



Five-Year Run-on and Run-off Control System Plan

**FAR I RSW Landfill
Brilliant, Ohio**

October 2021

A handwritten signature in black ink, appearing to read "Shawn McGee".

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1.0 Introduction

The Cardinal Power Plant (Plant) is located in Wells Township, Jefferson County, near the town of Brilliant in eastern Ohio. The Plant is owned by Buckeye Power and AEP Generation Resources (GENCO). Cardinal Operating Company operates the Plant. The Fly Ash Reservoir I Residual Solid Waste Landfill (FAR I RSW Landfill) provides disposal for coal combustion residuals (CCR) from the Plant. The FAR I RSW Landfill is an existing CCR landfill and is subject to the requirements of the United States Environmental Protection Agency's (USEPA) CCR Rule (Title 40 Code of Federal Regulations (40 CFR) part 257 Subpart D – “Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.” The initial run-on and run-off control system plan was completed and placed in the Plant's operating record on October 17, 2016. A periodic revision to the run-on and run-off control system plan is required every 5 years pursuant to 40 CFR 257.81(c)(4).

The FAR I RSW Landfill consists of two cells covering an area of approximately 42 acres. The FAR 1 RSW Landfill operates under a Permit-to-Install (No. 06-07993) issued by the Ohio Environmental Protection Agency (Ohio EPA) with a permitted footprint of 127 acres consisting of two phases and six total cells considering future lateral expansions. In 2020 and 2021, modifications to the leachate management and treatment system were made in anticipation of future operational changes modifications. Since 2016, there has not been a lateral expansion of the FAR I RSW Landfill that would impact the Initial Run-on and Run-off Control System Plan was developed (AEP, 2016).

Federal Regulations

Pursuant to 40 CFR 257.81, landfills that manage CCR are subject to the following requirements:

- (a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:
 - 1. A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and
 - 2. A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
- (b) Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 40 CFR 257.3-3.
- (c) Run-on and run-off control system plan
 - 1. Content of the Plan. The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit every five years. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations.

2.0 Objective

This report was prepared by TRC Engineers, Inc. (TRC) to fulfill requirements of 40 CFR 257.81 and document the design and construction of the run-on control system and the run-off control system manage the discharge for the design storm event. This is the first 5-year periodic assessment as required per 40 CFR 257.81(c)(4).

To develop the periodic assessment TRC performed the following scope:

- Reviewed historical documents including:
 - Run-on and Run-off Control System Plan (AEP, 2016), refer to Appendix A.
 - Permit-to-Install Application Cardinal FAR I Residual Waste Landfill Facility, Volume 4 supporting calculations prepared by American Electric Power Service Corporation and GeoSyntec Consultants, November 2006 (Attachment B).
 - Permit Alteration Request of PTI No. 06-7993 (Burns & McDonnell, 2020).
 - Permit Alteration Request of PTI No. 06-7993 (Burns & McDonnell, 2021).
 - The 2016-2021 FAR I landfill annual inspection reports.
- Reviewed the current design precipitation values for the 24-hour, 25-year storm event,
- Performed a site visit on September 1, 2021 to observe current conditions, and
- Developed an periodic revision to the Run-on and Run-off Control System Plan.

3.0 Design Storm Data

According to the National Oceanic and Atmospheric Administration's National Weather Service, a 24-hour, 25-year storm event at the FAR I RSW Landfill is equivalent to a 4.00-inch precipitation event. This design rain event is consistent with the precipitation used in the stormwater calculations for the design of the FAR I RSW Landfill (AEP and Geosyntec, 2006) which is the basis of the Initial Run-on and Run-off Control System Plan (AEP, 2016).

4.0 Run-On and Run-Off Control Systems

4.1 Run-On Control

The run-on control system for the FAR I RSW Landfill employs containment berms, stormwater channels, culverts, and protective vegetation to prevent stormwater falling outside of the landfill from run onto the active portions of the landfill. The surface controls have been developed in accordance with the Design and Construction Requirements contained in the Ohio EPA Solid Waste Regulations and can adequately manage the precipitation from a 24-hour, 25-year storm event.

4.2 Run-Off Control

The FAR I RSW Landfill is equipped with run-off controls to collect and route stormwater that lands on the active portion of the landfill. These controls include an outer perimeter containment berm, a leachate collection system, and a leachate treatment system. The leachate treatment system includes two 50,000-gallon settling tanks. The treated leachate is decanted from the settling tanks before transported to the permitted outfall. These structures are designed to control and contain the design storm event.

4.3 Discharge

Discharge from FAR I RSW Landfill is regulated in accordance with an NPDES permit issued by the Ohio Environmental Protection Agency. The permit grants the Plant permission to discharge from the landfill to an internal outfall ultimately discharging to Blockhouse Run in accordance with effluent limitations, monitoring requirements, and other conditions. The NPDES permit is issued in accordance with the provisions of the Federal Clean Water Act. Therefore, by complying with the NPDES permit, the discharge from FAR I RSW Landfill is also being handled in accordance with the applicable surface water requirements.

5.0 Site Visit

TRC performed a site visit on September 1, 2021 to observe the current conditions of the FAR RSW I Landfill. Based on the observations made during the site visit, the conditions presented in the Initial Run-on and Run-off Control System Plan and subsequent modifications accurately reflect the current conditions of the FAR I RSW Landfill.

6.0 Conclusion

The FAR I RSW Landfill adequately manages run-on and run-off in accordance with the requirements of 40 CFR 257.81. Run-off is collected a leachate collection system and treated prior to discharge through an NPDES permitted outfall satisfying the requirements of 40 CFR 257.3-3.

This Run-On and Run-Off Plan was been completed in compliance with the requirements set forth in 40 CFR 257.81. This document will be placed in the operating record, posted to the publicly accessible website, and government notifications will be provided.

A Run-On and Run-Off Control System Plan must be revised every 5 years. The next periodic revision is required by October 2026.

The Plan must be amended whenever the periodic review period is reached or if changes in site conditions, either intentionally or unintentionally, occur that will sustainably impact the current written plan in effect.

7.0 Limitations

The observations, assessment, and recommendations presented in this Report are based on our limited scope of work and on information disclosed by our visual observations, the conditions of the site at the time of the September 1, 2021 inspection, the design information available at the time of this investigation, and only apply to the Cardinal FAR I Residual Solid Waste Landfill. This work has been performed in accordance with our authorized scope of work and is based on the level of effort and investigative techniques using that degree of care and skill ordinarily exercised under similar conditions by reputable members of the profession practicing in the same or similar locality at the time of service. No other warranties, expressed or implied, are made or intended by this Report. These services were intended to provide an indication of the current, observable conditions of the dam at the time of the visual observations on the date indicated in this Report. Such a limited visual review does not account for other non-visible, hidden, subsurface or material condition analyses, and the professional services rendered are not guaranteed to be a representation by TRC of inaccessible and unobservable site conditions or actual conditions subsequent to the date of TRC's site visit. Therefore, the evaluations, conclusions, recommendations and opinions provided in this Report are subject to change as a result of future natural or manmade processes and as a result of an additional comprehensive, intrusive investigation and engineering analyses beyond TRC's visual observations. TRC is not responsible for any conclusions or opinions drawn by others from the data included herein, nor are the recommendations specifically presented in this Report intended for use or reliance as construction specifications.

8.0 Certification

I, the undersigned Ohio Professional Engineer, hereby certify that I am familiar with the technical requirements of 40 CFR 257 Subpart D. I also certify that it is my professional opinion that, to the best of my knowledge, information, and belief, that the information in this demonstration is in accordance with current good and accepted engineering practice(s) and standard(s) and meets the requirements of 40 CFR 257.81.

For the purpose of this document, “certify” and “certification” shall be interpreted and construed to be a “statement of professional opinion.” The certification is understood and intended to be an expression of my professional opinion as a Licensed Professional Engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

Shawn D. McGee, P.E.

Name



Signature of Professional Engineer

PE.68761

Engineer License Number

10/8/2021

Date



9.0 References

- AECOM. 2019. 2018 Annual Landfill Inspection Report: Cardinal Plant – Fly Ash Reservoir I Landfill. January 2019.
- AECOM. 2020. 2019 Annual Landfill Inspection Report: Cardinal Plant – Fly Ash Reservoir I Landfill. January 2020.
- AEP and GeoSyntec Consultants. 2006. Permit -to-Install Application: Cardinal FAR 1 Residual Waste Landfill Facility. November 2006.
- AEP. 2016. Run-On and Run-Off Control System Plan – CFR 257.81: Fly Ash Reservoir I Landfill Cardinal Plant, Brilliant, Ohio. Geotechnical Engineering Services. October 2016.
- AEP. 2017. 2017 Landfill Inspection Report: Fly Ash Reservoir Landfill – Cardinal Plant, Brilliant, Ohio. Geotechnical Engineering Services. GERS-17-013. June 2017.
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- American Electric Power Service Corporation (AEP). 2016. 2016 Landfill Inspection Report: Fly Ash Reservoir Landfill – Cardinal Plant Brilliant, Ohio. Geotechnical Engineering Services. GERS-16-004. June 2016.
- Burns and McDonnell. 2020. Permit Alteration Request of PTI No. 06-7993: Permit Alteration to the Leachate Transport and Treatment System. Revision 0. December 18, 2020.
- Burns and McDonnell. 2020. Permit Alteration Request of PTI No. 06-7993: Permit Alteration to the Leachate Treatment System. Revision 0. March 15, 2021.
- US Department of Commerce, NOAA. *PF Map: Contiguous Us*, US Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, 7 Nov. 2005, https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=oh.

Appendix A: Initial Run-On and Run-Off Control System Plan

RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

CFR 257.81

Fly Ash Reservoir 1 Landfill
Cardinal Plant
Brilliant, Ohio

October, 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



GERS-16-123

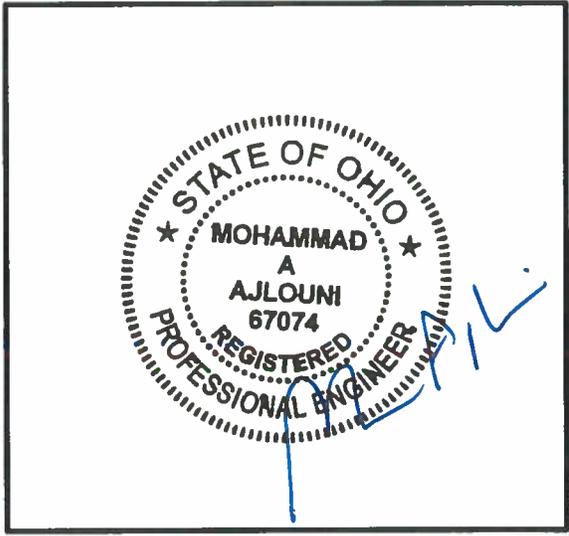
RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN
CFR 257.81
FLY ASH RESERVOIR FAR 1 LANDFILL
CARDINAL PLANT

GERS-16-123

PREPARED BY *M.A.L.* **DATE** 10/04/2016
Mohammad A. Ajlouni, Ph.D., P.E.

REVIEWED BY *D.P.* **DATE** 10/10/2016
Daniel W. Pizzino, P.E.

APPROVED BY *Gary F. Zych* **DATE** 10/11/2016
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 Run-On and Run-Off Control System plan meets the requirements of 40 CFR § 257.81

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1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.81 for Run-On and Run-Off Control System plan 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 RUN-ON AND RUN-OFF CONTROL SYSTEM 257.81(c)(1)

[The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section.]

Since the Cardinal FAR 1 Landfill is an operating facility, this Plan describes the existing run-on and run-off control features as well as those planned as part of future phase construction. Generally, run-on control features address collection and conveyance features associated with non-contact stormwater (i.e., liquid not coming in contact with the waste). Run-off control features address collection, conveyance, and treatment features for contact stormwater (i.e., liquid coming in contact with the waste).

This Plan summarizes the run-on and run-off control features and provides supporting calculations and figures. The supporting calculations and figures are similar to those submitted as part of the permit application process for the currently approved Solid Waste/National Pollutant Discharge Elimination System (NPDES) Permit from the OEPA associated with the Cardinal FAR 1 Landfill.

4.0 RUN-ON CONTROL SYSTEM 257.81 (a)(1)

[A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.]

4.1 RUN-ON CONTROL OUTSIDE THE LANDFILL FOOTPRINT

Run-on control outside of the landfill footprint generally consist of stormwater surface controls, which prevent stormwater falling outside of the landfill footprint from running onto the active portions of the landfill. These stormwater surface controls have been developed in accordance with the Design and Construction Requirements contained in the OEPA Solid Waste Regulations and meet the requirement for the Cardinal FAR 1 Landfill NPDES Permit.

These stormwater surface controls are constructed in phases associated with landfill development. The Cardinal FAR 1 Landfill has been subdivided into two phases reflecting the order in which each partial area of the landfill will be constructed and filled. Cardinal FAR 1 Landfill is currently

placing waste in Phase 1. Phase 1 consists of 3 separate cells, Cell 1, Cell 3, and Cell 2 which is/ will be constructed in this sequence. As the landfill operations progress, a subsequent phase/cells of the landfill is prepared and constructed. Surface water/erosion control structures (cover, diversion berms, channels, ditches, etc.) are then constructed as part of the phase development.

Along the FAR 1 landfill Highwall, no diversions were constructed and the run-on flow is collected using the highwall drainage layer (2-feet thick #57 stone layer) that is connected to the under drain layer (subsurface drainage layer of the landfill) which is ultimately transmitted to the FAR II Reservoir.

A General Phasing Plan (Drawing No. 13-30100-4B in Attachment B) depicts an overview of the landfill sequencing. Drawing Nos. 13-30100-6A through 13-30100-6G in Attachment B provide detail regarding the individual phase development. During operation of the landfill, regular maintenance and inspection of these structures is performed to ensure proper control of surface water and eroded sediments.

Other standard operating procedures associated with control of surface water and eroded sediments are implemented on a regular as-needed basis and include:

- Construction of containment berms;
- Inspection of control structures;
- Maintenance and repair of channels and structures;
- Removal of accumulated sediment in sediment ponds;
- Placement of temporary and permanent protective cover and establishment of cover vegetation;
- Minimizing active fill areas within the phase;
- Installation and maintenance of silt fence and inlet protection; and,
- General best management practices as define in the Soil Erosion and Sediment Control Plan for the project.

A description of specific criteria used in the design of the stormwater surface controls, specifically stormwater channels, culverts, and sediment ponds, is included below.

4.1.1 STORMWATER CHANNEL AND CULVERT DESIGN

Existing and/or future permanent drainage channels collect and convey non-contact water to the FAR II sediment pond. The surface water channels are designed such that the run on volumes and peak flows were calculated using the "Soil-Cover Complex" methodology presented in Soil Conservation Service Technical Release No. 55 and 20 (USDA, SCS 1986 USDA -SCS, 1982). Site soils were classified as Hydrologic Soil Group "C", and all land covers were assumed to be in "good" condition. Times-of-concentration were computed using the "segmental" method in TR-55. Peak discharge factors were obtained from tables in TR-55.

The hydrologic design basis for surface water collection and conveyance structures is the 25-year, 24-hour storm. This design storm event is applicable to the site runoff collection channels and culverts. The Federal Highway Administration Hydraulic Engineering Circular No. 15 (HEC-15) was used as a guideline for channel linings and maximum velocities for drainage ditches. The 2-year, 24-hour; 25-year, 24-hour storms were used to calculate the runoff detention volume, the flood storage volume, freeboard, and the emergency spillway discharge, respectively, for the Sediment Pond.

The rainfall intensities at the location of the Cardinal FAR 1 Landfill applicable to the design of surface water structures were obtained from the United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Jefferson County, Ohio. The historical rainfall distribution for each 2-hour storm is based on the Soil Conservation Service (SCS) Type II rainfall distribution. Antecedent Moisture Condition II - Normal was assumed for design.

Seventeen (17) existing or future culverts are associated with Cardinal FAR 1 Landfill development. Riprap outlet protection is used to prevent erosion at each culvert. Refer to Drawing Nos. 13-30100-6G, 13-30100-7D, 13-30100-7E for the locations, sizes, and outlet protection specifics for the culverts.

Supporting calculations showing size and capacity for the channels and culverts using the above-described methodology (i.e., 24-hour, 25-years storm event) are presented in the PTI.

4.2 RUN-ON CONTROL INSIDE THE LANDFILL

Active waste operations will continue at the Cardinal FAR 1 Landfill until final design grades are reached. As waste placement reaches the planned exterior grades of the landfill throughout the planned operation of the facility, the waste will be covered with a protective cover system or cap constructed with the on-site soils.

Similar to the run-on control features, stormwater control features atop of the permanent cover (i.e., benches, down-chutes, etc.) have a hydrologic design basis of the 25-year, 24-hour storm event. Refer to the supporting calculations in the PTI.

5.0 RUN-OFF CONTROL SYSTEM 257.81 (a)(2)and(b)

[A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year]

[Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3.]

5.1 OUTER PERIMETER CONTAINMENT BERM

The Landfill is designed with an outer containment berm with a maximum exterior slope of 3 horizontal to 1 vertical (3H:1V) (Drawing 13-301007C). An internal perimeter ditch is constructed in which run-off over the waste outer slopes is collected and routed toward an internal sediment basins which convey the flow to the leachate collection pipes via risers (Drawing 13-301007C). The working surface of the active landfill remains relatively level with the active fill area being sloped towards the interior of the landfill where designed chimney drains collect and transmit the surface flow to the leachate collection pipes. The outer containment berm serves the purpose to separate run-off (contact water) from flowing outside of the waste placement area.

The initial containment berm for waste placement, positioned at the exterior of the two, has a minimum height of 10 feet, a crest width of 6 feet and side slopes of 3H:1V or flatter on the exterior side.

5.2 LEACHATE COLLECTION SYSTEM

Runoff from the active area (“contact water”) is collected as part of the leachate collection system and is conveyed, via the vertical chimney drains, to the leachate collection system, and associated transmission pipes. The surface of the active fill area is sloped towards the interior of the landfill, graded to minimize ponding of water, and directs excess surface water to chimney drain locations.

The Hydrologic Evaluation of Landfill Performance (HELP) model was used to calculate the average daily leachate flow and the average annual leachate volume for the Cardinal FAR 1 Landfill.

Note that the HELP Model calculations included in PTI include evaluations where the peak precipitation event is 4.01 inches, which corresponds to the 24-hour, 25-year storm event. Therefore, design aspects of Cardinal FAR 1 Landfill which rely on the above described leachate generation estimates are designed for the 24-hour, 25-year storm event per §257.81. Drawing Nos. 13-30100-4B and 13-30100-7B in Attachment C identify the location of the leachate collection system.

Leachate and contaminated stormwater (stormwater that has come in contact with waste) is collected by the leachate conveyance features and conveyed to leachate treatment Pond via transmission pipes.

Drawing Nos. 13-30100-4B and 13-30100-7B in Attachment C identify the location and the details of the leachate collection system and the Leachate Treatment Pond.

5.3 SEDIMENTATION AND LEACHATE TREATMENT POND

The FAR 1 RWL design incorporates the existing FAR II as the Facility sedimentation and Leachate Treatment Pond.

FAR II is an approximate 161 acre reservoir that accepts fly ash from the Cardinal Plant, is contained by a Fly Ash Reservoir Dam (FAD II) with current Top of Dam Elevation of 983 ft and maximum Pool Elevation of 974.0. FAR II is located adjacent to FAR 1 RWL, as shown on the permit drawings. The area accepting runoff into FAR II already includes the drainage area from the proposed FAR 1 RWL. FAR II stormwater storage has been designed for a 50 year 24-hour storm event exceeding the OAC 3745- 30-07 storage requirements for the Facility Sedimentation Pond. The FAR II emergency spillway was designed for the FAR II probable maximum flood (PMF). The principal spillway discharge structure controls the maximum pool, was designed for the 50 year 24-hour storm event, and is shown on permit Drawing 13-30100-7A.

The maximum holding capacity of the Leachate Storage Pond is 1,771 acre-feet (ac-ft). The holding capacity is sufficient to contain the anticipated leachate volume for a 30 day period, as required by the OEPA Solid Waste Regulations. In addition, the FAR II pond is capable of managing the PMF storm for FAR II Drainage area without overtopping of the dam crest.

The Leachate Treatment Pond pool elevation is monitored and managed on a regular basis by the landfill operator. Leachate is mixed with the fly ash sluicing water and released from the reservoir via the Principle spillway as a part of the normal operation of the FAR II Dam.

6.0 PLAN REVIEW AND CHANGES IN FACILITY CONFIGURATION

In accordance with §257.81, this Run-On and Run-Off Control Plan shall be reviewed periodically, at a minimum of every 5 years. During such reviews, this Plan will be updated as needed to reflect the current design and operation of the Cardinal FAR 1 Landfill. A Plan Review Log to record periodic Plan reviews and revisions is included in Attachment A.

ATTACHMENT A
PLAN REVIEW LOG

Cardinal FAR 1 LANDFILL

**RUN-ON, RUN-OFF CONTROL PLAN
PLAN REVIEW LOG**

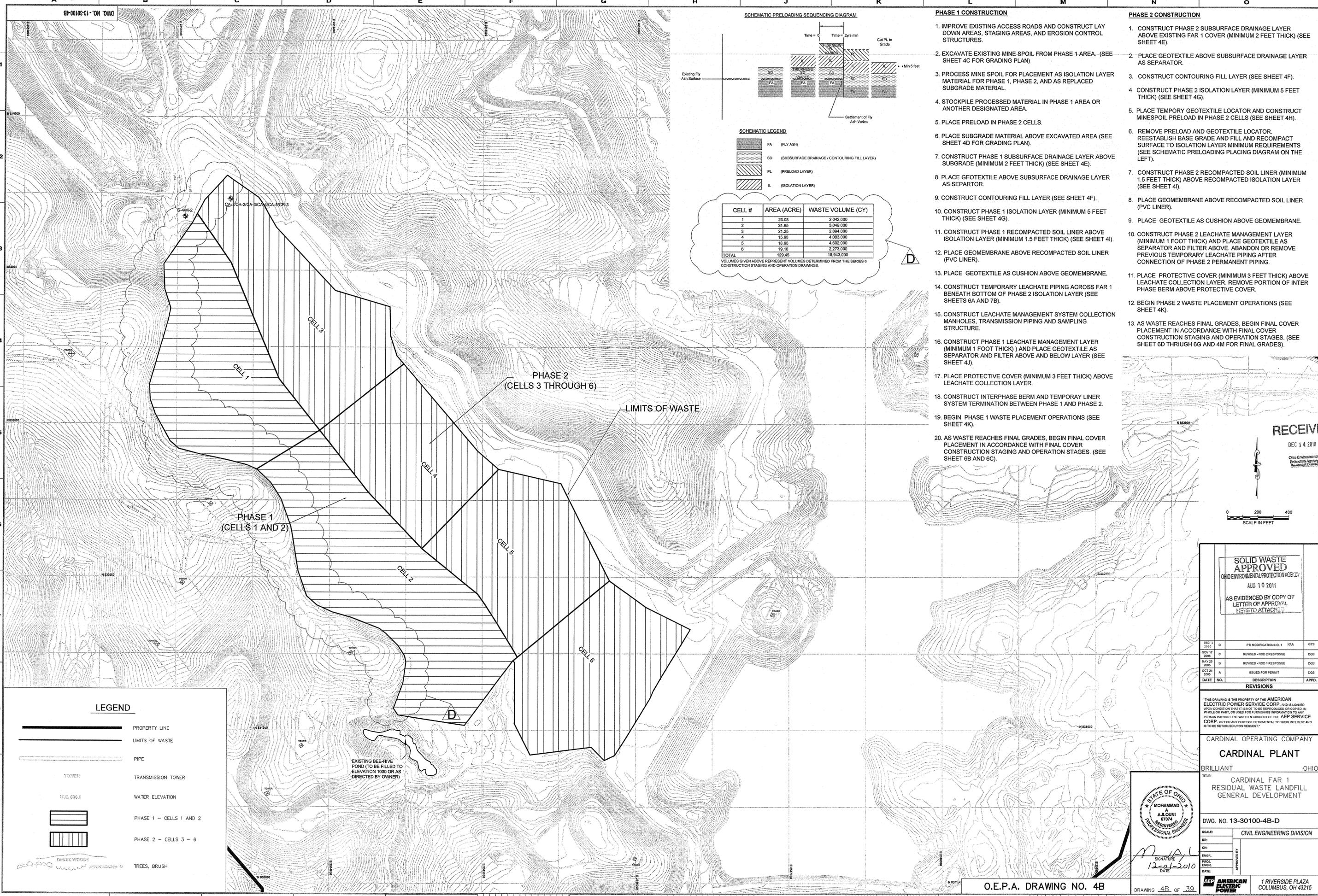
Action	Performed by:	Date
Prepare Initial Run-On, Run-Off Control Plan	AEP	10/17/2016

Note:

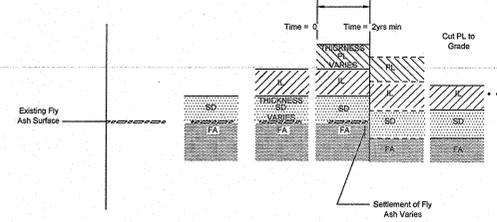
1. In accordance with §257.81, this Run-On and Run-Off Control Plan shall be reviewed periodically, at a minimum of every 5 years.

ATTACHMENT B

RUN-ON CONTROL SYSTEM SUPPORTING DRAWINGS



SCHEMATIC PRELOADING SEQUENCING DIAGRAM



SCHEMATIC LEGEND

- FA (FLY ASH)
- SD (SUBSURFACE DRAINAGE / CONTOURING FILL LAYER)
- PL (PRELOAD LAYER)
- IL (ISOLATION LAYER)

CELL #	AREA (ACRE)	WASTE VOLUME (CY)
1	23.03	2,042,000
2	31.55	3,042,000
3	21.25	2,884,000
4	15.68	4,083,000
5	18.66	4,602,000
6	19.18	2,273,000
TOTAL	129.45	18,943,000

VOLUMES GIVEN ABOVE REPRESENT VOLUMES DETERMINED FROM THE SERIES 6 CONSTRUCTION STAGING AND OPERATION DRAWINGS.

PHASE 1 CONSTRUCTION

1. IMPROVE EXISTING ACCESS ROADS AND CONSTRUCT LAY DOWN AREAS, STAGING AREAS, AND EROSION CONTROL STRUCTURES.
2. EXCAVATE EXISTING MINE SPOIL FROM PHASE 1 AREA. (SEE SHEET 4C FOR GRADING PLAN)
3. PROCESS MINE SPOIL FOR PLACEMENT AS ISOLATION LAYER MATERIAL FOR PHASE 1, PHASE 2, AND AS REPLACED SUBGRADE MATERIAL.
4. STOCKPILE PROCESSED MATERIAL IN PHASE 1 AREA OR ANOTHER DESIGNATED AREA.
5. PLACE PRELOAD IN PHASE 2 CELLS.
6. PLACE SUBGRADE MATERIAL ABOVE EXCAVATED AREA (SEE SHEET 4D FOR GRADING PLAN).
7. CONSTRUCT PHASE 1 SUBSURFACE DRAINAGE LAYER ABOVE SUBGRADE (MINIMUM 2 FEET THICK) (SEE SHEET 4E).
8. PLACE GEOTEXTILE ABOVE SUBSURFACE DRAINAGE LAYER AS SEPARATOR.
9. CONSTRUCT CONTOURING FILL LAYER (SEE SHEET 4F).
10. CONSTRUCT PHASE 1 ISOLATION LAYER (MINIMUM 5 FEET THICK) (SEE SHEET 4G).
11. CONSTRUCT PHASE 1 RECOMPACTED SOIL LINER ABOVE ISOLATION LAYER (MINIMUM 1.5 FEET THICK) (SEE SHEET 4I).
12. PLACE GEOMEMBRANE ABOVE RECOMPACTED SOIL LINER (PVC LINER).
13. PLACE GEOTEXTILE AS CUSHION ABOVE GEOMEMBRANE.
14. CONSTRUCT TEMPORARY LEACHATE PIPING ACROSS FAR 1 BENEATH BOTTOM OF PHASE 2 ISOLATION LAYER (SEE SHEETS 6A AND 7B).
15. CONSTRUCT LEACHATE MANAGEMENT SYSTEM COLLECTION MANHOLES, TRANSMISSION PIPING AND SAMPLING STRUCTURE.
16. CONSTRUCT PHASE 1 LEACHATE MANAGEMENT LAYER (MINIMUM 1 FOOT THICK) AND PLACE GEOTEXTILE AS SEPARATOR AND FILTER ABOVE AND BELOW LAYER (SEE SHEET 4J).
17. PLACE PROTECTIVE COVER (MINIMUM 3 FEET THICK) ABOVE LEACHATE COLLECTION LAYER.
18. CONSTRUCT INTERPHASE BERM AND TEMPORARY LINER SYSTEM TERMINATION BETWEEN PHASE 1 AND PHASE 2.
19. BEGIN PHASE 1 WASTE PLACEMENT OPERATIONS (SEE SHEET 4K).
20. AS WASTE REACHES FINAL GRADES, BEGIN FINAL COVER PLACEMENT IN ACCORDANCE WITH FINAL COVER CONSTRUCTION STAGING AND OPERATION STAGES. (SEE SHEET 6B AND 6C).

PHASE 2 CONSTRUCTION

1. CONSTRUCT PHASE 2 SUBSURFACE DRAINAGE LAYER ABOVE EXISTING FAR 1 COVER (MINIMUM 2 FEET THICK) (SEE SHEET 4E).
2. PLACE GEOTEXTILE ABOVE SUBSURFACE DRAINAGE LAYER AS SEPARATOR.
3. CONSTRUCT CONTOURING FILL LAYER (SEE SHEET 4F).
4. CONSTRUCT PHASE 2 ISOLATION LAYER (MINIMUM 5 FEET THICK) (SEE SHEET 4G).
5. PLACE TEMPORY GEOTEXTILE LOCATOR AND CONSTRUCT MINESPOIL PRELOAD IN PHASE 2 CELLS (SEE SHEET 4H).
6. REMOVE PRELOAD AND GEOTEXTILE LOCATOR. REESTABLISH BASE GRADE AND FILL AND RECOMPACT SURFACE TO ISOLATION LAYER MINIMUM REQUIREMENTS (SEE SCHEMATIC PRELOADING PLACING DIAGRAM ON THE LEFT).
7. CONSTRUCT PHASE 2 RECOMPACTED SOIL LINER (MINIMUM 1.5 FEET THICK) ABOVE RECOMPACTED ISOLATION LAYER (SEE SHEET 4I).
8. PLACE GEOMEMBRANE ABOVE RECOMPACTED SOIL LINER (PVC LINER).
9. PLACE GEOTEXTILE AS CUSHION ABOVE GEOMEMBRANE.
10. CONSTRUCT PHASE 2 LEACHATE MANAGEMENT LAYER (MINIMUM 1 FOOT THICK) AND PLACE GEOTEXTILE AS SEPARATOR AND FILTER ABOVE. ABANDON OR REMOVE PREVIOUS TEMPORARY LEACHATE PIPING AFTER CONNECTION OF PHASE 2 PERMANENT PIPING.
11. PLACE PROTECTIVE COVER (MINIMUM 3 FEET THICK) ABOVE LEACHATE COLLECTION LAYER. REMOVE PORTION OF INTER PHASE BERM ABOVE PROTECTIVE COVER.
12. BEGIN PHASE 2 WASTE PLACEMENT OPERATIONS (SEE SHEET 4K).
13. AS WASTE REACHES FINAL GRADES, BEGIN FINAL COVER PLACEMENT IN ACCORDANCE WITH FINAL COVER CONSTRUCTION STAGING AND OPERATION STAGES. (SEE SHEET 6D THROUGH 6G AND 4M FOR FINAL GRADES).

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SCALE IN FEET
0 200 400

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

DATE	NO.	DESCRIPTION	APPR.
DEC 1 2010	D	PTI MODIFICATION NO. 1	PKA
NOV 17 2009	C	REVISED - HOD 2 RESPONSE	DOB
MAY 25 2009	B	REVISED - HOD 1 RESPONSE	DOB
OCT 24 2008	A	ISSUED FOR PERMIT	DOB

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE: **CARDINAL FAR 1 RESIDUAL WASTE LANDFILL GENERAL DEVELOPMENT**

DWG. NO. **13-30100-4B-D**

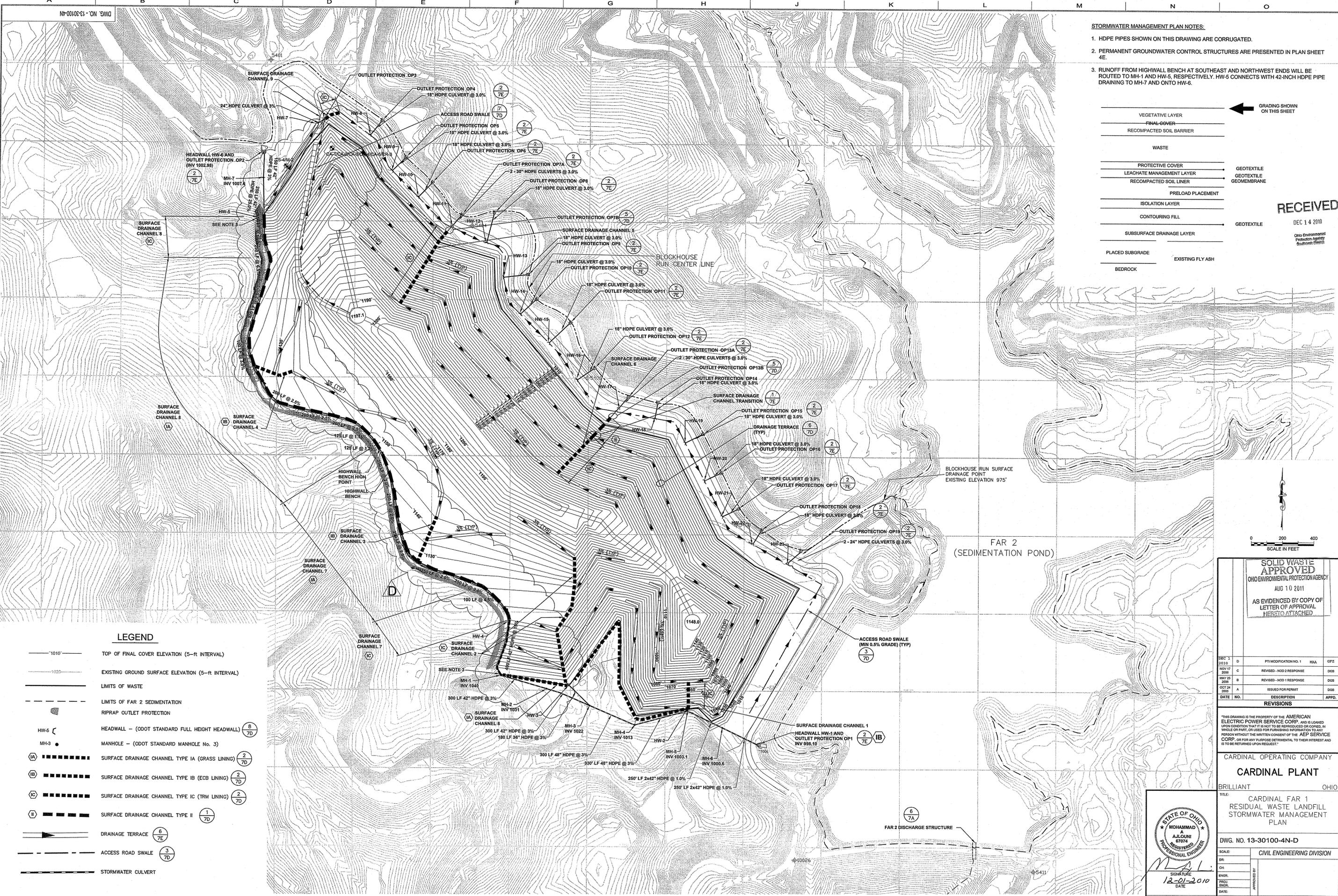
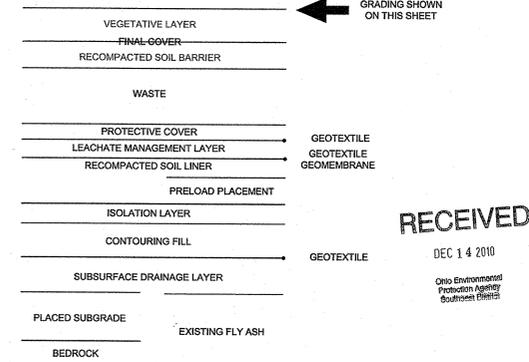
SCALE: **CIVIL ENGINEERING DIVISION**

STATE OF OHIO
MUSKIEGEE COUNTY
MUHAMMAD A. ALJOUNI
67074
REGISTERED PROFESSIONAL ENGINEER

DATE: **12-01-2010**

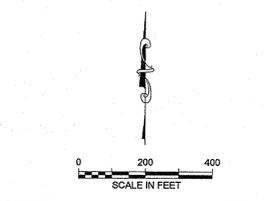
STORMWATER MANAGEMENT PLAN NOTES:

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 MH-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-5 HEADWALL - (ODOT STANDARD FULL HEIGHT HEADWALL) (8/7D)
- MH-3 MANHOLE - (ODOT STANDARD MANHOLE No. 3)
- (IA) SURFACE DRAINAGE CHANNEL TYPE IA (GRASS LINING) (2/7D)
- (IB) SURFACE DRAINAGE CHANNEL TYPE IB (ECB LINING) (2/7D)
- (IC) SURFACE DRAINAGE CHANNEL TYPE IC (TRM LINING) (2/7D)
- (II) SURFACE DRAINAGE CHANNEL TYPE II (1/7D)
- ▬ DRAINAGE TERRACE (6/7E)
- ACCESS ROAD SWALE (3/7D)
- STORMWATER CULVERT



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

REV. NO.	DATE	DESCRIPTION	APPROVED
2010	D	PTI MODIFICATION NO. 1	KAA, GPZ
NOV 17 2008	C	REVISED - MOD 2 RESPONSE	DOB
MAY 25 2007	B	REVISED - MOD 1 RESPONSE	DOB
OCT 24 2005	A	ISSUED FOR PERMIT	DOB

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE: **CARDINAL FAR 1 RESIDUAL WASTE LANDFILL STORMWATER MANAGEMENT PLAN**

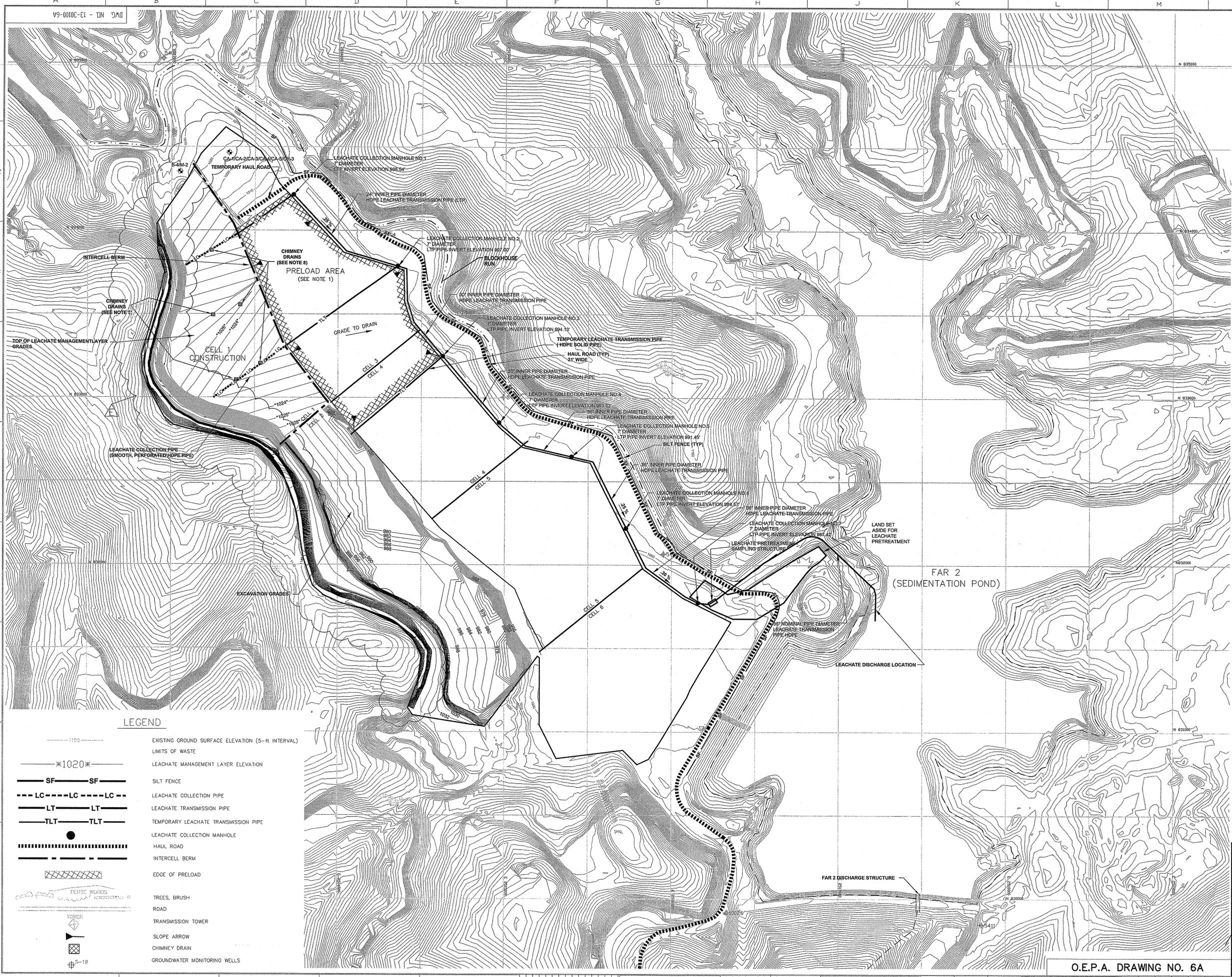
DWG. NO. 13-30100-4N-D

SCALE: CIVIL ENGINEERING DIVISION
APPROVED BY: [Signature]
DATE: 12-01-2010

AEP AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA
COLUMBUS, OH 43216

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

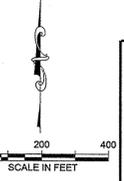
DRAWING 4N OF 39



- CELL 1:**
- EXCAVATE MINESPOIL, SHAPE AND GRADE REMAINING MINESPOIL BERM ALONG FAR 1.
 - CONSTRUCT SUBGRADE LAYER, SUBSURFACE DRAINAGE LAYER AND CONTOURING FILL LAYER.
 - CONSTRUCT 5 FOOT MINIMUM ISOLATION LAYER.
 - CONSTRUCT RECOMPACTED SOIL LINER, GEOMEMBRANE AND LEACHATE MANAGEMENT SYSTEM.
 - CONSTRUCT TEMPORARY LINER TERMINATION BERMS. INSTALL FUTURE TIE-IN LOCATIONS FOR RECOMPACTED SOIL LINER AND LEACHATE MANAGEMENT SYSTEM.
- CELL 2:**
- BEGIN EXCAVATION OF MINESPOIL, SHAPE AND GRADE LEFT IN PLACE MINESPOIL BERM ALONG FAR 1.
- CELL 3:**
- EXCAVATE TO AND CONSTRUCT/VERIFY SUBSURFACE DRAINAGE LAYER.
 - CONSTRUCT CONTOURING FILL LAYER AND ISOLATION LAYER.
 - INSTALL TEMPORARY LEACHATE TRANSMISSION PIPES.
 - INSTALL SUBSURFACE DRAINAGE AND LEACHATE TRANSMISSION PIPES, MANHOLES, AND STRUCTURAL FILL.
 - PLACE PRELOAD FILL
- CELL 4:**
- CONSTRUCT/VERIFY SUBSURFACE DRAINAGE LAYER.
 - CONSTRUCT CONTOURING FILL LAYER AND ISOLATION LAYER.
 - INSTALL TEMPORARY LEACHATE TRANSMISSION PIPES FOR FUTURE CONNECTION TO CELL 2 PIPING.
 - INSTALL SUBSURFACE DRAINAGE AND LEACHATE TRANSMISSION PIPES, MANHOLES, AND STRUCTURAL FILL.
 - CONTINUE PLACEMENT OF PRELOAD FILL.
- CELL 5:**
- INSTALL SUBSURFACE DRAINAGE AND LEACHATE TRANSMISSION PIPES, MANHOLES, AND STRUCTURAL FILL.
- CELL 6:**
- INSTALL SUBSURFACE DRAINAGE AND LEACHATE TRANSMISSION PIPES, MANHOLES, AND STRUCTURAL FILL.
 - INSTALL LEACHATE TREATMENT STRUCTURE AND DISCHARGE PIPING TO FAR 2.

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DEC 14 2010

- NOTES:**
- PRELOAD PLACEMENT IS ADVANCED BASED ON THE RATE OF EXCAVATION OF THE MINESPOIL BENCH AND PRODUCTION OF ISOLATION MATERIAL.
 - LEACHATE COLLECTION MANHOLES, TRANSMISSION PIPES AND TREATMENT STRUCTURE (OUTSIDE THE LIMITS OF WASTE) FOR THE ENTIRE RESIDUAL WASTE LANDFILL ARE TO BE CONSTRUCTED DURING CELL 1 CONSTRUCTION.
 - TEMPORARY LEACHATE TRANSMISSION PIPES WILL BE INSTALLED BENEATH ISOLATION LAYER AND ABANDONED AFTER CONSTRUCTION OF OVERLYING CELL LINER AND LEACHATE COLLECTION SYSTEMS.
 - LOCATION OF TEMPORARY HAUL ROADS FOR CELL CONSTRUCTION OR WASTE HAULING WILL VARY DURING OPERATIONS.
 - REFER TO SHEET 4E, 7A, AND 7F FOR SUBSURFACE DRAINAGE LAYER AND HIGHWALL DRAINAGE LAYER GRADING PLAN AND DETAILS.
 - SEE SHEET 4E FOR SUBSURFACE DRAINAGE LAYER PIPES.
 - RUN ON DIVERSION DITCHES TO BE INSTALLED ALONG HIGHWALL BENCHES.
 - CHIMNEY DRAINS ARE USED TO CONVEY CONTACT STORMWATER TO THE LEACHATE COLLECTION SYSTEM. WHERE POSSIBLE CHIMNEY DRAINS HAVE BEEN LOCATED ABOVE LEACHATE COLLECTION CORRIDOR PIPES WHERE THIS CAN NOT BE DONE DUE TO SURFACE DRAINAGE NEEDS THEY HAVE BEEN LOCATED ABOVE LEACHATE LATERAL COLLECTION PIPES. DRAIN LOCATIONS ARE SHOWN ON 6 SERIES DRAWINGS AND DRAWING 4J AT TOP LEFT CORNER. DETAILS ARE SHOWN ON DRAWING 7B.



LEGEND

- 1150 --- EXISTING GROUND SURFACE ELEVATION (5'-ft INTERVAL)
- SF --- SF --- LIMITS OF WASTE
- LC --- LC --- LC --- LEACHATE MANAGEMENT LAYER ELEVATION
- LT --- LT --- SILT FENCE
- TLT --- TLT --- LEACHATE COLLECTION PIPE
- TLT --- TLT --- LEACHATE TRANSMISSION PIPE
- TLT --- TLT --- TEMPORARY LEACHATE TRANSMISSION PIPE
- LEACHATE COLLECTION MANHOLE
- H --- H --- HAUL ROAD
- I --- I --- INTERCELL BERM
- E --- E --- EDGE OF PRELOAD
- T --- T --- TREES, BRUSH
- R --- R --- ROAD
- TOWER --- TOWER --- TRANSMISSION TOWER
- S --- S --- SLOPE ARROW
- CD --- CD --- CHIMNEY DRAIN
- MW --- MW --- GROUNDWATER MONITORING WELLS

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

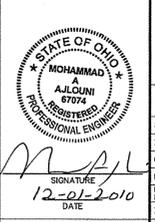
DATE	NO.	DESCRIPTION	APPROV.
DEC 1 2010	E	PTI MODIFICATION NO. 1	MBA, GFD
JAN 25 2007	D	REVISED - NCD 2 SUPPLEMENTAL RESPONSE	DGB
MAY 17 2006	C	REVISED - NCD 2 RESPONSE	DGB
MAY 25 2006	B	REVISED - NCD 1 RESPONSE	DGB
OCT 24 2005	A	ISSUED FOR PERMIT	DGB

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE: CARDINAL FAR 1
RESIDUAL WASTE LANDFILL
CONSTRUCTION STAGING AND
OPERATION STAGE A

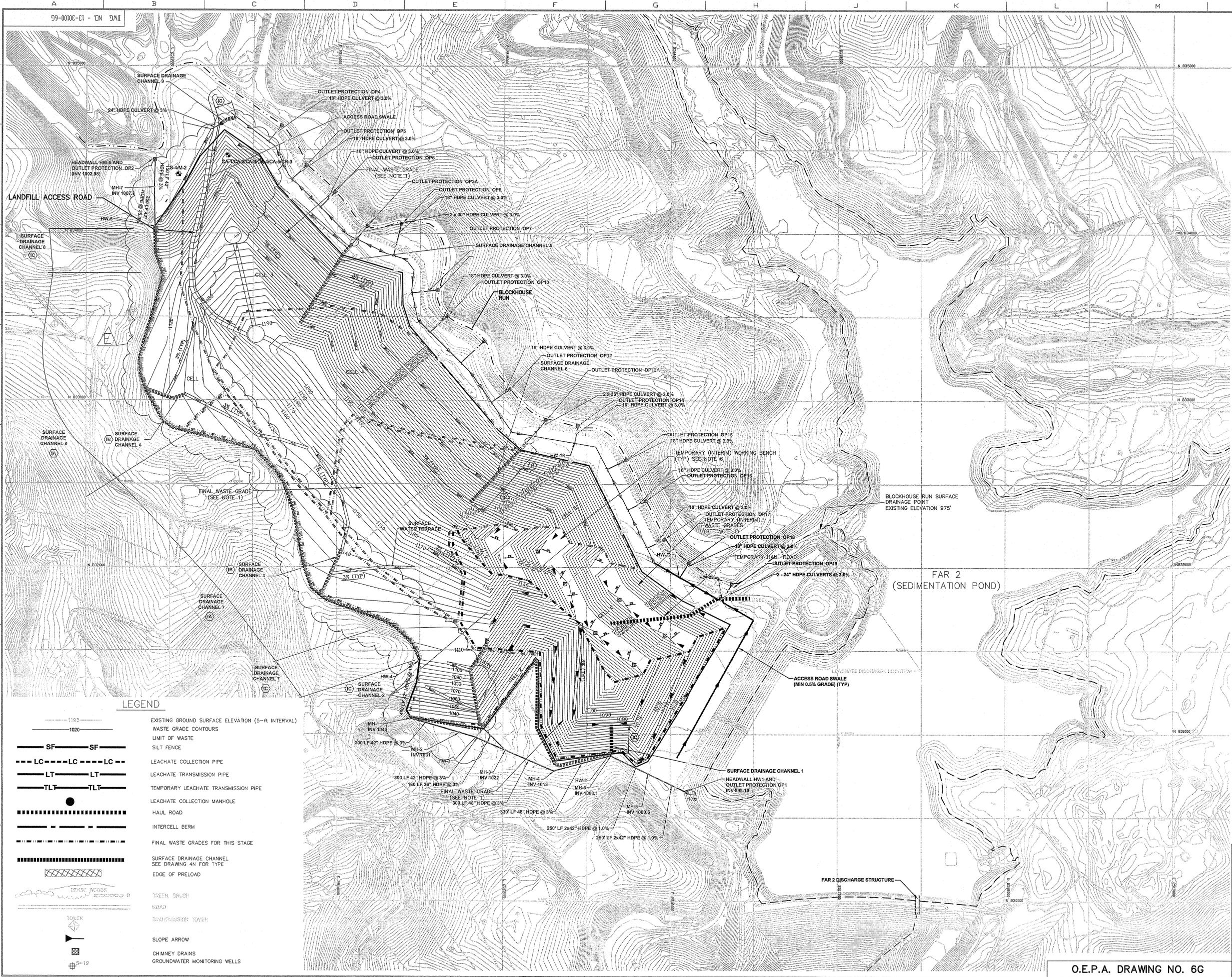
DWG. NO. 13-30100-6A-E
SCALE: CIVIL ENGINEERING DIVISION
SIGNATURE: [Signature]
DATE: 12-01-2010



O.E.P.A. DRAWING NO. 6A

DRAWING 6A OF 39

1 RIVERSIDE PLAZA
COLUMBUS, OH 43215



STAGE G DESCRIPTION

- CELL 1:
1. FINALIZE PHASE 2 FINAL COVER.
- CELL 2:
2. FINALIZE PHASE 2 WASTE GRADE.
- CELL 3:
1. FINALIZE PHASE 2 WASTE GRADE.
- CELL 4:
1. FINALIZE PHASE 2 WASTE GRADE.
- CELL 5:
1. FINALIZE PHASE 2 WASTE GRADE, BEGIN FINAL COVER.
2. CONTINUE CONSTRUCTING LANDFILL ACCESS ROAD.
- CELL 6:
1. BEGIN WASTE PLACEMENT.

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DEC 14 2010
Ohio Environmental Protection Agency

- NOTES:**
1. TEMPORARY COVER WILL BE PLACED IF FINAL OR INTERIM WASTE GRADES ARE TO BE EXPOSED FOR MORE THAN 180 DAYS BEFORE FINAL COVER IS PLACED.
 2. LOCATION OF TEMPORARY HAUL ROADS FOR CELL CONSTRUCTION OR WASTE HAULING WILL VARY DURING OPERATIONS.
 3. UNTIL FINAL COVER GRADES ARE ACHIEVED WASTE SURFACES SHALL BE GRADED TO DRAIN TOWARD CHIMNEY DRAINS AND/OR TEMPORARY INTERIM SLOPES. INTERIM SURFACE WORKING BENCHES WILL BE GRADED AT 2% OR HIGHER GRADES AND INTERIM DRAINAGE TERRACES GRADED AT 0.5% GRADE. TEMPORARY DIVERSION BERMS ALONG FINAL WASTE PERIMETER WILL BE NECESSARY.
 4. REFER TO SHEET 4E, 7A, AND 7F FOR SUBSURFACE DRAINAGE LAYER AND HIGHWALL DRAINAGE LAYER GRADING PLAN AND DETAILS.
 5. CHIMNEY DRAINS ARE USED TO CONVEY CONTACT STORMWATER TO THE LEACHATE COLLECTION SYSTEM. WHERE POSSIBLE CHIMNEY DRAINS HAVE BEEN LOCATED ABOVE LEACHATE COLLECTION CORRIDOR PIPES. WHERE THIS CAN NOT BE DONE DUE TO SURFACE DRAINAGE NEEDS THEY HAVE BEEN LOCATED ABOVE LEACHATE LATERAL COLLECTION PIPES. DRAIN LOCATIONS ARE SHOWN ON 6 SERIES DRAWINGS AND DRAWING 4J AT TOP LEFT CORNER. DETAILS ARE SHOWN ON DRAWING 7B.
 6. THE TEMPORARY INTERIM WORKING BENCHES WILL BE GRADED TO HAVE AT LEAST 2% SLOPE TOWARDS A CHIMNEY DRAIN.



LEGEND

- 1155 --- EXISTING GROUND SURFACE ELEVATION (5-ft INTERVAL)
- 1020 --- WASTE GRADE CONTOURS
- SF --- SF --- LIMIT OF WASTE
- LC --- LC --- LC --- LEACHATE COLLECTION PIPE
- LT --- LT --- LEACHATE TRANSMISSION PIPE
- TLT --- TLT --- TEMPORARY LEACHATE TRANSMISSION PIPE
- LEACHATE COLLECTION MANHOLE
- HUL --- HUL --- HAUL ROAD
- ICB --- ICB --- INTERCELL BERM
- FFG --- FFG --- FINAL WASTE GRADES FOR THIS STAGE
- SDC --- SDC --- SURFACE DRAINAGE CHANNEL SEE DRAWING 4N FOR TYPE
- EOP --- EOP --- EDGE OF PRELOAD
- DB --- DB --- DENSE WOODS
- R --- R --- ROAD
- TP --- TP --- TRANSMISSION TOWER
- SA --- SA --- SLOPE ARROW
- CD --- CD --- CHIMNEY DRAINS
- GMMW --- GMMW --- GROUNDWATER MONITORING WELLS

FAR 2 (SEDIMENTATION POND)

ACCESS ROAD SWALE (MIN 0.5% GRADE) (TYP)

SURFACE DRAINAGE CHANNEL 1

FAR 2 DISCHARGE STRUCTURE

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

DATE	NO.	DESCRIPTION	APPD.
DEC 1 2010	E	PTI MODIFICATION NO. 1	NDJA
JAN 24 2007	D	REVISED - NCD 2 SUPPLEMENTAL RESPONSE	DGB
NOV 17 2006	C	REVISED - NCD 2 RESPONSE	DGB
MAY 25 2005	B	REVISED - NCD 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
CONSTRUCTION STAGING AND
OPERATION
STAGE G

DWG. NO. 13-30100-6G-E

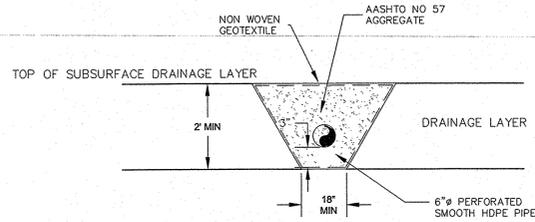
STATE OF OHIO
MOHAMMAD A. ALJOUNI
67074
PROFESSIONAL ENGINEER
SIGNATURE
12-01-2010
DATE

APPROVED BY: CIVIL ENGINEERING DIVISION
SCALE: AS SHOWN
DATE: 12-01-2010

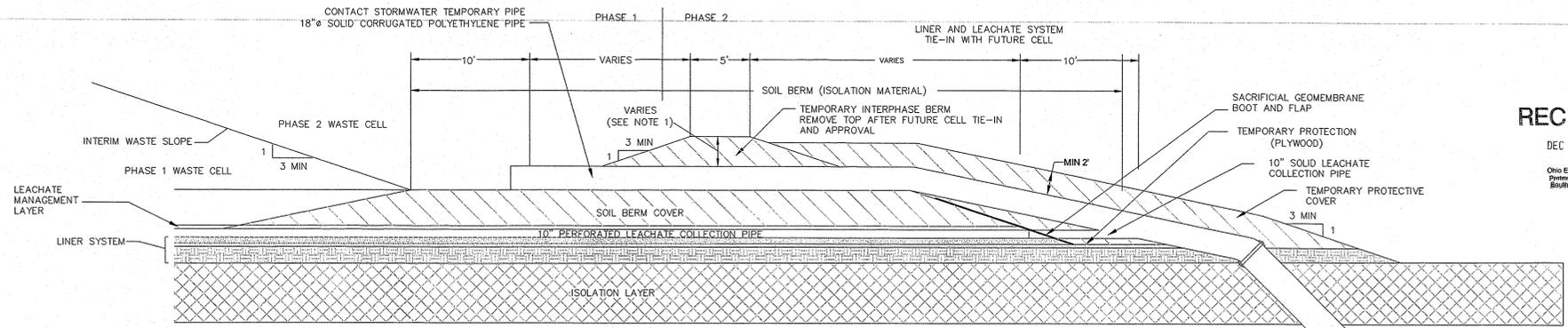
O.E.P.A. DRAWING NO. 6G

DRAWING 6G OF 39

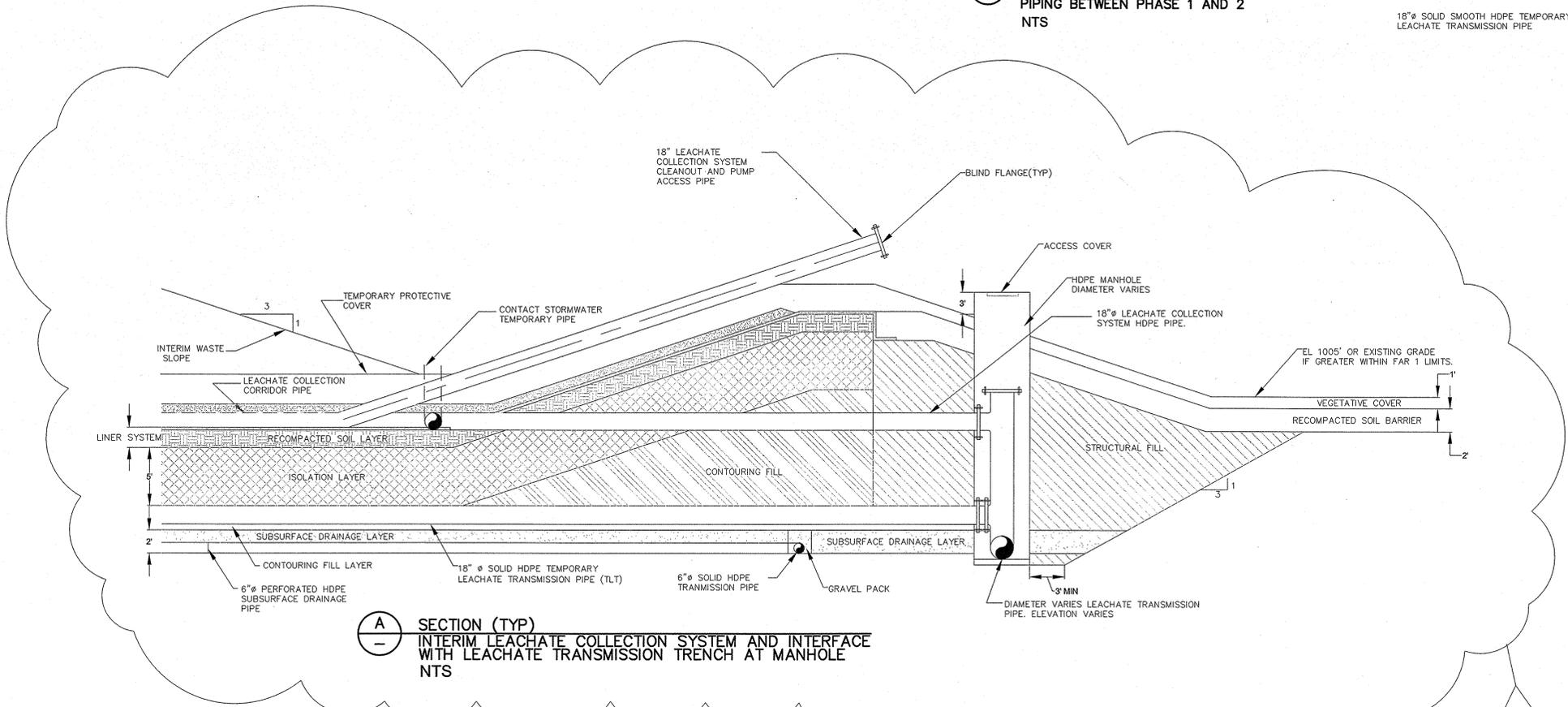
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215



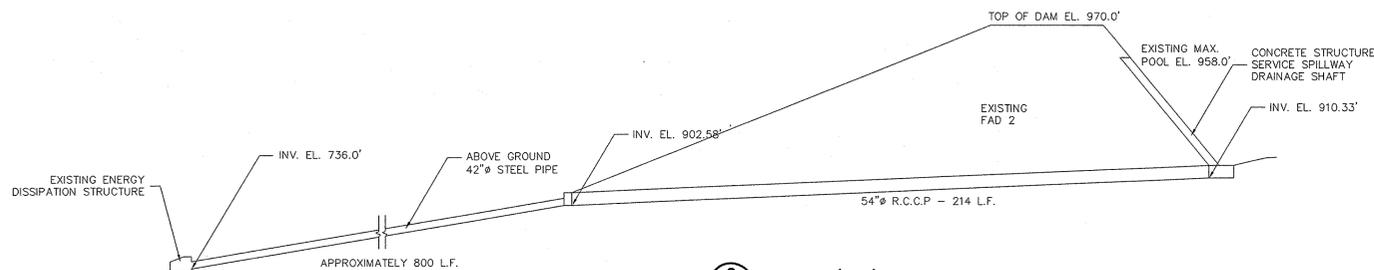
1
4E **DETAIL (TYP)**
SUBSURFACE DRAINAGE PIPE
NTS



5
5C **DETAIL (TYP)**
TEMPORARY LEACHATE COLLECTION
PIPING BETWEEN PHASE 1 AND 2
NTS



A
SECTION (TYP)
INTERIM LEACHATE COLLECTION SYSTEM AND INTERFACE
WITH LEACHATE TRANSMISSION TRENCH AT MANHOLE
NTS



6
4N **DETAIL (TYP)**
EXISTING FAR2 DISCHARGE STRUCTURE
NTS

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DEC 14 2010
Ohio Environmental
Protection Agency
Southeast District

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

DATE	NO.	DESCRIPTION	APP'D.
DEC 01 2010	D	PTI MODIFICATION NO. 1	GFZ
NOV 17 2010	C	REVISED - NOD 2 RESPONSE	DGB
MAY 25 2010	B	REVISED - NOD 1 RESPONSE	DGB
OCT 24 2009	A	ISSUED FOR PERMIT	DGB

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE:
CARDINAL FAR 1
RESIDUAL WASTE LANDFILL
SUBSURFACE DRAINAGE
AND OTHER DETAILS

DWG. NO. 13-30100-7A-D

SCALE: CIVIL ENGINEERING DIVISION

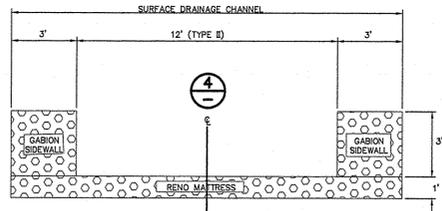
STATE OF OHIO
MOHAMMAD A. AJLOUNI
REGISTERED PROFESSIONAL ENGINEER
SIGNATURE
12-01-2010
DATE

DRAWING 7A OF 39

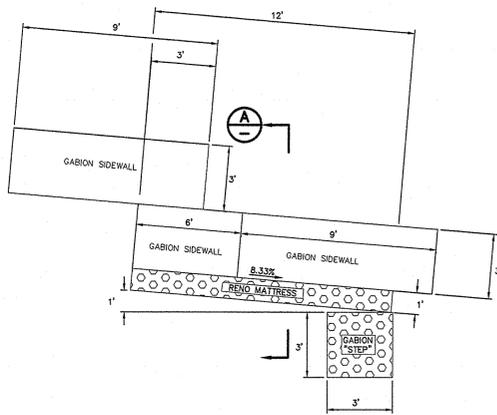
AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA
COLUMBUS, OH 43216

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

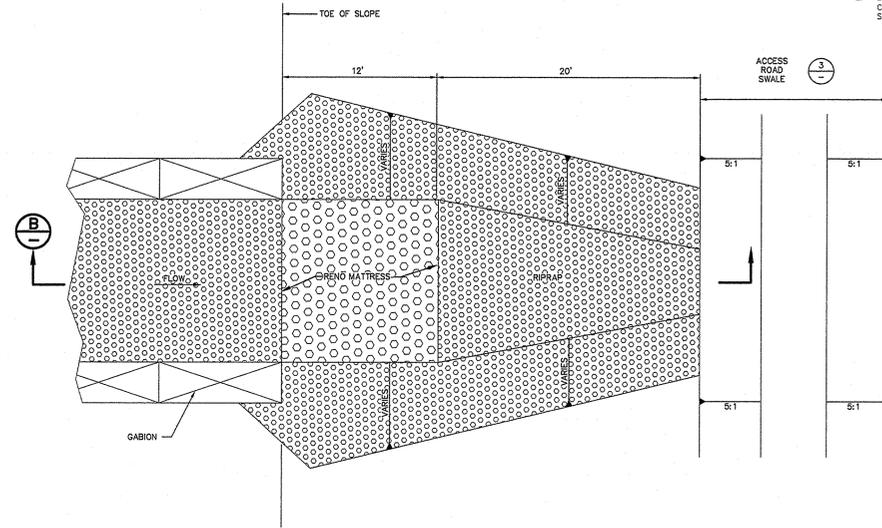
- NOTES:
- GABION BASKETS AND RENO MATTRESSES SHALL CONFORM TO ASTM A-975, STYLE
 - EROSION CONTROL BLANKET (ECB) SHALL BE NORTH AMERICAN GREEN S150, CURLEX 8 STITCHED, OR APPROVED EQUIVALENT. TURF REINFORCEMENT MAT (TRM) SHALL BE NORTH AMERICAN GREEN P350, LANDLOCK TDM 450, OR APPROVED EQUAL



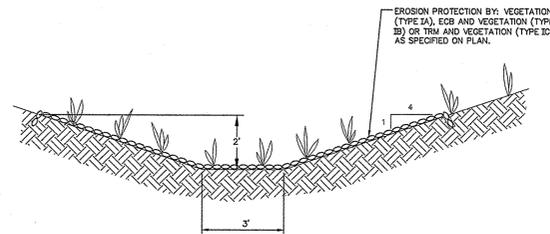
1
4N **DETAIL**
SURFACE DRAINAGE CHANNEL TYPE II
SCALE: NTS
(SEE NOTE 1 AND DETAIL 4 ON THIS SHEET)



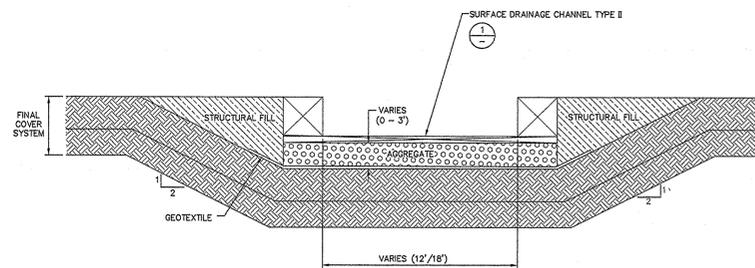
4
PROFILE
SURFACE DRAINAGE CHANNEL
SCALE: NTS
(SEE NOTE 1)



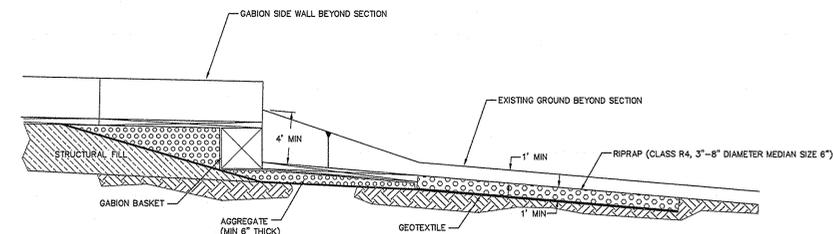
5
4N **PLAN**
OUTLET PROTECTION
SCALE: NTS
(SEE NOTE 1)



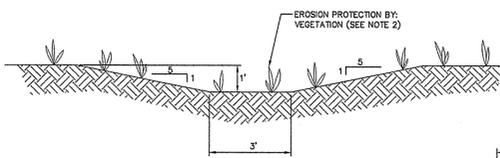
2
4N **DETAIL (TYP)**
SURFACE DRAINAGE CHANNEL TYPE IA/IB/IC
SCALE: NTS
(SEE NOTE 2)



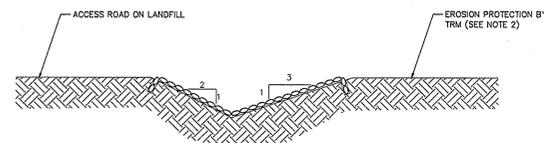
A
SECTION
SURFACE DRAINAGE CHANNEL TYPE II
SCALE: NTS
(SEE NOTE 1)



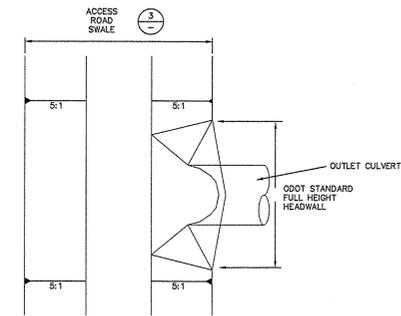
B
SECTION
TRANSITION
SCALE: NTS
(SEE NOTE 1)



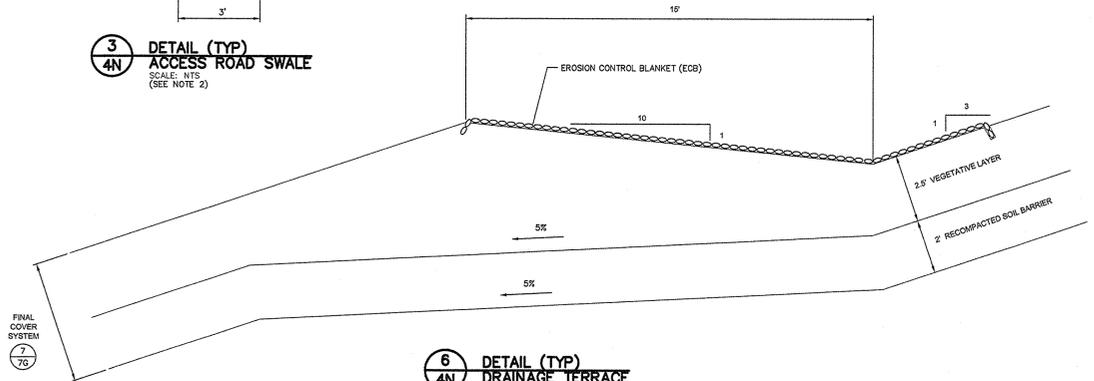
3
4N **DETAIL (TYP)**
ACCESS ROAD SWALE
SCALE: NTS
(SEE NOTE 2)



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 HERETO 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: _____
CR: _____
ENGR: _____
PROJ. ENGR: _____
DATE: _____

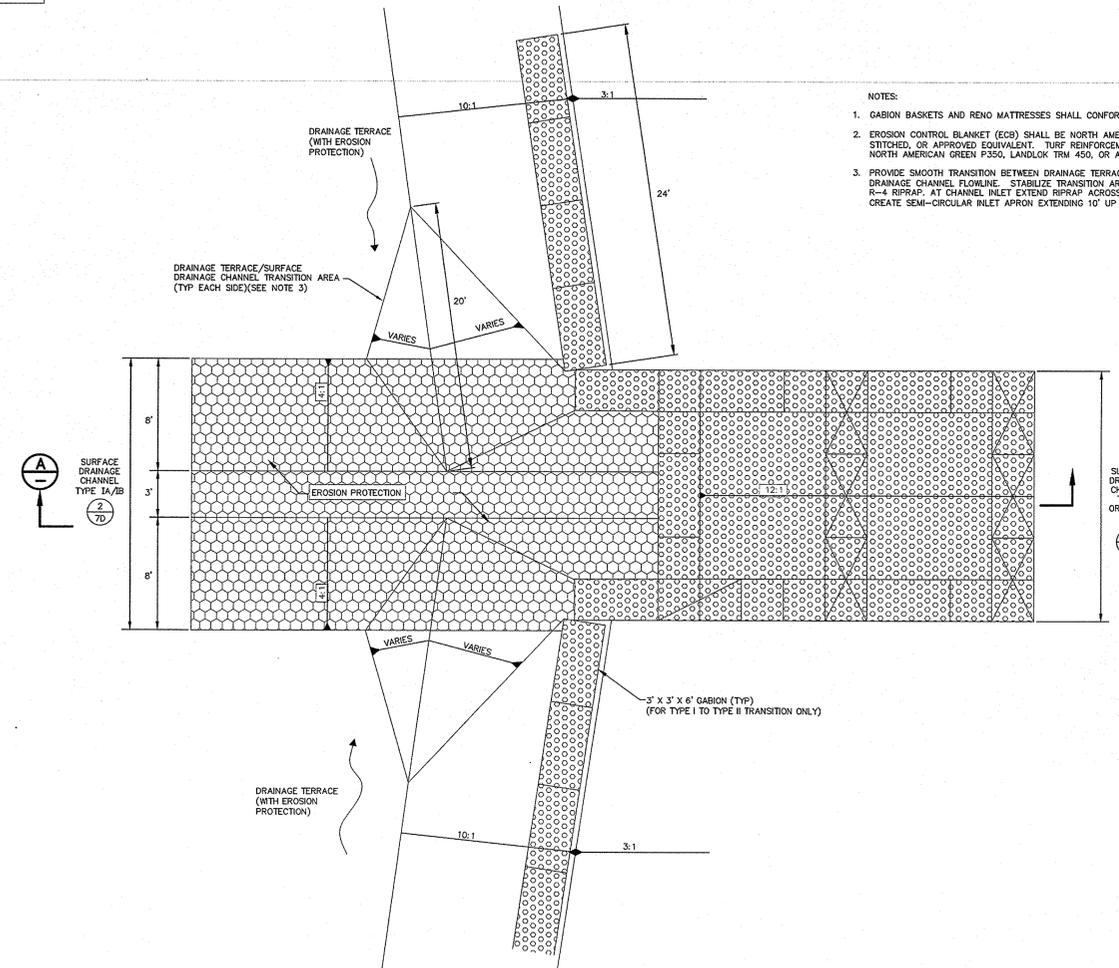


PROJECT NO. - 0169122
FILE NO. _____
DRAWING 7D OF 39

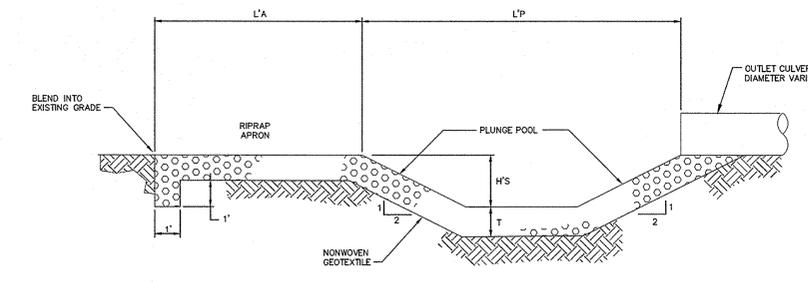
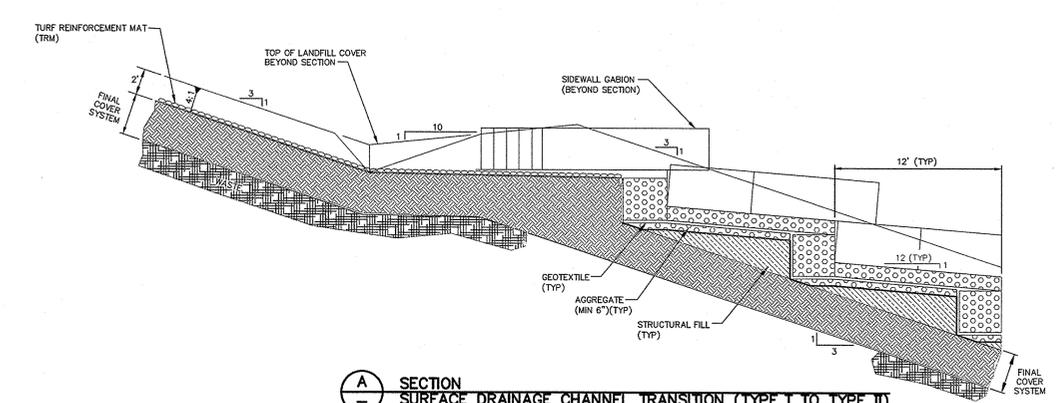
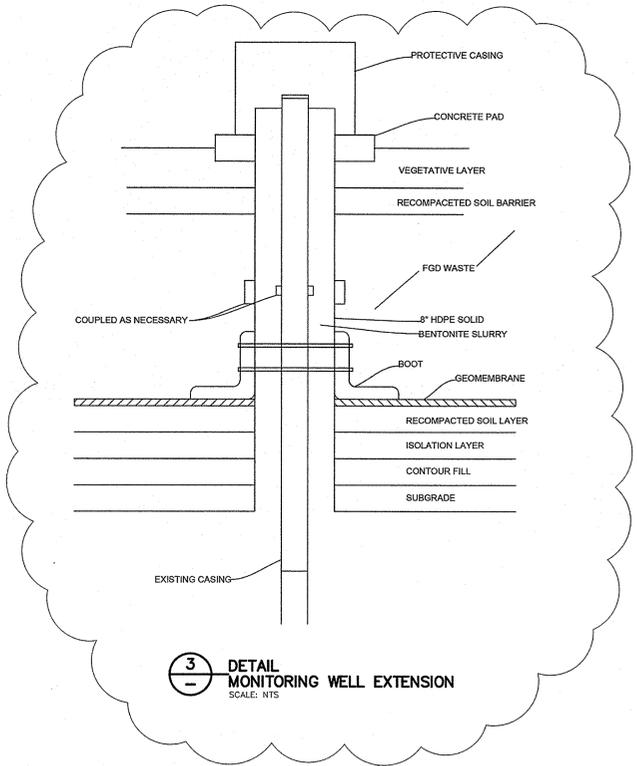
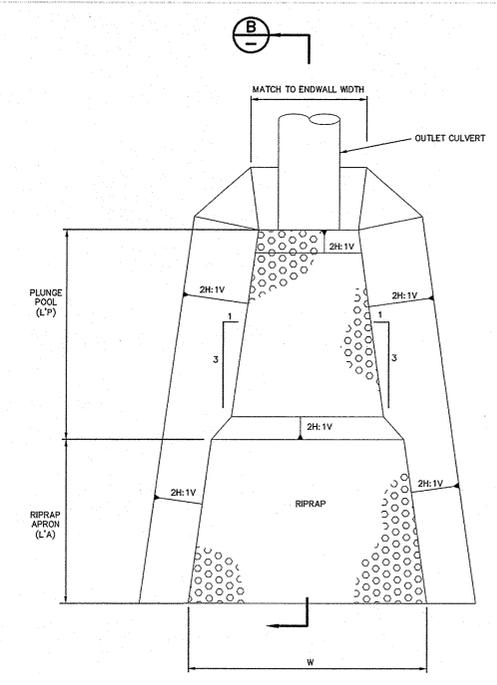
O.E.P.A. DRAWING NO. 7D

1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

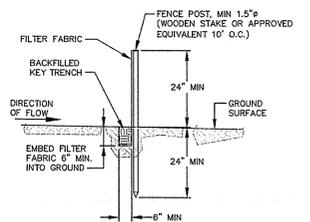
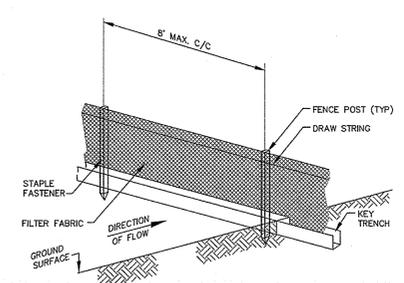
RECEIVED
DEC 14 2010
Ohio Environmental
Protection Agency
Southwest District



- NOTES:
- GABION BASKETS AND RENO MATTRESSES SHALL CONFORM TO ASTM A-975, STYLE 1.
 - EROSION CONTROL BLANKET (ECB) SHALL BE NORTH AMERICAN GREEN S150, CURLX II STITCHED, OR APPROVED EQUIVALENT. TURF REINFORCEMENT MAT (TRM) SHALL BE NORTH AMERICAN GREEN P350, LANDLOK TRM 450, OR APPROVED EQUAL.
 - PROVIDE SMOOTH TRANSITION BETWEEN DRAINAGE TERRACE FLOWLINE AND SURFACE DRAINAGE CHANNEL FLOWLINE. STABILIZE TRANSITION AREA USING 12" THICK LAYER OF R-4 RIPRAP. AT CHANNEL INLET EXTEND RIPRAP ACROSS ENTIRE CHANNEL WIDTH AND CREATE SEMI-CIRCULAR INLET APRON EXTENDING 10' UP GRADIENT.



STRUCTURE	RIPRAP		DIMENSION (FEET)			
	NATIONAL STONE ASSN. CLASSIFICATION	INSTALLATION THICKNESS (T)	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
OP 4 TO 19	R5 (5"-16" DIAMETER, MEDIAN SIZE 8")	18"	14	8	22	1.5



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

DATE	NO.	DESCRIPTION	APPD.
REVISIONS			

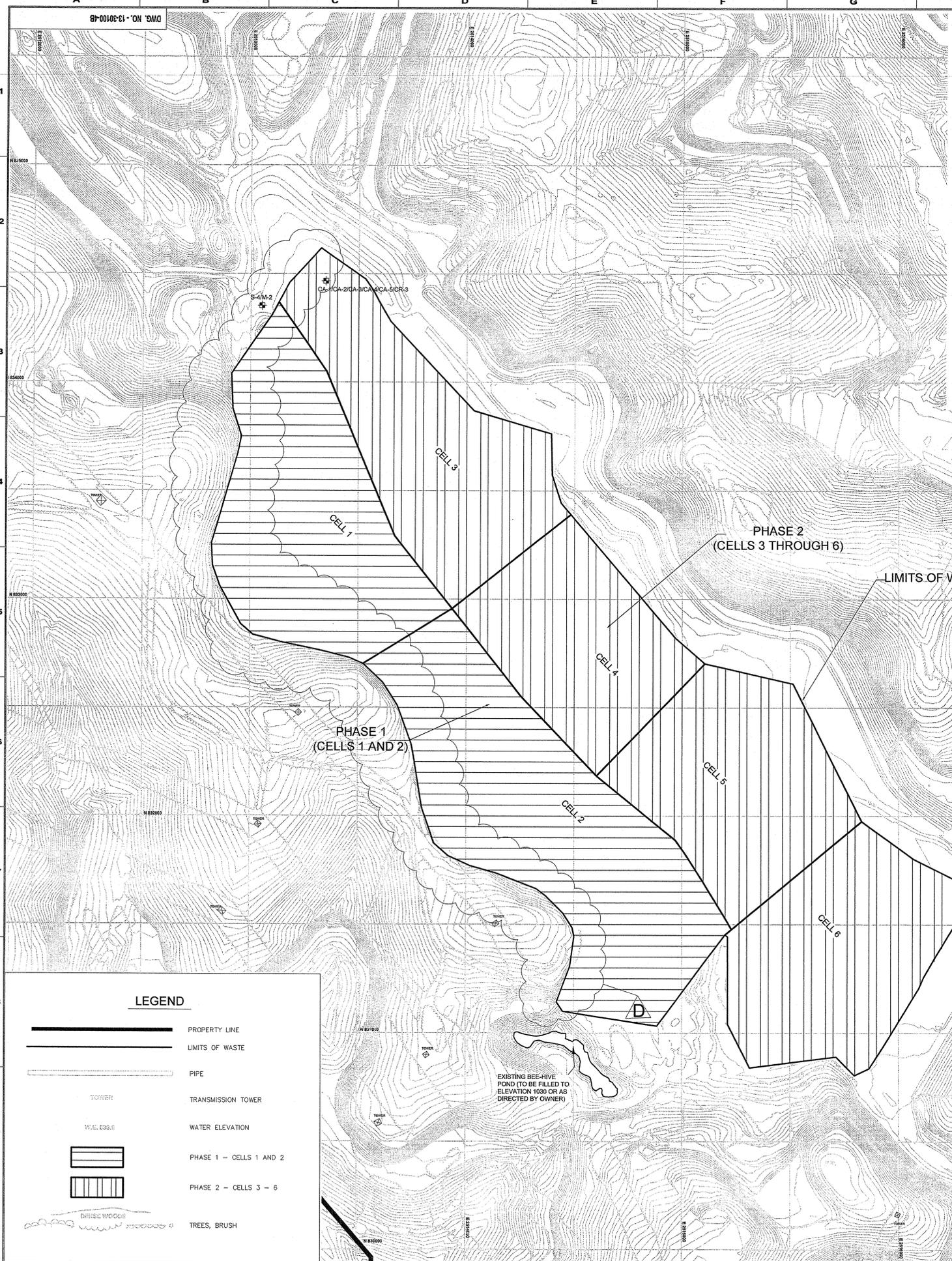
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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO
SITE: CARDINAL FAR 1
RESIDUAL WASTE LANDFILL
EROSION AND SEDIMENT
CONTROL / STORMWATER
CONTROL ELEMENTS II

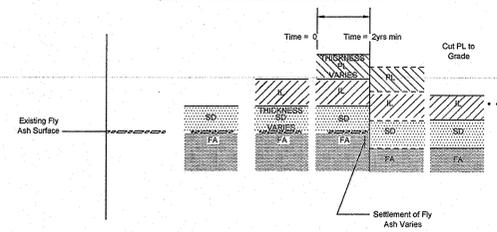
STATE OF OHIO
MOHAMMAD A. ALLOUNI
REGISTERED PROFESSIONAL ENGINEER
12-01-2010

ATTACHMENT C

RUN-OFF CONTROL SYSTEM SUPPORTING DRAWINGS



SCHEMATIC PRELOADING SEQUENCING DIAGRAM



SCHEMATIC LEGEND

- FA (FLY ASH)
- SD (SUBSURFACE DRAINAGE / CONTOURING FILL LAYER)
- PL (PRELOAD LAYER)
- IL (ISOLATION LAYER)

CELL #	AREA (ACRE)	WASTE VOLUME (CY)
1	23.03	2,042,000
2	31.55	3,042,000
3	21.25	2,884,000
4	15.68	4,083,000
5	18.66	4,602,000
6	19.18	2,273,000
TOTAL	129.45	18,943,000

VOLUMES GIVEN ABOVE REPRESENT VOLUMES DETERMINED FROM THE SERIES 6 CONSTRUCTION STAGING AND OPERATION DRAWINGS.

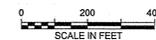
PHASE 1 CONSTRUCTION

1. IMPROVE EXISTING ACCESS ROADS AND CONSTRUCT LAY DOWN AREAS, STAGING AREAS, AND EROSION CONTROL STRUCTURES.
2. EXCAVATE EXISTING MINE SPOIL FROM PHASE 1 AREA. (SEE SHEET 4C FOR GRADING PLAN)
3. PROCESS MINE SPOIL FOR PLACEMENT AS ISOLATION LAYER MATERIAL FOR PHASE 1, PHASE 2, AND AS REPLACED SUBGRADE MATERIAL.
4. STOCKPILE PROCESSED MATERIAL IN PHASE 1 AREA OR ANOTHER DESIGNATED AREA.
5. PLACE PRELOAD IN PHASE 2 CELLS.
6. PLACE SUBGRADE MATERIAL ABOVE EXCAVATED AREA (SEE SHEET 4D FOR GRADING PLAN).
7. CONSTRUCT PHASE 1 SUBSURFACE DRAINAGE LAYER ABOVE SUBGRADE (MINIMUM 2 FEET THICK) (SEE SHEET 4E).
8. PLACE GEOTEXTILE ABOVE SUBSURFACE DRAINAGE LAYER AS SEPARATOR.
9. CONSTRUCT CONTOURING FILL LAYER (SEE SHEET 4F).
10. CONSTRUCT PHASE 1 ISOLATION LAYER (MINIMUM 5 FEET THICK) (SEE SHEET 4G).
11. CONSTRUCT PHASE 1 RECOMPACTED SOIL LINER ABOVE ISOLATION LAYER (MINIMUM 1.5 FEET THICK) (SEE SHEET 4I).
12. PLACE GEOMEMBRANE ABOVE RECOMPACTED SOIL LINER (PVC LINER).
13. PLACE GEOTEXTILE AS CUSHION ABOVE GEOMEMBRANE.
14. CONSTRUCT TEMPORARY LEACHATE PIPING ACROSS FAR 1 BENEATH BOTTOM OF PHASE 2 ISOLATION LAYER (SEE SHEETS 6A AND 7B).
15. CONSTRUCT LEACHATE MANAGEMENT SYSTEM COLLECTION MANHOLES, TRANSMISSION PIPING AND SAMPLING STRUCTURE.
16. CONSTRUCT PHASE 1 LEACHATE MANAGEMENT LAYER (MINIMUM 1 FOOT THICK) AND PLACE GEOTEXTILE AS SEPARATOR AND FILTER ABOVE AND BELOW LAYER (SEE SHEET 4J).
17. PLACE PROTECTIVE COVER (MINIMUM 3 FEET THICK) ABOVE LEACHATE COLLECTION LAYER.
18. CONSTRUCT INTERPHASE BERM AND TEMPORARY LINER SYSTEM TERMINATION BETWEEN PHASE 1 AND PHASE 2.
19. BEGIN PHASE 1 WASTE PLACEMENT OPERATIONS (SEE SHEET 4K).
20. AS WASTE REACHES FINAL GRADES, BEGIN FINAL COVER PLACEMENT IN ACCORDANCE WITH FINAL COVER CONSTRUCTION STAGING AND OPERATION STAGES. (SEE SHEET 6B AND 6C).

PHASE 2 CONSTRUCTION

1. CONSTRUCT PHASE 2 SUBSURFACE DRAINAGE LAYER ABOVE EXISTING FAR 1 COVER (MINIMUM 2 FEET THICK) (SEE SHEET 4E).
2. PLACE GEOTEXTILE ABOVE SUBSURFACE DRAINAGE LAYER AS SEPARATOR.
3. CONSTRUCT CONTOURING FILL LAYER (SEE SHEET 4F).
4. CONSTRUCT PHASE 2 ISOLATION LAYER (MINIMUM 5 FEET THICK) (SEE SHEET 4G).
5. PLACE TEMPORY GEOTEXTILE LOCATOR AND CONSTRUCT MINESPOIL PRELOAD IN PHASE 2 CELLS (SEE SHEET 4H).
6. REMOVE PRELOAD AND GEOTEXTILE LOCATOR. REESTABLISH BASE GRADE AND FILL AND RECOMPACT SURFACE TO ISOLATION LAYER MINIMUM REQUIREMENTS (SEE SCHEMATIC PRELOADING PLACING DIAGRAM ON THE LEFT).
7. CONSTRUCT PHASE 2 RECOMPACTED SOIL LINER (MINIMUM 1.5 FEET THICK) ABOVE RECOMPACTED ISOLATION LAYER (SEE SHEET 4I).
8. PLACE GEOMEMBRANE ABOVE RECOMPACTED SOIL LINER (PVC LINER).
9. PLACE GEOTEXTILE AS CUSHION ABOVE GEOMEMBRANE.
10. CONSTRUCT PHASE 2 LEACHATE MANAGEMENT LAYER (MINIMUM 1 FOOT THICK) AND PLACE GEOTEXTILE AS SEPARATOR AND FILTER ABOVE. ABANDON OR REMOVE PREVIOUS TEMPORARY LEACHATE PIPING AFTER CONNECTION OF PHASE 2 PERMANENT PIPING.
11. PLACE PROTECTIVE COVER (MINIMUM 3 FEET THICK) ABOVE LEACHATE COLLECTION LAYER. REMOVE PORTION OF INTER PHASE BERM ABOVE PROTECTIVE COVER.
12. BEGIN PHASE 2 WASTE PLACEMENT OPERATIONS (SEE SHEET 4K).
13. AS WASTE REACHES FINAL GRADES, BEGIN FINAL COVER PLACEMENT IN ACCORDANCE WITH FINAL COVER CONSTRUCTION STAGING AND OPERATION STAGES. (SEE SHEET 6D THROUGH 6G AND 4M FOR FINAL GRADES).

RECEIVED
DEC 14 2010



LEGEND

- PROPERTY LINE
- LIMITS OF WASTE
- PIPE
- TRANSMISSION TOWER
- WATER ELEVATION
- PHASE 1 - CELLS 1 AND 2
- PHASE 2 - CELLS 3 - 6
- TREES, BRUSH

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

DATE	NO.	DESCRIPTION	APPR.
DEC 1 2010	D	PTI MODIFICATION NO. 1	PKA
NOV 17 2009	C	REVISED - HOD 2 RESPONSE	DOB
MAY 25 2009	B	REVISED - HOD 1 RESPONSE	DOB
OCT 24 2008	A	ISSUED FOR PERMIT	DOB

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE: **CARDINAL FAR 1 RESIDUAL WASTE LANDFILL GENERAL DEVELOPMENT**

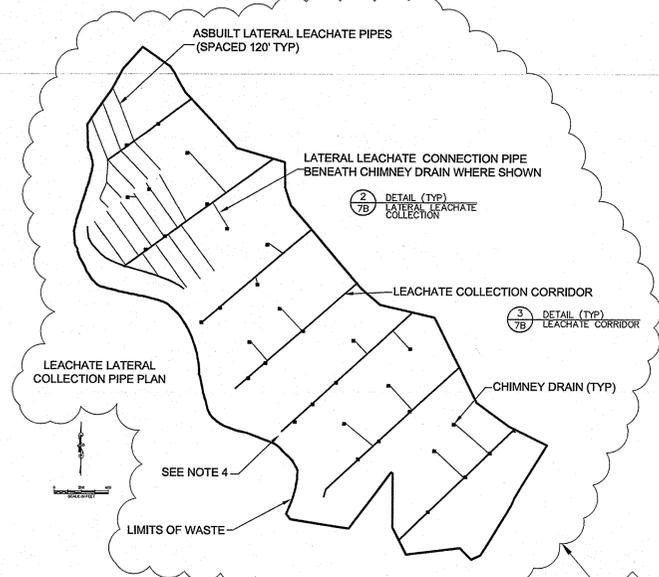
DWG. NO. **13-30100-4B-D**

SCALE: **CIVIL ENGINEERING DIVISION**



SIGNATURE: *M. Alouni*
DATE: **12-01-2010**

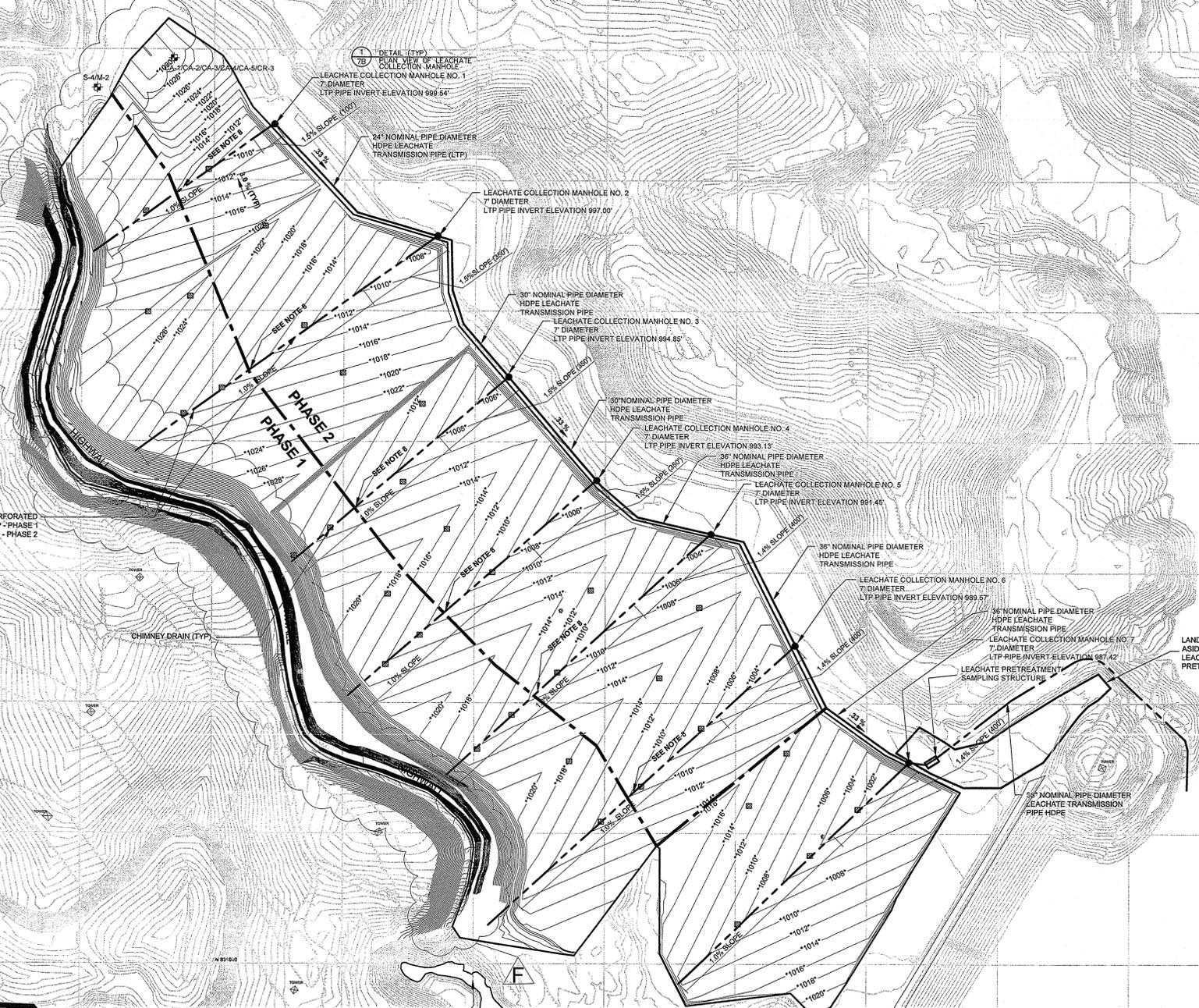
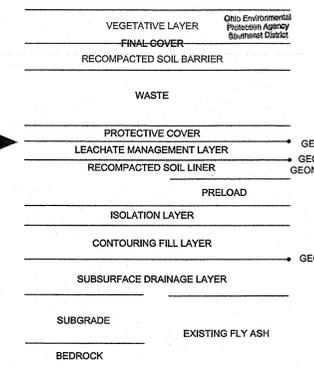
19'00"00"01" ON 3"MD



- LEACHATE MANAGEMENT / PROTECTIVE COVER PLAN NOTES:**
1. THIS SHEET SHOWS THE GRADES FOR TOP OF LEACHATE MANAGEMENT LAYER. THE HIGHWALL GRADES SHOWN ARE EXCAVATION GRADES ONLY.
 2. LEACHATE MANAGEMENT SYSTEM CONSISTS OF LEACHATE COLLECTION PIPES AND 1 FOOT GRANULAR DRAINAGE LAYER. A DOUBLE-SIDED GEOTEXTILE WILL BE USED FOR LEACHATE COLLECTION ALONG THE HIGHWALL. RECOMPACTED SOIL LINER AS SHOWN IN HIGHWALL DETAILS ON SHEET 7F.
 3. PLACE LEACHATE COLLECTION PIPES IN CORRIDORS AS SHOWN WITHIN THE 1 FOOT GRANULAR DRAINAGE LAYER.
 4. LATERAL LEACHATE PIPES ARE NOT PLACED ALONG THE HIGHWALL.
 5. LATERAL LEACHATE PIPES IN THE NORTHEAST CORNER ARE ALIGNED TO REFLECT LOCAL GRADING.
 6. PLACE GEOTEXTILE ABOVE LEACHATE MANAGEMENT LAYER.
 7. THREE (3) FEET PROTECTIVE COVER WILL BE PLACED OVER THE GRADES SHOWN ON THIS SHEET.
 8. AT THE COMPLETION OF EACH PHASE 2 CELL LINER SYSTEM CONSTRUCTION, THE PHASE 1 18-INCH DIAMETER PERFORATED LEACHATE COLLECTION PIPE WILL TRANSITION INTO A PERMANENT PHASE 2 18-INCH DIAMETER PERFORATED LEACHATE COLLECTION PIPE. THE 18-INCH PIPE WILL ALSO BE USED TO ACCOMMODATE ACCESS OF A CONTINGENCY LEACHATE COLLECTION PUMP WHEN AND IF NEEDED.

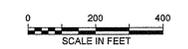
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RECOMPACTED SOIL BARRIER PLAN NOTES: DEC 14 2010



GRADING SHOWN ON THIS SHEET

ACTIVE FLY ASH RESERVOIR (FAR 2)



SOLID WASTE APPROVED

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUG 10 2011

AS EVIDENCED BY COPY OF LETTER OF APPROVAL HERETO ATTACHED

DATE	NO.	DESCRIPTION	APPROV.
DEC 1 2010	F	PTI MODIFICATION NO. 1	HAA
JAN 31 2007	E	REVISED TO REFLECT LEACHATE LATERAL PIPES REMOVAL	DGR
NOV 17 2006	D	REVISED - HDD 2 SUPPLEMENTAL RESPONSE	DGR
MAY 25 2006	C	REVISED - HDD 2 RESPONSE	DGR
OCT 24 2005	B	REVISED - HDD 1 RESPONSE	DGR
	A	ISSUED FOR PERMIT	DGR

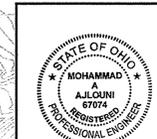
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CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

TITLE: CARDINAL FAR 1 RESIDUAL WASTE LANDFILL LEACHATE MANAGEMENT PLAN

DWG. NO. 13-30100-4J-F

CIVIL ENGINEERING DIVISION

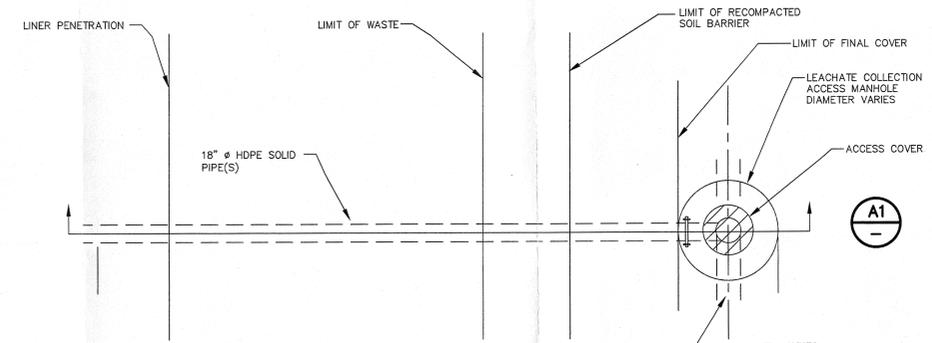


SIGNATURE: *A.J. Jilcuni*

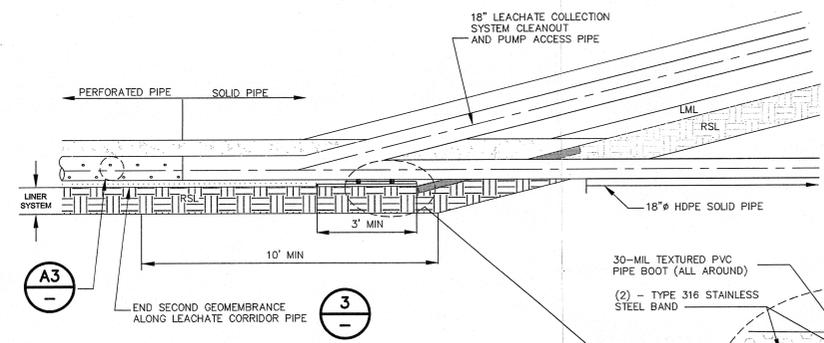
DATE: 12-01-2010

LEGEND

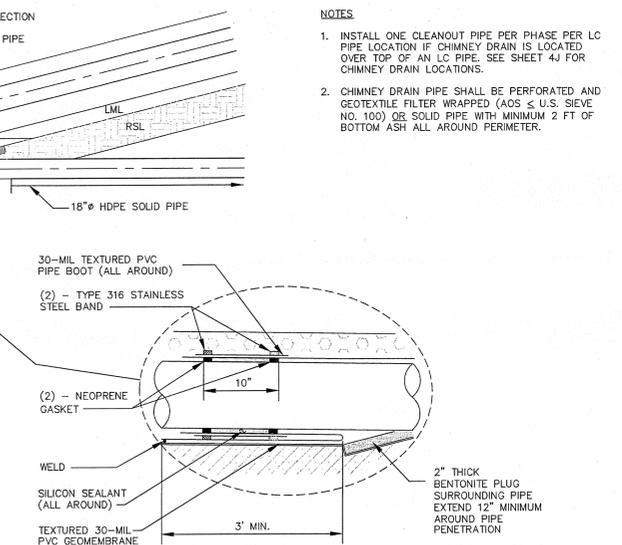
- *1010*
- 1050
- TOP OF LEACHATE MANAGEMENT LAYER (2'-ft INTERVAL)
- EXISTING GROUND SURFACE ELEVATION (5'-ft INTERVAL)
- LIMITS OF WASTE
- PIPE
- LEACHATE COLLECTION PIPE
- LEACHATE COLLECTION MANHOLE
- INTERCELL BERM BETWEEN PHASES
- DENSE WOODS
- TREES, BRUSH
- TOWER
- TRANSMISSION TOWER
- EXISTING WATER ELEVATION
- PROPERTY LINE
- CHIMNEY DRAINS



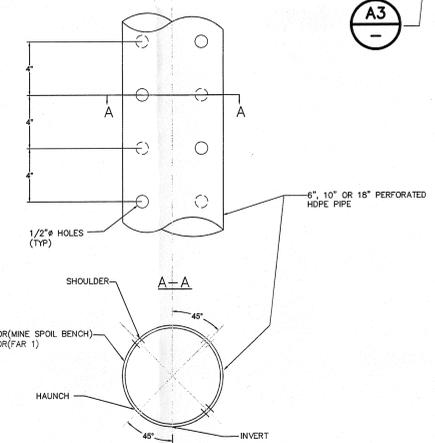
1
4J
DETAIL (TYP)
PLAN VIEW OF LEACHATE COLLECTION
MANHOLE ENTRANCES
NTS



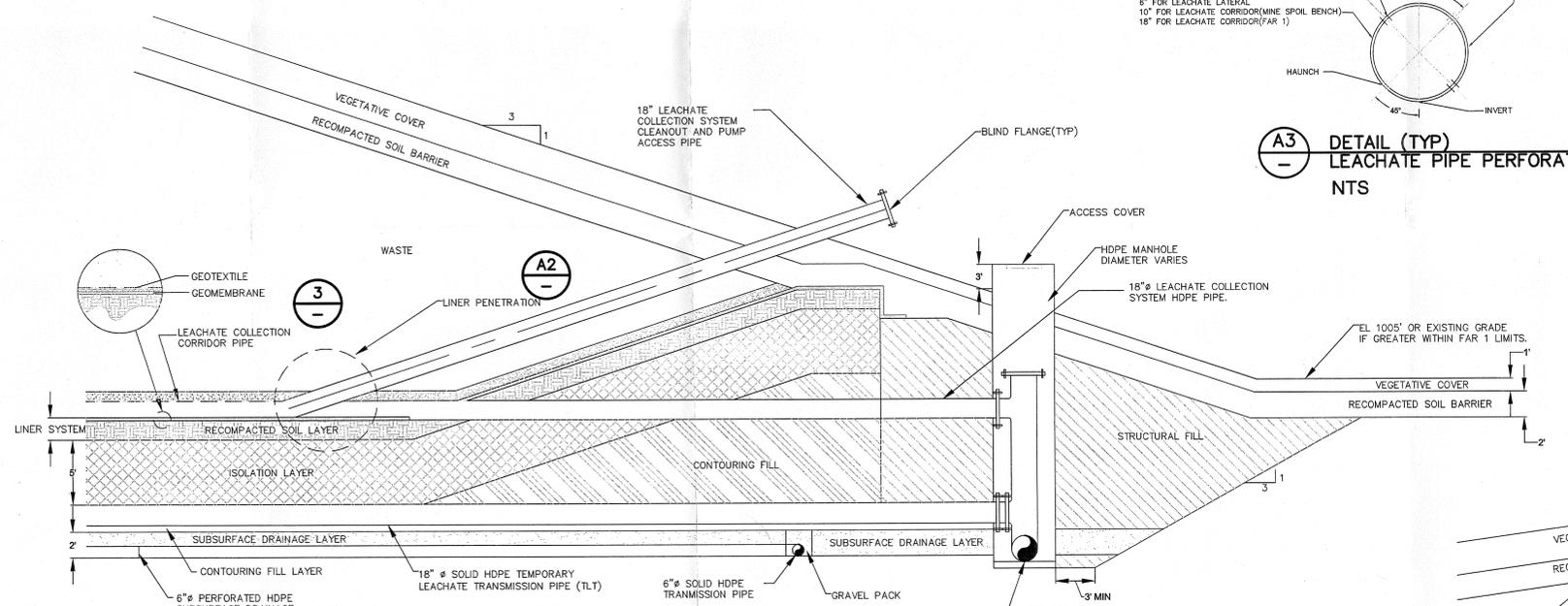
A2
DETAIL (TYP)
LINER PENETRATION
NTS



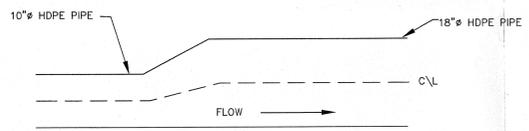
- NOTES**
1. INSTALL ONE CLEANOUT PIPE PER PHASE PER LC PIPE LOCATION IF CHIMNEY DRAIN IS LOCATED OVER TOP OF AN LC PIPE. SEE SHEET 4J FOR CHIMNEY DRAIN LOCATIONS.
 2. CHIMNEY DRAIN PIPE SHALL BE PERFORATED AND GEOTEXTILE FILTER WRAPPED (AOS < U.S. SIEVE NO. 100) OR SOLID PIPE WITH MINIMUM 2 FT OF BOTTOM ASH ALL AROUND PERIMETER.



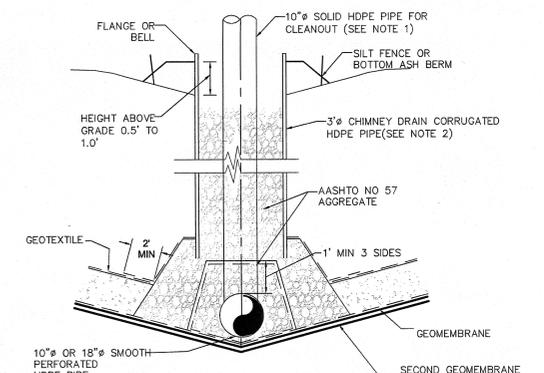
A3
DETAIL (TYP)
LEACHATE PIPE PERFORATIONS
NTS



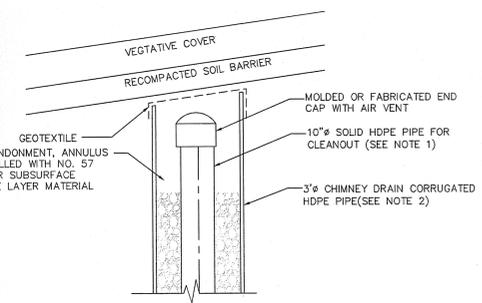
A1
SECTION (TYP)
LEACHATE COLLECTION SYSTEM AND INTERFACE
WITH LEACHATE TRANSMISSION TRENCH AT MANHOLE
NTS



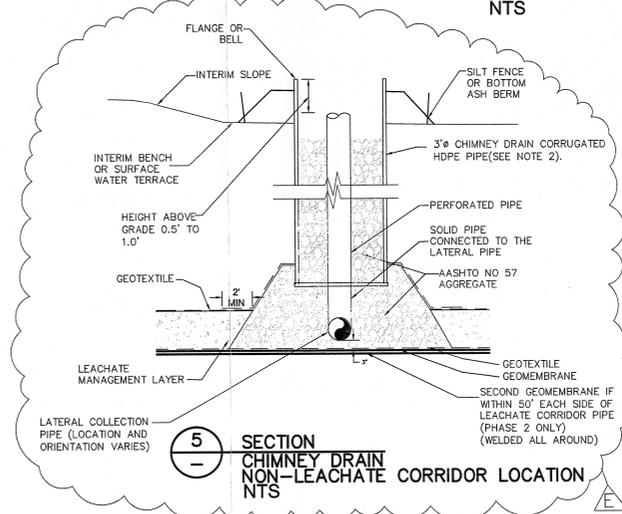
6
FABRICATED 10" TO 18" TRANSITION
NTS



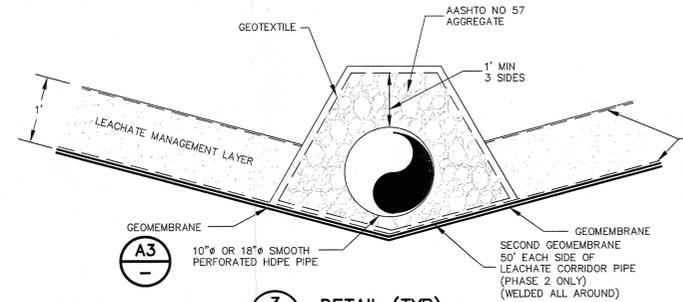
4
SECTION
CHIMNEY DRAIN
LEACHATE CORRIDOR LOCATION
NTS



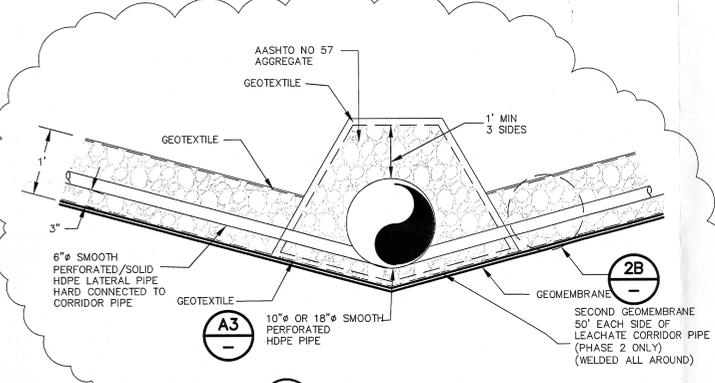
7
DETAIL (TYP)
CHIMNEY DRAIN ABANDONMENT
NTS



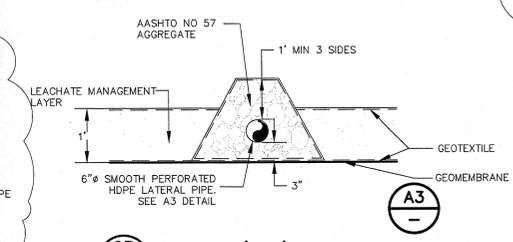
5
SECTION
CHIMNEY DRAIN
NON-LEACHATE CORRIDOR LOCATION
NTS



3
4J
DETAIL (TYP)
LEACHATE CORRIDOR
NTS



2
4J
DETAIL (TYP)
LATERAL CONNECTION TO CORRIDOR
NTS



2B
DETAIL (TYP)
LATERAL COLLECTION PROFILE
NTS

DATE	NO.	DESCRIPTION	APPD.
OCT 25 2010	E	REVISED TO REFLECT LEACHATE LATERAL PIPES REMOVAL	AJA
JAN 29 2011	D	REVISED NOD 2 SUPPLEMENTAL RESPONSE	DGB
NOV 17 2009	C	REVISED - NOD 2 RESPONSE	DGB
MAY 21 2008	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 LEACHATE COLLECTION AND MANAGEMENT SYSTEM ELEMENTS**

DWG. NO. 13-30100-7B-E
CIVIL ENGINEERING DIVISION

SOLID WASTE
APPROVED
OHIO ENVIRONMENTAL PROTECTION AGENCY
DEC 03 2010
ALTERS AUTHORIZATION APPROVED
DATE: MAY 11, 2007

STATE OF OHIO
REGISTERED PROFESSIONAL ENGINEER
A. J. LOUHI
67074

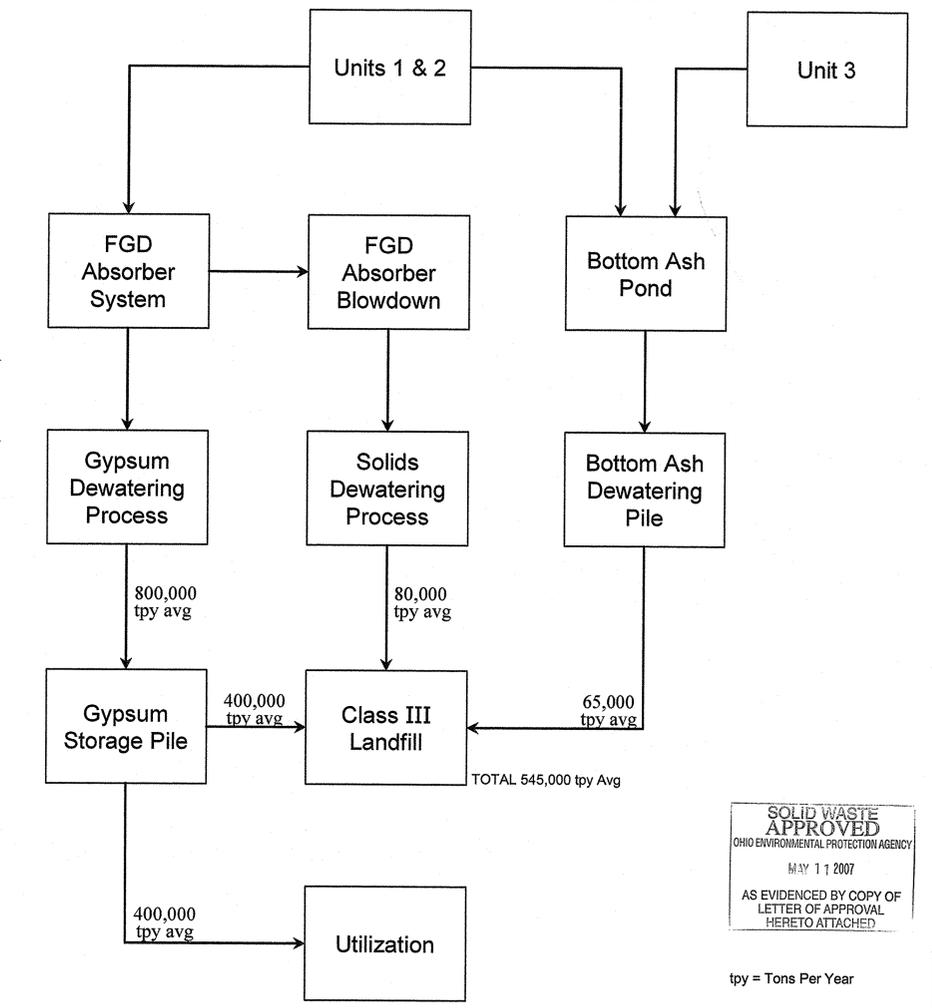
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DATE: October 25, 2010

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

DRAWING 7B OF 39

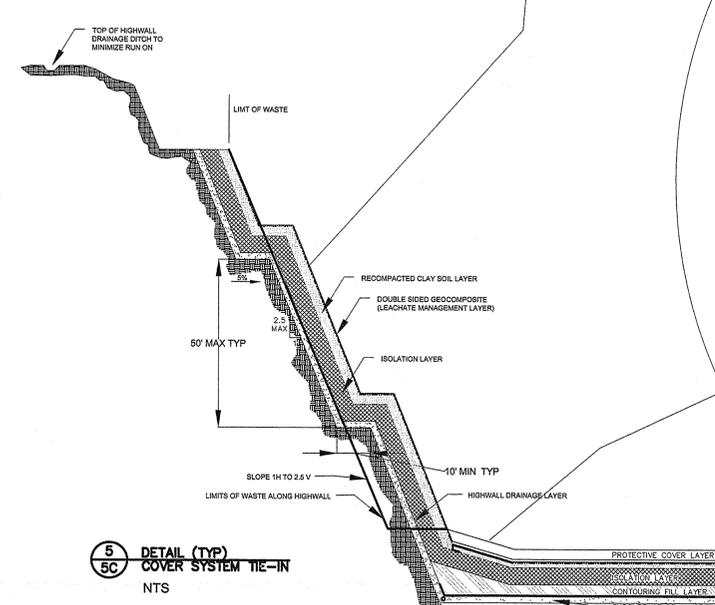
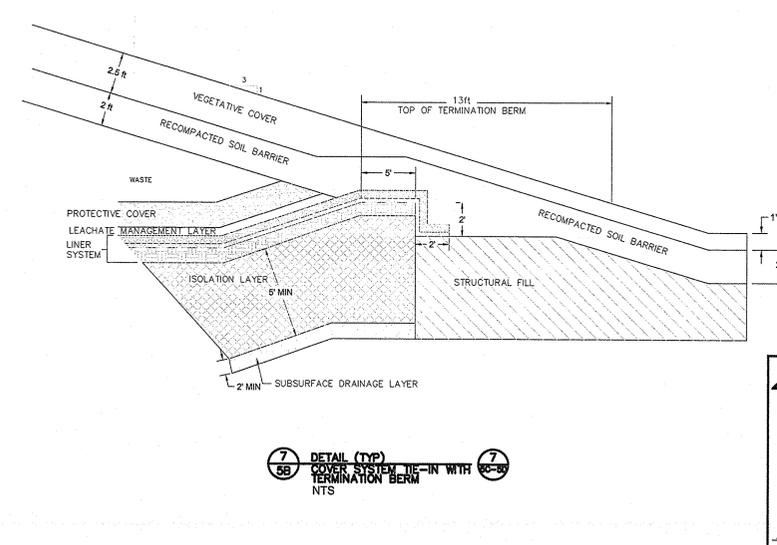
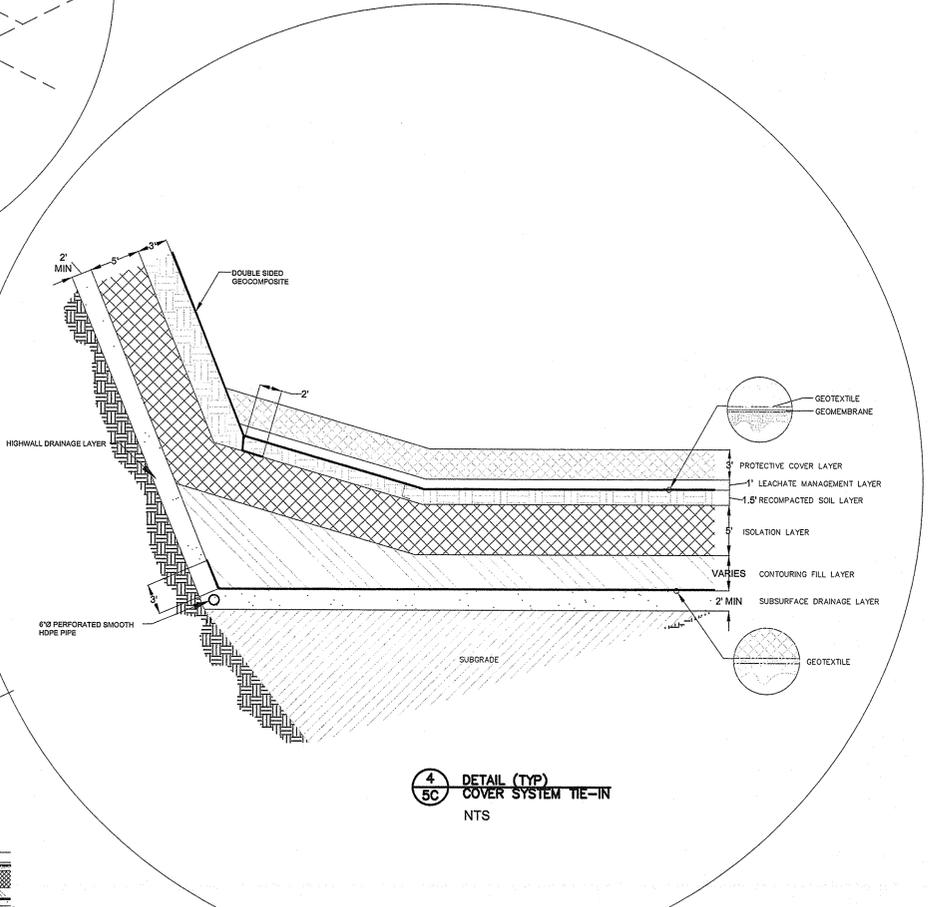
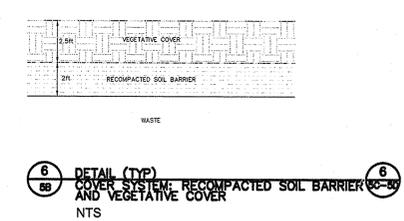
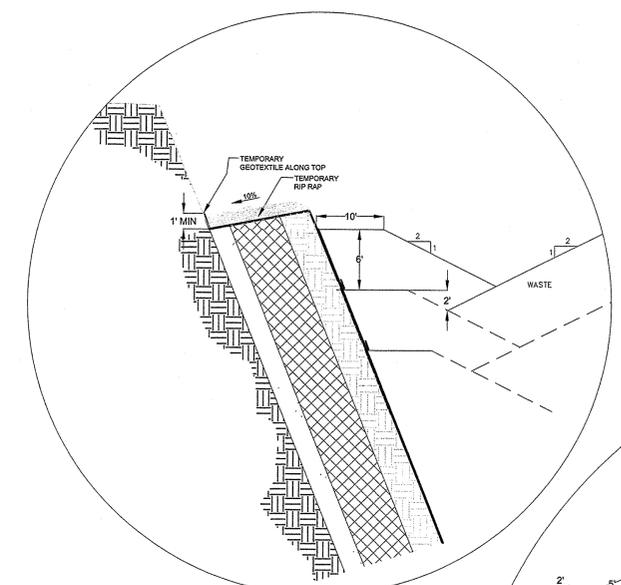
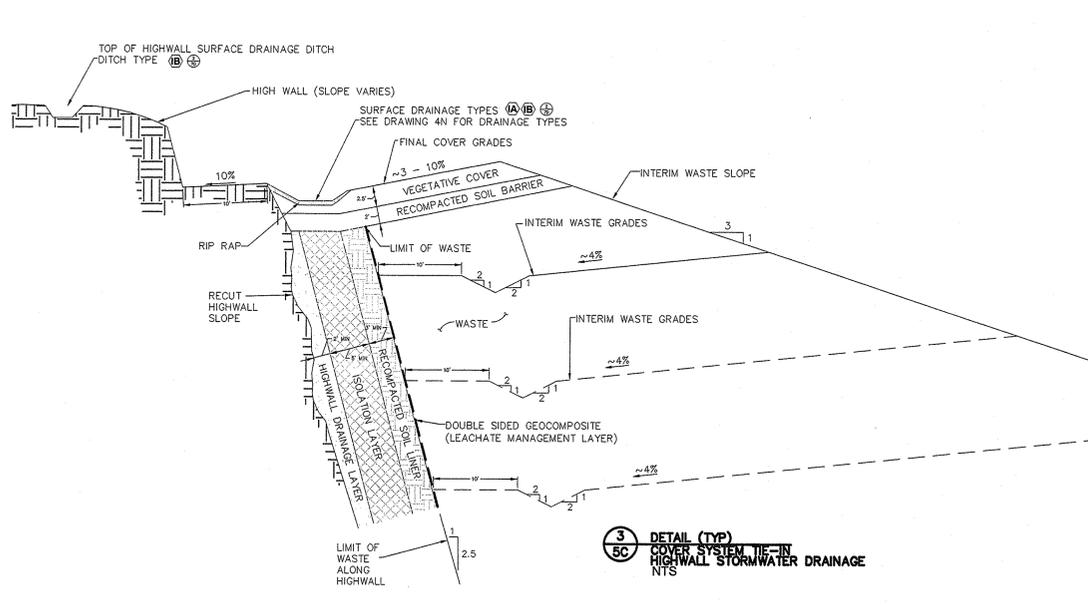
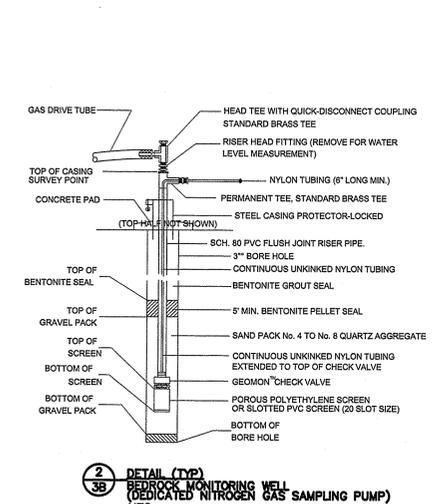
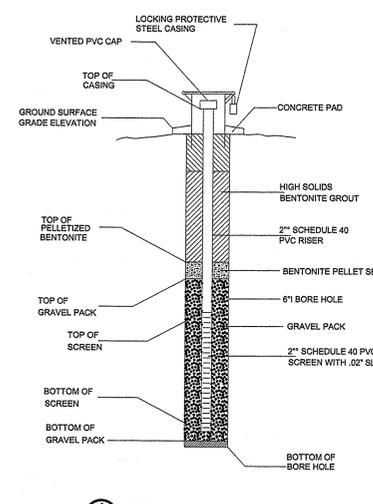
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

GENERAL PROCESS FLOW DIAGRAM



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

tpy = Tons Per Year



RECEIVED
 MAY 02 2007
 Ohio Environmental Protection Agency
 Southeast District

DATE	NO.	DESCRIPTION	APPD.
JAN 25 2007	D	REVISED NOD 2 SUPPLEMENTAL RESPONSE	DGB
NOV 17 2006	C	REVISED - NOD 2 RESPONSE	DGB
MAY 25 2006	B	REVISED - NOD 1 RESPONSE	DGB
OCT 24 2005	A	ISSUED FOR PERMIT	DGB

REVISIONS

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CARDINAL OPERATING COMPANY
CARDINAL PLANT
 BRILLIANT OHIO

TITLE: **CARDINAL FAR 1 RESIDUAL WASTE LANDFILL COVER SYSTEM AND OTHER DETAILS**

DWG. NO. 13-30100-7F-D

SCALE: **CIVIL ENGINEERING DIVISION**

PROJECT NO. CHER126
 FILE NO. **7E** OF **39**

DATE: **25 Jan 2007**

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