

CLOSURE PLAN

CFR 257.102(b)

Fly Ash Reservoir 1 Landfill
Cardinal Plant
Brilliant, Ohio

September, 2016

Prepared for: Cardinal Operating Company - Cardinal Plant
Brilliant, Ohio

Prepared by: Geotechnical Engineering Services
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215

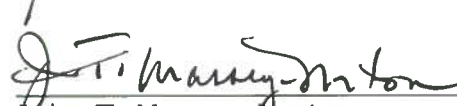


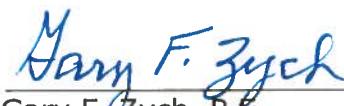
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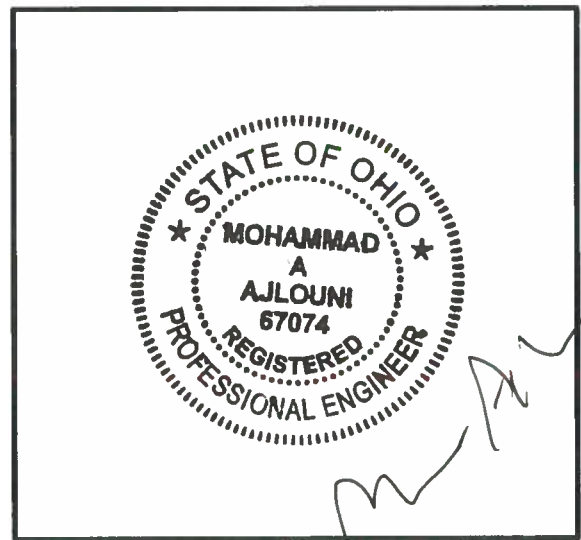
CLOSURE PLAN
CFR 257.102(b)
FLY ASH RESERVOIR FAR1 LANDFILL
CARDINAL PLANT

GERs-16-064

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Gary F. Zych, P.E.
Manager – AEP Geotechnical Engineering



I certify to the best of my knowledge, information, and belief that the information contained in this closure plan meets the requirements of 40 CFR § 257.102

I certify to the best of my knowledge, information and belief that design of the final cover system as described in this closure plan meets the requirements of 40 CFR § 257.102.

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1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.102(b) for Closure Plans of CCR units.

2.0 DESCRIPTION OF THE CCR UNIT

The Cardinal Fly Ash Reservoir 1 (FAR 1) Residual Solid Waste Landfill is located in Jefferson County, Brilliant, Ohio. The landfill is owned by Buckeye Power and AEP Generation Resources (GENCO) a unit of American Electric Power. The landfill is operated by Cardinal Operating Company-Cardinal Plant. Cardinal Landfill is being constructed under Permit To Install (PTI) No. 06-07993, issued on May 11, 2007. The Cardinal Power Plant in Wells Township, Jefferson County, near the town of Brilliant in eastern Ohio.

The 127 acre landfill consists of two phases and six cells. Phase 1 overlies the bench area between the FAR 1 impoundment and the highwall and consists of Cells 1 and 2 in addition to Cell 3. Phase 2 will be developed over the FAR 1 impoundment (except for Cell 3) and consists of Cells 4 – 6.

The FAR 1 landfill receives gypsum from the plant via trucks.

3.0 DESCRIPTION OF CLOSURE PLAN 257.102(b)(1)(i)

[A narrative description of how the CCR unit will be closed in accordance with this section]

The FAR 1 Landfill will be closed by closure in place. The FAR 1 Landfill will be closed periodically during the life of the facility. The closure activities are further discussed in the OEPA-approved Closure Plan in Attachment A. This Plan in Attachment A contains all of the pertinent information and requirements of Section 257.102 (b).

4.0 CLOSURE IN PLACE 257.102 (b)(1)(iii)

[If closure of the CCR unit will be accomplished by leaving the CCR in place, a description of the final cover system, designed in accordance with paragraph(d) of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section.]

4.1 CLOSURE PERFORMANCE STANDARDS 257.102 (d)(1)

4.1.1 SECTION 257.102(d)(1)(i)

[Control, minimize or eliminate, the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.]

The final cover system is designed to minimize infiltration into the landfill.

4.1.2 SECTION 257.102(d)(1)(ii)

[Preclude the probability of future impoundment of water, sediment, or slurry.]

The final surface areas will be graded to a minimum slope of 2% to prevent the ponding of surface water runoff. Drainage features will be designed to have positive drainage.

4.1.3 SECTION 257.102(d)(1)(iii)

[Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period.]

The final cover system will be graded with side slopes with a minimum of 2% slope and a maximum 3:1 slope with channels provided to drain stormwater. The final configuration of the facility will meet the stability requirements to prevent the sloughing or movement of the final cover system during the closure and post-closure care period.

4.1.4 SECTION 257.102(d)(1)(iv)

[Minimize the need for further maintenance of the CCR unit.]

The facility will be vegetated to prevent erosion. Maintenance of the final cover system will include mowing.

4.1.5 SECTION 257.102(d)(1)(v)

[Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.]

The CCR unit will be closed in a timeframe consistent with recognized and generally accepted good engineering practices. As the fill reaches the approved final grades, periodic closure activities may occur.

4.2 DRAINING AND STABILIZING OF THE SURFACE IMPOUNDMENT

257.102(d)(2)

[The owner or operator of a CCR surface impoundment of any lateral expansion of a CCR surface impoundment must meet the requirements of paragraph (d)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (d)(3) of this section.]

This section is not applicable to a landfill.

4.3 FINAL COVER SYSTEM 257.102 (d)(3)

[If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (d)(3)(i) of this section, or the requirements of the alternative final cover system specified in paragraph (d)(3)(ii) of this section.]

The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan.]

The final cover system as described in Attachment A meets the requirements of the referenced paragraphs.

5.0 ESTIMATE OF MAXIMUM CCR VOLUME 257.102 (b)(1)(iv)

[An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.]

The estimated maximum CCR volume ever on-site is approximately 18,943,000 yd³.

6.0 ESTIMATE OF LARGEST AREA OF CCR REQUIRING COVER 257.102 (b)(1)(v)

[An estimate of the largest area of CCR unit ever requiring a final cover

The largest area of the CCR unit ever requiring a final cover is 30 acres.

7.0 CLOSURE SCHEDULE 257.102(b)(1)(vi)

[A schedule for completing all activities necessary to satisfy the closure criteria in the section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of the CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of the CCR unit closure.

At this time, the facility will close upon retirement of the power plant. Once the CCR unit requires closure a schedule to satisfy this section will be prepared and the Plan amended.

ATTACHMENT A

Closure Plan from approved landfill permit

Final Closure/Post-Closure Plan

OAC 3745-30-05 (C)(9)(d)/OAC 3745-30-09

**PERMIT-TO-INSTALL APPLICATION
CARDINAL FAR 1 RESIDUAL WASTE LANDFILL FACILITY**

VOLUME 5

Submitted to

Ohio Environmental Protection Agency

Submitted and Owned by

Cardinal Operating Company
Brilliant, Ohio

Prepared by

American Electric Power Service Corporation
1 Riverside Plaza, Columbus Ohio 43215

and

GeoSyntec Consultants
55 West Wacker Drive, Suite 1100
Chicago, Illinois 60601

May 2006

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Appendix B	Draft Financial Insurance Instrument

LIST OF ACRONYMS

BAT	Best Available Technology
EPA	Environmental Protection Agency
FAD	Fly Ash Dam
FAR	Fly Ash Reservoir
FGD	Flue Gas Desulfurization
HDPE	High Density Polyethylene
OAC	Ohio Administrative Code
QA/QC	Quality Assurance/Quality Control
RSB	Recompacted Soil Barrier
RSL	Recompacted Soil Liner
RWL	Residual Waste Landfill

1. INTRODUCTION

This residual waste facility Final Closure/Post-Closure Plan presents information for the closure and post-closure operations of the Cardinal Operating Company's Fly Ash Reservoir 1 (FAR 1) Residual Waste Landfill (RWL) Facility pursuant to Ohio Administrative Code (OAC) 3745-30-09 and OAC 3745-30-10. Drawings referenced herein are presented in the accompanying Permit-to-Install (PTI) drawing set.

2. FACILITY LOCATION

The Cardinal FAR 1 Residual Waste Landfill (RWL) is located approximately 1.5 miles north of the Cardinal Plant electrical generating facility located near the town of Brilliant in Wells Township, Jefferson County, Ohio. More specifically, the RWL is located approximately 6,500 feet northeast of the intersection of Riddles Run Road (Township Road 163) and Township Road 164.

3. VARIANCES/EXEMPTIONS

At this time Cardinal Operating Company has not requested any variance or exemptions to the requirements specified in OAC 3745-30-09 or OAC 3745-30-10, for residual waste landfills.

4. FACILITY CONTACTS

Any questions regarding the FAR 1 RWL during the final closure and post-closure care period should be directed to:

American Electric Power
Waste Management and Mitigation Services Manager
1 Riverside Plaza
Columbus, Ohio 43215
Ph. (614) 716-1266

or

Cardinal FAR 1
Landfill Manager
306 County Road 7E
Brilliant, Ohio 43913
Ph. (740) 598-6540

5. PLANS AND DETAIL DRAWINGS

The plans showing the horizontal limits and top elevations of the waste, the cover system, and the surface water control structures are shown on Drawings 4K, 4M and 4N, respectively. Drawing 4N, the stormwater management plan, shows the permanent stormwater run-on and run-off controls and as well as FAR 2 (which receives treated leachate, as necessary, and non-contact stormwater from the FAR 1 RWL). Detail drawings of the RWL stormwater controls are included on Drawings 7D and 7E. The detail drawings of the cover system are included on Drawing 7F.

6. STATIC AND SEISMIC STABILITY ANALYSIS

The static and seismic stability analyses for the proposed completed landfill are provided in the *Stability Analysis Report* (Volume 3).

All factor of safety values calculated exceed the required minimum values of 1.50 for static conditions and 1.00 for seismic conditions, which are provided in OAC 3745-30-07(C)(11)(c) and OAC 3745-30-07(C)(11)(d) respectively, indicating that the proposed RWL is stable with respect to static and seismic conditions.

7. GROUNDWATER MONITORING PLAN

The *Groundwater Monitoring Plan* is included in Volume 1.

8. FINANCIAL ASSURANCE

Cardinal Operating Company will annually review, adjust and submit final closure and post-closure care cost estimates for the Cardinal FAR 1 RWL in accordance with OAC 3745-30-14(E)(14). The corporate guarantee will be used annually to demonstrate financial assurance for final closure and post-closure care. A draft copy of the financial assurance instrument is included in Appendix B.

The placement of final cover soils constitutes the most significant portion of final closure costs. Although the 127 acre footprint RWL will eventually be closed, the closure costs, as presented in this document, are based on the cost of closing the site at the time the largest area would require closure. The largest closure area would be approximately 53 acres and would occur after the completion of Phase 1 (Cells 1 and 2). The primary RWL closure components include placement and testing of the recompact soil barrier (RSB), placement of the vegetative layer and establishing a vegetative cover, installing stormwater controls and implementing erosion control measures. As summarized in Table 1, the final closure costs for the Cardinal FAR 1 RWL are estimated to be \$8,172,280. Supporting cost estimate calculations are included in Appendix A.

Post-closure care activities will begin following closure certification and will continue for 15 years. Post-closure care components will consist primarily of monitoring (groundwater, surface water and leachate) and maintenance (cover system, leachate and surface water control systems, monitoring wells and access controls). As summarized in Table 2, the total post-closure care costs for the FAR 1 RWL are estimated to be \$4,353,120. Supporting cost estimate calculations are included in Appendix A.

9. CLAY RESOURCES

The clay resources for the Cardinal FAR 1 RWL will be supplied from company owned borrow areas within a ten-mile radius of the landfill facility. It is anticipated that adequate resources will be available to satisfy the needs of the RWL through final closure and the post-closure care period. It is estimated that 489,961 cubic yards of RSB material and 604,370 cubic yards of cover soil would be required to construct a final cover system of the residual waste landfill over 165 acres of sloped and unsloped surfaces, including the extended cap over FAR 1 areas not within the limits of waste.

10. QUALITY ASSURANCE/QUALITY CONTROL PLAN

The *Quality Assurance and Quality Control Plan* is included in Volume 5. Section 5.7 of the *Quality Assurance and Quality Control Plan* addresses the material qualification, test pad construction, and material placement specifications to ensure that the cover system is constructed in a manner consistent with the performance standards established in OAC 3745-30.

11. EROSION CONTROL

Erosion and sediment control procedures are detailed on Drawings 7D, 7E and 7F. As indicated on Drawing 7E, soil erosion and sediment control practices will be implemented pursuant to the Ohio Rainwater and Land Development Manual and erosion and sediment controls will be maintained until construction is completed and/or the area is stabilized (i.e. vegetation is established). Supporting stormwater/surface water calculations are included in Volume 4.

12. MANDATORY CLOSURE CONDITIONS/NOTIFICATIONS

Final Closure will be completed in a manner that minimizes the need for maintenance activities. Final Closure will be initiated when one of the following conditions have occurred:

1. Cardinal Operating Company declares that no more residual waste will be accepted at the facility;
2. The facility's solid waste license has expired and another license has not been applied for;
3. All approved limits of waste placement have been reached;
4. The facility's solid waste license has expired and another license has been applied for and denied as a final action;
5. The facility's solid waste license has been revoked as a final action; or
6. The facility's solid waste license has been suspended as a final action.

Cardinal Operating Company will provide written notice by certified mail to Ohio EPA, the Jefferson County General Health District and the Belmont/Jefferson Regional Solid Waste Authority at least ninety (90) days in advance of commencing final closure if initiated by condition numbers 1, 2, or 3 above. Any changes to the information that identifies the facility's contact person will be provided to the Ohio EPA in writing by certified mail at least thirty (30) days prior to commencing final closure. Within seven (7) days of the date that the facility actually ceases to accept waste, written notice by certified mail will be provided to the Ohio EPA and the Jefferson County General Health District, informing the agency of the actual date.

13. FINAL CLOSURE ACTIVITIES

Final closure activities will begin within seven days of the date that the facility has ceased to accept waste. Final closure activities include:

1. Constructing the final cover system;
2. Establishing vegetative cover;
3. Constructing and maintaining drainage and erosion/sediment controls;
4. Operating and maintaining treatment and monitoring systems;
5. Securing the facility; and
6. Closure certification and deed notation.

The primary closure activity is the placement of the cover system that will consist of a minimum two (2) foot thick low permeable RSB and thirty (30) inches of soil to protect the RSB from freeze/thaw cycles and support a vegetative cover. The material used to construct the RSB will be qualified, placed and tested in accordance with the approved *Quality Assurance/Quality Control Plan* (Volume 5). The final grades of the completed cover system are shown on Drawing 4M. With the exception of the benches the cover system will have minimum slopes of five (5) percent and maximum slopes of thirty-three (33) percent to minimize the potential for standing water.

The final cover system will be constructed in a progressive manner with additional areas being completed in most years. As outer slopes reach final waste grades, the final cover system will be constructed on these areas during the summer/early fall months and seeded.

Benches, ditches and culverts will be constructed and maintained to efficiently collect and convey surface water run-off to FAR 2. Temporary sediment and erosion control measures will be installed, as necessary, until a dense vegetative cover is established. Surface water control structures will be inspected routinely to monitor erosion or blockage of flow.

The RWL's security will be maintained during the closure and post-closure period unless the facility is to be used for other purposes as deemed acceptable by the Ohio EPA. Access will be maintained to all active monitoring sites throughout the post-closure care period.

All final closure activities will be completed with one (1) year of the date that the facility ceased accepting waste unless an alternative schedule has been approved by the Ohio EPA. Within ninety (90) days of completing final closure activities, the final closure certification report will be submitted to the Ohio EPA and will include:

1. Documentation on the construction of the final cover system;
2. A topographic map of the closed facility showing the information specified in OAC 3745-30-09(H)(1);
3. Documentation on the groundwater monitoring system;
4. A copy of the plat and deed notation filed with the County Recorder; and

5. Documentation that the facility is protected from unauthorized access.

14. POST-CLOSURE CARE ACTIVITIES

Post-closure care activities will begin upon submittal of the final closure certification and will continue for a period of fifteen (15) years unless shortened or extended in accordance with OAC 3745-30-10(B). Post-closure care activities will include:

1. Continued operation and maintenance of the leachate management system, the stormwater/surface water management system and the groundwater monitoring program;
2. Maintenance of the final cover system;
3. Monitoring for leachate outbreaks and implementing remedial actions as necessary;
4. Fulfilling all inspection, monitoring, and reporting requirements; and
5. Submitting a post-closure care certification

Inspections of the closed RWL facility will be conducted quarterly throughout the post-closure care period. A written summary of the inspection will be submitted to the Ohio EPA within fifteen (15) days of conducting the inspection. The inspection report will document the nature and extent of any problem areas identified, as well as provide an estimated starting and completion date for required corrective measures to be taken.

The leachate and stormwater/surface water management systems, including piping, ditches, berms, and culverts, will be inspected for erosion, ponding, blockage of flow, sediment accumulation, and other evidence of improper performance. Discharge structures associated with FAR 2 will also be inspected to ensure operational performance.

Groundwater monitoring well locks, casing protectors and surface seals will be visually inspected during each sampling event and any unusual operational problems will be described in the groundwater reports submitted to the Ohio EPA.

The final cover system will be inspected for evidence of ponding, settlement and erosion, as well as damage caused by burrowing animals. Any damaged areas will be repaired by replacing the materials and restoring the site to final grade. If a condition reoccurs or persists, an investigation will be conducted to determine if a more permanent solution is warranted. Any permanent corrective measures that involve revisions to the facility's authorizing documents will be submitted to the Ohio EPA for review.

The condition of the vegetative cover will be evaluated (i.e. thickness, bare spots, invasive woody species) during each inspection. Corrective actions such as reseeding, fertilizing and selective herbicide applications will be implemented as necessary. Maintenance mowing will be conducted as necessary to discourage woody plant growth and to maintain the appearance and health of the vegetation.

In addition to the quarterly inspection reports, the facility will continue to monitor and report stormwater/surface water discharges during the post-closure care period in accordance with the facility's NPDES permit. It is anticipated that groundwater monitoring and reporting will continue on a semiannual basis. An annual report will be submitted containing a summary of the quantity of leachate generated, characteristics of the leachate and treatment received. The annual report will also update post-closure cost estimates.

Upon completion of the post-closure care period, a written certification will be prepared and submitted to the Ohio EPA with supporting documentation that all post-closure care activities have been completed in accordance with OAC 3745-30-10(D). The certification will be signed and sealed by a professional engineer registered in Ohio.

Table 1
Closure Cost Summary

Final Closure/Post-Closure Plan
Permit-to-Install Application
Cardinal FAR 1 Residual Waste Landfill Facility

Closure Component	Cost
Cap System Components	\$ 6,146,300
Permanent Surface Water Structures	\$ 255,600
Site Access Control	\$ 257,000
Engineering (QA/QC)	\$ 130,500
Subtotal of Closure Costs	\$ 6,789,400
Administration 10 % of subtotal:	\$ 678,940
Certification of Closure	\$ 25,000
Contingency 10 % of subtotal:	\$ 678,940
TOTAL COST OF CLOSURE	\$ 8,172,280

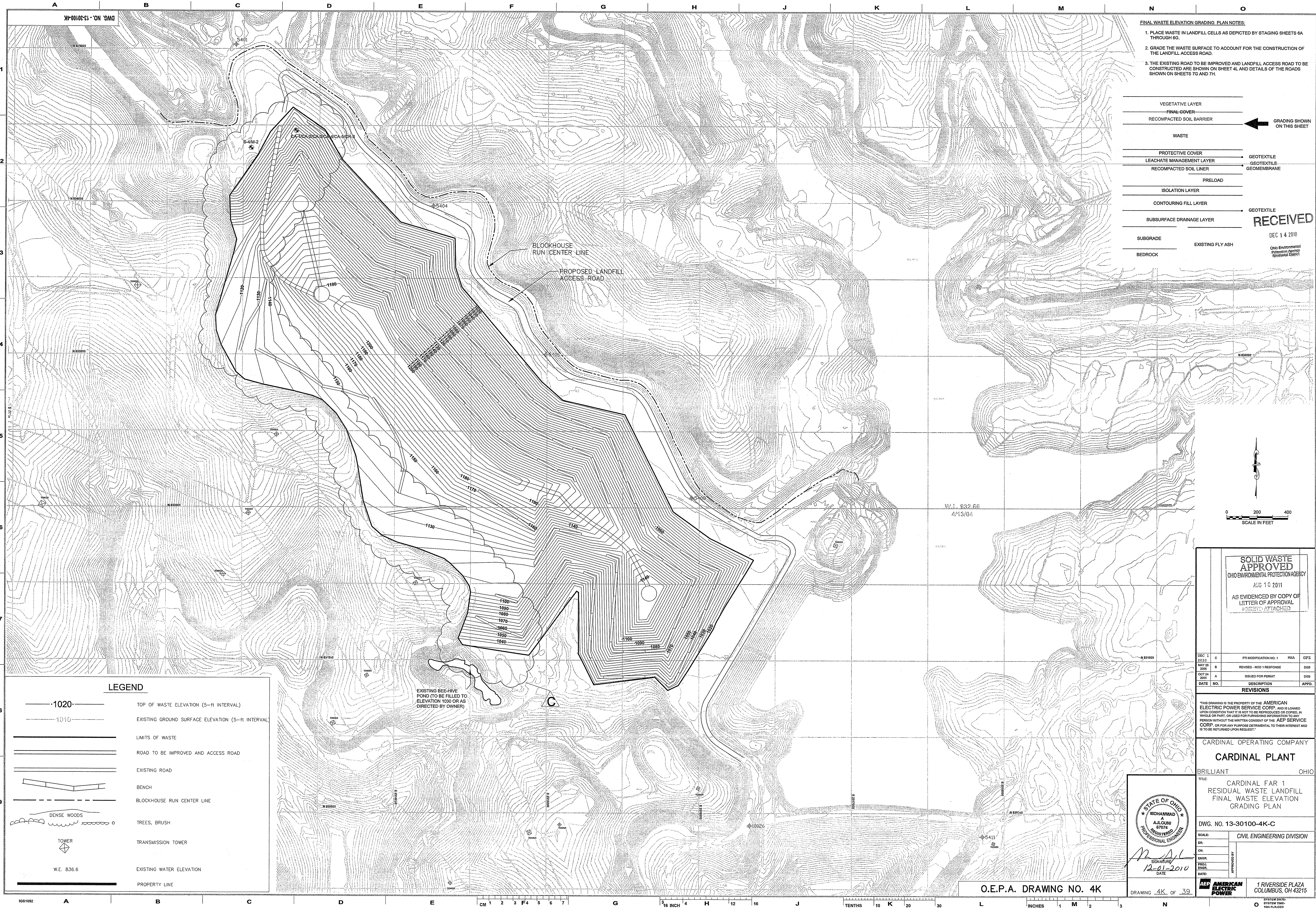
NA = Not Applicable

Table 2
Post-Closure Care Cost Summary

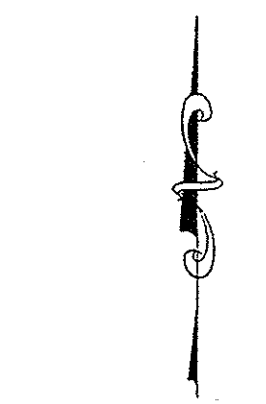
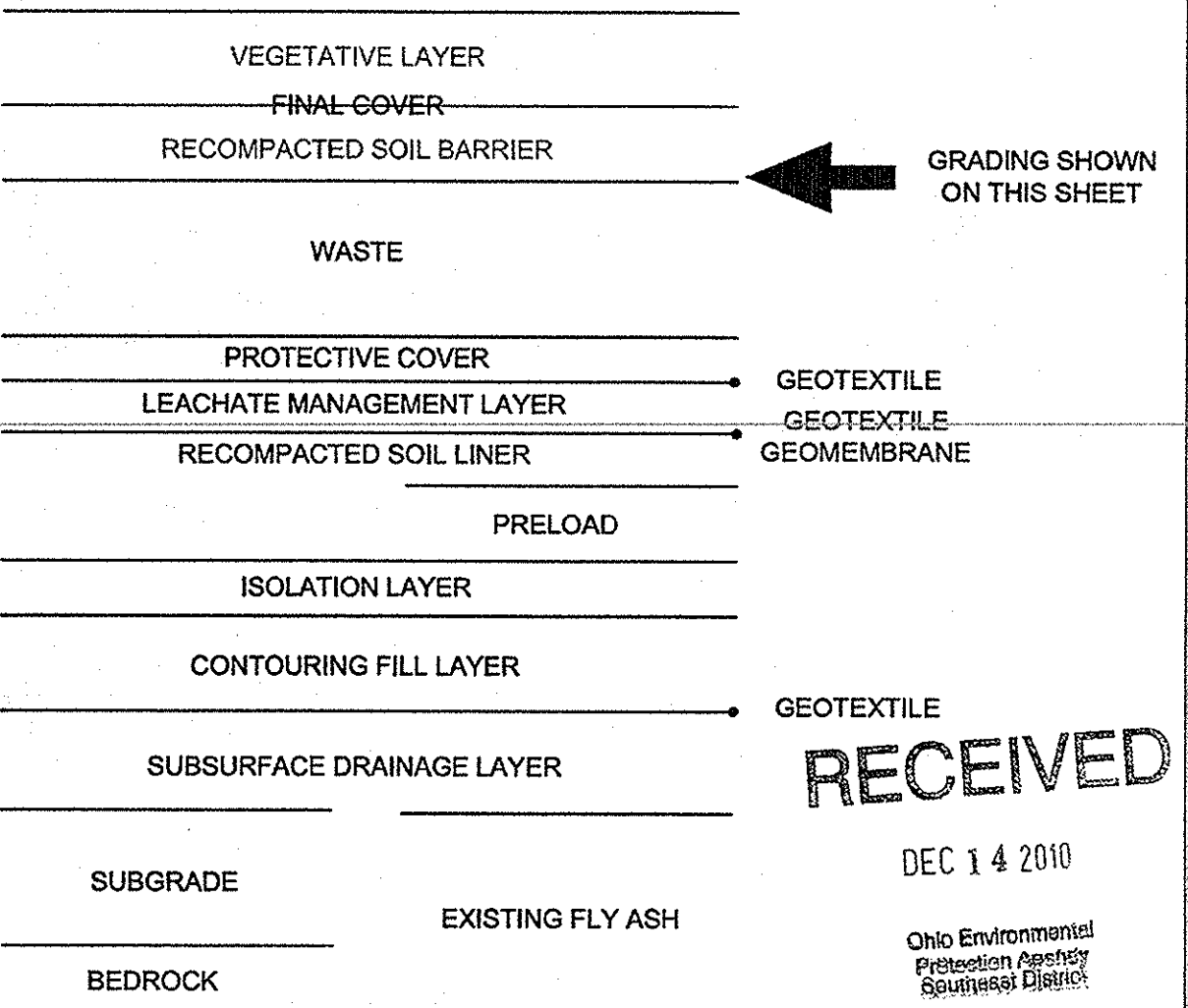
Final Closure/Post-Closure Plan
Permit-to-Install Application
Cardinal FAR 1 Residual Waste Landfill Facility

Post-Closure Care Component	Cost
Ground Water Monitoring	\$ 42,920
Leachate Monitoring	\$ 365
Surface Water Monitoring	\$ 365
Operation and Maintenance of Leachate Collection / Treatment Systems	\$ 10,000
Operation, Maintenance and Abandonment of Ground Water Monitoring Wells	\$ 11,433
Maintenance of Cover System	\$ 90,750
Operation and Maintenance of Surface Water Management System	\$ 18,000
Operation and Maintenance of Access Control Structures	\$ 57,000
Subtotal of Annual Post-Closure Care Costs	\$ 230,833
Subtotal of 15 Years of Post-Closure Care Costs	\$ 3,462,495
Administration 10 % of subtotal:	\$ 346,250
Final Certification Upon Completion of Post-Closure Care Period	\$ 25,000
Remedial Costs 15 % of subtotal:	\$ 519,375
TOTAL COST OF POST CLOSURE CARE	\$ 4,353,120

NA = Not Applicable



- FINAL WASTE ELEVATION GRADING PLAN NOTES:**
1. PLACE WASTE IN LANDFILL CELLS AS DEPICTED BY STAGING SHEETS 6A THROUGH 6G.
 2. GRADE THE WASTE SURFACE TO ACCOUNT FOR THE CONSTRUCTION OF THE LANDFILL ACCESS ROAD.
 3. THE EXISTING ROAD TO BE IMPROVED AND LANDFILL ACCESS ROAD TO BE CONSTRUCTED ARE SHOWN ON SHEET 4L AND DETAILS OF THE ROADS SHOWN ON SHEETS 7G AND 7H.



0 200 400
SCALE IN FEET

SOLID WASTE APPROVED
OHIO ENVIRONMENTAL PROTECTION AGENCY
AUG 10 2011
AS EVIDENCED BY COPY OF
LETTER OF APPROVAL
HEREIN ATTACHED

DEC 14 2010	C	PTI MODIFICATION NO. 1	MAA	GP2
MAY 25 2009	B	REVISED - NOO 1 RESPONSE		DOB
OCT 24 2009	A	ISSUED FOR PERMIT		DOB
DATE	NO.	DESCRIPTION		APPD.

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE: **CARDINAL FAR 1
RESIDUAL WASTE LANDFILL
FINAL WASTE ELEVATION
GRADING PLAN**

DWG. NO. 13-30100-4K-C

SCALE: **CIVIL ENGINEERING DIVISION**

DR: **MOHAMMAD A. ALLOUNI**
OR: **67074**
ENGR: **REGISTERED PROFESSIONAL ENGINEER**

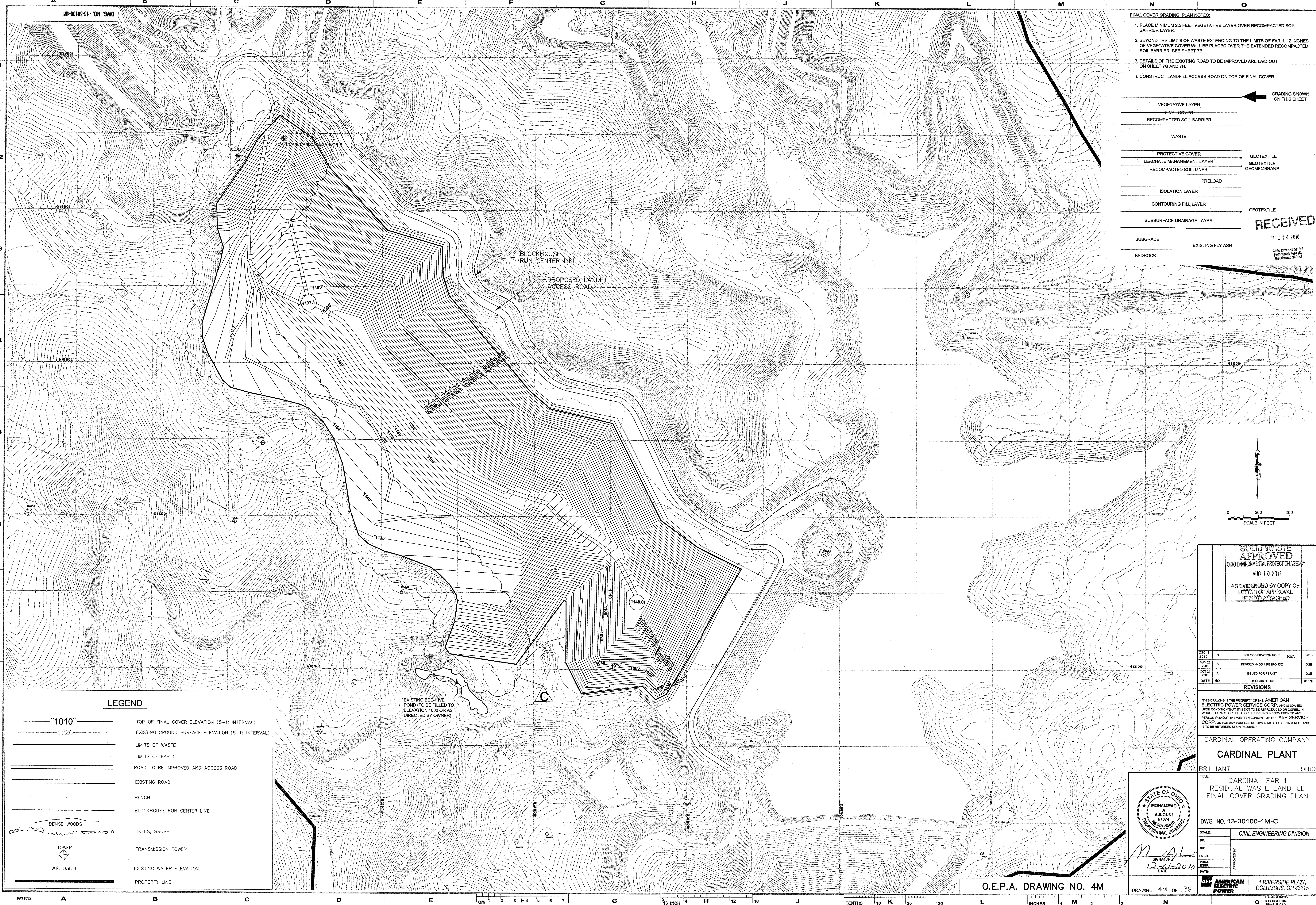
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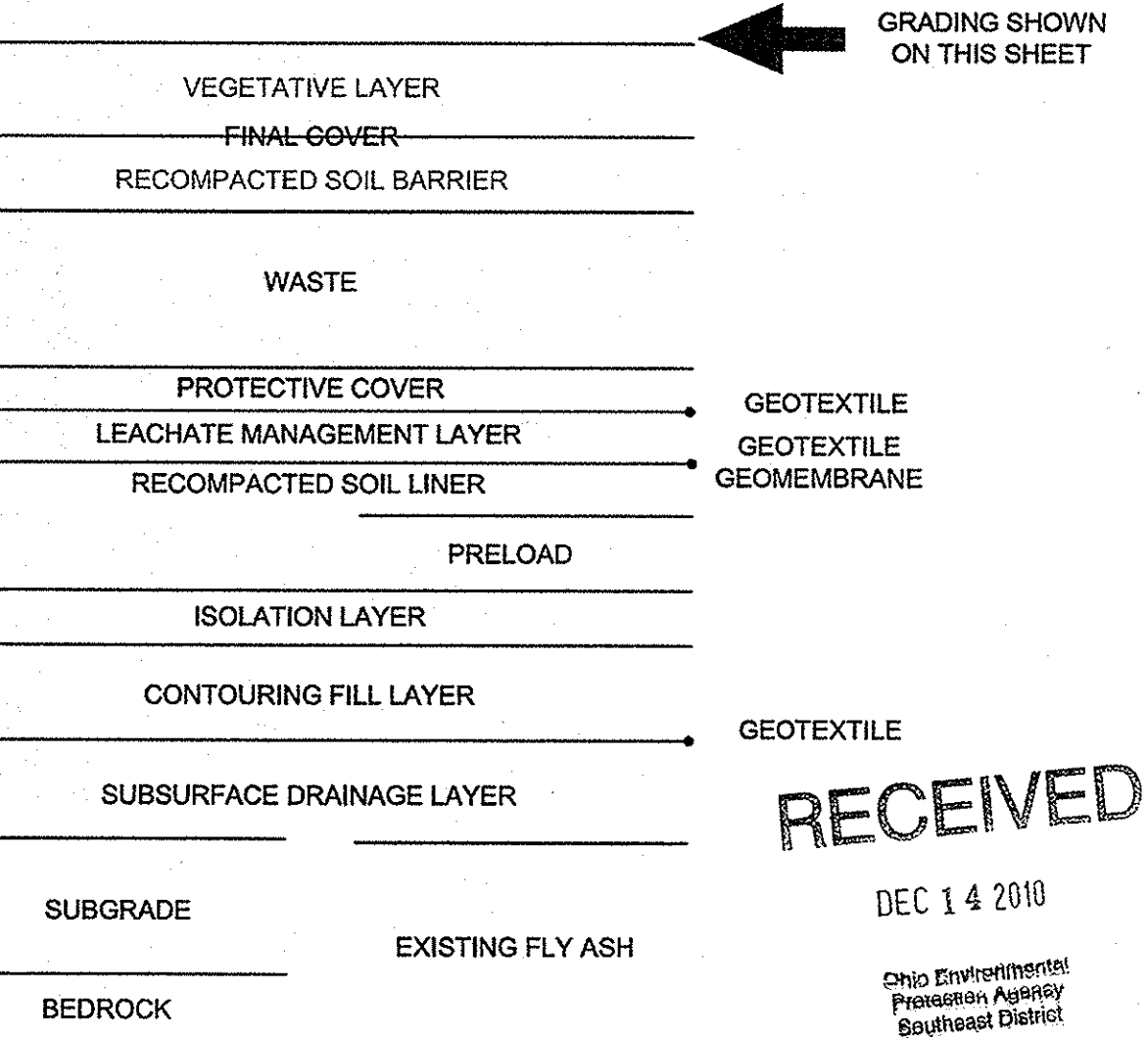
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

O.E.P.A. DRAWING NO. 4K

DRAWING 4K OF 39



- FINAL COVER GRADING PLAN NOTES:**
1. PLACE MINIMUM 2.5 FEET VEGETATIVE LAYER OVER RECOMPACTED SOIL BARRIER LAYER.
 2. BEYOND THE LIMITS OF WASTE EXTENDING TO THE LIMITS OF FAR 1, 12 INCHES OF VEGETATIVE COVER WILL BE PLACED OVER THE EXTENDED RECOMPACTED SOIL BARRIER. SEE SHEET 7B.
 3. DETAILS OF THE EXISTING ROAD TO BE IMPROVED ARE LAID OUT ON SHEET 7G AND 7H.
 4. CONSTRUCT LANDFILL ACCESS ROAD ON TOP OF FINAL COVER.



LEGEND

1010
1020

TOP OF FINAL COVER ELEVATION (5'-ft INTERVAL)
EXISTING GROUND SURFACE ELEVATION (5'-ft INTERVAL)
LIMITS OF WASTE
LIMITS OF FAR 1
ROAD TO BE IMPROVED AND ACCESS ROAD
EXISTING ROAD
BENCH
BLOCKHOUSE RUN CENTER LINE
DENSE WOODS
TREES, BRUSH
TRANSMISSION TOWER
EXISTING WATER ELEVATION
PROPERTY LINE

SOLID WASTE APPROVED
OHIO ENVIRONMENTAL PROTECTION AGENCY
AUG 10 2011
AS EVIDENCED BY COPY OF
LETTER OF APPROVAL
HEREIN ATTACHED

DATE	NO.	DESCRIPTION	APPROVED
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OCT 24 2005	A	ISSUED FOR PERMIT	DGR

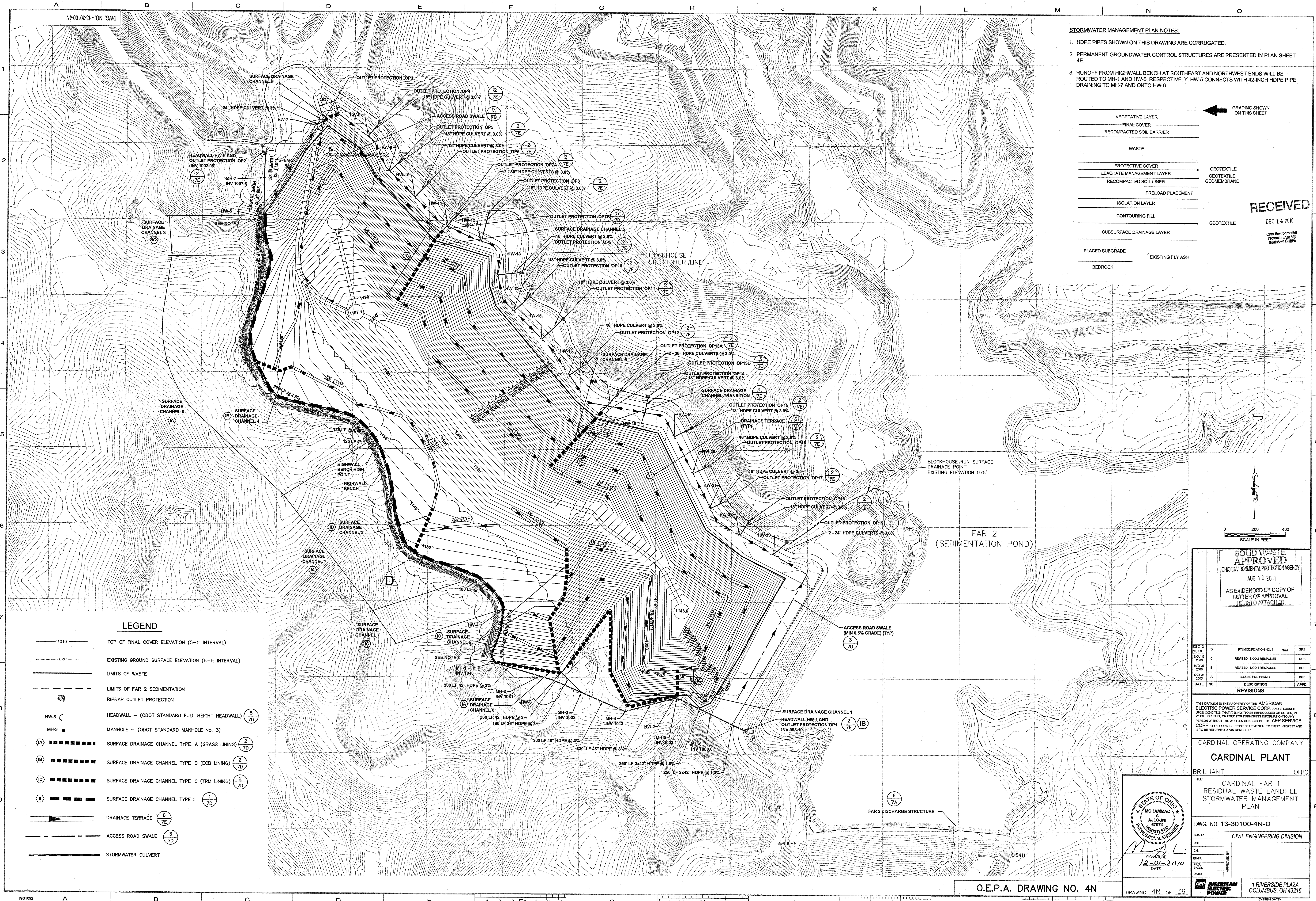
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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO
TITLE: CARDINAL FAR 1
RESIDUAL WASTE LANDFILL
FINAL COVER GRADING PLAN

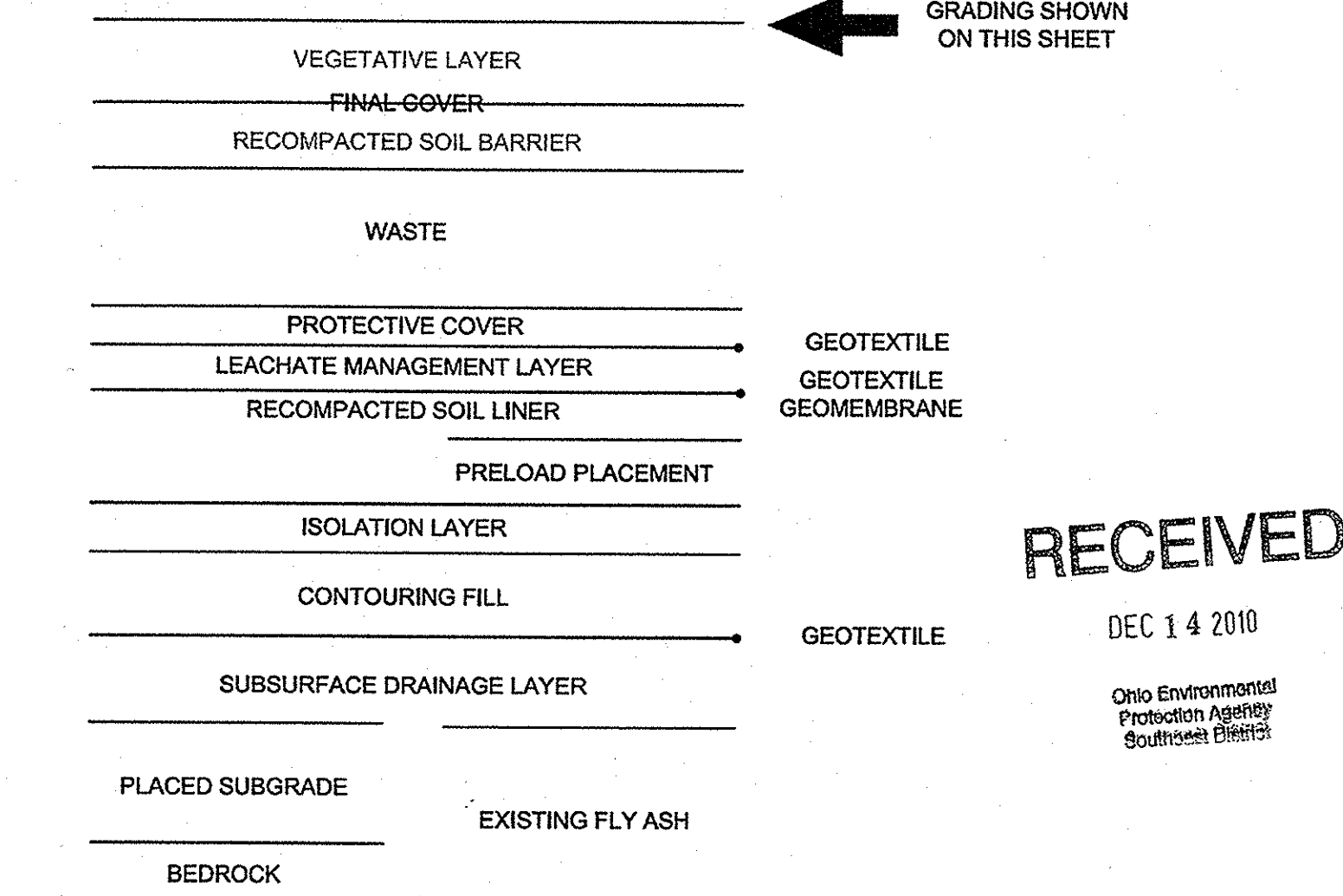
STATE OF OHIO
REGISTERED PROFESSIONAL ENGINEER
MOHAMMAD A. ALJOUNI
67074
SIGNATURE
12-01-2010
DATE

O.E.P.A. DRAWING NO. 4M

DWG. NO. 13-30100-4M-C
CIVIL ENGINEERING DIVISION
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

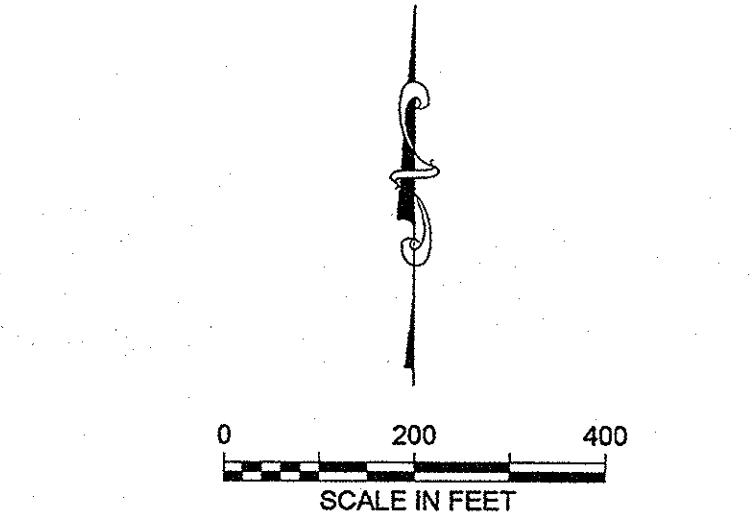


- STORMWATER MANAGEMENT PLAN NOTES:**
1. HDPE PIPES SHOWN ON THIS DRAWING ARE CORRUGATED.
 2. PERMANENT GROUNDWATER CONTROL STRUCTURES ARE PRESENTED IN PLAN SHEET 4E.
 3. RUNOFF FROM HIGHWALL BENCH AT SOUTHEAST AND NORTHWEST ENDS WILL BE ROUTED TO MH-1 AND HW-5, RESPECTIVELY. HW-5 CONNECTS WITH 42-INCH HDPE PIPE DRAINING TO MH-7 AND ONTO HW-6.



LEGEND

- 1010' TOP OF FINAL COVER ELEVATION (5-ft INTERVAL)
- 1020' EXISTING GROUND SURFACE ELEVATION (5-ft INTERVAL)
- LIMITS OF WASTE
- LIMITS OF FAR 2 SEDIMENTATION
- RIPRAP OUTLET PROTECTION
- HW-6 HEADWALL - (ODOT STANDARD FULL HEIGHT HEADWALL)
- MH-3 MANHOLE - (ODOT STANDARD MANHOLE No. 3)
- (IA) SURFACE DRAINAGE CHANNEL TYPE IA (GRASS LINING)
- (IB) SURFACE DRAINAGE CHANNEL TYPE IB (ECB LINING)
- (IC) SURFACE DRAINAGE CHANNEL TYPE IC (TRM LINING)
- (II) SURFACE DRAINAGE CHANNEL TYPE II
- DRAINAGE TERRACE
- ACCESS ROAD SWALE
- STORMWATER CULVERT



SOLID WASTE APPROVED
OHIO ENVIRONMENTAL PROTECTION AGENCY
AUG 10 2011
AS EVIDENCED BY COPY OF
LETTER OF APPROVAL
HERETO ATTACHED

DATE	NO.	DESCRIPTION	APPROVED
DEC 1 2010	D	PTI MODIFICATION NO. 1	N/A
NOV 17 2008	C	REVISED - NOD 2 RESPONSE	DGB
MAY 25 2007	B	REVISED - NOD 1 RESPONSE	DGB
OCT 24 2005	A	ISSUED FOR PERMIT	DGB

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE: CARDINAL FAR 1
RESIDUAL WASTE LANDFILL
STORMWATER MANAGEMENT PLAN

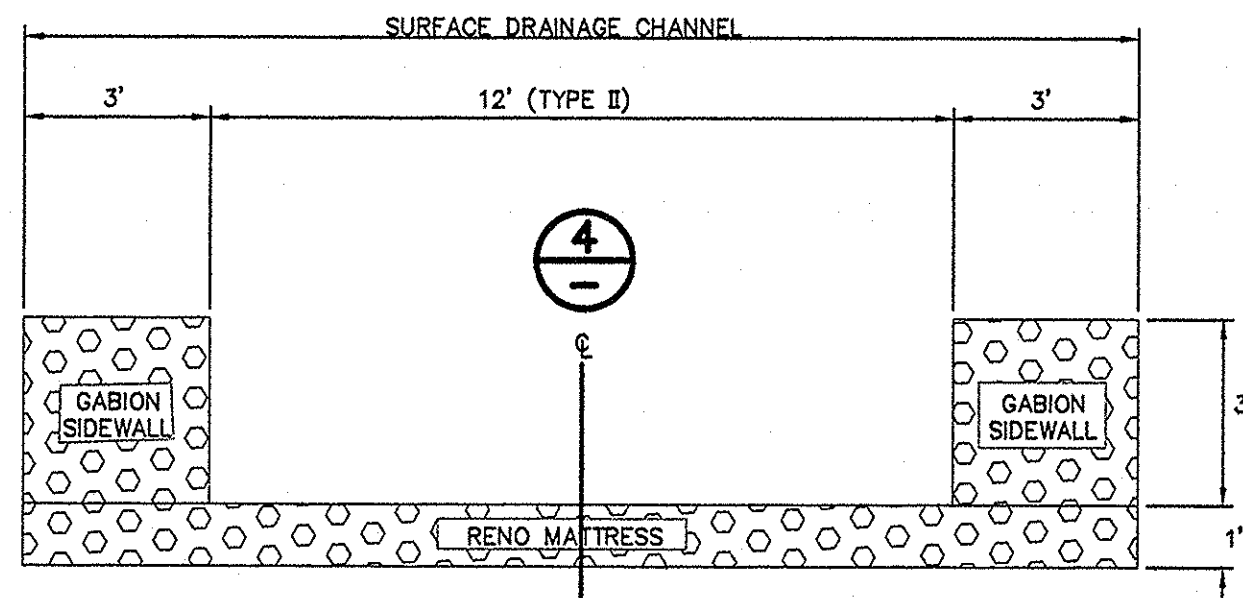
DWG. NO. 13-30100-4N-D
CIVIL ENGINEERING DIVISION

STATE OF OHIO
MOHAMMAD A. ALJOUNI
REGISTERED PROFESSIONAL ENGINEER
12-01-2010
DATE

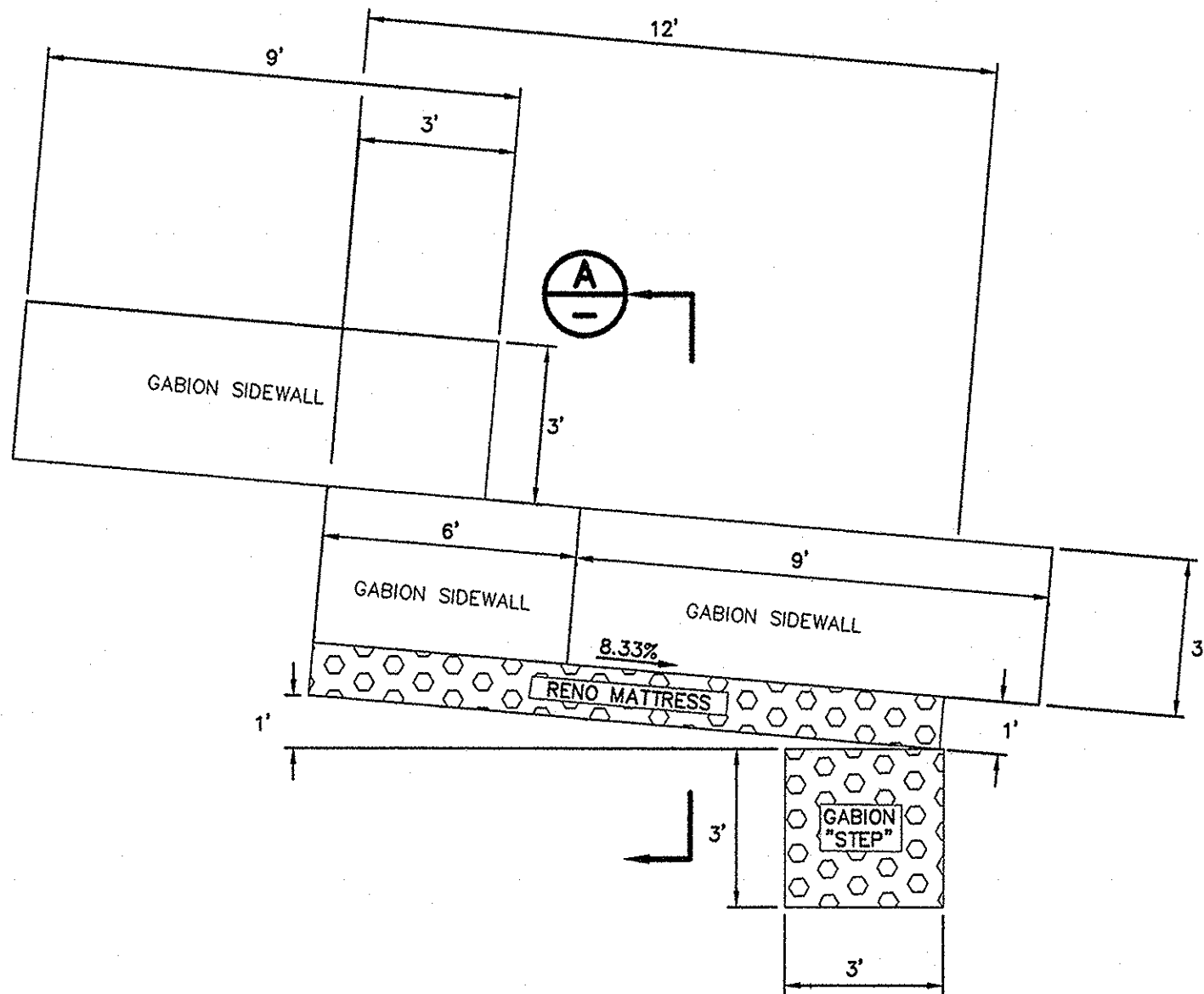
O.E.P.A. DRAWING NO. 4N

DRAWING 4N OF 39
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

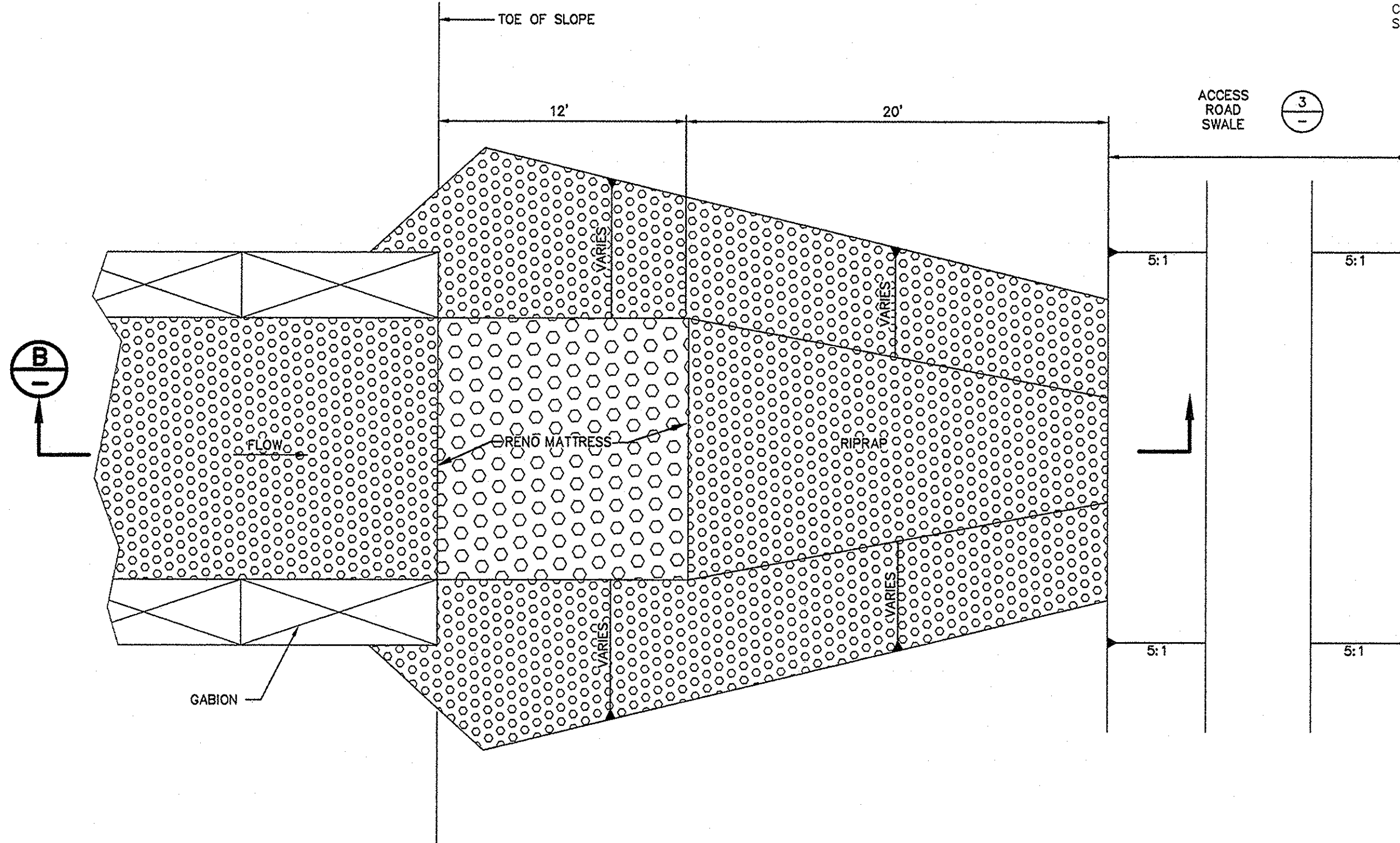
- NOTES:
- GABION BASKETS AND RENO MATTRESSES SHALL CONFORM TO ASTM A-975, STYLE
 - EROSION CONTROL BLANKET (ECB) SHALL BE NORTH AMERICAN GREEN S150, CURLEX II STITCHED, OR APPROVED EQUIVALENT. TURF REINFORCEMENT MAT (TRM) SHALL BE NORTH AMERICAN GREEN P350, LANDLOK TRM 450, OR APPROVED EQUAL



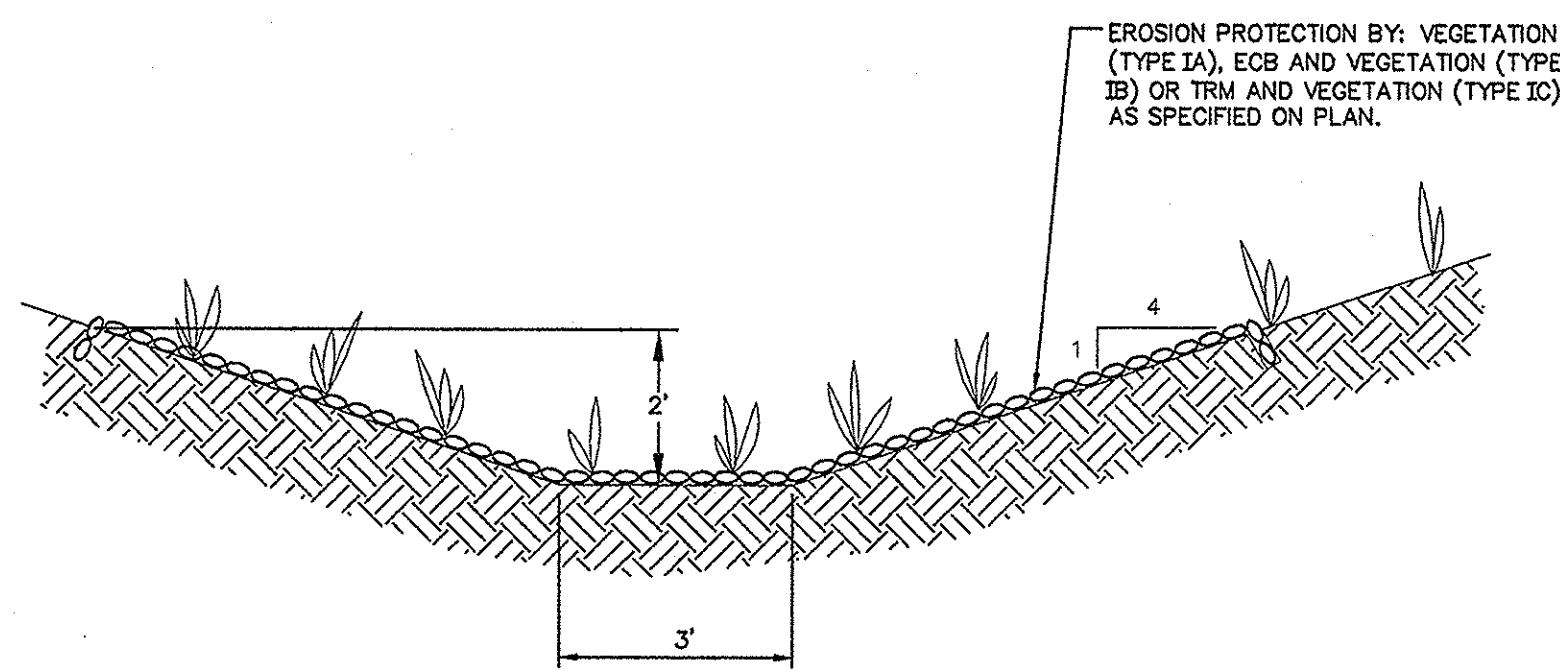
1
4N DETAIL
SURFACE DRAINAGE CHANNEL TYPE II
SCALE: NTS
(SEE NOTE 1 AND DETAIL 4 ON THIS SHEET)



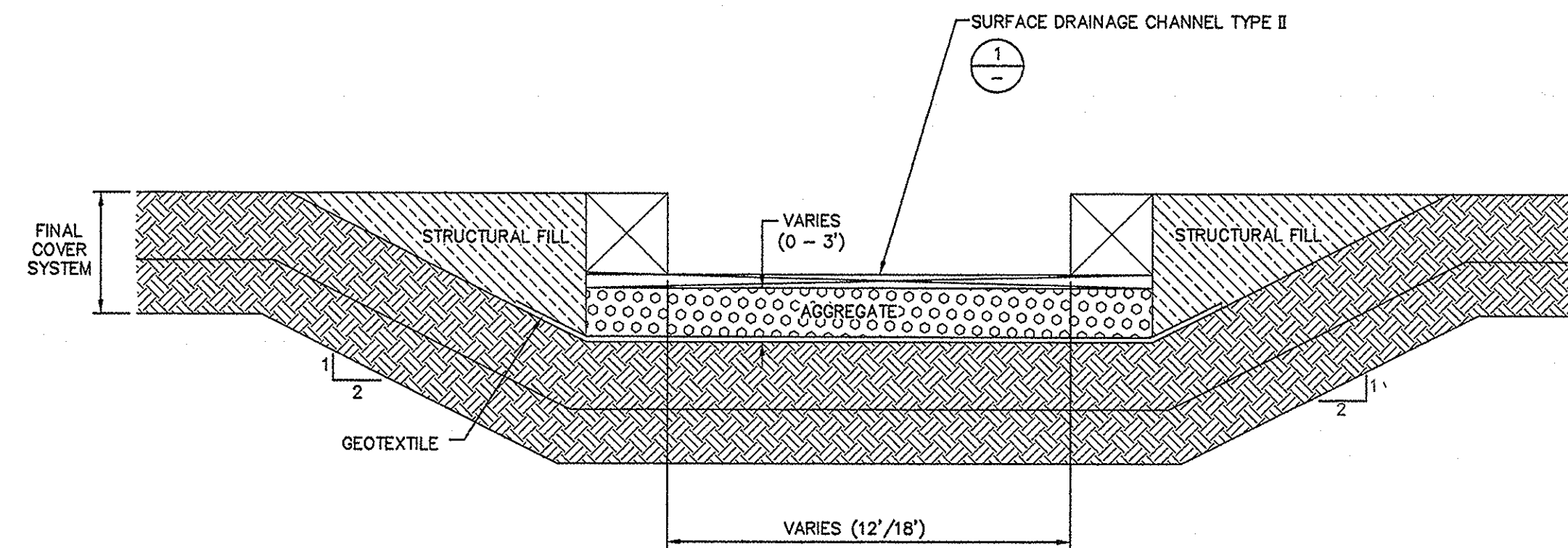
4
4N PROFILE
SURFACE DRAINAGE CHANNEL
SCALE: NTS
(SEE NOTE 1)



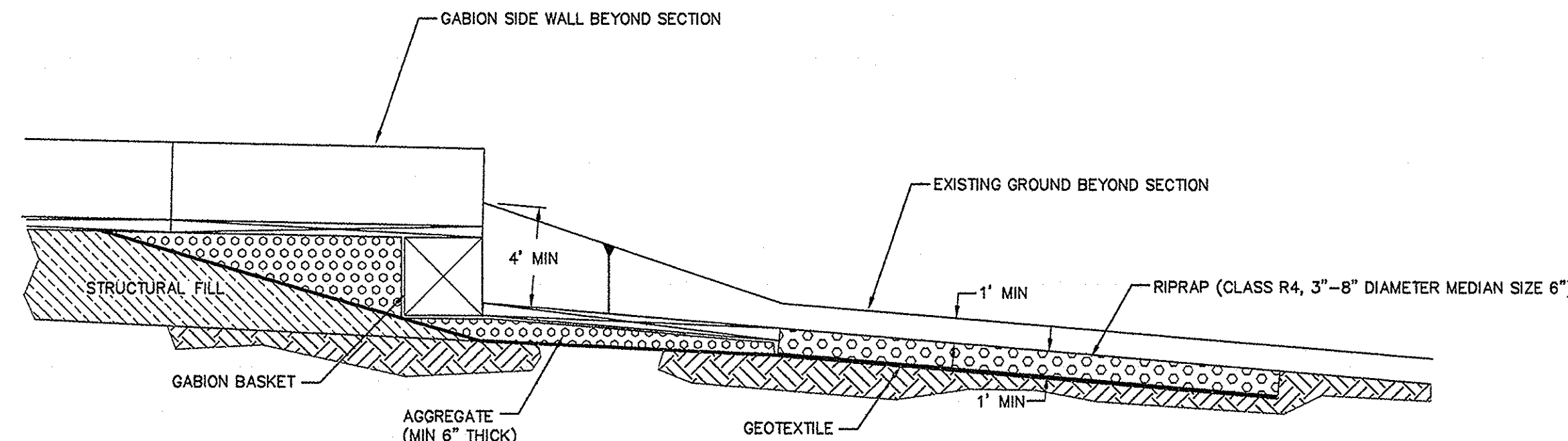
5
4N PLAN
OUTLET PROTECTION
SCALE: NTS
(SEE NOTE 1)



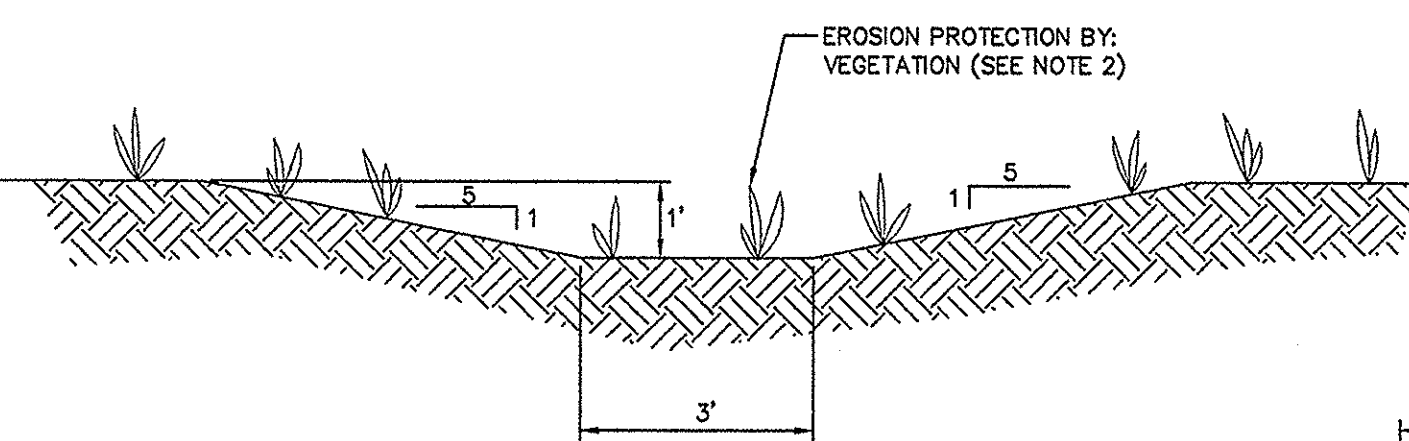
2
4N DETAIL (TYP)
SURFACE DRAINAGE CHANNEL TYPE IA/IB/IC
SCALE: NTS
(SEE NOTE 2)



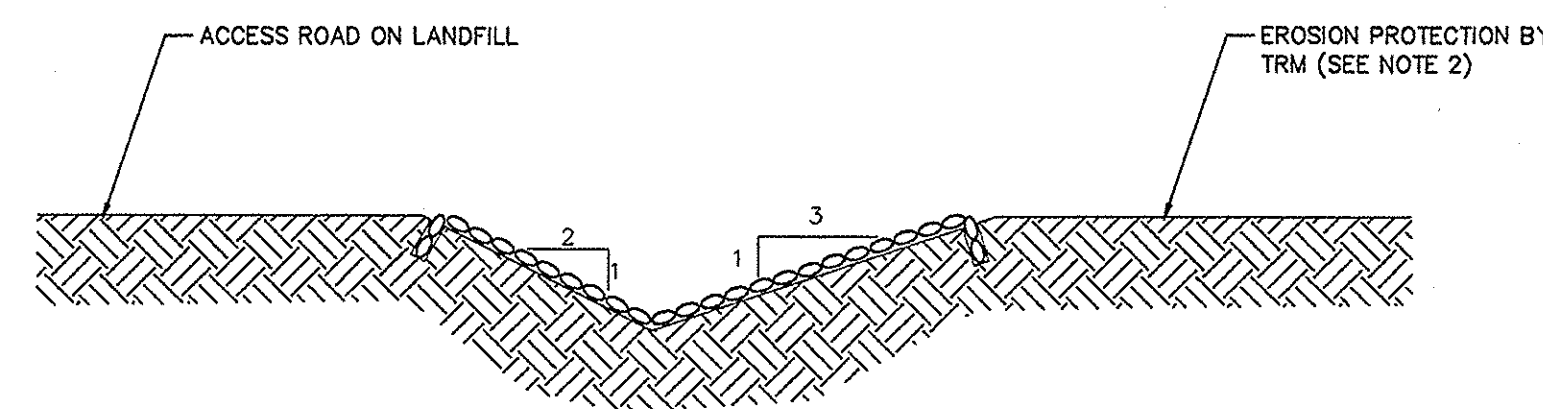
A
4N SECTION
SURFACE DRAINAGE CHANNEL TYPE II
SCALE: NTS
(SEE NOTE 1)



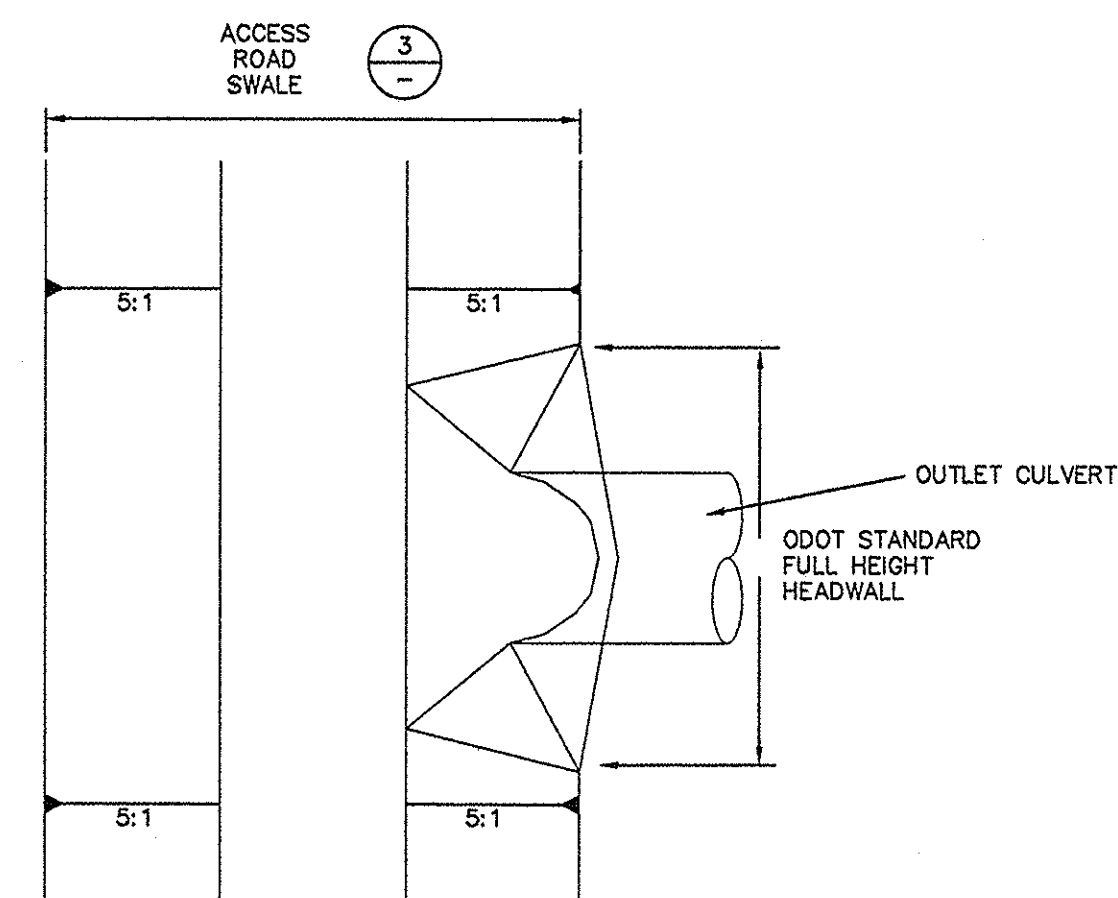
B
4N SECTION
TRANSITION
SCALE: NTS
(SEE NOTE 1)



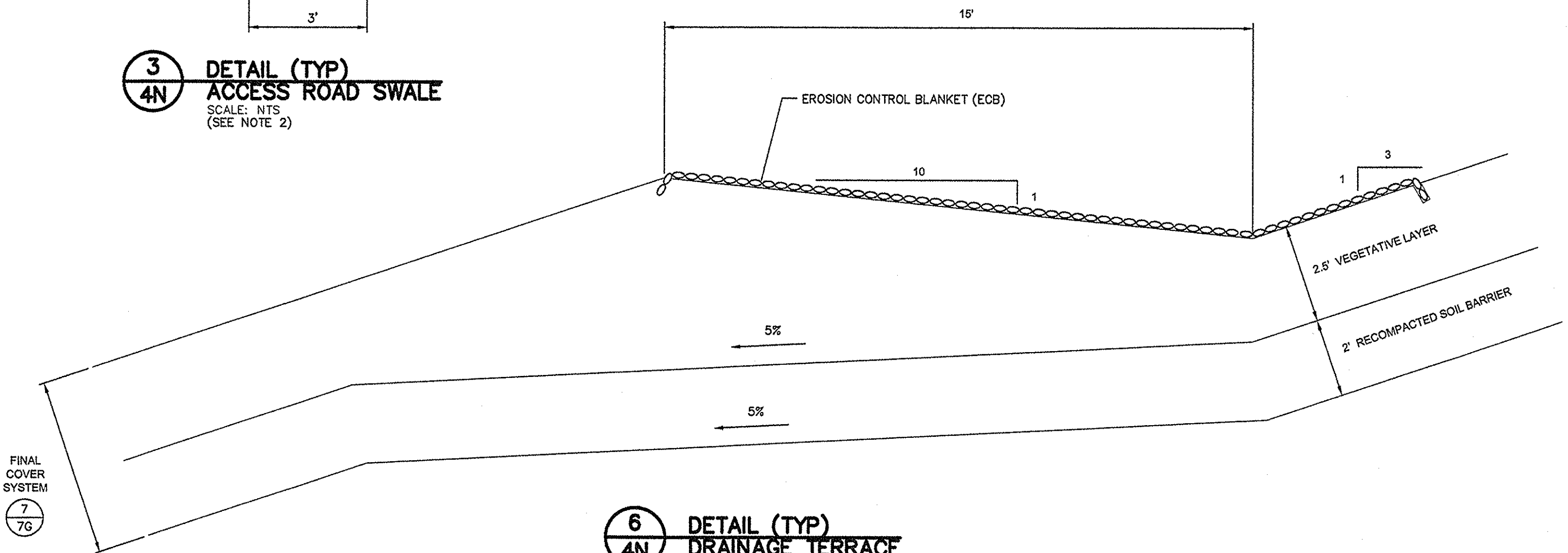
3
4N DETAIL (TYP)
ACCESS ROAD SWALE
SCALE: NTS
(SEE NOTE 2)



7
4N DETAIL (TYP)
ACCESS ROAD SWALE
SCALE: NTS
(SEE NOTE 2)



8
4N PLAN (TYP)
ACCESS ROAD SWALE CULVERT
SCALE: NTS



6
4N DETAIL (TYP)
DRAINAGE TERRACE
SCALE: NTS
(SEE NOTE 2)

SOLID WASTE
APPROVED
OHIO ENVIRONMENTAL PROTECTION AGENCY
MAY 11 2007
AS EVIDENCED BY COPY OF
LETTER OF APPROVAL
HERE TO ATTACHED

RECEIVED			
MAY 11 2007			
Ohio Environmental Protection Agency Southeast District			
MAY 29 2005	B	REVISED - NOD 1 RESPONSE	DGB
OCT 24 2005	A	ISSUED FOR PERMIT	DGB
DATE	NO.	DESCRIPTION	APPD.
REVISIONS			
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CARDINAL OPERATING COMPANY			
CARDINAL PLANT			
BRILLIANT OHIO			
TITLE: CARDINAL FAR 1 RESIDUAL WASTE LANDFILL EROSION AND SEDIMENT CONTROL /STORMWATER CONTROL ELEMENTS I			
DWG. NO. 13-30100-7D-B			
SCALE: CIVIL ENGINEERING DIVISION			
DR: [Signature]			
CH: [Signature]			
ENGR: [Signature]			
PROJ. ENGR: [Signature]			
DATE: 12/13/06			
PROJECT NO. 13-30100-7D-B			
FILE NO. 13-30100-7D-B			
DRAWING 7D OF 39			
O.E.P.A. DRAWING NO. 7D			
1 RIVERSIDE PLAZA COLUMBUS, OH 43215			

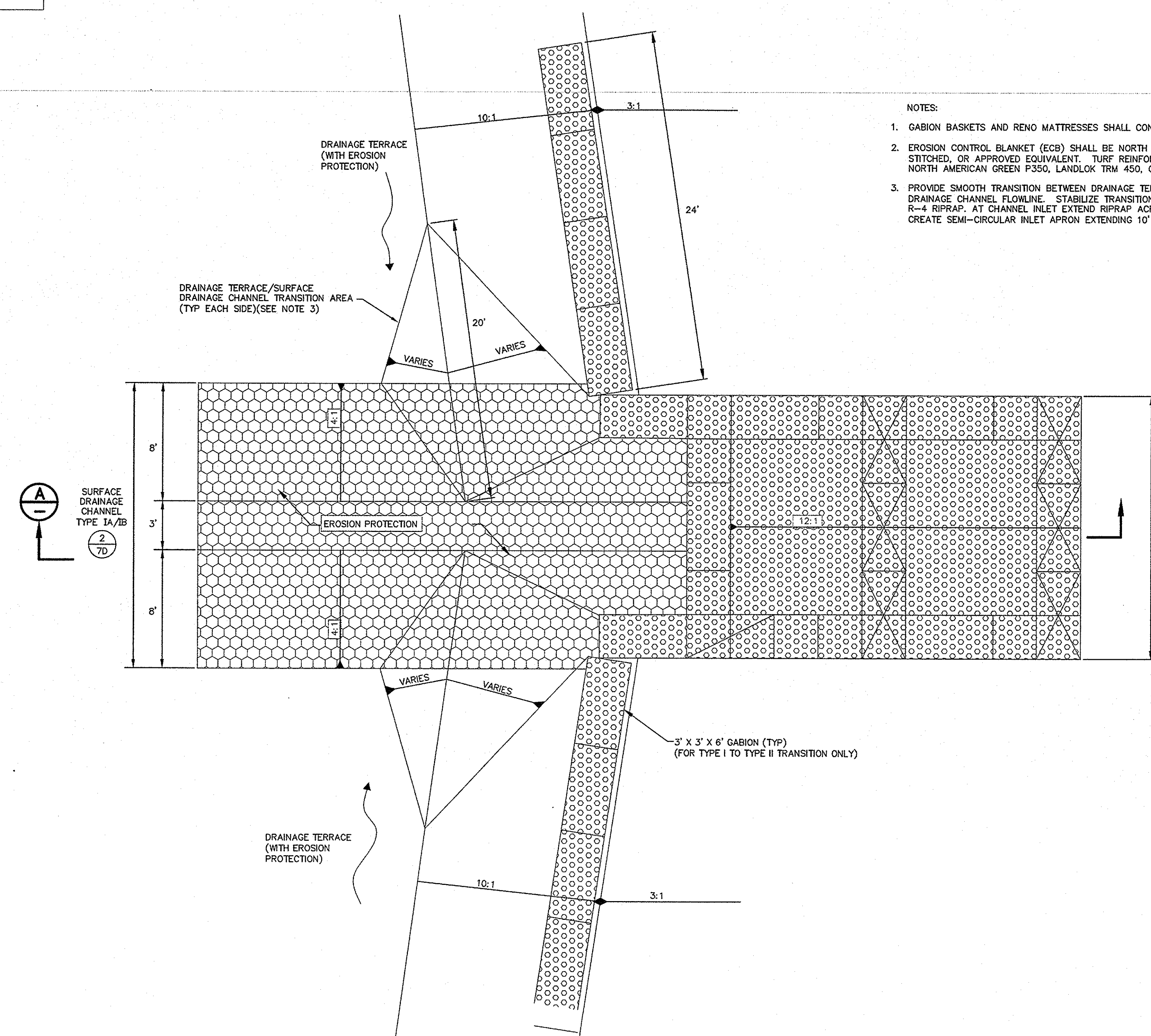
GROSYNTEC
CONSULTANTS
55 WEST WALKER DRIVE, SUITE 100
CHICAGO, IL 60651 USA
(312) 659-0500

STATE OF OHIO
DANIEL G. BOONIN
E-51383
Professional Engineer
13/13/06
DATE

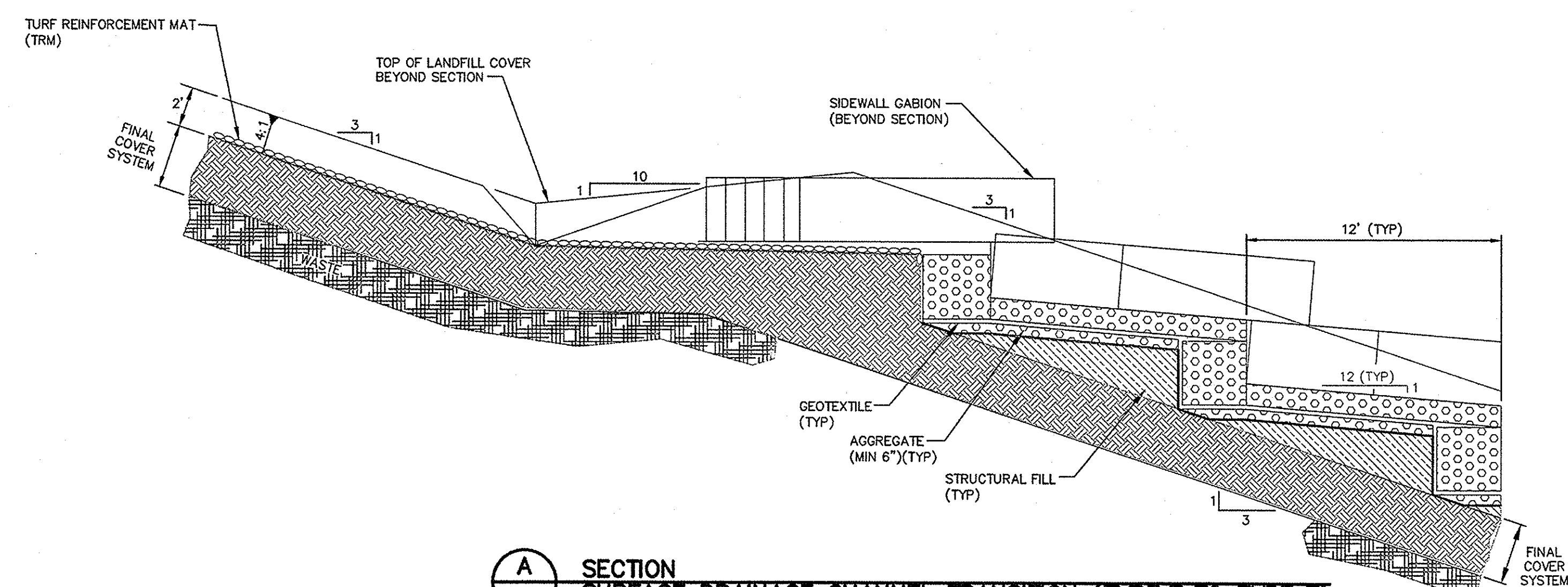
PROJECT NO. 13-30100-7D-B
FILE NO. 13-30100-7D-B
DRAWING 7D OF 39

AEP
AMERICAN
ELECTRIC
POWER

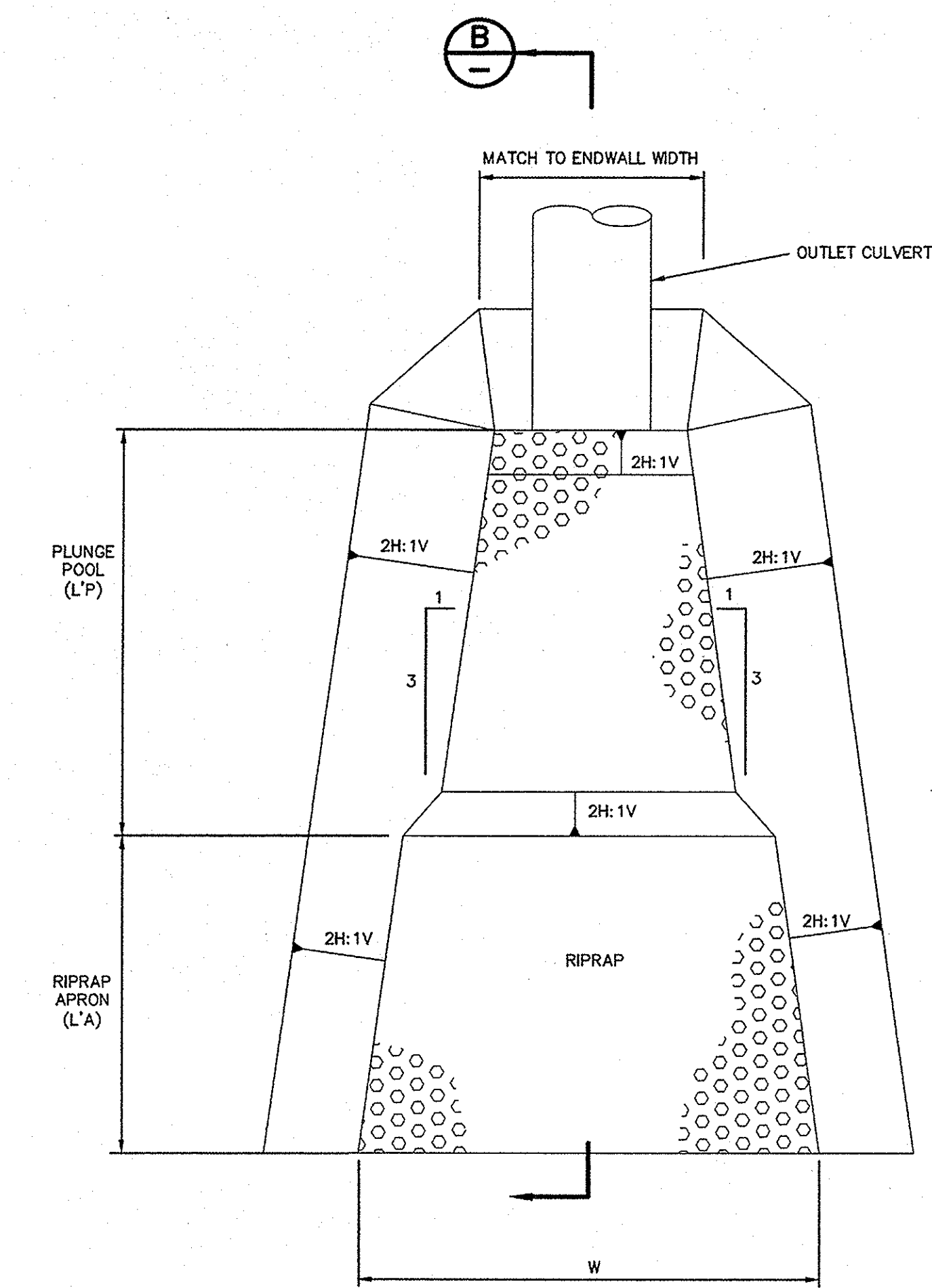
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215



1 PLAN
- SURFACE DRAINAGE CHANNEL TRANSITION
SCALE: NTS
(SEE NOTE 1)

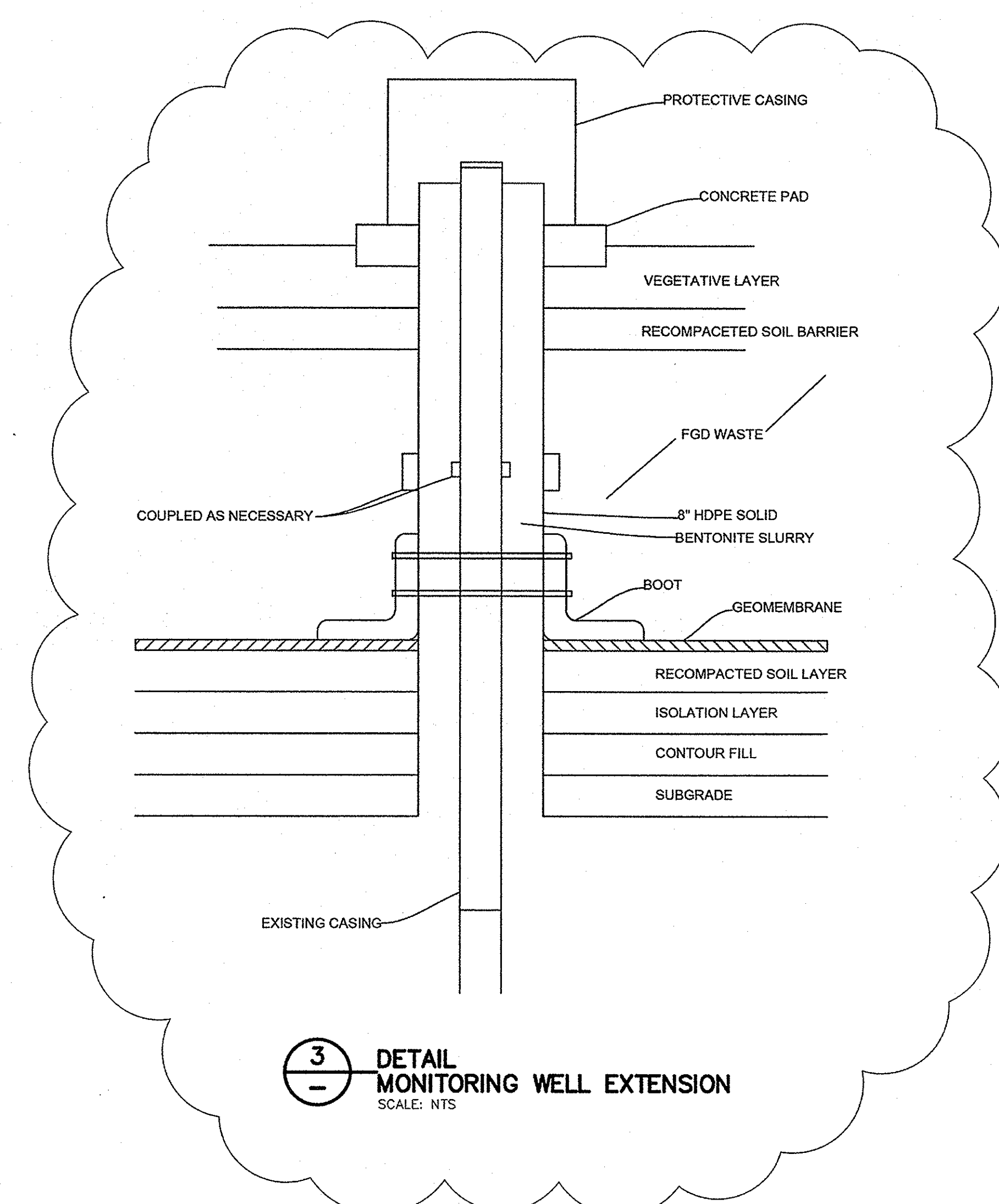


SECTION
SURFACE DRAINAGE CHANNEL TRANSITION (TYPE I TO TYPE II)
SCALE: NTS
(SEE NOTE 1)

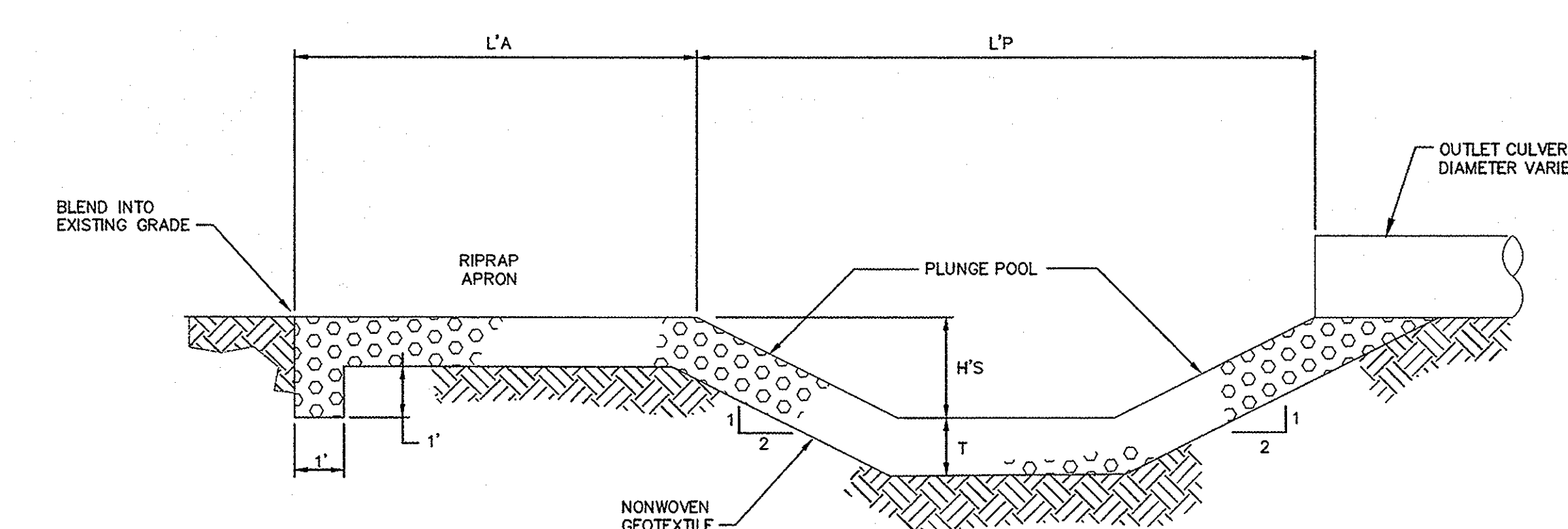


2
4N

DETAIL
OUTLET PROTECTION
SCALE: NTS

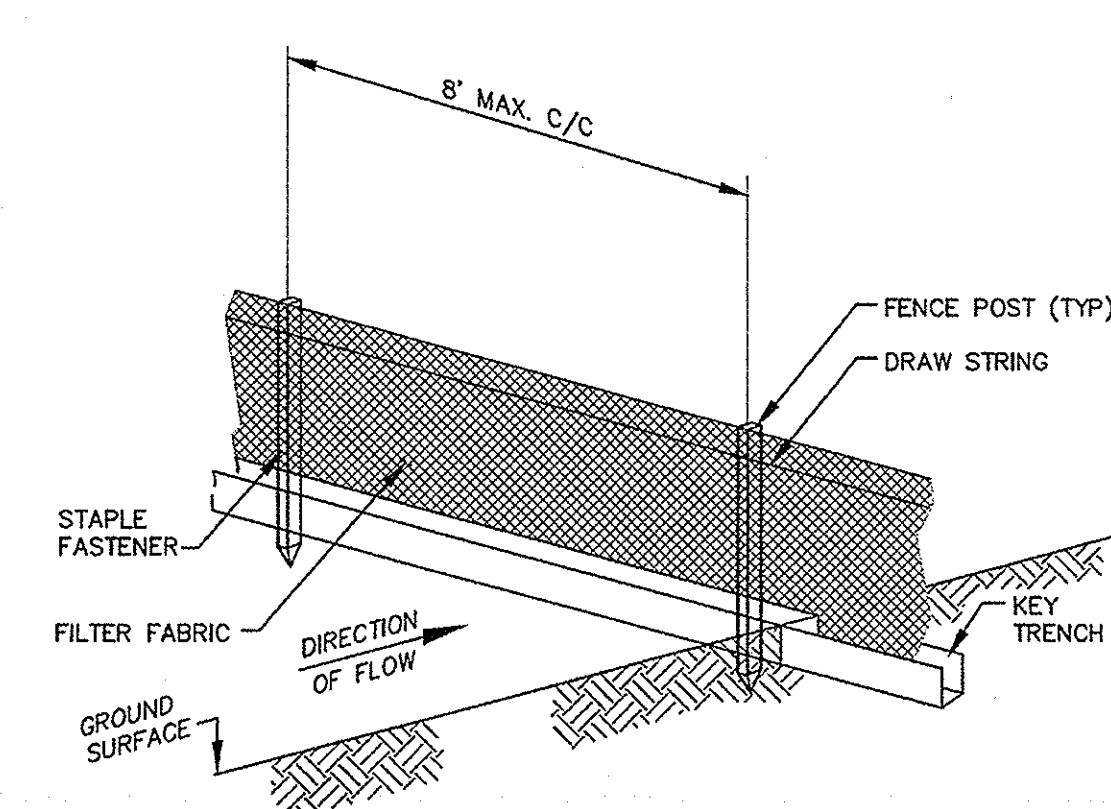


3
—
DETAIL
MONITORING WELL EXTENSION
SCALE: NTS



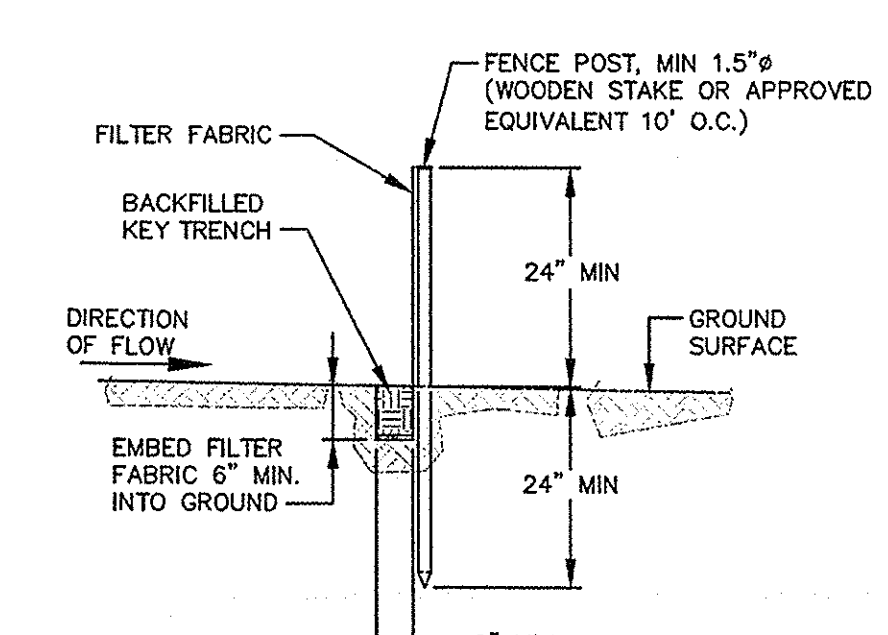
OUTLET PROTECTION SCHEDULE							
STRUCTURE	RIPRAP		INSTALLATION THICKNESS (T)	DIMENSION (FEET)			
	NATIONAL STONE ASSN. CLASSIFICATION			L'P	L'A	W	H'S
OP 1,2	R6 (7"-20" DIAMETER, MEDIAN SIZE 12")	24"	18	9	40	2	
OP 3	R6 (7"-20" DIAMETER, MEDIAN SIZE 12")	24"	10	5	20	1	

B SECTION
OUTLET PROTECTION
SCALE: 1/4" = 1'-0"



4
6A

DETAIL (TYP)
SILT FENCE



RECEIVED

DEC 14 2010

Ohio Environmental
Protection Agency
Southwest Division

**SOLID WASTE
APPROVED**
OHIO ENVIRONMENTAL PROTECTION AGENCY
AUG 10 2011
AS EVIDENCED BY COPY OF
LETTER OF APPROVAL
LETTERS ATTACHED

BBC 1 2015.1	C		PT1 MODIFICATION NO. 1	MAA
MAY 26 2006	B		REVISED - NOO 1 RESPONSE	DGB
OCT 24 2005	A		ISSUED FOR PERMIT	DGB
DATE	NO.		DESCRIPTION	APPRO.
REVISIONS				

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CARDINAL OPERATING COMPANY	
CARDINAL PLANT	
BRILLIANT	OHIO
TITLE: CARDINAL FAR 1 RESIDUAL WASTE LANDFILL EROSION AND SEDIMENT CONTROL / STORMWATER CONTROL ELEMENTS II	

DWC NO 13-30100-7E-C

DWG. NO. 13-50100-7 E-C

SCALE: CIVIL ENGINEERING DIVISION

DR:	Y
CH:	

ENGR.	8 034
-------	-------

PROJ.	
ENGR.	

DATE:	AM	
-------	----	--

AEP AMERICAN ELECTRIC 1 RIVERSIDE PLAZA

**ELECTRIC
POWER** COLUMBUS, OH 43215

	SYSTEM DATE-
0	SYSTEM TIME-
	Min. CLOG

O.E.P.A. DRAWING NO. 7E

[illegible]DRAWING 7E OF 39

3 N

1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

SYSTEM DATE-
SYSTEM TIME-
15th DEC 1977

