

**HISTORY OF CONSTRUCTION
EAST AND WEST ASH BASINS
WAUKEGAN STATION
OCTOBER 2016**

Geosyntec Consultants (Geosyntec) prepared this history of construction report for the East and West Ash Basins located at the Waukegan Station (Site) in Waukegan, Illinois, which is owned and operated by Midwest Generation, LLC (Midwest Generation). This history of construction report addresses the requirements of the Coal Combustion Residuals (CCR) Rule codified in the Code of Federal Regulations Title 40, Part 257, Subpart D. These regulations were published in the Federal Register on 17 April 2015 and became effective on 19 October 2015. This report identifies and addresses the specific requirements of §257.73(c) of the CCR Rule regarding preparing a history of construction report for CCR surface impoundments. Specifically, this report provides the history of construction through 17 October 2016 for the East and West Ash Basins.

This report was prepared under the direction of Ms. Jane Soule, P.E., and was reviewed in accordance with Geosyntec's internal review policy by Mr. Robert White of Geosyntec.

1. CCR Rule Requirements for History of Construction

History of construction requirements for existing CCR surface impoundments are included in the structural integrity criteria presented in §257.73 of the CCR Rule. The preamble of the CCR Rule (Page 21380) states that the history of construction for an existing CCR impoundment (in this case, the East and West Ash Basins) is required to include information only to the extent available and that only factual documentation, not anecdotal or speculative information, is to be included. Additionally, the preamble states that no new information should be generated to satisfy the requirements of §257.73(c).

2. History of Construction

2.1 Owner and Unit Identification - §257.73 (c)(1)(i)

Owner and unit identification for the East and West Ash Basins are presented in Table 1 below.

Table 1: Owner and Unit Identification

UNIT NAME	OWNER/OPERATOR	IDENTIFICATION NUMBER
East Ash Basin	Midwest Generation 804 Carnegie Center Princeton, NJ 08540	IL0002259
West Ash Basin	Midwest Generation 804 Carnegie Center Princeton, NJ 08540	IL0002259

2.2 Unit Location on USGS Map – §257.73 (c)(1)(ii)

The Site is located west of Lake Michigan in Waukegan, Illinois. Figure 1 presents the location of the East and West Ash Basins on a 7.5-minute United States Geological Survey (USGS) topographic quadrangle map.

2.3 Purpose of the CCR Units – §257.73 (c)(1)(iii)

The East and West Ash Basins serve as settling ponds for sluiced CCR and other process waters related to electrical power generation at the Site.

2.4 Name and Size of the Watershed – §257.73 (c)(1)(iv)

The East and West Ash Basins are located in the Waukegan River – Frontal Lake Michigan watershed (HUC12 040400020501), which is approximately 31,245 acres in size (USGS, 2015). However, surface water run-on to the Basins is limited to the area within the embankment crests because the basins are constructed with elevated embankments or run-on diversion berms surrounding them.

2.5 Description of Foundation– §257.73 (c)(1)(v)

The East and West Ash Basins consist of fill embankments on all sides. Because no formational materials provide lateral structural support for the embankments, the basins do not contain abutments. The area west of the West Ash Basin is at approximately the same elevation as the west embankment crest, such that there is not a downstream slope of the west embankment. A divider berm separates the two basins and acts as the west embankment for the East Ash Basin and the east embankment for the West Ash Basin. The remainder of this section addresses the foundation materials for the basins' embankments.

2.5.1 Physical Properties of Foundation Materials

Information on the physical properties of the foundation materials for the East and West Ash Basins is based on published geologic information and field investigations performed at the Site by KPRG in 2005 and 2015, Patrick Engineering in 2011, and Geosyntec in 2015. Detailed descriptions of these investigations and the regional geology at the Site are included in the Geosyntec (2016a).

The East and West Ash Basins are directly underlain by the Henry Formation which generally consists of approximately 30 feet of dense poorly graded sand with some gravel and silt and silty sand. The Henry Formation is underlain by the Wadsworth Formation which consists of very hard low plasticity clay in the vicinity of the Site.

2.5.2 Engineering Properties of Foundation

Table 2 presents engineering properties for the foundation materials at the Site developed for the safety factor assessment (Geosyntec, 2016a). These engineering properties are based on previous investigations performed at the Site, published correlations, and laboratory testing of samples collected from foundation soils during the Site investigations. Based on the observed very hard consistency of the Wadsworth Formation and its depth below the base of the embankments, the material is not considered in the safety factor assessment and engineering properties were not developed.

Table 2: Foundation Material Engineering Properties

MATERIAL	UNIT WEIGHT (PCF)	DRAINED FRICTION ANGLE (DEGREES)	EFFECTIVE COHESION (PSF)
Henry Formation	125	37	0

2.6 Description of the Materials, Methods, and Dates of Construction - §257.73 (c)(1)(vi)

The following sections describe the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the East and West Ash Basins, the method of site preparation and construction of each zone of the unit, and the approximate dates of construction of each successive stage of construction of the unit, to the extent the information is available.

Information presented in the following sections is based on available construction drawings (NUS, 1977 and 1978) and subsequent investigations at the Site. No as-built construction

drawings or construction completion reports detailing the actual materials and methods used for the construction of the basins were available for this report.

Based on the available construction drawings (NUS, 1977), dikes existed in the area of the East and West Ash Basins prior to their construction. Cross sections show areas where existing dikes were widened and raised during construction with compacted fill. Surface impoundment embankments were designed with typical crest widths ranging from 12 to 16 feet. Additional earthen structures overlay the downstream embankment slope to provide for auxiliary uses such as vehicular traffic and pipe support. These additional earthen structures are not required for structural support of the impoundment. The construction drawings indicate that compacted fill for dikes was required to be placed at 95% relative compaction and that the existing foundation areas should be stripped of unsuitable materials (NUS, 1977).

Interior slopes were designed at an inclination of 2H:1V (horizontal:vertical) and exterior slopes were designed at 2H:1V or flatter (NUS, 1977). The interior slopes and basin floor were originally lined with a geomembrane (Hypalon) liner. According to site personnel, in 2003 (East Ash Basin) and 2005 (West Ash Basin), the Hypalon liner was removed and replaced with the existing 60-mil smooth high-density polyethylene (HDPE) geomembrane liner. During this construction process, the interior slopes of the basins were flattened to 2.5H:1V (Midwest Generation, 2002). Based on 2015 aerial topography, existing exterior (or downstream) slopes range from approximately 1.4H:1V to 3H:1V or flatter (GeoTerra, 2015). Exterior slopes along the eastern and southeastern side of the East Ash Basin were flattened to 2H:1V in 2016.

2.6.1 Engineering Properties

Engineering properties used for the design and construction of the East and West Ash Basins were not available at the time of this report. However, engineering properties were estimated for use in the factor of safety assessment performed for the basins in accordance with the CCR Rule. The estimated engineering properties were based on investigations performed at the Site, published correlations, and laboratory testing of embankment materials and are presented in Geosyntec (2016a) and reproduced in Table 3. For engineering analyses, the embankments were divided into two different materials: Upper Fill located from the embankment surface to approximately 10 to 12 feet below the top of the embankment along its centerline and Lower Fill from the bottom of the Upper Fill to the foundation material.

Table 3: Embankment Fill Engineering Properties

MATERIAL	UNIT WEIGHT (PCF)	DRAINED FRICTION ANGLE (DEGREES)	EFFECTIVE COHESION (PSF)
Upper Fill	125	37	25
Lower Fill	115	32	25

2.6.2 Construction Dates

Construction dates for the East and West Ash Basin embankments, original liner system, and appurtenant structures are unknown; however, construction drawings were approved for construction in August 1977 (NUS, 1977). Replacement of the original liner systems were completed in 2003 and 2005 for the East and West Ash Basins, respectively. Modification of the eastern and southeastern slopes of the East Ash Basin was completed in September 2016.

2.7 Drawings - §257.73 (c)(1)(vii)

Available drawings relevant to the design, construction, operation, and maintenance of the East and West Ash Basin are included in Appendix A. Appendix A-1 includes construction drawings¹ (NUS, 1977 and 1978), Appendix A-2 includes a drawing from the liner replacement performed in 2003 (Midwest Generation, 2002) and Appendix A-3 includes construction drawings from the eastern and southeastern slope modifications completed in 2016 (Geosyntec, 2016b).

2.8 Instrumentation - §257.73 (c)(1)(viii)

Water level monitoring instrumentation was installed along the outboard (basin) side of the concrete weir walls within both the East and West Ash Basins in October 2016. This instrumentation includes ultrasonic level detectors with automated remote sensors that provide notification to station operators of basin water level conditions (high level, low level or no signal).

2.9 Area-Capacity Curve - §257.73 (c)(1)(ix)

Area-capacity curves for the East and West Ash Basins are included as Figure 2.

¹ The available construction drawings (NUS, 1977 and 1978) are based on a site specific vertical datum. Slope modification drawings (Geosyntec 2016) are based on the North American Vertical Datum of 1988 (NAVD88). The 1977 and 1978 construction drawings referred to the West Ash Basin as Pond I and the East Ash Basin as Pond II.

2.10 Spillway Description and Calculations - §257.73 (c)(1)(x)

The East and West Ash Basins do not contain spillways.

2.11 Construction Specifications and Provisions for Surveillance, Maintenance and Repair - §257.73 (c)(1)(xi)

Earthwork, HDPE geomembrane, and specifications from requests for proposals solicited by Midwest Generation for the liner replacement projects constructed in 2003 and 2005, for the East and West Ash Basins, respectively, are included in Appendix B-1 and B-2. Technical specifications for the 2016 slope modification project for the East Ash Basin, including specifications for earthwork and geosynthetics (Geosyntec, 2016c), are included in Appendix B-3.

As part of the 2003 and 2005 liner replacement projects, warning posts were installed at the toe of interior basin slopes above the geomembrane liner system. These posts are utilized as a visual guide to identify the toe of slope during CCR removal operations to limit potential damage to the liner system.

2.12 Record of Any Structural Instability - §257.73 (c)(1)(xii)

Midwest Generation retained Raymond Professional Group, Inc. (RPG) to prepare a Report of Engineering Study to propose repairs to instability observed in the interior embankments of the basins in January 2002 (RPG, 2002a). The recommendations included flattening the interior slopes of the basins to 2.5H:1V, which was completed during the liner replacement projects in 2003 and 2005.

Inspections of the east and south embankments for the East Ash Basin were also performed by RPG in 2002 and 2003. These inspections indicated areas of undercutting and soft soil at the downstream toe of the embankment, observations of some seepage from the embankment and localized erosion of the perimeter access road east of the East Ash Basin (RPG, 2002b and RPG, 2003). These inspections were performed before the liner replacement project for the East Ash Basin was completed. The eastern and southeastern slopes of the East Ash Basin, including the areas generally referenced in these inspections, were re-graded in 2016 (see Appendix A-2 and B-3).

Midwest Generation also retained Valdes Engineering to perform inspections of the East and West Ash Basins in 2009, 2014, and 2015. Inspection reports from these years did not document structural instability of the CCR units (Valdes, 2009, Valdes, 2014, and Valdes, 2015).

3. References

Geosyntec, 2016a. Soil Properties Calculations, Waukegan Station, October.

Geosyntec, 2016b. Plans for the Construction of: East Ash Basin Slope Modification, Waukegan Generating Station, Lake County, Illinois, July, 2016.

Geosyntec, 2016c. Technical Specification Sections 02200 and 02770 for the Construction of: East Ash Basin Slope Modification, Waukegan Generating Station, Lake County, Illinois, July, 2016.

KPRG and Associates, Inc., 2005. Geotechnical Analysis of Soil Surrounding Settling Basins/Ponds, KPRG Project No. 15805, October.

Midwest Generation, 2002. East and West Ash Pond Liner Replacement Plans, Sections, and Details, Sheet B739

NUS Corporation, 1977. Waste Water Treatment Facilities Waukegan:

Ash Pond – Location and Plot Plan, Sheet No. 5082-C-5000.

Ash Pond – Detail Plan, Sheet No. 5082-C-5006.

Ash Pond – Sections & Details, Sheet No. 5082-C-5007.

NUS Corporation, 1978. Waste Water Treatment Facilities Waukegan:

Ash Pond Sump – Plan, Sections and Details, Sheet No. 5082 C 5501

Ash Pond Sump Weir – Plan, Sections & Details, Sheet No. 5082 C 5502

Ash Pond Sump and Weir – Miscellaneous Sections and Details, Sheet No. 5082 C 5503

Ash Pond Inlet Flume & Distribution – Trough Details, Sheet No. 5082 C 5507

Patrick Engineering, 2011. Hydrogeological Assessment Report, Waukegan Generating Station, Waukegan, Illinois, Patrick Project No. 21053.070, February.

RPG, 2002a. “Report of Engineering Study on Waukegan Generating Station #16 Ash Pond Repairs,” 25 January 2002.

RPG, 2002b. “Ash Pond Berm Inspection Report,” Letter to Chris Lux, 2 May 2002.

RPG, 2003b. “Ash Pond Berm Inspection Report,” Letter to Chris Lux, 12 June 2003.

USGS, 2015. “Watershed Boundary Dataset,” accessed via The National Map, <http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd>, accessed 1 February 2016.

Valdes Engineering, 2009. “Ash Ponds Berm Inspection,” Letter to Chris Lux, 29 June 2009.

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Valdes Engineering, 2014. “Ash Pond Berm Visual Assessment,” Letter to Chris Lux, 12 June 2014.

Valdes Engineering, 2015. “Ash Pond Berm Visual Assessment,” Letter to Chris Lux, 29 May 2015.

Attachments

Figure 1 – Site Location

Figure 2 – Area-Capacity Curves

Appendix A – Construction Drawings

Appendix A-1 NUS Construction Drawings

Appendix A-2 Liner Replacement Construction Drawing

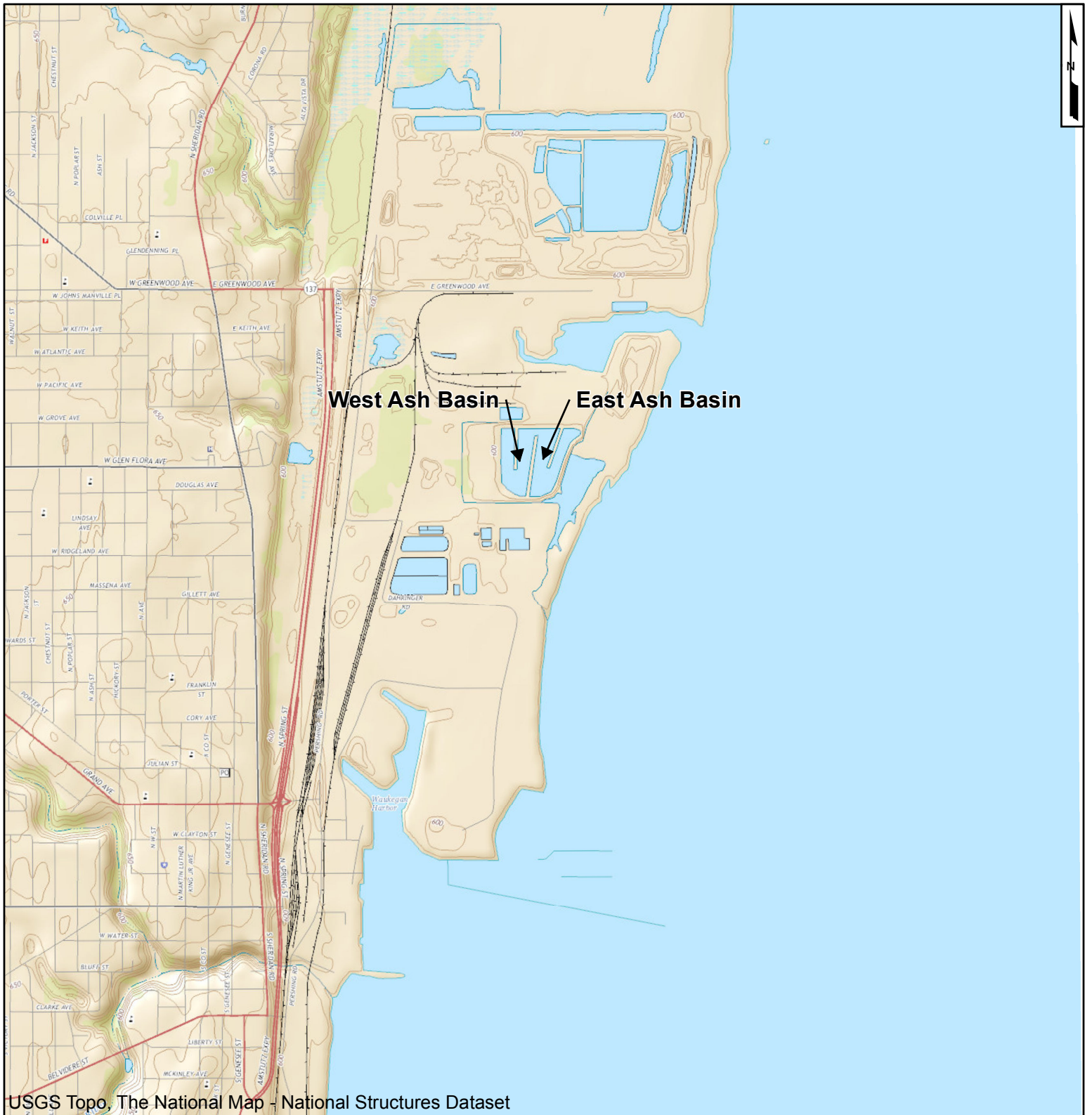
Appendix A-3 East Ash Basin Slope Modification Construction Drawings

Appendix B – Technical Specifications

Appendix B-1 East Ash Basin Liner Replacement Specifications

Appendix B-2 West Ash Basin Liner Replacement Specifications

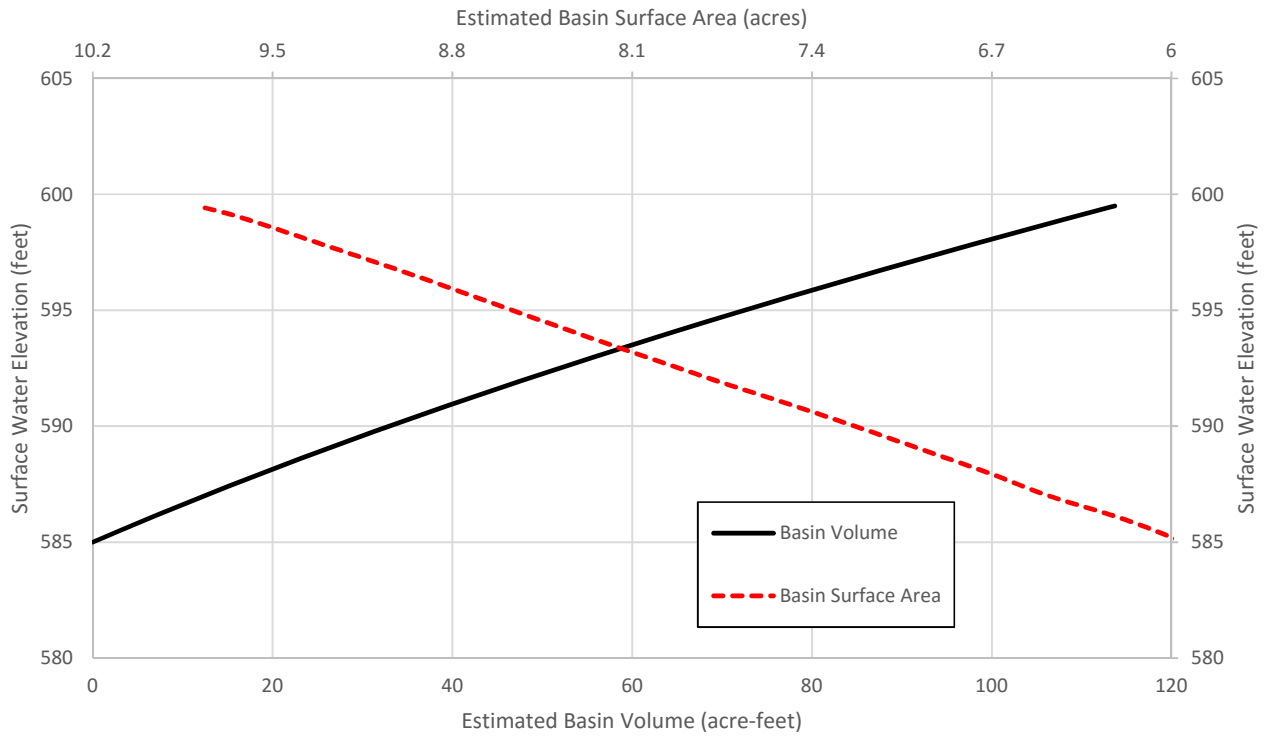
Appendix B-3 East Ash Basin Slope Modification Technical Specifications



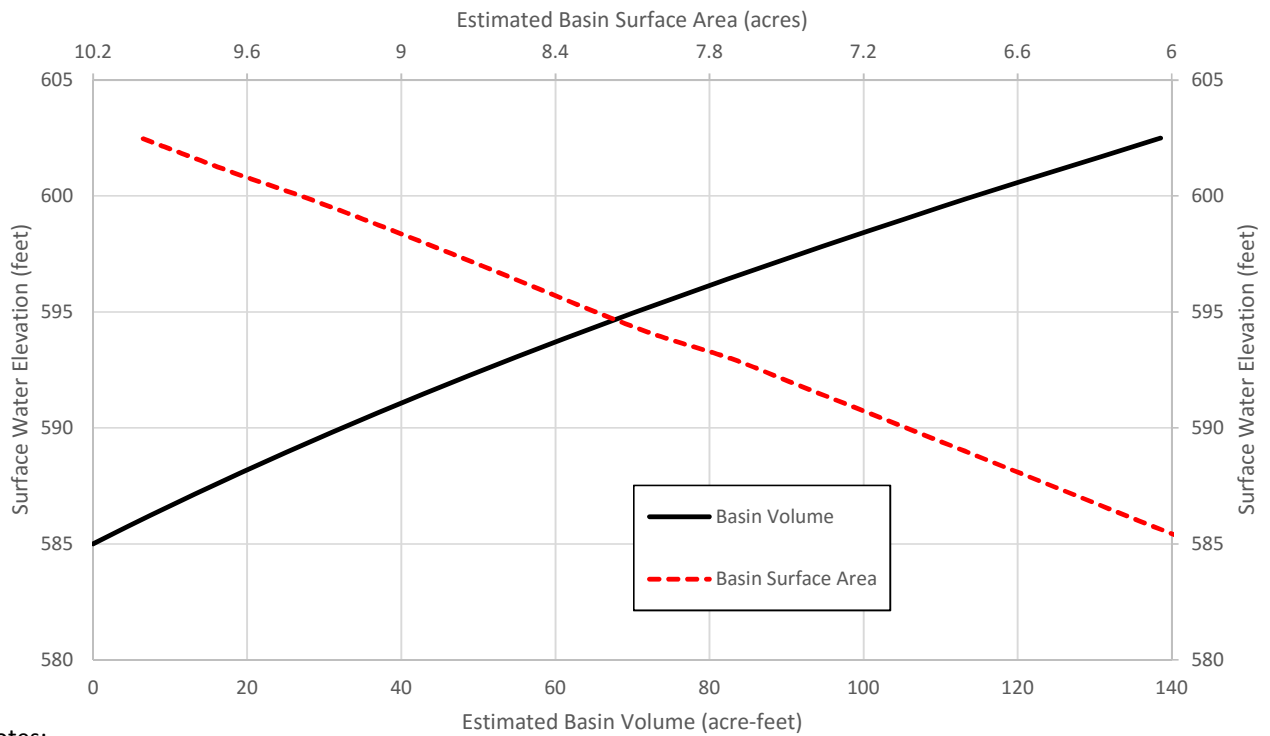
2,000 1,000 0 2,000 Feet 	
Site Location East and West Ash Basins Waukegan Station Waukegan, Illinois	
Figure 1	San Diego October 2016

K:\GIS\Waukegan\SiteLocation.mxd - J.Gordon

East Ash Basin



West Ash Basin



Notes:

- (1) Surface water elevations are NAVD88.
- (2) Basin volumes are estimated based on as-built information and 2015 site

OCTOBER 2016
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AREA-CAPACITY CURVES
EAST AND WEST ASH BASINS
WAUKEGAN STATION
WAUKEGAN, ILLINOIS

**FIGURE
2**

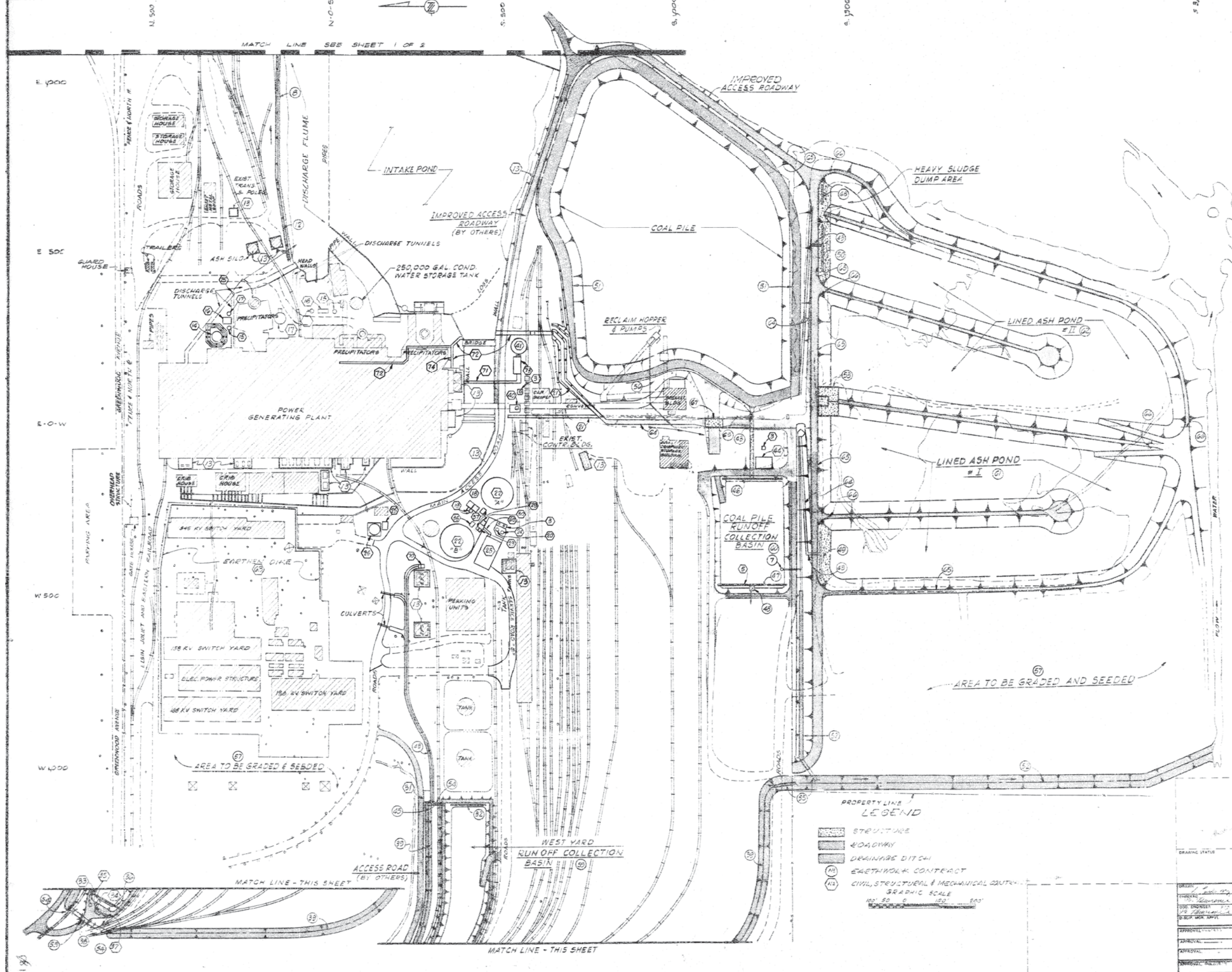
APPENDIX A

Construction Drawings

APPENDIX A-1

NUS Construction Drawings

NO.	REVISION
1	APPROVED FOR CONSTRUCTION



PROPERTY LINE LEGEND

- STRUCTURE
- ROADWAY
- DRAINAGE DITCH
- EARTHWORK CONTRACT
- CIVIL, STRUCTURAL & MECHANICAL OUTLET

GRAPHIC SCALE
1" = 50' 0" 1" = 100' 0"

PROVED FOR CONSTRUCTION

COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
WAUKEGAN

LOCATION AND PLOT PLAN

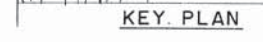
SCALE: 1" = 100'

NUS 5082 C5000

ROCKVILLE, MD



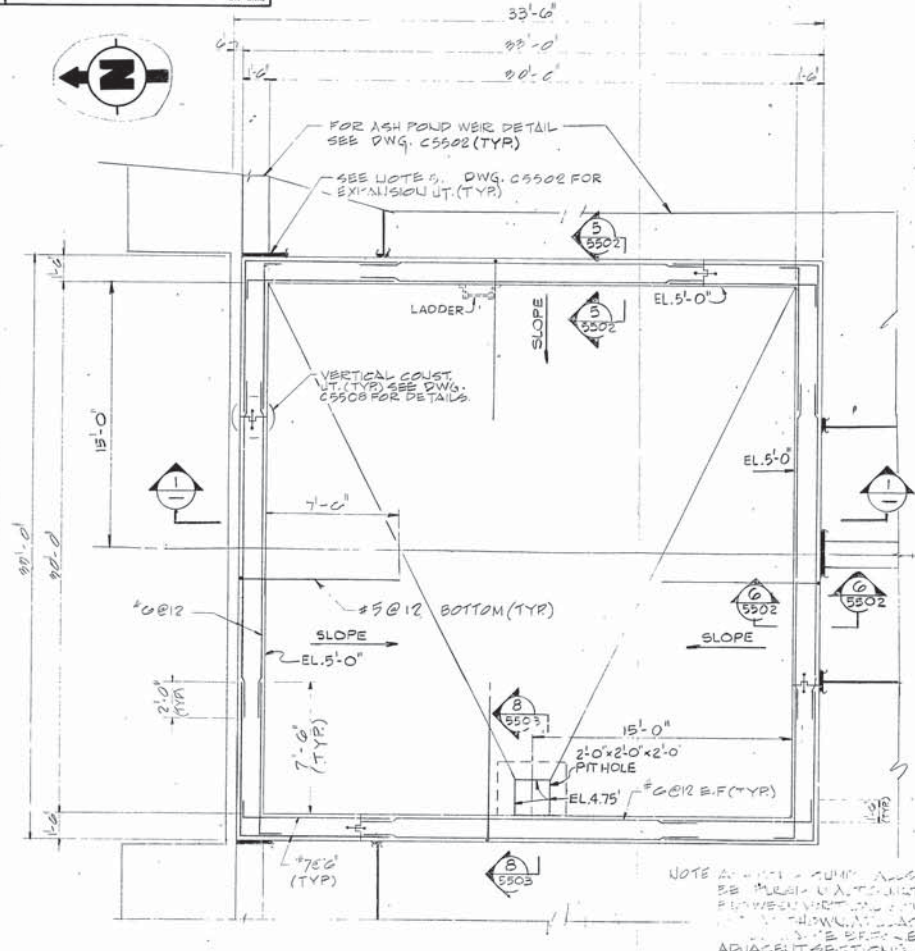
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1	11.0x11.0 POND & GUARDRAIL BY OTHERS	1	APPROVED FOR CONSTRUCTION
2	2.0x2.0 POND	2	REVISIONS TO SECTION 11 & NOTES AS NOTED ON SHEET 5082C 5501
3	2.0x2.0 POND	3	ADDED SECTION 11 & NOTES AS NOTED ON SHEET 5082C 5501



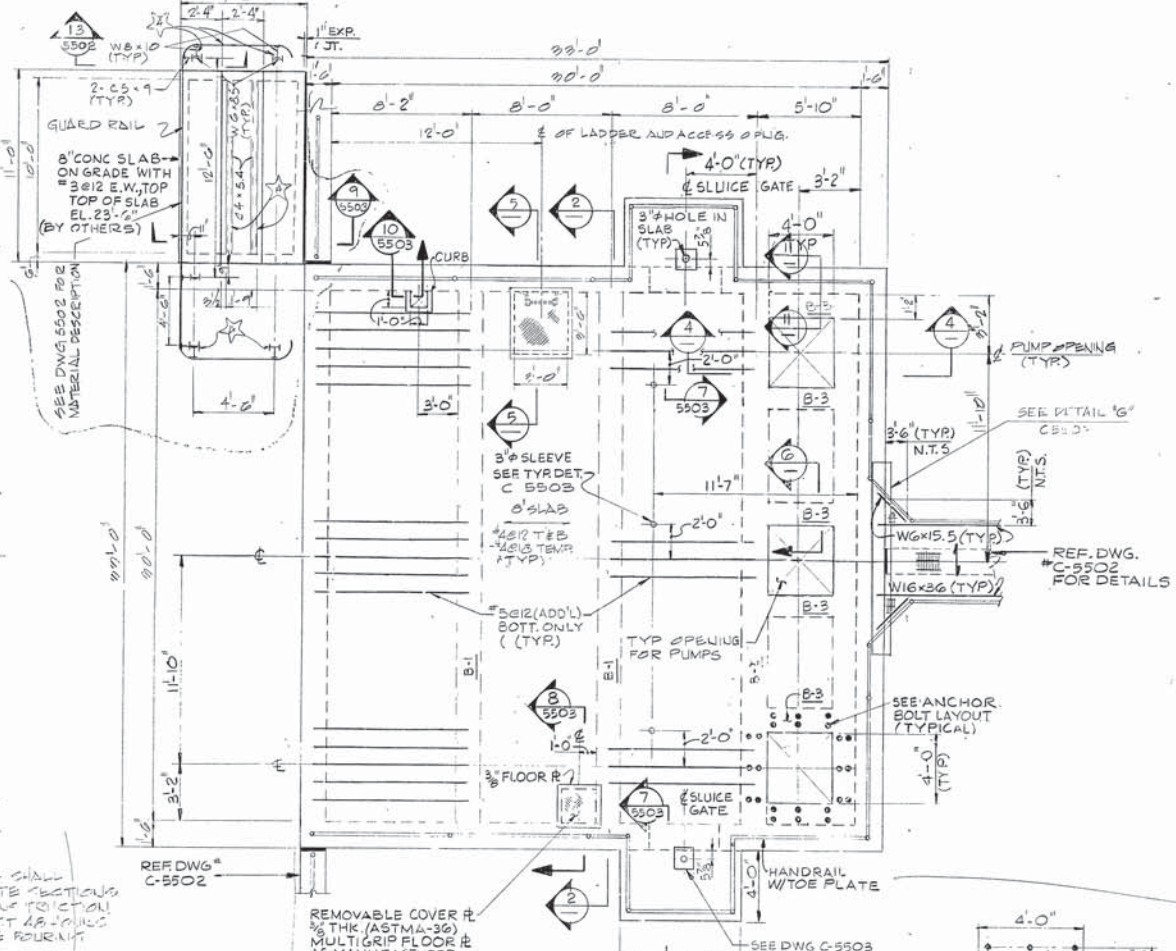
GENERAL NOTES

- THESE NOTES SHALL BE USED AS A SUPPLEMENT TO THE NOTES SHOWN ON INDIVIDUAL DRAWINGS
- FOUNDATION**
 - THE BOTTOM OF ALL EXCAVATIONS SHALL BE INSPECTED AND APPROVED BY THE OWNER OR HIS AUTHORIZED REPRESENTATIVE
 - THE DESIGN BEARING CAPACITY OF SOIL IS ASSUMED TO BE 3000 P.S.F.
 - ALL SLABS ON GRADE INCLUDING FOUNDATION PADS FOR EQUIPMENT SHALL BE PLACED ON 6" MIN. POLYETHYLENE VAPOUR BARRIER PLACED OVER WELL COMPACTED CRUSHED STONE OR GRAVEL 18" MINIMUM UNLESS OTHERWISE NOTED ON DRAWINGS
 - ALL FOUNDATIONS SHALL BEAR UPON UNDISTURBED SOIL AND WELL PREPARED COMPACTED SOIL
 - CONCRETE**
 - ALL STRUCTURAL CONCRETE SHALL BE STONE CONCRETE AND SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4000 P.S.I. AT 28 DAYS
 - ALL REINFORCING BARS SHALL BE DEFORMED BARS OF NEW BILLET STEEL CONFORMING TO A S T M A-615 GRADE 40 AND SHALL HAVE A MINIMUM YIELD STRESS OF 46,000 P.S.I.
 - UNLESS OTHERWISE NOTED, ALL DOVELS SHALL BE SAME IN NUMBER AND SIZE AS THE VERTICAL BARS TO WHICH THEY ARE SPICED.
 - MINIMUM CONCRETE PROTECTION FOR REINFORCING BARS SHALL BE AS INDICATED BELOW. PLACING OF ALL REINFORCING BARS SHALL CONFORM TO ACI 318-71, SECTION 7.3.

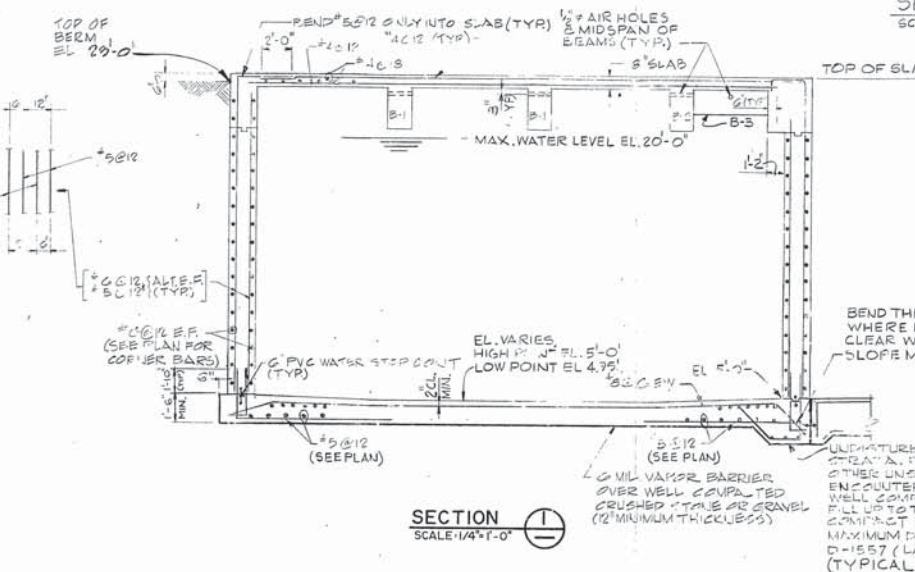
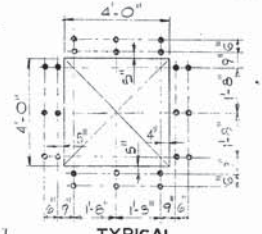
Cast-In-Place Concrete	Min. Cover, In.	Cast-In-Place Concrete	Min. Cover, In.
Cast against and permanently exposed to earth	3	Exposed to earth or weather:	
Not exposed to weather or in contact with the ground:		No. 6 through No. 18 Bars	2
Slabs, walls, joists:		No. 5 Bars, 5/8 In. wire, and smaller	1-1/2
No. 14 and No. 18 Bars	1-1/2	Beams, girders, columns:	
No. 11 and smaller	3/4	Principal reinforcement, ties, stirrups or spirals	1-1/2
 - STRUCTURAL STEEL**
 - ALL STRUCTURAL STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A-36
 - THE DESIGN, FABRICATION AND ERECTION OF ALL STRUCTURAL STEEL SHALL BE DONE IN ACCORDANCE WITH THE AISC MANUAL (SEVENTH EDITION)
 - ALL STRUCTURAL BOLTS SHALL BE 3/4" HIGH STRENGTH TYPE ASTM A-325-X.
 - UNLESS OTHERWISE NOTED, ALL CONNECTIONS SHALL BE SELECTED TO SUPPORT HALF THE TOTAL UNIFORM LOAD CAPACITY SHOWN IN "TABLES FOR ALLOWABLE LOADS ON BEAMS" (AISC MANUAL OF STEEL CONSTRUCTION - SEVENTH EDITION) + 5 KIPS FOR THE SHAPE AND SPAN SHOWN ON DRAWINGS
 - ALL WELDING SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF "STRUCTURAL WELDING CODE, AWS D1-1 REV 1-73" WELDING ELECTRODES SHALL BE E70XX
 - EARTHWORK**
 - ONE FOOT OF POROUS BACKFILL SHALL BE PLACED ALONG ALL WALLS FROM TOP OF FOUNDATION TO 1'-0" BELOW FINISHED GRADE WHERE SHOWN ON CONTRACT DRAWINGS
 - BACKFILLING SHALL NOT BE DONE UNTIL ALL CONCRETE HAS ATTAINED ITS' FULL DESIGN COMPRESSIVE STRENGTH
 - BACKFILLING SHALL BE DONE AND COMPACTED IN EQUAL LAYERS ALONG ALL SIDES OF STRUCTURE
 - CONTRACTOR SHALL ADEQUATELY PROTECT ALL WALLS DURING BACKFILLING OPERATIONS



ASH POND SUMP
SCALE: 1/4"=1'-0"
NOTE 1. FOR LOCATION OF ASH POND SUMP SEE DWG. C-5006
2. FOR STANDARD DETAILS SEE DWG. C-5508
3. NO BACKFILLING AGAINST THE WALL OF THE PUMP IS PERMITTED UNTIL THE TOP SLAB HAS ATTAINED AT LEAST 7 DAYS STRENGTH.
4. WALL CONSTRUCTION JOINTS NOT RECD IF WALL IS POURED IN ONE CONTINUOUS OPERATION.



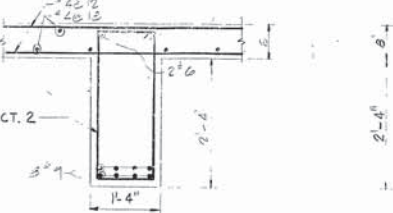
REMOVABLE COVER # 3/8 THK (ASTM A-36) MULTIGRIP FLOOR # AS MANUFACTURED BY U.S. STEEL OR APPROVED EQUAL PROVIDE LIFT HOLES (4) @ 7" EACH CORNER (TYPICAL) SCALE: 1/4"=1'-0"



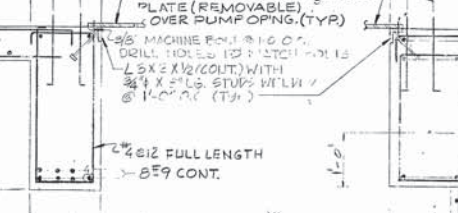
SECTION 1 SCALE: 3/4"=1'-0"



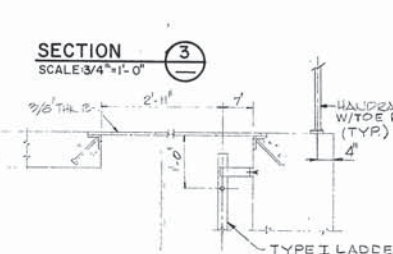
TYPICAL BEAM B-1 SECTION 2 SCALE: 1/4"=1'-0"



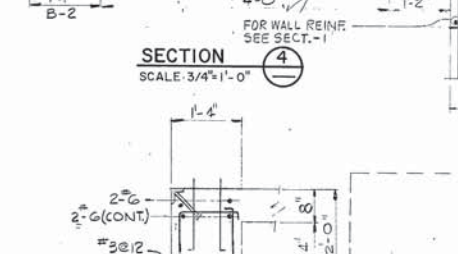
SECTION 3 SCALE: 3/4"=1'-0"



SECTION 4 SCALE: 3/4"=1'-0"



SECTION 5 SCALE: 3/4"=1'-0"



TYP BEAM B-3 SECTION 6 SCALE: 3/4"=1'-0"

MISCELLANEOUS:
1. THE ELEVATION SHOWN ON THESE DRAWINGS REFER TO WAUKEGAN CITY DATUM TO CORNER TO MEAN SEA LEVEL, ADD 580.264
2. NOTE FOR COVER SLAB, DESIGN LIVE LOAD = 200 PSF, DESIGN PUMP WEIGHT 4K.

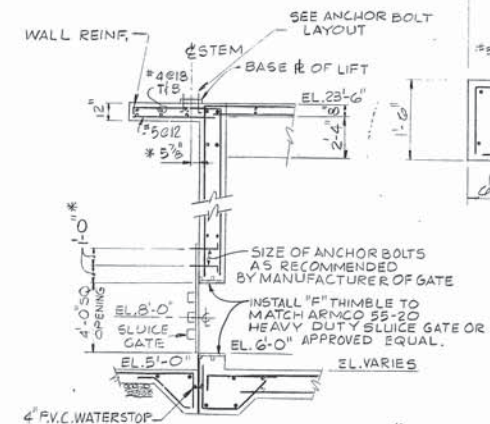
APPROVED FOR CONSTRUCTION

COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
WAUKEGAN

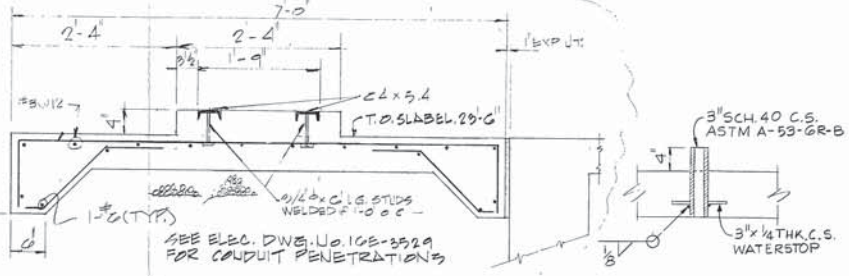
ASH POND SUMP
PLAN, SECTIONS AND DETAILS

CECO CONTRACT #02670 CECO DWG NO
NUS CORPORATION
5082C 5501
ROCKVILLE, MD

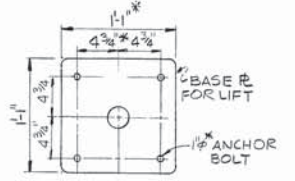
REV	DESCRIPTION
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3	ADDED DETAIL VIEW FOR DET E
4	ADDED DETAIL VIEW FOR DET F
5	ADDED DETAIL VIEW FOR DET G
6	ADDED DETAIL VIEW FOR DET H
7	ADDED DETAIL VIEW FOR DET I
8	ADDED DETAIL VIEW FOR DET J
9	ADDED DETAIL VIEW FOR DET K
10	ADDED DETAIL VIEW FOR DET L
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15	ADDED DETAIL VIEW FOR DET Q
16	ADDED DETAIL VIEW FOR DET R
17	ADDED DETAIL VIEW FOR DET S
18	ADDED DETAIL VIEW FOR DET T
19	ADDED DETAIL VIEW FOR DET U
20	ADDED DETAIL VIEW FOR DET V
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22	ADDED DETAIL VIEW FOR DET X
23	ADDED DETAIL VIEW FOR DET Y
24	ADDED DETAIL VIEW FOR DET Z



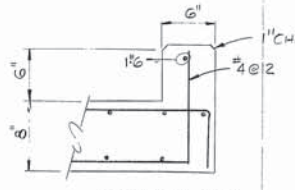
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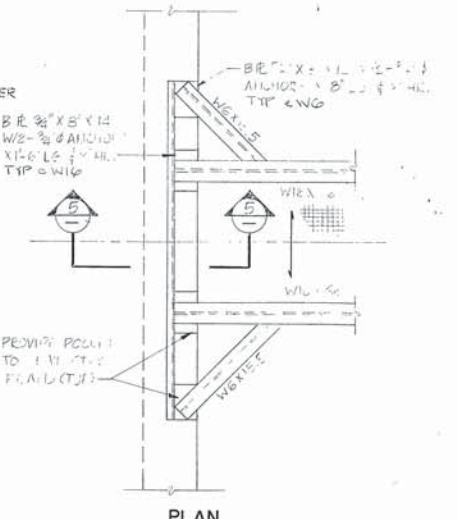
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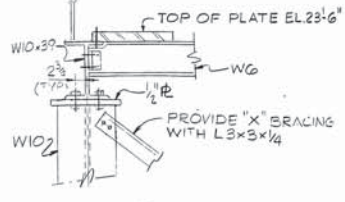
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SCALE: 1/2" = 1'-0"



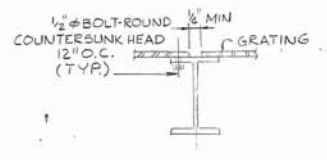
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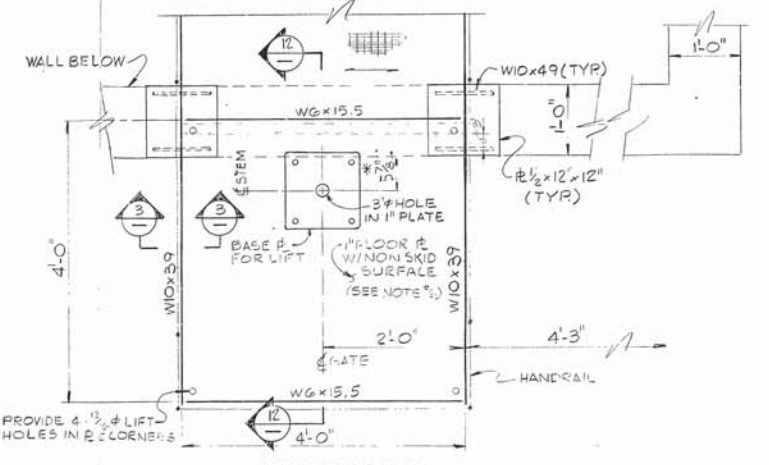
PLAN



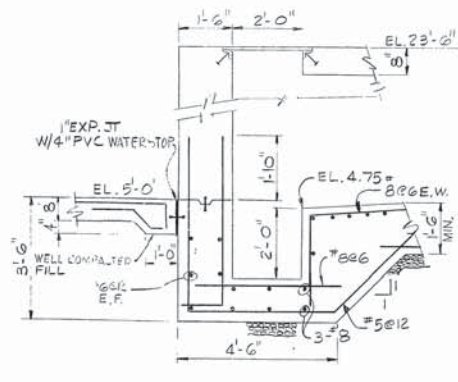
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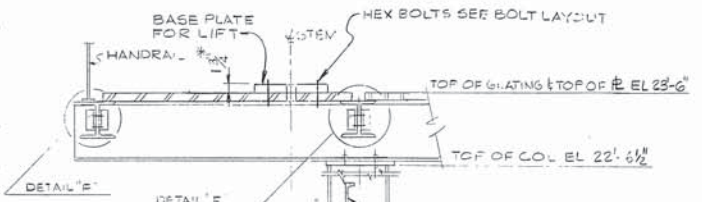
DETAIL E
N.T.S.



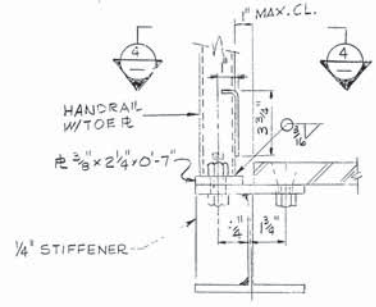
LIFT PLATFORM PLAN AT EL. 23'-6"
SCALE: 1/4" = 1'-0"



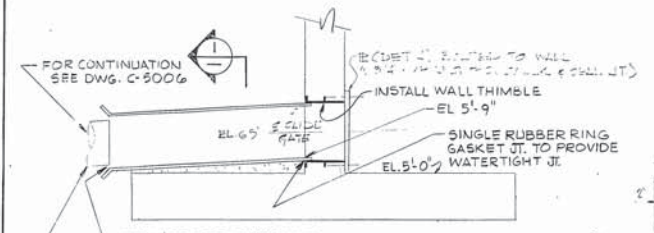
SECTION 8
SCALE: 1/2" = 1'-0"



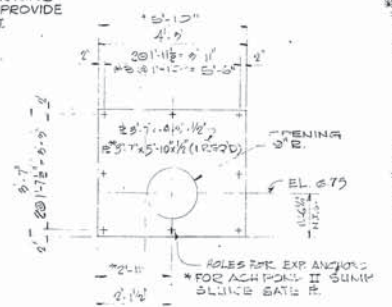
DETAIL F
N.T.S.



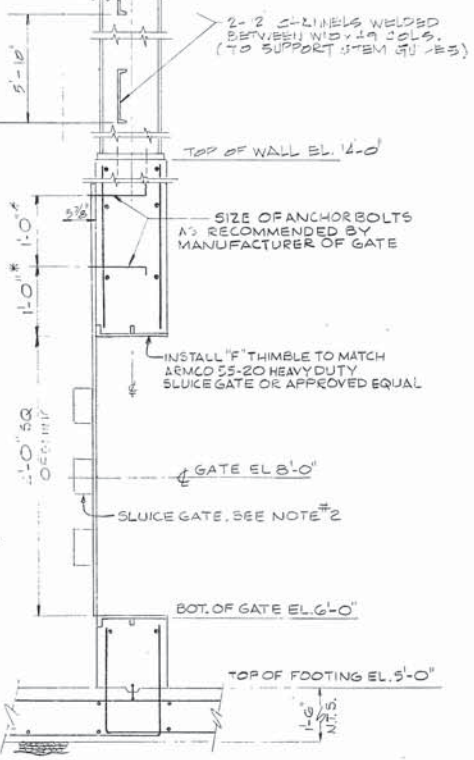
SECTION 4
N.T.S.



CONCRETE PIPE SLEEVE
SCALE: 3/8" = 1'-0"



DETAIL J
SCALE: 1/2" = 1'-0"



SECTION 12
SCALE: 1/4" = 1'-0"

NOTES:
1. THE CONTRACTOR SHALL FURNISH AND INSTALL SLUICE GATES & LIFTS IN THE LOCATION SHOWN ON DWG. C-5501 AND CONFORMING TO THE FOLLOWING. C-5502

SLUICE GATE
TYPE 55-20 HEAVY DUTY WITH FLATBACK FRAME, RISING STEM (2" SST) STANDARD BOTTOM AND ADJUSTABLE WEDGES (TOP, BOTTOM SIDES) AS MANUFACTURED BY ARMCO OR APPROVED EQUAL.

LIFT
MODEL CPE-12 (CRANK OPERATED) AS MANUFACTURED BY ARMCO OR APPROVED EQUAL

2. INSTALLATION OF THE GATE & LIFT SHALL BE IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATION.

3. INSTALLATION OF WALL THIMBLE SHALL BE IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATION.

4. DIMENSIONS MARKED THUS * SHALL BE COORDINATED WITH THE GATE MANUFACTURER.

5. FOR GENERAL NOTES, SEE DWG. C-5501.

6. THE CONTRACTOR SHALL COORDINATE THE INSTALLATION OF PLATE WITH THE LIFT GATE SUPPLIER.

7. THE CONTRACTOR SHALL FURNISH AND INSTALL SLUICE GATES & LIFTS IN THE LOCATION SHOWN ON DWG. C-5501 AND CONFORMING TO THE FOLLOWING. C-5502

SLUICE GATE: MODEL 20-100 WITH FLATBACK FRAME, RISING STEM (1/8" SST) AS MANUFACTURED BY ARMCO OR APPROVED EQUAL.

LIFT: TYPE 41-12 (HAND OPERATED) AS MANUFACTURED BY ARMCO OR APPROVED EQUAL.

8. 18" DIA. SLUICE GATE IS TO BE SUPPLIED WITH AN EPDM COATING OF 1/8" THICK BITUMASTIC 300-M OR AN APPROVED EQUAL, SHOWN APPLIED AT THE MANUFACTURER'S INSTRUCTIONS.

APPROVED FOR CONSTRUCTION

DRAWN	JUHR	DATE	6/29/23
CHECKED	SJC	DATE	7/10/23
DESIGNED	SPR	DATE	6/29/23
APPROVAL	SPR	DATE	7/10/23
APPROVAL	SPR	DATE	7/10/23

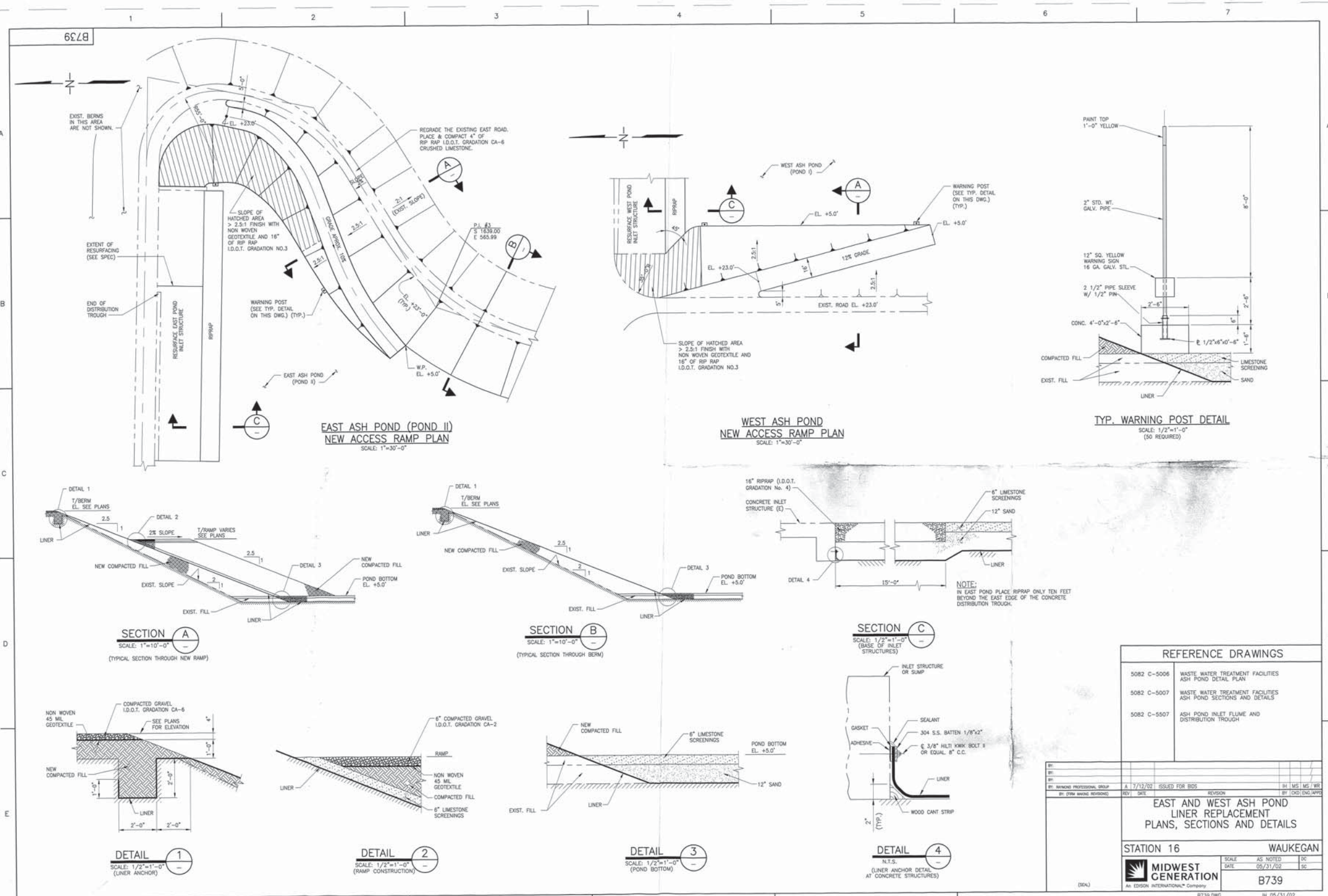
COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
WAUKEGAN

ASH POND SUMP AND WEIR
MISCELLANEOUS SECTIONS AND DETAILS

NUS CORPORATION
ROCKVILLE, MD
5082 C5503
SCALE AS NOTED SHEET 1 OF 1

APPENDIX A-2

Liner Replacement Construction Drawing

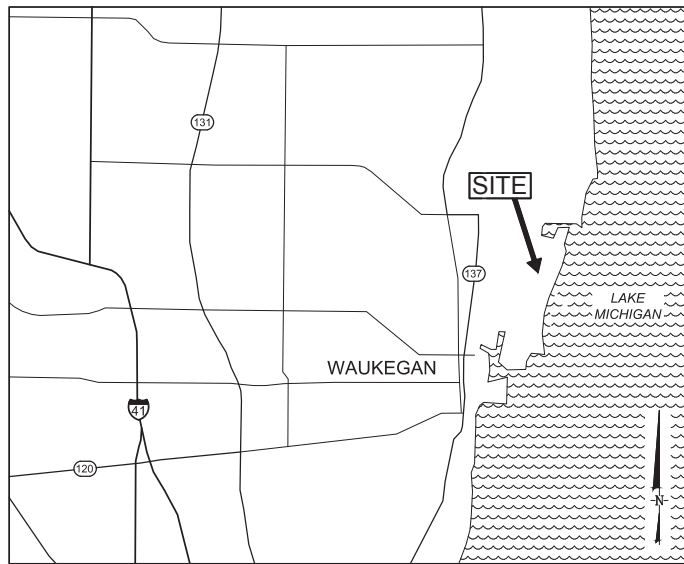


REFERENCE DRAWINGS	
5082 C-5006	WASTE WATER TREATMENT FACILITIES ASH POND DETAIL PLAN
5082 C-5007	WASTE WATER TREATMENT FACILITIES ASH POND SECTIONS AND DETAILS
5082 C-5507	ASH POND INLET FLUME AND DISTRIBUTION TROUGH

BY: []	DATE: []	ISSUED FOR BIDS	BY: []
BY: []	DATE: []	REVISION	BY: []
STATION 16		WAUKEGAN	
MIDWEST GENERATION		B739	
An EDISON INTERNATIONAL Company		SCALE: AS NOTED DATE: 05/31/02	
B739.DWG		IH 05/31/02	

APPENDIX A-3

East Ash Basin Slope Modification Construction Drawings



VICINITY MAP
NOT TO SCALE

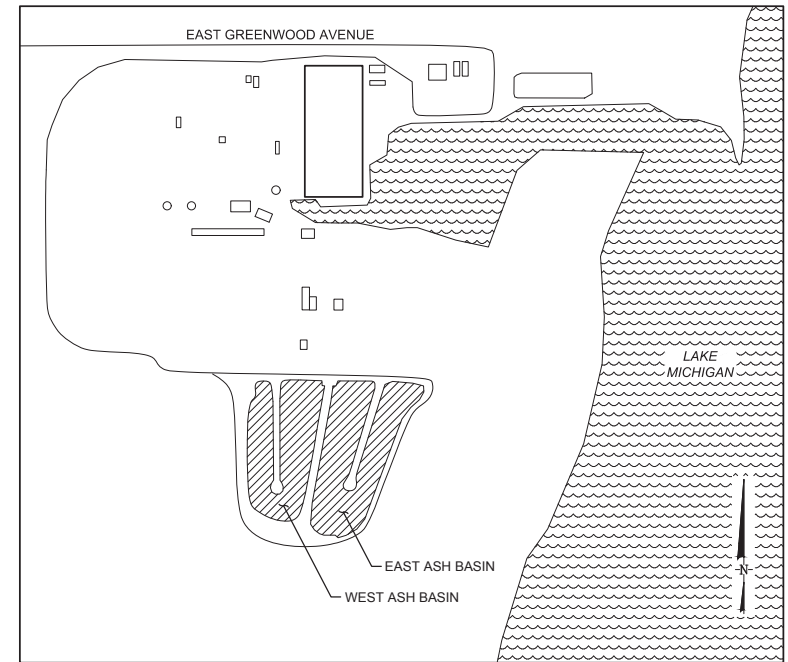
PLANS FOR THE CONSTRUCTION OF: EAST ASH BASIN SLOPE MODIFICATION

JULY 2016

WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS

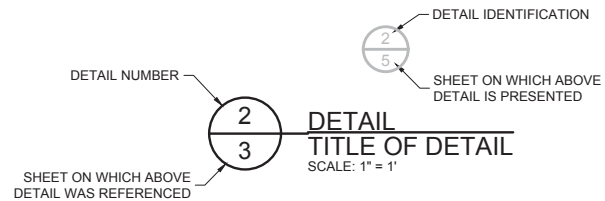
PREPARED FOR:
MIDWEST GENERATION, LLC

PREPARED BY:
Geosyntec Consultants
3990 OLD TOWN AVENUE, SUITE A-101
SAN DIEGO, CALIFORNIA 92110
(619) 810-4000
www.geosyntec.com



SITE LOCATION MAP
NOT TO SCALE

DETAIL IDENTIFICATION LEGEND



EXAMPLE: DETAIL NUMBER 2 PRESENTED ON SHEET NO. 5 WAS REFERENCED ON SHEET NO. 3.
NOTE: ABOVE REFERENCING SYSTEM ALSO APPLIES TO SECTION IDENTIFICATIONS.

GENERAL NOTES

- THE WORK UNDERTAKEN BY THIS DOCUMENT IS FOR MIDWEST GENERATION, LLC, HEREAFTER REFERRED TO AS OWNER. GEOSYNTEC CONSULTANTS, HEREAFTER REFERRED TO AS ENGINEER, PERFORMED DESIGN.
- THE PLANS AND OTHER DOCUMENTS SHALL GOVERN THE WORK AND SHALL BE CONSIDERED COMPLIMENTARY. ANYTHING FOUND IN THE PLANS AND NOT IN ANOTHER DOCUMENT OR FOUND IN ANOTHER DOCUMENT AND NOT IN THE PLANS SHALL BE CONSIDERED TO BE IN BOTH.
- CONTRACTOR SHALL, UPON DISCOVERING ANY ERROR OR OMISSION IN THE PLANS, IMMEDIATELY BRING IT TO THE ATTENTION OF ENGINEER.
- CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF PUBLIC AND PRIVATE PROPERTY ADJACENT TO THE WORK, AND EXERCISE DUE CAUTION TO AVOID DAMAGE TO SUCH PROPERTY. CONTRACTOR SHALL NOT PERFORM ANY WORK OR DISTURBANCE OUTSIDE OF THE WORK ZONE AND APPROVED SITE ACCESS ROUTES WITHOUT PREAPPROVAL BY THE OWNER.
- THROUGHOUT ALL PHASES OF CONSTRUCTION, INCLUDING SUSPENSION OF WORK, AND UNTIL FINAL ACCEPTANCE OF THE PROJECT, CONTRACTOR SHALL KEEP THE WORK SITE CLEAN AND FREE FROM RUBBISH AND DEBRIS.
- THE WORK SHALL BE CONDUCTED TO MINIMIZE DISTURBANCE TO ONGOING PLANT OPERATIONS. WORK THAT IMPACTS PLANT OPERATIONS SHALL BE COORDINATED THROUGH THE OWNER.
- CONTRACTOR SHALL KEEP A COPY OF THE PLANS AND OTHER DOCUMENTS AT THE WORK SITE, TO WHICH THE OWNER SHALL HAVE ACCESS UPON REQUEST.
- CONTRACTOR SHALL ASCERTAIN THE EXISTENCE OF ANY CONDITIONS AFFECTING THE COST OF THE WORK WHICH WOULD HAVE BEEN DISCLOSED BY REASONABLE EXAMINATION OF THE SITE.
- EXISTING IMPROVEMENT VISIBLE AT THE JOB SITE, FOR WHICH NO SPECIFIC DISPOSITION IS MADE ON THE PLANS, BUT WHICH COULD REASONABLY BE ASSUMED TO INTERFERE WITH SATISFACTORY COMPLETION OF THE WORK, SHALL BE BROUGHT TO THE ATTENTION OF OWNER.
- ALL MATERIALS, PARTS, AND EQUIPMENT FURNISHED BY CONTRACTOR SHALL BE NEW, HIGH GRADE, AND FREE OF DEFECTS. QUALITY OF WORK SHALL BE IN ACCORDANCE WITH GENERALLY ACCEPTED STANDARDS. MATERIALS AND WORK QUALITY SHALL BE SUBJECT TO APPROVAL BY ENGINEER.
- DEFECTIVE WORK OR MATERIAL SHALL BE REMOVED IMMEDIATELY FROM THE SITE BY CONTRACTOR, AT CONTRACTOR'S EXPENSE, WHEN SO DIRECTED.
- SOIL AND ROCK MATERIALS, REQUIRED FOR THE WORK, SHALL BE STOCKPILED AT LOCATIONS DESIGNATED BY THE OWNER AND APPROVED BY ENGINEER.
- CONTRACTOR SHALL PROVIDE AND MAINTAIN FACILITIES TO PROTECT ALL WORK AND EQUIPMENT WHETHER IN PLACE OR NOT.
- CONTRACTOR MAY SUPPLY EQUIVALENT REPLACEMENTS FOR ANY MATERIALS REQUIRED FOR COMPLETION OF THE WORK, SUBJECT TO APPROVAL BY ENGINEER.
- CONTRACTOR SHALL NOT INTERRUPT THE SERVICE FUNCTION OR DISTURB THE SUPPORT OF ANY UTILITY WITHOUT AUTHORIZATION FROM OWNER.
- UPON LEARNING OF THE EXISTENCE OF ANY UTILITY OMITTED FROM OR SHOWN INCORRECTLY ON THE PLANS, CONTRACTOR SHALL IMMEDIATELY NOTIFY ENGINEER IN WRITING.
- DRAWINGS ARE SCALED TO SIZE 22X34 INCH SHEETS. REPRODUCTION OF SHEETS MAY DISTORT DRAWINGS AND SCALE.

LEGEND

- PROOF ROLLED SUBGRADE
- SELECT FILL
- EXISTING GRADE
- AGGREGATE BASE
- GEOTEXTILE
- GEOMEMBRANE
- PROPOSED GRADE POINT

GENERAL LINES

- PROPOSED GRADING CONTOUR (10')
- PROPOSED GRADING CONTOUR (2')
- EXISTING GRADE CONTOUR (10')
- EXISTING GRADE CONTOUR (2')
- LIMITS OF PROPOSED GRADING
- FLOW LINE

ABBREVIATIONS

AC	ASPHALT CONCRETE	L	LENGTH
APPROX.	APPROXIMATE	LF	LINEAL FEET
C	CENTER LINE	MH	MANHOLE
CF	CUBIC FOOT	MIN.	MINIMUM
DIA.	DIAMETER	N	NORTHING
DIM.	DIMENSION	NTS	NOT TO SCALE
E	EASTING	NO.	NUMBER
EL.	ELEVATION	OC	ON CENTER
EW	EACH WAY	oz.	OUNCE
FG	FINISH GRADE	OD	OUTSIDE DIAMETER
F	FLOW LINE	R	RADIUS
GALV.	GALVANIZED	SCH.	SCHEDULE
HDPE	HIGH DENSITY POLYETHYLENE	STD.	STANDARD
INV.	INVERT	TYP.	TYPICAL

DRAWING INDEX

DRAWING NO.	DRAWING TITLE	FILE NAME
1	TITLE INDEX AND LEGEND	SW0251-11-01
2	SITE PLAN	SW0251-11-02
3	GRADING PLAN	SW0251-11-03
4	CROSS SECTIONS	SW0251-11-04
5	DETAILS	SW0251-11-05
6	SWPPP	SW0251-11-06
7	SURVEY CONTROL POINTS	SW0251-11-07

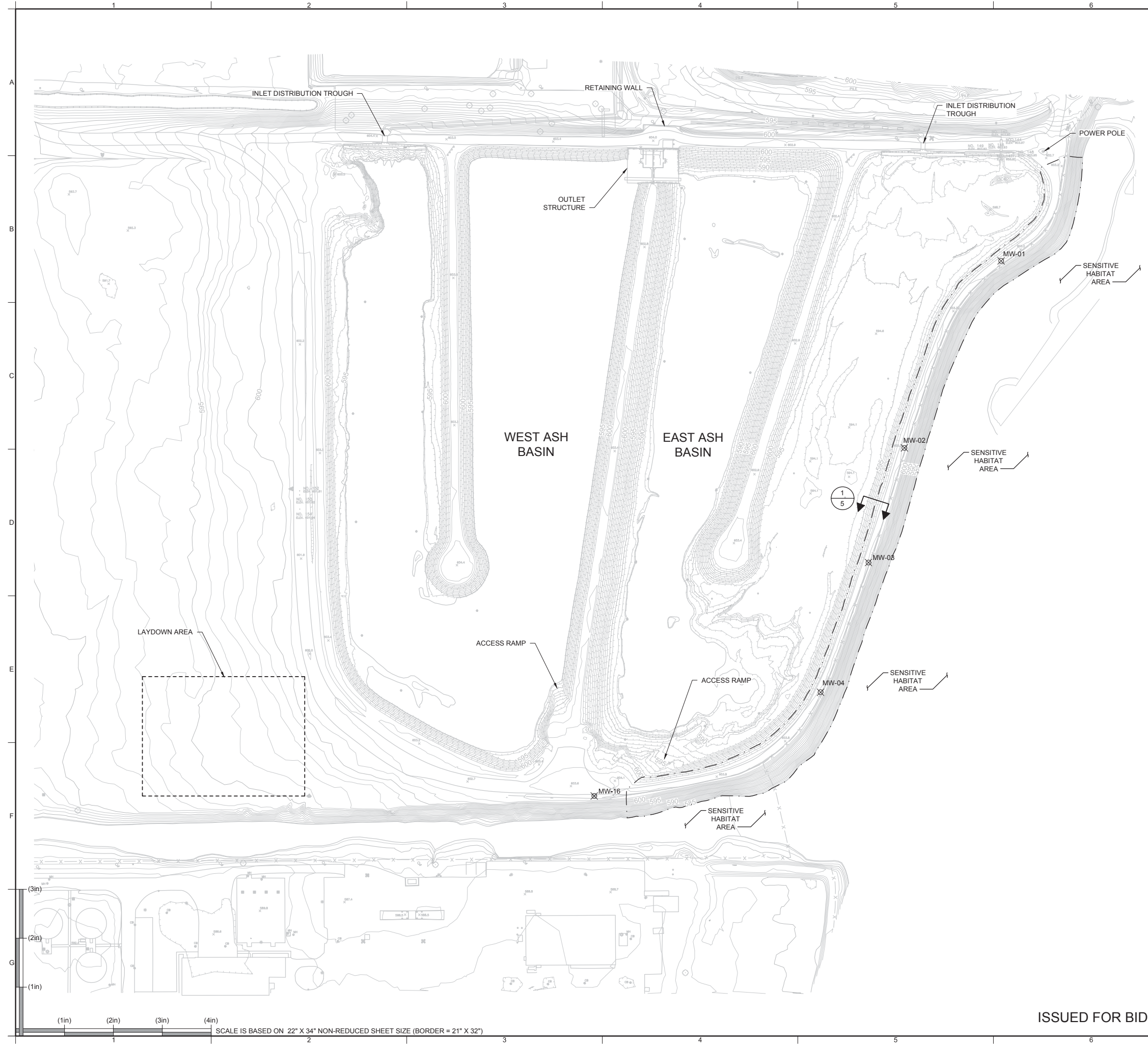
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SCALE IS BASED ON 22" X 34" NON-REDUCED SHEET SIZE (BORDER = 21" X 32")

ISSUED FOR BID

<p>3990 OLD TOWN AVENUE, SUITE A-101 SAN DIEGO, CA 92110 PHONE: 619.810.4000</p>		<p>TITLE: TITLE, INDEX, AND LEGEND</p>	
<p>PROJECT: EAST ASH BASIN SLOPE MODIFICATION</p>		<p>SITE: WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS</p>	
<p>THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.</p> <p></p> <p>SIGNATURE 7/1/16 DATE</p>	<p></p>	<p>DESIGN BY: JG</p> <p>DRAWN BY: JA</p> <p>CHECKED BY: GC</p> <p>REVIEWED BY: JS</p> <p>APPROVED BY: JS</p>	<p>DATE: JULY 2016</p> <p>PROJECT NO.: SW0251-11</p> <p>FILE: SW0251-11-01</p> <p>DRAWING NO.: 1 OF 7</p>

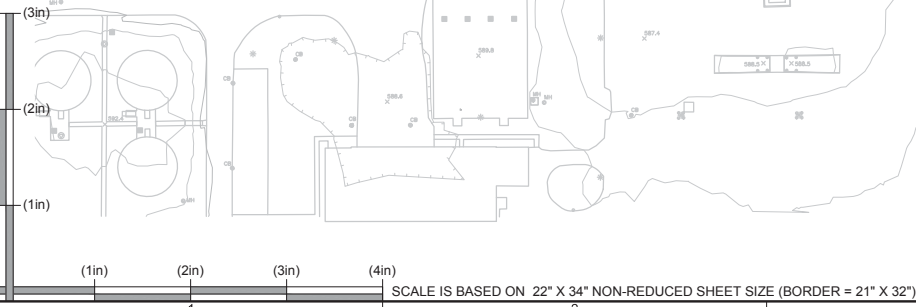
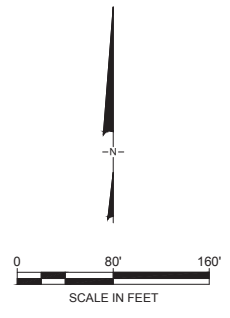
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LEGEND

	EXISTING GROUND MAJOR CONTOUR (10') [NOTE 2]
	EXISTING GROUND MINOR CONTOUR (2') [NOTE 2]
	EXISTING FENCE
	MONITORING WELL
	LIMITS OF GRADING

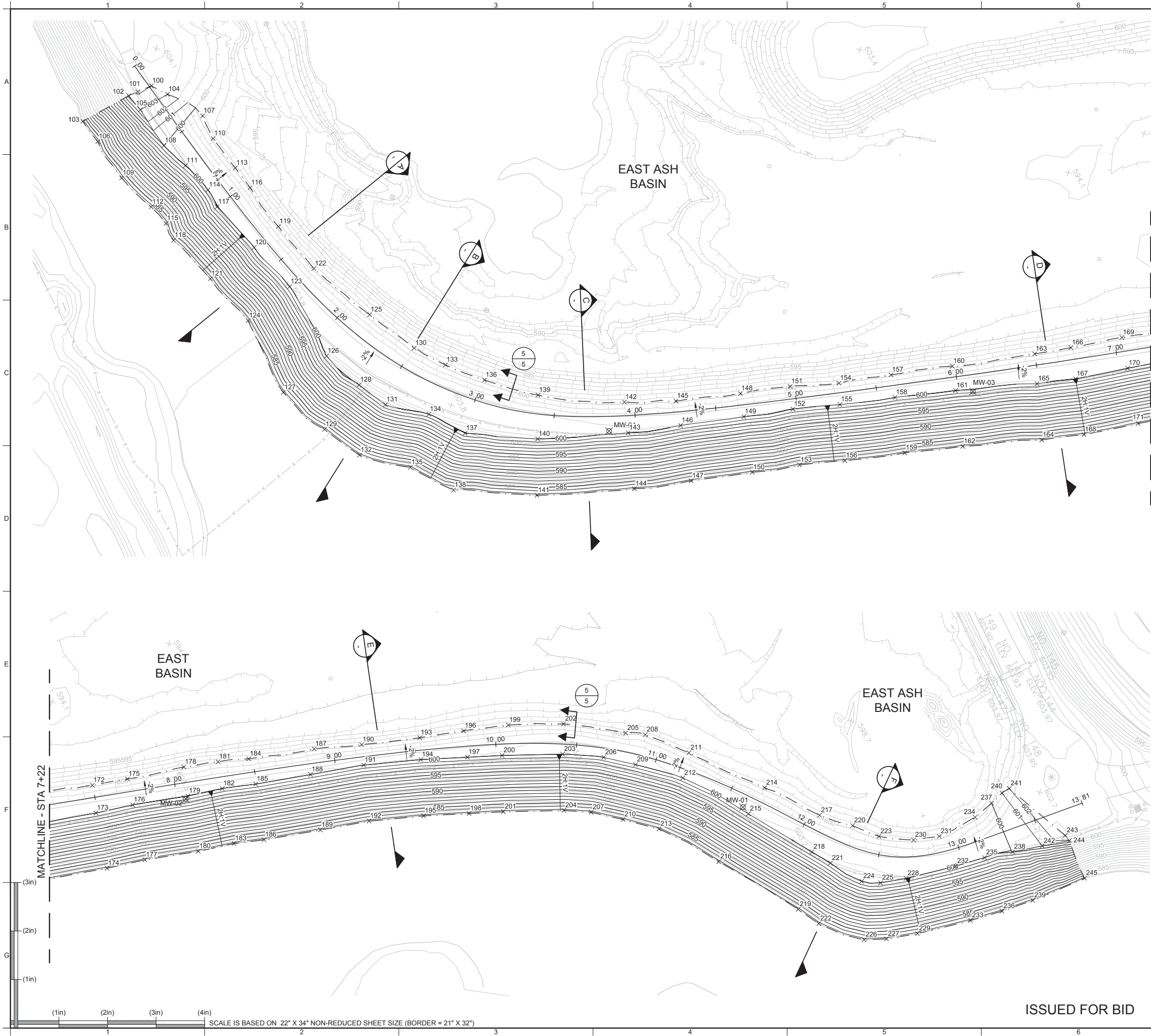
- NOTES**
- ALL PLANS IN THIS PLAN SET WERE DRAWN BASED ON THE FOLLOWING DATUM SOURCE:
HORIZONTAL CONTROL - NAD83 ILLINOIS STATE PLANE EAST, U.S. feet
VERTICAL CONTROL - NAVD 88., U.S. feet
 - EXISTING PHOTOGRAMMETRIC SURVEY DATA PROVIDED BY GEO TERRA. FLIGHT DATE: 4 DECEMBER 2015.
 - BASINS ARE CURRENTLY LINED WITH A SMOOTH HDPE GEOMEMBRANE ANCHORED NEAR THE INTERIOR CREST OF THE EMBANKMENT.
 - EXISTING TOPOGRAPHY ABOVE APPROXIMATE ELEVATION OF 587 FT REPRESENTS APPROXIMATE CCR DEPOSITS WITHIN EASTERN ASH BASIN.
 - SENSITIVE HABITAT IS PRESENT AT THE DOWNSTREAM TOE OF THE EASTERN AND SOUTHERN EMBANKMENTS.



REV	DATE	DESCRIPTION	DRN	APP
 3990 OLD TOWN AVENUE, SUITE A-101 SAN DIEGO, CA 92110 PHONE: 619.810.4000				
TITLE: SITE PLAN				
PROJECT: EAST ASH BASIN SLOPE MODIFICATION				
SITE: WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS				
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED. SIGNATURE 7/1/16 DATE		 DESIGN BY: JG DRAWN BY: JA CHECKED BY: GC REVIEWED BY: JS APPROVED BY: JS		DATE: JULY 2016 PROJECT NO.: SW0251-11 FILE: SW0251-11-02 DRAWING NO.: 2 OF 7

ISSUED FOR BID

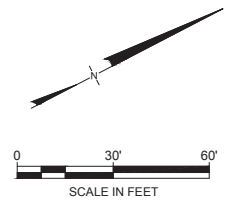
SCALE IS BASED ON 22" X 34" NON-REDUCED SHEET SIZE (BORDER = 21" X 32")



LEGEND

	EXISTING GROUND MAJOR CONTOUR (10') [NOTE 2]
	EXISTING GROUND MINOR CONTOUR (2') [NOTE 2]
	EXISTING FENCE
	PROPOSED GRADE MAJOR CONTOUR (10')
	PROPOSED GRADE MINOR CONTOUR (2')
	LIMITS OF GRADING
	MW-01 MONITORING WELL
	CROSS SECTION LOCATION
	125 SURVEY CONTROL POINT

- NOTES**
- ALL PLANS IN THIS PLAN SET WERE DRAWN BASED ON THE FOLLOWING DATUM SOURCE:
 HORIZONTAL CONTROL - NAD83 ILLINOIS STATE PLANE EAST, U.S. feet
 VERTICAL CONTROL - NAVD 88., U.S. feet
 - EXISTING PHOTOGRAMMETRIC SURVEY DATA PROVIDED BY GEO TERRA. FLIGHT DATE: 4 DECEMBER 2015.
 - CONTRACTOR SHALL REMOVE EXISTING FENCE AND GATES WITHIN WORK AREA AND PROPERLY DISPOSE OF OFFSITE.
 - CONTRACTOR SHALL INSTALL AND MAINTAIN 4-FT HIGH ORANGE BARRIER FENCING AT THE TOE OF THE SLOPE DURING THE DURATION OF THE WORK.
 - GRADING ELEVATIONS AT CREST OF EMBANKMENT REPRESENT TOP OF ROAD SURFACING LAYER.

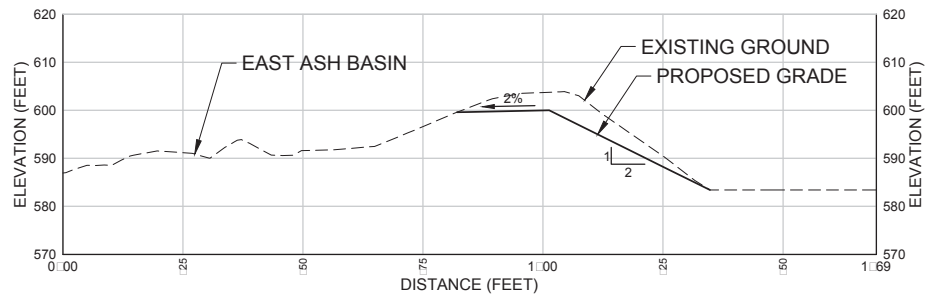


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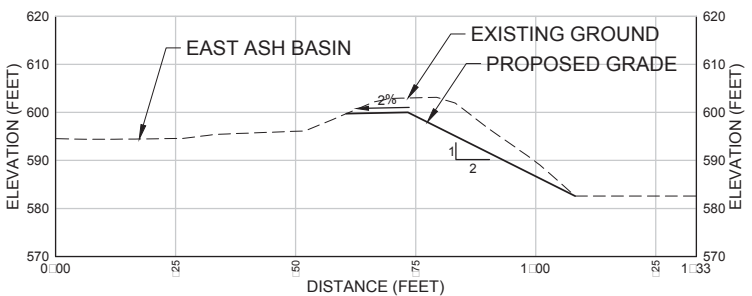
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TITLE: GRADING PLAN				
PROJECT: EAST ASH BASIN SLOPE MODIFICATION				
SITE: WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS				
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED. SIGNATURE 7/1/16 DATE		 DESIGN BY: JG DRAWN BY: JA CHECKED BY: GC REVIEWED BY: JS APPROVED BY: JS		DATE: JULY 2016 PROJECT NO.: SW0251-11 FILE: SW0251-11-03 DRAWING NO.: 3 OF 7

ISSUED FOR BID

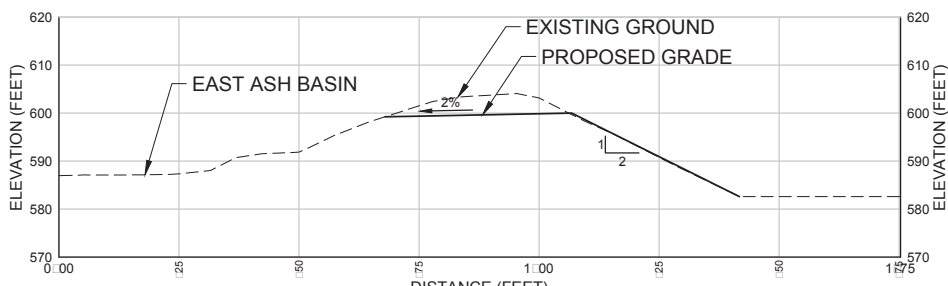
SCALE IS BASED ON 22" X 34" NON-REDUCED SHEET SIZE (BORDER = 21" X 32")



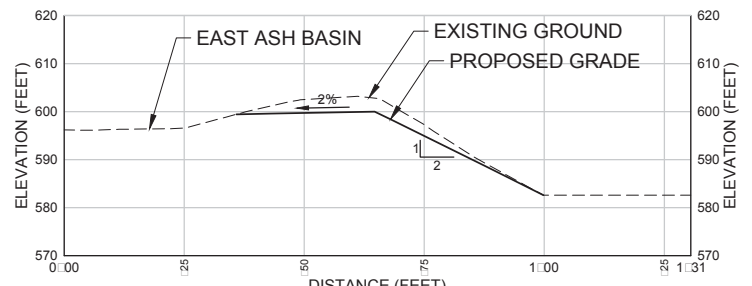
SECTION A
(STA. 1+49)



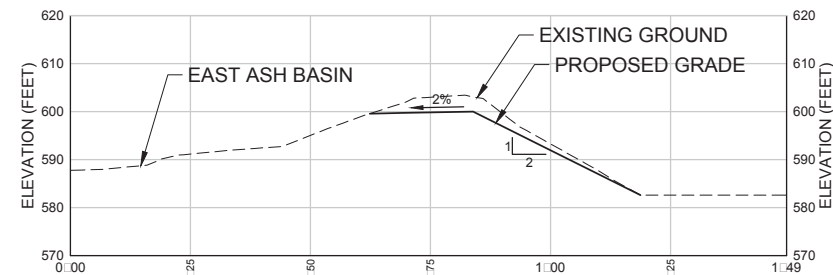
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(STA. 9+29)



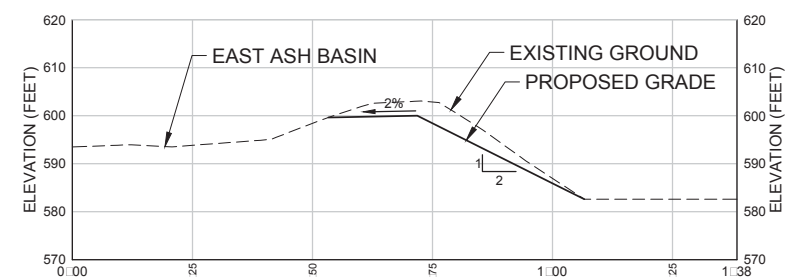
SECTION B
(STA. 2+50)



SECTION F
(STA. 12+35)



SECTION C
(STA. 3+70)



SECTION D
(STA. 6+58)

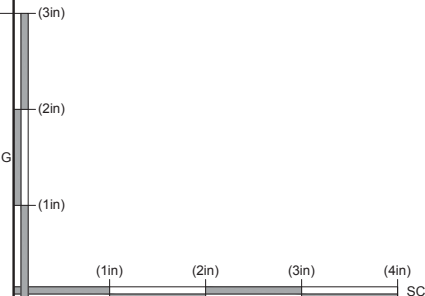
LEGEND

	EXISTING GROUND
	PROPOSED GRADE

- NOTES**
- ALL PLANS IN THIS PLAN SET WERE DRAWN BASED ON THE FOLLOWING DATUM SOURCE:
HORIZONTAL CONTROL - NAD83 ILLINOIS STATE PLANE EAST, U.S. feet
VERTICAL CONTROL - NAVD 88., U.S. feet
 - EXISTING PHOTOGRAMMETRIC SURVEY DATA PROVIDED BY GEO TERRA.
FLIGHT DATE: 4 DECEMBER 2015.
 - FOR SECTION LOCATIONS, SEE SHT 3.



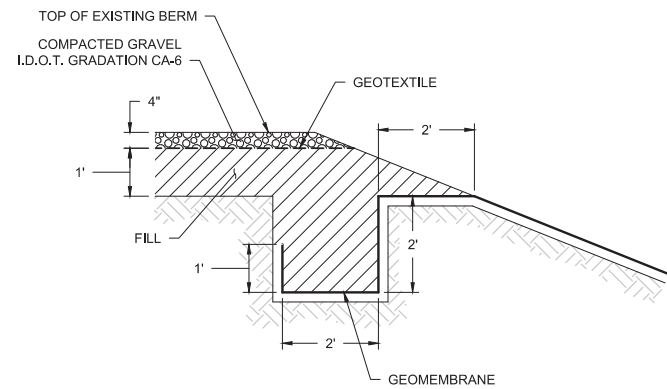
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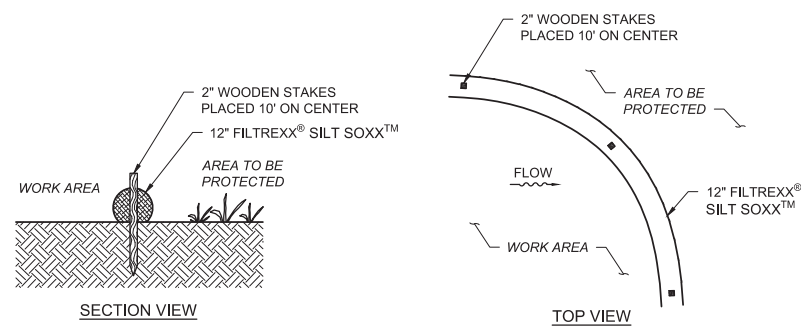
SCALE IS BASED ON 22" X 34" NON-REDUCED SHEET SIZE (BORDER = 21" X 32")

ISSUED FOR BID

REV	DATE	DESCRIPTION	DRN	APP
 3990 OLD TOWN AVENUE, SUITE A-101 SAN DIEGO, CA 92110 PHONE: 619.810.4000				
TITLE: CROSS SECTIONS				
PROJECT: EAST ASH BASIN SLOPE MODIFICATION				
SITE: WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS				
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED. SIGNATURE 7/1/16 DATE		 JANE W. SOULE 062-067766 LICENSED PROFESSIONAL ENGINEER STATE OF ILLINOIS		DESIGN BY: JG DRAWN BY: JA CHECKED BY: GC REVIEWED BY: JS APPROVED BY: JS
		DATE: JULY 2016 PROJECT NO.: SW0251-11 FILE: SW0251-11-04 DRAWING NO.: 4 OF 7		

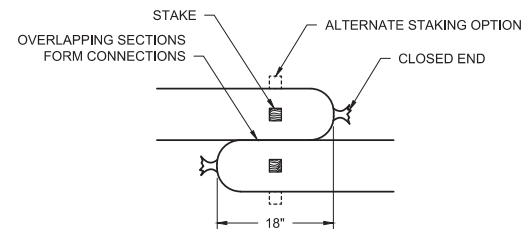


1
2 **DETAIL**
EXISTING ANCHOR TRENCH
SCALE: NTS



SECTION VIEW

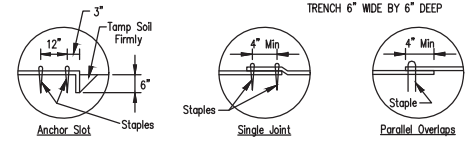
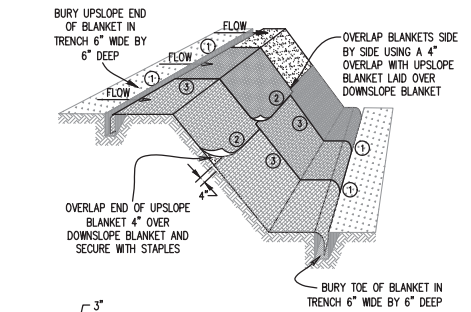
TOP VIEW



COMPOST SOCK CONNECTION/ATTACHMENT DETAIL

- NOTES:
1. ALL MATERIAL TO MEET FILTREXX® SPECIFICATIONS.
 2. SILT SOXX™ FILL TO MEET APPLICATION REQUIREMENTS.
 3. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY ENGINEER.

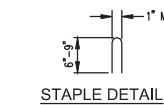
2
6 **DETAIL**
COMPOST SOCK
SCALE: NTS



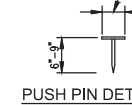
DETAIL 1

DETAIL 2

DETAIL 3



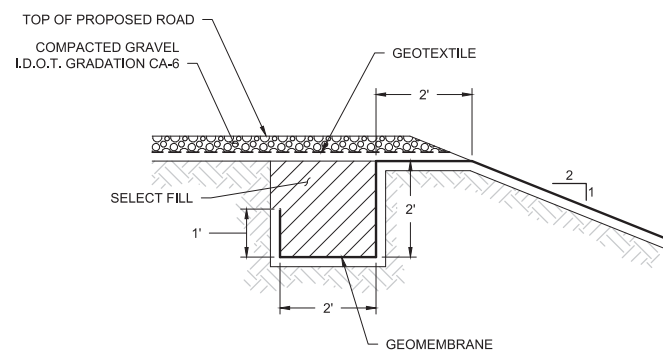
STAPLE DETAIL



PUSH PIN DETAIL

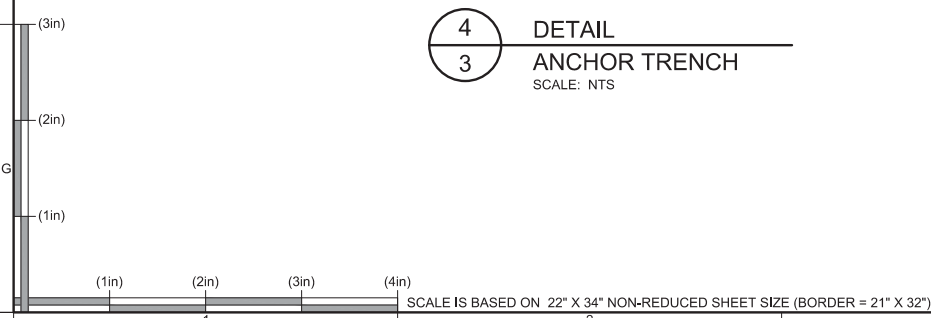
- NOTES:
1. Staples shall be placed in a diamond pattern at 2 per s.y. for stitched blankets. Non-stitched shall use 4 staples per s.y. of material. This equates to 200 staples with stitched blanket and 400 staples with non-stitched blanket per 100 s.y. of material.
 2. Staple or push pin lengths shall be selected based on soil type and conditions. (minimum staple length is 6").
 3. Erosion control material shall be placed in contact with the soil over a prepared seedbed.
 4. All anchor slots shall be stapled at approximately 12" intervals.
 5. Erosion Control Blanket shall be BioNet™ SC150BN® Erosion Control Blanket or approved equivalent. Blanket must be made of 100% biodegradable materials (i.e. no plastic netting).
 6. Anchor trench shall be 2' from top of slope.


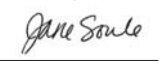

3
6 **DETAIL**
EROSION CONTROL BLANKET
INSTALLATION
SCALE: NTS



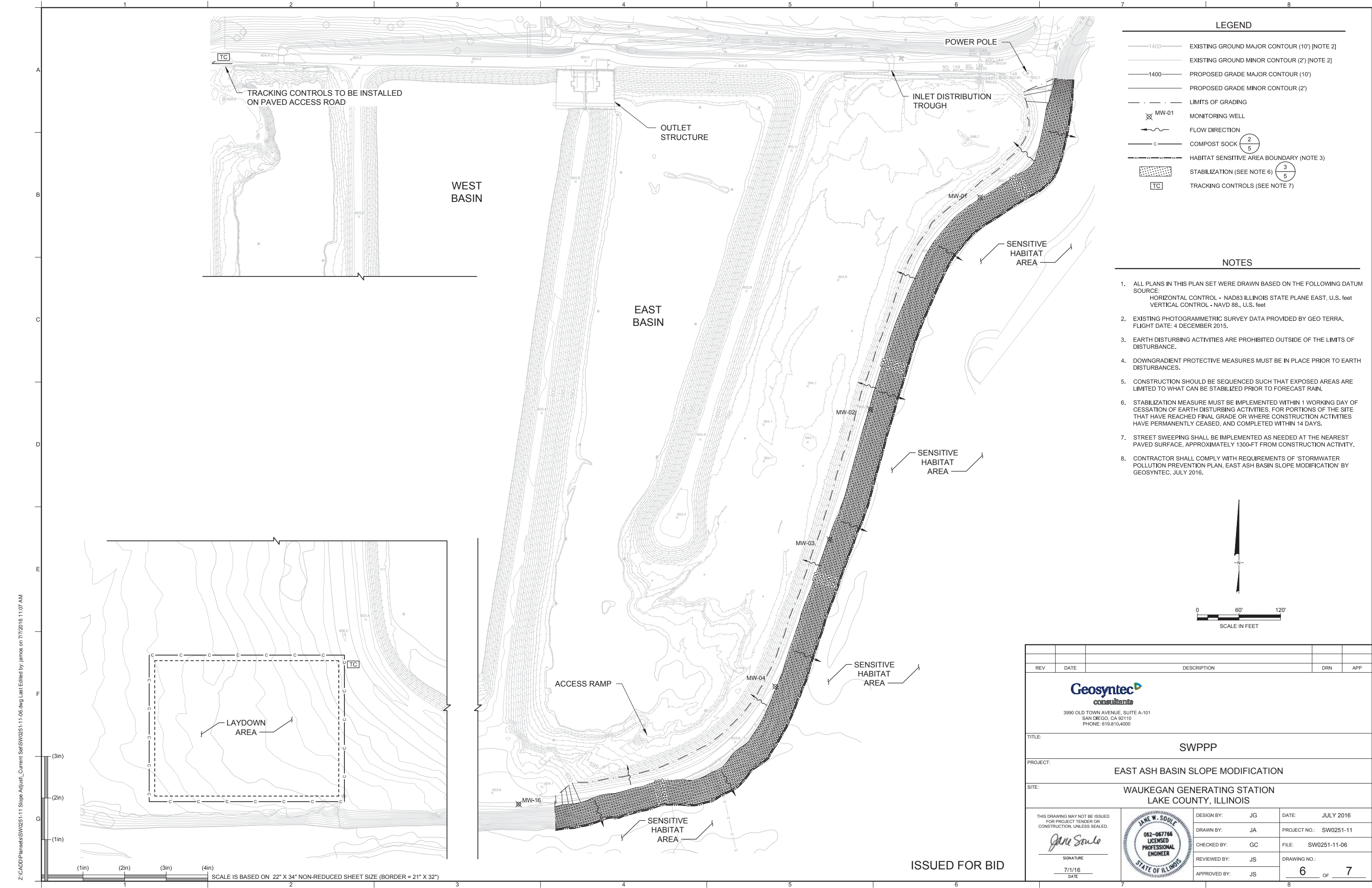
- NOTES:
1. Grading shown on Sheet 3 represents the top of the road surfacing layer.
 2. Geotextile shall be Propex 200ST or equivalent.

4
3 **DETAIL**
ANCHOR TRENCH
SCALE: NTS



REV	DATE	DESCRIPTION	DRN	APP
 3990 OLD TOWN AVENUE, SUITE A-101 SAN DIEGO, CA 92110 PHONE: 619.810.4000				
TITLE: DETAILS				
PROJECT: EAST ASH BASIN SLOPE MODIFICATION				
SITE: WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS				
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.  SIGNATURE 7/1/16 DATE				DESIGN BY: JG DRAWN BY: JA CHECKED BY: GC REVIEWED BY: JS APPROVED BY: JS
		DATE: JULY 2016 PROJECT NO.: SW0251-11 FILE: SW0251-11-05		DRAWING NO.: 5 OF 7

ISSUED FOR BID

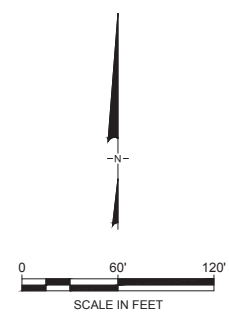


LEGEND

- 1400 — EXISTING GROUND MAJOR CONTOUR (10') [NOTE 2]
- — — EXISTING GROUND MINOR CONTOUR (2') [NOTE 2]
- 1400 — PROPOSED GRADE MAJOR CONTOUR (10')
- — — PROPOSED GRADE MINOR CONTOUR (2')
- - - - - LIMITS OF GRADING
- ⊗ MW-01 MONITORING WELL
- FLOW DIRECTION
- c — COMPOST SOCK (2/5)
- - - - - HABITAT SENSITIVE AREA BOUNDARY (NOTE 3)
- ▨ STABILIZATION (SEE NOTE 6) (3/5)
- TC TRACKING CONTROLS (SEE NOTE 7)

NOTES

1. ALL PLANS IN THIS PLAN SET WERE DRAWN BASED ON THE FOLLOWING DATUM SOURCE:
HORIZONTAL CONTROL - NAD83 ILLINOIS STATE PLANE EAST, U.S. feet
VERTICAL CONTROL - NAVD 88, U.S. feet
2. EXISTING PHOTOGRAMMETRIC SURVEY DATA PROVIDED BY GEO TERRA. FLIGHT DATE: 4 DECEMBER 2015.
3. EARTH DISTURBING ACTIVITIES ARE PROHIBITED OUTSIDE OF THE LIMITS OF DISTURBANCE.
4. DOWNGRADIENT PROTECTIVE MEASURES MUST BE IN PLACE PRIOR TO EARTH DISTURBANCES.
5. CONSTRUCTION SHOULD BE SEQUENCED SUCH THAT EXPOSED AREAS ARE LIMITED TO WHAT CAN BE STABILIZED PRIOR TO FORECAST RAIN.
6. STABILIZATION MEASURE MUST BE IMPLEMENTED WITHIN 1 WORKING DAY OF CESSATION OF EARTH DISTURBING ACTIVITIES, FOR PORTIONS OF THE SITE THAT HAVE REACHED FINAL GRADE OR WHERE CONSTRUCTION ACTIVITIES HAVE PERMANENTLY CEASED, AND COMPLETED WITHIN 14 DAYS.
7. STREET SWEEPING SHALL BE IMPLEMENTED AS NEEDED AT THE NEAREST PAVED SURFACE, APPROXIMATELY 1300-FT FROM CONSTRUCTION ACTIVITY.
8. CONTRACTOR SHALL COMPLY WITH REQUIREMENTS OF 'STORMWATER POLLUTION PREVENTION PLAN, EAST ASH BASIN SLOPE MODIFICATION' BY GEOSYNTEC, JULY 2016.



REV	DATE	DESCRIPTION	DRN	APP
 3990 OLD TOWN AVENUE, SUITE A-101 SAN DIEGO, CA 92110 PHONE: 619.810.4000				
TITLE: SWPPP				
PROJECT: EAST ASH BASIN SLOPE MODIFICATION				
SITE: WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS				
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.				DESIGN BY: JG DRAWN BY: JA CHECKED BY: GC REVIEWED BY: JS APPROVED BY: JS
 SIGNATURE 7/1/16 DATE		DATE: JULY 2016 PROJECT NO.: SW0251-11 FILE: SW0251-11-06 DRAWING NO.: 6 OF 7		ISSUED FOR BID

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SCALE IS BASED ON 22" X 34" NON-REDUCED SHEET SIZE (BORDER = 21" X 32")

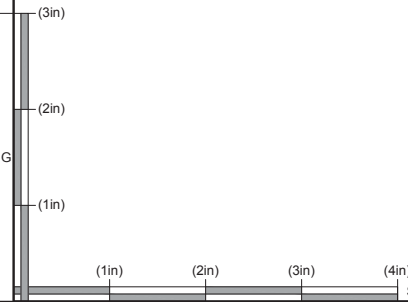
SURVEY CONTROL POINTS

PT NO.	NORTHING	EASTING	ELEV
100	2080081.36	1124398.00	604.00
101	2080072.25	1124397.50	604.19
102	2080066.08	1124397.19	603.33
103	2080033.65	1124398.72	583.40
104	2080087.98	1124407.11	603.00
105	2080068.79	1124408.21	603.00
106	2080036.43	1124414.03	583.40
107	2080101.42	1124428.72	599.40
108	2080071.84	1124434.52	600.00
109	2080039.57	1124440.76	583.40
110	2080101.02	1124444.16	599.52
111	2080078.27	1124451.51	600.00
112	2080047.90	1124464.91	583.40
113	2080105.13	1124466.59	599.57
114	2080083.99	1124471.13	600.00
115	2080051.53	1124478.09	583.40
116	2080107.88	1124481.58	599.55
117	2080084.37	1124483.01	600.00
118	2080051.09	1124489.55	583.40
119	2080112.86	1124510.84	599.60
120	2080093.64	1124515.78	600.00
121	2080060.84	1124520.90	583.40
122	2080120.84	1124543.90	599.63
123	2080102.49	1124547.18	600.00
124	2080070.12	1124554.54	583.40
125	2080138.95	1124584.79	599.31
126	2080103.78	1124595.75	600.00
127	2080069.83	1124603.94	582.60
128	2080113.78	1124620.67	600.00
129	2080082.40	1124635.73	582.60
130	2080154.39	1124615.57	599.23
131	2080122.89	1124638.85	600.00
132	2080094.66	1124659.61	582.60
133	2080167.03	1124633.47	599.36
134	2080144.24	1124656.14	600.00
135	2080119.32	1124680.43	582.60
136	2080184.50	1124652.60	599.33
137	2080159.01	1124676.65	600.00
138	2080137.02	1124704.92	582.60
139	2080209.88	1124675.70	599.46
140	2080197.56	1124699.83	600.00
141	2080181.73	1124730.88	582.60
142	2080255.71	1124703.37	599.62
143	2080249.34	1124721.36	600.00
144	2080237.38	1124754.04	582.60
145	2080284.53	1124717.03	599.69
146	2080280.35	1124731.84	600.00
147	2080270.89	1124765.33	582.60
148	2080322.19	1124730.64	599.71
149	2080317.74	1124744.37	600.00
150	2080307.02	1124777.48	582.60
151	2080351.75	1124740.47	599.72
152	2080346.98	1124753.72	600.00
153	2080335.21	1124786.47	582.60




PT NO.	NORTHING	EASTING	ELEV
154	2080379.65	1124752.08	599.74
155	2080374.25	1124764.16	600.00
156	2080361.52	1124796.55	582.60
157	2080410.64	1124761.84	599.72
158	2080406.61	1124775.44	600.00
159	2080396.74	1124808.81	582.60
160	2080446.96	1124773.99	599.70
161	2080442.02	1124788.33	600.00
162	2080430.67	1124821.23	582.60
163	2080495.87	1124789.90	599.63
164	2080476.01	1124839.43	582.60
165	2080488.99	1124807.05	600.00
166	2080517.66	1124796.42	599.61
167	2080511.62	1124814.96	600.00
168	2080500.83	1124848.07	582.60
169	2080548.62	1124804.88	599.61
170	2080543.36	1124823.44	600.00
171	2080533.87	1124856.92	582.60
172	2080591.08	1124819.10	599.65
173	2080585.43	1124835.48	600.00
174	2080576.30	1124869.06	582.60
175	2080612.22	1124825.36	599.67
176	2080608.01	1124841.09	600.00
177	2080599.61	1124874.87	582.60
178	2080646.78	1124834.29	599.64
179	2080640.97	1124851.38	600.00
180	2080631.45	1124884.87	582.60
181	2080667.10	1124840.80	599.67
182	2080662.01	1124856.75	600.00
183	2080653.40	1124890.47	582.60
184	2080684.90	1124847.68	599.68
185	2080681.74	1124863.52	600.00
186	2080671.00	1124896.63	582.60
187	2080723.78	1124860.22	599.70
188	2080714.72	1124873.38	600.00
189	2080704.88	1124906.76	582.60
190	2080751.18	1124870.99	599.75
191	2080746.65	1124882.79	600.00
192	2080734.17	1124915.27	582.60
193	2080785.20	1124883.14	599.73
194	2080779.79	1124895.56	600.00
195	2080765.90	1124927.46	582.60
196	2080811.48	1124891.47	599.67
197	2080806.25	1124907.08	600.00
198	2080791.67	1124938.69	582.60
199	2080837.64	1124900.56	599.63
200	2080825.88	1124915.65	600.00
201	2080811.02	1124947.12	582.60
202	2080868.55	1124915.15	599.63
203	2080859.71	1124931.63	600.00
204	2080844.85	1124963.10	582.60
205	2080900.45	1124937.39	599.65
206	2080881.52	1124944.75	600.00
207	2080859.48	1124971.68	582.60

PT NO.	NORTHING	EASTING	ELEV
208	2080910.75	1124943.66	599.61
209	2080897.09	1124957.50	600.00
210	2080875.04	1124984.43	582.60
211	2080929.94	1124965.68	599.68
212	2080919.62	1124977.96	600.00
213	2080892.35	1124999.58	582.60
214	2080962.13	1125005.97	599.62
215	2080945.99	1125015.91	600.00
216	2080916.36	1125034.16	582.60
217	2080984.92	1125036.30	599.56
218	2080970.60	1125054.50	600.00
219	2080947.16	1125082.42	582.60
220	2081000.35	1125051.10	599.46
221	2080977.71	1125065.76	600.00
222	2080954.57	1125096.01	582.60
223	2081011.89	1125064.39	599.43
224	2080990.03	1125084.39	600.00
225	2081000.04	1125090.47	600.00
226	2080975.23	1125117.45	582.60
227	2080987.80	1125123.13	582.60
228	2081015.31	1125095.09	600.00
229	2081006.42	1125128.75	582.60
230	2081030.06	1125075.92	599.56
231	2081045.21	1125080.97	599.59
232	2081046.14	1125101.99	600.00
233	2081039.38	1125136.13	582.60
234	2081070.37	1125080.32	599.49
235	2081064.50	1125105.23	600.00
236	2081059.28	1125139.65	582.60
237	2081083.36	1125077.08	600.00
238	2081081.49	1125109.79	600.02
239	2081079.32	1125142.19	582.60
240	2081091.91	1125074.28	601.00
241	2081097.13	1125073.74	602.00
242	2081099.55	1125114.69	601.00
243	2081115.13	1125115.22	603.00
244	2081116.09	1125119.17	601.90
245	2081114.11	1125144.19	582.60

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ISSUED FOR BID

REV	DATE	DESCRIPTION	DRN	APP
 3990 OLD TOWN AVENUE, SUITE A-101 SAN DIEGO, CA 92110 PHONE: 619.810.4000				
TITLE: SURVEY CONTROL POINTS				
PROJECT: EAST ASH BASIN SLOPE MODIFICATION				
SITE: WAUKEGAN GENERATING STATION LAKE COUNTY, ILLINOIS				
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.		 SIGNATURE 7/1/16 DATE		
DESIGN BY:	JG	DATE:	JULY 2016	
DRAWN BY:	JA	PROJECT NO.:	SW0251-11	
CHECKED BY:	GC	FILE:	SW0251-11-07	
REVIEWED BY:	JS	DRAWING NO.:	7 OF 7	
APPROVED BY:	JS			

APPENDIX B

Technical Specifications

APPENDIX B-1

East Ash Basin Liner Replacement Specifications

1.0 WORK INCLUDED

- 1.1 This work includes furnishing materials, tools, equipment, and labor to perform bulk and structural excavation, grading, dewatering and place and compact fill, backfill, and bedding materials.
- 1.2 Excavation includes, sheeting and bracing required for proper execution of the work, loosening, digging, wedging, ripping, loading, hauling, stockpiling, dumping, and disposal of excavated materials in legal disposal areas approved by Owner's Representative.
- 1.3 Excavation is unclassified and includes, but is not limited to soil, ash and rock materials, abandoned underground conduits or pipes, and buried concrete and masonry structures.

2.0 QUALITY CONTROL

- 2.1 Existing and new materials to be used as fill, backfill or bedding are subject to the approval of Owner's Representative.
- 2.2 Bottom ash from the site may be incorporated in the fill material if the Contractor provides tests results and a statement from a geotechnical engineer that use of the bottom ash in conjunction with the other proposed fill materials will not compromise the stability of the 2.5:1 slope.
- 2.3 To obtain approval of fill, backfill, and bedding materials, designate the proposed borrow area and notify the Owner's Site Representative for a visual inspection prior to placing the material.

3.0 REFERENCES

- 3.1 Occupational Safety and Health Administration (OSHA)
 - A. OSHA 2206 General Industry Standards
 - B. OSHA 2207 Construction Industry Standards
- 3.2 Illinois Department of Transportation (IDOT) - Standard Specifications for Road and Bridge Construction.
- 3.3 American Society for Testing and Materials (ASTM)
 - A. ASTM D 1556- Test for Density of Soil in place by Sand Cone Method
 - B. ASTM D 1557- Tests for Moisture-Density Relations of Soils Using 10 lb. Hammer and 18 inch drop.
 - C. ASTM D 2167- Test for Density of Soil in place by Rubber Balloon Method
- 3.4 The above references shall be the current revision for each.

4.0 SUBMITTALS

- 4.1 With Contractors' Proposals
 - A. Submit product data sheets for the chosen liner material.
 - B. Submit the estimated quantities of materials required to complete the work.

- 4.2 Two weeks prior to the start of the work, submit to the Owner's Engineer for review, procedures for placing and compacting fill on top of the new liner without damaging the liner material. Include a statement from the liner manufacture that says the procedure is acceptable.

5.0 SITE CONDITIONS

- 5.1 Prior to start of work become thoroughly familiar with the site, site access, the site conditions, and all portions of the work.
- 5.2 One pond will be operational while the work on the second pond is being performed.

6.0 MATERIALS

- 6.1 Make maximum use of suitable on site material for fill when building the pond slopes and entrance ramps. Suitable on site fill material is granular soil or soil/rock mixture that is free from organic matter and other deleterious substances. Material containing rocks or lumps over 1½" in greatest dimension, or containing 15% rocks or lumps larger than ½" in greatest dimension is not acceptable. The material shall have an angle of repose of 30° or greater.
- 6.2 Imported fill and backfill material shall meet the requirements of Item 6.1 above and, in addition, shall contain predominantly granular material with a maximum particle size of 2".
- 6.3 Sand used as the protective layer for the pond liners shall be approved by the liner manufacturer.
- 6.4 Rip rap, coarse aggregate and limestone screenings shall comply with I.D.O.T. specifications.

7.0 BULK AND STRUCTURAL EXCAVATION

- 7.1 Perform bulk and structural excavation in accordance with the most recent revision of the OSHA General Industry Standards (OSHA 2206) and the OSHA Construction Industry Standards (OSHA 2207).
- 7.2 Provide temporary grading, ditches and other means as required to drain the areas of the work.
- 7.3 Perform excavation to lines and grades shown on the contract drawings and as directed by Owner's Representative.
- 7.4 When the sides of an excavation are five feet or more in depth or when employees are required to enter the excavated area where danger from moving ground exists, perform excavation by open cut to a stable slope or by sheeting and bracing.
- 7.5 Remove unstable subsoil material, where encountered at the bottom of excavation, to a depth required to obtain satisfactory bearing conditions. Contractor is responsible for bringing the excavation back to the proper elevation by installing compacted bedding material as specified in this section.

- 7.6 Remove spoil from areas of excavation and stockpile for later use at locations no closer than 2'-0" from edge of excavation unless otherwise approved by Owner's Representative. Remove excess spoil and excavated materials not specifically approved by Owner's Representative for fill, backfill or stockpiling from the site and dispose of these materials at locations and in a manner approved by Federal, State and Local Authorities.
- 7.7 Properly grade bottom of bulk and structural excavations, remove loose materials, and maintain excavations in good condition, keeping them dry in accordance with Article 8.0 Dewatering, of this section, and free from debris, ice, and frost until completion of the work.

8.0 DEWATERING

- 8.1 Provide and maintain in operation adequate pumping capacity from sumps, deep wells, or well point installation and perform all other work necessary to keep excavations dry and free of groundwater or surface water during the progress of the work.
- 8.2 Construction is not permitted in flowing or standing water.
- 8.3 Dispose of water pumped or drained from the work area in a manner satisfactory to the Owner's Representative, without damage to adjacent property or to other work under construction.
- 8.4 Take necessary precautions to protect the work against flooding.

9.0 COMPACTION

- 9.1 Determine the types of equipment and the number of passes required to obtain the required compaction. A pass is defined as one complete coverage of the area by the compaction equipment being used.
- 9.2 Compact fill and backfill materials to a minimum of 90% of maximum dry density in all areas except in road areas where a minimum of 95% of maximum dry density is required.
- 9.3 Compact surfaces that are scarified along with and as part of the first lift of fill material that is spread thereon.
- 9.4 Maximum dry density is defined as the maximum density that can be produced when the same material is compacted in the laboratory in accordance with ASTM D 698 (Standard Proctor).

10.0 INSTALLATION OF FILL AND BACKFILL

- 10.1 Install fill and backfill material by placing fill and backfill material in uniform layers not to exceed 6" loose measurement unless otherwise noted on the contract drawings or elsewhere in this specification. Compact to minimum specified compaction as set forth in Article 9.2 of this Section.
- 10.2 Install the 12" protective sand layer on top of the liner material in a single layer.
- 10.3 Moisten and scarify surfaces to a depth of 4", against which new fill or roadway material is to be placed.
- 10.4 Remove shoring as backfill progresses only when banks are safe from caving or collapse.

- 10.5 Water or aerate the material as necessary, and thoroughly mix to obtain a moisture content that will permit proper compaction.
- 10.6 Do not place fill or backfill materials on a frozen surface. Do not incorporate snow, ice or frozen earth with the fill. Distribute and grade fill and backfill materials throughout the work such that fill will be free from lenses, pockets, streaks or layers of materials differing in texture or gradation from the surrounding material. Do not place successive layers until the layer under construction has been satisfactorily compacted. Place materials in horizontal lifts.
- 10.7 Remove, dispose and replace any material that Owner's Representative considers objectionable without additional cost to Owner.
- 10.8 Bring subgrades to a plus or minus tolerance of 0.10 feet.

11.0 FIELD QUALITY CONTROL

- 11.1 Do not allow or cause any of the work performed or installed to be covered up or enclosed prior to required inspections, tests, and approvals.
- 11.2 Should any of the work be enclosed or covered up before it has been approved, uncover such work at no additional cost to Owner.
- 11.3 After the work has been completed, tested, inspected, and approved, make repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, at no additional cost to the Owner.
- 11.4 Owner may engage (at his own expense), a testing laboratory to inspect and perform tests on all fill, backfill, and bedding materials.
 - A. The testing laboratory shall conduct and interpret the following ASTM tests to determine the degree of compaction achieved by compaction operations:
 1. ASTM D 1556 Test for Density of Soil in place by Sand Cone Method
 2. ASTM D 2167 Test for Density of Soil in place by Rubber Balloon Method
 3. ASTM D 2922 Test for Density of Soil in place by Nuclear Methods
 - B. The testing laboratory shall prepare a test report stating whether the test specimens comply with the work requirements, and specifically state any deviations therefrom.
 - C. Contractor shall provide access for Owner's testing personnel to all required areas so that required inspection and testing can be accomplished.
 - D. The Owner shall have the right to reject any materials or work not complying with the requirements of the Specification.
 - E. Contractor shall be responsible for all costs associated with the removal and replacement of all materials determined by Owner's testing personnel to have failed the testing acceptance standards.

END OF SECTION

1.0 WORK INCLUDED

This work includes furnishing materials, tools, equipment, and labor to install a 60-mil thick, high-density polyethylene liner with a reflective white coating.

2.0 REFERENCES

2.1 American Society for Testing and Materials (ASTM)

- D 638 Standard Test Method for Tensile Properties of Plastics
- D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
- D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
- D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D 1603 Test Method for Carbon Black in Olefin Plastics
- D 3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
- D 5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- D 6392 Standard Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

2.2 Geosynthetic Research Institute

- GM9 Cold Weather Seaming of Geomembranes
- GM13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
- GM19 Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

3.0 DEFINITIONS

- 3.1 Lot - A quantity of resin (usually the capacity of one rail car) used in the manufacture of polyethylene geomembrane rolls. The finished roll will be identified by a roll number traceable to the resin lot used.
- 3.2 Construction Quality Assurance Consultant (consultant) - Party, independent from manufacturer and installer that is responsible for observing and documenting activities related to quality assurance during the lining system construction.
- 3.3 Engineer - The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

- 3.4 Geomembrane Manufacturer (manufacturer) - The party responsible for manufacturing the geomembrane rolls.
- 3.5 Geosynthetic Quality Assurance Laboratory (testing laboratory) - Party, independent from the owner, manufacturer and installer, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the owner.
- 3.6 Installer - Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.
- 3.7 Panel - Unit area of a geomembrane that will be seamed in the field that is larger than 100 square feet.
- 3.8 Patch - Unit area of a geomembrane that will be seamed in the field that is less than 100 square feet.
- 3.9 Subgrade Surface - Soil layer surface which immediately underlies the geosynthetic material.

4.0 SUBMITTALS POST-AWARD

- 4.1 Furnish the following product data, in writing, to engineer prior to installation of the geomembrane material:
 - A. Resin Data shall include certification stating that the resin meets the specification requirements (see Section 8.0).
 - B. Statement certifying no more than 10% reclaimed polymer (of the same type) is added to the resin (product run may be recycled) per GRI GM 13.
- 4.2 The installer shall furnish the following information to the engineer and owner prior to installation:
 - A. Installation layout drawings
 - 1. Must show proposed panel layout including field seams and details
 - 2. Must be approved prior to installing the geomembrane (Approved drawings will be for concept only and actual panel placement will be determined by site conditions).
 - B. Installer's Geosynthetic Field Installation Quality Assurance Plan
- 4.3 The installer will submit the following to the engineer upon completion of installation:
 - A. Certificate stating the geomembrane has been installed in accordance with the Contract Documents
 - B. Material and installation warranties
 - C. As-built drawings showing actual geomembrane placement and seams including typical anchor trench detail/

5.0 QUALITY ASSURANCE

5.1 The Owner may engage and pay for the services of a Quality Assurance Consultant to monitor geomembrane installation.

5.2 Qualifications

A. Manufacturer

1. Geomembrane shall be manufactured by GSE Lining Technology, Inc. or an approved equal.
2. Manufacturer shall have manufactured a minimum of 10,000,000 square feet of polyethylene geomembrane during the last year.

B. Installer

1. The liner manufacturer shall install the liner.
2. Installer shall have installed a minimum of 3,000,000 square feet of HDPE geomembrane during the last five years.
3. Installer shall have worked in a similar capacity on at least three projects similar in complexity to the project described in the contract documents.
4. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.
5. The installer shall provide a minimum of one Master Seamer for work on the project.
6. Must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for the use on this Project.

6.0 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

6.1 Labeling - Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label will identify:

- A. Manufacturer's name
- B. Product identification
- C. Roll number

6.2 Delivery - Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

6.3 Storage - The on-site storage location for geomembrane material, provided by the contractor to protect the geomembrane from punctures, abrasions and excessive dirt and moisture for should have the following characteristics:

- A. Level (no wooden pallets)
- B. Smooth
- C. Dry

- D. Protected from theft and vandalism
 - E. Adjacent to the area being lined
- 6.4 Handling - Materials are to be handled so as to prevent damage.

7.0 WARRANTY

- 7.1 Material shall be warranted, on a pro-rata basis against Manufacturer's defects for a period of five years from the date of geomembrane installation.
- 7.2 Installation shall be warranted against defects in workmanship for a period of one year from the date of geomembrane completion.

8.0 GEOMEMBRANE

8.1 Material shall be smooth/textured polyethylene geomembrane as shown on the drawings.

8.2 Resin

- A. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
- B. Natural resin (without carbon black) shall meet the following additional minimum requirements:

Property	Test Method ⁽¹⁾	HDPE
Density [g/cm ³]	ASTM D 1505	0.932
Melt Flow Index [g/10 min.]	ASTM D 1238 (190/2.16)	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 atm/200°C)	100

8.3 Geomembrane Rolls

- A. Do not exceed a combined maximum total of one percent by weight of additives other than carbon black.
- B. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
- C. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating both number, thickness, length, width and manufacturer.
- D. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Section 8.2, and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

8.4 Smooth, white surfaced geomembrane shall meet the requirements shown in Table 1.2

The geomembrane shall be a white-surfaced, coextruded geomembrane. The white surface shall be installed upwards.

8.5 Extrudate Rod or Bead

- A. Extrudate material shall be made from same type resin as the geomembrane.
- B. Additives shall be thoroughly dispersed.
- C. Materials shall be free of contamination by moisture or foreign matter.

9.0 EQUIPMENT

Welding equipment and accessories shall meet the following requirements:

- 9.1 Gauges showing temperatures in apparatus (extrusion welder) or wedge (wedge welder) shall be present.
- 9.2 An adequate number of welding apparatus shall be available to avoid delaying work.
- 9.3 Power source capable of providing constant voltage under combined line load shall be used.

10.0 DEPLOYMENT

- 10.1 Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.
- 10.2 Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.
- 10.3 Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:
 - A. Unroll geomembrane panels using methods that will not damage geomembrane and will protect underlying surface from damage (i.e., spreader bar, protected equipment bucket).
 - B. Place ballast (commonly sandbags) on geomembrane that will not damage geomembrane to prevent wind uplift.
 - C. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage the geomembrane. Smoking will not be permitted on the geomembrane.
 - D. Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than six psi.
 - E. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
- 10.4 Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

11.0 FIELD SEAMING

11.1 Seams shall meet the following requirements:

- A. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.
- B. Minimize number of field seams in corners, odd shaped geometric locations and outside corners.
- C. Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area.
- D. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the consultant and installer.
- E. Align seam overlaps consistent with the requirements of the welding equipment being used. A six-inch overlap is commonly suggested.

11.2 During Welding Operations provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

11.3 Extrusion Welding

- A. Hot-air tack adjacent pieces together using procedures that do not damage geomembrane.
- B. Clean geomembrane surfaces by disc grinder or equivalent.
- C. Purge welding apparatus of heat degraded extrudate before welding.

11.4 Hot Wedge Welding

- A. Welding apparatus shall be a self-propelled device equipped with an electronic controller that displays applicable temperatures.
- B. Clean seam area of dust, mud, moisture and debris immediately ahead of the hot wedge welder.
- C. Protect against moisture build up between sheets.

12.0 Trial Welds

- A. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
- B. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
- C. Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid shift.
- D. Cut four, one-inch wide by six-inch long test strips from the trial weld.
- E. Quantitatively test specimens for peel adhesion, and then for bonded seam strength (shear).
- F. Trial weld specimens shall pass when the results shown in Table 3 are achieved in both peel and shear test.
 - 1. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).

2. The break is ductile.
 - G. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
 - H. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.
- 12.2 Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.
- 12.3 Defects and Repairs
- A. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
 - B. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

13.0 FIELD QUALITY ASSURANCE

- 13.1 Manufacturer/installer shall participate in and conform to all terms and requirements of the Owner's quality assurance program. Contractor shall be responsible for assuring this participation.
- 13.2 Field Testing
- A. Non-destructive testing shall be carried out as the seaming progresses.
 1. Vacuum Testing - Shall be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
 2. Air Pressure Testing - Shall be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
- 13.3 Destructive Testing (performed by the installer witnessed by the consultant)
- A. Location and Frequency of Testing
 1. Collect destructive test samples at a frequency of one per every 1500 lineal feet of seam length.
 2. Test locations will be determined after seaming.
 3. Exercise Method of Attributes as described by GRI GM-14 (Geosynthetic Institute, <http://www.geosynthetic-institute.org>) to minimize test samples taken.
 - B. Sampling Procedures are performed as follows:
 1. Installer shall cut samples at locations designated by the consultant as the seaming progresses in order to obtain field laboratory test results before the geomembrane is covered.
 2. Consultant will number each sample, and the location will be noted on the installation as built.

3. Samples shall be twelve inches wide by minimal length with the seam centered lengthwise.
4. Cut a two-inch wide strip from each end of the sample for field-testing.
5. Cut the remaining sample into two parts for distribution as follows:
 - a. One portion for installer, twelve inches by twelve inches
 - b. One portion for the third party laboratory, 12-inches by 18-inches
 - c. Additional samples may be archived if required.
- C. Destructive testing shall be performed in accordance with ASTM D 6392, Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
- D. Installer shall repair all holes in the geomembrane resulting from destructive sampling.
- E. Repair and test the continuity of the repair in accordance with these Specifications.

13.4 Failed Seam Procedures

- A. If the seam fails, installer shall follow one of two options:
 1. Reconstruct the seam between any two passed test locations.
 2. Trace the weld to an intermediate location at least ten feet minimum or to where the seam ends in both directions from the location of the failed test.
- B. The next seam welded using the same welding device is required to obtain an additional sample, i.e., if one side of the seam is less than ten feet long.
- C. If sample passes, then the seam shall be reconstructed or capped between the test sample locations.
- D. If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.

14.0 REPAIR PROCEDURES

- 14.1 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
- 14.2 Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.
- 14.3 Installer shall be responsible for repair of defective areas.
- 14.4 Agreement upon the appropriate repair method shall be decided between consultant and installer by using one of the following repair methods:
 - A. Patching - Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
 - B. Abrading and Rewelding - Used to repair short section of a seam.
 - C. Spot Welding - Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.

- D. Capping - Used to repair long lengths of failed seams.
 - E. Flap Welding - Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
 - F. Remove the unacceptable seam and replace with new material.
- 14.5 The following procedures shall be observed when a repair method is used:
- A. All geomembrane surfaces shall be clean and dry at the time of repair.
 - B. Surfaces of the polyethylene that are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.
 - C. Extend patches or caps at least six inches for extrusion welds and four inches for wedge welds beyond the edge of the defect, and around all corners of patch material.
- 14.6 Repair Verification
- A. Number and log each patch repair (performed by consultant).
 - B. Non-destructively test each repair using methods specified in this Specification.

Table 3.1: Minimum Weld Values for Smooth HDPE Geomembranes

Property	Test Method	60 (1.5)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	98 (17)
Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392	78 (14)
Shear Strength (fusion & ext.), ppi (kN/m)	ASTM D 6392	121 (21)

Table 1.2: Minimum Values for Smooth White-Surfaced HDPE Geomembranes

Property	Test Method	
Thickness, mil (mm)	ASTM D 5199	
Minimum Average		60 (1.5)
Lowest Individual Reading		54 (1.4)
Density, g/cm ³	ASTM D 1505	0.94
Carbon Black Content ⁽²⁾ , %	ASTM D 1603	2.0
Carbon Black Dispersion	ASTM D 5596	<i>Note 3</i>
<i>Tensile Properties:</i>	ASTM D 638	
<i>(each direction)</i>	Type IV, 2 ipm	
Strength at Yield, lb/in (kN/m)		130 (23)
Strength at Break, lb/in (kN/m)		243 (43)
Elongation at Yield, %	(1.3" gauge length)	13
Elongation at Break, %	(2.0" gauge length)	700
Tear Resistance, lb (N)	ASTM D 1004	42 (187)
Puncture Resistance, lb (N)	ASTM D 4833	119 (530)
Notched Constant Tensile Load, hours	ASTM D 5397,	400
Oxidative Induction Time, min.	ASTM D 3895	100

Geomembrane may have an overall ash content greater than 3.0% due to the white layer.

The OIT values apply to the black layer only.

Only near spherical agglomerates are considered. 9 of 10 views shall be Category 1 or 2. No more than one view Category 3.

END OF SECTION

1.0 SCOPE OF WORK

- 1.1 The work to be performed under this section of the specification shall consist of furnishing all necessary supervision, materials, labor, and equipment to design a shotcrete mix, prepare the surface and install the repair/wear layer on the ash pond inlet structures as specified herein.
- 1.2 Shotcrete Mix: The shotcrete mix selected by the contractor shall be designed to minimize shrinkage cracking and to provide an abrasion resistant surface.
 - A. Option 1: Use a mix design of Portland cement, hard natural aggregates and admixtures that data and references show to be abrasion resistant.
 - B. Option 2: Incorporate silica fume into the mix design at a rate of not less than 4%.

2.0 REFERENCES

- 2.1 American Concrete Institute
 - A. ACI 308 Standard Practice for Curing Concrete
 - B. ACU 506R Guide to Shotcreting
 - C. ACI 506.2 Specification for Shotcrete
- 2.2 American Society for Testing and Materials
 - A. ASTM C33 Standard Specification for Concrete Aggregates
 - B. ASTM C150 Standard Specification for Portland Cement
 - C. ASTM C309 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
 - D. ASTM C685 Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
 - E. ASTM C1116 Standard Specification for Fiber Reinforced Concrete and Shotcrete

3.0 MATERIALS

- 3.1 Cement: Portland Cement conforming to ASTM C150 Type I.
- 3.2 Aggregate: Shall conform to ASTM C33.
- 3.3 Mixing Water: Shall conform to the requirements of ASTM C-94.
- 3.4 Silica Fume: "Force 10,000D" microsilica as manufactured by W.R. Grace or an approved equal.
- 3.5 Synthetic Reinforcing Fibers: "Strux 85/50" fibers as manufactured by W.R. Grace or an approved equal.
- 3.6 Curing Compounds: Wax based (Type I) or water emulsified, resin base (Type II)

4.0 SUBMITTALS

- 4.1 The contractors shall submit the proposed mix designs and test data with their proposal. If test data is not available prior to award, the contractor shall be responsible for performing preconstruction testing of the mix after award. The mix shall have a 28-day strength of not less than 6,000 psi.
- 4.2 Two weeks before starting the shotcreting work, the contractor shall submit the qualifications of the nozzlemen who will be performing the work. Every nozzleman shall be certified and have a minimum of 3000 hours of experience as a nozzleman.

5.0 SURFACE PREPARATION

- 5.1 Inspect surfaces and conditions where shotcrete is to be placed. Notify the Owner's Representative immediately of any unsatisfactory conditions and do not proceed until those unsatisfactory conditions have been corrected.
- 5.2 Remove previously applied patching materials.
- 5.3 Chip or scarify the edges of the eroded areas of the concrete slab such that the change in thickness of the shotcrete application will be no greater than ... per linear foot. Scarify the remainder of the existing structure to allow for a minimum shotcrete application of —". Taper edges to leave no square shoulders at the perimeter of a cavity. Perform these procedures with equipment and in a manner that leaves the maximum reveal to insure excellent bonding.
- 5.4 Inspect the surface upon completing the scarifying to insure no residual fractured fragments from the scarifying process remain.
- 5.5 Thoroughly clean the surfaces to be repaired by water blasting to remove any traces of dirt, dust, grease, oil or other substances that could effect the bond of the shotcrete to the existing concrete.
- 5.6 Adequately saturate the repair surface before beginning the shotcreting process.

6.0 INSTALLATION

- 6.1 Shotcrete shall be applied using the dry mix process.
- 6.2 Batching and Mixing:
 - A. Materials shall be volume proportioned by a calibrated screw conveyor or other approved methods.
 - B. Batching tolerances shall not exceed 1% for water, 1 | % for cementitious materials, 2% for sand and coarse aggregates and 3% for reinforcing fibers.
 - C. The percentage of surface moisture in the sand shall be maintained within 3% to 6% by weight.
 - D. Shotcrete batches that have been in contact with damp aggregate or other moisture for more than two hours shall be wasted at the contractor's expense.
 - E. Mixers for the mixing the dry ingredients shall be capable of mixing and discharging a uniform product without segregation of ingredients.

- F. The discharge nozzle of the applicator shall be equipped with a manual water injection system capable of ready adjustment and convenient to the nozzleman.

6.3 Placing of Shotcrete:

- A. Shotcrete shall be placed, starting at the bottom of the Work and proceeding upward, using nozzles and air compressors capable of supplying clean and dry air adequate for maintaining uniform and sufficient nozzle velocity for the Work.
- B. The minimum thickness of shotcrete shall be — in. per layer. The maximum total thickness shall not exceed 3" per layer, unless otherwise indicated on the Contract Drawings.
- C. The surface of freshly placed shotcrete shall be broomed or cleaned to remove laitance. Shotcrete shall be placed in one layer; where shotcrete is placed over existing cementitious surfaces, such surfaces shall be dampened prior to application of the new shotcrete.
- D. The finished repair surface shall not vary from smooth by more than +/- ... within any ten feet.
- E. Fill corners filled first with sound material so as to prevent rebound collecting therein. Corners, or any area where rebound cannot easily escape or be blown out, are the most likely places for "sand pockets" to develop.
- F. If placement results in sagging or sloughing off of materials, shotcreting shall be halted until causes have been determined and corrections have been made. If wind or air currents cause separation of nozzle stream during placement, or if rain occurs and it may wash cement out of the freshly placed material, shotcreting shall be discontinued or suitable means shall be provided to eliminate the problem. Shotcreting shall not be performed when ambient temperature is below 40°F at the pump or at the placement area.
- G. The contractor shall provide and maintain sufficient standby equipment to assure continuous production and application of shotcrete.

6.4 All construction, placement and other joints shall be tapered with a height of at least twice the shotcrete thickness.

6.5 Any placed shotcrete which is damaged, or lacks uniformity, exhibits segregation, honeycomb or lamination, or contains dry patches, slugs, voids or sand pockets, shall be removed and replaced with dry mixed mortar.

6.6 Under no circumstances shall any rebound or previously expended material be used in the shotcrete mix.

6.7 Curing:

- A. Curing shall commence immediately after the concrete has attained enough set to prevent damage to the concrete surface. Water curing shall be continued for seven days after shotcreting. During this curing period, the shotcrete work shall be maintained above 50°F.
- B. After water curing, final curing may be performed by apply curing compounds. The rate of application shall be at least twice that recommended by the manufacturer for smooth concrete surfaces.

7.0 INSPECTION AND TESTING

- 7.1 Contractor shall be responsible for all inspection and testing work as required or as needed, unless otherwise indicated. Owner's Representative may, during the course of the Work, observe the various phases of the Work for full compliance with all requirements of this Specification and the Contract Drawings. Any work failing to meet the specified requirements shall be rectified or replaced by Contractor at his expense at no additional cost to Owner.
- 7.2 Test Specimens:
- A. Test specimens shall be made by each shotcrete application crew using the materials, equipment, and mix proportions used for the subject work.
 - B. A test panel of at least 30" x 30" shall be made with suitable backing material for each mix design being considered, and also for each shooting position to be encountered in the Work (i.e., horizontal, vertical and overhead positions). At least half of each panel to be tested for proper embedment of reinforcement shall contain the same reinforcement as the structure. The thickness of test panels shall be the same as the structure.
 - C. At least five cores shall be taken from each test panel for testing. All cored surfaces shall be dense and free from laminations and sand pockets. Embedment of reinforcement shall be examined in each panel.
- 7.3 Test specimens shall be obtained and tested in accordance with ASTM C42 and C39 for compressive strength only.

END OF SECTION

APPENDIX B-2

West Ash Basin Liner Replacement Specifications

1.0 WORK INCLUDED

- 1.1 This work includes furnishing materials, tools, equipment, and labor to perform bulk and structural excavation, grading, dewatering and place and compact fill, backfill, and bedding materials.
- 1.2 Excavation includes, sheeting and bracing required for proper execution of the work, loosening, digging, wedging, ripping, loading, hauling, stockpiling, dumping, and disposal of excavated materials in legal disposal areas approved by Owner's Representative.
- 1.3 Excavation is unclassified and includes, but is not limited to soil, ash and rock materials, abandoned underground conduits or pipes, and buried concrete and masonry structures.

2.0 QUALITY CONTROL

- 2.1 Existing and new materials to be used as fill, backfill or bedding are subject to the approval of Owner's Representative.
- 2.2 To obtain approval of fill, backfill, and bedding materials, designate the proposed borrow area and notify the Owner's Site Representative for a visual inspection prior to placing the material.

3.0 REFERENCES

- 3.1 Occupational Safety and Health Administration (OSHA)
 - A. OSHA 2206 General Industry Standards
 - B. OSHA 2207 Construction Industry Standards
- 3.2 Illinois Department of Transportation (IDOT) - Standard Specifications for Road and Bridge Construction.
- 3.3 American Society for Testing and Materials (ASTM)
 - A. ASTM D 1556- Test for Density of Soil in place by Sand Cone Method
 - B. ASTM D 1557- Tests for Moisture-Density Relations of Soils Using 10 lb. Hammer and 18 inch drop.
 - C. ASTM D 2167- Test for Density of Soil in place by Rubber Balloon Method
- 3.4 The above references shall be the current revision for each.

4.0 SUBMITTALS

- 4.1 With Contractors' Proposals
 - A. Submit product data sheets for the chosen liner material.
 - B. Submit the estimated quantities of materials required to complete the work.
- 4.2 Two weeks prior to the start of the work, submit to the Owner's Engineer for review, procedures for placing and compacting fill on top of the new liner without damaging the liner material. Include a statement from the liner manufacture that says the procedure is acceptable.

5.0 SITE CONDITIONS

- 5.1 Prior to start of work become thoroughly familiar with the site, site access, the site conditions, and all portions of the work.
- 5.2 One pond will be operational while the work on the second pond is being performed.

6.0 MATERIALS

- 6.1 Make maximum use of suitable on site material for fill when building the pond slopes and entrance ramps. Suitable on site fill material is granular soil or soil/rock mixture that is free from organic matter and other deleterious substances. Material containing rocks or lumps over 1½" in greatest dimension, or containing 15% rocks or lumps larger than ½" in greatest dimension is not acceptable. The material shall have an angle of repose of 30° or greater.
- 6.2 Imported fill and backfill material shall meet the requirements of Item 6.1 above and, in addition, shall contain predominantly granular material with a maximum particle size of 2".
- 6.3 Sand used as the protective layer for the pond liners shall be approved by the liner manufacturer.
- 6.4 Rip rap, coarse aggregate and limestone screenings shall comply with I.D.O.T. specifications.

7.0 BULK AND STRUCTURAL EXCAVATION

- 7.1 Perform bulk and structural excavation in accordance with the most recent revision of the OSHA General Industry Standards (OSHA 2206) and the OSHA Construction Industry Standards (OSHA 2207).
- 7.2 Provide temporary grading, ditches and other means as required to drain the areas of the work.
- 7.3 Perform excavation to lines and grades shown on the contract drawings and as directed by Owner's Representative.
- 7.4 When the sides of an excavation are five feet or more in depth or when employees are required to enter the excavated area where danger from moving ground exists, perform excavation by open cut to a stable slope or by sheeting and bracing.
- 7.5 Remove unstable subsoil material, where encountered at the bottom of excavation, to a depth required to obtain satisfactory bearing conditions. Contractor is responsible for bringing the excavation back to the proper elevation by installing compacted bedding material as specified in this section.

- 7.6 Remove spoil from areas of excavation and stockpile for later use at locations no closer than 2'-0" from edge of excavation unless otherwise approved by Owner's Representative. Remove excess spoil and excavated materials not specifically approved by Owner's Representative for fill, backfill or stockpiling from the site and dispose of these materials at locations and in a manner approved by Federal, State and Local Authorities.
- 7.7 Properly grade bottom of bulk and structural excavations, remove loose materials, and maintain excavations in good condition, keeping them dry in accordance with Article 8.0 Dewatering, of this section, and free from debris, ice, and frost until completion of the work.

8.0 DEWATERING

- 8.1 Provide and maintain in operation adequate pumping capacity from sumps, deep wells, or well point installation and perform all other work necessary to keep excavations dry and free of groundwater or surface water during the progress of the work.
- 8.2 Construction is not permitted in flowing or standing water.
- 8.3 Dispose of water pumped or drained from the work area in a manner satisfactory to the Owner's Representative, without damage to adjacent property or to other work under construction.
- 8.4 Take necessary precautions to protect the work against flooding.

9.0 COMPACTION

- 9.1 Determine the types of equipment and the number of passes required to obtain the required compaction. A pass is defined as one complete coverage of the area by the compaction equipment being used.
- 9.2 Compact fill and backfill materials to a minimum of 90% of maximum dry density in all areas except in road areas where a minimum of 95% of maximum dry density is required.
- 9.3 Compact surfaces that are scarified along with and as part of the first lift of fill material that is spread thereon.
- 9.4 Maximum dry density is defined as the maximum density that can be produced when the same material is compacted in the laboratory in accordance with ASTM D 698 (Standard Proctor).

10.0 INSTALLATION OF FILL AND BACKFILL

- 10.1 Install fill and backfill material by placing fill and backfill material in uniform layers not to exceed 6" loose measurement unless otherwise noted on the contract drawings or elsewhere in this specification. Compact to minimum specified compaction as set forth in Article 9.2 of this Section.
- 10.2 Install the 12" protective sand layer on top of the liner material in a single layer.
- 10.3 Moisten and scarify surfaces to a depth of 4", against which new fill or roadway material is to be placed.
- 10.4 Remove shoring as backfill progresses only when banks are safe from caving or collapse.

- 10.5 Water or aerate the material as necessary, and thoroughly mix to obtain a moisture content that will permit proper compaction.
- 10.6 Do not place fill or backfill materials on a frozen surface. Do not incorporate snow, ice or frozen earth with the fill. Distribute and grade fill and backfill materials throughout the work such that fill will be free from lenses, pockets, streaks or layers of materials differing in texture or gradation from the surrounding material. Do not place successive layers until the layer under construction has been satisfactorily compacted. Place materials in horizontal lifts.
- 10.7 Remove, dispose and replace any material that Owner's Representative considers objectionable without additional cost to Owner.
- 10.8 Bring subgrades to a plus or minus tolerance of 0.10 feet.

11.0 FIELD QUALITY CONTROL

- 11.1 Do not allow or cause any of the work performed or installed to be covered up or enclosed prior to required inspections, tests, and approvals.
- 11.2 Should any of the work be enclosed or covered up before it has been approved, uncover such work at no additional cost to Owner.
- 11.3 After the work has been completed, tested, inspected, and approved, make repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, at no additional cost to the Owner.
- 11.4 Contractor shall engage a testing laboratory to inspect and perform tests on all fill, backfill, and bedding materials.
 - A. The testing laboratory shall conduct and interpret the following ASTM tests to determine the degree of compaction achieved by compaction operations:
 1. ASTM D 1556 Test for Density of Soil in place by Sand Cone Method
 2. ASTM D 2167 Test for Density of Soil in place by Rubber Balloon Method
 3. ASTM D 2922 Test for Density of Soil in place by Nuclear Methods
 - B. The testing laboratory shall prepare a test report stating whether the test specimens comply with the work requirements, and specifically state any deviations therefrom.
 - C. The Owner shall have the right to reject any materials or work not complying with the requirements of the Specification.
 - D. Contractor shall be responsible for all costs associated with the removal and replacement of all materials determined by testing personnel to have failed the testing acceptance standards.

END OF SECTION

1.0 WORK INCLUDED

This work includes furnishing materials, tools, equipment, and labor to install a 60-mil thick, high-density polyethylene liner with a reflective white coating.

2.0 REFERENCES

2.1 American Society for Testing and Materials (ASTM)

- D 638 Standard Test Method for Tensile Properties of Plastics
- D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
- D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
- D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D 1603 Test Method for Carbon Black in Olefin Plastics
- D 3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
- D 5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- D 6392 Standard Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

2.2 Geosynthetic Research Institute

- GM9 Cold Weather Seaming of Geomembranes
- GM13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
- GM19 Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

3.0 DEFINITIONS

- 3.1 Lot - A quantity of resin (usually the capacity of one rail car) used in the manufacture of polyethylene geomembrane rolls. The finished roll will be identified by a roll number traceable to the resin lot used.
- 3.2 Construction Quality Assurance Consultant (consultant) - Party, independent from manufacturer and installer that is responsible for observing and documenting activities related to quality assurance during the lining system construction.
- 3.3 Engineer - The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

- 3.4 Geomembrane Manufacturer (manufacturer) - The party responsible for manufacturing the geomembrane rolls.
- 3.5 Geosynthetic Quality Assurance Laboratory (testing laboratory) - Party, independent from the owner, manufacturer and installer, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the owner.
- 3.6 Installer - Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.
- 3.7 Panel - Unit area of a geomembrane that will be seamed in the field that is larger than 100 square feet.
- 3.8 Patch - Unit area of a geomembrane that will be seamed in the field that is less than 100 square feet.
- 3.9 Subgrade Surface - Soil layer surface which immediately underlies the geosynthetic material.

4.0 SUBMITTALS POST-AWARD

- 4.1 Furnish the following product data, in writing, to engineer prior to installation of the geomembrane material:
 - A. Resin Data shall include certification stating that the resin meets the specification requirements (see Section 8.0).
 - B. Statement certifying no more than 10% reclaimed polymer (of the same type) is added to the resin (product run may be recycled) per GRI GM 13.
- 4.2 The installer shall furnish the following information to the engineer and owner prior to installation:
 - A. Installation layout drawings
 - 1. Must show proposed panel layout including field seams and details
 - 2. Must be approved prior to installing the geomembrane (Approved drawings will be for concept only and actual panel placement will be determined by site conditions).
 - B. Installer's Geosynthetic Field Installation Quality Assurance Plan
- 4.3 The installer will submit the following to the engineer upon completion of installation:
 - A. Certificate stating the geomembrane has been installed in accordance with the Contract Documents
 - B. Material and installation warranties
 - C. As-built drawings showing actual geomembrane placement and seams including typical anchor trench detail/

5.0 QUALITY ASSURANCE

5.1 The Contractor shall engage and pay for the services of a Quality Assurance Consultant to monitor geomembrane installation.

5.2 Qualifications

A. Manufacturer

1. Geomembrane shall be manufactured by GSE Lining Technology, Inc. or an approved equal.
2. Manufacturer shall have manufactured a minimum of 10,000,000 square feet of polyethylene geomembrane during the last year.

B. Installer

1. The liner manufacturer shall install the liner.
2. Installer shall have installed a minimum of 3,000,000 square feet of HDPE geomembrane during the last five years.
3. Installer shall have worked in a similar capacity on at least three projects similar in complexity to the project described in the contract documents.
4. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.
5. The installer shall provide a minimum of one Master Seamer for work on the project.
6. Must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for the use on this Project.

6.0 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

6.1 Labeling - Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label will identify:

- A. Manufacturer's name
- B. Product identification
- C. Roll number

6.2 Delivery - Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

6.3 Storage - The on-site storage location for geomembrane material, provided by the contractor to protect the geomembrane from punctures, abrasions and excessive dirt and moisture for should have the following characteristics:

- A. Level (no wooden pallets)
- B. Smooth
- C. Dry

- D. Protected from theft and vandalism
 - E. Adjacent to the area being lined
- 6.4 Handling - Materials are to be handled so as to prevent damage.

7.0 WARRANTY

- 7.1 Material shall be warranted, on a pro-rata basis against Manufacturer's defects for a period of five years from the date of geomembrane installation.
- 7.2 Installation shall be warranted against defects in workmanship for a period of one year from the date of geomembrane completion.

8.0 GEOMEMBRANE

- 8.1 Material shall be smooth/textured polyethylene geomembrane as shown on the drawings.
- 8.2 Resin
 - A. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
 - B. Natural resin (without carbon black) shall meet the following additional minimum requirements:

Property	Test Method ⁽¹⁾	HDPE
Density [g/cm ³]	ASTM D 1505	0.932
Melt Flow Index [g/10 min.]	ASTM D 1238 (190/2.16)	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 atm/200°C)	100

8.3 Geomembrane Rolls

- A. Do not exceed a combined maximum total of one percent by weight of additives other than carbon black.
- B. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
- C. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating both number, thickness, length, width and manufacturer.
- D. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Section 8.2, and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

- 8.4 Smooth, white surfaced geomembrane shall meet the requirements shown in Table 1.2
The geomembrane shall be a white-surfaced, coextruded geomembrane. The white surface shall be installed upwards.
- 8.5 Extrudate Rod or Bead
- A. Extrudate material shall be made from same type resin as the geomembrane.
 - B. Additives shall be thoroughly dispersed.
 - C. Materials shall be free of contamination by moisture or foreign matter.

9.0 EQUIPMENT

Welding equipment and accessories shall meet the following requirements:

- 9.1 Gauges showing temperatures in apparatus (extrusion welder) or wedge (wedge welder) shall be present.
- 9.2 An adequate number of welding apparatus shall be available to avoid delaying work.
- 9.3 Power source capable of providing constant voltage under combined line load shall be used.

10.0 DEPLOYMENT

- 10.1 Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.
- 10.2 Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.
- 10.3 Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:
 - A. Unroll geomembrane panels using methods that will not damage geomembrane and will protect underlying surface from damage (i.e., spreader bar, protected equipment bucket).
 - B. Place ballast (commonly sandbags) on geomembrane that will not damage geomembrane to prevent wind uplift.
 - C. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage the geomembrane. Smoking will not be permitted on the geomembrane.
 - D. Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than six psi.
 - E. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
- 10.4 Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

11.0 FIELD SEAMING

11.1 Seams shall meet the following requirements:

- A. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.
- B. Minimize number of field seams in corners, odd shaped geometric locations and outside corners.
- C. Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area.
- D. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the consultant and installer.
- E. Align seam overlaps consistent with the requirements of the welding equipment being used. A six-inch overlap is commonly suggested.

11.2 During Welding Operations provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

11.3 Extrusion Welding

- A. Hot-air tack adjacent pieces together using procedures that do not damage geomembrane.
- B. Clean geomembrane surfaces by disc grinder or equivalent.
- C. Purge welding apparatus of heat degraded extrudate before welding.

11.4 Hot Wedge Welding

- A. Welding apparatus shall be a self-propelled device equipped with an electronic controller that displays applicable temperatures.
- B. Clean seam area of dust, mud, moisture and debris immediately ahead of the hot wedge welder.
- C. Protect against moisture build up between sheets.

12.0 Trial Welds

- A. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
- B. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
- C. Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid shift.
- D. Cut four, one-inch wide by six-inch long test strips from the trial weld.
- E. Quantitatively test specimens for peel adhesion, and then for bonded seam strength (shear).
- F. Trial weld specimens shall pass when the results shown in Table 3 are achieved in both peel and shear test.
 - 1. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).

2. The break is ductile.
 - G. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
 - H. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.
- 12.2 Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.
- 12.3 Defects and Repairs
- A. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
 - B. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

13.0 FIELD QUALITY ASSURANCE

- 13.1 Manufacturer/installer shall participate in and conform to all terms and requirements of the Owner's quality assurance program. Contractor shall be responsible for assuring this participation.
- 13.2 Field Testing
- A. Non-destructive testing shall be carried out as the seaming progresses.
 1. Vacuum Testing - Shall be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
 2. Air Pressure Testing - Shall be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
- 13.3 Destructive Testing (performed by the installer witnessed by the consultant)
- A. Location and Frequency of Testing
 1. Collect destructive test samples at a frequency of one per every 1500 lineal feet of seam length.
 2. Test locations will be determined after seaming.
 3. Exercise Method of Attributes as described by GRI GM-14 (Geosynthetics Institute, <http://www.geosynthetic-institute.org>) to minimize test samples taken.
 - B. Sampling Procedures are performed as follows:
 1. Installer shall cut samples at locations designated by the consultant as the seaming progresses in order to obtain field laboratory test results before the geomembrane is covered.
 2. Consultant will number each sample, and the location will be noted on the installation as built.

3. Samples shall be twelve inches wide by minimal length with the seam centered lengthwise.
4. Cut a two-inch wide strip from each end of the sample for field-testing.
5. Cut the remaining sample into two parts for distribution as follows:
 - a. One portion for installer, twelve -inches by twelve inches
 - b. One portion for the third party laboratory, 12-inches by 18-inches
 - c. Additional samples may be archived if required.
- C. Destructive testing shall be performed in accordance with ASTM D 6392, Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
- D. Installer shall repair all holes in the geomembrane resulting from destructive sampling.
- E. Repair and test the continuity of the repair in accordance with these Specifications.

13.4 Failed Seam Procedures

- A. If the seam fails, installer shall follow one of two options:
 1. Reconstruct the seam between any two passed test locations.
 2. Trace the weld to an intermediate location at least ten feet minimum or to where the seam ends in both directions from the location of the failed test.
- B. The next seam welded using the same welding device is required to obtain an additional sample, i.e., if one side of the seam is less than ten feet long.
- C. If sample passes, then the seam shall be reconstructed or capped between the test sample locations.
- D. If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.

14.0 REPAIR PROCEDURES

- 14.1 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
- 14.2 Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.
- 14.3 Installer shall be responsible for repair of defective areas.
- 14.4 Agreement upon the appropriate repair method shall be decided between consultant and installer by using one of the following repair methods:
 - A. Patching - Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
 - B. Abrading and Rewelding - Used to repair short section of a seam.
 - C. Spot Welding - Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.

- D. Capping - Used to repair long lengths of failed seams.
 - E. Flap Welding - Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
 - F. Remove the unacceptable seam and replace with new material.
- 14.5 The following procedures shall be observed when a repair method is used:
- A. All geomembrane surfaces shall be clean and dry at the time of repair.
 - B. Surfaces of the polyethylene that are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.
 - C. Extend patches or caps at least six inches for extrusion welds and four inches for wedge welds beyond the edge of the defect, and around all corners of patch material.
- 14.6 Repair Verification
- A. Number and log each patch repair (performed by consultant).
 - B. Non-destructively test each repair using methods specified in this Specification.

Table 3.1: Minimum Weld Values for Smooth HDPE Geomembranes

Property	Test Method	60 (1.5)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	98 (17)
Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392	78 (14)
Shear Strength (fusion & ext.), ppi (kN/m)	ASTM D 6392	121 (21)

Table 1.2: Minimum Values for Smooth White-Surfaced HDPE Geomembranes

Property	Test Method	
Thickness, mil (mm)	ASTM D 5199	
Minimum Average		60 (1.5)
Lowest Individual Reading		54 (1.4)
Density, g/cm ³	ASTM D 1505	0.94
Carbon Black Content ⁽²⁾ , %	ASTM D 1603	2.0
Carbon Black Dispersion	ASTM D 5596	<i>Note 3</i>
<i>Tensile Properties:</i>	ASTM D 638	
<i>(each direction)</i>	Type IV, 2 ipm	
Strength at Yield, lb/in (kN/m)		130 (23)
Strength at Break, lb/in (kN/m)		243 (43)
Elongation at Yield, %	(1.3" gauge length)	13
Elongation at Break, %	(2.0" gauge length)	700
Tear Resistance, lb (N)	ASTM D 1004	42 (187)
Puncture Resistance, lb (N)	ASTM D 4833	119 (530)
Notched Constant Tensile Load, hours	ASTM D 5397,	400
Oxidative Induction Time, min.	ASTM D 3895	100

Geomembrane may have an overall ash content greater than 3.0% due to the white layer.

The OIT values apply to the black layer only.

Only near spherical agglomerates are considered. 9 of 10 views shall be Category 1 or 2. No more than one view Category 3.

END OF SECTION

1.0 SCOPE OF WORK

- 1.1 The work to be performed under this section of the specification shall consist of furnishing all necessary supervision, materials, labor, and equipment to design a shotcrete mix, prepare the surface and install the repair/wear layer on the ash pond inlet structures as specified herein.
- 1.2 Shotcrete Mix: The shotcrete mix selected by the contractor shall be designed to minimize shrinkage cracking and to provide an abrasion resistant surface.
 - A. Option 1: Use a mix design of Portland cement, hard natural aggregates and admixtures that data and references show to be abrasion resistant.
 - B. Option 2: Incorporate silica fume into the mix design at a rate of not less than 4%.

2.0 REFERENCES

- 2.1 American Concrete Institute
 - A. ACI 308 Standard Practice for Curing Concrete
 - B. ACU 506R Guide to Shotcreting
 - C. ACI 506.2 Specification for Shotcrete
- 2.2 American Society for Testing and Materials
 - A. ASTM C33 Standard Specification for Concrete Aggregates
 - B. ASTM C150 Standard Specification for Portland Cement
 - C. ASTM C309 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
 - D. ASTM C685 Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
 - E. ASTM C1116 Standard Specification for Fiber Reinforced Concrete and Shotcrete

3.0 MATERIALS

- 3.1 Cement: Portland Cement conforming to ASTM C150 Type I.
- 3.2 Aggregate: Shall conform to ASTM C33.
- 3.3 Mixing Water: Shall conform to the requirements of ASTM C-94.
- 3.4 Silica Fume: "Force 10,000D" microsilica as manufactured by W.R. Grace or an approved equal.
- 3.5 Synthetic Reinforcing Fibers: "Strux 85/50" fibers as manufactured by W.R. Grace or an approved equal.
- 3.6 Curing Compounds: Wax based (Type I) or water emulsified, resin base (Type II)

4.0 SUBMITTALS

- 4.1 The contractors shall submit the proposed mix designs and test data with their proposal. If test data is not available prior to award, the contractor shall be responsible for performing preconstruction testing of the mix after award. The mix shall have a 28-day strength of not less than 6,000 psi.
- 4.2 Two weeks before starting the shotcreting work, the contractor shall submit the qualifications of the nozzlemen who will be performing the work. Every nozzleman shall be certified and have a minimum of 3000 hours of experience as a nozzleman.

5.0 SURFACE PREPARATION

- 5.1 Inspect surfaces and conditions where shotcrete is to be placed. Notify the Owner's Representative immediately of any unsatisfactory conditions and do not proceed until those unsatisfactory conditions have been corrected.
- 5.2 Remove previously applied patching materials.
- 5.3 Chip or scarify the edges of the eroded areas of the concrete slab such that the change in thickness of the shotcrete application will be no greater than ¼" per linear foot. Scarify the remainder of the existing structure to allow for a minimum shotcrete application of ¾". Taper edges to leave no square shoulders at the perimeter of a cavity. Perform these procedures with equipment and in a manner that leaves the maximum reveal to insure excellent bonding.
- 5.4 Inspect the surface upon completing the scarifying to insure no residual fractured fragments from the scarifying process remain.
- 5.5 Thoroughly clean the surfaces to be repaired by water blasting to remove any traces of dirt, dust, grease, oil or other substances that could effect the bond of the shotcrete to the existing concrete.
- 5.6 Adequately saturate the repair surface before beginning the shotcreting process.

6.0 INSTALLATION

- 6.1 Shotcrete shall be applied using the dry mix process.
- 6.2 Batching and Mixing:
 - A. Materials shall be volume proportioned by a calibrated screw conveyor or other approved methods.
 - B. Batching tolerances shall not exceed 1% for water, 1 1/2% for cementitious materials, 2% for sand and coarse aggregates and 3% for reinforcing fibers.
 - C. The percentage of surface moisture in the sand shall be maintained within 3% to 6% by weight.
 - D. Shotcrete batches that have been in contact with damp aggregate or other moisture for more than two hours shall be wasted at the contractor's expense.
 - E. Mixers for the mixing the dry ingredients shall be capable of mixing and discharging a uniform product without segregation of ingredients.

- F. The discharge nozzle of the applicator shall be equipped with a manual water injection system capable of ready adjustment and convenient to the nozzleman.

6.3 Placing of Shotcrete:

- A. Shotcrete shall be placed, starting at the bottom of the Work and proceeding upward, using nozzles and air compressors capable of supplying clean and dry air adequate for maintaining uniform and sufficient nozzle velocity for the Work.
- B. The minimum thickness of shotcrete shall be $\frac{3}{4}$ " per layer. The maximum total thickness shall not exceed 3" per layer, unless otherwise indicated on the Contract Drawings.
- C. The surface of freshly placed shotcrete shall be broomed or cleaned to remove laitance. Shotcrete shall be placed in one layer; where shotcrete is placed over existing cementitious surfaces, such surfaces shall be dampened prior to application of the new shotcrete.
- D. The finished repair surface shall not vary from smooth by more than $\pm \frac{1}{4}$ " within any ten feet.
- E. Fill corners filled first with sound material so as to prevent rebound collecting therein. Corners, or any area where rebound cannot easily escape or be blown out, are the most likely places for "sand pockets" to develop.
- F. If placement results in sagging or sloughing off of materials, shotcreting shall be halted until causes have been determined and corrections have been made. If wind or air currents cause separation of nozzle stream during placement, or if rain occurs and it may wash cement out of the freshly placed material, shotcreting shall be discontinued or suitable means shall be provided to eliminate the problem. Shotcreting shall not be performed when ambient temperature is below 40°F at the pump or at the placement area.
- G. The contractor shall provide and maintain sufficient standby equipment to assure continuous production and application of shotcrete.

6.4 All construction, placement and other joints shall be tapered with a height of at least twice the shotcrete thickness.

6.5 Any placed shotcrete which is damaged, or lacks uniformity, exhibits segregation, honeycomb or lamination, or contains dry patches, slugs, voids or sand pockets, shall be removed and replaced with dry mixed mortar.

6.6 Under no circumstances shall any rebound or previously expended material be used in the shotcrete mix.

6.7 Curing:

- A. Curing shall commence immediately after the concrete has attained enough set to prevent damage to the concrete surface. Water curing shall be continued for seven days after shotcreting. During this curing period, the shotcrete work shall be maintained above 50°F.
- B. After water curing, final curing may be performed by apply curing compounds. The rate of application shall be at least twice that recommended by the manufacturer for smooth concrete surfaces.

7.0 INSPECTION AND TESTING

- 7.1 Contractor shall be responsible for all inspection and testing work as required or as needed, unless otherwise indicated. Owner's Representative may, during the course of the Work, observe the various phases of the Work for full compliance with all requirements of this Specification and the Contract Drawings. Any work failing to meet the specified requirements shall be rectified or replaced by Contractor at his expense at no additional cost to Owner.
- 7.2 Test Specimens:
- A. Test specimens shall be made by each shotcrete application crew using the materials, equipment, and mix proportions used for the subject work.
 - B. A test panel of at least 30" x 30" shall be made with suitable backing material for each mix design being considered, and also for each shooting position to be encountered in the Work (i.e., horizontal, vertical and overhead positions). At least half of each panel to be tested for proper embedment of reinforcement shall contain the same reinforcement as the structure. The thickness of test panels shall be the same as the structure.
 - C. At least five cores shall be taken from each test panel for testing. All cored surfaces shall be dense and free from laminations and sand pockets. Embedment of reinforcement shall be examined in each panel.
- 7.3 Test specimens shall be obtained and tested in accordance with ASTM C42 and C39 for compressive strength only.

END OF SECTION

APPENDIX B-3

East Ash Basin Slope Modification Technical Specifications

SECTION 02200

EARTHWORK

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, equipment, and incidentals necessary to perform all Earthwork. The Work shall be carried out as specified herein and in accordance with the Construction Drawings.

B. The Work shall include, but not be limited to clearing and grubbing, excavating, hauling, placing, moisture conditioning, backfilling, compacting, grading, and subgrade preparation. Earthwork shall conform to the dimensions, lines, grades and sections shown on the Construction Drawings or as directed by the Construction Manager.

1.02 RELATED SECTIONS

A. Section 02770 – Geosynthetics

1.03 REFERENCES

A. Construction Drawings

B. Latest version of the Occupational Safety and Health Administration (OSHA) rules and regulations.

C. “Stormwater Pollution Prevention Plan, East Ash Basin Slope Modification”, Geosyntec, July 2016.

D. 2015 Standard Specifications for Public Works Construction “Greenbook” (Greenbook)

E. “Construction Quality Assurance (CQA) Plan, East Ash Basin Slope Modification, Waukegan Generating Station” by Geosyntec, dated June 2016

F. Illinois Department of Transportation (IDOT), Standard Specifications for Road and Bridge Construction, January 2012.

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

ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D422 Standard Method for Particle-Size Analysis of Soils

ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

ASTM D2487 Standard Test Method for Classification of Soils for Engineering Purposes

ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

H. Submittals

I. The Contractor shall submit to the Construction Manager a description of equipment and methods proposed for all earthwork components including excavation, ash relocation, select and engineered fill placement, moisture conditioning, and compaction, stockpiling, road subgrade preparation and road surfacing placement and compaction at least 5 days prior to the start of activities covered by this Section.

J. The Contractor shall submit copies of all permits obtained for site work. The permits shall be provided prior to initiating the applicable site activities.

K. The Contractor shall submit as-built Record Drawing electronic files and data, to the Construction Manager, within 7 days of project substantial completion, in accordance with this Section. The Record Drawings shall be submitted in AutoCAD version 2015 format or newer, or in a DXF format that can be converted to AutoCAD.

1.04 QUALITY ASSURANCE

A. The Contractor shall ensure that the materials and methods used for Earthwork meet the requirements of the Construction Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager will be rejected and shall be repaired or replaced by the Contractor at the Contractor's expense.

B. The Contractor shall be aware of and accommodate all monitoring and field/laboratory conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed Work, will be performed by the CQA Consultant. If nonconformances or other deficiencies are found in the materials or completed Work, the Contractor will be required to repair the deficiency or replace the deficient materials at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Engineered Fill – Engineered Fill shall consist of relatively homogeneous soils that contain no debris, foreign objects, large rock fragments (greater than 6 inches in maximum dimension), roots, and organics. No materials larger than 6 inches shall be allowed within the Engineered Fill. The Engineered Fill shall be classified according to the Unified Soil Classification System (per ASTM D2487) as, ML, CL, CL-ML, SM, SC, SW, SP, GW, GP, GM, GC, or combinations of these materials. The Contractor may propose the use of other soil types as Engineered Fill, but such use shall be at the sole discretion of the Engineer.

B. Select Soil – Select Soil shall have at least 40 percent material smaller than ¼-inch in size, no particles larger than 3 inches, and not having any sharp, angular pieces greater than ¼-inch or perishable, spongy, deleterious, or otherwise unsuitable material. Select soil shall be utilized to backfill geomembrane anchor trenches.

C. Aggregate Base – Aggregate Base shall meet the requirements of Illinois Department of Transportation Gradation CA 6.

D. CCR – CCR (Coal Combustion Residuals) are materials located within the geomembrane lined areas of the West and East Ash Basins.

2.02 EQUIPMENT

- A. The Contractor shall furnish, operate, and maintain compaction equipment as necessary to produce the required in-place soil density and moisture content.
- B. The Contractor shall furnish, operate and maintain tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.
- C. The Contractor shall furnish, operate, and maintain miscellaneous equipment such as scarifiers or disks, earth excavating equipment, earth hauling equipment, and other equipment, as necessary for Earthwork construction.
- D. When relocating CCR Deposits or placing excavated material within the basin in areas lined with a geomembrane, the Contractor shall use equipment which will not damage the underlying geomembrane in accordance with the Geomembrane Manufacturer's recommendations.

PART 3 – EXECUTION

3.01 GENERAL

- A. The Contractor shall not disturb or impact areas outside of the limits of work as defined on the Construction Drawings without prior approval from the Construction Manager. If work outside of the limit cannot be avoided, the Contractor shall notify the Construction Manager a minimum of 3 days prior to disturbance outside of the limits for approval prior to starting the work.
- B. Prior to initiating earthwork activities, the Contractor shall have implemented the site SWPPP.
- C. The Contractor shall obtain all applicable grading permits, or other applicable work permits, prior to initiating the work covered by the permit.
- D. When hauling is done over roadways or city streets, the loads shall comply with legal load requirements, all material shall be removed from shelf areas of vehicles in order to eliminate spilling of material, and loads shall be watered or covered to eliminate dust.
- E. Under this Work, the Contractor shall apply water for dust control, for compaction purposes, and for such other purposes (not provided for in other Sections) called for on the Construction Drawings or as directed by the Construction Manager. Contractor shall coordinate with Owner for access to onsite water source. Contractor shall not waste water or allow water application to create erosion or other deleterious conditions to the work area or adjacent areas.
- F. Well heads for existing groundwater wells within the work area will be removed by others and wells will be capped prior to work. The Contractor shall provide protection to existing groundwater monitoring wells throughout construction. Any damage to these items shall be repaired or replaced to the Construction Manager's satisfaction at the Contractor's sole expense.

3.02 FAMILIARIZATION

- A. Prior to implementing any of the Work in this Section, the Contractor shall become thoroughly familiar with the Site, the Site conditions, and all portions of the Work falling within this and other related Sections.

3.03 CLEARING AND GRUBBING

- A. Prior to Site clearing, Contractor shall have implemented the SWPPP.
- B. The Contractor shall remove and properly dispose of all vegetation, debris, organic and deleterious material that exist along the crest of the embankment and eastern and southern facing slopes of the embankment within the work area.
- C. No burning of combustible materials shall be allowed.
- D. Clearing and grubbing shall include, but not be limited to removal and disposal of trees, plants and shrubs and vegetation as well as rocks, and surficial and shallow debris.
- E. Vegetation, debris and organic matter shall be properly disposed of offsite.
- F. Remove all tree root balls associated with trees with a diameter greater than 4-inches. Tree root ball holes in non-excavation areas shall be backfilled in accordance with Section 3.07.

3.04 EXCAVATION

- A. CCR located on top of the geomembrane along the slope area within the East Ash Basin shall be relocated, as necessary, to accommodate grading of the embankment. Excavated CCR materials shall be placed within the western portion of the East Ash Basin. CCR shall not be placed at inclinations greater than 5H:1V (Horizontal:Vertical). Excavation of CCR shall be performed with care to ensure no damage to the underlying geomembrane. Damage to the underlying geomembrane shall be repaired to the Construction Manager's satisfaction at the Contractor's expense.
- B. Perform all excavations, regardless of the type, nature, or condition of material encountered, as specified, shown, required or implied to accomplish the construction. Excavated soil shall be placed within the western portion of the East Ash Basin at inclinations no greater than 5H:1V.
- C. Allow for working space, overlying materials, and finish grades as shown or required. Do not carry excavations deeper than the elevation shown, unless soft or wet materials are encountered. Excavation carried below the grade lines in areas of unsuitable materials, including root balls, shall be replaced with over excavated material compacted to at least 90% relative compaction and to -3 percent to +1 percent of optimum moisture. Cuts below grade shall be corrected by filling and compacting soil material to at least 90% relative compaction and -3 percent to +1 percent of optimum moisture, and creating a smooth transition. All overexcavation in areas of suitable materials will be filled and compacted at the Contractor's expense.
- D. After completion of excavation, and prior to placement of aggregate base on the embankment crest (Section 3.06), proof-roll the berm crest to detect soft, wet, or loose materials. Notify the Owner or Owner's Representative prior to commencement of proof rolling. If soft, wet, or loose materials are found, excavate the soft or loose material to a depth accepted by the Engineer, then fill and compact in accordance with Section 3.07.
- E. Perform all earthwork to the lines and grades as shown and/or established by the Owner or Owner's Representative. Make slopes free of all exposed roots and stones exceeding 3-inch diameter which are loose and liable to fall. Neatly blend all new grading into surrounding, existing terrain. The Owner or Owner's Representative shall review finished site grading.
- F. After excavating existing aggregate base materials on the embankment crest within the work area, Contractor shall remove existing geotextile and properly dispose of offsite.

3.05 ANCHOR TRENCH EXCAVATION AND BACKFILL

- A. The Contractor shall excavate 2 ft by 2 ft anchor trenches to secure the geomembrane prior to placement of the geotextile and aggregate base material.
- B. Anchor trenches shall be backfilled with select fill and compacted in accordance with Subpart 3.07, below.

3.06 ACCESS ROAD SURFACING

- A. The Contractor shall grade access road along the crest of the embankment to the widths and minimum slope inclinations as shown on the Construction Drawings.
- B. Prior to placing aggregate base, the Contractor shall moisten the area to be covered. The area shall be kept moist, but not wet (i.e. no ponding water or saturated soils), until the geotextile and overlying aggregate base is installed.
- C. Geotextile shall be placed prior to aggregate base placement in accordance with Section 02770.
- D. The access road shall be surfaced with 4 inches of aggregate base to the lines and grades shown on the Construction Drawings. Aggregate base shall be as described in Section 2.01 and in locations indicated on the Construction Drawings.
- E. The aggregate base shall be compacted to a minimum of 95 percent relative compaction and within ± 2 percent of the optimum moisture content as determined by ASTM D1557.
- F. After initial compaction, the Contractor shall trim off high spots to within tolerance wherever the finished surface is higher than the specified tolerance. Following trimming, the Contractor shall compact trimmed areas with one complete coverage so the entire layer complies with compaction requirements. Loose material at the surface and tear marks shall not be permitted.

3.07 ENGINEERED AND SELECT FILL

- A. Prior to placing engineered fill, the soil subgrade shall be scarified to a depth of 6 inches and recompact.
- B. Engineered fill and select fill shall be compacted to a minimum of 90 percent relative compaction and -3 percent to +1 percent of optimum moisture percent as measured in accordance with ASTM D1557.

3.08 STOCKPILING

- A. If deemed acceptable for reuse, existing aggregate base material may be stockpiled within the laydown area or an area approved by the Owner. Stockpiles shall be no steeper than 2.5H:1V (Horizontal:Vertical), unless stockpiles are to be created within the East Ash Basin in which case the stockpiles shall be no steeper than 5H:1V, or other slope approved by the Engineer, graded to drain, sealed by tracking parallel to the slope with a dozer or other means approved by the Construction Manager, and dressed daily during periods when fill is taken from the stockpile. The Contractor shall employ temporary erosion and sediment control measures (i.e. silt fence) around stockpile areas in accordance with Construction Drawings.
- B. There are no compaction requirements for temporary stockpiled materials.

3.09 FIELD TESTING

A. The minimum frequency and details of quality control testing are provided below. This testing will be performed by the CQA Consultant. Additional testing may be performed at the discretion of the CQA Consultant, Construction Manager or Owner. The Contractor shall consider this testing frequency when preparing the construction schedule.

1. The CQA Consultant will perform conformance tests on placed and compacted engineered fill, select soil and aggregate base to evaluate compliance with these Specifications. These tests will include in-situ moisture content and dry density. The frequency and procedures for moisture-density testing are provided in the CQA Plan. At a minimum, the dry density and moisture content of the soil will be measured in-situ in accordance with ASTM D6938. The CQA Consultant shall approve the material prior to placement of overlying materials.
2. Increased testing frequencies may be used by the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing will be considered when:
 - a. The rollers slip during rolling operation
 - b. The lift thickness is greater than specified
 - c. The fill is at improper and/or variable moisture content
 - d. Fewer than the specified number of roller passes are made
 - e. Dirt-clogged rollers are used to compact the material
 - f. The rollers do not have optimum ballast
 - g. The degree of compaction is doubtful
3. During construction, the frequency of testing will be increased by the CQA Consultant in the following situations:
 - a. Adverse weather conditions
 - b. Breakdown of equipment
 - c. At the start and finish of grading
 - d. If the material fails to meet specifications
 - e. The Work area is reduced

B. Defective Areas:

1. If a defective area is discovered in the Earthwork, the CQA Consultant will evaluate the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Consultant will 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. The CQA Consultant shall notify the Construction Manager within 1 day of defective area discovery.

2. Once the extent and nature of a defect is determined, the Contractor shall correct the deficiency to the satisfaction of the CQA Consultant and Construction Manager. The Contractor shall not perform additional Work in the area until the CQA Consultant and Construction Manager approve the correction of the defect.
3. Additional testing may be performed by the CQA Consultant to verify that the defect has been corrected. This additional testing will be performed before any additional Work is allowed in the area of deficiency. The cost of the additional testing shall be borne by the Contractor.

3.10 SURVEY CONTROL

- A. The Contractor shall perform all surveys necessary for construction layout and control.
 1. At a minimum, all surfaces should be surveyed on a square grid not wider spaced than 50 ft and shall include additional points for grade breaks (top and toe of slope).

3.11 CONSTRUCTION TOLERANCE

- A. Tolerances for designed thicknesses shown on Construction Drawings and for elevations shown on Construction Drawings are ± 0.10 foot unless otherwise specified.

3.12 AS-BUILT SURVEY

- A. The Contractor shall produce complete electronic as-built Record Drawings in conformance with the requirements set forth in this Section. This electronic file shall be provided to the Construction Manager for verification. Surveys shall be submitted for the following:
 1. Existing topography;
 2. Anchor trench;
 3. Finish grade and limits of the access road;
 4. Final topography.
- A. Record survey shall be performed, at a minimum, at all grade breaks, flow lines, and on a 50-foot grid.

3.13 PROTECTION OF WORK

- A. The Contractor shall use all means necessary to protect completed Work of this Section.
- B. At the end of each day, the Contractor shall verify that the entire Work area is left in a state that promotes drainage of surface water away from the area and from finished Work. If threatening weather conditions are forecast, at a minimum, compacted surfaces shall be seal-rolled to protect finished Work.
- C. In the event of damage to prior Work, the Contractor shall make repairs and replacements to the satisfaction of the Construction Manager, at the expense of the Contractor.

[END OF SECTION]

**SECTION 02770
GEOSYNTHETICS**

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, equipment, and incidentals necessary for the repair of the existing geomembrane and installation of geotextile. The Work shall be carried out as specified herein and in accordance with the Drawings.
- B. The Work shall include, but not be limited to, delivery, storage, and placement of the various geosynthetic components of the project.
- C. The intent is for the Contractor to re-use existing geomembrane by cutting the existing geomembrane in sections to facilitate folding the geomembrane down the slope to allow excavation of the underlying soils. Contractor shall exercise caution while folding geomembrane and excavating soil to not damage the existing geomembrane. Once excavation is complete and the new anchor trench has been excavated, the intent is to pull the sections of geomembrane back up the slope, cut the geomembrane to the appropriate length, and place the geomembrane into the new anchor trench. Vertical cuts in the existing geomembrane, along with other damage, will be repaired with new geomembrane, in accordance with this section.
- D. Geotextile shall be placed beneath the aggregate base surfacing on the embankment crest.
- E. Existing geomembrane shall be repaired/patched as necessary to achieve the lines and grades shown on the Drawings.

1.02 RELATED SECTIONS

Section 02200 – Earthwork

1.03 REFERENCES

- A. Drawings
- B. “Construction Quality Assurance (CQA) Plan, East Ash Basin Slope Modification, Waukegan Generating Station” by Geosyntec, dated June 2016
- C. Latest version of ASTM International (ASTM) standards:
 - ASTM D792 Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
 - ASTM D1004 Standard Test Method for Initial Tear Resistance (Graves Tear) of Plastic Film and Sheeting
 - ASTM D1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
 - ASTM D1505 Standard Test Methods for Density of Plastics by Density-Gradient Technique

- ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics
 - ASTM D4355 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
 - ASTM D4439 Terminology for Geosynthetics
 - ASTM D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - ASTM D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
 - ASTM D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
 - ASTM D5199 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
 - ASTM D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
 - ASTM D5641 Practice for Geomembrane Seam Evaluation by Vacuum Chamber
 - ASTM D5820 Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
 - ASTM D6241 Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products using a 50-mm Probe
 - ASTM D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced using Thermo-Fusion Methods.
 - ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- D. GRI GM9 Cold Weather Seaming of Geomembranes
 - E. GRI GM10 The Stress Crack Resistance of HDPE Geomembrane Sheet
 - F. GRI GM13 Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
 - G. GRI GM19 Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

1.04 WARRANTY

- A. The Geosynthetic Installer shall furnish the Owner with a 1-year written warranty against defects in workmanship. Warranty conditions concerning limits of liability will be evaluated by, and must be acceptable to, the Owner.

1.05 SUBMITTALS

- A. The Contractor shall submit to the Construction Manager, at least 7 days prior to commencement of work, the following information regarding the proposed geomembrane and geotextile:
 - 1. Manufacturer and product name
 - 2. Minimum property values of the proposed geotextile and the corresponding test procedures
 - 3. Minimum property values of the proposed geomembrane and the corresponding test procedures
 - 4. Projected delivery dates
 - 5. List of roll numbers for rolls to be delivered to the Site
- B. Upon completion of the installation, the Contractor shall be responsible for the submission to the Construction Manager of a warranty as specified in Subpart 1.04 of this Section.
- C. Upon completion of the installation of the geomembrane repair, the Contractor shall be responsible for the submission to the Construction Manager of a Record Drawing showing the locations and numbers of repairs.

1.06 QUALITY ASSURANCE

- A. The Contractor shall ensure that the geomembrane and geotextile materials, and installation methods used meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, will be rejected and shall be repaired or replaced by the Contractor.
- B. The Contractor shall be aware of and accommodate all monitoring and conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed Work, will be performed by the CQA Consultant. If non-conformances or other deficiencies are found in the Contractor's materials or completed Work, the Contractor will be required to repair the deficiency or replace the deficient materials, at the expense of the Contractor.

PART 2 – PRODUCTS

2.01 GEOTEXTILE

- A. Geotextile shall be GEOTEX[®] 200ST woven polypropylene manufactured by Propex GeoSolutions or equivalent as approved by the Engineer.
- B. Geotextile suppliers shall furnish materials, which meet or exceed the criteria specified in Table 02770-1 in accordance with the minimum average roll value (MARV), as defined by ASTM D4439.

2.02 GEOMEMBRANE

- A. The geomembrane shall be a 60-mil smooth or textured high density polyethylene (HDPE) geomembrane.
- B. Geomembranes shall be produced in rolls free of holes, blisters, striations, undispersed raw materials, or any sign of contamination by foreign matter.
- C. Resin used in the manufacturing of the geomembrane shall be new, first-quality, virgin polyethylene resin. The addition of reworked polymer (from the manufacturing process) to resin shall be permitted if it does not exceed 2% by weight, contains no encapsulated scrim, and is performed with appropriate cleanliness. The addition of post-consumer resin shall not be permitted.
- D. Geomembrane resin shall be mixed with the specified amount of carbon black. The carbon black shall be pre-blended with the resin.
- E. The geomembrane shall exhibit the minimum physical properties listed in Table 02770-2 (smooth geomembrane) or Table 02770-3 (textured geomembrane). Manufacturer quality control testing shall be performed in accordance with the frequencies presented in Table 02770-2 or 02770-3, accordingly.
- F. The geomembrane shall be a white-surface geomembrane. The white surface shall be installed upwards.
- G. Geomembrane trials seams shall meet the minimum requirements listed in GRI Test Method GM-19, shown in Table 02770-4. Frequency of trial seam testing shall be in accordance with Section 3.05H
- H. Resin used for extrusion welding shall be produced from same resin type as the geomembrane and shall be the same color as the geomembrane surface to be exposed (i.e. white). Physical properties of the welding resin shall be the same as those of the resin used in the geomembrane.

2.03 MANUFACTURING QUALITY CONTROL (MQC)

- A. The geotextile and geomembrane shall be manufactured with MQC procedures that meet or exceed generally accepted industry standards.

2.04 PACKING AND LABELING

- A. Geotextile shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.
- B. Geomembrane and geotextile rolls shall be marked or tagged with the following information:
 - 1. Manufacturer's name
 - 2. Product identification
 - 3. Lot or batch number
 - 4. Roll number

5. Roll dimensions

2.05 TRANSPORTATION, HANDLING, AND STORAGE

- A. The Contractor shall be liable for any damage to the materials incurred prior to and during transportation to the Site.
- B. Handling, unloading, storage, and care of the geomembrane and geotextile prior to and following installation at the Site, is the responsibility of the Contractor and shall be performed in accordance with ASTM D4873.
- C. The geotextile shall be protected from sunlight, puncture, or other damaging or deleterious conditions.
- D. The geomembrane shall be protected from excessive puncture, cutting, or other damaging or deleterious conditions. Any additional storage procedures required by the Geomembrane Manufacturer shall be the Contractor's responsibility.

2.06 EQUIPMENT

- A. The Contractor shall furnish all necessary equipment required to accomplish the installation of the geosynthetics specified herein.

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 described in this Section.
- B. If the Contractor has any concerns regarding the installed work of other Sections or the site, the Construction Manager shall be notified, in writing, prior to commencing the work. Failure to notify the Construction Manager or commencing installation of the geomembrane or geotextile will be construed as the Contractor's acceptance of the related work of all other Sections.

3.02 GEOTEXTILE PLACEMENT

- A. The Contractor shall handle all geotextile in such a manner as to ensure it is not damaged in any way.
- B. All geotextiles shall be deployed in accordance with the Manufacturer's recommendations, standards, and guidelines.
- C. The Contractor shall ballast or anchor all geotextile with sandbags, or equivalent, to prevent wind uplift.
- D. The Contractor shall examine the entire geotextile surface after installation to ensure that no foreign objects are present that may damage the geotextile. The Contractor shall remove any such foreign objects and shall replace any damaged geotextile.
- E. Adjacent geotextile panels shall be overlapped a minimum of 12 inches.

3.03 GEOTEXTILE REPAIR

- A. Holes or tears in the geotextile shall be repaired as follows: A patch made from the same geotextile shall be overlapped a minimum of 12 inches in each direction.

3.04 GEOMEMBRANE PLACEMENT

- A. Cuts to existing geomembrane will be minimized to only those needed to facilitate temporary movement. Horizontal cuts on the side slope will not be allowed. Panel seams shall be installed at an angle of at least 45 degrees from vertical.
- B. The geomembrane shall be weighted with sandbags or the equivalent ballast materials, to prevent movement caused by wind. In case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind uplift of panels.
- C. Geomembrane shall not be placed when the ambient temperature is below 32°F or above 122°F unless otherwise authorized in writing by the Engineer. Geomembrane panels shall be allowed to equilibrate to temperature of adjacent panels prior to seaming.
- D. Geomembrane shall not be placed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of wind speeds greater than 20 mph.
- E. The Contractor shall ensure that:
 - 1. No vehicular traffic is allowed on the geomembrane with the exception of ATV's with a contact pressures less than 6 psi.
 - 2. Equipment used does not damage the geomembrane by handling, trafficking, or leakage of hydrocarbons (i.e., fuels).
 - 3. Personnel working on the geomembrane do not smoke, wear damaging shoes, bring glass onto the geomembrane, or engage in other activities that could damage the geomembrane.
 - 4. The method used to unroll the panels does not scratch or crimp the geomembrane and does not damage the supporting soil or geosynthetics.
 - 5. The geomembrane shall be securely anchored and then rolled in such a manner as to continually keep the geomembrane in tension to preclude folding.
 - 6. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The method used to place the panels results in intimate contact between the geomembrane and adjacent components.
 - 7. The geomembrane is especially protected from damage in heavily trafficked areas.
 - 8. Any field panel or portion thereof that becomes seriously damaged (torn, twisted, or crimped) shall be replaced with new material. Less serious damage to the geomembrane may be repaired, as approved by the Construction Manager and CQA Site Manager. Damaged panels or portions of damaged panels that have been rejected shall be removed from the work area and not reused.
- F. If the Contractor intends to install geomembrane between one hour before sunset and one hour after sunrise, he shall notify the Construction Manager in writing prior to the start of

the work. The Contractor shall indicate additional precautions that shall be taken during these installation hours. The Contractor shall provide proper illumination for work during this time period.

3.05 FIELD SEAMING

A. Seam Layout:

1. In corners and at odd-shaped geometric locations, the number of field seams shall be minimized. No seams shall be located in an area of potential stress concentration.

B. Weather Conditions for Seaming:

1. No seaming shall be attempted below 32°F or above 122°F without approval of the Owner or Owner's Representative.
2. Geomembrane seaming below 32°F, if approved by the Owner or Owner's Representative, shall be performed in accordance with GRI Test Method GM9.
3. Preheating of the geomembrane is not required for temperatures above 32°F.
4. Geomembrane shall be dry and protected from wind.
5. In the event of seaming below 32°F or above 122°F, certify in writing that low-temperature or high-temperature seaming procedures does not cause any physical or chemical modification to geomembrane that will generate any short or long-term damage to geomembrane.

C. Seam Preparation:

1. Prior to seaming, seam shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material.
2. If seam overlap grinding is required, process shall be completed according to the Manufacturer's instructions and in a way not damaging to the geomembrane.
3. Align seams with least possible number of wrinkles and "fish mouths".

D. General Seaming Requirements:

1. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle to achieve a flat overlap, ending the cut with circular cut-out. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is insufficient shall be patched with an oval or round patch of geomembrane that extends a minimum of 6 inches beyond the cut in all directions.
2. Place electric generator on smooth base. Place smooth insulating plate or fabric beneath hot welding apparatus after use. When protective material is in place, sudden stops or starts, sharp turns, and stationary churning of vehicles shall be strictly prohibited. Only use apparatus specifically approved by geomembrane Manufacturer.
3. Use double-track fusion welding for installation seaming wherever possible.
4. Seams shall extend to the top of the anchor trench.

E. Seaming Process:

1. Approved processes for field seaming are fusion welding and extrusion welding. Proposed alternate processes shall be documented and submitted to the Design Engineer and/CQA Engineer for approval prior to use. Extrusion welding shall be restricted to repairs and welding applications not possible by the fusion process.
2. Extrusion Equipment and Procedures:
 - a. The Contractor shall maintain at least one spare operable seaming apparatus on site.
 - b. Extrusion welding apparatuses shall be equipped with gauges giving the temperatures in the apparatuses.
 - c. Prior to beginning an extrusion seam, the extruder shall be purged until all heat-degraded extrudate has been removed from the barrel.
 - d. Grind edges of cross seams to an incline prior to welding.

F. Trial Seams:

1. Trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Trial seams shall be conducted on the same material to be installed and under similar field conditions as production seams. Such trial seams shall be made at the beginning of each seaming period, typically at the beginning of the day and after lunch, for each seaming apparatus used each day, but no less frequently than once every 5 hours. The trial seam sample shall be a minimum of 5 feet long by 1 foot wide (after seaming) with the seam centered lengthwise for fusion equipment and at least 3 feet long by 1 foot wide for extrusion equipment. Seam overlap shall be as indicated in Subpart 3.05.C of this Section.
2. Four coupon specimens, each 1-inch wide, shall be cut from the trial seam sample by the Geosynthetics Installer using a die cutter to ensure precise 1-inch wide coupons. The coupons shall be tested, by the Contractor, with the CQA Site Manager present, in peel (both the outside and inside track for fusion welded seams) and in shear using an electronic readout field tensiometer in accordance with ASTM D 6392, at a strain rate of 2 inches/minute. The samples shall not exhibit failure in the seam, i.e., they shall exhibit a Film Tear Bond (FTB), which is a failure (yield) in the parent material. The required peel and shear seam strength values are listed in Table 02770-4. At no time shall specimens be soaked in water.
3. An additional trial weld shall be performed if a wide change in temperature ($\pm 30^{\circ}\text{F}$), humidity, or wind speed occurs since the previous trial weld.
4. If any coupon specimen fails, the trial seam shall be considered failing and the entire operation shall be repeated. If any of the additional coupon specimens fail, 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.

G. Nondestructive Seam Continuity Testing:

1. The Contractor shall nondestructively test for continuity on all field seams over their full length. Continuity testing shall be carried out as the seaming work progresses, not

at the completion of all field seaming. The Contractor shall complete any required repairs in accordance with Subpart 3.05.I of this Section. The following procedures shall apply:

- a. Vacuum testing in accordance with ASTM D 5641.
- b. Air channel pressure testing for double-track fusion seams in accordance with ASTM D 5820 and the following:
 - i. Insert needle, or other approved pressure feed device, from pressure gauge and inflation device into the air channel at one end of a double track seam.
 - ii. Energize the air pump and inflate air channel to a pressure between 25 and 30 pounds per square inch (psi). Close valve and sustain the pressure for not less than 5 minutes.
 - iii. If loss of pressure exceeds 3 psi over 5 minutes, or if the pressure does not stabilize, locate the faulty area(s) and repair seam in accordance with Subpart 3.05.I of this Section.
 - iv. After 5 minutes, cut the end of air channel opposite from the end with the pressure gauge and observe release of pressure to ensure air channel is not blocked. If the channel does not depressurize, find and repair the portion of the seam containing the blockage per Subpart 3.05.I of this Section. Repeat the air pressure test on the resulting segments of the original seam created by the repair and the ends of the seam. Repeat the process until the entire length of seam has successfully passed pressure testing or contains a repair. Repairs shall also be non-destructively tested per Subpart 3.05.I.5 of this Section.
 - v. Remove needle, or other approved pressure feed device, and seal repair in accordance with Subpart 3.05.I of this Section.

H. Defects and Repairs:

1. The geomembrane will be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Contractor if surface contamination inhibits inspection.
2. At observed suspected flawed location, both in seamed and non-seamed areas, shall be nondestructively tested using the methods described herein. Each location that fails nondestructive testing shall be marked by the CQA Site Manager and repaired by the Contractor.
3. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the CQA Site Manager shall identify all excessive geomembrane wrinkles. The Contractor shall cut and reseam all wrinkles so identified. The seams thus produced shall be tested.
4. Repair Procedures:

- a. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Contractor. Several repair procedures are acceptable. The final decision as to the appropriate repair procedure shall be agreed upon between the Design Engineer and the Contractor. The procedures available include:
 - i. Patching – extrusion welding a patch to repair holes larger than 1/16 inch, tears, undispersed raw materials, and contamination by foreign matter;
 - ii. Abrading and re-seaming – applying an extrusion seam to repair very small sections of faulty extruded seams;
 - iii. Spot seaming – applying an extrusion bead to repair minor, localized flaws such as scratches and scuffs;
 - iv. Capping – extrusion welding a geomembrane cap over long lengths of failed seams; and
 - v. Strip repairing – cutting out bad seams and replacing with a strip of new material seamed into place on both sides with fusion welding.

- b. In addition, the following criteria shall be satisfied:
 - i. Surfaces of the geomembrane that are to be repaired shall be abraded no more than 20 minutes prior to the repair;
 - ii. The grind depth around the repair shall not exceed ten percent of the core geomembrane thickness;
 - iii. All surfaces must be clean and dry at the time of repair;
 - iv. All seaming equipment used in repair procedures must be approved by trial seaming;
 - v. Any other potential repair procedures shall be approved in advance, for the specific repair, by the design engineer;
 - vi. Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches and holes shall be rounded with a radius of at least 3 inches;
 - vii. All ends of wrinkle or relief cuts should be cut to a rounded hole and patched or capped; and
 - viii. Extrudate shall extend a minimum of 3 inches beyond the edge of the patch.
 - ix. Cap strips shall not be installed on top of existing cap strips. In the event that a cap strip is required in proximity to an existing repair, the existing cap strip should be removed and a single new cap strip should be installed over the entire repair area.
 - x.

5. Repair Verification:

- a. Repairs shall be nondestructively tested using the methods described in Subpart 3.05.H of this Section, as appropriate. Repairs that pass nondestructive testing shall be considered acceptable repairs. Repairs that failed nondestructive or destructive testing will require the repair to be reconstructed and retested until passing test results are observed. At the discretion of the CQA Consultant, destructive testing may be required on any caps.

3.06 PROTECTION OF WORK

- A. The Contractor shall protect all Work of this Section.
- B. In the event of damage, the Contractor shall make repairs and replacements to the satisfaction of the CQA Consultant at the expense of the Contractor.

**TABLE 02770-1
WOVEN GEOTEXTILE PROPERTIES**

Properties	Test Method	Manufacturer QC Test Frequency	Required Test Values
Grab Strength (min. avg.)	ASTM D4632	1 per 100,000 sf	200 lbs
Puncture Strength (min. avg.)	ASTM D6241	1 per 100,000 sf	700 lbs
UV Resistance	ASTM D4355	1 per resin formulation	70% ⁽¹⁾

Notes: (1) After 500 hours of exposure.

TABLE 02770-2
60-MIL SMOOTH HDPE GEOMEMBRANE PROPERTIES

Properties	Test Method	Manufacturer QC Test Frequency	Required Test Values ⁽⁹⁾
Thickness (min. avg.) • Lowest individual of 10 values	ASTM D5199	1 per Roll	54 mil
Density (min ave.)	ASTM D792 or ASTM D1505	1 per 200,000 lb	0.940 g/cc
Tensile Properties ⁽¹⁾ (min. avg.) • Yield strength • Break strength • Yield elongation • Break elongation	ASTM D6693 Type IV	1 per 20,000 lb	126 lb/in 228 lb/in 12% 700%
Tear Resistance (min. avg.)	ASTM D1004 Die C	1 per 45,000 lb	42 lbs
Puncture Resistance (min. avg.)	ASTM D4833	1 per 45,000 lb	108 lbs
Stress Crack Resistance ⁽²⁾	ASTM D5397 (App.)	Per GRI-GM10	500 hr
Carbon Black Content	ASTM D4218	1 per 20,000 lb	2.0-3.0%
Carbon Black Dispersion	ASTM D5596	1 per 45,000 lb	Note 3
Oxidative Induction Time (OIT) ⁽⁴⁾ (a) Standard OIT (min avg.) or (b) High Pressure OIT (min avg.)	ASTM D3895 ASTM D5885	1 per 200,000 lb	100 400
Oven Aging at 85°C ⁽⁴⁾⁽⁵⁾ (a) Standard OIT (min avg.) or (b) High Pressure OIT (min avg.)	ASTM D5721 ASTM D3895 ASTM D5885	1 per Formulation	55% retained after 90d 80% retained after 90d
UV Resistance ⁽⁶⁾ (a) Standard OIT (min avg.) or (b) High Pressure OIT (min avg.) ⁽⁸⁾	ASTM D7238 ASTM D3895 ASTM D5885	1 per Formulation	N.R. (7) 50% retained after 1600 hrs

Notes:

- (1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Yield elongation is calculated using a gage length of 1.3 inches
- Break elongation is calculated using a gage length of 2.0 inches
- (2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQA testing.
- (3) Carbon black dispersion (only near spherical agglomerates) for 10 different views. 9 in Categories 1 or 2 and 1 in Category 3.
- (4) The manufacturer has the option to select either one of the OIT methods listed to evaluation the antioxidant content in the geomembrane.
- (5) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
- (6) The condition of the test should be 20hr. UV cycle at 75 °C followed by 4 hr. condensation at 60°C.
- (7) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed sample.
- (8) UV resistance is based on percent retained value regardless of the original HP-OIT value.
- (9) Based on GRI GM13, Rev. 14, 1/6/16

**TABLE 02770-3
60-MIL TEXTURED HDPE GEOMEMBRANE PROPERTIES**

Properties	Test Method	Manufacturer QC Test Frequency	Required Test Values⁽⁹⁾
Thickness (min. avg.) <ul style="list-style-type: none"> • Lowest individual for 8 out of 10 values • Lowest individual for any of the 10 values 	ASTM D5199	1 per Roll	57 mil 54 mil 51 mil
Asperity Height (min. avg.)	ASTM D7466	Every 2 nd Roll	16 mil
Density (min ave.)	ASTM D792 or ASTM D1505	1 per 200,000 lb	0.940 g/cc
Tensile Properties ⁽¹⁾ (min. avg.) <ul style="list-style-type: none"> • Yield strength • Break strength • Yield elongation • Break elongation 	ASTM D6693 Type IV	1 per 20,000 lb	126 lb/in 90 lb/in 12% 100%
Tear Resistance (min. avg.)	ASTM D1004 Die C	1 per 45,000 lb	42 lbs
Puncture Resistance (min. avg.)	ASTM D4833	1 per 45,000 lb	90 lbs
Stress Crack Resistance ⁽²⁾	ASTM D5397 (App.)	Per GRI-GM10	500 hr
Carbon Black Content	ASTM D4218	1 per 20,000 lb	2.0-3.0%
Carbon Black Dispersion	ASTM D5596	1 per 45,000 lb	Note 3
Oxidative Induction Time (OIT) ⁽⁴⁾ <p>(c) Standard OIT (min avg.) or (d) High Pressure OIT (min avg.)</p>	ASTM D3895 ASTM D5885	1 per 200,000 lb	100 400
Oven Aging at 85°C ⁽⁴⁾⁽⁵⁾ <p>(c) Standard OIT (min avg.) or (d) High Pressure OIT (min avg.)</p>	ASTM D5721 ASTM D3895 ASTM D5885	1 per Formulation	55% retained after 90d 80% retained after 90d
UV Resistance ⁽⁶⁾ <p>(c) Standard OIT (min avg.), or (d) High Pressure OIT (min avg.)⁽⁸⁾</p>	ASTM D7238 ASTM D3895 ASTM D5885	1 per Formulation	N.R. (7) 50% retained after 1600 hrs

Notes:

- (10) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
 - Yield elongation is calculated using a gage length of 1.3 inches
 - Break elongation is calculated using a gage length of 2.0 inches
- (11) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQA testing.
- (12) Carbon black dispersion (only near spherical agglomerates) for 10 different views. 9 in Categories 1 or 2 and 1 in Category 3.
- (13) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- (14) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
- (15) The condition of the test should be 20hr. UV cycle at 75 °C followed by 4 hr. condensation at 60°C.
- (16) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed sample.
- (17) UV resistance is based on percent retained value regardless of the original HP-OIT value.
- (18) Based on GRI GM13, Rev. 14, 1/6/16

**TABLE 02770-4
MINIMUM 60-MIL HDPE SEAM PROPERTIES**

Property	Qualifier	Unit	Specified Value⁽¹⁾	Test Method
Shear Strength (at yield point)	Minimum	lb./in. width	120	ASTM D6392
Peel Adhesion Fusion	Minimum	lb./in. width	91	ASTM D6392
Peel Adhesion Extrusion	Minimum	lb./in. width	78	ASTM D6392

(1) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values

[END OF SECTION]