 hr. and test shall be performed once every resin lot.

4. Quality Control certificates, signed by a responsible party employed by the Manufacturer, shall be submitted to the CQA Firm prior to the installation of the geomembrane. The certificates shall include roll identification numbers, testing procedures, and results of quality control tests.

B. Conformance Testing

1. Upon the delivery of the geomembrane rolls to the project site, a qualified representative of the CQA Firm shall obtain samples of the material at a frequency of at least one sample per 100,000 square feet and at least one sample per lot of material shipped, and forward the samples to the Geosynthetics Quality Assurance Laboratory for conformance testing.

2. Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width. The CQA Finn representative shall mark the machine direction on the samples.

3. Conformance testing shall include the following tests, as a minimum:

   a. Density or Specific Gravity - ASTM D 1505 or ASTM D 792 Method A

b. Carbon Black Content - ASTM D 1603 or 4218

c. Carbon Black Dispersion - ASTM D 5596

d. Thickness - ASTM D 5994 (textured) or ASTM D 5199 (smooth)

e. Tensile Properties (Yield Strength, Break Strength, Elongation at Yield and Elongation at Break) - ASTM D 6693, Type IV or GRI-GM-13

f. Puncture Resistance – ASTM D 4833

g. Tear Resistance - ASTM D 1004, Die C

2.02 GEOMEMBRANE

A. The geomembrane shall consist of new, first quality products designed and manufactured specifically for the purpose of this work, which shall have been satisfactorily demonstrated by prior testing to be suitable and durable for such purposes. The geomembrane shall be an unmodified seamless, high-density polyethylene (HDPE) containing no plasticizers, fillers, chemical additives, or extenders. The geomembrane shall be textured on both sides and shall be supplied as a continuous sheet with no factory seams in rolls. The roll length and width shall be maximized to provide the largest manageable sheet for the fewest field seams.

B. The geomembrane material shall be produced free of holes, blisters, undispersed raw materials or any signs of contamination by foreign matter. Defects shall be repaired by replacement and by using the extrudate welding technique in accordance with the manufacturer's recommendations.

C. The geomembrane shall be 60-mil HDPE (textured) for bottom and slope lining.

D. Physical Properties

1. Geomembrane for the bottom lining and final cover systems shall meet or exceed the following specifications:

TABLE 02277-1
GEOMEMBRANE MATERIAL SPECIFICATIONS

Property	Units	Test Method	60-mil HDPE Textured
Thickness	Mils	ASTM D 5994	57 min / 60 Ave
Resin Density	g/cm^3	ASTM D 1505/792	0.940 min
Carbon Black Content	%	ASTM D 1603	2.0 – 3.0
Tensile Strength at Yield	ppi	ASTM D 6693, GRI-GM-13	126 min
Tensile Strength at Break	ppi	Same as above	90 min
Elongation at Yield	%	Same as above	12
Elongation at Break	%	Same as above	100
Tear Resistance	Lbs	ASTM D 1004	42
Puncture Resistance	Lbs	ASTM D 4833	90
Carbon Black Dispersion	Category	ASTM D 5596	1, 2

TABLE 02277-2
GEOMEMBRANE SEAM SPECIFICATIONS

Type of Material	ASTM Method	Peel Extrusion	Peel Fusion	Shear Extrusion	Shear Fusion
60-mil HDPE Textured	ASTM D 6392	78 PPI and FTB	91 PPI and FTB	120 PPI	120 PPI

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. The subgrade shall be prepared as specified in Section 02200. The subgrade shall be smooth and uniform, and free of all trash and debris, prior to installation of the geomembrane.

B. The Geomembrane Installer and the CQA Firm representative shall walk over the surface to be covered with geomembrane on each day's operations prior to placement of geomembrane.

C. The Geomembrane Installer shall provide to the CQA Firm written acceptance daily for the surface to be covered by geomembrane in that day's operations. The surface shall be maintained as acceptable during geomembrane installation.

D. Subgrade damaged by construction equipment during the geomembrane deployment operation shall be repaired prior to placement of the geomembrane. The repairs shall be approved by the CQA Firm or his representative.

E. Subgrade damaged by erosion, rutting, or other means following geomembrane deployment shall be exposed and the damage repaired. Repairs shall be in accordance with Section 02220. The subgrade shall be re-approved in accordance with subsection 3.01.C of this section.

3.02 GEOMEMBRANE PLACEMENT

A. The geomembrane shall be installed as shown on the Drawings.

B. Panel Nomenclature

1. A field panel is defined as unit of geomembrane, which is to be seamed in the field. A field pane is a roll or a portion of a roll cut in the field. The CQA Firm shall be responsible to ensure that each field panel is given an identification code (number or letter-number) consistent with the layout plan. This identification code shall be as simple and logical as possible and shall be agreed upon by the Project Manager, Installer and CQA Firm.

2. The CQA Firm shall establish a table or chart showing correspondence between roll numbers and field panel identification codes. The field panel identification code shall be used for all quality assurance records.

C. Panel Deployment Procedure

1. The CQA Firm shall review the panel deployment progress of the Installer and advise the Project Manager on changes in panel deployment. The CQA Firm shall also review the panel deployment for suitability to actual field condition such as issues relating to wind, rain, soil liner desiccation and other site-specific conditions. The CQA Firm shall verify that the condition of the underlying soil does not change detrimentally during installation. The CQA Firm shall record the identification code, location, and date of installation of each field panel.

D. Deployment Weather Conditions

1. Geomembrane deployment shall not be undertaken if weather conditions will preclude material seaming following deployment.

2. The normal acceptable weather conditions for seaming are as follows:

   a. Ambient temperature between 32° F and 104° F.

   b. Dry conditions (no precipitation or other excessive moisture).

   c. No excessive winds.

3. Ambient temperature shall be measured and ambient conditions appraised by the CQA Firm in the area in which the panels area to be placed.

4. The CQA Firm shall inform the Project Manager of any weather-related problems, which may not allow geomembrane placement to proceed. The Project Manager will determine if the installation is to be stopped or special procedures are to be used.

E. Method of Deployment

1. Before the geomembrane is handled on site, the CQA Firm shall verify that deployment equipment and method of deployment proposed by the Installer to be used on the site is adequate and does not pose risk of damage to the geomembrane or underlying subgrade. If vehicles are used which must operate on the geomembrane, driver shall proceed with caution during deployment of the geomembrane to prevent spinning of tires, sharp turns and quick stops. During handling, the CQA Firm shall observe and verify that the Installer's personnel handle the geomembrane with care.

2. The CQA Firm shall verify the following:

   a. Equipment used does not damage the geomembrane or underlying subgrade by handling.

   b. The prepared surface underlying the geomembrane is acceptable immediately prior to geomembrane placement.

   c. Geosynthetic elements immediately underlying the geomembrane are clean and free of debris.

   d. Personnel do not smoke or wear damaging shoes while working on the geomembrane, or engage in other activities, which could damage the geomembrane.

e. The method used to unroll the panels does not cause excessive scratches or crimps in the geomembrane and does not damage the supporting roll.

f. The method used to place the panels minimizes wrinkles especially differential wrinkles between adjacent panels.

g. Adequate temporary lading and/or anchoring (such as sandbags or tires), not likely to damage the geomembrane, are placed to prevent uplift by wind. In case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels.

h. Direct contact with the geomembrane is minimized, and the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where repeated traffic use may be expected.

i. Liner has promptly been anchored in trench where applicable.

The CQA Firm shall notify the Project Manager if the above conditions are not fulfilled.

F. Damage and Defects

1. Upon delivery to the site, the CQA Firm shall conduct a surface observation of all rolls for defects and for damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected. The CQA Firm shall advise the Project Manager, in writing, or any rolls or portions of rolls, which should be rejected and removed from the site because they have severe flaws, and/or minor repairable flaws.

2. The CQA Firm shall examine each panel, after placement and prior to seaming, for damage and/or defects. The CQA Firm shall advise the Project Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels, or portions of damaged panels, which have been rejected shall be marked and their removal from the work area recorded by the CQA Firm. Repairs shall be made using procedures described in 3.06 of this section.

G. Writing on the Liner

To avoid confusion, the Installer and the CQA Firm shall each use different colored markers or other materials approved by the Project Manager that are

readily visible for writing on the geomembrane. The markers used must be semi-permanent and compatible with the geomembrane. The Installer shall use a white marker to write on the geomembrane while the CQA Firm shall use a yellow marker.

3.03 FIELD SEAMING

A. Seam Layout

1. Before installation begins, the Installer shall provide the Project Manager and the CQA Firm's with a panel layout drawing. The drawing shall present all the proposed seams of the lining system at the facility. The CQA Engineer shall review the panel layout drawing and verify that it is consistent with accepted industry standards.

2. In general, seams should be oriented parallel to the line of maximum slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam should be less than five feet from the toe or crest of the slope, or from areas of potential stress concentrations, unless otherwise authorized by the Project Manager.

3. Horizontal seams shall be allowed under the following conditions:

   a. Seams are offset in adjacent panels by one panel width.

   b. Seams are "shingled" downhill.

4. A seam numbering system compatible with the panel numbering system shall be used by the CQA Firm.

B. Accepted Seaming Methods

1. Approved processes for field seaming are fusion and extrusion welding. Proposed alternate processes shall be documented and submitted by the Installer to the Project Manager for approval. The Project Manager shall submit all documentation regarding seaming methods to be used to the CQA Firm for review.

2. Fusion Process

   a. The CQA Firm shall log ambient, seaming apparatus and geomembrane surface temperatures at appropriate intervals and report any noncompliance to the Project Manager.

   b. The CQA Firm shall also verify that:

      i. The Installer maintains on-site the number of spare operable seaming apparatus agreed at the pre-construction meeting.

      ii. Equipment used for seaming is not likely to damage the geomembrane.

      iii. The electrical generator is placed on a smooth base such that no damage occurs to the geomembrane and any fuel spills are promptly cleaned up. Fuel shall not be stored on the liner surface.

      iv. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage such that no damage occurs to the geomembrane.

      v. A movable protective layer is used as required by the Installer directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets and to prevent debris from collecting around the pressure rollers.

      vi. In general, the geomembrane panels shall be aligned to have an overlap of four to six inches for fusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

      vii. No solvent or adhesive is used.

      viii. The geomembrane is protected from damage in heavy traffic areas.

3. Extrusion Process

   a. The CQA Firm shall log ambient, seaming apparatus and geomembrane surface temperatures at appropriate intervals and report any noncompliance to the Project Manager.

b. The CQA Firm shall also verify that:

i. The Installer maintains on-site the number of spare operable seaming apparatus agreed at the pre-construction meeting.

ii. Equipment used for seaming is not likely to damage the geomembrane.

iii. Prior to beginning a seam, the extruder is purged until all heat degraded extrudate has been removed from the barrel.

iv. Clean and dry welding rods or extrudate pellets are used.

v. The electric generator is placed on a smooth base that no damage occurs to the geomembrane.

vi. Grinding is completed no more than one hour prior to seaming.

vii. A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage such that no damage occurs to the geomembrane.

viii. The geomembrane is protected from damage in heavy traffic areas.

ix. Exposed grinding marks adjacent to an extrusion weld shall be minimized. In no instances shall exposed grinding marks extend more than 1/inch from the finished seamed area.

x. In general, the geomembrane panels are aligned to have a nominal overlap of three inches for extrusion welding. In any event, the final overlap shall be sufficient to allow peel tests to be performed on the seam.

xi. No solvent or adhesive is used.

xii. The procedure use to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any temporary welding apparatus is controlled such that the geomembrane is not damaged.

C. Seam Preparation

1. The CQA Firm shall verify that prior to seaming; the seam area is clean and free of moisture, dust, dirt, debris or foreign material of any kind. If seam overlap grinding is required, the CQA Firm must ensure that the process is completed according to the Manufacturer's instructions within one hour of the seaming operation, and in a way that does not damage the geomembrane. The CQA Firm shall also verify that seams are aligned with the fewest number of wrinkles and "fishmouths".

D. Trial Seams

1. Trial seams shall be made on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming. Such trial seams shall be made at the beginning of each seaming period, and at least once each five hours, for each production seaming apparatus used that day. Trial seams shall be made under the same conditions as production seams.

2. The trial seam sample shall be at least five feet long by one foot wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as indicated in Section 3.03 B. Three specimens shall be cut from the sample with one-inch wide die.

3. The specimens shall be tested in peel and shear using a field tensiometer. The tensiometer shall be capable of maintaining a constant jaw separation rate of two inches per minute. They should not fail in the seam as described in Section 3.05 E. If a specimen fails, the entire trial seam operation shall be repeated. If the additional specimen fails, the seaming apparatus and 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. The CQA Firm shall observe all trial seam procedures.

4. The remainder of the successful trial seam sample shall be retained until project completion in the CQA Firm's archives for possible laboratory testing. Each sample shall be assigned a number and marked accordingly by the CQA Firm, who shall also log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description.

5. If agreed upon by the Project Manager and the CQA Engineer, and documented by the CQA Engineer in his daily report, the remaining portion of the trial seam sample can be subjected to destructive testing as indicated in Section 3.05 F. If a trial seam sample fails a test conducted by the CQA

Laboratory, then a destructive seam test sample shall be taken from each of the seams completed by the seamer during the **shift related the subject trial** seam. These samples shall be forwarded to the CQA Laboratory and, if they fail the tests, the procedure indicated in Section 3.05 G shall apply. The conditions of this paragraph shall be considered satisfied for a given seam if a destructive seam test sample has already been taken.

E. General Seaming Procedures

1. During general seaming, the CQA Firm shall ensure the following:

   a. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of six inches beyond the cut in all directions.

   b. If seaming operations are carried out at night, adequate illumination shall be provided.

   c. Seaming shall extend to the outside edge of panels placed in the anchor trench.

   d. All cross seam tees should be extrusion welded to a minimum distance of four inches on each side of the tee.

   e. A firm substance may be required to be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

   The CQA Firm shall verify that the above seaming procedures or any other procedures agreed upon and indicated in the project Quality Assurance Plan are followed, and shall inform the Project Manager of any nonconformance.

F. Seaming Weather Conditions

1. Cold Weather Conditions

   a. To ensure a quality installation, if seaming is conducted when the ambient temperature is below 32° F, the following conditions shall be met:

i. Geomembrane surface temperatures shall be determined by the CQA Firm at intervals of at least once per 100 feet of seam length to determine if preheating is required. For extrusion welding, preheating is required if the surface temperature of the geomembrane is below 32° F.

ii. For fusion welding, preheating may be waived by the Project Manager based on a recommendation for the CQA Engineer, if the Installer demonstrates to the CQA Engineer's satisfaction that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.

iii. If preheating is required, the CQA Firm shall observe all areas of geomembrane that have been preheated by a hot air device prior to seaming, to ensure that they have not been overheated.

iv. Care shall be taken to conform that wind chill does not adversely affect the pre-heat requirements specified for welding. It may be necessary to provide wind protection for the seam area.

v. All preheating devices shall be approved prior to use by the Project Manager.

vi. Sheet grinding may be performed before preheating, if applicable.

vii. Trial seaming, as described in Section 3.04 D, shall be conducted under the same ambient temperature conditions as the production seams. At the option of the CQA Firm, additional destructive tests may be required for any suspect areas.

3.04 NON-DESTRUCTIVE SEAM TESTING

A. Concept

The Installer shall nondestructively test all field seams over their full length using an air pressure test (for double fusion seams only), a vacuum test or other approved method. Air pressure testing and vacuum testing are described in Sections 3.04 B and 3.04 C, respectively. The purpose of nondestructive tests is to check the continuity of seams. It does not provide quantitative information on seam strength. Nondestructive testing shall be carried out as the seaming work

progresses, not at the completion of all field seaming. For all seams, the CQA Firm shall:

1. Observe nondestructive testing procedures.
2. Record location, data, test unit number, name of tester, and outcome of all testing.
3. Inform the Installer and Project Manager of any required repairs.

B. Air Pressure Testing

1. Air pressure testing is applicable to double fusion welding which produces a double seam with an enclosed space.

   a. The equipment for air pressure testing shall consist of the following:

      i. An air pump (manual or motor driven), equipped with pressure gauge and capable of generating and sustaining a pressure between 25 and 30 psi and mounted on a cushion to protect the geomembrane.

      ii. A rubber hose with fittings and connections.

      iii. A sharp hollow needle or other pressure feed device, approved by Project Manager.

   b. The following procedures shall be followed:

      i. Seal both ends of the seam to be tested.

      ii. Insert needle or other approved pressure feed device into the air channel created by the fusion weld.

      iii. Insert a protective cushion between the air pump and the geomembrane.

      iv. Pressurize the air channel to a pressure of approximately 30 psi. Close valve, allow two minutes for pressure to stabilize, and sustain pressure for at least five minutes.

      v. If loss of pressure exceeds the maximum permissible pressure differential as outlined in the project specifications or does not stabilize, locate faulty area and repair in accordance with Section 3.06 C.

      vi. Cut opposite end of tested seam area once testing is completed to verify continuity of the air channel. If air does not escape, locate

blockage and retest unpressurized area. Seam the cut end of the air channel.

vii. Remove needle or other approved pressure feed device and seal the hole in the geomembrane.

C. Vacuum Testing

1. Vacuum testing is applicable to extrusion welding and to non-seam areas of the liner.

a. The equipment shall consist of the following:

i. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a porthole or valve assembly, and a vacuum gauge.

ii. A pump assembly equipped with a pressure controller and pipe connections.

iii. A rubber pressure/vacuum hose with fittings and connections.

iv. A soapy solution. (CQA Firm shall ensure solution makes bubbles when air is passed through. Windshield washer fluid shall be used as anti-freeze in cold weather.)

v. A bucket and wide paintbrush, or other means of applying the soapy solution.

b. The following procedures shall be followed:

i. Wet a strip of geomembrane approximately 12 inches by 48 inches with the soapy solution.

ii. Place the box over the wetted area.

iii. Close the bleed valve and open the vacuum valve.

iv. Ensure that a leak-tight seal is created.

v. Energize the vacuum/venturi pump and reduce the applied pressure to approximately five psi (10 in of Hg) gauge.

vi. For a minimum of ten seconds, apply vacuum with the box placed and maintaining a seal, examine the geomembrane through the viewing window for the presence of soap bubbles.

vii. If no bubble appears after ten seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum three inches overlap, and repeat the process.

viii. All areas where soap bubbles appear shall be marked and repaired in accordance with Section 3.06 C. D. Test Failure Procedures.

2. The Installer shall complete any required repairs in accordance with Section 3.06. For repairs, the CQA Engineer shall:

   a. Observe the repair and testing of the repair.

   b. Mark on the geomembrane that the repair has been made.

   c. Document the repair procedures and test results.

3.05 DESTRUCTIVE SEAM TESTING

A. Concept

1. The purpose of destructive tests is to evaluate seam strength. Destructive seam tests shall be performed at selected locations. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

B. Location and Frequency

1. The CQA Firm shall select where seam samples will be cut out for laboratory testing. The frequency and locations shall be established as follows:

   a. A minimum frequency of one test location per 500 feet of production seam length. This frequency is to be determined as an average taken throughout the entire facility.

   b. Test locations shall be determined during seaming at the CQA Firm's discretion. Special consideration shall be given to locations where the potential for imperfect welding, such as overheating, contamination, and offset welds exist.

2. The Installer shall not be informed in advance of the locations where the seam samples will be taken.

C. Sampling Procedures

1. The Installer shall cut samples at locations chosen by the CQA Firm as the seaming progresses so that laboratory test results are available before the geomembrane is covered by another material. The CQA Firm shall:

a. Observe sample cutting.

b. Assign a number to each sample, and mark it accordingly.

c. Record sample location on layout drawing.

d. Record reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

2. All holes in the geomembrane resulting from destructive seam sampling shall be repaired in accordance with repair procedures described in Section 3.06 C immediately following receipt of successful test results. The continuity of the new seams in the repaired area shall be tested according to Section 3.04 C.

D. Sample Dimensions

1. At each sampling location, two types of samples shall be taken by the Installer. First, two specimens for field-testing should be taken. Each of these samples shall be cut with a one inch wide die, with the seam centered parallel to the width. The distance between these two samples shall be 30 inches. If both samples pass the field test described in Section 3.05 E, a sample for laboratory testing shall be taken.

2. The sample for laboratory testing shall be located between the samples for field-testing. The sample for laboratory testing shall be 12 inches wide by 30 inches long with the seam centered lengthwise. The sample shall be cut into two parts and distributed as follows:

a. One 12 inches wide by 18 inches long portion for conformance testing by the CQA Laboratory.

b. One 12 inches wide by 12 inches long portion to the CQA Firm.

3. Final determination of the sample sizes shall be made at the pre-construction meeting.

E. Field Testing

1. The three one inch wide specimens mentioned in Section 3.03 D and Section 3.05D shall be tested in the field using a tensiometer for peel and shear and shall not fail according to the criteria in the project specifications. The tensiometer shall be capable of maintaining a constant jaw separation rate of two inches per minute. If the test passes in accordance with this section, the sample qualifies for testing in the laboratory. If it is non-conforming, the seam should be repaired in accordance with Section 3.05 G. Final judgment

regarding seam acceptability, based on the conformance criteria provided in the project specifications, rests with the CQA Engineer.

2. The CQA Firm shall witness all field tests and mark all samples and portions with their number. The CQA Firm shall also log the date and time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail description, and attach a copy to each sample portion.

F. Laboratory Testing (on or off-site)

1. Destructive test samples shall be packaged and shipped, if necessary, under the responsibility of the CQA Firm in a manner, which will not damage the test sample. The sample shall be shipped as soon as possible to expedite laboratory testing. The CQA Firm will be responsible for storing the archive samples. Test samples shall be tested by the CQA Laboratory.

2. Testing shall include seam strength and peel adhesion (ASTM D4437). The minimum acceptable values to be obtained in these tests are provided in Section 2.02 D. At least four specimens shall be tested successfully, each in both shear and peel. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear). A passing test shall meet the minimum acceptable values in at least four of the five specimens tested for each method.

3. The CQA Laboratory shall provide test results within 24 hours of receiving the samples. The CQA Engineer shall review laboratory test results as soon as they become available, and make appropriate recommendations to the Project Manager.

G. Destructive Test Failure

1. When a sample fails a destructive test, whether that test is conducted by the CQA Laboratory or by field tensiometer, the Installer has two options:

   a. The Installer can repair the seam between any two passing destructive test locations.

   b. The Installer can trace the welding path to an intermediate location ten feet minimum from the point of the failed test in each direction and take a sample with a one inch wide die for an additional field test at each location. If these additional samples pass the test, then full laboratory

samples are taken. If these laboratory samples pass the tests, then the seam is repaired between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be repaired.

2. All acceptable repaired seams shall be bound by two locations from which samples passing laboratory destructive tests have been taken. Passing laboratory destructive tests of trial seam samples taken as indicated in Section 3.03 D may be used as a boundary for the failing seam. In cases exceeding 150 feet of repaired seam, a sample taken from the zone in which the seam has been repaired must pass destructive testing. Repairs shall be made in accordance with Section 3.06.

3. The CQA Firm shall document all actions taken in conjunction with destructive test failures.

3.06 DEFECTS AND REPAIRS

A. Identification

1. All seams and non-seam areas of the geomembrane shall be examined by the CQA Firm for identification of defects, holes, blisters, undispersed raw materials, large wrinkles and any sign of contamination by foreign matter. The geomembrane surface shall be cleaned by the Installer prior to examination if the CQA Firm determines that the amount of dust or mud inhibits examination.

B. Evaluation

1. Each suspect location both in seam and non-seam areas shall be nondestructively tested using the methods described in Section 3.04. Each location, which fails the nondestructive testing, shall be marked by the CQA Firm and repaired by the Installer. Work shall not proceed with any materials, which will cover locations, which have been repaired until successful nondestructive and/or laboratory tests are obtained.

2. When seaming of the geomembrane is completed, and prior to placing overlying materials, the CQA Firm shall indicate to the Project Manager any large wrinkles, which should be cut and reseamed by the Installer. The number of wrinkles to be repaired should be kept to an absolute minimum. Therefore, wrinkles should be located during the coldest part of the installation period, while keeping in mind the forecasted weather to which the uncovered geomembrane may be exposed. Wrinkles are considered to be large when

the geomembrane can be folded over on to itself, which is generally a wrinkle that extends 12 inches from the subgrade. Seams produced while repairing wrinkles shall be nondestructively tested.

3. When placing overlying material on the geomembrane, every effort must be made to minimize wrinkle development. If possible, cover should be placed during the coolest weather. In addition, small wrinkles should be isolated and covered as quickly as possible to prevent their growth. The placement of cover materials shall be observed by the CQA Firm to ensure that wrinkle formation is minimized and that, in all cases, the geomembrane is not folded over on itself.

C. Repair Procedures

1. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the Project Manager, Installer, Designer, and CQA Firm.

   a. The repair procedures available include:

      i. Patching, used to repair holes, tears, undispersed raw materials, and contamination by foreign matter.

      ii. Spot welding used to repair pinholes, or other minor, localized flaws.

      iii. Capping, used to repair large lengths of failed seams.

      iv. Extrusion welding the flap, used to repair areas of inadequate fusion seams which have an exposed edge.

      v. Removing bad seam and replacing with a strip of new material welded into place.

   b. For any repair method, the following provisions shall be satisfied:

      i. Surfaces of the geomembrane which are to be repaired using extrusion methods shall be ground no more than one hour prior to the repair.

      ii. All surfaces shall be clean and dry at the time of repair.

      iii. All seaming equipment used in repairing procedures shall meet the requirements of the project Quality Assurance Plan.

iv. Patches or caps shall extend at least six inches beyond the edge of the defect and all corners of patches shall be rounded with a radius of approximately three inches.

D. Repair Verification

1. The CQA Firm shall observe all nondestructive testing of repairs and shall record the number of each repair, date and test outcome. Each repair shall be nondestructively tested using the methods described in Section 3.04 as appropriate. Repairs, which pass the nondestructive test, shall be taken as an indication of an adequate repair. Repairs more than 150 consecutive feet long require destructive test sampling. Failed tests require that the repair shall be redone and retested until a passing test result.

3.07 GEOMEMBRANE PROTECTION

A. The quality assurance procedures indicated in this Section are intended only to assure that the installation of adjacent materials does not damage the geomembrane. The quality assurances of the adjacent materials themselves are covered in separate Sections of this manual.

B. Soils

1. A copy of the project specifications prepared by the Designer for placement of soils shall be given to the CQA Engineer by the Project Manager. The CQA Engineer shall verify that these project specifications are consistent with geosynthetic state-of-practice such as:

a. Placement of soils on the geomembrane shall not proceed at an ambient temperature below 32° F nor above 104° F unless otherwise specified.

b. Placement of soil on the geomembrane should be done during the coolest part of the day to minimize the development of wrinkles in the geomembrane.

c. Equipment used for placing soil shall not be driven directly on the geomembrane.

d. A minimum thickness of one foot of soil is specified between a light dozer, ground pressure of five-psi or lighter, and the geomembrane.

e. In any areas traversed by construction traffic (any vehicles other than deployment equipment approved by the Project Manager) the soil

layer shall have a minimum thickness of three feet. This requirement may be waived if provisions are made to protect the geomembrane through an engineered design. Drivers shall proceed with caution when on the overlying soil and prevent spinning of tires or sharp turns.

2. The CQA Firm shall measure soil thickness and verify that the required thickness is present. The CQA Firm must also verify that final thickness is consistent with the design and verify that placement of the soil is done in such a manner that geomembrane damage is unlikely. The CQA Engineer shall inform the Project Manager if the above conditions are not fulfilled.

C. Sumps and Appurtenances

1. A copy of the plans and project specifications prepared by the Designer for sumps and appurtenances shall be given by the Project Manager to the CQA Firm. The CQA Firm shall review these plans and verify that:
   a. Installation of the geomembrane in sump and appurtenant areas, and connection of geomembrane to sumps and appurtenances have been made according to project specifications.
   b. Extreme care is taken while welding around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas.
   c. The geomembrane has not been visibly damaged while making connections to sumps and appurtenances.
   d. A representative of the CQA Firm shall be present at all times when the Installer is welding geomembrane to appurtenant structures.

2. The CQA Firm shall inform the Project Manager in writing if the above conditions are not fulfilled.

D. Concrete

1. A copy of the project specifications prepared by the Designer for placement of concrete shall be given by the Project Manager to the CQA Firm. The CQA Firm shall verify that these specifications are consistent with the state-of practice, including the use of geosynthetic layers between concrete and geomembrane. The CQA Firm shall verify that geosynthetic layers are placed between the concrete and the geomembrane according to design specifications. The CQA Firm will also verify that construction methods used are not likely to damage the geomembrane.

E. For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test seam. The Geomembrane Installer shall then take more destructive test portions at locations indicated by the CQA Firm and the same laboratory tests required of test seams shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip. The cap-strip shall be non-destructively tested and repaired, as required, until adequacy of the seams is achieved.

F. A passing non-destructive test of field seams and repairs shall be considered to indicate the adequacy of field seams and repairs.

3.08 ANCHOR TRENCH

Construct as specified in Section 02220.

3.09 DISPOSAL OF SCRAP MATERIALS

On completion of installation, the Geomembrane Installer shall dispose of all trash and scrap material in a location approved by the Owner, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner. No scrap material shall be allowed to remain on the geomembrane surface.

END OF SECTION

SECTION 02278
GEOTEXTILES AND GEOCOMPOSITES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes furnishing and installing geotextile and geocomposite as part of the Landfill bottom liner and leachate collection construction.

1.02 REFERENCES

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

1. ASTM D 413, Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate.
2. ASTM D 7179, Standard Test Method for Determining Geonet Breaking Force.
3. ASTM D 1505, Standard Test Method for Density of Plastics by the Density Gradient Technique.
4. ASTM D 1603, Standard Test Method for Carbon Black in Olefin Plastics.
5. ASTM D 7005, Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites.
6. ASTM D 3786, Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Busting Strength Tester Method.
7. ASTM D 4218, Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
8. ASTM D 4354, Standard Practice for Sampling of Geosynthetics for Testing.
9. ASTM D 4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
10. ASTM D 4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
11. ASTM D 4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.

12. ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

13. ASTM D 4716, Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.

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

15. ASTM D 4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

16. ASTM D 5199, Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

17. ASTM D 5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

1.03 SUBMITTALS

A. Submit the following to the CQA Engineer, for review and approval, no later than 14 calendar days prior to scheduled shipment of geotextile and geocomposites:

1. Documentation of manufacturers' qualifications as specified in subsection 1.04.A of this Section.

2. Manufacturer's quality control program manual or descriptive documentation.

3. List of material properties and samples of the material.

4. Manufacturers' certification that the products to be furnished will comply with all product specifications in this section.

5. Documentation of installers' qualifications, as specified in subsection 1.04.13 of this Section.

B. Submit the following to the CQA Engineer for review and approval no later than one calendar day prior to shipment of the products:

1. The manufacturers' quality control certifications, including results of source quality control testing of the products, as specified in subsection 2.01 of this Section, to verify that the materials supplied for the project are in compliance with all product specifications in this Section. The certifications shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or

Technical Services Manager. Certifications shall include lot and roll numbers, and corresponding shipping information.

C. No geotextile or geocomposite shall be deployed until the manufacturer's quality control certifications are submitted to and approved by the CQA Engineer. Should the material be deployed prior to CQA Engineer's approval, it shall be at sole risk of the Installer and Contractor, and if the material does not meet project specifications, it shall be removed from the project at the expense of the Contractor.

1.04 QUALITY ASSURANCE/QUALITY CONTROL

A. Manufacturer's Qualifications: The manufacturers shall be specialists in the manufacture of geotextile and/or geocomposite, as applicable. Geotextile and drainage geocomposite manufacturers shall have at least five years experience in the manufacture of such material.

B. Installer's Qualifications

1. The Installer shall be the manufacturer or an approved contractor trained and licensed (if applicable) to install the manufacturer's product.

2. The Installer shall have at least five years experience in the installation of the product. The Installer shall have installed at least 1 million square feet of the product during the last five years or shall provide to the CQA Engineer satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the product will be installed in a competent, professional manner.

C. Owner shall retain the services of independent inspection and testing firms (Geosynthetics Quality Assurance Firm and Geosynthetics Quality Assurance Laboratory) to check conformance of the materials and installation with the specifications.

D. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store material off of ground, rolled and covered to protect from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

B. Rolls shall be marked or tagged with the following information:

1. Manufacturer's name
2. Product identification
3. Lot number
4. Roll number
5. Roll dimensions

C. Replace defective or torn material at no cost to the Owner.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. The following test methods and frequencies shall be used, at a minimum, by the manufacturer for the quality assurance and control of the geotextiles and geocomposites prior to shipment of each product. Sampling and testing frequency shall conform to ASTM D 4354. Every effort shall be made to minimize the number of lots of each geosynthetic for use in the project.

B. Geotextile Manufacturing QC

1. Geotextile Tests:

a. Mass Per Unit Area - ASTM D 5261

b. Grab Tensile Strength and Grab Tensile Elongation - ASTM D 4632

c. Thickness – ASTM D5199

d. Puncture Resistance - ASTM D 6241

e. Apparent Opening Size - ASTM D 4751

f. Permittivity - ASTM D 4491

g. Trapezoid Tear Strength - ASTM D 4533

h. Mullin Burst – ASTM D3786

Frequency: Minimum of one test per 100,000 square feet and minimum of one test per lot.

C. Geocomposite (geotextile/geonet/geotextile) Manufacturing QC

1. Tests for Geonet Component:

a. Polymer Density - ASTM D 1505
b. Carbon Black Content - ASTM D 4218 or 1603
c. Transmissivity (at gradient = 0.1 and pressure = 10,000 psf) - ASTM D 4716
d. Peak Tensile Strength - ASTM D 7179
e. Thickness – ASTM D5199

Frequency: Minimum of one test per 100,000 square feet and minimum of one test per lot for all except ASTM D 4716, which shall be tested once per 100,000 square feet and minimum of one test per lot.

2. Tests for Geotextile Portion of Geocomposite: same as Section 2.01 B, above. Tests shall be run on product prior to adhering to geonet.

Frequency: Minimum of one test per 100,000 square feet and minimum of one test per lot.

D. For manufacturer's quality control testing of geotextiles and geocomposites, the sample average test results (weaker principle direction for mechanical tests) for a particular property for any individual roll tested within a lot designated as first quality shall meet or exceed the Minimum Average Roll Value indicated in the manufacturer's certification.

2.02 GEOTEXTILE

A. The geotextile shall be a continuous filament polyester or polypropylene nonwoven needle-punched fabric. The fabric shall be inert to commonly encountered chemicals, biological degradation, hydrocarbons, acids, alkalines and mildew. The fabric shall be resistant to rot, ultraviolet light, insects and rodents.

B. The polyester or polypropylene filaments shall be formed into a stable network such that the filaments retain their relative position.

C. Geotextile for leachate collection trenches shall conform to the following minimum requirements:

TABLE 02278-1
GEOTEXTILE PROPERTIES

Fabric Property	Unit	Test Method	Min. Avg. Roll Value *
Fabric Weight	oz/sq yd	ASTM D 5261	$\geq$ 10
Grab Strength	Lbs	ASTM D 4632	270
Grab Elongation	%	ASTM D 4632	50
Trapezoid Tear Strength	Lbs	ASTM D 4533	100
Puncture Resistance	Lbs	ASTM D 6241	725
Permittivity, T	Sec^{-1}	ASTM D 4491	0.94
AOS (largest opening size)	Sieve Size	ASTM D 4751	100

*Weakest Principal Direction

D. Minimum roll width shall be 12.5 feet. The roll length shall be maximized in order to minimize seams.

2.03 GEOCOMPOSITE

A. Geocomposite shall be composed of a geonet core material with non-woven geotextile attached to each side of the geonet.

B. The geonet portion of the geocomposite shall be extruded, as a continuous web comprised of two strands of polyethylene to form a three-dimensional structure to provide planar water flow, and conforming to the following minimum requirements:

TABLE 02278-2
GEONET PROPERTIES

Geonet Properties	Unit	Test Method	Min. Avg. Roll Value
Thickness	mil	ASTM D5199	250
Polymer Density	g/cm^3	ASTM D1505	0.94
Peak Tensile Strength (1)	lb/in	ASTM D7179	45
Transmissivity (2)	m^2/s	ASTM D4716	2.5×10^{-3}
Carbon Black Content	%	ASTM D1603	2

(1) Machine direction.

(2) Measured using water @ 21 $\pm$ 2°C with a gradient of 0.1, between two steel plates, after 15 minutes. Confining pressure 10,000 psf.

C. Geotextile used as part of the geocomposite shall conform to the following minimum requirements:

TABLE 02278-3
GEOTEXTILE PROPERTIES

Fabric Property	Unit	Test Method	Min. Avg. Roll Value *
Fabric Weight	oz/sq yd	ASTM D 5261	$\geq$ 6
Grab Strength	lbs	ASTM D 4632	160
Water Flow Rate	gpm/ft^2	ASTM D 4491	125
Trapezoidal Tear Strength	lbs	ASTM D 4533	65
AOS (largest opening size)	Sieve Size	ASTM D 4751	70

* Weakest Principal Direction

D. The geocomposite shall be manufactured by heat bonding the geotextile continuously to the geonet on both sides. No burn through geotextiles shall be permitted. No glue or adhesive shall be permitted.

E. The finished geocomposite product shall conform to the following minimum requirements:

TABLE 02278-4
GEOCOMPOSITE PROPERTIES

Geocomposite Properties	Unit	Test Method	Min. Avg. Roll Value (1)
Ply Adhesion	Lb/in	ASTM D 7005	0.5
Transmissivity(2)	m^2/s	ASTM D 4716	1 X 10^{-4}

(1) Machine direction.

(2) Measured using water @ 20 $\pm$ 2°C with a gradient of 0.1, between two steel plates, after 15 minutes. Confining pressure 10,000 psf.

F. The bond between the geotextile and the geonet shall exhibit a minimum peel strength of one-half pound per inch, and an average peel strength of one pound per inch in accordance with ASTM D 7005.

G. Minimum roll width of the geocomposite shall be 10 feet.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Conformance Testing for Geotextile and Geocomposite Products:

1. Conformance testing samples shall be taken by the independent testing firm upon delivery of each product to site.

2. Samples shall be taken at the following frequency: a minimum of one test per 100,000 square feet and minimum of one test per lot.

3. Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width.

4. Each sample shall be identified by manufacturer's name, product identification, lot number, roll dimensions, and roll number. The machine direction shall be noted on the samples with a waterproof marker.

5. As a minimum, the following tests shall be performed for the geotextile product (not part of geocomposite):

   a. Fabric Weight - ASTM D 5261
   b. Grab Strength and Grab Elongation - ASTM D 4632
   c. Trapezoidal Tear Strength - ASTM D 4533
   c. Puncture Resistance - ASTM D 6241
   d. Permittivity - ASTM D 4491
   e. Apparent Opening Size - ASTM D 4751

6. The following tests shall be performed for the finished geocomposite product:

   a. Transmissivity (Gradient= 0.1 at 10,000 psf - ASTM D 4716)
   b. Geotextile Adhesion to Geonet - ASTM D 7005

B. The CQA Firm shall ensure that the geotextiles and the geocomposite are installed according to manufacturer recommendations and the Contract Documents. The CQA Firm shall observe and document the installation activities.

3.02 PREPARATION

Surfaces to receive geotextile and geocomposites shall be smooth and free of litter, sharp protrusions, and large stones.

3.03 GEOTEXTILE INSTALLATION

A. General

1. All geotextiles shall be weighted with sandbags or the equivalent when required. Such sandbags shall be installed during placement and shall remain until replaced with cover material.

B. Installation

1. The geotextile shall be placed where shown on the Drawings, and placed in such a manner that placement of overlying material will not excessively stretch or tear the fabric.
2. On side slopes, the rolls shall be continuous for the full height of slope, without joints.
3. Overlapping of panels without seaming will be allowed in the leachate collection system and leak detection collection system.
4. Overlapped seams shall have a minimum overlap of 12 inches.

C. Seaming

1. Seaming shall be by sewing, adhesives, fusion or other approved bonds. All seams shall be continuously seamed. Spot seaming may only be considered as a measure against wind uplift. Overlaps shall be oriented in the direction of earth filling. No horizontal seaming shall be allowed on slopes steeper than 10 horizontal to 1 vertical.

2. Any sewing shall be done using polymeric thread with chemical properties equal to or exceeding those of the geotextile.

3.04 GEOTEXTILE REPAIR

A. Holes or tears in the fabric shall be repaired as follows:

1. On steep slopes (steeper than 10 to 1): A fabric patch shall be sewn into place using a double sewn lock stitch (1/4 inch to 3/4 inch apart and no closer than one inch from any edge). Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced.

2. Flat Areas (flatter than 10 to 1): A fabric patch shall be spot-seamed in place with a minimum of 36 inches of overlap beyond the perimeter of the tear or damage in all directions.

B. Care shall be taken to remove any soil or other material, which may have penetrated through the torn geotextile.

3.05 GEOCOMPOSITE INSTALLATION

A. Care shall be taken to keep the geocomposite clean and free from debris prior to installation.

B. The geonet portion of the geocomposite between adjacent rolls shall be overlapped by at least four inches.

C. The geonet overlaps shall be tied with plastic fasteners. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

D. The plastic ties shall be installed every five feet along the length at adjacent rolls, every six inches in the anchor trench and every six inches along end-to-end seams.

E. In general, no horizontal seams shall be allowed on side slopes, except as part of a patch. When horizontal seams are necessary, they shall be offset in adjacent panels and shall be "shingled" downhill.

F. The top geotextile of the geocomposite shall be overlapped, and sewn or heat-fused along the entire length of joints in accordance with the manufacturer's recommendations, and sufficient to prevent opening by wind action.

G. At locations where the geocomposite is damaged and soil penetrates the geocomposite material, it shall be removed and replaced with clean, unused geocomposite material.

H. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite.

I. During placement of the geocomposite, care shall be taken not to entrap, in or beneath the geotextile portion of the material, stones, excessive dust, or moisture that could damage the geomembrane, cause clogging of drains or filters, or hamper subsequent seaming.

END OF SECTION

SECTION 02279
GEOTEXTILE USED IN SUBGRADE

1.0 GENERAL

1.1 SECTION INCLUDES

A. Geotextile to stabilize and reinforce an aggregate cover material (subbase, base, select embankment, etc.) of an unpaved roadway. The stabilization and reinforcement application is appropriate for unpaved roadways constructed over soft subgrade soils with a California Bearing Ratio (CBR) less than 3 (CBR <3) (shear strength less than approximately 90 kPa).

1.2 RELATED SECTIONS

A. Section 02050 - Basic Site Materials and Methods

B. Section 02100 - Site Remediation

C. Section 02200 - Site Preparation

D. Section 02300 - Earthwork

E. Section 02700 - Bases, Ballasts, Pavements, and Appurtenances

1.3 UNIT PRICES

A. Method of Measurement: See Construction Documents

1.4 REFERENCES

A. AASHTO Standards:

1. T88 - Particle Size Analysis of Soils
2. T90 - Determining the Plastic Limit and Plasticity Index of Soils
3. T99 - The Moisture-Density Relations of Soils Using a 5.5lb (2.5 kg) Rammer and a 12in (305 mm) Drop.
4. M288-96 - Geotextile Specification for Highway Applications

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

1. D 123 - Standard Terminology Relating to Textiles
2. D 276 - Test Method for Identification of Fibers in Textiles

3. D 3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics
4. D 4354 - Practice for Sampling of Geosynthetics for Testing
5. D 4355 - Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
6. D 4439 - Terminology for Geotextiles
7. D 4491 - Test Methods for Water Permeability of Geotextiles by Permittivity
8. D 4533 - Test Method for Index Trapezoid Tearing Strength of Geotextiles
9. D 4595 - Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
10. D 4632 - Test Method for Grab Breaking Load and Elongation of Geotextiles
11. D 4751 - Test Method for Determining Apparent Opening Size of a Geotextile
12. D 4759 - Practice for Determining the Specification Conformance of Geosynthetics
13. D 4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
14. D 4873 - Guide for Identification, Storage, and Handling of Geotextiles
15. D 5141 - Test Method to Determine Filtering Efficiency and Flow Rate for Silt Fence Applications Using Site Specific Soils

C. Federal Highway Administration (FHWA) - Geosynthetic Design and Construction Guidelines, Publication No. FHWA HI-95-038, May 1995.

D. American Association for Laboratory Accreditation (A2LA).

E. Geosynthetic Accreditation Institute (GAI) - Laboratory Accreditation Program (LAP).

F. National Transportation Product Evaluation Program (NTPEP).

1.5 DEFINITIONS

A. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

1.6 SUBMITTALS

A. Submit the following :

1. Certification: The contractor shall provide to the Engineer a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile. The Certification shall state that the furnished geotextile meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the Manufacturer.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Geosynthetic Accreditation Institute (GAI) - Laboratory Accreditation Program (LAP)

2. American Association for Laboratory Accreditation (A2LA)

1.8 DELIVERY, STORAGE, AND HANDLING

A. Geotextiles labeling, shipment, and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.

C. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are

strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geotextile.

2.0 PRODUCTS

2.1 MANUFACTURERS

A. Mirafi Construction Products
365 South Holland Drive
Pendergrass, GA, USA 30567
1-888-795-0808
1-706-693-2226
1-706-693-2083, fax
www.mirafi.com

2.2 MATERIALS

A. Geotextile:

1. The geotextile shall be woven from high-tenacity long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

2. The geotextile shall meet the requirements of Table 1. All numeric values in Table 1 except AOS represent MARV in the specified direction. Values for AOS represent maximum average roll values.

TABLE 1 - SUBGRADE STABILIZATION GEOTEXTILE

Property	Test Method	Units	Required Value	
Reinforcement Properties			MD[1]	CD[1]
Ultimate Tensile Strength	ASTM D 4595	kN/m (lbs/ft)	47.3 (3240)	39.4 (2700)
Tensile Strength @ 2% Strain	ASTM D 4595	kN/m (lbs/ft)	7.9 (540)	7.9 (540)
Tensile Strength @ 5% Strain	ASTM D 4595	kN/m (lbs/ft)	19.8 (1356)	19.8 (1356)
Coefficient of Interaction -Ci (sand)	ASTM D 5321	--	0.8	
Permittivity	ASTM D 4491	sec^{-1}	0.52	
Apparent Opening Size	ASTM D 4751	mm (U.S. Sieve)	0.6 (30)	
Sewn Seam Strength[2]	ASTM D 4884	kN/m (lbs/ft)	24.6 (1688)	
Survivability Index Values			MD[1]	CD[1]
Grab Tensile Strength	ASTM D 4632	N (lbs)	1780 (400)	1100 (250)
Tear Strength	ASTM D 4533	N (lbs)	800 (180)	440 (100)
Puncture Strength	ASTM D 4833	N (lbs)	800 (180)	
Burst Strength	ASTM D 3786	kPa (psi)	5506 (800)	
Ultraviolet Stability (after 500 hrs)	ASTM D 4355	%	70	

[1] MD - Machine, or roll, direction; CD - Cross machine direction

[2] When sewn seams are required. Refer to **Section 3 - Execution** for overlap / seam requirements.

3. Approved geotextiles are as follows: Mirafi HP370

2.3 QUALITY CONTROL

A. Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP and A2LA for tests required for the geotextile, at frequency meeting or exceeding ASTM D 4354.

B. Sewn Seam Strength shall be verified based on testing of either conformance samples obtained using Procedure A of ASTM D 4354, or based on manufacturer's certifications and testing of quality assurance samples obtained using Procedure B of ASTM D 4354. A lot size for conformance or quality assurance sampling shall be considered to be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

C. Ultraviolet Stability shall be verified by an independent laboratory on the geotextile or a geotextile of similar construction and yarn type.

3.0 EXECUTION

3.1 PREPARATION

A. The installation site shall be prepared by clearing, grubbing, and excavation or filling the area to the design grade. This includes removal of topsoil and vegetation.

3.2 INSTALLATION

A. The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Adjacent geotextile rolls shall be overlapped, sewn or joined as required in the plans. Overlaps shall be in the direction as shown on the plans. See table below for overlap requirements.

Soil CBR	**Method of Joining**
Greater than 3	300 - 450 mm (12 - 18 in) overlap
1 - 3	600 - 1000 mm (24 - 40 in) overlap
0.5 - 1	1000 mm (40 in) overlap or sewn
Less than 0.5	Sewn
All roll ends	1000 mm (40 in) overlap or sewn

B. On curves, the geotextile may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock.

C. Prior to covering, the geotextile shall be inspected by a certified inspector of the Engineer to ensure that the geotextile has not been damaged during installation. Damaged geotextiles, as identified by the Engineer, shall be repaired immediately. Cover the damaged area with a geotextile patch which extends an amount equal to the required overlap beyond the damaged area.

D. The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed subbase aggregate. On soils with CBR>3, most rubber-tired vehicles can be driven at slow speeds, less than 16 km/h (10 mph) and in straight paths over the exposed geotextile without causing damage to the geotextile. Sudden braking and sharp turning should be avoided. Tracked construction equipment should not be operated directly upon the geotextile. A minimum fill soil thickness of 15cm (6 in) is required prior to operation of tracked vehicles over the geotextile. Turning of tracked vehicles

should be kept to a minimum to prevent tracks from displacing the fill and damaging the geotextile. Turning of vehicles shall not be permitted on the first lift above the geotextile.

E. On subgrades having a CBR value of less than 1, the subbase aggregate should be spread in its full thickness as soon as possible after dumping to minimize the potential of localized subgrade failure due to overloading of the subgrade.

F. Any ruts occurring during construction shall be filled with additional subbase material, and compacted to the specified density.

G. If placement of the backfill material causes damage to the geotextile, the damaged area shall be repaired as previously described above. The placement procedure shall then be modified to eliminate further damage from taking place.

END OF SECTION

SECTION 02505
GRAVEL ACCESS ROAD

PART 1 GENERAL

1.01 SUMMARY

A. Section includes construction of gravel access roads including grading, testing, and installation of aggregate surface course material.

B. Related Sections:

1. Section 02200 - Earthwork

1.02 REFERENCES

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

1. ASTM D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
2. ASTM D 1557, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using Ten-Pound (4.54 kg) Hammer and 18-Inch (457 mm) Drop.
3. ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
4. ASTM D 2487, Standard Test Method for Classification of Soils for Engineering Purposes.
5. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
7. ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

B. Standard Specification for Highway Construction, Arkansas State Highway and Transportation Department (AHTD), P.O. Box 2262, Little Rock, Arkansas 72203.

1. AHTD 303, Aggregate Base Course.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit written test reports of all specified tests showing conformance of the materials and constructed work with the specifications. Submit test results within three days after samples are obtained.

1.04 QUALITY ASSURANCE/QUALITY CONTROL

Owner will retain the services of an independent inspection and testing firm to determine conformance of earthwork materials and constructed work.

1.05 PROJECT CONDITIONS

A. Work shall be performed in a manner that does not disturb existing environmental monitoring wells or other site facilities not indicated to be removed within the construction limits.

B. Provide temporary controls as specified in Sections 01563 and 01565.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

Proposed materials and source of supply shall be approved for use on this project by the Engineer as specified, prior to use of the materials in the construction.

2.02 GENERAL FILL

General Fill shall be as specified in Section 02200.

2.03 AGGREGATE SURFACE COURSE MATERIAL

Naturally or artificially graded mixture of natural or crushed gravel, or crushed stone shall be free of clay balls, organic material and debris. Material shall be graded with 100 percent passing the 1-1/2 inch sieve and between 3 and 10 percent passing the Number 200 sieve (See Table 303-1 in the AHTD Standard Specification for Highway Construction for detailed particle size requirements).

PART 3 EXECUTION

3.01 PREPARATION

Prepare road subgrade to the lines, grades and elevations as shown on the Drawings, and as specified in Section 02200, subsection 3.01.

3.02 PLACEMENT OF AGGREGATE SURFACE COURSE

A. Place and grade aggregate surface course material to the dimensions shown on the Drawings.

END OF SECTION

SECTION 02631
POLYETHYLENE PRESSURE PIPE AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes installation of dual-contained high-density polyethylene (HDPE) pressure pipe and fittings.

B. Related Sections:

1. Section 02715 - Leachate System Piping

1.02 REFERENCES

A. American Society for Test

1. ASTM D 1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
2. ASTM D 2657, Standard Practice for Heat-Joining Polyolefin Pipe and Fittings.
3. ASTM D 3035, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
4. ASTM D 3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
5. ASTM D 3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
6. ASTM F 714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit manufacturer's certificates of conformance with the specifications and product data for specified pipe and fittings.

C. Submit certification of personnel training in heat fusion procedures, as specified in subsection 1.04.13 of this Section.

1.04 QUALITY ASSURANCE/QUALITY CONTROL

A. Pipe manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings specified.

B. Heat fusion of polyethylene piping shall be performed by personnel trained in the pipe manufacturers recommended procedures. Training shall have been received not more than 12 months prior to start of construction.

1.05 DELIVERY, STORAGE AND HANDLING

A. During loading, transporting, and unloading, exercise care to prevent damage to materials.

B. Pipe shall be marked with manufacturer's identification symbol, size, date of manufacture, material classification, pressure rating, standard dimension ration, and other applicable product specification identification numbering.

C. All materials shall be inspected by the Contractor upon delivery to the site. The Contractor shall notify the Engineer of any loss or damage. Damaged or defective materials shall be rejected and shall be replaced with new materials at the supplier's or Contractor's expense.

PART 2 PRODUCTS

2.01 DUAL CONTAINMENT POLYETHYLENE PIPE AND FITTINGS

A. Piping shall be a dual containment system as shown on the Drawings and as specified herein.

B. Materials used for the manufacture of polyethylene pipe and fittings shall be as follows:

1. PE3408 high density polyethylene, with a cell classification of PE345434C in compliance with ASTM D 3350, and material classification Type III, Class C, Category 5, Grade P34 in compliance with ASTM D 1248.

C. Carrier pipe and containment pipe shall be manufactured in accordance with ASTM F 714 or ASTM D 3035. Carrier pipe shall be SDR 11 with an inside

diameter of 3 inches, and containment pipe shall be SDR 26 with an inside diameter of six inches.

D. Molded fittings shall be manufactured in accordance with ASTM D 3261. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, sheet stock, or molded fittings. Each fabricated fitting shall be rated for internal pressure service equivalent to the full service pressure rating of the pipe to which it is joined.

E. Manufacturer's standard flange adapters, back-up rings and flange bolts shall be provided for a complete system.

F. The dual containment system shall consist of factory pre-fabricated components.

G. Pre-fabricated pipe and fittings shall provide a continuous annular space between the carrier and the containment piping to allow unrestricted passage of possible flow of fluid from the carrier pipe.

H. The carrier pipe shall be factory installed within the containment pipe, with support spacers secured to the carrier pipe at standard intervals. Support spacers shall be manufactured from non-metallic, corrosion resistant material.

I. Pipe shall be provided in nominal lengths of 20 feet or 40 feet, and shall allow for field adjustment of pipe length.

J. Dual containment fittings shall have the carrier-fitting factory installed within the containment fitting, with all necessary support spacers installed.

2.02 IDENTIFICATION TAPE

Shall be a three-inch or six-inch wide detectable direct burial identification tape with Caution - Pipe Buried Below.

2.03 PIPE BEDDING AND TRENCH BACKFILL MATERIALS

Specified in Section 02223.

PART 3 EXECUTION

3.01 PREPARATION - EXCAVATION

A. Excavate trenches as specified in Section 02223.

B. Examine areas to receive pipe for adherence to specified line and grade.

C. Install pipe only when acceptable conditions exist.

3.02 DUAL CONTAINMENT POLYETHYLENE PIPE INSTALLATION

A. Examine pipe and fittings before installation and assure no defective materials are incorporated. Keep inside of pipes and fittings free of dirt and debris.

B. Installation of all pipe and fittings shall be subject to the review of the Engineer.

C. Install piping as shown, as recommended by the manufacturer, in conformance with reference standards, and as specified herein.

1. Carrier to carrier joints and containment to containment joints shall be made using thermal butt fusion procedures recommended by the manufacturer.

2. Carrier joints and containment joints should be made independently of each other. However, simultaneous fusion of carrier joints and containment joints are permitted if the installer can demonstrate tight joints with no leakage when subjected to hydrostatic test pressures specified below. The Engineer shall observe jointing.

D. Field cutting of piping, where required, shall be made with a plastic pipe cutter, hack saw or other suitable tools as recommended by the manufacturer. Cuts shall be carefully done, without damage to piping, so as to leave a square end at right angles to the axis of the piping. Piping damaged by improper or careless methods of cutting shall be replaced or repaired at Contractor's expense.

E. Pipe and fittings shall be joined by heat fusion (butt fusion) or with approved mechanical fittings.

F. Only equipment approved by the pipe and fitting manufacturer(s) shall be used to make heat fusion joints.

G. Joints of plain end pipes, and joints between plain end pipes and fittings of the same material, shall be made by butt heat fusion in conformance with ASTM D 2657 and manufacturer's recommendations. When making a butt fusion joint, the equipment shall hold the heating element square to the ends of the pipe,

compress the heated ends of the pipe, and hold the pipe in proper alignment while the plastic hardens.

H. Heat fusion equipment shall be kept in good working conditions at all times. Faces of the cleaning elements shall be cleaned properly after each use.

I. Polyethylene pipe and fittings shall be joined to other materials by means of flanged connections (flange adapters and back-up rings) or mechanical couplings specially designed for polyethylene pipe connections. Mechanical couplings and flange connections shall be installed in accordance with the pipe manufacturer's recommendations, and shall be pressure rated and fully thrust restrained.

J. Pipe connections to structures shall be made as shown on the Drawings.

K. Anchorage and Blocking for Buried Pipe

1. Provide suitable concrete thrust blocking, anchors, joint connections, as shown on Drawings, and as otherwise required to prevent movement of piping causing by internal pressure in all piping tees, plugs, or bends.

2. Concrete thrust blocking shall be as specified below.

a. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms.

b. Blocking shall be placed so that the fitting joints will be accessible for repair.

L. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.

M. Request instructions from Engineer before proceeding if there is a conflict between the manufacturer's recommendation and the Drawings or Specifications.

N. Whenever pipe laying is not actively in progress, the open ends of the piping shall be closed by a temporary plug or cap to prevent soil, and other foreign matter from entering the piping.

3.03 FIELD QUALITY CONTROL

A. Butt Fusion Trial Testing

1. On every day that butt heat fusions are to be made, a trial fusion shall be performed prior to the start of construction fusion joining.

2. The trial fusion shall be performed under the same conditions and with the same equipment as for construction fusion.

3. After allowing the fusion to cool completely, one fusion test strap shall be cut out at the joint. The test strap dimensions shall be 12 inches minimum in length, with the fusion at the center; and one inch minimum in width.

4. The test strap shall be bent until the ends of the strap touch. If the fusion fails at the joint, fusion procedures and machine setup shall be changed as necessary, and a new trial fusion shall be prepared and tested.

5. Construction butt fusion shall not commence until a trial fusion has passed the bent strap test.

B. Visually inspect completed piping to assure joints are intact. This shall include inspection of fusion beads at each joint. The size and shape of the fusion beads shall comply with the manufacturer's recommendations.

C. Hydrostatic Testing for Dual-Containment Piping

1. After the piping is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping shall, unless otherwise specified, be subjected to hydrostatic pressure testing as specified below.

2. Pressure/leak testing shall be conducted in accordance with the pipe manufacturer's recommendations. Only hydrostatic testing is allowed. Pneumatic pressure testing shall not be used.

3. Hydrostatic testing shall be performed in the presence of the Engineer.

4. Furnish all labor, materials, equipment and services required for making tests as specified, including pumps, gauges, thrust protects, temporary bulkheads and other miscellaneous items required.

5. Testing shall be performed in such a manner as to avoid injury to personnel or damage to other equipment, work, or surrounding territory.

6. The carrier pipe of the dual containment piping shall be tested in place at 150 percent of the rated operating pressure of the pipe.

7. Devices, which could be damaged by the test pressure, shall be isolated or removed from the system during the testing periods. If the device cannot be removed or isolated, then the limiting section test pressure shall be the maximum allowable test pressure for that device.

8. The initial pressure test shall be applied and allowed to stand without makeup pressure for a sufficient time (approximately 2 to 3 hours) to allow for pipe expansion and for stretching to stabilize.

9. After the equilibrium period, return the test section to the test pressure and hold the pressure for a minimum of one to three hours. Water shall be added, and accurately measured, to maintain the pressure for the specified time period.

10. Allowable amounts of makeup water to account for normal pipe expansion during the test period is as follows:

    a. For three-inch diameter pipe: 0.15 gallons per 100 feet of pipe per hour.

    b. For six-inch diameter pipe: 0.30 gallons per 100 feet of pipe per hour.

11. Exposed pipe, joints, and fittings shall be carefully examined during the pressure testing.

12. Any leakage or defective piping disclosed by the testing shall be replaced or repaired by the Contractor at his own expense. Defective piping shall be repaired in a manner acceptable to the Engineer. The Engineer shall have the option to reject any repaired pipe if he feels the repair is unsatisfactory.

13. Pipe installation shall not be considered completed until all tests have been made, and all defects corrected to meet the requirements of the specified test, and all piping proves tight. No caulking of defective piping or joints shall be permitted.

END OF SECTION

SECTION 02642
VALVES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes furnishing materials, installation and testing of valves and accessories for leachate pipelines, and storm water discharge valves.

1.02 RELATED SECTIONS

Section 02715 leachate collection system piping.

1.03 REFERENCES

American Water Works Association (AWWA) specifications for gate, ball, and check valves (AWWA C500, AWWA C508, and AWWA C509).

1.04 SUBMITTALS

Submit in accordance with Section 013000

PART 2 PRODUCTS

2.01 BALL VALVES

Ball valves 2-inch diameter SDR-11 HDPE, IPS ball valves. The valves shall be rated for working pressure of 150 psi and shall be non-rising stem design.

2.02 ACCESSORIES

Valves to be complete and arrive at job site assembled with all necessary operators, valve boxes, extension stems, floor stands, worm and gear operators, operating nuts, etc., required for completion of work.

PART 3 EXECUTION

3.01 INSTALLATION

Install and test valves and equipment in accordance with the requirements of applicable AWWA specifications including test requirements recommended by the manufacturers.

END OF SECTION

SECTION 02715
LEACHATE COLLECTION SYSTEM AND RISER PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes furnishing and installing 6-inch and 18-inch diameter high density polyethylene leachate collection system piping (perforated piping, solid piping, and fittings) and leachate riser piping.

B. Related Sections:

1. Section 02223 – Trenching, Backfilling and Compacting

2. Section 02278 - Geotextiles and Geocomposite

1.02 REFERENCES

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

1. ASTM D 1248, Specification for Polyethylene Plastics Molding and Extrusion Materials.
2. ASTM D 2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
3. ASTM D 3035, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
4. ASTM D 3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
5. ASTM D 3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
6. ASTM F 714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit manufacturer's certificates of conformance with specifications, and product data, for the leachate collection piping, fittings and accessories and the leachate riser pipes.

C. Submit shop drawings for fabrication of leachate piping, riser pipe, and fittings.

D. Submit certification of personnel training in heat fusion procedures, as specified in subsection 1.04.B of this Section.

1.04 QUALITY ASSURANCE/QUALITY CONTROL

A. Pipe manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings specified.

B. Heat fusion of polyethylene piping shall be performed by personnel trained in the pipe manufacturer's recommended procedures. Training shall have been received not more than 12 months prior to start of construction.

1.05 DELIVERY, STORAGE AND HANDLING

A. During loading, transporting, and unloading, exercise care to prevent damage to materials.

B. Pipe shall be marked with manufacturer's identification symbol, size, date of manufacture, class of pipe and applicable product specification identification number.

C. All materials shall be inspected by the Contractor upon delivery to the site. The Contractor shall notify the Engineer of any loss or damage. Damaged or defective materials shall be rejected and shall be replaced with new materials at the supplier's or Contractor's expense.

PART 2 PRODUCTS

2.01 PERFORATED LEACHATE COLLECTION PIPE

A. Materials used for the manufacture of polyethylene pipe and fittings shall be as follows:

1. PE3408 high density polyethylene, with a cell classification of PE345434C in compliance with ASTM D 3350, and material classification Type III, Class C, Category 5, Grade P34 in compliance with ASTM D 1248.

B. Pipe shall be manufactured in accordance with ASTM F 714 or ASTM D 3035. Pipe shall have a standard dimension ratio (SDR) of 11 and an inside diameter of six inches.

C. Molded fittings shall be manufactured in accordance with ASTM D 3261 or ASTM D 2683. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, sheet stock, or molded fittings. Each fabricated fitting shall be rated for internal pressure service equivalent to the full service pressure rating of the pipe to which it is joined.

D. Size and arrangement of perforations shall be as shown on the construction drawing.

2.01 LEACHATE RISER PIPES

A. Materials used for the manufacture of polyethylene riser pipe shall be as follows:

1. PE3408 high density polyethylene, with a cell classification of PE345434C in compliance with ASTM D 3350, and material classification Type III, Class C, Category 5, Grade P34 in compliance with ASTM D 1248.

B. Pipe shall be manufactured in accordance with ASTM F 714 or ASTM D 3035. Pipe shall have a standard dimension ratio (SDR) of 17 and a nominal pipe size of 18 inches.

C. Perforations shall be 3/8” diameter holes equally spaced at 6” each way. Perforations shall extend approximately 7’ from edge of 3’ wide by 6’ long by 2” thick HDPE sheet stock.

D. Sheet stock (3’ wide by 6’ long by 2” thick HDPE) shall be extrusion welded to 18” riser pipe to match the 3:1 side slope.

E. Molded fittings shall be manufactured in accordance with ASTM D 3261 or ASTM D 2683. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, sheet stock, or molded fittings. Each fabricated fitting shall be rated for internal pressure service equivalent to the full service pressure rating of the pipe to which it is joined.

2.03 WASHED GRAVEL BACKFILL FOR LEACHATE COLLECTION SYSTEMS

Specified in Section 02227.

2.04 GEOTEXTILE FOR LEACHATE COLLECTION

Geotextile as specified in Section 02278.

PART 3 EXECUTION

3.01 PREPARATION

A. Excavate and grade trenches for leachate collection piping to the width, depth, grade and alignment shown on the Drawings, and as specified in Section 02223.

3.02 GEOTEXTILE INSTALLATION FOR LEACHATE COLLECTION SYSTEMS

A. Place geotextile on the bottom and sides of the pipe trenches as shown on the Drawings.

B. Place geotextile in such a manner that placement of overlying material will not stretch or tear the fabric.

C. Overlaps of adjacent rolls of geotextile and at the top of the gravel backfill shall be approximately three feet, or as otherwise shown on the Drawings.

3.03 LEACHATE COLLECTION PIPE INSTALLATION

A. Examine pipe and fittings before installation and assure no defective materials are incorporated. Keep inside of pipes and fittings free of dirt and debris.

B. Lay piping on firm bedding for entire length of alignment.

C. Installation of all pipe, and fittings shall be subject to the review of the Engineer.

D. Polyethylene pipe and fittings shall be joined by heat fusion (butt fusion, saddle/sidewall fusion, socket fusion or electrofusion) as specified in Section 02631.

E. Install piping accurately to line and grade as shown on Drawings unless otherwise approved by the Engineer.

F. Place stone backfill around and over the pipe in trenches and in sumps as indicated on the Drawings.

G. Whenever pipe laying is not actively in progress, the open ends of the piping shall be closed by a temporary plug or cap to prevent soil, and other foreign matter from entering the piping.

H. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

END OF SECTION

SECTION 02830
CHAIN LINK FENCE

PART 1 GENERAL

1.01 DESCRIPTION

A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing six-foot tall galvanized chain link fencing, as shown on the Construction Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fencing materials shall conform to AASHTO M 181. Sizes of posts, gate frames, rails and braces shall conform to the dimensions and weights shown in Table No. 1. ***Recycled Fencing and related materials will be allowed, at Engineers approval, for installation of six-foot tall chain link fence as shown on the Construction Drawings.***

TABLE 02830-1

USE	MINIMUM NOMINAL PIPE SIZE INCHES
End, corner and pull posts for fabric heights: six (6) feet or less	2⅞
Interior bracing for fabric heights: six (6) feet or less	1½
Rail and post braces	1⅝
Intermediate posts for fabric heights: six (6) feet or less	1⅞

B. Sizes of posts, gate frames, rails and braces for fabric heights over six feet shall be shown on the Drawings.

C. Stretcher bars shall not be less than 3/16" by 3/4", and shall be of lengths one-inch less than the full height of the fabric with which they are to be used. The stretcher bars shall be arranged for attaching the fabric to all terminal posts by threading through the fabric, by bands, or by other positive mechanical means. One stretcher bar shall be provided for each gate, and end post and two for each corner and pull post.

D. Ties or clips of adequate strength shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding 15 inches.

E. Bands or clips of adequate strength shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding 15 inches.

F. Posts. Interior posts shall be of the length required for a footing depth of three feet. End posts shall be of the length required for a footing depth of four feet. All posts shall be tubular.

G. Reinforcing Wires. Top reinforcing wire shall be provided. The reinforcing wires shall be of coiled spring wire not less than seven gauge plus, or minus 0.005-inch in diameter. Ties or clips shall be provided for attaching each wire to the fabric at intervals not exceeding two feet.

H. Portland cement concrete shall be at least 2500 psi and conform to ACI Standards.

I. Mesh and wire size shall be two-inch mesh, 0.148-inch in diameter.

PART 3 EXECUTION

3.01 GENERAL

A. All trees, brush, and other obstacles that would interfere with the construction of the fence shall be removed and disposed of as directed by the ENGINEER.

B. Prior to installing the fence, the existing ground along the line of the fence location shall be graded to a smooth, uniform surface, to the extent that no abrupt changes in grade exist between adjacent fence posts.

C. All posts shall be set in portland cement concrete footings. The tops of the footings shall be level with the ground, shall be crowned to provide drainage, and shall be troweled smooth. Concrete footings shall be eight inch diameter. The footings shall be allowed to cure for a period of at least seven days and achieve at least 75% of design strength before any stress is applied.

D. The posts shall be set vertical and shall be of uniform and equal height above the ground, with a maximum horizontal spacing of ten feet, center-to-center. The chain link fabric shall be fastened to the top reinforcing wire, and the lower edge of the fabric shall be fastened to the bottom tension wire.

E. For fabric heights of six feet or more, a 1 1/4" inch top rail shall be provided. Top rails for fabric heights less than six feet, and intermediate brace rails shall be provided, if shown on the Drawings.

F. At each location where an electric transmission, distribution or secondary line crosses any of the types of fences covered by these Specifications, the CONTRACTOR shall furnish and install a ground rod and connection to the fence conforming to the requirements of Section Nine of the National Electric Safety Code.

G. Ground rods and connectors shall be placed at minimum intervals of 400 feet in length, one ground rod with connection to the fence shall be required.

H. Grading. The fence shall be constructed to follow a smooth profile. Nowhere, however, throughout the fence length shall be the distance between the ground surface and the bottom tension wire be greater than four inches, nor less than two inches. Where excavation is necessary to meet this requirement, the ground will be graded level not less than one foot on either side of the fence. Grading for all specific conditions shall be such that water will not be allowed to pond in the immediate area of the fence.

I. General Appearance. All runs of fence shall present the same general appearance. The product of one manufacturer only will be accepted, except for items which do not influence the appearance of the completed fence. The fence shall be the product of a manufacturer who has demonstrated by actual installations of a similar nature, that its product is the type required. No used, re-rolled, or open seam steel will be permitted in posts, gate frames, rails or braces.

END OF SECTION

SECTION 02930
SEEDING AND MULCHING

PART 1 GENERAL

1.01 SUMMARY

Section includes establishing a stand of grass on all areas disturbed by construction within the construction limits and areas with inactive waste fill.

1.02 QUALITY ASSURANCE/QUALITY CONTROL

Seeding shall be accomplished according to standard local practice and in compliance with requirements of applicable state and federal regulations.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in containers showing weight, analysis and name of manufacturer.

B. Protect materials from deterioration during delivery, and while stored at site.

1.04 PROJECT CONDITIONS

A. Perform seedbed preparation and seeding as soon as possible after completion of grading and compaction in each area.

B. Seeding shall be performed only during the appropriate growing season for the particular seed mix, as recommended by the local agricultural extension office and approved by the Engineer.

PART 2 PRODUCTS

2.01 FERTILIZER

A. Shall be a standard commercial fertilizer, delivered to the project in bags clearly labeled showing percentages of nitrogen, phosphoric acid, and potash nutrients.

B. The grade of fertilizer shall be the one of the following:

Di-Ammonium Phosphate

Nutrient	% by Weight
Nitrogen	18
Phosphorous	46
Pottasium	0

Mono-Ammonium Phosphate

Nutrient	% by Weight
Nitrogen	11
Phosphorous	52
Pottasium	0

2.02 LIME

Shall be ground limestone containing not less than 85 percent total carbonates and of a fineness so that 90 percent will pass through a No. 20 mesh sieve and 50 percent will pass through a No. 100 mesh sieve.

2.03 SEED

A. The following quantities of grass seed to be planted per acre are as follows:

1. ***Spring Planting (March 15 - June 15):***

Bermuda Grass (Common) unhulled	10 lbs.
Bermuda Grass (Common) hulled	5 lbs.
Laspedeza (Korean)	30 lbs.

2. ***Summer Planting (June 16 - August 31):***

Bermuda Grass (Common) unhulled	10 lbs.
Bermuda Grass (Common) hulled	5 lbs.
Buffalo Grass	10 lbs.

3. ***Fall/Winter Planting (September 1 - March 14):***

Annual Rye grass or other Cereal Grasses	100 lbs.
Crimson Clover (Dixie)	20 lbs.
Bermuda Grass (Common) unhulled	30 lbs.
Coreopsis	5 lbs.
Laspedeza (Korean)	30 lbs.

2.04 WATER

Clean, potable.

2.05 MULCH AND OTHER EROSION CONTROL

A. Cover material shall be chopped hay mulch generally derived from rice, wheat, oats, barley, or other suitable material free from Johnson grass, weeds, foreign matter detrimental to plant life, and in dry conditions.

PART 3 EXECUTION

3.01 SOIL SAMPLING

A. An independent testing firm retained by the Contractor shall obtain samples of the soil to be seeded and send the samples to a local agricultural extension office for recommendations on fertilizer, lime and seed mix to be used.

B. One sample shall be taken at approximately every five (5) acres of area, or as otherwise determined necessary by the Engineer. Each sample shall be a minimum ten-ounce sample.

3.02 PREPARATION

A. Surface shall be scarified to an approximate depth of three inches to be seeded.

B. Surface shall be reasonably smooth and free of litter, large clods, roots, sharp protrusions, and large stones.

C. The seed mixtures specified in paragraph 2.03A shall be applied to areas disturbed from construction activities.

3.03 APPLICATION METHODS

A. Spread lime (if required) uniformly on soil surface at rate specified in subsection 3.04. Incorporate lime into top three inches of soil.

B. Seed, fertilizer, and mulch materials shall be placed by the method described below, as approved by the Engineer.

1. Hydraulic Method

a. The seed and fertilizer, or seed, fertilizer and mulch shall be mixed in the specified amount of water to produce a slurry. Any of the above combinations may be used, provided that the products are added to the water in the following order as applicable: fertilizer, seed, and mulch.

b. The slurry shall then be uniformly applied under pressure to the areas and at the rates indicated in subsection 3.04 below.

c. Areas inadequately covered shall be re-treated as directed by the Engineer.

2. Dry Method

a. The seed and fertilizer shall be applied uniformly at the specified rate, using power drawn seeders, seed drills, or other mechanical methods approved by the engineer. Hand operated seeding devices may be used on areas which are inaccessible to mechanical seeders.

b. The seed and fertilizer shall be applied separately. Fertilizer shall be incorporated into the full depth of loosened soil to the seeding operation.

3.04 APPLICATION RATES

A. Lime: Two tons per acre for pH 4 to 5, one ton per acre for pH 5 to 6, or as otherwise determined based on soil test results.

B. Fertilizer:

1. Apply at rate of 1,000 pounds of grade 10-20-10 fertilizer per acre or a sufficient quantity of any other acceptable grades of fertilizer that will provide at least 100 pounds of nitrogen, 200 pounds of available phosphoric acid, and 100 pounds of total potash per acre, as computed from the nominal contents of fertilizing ingredients.

2. Other rates of application may be allowed by the Engineer based on soil test results.

C. Seed mixtures for permanent vegetation shall be applied at the rate of approximately 60 pounds per acre or as otherwise directed by the Engineer.

3.05 APPLICATION TIMES

A. Seeding for temporary vegetation shall comply with Section 01565.

B. Seeding for permanent vegetation shall be performed during the first optimum planting season following completion of work in an area. Optimum planting seasons are Spring (March through May) and Fall (September through October).

3.06 MULCHING

A. Spread mulch uniformly over seeded area in a continuous blanket.

B. Mulch may be spread by hand or by machinery. Mulch shall be spread not later than 48 hours after seeding.

3.07 ESTABLISHMENT OF GRASS

A. Begin maintenance immediately after seed placement.

B. Maintain seeded areas not less than 60 days after substantial completion and longer to establish a good stand of grass as per the Engineer.

C. If seeded in Fall, Contractor shall maintain seeded areas throughout Winter and provide a Spring seeding.

D. Carry out watering as needed during the establishment period to maintain moisture in upper four inches of soil.

E. Fill, level, and repair washed or eroded areas as necessary.

F. Re-seed mulch areas larger than one square foot not having a uniform stand of grass.

3.08 ACCEPTANCE

A. Seeded areas will be accepted when a full and uniform stand of grass has become established.

END OF SECTION

DIVISION 3
CONCRETE

SECTION 03310
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the manufacture, storage, delivery, and installation of cast-in-place concrete, as specified herein, and as shown on the Drawings.

B. The work shall include, but not be limited to the building pad.

C. The Contractor shall coordinate the installation of the cast-in-place concrete with other construction activities and subcontractors at the site.

1.02 RELATED SECTIONS

A. Section 02210 - Structural Fill

1.03 REFERENCES

A. *Construction Quality Assurance Plan, Waste Management – Two Pine Class 1 Landfill (May 2006), Terracon Consultants, Inc.*

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

1. ASTM A 185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement.
2. ASTM A 427 Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
3. ASTM A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM C 31 Standard Methods of Making and Curing Concrete Test Specimens in the Field.
5. ASTM C 33 Standard Specification for Concrete Aggregates.
6. ASTM C 39 Standard Method of Compressive Strength of Cylindrical Concrete Specimens.
7. ASTM C 94 Standard Specification for Ready-Mixed Concrete.

8. ASTM C 143 Standard Test Method for Slump of Portland Cement Concrete.
9. ASTM C 150 Standard Specification for Portland Cement.
10. ASTM C 171 Standard Specification for Sheet Materials for Curing concrete.
11. ASTM C 172 Standard Test Method for Sampling Freshly Mixed Concrete.
12. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
13. ASTM C 260 Specification for Air - Entraining Admixtures for Concrete.
14. ASTM C 494 Specifications for Chemical Admixtures for Concrete.
15. ASTM C 618 Specification for Fly Ash and Raw or Calcined Pozzolans for use in Portland Cement Concrete.

C. Latest version of American Concrete Institute (ACI) standards:

1. ACI 211.1 Selecting Proportions for Normal Weight Concrete.
2. ACI 214 Evaluation of Compression Test Results of Field Concrete.
3. ACI 301 Specifications for Structural Concrete for Buildings.
4. ACI 304 Measuring, Mixing, Transporting and Placing Concrete.
5. ACI 305 Hot Weather Concreting.
6. ACI 318 Requirements for Reinforced Concrete.

1.04 SUBMITTALS

A. The Contractor shall provide the following to the Owner for approval prior to placement of concrete:

1. certifications as required by ASTM C 94;
2. shop drawings for all reinforcing steel;
3. certificates of Compliance for the following items:
   a. cement;
   b. aggregates;
   c. admixtures; and
   d. reinforcing steel.
4. Design Mixes: At least 30 days prior to start of placing concrete, the Contractor shall submit design mixes for each Class and Type of concrete specified, indicating that the concrete ingredients and proportions will result in a concrete mix meeting the requirements specified.

B. Compression Test Data:

1. Compression test cylinders from all concrete used on the project, except for precast concrete items, will be made by the Owner and tested in accordance with the ACI Code and ASTM C 39.

2. Concrete which does not meet the specifications will be required to be removed and replaced at the Contractor's expense or may be subjected to a load test, also at the Contractor's expense.

C. Batch Tickets:

1. Submit certificate to the Owner before unloading concrete at the site or submit a delivery ticket to the Owner from the concrete supplier for each batch of concrete delivered to the site. The certificate or delivery ticket shall set forth the following information:

   a. name of supplier;

   b. name of batching plant and location;

   c. serial number of ticket or certificate;

   d. date;

   e. truck number;

   f. specific job designation (contract number and location);

   g. the volume of concrete (cubic yards);

   h. specific Class and Type of concrete (in conformance with the Specifications);

   i. time loaded;

   j. type and brand of cement;

   k. weight of cement;

   l. maximum size of aggregates;

   m. weights of coarse and fine aggregates, respectively;

   n. amount of water added at the plant and maximum amount of water to be added at the site, if any; and

   o. kind and amount of admixtures.

D. Following installation, the Contractor shall submit a Placement Log for all cast-in-place concrete items including the following information:

1. date of placement;
2. location and extent of placement;
3. quantity of concrete;
4. air temperature; and
5. tests and samples taken.

1.05 CONSTRUCTION QUALITY ASSURANCE

A. Ready Mixed Concrete Plant shall be currently certified to comply with approval requirements of one or more of the following:

1. Concrete Materials Engineering Council;
2. National Ready Mixed Concrete Association; and
3. Prestressed Concrete Institute.

B. Testing and Inspection Agency shall be currently accredited by one or more of the following:

1. Concrete Materials Engineering Council; and
2. Other accreditation authority of equivalent standing to the above, on the basis of its compliance with the requirements of ASTM C 1077.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Concrete Mix

Concrete mix shall conform with ASTM C 94, and shall be ready-mixed, normal weight, air entrained, minimum compressive strength 3,500 psi at 28 days, except concrete for anti-flotation collars, buttresses, and pipe encasement shall have a minimum compressive strength of 2,500 psi. The concrete slump shall be 3 ± 1 inches.

B. Cement

Cement shall conform to ASTM C 150, Type I or II.

C. Aggregate

Aggregate shall conform with ASTM C 33. Maximum size of coarse aggregate shall be the smallest of 1-1/2 inches, 3/4 of the minimum clear spacing between reinforcing bars, or 1/3 the thickness of slabs.

D. Water

Water shall be potable.

E. Reinforcing Steel

All deformed billet steel shall conform to ASTM A 615 Grade 60. All wire fabric shall be welded steel in conformance with ASTM A 185.

2.02 CONCRETE MIXING

A. The Ready Mix Concretes shall comply with requirement of ASTM C 94 for mixing time and water addition. Total mixing time for concrete shall be determined in accordance with ASTM C 94 for type of mixing equipment used. Concrete that has been in truck for more than 1-1/2 hours after addition of water, or had more than 300 revolutions, or concrete which has become hard or non-plastic, shall not be used. When concrete arrives at the site with a slump below that specified herein, water may be added only if neither the maximum specified water/cement ratio nor the maximum specified slump is exceeded. The additional water should be incorporated into the mix by increasing the mixing time at least 1-1/2 times the total mixing time required by ASTM C 94. However, the Contractor shall bear total responsibility for the effects of adding water on the quality and strength of the concrete.

B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

2.03 NON-SHRINK GROUT

A. Non-shrink grout shall conform to Corps of Engineers Specification CRD C621 (588).

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section, the Contractor shall become thoroughly familiar with all portions of the work falling within this Section.

B. Inspection:

1. Prior to implementing any of the work in this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.

2. If the Contractor has any concerns regarding the installed work of other Sections, the Contractor shall notify the Owner in writing within 48 hours of the site inspection.

Failure to inform the Owner in writing or installation of cast-in-place concrete shall be construed as Contractor's acceptance of the related work of all other Sections.

3.02 EXAMINATION AND PREPARATION

A. The Owner's Representative shall examine formwork, reinforcing steel, embed inserts, sleeves, and joint materials prior to placement of concrete. Defective material shall be removed and replaced with new material at no cost to the Owner.

B. The Contractor shall clean all formwork and structural excavations of foreign matter, debris, loose material, and water.

C. The Owner's Representative shall be notified at least two working days in advance of a scheduled delivery to allow time for adequate observation of the site.

3.03 PLACING REINFORCEMENT

A. Reinforcement shall be placed to the dimensions shown on the Drawings.

B. Stirrups and tie bars shall be bent around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness except for bars larger than one inch, in which case the bends shall be made around a pin of eight bar diameters. All bars shall be bent cold.

C. Reinforcement shall be shipped to the site with bars of the same size and shape securely fastened in bundles with wired metal identification tags containing the bar size. The identification tags shall be labeled with the same designation as shown on submitted bar schedules and shop drawings.

D. All bars shall be stored off the ground and shall be protected from moisture and kept free from dirt, oil, and other foreign substances.

E. Unless otherwise shown on the Drawings, splices in reinforcement bars shall be lapped not less than 24 diameters. All bar splices shall be staggered wherever possible. When splicing bars of different diameters, the length of lap is based on the larger bar.

F. Before placing in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt, and other coatings that may reduce or destroy bond. Where there is delay in depositing concrete after reinforcement is in place, bars shall be re-inspected and cleaned when necessary.

3.04 PLACING CONCRETE

A. Formwork and joints shall be erected, and accessories shall be installed in accordance with the Drawings.

B. Concrete shall not be placed until the forms, reinforcement and other conditions are approved for pouring by the Owner's Representative and until all pipes, conduits, sleeves, thimbles, hangers, anchors, flashing and other work required to be placed in the concrete have been properly installed.

C. Water shall be removed from the space to be occupied by concrete, and any continuous flows of water shall be diverted to a sump or removed by pumping.

D. Hardened concrete and foreign materials shall be removed from the inner surfaces of mixing and conveying equipment before concrete is mixed. Before depositing concrete, forms shall be thoroughly wetted and all debris removed.

E. Concrete Placement:

1. Practices shall comply with ACI 304 and as herein specified.
2. Concrete shall be deposited in horizontal layers not deeper than 24 inches in such a manner as to prevent flow of concrete. Concrete shall be deposited to maintain a plastic surface which is approximately horizontal and in a manner to avoid inclined construction joints.
3. Where placement consists of several layers, each layer shall be placed while the preceding layer is still plastic to avoid cold joints.
4. Concrete shall be consolidated by internal mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping in accordance with ACI 304 during and immediately after placing.
5. Reinforcing, inserts, embeds, and joints shall be maintained in proper position during concrete placement.
6. Pumping placement of concrete shall be done with pumps, pipelines, and accessory equipment provided in accordance with ACI 304 and ACI 304-2R.

F. Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited against concrete which has hardened. If a section cannot be placed continuously, construction joints may be located at points as provided for in the Drawings or approved by the Owner's Representative. Before depositing new concrete against old concrete, the forms shall be retightened, the hardened surfaces cleaned and covered with a coating of neat cement grout.

G. In the event of rain during concrete placement, the placement shall be terminated as soon as practicable at a point approved by the Owner's Representative and freshly placed concrete shall be protected with a waterproof covering that shall prevent marring or damage of surfaces.

H. Concrete shall not be placed without consent of the Owner's Representative when the temperature is 50 degrees Fahrenheit or less, or when there is reason to expect a drop in temperature to below 50 degrees Fahrenheit within 12 hours of the conclusion of the pour. Concrete placed at air temperature below 40 degrees Fahrenheit shall have a minimum temperature of 60 degrees Fahrenheit. When the air temperature is below 40 degrees Fahrenheit or near 40 degrees Fahrenheit and falling, the water and aggregates shall be heated before mixing. Accelerating chemicals shall not be used to prevent freezing.

I. Hot weather placement of concrete shall comply with ACI 305.

3.05 CONCRETE CURING AND PROTECTION

A. Freshly placed concrete shall be protected from premature drying and excessive cold or hot temperatures.

B. Curing procedures shall begin immediately after placement in accordance with ACI 301 procedures to provide continuous moist curing above 50 degrees Fahrenheit for at least seven days.

C. Curing of concrete shall be performed by moist curing and by moisture retaining cover curing, as herein specified. Moisture curing shall be provided by one of the following methods: covering with water, sprinkled with water, continuous water fog spray, and covering concrete surface with specified absorptive cover, thoroughly saturating cover with water, and keeping continuously wet. The Contractor shall submit for approval by the Owner's Representative the methods proposed for use against low temperatures. No salt, manure, or other chemicals shall be used for protection.

D. Protection of Completed Work:

1. Concrete shall be protected from damaging mechanical disturbances, water flow, loading, shock, and vibration during the entire curing period.

2. Concrete surfaces shall be kept free from all foot and vehicular traffic and all other sources of abrasion for not less than 72 hours after finishing.

3. Any protective coverings shall be maintained continuously during entire curing period, and damage to coverings shall be repaired immediately at no additional expense to the Owner.

4. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

3.06 REPAIRS

A. Repair of rock pockets, honeycombs, and sand streaks shall be done by: cutting and removing concrete to at least one inch deep with sides perpendicular to surface; flushing with clean water; coating with neat cement paste; filling with cement drypack mix; curing as specified for concrete; and grinding smooth and flush with adjacent surfaces.

3.07 FIELD QUALITY CONTROL

A. The Owner shall employ a testing laboratory to perform tests and to submit test reports, except as designated otherwise.

B. Sampling fresh concrete shall be performed in accordance to ASTM C 172, except modified for slump to comply with ASTM C 94:

1. Slump test according to ASTM C 143 shall be measured according to:
   a. one test at point of discharge for each set of compression cylinders taken;
   b. additional tests when concrete consistency appears to have changed; and
   c. one test on each truck load of concrete delivered to the site.

2. Molded concrete compression cylinders shall be sampled in accordance with ASTM C 172, processed and cured in accordance with ASTM C 31, and prepared and tested in accordance with ASTM C 39:
   a. One set of four cylinders shall be obtained for each 50 cubic yards, or fraction thereof, for each day's placement of each mix design.
   b. One cylinder shall be tested at age three days or seven days, as required by job conditions, and two cylinders for one valid strength test at 28 days.
   c. The fourth cylinder shall be cured and held for testing at 42 days if 28-day test indicated deficient results, or as a spare in case of cylinder damage.

C. Certified written reports shall be promptly submitted with the following additional data:
1. time concrete batched and time sampled;
2. water added at site;
3. strength class;
4. delivery ticket number;

5. concrete suppliers mix designation; and
6. location of concrete in the work.

3.08 PRODUCT PROTECTION

A. The Contractor shall use all means necessary to protect all prior work, including all materials and completed work of other Sections.

B. In the event of damage to prior work or work specified in this Section, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

END OF SECTION

DIVISION 11
EQUIPMENT

SECTION 11305
LEACHATE PUMPING UNIT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes furnishing, installing, testing and start-up of leachate pumping unit, including the pump, the wheeled sump drainer, disconnect system, sump level controls, high level alarm and pump cut-off for leachate storage tank, 1-½" diameter SDR-11 solid HDPE discharge pipe, cam lock fitting(s), nylon cable, electrical and control lead, electrical control panel, and disconnect.

1.02 SYSTEM DESCRIPTION

A. The leachate pumping unit shall be provided by the Contractor complete and shall consist of the following:

1. Submersible pump with motor and electrical cable;
2. Level control and mounting hardware;
3. 1-½" diameter SDR-11 solid HDPE discharge pipe, cam lock fitting for quick disconnect, and accessories;
4. Pump control panel and mounting hardware;
5. Tank level sensor system and mounting hardware.

1.03 SUBMITTALS

A. Submit the following items under the provisions of Section 01300:

1. Pump system arrangement Drawings;
2. Pump catalog information, specifications and certified pump curves;
3. Pump manufacturer's parts lists, schematic and wiring diagrams;
4. Complete lubrication, maintenance, and operating instructions including initial startup instructions;
5. Control panel submittals including wiring diagrams, panel layout and catalog information for each control system component;
6. Interconnection wiring diagrams showing field wiring;
7. Other technical, installation and maintenance data as applicable;
8. Listing of special tools required for repair and maintenance; and
9. Factory Test report.

1.04 MANUFACTURER'S SERVICES

A. Unless otherwise instructed by the Engineer or the Owner, a manufacturer's representative for the equipment specified shall be present at the job site for installation assistance, inspection and certification of the installation, and equipment testing.

1.05 GUARANTEE

A. The manufacturer shall guarantee in writing that the submersible sump pump system will meet the performance requirements specified in this section, provided that the manufacturer's operations and maintenance procedures are followed. The manufacturer shall guarantee the system, parts and labor included, for one year from the first day the system is placed in operation.

PART 2 PRODUCTS

2.01 PUMPING UNIT

A. Pumping unit shall be a multi-stage, stainless steel submersible pump, Grundfos Model 25S10-7, 1 horsepower, including 100' jacketed motor lead, submersible lever sensor with 100' lead and 100' length 1/8" stainless steel cable with clamps, as manufactured by Advanced Fluid Technologies (501-835-3200), 7801 Warden Road, Sherwood, AR 72120, meeting the following requirements:

1. Unit shall be suitable for side-slope riser installation;

2. Unit shall come with a 1 horsepower, submersible electric motor for operation on 230 volts, single phase, 60 hertz service with 100 feet of cable;

3. Unit shall have a 1 ½ inch threaded discharge nozzle and shall be capable of delivering 25 GPM at 50 feet of TDH;

4. Unit shall have liquid level sensor system including a submersible level transmitter and chemically resistant lead wire;

5. The unit should be capable of pumping down leachate within the leachate collection sump to within eight inches of the sump bottom without any loss of performance or damage to the pump; and

6. The pump shall be equipped with a vent valve to assist with the evacuation of air from the Sump Drainer.

B. Materials: Major components shall be made of type 304 stainless steel, seals shall be made of Teflon, and all bearings shall be made of E-Glide. All fasteners shall be made of type 304 stainless steel.

C. Check Valve: Unit shall include a built-in check valve, with housing and disc of type 304 stainless steel and a Teflon valve seat.

D. Shaft: The shaft shall be made of type 304 stainless steel and rotate on E-Glide bearings which are product lubricated.

E. Diffuser Chamber: The diffuser chambers for each impeller shall be of type 304 stainless steel and shall be fitted with Teflon impeller seal rings.

F. Impellers: The impeller shall be closed type and shall be constructed of type 304 stainless steel.

G. Motor: The motor shall be a submersible, hermetically sealed Franklin motor (or equal) of type 316 stainless steel construction. The motor shall be designed for continuous duty and capable of sustaining up to 100 starts per day. The motor shall be connected to the pump via a motor adaptor and coupling in type 304 stainless steel.

H. Motor Lead Wire: The lead wire shall be no-splice with water proof "chemically resistant" insulation and be 100 feet long.

I. Discharge Pipe: The pump should be connected to 1-½" diameter SDR-11 solid HDPE discharge pipe by cam lock fitting.

J. Pump unit shall be installed as shown on the Drawings.

2.02 PUMP CONTROL SYSTEM

A. Pump control system shall be Advanced Fluid Technologies (501-835-3200), 7801 Warden Road, Sherwood, AR 72120, meeting the following requirements, AFT-Level Controller-WM, including a meter and top mounted alarm light, control panel system to operate pump motor and auxiliary equipment in manual or automatic mode.

B. The pump control system shall operate in simplex mode. Pumping unit shall be provided with a HAND-OFF-AUTO (HOA) selector switch which shall control the pump as follows:

1. Hand Position: When the HOA switch is placed in the HAND position, the pump shall immediately start and run until the HOA switch is placed in the OFF position. The pump shall not be controlled by the level sensor when the HOA switch is in the HAND position.

2. Off Position: When the HOA switch is placed in the OFF position, the pump shall immediately stop regardless of the water level.

3. Auto Position: When the HOA switch is placed in the AUTO position, the pump shall start and stop in response to the leachate level within the collection sump. The pump will start when the leachate level rises above the Pump ON level. The

pump shall run continuously until the leachate level decreases to the Pump OFF level.

C. Control Panel: Circuit breakers, motor starters, control power transformers, control relays, interlocks, selector switches, contacts for remote mounted equipment and other devices as required to meet the functional requirements specified above and Division 16 shall be provided. Control panel shall be sized to house the required components. The control panel shall be designed and furnished by Advanced Fluid Technologies (501-835-3200), 7801 Warden Road, Sherwood, AR 72120, and shall include the following:

1. Enclosure shall be NEMA 4X construction. The enclosure shall come equipped with inner door, stainless drip shield and tamper-resistant latch. Enclosure finish shall be with polyester urethane paint;

2. Intrinsically-safe barrier relays for liquid level sensor circuits;

3. Running light units shall be oil-tight type. Units shall be of the illuminated push-button type with the push-button wired for push-to-test function. Two spare lamps shall be provided;

4. Control transformer shall be with fused primary to isolate control circuit from power circuit and safer field wiring of accessories. Transformer shall lower incoming voltage to 120 Volts;

5. Selector switch shall be: three-position, heavy duty, oil tight, NEMA 4X rated switch mounted to the inner door of panel;

6. Panel wiring shall be stranded type XHHW or SIS rate 90 degree Celsius with a minimum size of No. 14 AWG. Compression spade or ring tongue type lugs shall be used for terminations. Wires crossing hinges shall be installed in a manner to prevent chafing. Plastic wire gutters and nylon cable wraps and ties shall be used to guide and train the wires, as necessary;

7. Level Control: The level control shall be mounted on the inner door. Meter shall have digital readout, and shall have the capability to monitor and maintain pumping operations as well as at least two other level signals. Level control shall be accurate to within 0.1 inch;

8. Heater with Adjustable Thermostat: To promote even distribution of heat and elimination of hot spots and condensation. Heater element shall be mounted in space between the sub-panel and the back of the enclosure, and provide a minimum of 144 square inches of heating area;

9. Lighting Arrestor: Shall be grounded, metal to metal, to water strata; and

10. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year.

E. Submersible Level Sensing System:

1. The level transmitter shall be designed to operate integrally with the sump drainer system specified in this Section.

2. The submersible pressure transmitter level sensor shall have a range of 0 to 11.5 feet with 4 to 20 MA output signal.

3. Transmitter construction shall be stainless steel body, stainless steel diaphragm and Viton seals with chemically resistant signal cable.

4. The transmitter circuit shall be protected by intrinsically safe barriers.

F. Tank Level Sensor: The control system should be connected to the existing tank sensors.

2.03 PIPE AND FITTINGS

A. Discharge piping and fittings leading from the pump discharge elbows shall be HDPE as shown on the Drawings and as specified in Section 02631.

2.04 MISCELLANEOUS

A. All nuts, bolts, washers, and miscellaneous pump hardware that are in contact with the pumped leachate liquid shall be Type 316 stainless steel.

2.05 SPARE PARTS, ACCESSORIES, AND SPECIAL TOOLS

A. The manufacturer's standard spare parts shall be furnished, suitably marked and packaged for shipment and storage. Provide a suggested parts list from the manufacturer for the pump control panel with pricing.

B. One set of any special tools required to service the pumps shall be provided.

PART 3 EXECUTION

3.01 GENERAL

A. A minimum buffer distance of 14 feet shall be maintained between the liner system anchor trench and the landfill operations road in order to provide sufficient space for the valve box system, concrete retaining structure and surface water control conveyance.

B. The pump field control panel shall be completely shop fabricated. Field work shall be limited to mounting, connections, testing and start-up.

C. The control panel should be constructed with the interface facing the landfill.

3.02 PIPING

A. The types and sizes of pipes to be used shall be as specified.

B. Pipe shall be installed as closely as indicated on the Drawings. Major adjustments, if required, shall be approved by the Engineer.

C. The interior of piping shall be cleaned before assembly and connection.

D. Flanged joints shall be square with even pressure upon the gaskets and shall be airtight.

3.03 PUMPING UNIT

A. Pumping unit shall be installed as specified and as recommended by the manufacturer. The Contractor shall protect the integrity of the power lead to pump motor connection and shall be responsible for keeping the connection watertight. Power leads shall not be used to lift or position the pumping unit.

B. Level sensors shall be positioned as recommended by the manufacturer.

3.04 CONTROL EQUIPMENT

A. Control equipment shall be installed in accordance with manufacturer's printed instructions.

3.05 TESTING

A. All major system components shall be factory tested for compliance with the construction and functional requirements specified herein, and a certification of the results of these tests shall be submitted to the Owner.

B. Prior to system start-up, all system components shall be inspected for proper alignment, noise levels, proper connection and satisfactory performance. The manufacturer's representative shall provide a written certification for all system components to the Owner that the furnished equipment has been installed in accordance with the manufacturer's instructions and is ready for permanent operation.

C. Operational acceptance tests shall be performed for a minimum of three days to demonstrate that the systems furnished perform in accordance with all provisions of these specifications. In the case of a non-conforming system, the Owner may, at his option, withhold final payment to the manufacturer until the system is reclassified as conforming.

END OF SECTION

DIVISION 13
SPECIAL CONSTRUCTION

SECTION 13186
CONCRETE HEADWALL

PART 1 GENERAL

1.01 SUMMARY

A. This section includes construction of a Concrete Structure for the 18" riser pipe, 6" cleanout, and leachate pump system at the perimeter of Constructed Cells.

B. Related Sections:

1. Section 02200 - Earthwork
2. Section 02210 - Grading
3. Section 02631 - Leachate Pressure Pipe and Fittings
4. Section 11305 - Leachate Pumping Units
5. Section 03310 – Cast in Place Concrete
6. Section 16010 – Basic Electrical Requirements
7. Section 16111 – Conduit

1.02 SYSTEM DESCRIPTION

A. The Concrete Structure including all material and labor shall be provided by the Contractor complete and shall consist of the following:

1. Reinforced concrete foundation, 4" containment curb, and headwall to accommodate 18 HDPE riser pipe and 6" HDPE cleanout, electrical conduit, pump control; and HDPE leachate lines.

1.03 DELIVERY, STORAGE AND HANDLING

A. Contractor shall be responsible for the delivery of material and construction of Concrete Structure and Gate and prepared concrete foundation.

B. The Contractor is responsible for all material stored at the site and be protected from weather and damage.

PART 2 EXECUTION

2.01 PREPARATION

A. Prepare Concrete Structure and foundation as shown on the Drawings specified in Sections 02200 and 03310.

B. Construct Structure in accordance with the Southern Building Code.

END OF SECTION

SECTION 13310
LEACHATE FLOW METER

PART 1 GENERAL

1.01 SUMMARY

A. This section includes supplying and installing a magnetic type flow meter on the leachate piping system.

B. Related Sections:
1. Section 02200 - Earthwork
2. Section 02210 - Grading
3. Section 02631 - Leachate Pressure Pipe and Fittings
4. Section 11305 - Leachate Pumping Units
5. Section 03310 – Cast in Place Concrete
6. Section 16010 – Basic Electrical Requirements
7. Section 16111 - Conduit

1.02 SUBMITTALS

A. Submit the following items under the provisions of Section 01300:

1.03 MATERIALS

A. Material information can be found following this section.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. The flow meter manufacturer shall have meters of the DC pulse type in similar flowing mediums for a minimum of five (5) years.

B. Acceptable manufacturers:
1. Great Plain Industries, Inc.
2. Sparling
3. Endress and Hauser, Inc.

4. McCrometer
5. BadgerMeter, Inc.
6. Approved equal.

2.2 METER

A. Meter size shall be 1 ½ -inch.

B. Flowrate Capacity:

1. Minimum flowrate capacity shall be 10 gpm.
2. Maximum flowrate capacity shall be 100 gpm.

2.3 TESTING

A. Volumetric testing of all meters must be performed and approved prior to shipment.

B. The complete meter assembly and signal converter must be wet accuracy tested and calibrated as a unit at near minimum, intermediate, and maximum manufacturers specified.

C. Flow ranges of the meter.

D. The amount of water used to conduct the test must be shown on a shipping tag attached to the meter.

E. The test facility must be certified annually to an accuracy of ±0.2% and be traceable to the National Institute of Standards and Technology.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare Headwall Structure and concrete foundation as shown on the Drawings specified in Sections 02200 and 03310.

B. Construct Structure in accordance with the Southern Building Code.

C. Contractor shall perform Work in accordance with N.E.C., N.F.P.A., U.L., and N.E.C.A. (latest versions).

END OF SECTION

DIVISION 16
ELECTRICAL

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. This section addresses basic electrical requirements specifically applicable to Division 16 sections in addition to applicable Division 1 sections of the Specifications.

1.02 COORDINATION

A. The electrical work shall be installed in cooperation with other trades installing inter-related work.

1.03 SUBMITTALS

A. Deviation from the Drawings and Specifications shall be called to the attention of the Engineer in writing at the time of submission of the Shop Drawings. The Engineer's checking of any drawing shall not release the subcontractor from responsibility for such deviations.

B. The Contractor shall furnish seven complete sets of certified Shop Drawings. Submittals must be one installment in bound manual with title sheet and numbered index at the beginning. Piecemeal submittals will be returned without consideration. Thermofax copies are not acceptable; only permanent type prints will be allowed. Shop Drawings are required even though the equipment is as specified. All submittals shall give complete catalog data for every manufactured item of equipment and all components to be used. Partial list of submittals as follows: wire and cable, devices, panels with circuit number shown, ballasts, disconnect switches, fixtures, conduit, and fire alarm.

C. Where equipment requiring different arrangement of connections from those shown is approved, it shall be the responsibility of the subcontractor to install the equipment to operate properly and in harmony with the intent of the Contract Documents, and to make all changes in the work required by the different arrangement of connections and pay all charges resulting from changes.

1.04 CODES, ORDINANCES, INSPECTIONS, AND PERMITS

A. Contractor shall obtain and pay for required fees, permits, and inspections for electrical work.

B. Contractor shall perform Work in accordance with N.E.C., N.F.P.A., U.L., and N.E.C.A. (latest versions)

1.05 DELIVERY, STORAGE AND HANDLING

A. Contractor shall place stored materials on clean, hard surfaces above ground and keep covered at all times to ensure protection from paint, plaster, dust, water, and other construction debris or operations.

1.06 ACCURACY OF DATA

A. The data given herein and on the Drawings are as exact as could be secured, but their absolute accuracy is not guaranteed. Exact locations, distances, levels, etc., will be governed by the building, and the Contractor shall use the data contained herein with this understanding.

1.07 INTENT OF DRAWINGS AND SPECIFICATIONS

A. The intent of the Electrical Drawings and Specifications is that the subcontractor shall furnish all labor and materials, equipment and transportation necessary for the proper execution of the work. This subcontractor shall thoroughly examine the Drawings and Specifications relating to other trades in order to include all necessary work in his bid. No additional payments shall be considered for failure to properly interpret the responsibilities to other trades. The subcontractor shall do all the work shown on the Drawings and described in the Specifications and all incidental work necessary to complete the work ready for use, occupancy, and operation by the Owner. The Engineer reserves the right to make any reasonable changes up to six feet in the locations indicated without additional cost to Owner.

1.08 OPERATING AND MAINTENANCE MANUALS

A. Contractor shall deliver to the Engineer for the Owner's use, two complete operating and maintenance manuals covering all equipment and systems installed by this Division.

B. Contractor shall include approved equipment and material submittals, parts lists, wiring diagrams, and operating instructions for all operating equipment.

C. Contractor shall bind brochures in hard back three ring binder and tab indexed with front cover and back spine labeled to indicate project name. Contractor shall also include page showing data and local responsible vendors with addresses and telephone numbers and furnishing parts and information on equipment.

1.09 OBSERVATION OF WORK

A. General: Refer to Agreement.

B. The Engineer will make final on site review of the Work of this division, prepare punch list, and visit the job site to check the punch list.

C. The Contractor shall furnish assistance and information as required by the Engineer.

D. If additional trips are required to the job because the Contractor did not perform the work as shown and called for on the punch list, then the Contractor shall reimburse the Engineer for charges at the rate of $125.00 per hour plus 65 cents per mile for travel expenses.

E. The Contractor shall allow the Engineer access to all parts of the Work and shall furnish assistance and information as required by the Engineer.

1.10 PROJECT RECORD DRAWINGS

A. The Contractor shall store the Project record drawings on the project site. Each day, Contractor shall make corrections and additions with colored pencil with date and authorization of change. Contractor shall locate all underground and concealed work. Project record drawings shall be complete in every detail.

B. The Contractor shall transfer information from Project record drawings to tracings or mylars of original drawings so Owner may reproduce copies as required. Contractor shall pay for tracings or mylars. Project record drawings must be submitted to the Engineer before project will be accepted.

1.11 INSPECTION OF SITES

A. Refer to Section II, Waste Management Agreement and Contract Documents.

B. Contractor shall inspect the site and become thoroughly familiar with conditions to be met and the work to be accomplished. At existing building sites, Contractor shall verify, prior to bid, all conditions shown affecting work.

1.12 SAFETY AND WORK METHODS

A. Refer to General Conditions.

B. The Electrical Subcontractor is completely responsible for performance of his work; safety, in, on, or about the job site; methods of performance; and timeliness in such performance. In the event he is unsatisfied with the performance of other trades, he shall set forth such complaints in writing for the Owner's review. In no event shall this subcontractor expect to be specifically directed in the protection of personnel or material by the Owner or Engineer.

1.13 PAINTING

A. Contractor shall repair finish surfaces damaged by Work of the section.

B. Contractor shall paint equipment and material furnished and installed under this section that has only a prime coat of paint, using color and brand of paint selected by Engineer.

1.14 TEMPORARY CONSTRUCTION POWER

A. This Contractor shall furnish and install temporary construction power wiring as required. Temporary electrical service shall be obtained in the name of the General Contractor, and it will be the General Contractor's responsibility to pay all power company charges. The temporary service shall be obtained from the local utility company. Provide temporary lighting as required for adequate illumination for construction and safety purpose.

PART 2 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. In order to establish standards of quality, the Engineer has referred to certain products by name and catalog number. This procedure is not to be construed as eliminating from competition other products of equivalent or better design. Where multiple manufacturing sources are shown on the Drawings or herein specified, the subcontractor shall limit his bid to one of those manufacturers.

B. The subcontractor shall abide by the Engineer's judgment when proposed substitute materials or items of equipment are judged to be unacceptable and shall furnish the specified material or item of equipment in such case. All proposals for substitution shall be submitted in writing by the General Contractor and not by the Electrical Subcontractor or material suppliers. The Engineer will approve or disapprove proposed substitutions in writing. If any request for a substitution is rejected, the Contractor shall automatically furnish material specified. All materials shall be new and shall bear the manufacturer's name and the Underwriters Laboratory label. Materials of the same general type shall be the same throughout the job to provide uniform appearance, operation, and maintenance.

2.02 LABELING

A. Electrical equipment, safety switches, time clock, starters, panels and transformers shall have black and white laminated bakelite nameplates securely fastened to device with screws, and be exposed. Edge of plates shall be beveled. Letters shall be white with black field. Letters shall be 3/8-inch upper case. Nameplate shall state its purpose and the voltage of the equipment. 120 or 240 volt equipment shall have black.

PART 3 EXECUTION

3.01 CLEARANCES

A. Clearances in front of electrical equipment shall be maintained as required by code. Discrepancies shall be reported to Engineer.

3.02 EXCAVATING, TRENCHING AND BACKFILLING

A. Perform as specified in Section 02223.

3.03 CONNECTION TO EQUIPMENT NOT SPECIFIED IN THIS DIVISION

A. Provide necessary materials and make connections to equipment requiring electrical power.

B. Rough-in for connection of this equipment according to shop drawings furnished with the equipment or by actual measurements taken from equipment on site. Provide junction boxes, disconnect switches, etc., required to properly connect each piece of equipment unless specifically stated otherwise.

3.04 UTILITIES LOCATIONS, METERS, AND CONNECTIONS

A. Arrange with proper authorities and utility companies for service connections, verifying locations and arrangements. Pay all costs of service as shown and provide all required conduits, meter bases wiring for indicated service. Contact the serving utility prior to bid and include all cost in bid.

B. When connections to existing lines, rerouting of utility lines, modifications to services, etc., would interrupt service or interfere with normal use of the buildings, arrange work such that outages are minimized and schedule outages to occur at times satisfactory to the Owner.

C. Before ordering equipment and proceeding with Work, verify with the utility company existing or available voltages shown on Drawings. If voltage differs from that noted on the Drawings and in the Specifications; notify the Engineer immediately.

3.05 APPEARANCE OF WORK

A. Contractor shall arrange and install exposed portions on Work specified under this division such as devices, fixtures, panels and safety switches to fit in and harmonize with Work specified in other divisions.

B. Contractor shall run conduits concealed in chases, attics or cable trenches unless indicated otherwise. Run conduit exposed to view in mechanical rooms and electrical equipment rooms.

C. Run conduit panel parallel or perpendicular to building lines.

3.06 TESTS

A. Test panel feeders, motor circuits, and conductors larger than #6 with a 600 volt Megger to prove insulation resistances.

B. Record readings on Contractor's letterhead and submit three copies of tabulated results to Engineer prior to final inspection.

C. Upon completion of installation of equipment, work with other trades to start equipment and make necessary tests and adjustments to place systems in first-class operating condition.

D. Test grounding electrode system to verify compliance with N.E.C. requirements. Submit results to Engineer.

3.07 GUARANTY PERIOD

A. Electrical Contractor shall warrant equipment furnished and work performed for a period of one year from date of written acceptance of work. This guarantee shall cover patching, refinishing, etc., required to restore faulty condition at no additional expense to Owner.

3.08 CLEANING

A. Cleaning during construction: Refer to Agreement

B. At completion of work, clean and polish fixtures, equipment, and materials.

3.09 CONFLICT

A. If there is conflicting variance between Drawings and Specifications, provisions of most stringent shall control. Drawings and Specifications are complementary. Work required by one, but not required by other, shall be performed as though required by both.

3.10 MOTOR CONNECTIONS

A. Whenever equipment requiring electrical connection is specified, power wiring shall be furnished and installed under applicable sections of Electrical Division of Specifications. Starting switches, protective devices, and other means for operation and control of equipment shall be furnished under applicable equipment sections but shall be installed under applicable electrical section, unless specifically noted otherwise on Drawings. Additional disconnects required by National Electrical Code shall be furnished, installed and connected by Electrical Contractor. Motor terminals or equipment connections shall terminate in a junction box or disconnect adjacent to equipment.

END OF SECTION

SECTION 16111
CONDUIT

PART 1 GENERAL

1.01 SUMMARY

A. This section addresses:

1. Rigid metal conduit and fittings;
2. Electrical metallic tubing and fittings;
3. Flexible metal conduit and fittings;
4. Liquid-tight flexible metal conduit and fittings; and
5. Non-metallic conduit and fittings.

PART 2 PRODUCTS

2.01 RIGID CONDUIT AND FITTINGS

A. Rigid Steel Conduit: ANSI C80.1.

B. PVC Externally Coated Conduit: NEMA RN1: rigid steel conduit with external 20 mil PVC coating and internal galvanized surface.

C. Fitting and Conduit Bodies: ANSI / NEMA FB 1; threaded type, material to match conduit.

2.02 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. EMT: ANSI C80.3. galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1: steel compression type.

2.03 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: FS WW-C-566; steel.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1.

2.04 LIQUID-TIGHT FLEXIBLE CONDUIT AND FITTINGS

A. Conduit: Flexible metal conduit with PVC jacket.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1.

2.05 PLASTIC CONDUIT AND FITTINGS

A. Conduit: NEMA TC 2; Schedule 40 PVC.

B. Fittings and Conduit Bodies: NEMA TC 3.

2.06 ARMORED CABLE

A. Armored cable shall not be permitted.

PART 3 EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. Size conduit for conductor type installed, minimum size ¾-inch. Conduit sizes shown on Drawings are based on THWN.

B. Arrange conduit to maintain headroom and present a neat appearance.

C. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

D. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.

E. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

F. Do not fasten conduit with wire or perforated pipe straps or caddie clamps, remove all wire used for temporary conduit support during construction before conductors are pulled.

3.02 CONDUIT INSTALLATION

A. Cut conduit square using saw; de-burr cut ends.

B. Bring conduit to the shoulder of fittings and couplings and fasten securely.

C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pans.

E. Maximum Size Conduit in Slabs Above Grade: ¾-inch. Do not route conduits to cross each other in slabs above grade.

F. Use PVC-coated rigid steel factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs that have more than two bends regardless of length. Use rigid steel conduit to turn up out of concrete.

G. Install four spare ¾-inch conduits from each flush mounted power panel to an accessible point above ceiling and cap off.

H. Use long radius elbows on telephone conduit over 1-inch size.

3.03 CONDUIT INSTALLATION SCHEDULE

A. Galvanized rigid steel: Minimum ¾-inch size may be used in all areas.

B. Electrical Metallic Tubing: Minimum ¾-inch size may be used in indoor dry locations where it is:

1. Not subject to damage;

2. Not in contact with earth;

3. Not in concrete slabs on grade; and

4. In compliance with other qualifications in this section.

C. Schedule 40 PVC may be run for underground branch circuits and feeders. Utilize rigid steel where conduits exit the ground. Bury conduits 30 inches below finished grade.

D. Liquid-tight flexible steel conduit:

1. Use for outdoor final connections to mechanical equipment, length not to exceed three feet.

END OF SECTION