# MITCHELL LANDFILL
# RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

**Prepared for:**

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**d/b/a AMERICAN ELECTRIC POWER SERVICE CORPORATION**
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**CEC Project 356-929**

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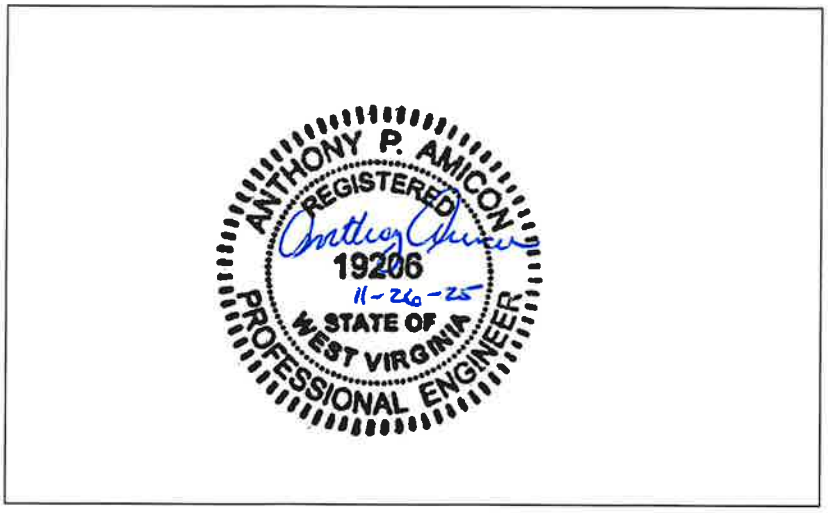
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## ENGINEER'S VERIFICATION STATEMENT

I hereby verify that the contents of this Run-On and Run-Off Control System Plan for the Mitchell Landfill owned by the Kentucky Power Company doing business as (d/b/a) American Electric Power Service Corporation meets the requirements of Federal Regulations Title 40, Part 257.81.




Anthony P. Amicon, P.E. - Principal
Civil & Environmental Consultants, Inc.

# 1.0 INTRODUCTION

The Mitchell landfill (ML) is owned and operated by Kentucky Power Company, doing business as (d/b/a) American Electric Power Service Corporation (AEP). The landfill is located along Gatts Ridge Road (Marshall County Road 72), approximately 2 miles north of the intersection with County Road 74 (about 2 miles due east of the Mitchell Power Generation Plant) in Marshall County, West Virginia. The ML is regulated by the West Virginia Department of Environmental Protection (WVDEP) under Solid Waste Permit No. WV0116742, allowing construction and operation of the landfill.

Overall, ML has a maximum disposal capacity of about 10 million cubic yards for excess Coal Combustion Residuals (CCR) produced from the Mitchell Power Generating Plant that is not beneficially reused. The landfill boundary comprises about 169.6 acres with CCR being placed within a footprint of 57.6 acres. Construction of ML was initiated in 2013 and operation of the landfill began in May of 2014.

The United States Environmental Protection Agency (USEPA) established a Rule for CCR waste units, which has been published in the Federal Register and is an extension of the current Code Federal Rules (CFR) Title 40, Part 257 (Rule §257). In accordance with §257.81, the ML is required to prepare a Run-On and Run-Off Control System Plan (Plan) by October 17, 2016. The Plan is to be included with the facility's Operating Record and periodically updated as required by § 257.105(g)(3). As such, in order to comply with §257.81, AEP has contracted Civil & Environmental Consultants, Inc. (CEC) to review and update the Plan to reflect current site conditions. This Plan addresses the following requirements of Rule §257.81:

- 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

- 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. Run-off from the active

portion of the CCR Unit must be handled in accordance with the surface water requirements under §257.3-3.

Since the ML 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. Note that 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 WVDEP associated with the ML.

CEC notes that there have been no revisions/alterations to the approved stormwater design since the revisions noted in the last Run-On and Run-Off Control Plan update, dated January 2020. Currently, the ML continues waste placement in the Phase 3 Area (see Drawing 12-30110-24-B in Appendix C). Construction of the Phase 4 base liner is planned for future operations and will be completed in accordance with the requirements outlined in this plan.

# 2.0 RUN-ON CONTROLS

## 2.1 RUN-ON CONTROL OUTSIDE THE LANDFILL FOOTPRINT

Run-on control outside of the landfill footprint generally consists 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 WVDEP Solid Waste Regulations and meet the requirement for the ML NPDES Permit.

These stormwater surface controls are constructed in phases associated with landfill development. The ML has been subdivided into numbered phases (Phases 1 through 5) reflecting the order in which each partial area of the landfill will be constructed and filled. ML is currently placing waste in Phase 3. As the landfill operations progress, a subsequent phase of the landfill is prepared and constructed. Sediment basin(s) and other associated surface water/erosion control structures (cover, diversion berms, channels, ditches, etc.) are then constructed as part of the phase development. A General Phasing Plan (Drawing No. 12-30110-13-B in Appendix C) depicts an overview of the landfill sequencing. Drawing Nos. 12-30110-21-B through 12-30110-26-B in Appendix C 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.

### 2.1.1 Stormwater Channel and Culvert Design

Existing and/or future permanent drainage channels collect and convey non-contact water to three permanent sediment ponds. The surface water channels are designed such that the stormwater volumes and peak flows were calculated using the "Soil-Cover Complex" methodology presented in Soil Conservation Service Technical Release No. 55 ("TR-55", SCS 1986). Site soils were classified as Hydrologic Soil Groups “B” and “C”, and all land covers were assumed to be in "good" condition. Since over 95% of the site consists of “C” type soils, type “C” soils curve numbers were used throughout the calculations. 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 2year, 24-hour; 10-year, 24-hour; 25-year, 24-hour; 50-year, 24-hour; 100-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 South, West, and East Sediment Ponds.

The rainfall intensities at the location of the ML 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 Marshall County, West Virginia. 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.

Several existing or future culverts are associated with ML development. Riprap outlet protection is used to prevent erosion at each culvert. Refer to Drawing Nos. 12-30110-18-B, 12-30110-21-B through 12-30110-28-B, 12-30110-40-A, 12-3011-43-A, 12-30110-41-A, 12-30110-44-A, and 12-30110-45-B in Appendix C 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 Appendix B Section 1 of this Plan.

### 2.1.2 Sediment Pond Design

Three permanent (all constructed) sediment ponds are associated with ML development. The primary sediment pond (South Pond) is located at the south end of the landfill and at the downstream end of the valley. The two other permanent sediment ponds (East and West Ponds) are located east and west of the landfill waste limits. These structures are used to collect stormwater and control sediment.

Current and future sediment ponds have been designed with outlet structures that control the discharge of stormwater through the basins. Each sediment control structure has sediment capacity of 0.125 acre-feet for each acre of disturbed area in the structure's watershed. In addition to the sediment capacity, the sediment control structures have a detention capacity to store a 2-year, 24-hour frequency storm. The detained stormwater is then released through a non-clogging dewatering skimmer device that allows the stored volume of water to be evacuated within a 7-day to 8-day period.

The structures provide a combination of principal and emergency spillways that safely discharge the 25-year, 24-hour storm without overtopping of the structure. The structures are designed to

ensure no outflow through the emergency spillway during the passage of a 10-year, 24-hour frequency storm.

During the design storm, each structure provides a minimum difference in elevation of 1 foot between the crest of the principal spillway and the crest of the emergency spillway. Additionally, a minimum difference in elevation of 1 foot of freeboard is provided between the maximum design flow elevation in the emergency spillway and the top of the embankment.

Supporting calculations used to size the sediment ponds using the above-described methodology (i.e., 24-hour, 25-years storm event) are presented in Appendix B Section 1 of this Plan. Refer to Drawings in Appendix C for the locations, design grades, and details associated with the Sediment Ponds and supporting structures.

## 2.2 RUN-ON CONTROL INSIDE THE LANDFILL FOOTPRINT

Active waste operations will continue at the ML 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. Details related to the cap are shown on Drawing No. 12-30110-48-B in Appendix C and specifics for the cover soils are described below.

The permanent cover for the ML will consist of a 2-foot thick layer of compacted cohesive soil meeting a minimum permeability of $1 \times 10^{-6}$ cm/sec. Selected natural soils and highly weathered bedrock will meet this criteria. The recompacted soils and bedrock samples tested achieved permeability values ranging between $1x10^{-5}$ cm/sec to $1x10^{-7}$ cm/sec (compacted to 95% of the Standard Proctor).

Lime, fertilizer and mulch will be provided as necessary to promote vegetative growth within the top 6 inches of the cover. The natural soil cover material will be generated from excavations required to achieve the landfill liner, sediment ponds, Leachate Storage Pond, and haul road grades.

Similar to the run-on control features, stormwater control features atop of the permanent cover (i.e., benches, downchutes, etc.) have a hydrologic design basis of the 25-year, 24-hour storm event. Refer to the supporting calculations in Appendix B Section 2 of this Plan for design calculations associated with the run-on control features within the landfill footprint.

# 3.0 RUN-OFF CONTROLS

## 3.1 PERIMETER CONTAINMENT BERMS

Generally, the working surface of the active landfill remains relatively level with the active fill area being sloped towards the interior of the landfill, such that the successive waste fill lifts increase the elevation within the phase. This is accomplished by constructing a containment berm at the planned exterior limits of the interim or final slope of the phase followed by placement of successive waste fill lifts within the phase until the approximate top of the containment berm is reached. This process is continued by shifting the outside edge of each subsequent containment berm to create a maximum exterior slope of 3 horizontal to 1 vertical (3H:1V) until the design grade of the phase is reached. These containment berms serve 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 toe of the first three phases in the valley bottom, 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. The initial containment berm for Phase 4 (future construction) will be increased to 15 feet in height. Subsequent containment berms have a maximum height of 5 feet and a crest width of 6 feet. The internal and external slopes have a minimum 2H:1V and 3H:1V, respectively.

## 3.2 LEACHATE COLLECTION SYSTEM

Contaminated runoff ("contact water") is collected as part of the leachate collection system and is conveyed to the Leachate Storage Pond via the vertical chimney drains, the leachate collection system, and associated lift station. 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 ML. The average daily

leachate flow for the ML, as estimated by the HELP model, is 560 gallons per acre per day for active landfill operation areas, and 180 gallons per acre per day after landfill closure.

The maximum average annual leachate volume will occur when a majority of the site is closed and a portion of the landfill remains active, and can be computed assuming the maximum area of the active phase is 15 acres with the remaining 42.6 acres of landfill area being closed. Using the above estimated daily leachate flows for active and closed conditions, the maximum average annual leachate volume for the entire 57.6-acre lined landfill area is expected to be 6,000,000 gallons per year. These volume estimates are based on steady-state flow conditions. Supporting calculations are contained in Appendix B Section 2 of this Plan.

Note that the HELP Model calculations included in Appendix B Section 2 include evaluations where the peak precipitation event is 4.44 inches, which corresponds to the 24-hour, 25-year storm event. Therefore, design aspects of ML which rely on the above-described leachate generation estimates are designed for the 24-hour, 25-year storm event per §257.81. Drawing Nos. 12-30110-15-B and 12-30110-16-A in Appendix C identify the location of the leachate collection system.

## 3.3 LEACHATE CONVEYANCE FEATURES

The leachate collection system consists of three main components:

- Geocomposite Drainage Net (GDN) [Phases 1 and 2 only] - comprised of a high density polyethylene (HDPE) geonet with nonwoven, needle-punched geotextiles heat-bonded to its upper and lower surfaces. GDN covers the entire bottom of the landfill within Phases 1 and 2 and collects and conveys leachate to pipe/aggregate envelopes located along the landfill side slopes and valley axes.
- Granular Drainage Material - constructed atop the GDN [Phases 1 and 2] or atop of a cushion geotextile [Phases 3 and 4] with a minimum thickness of 18-inches across the bottom of the landfill (within the main valley axis).

- Leachate collection system piping –comprised of perforated HDPE pipes, non-calcareous, free draining aggregate, and a nonwoven, needle-punched geotextile. The leachate collection system piping collects and conveys leachate out of the landfill via gravity flow and into a lift station for conveyance to the Leachate Storage Pond.

For Phases 1 and 2, GDN was selected as the primary leachate collection/conveyance layer due to its reduced thickness (results in additional landfill airspace), ease of installation (as compared to an aggregate layer), and high hydraulic conductivity (minimizes development of leachate head atop the composite liner). The GDN also acts as a cushion layer to protect the PVC geomembrane from damage during protective cover placement. Coarse aggregate envelopes the leachate collection pipes to provide high hydraulic conductivity. A non-carbonate stone is used to prevent degradation of the collection envelope over time. HDPE pipe was specified to withstand the landfill loads while being compatible with the anticipated leachate. The leachate collection system piping was also designed with cleanouts to facilitate maintenance.

For Phases 3 and 4, a geotextile cushion was installed directly above the PVC geomembrane to protect it from damage during leachate collection material placement. Bottom ash material serves as the primary leachate collection/conveyance layer in the leachate management system for the Phase 3 and 4 landfill valley bottom and side slopes areas. Additionally, leachate collection pipes enveloped with aggregate provide a flow path for leachate to be conveyed from the facility. HDPE pipe was specified to withstand the landfill loads while being compatible with the anticipated leachate. The leachate collection system piping was also designed with cleanouts to facilitate maintenance.

Leachate and contaminated stormwater (stormwater that has come in contact with waste) is collected by the leachate conveyance features and conveyed to a lift station. The lift station structure receives leachate via gravity flow from the landfill and transfers the leachate via a force main to the Leachate Storage Pond. The lift station structure is sealed and lined to prevent leakage and leachate pipes located outside of the landfill limits of waste are comprised of dual walled pipes. The capacity of the pump station is established based on the anticipated peak leachate flow rates from the leachate collection system and the operational efficiency requirements of the selected

pump(s). The pump station structure is lined and the associated force main is comprised of a dual walled HDPE pipe. The pump station is equipped with an automated control system to operate the pumps, provide alerts to the operator and monitor the leachate volumes pumped to the storage pond. The emergency overflow for the lift station is directed to a pipe that bypasses the South Pond and discharges to an unnamed tributary to Fish Creek.

The location and design details for the lift station and Leachate Storage Pond are included on Drawing Nos. 12-30110-15-B, 12-30110-16-A, 12-30110-45-B, 12-30110-47-B, and 12-30110-50B, DR-4-A, and DR-5-B in Appendix C.

## 3.4 LEACHATE STORAGE POND

A Leachate Storage Pond has been established as part of the initial landfill construction and will remain in service throughout the operational life of the landfill and during the post-closure period. The Leachate Storage Pond is located at the high point of the valley ridge west of the landfill such that the pond bottom is well above the seasonal high groundwater at the site. This pond has a composite liner comprised of a 4-feet thick geologic isolation layer, a 45-mil polypropylene geomembrane constructed atop a geosynthetic clay liner (GCL). The maximum holding capacity of the Leachate Storage Pond is 6.9 acre-feet (ac-ft.). The design holding capacity is sufficient to contain the anticipated leachate volume for a 30-day period, as required by the West Virginia Solid Waste Regulations. The 30-day storage capacity is calculated using the average annual leachate volume of 6,000,000 gallons per year adjusted to 30 days to get a required storage capacity of 500,000 gallons (1.5 ac-ft.). In addition, the storage pond has excess holding capacity (about 5.4 ac-ft.) to store contact runoff generated from heavy precipitation events. The additional holding capacity, in excess of the 30-day storage capacity, allows for storage of leachate that is generated from a 100-year 24-hour storm applied over 15 acres of active disposal area draining to the leachate collection system.

The Leachate Storage Pond pool elevation is monitored and managed on a regular basis by the landfill operator. Leachate is removed from the storage pond on an as needed basis to maintain sufficient storage capacity. The leachate removed from the pond is beneficially reused (dust

suppression within the landfill, moisture conditioning of fly ash to facilitate compaction or moisture conditioning of fly ash at the storage silo) or treated at the wastewater treatment bottom ash pond complex at the Mitchell Plant. No overflow discharge will occur from the pond except on an emergency basis. Design details for the Leachate Storage Pond are included on Drawings DR-4-A and DR-5-B in Appendix C.

## 3.5 WASTE FILLING OPERATIONS

Generally, waste materials are spread and graded in 12-inch thick loose lifts. If necessary, the material is moisture conditioned to prior to compaction. Each lift is compacted using a smooth drum vibratory roller to achieve an in-situ density of at least 95 percent of the maximum laboratory dry density as determined by ASTM D-698. The smooth drum roller has a minimum dynamic force of 500 pounds per linear inch and a static weight of 125 pounds per lineal inch. The compaction units shall travel at a speed not exceeding 2.5 miles per hour with a minimum of six passes. Each pass of the vibratory roller overlaps the adjacent pass. The compaction equipment, lift thickness and number of passes are subject to change based on verification that the in-place density of the waste is achieved using alternative methods. Within the distance of 8 feet from any structure, the use of the above-specified roller shall be discontinued and hand-operated compactors shall be used. In addition, the fly ash, bottom ash and gypsum is commingled in normal waste placement operational areas without any specified segregation.

To assure an environmentally sound operation, the ML site waste hauling procedures require the following:

- Trucks shall be tarped while traveling to and from the landfill;
- Trucks shall maintain posted speed limits; and
- Upon trucks leaving the landfill site on their return trip, the disposal contractor must make certain that the truck body and wheels are free of all ash and/or mud before entering roads. A truck washing facility may be established at the landfill site, if necessary, to safeguard against these conditions occurring.

## 4.0 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 ML. A Plan Review Log to record periodic Plan reviews and revisions is included in Appendix A.

# APPENDIX A

# PLAN REVIEW LOG

# MITCHELL LANDFILL
# RUN-ON, RUN-OFF CONTROL PLAN

## PLAN REVIEW LOG

| Action | Performed by: | Date |
|---|---|---|
| Prepare Initial Run-On, Run-Off Control Plan | CEC | 10/11/2016 |
| Revision No. 1 – Elimination of North Sediment Pond and Addition of the East Sediment Pond; Updated Water balance Calculations | CEC | 1/7/2020 |
| Revision No. 2 – 5-Year Plan Review and Update | CEC | 11/26/2025 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

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.

# APPENDIX B

# SUPPORTING CALCULATIONS

# APPENDIX B
# SECTION 1

# RUN-ON CONTROL FEATURE SUPPORTING CALCULATIONS

# SURFACE WATER CONTROL CALCULATIONS

## (Taken from the Solid Waste/NPDES Permit Application for the Mitchell Landfill)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | Surface Water Control Structures | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 3.16.c.4. Stormwater, Soil Erosion, and Sedimentation Control Plan | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE | 1 | OF | 9 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JDM | DATE | 04/03/12 | |

## OBJECTIVE:

To design the proposed surface water control structures for the Mitchell Landfill which divert all stormwater runoff from the disturbed area to the South, West, and North Ponds. All calculations for the South, West and North Sedimentation Ponds can be found in the calculation entitled **"Sediment Pond Design Calculations"**. The calculations for all surface water control structures satisfy the regulations for residual waste landfills as follows:

**33CSR1 3.16.c.4.**

An application to conduct transfer station activities must include a plan to manage surface storm water soil erosion and sedimentation control during the various phases of construction and operation on the permit area. Calculations indicating water quantities must be based on the twenty-five (25)-year, twenty-four (24)-hour storm event. The plan must include fully dimensioned diversion ditches and indicate length, gradient, and cross-section for configuration by reach and capacities for ditch volume by reach. Calculations that are necessary to support design and siting must be included in the plan.

The design is based upon accepted engineering design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, HydroCAD Version 10, Copyright 2012.

## METHOD:

Peak flows have been estimated with SCS TR-55 by calculating the time of concentration (Tc) of each channel reach, the composite runoff curve number describing the reach's watershed and the total area of the reach's watershed. A computer software package entitled "HydroCAD" Version 10, Copyright 2012, was utilized to perform the SCS TR-55 calculations.

The rainfall values for this site are listed below. The United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Mitchell County, West Virginia, provided the estimated rainfall depths and is presented in "Sediment Ponds Design Calculations".

| RAINFALL DATA | | |
|---|---|---|
| **Frequency** | **Duration** | **Depth (in)** |
| 2 yr | 24 hr | 2.54 |
| 10 yr | 24 hr | 3.81 |
| 25 yr | 24 hr | 4.44 |
| 100 yr | 24 hr | 5.10 |

According to the TR-55 methods, times of concentration were estimated as the sum of sheet flow, shallow concentrated flow, and channel flow. Flow calculations utilized a Curve Number (CN) representative of the post construction surface conditions. Maximum sheet flow length used was 200 feet. Shallow concentrated flow time of concentration as estimated based upon the condition of the flow path.

This site is located in an area of hydrologic soil groups B & C. Since over 95 percent of the site consists of type C soils, hydrologic soil group C was used throughout. Based on the existing and proposed site conditions the following runoff coefficients have been determined and will be utilized.

| CN DATA | |
|---|---|
| **Description** | **CN** |
| Existing (Woods Grass Combination, Fair) | 76 |
| Newly Graded Areas (Ditches) | 91 |
| Landfill (50-75% Grass Cover, Fair) | 91 |
| Impervious Areas (Paved Haul Road) | 98 |

Utilizing a series of downchutes, perimeter channels, pipe culverts, and basins, all stormwater runoff is directed to the South, West, or North Ponds. The outboard perimeter channels collect all runoff outside of the landfill limits, within clearing limits, and direct the stormwater into the sediment ponds. The perimeter channel and downchute then convey all runoff from within the drainage area to the sedimentation pond via a pipe culvert. The locations of the channels are shown within the permit documents.

**CALCULATIONS:**

With the peak discharge known for each channel, the channel cross section is sized and a channel lining material is selected (from the channel lining design options, included below). Flow properties within the channels are estimates from the HydroCAD output and hydrographs utilizing Manning's Equation (EQ. 1):

$$V = \frac{Q}{A} = 1.49\frac{R^{2/3}\sqrt{S_f}}{n} = 1.49\frac{\left[\frac{A}{WP}\right]^{2/3}\sqrt{S_f}}{n}$$

*Where*:

V = Velocity, fps

Q = Flowrate, cfs

A = Cross – Sectional area of flow, sf

R = Hydraulic Radius, ft

WP = Wetted Perimeter, ft

$S_f$ = Slope of channel, ft / ft

n = Manning's roughness coefficient

See Local Drainage Map for the drainage areas utilized. "S" designation throughout HydroCAD reports and drainage maps are Sub-Areas. "R" designation throughout HydroCAD reports and tables are Channel designations. The tables below show the drainage watershed identification, length, inlet and outlet invert elevations, contributing area, and peak flow for each channel based on the 25-year/24-hour storm event:

**Channels:**

| Channel | Drainage Area ID | Invert Elevations | | Length (ft) | Slope (%) | Drainage Area (acres) | Peak Flow (cfs) | Max. Velocity (fps) | (R)Riprap Class/ (G)Grout Class |
|---|---|---|---|---|---|---|---|---|---|
| | | Inlet | Outlet | | | | | | |
| South | CH-1 | 1205.0 | 1038.4 | 708 | 23.54 | 9.8 | 36.7 | 13.7 | G-6 |
| East | CH-2 | 1298.3 | 1170.5 | 1,402 | 9.12 | 2.4 | 11.6 | 5.1 | R-6 |
| East | CH-3 | 1298.7 | 1205.0 | 1,235 | 7.59 | 2.5 | 9.0 | 4.0 | R-5 |
| South | CH-4 | 1230.0 | 1040.0 | 772 | 24.61 | 6.0 | 29.8 | 13.2 | G-6 |
| South | CH-5 | 1224.0 | 1036.0 | 1,793 | 10.48 | 6.1 | 26.1 | 7.8 | G-6 |
| South | CH-6 | 1067.0 | 1037.0 | 1,028 | 2.92 | 35.7 | 171.4 | 6.6 | R-7 |
| South | CH-7 | 1222.6 | 1041.9 | 1,908 | 9.47 | 1.4 | 6.2 | 4.2 | R-5 |
| South | CH-9 | 1383.0 | 1050.0 | 1,368 | 24.34 | 33.3 | 96.7 | 14.1 | G-6 |
| North | CH-10 | 1301.0 | 1223.9 | 1,579 | 4.88 | 3.8 | 11.9 | 4.1 | R-5 |
| West | CH-11 | 1370.0 | 1130.0 | 683 | 35.16 | 13.9 | 51.6 | 16.4 | G-7 |
| North | CH-12 | 1301.0 | 1256.4 | 904 | 4.94 | 1.2 | 4.7 | 3.1 | R-4 |
| North | CH-13 | 1298.7 | 1255.0 | 846 | 5.17 | 2.7 | 13.2 | 3.8 | R-5 |
| North | CH-14 | 1380.0 | 1257.8 | 602 | 20.31 | 3.8 | 16.3 | 9.5 | G-6 |
| West | CH-15 | 1244.6 | 1224.8 | 876 | 2.26 | 3.8 | 15.8 | 3.0 | R-4 |
| West | CH-16 | 1253.6 | 1224.8 | 1,407 | 2.05 | 4.5 | 16.8 | 2.9 | R-4 |
| West | CH-17 | 1241.3 | 1226.5 | 780 | 1.89 | 4.1 | 13.0 | 2.7 | R-3 |
| West | CH-18 | 1233.2 | 1224.5 | 421 | 2.05 | 0.9 | 4.1 | 2.2 | R-3 |
| West | CH-19 | 1215.2 | 1201.0 | 175 | 8.11 | 27.9 | 100.9 | 11.9 | G-6 |

For channel details and schedule, see details sheet of the Permit to Install application drawing set.
CH-8 has been eliminated.

The riprap class was chosen dependent upon the velocity for lining of the channels. Channel lining sizes are provided in the following table:

| CHANNEL LININGS | |
|---|---|
| **Riprap Class** | **D50 (in)** |
| R-3 | 3 |
| R-4 | 6 |
| R-5 | 9 |
| R-6 | 15 |
| R-7 | 18 |

For channel slopes between 2% and 10%:
$D50 = [q\ (S)^{1.5}/4.75(10)^{-3}]^{0.53}$

For channel slopes between 10% and 40%:
$D50 = [q\ (S)^{0.58}/3.93(10)^{-2}]^{0.53}$

D50 = Particle size for which 50% (by weight) of the sample is finer, in.
S = Bed slope, ft./ft.
q = Unit discharge, ft3/s/ft

| CHANNEL LININGS | |
|---|---|
| **Grout Class** | **D50 (in)** |
| G-5 | 9 |
| G-6 | 15 |
| G-7 | 18 |

For channel velocities below 7.5 fps, use G-5.
For channel velocities between 7.5 fps and 15 fps, use G-6.
For channel velocities between 15 fps and 17.5 fps, use G-7.

**Pipes:**

| Pipe | Tributary to Pond | Invert Elevations | | Length (ft) | Pipe Dia. (in.) | Slope (%) | Drainage Area (acres) | Peak Flow (cfs) | Max. Velocity (fps) |
|---|---|---|---|---|---|---|---|---|---|
| | | Inlet | Outlet | | | | | | |
| 4 | South | 1036.0 | 1034.0 | 92.2 | 2-42 | 2.17 | 47.8 | 223.9 | 16.9 |
| 5 | South | 1045.0 | 1035.3 | 388.3 | 36 | 2.49 | 17.9 | 89.6 | 16.7 |
| 6 | South | 1070.0 | 1045.0 | 147.5 | 12 | 16.95 | 3.0 | 15.0 | 21.3 |
| 8 | West | 1218.0 | 1214.0 | 183.2 | 24 | 2.18 | 5.8 | 17.1 | 10.7 |
| 9 | West | 1223.9 | 1219.0 | 243.9 | 18 | 2.01 | 2.8 | 11.8 | 9.4 |
| 10 | West | 1217.0 | 1215.2 | 106.0 | 42 | 1.74 | 27.2 | 98.7 | 15.1 |
| 11 | West | 1220.0 | 1218.0 | 98.7 | 18 | 2.03 | 4.1 | 13.0 | 9.5 |
| 12 | West | 1218.0 | 1217.0 | 68.0 | 36 | 1.47 | 22.2 | 84.0 | 13.0 |
| 13 | North | 1240.0 | 1238.9 | 90.8 | 12 | 1.19 | 0.3 | 1.9 | 4.9 |
| 15 | North | 1247.4 | 1245.0 | 160.8 | 30 | 1.50 | 7.7 | 33.5 | 11.0 |
| 16 | North | 1248.0 | 1247.4 | 57.4 | 30 | 1.01 | 6.5 | 29.2 | 9.1 |

Pipes 1-3, 7 and 14 are shown within Sediment Pond Design Calculations.

**Pipe Outlet Protection:**

| Pipe | Tributary to Pond | Pipe Dia. (in.) | Peak Flow (cfs) | Max. Velocity (fps) | Width Outlet (ft) | Width at End (ft) | Length (ft) | D50 (in) | (R)Riprap Class/ (G)Grout Class |
|---|---|---|---|---|---|---|---|---|---|
| 1 | South Outlet | 48 | 205.09 | 16.3 | 12 | 44 | 40 | 18 | G-7 |
| 4 | South | 2-42 | 223.9 | 16.9 | 10.5 | 48.5 | 45 | 24 | G-7 |
| 5 | South | 36 | 89.6 | 16.7 | 9 | 33 | 30 | 15 | G-6 |
| 7 | West Outlet | 36 | 88.4 | 12.5 | 9 | 23 | 20 | 9 | R-5 |
| 8 | West | 24 | 17.1 | 10.7 | 6 | 17 | 15 | 6 | R-4 |
| 10 | West | 42 | 98.7 | 15.1 | 10.5 | 33.5 | 30 | 15 | G-6 |
| 13 | North | 12 | 1.9 | 4.9 | 3 | 6 | 5 | 6 | R-4 |
| 14 | North Outlet | 24 | 13.2 | 4.2 | 6 | 12 | 10 | 6 | R-4 |
| 15 | North | 30 | 29.2 | 9.1 | 7.5 | 22.5 | 20 | 6 | R-4 |

**CONCLUSIONS:**

All surface water control structures were designed based on the drainage area, flow rate, channel slope, and channel lining based on the peak flows resulting from the 25-year, 24-hour storm event. Utilizing a series of surface water diversion berms, downchutes, perimeter channels, pipe culverts, and ponds all stormwater runoff from landfill will be directed to the three Sedimentation Ponds in order to control runoff as well as meet applicable regulations. All surface water channels will be lined with riprap, the type depending on flow velocity. See Drawings for the channel schedules and details. The Surface Water Channel Design HydroCAD output and hydrograph files are attached.

## REFERENCES:

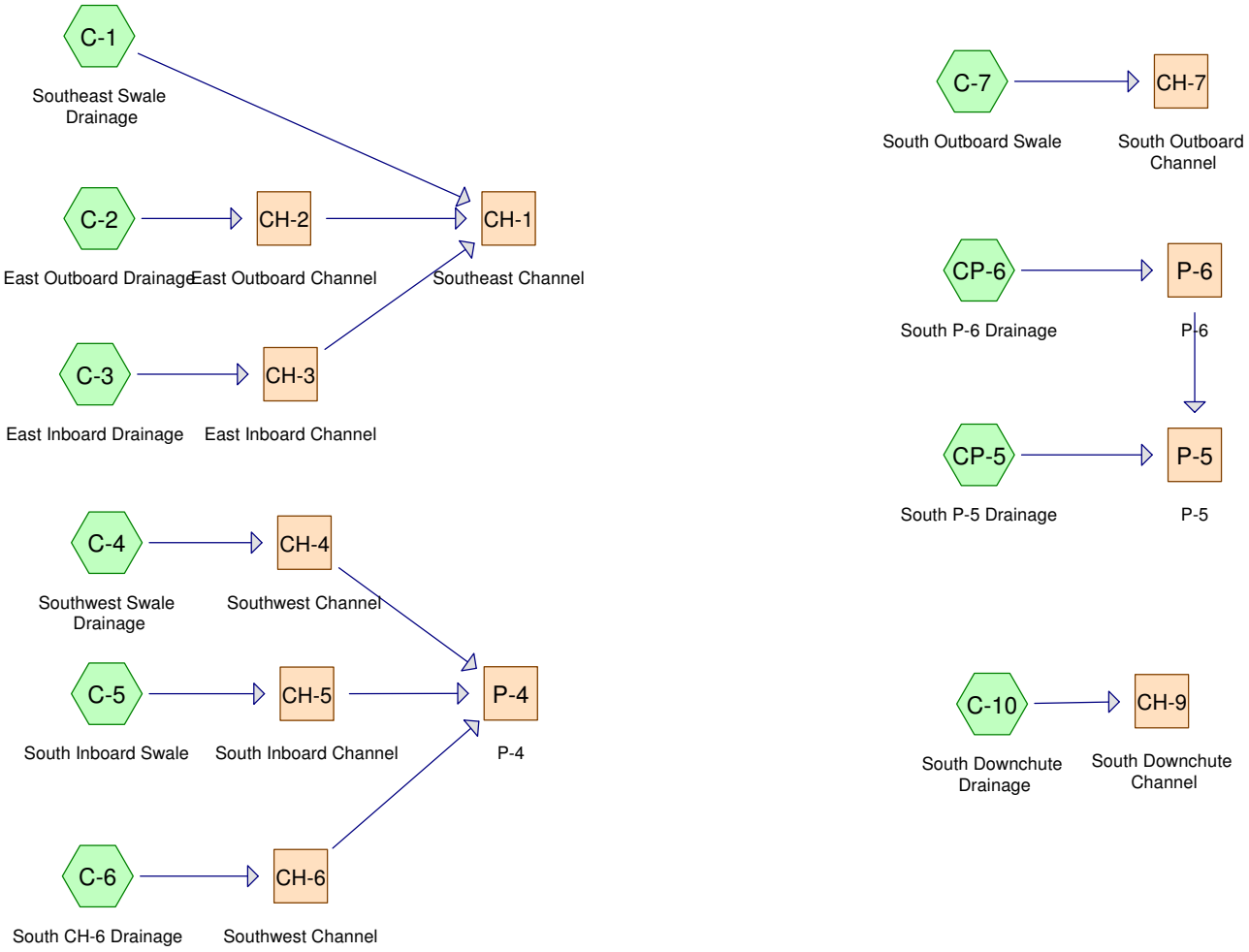
1. United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Mitchell County, West Virginia.

2. National Resources Conservation Service, LINED WATERWAY OR OUTLET, September 2010. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026310.pdf

3. HydroCAD Software Solutions LLC, HYDROCAD, Version 10, 2012, Computer Software Program.

4. U.S. Department of Transportation, Federal Highway Administration. Hydraulic Engineering Circular No. 15, Third Edition: Design of Roadside Channels with Flexible Linings.

## SURFACE WATER CHANNEL DESIGN HYDROCAD OUTPUT AND HYDROGRAPH FILES




Subcat Reach Pond Link

**Routing Diagram for South Channels**
Prepared by Microsoft, Printed 4/4/2012
HydroCAD® 10.00 s/n 01566 © 2012 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 10.934 | 91 | (C-1, C-4) |
| 7.508 | 94 | (C-5, C-7) |
| 4.902 | 94 | Fallow, bare soil, HSG C (C-2, C-3) |
| 53.604 | 91 | Newly graded area, HSG C (C-6, CP-5, CP-6) |
| 33.275 | 91 | Urban industrial, 72% imp, HSG C (C-10) |
| **110.223** | **91** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 91.781 | HSG C | C-10, C-2, C-3, C-6, CP-5, CP-6 |
| 0.000 | HSG D | |
| 18.442 | Other | C-1, C-4, C-5, C-7 |
| **110.223** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 18.442 | 18.442 | | C-1, C-4, C-5, C-7 |
| 0.000 | 0.000 | 4.902 | 0.000 | 0.000 | 4.902 | Fallow, bare soil | C-2, C-3 |
| 0.000 | 0.000 | 53.604 | 0.000 | 0.000 | 53.604 | Newly graded area | C-6, CP-5, CP-6 |
| 0.000 | 0.000 | 33.275 | 0.000 | 0.000 | 33.275 | Urban industrial, 72% imp | C-10 |
| **0.000** | **0.000** | **91.781** | **0.000** | **18.442** | **110.223** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | P-4 | 1,036.00 | 1,034.00 | 92.2 | 0.0217 | 0.013 | 42.0 | 0.0 | 0.0 |
| 2 | P-5 | 1,045.00 | 1,035.33 | 388.2 | 0.0249 | 0.013 | 36.0 | 0.0 | 0.0 |
| 3 | P-6 | 1,070.00 | 1,045.00 | 147.5 | 0.1695 | 0.013 | 12.0 | 0.0 | 0.0 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment C-1: Southeast Swale** Runoff Area=215,218 sf 0.00% Impervious Runoff Depth=3.44"
Tc=20.0 min CN=91 Runoff=18.34 cfs 1.416 af

**Subcatchment C-10: South Downchute** Runoff Area=1,449,459 sf 72.00% Impervious Runoff Depth=3.44"
Tc=30.0 min CN=91 Runoff=97.39 cfs 9.539 af

**Subcatchment C-2: East Outboard** Runoff Area=106,050 sf 0.00% Impervious Runoff Depth=3.76"
Tc=10.0 min CN=94 Runoff=12.92 cfs 0.762 af

**Subcatchment C-3: East Inboard Drainage** Runoff Area=107,478 sf 0.00% Impervious Runoff Depth=3.76"
Tc=20.0 min CN=94 Runoff=9.74 cfs 0.772 af

**Subcatchment C-4: Southwest Swale** Runoff Area=261,060 sf 0.00% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=91 Runoff=30.09 cfs 1.718 af

**Subcatchment C-5: South Inboard Swale** Runoff Area=264,718 sf 0.00% Impervious Runoff Depth=3.76"
Tc=15.0 min CN=94 Runoff=27.55 cfs 1.902 af

**Subcatchment C-6: South CH-6 Drainage** Runoff Area=1,556,393 sf 0.00% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=91 Runoff=179.38 cfs 10.243 af

**Subcatchment C-7: South Outboard Swale** Runoff Area=62,327 sf 0.00% Impervious Runoff Depth=3.76"
Tc=10.0 min CN=94 Runoff=7.59 cfs 0.448 af

**Subcatchment CP-5: South P-5 Drainage** Runoff Area=648,574 sf 0.00% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=91 Runoff=74.75 cfs 4.268 af

**Subcatchment CP-6: South P-6 Drainage** Runoff Area=130,036 sf 0.00% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=91 Runoff=14.99 cfs 0.856 af

**Reach CH-1: Southeast Channel** Avg. Flow Depth=0.67' Max Vel=13.70 fps Inflow=36.85 cfs 2.951 af
n=0.030 L=707.7' S=0.2354 '/' Capacity=1,072.94 cfs Outflow=36.77 cfs 2.951 af

**Reach CH-2: East Outboard Channel** Avg. Flow Depth=0.74' Max Vel=5.06 fps Inflow=12.92 cfs 0.762 af
n=0.055 L=1,401.9' S=0.0912 '/' Capacity=85.61 cfs Outflow=11.63 cfs 0.762 af

**Reach CH-3: East Inboard Channel** Avg. Flow Depth=0.60' Max Vel=3.99 fps Inflow=9.74 cfs 0.772 af
n=0.055 L=1,235.0' S=0.0759 '/' Capacity=332.24 cfs Outflow=9.03 cfs 0.772 af

**Reach CH-4: Southwest Channel** Avg. Flow Depth=0.60' Max Vel=13.16 fps Inflow=30.09 cfs 1.718 af
n=0.030 L=772.0' S=0.2461 '/' Capacity=1,097.00 cfs Outflow=29.84 cfs 1.718 af

**Reach CH-5: South Inboard Channel** Avg. Flow Depth=0.67' Max Vel=7.78 fps Inflow=27.55 cfs 1.902 af
n=0.040 L=1,792.9' S=0.1048 '/' Capacity=194.25 cfs Outflow=26.10 cfs 1.902 af

**Reach CH-6: Southwest Channel** Avg. Flow Depth=3.03' Max Vel=6.62 fps Inflow=179.38 cfs 10.243 af
n=0.055 L=1,028.0' S=0.0292 '/' Capacity=307.58 cfs Outflow=171.40 cfs 10.243 af

**Reach CH-7: South Outboard Channel** Avg. Flow Depth=0.51' Max Vel=4.21 fps Inflow=7.59 cfs 0.448 af
n=0.055 L=1,908.0' S=0.0947 '/' Capacity=96.11 cfs Outflow=6.20 cfs 0.448 af

**Reach CH-9: South Downchute** Avg. Flow Depth=0.99' Max Vel=14.05 fps Inflow=97.39 cfs 9.539 af
n=0.040 L=1,368.0' S=0.2434 '/' Capacity=414.20 cfs Outflow=96.74 cfs 9.539 af

**Reach P-4: P-4** Avg. Flow Depth=2.27' Max Vel=16.93 fps Inflow=223.94 cfs 13.863 af
42.0" Round Pipe x 2.00 n=0.013 L=92.2' S=0.0217 '/' Capacity=296.36 cfs Outflow=223.92 cfs 13.863 af

**Reach P-5: P-5** Avg. Flow Depth=2.13' Max Vel=16.72 fps Inflow=89.72 cfs 5.124 af
36.0" Round Pipe n=0.013 L=388.2' S=0.0249 '/' Capacity=105.27 cfs Outflow=89.54 cfs 5.124 af

**Reach P-6: P-6** Avg. Flow Depth=0.84' Max Vel=21.29 fps Inflow=14.99 cfs 0.856 af
12.0" Round Pipe n=0.013 L=147.5' S=0.1695 '/' Capacity=14.67 cfs Outflow=14.98 cfs 0.856 af

**Total Runoff Area = 110.223 ac Runoff Volume = 31.926 af Average Runoff Depth = 3.48"**
**78.26% Pervious = 86.265 ac 21.74% Impervious = 23.958 ac**

## Summary for Subcatchment C-1: Southeast Swale Drainage

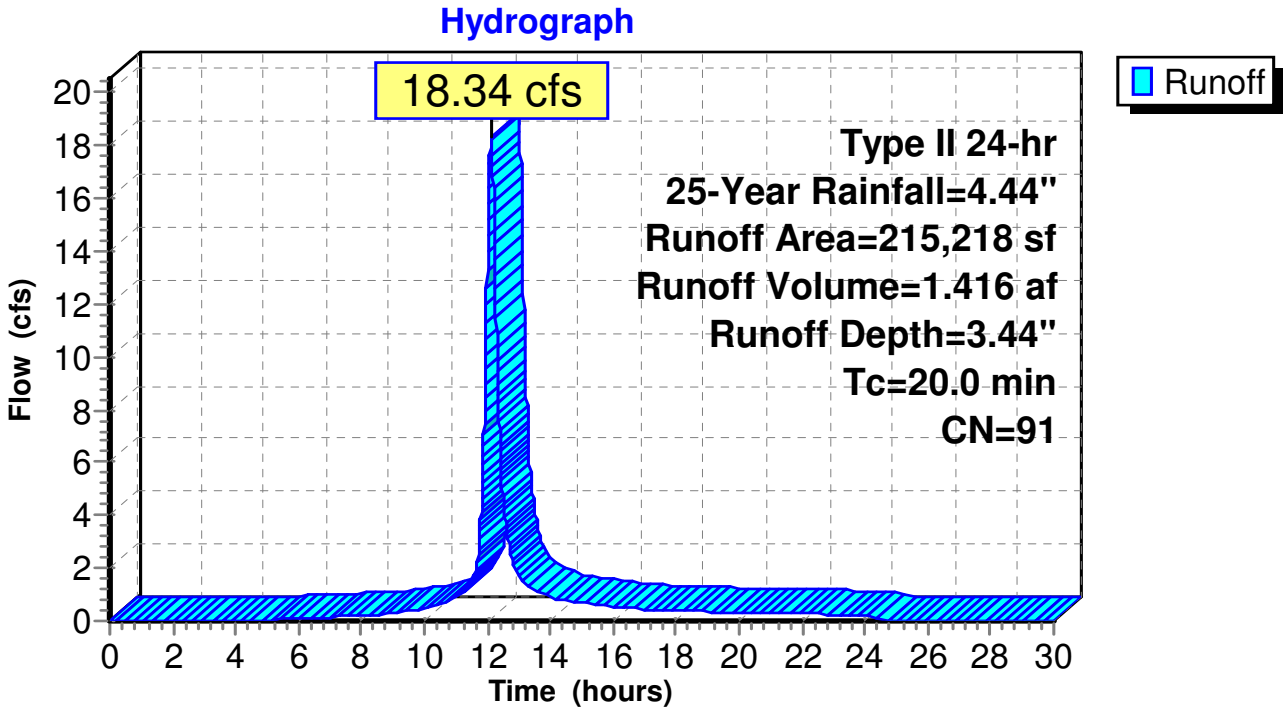
Runoff = 18.34 cfs @ 12.11 hrs, Volume= 1.416 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 215,218 | 91 | |
| | 215,218 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment C-1: Southeast Swale Drainage



## Summary for Subcatchment C-10: South Downchute Drainage

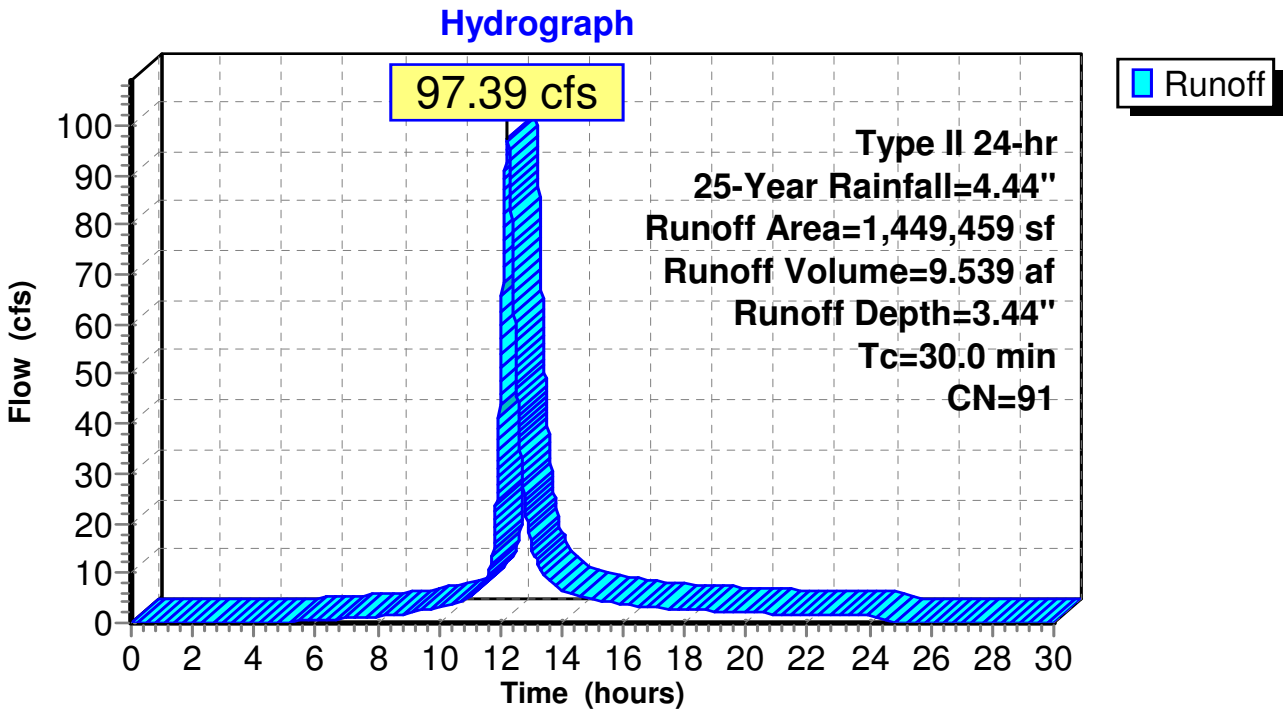
Runoff = 97.39 cfs @ 12.23 hrs, Volume= 9.539 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 1,449,459 | 91 | Urban industrial, 72% imp, HSG C |
| 405,849 | | 28.00% Pervious Area |
| 1,043,610 | | 72.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 30.0 | | | | | **Direct Entry,** |

### Subcatchment C-10: South Downchute Drainage



## Summary for Subcatchment C-2: East Outboard Drainage

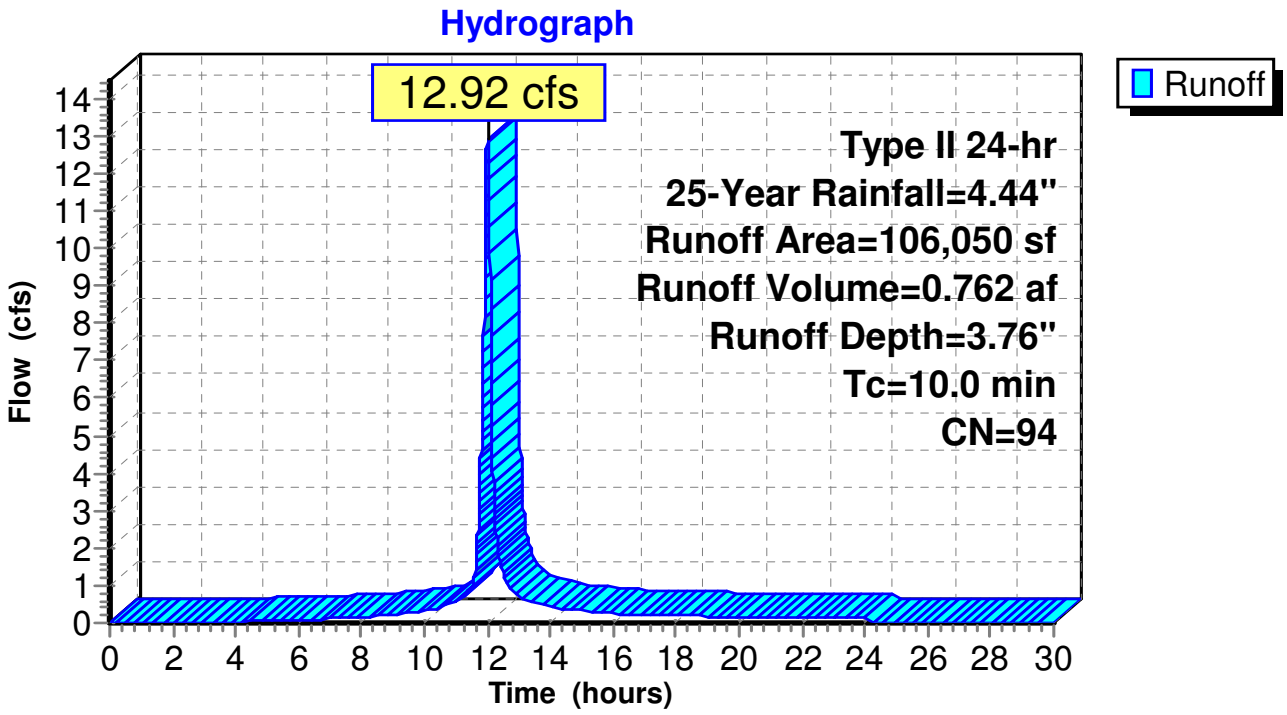
Runoff = 12.92 cfs @ 12.01 hrs, Volume= 0.762 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 106,050 | 94 | Fallow, bare soil, HSG C |
| | 106,050 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-2: East Outboard Drainage



## Summary for Subcatchment C-3: East Inboard Drainage

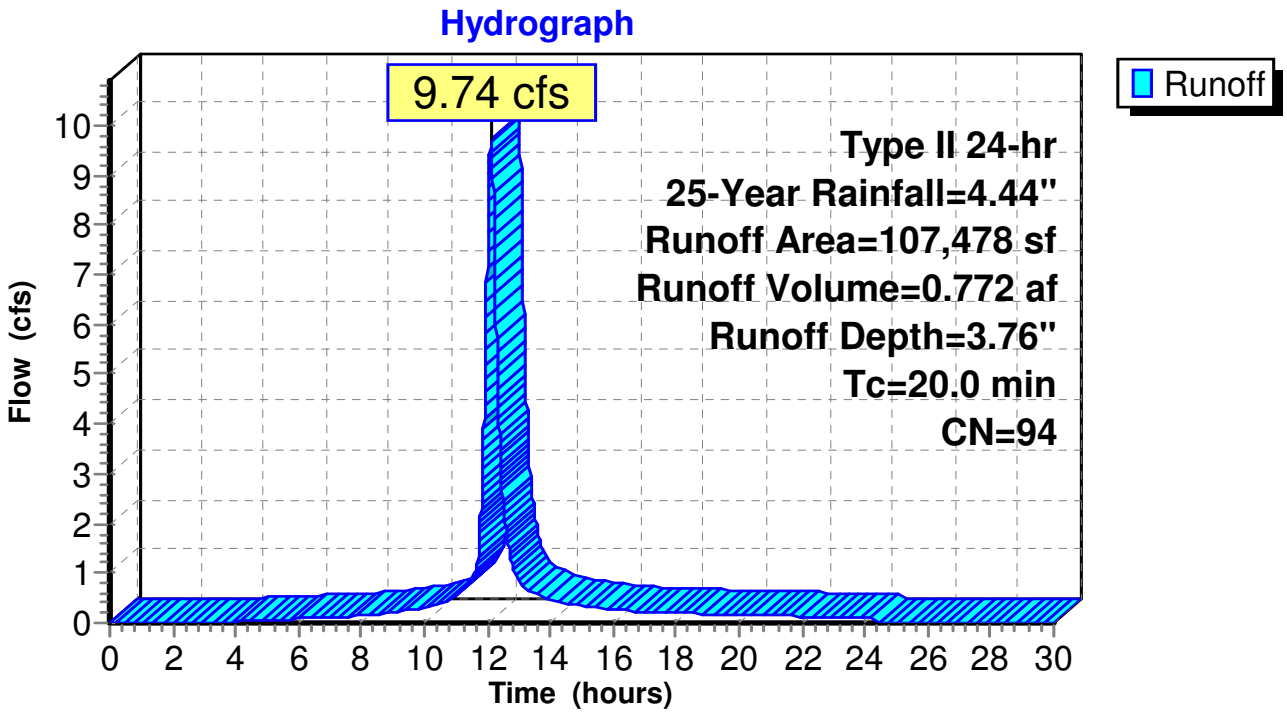
Runoff = 9.74 cfs @ 12.11 hrs, Volume= 0.772 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 107,478 | 94 | Fallow, bare soil, HSG C |
| | 107,478 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

### Subcatchment C-3: East Inboard Drainage



## Summary for Subcatchment C-4: Southwest Swale Drainage

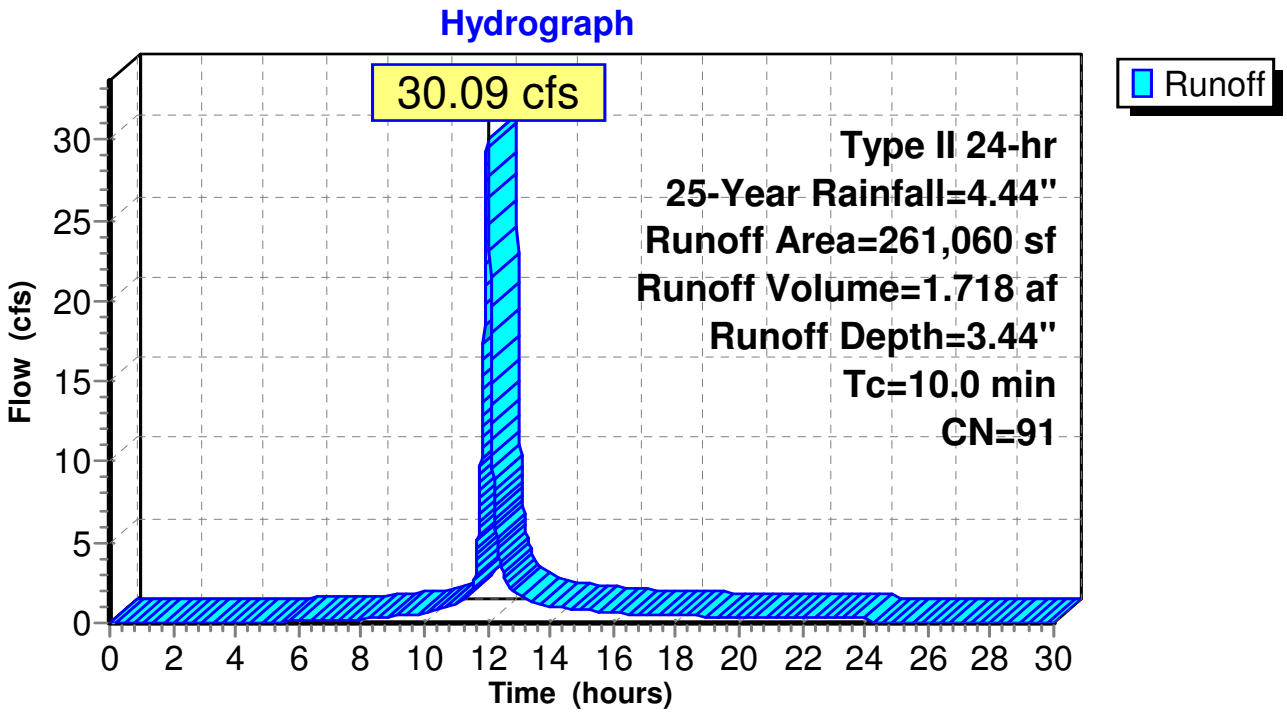
Runoff = 30.09 cfs @ 12.01 hrs, Volume= 1.718 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 261,060 | 91 | |
| | 261,060 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-4: Southwest Swale Drainage



## Summary for Subcatchment C-5: South Inboard Swale

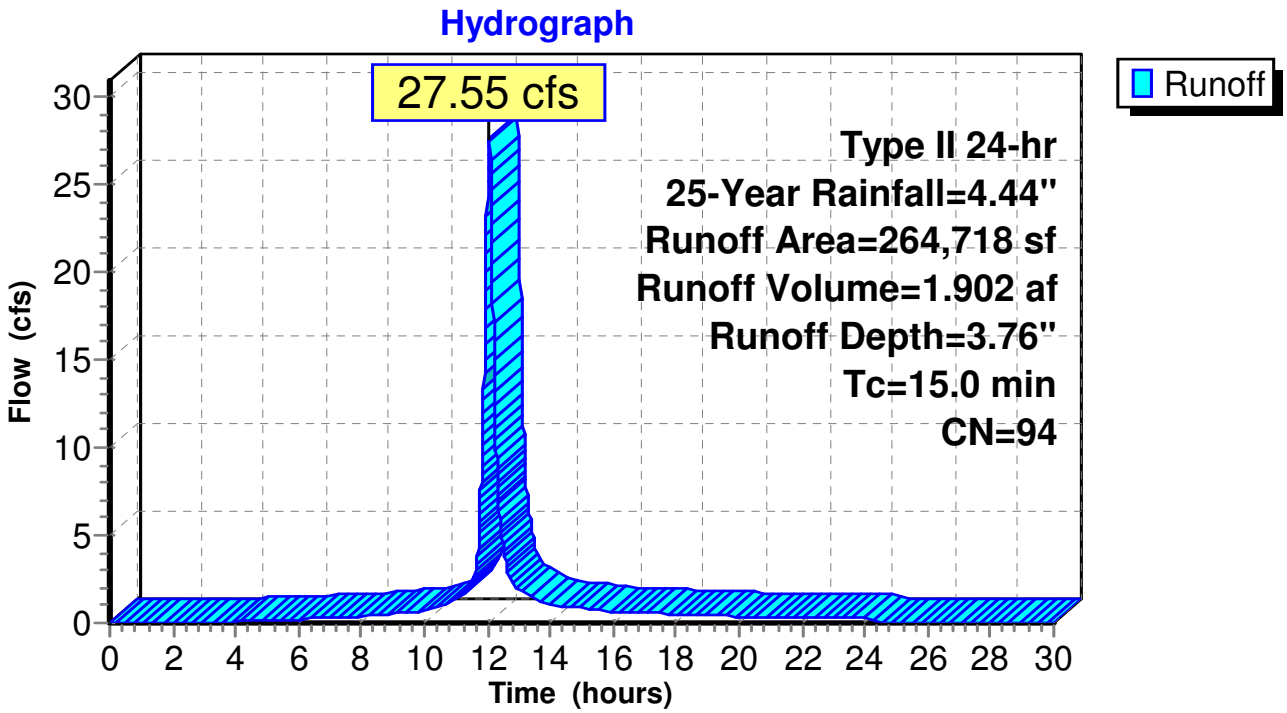
Runoff = 27.55 cfs @ 12.06 hrs, Volume= 1.902 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 264,718 | 94 | |
| | 264,718 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

### Subcatchment C-5: South Inboard Swale



## Summary for Subcatchment C-6: South CH-6 Drainage

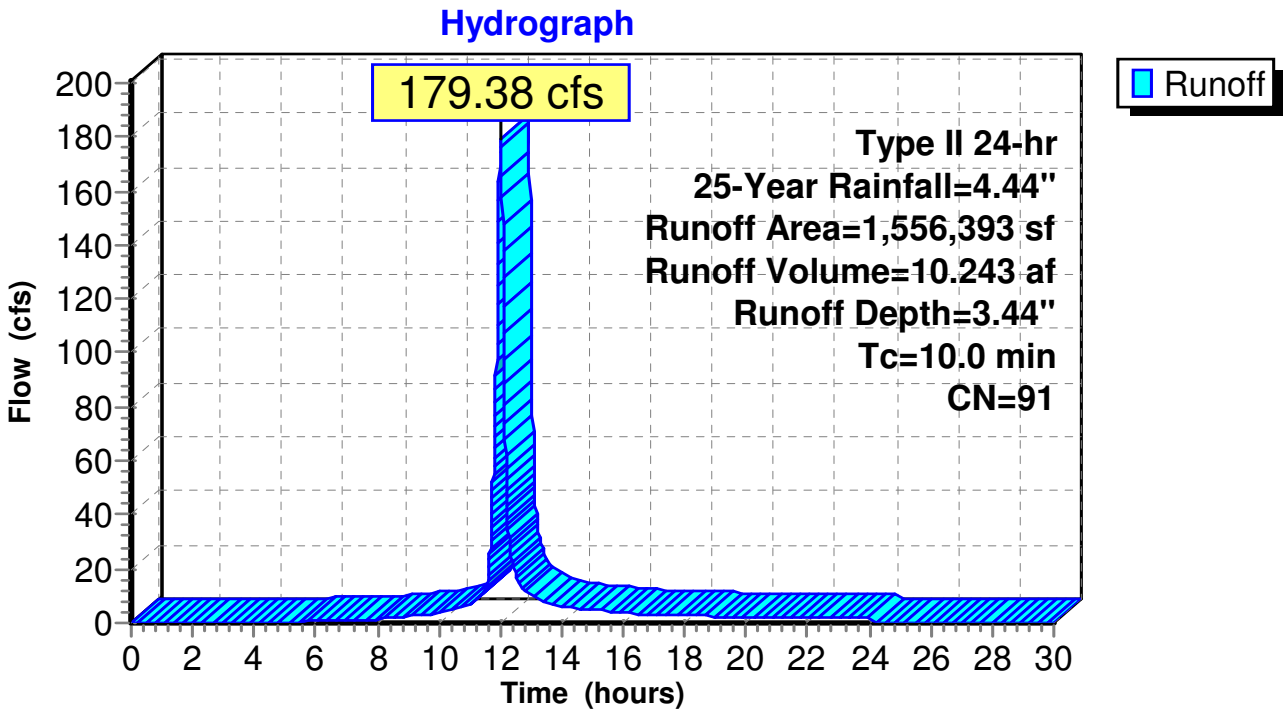
Runoff = 179.38 cfs @ 12.01 hrs, Volume= 10.243 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 1,556,393 | 91 | Newly graded area, HSG C |
| 1,556,393 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-6: South CH-6 Drainage



## Summary for Subcatchment C-7: South Outboard Swale

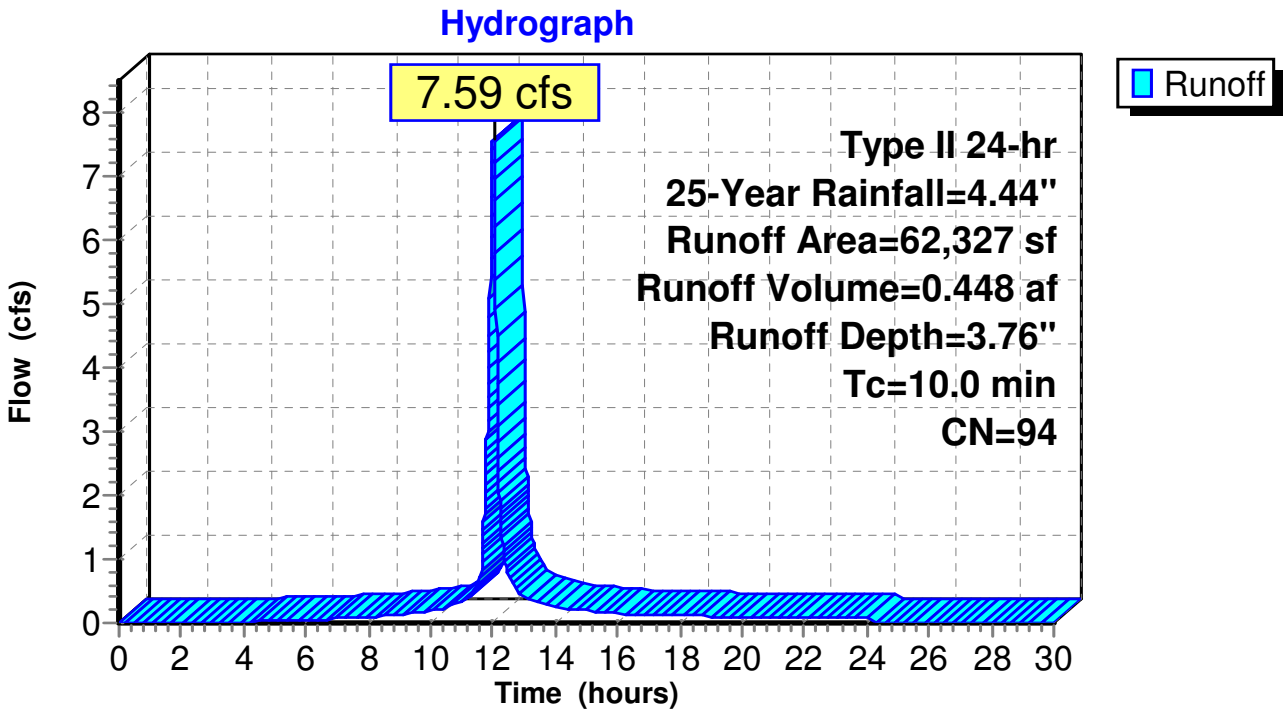
Runoff = 7.59 cfs @ 12.01 hrs, Volume= 0.448 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 62,327 | 94 | |
| | 62,327 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-7: South Outboard Swale



## Summary for Subcatchment CP-5: South P-5 Drainage

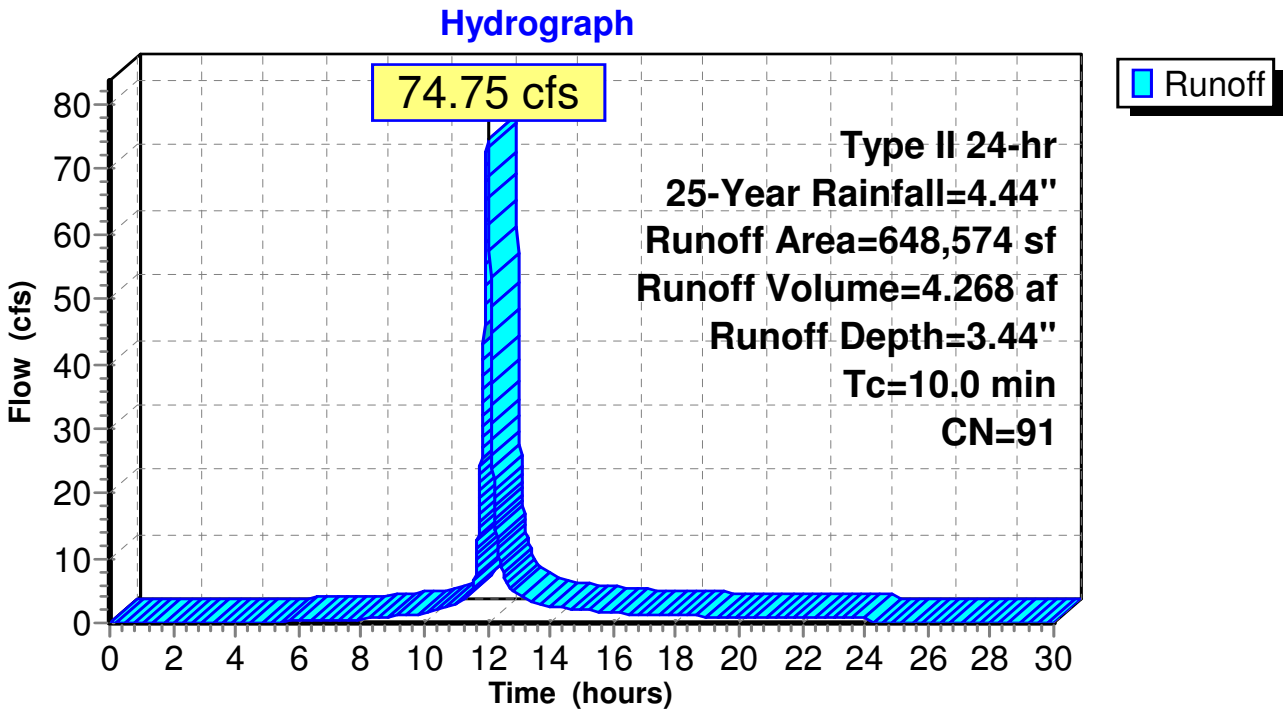
Runoff = 74.75 cfs @ 12.01 hrs, Volume= 4.268 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 648,574 | 91 | Newly graded area, HSG C |
| 648,574 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment CP-5: South P-5 Drainage



## Summary for Subcatchment CP-6: South P-6 Drainage

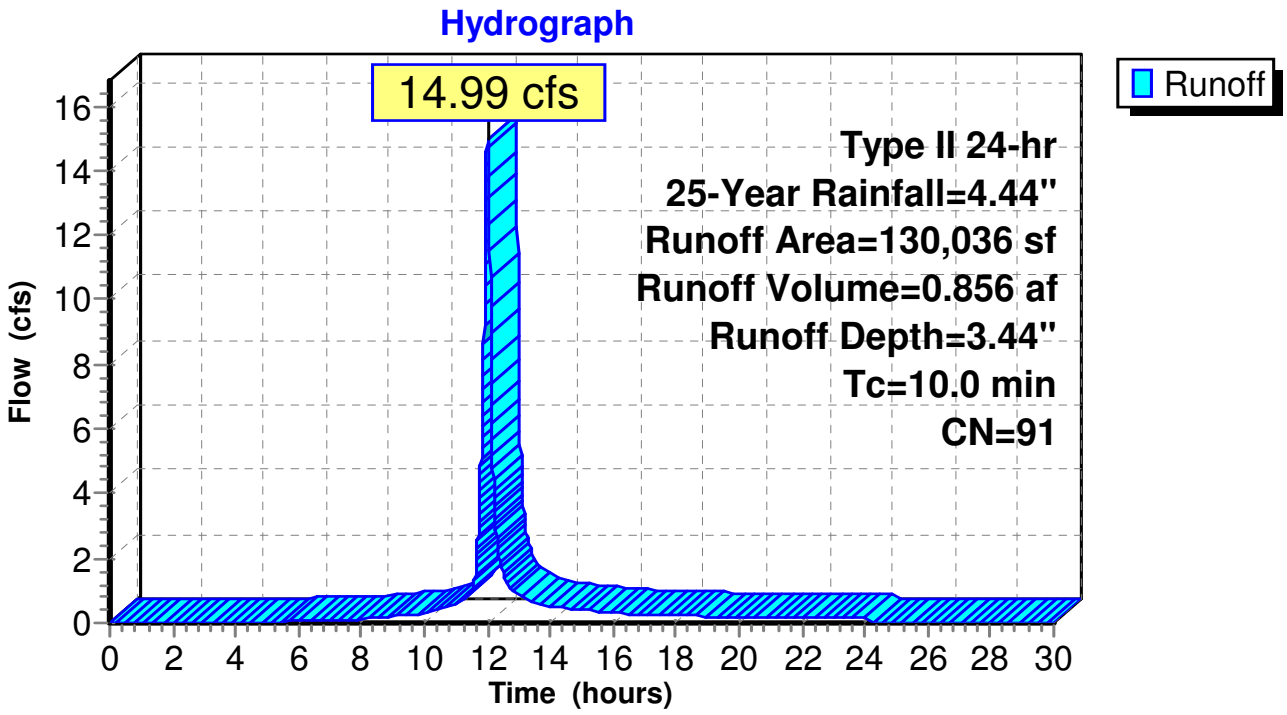
Runoff = 14.99 cfs @ 12.01 hrs, Volume= 0.856 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 130,036 | 91 | Newly graded area, HSG C |
| 130,036 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment CP-6: South P-6 Drainage



## Summary for Reach CH-1: Southeast Channel

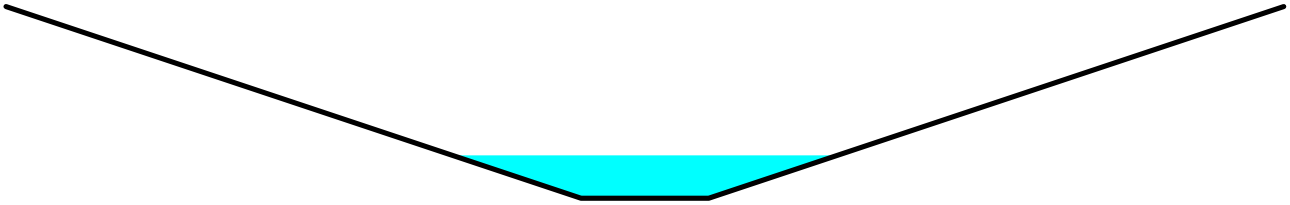
[62] Hint: Exceeded Reach CH-2 OUTLET depth by 34.59' @ 12.29 hrs
[62] Hint: Exceeded Reach CH-3 OUTLET depth by 0.13' @ 12.02 hrs

Inflow Area = 9.843 ac, 0.00% Impervious, Inflow Depth = 3.60" for 25-Year event
Inflow = 36.85 cfs @ 12.10 hrs, Volume= 2.951 af
Outflow = 36.77 cfs @ 12.11 hrs, Volume= 2.951 af, Atten= 0%, Lag= 0.6 min

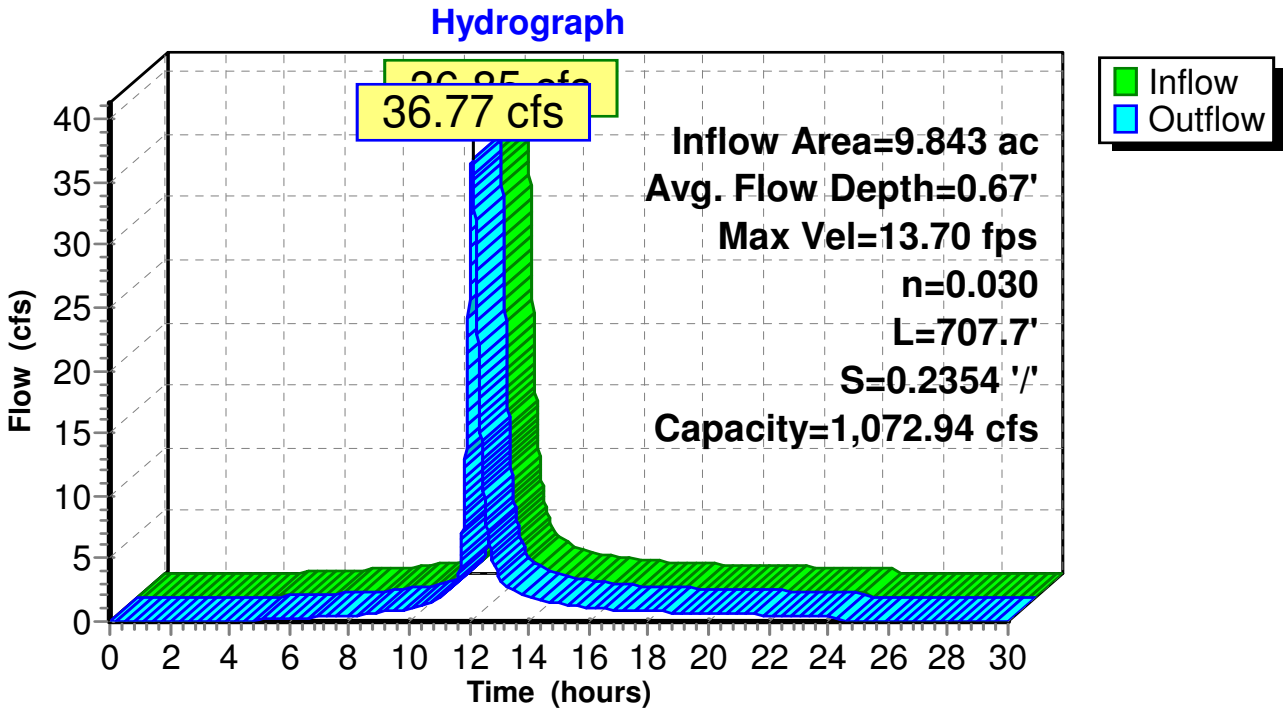
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 13.70 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 4.08 fps, Avg. Travel Time= 2.9 min

Peak Storage= 1,899 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 1,072.94 cfs

2.00' x 3.00' deep channel, n= 0.030 Grouted Riprap
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 707.7' Slope= 0.2354 '/'
Inlet Invert= 1,204.98', Outlet Invert= 1,038.36'



## Reach CH-1: Southeast Channel



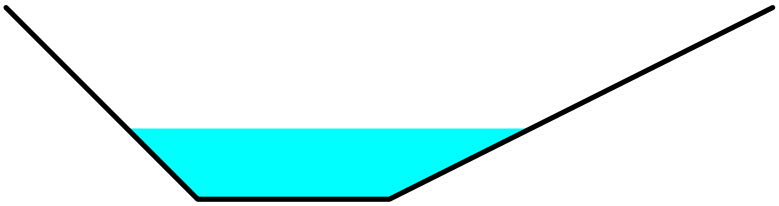
## Summary for Reach CH-2: East Outboard Channel

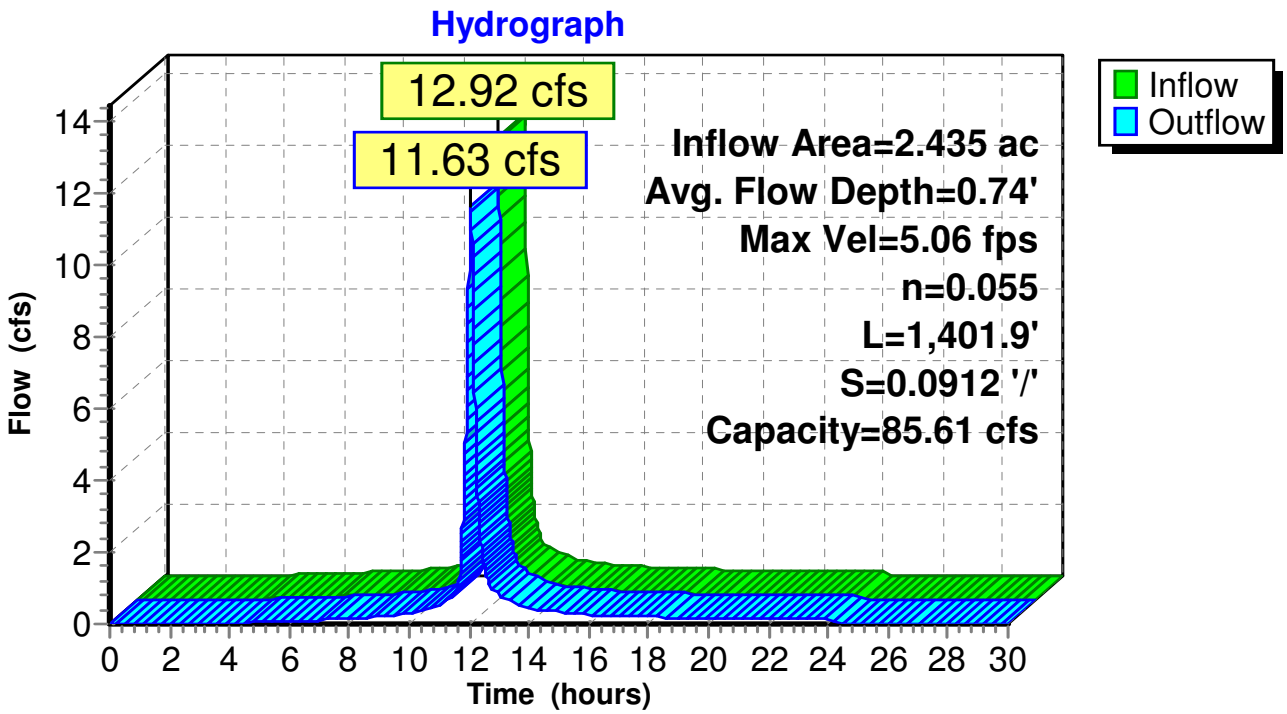
Inflow Area = 2.435 ac, 0.00% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 12.92 cfs @ 12.01 hrs, Volume= 0.762 af
Outflow = 11.63 cfs @ 12.05 hrs, Volume= 0.762 af, Atten= 10%, Lag= 2.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.06 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 18.4 min

Peak Storage= 3,220 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 85.61 cfs

2.00' x 2.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 1.0 2.0 '/' Top Width= 8.00'
Length= 1,401.9' Slope= 0.0912 '/'
Inlet Invert= 1,298.32', Outlet Invert= 1,170.53'





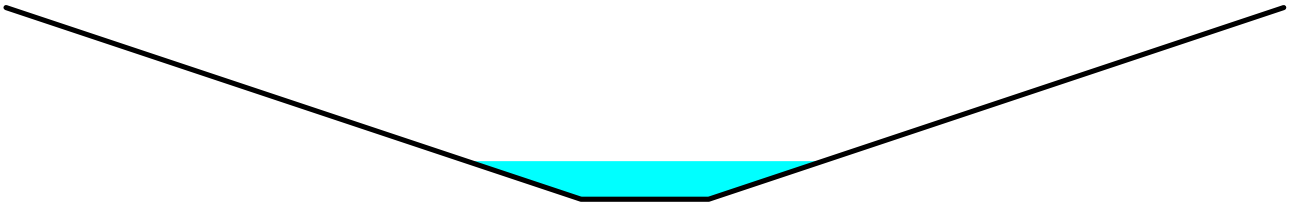
## Summary for Reach CH-3: East Inboard Channel

Inflow Area = 2.467 ac, 0.00% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 9.74 cfs @ 12.11 hrs, Volume= 0.772 af
Outflow = 9.03 cfs @ 12.17 hrs, Volume= 0.772 af, Atten= 7%, Lag= 3.7 min

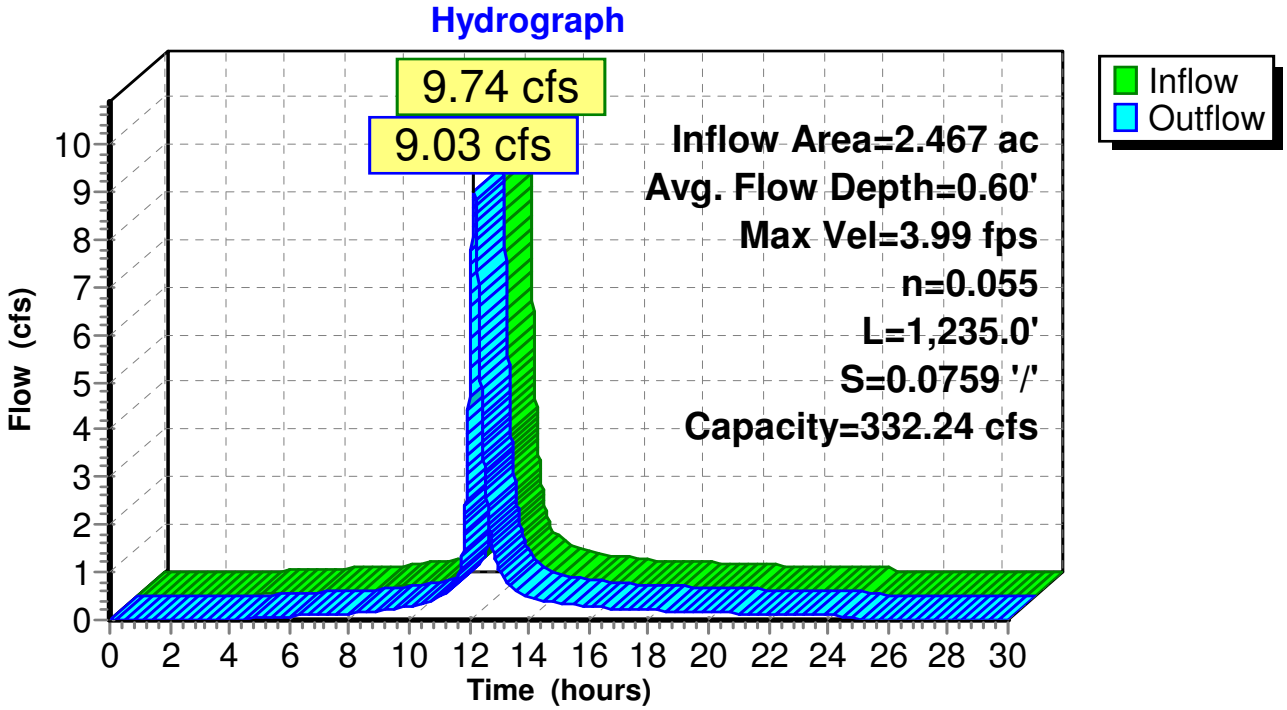
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.99 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 1.21 fps, Avg. Travel Time= 17.0 min

Peak Storage= 2,796 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 332.24 cfs

2.00' x 3.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 1,235.0' Slope= 0.0759 '/'
Inlet Invert= 1,298.69', Outlet Invert= 1,204.98'



**Reach CH-3: East Inboard Channel**



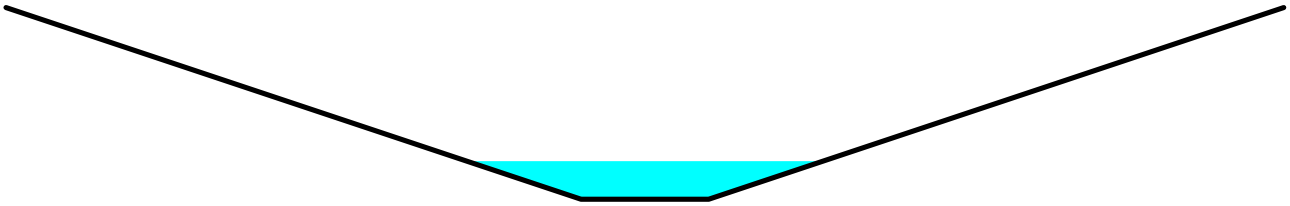
## Summary for Reach CH-4: Southwest Channel

Inflow Area = 5.993 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 30.09 cfs @ 12.01 hrs, Volume= 1.718 af
Outflow = 29.84 cfs @ 12.02 hrs, Volume= 1.718 af, Atten= 1%, Lag= 0.7 min

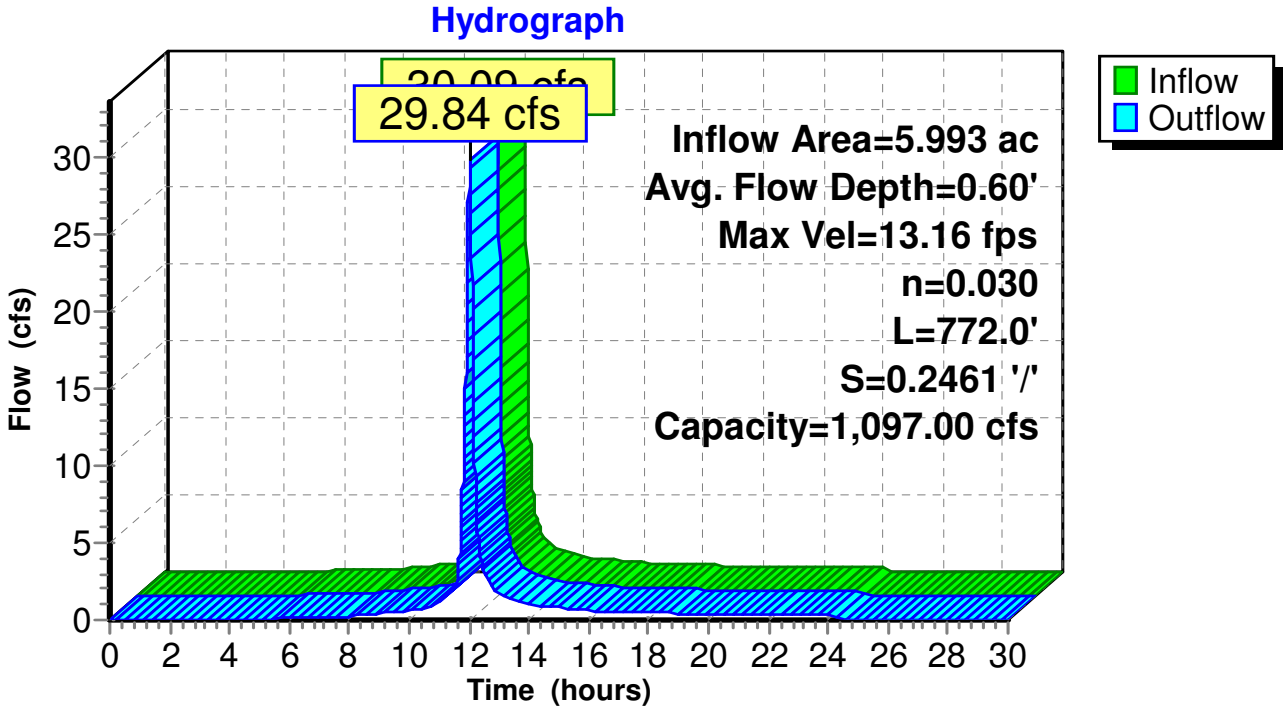
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 13.16 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 3.78 fps, Avg. Travel Time= 3.4 min

Peak Storage= 1,750 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 1,097.00 cfs

2.00' x 3.00' deep channel, n= 0.030 Grouted Riprap
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 772.0' Slope= 0.2461 '/'
Inlet Invert= 1,230.00', Outlet Invert= 1,040.00'



**Reach CH-4: Southwest Channel**



## Summary for Reach CH-5: South Inboard Channel

Inflow Area = 6.077 ac, 0.00% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 27.55 cfs @ 12.06 hrs, Volume= 1.902 af
Outflow = 26.10 cfs @ 12.10 hrs, Volume= 1.902 af, Atten= 5%, Lag= 2.4 min

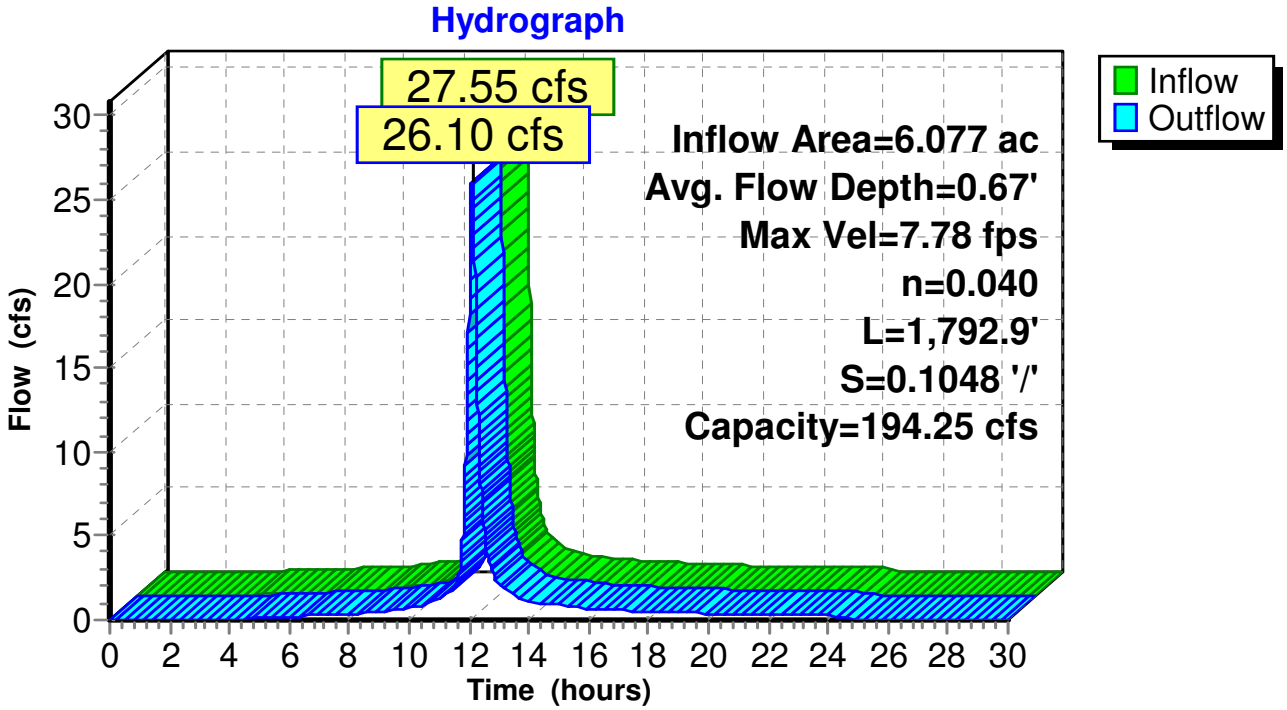
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.78 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 1.84 fps, Avg. Travel Time= 16.2 min

Peak Storage= 6,013 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 194.25 cfs

4.00' x 2.00' deep channel, n= 0.040 Grouted Riprap
Side Slope Z-value= 1.0 2.0 '/' Top Width= 10.00'
Length= 1,792.9' Slope= 0.1048 '/'
Inlet Invert= 1,223.96', Outlet Invert= 1,036.00'



**Reach CH-5: South Inboard Channel**



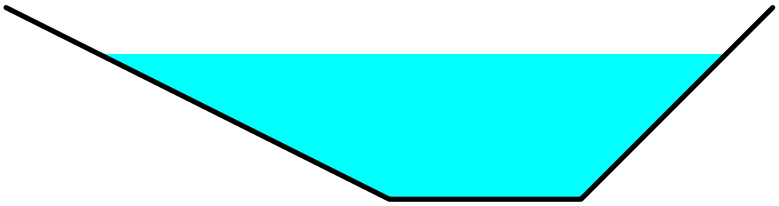
## Summary for Reach CH-6: Southwest Channel

Inflow Area = 35.730 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 179.38 cfs @ 12.01 hrs, Volume= 10.243 af
Outflow = 171.40 cfs @ 12.04 hrs, Volume= 10.243 af, Atten= 4%, Lag= 1.7 min

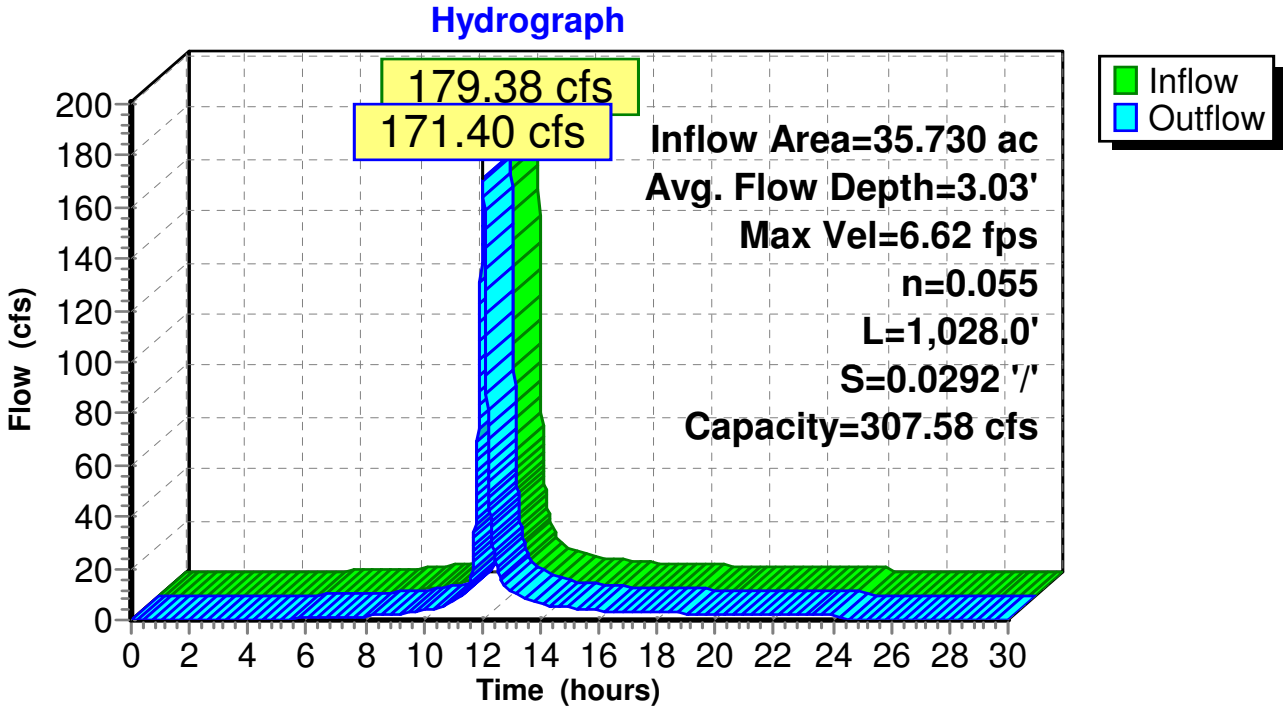
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.62 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.74 fps, Avg. Travel Time= 9.8 min

Peak Storage= 26,605 cf @ 12.04 hrs
Average Depth at Peak Storage= 3.03'
Bank-Full Depth= 4.00' Flow Area= 40.0 sf, Capacity= 307.58 cfs

4.00' x 4.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 2.0 1.0 '/' Top Width= 16.00'
Length= 1,028.0' Slope= 0.0292 '/'
Inlet Invert= 1,067.00', Outlet Invert= 1,037.00'



**Reach CH-6: Southwest Channel**



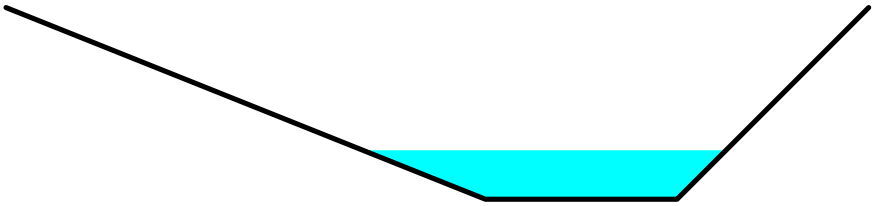
## Summary for Reach CH-7: South Outboard Channel

Inflow Area = 1.431 ac, 0.00% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 7.59 cfs @ 12.01 hrs, Volume= 0.448 af
Outflow = 6.20 cfs @ 12.07 hrs, Volume= 0.448 af, Atten= 18%, Lag= 3.6 min

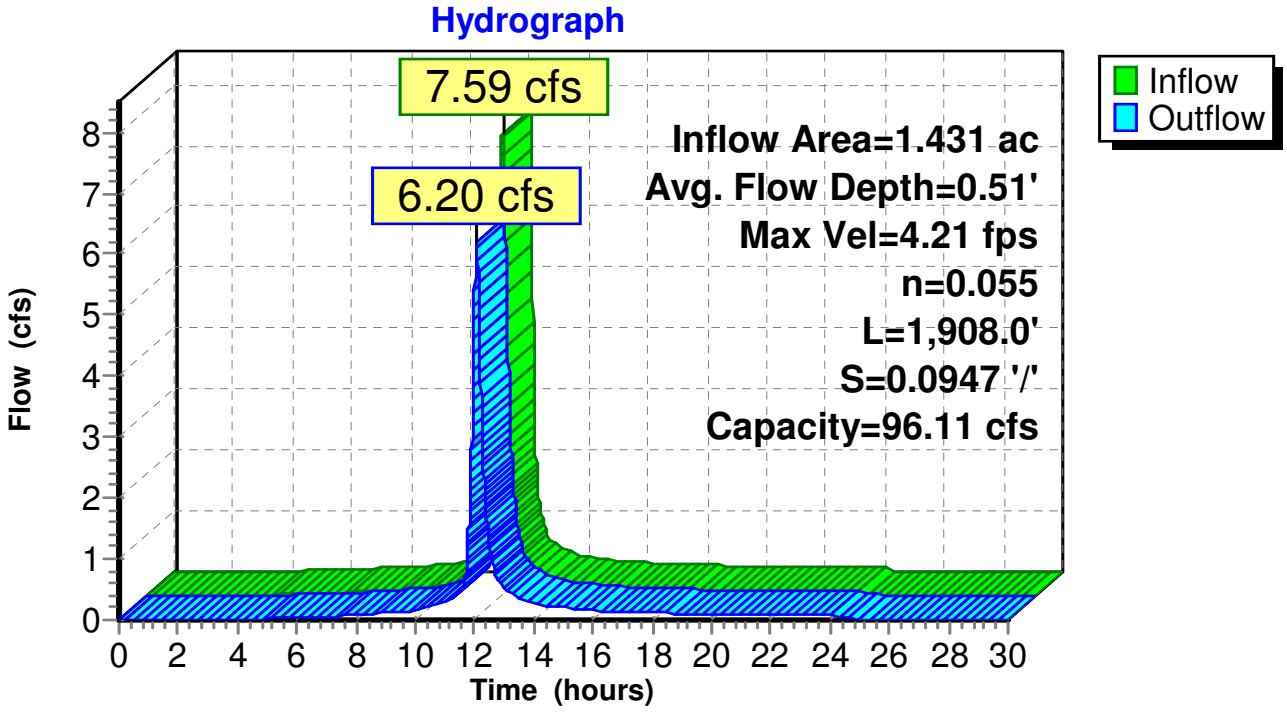
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.21 fps, Min. Travel Time= 7.6 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 30.1 min

Peak Storage= 2,810 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 2.00' Flow Area= 11.0 sf, Capacity= 96.11 cfs

2.00' x 2.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 2.5 1.0 '/' Top Width= 9.00'
Length= 1,908.0' Slope= 0.0947 '/'
Inlet Invert= 1,222.59', Outlet Invert= 1,041.85'



**Reach CH-7: South Outboard Channel**



## Summary for Reach CH-9: South Downchute Channel

Inflow Area = 33.275 ac, 72.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 97.39 cfs @ 12.23 hrs, Volume= 9.539 af
Outflow = 96.74 cfs @ 12.25 hrs, Volume= 9.539 af, Atten= 1%, Lag= 1.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 14.05 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 4.28 fps, Avg. Travel Time= 5.3 min

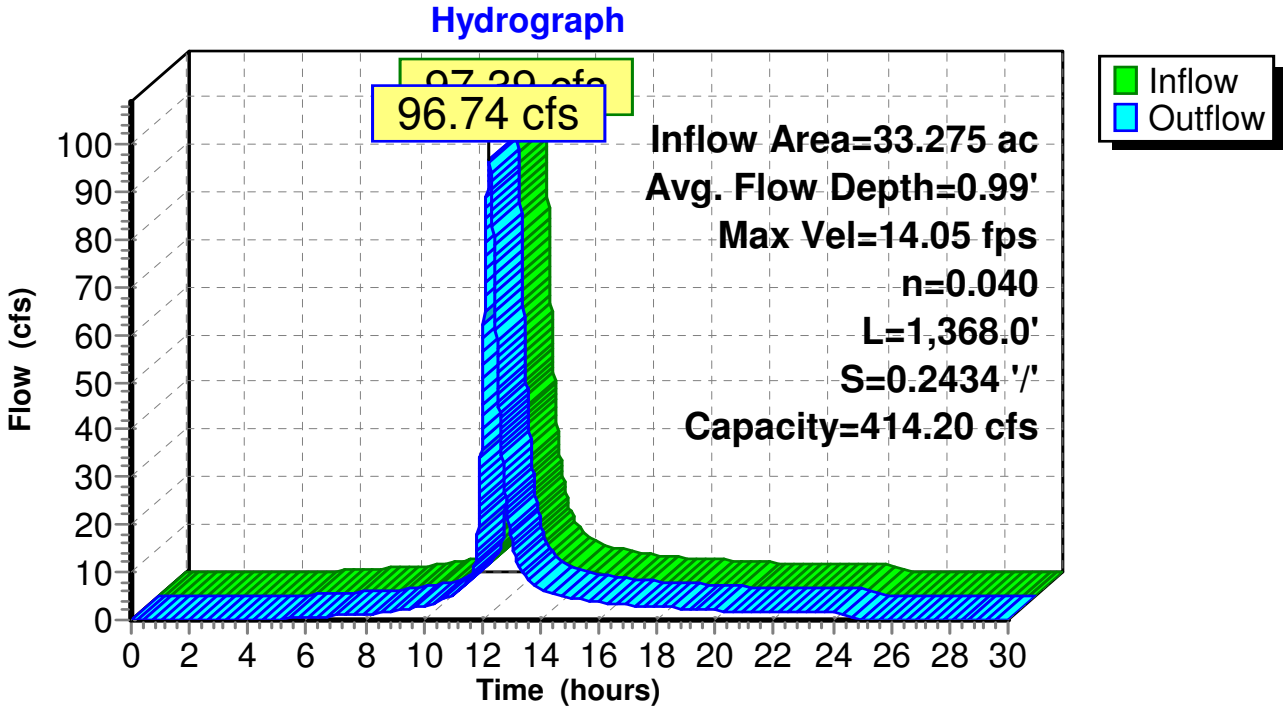
Peak Storage= 9,417 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.99'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 414.20 cfs

4.00' x 2.00' deep channel, n= 0.040 Grouted Riprap
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 1,368.0' Slope= 0.2434 '/'
Inlet Invert= 1,382.95', Outlet Invert= 1,050.03'



‡

**Reach CH-9: South Downchute Channel**



## Summary for Reach P-4: P-4

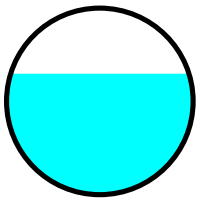
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach CH-5 OUTLET depth by 1.65' @ 12.03 hrs
[61] Hint: Exceeded Reach CH-6 outlet invert by 1.27' @ 12.04 hrs

Inflow Area = 47.800 ac, 0.00% Impervious, Inflow Depth = 3.48" for 25-Year event
Inflow = 223.94 cfs @ 12.04 hrs, Volume= 13.863 af
Outflow = 223.92 cfs @ 12.04 hrs, Volume= 13.863 af, Atten= 0%, Lag= 0.1 min

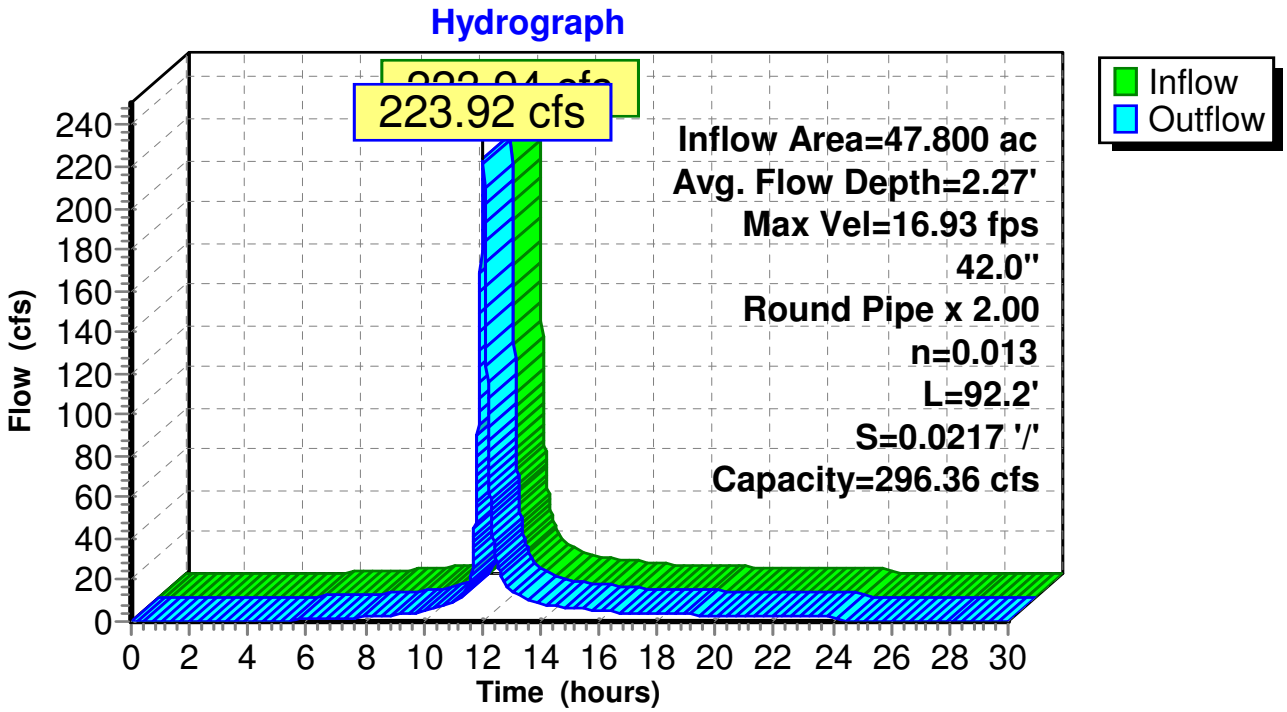
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 16.93 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.64 fps, Avg. Travel Time= 0.3 min

Peak Storage= 1,220 cf @ 12.04 hrs
Average Depth at Peak Storage= 2.27'
Bank-Full Depth= 3.50' Flow Area= 19.2 sf, Capacity= 296.36 cfs

A factor of 2.00 has been applied to the storage and discharge capacity
42.0" Round Pipe
n= 0.013
Length= 92.2' Slope= 0.0217 '/'
Inlet Invert= 1,036.00', Outlet Invert= 1,034.00'



## Reach P-4: P-4


Hydrograph
223.92 cfs
Inflow
Outflow
Inflow Area=47.800 ac
Avg. Flow Depth=2.27'
Max Vel=16.93 fps
42.0"
Round Pipe x 2.00
n=0.013
L=92.2'
S=0.0217 '/'
Capacity=296.36 cfs
Flow (cfs)
0
20
40
60
80
100
120
140
160
180
200
220
240
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Time (hours)

## Summary for Reach P-5: P-5

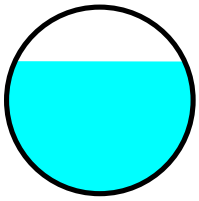
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach P-6 OUTLET depth by 1.29' @ 12.02 hrs

Inflow Area = 17.874 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 89.72 cfs @ 12.01 hrs, Volume= 5.124 af
Outflow = 89.54 cfs @ 12.02 hrs, Volume= 5.124 af, Atten= 0%, Lag= 0.3 min

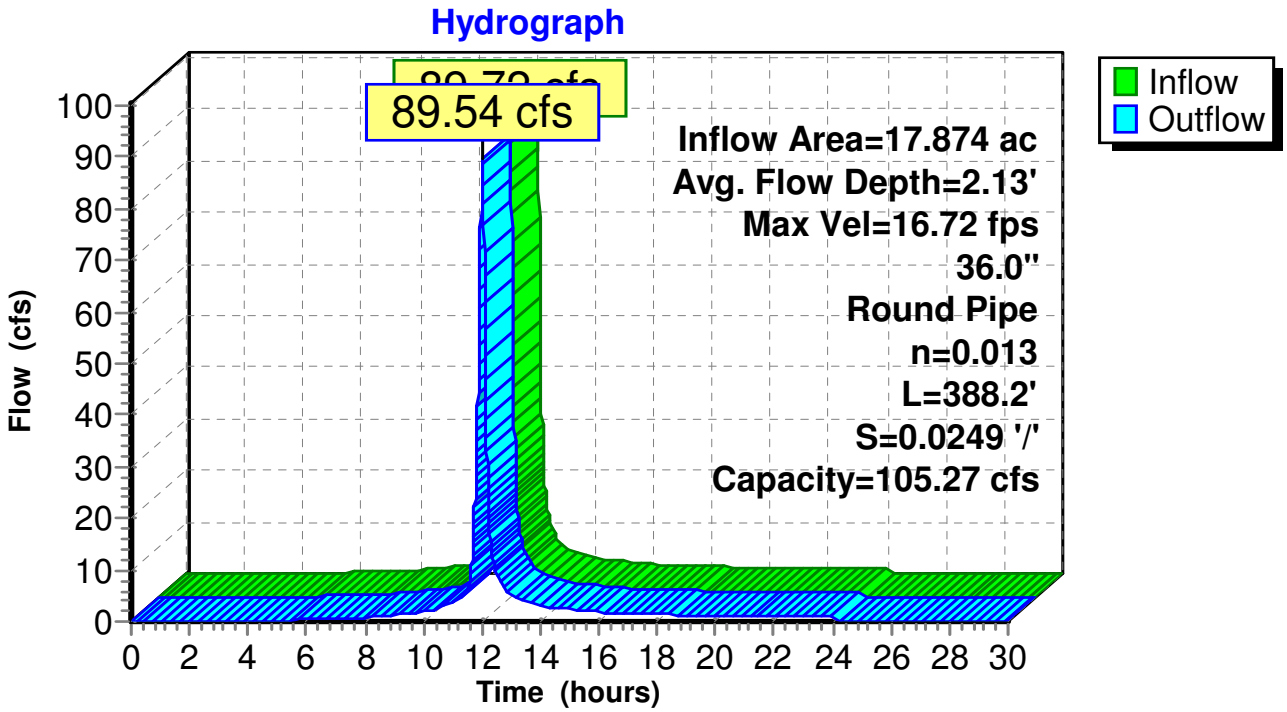
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 16.72 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 5.24 fps, Avg. Travel Time= 1.2 min

Peak Storage= 2,079 cf @ 12.02 hrs
Average Depth at Peak Storage= 2.13'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 105.27 cfs

36.0" Round Pipe
n= 0.013
Length= 388.2' Slope= 0.0249 '/'
Inlet Invert= 1,045.00', Outlet Invert= 1,035.33'



## Reach P-5: P-5


Hydrograph
89.54 cfs
Inflow
Outflow
Inflow Area=17.874 ac
Avg. Flow Depth=2.13'
Max Vel=16.72 fps
36.0"
Round Pipe
n=0.013
L=388.2'
S=0.0249 '/'
Capacity=105.27 cfs
Flow (cfs)
0
10
20
30
40
50
60
70
80
90
100
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Time (hours)

## Summary for Reach P-6: P-6

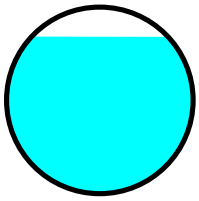
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 102% of Manning's capacity

Inflow Area = 2.985 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 14.99 cfs @ 12.01 hrs, Volume= 0.856 af
Outflow = 14.98 cfs @ 12.01 hrs, Volume= 0.856 af, Atten= 0%, Lag= 0.1 min

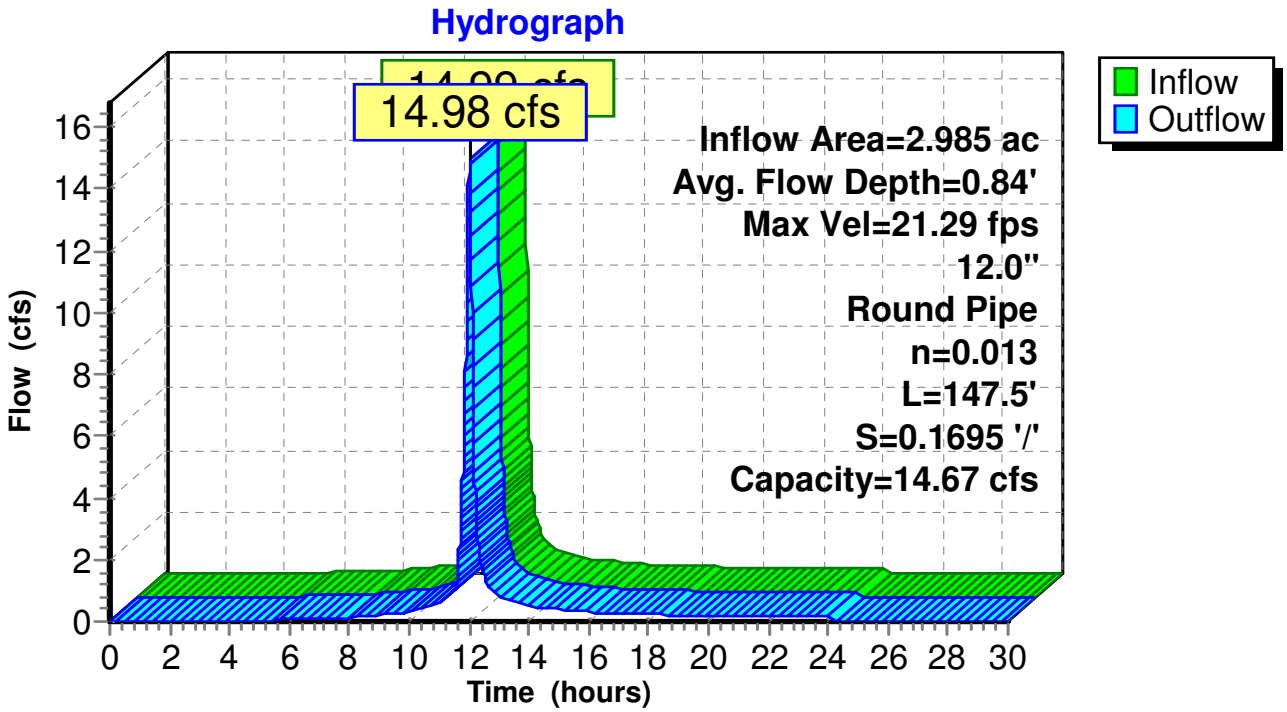
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 21.29 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 7.00 fps, Avg. Travel Time= 0.4 min

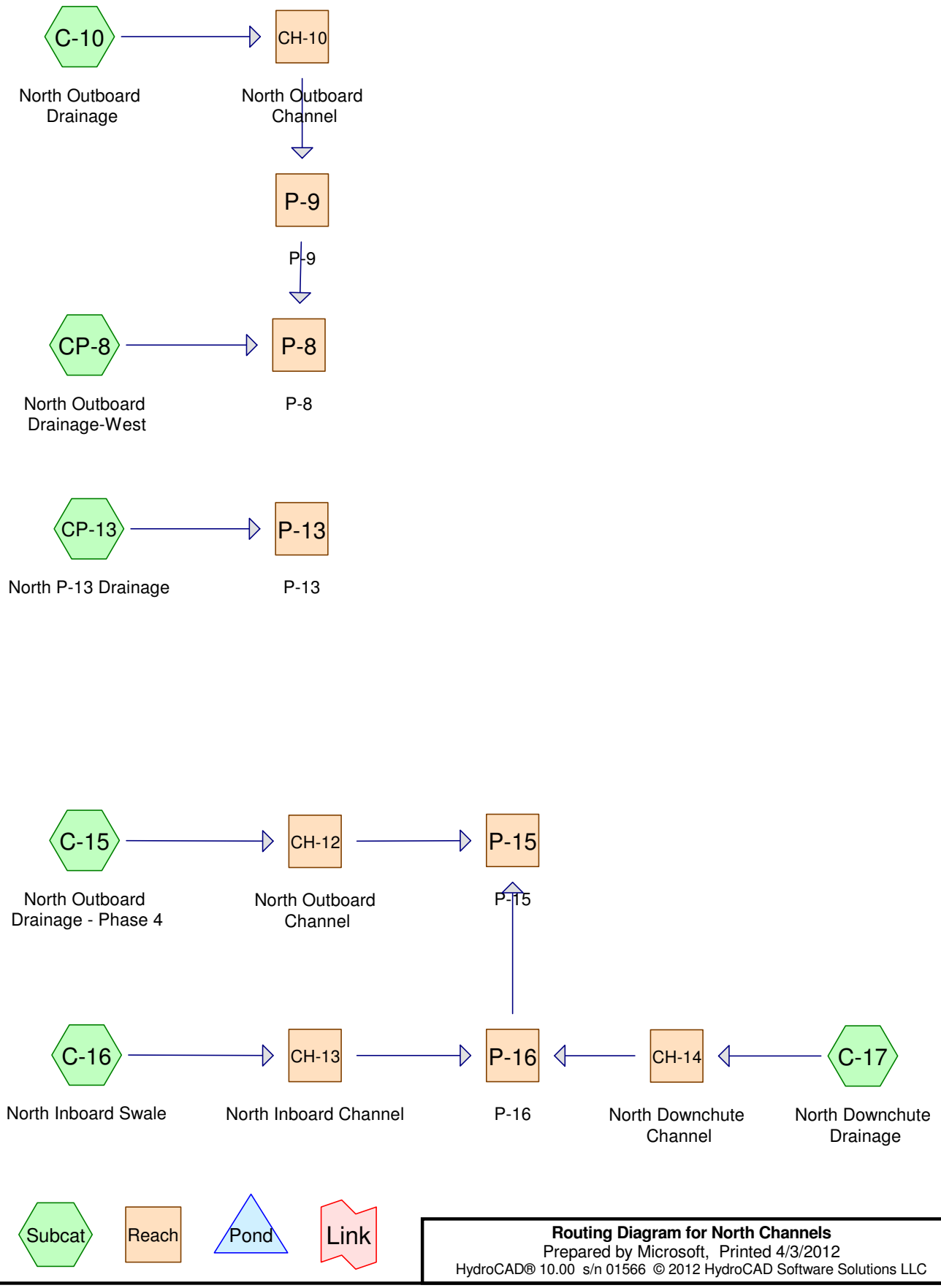
Peak Storage= 104 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.84'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 14.67 cfs

12.0" Round Pipe
n= 0.013
Length= 147.5' Slope= 0.1695 '/'
Inlet Invert= 1,070.00', Outlet Invert= 1,045.00'



## Reach P-6: P-6


Hydrograph
14.98 cfs
Inflow
Outflow
Inflow Area=2.985 ac
Avg. Flow Depth=0.84'
Max Vel=21.29 fps
12.0"
Round Pipe
n=0.013
L=147.5'
S=0.1695 '/'
Capacity=14.67 cfs
Flow (cfs)
0
2
4
6
8
10
12
14
16
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Time (hours)




**Routing Diagram for North Channels**

Prepared by Microsoft, Printed 4/3/2012

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## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 2.677 | 94 | (C-16) |
| 3.825 | 91 | (C-17) |
| 5.544 | 91 | Newly graded area, HSG C (C-10, C-15, CP-13, CP-8) |
| **12.045** | **92** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 5.544 | HSG C | C-10, C-15, CP-13, CP-8 |
| 0.000 | HSG D | |
| 6.501 | Other | C-16, C-17 |
| **12.045** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 6.501 | 6.501 | | C-16, C-17 |
| 0.000 | 0.000 | 5.544 | 0.000 | 0.000 | 5.544 | Newly graded area | C-10, C-15, CP-13, CP-8 |
| **0.000** | **0.000** | **5.544** | **0.000** | **6.501** | **12.045** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | P-13 | 1,240.00 | 1,238.92 | 90.8 | 0.0119 | 0.013 | 12.0 | 0.0 | 0.0 |
| 2 | P-15 | 1,247.42 | 1,245.00 | 160.8 | 0.0150 | 0.013 | 30.0 | 0.0 | 0.0 |
| 3 | P-16 | 1,248.00 | 1,247.42 | 57.4 | 0.0101 | 0.013 | 30.0 | 0.0 | 0.0 |
| 4 | P-8 | 1,218.00 | 1,214.00 | 183.2 | 0.0218 | 0.013 | 24.0 | 0.0 | 0.0 |
| 5 | P-9 | 1,223.90 | 1,219.00 | 243.9 | 0.0201 | 0.013 | 18.0 | 0.0 | 0.0 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment C-10: North Outboard** Runoff Area=122,478 sf 0.00% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=91 Runoff=14.12 cfs 0.806 af

**Subcatchment C-15: North Outboard** Runoff Area=52,658 sf 0.00% Impervious Runoff Depth=3.44"
Flow Length=200' Slope=0.2460 '/' Tc=15.4 min CN=91 Runoff=5.11 cfs 0.347 af

**Subcatchment C-16: North Inboard Swale** Runoff Area=116,589 sf 0.00% Impervious Runoff Depth=3.76"
Tc=10.0 min CN=94 Runoff=14.21 cfs 0.838 af

**Subcatchment C-17: North Downchute** Runoff Area=166,599 sf 0.00% Impervious Runoff Depth=3.44"
Tc=15.0 min CN=91 Runoff=16.35 cfs 1.096 af

**Subcatchment CP-13: North P-13 Drainage** Runoff Area=14,236 sf 0.00% Impervious Runoff Depth=3.44"
Tc=5.0 min CN=91 Runoff=1.93 cfs 0.094 af

**Subcatchment CP-8: North Outboard** Runoff Area=52,138 sf 0.00% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=91 Runoff=6.01 cfs 0.343 af

**Reach CH-10: North Outboard Channel** Avg. Flow Depth=0.88' Max Vel=4.06 fps Inflow=14.12 cfs 0.806 af
n=0.055 L=1,579.0' S=0.0488 '/' Capacity=62.66 cfs Outflow=11.85 cfs 0.806 af

**Reach CH-12: North Outboard Channel** Avg. Flow Depth=0.53' Max Vel=3.14 fps Inflow=5.11 cfs 0.347 af
n=0.055 L=904.0' S=0.0494 '/' Capacity=63.00 cfs Outflow=4.71 cfs 0.347 af

**Reach CH-13: North Inboard Channel** Avg. Flow Depth=0.79' Max Vel=3.83 fps Inflow=14.21 cfs 0.838 af
n=0.055 L=846.0' S=0.0517 '/' Capacity=274.13 cfs Outflow=13.15 cfs 0.838 af

**Reach CH-14: North Downchute** Avg. Flow Depth=0.34' Max Vel=9.51 fps Inflow=16.35 cfs 1.096 af
n=0.030 L=602.0' S=0.2031 '/' Capacity=504.48 cfs Outflow=16.29 cfs 1.096 af

**Reach P-13: P-13** Avg. Flow Depth=0.50' Max Vel=4.94 fps Inflow=1.93 cfs 0.094 af
12.0" Round Pipe n=0.013 L=90.8' S=0.0119 '/' Capacity=3.89 cfs Outflow=1.93 cfs 0.094 af

**Reach P-15: P-15** Avg. Flow Depth=1.49' Max Vel=10.97 fps Inflow=33.53 cfs 2.281 af
30.0" Round Pipe n=0.013 L=160.8' S=0.0150 '/' Capacity=50.32 cfs Outflow=33.52 cfs 2.281 af

**Reach P-16: P-16** Avg. Flow Depth=1.55' Max Vel=9.11 fps Inflow=29.19 cfs 1.934 af
30.0" Round Pipe n=0.013 L=57.4' S=0.0101 '/' Capacity=41.23 cfs Outflow=29.19 cfs 1.934 af

**Reach P-8: P-8** Avg. Flow Depth=1.01' Max Vel=10.70 fps Inflow=17.12 cfs 1.149 af
24.0" Round Pipe n=0.013 L=183.2' S=0.0218 '/' Capacity=33.43 cfs Outflow=17.11 cfs 1.149 af

**Reach P-9: P-9** Avg. Flow Depth=1.01' Max Vel=9.35 fps Inflow=11.85 cfs 0.806 af
18.0" Round Pipe n=0.013 L=243.9' S=0.0201 '/' Capacity=14.89 cfs Outflow=11.84 cfs 0.806 af

**Total Runoff Area = 12.045 ac Runoff Volume = 3.524 af Average Runoff Depth = 3.51"**
**100.00% Pervious = 12.045 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment C-10: North Outboard Drainage

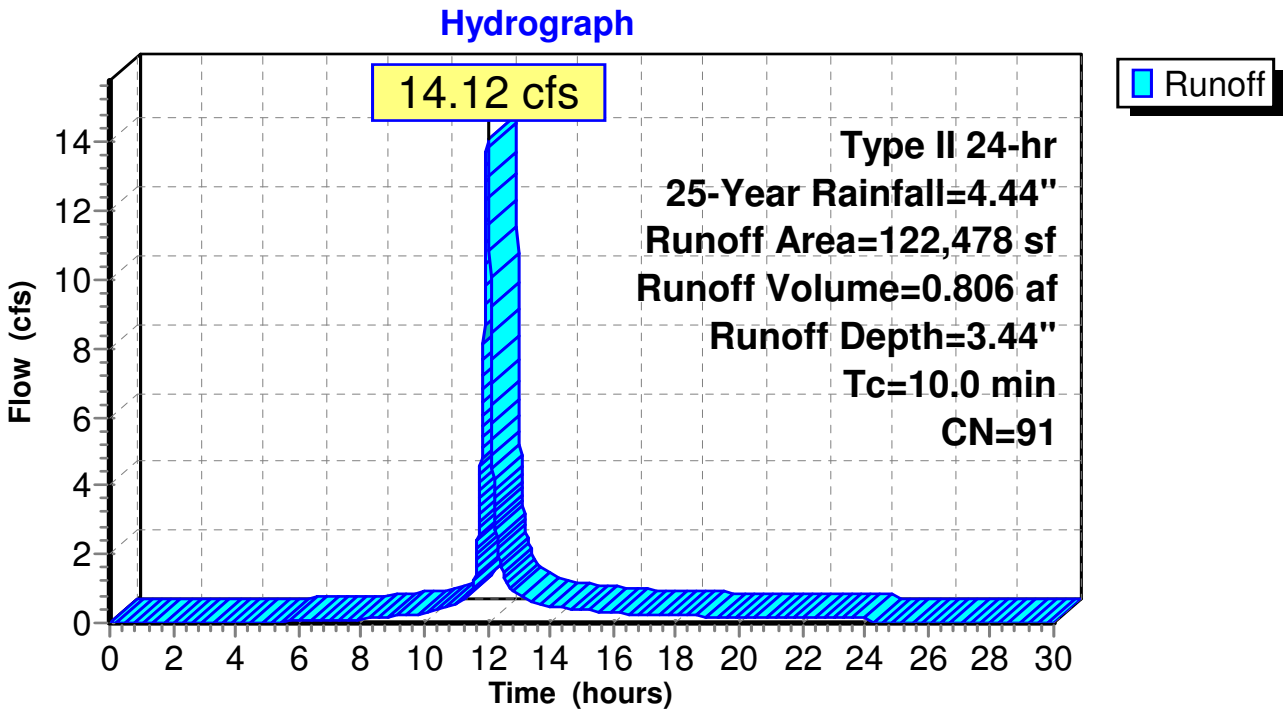
Runoff = 14.12 cfs @ 12.01 hrs, Volume= 0.806 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 122,478 | 91 | Newly graded area, HSG C |
| | 122,478 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-10: North Outboard Drainage



## Summary for Subcatchment C-15: North Outboard Drainage - Phase 4

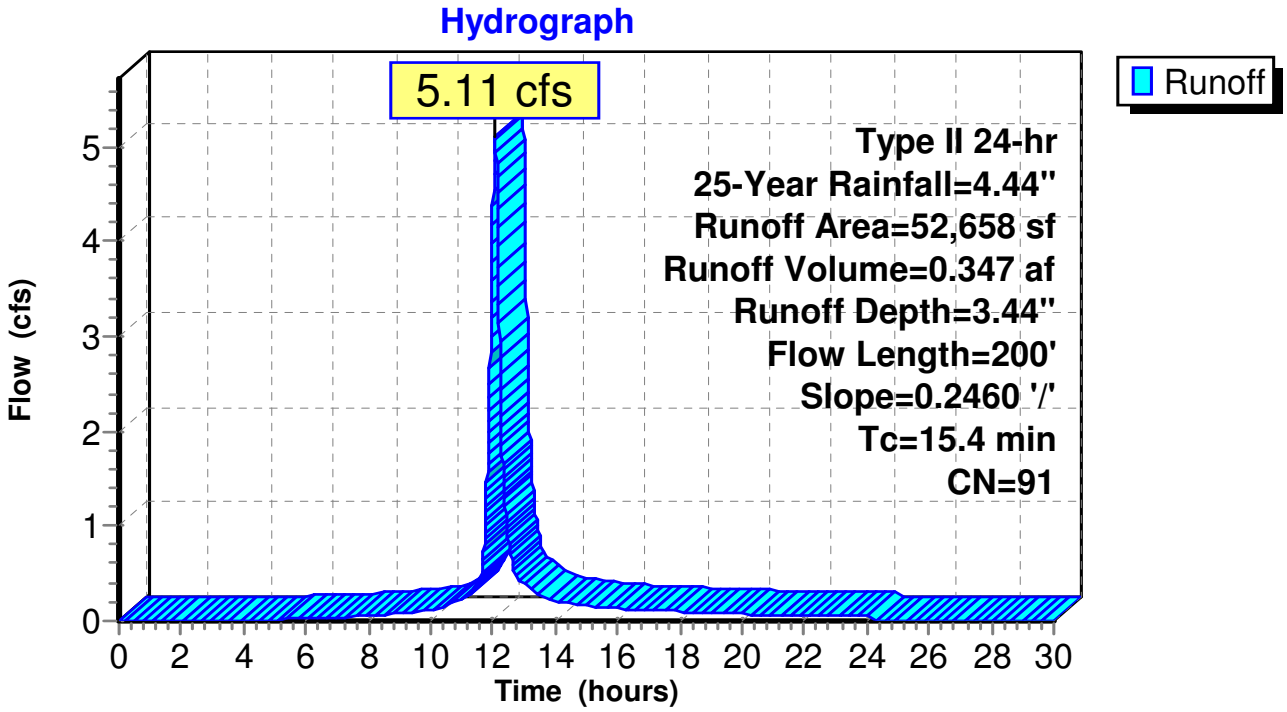
Runoff = 5.11 cfs @ 12.07 hrs, Volume= 0.347 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 52,658 | 91 | Newly graded area, HSG C |
| 52,658 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.4 | 200 | 0.2460 | 0.22 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.54" |

## Subcatchment C-15: North Outboard Drainage - Phase 4



## Summary for Subcatchment C-16: North Inboard Swale

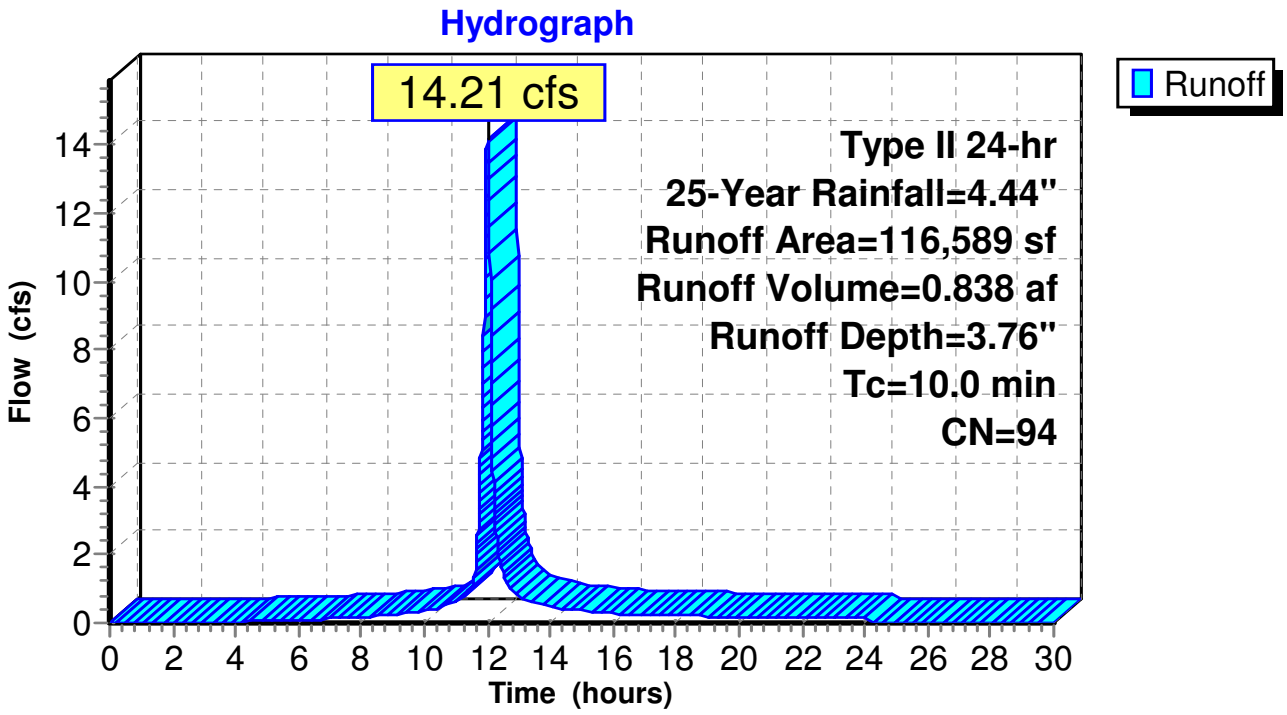
Runoff = 14.21 cfs @ 12.01 hrs, Volume= 0.838 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 116,589 | 94 | |
| | 116,589 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-16: North Inboard Swale



## Summary for Subcatchment C-17: North Downchute Drainage

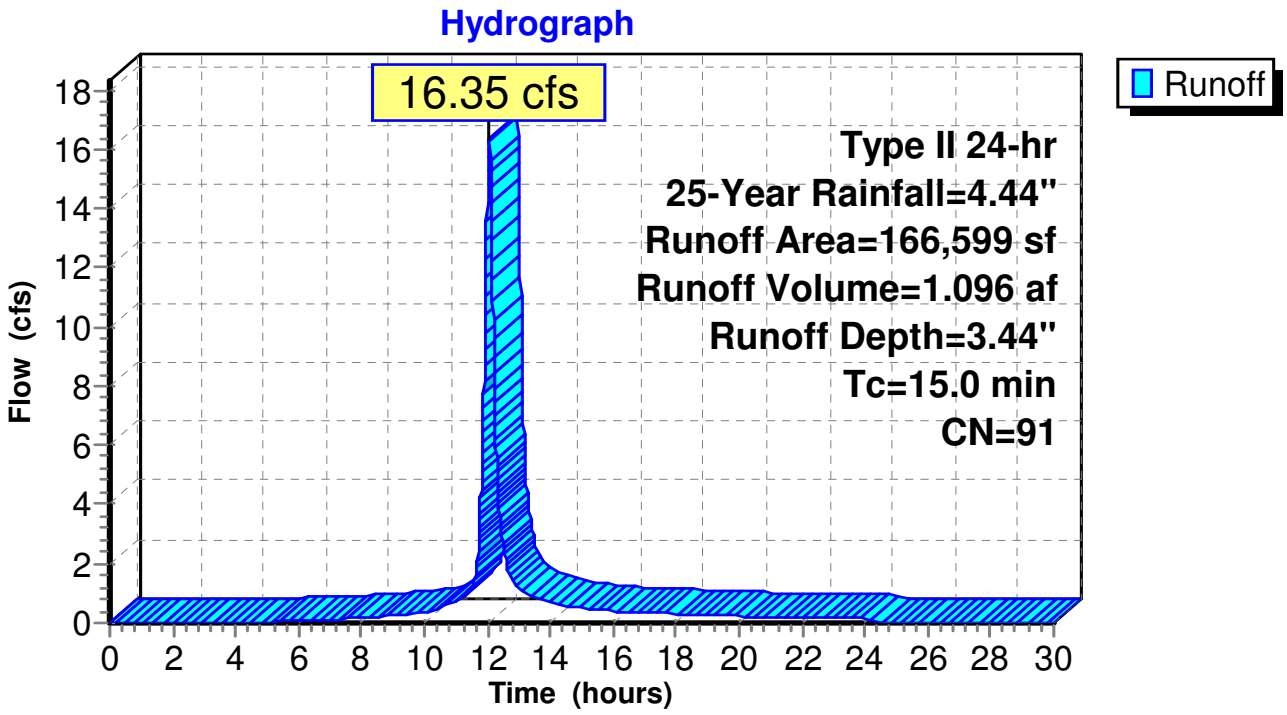
Runoff = 16.35 cfs @ 12.06 hrs, Volume= 1.096 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 166,599 | 91 | |
| | 166,599 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

### Subcatchment C-17: North Downchute Drainage



## Summary for Subcatchment CP-13: North P-13 Drainage

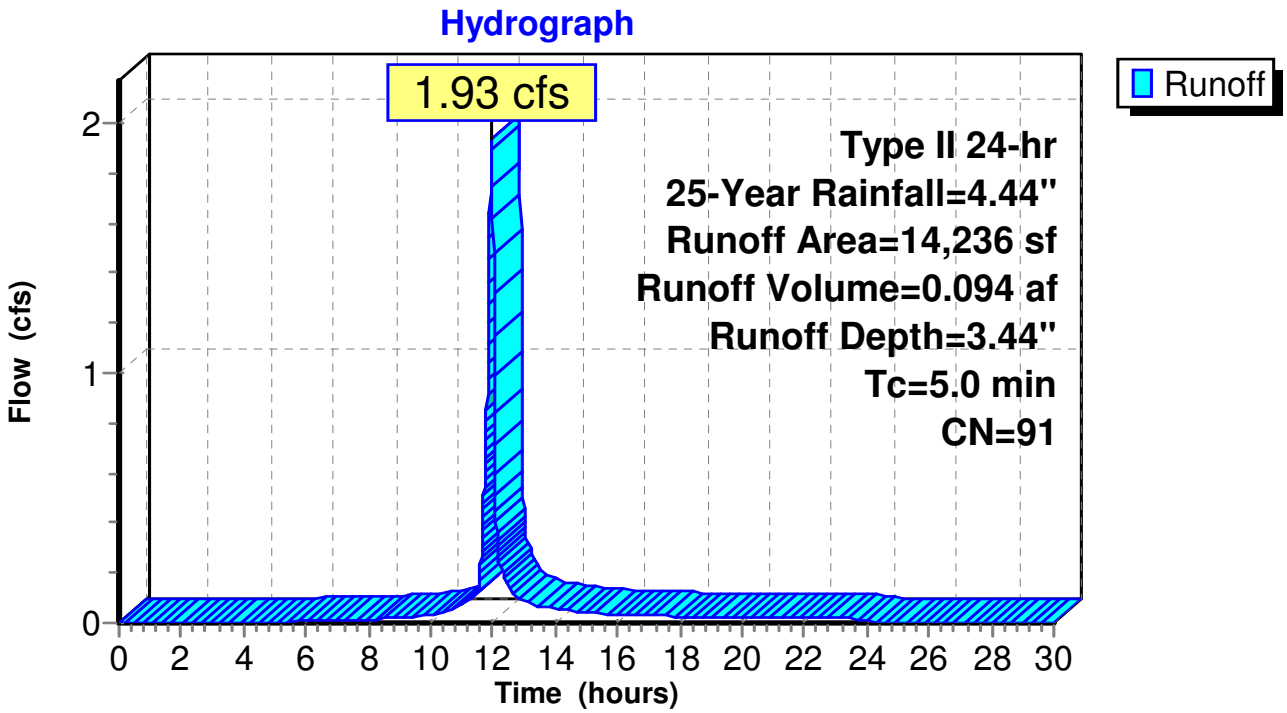
Runoff = 1.93 cfs @ 11.96 hrs, Volume= 0.094 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 14,236 | 91 | Newly graded area, HSG C |
| 14,236 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment CP-13: North P-13 Drainage



## Summary for Subcatchment CP-8: North Outboard Drainage-West

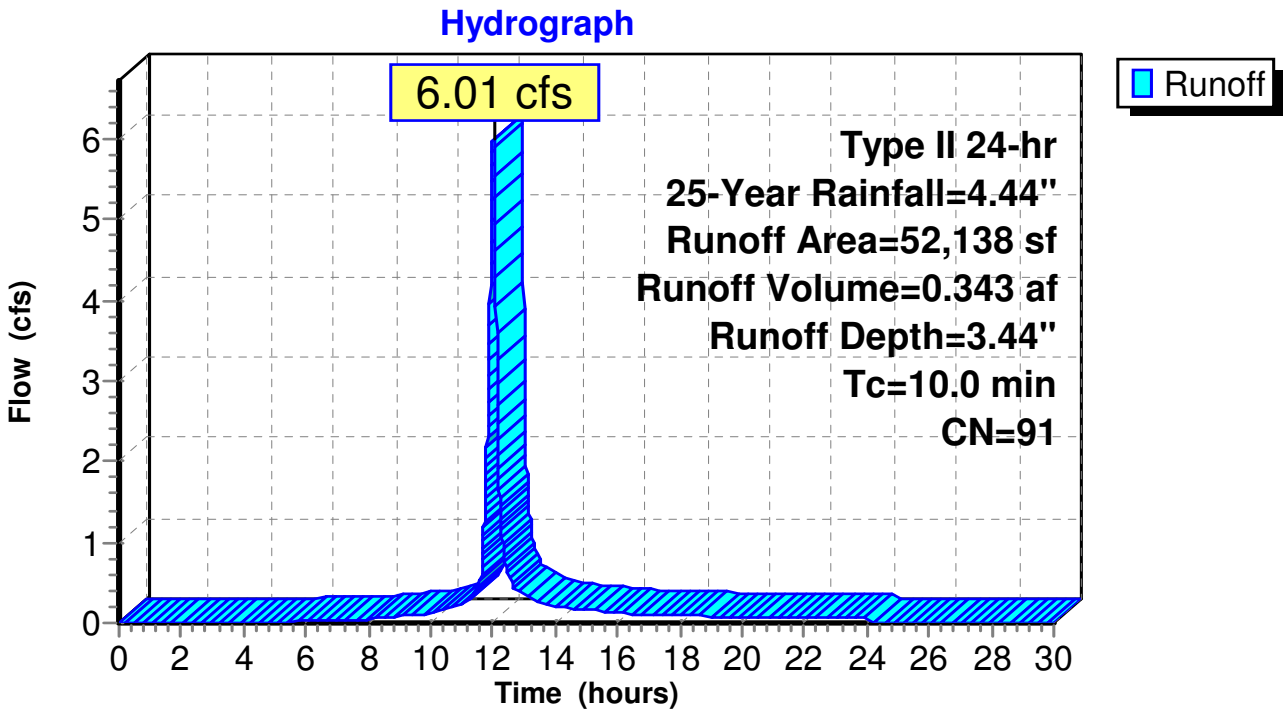
Runoff = 6.01 cfs @ 12.01 hrs, Volume= 0.343 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 52,138 | 91 | Newly graded area, HSG C |
| 52,138 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment CP-8: North Outboard Drainage-West



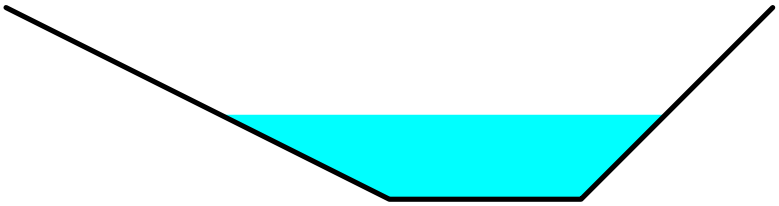
## Summary for Reach CH-10: North Outboard Channel

Inflow Area = 2.812 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 14.12 cfs @ 12.01 hrs, Volume= 0.806 af
Outflow = 11.85 cfs @ 12.07 hrs, Volume= 0.806 af, Atten= 16%, Lag= 3.3 min

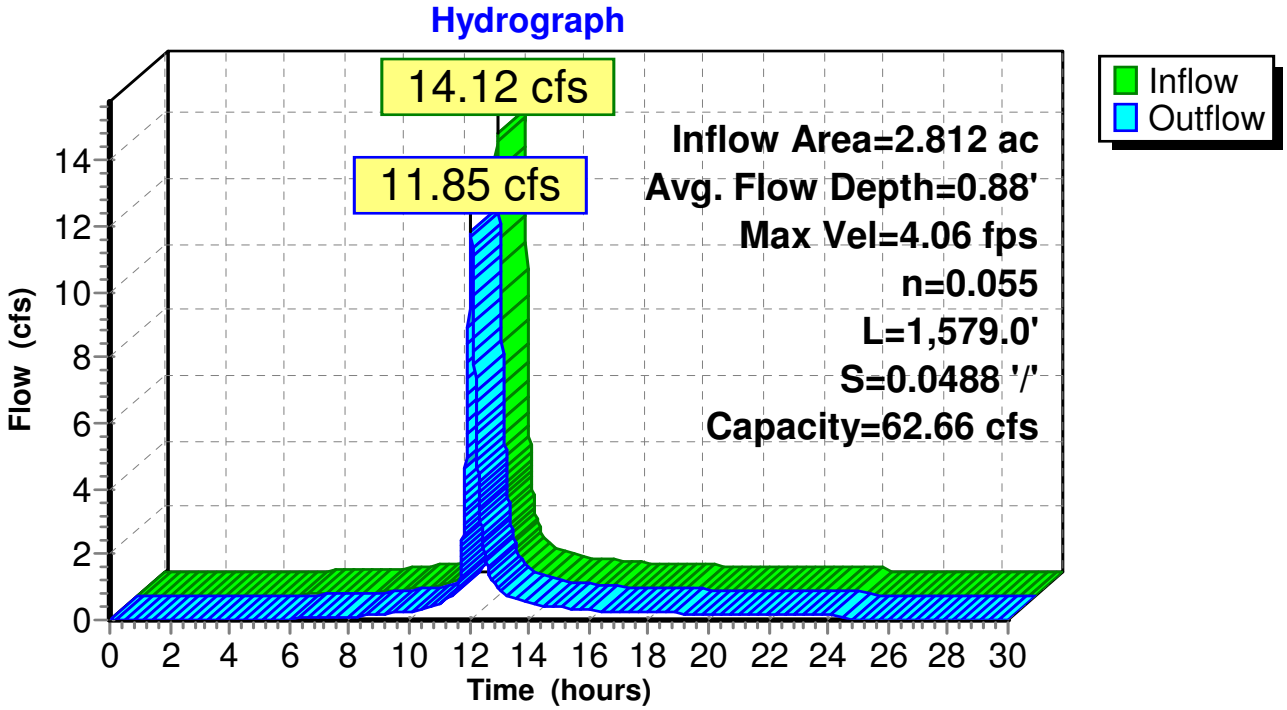
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.06 fps, Min. Travel Time= 6.5 min
Avg. Velocity = 1.02 fps, Avg. Travel Time= 25.8 min

Peak Storage= 4,612 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 62.66 cfs

2.00' x 2.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 2.0 1.0 '/' Top Width= 8.00'
Length= 1,579.0' Slope= 0.0488 '/'
Inlet Invert= 1,301.00', Outlet Invert= 1,223.90'



**Reach CH-10: North Outboard Channel**



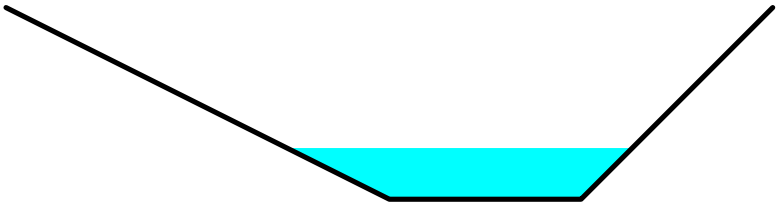
## Summary for Reach CH-12: North Outboard Channel

Inflow Area = 1.209 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 5.11 cfs @ 12.07 hrs, Volume= 0.347 af
Outflow = 4.71 cfs @ 12.12 hrs, Volume= 0.347 af, Atten= 8%, Lag= 3.1 min

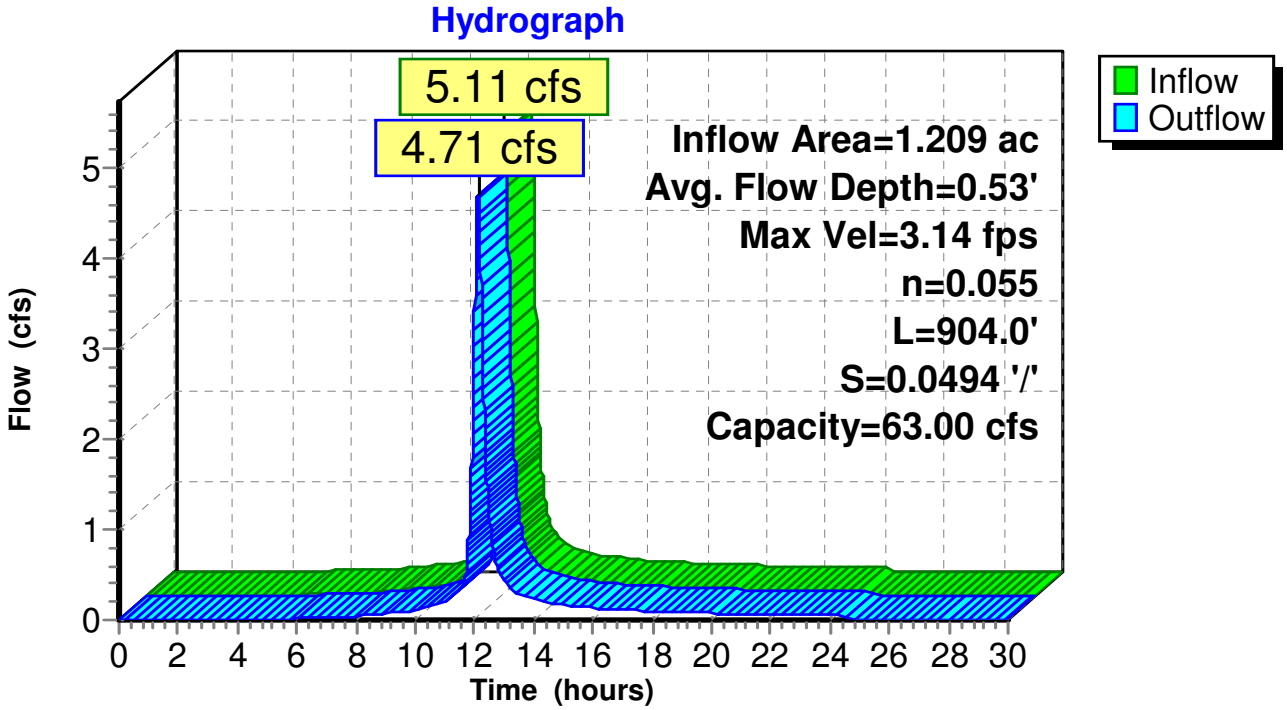
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.14 fps, Min. Travel Time= 4.8 min
Avg. Velocity = 0.82 fps, Avg. Travel Time= 18.4 min

Peak Storage= 1,354 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 63.00 cfs

2.00' x 2.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 2.0 1.0 '/' Top Width= 8.00'
Length= 904.0' Slope= 0.0494 '/'
Inlet Invert= 1,301.00', Outlet Invert= 1,256.38'



**Reach CH-12: North Outboard Channel**



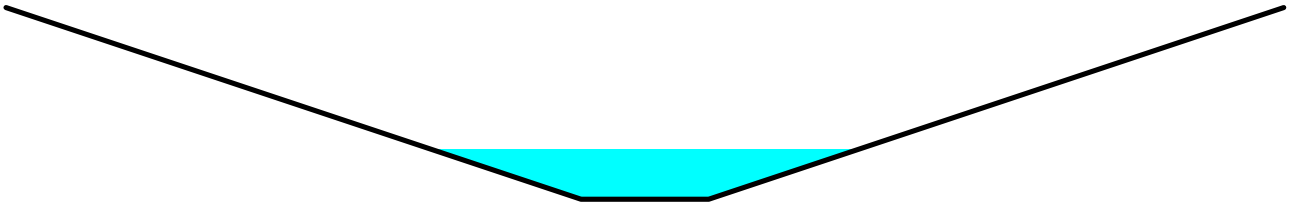
## Summary for Reach CH-13: North Inboard Channel

Inflow Area = 2.677 ac, 0.00% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 14.21 cfs @ 12.01 hrs, Volume= 0.838 af
Outflow = 13.15 cfs @ 12.05 hrs, Volume= 0.838 af, Atten= 7%, Lag= 2.2 min

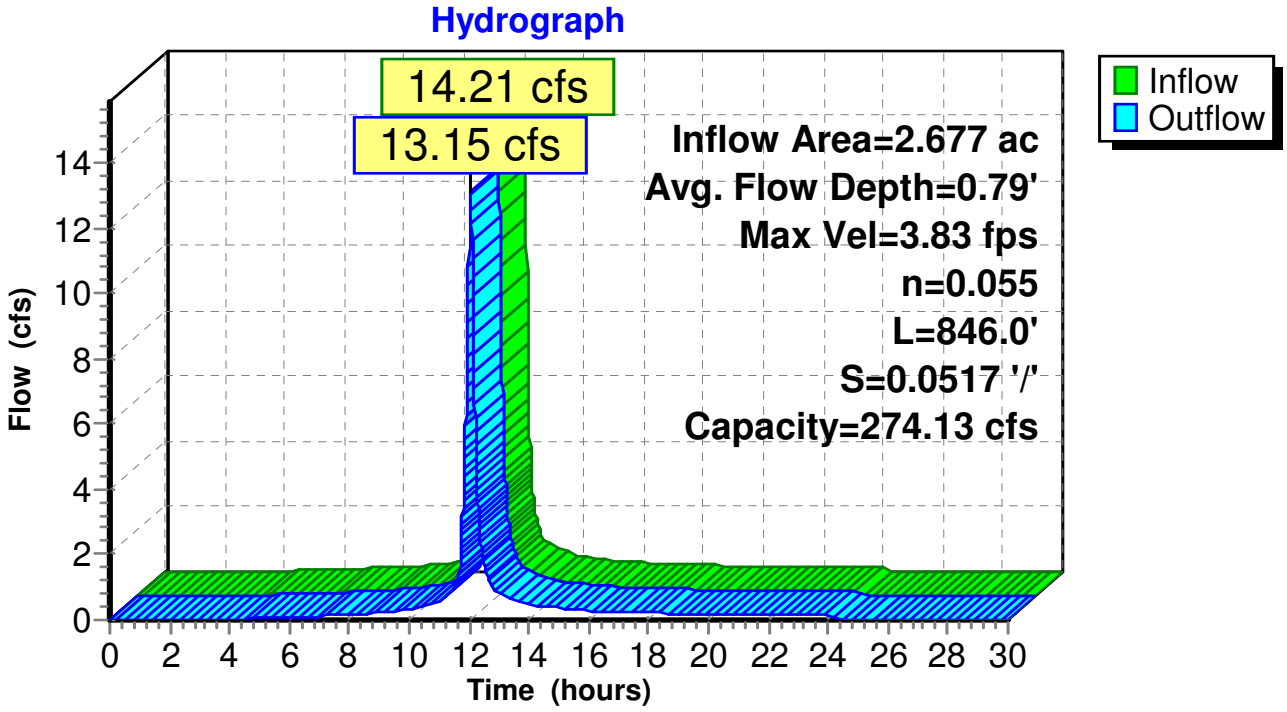
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.83 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 12.9 min

Peak Storage= 2,906 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 274.13 cfs

2.00' x 3.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 846.0' Slope= 0.0517 '/'
Inlet Invert= 1,298.69', Outlet Invert= 1,254.99'



**Reach CH-13: North Inboard Channel**



## Summary for Reach CH-14: North Downchute Channel

Inflow Area = 3.825 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 16.35 cfs @ 12.06 hrs, Volume= 1.096 af
Outflow = 16.29 cfs @ 12.08 hrs, Volume= 1.096 af, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.51 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.47 fps, Avg. Travel Time= 4.1 min

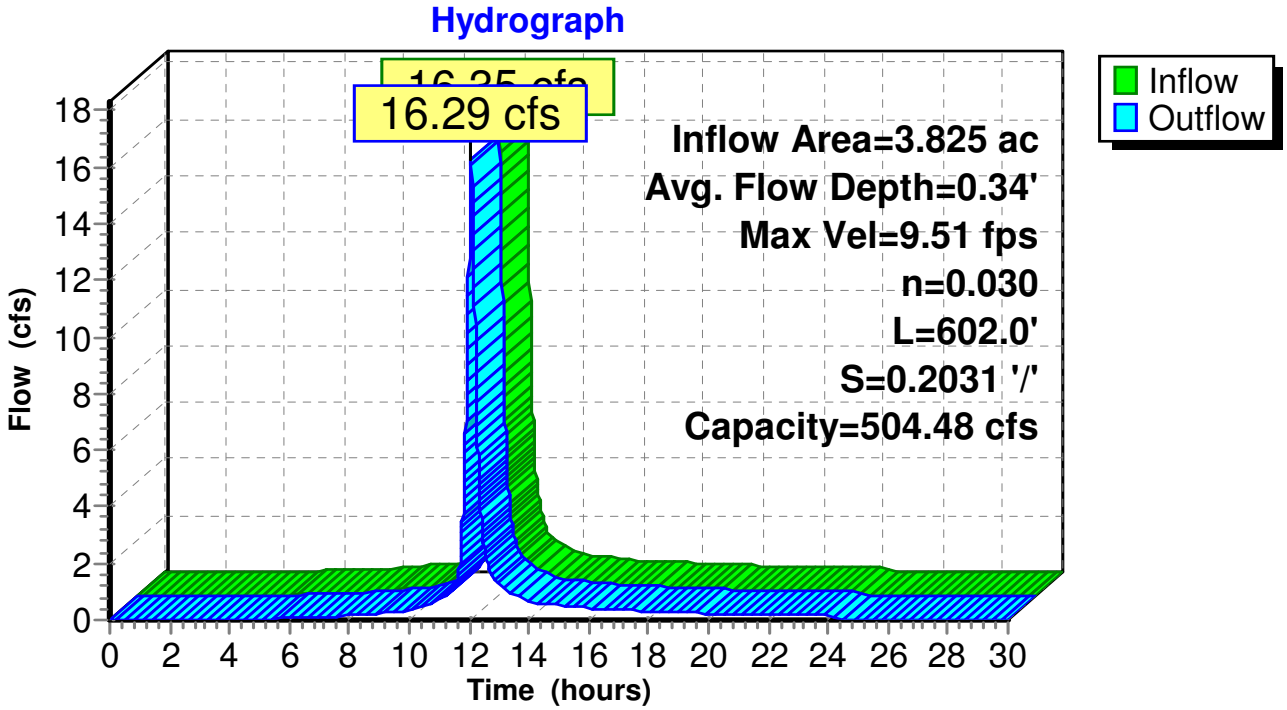
Peak Storage= 1,031 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 504.48 cfs

4.00' x 2.00' deep channel, n= 0.030 Grouted Riprap
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 602.0' Slope= 0.2031 '/'
Inlet Invert= 1,380.00', Outlet Invert= 1,257.75'

‡



**Reach CH-14: North Downchute Channel**



## Summary for Reach P-13: P-13

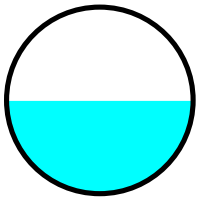
[52] Hint: Inlet/Outlet conditions not evaluated

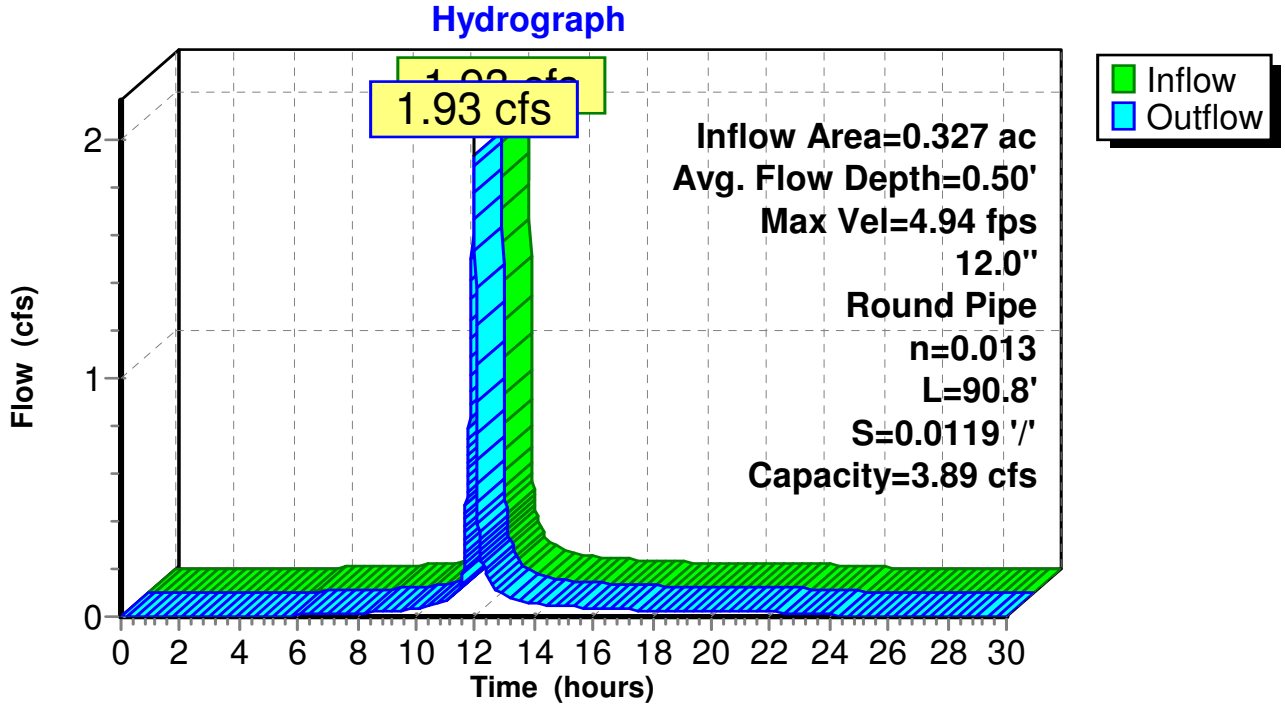
Inflow Area = 0.327 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 1.93 cfs @ 11.96 hrs, Volume= 0.094 af
Outflow = 1.93 cfs @ 11.96 hrs, Volume= 0.094 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.94 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.43 fps, Avg. Travel Time= 1.1 min

Peak Storage= 36 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.89 cfs

12.0" Round Pipe
n= 0.013
Length= 90.8' Slope= 0.0119 '/'
Inlet Invert= 1,240.00', Outlet Invert= 1,238.92'





## Summary for Reach P-15: P-15

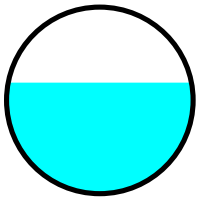
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach P-16 OUTLET depth by 0.03' @ 12.26 hrs

Inflow Area = 7.710 ac, 0.00% Impervious, Inflow Depth = 3.55" for 25-Year event
Inflow = 33.53 cfs @ 12.07 hrs, Volume= 2.281 af
Outflow = 33.52 cfs @ 12.07 hrs, Volume= 2.281 af, Atten= 0%, Lag= 0.2 min

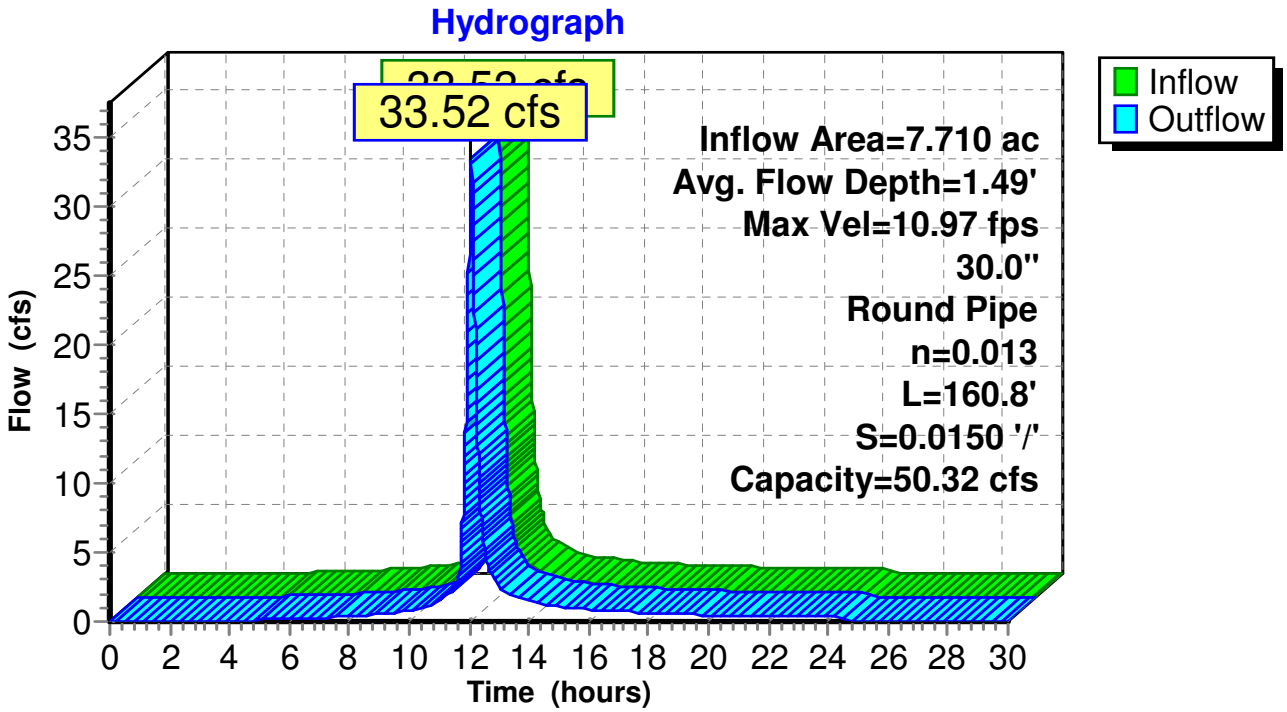
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.97 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.17 fps, Avg. Travel Time= 0.8 min

Peak Storage= 491 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.49'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 50.32 cfs

30.0" Round Pipe
n= 0.013
Length= 160.8' Slope= 0.0150 '/'
Inlet Invert= 1,247.42', Outlet Invert= 1,245.00'



## Reach P-15: P-15



## Summary for Reach P-16: P-16

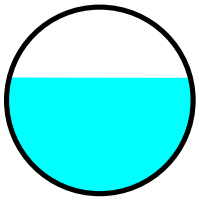
[52] Hint: Inlet/Outlet conditions not evaluated

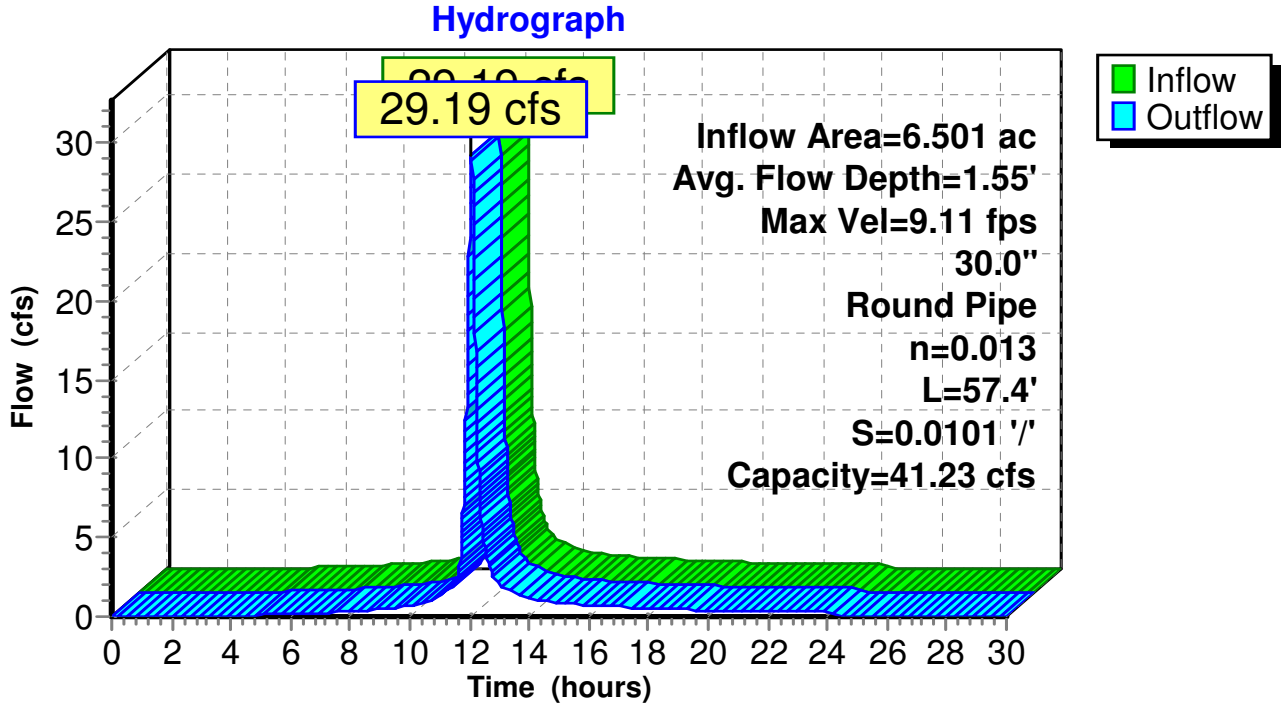
Inflow Area = 6.501 ac, 0.00% Impervious, Inflow Depth = 3.57" for 25-Year event
Inflow = 29.19 cfs @ 12.06 hrs, Volume= 1.934 af
Outflow = 29.19 cfs @ 12.06 hrs, Volume= 1.934 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.11 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.68 fps, Avg. Travel Time= 0.4 min

Peak Storage= 184 cf @ 12.06 hrs
Average Depth at Peak Storage= 1.55'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 41.23 cfs

30.0" Round Pipe
n= 0.013
Length= 57.4' Slope= 0.0101 '/'
Inlet Invert= 1,248.00', Outlet Invert= 1,247.42'





## Summary for Reach P-8: P-8

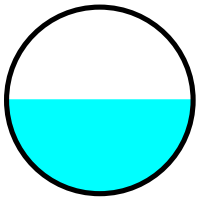
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach P-9 outlet invert by 0.01' @ 12.05 hrs

Inflow Area = 4.009 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 17.12 cfs @ 12.05 hrs, Volume= 1.149 af
Outflow = 17.11 cfs @ 12.05 hrs, Volume= 1.149 af, Atten= 0%, Lag= 0.2 min

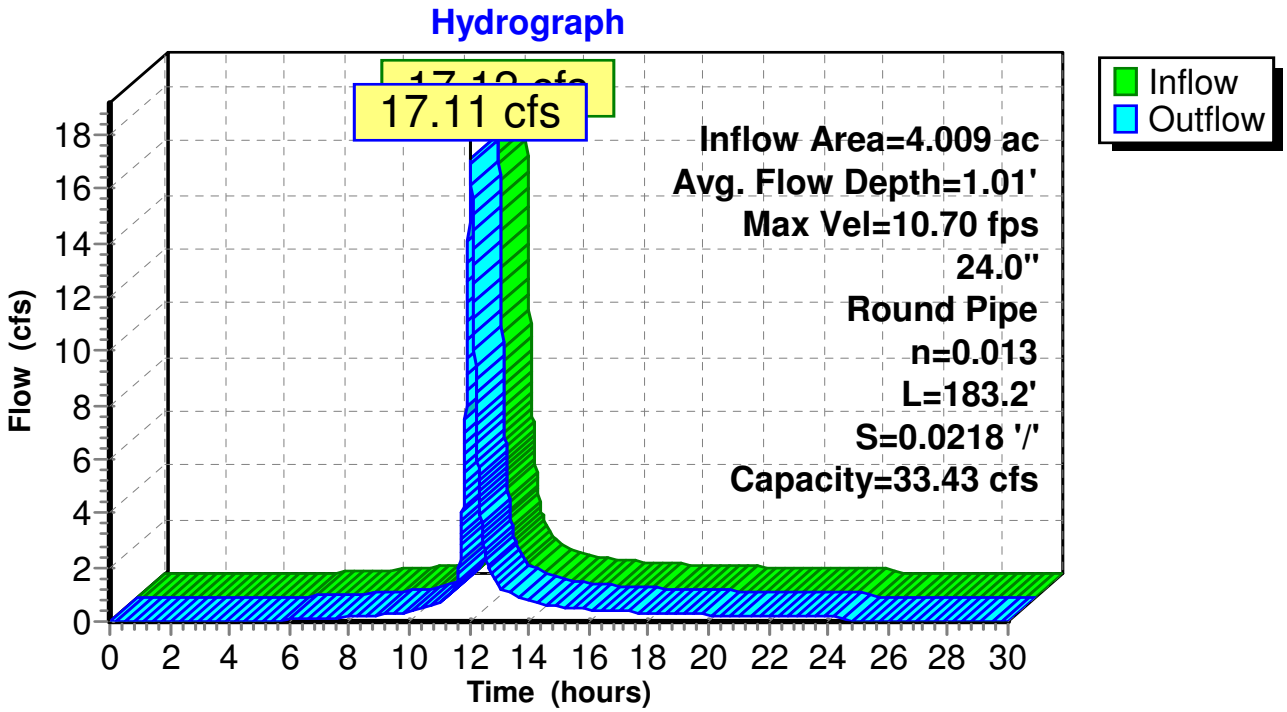
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.70 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.92 fps, Avg. Travel Time= 1.0 min

Peak Storage= 293 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.01'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 33.43 cfs

24.0" Round Pipe
n= 0.013
Length= 183.2' Slope= 0.0218 '/'
Inlet Invert= 1,218.00', Outlet Invert= 1,214.00'



## Reach P-8: P-8


Hydrograph
17.11 cfs
Inflow
Outflow
Inflow Area=4.009 ac
Avg. Flow Depth=1.01'
Max Vel=10.70 fps
24.0"
Round Pipe
n=0.013
L=183.2'
S=0.0218 '/'
Capacity=33.43 cfs
Flow (cfs)
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Time (hours)

## Summary for Reach P-9: P-9

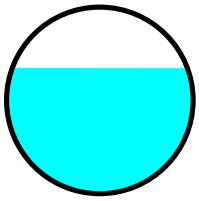
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach CH-10 OUTLET depth by 0.13' @ 12.08 hrs

Inflow Area = 2.812 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 11.85 cfs @ 12.07 hrs, Volume= 0.806 af
Outflow = 11.84 cfs @ 12.07 hrs, Volume= 0.806 af, Atten= 0%, Lag= 0.4 min

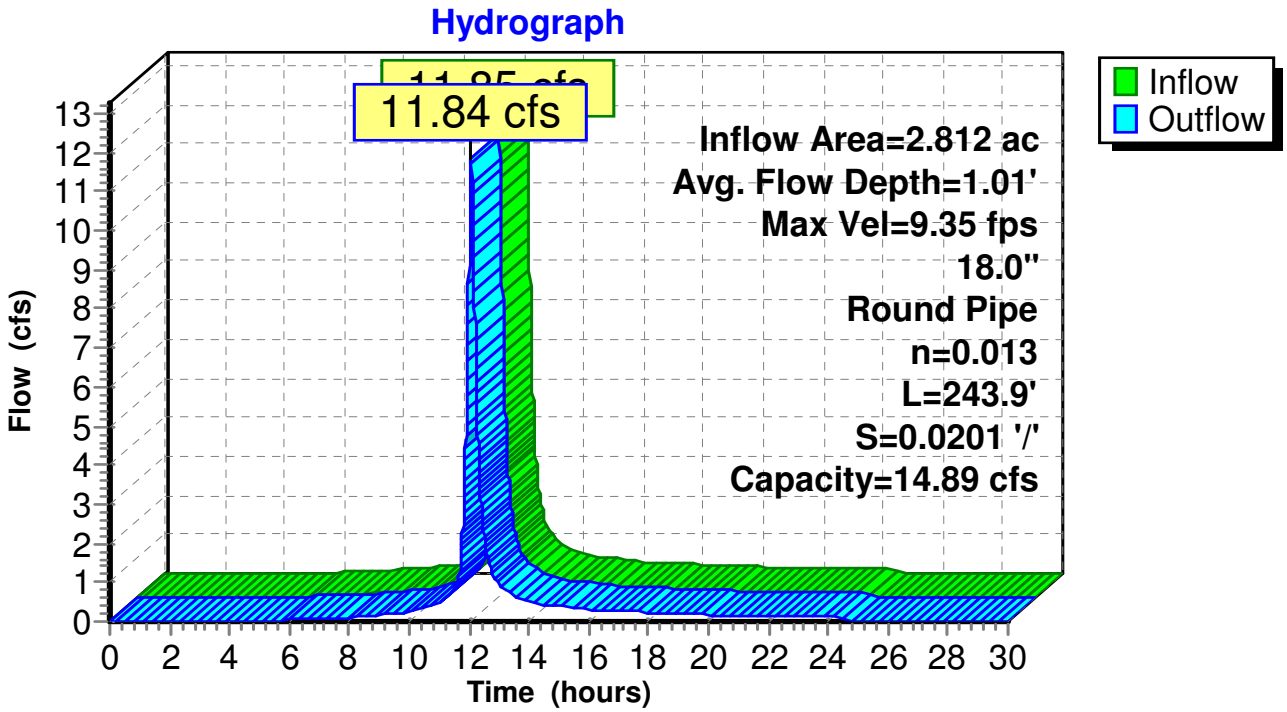
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.35 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.64 fps, Avg. Travel Time= 1.5 min

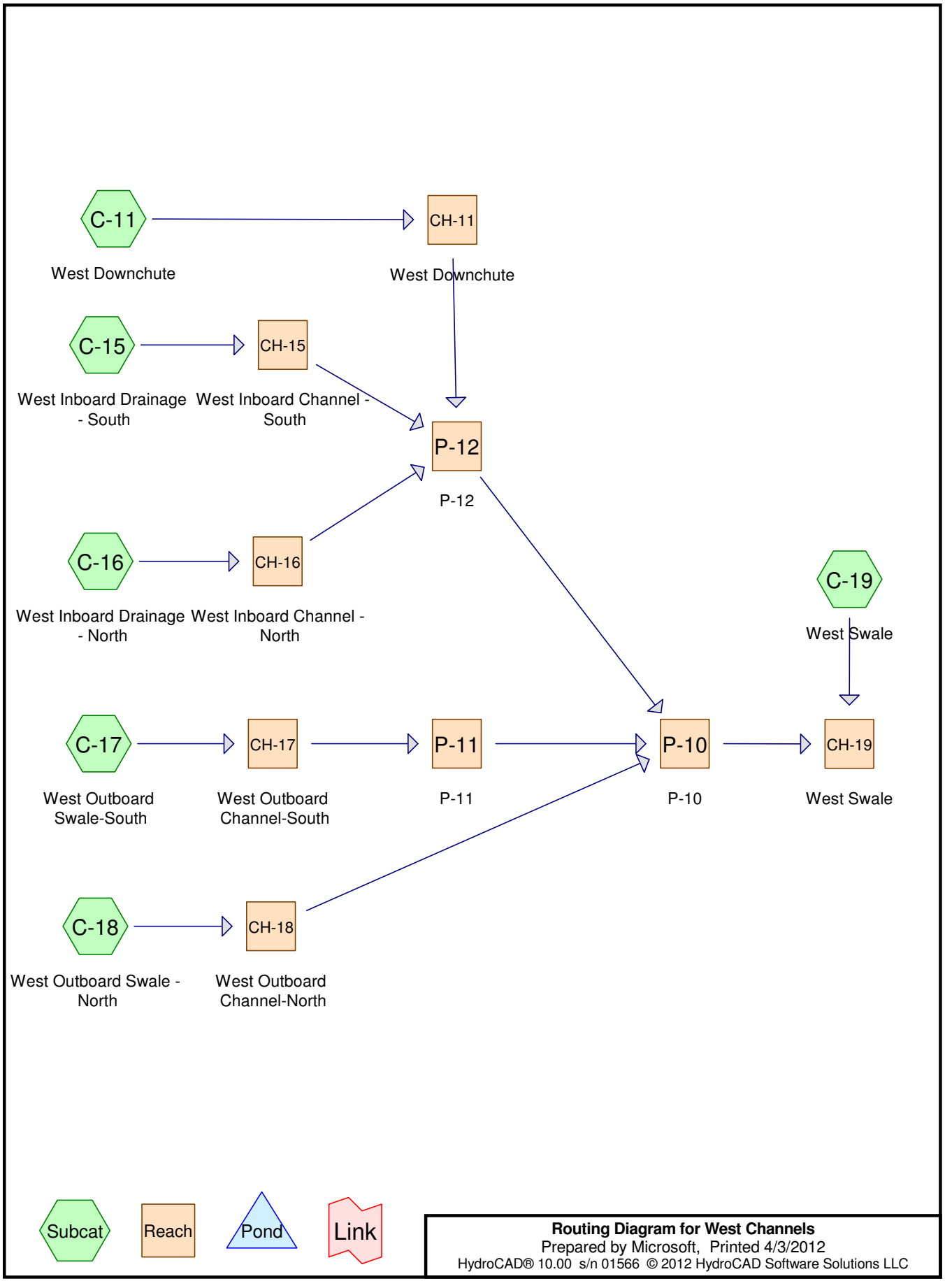
Peak Storage= 309 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.01'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 14.89 cfs

18.0" Round Pipe
n= 0.013
Length= 243.9' Slope= 0.0201 '/'
Inlet Invert= 1,223.90', Outlet Invert= 1,219.00'



## Reach P-9: P-9


Hydrograph
11.84 cfs
Inflow
Outflow
Inflow Area=2.812 ac
Avg. Flow Depth=1.01'
Max Vel=9.35 fps
18.0"
Round Pipe
n=0.013
L=243.9'
S=0.0201 '/'
Capacity=14.89 cfs
Flow (cfs)
0 1 2 3 4 5 6 7 8 9 10 11 12 13
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30




**Routing Diagram for West Channels**
Prepared by Microsoft, Printed 4/3/2012
HydroCAD® 10.00 s/n 01566 © 2012 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 14.806 | 91 | (C-11, C-18) |
| 0.722 | 94 | (C-19) |
| 8.956 | 94 | Fallow, bare soil, HSG C (C-15, C-16, C-17) |
| 3.444 | 76 | Woods/grass comb., Fair, HSG C (C-17) |
| **27.928** | **90** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 12.400 | HSG C | C-15, C-16, C-17 |
| 0.000 | HSG D | |
| 15.528 | Other | C-11, C-18, C-19 |
| **27.928** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 15.528 | 15.528 | | C-11, C-18, C-19 |
| 0.000 | 0.000 | 8.956 | 0.000 | 0.000 | 8.956 | Fallow, bare soil | C-15, C-16, C-17 |
| 0.000 | 0.000 | 3.444 | 0.000 | 0.000 | 3.444 | Woods/grass comb., Fair | C-17 |
| **0.000** | **0.000** | **12.400** | **0.000** | **15.528** | **27.928** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | P-10 | 1,217.00 | 1,215.16 | 106.0 | 0.0174 | 0.013 | 42.0 | 0.0 | 0.0 |
| 2 | P-11 | 1,220.00 | 1,218.00 | 98.7 | 0.0203 | 0.013 | 18.0 | 0.0 | 0.0 |
| 3 | P-12 | 1,218.00 | 1,217.00 | 68.0 | 0.0147 | 0.013 | 36.0 | 0.0 | 0.0 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment C-11: West Downchute** Runoff Area=607,281 sf 0.00% Impervious Runoff Depth=3.44"
Tc=20.0 min CN=91 Runoff=51.75 cfs 3.997 af

**Subcatchment C-15: West Inboard** Runoff Area=165,799 sf 0.00% Impervious Runoff Depth=3.76"
Tc=15.0 min CN=94 Runoff=17.26 cfs 1.191 af

**Subcatchment C-16: West Inboard** Runoff Area=193,911 sf 0.00% Impervious Runoff Depth=3.76"
Tc=15.0 min CN=94 Runoff=20.18 cfs 1.393 af

**Subcatchment C-17: West Outboard** Runoff Area=180,428 sf 0.00% Impervious Runoff Depth=2.33"
Tc=10.0 min CN=79 Runoff=14.84 cfs 0.803 af

**Subcatchment C-18: West Outboard Swale -** Runoff Area=37,647 sf 0.00% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=91 Runoff=4.34 cfs 0.248 af

**Subcatchment C-19: West Swale** Runoff Area=31,468 sf 0.00% Impervious Runoff Depth=3.76"
Tc=10.0 min CN=94 Runoff=3.83 cfs 0.226 af

**Reach CH-11: West Downchute** Avg. Flow Depth=0.55' Max Vel=16.43 fps Inflow=51.75 cfs 3.997 af
n=0.030 L=682.6' S=0.3516 '/' Capacity=3,164.65 cfs Outflow=51.62 cfs 3.997 af

**Reach CH-15: West Inboard Channel -** Avg. Flow Depth=1.04' Max Vel=2.96 fps Inflow=17.26 cfs 1.191 af
n=0.055 L=876.4' S=0.0226 '/' Capacity=181.34 cfs Outflow=15.75 cfs 1.191 af

**Reach CH-16: West Inboard Channel -** Avg. Flow Depth=1.09' Max Vel=2.90 fps Inflow=20.18 cfs 1.393 af
n=0.055 L=1,407.0' S=0.0205 '/' Capacity=172.53 cfs Outflow=16.75 cfs 1.393 af

**Reach CH-17: West Outboard** Avg. Flow Depth=1.01' Max Vel=2.68 fps Inflow=14.84 cfs 0.803 af
n=0.055 L=780.0' S=0.0189 '/' Capacity=311.13 cfs Outflow=13.01 cfs 0.803 af

**Reach CH-18: West Outboard** Avg. Flow Depth=0.63' Max Vel=2.21 fps Inflow=4.34 cfs 0.248 af
n=0.055 L=421.0' S=0.0205 '/' Capacity=40.60 cfs Outflow=4.09 cfs 0.248 af

**Reach CH-19: West Swale** Avg. Flow Depth=1.25' Max Vel=11.91 fps Inflow=100.94 cfs 7.858 af
n=0.030 L=174.6' S=0.0811 '/' Capacity=278.74 cfs Outflow=100.92 cfs 7.858 af

**Reach P-10: P-10** Avg. Flow Depth=2.25' Max Vel=15.10 fps Inflow=98.73 cfs 7.632 af
42.0" Round Pipe n=0.013 L=106.0' S=0.0174 '/' Capacity=132.55 cfs Outflow=98.73 cfs 7.632 af

**Reach P-11: P-11** Avg. Flow Depth=1.08' Max Vel=9.53 fps Inflow=13.01 cfs 0.803 af
18.0" Round Pipe n=0.013 L=98.7' S=0.0203 '/' Capacity=14.95 cfs Outflow=13.01 cfs 0.803 af

**Reach P-12: P-12** Avg. Flow Depth=2.58' Max Vel=13.04 fps Inflow=84.00 cfs 6.582 af
36.0" Round Pipe n=0.013 L=68.0' S=0.0147 '/' Capacity=80.88 cfs Outflow=84.00 cfs 6.582 af

**Total Runoff Area = 27.928 ac Runoff Volume = 7.858 af Average Runoff Depth = 3.38"**
**100.00% Pervious = 27.928 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment C-11: West Downchute

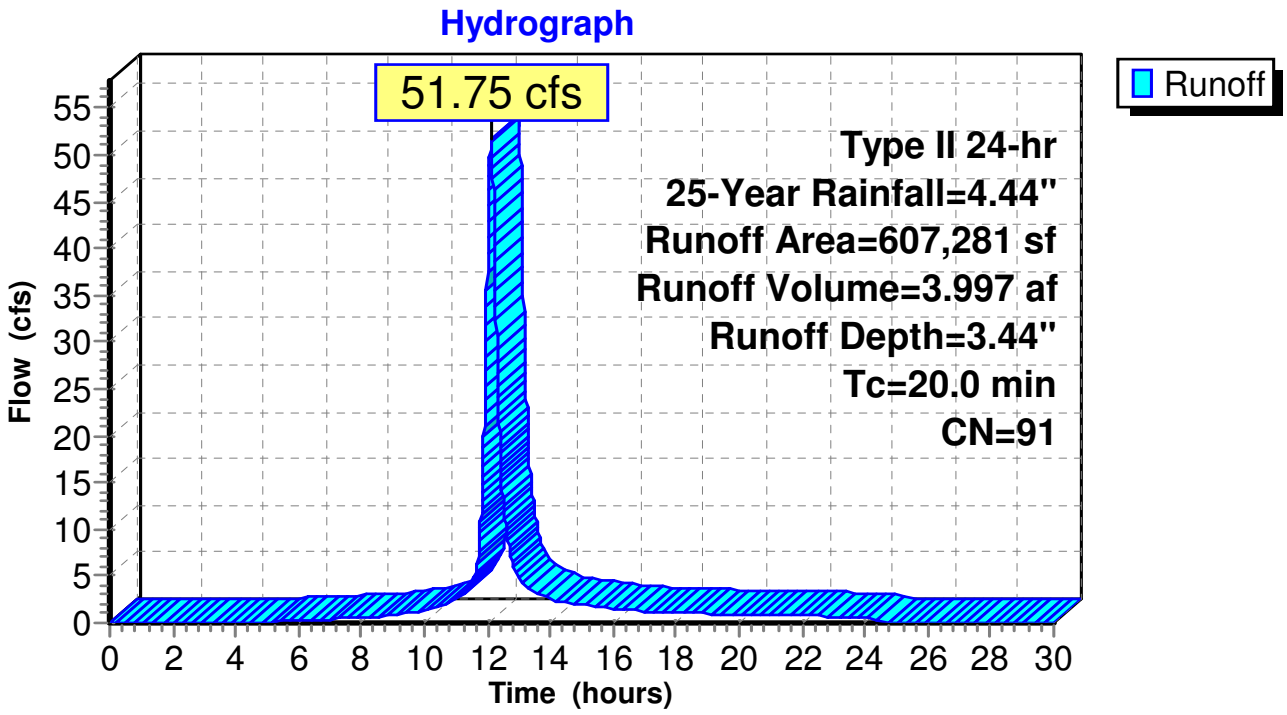
Runoff = 51.75 cfs @ 12.11 hrs, Volume= 3.997 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 607,281 | 91 | |
| | 607,281 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

### Subcatchment C-11: West Downchute



## Summary for Subcatchment C-15: West Inboard Drainage - South

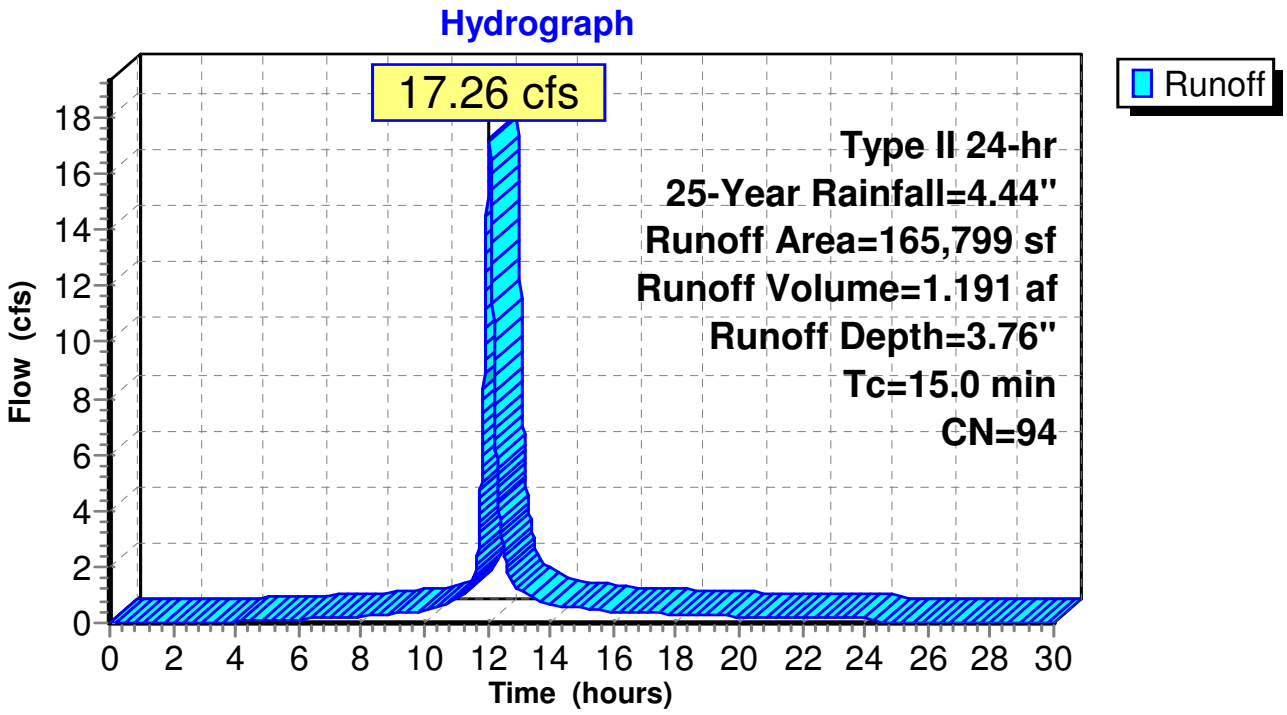
Runoff = 17.26 cfs @ 12.06 hrs, Volume= 1.191 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 165,799 | 94 | Fallow, bare soil, HSG C |
| | 165,799 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

### Subcatchment C-15: West Inboard Drainage - South



## Summary for Subcatchment C-16: West Inboard Drainage - North

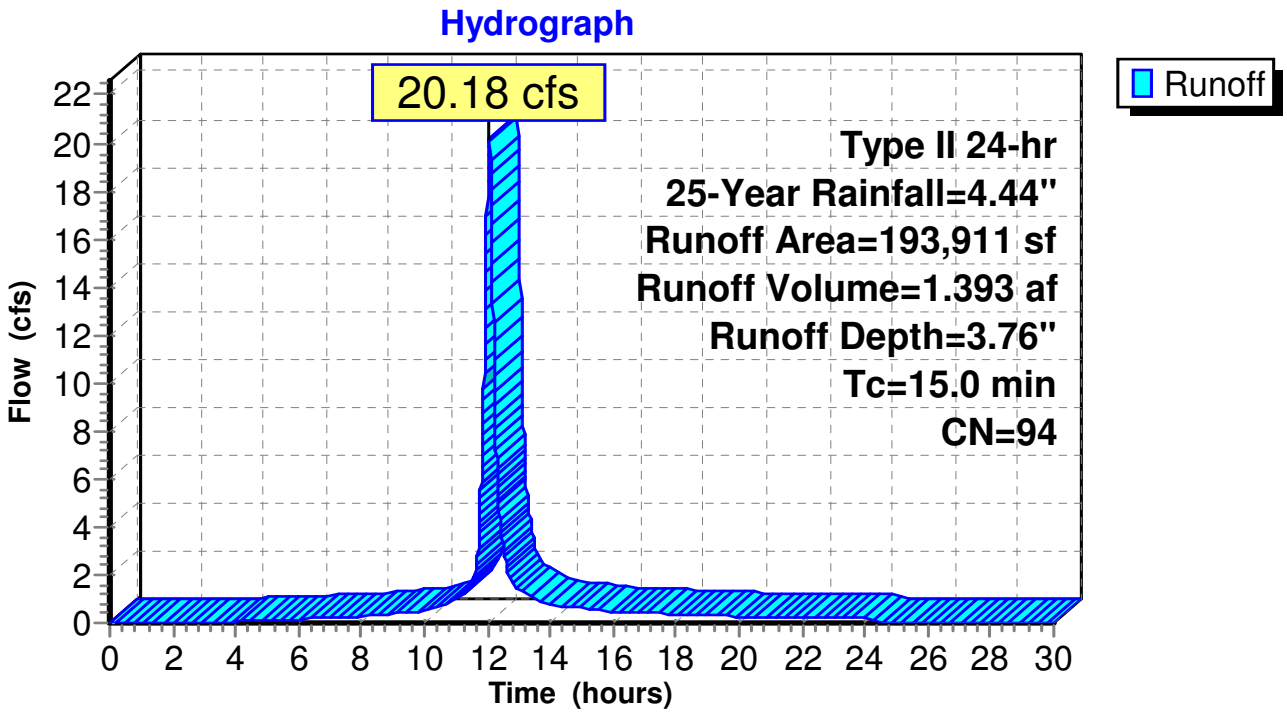
Runoff = 20.18 cfs @ 12.06 hrs, Volume= 1.393 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 193,911 | 94 | Fallow, bare soil, HSG C |
| | 193,911 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

### Subcatchment C-16: West Inboard Drainage - North



## Summary for Subcatchment C-17: West Outboard Swale-South

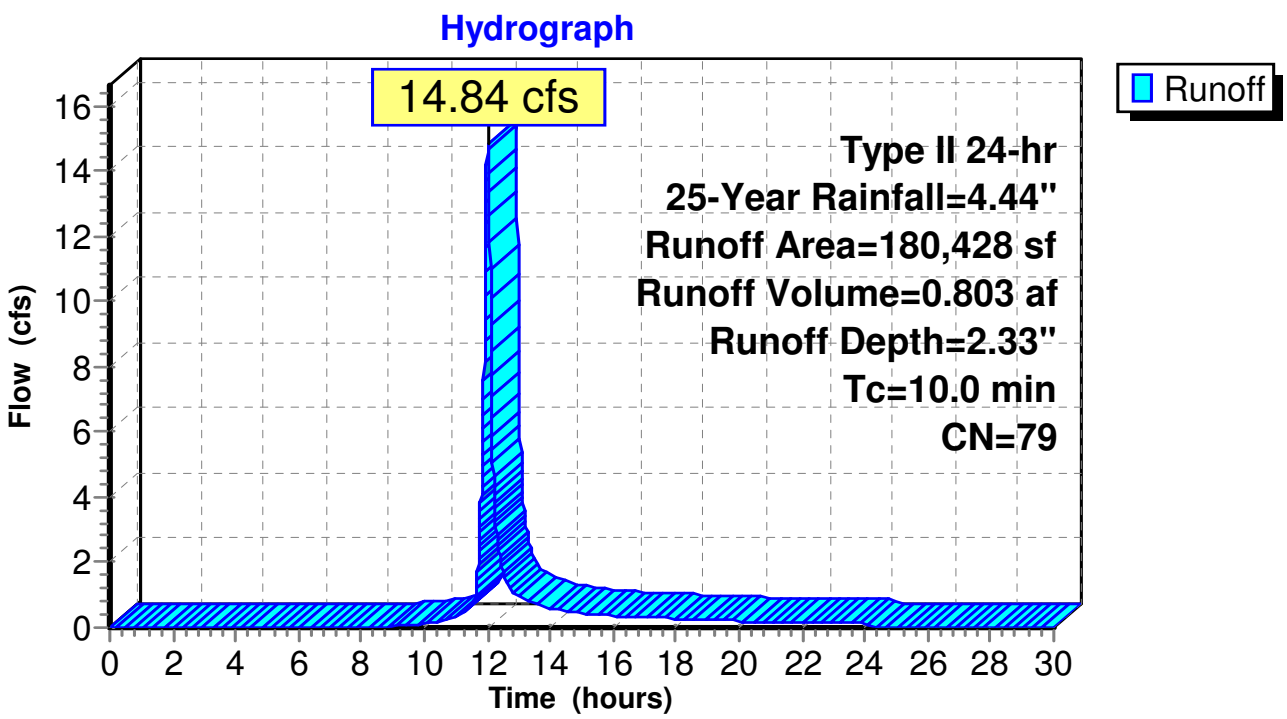
Runoff = 14.84 cfs @ 12.02 hrs, Volume= 0.803 af, Depth= 2.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 30,428 | 94 | Fallow, bare soil, HSG C |
| | 150,000 | 76 | Woods/grass comb., Fair, HSG C |
| | 180,428 | 79 | Weighted Average |
| | 180,428 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-17: West Outboard Swale-South



## Summary for Subcatchment C-18: West Outboard Swale - North

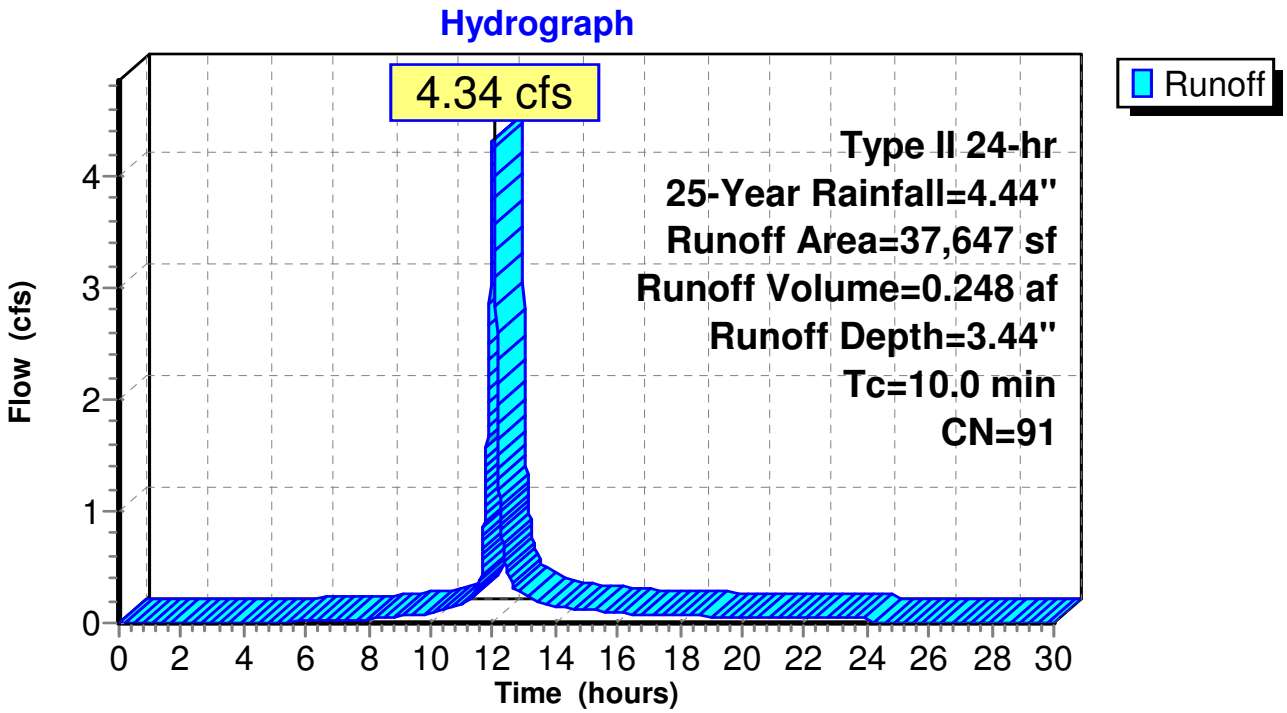
Runoff = 4.34 cfs @ 12.01 hrs, Volume= 0.248 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 37,647 | 91 | |
| | 37,647 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-18: West Outboard Swale - North



## Summary for Subcatchment C-19: West Swale

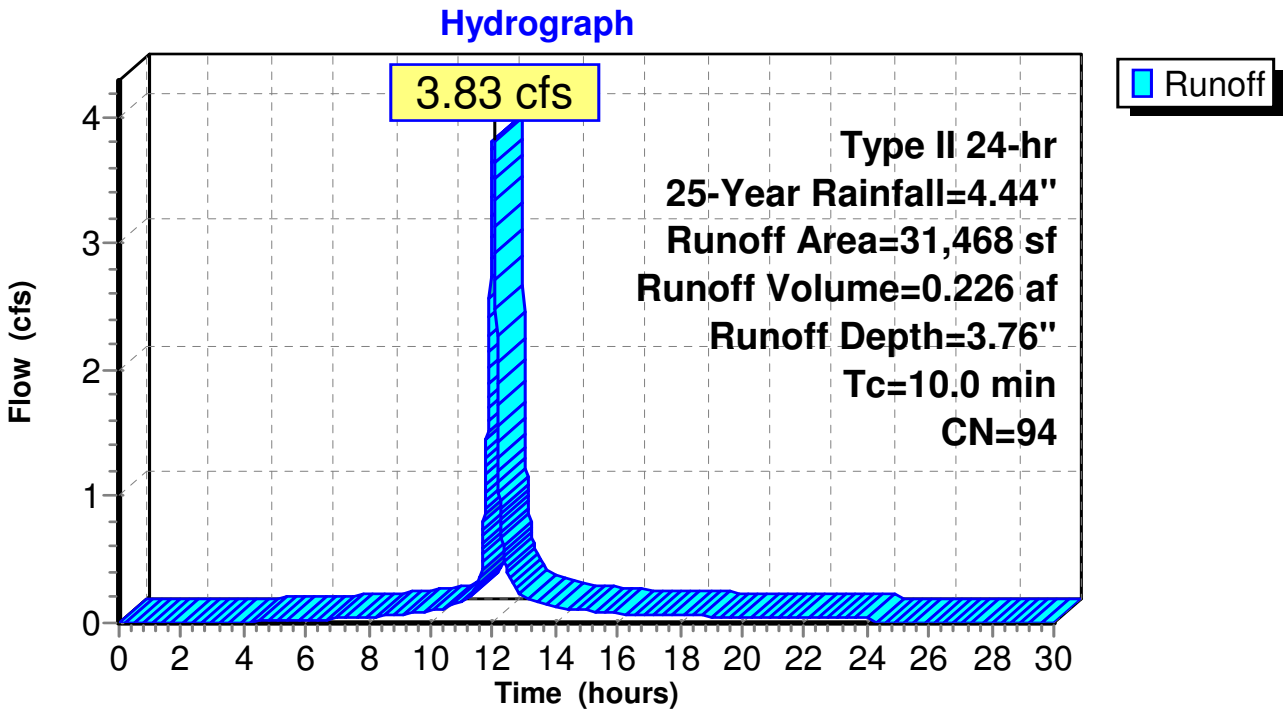
Runoff = 3.83 cfs @ 12.01 hrs, Volume= 0.226 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 31,468 | 94 | |
| | 31,468 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

### Subcatchment C-19: West Swale



## Summary for Reach CH-11: West Downchute

Inflow Area = 13.941 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 51.75 cfs @ 12.11 hrs, Volume= 3.997 af
Outflow = 51.62 cfs @ 12.12 hrs, Volume= 3.997 af, Atten= 0%, Lag= 0.6 min

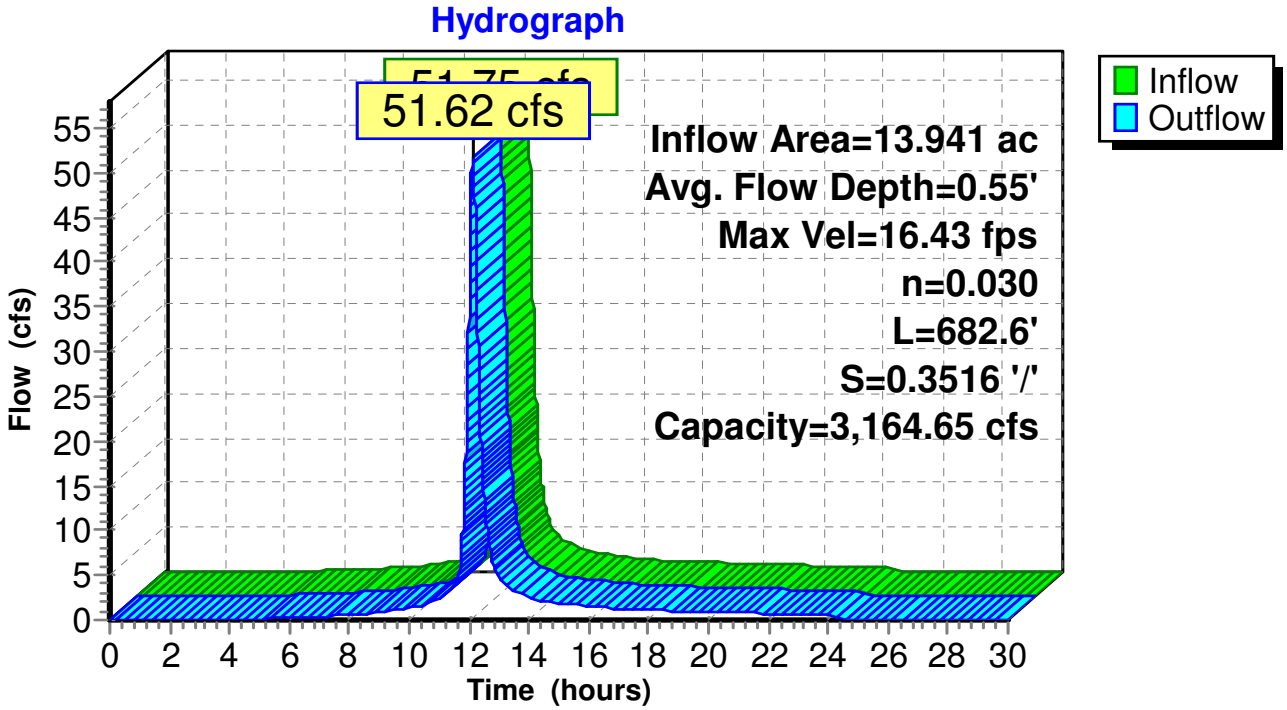
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 16.43 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 4.81 fps, Avg. Travel Time= 2.4 min

Peak Storage= 2,144 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 4.00' Flow Area= 64.0 sf, Capacity= 3,164.65 cfs

4.00' x 4.00' deep channel, n= 0.030 Grouted Riprap
Side Slope Z-value= 3.0 '/' Top Width= 28.00'
Length= 682.6' Slope= 0.3516 '/'
Inlet Invert= 1,370.00', Outlet Invert= 1,130.00'



**Reach CH-11: West Downchute**



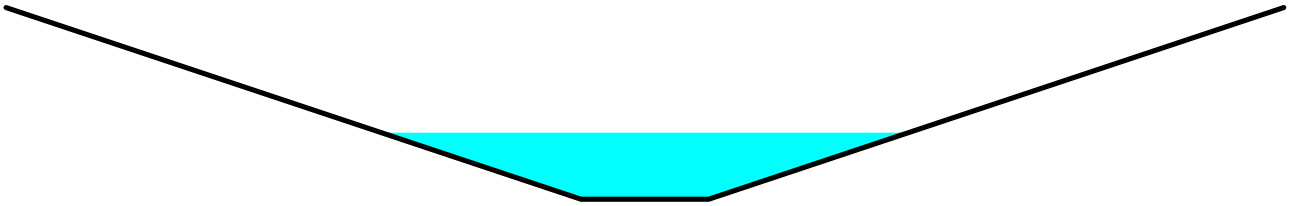
## Summary for Reach CH-15: West Inboard Channel - South

Inflow Area = 3.806 ac, 0.00% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 17.26 cfs @ 12.06 hrs, Volume= 1.191 af
Outflow = 15.75 cfs @ 12.12 hrs, Volume= 1.191 af, Atten= 9%, Lag= 3.2 min

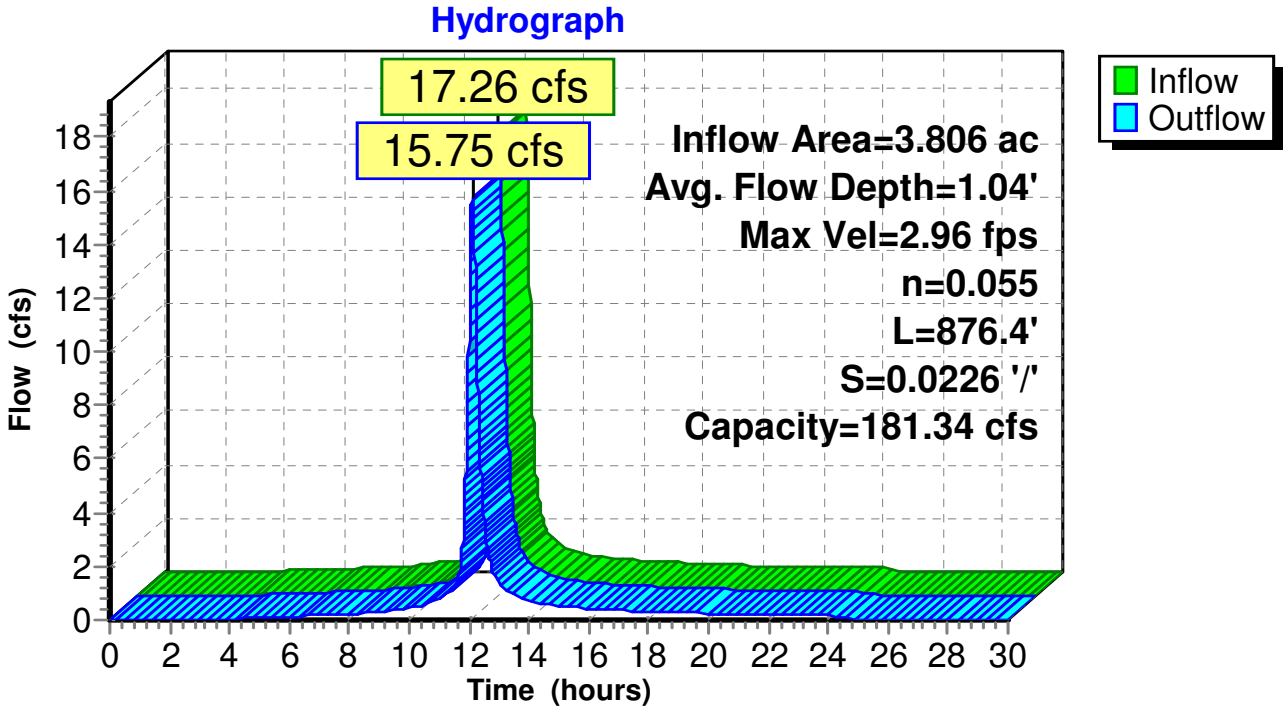
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.96 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 0.88 fps, Avg. Travel Time= 16.7 min

Peak Storage= 4,668 cf @ 12.12 hrs
Average Depth at Peak Storage= 1.04'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 181.34 cfs

2.00' x 3.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 876.4' Slope= 0.0226 '/'
Inlet Invert= 1,244.62', Outlet Invert= 1,224.81'



**Reach CH-15: West Inboard Channel - South**



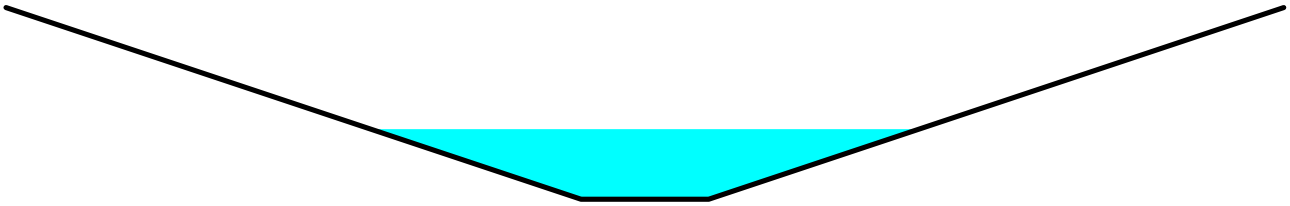
## Summary for Reach CH-16: West Inboard Channel - North

Inflow Area = 4.452 ac, 0.00% Impervious, Inflow Depth = 3.76" for 25-Year event
Inflow = 20.18 cfs @ 12.06 hrs, Volume= 1.393 af
Outflow = 16.75 cfs @ 12.14 hrs, Volume= 1.393 af, Atten= 17%, Lag= 4.5 min

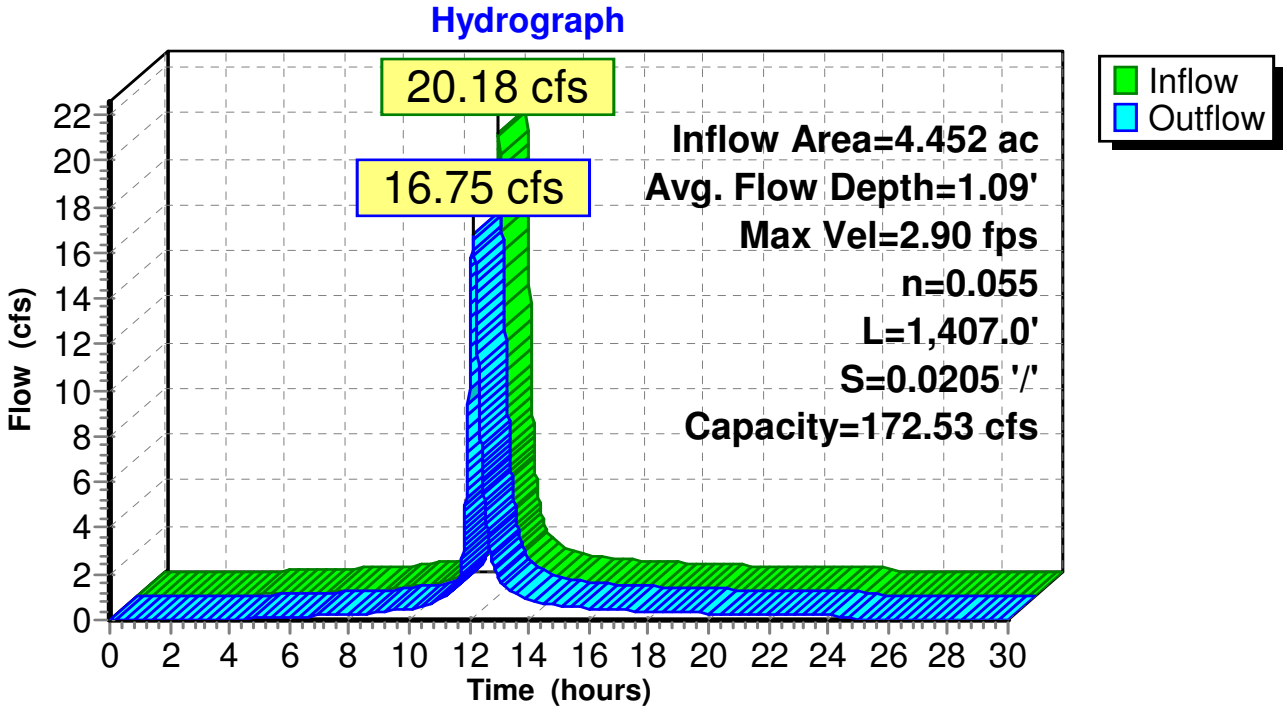
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.90 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 0.87 fps, Avg. Travel Time= 27.1 min

Peak Storage= 8,141 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.09'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 172.53 cfs

2.00' x 3.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 1,407.0' Slope= 0.0205 '/'
Inlet Invert= 1,253.60', Outlet Invert= 1,224.81'



**Reach CH-16: West Inboard Channel - North**



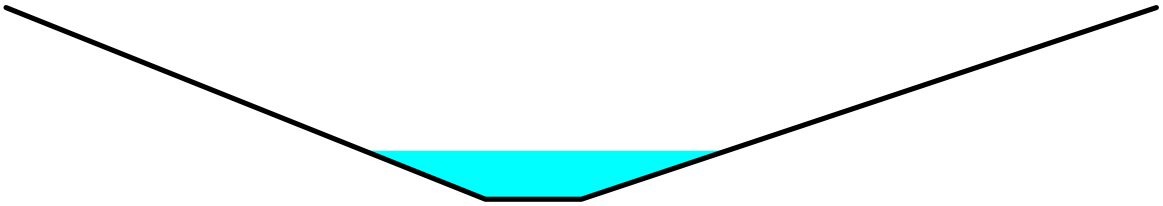
## Summary for Reach CH-17: West Outboard Channel-South

Inflow Area = 4.142 ac, 0.00% Impervious, Inflow Depth = 2.33" for 25-Year event
Inflow = 14.84 cfs @ 12.02 hrs, Volume= 0.803 af
Outflow = 13.01 cfs @ 12.06 hrs, Volume= 0.803 af, Atten= 12%, Lag= 2.8 min

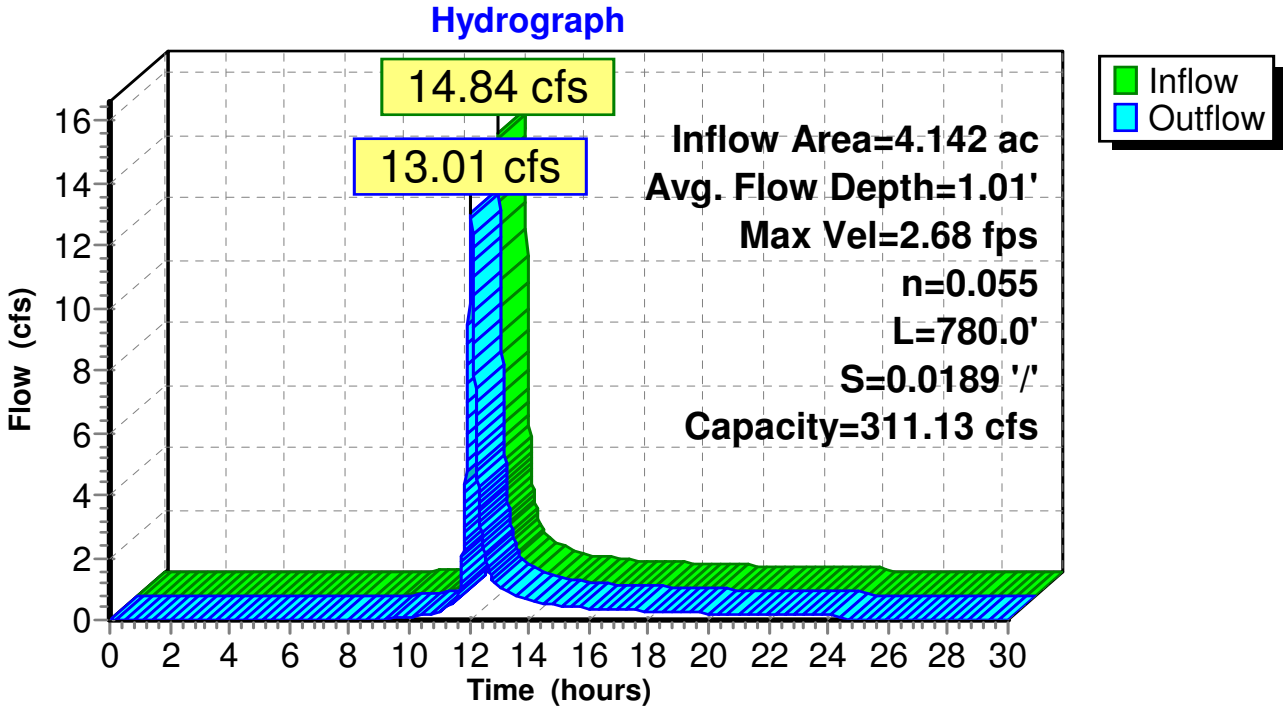
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.68 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 0.83 fps, Avg. Travel Time= 15.8 min

Peak Storage= 3,791 cf @ 12.06 hrs
Average Depth at Peak Storage= 1.01'
Bank-Full Depth= 4.00' Flow Area= 52.0 sf, Capacity= 311.13 cfs

2.00' x 4.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 2.5 3.0 '/' Top Width= 24.00'
Length= 780.0' Slope= 0.0189 '/'
Inlet Invert= 1,241.26', Outlet Invert= 1,226.53'



**Reach CH-17: West Outboard Channel-South**



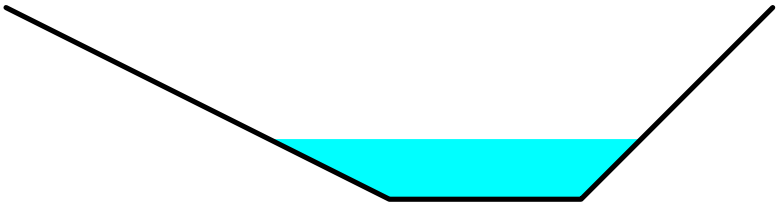
## Summary for Reach CH-18: West Outboard Channel-North

Inflow Area = 0.864 ac, 0.00% Impervious, Inflow Depth = 3.44" for 25-Year event
Inflow = 4.34 cfs @ 12.01 hrs, Volume= 0.248 af
Outflow = 4.09 cfs @ 12.04 hrs, Volume= 0.248 af, Atten= 6%, Lag= 2.0 min

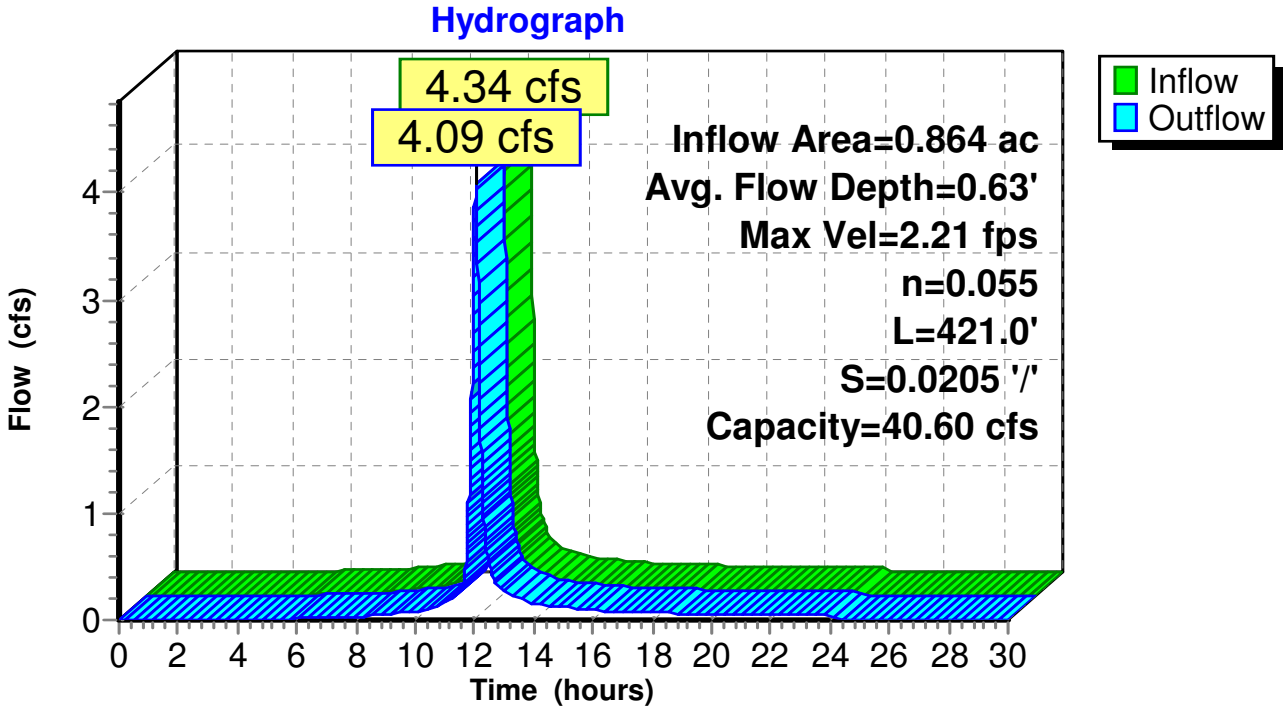
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.21 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 12.6 min

Peak Storage= 779 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.63'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 40.60 cfs

2.00' x 2.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 2.0 1.0 '/' Top Width= 8.00'
Length= 421.0' Slope= 0.0205 '/'
Inlet Invert= 1,233.15', Outlet Invert= 1,224.52'



**Reach CH-18: West Outboard Channel-North**



## Summary for Reach CH-19: West Swale

[61] Hint: Exceeded Reach P-10 outlet invert by 1.25' @ 12.11 hrs

Inflow Area = 27.928 ac, 0.00% Impervious, Inflow Depth = 3.38" for 25-Year event
Inflow = 100.94 cfs @ 12.11 hrs, Volume= 7.858 af
Outflow = 100.92 cfs @ 12.11 hrs, Volume= 7.858 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 11.91 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.21 fps, Avg. Travel Time= 0.9 min

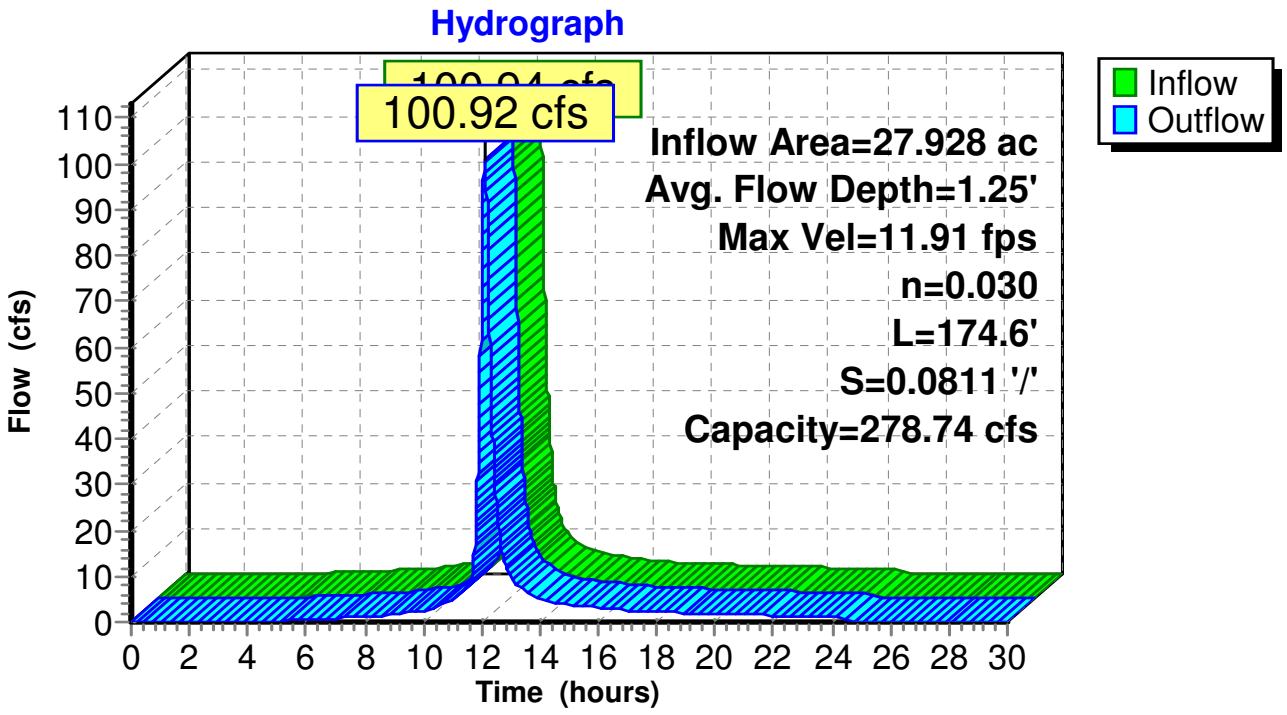
Peak Storage= 1,480 cf @ 12.11 hrs
Average Depth at Peak Storage= 1.25'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 278.74 cfs

3.00' x 2.00' deep channel, n= 0.030 Grouted Riprap
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 174.6' Slope= 0.0811 '/'
Inlet Invert= 1,215.16', Outlet Invert= 1,201.00'



‡

**Reach CH-19: West Swale**



## Summary for Reach P-10: P-10

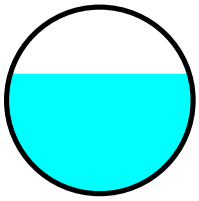
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach P-11 OUTLET depth by 0.31' @ 12.16 hrs
[61] Hint: Exceeded Reach P-12 outlet invert by 2.25' @ 12.11 hrs

Inflow Area = 27.205 ac, 0.00% Impervious, Inflow Depth = 3.37" for 25-Year event
Inflow = 98.73 cfs @ 12.11 hrs, Volume= 7.632 af
Outflow = 98.73 cfs @ 12.11 hrs, Volume= 7.632 af, Atten= 0%, Lag= 0.1 min

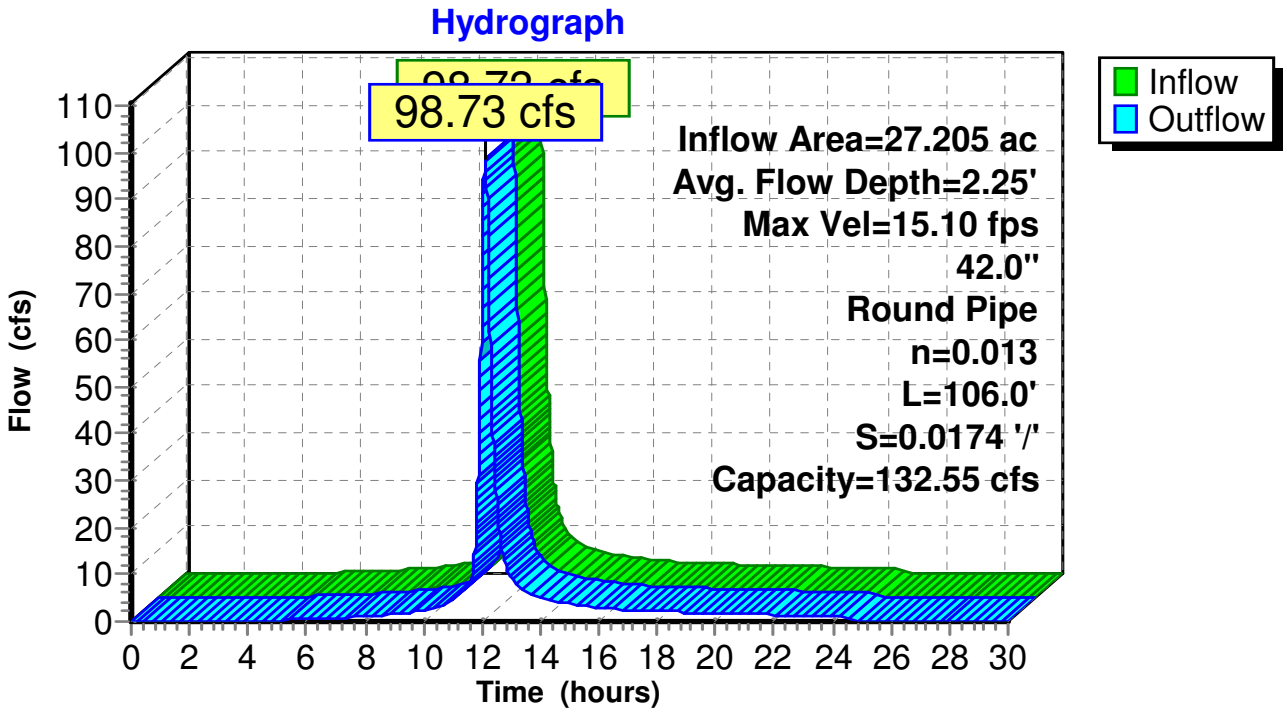
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 15.10 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.28 fps, Avg. Travel Time= 0.4 min

Peak Storage= 693 cf @ 12.11 hrs
Average Depth at Peak Storage= 2.25'
Bank-Full Depth= 3.50' Flow Area= 9.6 sf, Capacity= 132.55 cfs

42.0" Round Pipe
n= 0.013
Length= 106.0' Slope= 0.0174 '/'
Inlet Invert= 1,217.00', Outlet Invert= 1,215.16'



## Reach P-10: P-10



## Summary for Reach P-11: P-11

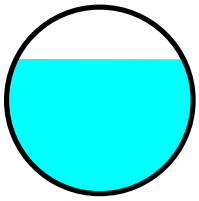
[52] Hint: Inlet/Outlet conditions not evaluated

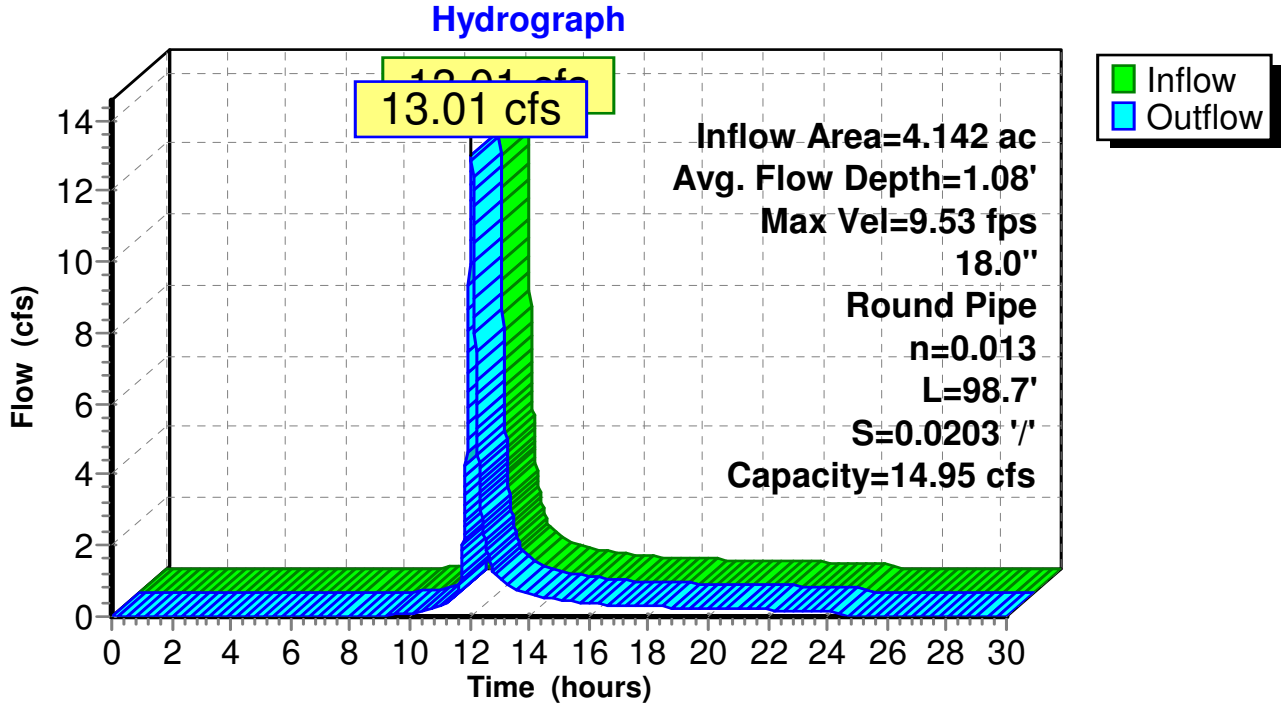
Inflow Area = 4.142 ac, 0.00% Impervious, Inflow Depth = 2.33" for 25-Year event
Inflow = 13.01 cfs @ 12.06 hrs, Volume= 0.803 af
Outflow = 13.01 cfs @ 12.07 hrs, Volume= 0.803 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.53 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.98 fps, Avg. Travel Time= 0.6 min

Peak Storage= 135 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.08'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 14.95 cfs

18.0" Round Pipe
n= 0.013
Length= 98.7' Slope= 0.0203 '/'
Inlet Invert= 1,220.00', Outlet Invert= 1,218.00'





## Summary for Reach P-12: P-12

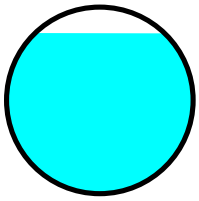
[52] Hint: Inlet/Outlet conditions not evaluated
[55] Hint: Peak inflow is 104% of Manning's capacity
[62] Hint: Exceeded Reach CH-11 OUTLET depth by 90.02' @ 12.13 hrs

Inflow Area = 22.199 ac, 0.00% Impervious, Inflow Depth = 3.56" for 25-Year event
Inflow = 84.00 cfs @ 12.13 hrs, Volume= 6.582 af
Outflow = 84.00 cfs @ 12.13 hrs, Volume= 6.582 af, Atten= 0%, Lag= 0.1 min

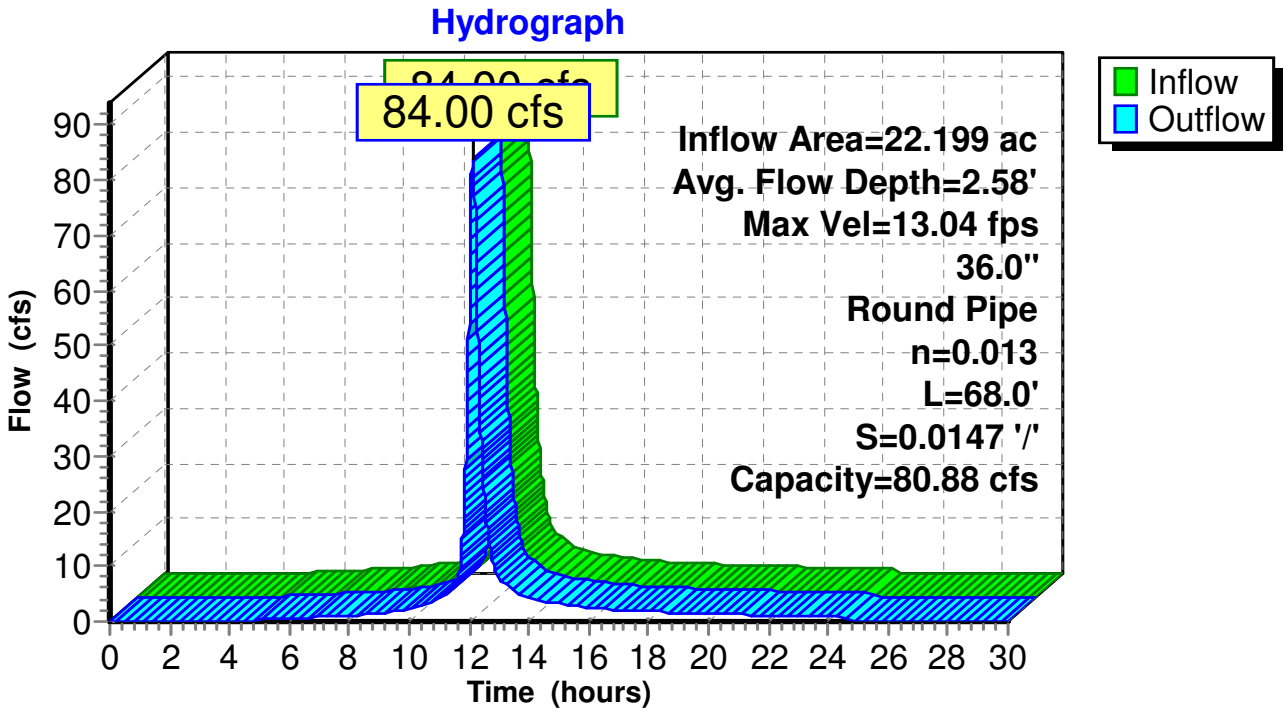
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 13.04 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.93 fps, Avg. Travel Time= 0.3 min

Peak Storage= 439 cf @ 12.13 hrs
Average Depth at Peak Storage= 2.58'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 80.88 cfs

36.0" Round Pipe
n= 0.013
Length= 68.0' Slope= 0.0147 '/'
Inlet Invert= 1,218.00', Outlet Invert= 1,217.00'



## Reach P-12: P-12



## LEGEND:

DRAINAGE AREA

DRAINAGE BERM/ CHANNEL

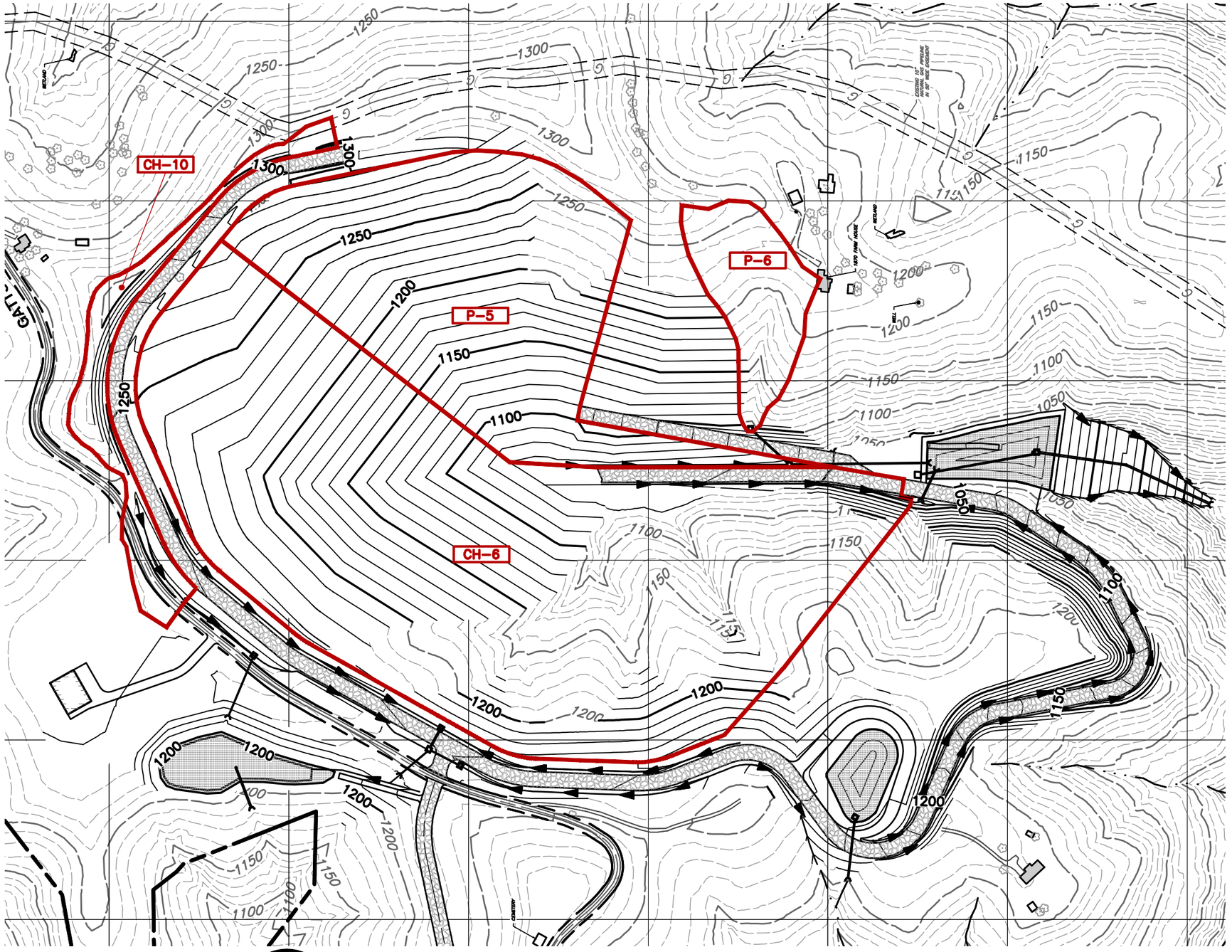
DRAINAGE AREA NAME — DRAINAGE NAME

EXISTING CONTOURS — 1000

PROPOSED TOP OF LINER/FILL GRADING — 1000

## NOTES:

1. REFER TO HYDROCAD OUTPUT FOR DETAILED INFORMATION REGARDING TIME OF CONCENTRATIONS, FLOW LENGTHS AND CN NUMBERS.




NORTH
SCALE IN FEET
0 300 600


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American Electric Power
Mitchell Landfill
Gatts Ridge Road
Marshall County, West Virginia

LOCAL DRAINAGE MAP

| DRAWN BY: | MTF | CHECKED BY: | JDM | APPROVED BY: | | FIGURE NO.: |
|---|---|---|---|---|---|---|
| DATE: | APRIL 3, 2012 | DWG SCALE: | 1"=300' | PROJECT NO: | 110-416 | 1 |

P:\2011\110-416\-CADD\DWG\Xrefs\110-416_XR-HYD-Post-Channels.dwg[POST-CHANNELS - PHASE-1] LS:(05/04/2012 - tford) - LP: 4/5/2012 9:58 AM

## LEGEND:

DRAINAGE AREA

DRAINAGE BERM/ CHANNEL

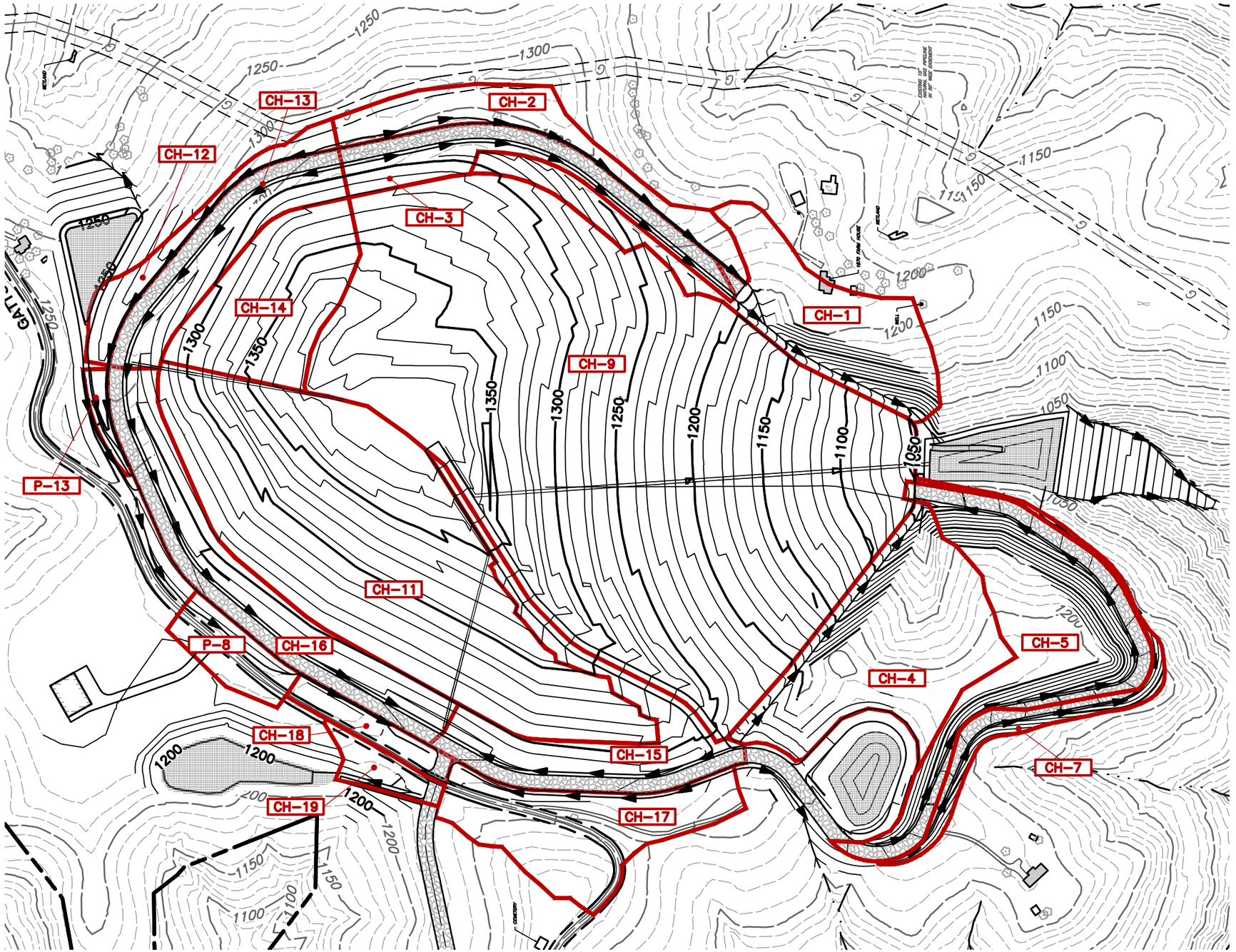
DRAINAGE AREA NAME — DRAINAGE NAME

EXISTING CONTOURS — 1000

PROPOSED TOP OF LINER/FILL GRADING — 1000

## NOTES:

1. REFER TO HYDROCAD OUTPUT FOR DETAILED INFORMATION REGARDING TIME OF CONCENTRATIONS, FLOW LENGTHS AND CN NUMBERS.




NORTH
SCALE IN FEET
0 300 600


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Gatts Ridge Road
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LOCAL DRAINAGE MAP

| DRAWN BY: | MTF | CHECKED BY: | JDM | APPROVED BY: | | FIGURE NO.: |
|---|---|---|---|---|---|---|
| DATE: | APRIL 3, 2012 | DWG SCALE: | 1"=300' | PROJECT NO: | 110-416 | J |

P:\2011\110-416\-CADD\DWG\Xrefs\110-416_XR-HYD-Post-Channels.dwg[POST-CHANNELS - PHASE-5] LS:(04/04/2012 - tford) - LP: 4/5/2012 9:54 AM

**SURFACE WATER CONTROL CALCULATIONS**
**Original Permit Design**

**Note that Stormwater controls associated with the North Pond are now routed to the East Pond. Text revisions to the Surface Water Control Calculations have not been made. Instead, a separate calculation brief for only those features near the East Pond was prepared and is presented immediately after this calculation brief.**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | Surface Water Control Structures | | | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 3.16.c.4. Stormwater, Soil Erosion, and Sedimentation Control Plan | | | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill Excess Soil | | | | | | | PAGE | 1 | OF | 8 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | | | |
| | MADE BY | EGK | DATE | 05/11/16 | CHECKED BY | MTF | DATE | | | | |

## OBJECTIVE:

To design proposed surface water control structures for the Mitchell Landfill Excess Soil Area. These structures will capture surface water flow from the disturbed area of this project, portions of the existing Mitchell Landfill, and 4.4 acres of offsite area, and divert it to the East and Northeast Sediment Ponds. All Sediment Pond calculations can be found in the PTI calculation entitled **"Sediment Pond Design Calculations"**. The calculations for all surface water control structures satisfy the regulations for residual waste landfills as follows:

**33CSR1 3.16.c.4.**

An application to conduct transfer station activities must include a plan to manage surface storm water soil erosion and sedimentation control during the various phases of construction and operation on the permit area. Calculations indicating water quantities must be based on the twenty-five (25)-year, twenty-four (24)-hour storm event. The plan must include fully dimensioned diversion ditches and indicate length, gradient, and cross-section for configuration by reach and capacities for ditch volume by reach. Calculations that are necessary to support design and siting must be included in the plan.

The design is based upon accepted engineering design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, HydroCAD Version 10.00-14, Copyright 2015.

## METHOD:

Peak flows have been estimated with SCS TR-55 by calculating the time of concentration (Tc) of each channel reach, the composite runoff curve number describing the reach's watershed and the total area of the reach's watershed. A computer software package entitled "HydroCAD" Version 10.00-14, Copyright 2015, was utilized to perform the SCS TR-55 calculations.

The rainfall values for this site are listed below. The United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Mitchell County, West Virginia, provided the estimated rainfall depths and is presented in "Sediment Ponds Design Calculations".

| RAINFALL DATA | | |
|---|---|---|
| **Frequency** | **Duration** | **Depth (in)** |
| 25 yr | 24 hr | 4.44 |

According to the TR-55 methods, times of concentration were estimated as the sum of sheet flow, shallow concentrated flow, and channel flow. Flow calculations utilized a Curve Number (CN) representative of the post construction surface conditions. Maximum sheet flow length used was 200 feet. Shallow concentrated flow time of concentration as estimated based upon the condition of the flow path.

This site is located in an area of hydrologic soil groups B & C. Since over 95 percent of the site consists of type C soils, hydrologic soil group C was used throughout. Based on the existing and proposed site conditions the following runoff coefficients have been determined and will be utilized.

| CN DATA | |
|---|---|
| **Description** | **CN** |
| Existing (Woods Grass Combination, Fair) | 76 |
| Newly Graded Areas (Including Ditches) | 91 |
| Landfill (50-75% Grass Cover, Fair) | 91 |
| Impervious Areas (Access Road and Pond) | 98 |

Utilizing a series of downchutes, roadside channels, pipe culverts, and basins, all stormwater runoff from disturbed areas is directed to the East Sediment Pond. At the western portion of the site, the access road channel collects runoff from the north slope of Mitchell Landfill, a portion of the existing haul road, and both off- and on-site areas upslope from the access road. At the northern portion of the site, a downchute conveys runoff from off-site and from the benched excess soil fill slope to the Northeast Sediment Pond. These flows from the western and northern areas collect in the East Sediment Pond before being released below the impoundment. Cutoff trenches and/or berms will be constructed along site boundaries downslope from existing terrain, and will bypass off-site stormwater runoff around the East Sediment Pond and ultimately to the toe of the impoundment. The locations of the channels, culverts, ponds, and cutoff trenches/berms are shown within the permit documents.

**CALCULATIONS:**

With the peak discharge known for each channel, the channel cross section is sized and a channel lining material is selected (from the channel lining design options, included below). Flow properties within the channels are estimates from the HydroCAD output and hydrographs utilizing Manning's Equation (EQ. 1):

$$V = \frac{Q}{A} = 1.49\frac{R^{2/3}\sqrt{S_f}}{n} = 1.49\frac{\left[\frac{A}{WP}\right]^{2/3}\sqrt{S_f}}{n}$$

*Where*:

V = Velocity, fps

Q = Flowrate, cfs

A = Cross – Sectional area of flow, sf

R = Hydraulic Radius, ft

WP = Wetted Perimeter, ft

$S_f$ = Slope of channel, ft / ft

n = Manning's roughness coefficient

See Local Drainage Map for the drainage areas utilized. "S" designation throughout HydroCAD reports and drainage maps are Sub-Areas. "CH" designation throughout HydroCAD reports and tables are Channel designations. The tables below show the drainage watershed identification, length, inlet and outlet invert elevations, contributing area, and peak flow for each channel based on the 25-year/24-hour storm event:

**Channels:**

| Channel | Drainage Area ID | Invert Elevations | | Length (ft) | Slope (%) | Drainage Area (acres) | Peak Flow (cfs) | Max. Velocity (fps) | (R)Riprap Class/ (G)Grout Class |
|---|---|---|---|---|---|---|---|---|---|
| | | Inlet | Outlet | | | | | | |
| CH-1 | S-1 | 1281.3 | 1138.9 | 1070 | 13.31 | 4.56 | 22.53 | 6.10 | R-5 |
| CH-2 | S-1,4,6,7 | 1145.6 | 1117.3 | 97 | 29.20 | 15.68 | 82.47 | 12.60 | G-6 |
| CH-3 | S-3 | 1232.7 | 1120.9 | 462 | 24.20 | 12.48 | 64.34 | 11.02 | G-6 |
| CH-4 | S-4 | 1276.4 | 1153.5 | 1037 | 11.85 | 11.12 | 60.75 | 8.34 | G-6 |
| CH-5 | S-5 | 1118.8 | 1055.9 | 222 | 28.36 | 10.33 | 25.67 | 9.17 | G-6 |
| CH-6 | S-6 | 1118.7 | 1055.9 | 274 | 22.89 | 10.07 | 23.39 | 8.27 | G-6 |
| CH-8 | S-8 | 1269.2 | 1118.7 | 935 | 16.11 | 5.01 | 11.02 | 5.91 | R-5 |
| CH-9A | S-9A | 1148.8 | 1129.6 | 129 | 14.90 | 3.70 | 9.13 | 5.45 | R-5 |
| CH-9B | S-9B | 1129.6 | 1118.8 | 372 | 2.91 | 8.40 | 20.74 | 3.75 | R-3 |

For channel details and schedule, see Details sheet of the Permit to Install application drawing set.

Channel protection was designed using NRCS guidance referenced at the end of this report. The riprap class was selected after the D50 was determined using empirical formulas based on unit discharge and channel slope. Channels requiring larger than R-7 riprap were designed with grouted riprap according to channel velocity. Minimum depth of protection must be 2 x D50. Channel lining sizes are provided in the following table:

| CHANNEL LININGS | |
|---|---|
| **Riprap Class** | **D50 (in)** |
| R-3 | 3 |
| R-4 | 6 |
| R-5 | 9 |
| R-6 | 15 |
| R-7 | 18 |

For channel slopes and outlet protection between 2% and 10%:
$D50 = [q\ (S)^{1.5}/4.75(10)^{-3}]^{0.53}$

For channel slopes between 10% and 40%:
$D50 = [q\ (S)^{0.58}/3.93(10)^{-2}]^{0.53}$

D50 = Particle size for which 50% (by weight) of the sample is finer, in.
S = Bed slope, ft./ft.
q = Unit discharge, ft3/s/ft

For channels and outlet protection requiring larger than R-7 rip rap:

For flow velocities below 7.5 fps, use G-5.
For flow velocities between 7.5 fps and 15 fps, use G-6.
For flow velocities between 15 fps and 17.5 fps, use G-7.

| CHANNEL LININGS | |
|---|---|
| **Grout Class** | **D50 (in)** |
| G-5 | 9 |
| G-6 | 15 |
| G-7 | 18 |

**Pipes:** (Pipes 1 and 2 are shown within Sediment Pond Design Calculations)

| Pipe | HydroCAD I.D. | Invert Elevations | | Length (ft) | Pipe Dia. (in.) | Slope (%) | Drainage Area (acres) | Peak Flow (cfs) | Max. Velocity (fps) |
|---|---|---|---|---|---|---|---|---|---|
| | | Inlet | Outlet | | | | | | |
| 1 | P-6 | 1268.63 | 1266.77 | 175.4 | 36 | 1.06 | 5.89 | 29.10 | 4.12 |
| 2 | P-1 | 1146.16 | 1145.69 | 47 | 36 | 1.0 | 11.12 | 50.84 | 7.19 |

**Pipe Outlet Protection:**

| Pipe | Pipe Dia. (in.) | Peak Flow (cfs) | Max. Velocity (fps) | Width Outlet (ft) | Width at End (ft) | Length (ft) | D50 (in) | Depth (in) | (R)Riprap Class/ (G)Grout Class |
|---|---|---|---|---|---|---|---|---|---|
| P-6 | 36 | 34.02 | 4.81 | 10 | 10 | 10 | 15 | 30 | G-6 |
| P-1 | 36 | 60.68 | 8.59 | 10 | 10 | 10 | 18 | 36 | G-7 |
| 1P | 24 | 31.88* | 3.31 | 10 | 10 | 10 | 15 | 30 | G-6 |
| 2P | 42 | 57.59 | 6.92 | 10 | 10 | 10 | 15 | 30 | G-6 |

* Peak flow and velocity controlled by upstream riser wier.

** Plan dimensions governed by receiving rock-lined channel.

## CONCLUSIONS:

All surface water control structures were designed based on peak flows resulting from the 25-year, 24-hour storm event. A series of channels, pipe culverts, downchutes, diversion berms, and ponds divert all stormwater runoff from the Excess Soil Disposal Area, a portion of the existing Mitchell Landfill, and 4.4 offsite acres to the East and Northeast Sedimentation Ponds. Runoff will be controlled in a manner that satisfies applicable regulations. See Drawings for complete construction details. See attachments for Surface Water Channel Design HydroCAD output and hydrograph files.

## REFERENCES:

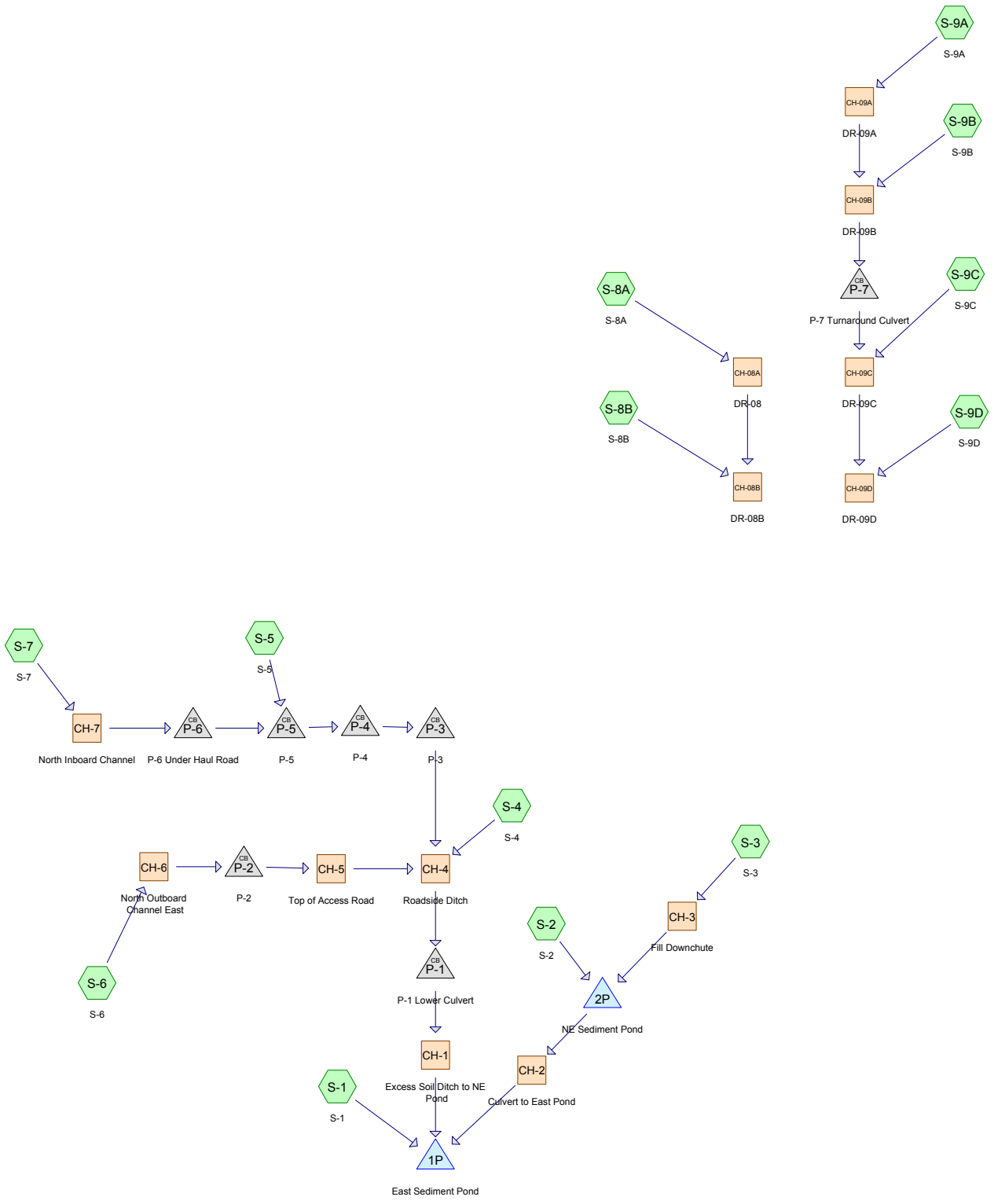
1. United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Mitchell County, West Virginia.

2. National Resources Conservation Service, LINED WATERWAY OR OUTLET, September 2010. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026310.pdf

3. HydroCAD Software Solutions LLC, HYDROCAD, Version 10.00-14, 2015, Computer Software Program.

4. U.S. Department of Transportation, Federal Highway Administration. Hydraulic Engineering Circular No. 15, Third Edition: Design of Roadside Channels with Flexible Linings.

# SURFACE WATER CHANNEL DESIGN HYDROCAD OUTPUT AND HYDROGRAPH FILES




**Routing Diagram for East Basin_Excess Soil**
Prepared by CEC, Inc., Printed 5/12/2016
HydroCAD® 10.00-14 s/n 01566 © 2015 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.485 | 98 | Impervious (Gravel Road), HSG C (S-1, S-4, S-5) |
| 1.242 | 98 | Impervious (Pond Surface) (S-1, S-2) |
| 5.393 | 91 | Landfill (50-75% grass cover, fair), HSG C (S-7) |
| 19.847 | 91 | Newly graded area, HSG C (S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8B, S-9D) |
| 0.500 | 98 | Paved haul road, HSG C (S-7) |
| 25.376 | 76 | Woods/grass comb., Fair, HSG C (S-3, S-4, S-5, S-6, S-8A, S-8B, S-9A, S-9B, S-9C, S-9D) |
| **52.843** | **84** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 51.601 | HSG C | S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8A, S-8B, S-9A, S-9B, S-9C, S-9D |
| 0.000 | HSG D | |
| 1.242 | Other | S-1, S-2 |
| **52.843** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchmer Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.485 | 0.000 | 0.000 | 0.485 | Impervious (Gravel Road) | |
| 0.000 | 0.000 | 0.000 | 0.000 | 1.242 | 1.242 | Impervious (Pond Surface) | |
| 0.000 | 0.000 | 5.393 | 0.000 | 0.000 | 5.393 | Landfill (50-75% grass cover, fair) | |
| 0.000 | 0.000 | 19.847 | 0.000 | 0.000 | 19.847 | Newly graded area | |
| 0.000 | 0.000 | 0.500 | 0.000 | 0.000 | 0.500 | Paved haul road | |
| 0.000 | 0.000 | 25.376 | 0.000 | 0.000 | 25.376 | Woods/grass comb., Fair | |
| **0.000** | **0.000** | **51.601** | **0.000** | **1.242** | **52.843** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1P | 1,073.25 | 1,056.45 | 224.0 | 0.0750 | 0.013 | 24.0 | 0.0 | 0.0 |
| 2 | 2P | 1,127.00 | 1,126.04 | 96.4 | 0.0100 | 0.013 | 36.0 | 0.0 | 0.0 |
| 3 | P-1 | 1,147.82 | 1,147.58 | 47.7 | 0.0050 | 0.013 | 36.0 | 0.0 | 0.0 |
| 4 | P-2 | 1,269.40 | 1,269.16 | 49.0 | 0.0049 | 0.013 | 15.0 | 0.0 | 0.0 |
| 5 | P-3 | 1,248.43 | 1,247.06 | 254.5 | 0.0054 | 0.013 | 36.0 | 0.0 | 0.0 |
| 6 | P-4 | 1,249.40 | 1,248.43 | 195.0 | 0.0050 | 0.013 | 36.0 | 0.0 | 0.0 |
| 7 | P-5 | 1,249.95 | 1,249.40 | 109.4 | 0.0050 | 0.013 | 36.0 | 0.0 | 0.0 |
| 8 | P-6 | 1,250.39 | 1,249.95 | 44.2 | 0.0100 | 0.013 | 30.0 | 0.0 | 0.0 |
| 9 | P-7 | 1,125.92 | 1,123.94 | 35.0 | 0.0566 | 0.013 | 30.0 | 0.0 | 0.0 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**SubcatchmentS-1: S-1** Runoff Area=235,251 sf 19.89% Impervious Runoff Depth=3.54"
Flow Length=588' Slope=0.2200 '/' Tc=8.7 min CN=92 Runoff=28.85 cfs 1.595 af

**SubcatchmentS-2: S-2** Runoff Area=1.730 ac 15.61% Impervious Runoff Depth=3.54"
Flow Length=457' Tc=8.0 min CN=92 Runoff=9.46 cfs 0.511 af

**SubcatchmentS-3: S-3** Runoff Area=12.481 ac 0.00% Impervious Runoff Depth=3.14"
Flow Length=1,021' Tc=14.3 min CN=88 Runoff=50.89 cfs 3.266 af

**SubcatchmentS-4: S-4** Runoff Area=227,818 sf 6.76% Impervious Runoff Depth=2.95"
Flow Length=991' Tc=10.0 min CN=86 Runoff=23.28 cfs 1.285 af

**SubcatchmentS-5: S-5** Runoff Area=28,663 sf 4.41% Impervious Runoff Depth=2.33"
Flow Length=212' Tc=4.1 min CN=79 Runoff=2.92 cfs 0.128 af

**SubcatchmentS-6: S-6** Runoff Area=32,588 sf 0.00% Impervious Runoff Depth=2.41"
Flow Length=688' Tc=14.0 min CN=80 Runoff=2.42 cfs 0.150 af

**SubcatchmentS-7: S-7** Runoff Area=275,376 sf 7.91% Impervious Runoff Depth=3.54"
Flow Length=580' Tc=10.1 min CN=92 Runoff=32.25 cfs 1.867 af

**SubcatchmentS-8A: S-8A** Runoff Area=5.010 ac 0.00% Impervious Runoff Depth=2.08"
Flow Length=784' Tc=17.9 min CN=76 Runoff=12.31 cfs 0.869 af

**SubcatchmentS-8B: S-8B** Runoff Area=5.004 ac 0.00% Impervious Runoff Depth=2.16"
Flow Length=751' Tc=11.4 min CN=77 Runoff=15.86 cfs 0.902 af

**SubcatchmentS-9A: S-9A** Runoff Area=3.700 ac 0.00% Impervious Runoff Depth=2.08"
Flow Length=772' Tc=13.1 min CN=76 Runoff=10.63 cfs 0.642 af

**SubcatchmentS-9B: S-9B** Runoff Area=3.670 ac 0.00% Impervious Runoff Depth=2.08"
Flow Length=860' Tc=13.3 min CN=76 Runoff=10.47 cfs 0.637 af

**SubcatchmentS-9C: S-9C** Runoff Area=1.030 ac 0.00% Impervious Runoff Depth=2.08"
Flow Length=630' Tc=13.8 min CN=76 Runoff=2.89 cfs 0.179 af

**SubcatchmentS-9D: S-9D** Runoff Area=1.860 ac 0.00% Impervious Runoff Depth=2.16"
Flow Length=925' Tc=13.5 min CN=77 Runoff=5.48 cfs 0.335 af

**Reach CH-08A: DR-08** Avg. Flow Depth=1.03' Max Vel=2.89 fps Inflow=12.31 cfs 0.869 af
n=0.055 L=275.0' S=0.0209 '/' Capacity=26.52 cfs Outflow=12.16 cfs 0.869 af

**Reach CH-08B: DR-08B** Avg. Flow Depth=0.83' Max Vel=8.50 fps Inflow=25.95 cfs 1.771 af
n=0.055 L=262.0' S=0.2292 '/' Capacity=37.54 cfs Outflow=25.92 cfs 1.771 af

**Reach CH-09A: DR-09A** Avg. Flow Depth=0.57' Max Vel=5.96 fps Inflow=10.63 cfs 0.642 af
n=0.055 L=152.0' S=0.1694 '/' Capacity=32.27 cfs Outflow=10.62 cfs 0.642 af

**Reach CH-09B: DR-09B** Avg. Flow Depth=1.32' Max Vel=3.43 fps Inflow=21.09 cfs 1.279 af
n=0.055 L=166.0' S=0.0226 '/' Capacity=27.57 cfs Outflow=21.00 cfs 1.279 af

**Reach CH-09C: DR-09C** Avg. Flow Depth=1.32' Max Vel=3.88 fps Inflow=23.89 cfs 1.457 af
n=0.055 L=159.0' S=0.0289 '/' Capacity=31.20 cfs Outflow=23.81 cfs 1.457 af

**Reach CH-09D: DR-09D** Avg. Flow Depth=0.83' Max Vel=9.69 fps Inflow=29.23 cfs 1.793 af
n=0.055 L=192.0' S=0.3006 '/' Capacity=42.99 cfs Outflow=29.21 cfs 1.793 af

**Reach CH-1: Excess Soil Ditch to NE** Avg. Flow Depth=1.14' Max Vel=11.31 fps Inflow=55.46 cfs 3.430 af
n=0.055 L=100.0' S=0.2882 '/' Capacity=185.07 cfs Outflow=55.45 cfs 3.430 af

**Reach CH-2: Culvert to East Pond** Avg. Flow Depth=1.13' Max Vel=9.28 fps Inflow=44.76 cfs 3.772 af
n=0.055 L=34.0' S=0.1959 '/' Capacity=152.58 cfs Outflow=44.76 cfs 3.772 af

**Reach CH-3: Fill Downchute** Avg. Flow Depth=1.16' Max Vel=10.11 fps Inflow=50.89 cfs 3.266 af
n=0.055 L=375.0' S=0.2266 '/' Capacity=164.12 cfs Outflow=50.73 cfs 3.266 af

**Reach CH-4: Roadside Ditch** Avg. Flow Depth=1.41' Max Vel=8.18 fps Inflow=56.40 cfs 3.430 af
n=0.055 L=779.6' S=0.1202 '/' Capacity=119.52 cfs Outflow=55.46 cfs 3.430 af

**Reach CH-5: Top of Access Road** Avg. Flow Depth=0.26' Max Vel=3.45 fps Inflow=2.23 cfs 0.150 af
n=0.055 L=163.7' S=0.1350 '/' Capacity=126.67 cfs Outflow=2.23 cfs 0.150 af

**Reach CH-6: North Outboard Channel** Avg. Flow Depth=0.35' Max Vel=2.37 fps Inflow=2.42 cfs 0.150 af
n=0.055 L=604.0' S=0.0455 '/' Capacity=73.56 cfs Outflow=2.23 cfs 0.150 af

**Reach CH-7: North Inboard Channel** Avg. Flow Depth=1.16' Max Vel=4.77 fps Inflow=32.25 cfs 1.867 af
n=0.055 L=844.0' S=0.0518 '/' Capacity=274.48 cfs Outflow=30.53 cfs 1.867 af

**Pond 1P: East Sediment Pond** Peak Elev=1,117.59' Storage=323,191 cf Inflow=119.15 cfs 8.796 af
Primary=20.78 cfs 4.347 af Secondary=0.00 cfs 0.000 af Outflow=20.78 cfs 4.347 af

**Pond 2P: NE Sediment Pond** Peak Elev=1,130.23' Storage=40,265 cf Inflow=57.54 cfs 3.777 af
36.0" Round Culvert n=0.013 L=96.4' S=0.0100 '/' Outflow=44.76 cfs 3.772 af

**Pond P-1: P-1 Lower Culvert** Peak Elev=1,152.34' Inflow=55.46 cfs 3.430 af
36.0" Round Culvert n=0.013 L=47.7' S=0.0050 '/' Outflow=55.46 cfs 3.430 af

**Pond P-2: P-2** Peak Elev=1,270.28' Inflow=2.23 cfs 0.150 af
15.0" Round Culvert n=0.013 L=49.0' S=0.0049 '/' Outflow=2.23 cfs 0.150 af

**Pond P-3: P-3** Peak Elev=1,251.02' Inflow=31.72 cfs 1.994 af
36.0" Round Culvert n=0.013 L=254.5' S=0.0054 '/' Outflow=31.72 cfs 1.994 af

**Pond P-4: P-4** Peak Elev=1,252.34' Inflow=31.72 cfs 1.994 af
36.0" Round Culvert n=0.013 L=195.0' S=0.0050 '/' Outflow=31.72 cfs 1.994 af

**Pond P-5: P-5** Peak Elev=1,253.20' Inflow=31.72 cfs 1.994 af
36.0" Round Culvert n=0.013 L=109.4' S=0.0050 '/' Outflow=31.72 cfs 1.994 af

**Pond P-6: P-6 Under Haul Road** Peak Elev=1,254.86' Inflow=30.53 cfs 1.867 af
30.0" Round Culvert n=0.013 L=44.2' S=0.0100 '/' Outflow=30.53 cfs 1.867 af

**Pond P-7: P-7 Turnaround Culvert** Peak Elev=1,127.97' Inflow=21.00 cfs 1.279 af
30.0" Round Culvert n=0.013 L=35.0' S=0.0566 '/' Outflow=21.00 cfs 1.279 af

**Total Runoff Area = 52.843 ac Runoff Volume = 12.364 af Average Runoff Depth = 2.81"**
**95.78% Pervious = 50.616 ac 4.22% Impervious = 2.227 ac**

## Summary for Subcatchment S-1: S-1

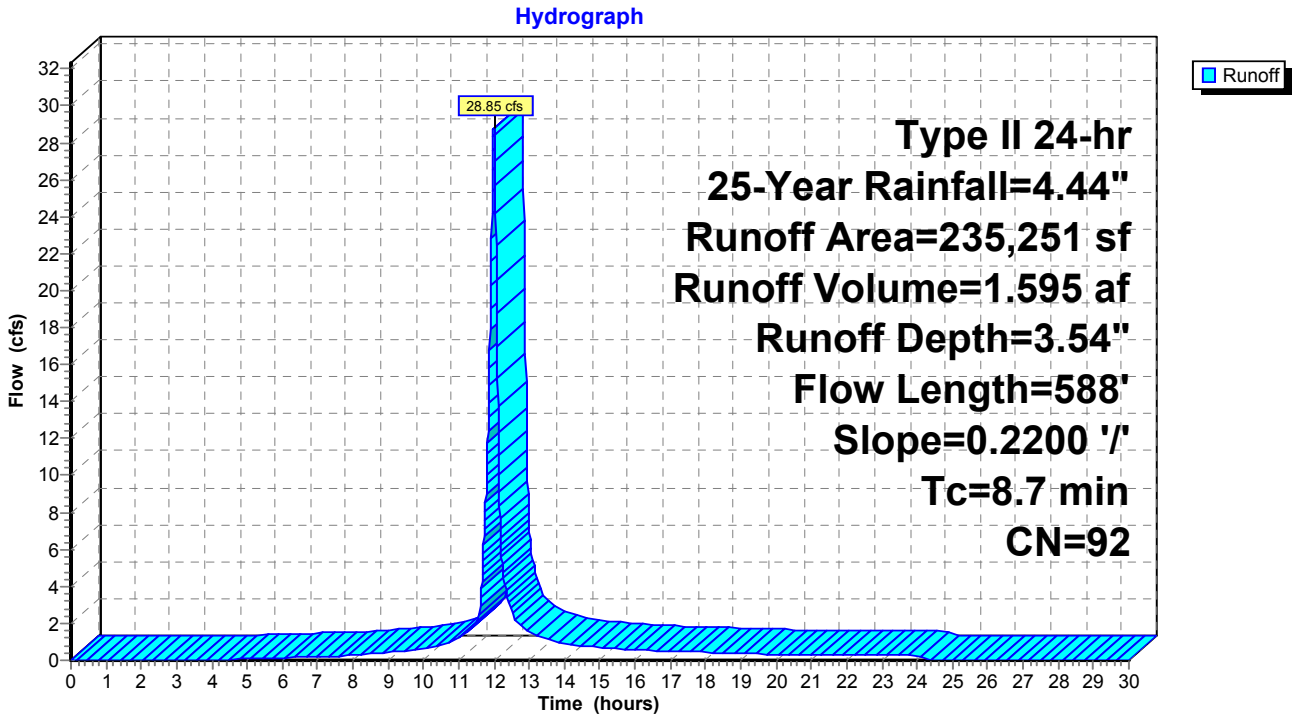
Runoff = 28.85 cfs @ 12.00 hrs, Volume= 1.595 af, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 188,449 | 91 | Newly graded area, HSG C |
| * | 42,362 | 98 | Impervious (Pond Surface) |
| * | 4,440 | 98 | Impervious (Gravel Road), HSG C |
| | 235,251 | 92 | Weighted Average |
| | 188,449 | | 80.11% Pervious Area |
| | 46,802 | | 19.89% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.3 | 200 | 0.2200 | 0.45 | | **Sheet Flow, L-1** Grass: Short n= 0.150 P2= 2.54" |
| 1.4 | 388 | 0.2200 | 4.69 | | **Shallow Concentrated Flow, L-2** Nearly Bare & Untilled Kv= 10.0 fps |
| 8.7 | 588 | Total | | | |

## Subcatchment S-1: S-1



## Summary for Subcatchment S-2: S-2

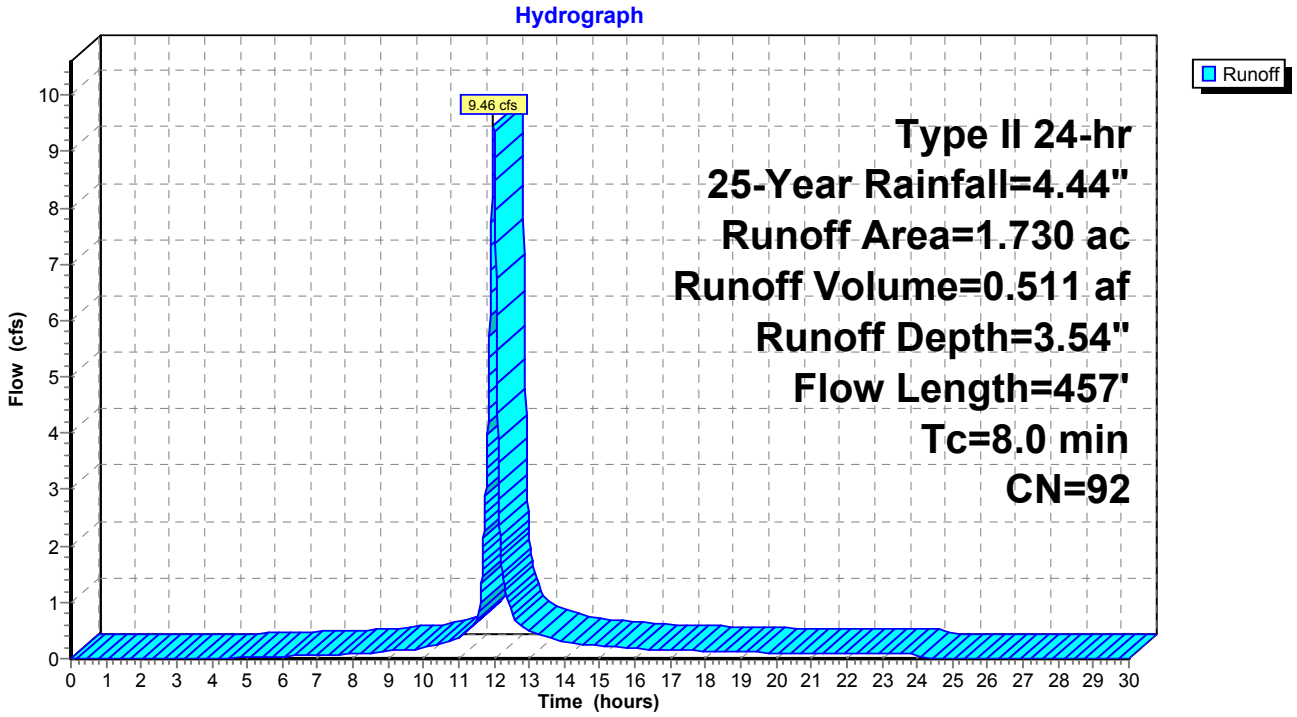
Runoff = 9.46 cfs @ 11.99 hrs, Volume= 0.511 af, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (ac) | CN | Description |
|---|---|---|---|
| | 1.460 | 91 | Newly graded area, HSG C |
| * | 0.270 | 98 | Impervious (Pond Surface) |
| | 1.730 | 92 | Weighted Average |
| | 1.460 | | 84.39% Pervious Area |
| | 0.270 | | 15.61% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.2 | 200 | 0.2310 | 0.46 | | **Sheet Flow, L-1** Grass: Short n= 0.150 P2= 2.54" |
| 0.8 | 257 | 0.3000 | 5.48 | | **Shallow Concentrated Flow, L-2** Nearly Bare & Untilled Kv= 10.0 fps |
| 8.0 | 457 | Total | | | |

## Subcatchment S-2: S-2



## Summary for Subcatchment S-3: S-3

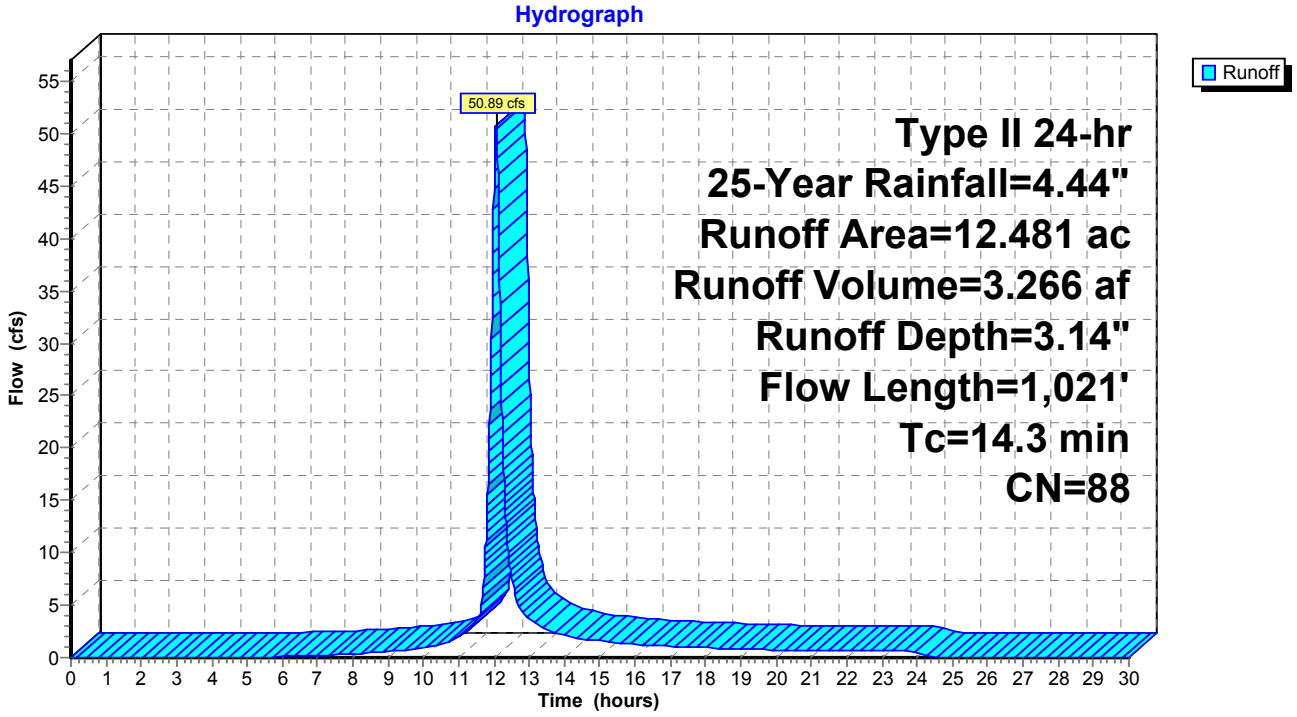
Runoff = 50.89 cfs @ 12.06 hrs, Volume= 3.266 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (ac) | CN | Description |
|---|---|---|
| 9.675 | 91 | Newly graded area, HSG C |
| 2.806 | 76 | Woods/grass comb., Fair, HSG C |
| 12.481 | 88 | Weighted Average |
| 12.481 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.8 | 138 | 0.2840 | 0.21 | | **Sheet Flow, L-1** Woods: Light underbrush n= 0.400 P2= 2.54" |
| 1.5 | 365 | 0.1680 | 4.10 | | **Shallow Concentrated Flow, L-3** Nearly Bare & Untilled Kv= 10.0 fps |
| 1.0 | 143 | 0.0290 | 2.46 | 10.33 | **Channel Flow, L-4** Area= 4.2 sf Perim= 42.5' r= 0.10' n= 0.022 Earth, clean & straight |
| 1.0 | 375 | 0.2350 | 6.13 | 24.51 | **Channel Flow, L-5** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.055 |
| 14.3 | 1,021 | Total | | | |

## Subcatchment S-3: S-3



## Summary for Subcatchment S-4: S-4

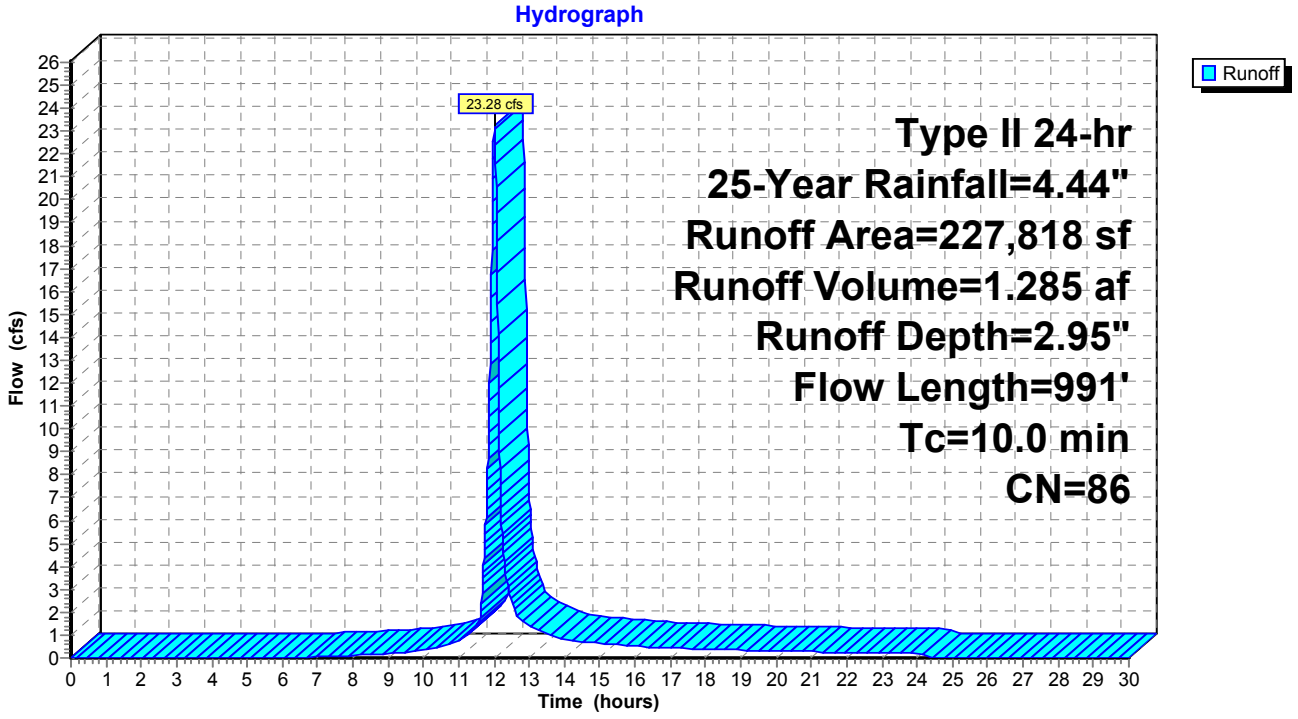
Runoff = 23.28 cfs @ 12.01 hrs, Volume= 1.285 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 133,696 | 91 | Newly graded area, HSG C |
| * | 15,407 | 98 | Impervious (Gravel Road), HSG C |
| | 78,715 | 76 | Woods/grass comb., Fair, HSG C |
| | 227,818 | 86 | Weighted Average |
| | 212,411 | | 93.24% Pervious Area |
| | 15,407 | | 6.76% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.8 | 200 | 0.1860 | 0.42 | | **Sheet Flow, L-1** Grass: Short n= 0.150 P2= 2.54" |
| 1.0 | 161 | 0.1350 | 2.57 | | **Shallow Concentrated Flow, L-2** Short Grass Pasture Kv= 7.0 fps |
| 1.2 | 630 | 0.1200 | 9.09 | 181.77 | **Channel Flow, L-3** Area= 20.0 sf Perim= 20.9' r= 0.96' n= 0.055 |
| 10.0 | 991 | Total | | | |

## Subcatchment S-4: S-4



## Summary for Subcatchment S-5: S-5

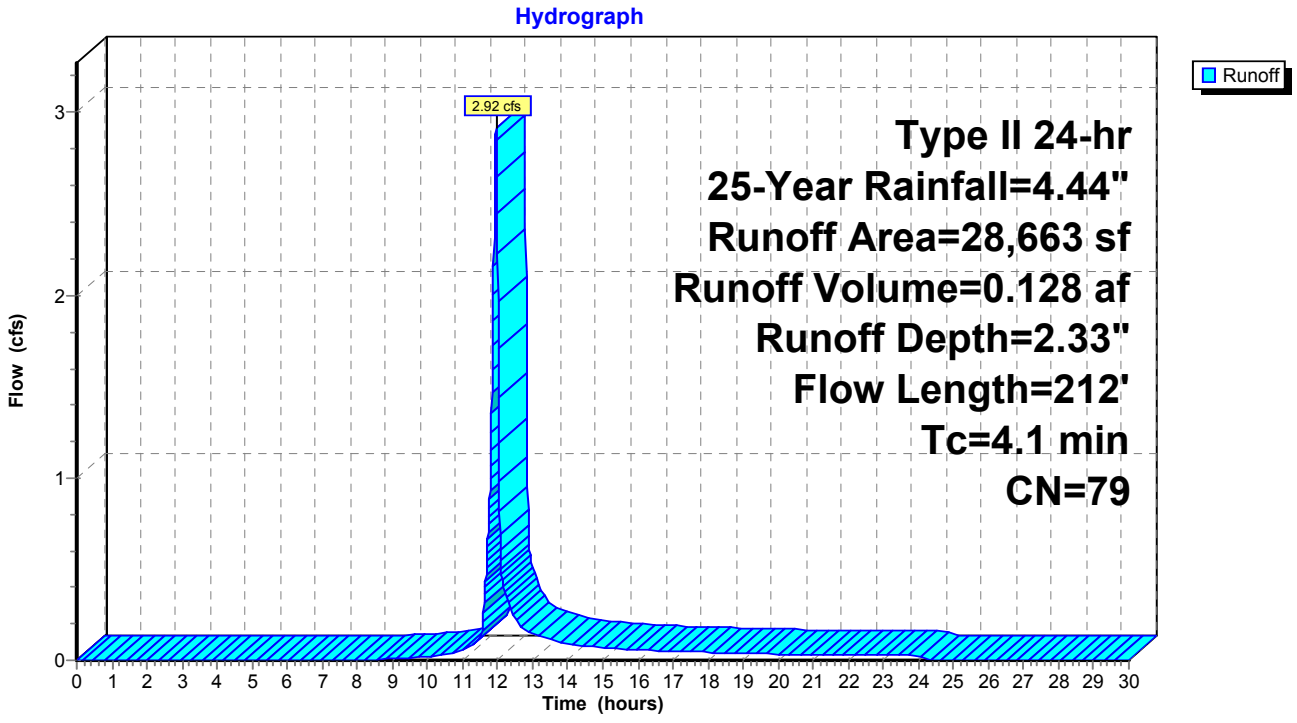
Runoff = 2.92 cfs @ 11.95 hrs, Volume= 0.128 af, Depth= 2.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 22,651 | 76 | Woods/grass comb., Fair, HSG C |
| | 4,749 | 91 | Newly graded area, HSG C |
| * | 1,263 | 98 | Impervious (Gravel Road), HSG C |
| | 28,663 | 79 | Weighted Average |
| | 27,400 | | 95.59% Pervious Area |
| | 1,263 | | 4.41% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 3.7 | 103 | 0.3160 | 0.46 | | **Sheet Flow, L-1** Grass: Short n= 0.150 P2= 2.54" |
| 0.4 | 109 | 0.0620 | 4.65 | 55.77 | **Channel Flow, L-2** Area= 12.0 sf Perim= 20.9' r= 0.57' n= 0.055 |
| 4.1 | 212 | Total | | | |

## Subcatchment S-5: S-5



## Summary for Subcatchment S-6: S-6

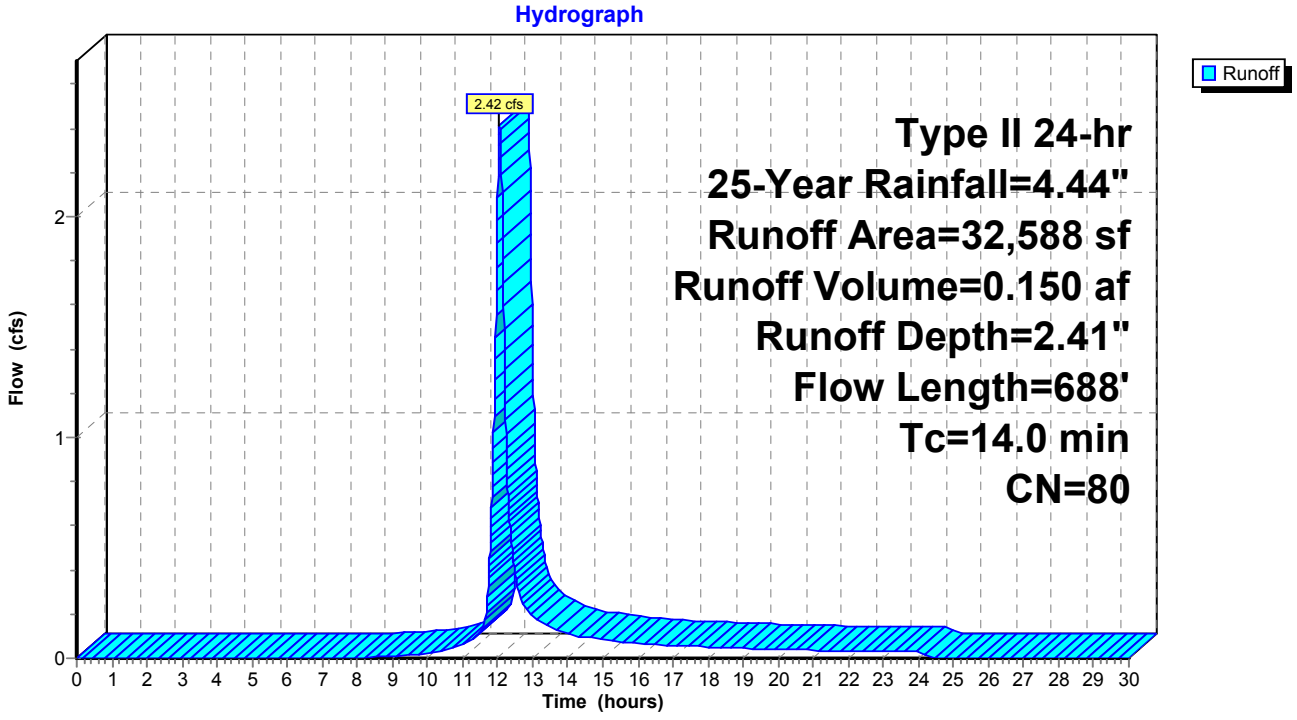
Runoff = 2.42 cfs @ 12.06 hrs, Volume= 0.150 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (sf) | CN | Description |
|---|---|---|
| 23,793 | 76 | Woods/grass comb., Fair, HSG C |
| 8,795 | 91 | Newly graded area, HSG C |
| 32,588 | 80 | Weighted Average |
| 32,588 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.5 | 84 | 0.0890 | 0.12 | | **Sheet Flow, L-1** Woods: Light underbrush n= 0.400 P2= 2.54" |
| 2.5 | 604 | 0.0455 | 3.98 | 47.77 | **Channel Flow, L-2** Area= 12.0 sf Perim= 20.9' r= 0.57' n= 0.055 |
| 14.0 | 688 | Total | | | |

## Subcatchment S-6: S-6



## Summary for Subcatchment S-7: S-7

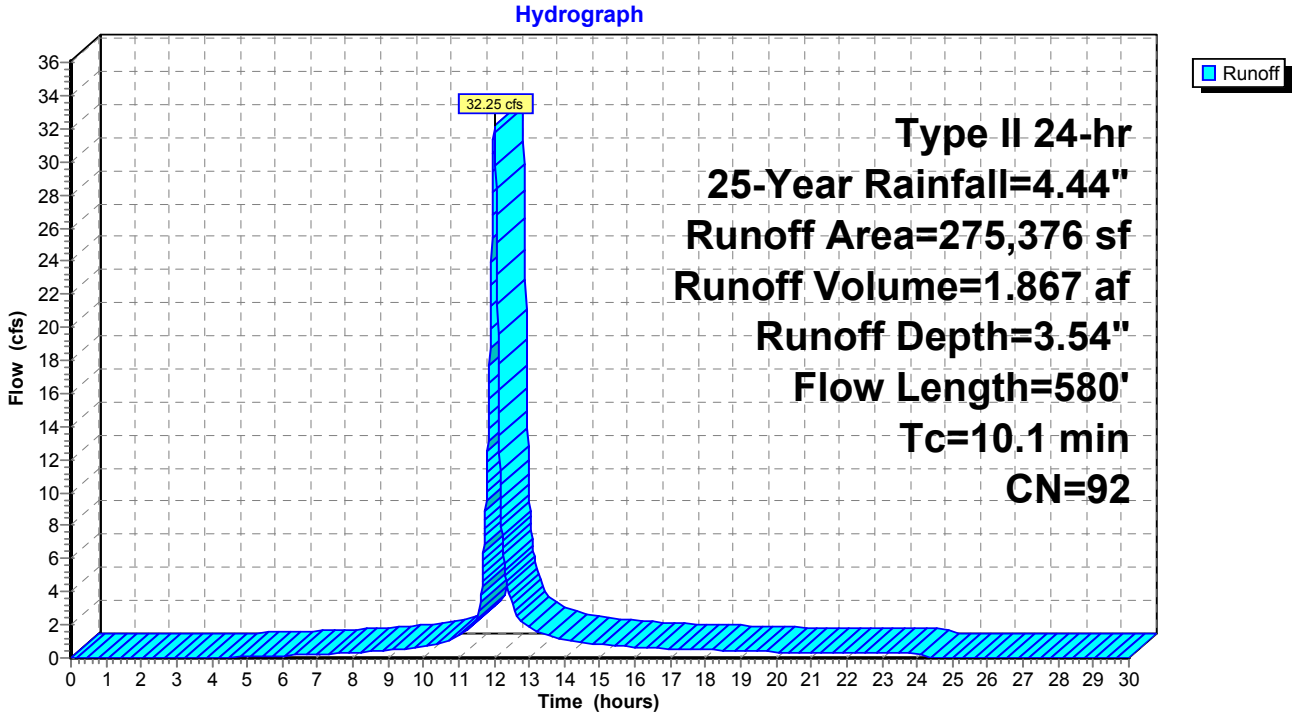
Runoff = 32.25 cfs @ 12.01 hrs, Volume= 1.867 af, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 21,792 | 98 | Paved haul road, HSG C |
| | 18,668 | 91 | Newly graded area, HSG C |
| * | 234,916 | 91 | Landfill (50-75% grass cover, fair), HSG C |
| | 275,376 | 92 | Weighted Average |
| | 253,584 | | 92.09% Pervious Area |
| | 21,792 | | 7.91% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.5 | 200 | 0.0170 | 0.39 | | **Sheet Flow, L-1** Fallow n= 0.050 P2= 2.54" |
| 1.3 | 218 | 0.0790 | 2.81 | | **Shallow Concentrated Flow, L-2** Nearly Bare & Untilled Kv= 10.0 fps |
| 0.3 | 162 | 0.2120 | 8.98 | 179.64 | **Channel Flow, L-3** Area= 20.0 sf Perim= 32.6' r= 0.61' n= 0.055 |
| 10.1 | 580 | Total | | | |

## Subcatchment S-7: S-7



## Summary for Subcatchment S-8A: S-8A

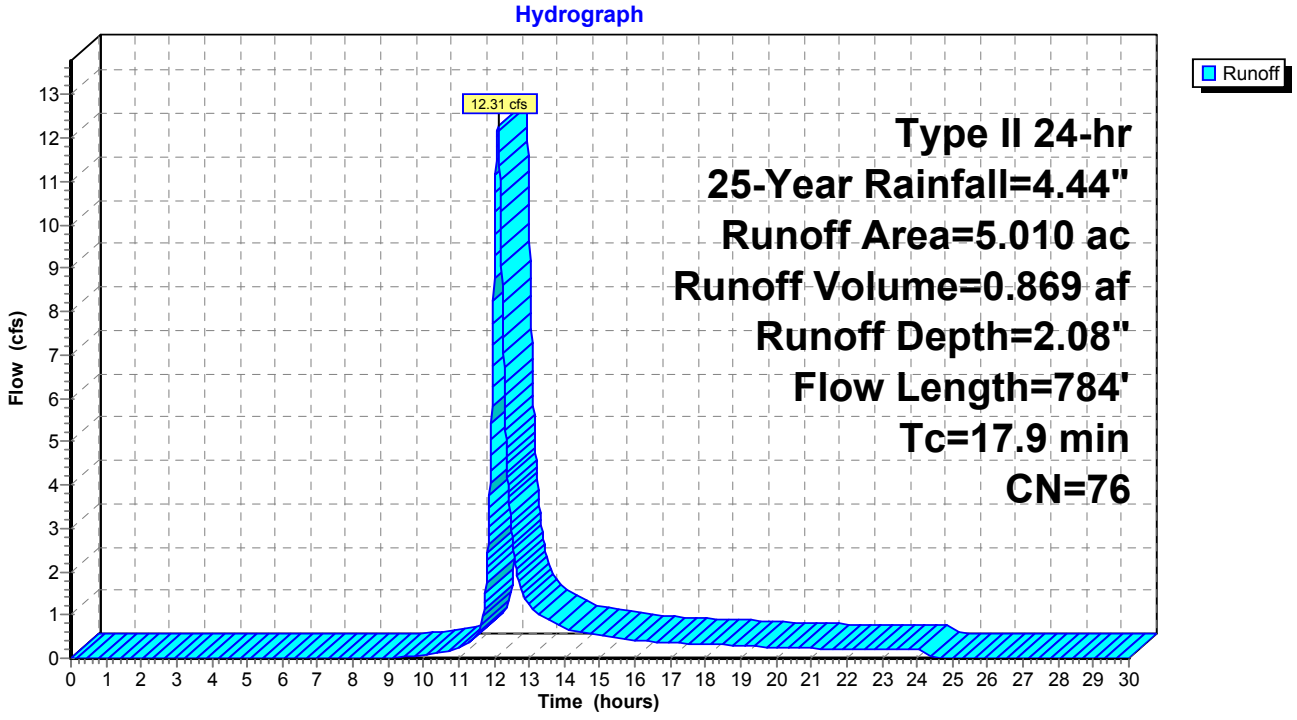
Runoff = 12.31 cfs @ 12.11 hrs, Volume= 0.869 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (ac) | CN | Description |
|---|---|---|
| 5.010 | 76 | Woods/grass comb., Fair, HSG C |
| 5.010 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.3 | 200 | 0.2960 | 0.23 | | **Sheet Flow, L-1** Woods: Light underbrush n= 0.400 P2= 2.54" |
| 1.6 | 382 | 0.3380 | 4.07 | | **Shallow Concentrated Flow, L-2** Short Grass Pasture Kv= 7.0 fps |
| 2.0 | 202 | 0.0170 | 1.65 | 6.59 | **Channel Flow, L-3** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.055 |
| 17.9 | 784 | Total | | | |

## Subcatchment S-8A: S-8A



## Summary for Subcatchment S-8B: S-8B

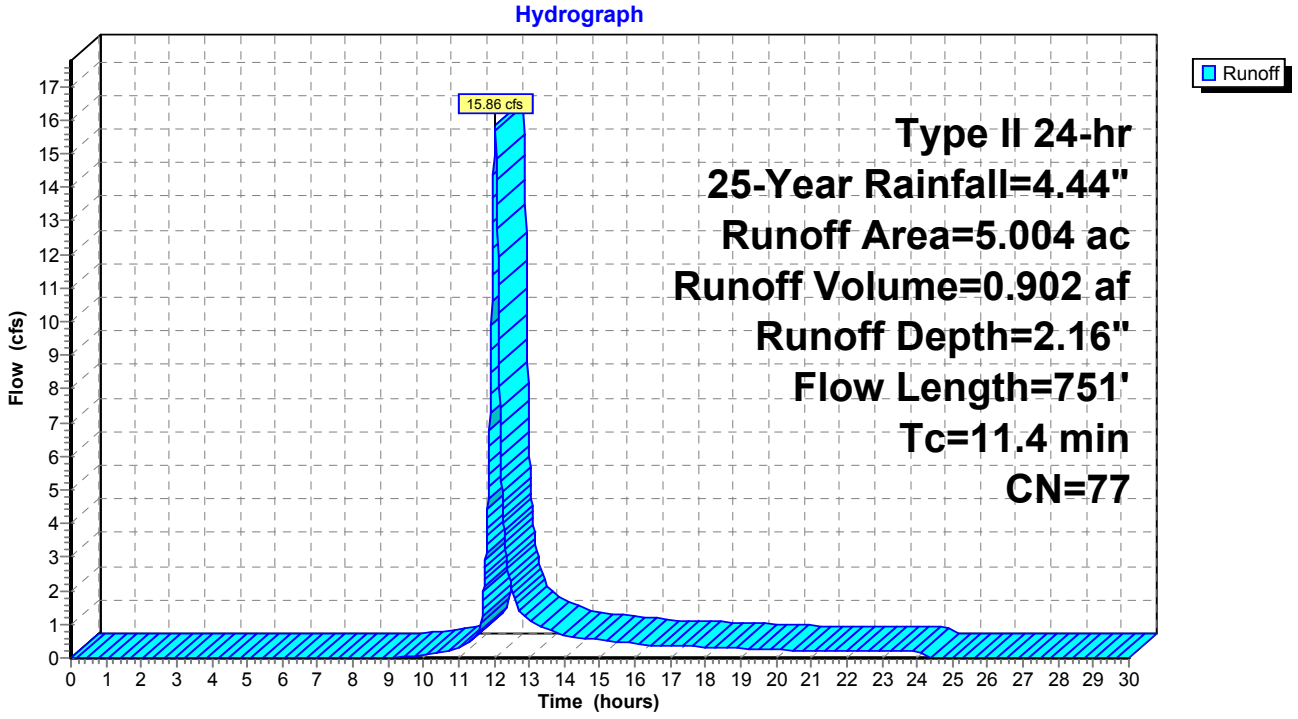
Runoff = 15.86 cfs @ 12.03 hrs, Volume= 0.902 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (ac) | CN | Description |
|---|---|---|
| 4.590 | 76 | Woods/grass comb., Fair, HSG C |
| 0.414 | 91 | Newly graded area, HSG C |
| 5.004 | 77 | Weighted Average |
| 5.004 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.5 | 200 | 0.2950 | 0.35 | | **Sheet Flow, L-1** Grass: Dense n= 0.240 P2= 2.54" |
| 1.2 | 261 | 0.2870 | 3.75 | | **Shallow Concentrated Flow, L-2** Short Grass Pasture Kv= 7.0 fps |
| 0.3 | 157 | 0.4220 | 7.53 | 30.11 | **Channel Flow, L-3** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.060 |
| 0.4 | 133 | 0.2160 | 5.87 | 23.50 | **Channel Flow, L-4** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.055 |
| 11.4 | 751 | Total | | | |

## Subcatchment S-8B: S-8B



## Summary for Subcatchment S-9A: S-9A

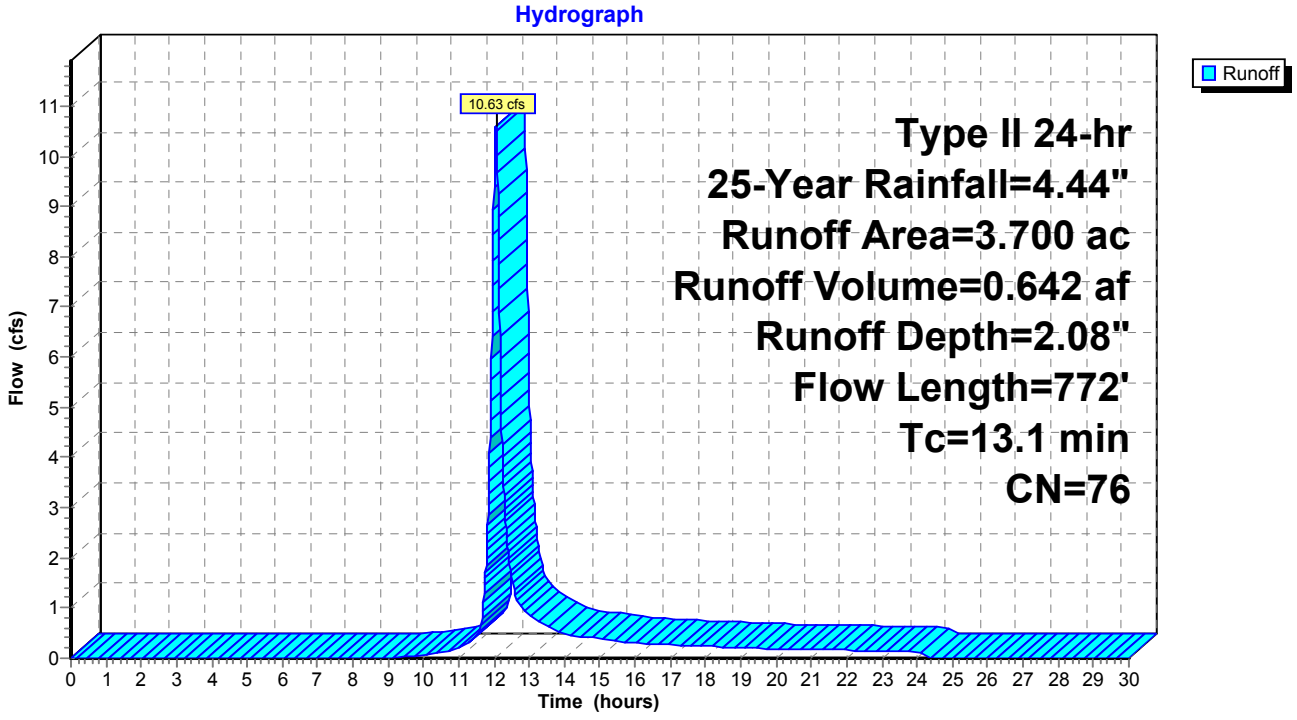
Runoff = 10.63 cfs @ 12.05 hrs, Volume= 0.642 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (ac) | CN | Description |
|---|---|---|
| 3.700 | 76 | Woods/grass comb., Fair, HSG C |
| 3.700 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.4 | 200 | 0.2350 | 0.32 | | **Sheet Flow, L-1** Grass: Dense n= 0.240 P2= 2.54" |
| 2.4 | 482 | 0.2210 | 3.29 | | **Shallow Concentrated Flow, L-2** Short Grass Pasture Kv= 7.0 fps |
| 0.3 | 90 | 0.1790 | 5.35 | 21.39 | **Channel Flow, L-3** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.055 |
| 13.1 | 772 | Total | | | |

## Subcatchment S-9A: S-9A



## Summary for Subcatchment S-9B: S-9B

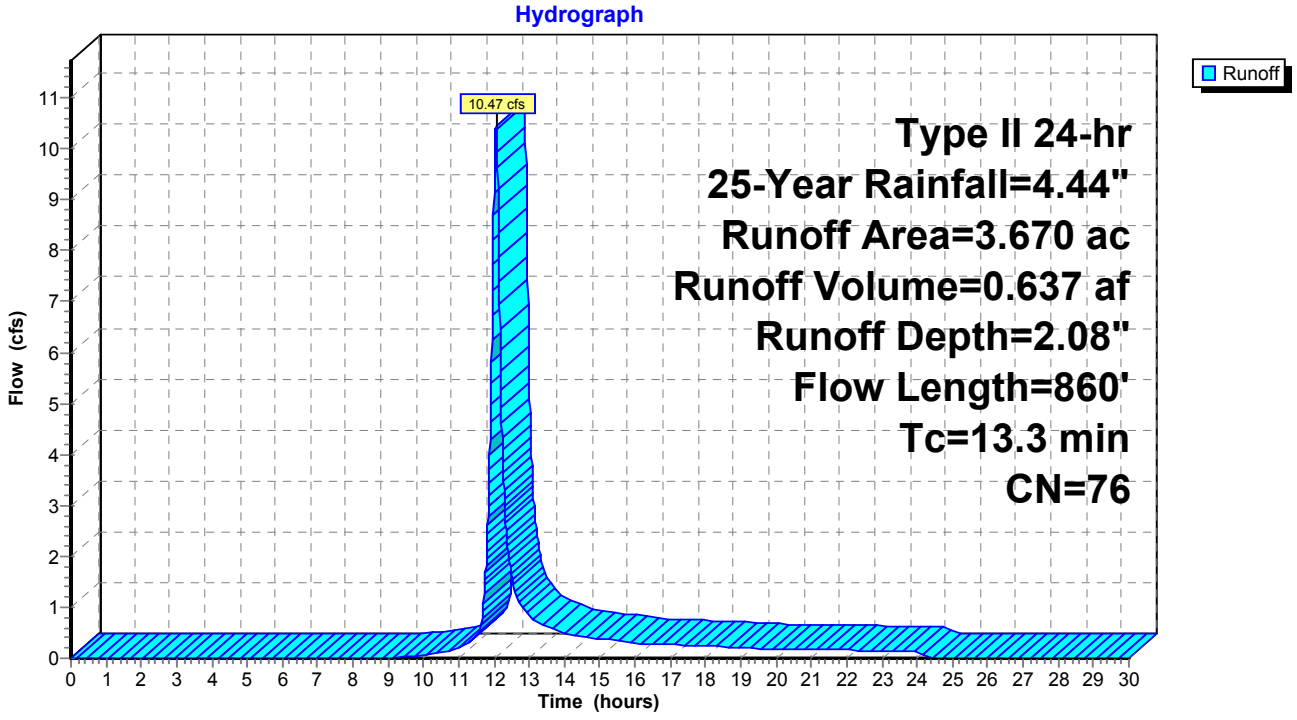
Runoff = 10.47 cfs @ 12.05 hrs, Volume= 0.637 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (ac) | CN | Description |
|---|---|---|
| 3.670 | 76 | Woods/grass comb., Fair, HSG C |
| 3.670 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.6 | 200 | 0.2900 | 0.35 | | **Sheet Flow, L-1** Grass: Dense n= 0.240 P2= 2.54" |
| 2.3 | 495 | 0.2560 | 3.54 | | **Shallow Concentrated Flow, L-2** Short Grass Pasture Kv= 7.0 fps |
| 1.4 | 165 | 0.0220 | 1.97 | 9.85 | **Channel Flow, L-3** Area= 5.0 sf Perim= 14.5' r= 0.34' n= 0.055 |
| 13.3 | 860 | Total | | | |

## Subcatchment S-9B: S-9B



## Summary for Subcatchment S-9C: S-9C

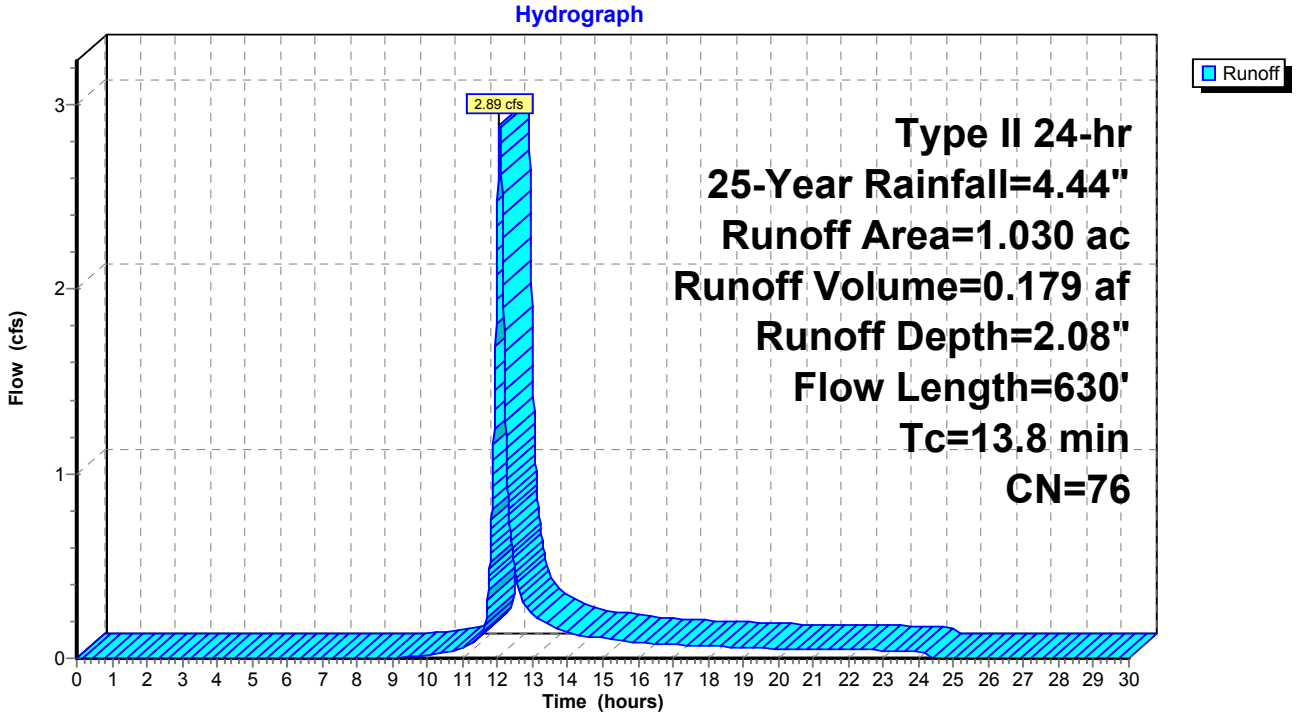
Runoff = 2.89 cfs @ 12.06 hrs, Volume= 0.179 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (ac) | CN | Description |
|---|---|---|
| 1.030 | 76 | Woods/grass comb., Fair, HSG C |
| 1.030 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.3 | 200 | 0.1910 | 0.29 | | **Sheet Flow, L-1** Grass: Dense n= 0.240 P2= 2.54" |
| 1.3 | 271 | 0.2460 | 3.47 | | **Shallow Concentrated Flow, L-2** Short Grass Pasture Kv= 7.0 fps |
| 1.2 | 159 | 0.0280 | 2.22 | 11.12 | **Channel Flow, L-3** Area= 5.0 sf Perim= 14.5' r= 0.34' n= 0.055 |
| 13.8 | 630 | Total | | | |

## Subcatchment S-9C: S-9C



## Summary for Subcatchment S-9D: S-9D

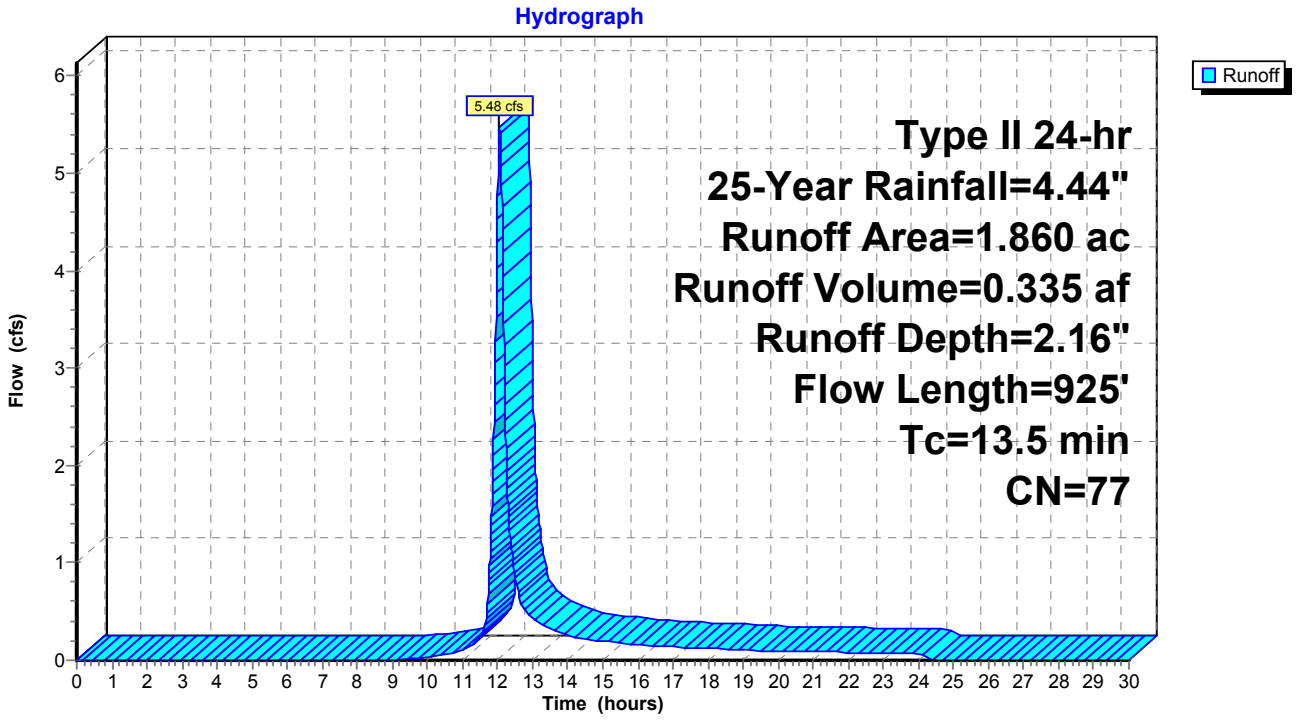
Runoff = 5.48 cfs @ 12.06 hrs, Volume= 0.335 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year Rainfall=4.44"

| Area (ac) | CN | Description |
|---|---|---|
| 1.697 | 76 | Woods/grass comb., Fair, HSG C |
| 0.163 | 91 | Newly graded area, HSG C |
| 1.860 | 77 | Weighted Average |
| 1.860 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.4 | 200 | 0.2330 | 0.32 | | **Sheet Flow, L-1** Grass: Dense n= 0.240 P2= 2.54" |
| 2.8 | 590 | 0.2560 | 3.54 | | **Shallow Concentrated Flow, L-2** Short Grass Pasture Kv= 7.0 fps |
| 0.3 | 135 | 0.3590 | 7.57 | 30.29 | **Channel Flow, L-3** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.055 |
| 13.5 | 925 | Total | | | |

## Subcatchment S-9D: S-9D



## Summary for Reach CH-08A: DR-08

Inflow Area = 5.010 ac, 0.00% Impervious, Inflow Depth = 2.08" for 25-Year event
Inflow = 12.31 cfs @ 12.11 hrs, Volume= 0.869 af
Outflow = 12.16 cfs @ 12.13 hrs, Volume= 0.869 af, Atten= 1%, Lag= 1.0 min

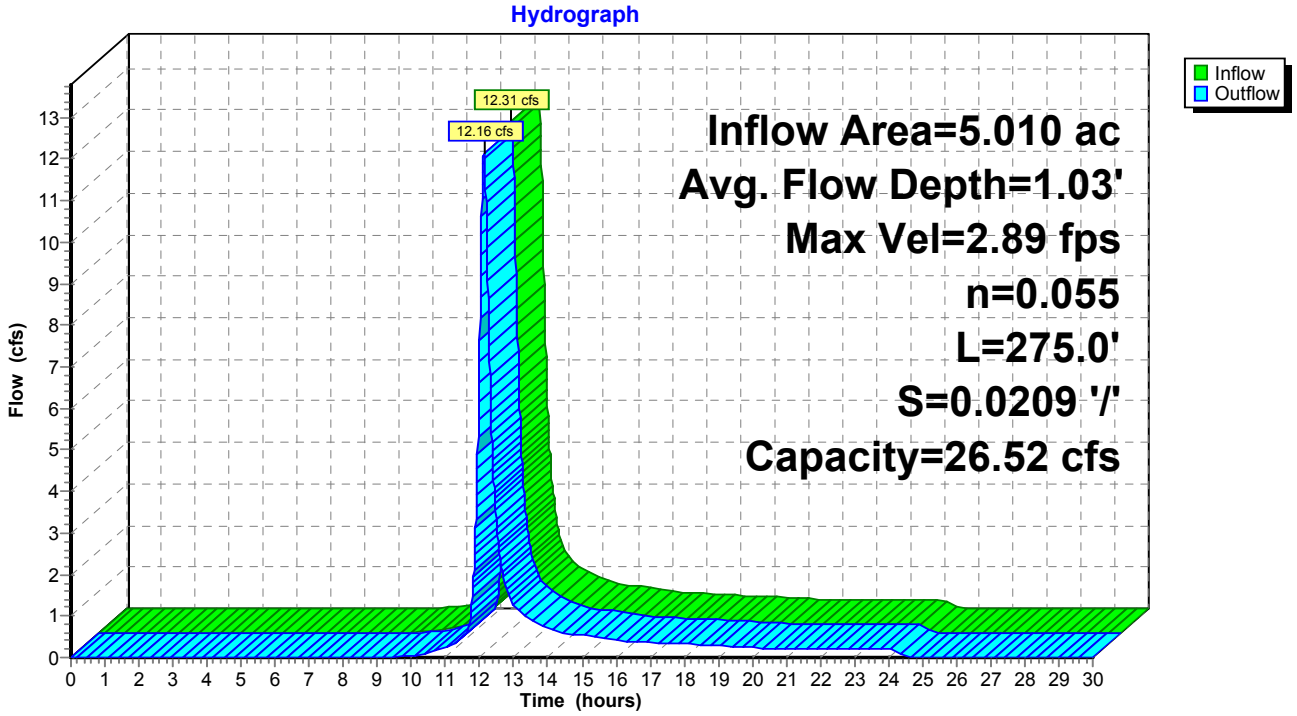
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.89 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.92 fps, Avg. Travel Time= 5.0 min

Peak Storage= 1,158 cf @ 12.13 hrs
Average Depth at Peak Storage= 1.03'
Bank-Full Depth= 1.50' Flow Area= 7.5 sf, Capacity= 26.52 cfs

2.00' x 1.50' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 275.0' Slope= 0.0209 '/'
Inlet Invert= 1,124.75', Outlet Invert= 1,119.00'



### Reach CH-08A: DR-08



## Summary for Reach CH-08B: DR-08B

[62] Hint: Exceeded Reach CH-08A OUTLET depth by 0.01' @ 9.20 hrs

Inflow Area = 10.014 ac, 0.00% Impervious, Inflow Depth = 2.12" for 25-Year event
Inflow = 25.95 cfs @ 12.06 hrs, Volume= 1.771 af
Outflow = 25.92 cfs @ 12.07 hrs, Volume= 1.771 af, Atten= 0%, Lag= 0.4 min

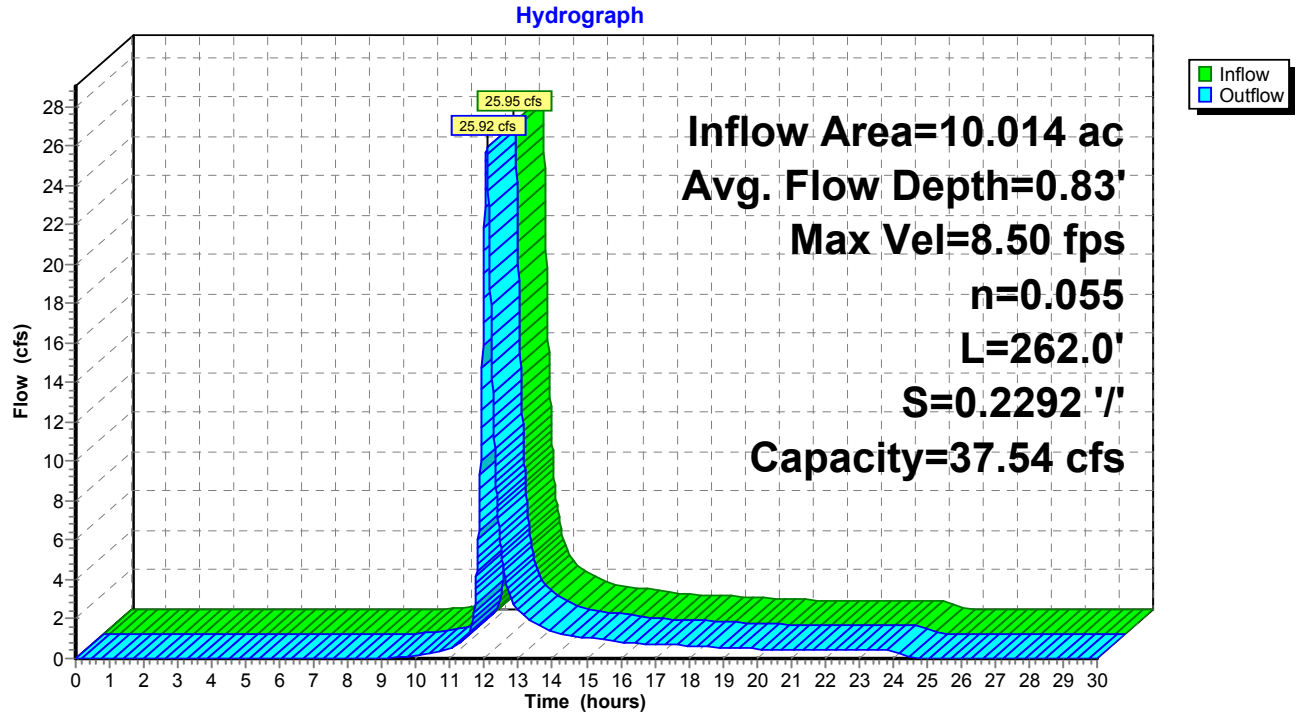
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.50 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.58 fps, Avg. Travel Time= 1.7 min

Peak Storage= 799 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.83'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 37.54 cfs

2.00' x 1.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 262.0' Slope= 0.2292 '/'
Inlet Invert= 1,119.00', Outlet Invert= 1,058.95'



**Reach CH-08B: DR-08B**



## Summary for Reach CH-09A: DR-09A

Inflow Area = 3.700 ac, 0.00% Impervious, Inflow Depth = 2.08" for 25-Year event
Inflow = 10.63 cfs @ 12.05 hrs, Volume= 0.642 af
Outflow = 10.62 cfs @ 12.06 hrs, Volume= 0.642 af, Atten= 0%, Lag= 0.3 min

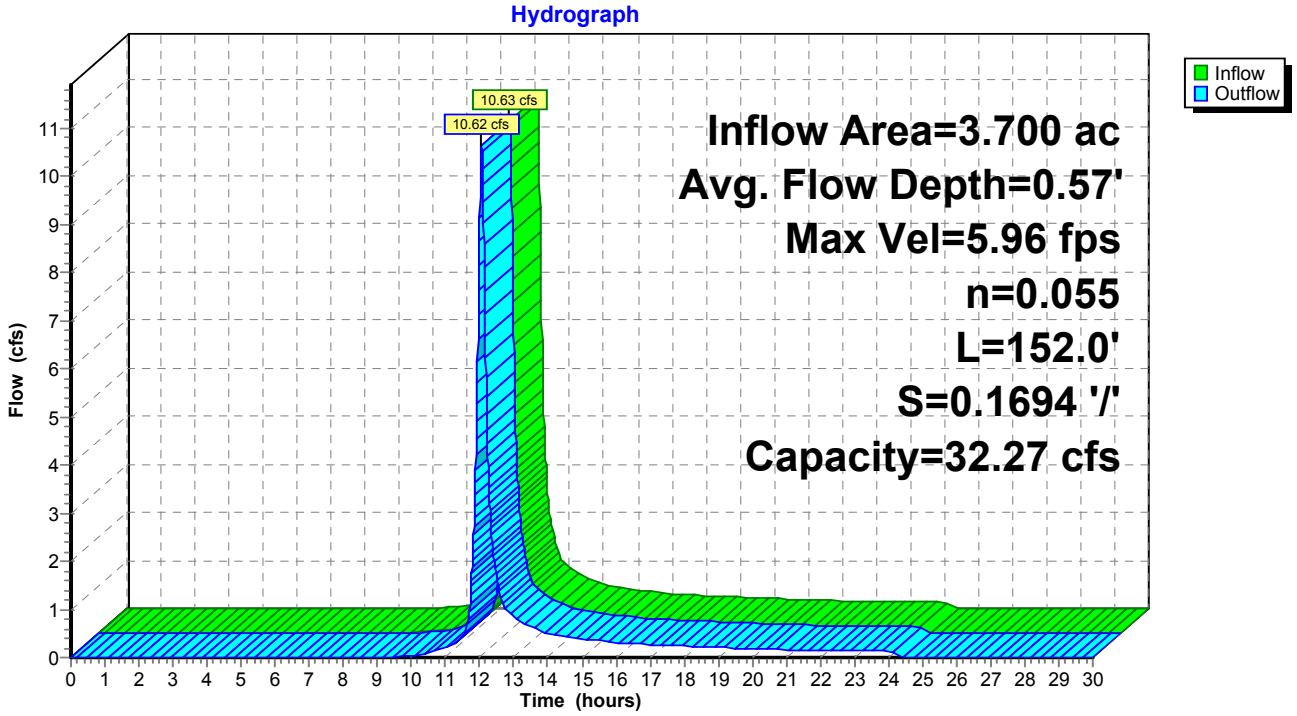
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.96 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 1.4 min

Peak Storage= 271 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 32.27 cfs

2.00' x 1.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 152.0' Slope= 0.1694 '/'
Inlet Invert= 1,155.42', Outlet Invert= 1,129.67'



### Reach CH-09A: DR-09A



## Summary for Reach CH-09B: DR-09B

[62] Hint: Exceeded Reach CH-09A OUTLET depth by 0.75' @ 12.08 hrs

Inflow Area = 7.370 ac, 0.00% Impervious, Inflow Depth = 2.08" for 25-Year event
Inflow = 21.09 cfs @ 12.06 hrs, Volume= 1.279 af
Outflow = 21.00 cfs @ 12.07 hrs, Volume= 1.279 af, Atten= 0%, Lag= 0.6 min

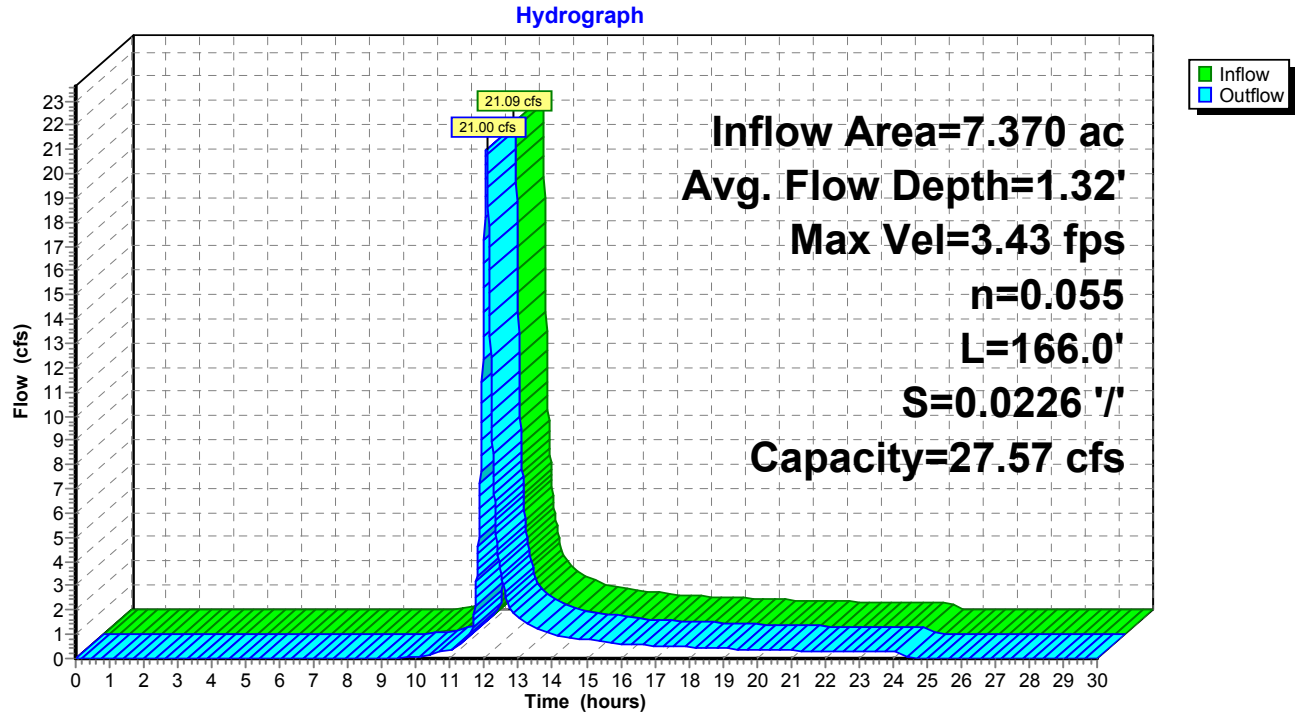
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.43 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.11 fps, Avg. Travel Time= 2.5 min

Peak Storage= 1,017 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.32'
Bank-Full Depth= 1.50' Flow Area= 7.5 sf, Capacity= 27.57 cfs

2.00' x 1.50' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 166.0' Slope= 0.0226 '/'
Inlet Invert= 1,129.67', Outlet Invert= 1,125.92'



### Reach CH-09B: DR-09B



## Summary for Reach CH-09C: DR-09C

Inflow Area = 8.400 ac, 0.00% Impervious, Inflow Depth = 2.08" for 25-Year event
Inflow = 23.89 cfs @ 12.07 hrs, Volume= 1.457 af
Outflow = 23.81 cfs @ 12.07 hrs, Volume= 1.457 af, Atten= 0%, Lag= 0.5 min

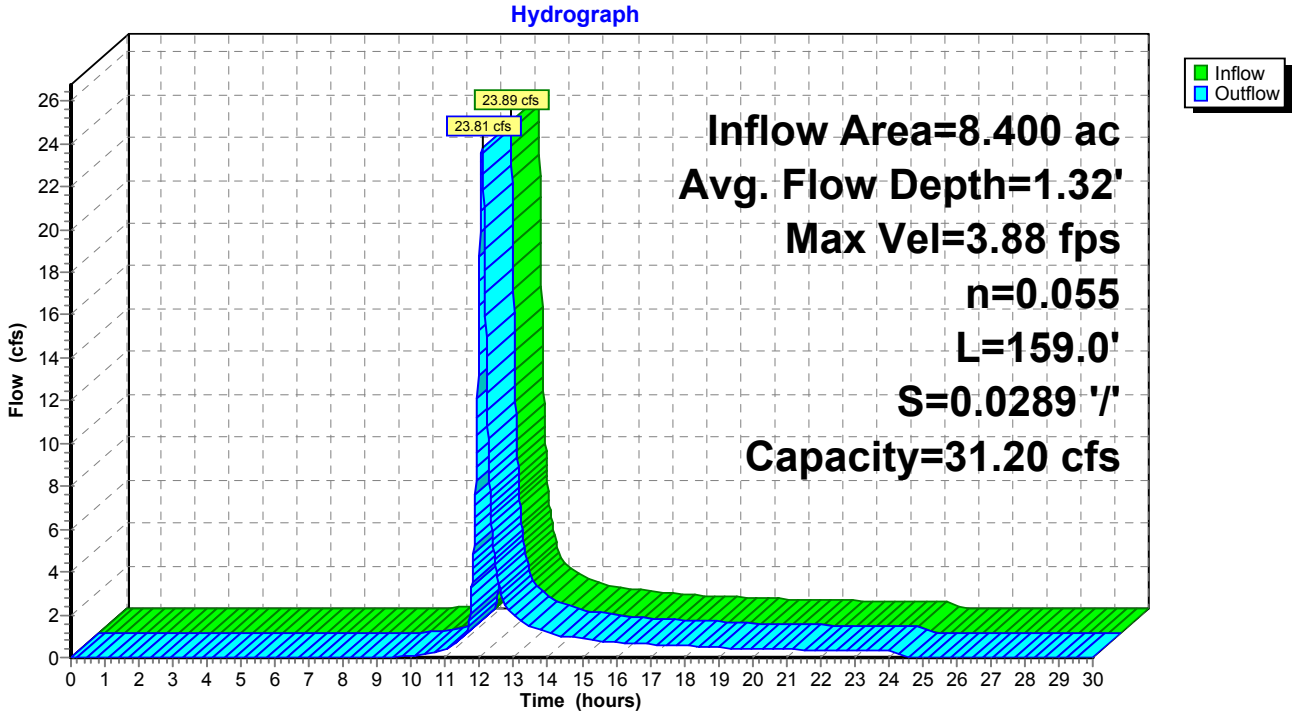
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.88 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.25 fps, Avg. Travel Time= 2.1 min

Peak Storage= 976 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.32'
Bank-Full Depth= 1.50' Flow Area= 7.5 sf, Capacity= 31.20 cfs

2.00' x 1.50' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 159.0' Slope= 0.0289 '/'
Inlet Invert= 1,123.94', Outlet Invert= 1,119.34'



### Reach CH-09C: DR-09C



## Summary for Reach CH-09D: DR-09D

[61] Hint: Exceeded Reach CH-09C outlet invert by 0.82' @ 12.08 hrs

Inflow Area = 10.260 ac, 0.00% Impervious, Inflow Depth = 2.10" for 25-Year event
Inflow = 29.23 cfs @ 12.07 hrs, Volume= 1.793 af
Outflow = 29.21 cfs @ 12.08 hrs, Volume= 1.793 af, Atten= 0%, Lag= 0.2 min

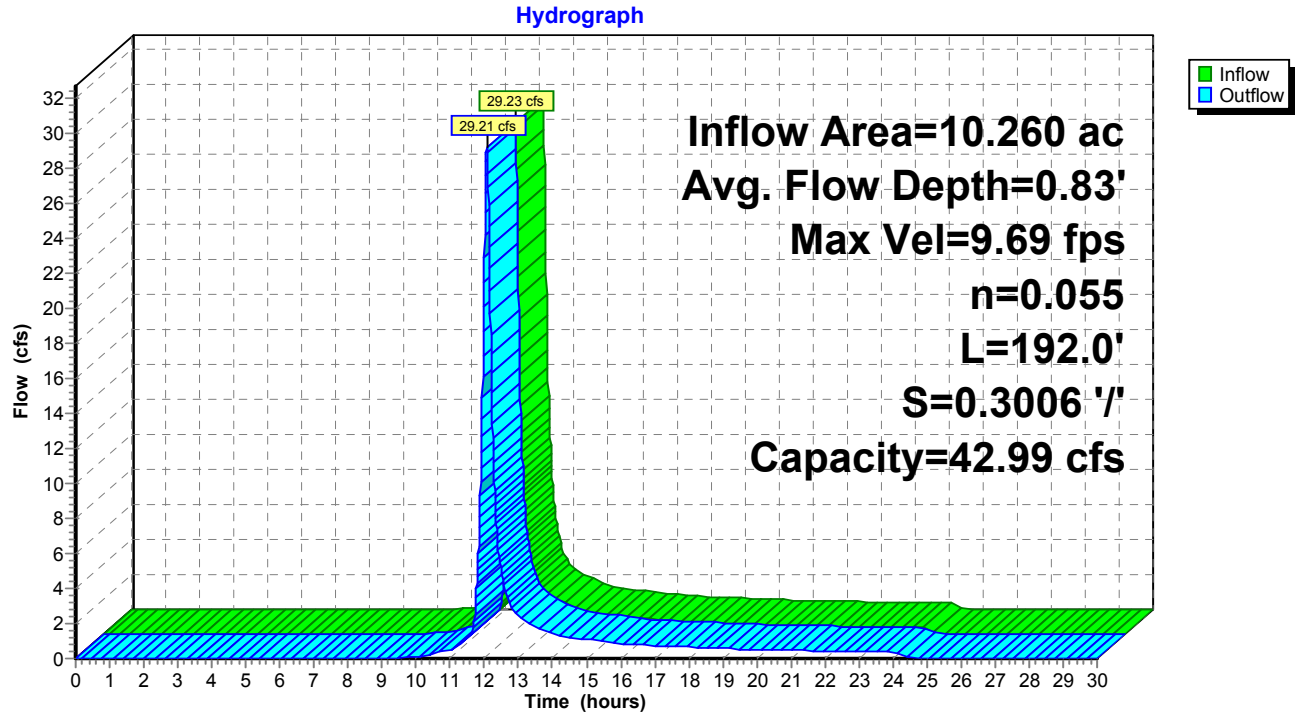
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.69 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.89 fps, Avg. Travel Time= 1.1 min

Peak Storage= 578 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.83'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 42.99 cfs

2.00' x 1.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 192.0' Slope= 0.3006 '/'
Inlet Invert= 1,119.34', Outlet Invert= 1,061.62'



**Reach CH-09D: DR-09D**



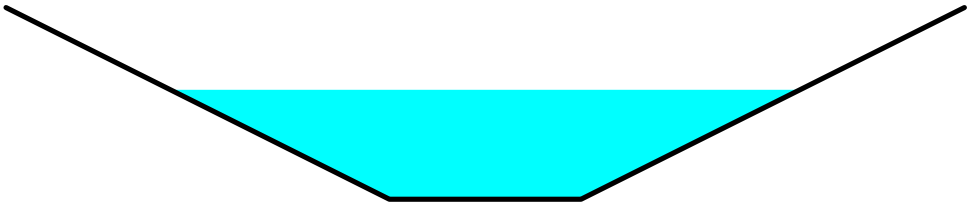
## Summary for Reach CH-1: Excess Soil Ditch to NE Pond

Inflow Area = 12.958 ac, 6.81% Impervious, Inflow Depth = 3.18" for 25-Year event
Inflow = 55.46 cfs @ 12.05 hrs, Volume= 3.430 af
Outflow = 55.45 cfs @ 12.05 hrs, Volume= 3.430 af, Atten= 0%, Lag= 0.1 min

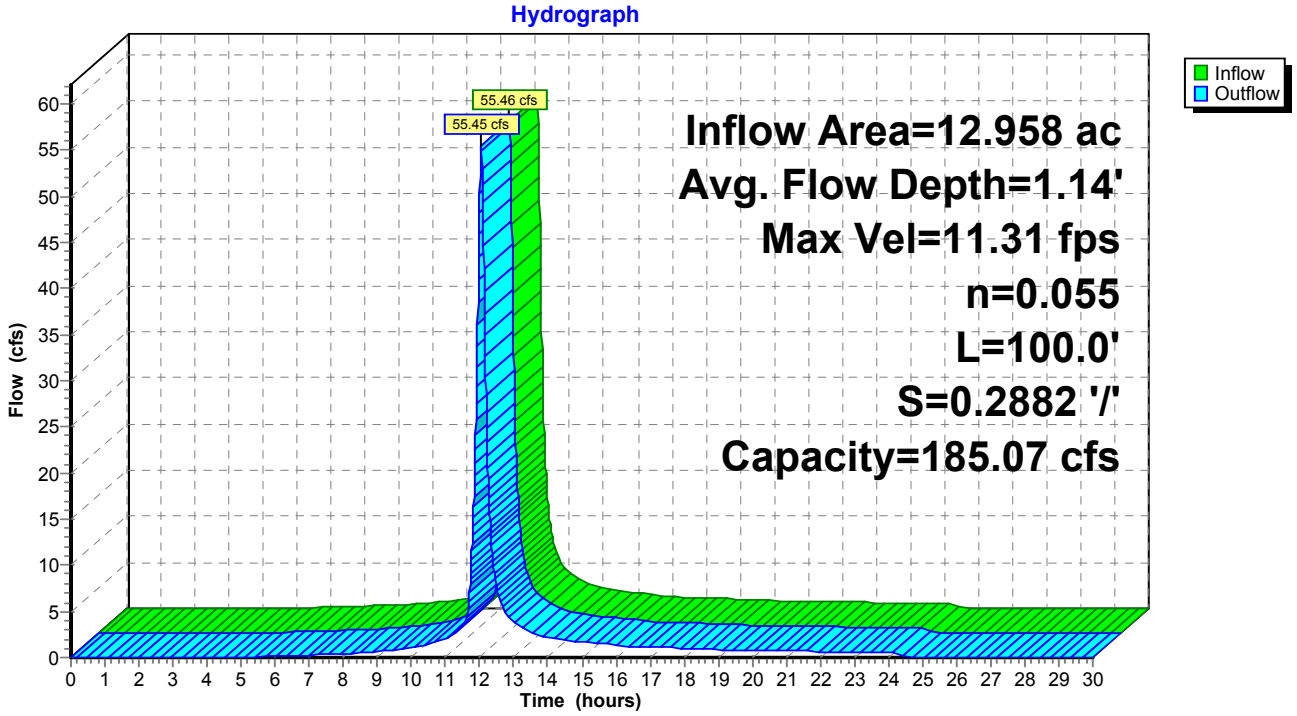
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 11.31 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.87 fps, Avg. Travel Time= 0.6 min

Peak Storage= 490 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.14'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 185.07 cfs

2.00' x 2.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 100.0' Slope= 0.2882 '/'
Inlet Invert= 1,147.82', Outlet Invert= 1,119.00'



## Reach CH-1: Excess Soil Ditch to NE Pond



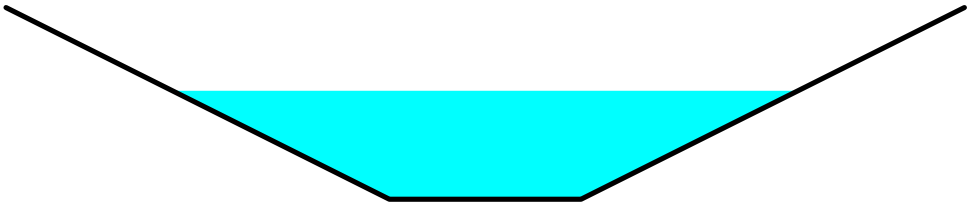
## Summary for Reach CH-2: Culvert to East Pond

Inflow Area = 14.211 ac, 1.90% Impervious, Inflow Depth > 3.19" for 25-Year event
Inflow = 44.76 cfs @ 12.14 hrs, Volume= 3.772 af
Outflow = 44.76 cfs @ 12.14 hrs, Volume= 3.772 af, Atten= 0%, Lag= 0.0 min

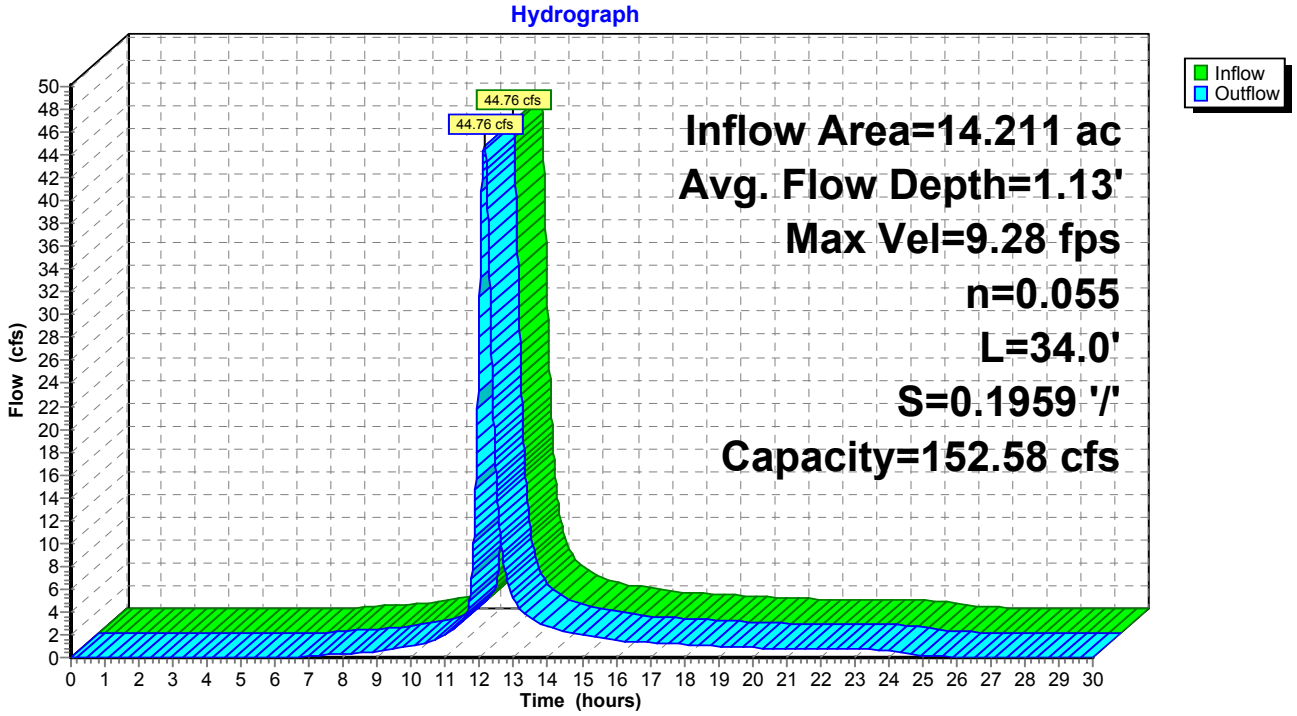
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.28 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.62 fps, Avg. Travel Time= 0.2 min

Peak Storage= 164 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.13'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 152.58 cfs

2.00' x 2.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 34.0' Slope= 0.1959 '/'
Inlet Invert= 1,125.66', Outlet Invert= 1,119.00'



## Reach CH-2: Culvert to East Pond



## Summary for Reach CH-3: Fill Downchute

Inflow Area = 12.481 ac, 0.00% Impervious, Inflow Depth = 3.14" for 25-Year event
Inflow = 50.89 cfs @ 12.06 hrs, Volume= 3.266 af
Outflow = 50.73 cfs @ 12.07 hrs, Volume= 3.266 af, Atten= 0%, Lag= 0.4 min

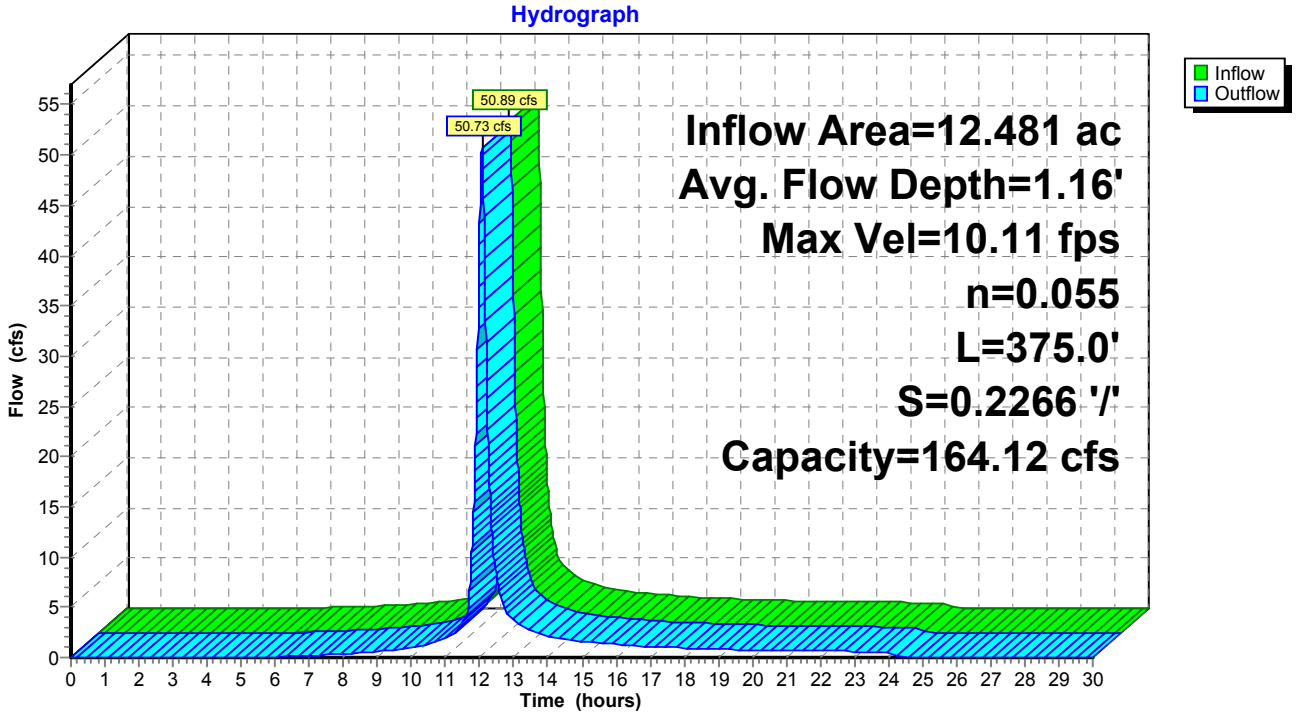
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.11 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 3.07 fps, Avg. Travel Time= 2.0 min

Peak Storage= 1,881 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 164.12 cfs

2.00' x 2.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 375.0' Slope= 0.2266 '/'
Inlet Invert= 1,213.99', Outlet Invert= 1,129.00'



## Reach CH-3: Fill Downchute



## Summary for Reach CH-4: Roadside Ditch

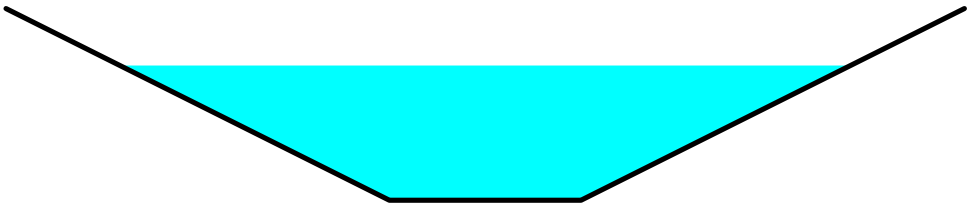
[62] Hint: Exceeded Reach CH-5 OUTLET depth by 1.18' @ 12.03 hrs

Inflow Area = 12.958 ac, 6.81% Impervious, Inflow Depth = 3.18" for 25-Year event
Inflow = 56.40 cfs @ 12.03 hrs, Volume= 3.430 af
Outflow = 55.46 cfs @ 12.05 hrs, Volume= 3.430 af, Atten= 2%, Lag= 1.1 min

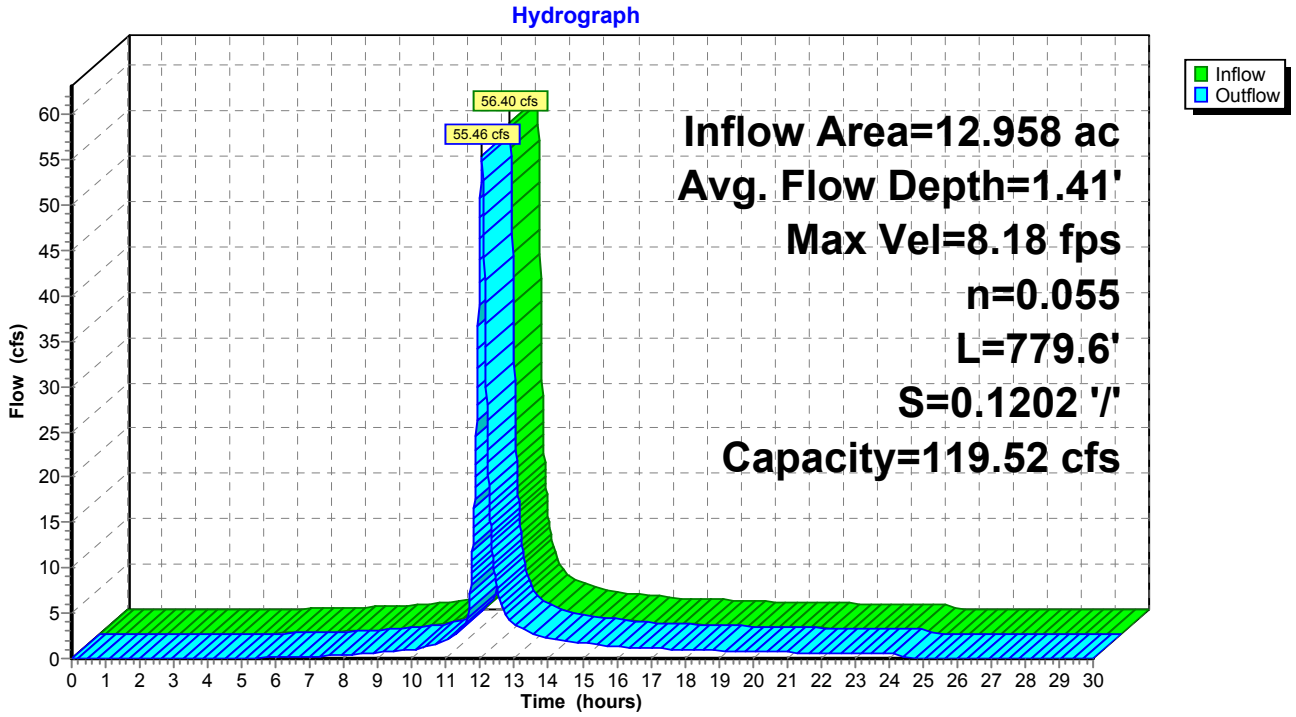
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.18 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 2.01 fps, Avg. Travel Time= 6.5 min

Peak Storage= 5,282 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.41'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 119.52 cfs

2.00' x 2.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 779.6' Slope= 0.1202 '/' (1000 Elevation Intervals)
Inlet Invert= 1,247.06', Outlet Invert= 1,153.36'



### Reach CH-4: Roadside Ditch



## Summary for Reach CH-5: Top of Access Road

Inflow Area = 0.748 ac, 0.00% Impervious, Inflow Depth = 2.41" for 25-Year event
Inflow = 2.23 cfs @ 12.10 hrs, Volume= 0.150 af
Outflow = 2.23 cfs @ 12.11 hrs, Volume= 0.150 af, Atten= 0%, Lag= 0.6 min

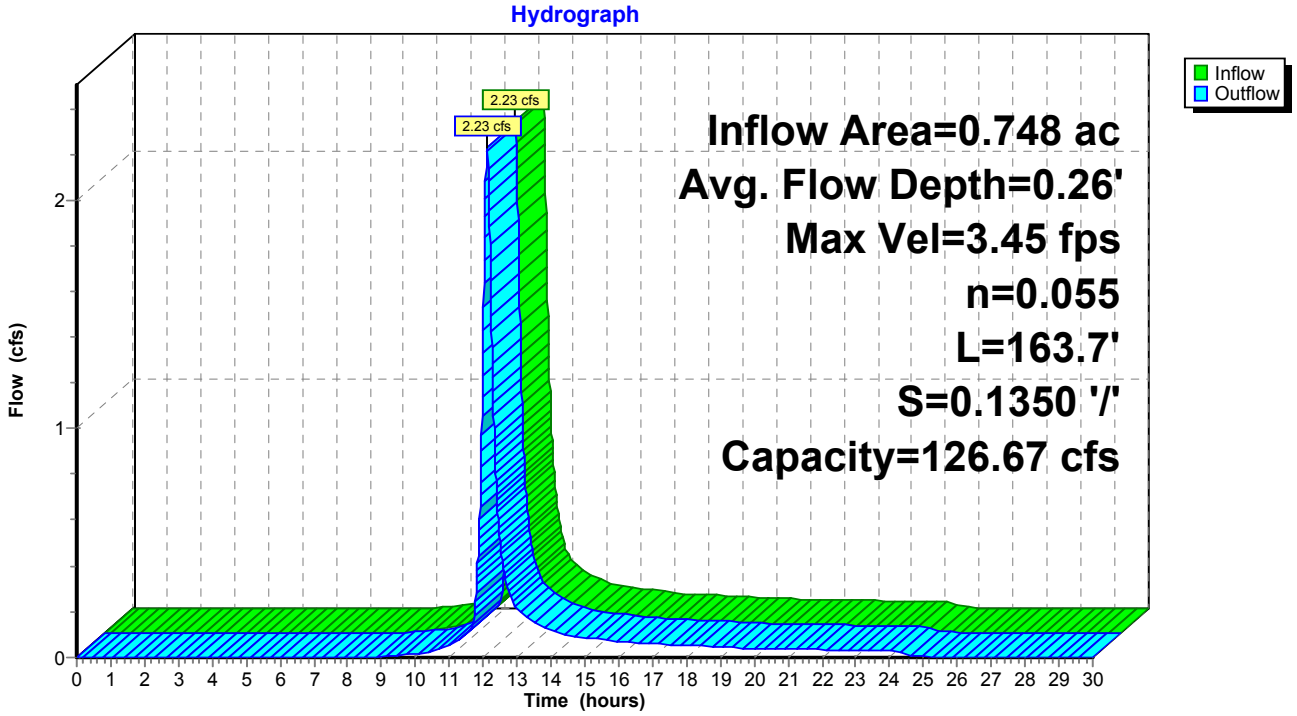
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.45 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.95 fps, Avg. Travel Time= 2.9 min

Peak Storage= 106 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 126.67 cfs

2.00' x 2.00' deep channel, n= 0.055
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 163.7' Slope= 0.1350 '/'
Inlet Invert= 1,269.16', Outlet Invert= 1,247.06'



## Reach CH-5: Top of Access Road



## Summary for Reach CH-6: North Outboard Channel East

Inflow Area = 0.748 ac, 0.00% Impervious, Inflow Depth = 2.41" for 25-Year event
Inflow = 2.42 cfs @ 12.06 hrs, Volume= 0.150 af
Outflow = 2.23 cfs @ 12.10 hrs, Volume= 0.150 af, Atten= 8%, Lag= 2.7 min

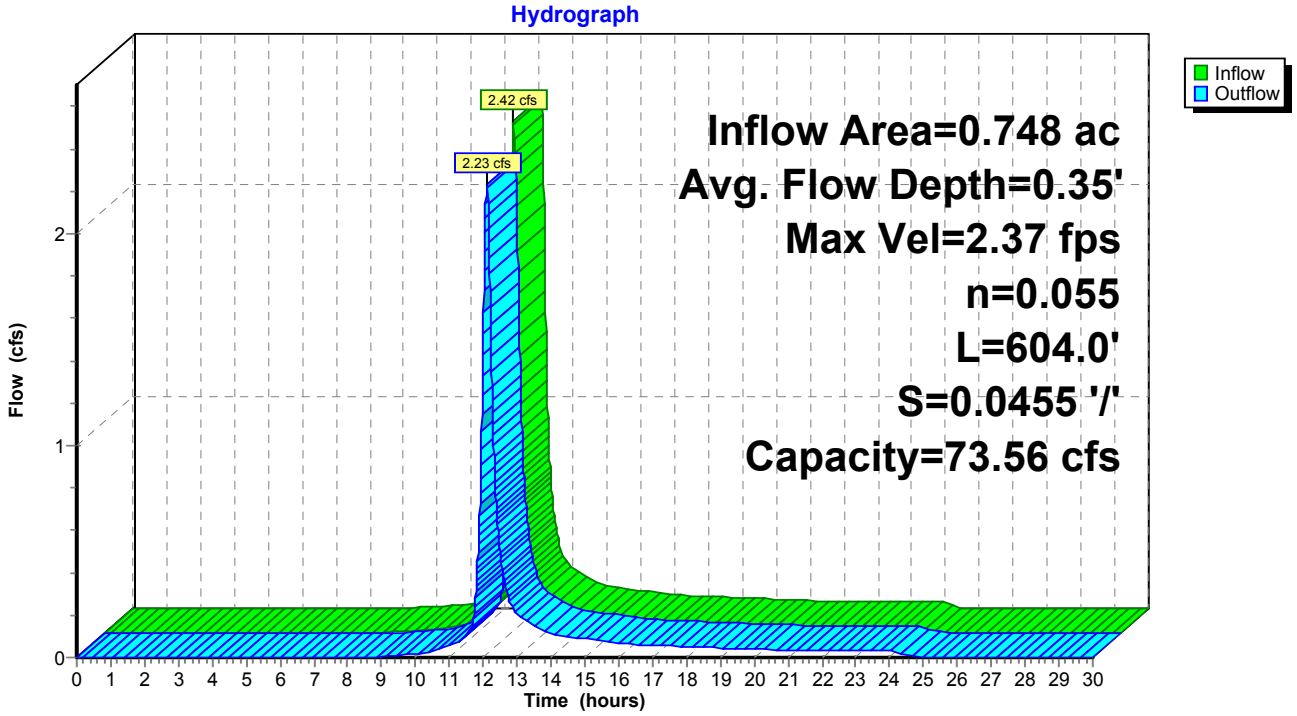
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.37 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.54 fps, Avg. Travel Time= 18.8 min

Peak Storage= 568 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 73.56 cfs

2.00' x 2.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 604.0' Slope= 0.0455 '/' (1000 Elevation Intervals)
Inlet Invert= 1,300.90', Outlet Invert= 1,273.40'



## Reach CH-6: North Outboard Channel East



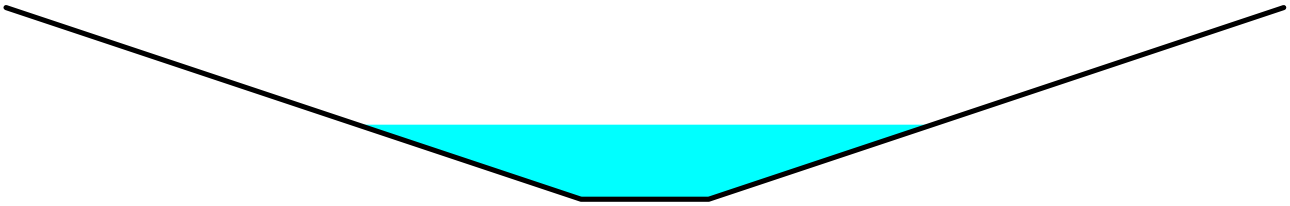
## Summary for Reach CH-7: North Inboard Channel

Inflow Area = 6.322 ac, 7.91% Impervious, Inflow Depth = 3.54" for 25-Year event
Inflow = 32.25 cfs @ 12.01 hrs, Volume= 1.867 af
Outflow = 30.53 cfs @ 12.04 hrs, Volume= 1.867 af, Atten= 5%, Lag= 1.8 min

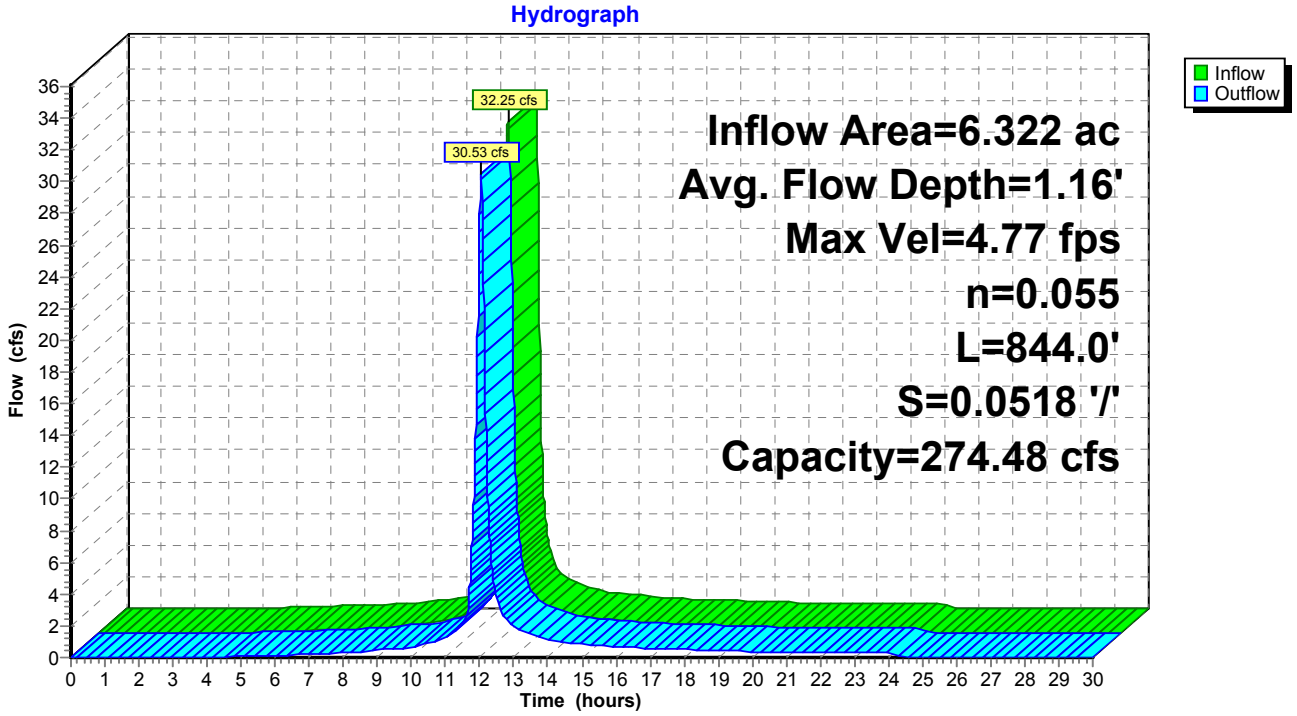
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.77 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 1.40 fps, Avg. Travel Time= 10.1 min

Peak Storage= 5,401 cf @ 12.04 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 274.48 cfs

2.00' x 3.00' deep channel, n= 0.055 Rock Riprap
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 844.0' Slope= 0.0518 '/'
Inlet Invert= 1,298.71', Outlet Invert= 1,255.00'



## Reach CH-7: North Inboard Channel



## Summary for Pond 1P: East Sediment Pond

Inflow Area = 32.569 ac, 6.84% Impervious, Inflow Depth = 3.24" for 25-Year event
Inflow = 119.15 cfs @ 12.04 hrs, Volume= 8.796 af
Outflow = 20.78 cfs @ 12.57 hrs, Volume= 4.347 af, Atten= 83%, Lag= 31.8 min
Primary = 20.78 cfs @ 12.57 hrs, Volume= 4.347 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 1,109.45' Surf.Area= 18,667 sf Storage= 102,458 cf
Peak Elev= 1,117.59' @ 12.57 hrs Surf.Area= 36,428 sf Storage= 323,191 cf (220,733 cf above start)
Flood Elev= 1,119.00' Surf.Area= 39,851 sf Storage= 377,013 cf (274,555 cf above start)

Plug-Flow detention time= 503.6 min calculated for 1.995 af (23% of inflow)
Center-of-Mass det. time= 153.7 min ( 963.7 - 810.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 1,100.00' | 418,076 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

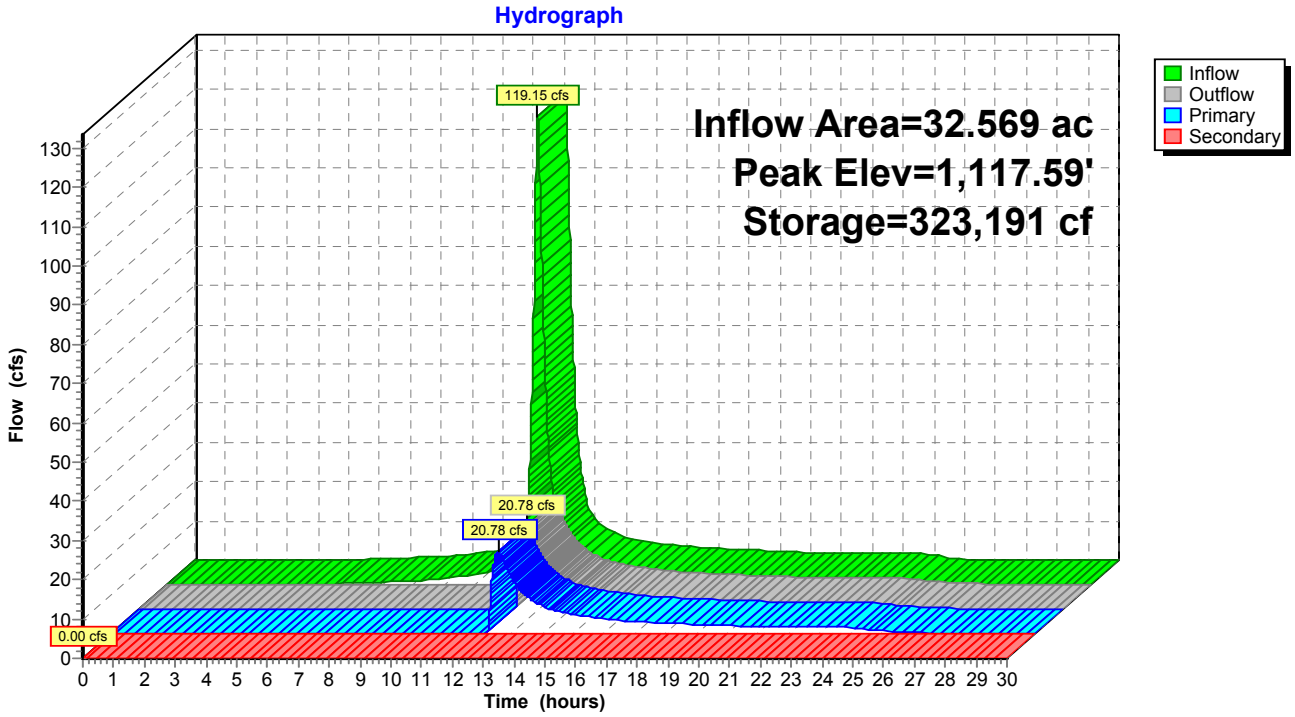
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 1,100.00 | 3,863 | 0 | 0 |
| 1,105.00 | 10,932 | 36,988 | 36,988 |
| 1,106.00 | 12,571 | 11,752 | 48,739 |
| 1,107.00 | 14,321 | 13,446 | 62,185 |
| 1,108.00 | 15,995 | 15,158 | 77,343 |
| 1,109.00 | 17,817 | 16,906 | 94,249 |
| 1,110.00 | 19,705 | 18,761 | 113,010 |
| 1,111.00 | 21,660 | 20,683 | 133,693 |
| 1,112.00 | 23,682 | 22,671 | 156,364 |
| 1,113.00 | 25,771 | 24,727 | 181,090 |
| 1,115.00 | 30,150 | 55,921 | 237,011 |
| 1,120.00 | 42,276 | 181,065 | 418,076 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,073.25' | **24.0" Round Culvert**<br>L= 224.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 1,073.25' / 1,056.45' S= 0.0750 '/' Cc= 0.900<br>n= 0.013, Flow Area= 3.14 sf |
| #2 | Device 1 | 1,116.82' | **36.0" Horiz. Orifice/Grate** C= 0.600 in 36.0" Grate (100% open area)<br>Limited to weir flow at low heads |
| #3 | Secondary | 1,119.00' | **20.0' long x 20.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63 |

**Primary OutFlow** Max=20.77 cfs @ 12.57 hrs HW=1,117.59' (Free Discharge)
└**1=Culvert** (Passes 20.77 cfs of 93.59 cfs potential flow)
└**2=Orifice/Grate** (Weir Controls 20.77 cfs @ 2.87 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,109.45' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond 1P: East Sediment Pond



## Summary for Pond 2P: NE Sediment Pond

[62] Hint: Exceeded Reach CH-3 OUTLET depth by 0.21' @ 12.17 hrs

Inflow Area = 14.211 ac, 1.90% Impervious, Inflow Depth = 3.19" for 25-Year event
Inflow = 57.54 cfs @ 12.05 hrs, Volume= 3.777 af
Outflow = 44.76 cfs @ 12.14 hrs, Volume= 3.772 af, Atten= 22%, Lag= 5.4 min
Primary = 44.76 cfs @ 12.14 hrs, Volume= 3.772 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 1,127.00' Surf.Area= 5,571 sf Storage= 16,509 cf
Peak Elev= 1,130.23' @ 12.14 hrs Surf.Area= 9,235 sf Storage= 40,265 cf (23,756 cf above start)

Plug-Flow detention time= 93.6 min calculated for 3.393 af (90% of inflow)
Center-of-Mass det. time= 18.7 min ( 823.7 - 805.0 )

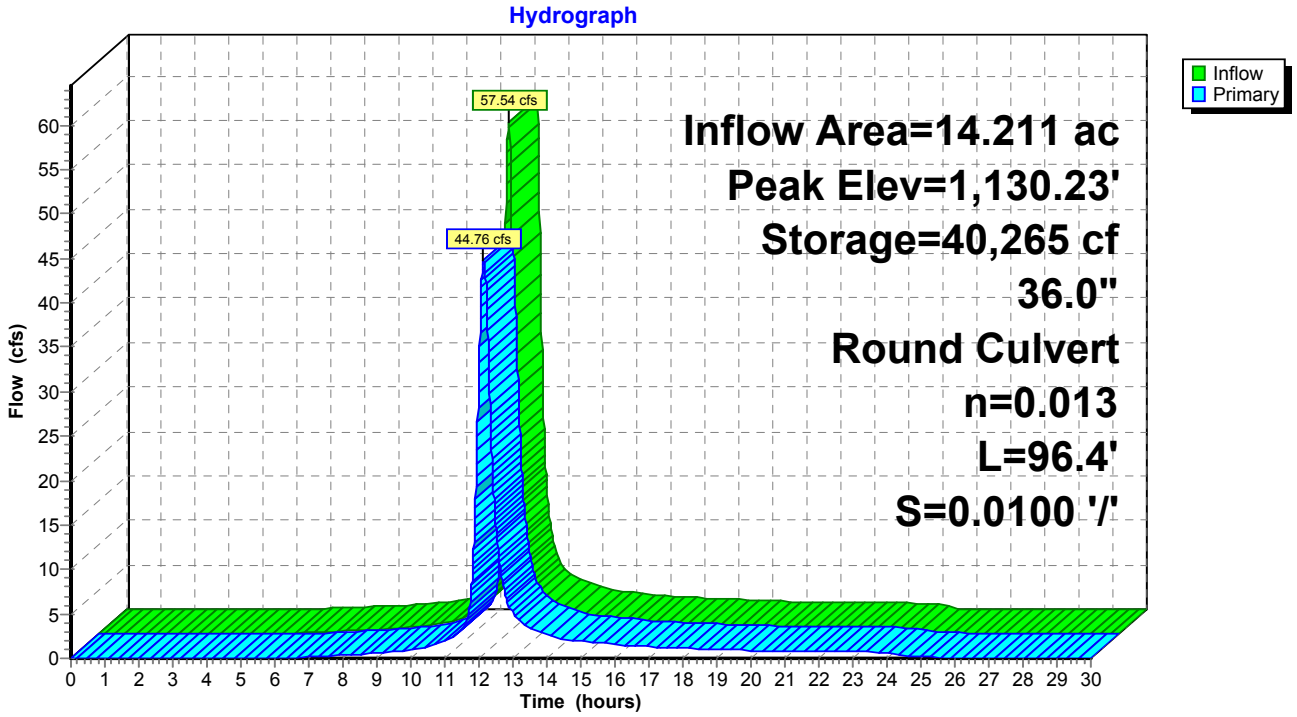
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 1,121.00' | 58,583 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 1,121.00 | 594 | 0 | 0 |
| 1,122.00 | 1,008 | 801 | 801 |
| 1,123.00 | 1,561 | 1,285 | 2,086 |
| 1,124.00 | 2,700 | 2,131 | 4,216 |
| 1,125.00 | 3,600 | 3,150 | 7,366 |
| 1,126.00 | 4,557 | 4,079 | 11,445 |
| 1,127.00 | 5,571 | 5,064 | 16,509 |
| 1,128.00 | 6,640 | 6,106 | 22,614 |
| 1,129.00 | 7,767 | 7,204 | 29,818 |
| 1,130.00 | 8,950 | 8,359 | 38,176 |
| 1,131.00 | 10,189 | 9,570 | 47,746 |
| 1,132.00 | 11,486 | 10,838 | 58,583 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,127.00' | **36.0" Round Culvert**<br>L= 96.4' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 1,127.00' / 1,126.04' S= 0.0100 '/' Cc= 0.900<br>n= 0.013, Flow Area= 7.07 sf |

**Primary OutFlow** Max=44.76 cfs @ 12.14 hrs HW=1,130.23' TW=1,126.79' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 44.76 cfs @ 6.33 fps)

## Pond 2P: NE Sediment Pond



## Summary for Pond P-1: P-1 Lower Culvert

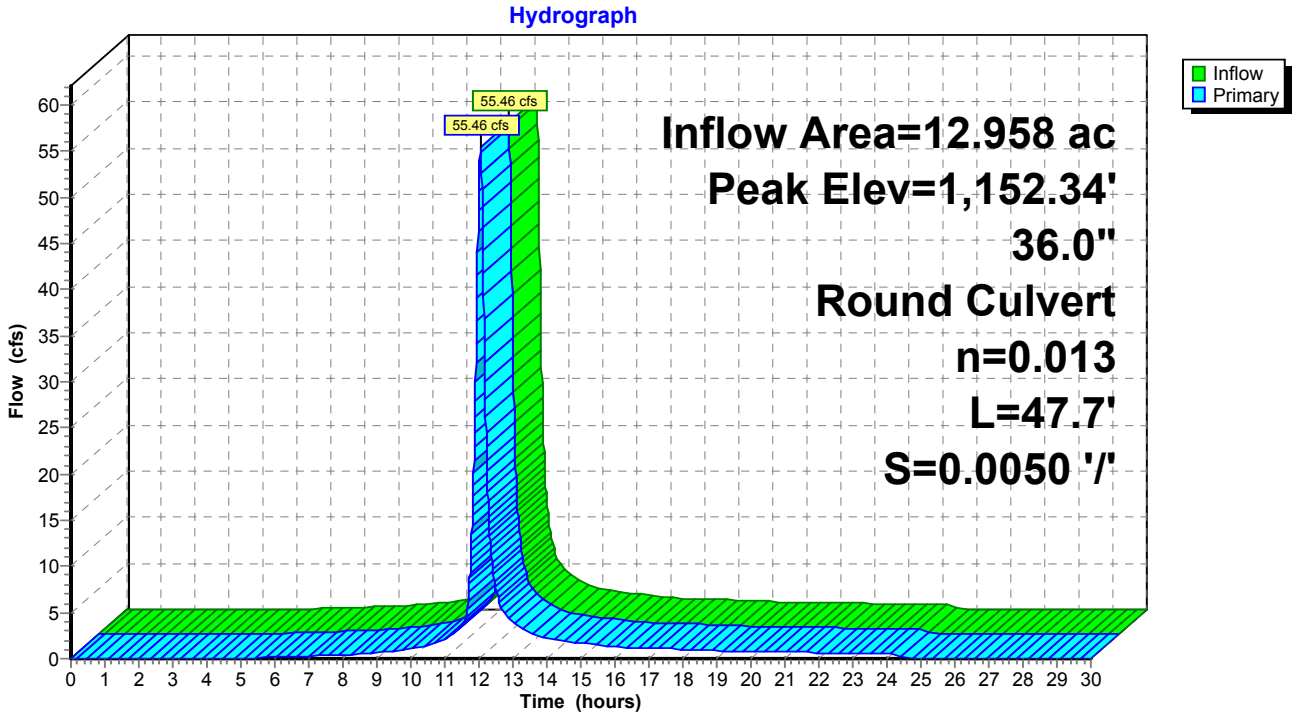
Inflow Area = 12.958 ac, 6.81% Impervious, Inflow Depth = 3.18" for 25-Year event
Inflow = 55.46 cfs @ 12.05 hrs, Volume= 3.430 af
Outflow = 55.46 cfs @ 12.05 hrs, Volume= 3.430 af, Atten= 0%, Lag= 0.0 min
Primary = 55.46 cfs @ 12.05 hrs, Volume= 3.430 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 1,152.34' @ 12.05 hrs
Flood Elev= 1,152.82'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,147.82' | **36.0" Round Culvert** L= 47.7' Ke= 0.500<br>Inlet / Outlet Invert= 1,147.82' / 1,147.58' S= 0.0050 '/' Cc= 0.900<br>n= 0.013, Flow Area= 7.07 sf |

**Primary OutFlow** Max=55.40 cfs @ 12.05 hrs HW=1,152.34' TW=1,148.96' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 55.40 cfs @ 7.84 fps)

## Pond P-1: P-1 Lower Culvert



## Summary for Pond P-2: P-2

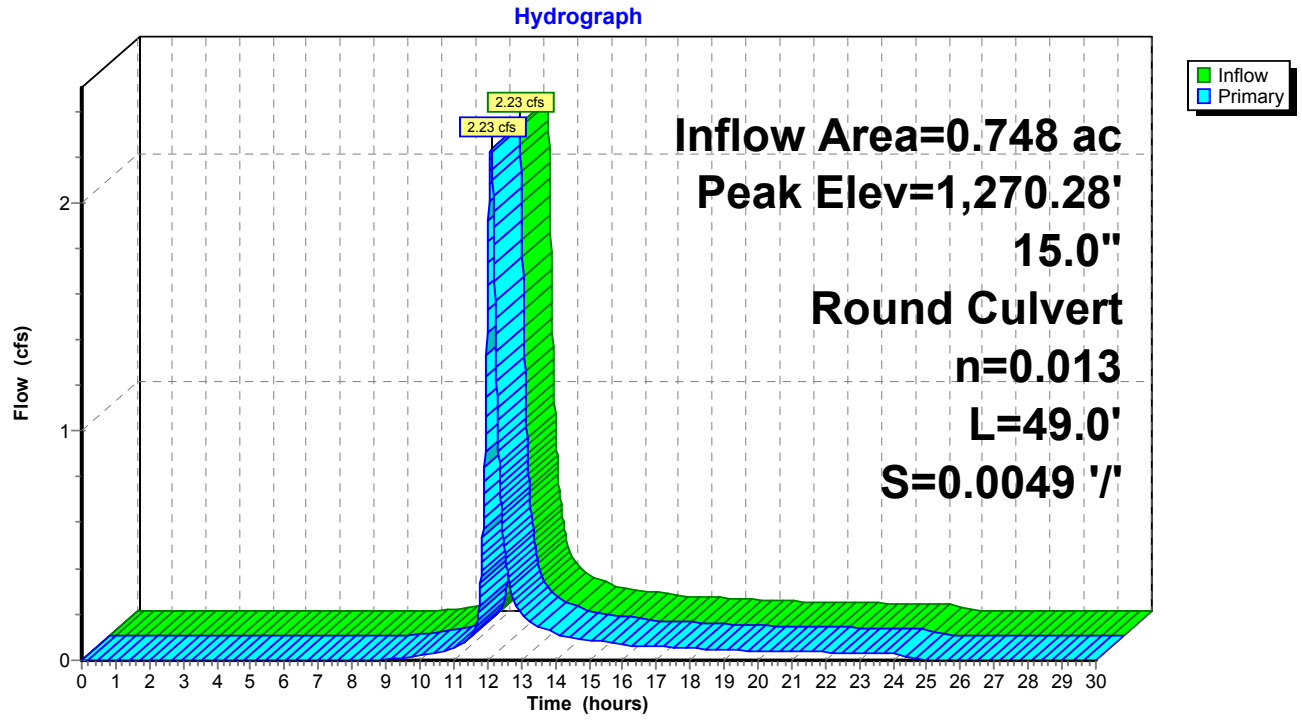
Inflow Area = 0.748 ac, 0.00% Impervious, Inflow Depth = 2.41" for 25-Year event
Inflow = 2.23 cfs @ 12.10 hrs, Volume= 0.150 af
Outflow = 2.23 cfs @ 12.10 hrs, Volume= 0.150 af, Atten= 0%, Lag= 0.0 min
Primary = 2.23 cfs @ 12.10 hrs, Volume= 0.150 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 1,270.28' @ 12.10 hrs
Flood Elev= 1,273.40'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,269.40' | **15.0" Round Culvert**<br>L= 49.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 1,269.40' / 1,269.16' S= 0.0049 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.23 sf |

**Primary OutFlow** Max=2.23 cfs @ 12.10 hrs HW=1,270.28' TW=1,269.42' (Dynamic Tailwater)
**1=Culvert** (Barrel Controls 2.23 cfs @ 3.38 fps)

## Pond P-2: P-2



## Summary for Pond P-3: P-3

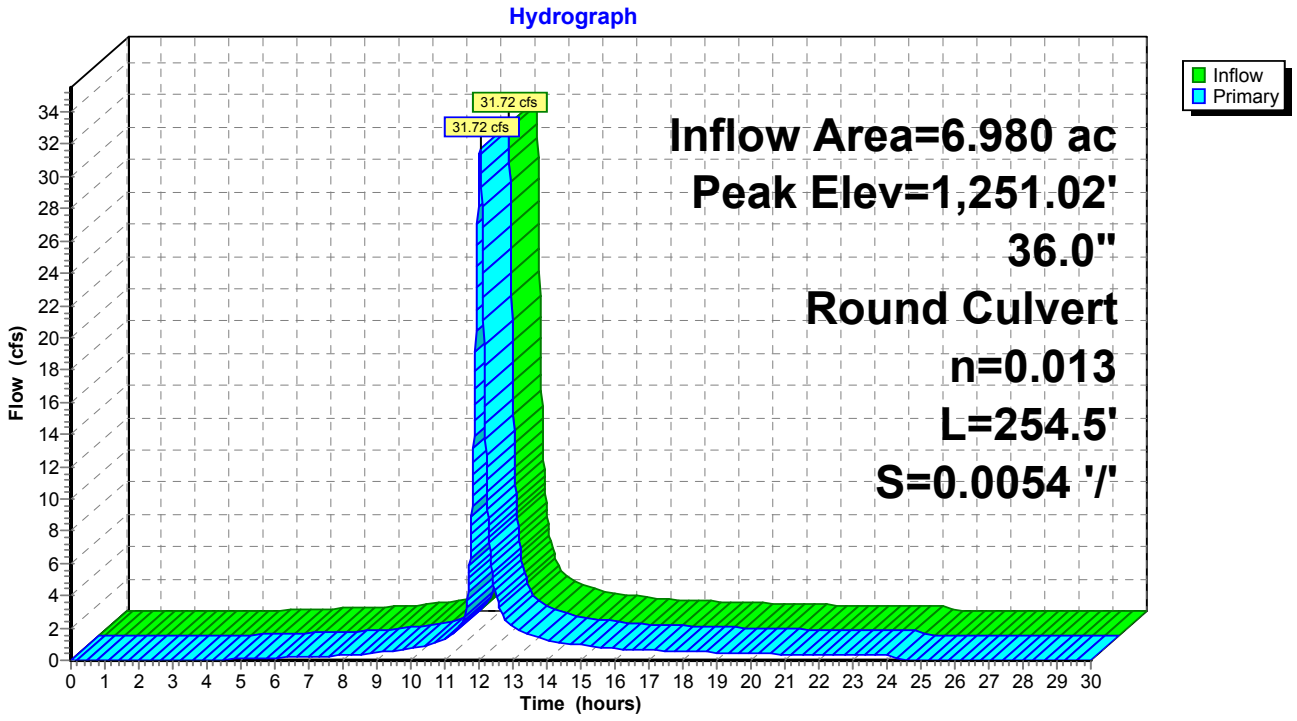
Inflow Area = 6.980 ac, 7.58% Impervious, Inflow Depth = 3.43" for 25-Year event
Inflow = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af
Outflow = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af, Atten= 0%, Lag= 0.0 min
Primary = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 1,251.02' @ 12.04 hrs
Flood Elev= 1,279.70'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,248.43' | **36.0" Round Culvert**<br>L= 254.5' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 1,248.43' / 1,247.06' S= 0.0054 '/' Cc= 0.900<br>n= 0.013, Flow Area= 7.07 sf |

**Primary OutFlow** Max=31.69 cfs @ 12.04 hrs HW=1,251.02' TW=1,248.46' (Dynamic Tailwater)
**1=Culvert** (Barrel Controls 31.69 cfs @ 6.55 fps)

## Pond P-3: P-3



## Summary for Pond P-4: P-4

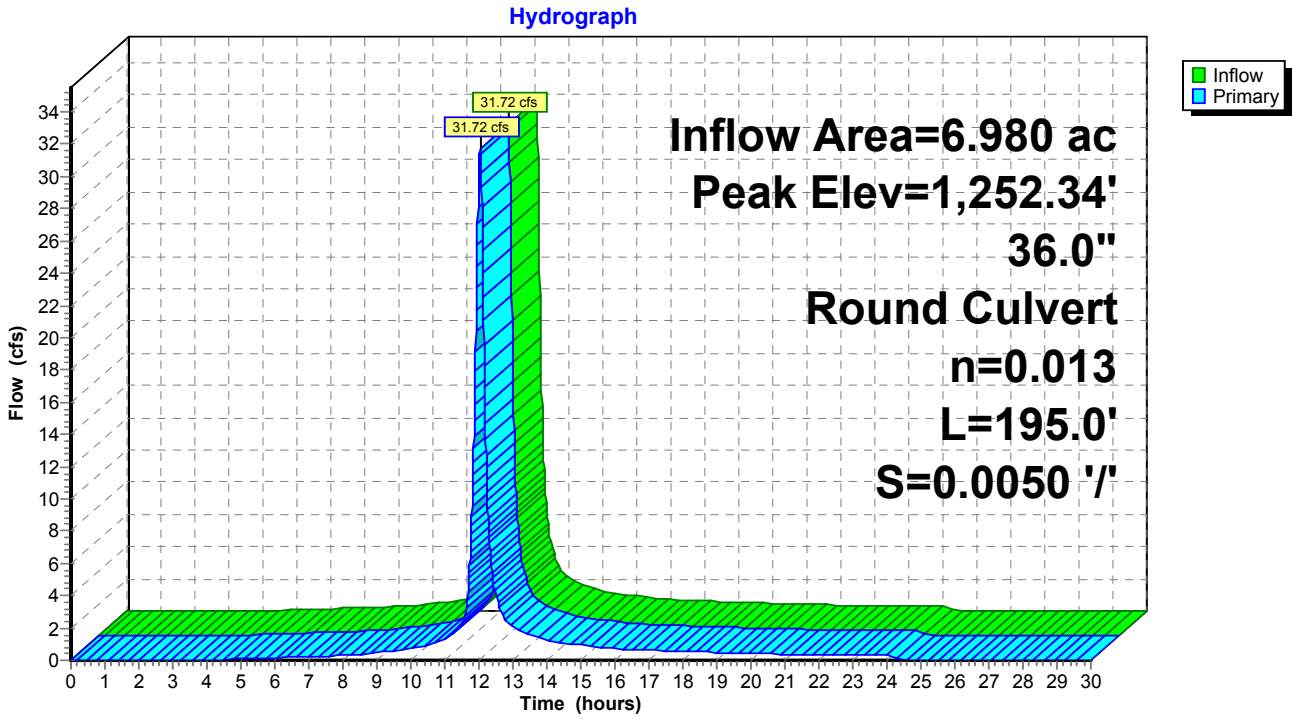
Inflow Area = 6.980 ac, 7.58% Impervious, Inflow Depth = 3.43" for 25-Year event
Inflow = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af
Outflow = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af, Atten= 0%, Lag= 0.0 min
Primary = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 1,252.34' @ 12.04 hrs
Flood Elev= 1,268.71'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,249.40' | **36.0" Round Culvert**<br>L= 195.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 1,249.40' / 1,248.43' S= 0.0050 '/' Cc= 0.900<br>n= 0.013, Flow Area= 7.07 sf |

**Primary OutFlow** Max=31.61 cfs @ 12.04 hrs HW=1,252.33' TW=1,251.02' (Dynamic Tailwater)
**1=Culvert** (Outlet Controls 31.61 cfs @ 5.69 fps)

## Pond P-4: P-4



## Summary for Pond P-5: P-5

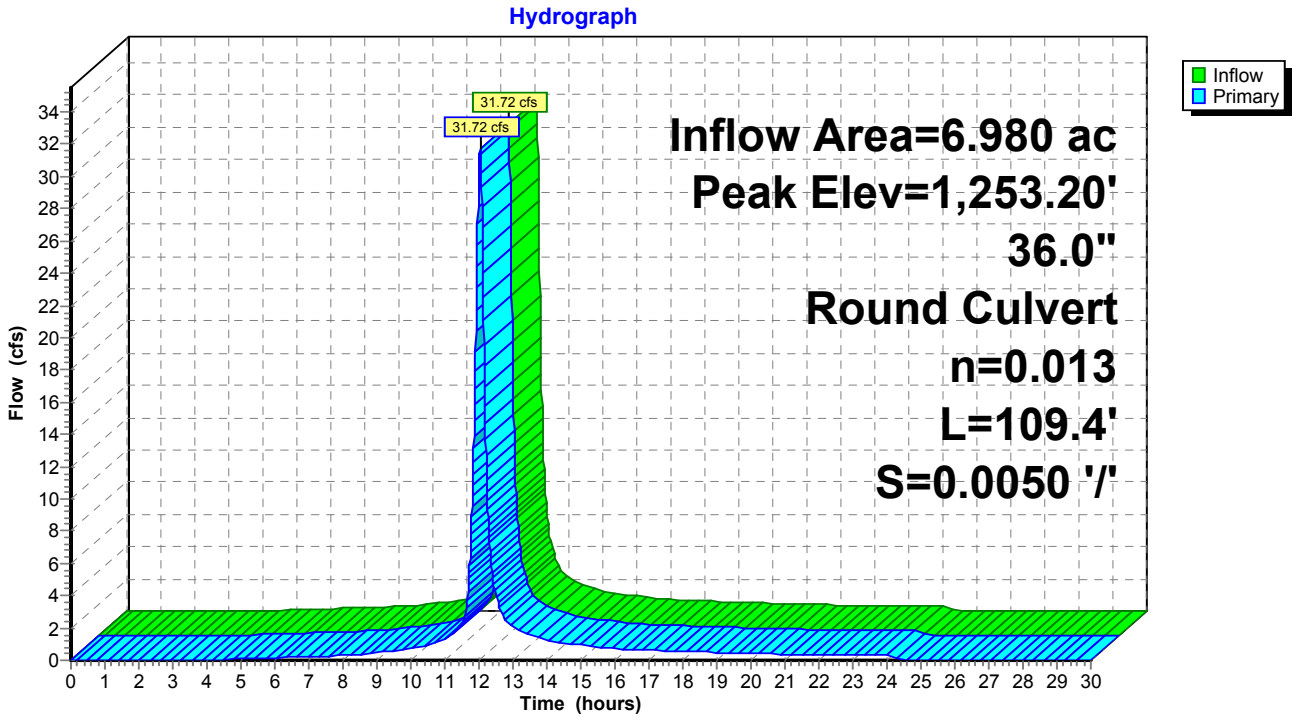
Inflow Area = 6.980 ac, 7.58% Impervious, Inflow Depth = 3.43" for 25-Year event
Inflow = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af
Outflow = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af, Atten= 0%, Lag= 0.0 min
Primary = 31.72 cfs @ 12.04 hrs, Volume= 1.994 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 1,253.20' @ 12.04 hrs
Flood Elev= 1,257.58'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,249.95' | **36.0" Round Culvert**<br>L= 109.4' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 1,249.95' / 1,249.40' S= 0.0050 '/' Cc= 0.900<br>n= 0.013, Flow Area= 7.07 sf |

**Primary OutFlow** Max=31.40 cfs @ 12.04 hrs HW=1,253.19' TW=1,252.33' (Dynamic Tailwater)
**1=Culvert** (Outlet Controls 31.40 cfs @ 5.12 fps)

## Pond P-5: P-5



## Summary for Pond P-6: P-6 Under Haul Road

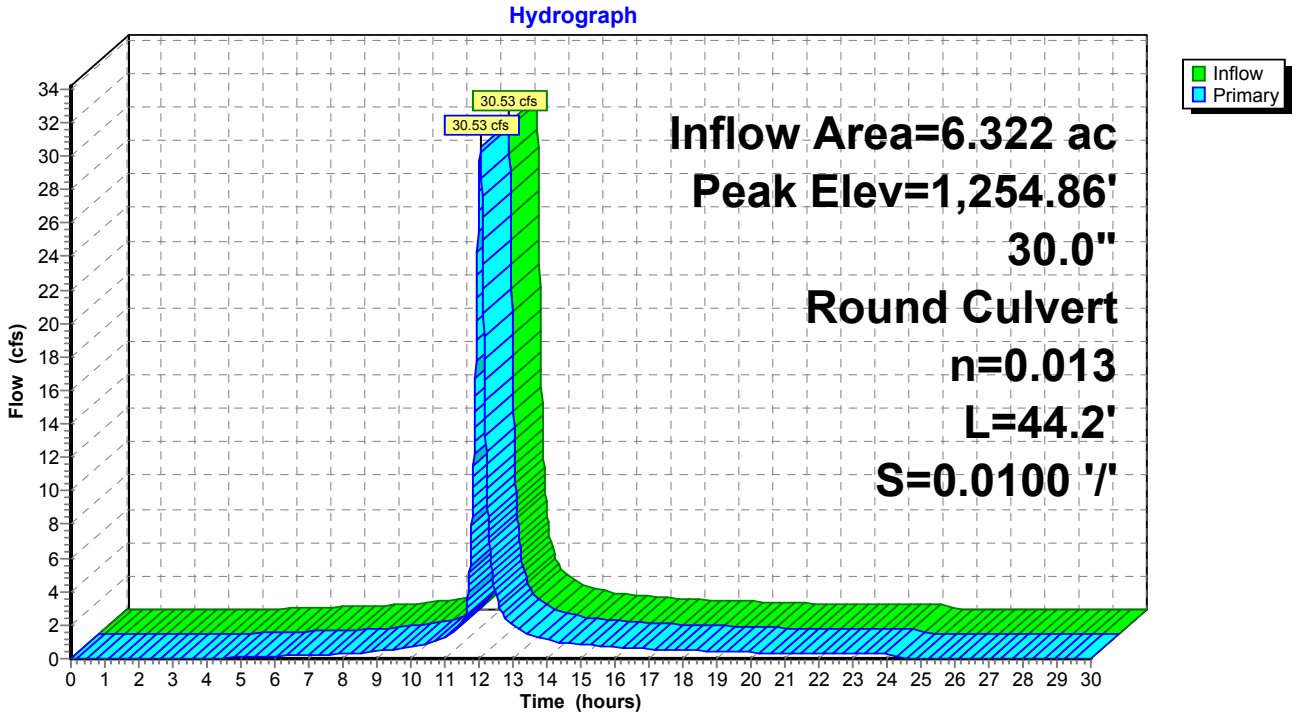
Inflow Area = 6.322 ac, 7.91% Impervious, Inflow Depth = 3.54" for 25-Year event
Inflow = 30.53 cfs @ 12.04 hrs, Volume= 1.867 af
Outflow = 30.53 cfs @ 12.04 hrs, Volume= 1.867 af, Atten= 0%, Lag= 0.0 min
Primary = 30.53 cfs @ 12.04 hrs, Volume= 1.867 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 1,254.86' @ 12.05 hrs
Flood Elev= 1,255.14'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,250.39' | **30.0" Round Culvert** L= 44.2' Ke= 0.500<br>Inlet / Outlet Invert= 1,250.39' / 1,249.95' S= 0.0100 '/' Cc= 0.900<br>n= 0.013, Flow Area= 4.91 sf |

**Primary OutFlow** Max=30.41 cfs @ 12.04 hrs HW=1,254.85' TW=1,253.20' (Dynamic Tailwater)
**1=Culvert** (Inlet Controls 30.41 cfs @ 6.20 fps)

## Pond P-6: P-6 Under Haul Road



## Summary for Pond P-7: P-7 Turnaround Culvert

[62] Hint: Exceeded Reach CH-09B OUTLET depth by 0.73' @ 12.07 hrs

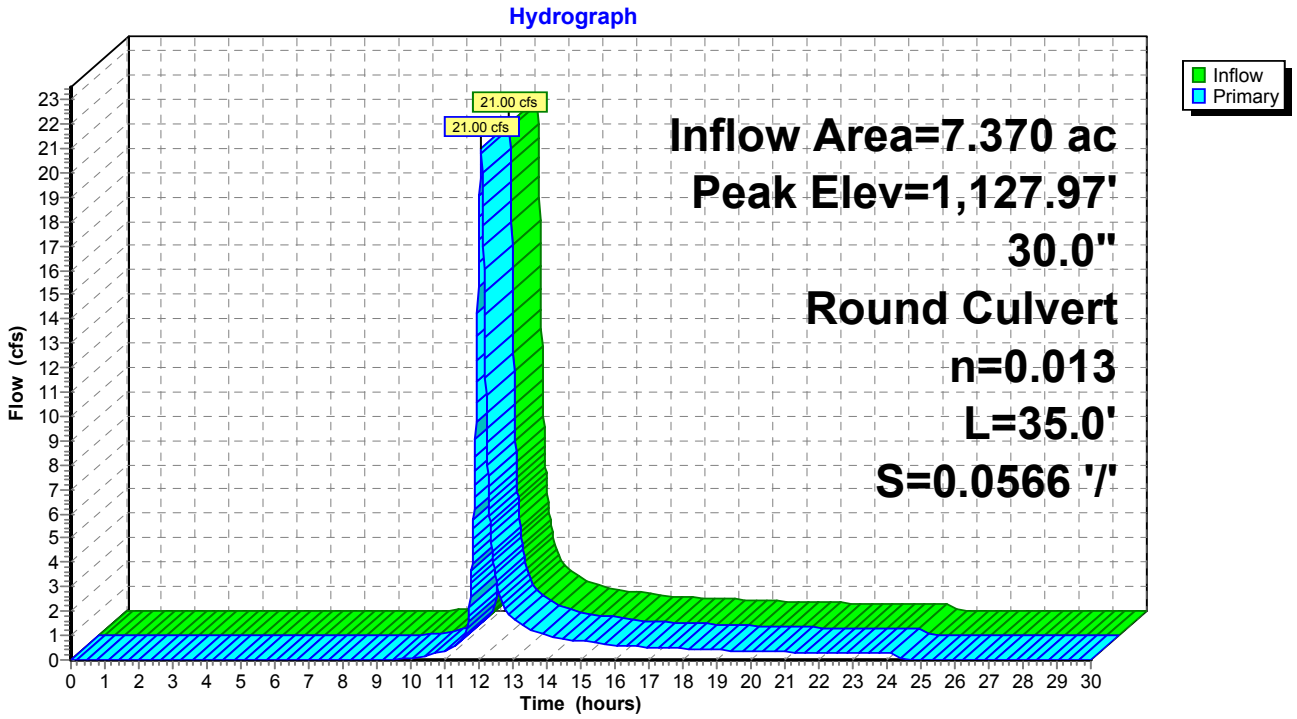
Inflow Area = 7.370 ac, 0.00% Impervious, Inflow Depth = 2.08" for 25-Year event
Inflow = 21.00 cfs @ 12.07 hrs, Volume= 1.279 af
Outflow = 21.00 cfs @ 12.07 hrs, Volume= 1.279 af, Atten= 0%, Lag= 0.0 min
Primary = 21.00 cfs @ 12.07 hrs, Volume= 1.279 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 1,127.97' @ 12.07 hrs
Flood Elev= 1,128.25'

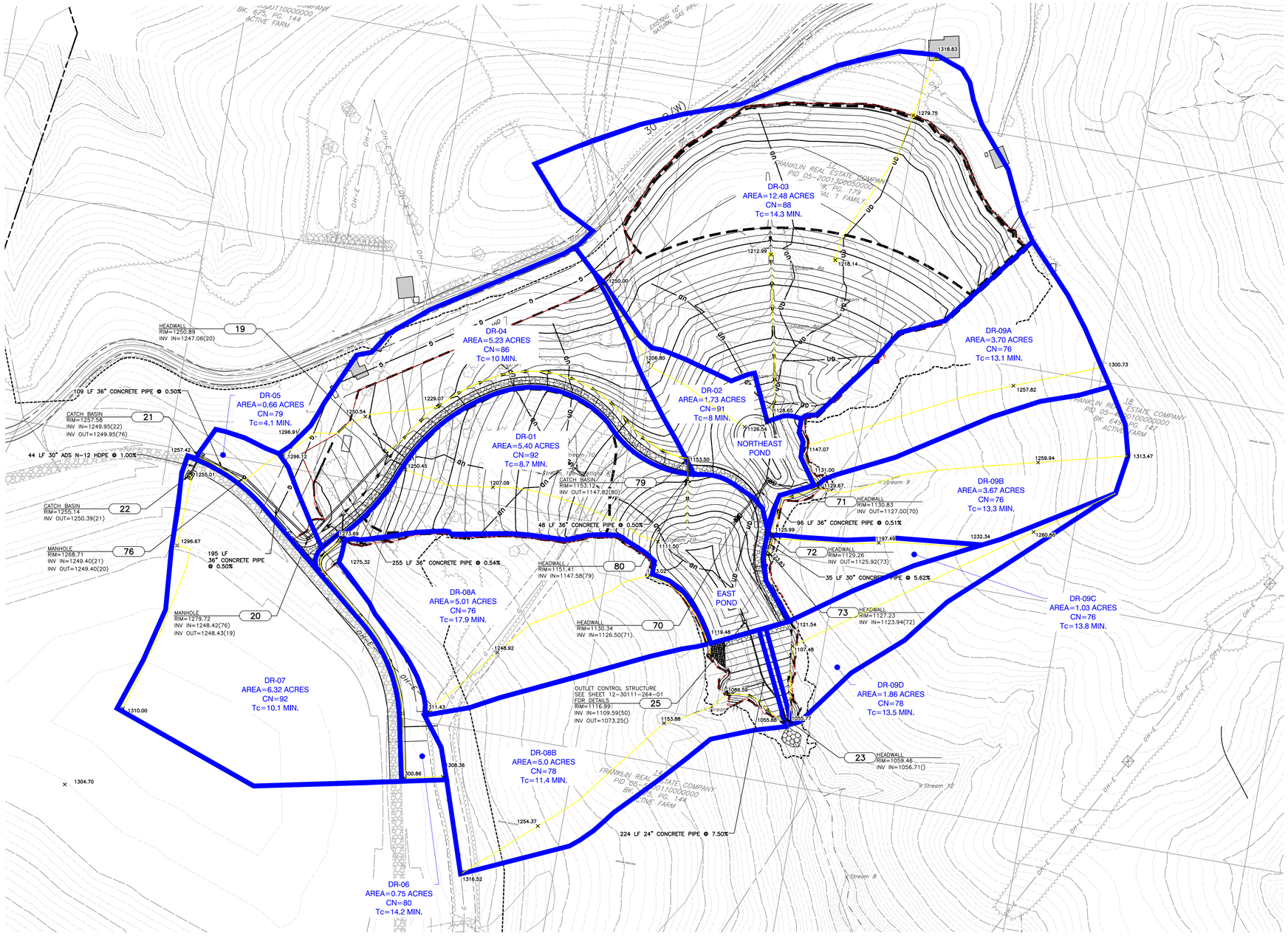
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 1,125.92' | **30.0" Round Culvert**<br>L= 35.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 1,125.92' / 1,123.94' S= 0.0566 '/' Cc= 0.900<br>n= 0.013, Flow Area= 4.91 sf |

**Primary OutFlow** Max=20.98 cfs @ 12.07 hrs HW=1,127.97' TW=1,125.26' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 20.98 cfs @ 4.87 fps)

### Pond P-7: P-7 Turnaround Culvert



DWG NO:


DR-03
AREA=12.48 ACRES
CN=88
Tc=14.3 MIN.
DR-04
AREA=5.23 ACRES
CN=86
Tc=10 MIN.
DR-05
AREA=0.66 ACRES
CN=79
Tc=4.1 MIN.
DR-01
AREA=5.40 ACRES
CN=92
Tc=8.7 MIN.
DR-02
AREA=1.73 ACRES
CN=91
Tc=8 MIN.
DR-09A
AREA=3.70 ACRES
CN=76
Tc=13.1 MIN.
DR-09B
AREA=3.67 ACRES
CN=76
Tc=13.3 MIN.
DR-09C
AREA=1.03 ACRES
CN=76
Tc=13.8 MIN.
DR-09D
AREA=1.86 ACRES
CN=78
Tc=13.5 MIN.
DR-08A
AREA=5.01 ACRES
CN=76
Tc=17.9 MIN.
DR-08B
AREA=5.0 ACRES
CN=78
Tc=11.4 MIN.
DR-07
AREA=6.32 ACRES
CN=92
Tc=10.1 MIN.
DR-06
AREA=0.75 ACRES
CN=80
Tc=14.2 MIN.
NORTHEAST POND
EAST POND
HEADWALL RIM=1250.89 INV IN=1247.06(20)
19
109 LF 36" CONCRETE PIPE @ 0.50%
CATCH BASIN RIM=1257.58 INV IN=1249.95(22) INV OUT=1249.95(76)
21
44 LF 30" ADS N-12 HDPE @ 1.00%
CATCH BASIN RIM=1255.14 INV OUT=1250.39(21)
22
MANHOLE RIM=1268.71 INV IN=1249.40(21) INV OUT=1249.40(20)
76
195 LF 36" CONCRETE PIPE @ 0.50%
MANHOLE RIM=1279.72 INV IN=1248.42(76) INV OUT=1248.43(19)
20
CATCH BASIN RIM=1153.12 INV OUT=1147.82(80)
79
48 LF 36" CONCRETE PIPE @ 0.50%
HEADWALL RIM=1151.41 INV IN=1147.58(79)
80
255 LF 36" CONCRETE PIPE @ 0.54%
HEADWALL RIM=1130.34 INV IN=1126.50(71)
70
OUTLET CONTROL STRUCTURE SEE SHEET 12-30111-264-01 FOR DETAILS RIM=1116.99 INV IN=1109.59(50) INV OUT=1073.25()
25
HEADWALL RIM=1130.83 INV OUT=1127.00(70)
71
96 LF 36" CONCRETE PIPE @ 0.51%
HEADWALL RIM=1129.26 INV OUT=1125.92(73)
72
35 LF 30" CONCRETE PIPE @ 5.62%
HEADWALL RIM=1127.23 INV IN=1123.94(72)
73
HEADWALL RIM=1059.46 INV IN=1056.71()
23
224 LF 24" CONCRETE PIPE @ 7.50%
FRANKLIN REAL ESTATE COMPANY PID 05-20013000550000 BK. 675, PG. 144 ACTIVE FARM
FRANKLIN REAL ESTATE COMPANY PID 05-20011000000000 BK. 641, PG. 142 ACTIVE FARM
EXISTING 16" NATURAL GAS PIPE
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# SURFACE WATER CONTROL CALCULATIONS

## Excess Soil Area

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|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | Sediment Pond Design Calculations | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 4.5.b.3.A. Design and Construction Requirements | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE | 1 | OF | 12 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JDM | DATE | 04/03/12 | |
| | REV 1 BY | EGK | DATE | 05/11/16 | CHECKED BY | MTF | DATE | 5/12/16 | |

## OBJECTIVE:

To design the proposed Sedimentation Ponds, and provide stormwater management and sedimentation control, by satisfying the following regulations for residual waste landfills:

**33CSR1 4.5.b.3.A.3.**

All sediment control structures must have a sediment capacity of 0.125 acre-feet for each acre of disturbed area in the structure's watershed. In addition to the sediment capacity, the sediment control structure must have the detention capacity to store a two (2)-year, twenty-four (24)-hour frequency storm. The water stored from this storm must be released through a nonclogging dewatering device that allows the stored volume of water to be evacuated within a seven (7)-day to eight (8)-day period. The elevation of the nonclogging dewatering device must not be lower than the maximum elevation of the designed sediment storage volume and also satisfy the storm water provisions of the Federal Clean Water Act as reflected in W. Va. Code § 22-11-1, et seq., and any rules promulgated thereunder.

**33CSR1 4.5.b.3.A.7.(b)**

Sediment control structures must provide a combination of principal and emergency spillways that will safely discharge a minimum twenty-five (25)-year, twenty-four (24)-hour storm without overtopping of the structure. There must be no outflow through the emergency spillway during the passage of a ten (10)-year, twenty-four (24)-hour frequency storm through the sediment control structure. All spillways must discharge an adequate distance beyond the downstream toe of the structure to a natural drainway to prevent erosion of the downstream toe.

The design is based upon accepted engineering design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2011 Version 8, Copyright 2007-2010.

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| SUBJECT | Sediment Pond Design Calculations | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 4.5.b.3.A. Design and Construction Requirements | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE | 2 | OF | 12 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JDM | DATE | 04/03/12 | |
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**METHOD:**

Stormwater routings have been performed with a storage-elevation routing methodology. The inflow hydrographs have been developed using the Hydraflow hydrograph method, which utilizes components of TR-20 and TR-55, using the times of concentration (Tc) and watershed parameters determined for each contributing watershed.

The rainfall values for this site are listed below. The United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Mitchell County, West Virginia., provided the estimated rainfall depths and is presented in "Sedimentation Pond – Phase 1 Calculations".

| RAINFALL DATA | | |
|---|---|---|
| **Frequency** | **Duration** | **Depth (in)** |
| 2 yr | 24 hr | 2.54 |
| 10 yr | 24 hr | 3.81 |
| 25 yr | 24 hr | 4.44 |
| 100 yr | 24 hr | 5.10 |

According to the TR-55 methods, times of concentration were estimated as the sum of sheet flow, shallow concentrated flow and channel flow. Flow calculations utilized a Curve Number (CN) representative of the post construction surface conditions. Maximum sheet flow length used was 200 feet. Shallow concentrated flow times of concentration were estimated depending on the condition of the flow path.

This site is located in an area of hydrologic soil groups B & C. Since over 95 percent of the site consists of type C soils, hydrologic soil group C was used throughout. Based on the existing and proposed site conditions the following runoff coefficients have been determined and will be utilized.

| CN DATA | |
|---|---|
| **Description** | **CN** |
| Existing (Woods Grass Combination, Fair) | 76 |
| Newly Graded Areas (Ditches) | 91 |
| Landfill (50-75% Grass Cover, Fair) | 91 |
| Impervious Areas (Paved Haul Road) | 98 |

The inflow hydrographs were developed using Hydraflow for each contributing watershed based on the previously mentioned criteria and the delineated drainage areas. These areas can be found in Figures A-H of Sedimentation Ponds. For Phase 1 through Phase 4 – Filled, 5-acres of drainage has been removed from the South Pond drainage areas and accounted for within the Leachate Calculations. The contributing drainage areas for the sedimentation ponds are summarized below:

| Drainage Area | CN | Watershed Area (Acre) | Tc (Minutes) |
|---|---|---|---|
| South - Phase 1 | 82 | 80.10 | 17.8 |
| West – Phase 1 | 89 | 18.37 | 22.1 |
| South - Phase 2 | 85 | 78.10 | 17.8 |
| West – Phase 2 | 90 | 22.48 | 22.1 |
| South - Phase 2 - Filled | 84 | 68.68 | 17.8 |
| West – Phase 2 - Filled | 90 | 31.90 | 22.1 |
| South - Phase 3 | 86 | 68.89 | 17.8 |
| West – Phase 3 | 90 | 31.90 | 22.1 |
| South - Phase 3 - Filled | 86 | 62.76 | 17.8 |
| West – Phase 3 - Filled | 90 | 30.32 | 22.1 |
| East – Phase 3 - Filled | 89 | 35.34 | 19.8 |
| South - Phase 4 | 89 | 62.76 | 17.8 |
| West – Phase 4 | 90 | 30.32 | 22.1 |
| East – Phase 4 | 89 | 35.34 | 19.8 |
| South - Phase 4 - Filled | 88 | 54.05 | 17.8 |
| West – Phase 4 - Filled | 90 | 38.82 | 22.1 |
| East – Phase 4 - Filled | 89 | 35.56 | 19.8 |
| South - Phase 5 | 88 | 60.35 | 17.8 |
| West – Phase 5 | 90 | 38.20 | 22.1 |
| East – Phase 5 | 89 | 35.09 | 19.8 |

Using the developed inflow hydrographs, all routings have been performed with the initial pool elevation within the ponds at the top of the required sediment storage volume. The required sedimentation storage volume and the 2-year runoff volume have been provided below the invert of the principal spillway. The inflow hydrograph from the 10-year/24-hour storm event was then used to size the principal spillway. The 25-year/24-hour storm event was then passed through the principal spillway in order to determine the elevation at which the emergency spillway was to be placed. The 100-year/24-hour storm event was then used to design the emergency spillway.

## ANALYSIS:

## SEDIMENT VOLUME SIZING:

According to 33CSR1 4.5.b.3.A., the sedimentation pond must have adequate sediment storage volume for the runoff from the 2-year/24-hour storm event and 0.125 acre-feet per acre of disturbed area.

**Volume Requirement for two-year/twenty-four-hour storm:**
Utilizing the hydrographs from HydroCAD, the runoff from the 2-year/24-hour storm event for each phase is shown in the table below.

**Volume Requirement for 0.125 acre-feet per disturbed acre:**

Per the mentioned regulation, the storage volume required for each drainage area is calculated as follows:

$$V = Disturbed\ Area\left(\frac{0.125\,acre-ft}{acre}\right)$$

The expected total disturbed drainage area and total storage volume requirements for each phase are shown in the table below. The total volume of the two-year/twenty-four-hour runoff plus the sediment storage volume was calculated for each phase as shown in the table below.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | Sediment Pond Design Calculations | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 4.5.b.3.A. Design and Construction Requirements | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE | 5 | OF | 12 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JDM | DATE | 04/03/12 | |
| | REV 1 BY | EGK | DATE | 05/11/16 | CHECKED BY | MTF | DATE | 5/12/16 | |

| South Drainage Areas | 2-Year Runoff (CF) | Disturbed Area (SF) | Sediment Volume (CF) | Total Volume (CF) |
|---|---|---|---|---|
| South - Phase 1 | 295,354 | 1,678,824 | 209,853 | 505,207 |
| South - Phase 2 | 339,253 | 1,565,052 | 195,631 | 534,884 |
| South - Phase 2 - Filled | 282,725 | 1,146,447 | 143,306 | 426,031 |
| South - Phase 3 | 315,519 | 1,643,200 | 205,400 | 520,919 |
| South - Phase 3 - Filled | 287,443 | 1,238,775 | 154,847 | 442,290 |
| **South - Phase 4** | **335,536** | **1,616,548** | **202,069** | **537,605** |
| South - Phase 4 - Filled | 274,619 | 1,082,465 | 135,308 | 409,927 |
| South - Phase 5 | 306,629 | 550,149 | 68,769 | 375,398 |

| West Drainage Areas | 2-Year Runoff (CF) | Disturbed Area (SF) | Sediment Volume (CF) | Total Volume (CF) |
|---|---|---|---|---|
| West – Phase 1 | 98,454 | 547,823 | 68,478 | 166,932 |
| West – Phase 2 | 126,706 | 135,399 | 16,925 | 143,631 |
| West – Phase 2 - Filled | 179,801 | 410,290 | 51,286 | 231,087 |
| West – Phase 3 | 179,801 | 410,290 | 51,286 | 231,087 |
| West – Phase 3 - Filled | 170,896 | 457,366 | 57,171 | 228,067 |
| West – Phase 4 | 170,896 | 311,957 | 38,995 | 209,891 |
| **West – Phase 4 - Filled** | **218,805** | **516,636** | **64,580** | **283,385** |
| West – Phase 5 | 215,311 | 325,552 | 40,694 | 256,005 |

| East Drainage Areas* | 2-Year Runoff (CF) | Disturbed Area (SF) | Sediment Volume (CF) | Total Volume (CF) |
|---|---|---|---|---|
| **East – Phase 3 - Filled** | **32,532** | **220,026** | **27,503** | **60,035** |
| East – Phase 4 | 32,532 | 47,485 | 5,936 | 38,468 |
| East – Phase 4 - Filled | 33,655 | 180,948 | 22,619 | 56,273 |
| East – Phase 5 | 30,156 | 151,619 | 18,952 | 49,108 |

* For comparison purposes, calculations are only for areas inside of the outboard perimeter channel of the Haul Road. The remaining portion of East Drainage areas is the same for all Phases.

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|---|---|---|---|---|---|---|---|---|---|
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The South Pond was designed to accommodate the Phase 4 volume throughout all calculations. The West Pond was designed to accommodate the Phase 4 – Filled volume throughout all calculations. The East Pond was designed to accommodate the Phase 3 – Filled volume throughout all calculations. Based on the above calculations and the actual available sediment storage of the sedimentation pond, it can be assumed that cleaning of each Sedimentation Pond will be required prior to each phase.

Each pond has been designed to release the 2-year/24-hour storm event through a floating skimmer over a 7-day period. The calculations are based on the Faircloth Skimmer Online Sizing Calculator. Below is the summary for each of the skimmers.

| Drainage Areas | 2-Year Runoff (CF) | Days to Drain | Skimmer Size (in) | Orifice Diameter (in) | Flow Rate (cfs) |
|---|---|---|---|---|---|
| South Pond | 335,536 | 7 | 6.0 | 5.8 | 0.5548 |
| West Pond | 218,805 | 7 | 5.0 | 4.9 | 0.3618 |
| East Pond | 194,687 | 7 | 5.0 | 4.6 | 0.2840 |

The chart below shows the provided volumes and elevations for the design Ponds:

| Design Drainage Area | Required Volume (CF) | Required Volume Provided at Elevation | Principal Spillway Elevation | 25-YR Routed Storage Elevation | Emergency Spillway Elevation | Top Of Berm Elevation |
|---|---|---|---|---|---|---|
| South - Phase 4 | 537,605 | 1038.88 | 1038.88 | 1039.65 | 1039.88 | 1041.08 |
| West – Phase 4 - Filled | 283,385 | 1201.67 | 1201.67 | 1202.54 | 1202.67 | 1204.00 |
| East – Phase 3 - Filled | 310,698* | 1117.03 | 1117.03 | 1117.98 | 1119.00 | 1120.00 |

*16,434 CF sediment volume is provided in the Northeast Pond.

## PRINCIPAL SPILLWAY DESIGN:

According to 33CSR1 4.5.b.3.A.7.(b) Sediment control structures must provide a combination of principal and emergency spillways that will safely discharge a minimum twenty-five (25)-year, twenty-four (24)-hour storm without overtopping of the structure. There must be no outflow

through the emergency spillway during the passage of a ten (10)-year, twenty-four (24)-hour frequency storm through the sediment control structure. To fulfill this regulation, the principal spillway was placed at the elevation of the 2-year/24-hour storm elevation, which provides the required sediment storage volume. The 25-year/24-hour storm event was then routed through the designed principal spillway in order to determine the 25-year/24-hour elevation. Therefore, if the principal spillway is capable of releasing the flow from the 25-year/24-hour storm event, it is capable of safely handling the flow from the 10-year/24-hour storm event.

The details of the principal spillway for each Sedimentation Pond are found within the Hydraflow printout and are summarized as follows:

| South Pond | Culvert | Principal Spillway Riser |
|---|---|---|
| Structure Type | 48” Pipe | 13’ x 13’ Box |
| Invert Elevation | 980.00 | 1038.88 |
| Pipe/Crest Length (feet) | 250.88 | 52.00 |
| Slope (%) | 11.67 | n/a |
| N-Value | 0.013 | n/a |
| Orifice/Weir Coefficient | 0.6 | 3.33 |

| West Pond | Culvert | Principal Spillway Riser |
|---|---|---|
| Structure Type | 36” Pipe | 60” Dia. Pipe |
| Invert Elevation | 1190.00 | 1201.67 |
| Pipe/Crest Length (feet) | 119.10 | 15.71 |
| Slope (%) | 4.2 | n/a |
| N-Value | 0.013 | n/a |
| Orifice/Weir Coefficient | 0.6 | 3.33 |

| East Pond | Culvert | Principal Spillway Riser |
|---|---|---|
| Structure Type | 24” Pipe | 36” Dia. Pipe |
| Invert Elevation | 1073.25 | 1117.03 |
| Pipe/Crest Length (feet) | 224 | 9.42 |
| Slope (%) | 7.5 | n/a |
| N-Value | 0.013 | n/a |
| Orifice/Weir Coefficient | 0.6 | 3.33 |

According to 33CSR1 4.5.b.3.A.7.(b), the routing, included with this calculation, shows that the maximum pool elevation is below the invert elevation of the emergency spillway. Thus, during the 25-year/24-hour storm event, the emergency spillway provides flood storage with no flow entering the emergency spillway while allowing flow through the principal spillway.

## EMERGENCY SPILLWAY DESIGN:

According to 33CSR1 4.5.b.3.A.7.(b), the emergency spillway has been designed such that the combination of the principal spillway and emergency spillway will safely discharge the 25-year/24-hour storm event. This design requirement has been evaluated by routing flow from the 25-year/24-hour storm through the pond using the previously designed principal spillway.

All spillways must discharge an adequate distance beyond the downstream toe of the structure to a natural drainway to prevent erosion of the downstream toe. The inverts of the emergency spillways have been set above the elevation of the 25-year/24-hour storm event.

The details of the emergency spillway for each Sedimentation Pond are found within the Hydraflow printout and are summarized as follows:

| | | | | | | | | | |
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| South Pond (Phase 2) | Emergency Spillway |
|---|---|
| Spillway Type | 8’ Pipe |
| Crest Elevation | 1039.88 |
| Crest Length (feet) | 25.13 |
| Weir Coefficient | 3.33 |
| Channel Lining | n/a |
| Maximum pool elevation 25-year 24-hour storm | 1039.65 |
| Top of Embankment | 1041.08 |
| Freeboard above the 25-year elevation | 1.43 |

| West Pond (Phase 4 – Filled) | Emergency Spillway |
|---|---|
| Spillway Type | Cipoletti |
| Crest Elevation | 1202.67 |
| Crest Length (feet) | 50.00 |
| Weir Coefficient | 3.33 |
| Channel Lining | Rock |
| Maximum pool elevation 25-year 24-hour storm | 1202.54 |
| Top of Embankment | 1204.00 |
| Freeboard above the 25-year elevation | 1.46 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | Sediment Pond Design Calculations | | | | | PROJECT NO. | 110-416 | | |
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| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JDM | DATE | 04/03/12 | |
| | REV 1 BY | EGK | DATE | 05/11/16 | CHECKED BY | MTF | DATE | 5/12/16 | |

| East Pond (Phase 3 – Filled) | Value |
|---|---|
| Spillway Type | Cipoletti |
| Crest Elevation | 1119.00 |
| Crest Length (feet) | 20.00 |
| Weir Coefficient | 3.33 |
| Channel Lining | Rock |
| Maximum pool elevation 25-year 24-hour storm | 1117.98 |
| Top of Embankment | 1120.00 |
| Freeboard above the 25-year elevation | 2.02 |

## OUTLET CHANNEL:

The proposed principal spillway and emergency spillway will outlet to the existing drainage channels downstream of the proposed Sedimentation Ponds. (Please see "Permanent Surface Water Control Structures Perimeter Channel Design Calculations" for additional information regarding the channel design)

## CONCLUSIONS:

The proposed Sedimentation Ponds have been designed to meet the regulations as outlined in 33CSR1 4.5.b.3.A.7. All three ponds utilize primary spillways to convey the 10-year/24-hour storm event within each watershed. The routing of the 25-year/24-hour storm event produces water level elevations below the invert of the proposed emergency spillway. The flow from the 100-yr/24-hr storm was routed through the proposed principal spillway and the emergency spillway. All sedimentation ponds provide over one foot of freeboard for a 100-year/24-hour storm event in relation to the top of the embankment.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | Sediment Pond Design Calculations | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 4.5.b.3.A. Design and Construction Requirements | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE | 11 | OF | 12 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JDM | DATE | 04/03/12 | |
| | REV 1 BY | EGK | DATE | 05/11/16 | CHECKED BY | MTF | DATE | 5/12/16 | |

## REFERENCES:


1. United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Mitchell County, West Virginia.

2. Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014, Version 10.3, 2007-2014, Computer Software Program.

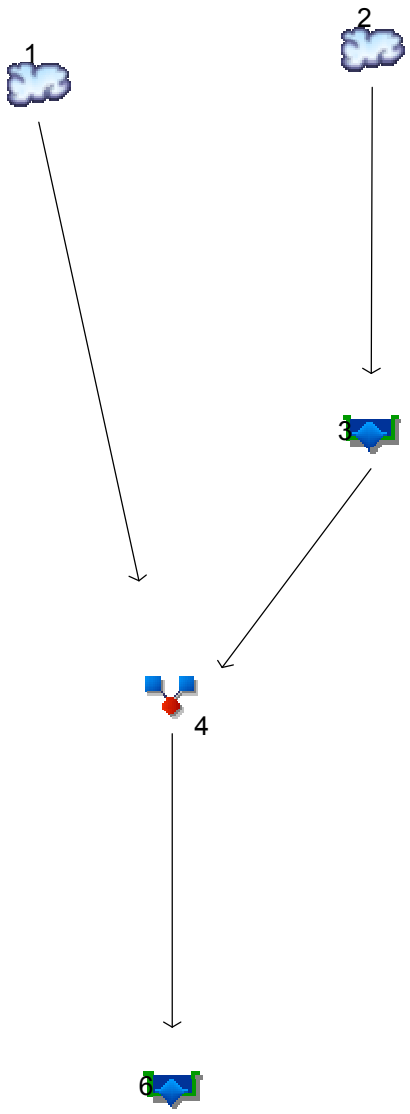
3. Faircloth Skimmer Online Sizing Calculator. <http://www.fairclothskimmer.com/skimmer.html>

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | Sediment Pond Design Calculations | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 4.5.b.3.A. Design and Construction Requirements | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE | 12 | OF | 12 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JDM | DATE | 04/03/12 | |
| | REV 1 BY | EGK | DATE | 05/11/16 | CHECKED BY | MTF | DATE | 5/12/16 | |

## SEDIMENTATION POND – HYDRAFLOW OUTPUT AND HYDROGRAPH FILES

# Watershed Model Schematic






## Legend

| Hyd. | Origin | Description |
|---|---|---|
| 1 | SCS Runoff | East Pond Only |
| 2 | SCS Runoff | NE Pond Only |
| 3 | Reservoir | NE Pond |
| 4 | Combine | East Pond Inflow |
| 6 | Reservoir | East Pond Total |

# Hydrograph Return Period Recap



| Hyd. No. | Hydrograph type (origin) | Inflow hyd(s) | Peak Outflow (cfs) | | | | | | | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | |
| 1 | SCS Runoff | ------ | ------- | 42.46 | ------- | ------- | 72.86 | 87.97 | ------- | 103.75 | East Pond Only |
| 2 | SCS Runoff | ------ | ------- | 27.16 | ------- | ------- | 48.28 | 58.87 | ------- | 69.97 | NE Pond Only |
| 3 | Reservoir | 2 | ------- | 19.86 | ------- | ------- | 34.01 | 43.08 | ------- | 50.74 | NE Pond |
| 4 | Combine | 1, 3 | ------- | 60.46 | ------- | ------- | 101.04 | 126.49 | ------- | 150.10 | East Pond Inflow |
| 6 | Reservoir | 4 | ------- | 0.275 | ------- | ------- | 10.14 | 29.29 | ------- | 39.37 | East Pond Total |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 42.46 | 1 | 723 | 121,615 | ------ | ------ | ------ | East Pond Only |
| 2 | SCS Runoff | 27.16 | 1 | 722 | 73,080 | ------ | ------ | ------ | NE Pond Only |
| 3 | Reservoir | 19.86 | 1 | 728 | 73,072 | 2 | 1129.04 | 13,613 | NE Pond |
| 4 | Combine | 60.46 | 1 | 724 | 194,687 | 1, 3 | ------ | ------ | East Pond Inflow |
| 6 | Reservoir | 0.275 | 1 | 1462 | 34,700 | 4 | 1116.54 | 181,775 | East Pond Total |

# Hydrograph Report

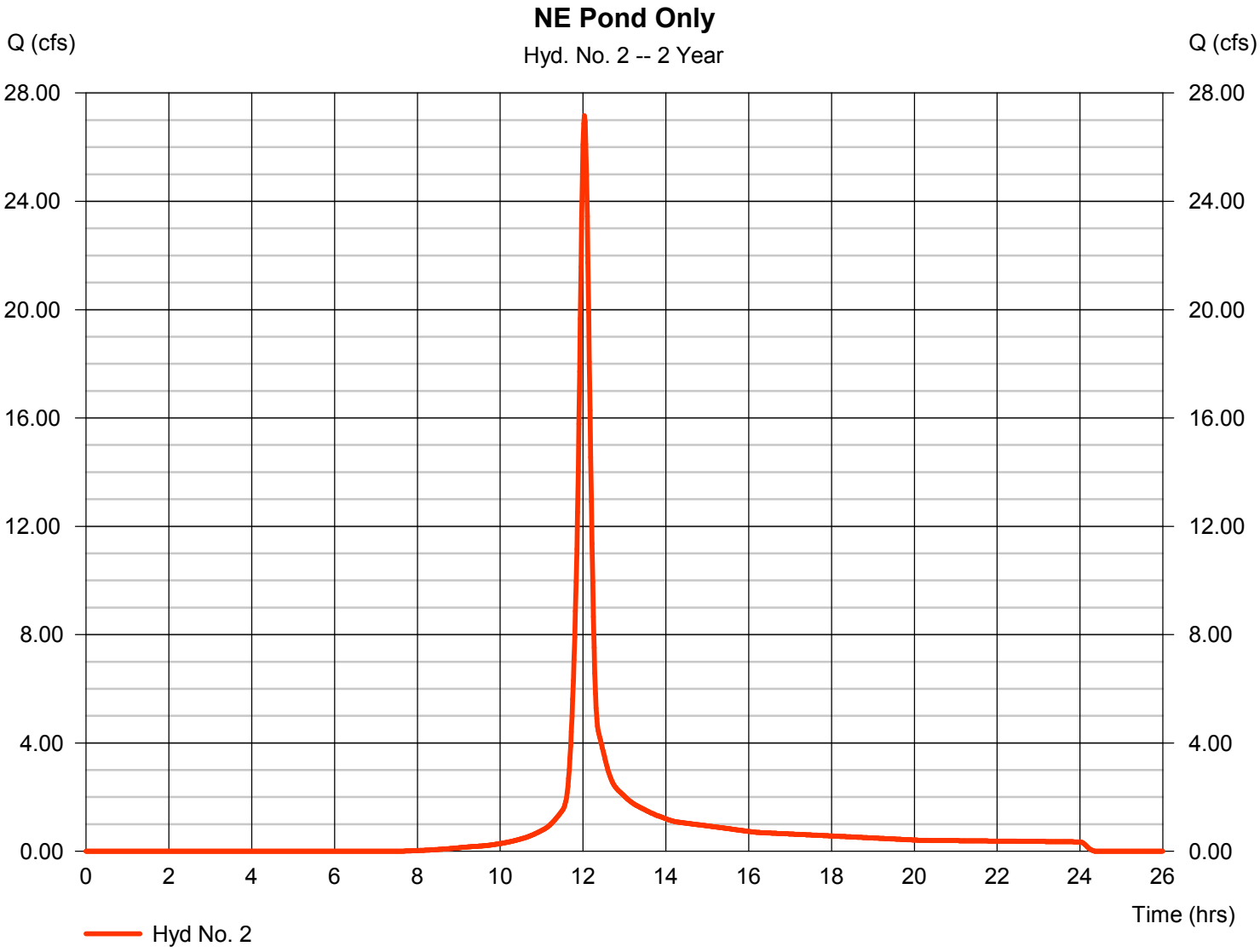


## Hyd. No. 2

NE Pond Only

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 27.16 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 12.03 hrs |
| Time interval | = 1 min | Hyd. volume | = 73,080 cuft |
| Drainage area | = 14.220 ac | Curve number | = 88* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 13.60 min |
| Total precip. | = 2.54 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(11.140 x 91) + (2.810 x 76) + (0.270 x 98)] / 14.220



# TR55 Tc Worksheet



## Hyd. No. 2

NE Pond Only

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.400 | | 0.150 | | 0.011 | | |
| Flow length (ft) | = 138.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.54 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 28.40 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.79** | **+** | **0.00** | **+** | **0.00** | **=** | **10.79** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 365.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 16.80 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Unpaved | | Paved | | |
| Average velocity (ft/s) | =6.61 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.92** | **+** | **0.00** | **+** | **0.00** | **=** | **0.92** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 4.20 | | 4.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 42.50 | | 12.50 | | 0.00 | | |
| Channel slope (%) | = 2.90 | | 23.50 | | 0.00 | | |
| Manning's n-value | = 0.022 | | 0.050 | | 0.015 | | |
| Velocity (ft/s) | =2.45 | | 6.73 | | 0.00 | | |
| Flow length (ft) | ({0})143.0 | | 375.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.97** | **+** | **0.93** | **+** | **0.00** | **=** | **1.90** |

**Total Travel Time, Tc ..... 13.60 min**

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 72.86 | 1 | 723 | 212,643 | ------ | ------ | ------ | East Pond Only |
| 2 | SCS Runoff | 48.28 | 1 | 722 | 131,785 | ------ | ------ | ------ | NE Pond Only |
| 3 | Reservoir | 34.01 | 1 | 728 | 131,777 | 2 | 1130.31 | 24,576 | NE Pond |
| 4 | Combine | 101.04 | 1 | 725 | 344,420 | 1, 3 | ------ | ------ | East Pond Inflow |
| 6 | Reservoir | 10.14 | 1 | 776 | 168,290 | 4 | 1117.49 | 214,373 | East Pond Total |

# Hydrograph Report

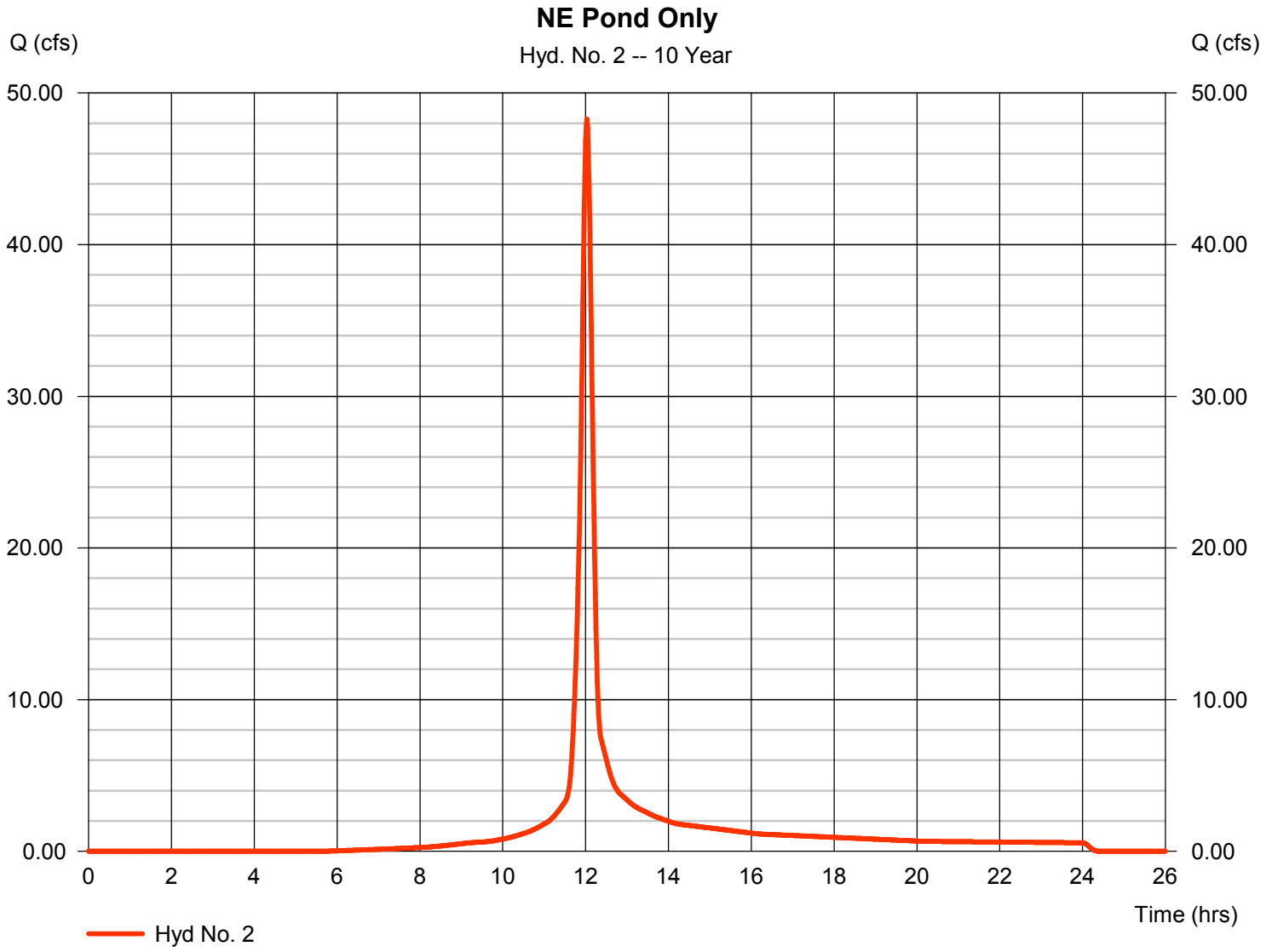


## Hyd. No. 2

NE Pond Only

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 48.28 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 12.03 hrs |
| Time interval | = 1 min | Hyd. volume | = 131,785 cuft |
| Drainage area | = 14.220 ac | Curve number | = 88* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 13.60 min |
| Total precip. | = 3.81 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(11.140 x 91) + (2.810 x 76) + (0.270 x 98)] / 14.220



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 87.97 | 1 | 723 | 259,135 | ------ | ------ | ------ | East Pond Only |
| 2 | SCS Runoff | 58.87 | 1 | 722 | 162,074 | ------ | ------ | ------ | NE Pond Only |
| 3 | Reservoir | 43.08 | 1 | 728 | 162,066 | 2 | 1130.79 | 29,131 | NE Pond |
| 4 | Combine | 126.49 | 1 | 724 | 421,201 | 1, 3 | ------ | ------ | East Pond Inflow |
| 6 | Reservoir | 29.29 | 1 | 749 | 244,963 | 4 | 1117.98 | 231,607 | East Pond Total |

# Hydrograph Report

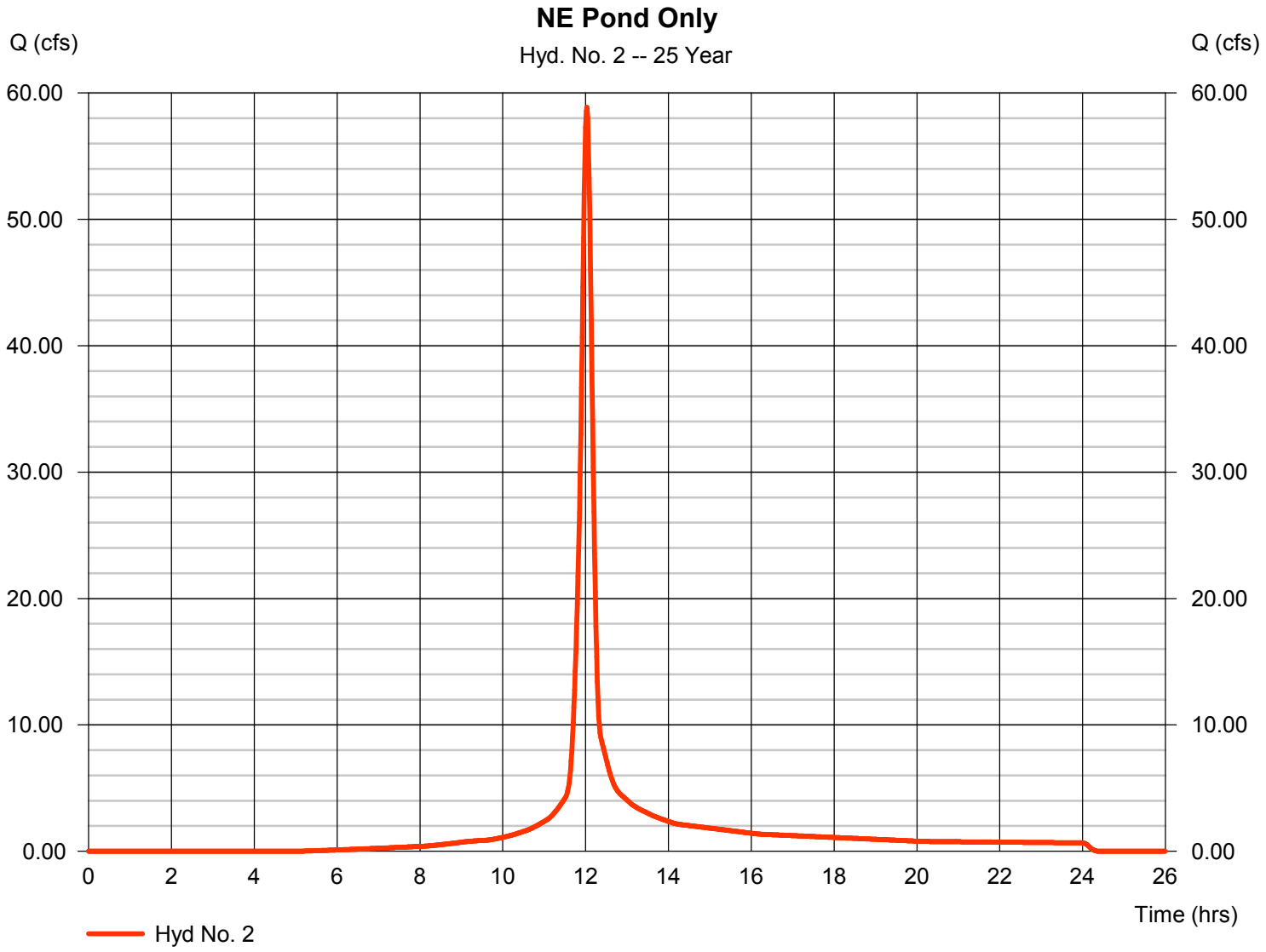


## Hyd. No. 2

NE Pond Only

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 58.87 cfs |
| Storm frequency | = 25 yrs | Time to peak | = 12.03 hrs |
| Time interval | = 1 min | Hyd. volume | = 162,074 cuft |
| Drainage area | = 14.220 ac | Curve number | = 88* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 13.60 min |
| Total precip. | = 4.44 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(11.140 x 91) + (2.810 x 76) + (0.270 x 98)] / 14.220



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 103.75 | 1 | 723 | 308,385 | ------ | ------ | ------ | East Pond Only |
| 2 | SCS Runoff | 69.97 | 1 | 722 | 194,292 | ------ | ------ | ------ | NE Pond Only |
| 3 | Reservoir | 50.74 | 1 | 728 | 194,284 | 2 | 1131.28 | 34,201 | NE Pond |
| 4 | Combine | 150.10 | 1 | 724 | 502,669 | 1, 3 | ------ | ------ | East Pond Inflow |
| 6 | Reservoir | 39.37 | 1 | 746 | 326,346 | 4 | 1118.75 | 260,601 | East Pond Total |

# Hydrograph Report

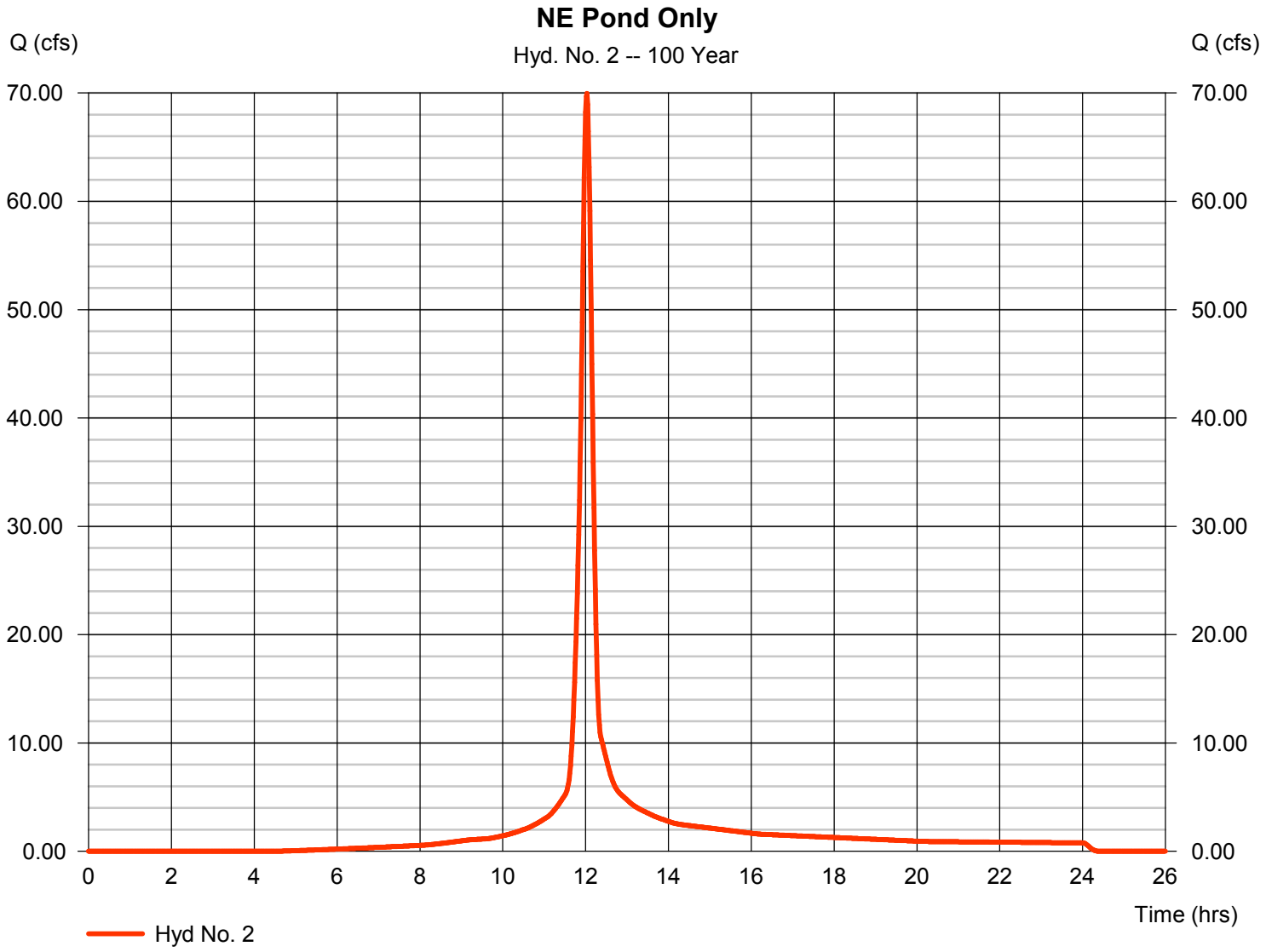


## Hyd. No. 2

NE Pond Only

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 69.97 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 12.03 hrs |
| Time interval | = 1 min | Hyd. volume | = 194,292 cuft |
| Drainage area | = 14.220 ac | Curve number | = 88* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 13.60 min |
| Total precip. | = 5.10 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(11.140 x 91) + (2.810 x 76) + (0.270 x 98)] / 14.220



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 2 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 10 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 25 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 50 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 100 | 0.0000 | 0.0000 | 0.0000 | -------- |

File name: SampleFHA.idf

### Intensity = B / (Tc + D)^E

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\2011\110-416\-Calculations\Marchall_Co_WV.pcp

| Storm Distribution | Rainfall Precipitation Table (in) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| SCS 24-hour | 2.25 | 2.54 | 0.00 | 3.25 | 3.81 | 4.44 | 0.00 | 5.10 |
| SCS 6-Hr | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-1st | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-2nd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-3rd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-4th | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-Indy | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Custom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## SEDIMENT POND CALCULATIONS

**(Taken from the Solid Waste/NPDES Permit Application for the Mitchell Landfill)**

**Note that the current sediment pond calculations associated with the South Pond in a separate calculation brief presented immediately after this calculation brief.**

# SEDIMENT POND CALCULATIONS

## South Pond

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SUBJECT | South Pond Design Calculations | | | | | PROJECT NO. | 110-416 | | |
| APPLICABLE RULE | 33CSR1 4.5.b.3.A. Design and Construction Requirements | | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE | 1 | OF | 8 |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | | |
| | MADE BY | MTF | DATE | 04/03/12 | CHECKED BY | JRI | REV. DATE | 01/29/13 | |

## OBJECTIVE:

To design the proposed Sedimentation Ponds, and provide stormwater management and sedimentation control, by satisfying the following regulations for residual waste landfills:

**33CSR1 4.5.b.3.A.3.**

All sediment control structures must have a sediment capacity of 0.125 acre-feet for each acre of disturbed area in the structure's watershed. In addition to the sediment capacity, the sediment control structure must have the detention capacity to store a two (2)-year, twenty-four (24)-hour frequency storm. The water stored from this storm must be released through a nonclogging dewatering device that allows the stored volume of water to be evacuated within a seven (7)-day to eight (8)-day period. The elevation of the nonclogging dewatering device must not be lower than the maximum elevation of the designed sediment storage volume and also satisfy the storm water provisions of the Federal Clean Water Act as reflected in W. Va. Code § 22-11-1, et seq., and any rules promulgated thereunder.

**33CSR1 4.5.b.3.A.7.(b)**

Sediment control structures must provide a combination of principal and emergency spillways that will safely discharge a minimum twenty-five (25)-year, twenty-four (24)-hour storm without overtopping of the structure. There must be no outflow through the emergency spillway during the passage of a ten (10)-year, twenty-four (24)-hour frequency storm through the sediment control structure. All spillways must discharge an adequate distance beyond the downstream toe of the structure to a natural drainway to prevent erosion of the downstream toe.

The design is based upon accepted engineering design equations, methodologies and assumptions. Where applicable, design references have been made. Calculations have been performed using the software package, Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2011 Version 8, Copyright 2007-2010.

## METHOD:

Stormwater routings have been performed with a storage-elevation routing methodology. The inflow hydrographs have been developed using the Hydraflow hydrograph method, which

utilizes components of TR-20 and TR-55, using the times of concentration (Tc) and watershed parameters determined for each contributing watershed.

The rainfall values for this site are listed below. The United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Marshall County, West Virginia., provided the estimated rainfall depths and is presented in "Sedimentation Pond – Phase 1 Calculations".

| RAINFALL DATA | | |
|---|---|---|
| **Frequency** | **Duration** | **Depth (in)** |
| 2 yr | 24 hr | 2.54 |
| 10 yr | 24 hr | 3.81 |
| 25 yr | 24 hr | 4.44 |
| 100 yr | 24 hr | 5.10 |

According to the TR-55 methods, times of concentration were estimated as the sum of sheet flow, shallow concentrated flow and channel flow. Flow calculations utilized a Curve Number (CN) representative of the post construction surface conditions. Maximum sheet flow length used was 200 feet. Shallow concentrated flow times of concentration were estimated depending on the condition of the flow path.

This site is located in an area of hydrologic soil groups B & C. Since over 95 percent of the site consists of type C soils, hydrologic soil group C was used throughout. Based on the existing and proposed site conditions the following runoff coefficients have been determined and will be utilized.

| CN DATA | |
|---|---|
| **Description** | **CN** |
| Existing (Woods Grass Combination, Fair) | 76 |
| Newly Graded Areas (Ditches) | 91 |
| Landfill (50-75% Grass Cover, Fair) | 91 |
| Impervious Areas (Paved Haul Road) | 98 |

The inflow hydrographs were developed using Hydraflow for each contributing watershed based on the previously mentioned criteria and the delineated drainage areas. These areas can be

found in Figure A of South Pond. The contributing drainage areas for the sedimentation ponds are summarized below:

| Drainage Area | CN | Watershed Area (Acre) | Tc (Minutes) |
|---|---|---|---|
| South Pond | 82 | 86.52 | 17.8 |

Using the developed inflow hydrographs, all routings have been performed with the initial pool elevation within the ponds at the top of the required sediment storage volume. The required sedimentation storage volume and the 2-year runoff volume have been provided below the invert of the principal spillway. The inflow hydrograph from the 10-year/24-hour storm event was then used to size the principal spillway. The 25-year/24-hour storm event was then passed through the principal spillway in order to determine the elevation at which the emergency spillway was to be placed. The 100-year/24-hour storm event was then used to design the emergency spillway.

## ANALYSIS:

## SEDIMENT VOLUME SIZING:

According to 33CSR1 4.5.b.3.A., the sedimentation pond must have adequate sediment storage volume for the runoff from the 2-year/24-hour storm event and 0.125 acre-feet per acre of disturbed area.

**Volume Requirement for two-year/twenty-four-hour storm:**
Utilizing the hydrographs from HydroCAD, the runoff from the 2-year/24-hour storm event for each phase is shown in the table below.

**Volume Requirement for 0.125 acre-feet per disturbed acre:**

Per the mentioned regulation, the storage volume required for each drainage area is calculated as follows:

$$V = Disturbed\ Area\left(\frac{0.125\,acre-ft}{acre}\right)$$

The expected total disturbed drainage area and total storage volume requirements for each phase are shown in the table below. The total volume of the two-year/twenty-four-hour runoff plus the sediment storage volume was calculated for each phase as shown in the table below.

| South Drainage Areas | 2-Year Runoff (CF) | Disturbed Area (SF) | Sediment Volume (CF) | Total Volume (CF) |
|---|---|---|---|---|
| South Pond | 319,027 | 1,657,896 | 207,237 | 526,264 |

The South Pond was designed to accommodate the Phase 1 volume throughout all calculations. The designed capacity of the pond, including provision for sediment accumulation, anticipates that accumulated sediment will be removed from the ponds periodically during the life of the landfill. The volume in each pond allocated to sediment is identified in the tables above. In accordance with 33CSR1 Section 4.5.b.3.A.6, sediment will be removed when 60% of the maximum allowable sediment accumulation is reached. The following table identifies the pond stage (elevation), that when reached by accumulated sediment, will indicate that 60% of the designed sediment accumulation volume has been consumed and a sediment removal event is necessary. Staff gauges can be established in the ponds to identify when the sediment level reaches the removal stage.

| Required Sediment Removal Stage | |
|---|---|
| Sediment Pond | Elevation (feet amsl) |
| South Pond | 1027.64 |

Each pond has been designed to release the 2-year/24-hour storm event through a floating skimmer over a 7-day period. The calculations are based on the Faircloth Skimmer Online Sizing Calculator. Below is the summary for each of the skimmers.

| Drainage Areas | 2-Year Runoff (CF) | Days to Drain | Skimmer Size (in) | Orifice Diameter (in) | Flow Rate (cfs) |
|---|---|---|---|---|---|
| South Pond | 319,027 | 7 | 6.0 | 5.7 | 0.5275 |

The chart below shows the provided volumes and elevations for the design Ponds:

| Design Drainage Area | Required Volume (CF) | Required Volume Provided at Elevation | Principal Spillway Elevation | 25-YR Routed Storage Elevation | Emergency Spillway Elevation | Top Of Berm Elevation |
|---|---|---|---|---|---|---|
| South Pond | 526,264 | 1038.92 | 1038.92 | 1039.60 | 1040.08 | 1041.08 |

## PRINCIPAL SPILLWAY DESIGN:

According to 33CSR1 4.5.b.3.A.7.(b) Sediment control structures must provide a combination of principal and emergency spillways that will safely discharge a minimum twenty-five (25)-year, twenty-four (24)-hour storm without overtopping of the structure. There must be no outflow through the emergency spillway during the passage of a ten (10)-year, twenty-four (24)-hour frequency storm through the sediment control structure. To fulfill this regulation, the principal spillway was placed at the elevation of the 2-year/24-hour storm elevation, which provides the required sediment storage volume. The 25-year/24-hour storm event was then routed through the designed principal spillway in order to determine the 25-year/24-hour elevation. Therefore, if the principal spillway is capable of releasing the flow from the 25-year/24-hour storm event, it is capable of safely handling the flow from the 10-year/24-hour storm event.

The details of the principal spillway for each Sedimentation Pond are found within the Hydraflow printout and are summarized as follows:

| South Pond | Culvert | Principal Spillway Riser |
|---|---|---|
| Structure Type | 42” Pipe | Weir |
| Invert Elevation | 968.28 | 1038.92 |
| Pipe/Crest Length (feet) | 204.547 | 80.00 |
| Slope (%) | 11.50 | n/a |
| N-Value | 0.012 | n/a |
| Orifice/Weir Coefficient | 0.6 | 3.33 |

According to 33CSR1 4.5.b.3.A.7.(b), the routing, included with this calculation, shows that the maximum pool elevation is below the invert elevation of the emergency spillway. Thus, during the 25-year/24-hour storm event, the emergency spillway provides flood storage with no flow entering the emergency spillway while allowing flow through the principal spillway.

## EMERGENCY SPILLWAY DESIGN:

According to 33CSR1 4.5.b.3.A.7.(b), the emergency spillway has been designed such that the combination of the principal spillway and emergency spillway will safely discharge the 25-year/24-hour storm event. This design requirement has been evaluated by routing flow from the 25-year/24-hour storm through the pond using the previously designed principal spillway.

All spillways must discharge an adequate distance beyond the downstream toe of the structure to a natural drainway to prevent erosion of the downstream toe. The inverts of the emergency spillways have been set above the elevation of the 25-year/24-hour storm event.

The details of the emergency spillway for the South Pond are found within the Hydraflow printout and are summarized as follows:

| South Pond (Phase 1) | Emergency Spillway |
|---|---|
| Spillway Type | 8' Dia. MH |
| Crest Elevation | 1040.08 |
| Crest Length (feet) | 25.13 |
| Weir Coefficient | 3.33 |
| Channel Lining | n/a |
| Maximum pool elevation 25-year 24-hour storm | 1039.60 |
| Top of Embankment | 1041.08 |
| Freeboard above the 25-year elevation | 1.48 |

## OUTLET CHANNEL:

The proposed principal spillway and emergency spillway will outlet to the existing drainage channels downstream of the proposed Sedimentation Ponds. (Please see "Permanent Surface Water Control Structures Perimeter Channel Design Calculations" for additional information regarding the channel design)

## CONCLUSIONS:

The proposed South Pond has been designed to meet the regulations as outlined in 33CSR1 4.5.b.3.A.7. The temporary pond utilizes the primary spillway to convey the 10-year/24-hour storm event within the watershed. The routing of the 25-year/24-hour storm event produces water level elevations below the invert of the proposed emergency spillway. The flow from the 100-yr/24-hr storm was routed through the proposed principal spillway and the emergency spillway. The South Pond provides over one foot of freeboard for a 100-year/24-hour storm event in relation to the top of the emergency spillway and an additional one foot of freeboard from the emergency spillway to the top of embankment.

## REFERENCES:

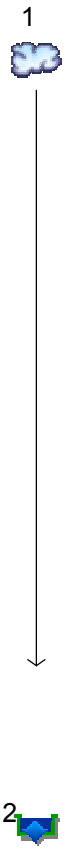
1. United States Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, for Mitchell County, West Virginia.

2. Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011, Version 8, 2007-2010, Computer Software Program.

3. Faircloth Skimmer Online Sizing Calculator. <http://www.fairclothskimmer.com/skimmer.html>

# Watershed Model Schematic





# Hydrograph Return Period Recap



| Hyd. No. | Hydrograph type (origin) | Inflow hyd(s) | Peak Outflow (cfs) | | | | | | | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr | |
| 1 | SCS Runoff | ------ | ------- | 106.03 | ------- | ------- | 214.10 | 270.59 | ------- | 330.73 | South - Phase 1 |
| 2 | Reservoir | 1 | ------- | 1.875 | ------- | ------- | 54.05 | 164.39 | ------- | 270.66 | South Pond - Phase 1 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 106.03 | 1 | 724 | 319,027 | ------ | ------ | ------ | South - Phase 1 |
| 2 | Reservoir | 1.875 | 1 | 1374 | 16,638 | 1 | 1038.83 | 304,039 | South Pond - Phase 1 |

# Hydrograph Report

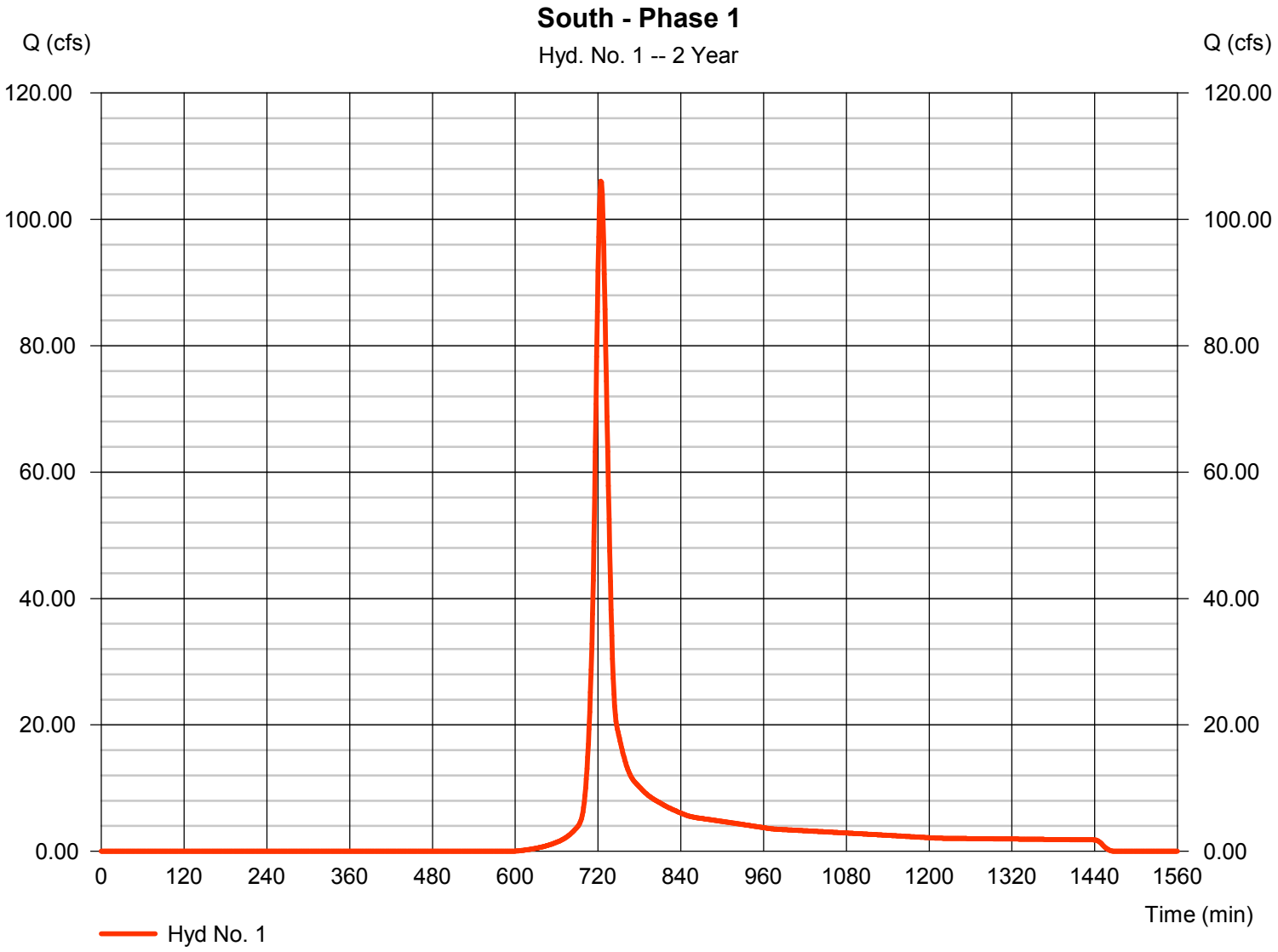


## Hyd. No. 1

South - Phase 1

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 106.03 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 724 min |
| Time interval | = 1 min | Hyd. volume | = 319,027 cuft |
| Drainage area | = 86.520 ac | Curve number | = 82* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 17.80 min |
| Total precip. | = 2.54 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(48.110 x 76) + (10.320 x 91) + (18.200 x 91) + (3.470 x 98)] / 86.520



# TR55 Tc Worksheet



## Hyd. No. 1

South - Phase 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.400 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 200.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 2.54 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 19.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 17.05** | **+** | **0.00** | **+** | **0.00** | **=** | **17.05** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 188.87 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 28.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =8.54 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.37** | **+** | **0.00** | **+** | **0.00** | **=** | **0.37** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 33.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 20.97 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 21.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.040 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =23.13 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})554.9 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.40** | **+** | **0.00** | **+** | **0.00** | **=** | **0.40** |

**Total Travel Time, Tc ..... 17.80 min**

# Hydrograph Report

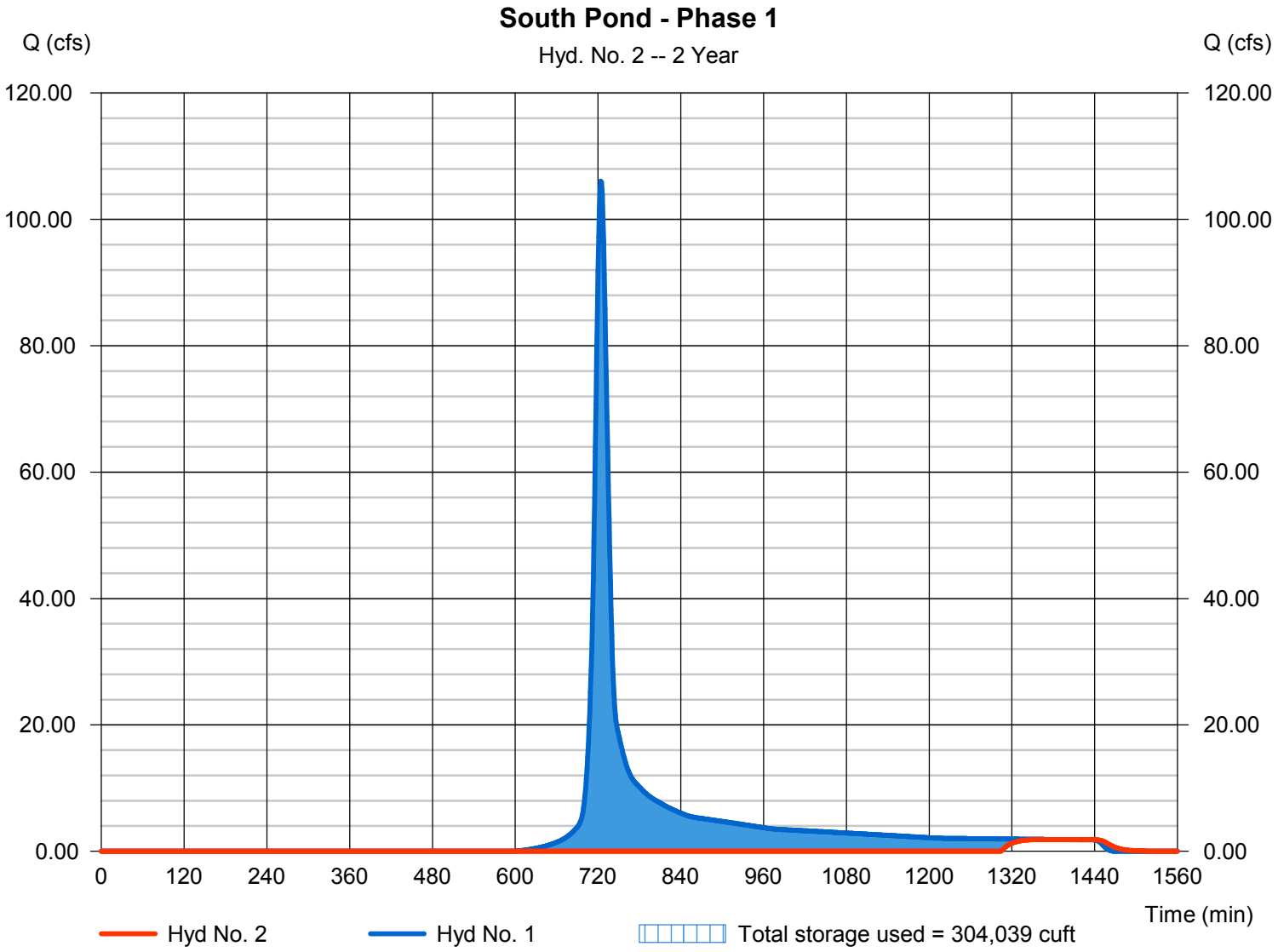


## Hyd. No. 2

South Pond - Phase 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 1.875 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 1374 min |
| Time interval | = | 1 min | Hyd. volume | = | 16,638 cuft |
| Inflow hyd. No. | = | 1 - South - Phase 1 | Max. Elevation | = | 1038.83 ft |
| Reservoir name | = | South Pond-Minus Sediment | Max. Storage | = | 304,039 cuft |

Storage Indication method used.



# Pond Report





## Pond No. 2 - South Pond-Minus Sediment

### Pond Data

**Contours -**User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1031.08 ft

### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|---|---|---|---|---|
| 0.00 | 1031.08 | 28,316 | 0 | 0 |
| 0.92 | 1032.00 | 31,119 | 27,327 | 27,327 |
| 1.92 | 1033.00 | 34,041 | 32,566 | 59,893 |
| 2.92 | 1034.00 | 37,125 | 35,568 | 95,461 |
| 3.92 | 1035.00 | 40,351 | 38,723 | 134,184 |
| 4.92 | 1036.00 | 43,689 | 42,005 | 176,189 |
| 5.92 | 1037.00 | 47,242 | 45,449 | 221,638 |
| 6.92 | 1038.00 | 50,922 | 49,066 | 270,704 |
| 7.84 | 1038.92 | 54,000 | 48,257 | 318,961 |
| 7.92 | 1039.00 | 54,936 | 4,352 | 323,313 |
| 8.92 | 1040.00 | 58,879 | 56,890 | 380,203 |
| 9.92 | 1041.00 | 62,901 | 60,873 | 441,076 |
| 10.00 | 1041.08 | 64,074 | 5,078 | 446,154 |

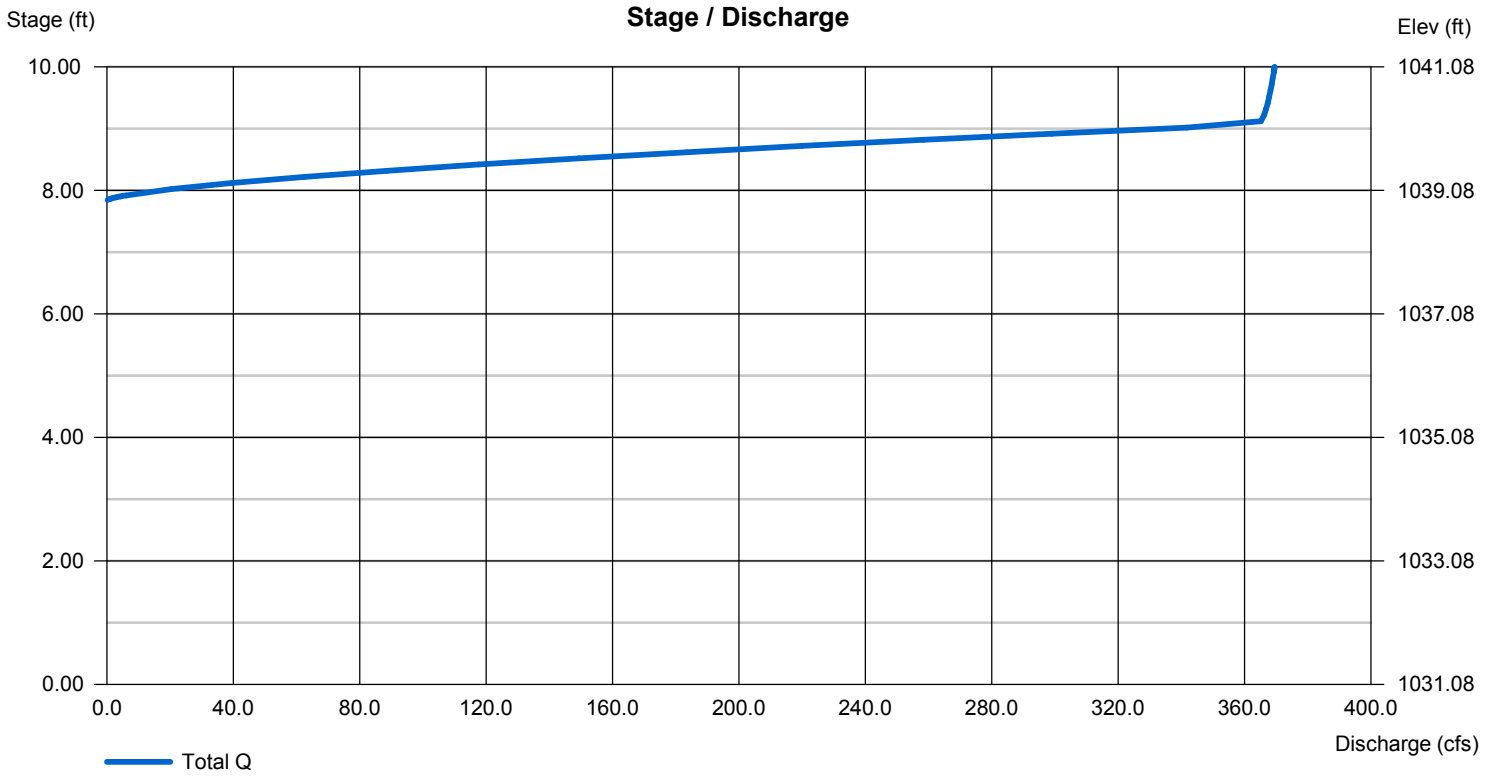
### Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|---|---|---|---|---|
| **Rise (in)** | = 40.87 | 0.00 | Inactive | Inactive |
| **Span (in)** | = 40.87 | 0.00 | 0.00 | 0.00 |
| **No. Barrels** | = 1 | 0 | 0 | 0 |
| **Invert El. (ft)** | = 968.28 | 0.00 | 0.00 | 0.00 |
| **Length (ft)** | = 204.55 | 0.00 | 0.00 | 0.00 |
| **Slope (%)** | = 11.50 | 0.00 | 0.00 | n/a |
| **N-Value** | = .012 | .013 | .013 | n/a |
| **Orifice Coeff.** | = 0.60 | 0.60 | 0.60 | 0.60 |
| **Multi-Stage** | = n/a | No | No | No |

### Weir Structures

| | [A] | [B] | [C] | [D] |
|---|---|---|---|---|
| **Crest Len (ft)** | = 80.00 | 25.13 | Inactive | Inactive |
| **Crest El. (ft)** | = 1038.92 | 1040.08 | 0.00 | 0.00 |
| **Weir Coeff.** | = 3.33 | 3.33 | 3.33 | 3.33 |
| **Weir Type** | = 1 | Rect | Ciplti | --- |
| **Multi-Stage** | = Yes | Yes | No | No |
| **Exfil.(in/hr)** | = 0.000 (by Contour) | | | |
| **TW Elev. (ft)** | = 0.00 | | | |

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 214.10 | 1 | 724 | 633,899 | ------ | ------ | ------ | South - Phase 1 |
| 2 | Reservoir | 54.05 | 1 | 741 | 331,510 | 1 | 1039.17 | 322,275 | South Pond - Phase 1 |

# Hydrograph Report

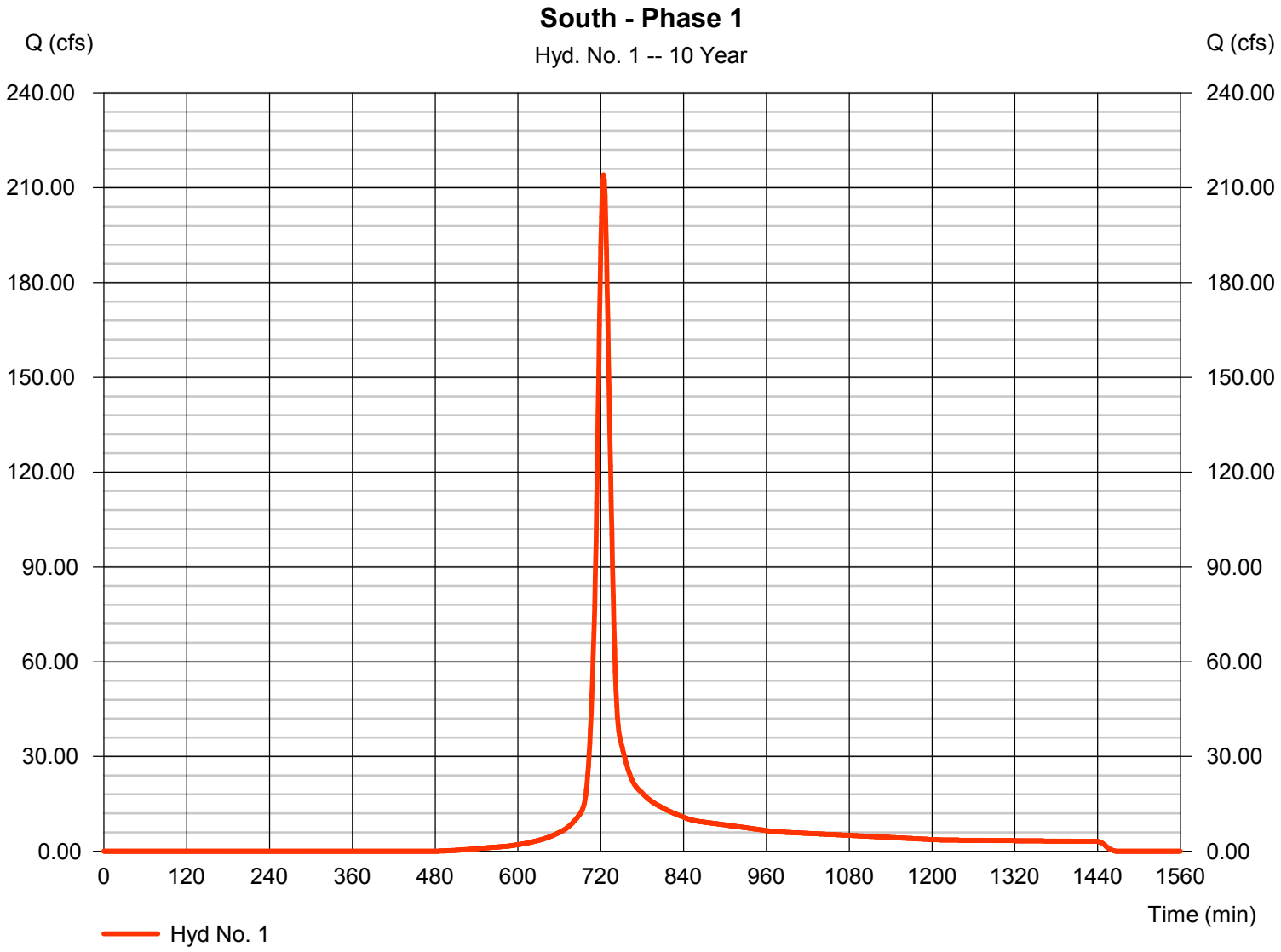


## Hyd. No. 1

South - Phase 1

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 214.10 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 724 min |
| Time interval | = 1 min | Hyd. volume | = 633,899 cuft |
| Drainage area | = 86.520 ac | Curve number | = 82* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 17.80 min |
| Total precip. | = 3.81 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(48.110 x 76) + (10.320 x 91) + (18.200 x 91) + (3.470 x 98)] / 86.520



# Hydrograph Report

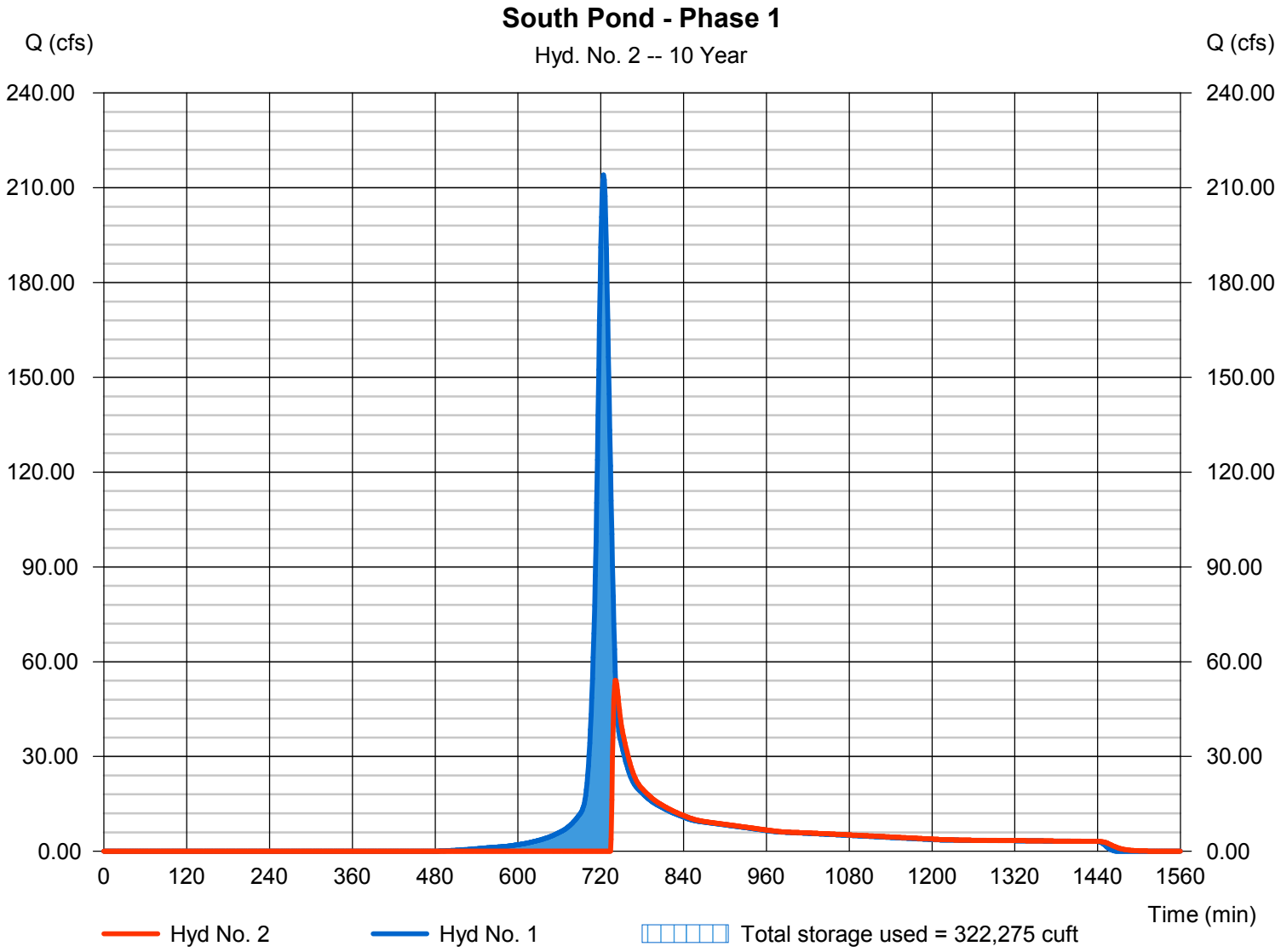


## Hyd. No. 2

South Pond - Phase 1

| | | | |
|---|---|---|---|
| Hydrograph type | = Reservoir | Peak discharge | = 54.05 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 741 min |
| Time interval | = 1 min | Hyd. volume | = 331,510 cuft |
| Inflow hyd. No. | = 1 - South - Phase 1 | Max. Elevation | = 1039.17 ft |
| Reservoir name | = South Pond-Minus Sediment | Max. Storage | = 322,275 cuft |

Storage Indication method used.



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 270.59 | 1 | 724 | 802,183 | ------ | ------ | ------ | South - Phase 1 |
| 2 | Reservoir | 164.39 | 1 | 733 | 499,794 | 1 | 1039.55 | 343,921 | South Pond - Phase 1 |

# Hydrograph Report

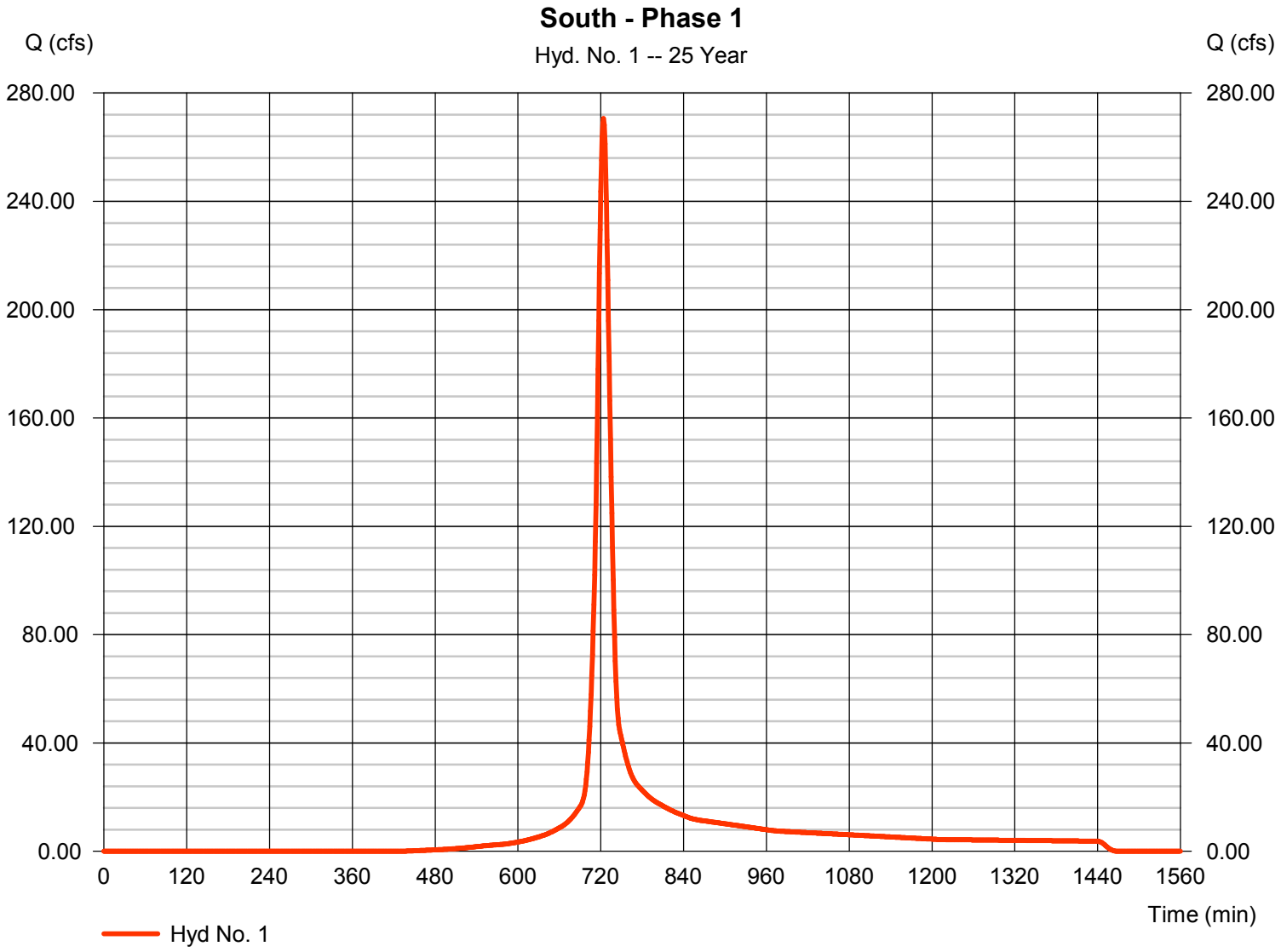


## Hyd. No. 1

South - Phase 1

| | | | |
|---|---|---|---|
| Hydrograph type | = SCS Runoff | Peak discharge | = 270.59 cfs |
| Storm frequency | = 25 yrs | Time to peak | = 724 min |
| Time interval | = 1 min | Hyd. volume | = 802,183 cuft |
| Drainage area | = 86.520 ac | Curve number | = 82* |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = TR55 | Time of conc. (Tc) | = 17.80 min |
| Total precip. | = 4.44 in | Distribution | = Type II |
| Storm duration | = 24 hrs | Shape factor | = 484 |

* Composite (Area/CN) = [(48.110 x 76) + (10.320 x 91) + (18.200 x 91) + (3.470 x 98)] / 86.520



# Hydrograph Report

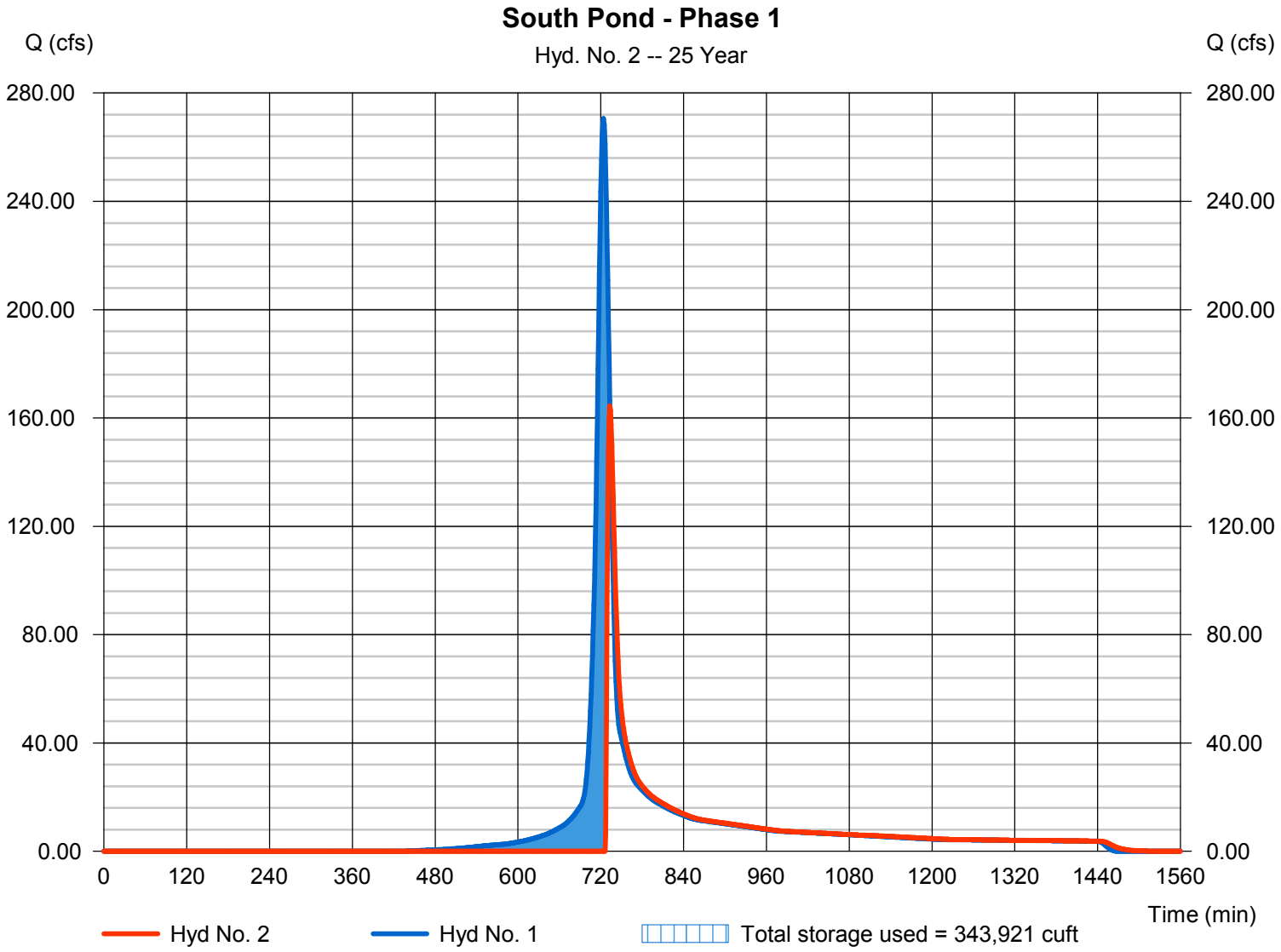


## Hyd. No. 2

South Pond - Phase 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 164.39 cfs |
| Storm frequency | = | 25 yrs | Time to peak | = | 733 min |
| Time interval | = | 1 min | Hyd. volume | = | 499,794 cuft |
| Inflow hyd. No. | = | 1 - South - Phase 1 | Max. Elevation | = | 1039.55 ft |
| Reservoir name | = | South Pond-Minus Sediment | Max. Storage | = | 343,921 cuft |

Storage Indication method used.



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 330.73 | 1 | 724 | 983,866 | ------ | ------ | ------ | South - Phase 1 |
| 2 | Reservoir | 270.66 | 1 | 729 | 681,476 | 1 | 1039.83 | 360,205 | South Pond - Phase 1 |

# Hydrograph Report

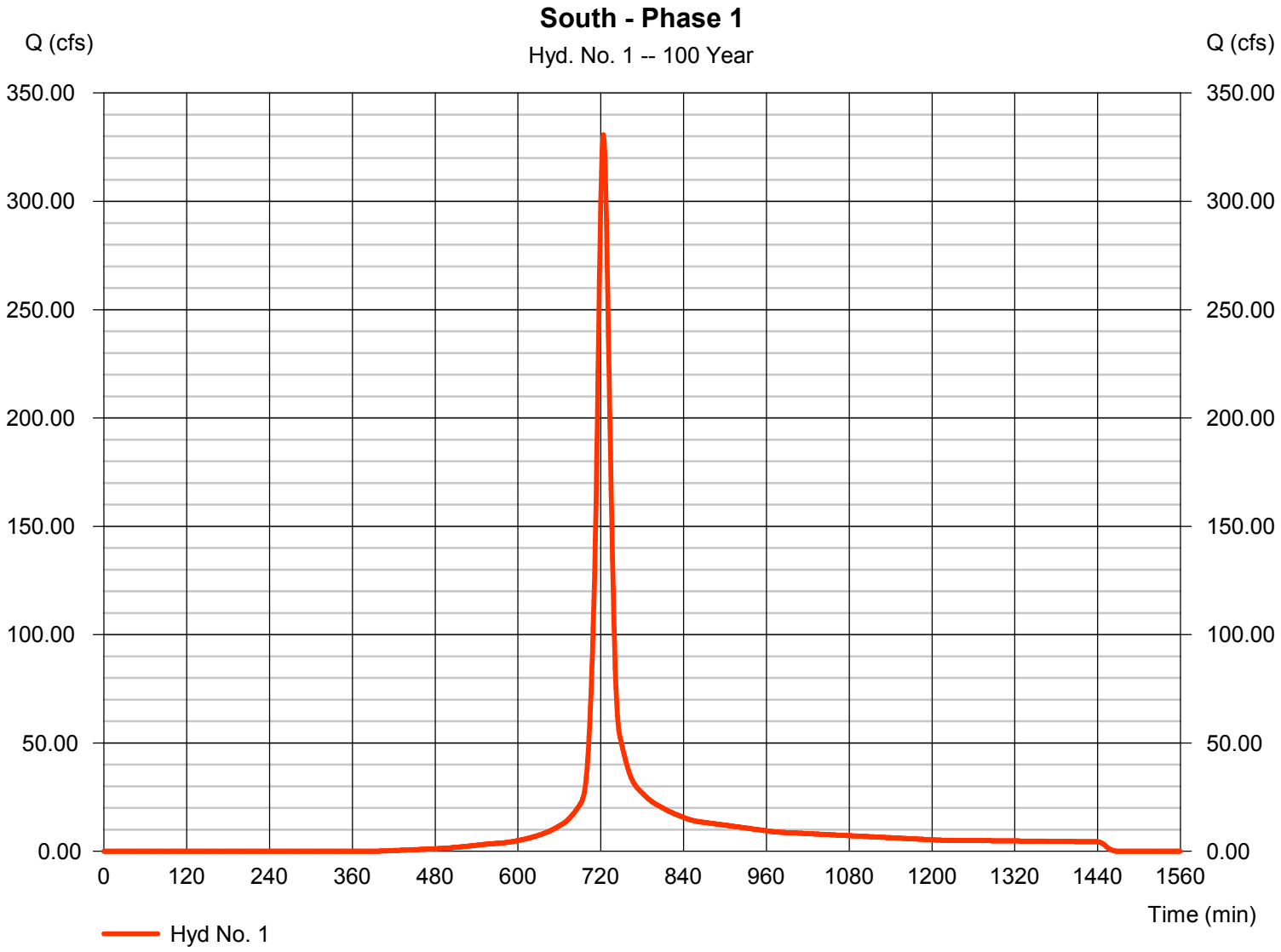


## Hyd. No. 1

South - Phase 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 330.73 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 724 min |
| Time interval | = | 1 min | Hyd. volume | = | 983,866 cuft |
| Drainage area | = | 86.520 ac | Curve number | = | 82* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 17.80 min |
| Total precip. | = | 5.10 in | Distribution | = | Type II |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(48.110 x 76) + (10.320 x 91) + (18.200 x 91) + (3.470 x 98)] / 86.520



# Hydrograph Report

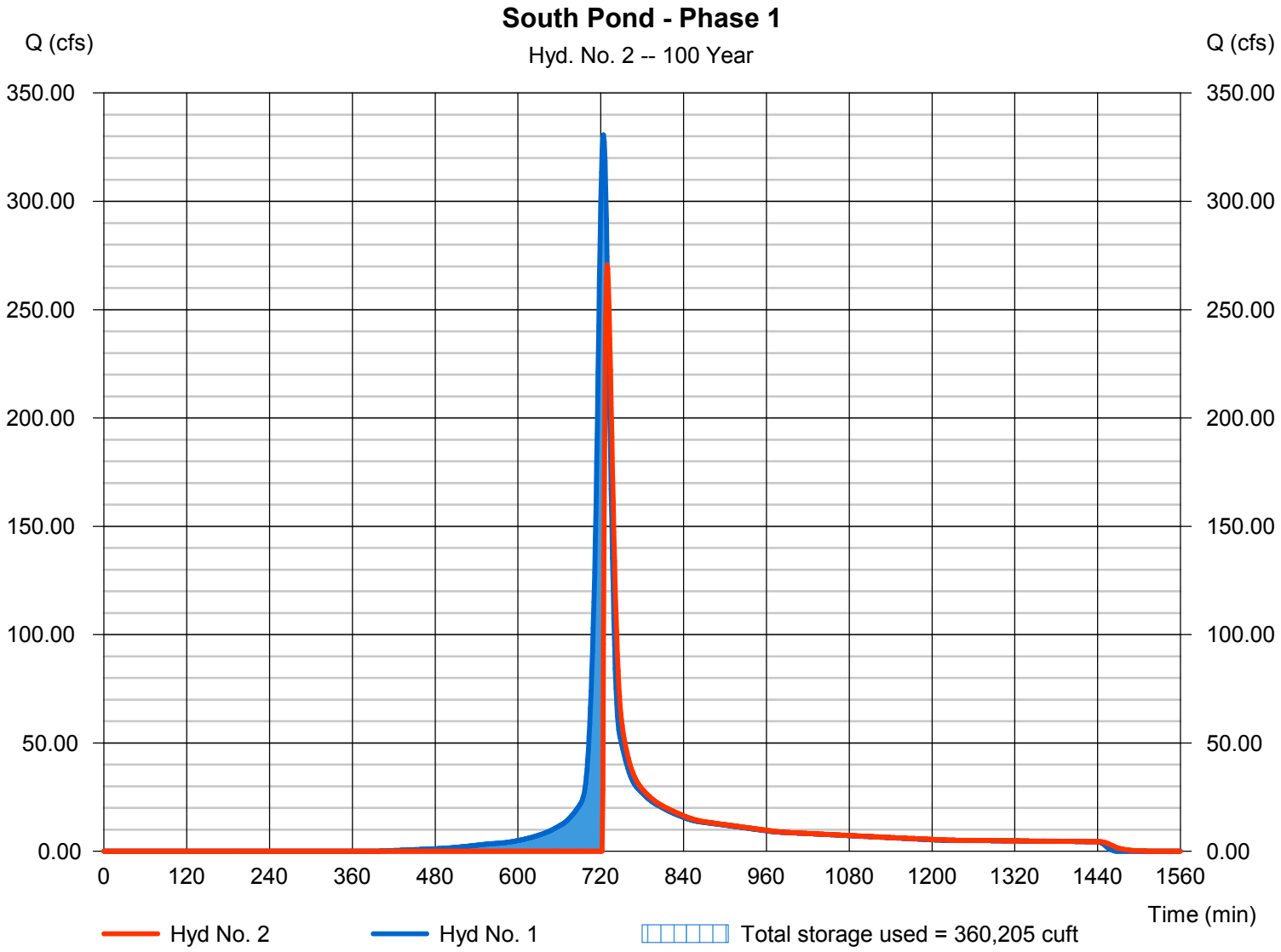


## Hyd. No. 2

South Pond - Phase 1

| | | | | | |
|---|---|---|---|---|---|
| Hydrograph type | = | Reservoir | Peak discharge | = | 270.66 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 729 min |
| Time interval | = | 1 min | Hyd. volume | = | 681,476 cuft |
| Inflow hyd. No. | = | 1 - South - Phase 1 | Max. Elevation | = | 1039.83 ft |
| Reservoir name | = | South Pond-Minus Sediment | Max. Storage | = | 360,205 cuft |

Storage Indication method used.



# Hydraflow Rainfall Report



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|---|---|---|---|---|
| | B | D | E | (N/A) |
| 1 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 2 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 3 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 5 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 10 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 25 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 50 | 0.0000 | 0.0000 | 0.0000 | -------- |
| 100 | 0.0000 | 0.0000 | 0.0000 | -------- |

File name: Lebanon.IDF

**Intensity = B / (Tc + D)^E**

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Tc = time in minutes. Values may exceed 60.

Precip. file name: Marchall_Co_WV.pcp

| Storm Distribution | Rainfall Precipitation Table (in) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-yr | 2-yr | 3-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| SCS 24-hour | 2.25 | 2.54 | 0.00 | 3.25 | 3.81 | 4.44 | 0.00 | 5.10 |
| SCS 6-Hr | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-1st | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-2nd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-3rd | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-4th | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Huff-Indy | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Custom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

AEP - Mitchell Landfill
South Pond

## Calculate Skimmer Size

| | | | | | |
|---|---|---|---|---|---|
| **Basin Volume in Cubic Feet** | 319,027 | Cu.Ft | **Skimmer Size** | **6.0** | Inch |
| **Days to Drain*** | 7 | Days | Orifice Radius | **2.8** | Inch[es] |
| | | | Orifice Diameter | **5.7** | Inch[es] |

*In NC assume 3 days to drain

## Estimate Volume of Basin

| | Length | Width | | | | |
|---|---|---|---|---|---|---|
| **Top of water surface in feet** | | | Feet | **VOLUME** | **0** | **Cu. Ft.** |
| **Bottom dimensions in feet** | | | Feet | | | |
| **Depth in feet** | | | Feet | | | |

## LEGEND:

Tc PATH

DRAINAGE AREA

DRAINAGE BERM/ CHANNEL

DRAINAGE AREA NAME — DRAINAGE NAME

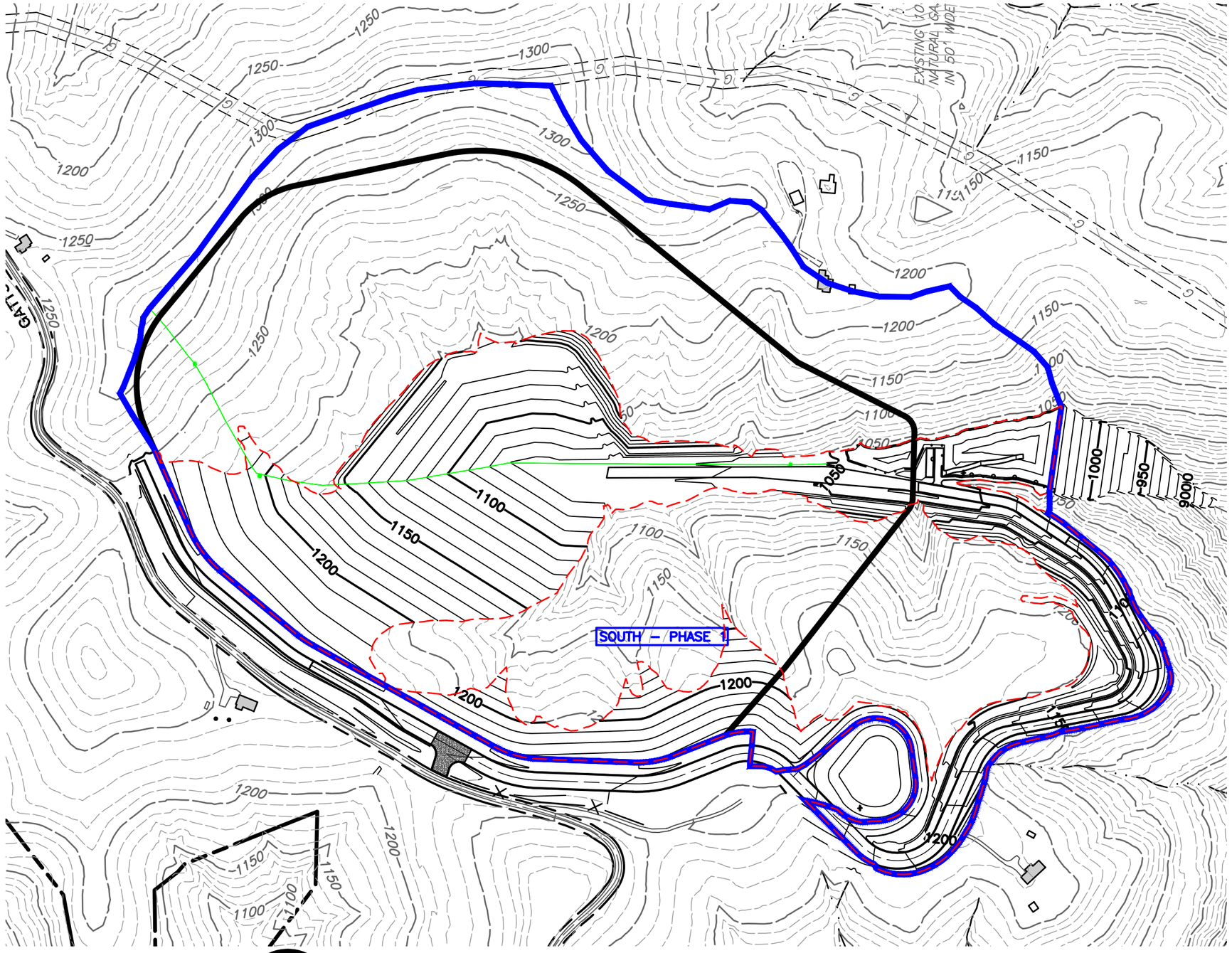
EXISTING CONTOURS — 1000

PROPOSED TOP OF LINER/FILL GRADING — 1000

DISTURBED LIMITS

## NOTES:

1. REFER TO HYDRAFLOW OUTPUT FOR DETAILED INFORMATION REGARDING TIME OF CONCENTRATIONS, FLOW LENGTHS AND CN NUMBERS.
2. POND SIZING AND DESIGN CAN BE FOUND IN THE CALCULATION ENTITLED "SEDIMENT POND DESIGN CALCULATIONS."




NORTH
SCALE IN FEET
0 300 600


Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road - Cincinnati, OH 45242
513-985-0226 · 800-759-5614
www.cecinc.com


American Electric Power
Mitchell Landfill
Gatts Ridge Road
Marshall County, West Virginia

SOUTH POND
PHASE 1 DRAINAGE MAP

| DRAWN BY: | MTF | CHECKED BY: | JRI | APPROVED BY: | | FIGURE NO.: |
|---|---|---|---|---|---|---|
| DATE: | JANUARY 25, 2013 | DWG SCALE: | 1"=300' | PROJECT NO: | 110-416 | A |

P:\2011\110-416\-CADD\DWG\Xrefs\Phase 1A Landfill\110-416_XR_HYD Post Phase 1A-Final.dwg[1 PHASE 1] LS:(25/01/2013 - tford) - LP: 1/25/2013 10:15 AM

# APPENDIX B
# SECTION 2

# RUN-OFF CONTROL FEATURE SUPPORTING CALCULATIONS

# WATER BALANCE CALCULATIONS

## (Taken from the Solid Waste/NPDES Permit Application for the Mitchell Landfill)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SUBJECT | Water Balance Calculation | | | | | PROJECT NO. | 110-416 | |
| APPLICABLE RULE | 33CSR1:3.8.e 1-9 | | | | | | | |
| PROJECT | American Electric Power – Mitchell Landfill | | | | | PAGE 1 | OF 37 | |
| LOCATION | Gatts Ridge Road, Marshall County, West Virginia | | | | | | | |
| MADE BY | AMH | DATE | 02/22/12 | CHECKED BY | RH | DATE | 2-27-12 | |
| REVISED BY: | TDM | DATE | 1/3/2019 | CHECKED BY | EDC | DATE | 1/7/19 | |

This calculation was updated in January 2019 to account for changes to the base liner system associated with Phase 3 and 4 Construction. Changes to the base liner system include elimination of the geocomposite on the sideslopes and floor, and exclusive use of bottom ash for the leachate collection layer material.

Note that this calculation previously included a discussion of flow rates coming from the leachate collection zone. These flow rates were calculated using assumed flow rates of $1 \times 10^{-2}$ cm/sec for the leachate collection material. This revised calculation has been prepared to determine the minimum permeability required to maintain the design maximum leachate heads as determined in the Liner Hydraulic Equivalency (GCL and CCL) Calculation Brief (i.e., 10-inch maximum leachate head). As such, reference to the flow rates coming from the leachate collection zone have been stricken from this calculation brief. Please refer to the previous calculation brief included in the permit application for the Mitchell Landfill for further discussion of leachate flow rates.

## OBJECTIVE:

This calculation will evaluate the water balance for Mitchell Landfill.

## METHOD OF ANALYSIS:

The Hydrologic Evaluation of Landfill Performance (HELP) Model (ver. 3.07) was used to simulate leachate generation. The HELP model is a computer program developed for the USEPA that is used to determine the fluid flux through landfill and landfill liner systems. The HELP model is a water balance model, and is widely used in landfill design. This model utilizes climatologic, soil and design data, and performs a solution technique that accounts for the effects of surface layer storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage to calculate a leachate generation volume.

## HELP MODEL ANALYSIS:

HELP Model Design Data:

The following climatological parameters are common to all model runs and were provided by the HELP model program. Historical climate data available for the Pittsburgh area was chosen because it is in close proximity to the project site (approximately 80 miles northeast), is similar in elevation and has comparable climatic characteristics. The following climate data is provided by the HELP program:

- Evapotranspiration;
- Precipitation;
- Temperature; and,
- solar radiation.

The program also requires specific data with respect to waste, liner and subbase characteristics, interior slope lengths and inclination, and cover slope characteristics.

The following design data was used for the layers in the simulations:

- Permeability of final cover = 1.0 x $10^{-6}$ cm/s (not used in intermediate conditions)
- Permeability of fly ash = 1.3 x $10^{-4}$ cm/s, per CEC test results
- The leachate collection layer permeability was varied for the floor and sideslope conditions until an acceptable maximum head on liner system was produced.
- Geomembrane installation is 'Good' with 2 pinholes and 4 installation defects / acre. Permeability of geomembrane = 2.0 x $10^{-11}$ cm/s
- Permeability of GCL = 5 x $10^{-9}$ cm/s (typical for commercial GCL products). CEC notes that the project design does require a GCL permeability of 3.4 x1 $0^{-9}$ cm/s. This lower permeability requirement was initially required to demonstrate equivalency to a compacted clay liner (CCL). However, for this analysis, the permeability of 5 x $10^{-9}$ cm/s was used to maintain consistency with the original permit documents. This difference in permeability does not have a substantial impact in calculating the maximum leachate head generated on the liner system.
- Permeability of subbase = 1 x $10^{-5}$ cm/s (comparison model runs indicate permeability of this layer does not affect flow through the barrier layer)

The following design data was used for the simulations involving the floor of the landfill:

- Bottom (liner) slope = 5% (minimum floor slope expected)
- Slope length = 60 feet (maximum floor slope length)

The following design data was used for the simulations involving the sideslopes of the landfill:

- Bottom (liner) slope = 33% (For 3H:1V Slopes)
- Bottom (liner) slope = 25% (For 4H:1V Slopes)
- Slope length = 900 feet (maximum sideslope length)

The following information was used for simulations involving intermediate conditions:

- Curve number of exposed fly ash = 86 [bare soil, Group B (USDA classification silt loam per CEC lab results)].
- Time span of 5 years

- Waste thickness = 10 feet, 100 feet

The following information was used for simulations involving final conditions:

- Curve number of exposed final cover = 86 [bare soil, Group B]
- Time span of 100 years
- Waste thickness = 10 feet, 100 feet, 250 feet

HELP Model Analyses:

Several HELP Model analyses were performed using the design data presented above. The following provides a summary of the input used in the models:

Intermediate Condition: Floor without final cover

| Layer | HELP Model Texture No. | Thickness (inches) | Permeability (cm/sec) |
|---|---|---|---|
| Waste (1) | 30 | Varies | 0.0013 |
| Granular leachate collection layer(1) | 1 | 18 | Varied |
| Geomembrane | 37 | 0.03 | $2.0 \times 10^{-11}$ |
| GCL (1) | 17 | 0.25 | $5.0 \times 10^{-9}$ |
| Subbase (1) | 26 | 6 | $1.0 \times 10^{-4}$ |
| Soil | 4 | 6 | 0.0017 |

Notes:
(1) Texture No. 0 in HELP Model because of change to permeability.

Intermediate Condition: Sideslopes without final cover

| Layer | HELP Model Texture No. | Thickness (inches) | Permeability (cm/sec) |
|---|---|---|---|
| Waste (1) | 30 | Varies | 0.0013 |
| | | | |
| Granular leachate collection layer(1) | 1 | 18 | Varied |
| Geomembrane | 37 | 0.03 | $2.0 \times 10^{-11}$ |
| GCL (1) | 17 | 0.25 | $5.0 \times 10^{-9}$ |
| Subbase (1) | 26 | 6 | $1.0 \times 10^{-4}$ |
| Soil | 4 | 6 | 0.0017 |

Notes:
(1) Texture No. 0 in HELP Model because of change to permeability.

Final Conditions: Floor with final cover

| Layer | HELP Model Texture No. | Thickness (inches) | Permeability (cm/sec) |
|---|---|---|---|
| Final cover (1) | 26 | 24 | $1.0x10^{-4}$ |
| Waste (1) | 30 | Varies | 0.0013 |
| Granular leachate collection layer(1) | 1 | 18 | Varied |
| Geomembrane | 37 | 0.03 | $2.0x10^{-11}$ |
| GCL (1) | 17 | 0.25 | $5.0x10^{-9}$ |
| Subbase (1) | 26 | 6 | $1.0x10^{-4}$ |
| Soil | 4 | 6 | 0.0017 |

Notes:
(1) Texture No. 0 in HELP Model because of change to permeability.

Final Conditions: Sideslopes with final cover

| Layer | HELP Model Texture No. | Thickness (inches) | Permeability (cm/sec) |
|---|---|---|---|
| Final cover (1) | 26 | 24 | $1.0x10^{-6}$ |
| Waste (1) | 30 | Varies | 0.0013 |
| | | | |
| Granular leachate collection layer(1) | 1 | 18 | Varied |
| Geomembrane | 37 | 0.03 | $2.0x10^{-11}$ |
| GCL (1) | 17 | 0.25 | $5.0x10^{-9}$ |
| Subbase (1) | 26 | 6 | $1.0x10^{-4}$ |
| Soil | 4 | 6 | 0.0017 |

Notes:
(1) Texture No. 0 in HELP Model because of change to permeability.

HELP Model Results:

The results of the HELP Model analyses are presented in Appendix A. **Table 1** presents a summary of data developed from the HELP model runs for intermediate conditions evaluated:

**Table 1: Summary for Intermediate Conditions**

| File Name | Floor/ Sideslope | Waste Thickness (ft) | Leachate Collection Layer Perm. (cm/sec) | Max. Head on Liner System (inches) |
|---|---|---|---|---|
| GCLFLI1 | Floor | 10 | $1.25 \times 10^{-3}$ | 9.994 |
| GCLFLI2 | Floor | 100 | $4.00 \times 10^{-4}$ | 9.994 |
| GCL3SSI1 | 3H:1V slope | 10 | $6.00 \times 10^{-3}$ | 9.532 |
| GCL3SSI2 | 3H:1V slope | 100 | $4.00 \times 10^{-3}$ | 9.091 |
| GCL4SSI1 | 4H:1V slope | 10 | $7.00 \times 10^{-3}$ | 9.912 |
| GCL4SSI2 | 4H:1V slope | 100 | $5.00 \times 10^{-3}$ | 9.147 |

**Table 2** presents a summary of data developed from the HELP model runs for final conditions evaluated:

**Table 2: Summary for Final Cover Conditions**

| File Name | Floor/ Sideslope | Waste Thickness (ft) | Leachate Collection Layer Perm. (cm/sec) | Max. Head on Liner System (inches) |
|---|---|---|---|---|
| GCLFLF1 | Floor | 10 | $1.3 \times 10^{-3}$ | 9.174 |
| GCLFLF2 | Floor | 100 | $1.0 \times 10^{-3}$ | 9.219 |
| GCLFLF3 | Floor | 250 | $1.0 \times 10^{-3}$ | 9.086 |
| GCL3SSF1 | 3H:1V Sideslope | 10 | $4.5 \times 10^{-3}$ | 9.466 |
| GCL3SSF2 | 3H:1V Sideslope | 100 | $3.5 \times 10^{-3}$ | 9.625 |
| GCL3SSF3 | 3H:1V Sideslope | 250 | $3.5 \times 10^{-3}$ | 9.470 |
| GCL4SSF1 | 4H:1V Sideslope | 10 | $6.0 \times 10^{-3}$ | 9.135 |
| GCL4SSF2 | 4H:1V Sideslope | 100 | $4.5 \times 10^{-3}$ | 9.482 |
| GCL4SSF3 | 4H:1V Sideslope | 250 | $4,5 \times 10^{-3}$ | 9.320 |

From the results above, it can be noted that the maximum head on the liner system when using an granular drainage layer with a minimum permeability of $7.00 \times 10^{-3}$ cm/sec is less than the maximum allowable leachate head of 10 inches.

## CONCLUSIONS:

The results above show that the maximum head on the liner system when using a granular drainage layer with a minimum permeability of $7.00 \times 10^{-3}$ cm/sec is less than the maximum allowable leachate head of 10 inches.

# APPENDIX A

```
**************************************************************************
**************************************************************************
**                                                                      **
**                                                                      **
**             HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**               HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)             **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                **
**                   USAE WATERWAYS EXPERIMENT STATION                  **
**            FOR USEPA RISK REDUCTION ENGINEERING LABORATORY           **
**                                                                      **
**                                                                      **
**************************************************************************
**************************************************************************


PRECIPITATION DATA FILE:    C:\HELP\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCLFLI1.D10
OUTPUT DATA FILE:           C:\HELP\GCLFLI1.OUT


TIME:  16:27     DATE:   1/ 3/2019



**************************************************************************

     TITLE:  AEP Mitchell - GCL, 10' waste, 5% slopes

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
               COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                              LAYER  1
                              --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =    120.00   INCHES
          POROSITY                      =      0.5410 VOL/VOL
          FIELD CAPACITY                =      0.1870 VOL/VOL
          WILTING POINT                 =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.2025 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.130000000000E-02 CM/SEC


                              LAYER  2
                              --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =     18.00   INCHES
          POROSITY                      =      0.5780 VOL/VOL
          FIELD CAPACITY                =      0.0760 VOL/VOL
          WILTING POINT                 =      0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.1990 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.124999997000E-02 CM/SEC
          SLOPE                         =      5.00   PERCENT
          DRAINAGE LENGTH               =     60.0    FEET


                              LAYER  3
                              --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  37
          THICKNESS                     =      0.03   INCHES
          POROSITY                      =      0.0000 VOL/VOL
          FIELD CAPACITY                =      0.0000 VOL/VOL
          WILTING POINT                 =      0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY           =      2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS      =      4.00   HOLES/ACRE
          FML PLACEMENT QUALITY         =  3 - GOOD


                              LAYER  4
                              --------

                 TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =      0.25   INCHES
          POROSITY                      =      0.7500 VOL/VOL
          FIELD CAPACITY                =      0.7470 VOL/VOL
          WILTING POINT                 =      0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.499999997000E-08 CM/SEC


                              LAYER  5
                              --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =      6.00   INCHES
          POROSITY                      =      0.4450 VOL/VOL
          FIELD CAPACITY                =      0.3930 VOL/VOL
          WILTING POINT                 =      0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC


                              LAYER  6
                              --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   4
          THICKNESS                     =      6.00   INCHES
          POROSITY                      =      0.4370 VOL/VOL
          FIELD CAPACITY                =      0.1050 VOL/VOL
          WILTING POINT                 =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.1089 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.170000002000E-02 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ---------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      2.332  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.328  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.376  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =     31.086  INCHES
          TOTAL INITIAL WATER                 =     31.086  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


               EVAPOTRANSPIRATION AND WEATHER DATA
               -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                    PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                    COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                    NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                    COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                 NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                    COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA
                      AND STATION LATITUDE  =  40.50 DEGREES



**************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
--------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 3.33     3.14     4.20     2.96     2.68     2.99
                           3.16     3.73     3.70     2.78     2.36     2.71

    STD. DEVIATIONS        0.67     1.06     0.65     0.91     1.22     0.43
                           1.09     1.44     2.42     1.41     0.85     1.13

  RUNOFF
  ------
    TOTALS                 1.984    1.817    3.929    0.411    0.023    0.021
                           0.021    0.139    0.056    0.009    0.001    0.217

    STD. DEVIATIONS        1.555    0.909    2.471    0.464    0.052    0.029
                           0.030    0.135    0.084    0.019    0.002    0.221

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.479    0.493    0.547    2.936    2.088    2.518
                           3.391    2.561    2.171    2.132    1.794    0.747

    STD. DEVIATIONS        0.144    0.158    0.114    0.790    1.294    0.744
                           1.237    0.633    0.787    0.904    0.149    0.274

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  -----------------------------------------
    TOTALS                 0.7610   0.5311   0.4492   0.4660   0.7966   0.7657
                           0.6599   0.5258   0.5079   0.6644   0.6887   0.7226

    STD. DEVIATIONS        0.2801   0.2078   0.2063   0.3162   0.2994   0.2474
                           0.1272   0.0851   0.1297   0.0762   0.2767   0.3199

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  -------------------------------------
    TOTALS                 0.0030   0.0021   0.0018   0.0018   0.0032   0.0030
                           0.0026   0.0021   0.0020   0.0026   0.0027   0.0029

    STD. DEVIATIONS        0.0011   0.0008   0.0008   0.0013   0.0012   0.0010
                           0.0005   0.0003   0.0005   0.0003   0.0011   0.0013

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  -------------------------------------
    TOTALS                 0.0016   0.0021   0.0028   0.0026   0.0016   0.0016
                           0.0021   0.0026   0.0025   0.0020   0.0018   0.0019

    STD. DEVIATIONS        0.0013   0.0012   0.0013   0.0015   0.0009   0.0010
                           0.0009   0.0005   0.0006   0.0007   0.0012   0.0012

--------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
--------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  -------------------------------------
    AVERAGES               4.1673   3.2114   2.4596   2.6371   4.3624   4.3330
                           3.6137   2.8794   2.8738   3.6382   3.8973   3.9569

    STD. DEVIATIONS        1.5339   1.2766   1.1297   1.7890   1.6393   1.3997
                           0.6968   0.4658   0.7340   0.4173   1.5658   1.7519

**************************************************************************


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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
--------------------------------------------------------------------------

                                  INCHES          CU. FEET        PERCENT
                              ------------------  ------------  ----------
```

| | | | | | |
|---|---|---|---|---|---|
| PRECIPITATION | 37.74 | ( | 0.555) | 136996.2 | 100.00 |
| RUNOFF | 8.629 | ( | 2.6381) | 31321.67 | 22.863 |
| EVAPOTRANSPIRATION | 21.860 | ( | 1.9291) | 79351.94 | 57.923 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 7.53889 | ( | 1.61185) | 27366.187 | 19.97587 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.02989 | ( | 0.00646) | 108.483 | 0.07919 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 3.503 | ( | 0.753) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.02505 | ( | 0.00862) | 90.914 | 0.06636 |
| CHANGE IN WATER STORAGE | -0.313 | ( | 2.1370) | -1134.51 | -0.828 |

**********

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.97 | 7151.100 |
| RUNOFF | 3.147 | 11424.2100 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.04386 | 159.22774 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000176 | 0.63763 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 7.445 | |
| MAXIMUM HEAD ON TOP OF LAYER 3 | 9.994 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN) | 19.6 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.000130 | 0.47220 |
| SNOW WATER | 4.87 | 17677.5410 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4714 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0470 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 23.4007 | 0.1950 |
| 2 | 2.8991 | 0.1611 |
| 3 | 0.0000 | 0.0000 |
| 4 | 0.1875 | 0.7500 |
| 5 | 2.3580 | 0.3930 |
| 6 | 0.6779 | 0.1130 |
| SNOW WATER | 0.000 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**           FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                      **
**                                                                      **
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**************************************************************************


PRECIPITATION DATA FILE:    C:\HELP\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCLFLI2.D10
OUTPUT DATA FILE:           C:\HELP\GCLFLI2.OUT


TIME:  16:40     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 100' waste, 5% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                              LAYER  1
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                              LAYER  2
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =  1200.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1875 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC



                              LAYER  3
                              --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.4170 VOL/VOL
          FIELD CAPACITY              =     0.0450 VOL/VOL
          WILTING POINT               =     0.0180 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1513 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.399999990000E-03 CM/SEC
          SLOPE                       =     5.00   PERCENT
          DRAINAGE LENGTH             =    60.0    FEET



                              LAYER  4
                              --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD



                              LAYER  5
                              --------

                    TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



                              LAYER  6
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                              LAYER  7
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1083 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC



                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =    240.632  INCHES
          TOTAL INITIAL WATER                 =    240.632  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
--------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 3.33     3.14     4.20     2.96     2.68     2.99
                           3.16     3.73     3.70     2.78     2.36     2.71

    STD. DEVIATIONS        0.67     1.06     0.65     0.91     1.22     0.43
                           1.09     1.44     2.42     1.41     0.85     1.13

  RUNOFF
  ------
    TOTALS                 2.615    2.184    4.498    0.899    0.413    0.575
                           0.923    1.182    1.321    0.389    0.337    0.665

    STD. DEVIATIONS        1.711    0.931    2.180    0.546    0.444    0.281
                           0.510    0.717    1.171    0.293    0.354    0.545

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.479    0.494    0.547    2.610    1.942    2.240
                           2.575    2.155    2.023    1.936    1.724    0.746

    STD. DEVIATIONS        0.144    0.158    0.114    0.737    1.368    0.707
                           0.993    0.555    0.871    0.830    0.118    0.276

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2535   0.2083   0.2031   0.1960   0.2333   0.2070
                           0.1938   0.1703   0.1681   0.1841   0.1804   0.2169

    STD. DEVIATIONS        0.1375   0.1180   0.1176   0.1157   0.1186   0.1155
                           0.0994   0.0897   0.0956   0.0770   0.0832   0.1166

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0032   0.0026   0.0025   0.0024   0.0029   0.0026
                           0.0024   0.0021   0.0021   0.0023   0.0022   0.0027

    STD. DEVIATIONS        0.0017   0.0015   0.0015   0.0014   0.0015   0.0015
                           0.0012   0.0011   0.0012   0.0010   0.0010   0.0015

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0017   0.0018   0.0023   0.0023   0.0021   0.0022
                           0.0024   0.0027   0.0025   0.0024   0.0023   0.0020

    STD. DEVIATIONS        0.0015   0.0013   0.0015   0.0015   0.0014   0.0015
                           0.0016   0.0014   0.0015   0.0014   0.0010   0.0011

--------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
--------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               4.3373   3.9391   3.4753   3.4664   3.9920   3.6606
                           3.3168   2.9147   2.9725   3.1498   3.1903   3.7111
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 2.3526 | 2.2480 | 2.0131 | 2.0460 | 2.0287 | 2.0430 |
| | 1.7017 | 1.5349 | 1.6913 | 1.3180 | 1.4711 | 1.9949 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 37.74 | ( 0.555) | 136996.2 | 100.00 |
| RUNOFF | 16.002 | ( 1.9740) | 58086.25 | 42.400 |
| EVAPOTRANSPIRATION | 19.471 | ( 1.3521) | 70680.94 | 51.593 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.41475 | ( 1.17340) | 8765.543 | 6.39838 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.02995 | ( 0.01468) | 108.703 | 0.07935 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 3.510 | ( 1.709) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.02676 | ( 0.01477) | 97.135 | 0.07090 |
| CHANGE IN WATER STORAGE | -0.175 | ( 1.4731) | -633.67 | -0.463 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.97 | 7151.100 |
| RUNOFF | 3.218 | 11680.9248 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.01404 | 50.95304 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000176 | 0.63763 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 7.445 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.994 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 19.6 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000136 | 0.49377 |
| SNOW WATER | 4.87 | 17677.5410 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4440 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.9272 | 0.4136 |
| 2 | 224.6011 | 0.1872 |
| 3 | 2.0204 | 0.1122 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6655 | 0.1109 |
| SNOW WATER | 0.000 | |

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**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
**************************************************************************
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PRECIPITATION DATA FILE:    C:\HELP\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL3SSI1.D10
OUTPUT DATA FILE:           C:\HELP\GCL3SSI1.OUT

TIME:  16:44     DATE:   1/ 3/2019

**************************************************************************

     TITLE:  AEP Mitchell - GCL, 10' waste, 33% slopes

**************************************************************************

     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    120.00   INCHES
          POROSITY                    =      0.5410 VOL/VOL
          FIELD CAPACITY              =      0.1870 VOL/VOL
          WILTING POINT               =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.2025 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC

                                LAYER  2
                                --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     18.00   INCHES
          POROSITY                    =      0.5780 VOL/VOL
          FIELD CAPACITY              =      0.0760 VOL/VOL
          WILTING POINT               =      0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.1482 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.600000005000E-02 CM/SEC
          SLOPE                       =     33.00   PERCENT
          DRAINAGE LENGTH             =    900.0    FEET

                                LAYER  3
                                --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =      0.03   INCHES
          POROSITY                    =      0.0000 VOL/VOL
          FIELD CAPACITY              =      0.0000 VOL/VOL
          WILTING POINT               =      0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD

                                LAYER  4
                                --------

                  TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =      0.25   INCHES
          POROSITY                    =      0.7500 VOL/VOL
          FIELD CAPACITY              =      0.7470 VOL/VOL
          WILTING POINT               =      0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC

                                LAYER  5
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =      6.00   INCHES
          POROSITY                    =      0.4450 VOL/VOL
          FIELD CAPACITY              =      0.3930 VOL/VOL
          WILTING POINT               =      0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC

                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =      6.00   INCHES
          POROSITY                    =      0.4370 VOL/VOL
          FIELD CAPACITY              =      0.1050 VOL/VOL
          WILTING POINT               =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.1065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC

                GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                ---------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

     SCS RUNOFF CURVE NUMBER             =     86.00

          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      2.332  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.328  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.376  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =     30.156  INCHES
          TOTAL INITIAL WATER                 =     30.156  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR

                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %

          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       2.86        2.40        3.58        3.28        3.54        3.30
       3.83        3.31        2.80        2.49        2.34        2.57

          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       26.70       28.80       38.50       50.10       59.70       68.10
       72.00       70.60       64.10       52.50       41.60       31.40

          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES

**************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                  3.33     3.14     4.20     2.96     2.68     2.99
                            3.16     3.73     3.70     2.78     2.36     2.71

    STD. DEVIATIONS         0.67     1.06     0.65     0.91     1.22     0.43
                            1.09     1.44     2.42     1.41     0.85     1.13

  RUNOFF
  ------
    TOTALS                  1.984    1.817    3.929    0.411    0.023    0.021
                            0.021    0.139    0.056    0.009    0.001    0.217

    STD. DEVIATIONS         1.555    0.909    2.471    0.464    0.052    0.029
                            0.030    0.135    0.084    0.019    0.002    0.221

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                  0.479    0.493    0.547    2.936    2.088    2.518
                            3.391    2.561    2.171    2.132    1.794    0.747

    STD. DEVIATIONS         0.144    0.158    0.114    0.790    1.294    0.744
                            1.237    0.633    0.787    0.904    0.149    0.274

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  ----------------------------------------
    TOTALS                  0.7830   0.4321   0.3075   0.4267   0.9870   0.8399
                            0.6154   0.4145   0.4642   0.7339   0.7483   0.7644

    STD. DEVIATIONS         0.3433   0.2238   0.2285   0.4333   0.3398   0.2577
                            0.0952   0.1113   0.1685   0.1919   0.4779   0.4494

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  --------------------------------------
    TOTALS                  0.0016   0.0009   0.0006   0.0009   0.0020   0.0017
                            0.0013   0.0009   0.0010   0.0015   0.0015   0.0016

    STD. DEVIATIONS         0.0007   0.0005   0.0005   0.0009   0.0007   0.0005
                            0.0002   0.0002   0.0003   0.0004   0.0010   0.0009

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  --------------------------------------
    TOTALS                  0.0010   0.0015   0.0019   0.0016   0.0006   0.0008
                            0.0013   0.0017   0.0015   0.0010   0.0011   0.0010

    STD. DEVIATIONS         0.0007   0.0005   0.0005   0.0009   0.0004   0.0004
                            0.0003   0.0003   0.0004   0.0006   0.0008   0.0008

------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  --------------------------------------
    AVERAGES                2.2456   1.3696   0.8820   1.2646   2.8307   2.4892
                            1.7650   1.1887   1.3757   2.1047   2.2177   2.1924

    STD. DEVIATIONS         0.9846   0.7149   0.6554   1.2842   0.9746   0.7638
                            0.2729   0.3191   0.4993   0.5504   1.4163   1.2890

**************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
------------------------------------------------------------------------------

                                INCHES            CU. FEET        PERCENT
                          --------------------  -------------   ---------
 PRECIPITATION             37.74    (   0.555)     136996.2     100.00
```

| | | | | |
|---|---|---|---|---|
| RUNOFF | 8.629 | ( 2.6381) | 31321.67 | 22.863 |
| EVAPOTRANSPIRATION | 21.860 | ( 1.9291) | 79351.94 | 57.923 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 7.51678 | ( 1.72446) | 27285.920 | 19.91728 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.01553 | ( 0.00359) | 56.362 | 0.04114 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 1.827 | ( 0.422) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.01501 | ( 0.00314) | 54.481 | 0.03977 |
| CHANGE IN WATER STORAGE | -0.280 | ( 1.7981) | -1017.81 | -0.743 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.97 | 7151.100 |
| RUNOFF | 3.147 | 11424.2100 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.05427 | 197.01524 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000113 | 0.41006 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 4.825 | |
| MAXIMUM HEAD ON TOP OF LAYER 3 | 9.532 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.000080 | 0.29139 |
| SNOW WATER | 4.87 | 17677.5410 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4714 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0470 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 23.4007 | 0.1950 |
| 2 | 2.1662 | 0.1203 |
| 3 | 0.0000 | 0.0000 |
| 4 | 0.1875 | 0.7500 |
| 5 | 2.3580 | 0.3930 |
| 6 | 0.6417 | 0.1070 |
| SNOW WATER | 0.000 | |

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**                                                                     **
**                                                                     **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE            **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)             **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                 **
**                 USAE WATERWAYS EXPERIMENT STATION                   **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                     **
**                                                                     **
*************************************************************************
*************************************************************************


PRECIPITATION DATA FILE:    C:\HELP\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL3SSI2.D10
OUTPUT DATA FILE:           C:\HELP\GCL3SSI2.OUT


TIME:  16:47     DATE:   1/ 3/2019


*************************************************************************

     TITLE:  AEP Mitchell - GCL, 100' waste, 33% slopes

*************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =   1200.00   INCHES
          POROSITY                     =      0.5410 VOL/VOL
          FIELD CAPACITY               =      0.1870 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1892 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.130000000000E-02 CM/SEC


                                LAYER  2
                                --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =    18.00   INCHES
          POROSITY                     =      0.5780 VOL/VOL
          FIELD CAPACITY               =      0.0760 VOL/VOL
          WILTING POINT                =      0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1617 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.400000019000E-02 CM/SEC
          SLOPE                        =     33.00   PERCENT
          DRAINAGE LENGTH              =    900.0    FEET


                                LAYER  3
                                --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  37
          THICKNESS                    =      0.03   INCHES
          POROSITY                     =      0.0000 VOL/VOL
          FIELD CAPACITY               =      0.0000 VOL/VOL
          WILTING POINT                =      0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY          =      2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
          FML PLACEMENT QUALITY        =  3 - GOOD


                                LAYER  4
                                --------

                  TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =      0.25   INCHES
          POROSITY                     =      0.7500 VOL/VOL
          FIELD CAPACITY               =      0.7470 VOL/VOL
          WILTING POINT                =      0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC


                                LAYER  5
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =      6.00   INCHES
          POROSITY                     =      0.4450 VOL/VOL
          FIELD CAPACITY               =      0.3930 VOL/VOL
          WILTING POINT                =      0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   4
          THICKNESS                    =      6.00   INCHES
          POROSITY                     =      0.4370 VOL/VOL
          FIELD CAPACITY               =      0.1050 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1079 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.170000002000E-02 CM/SEC


                GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                ---------------------------------------

      NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

     SCS RUNOFF CURVE NUMBER             =     86.00
     FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE   =      2.332  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.328  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.376  INCHES
     INITIAL SNOW WATER                  =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS    =    233.198  INCHES
     TOTAL INITIAL WATER                 =    233.198  INCHES
     TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


                EVAPOTRANSPIRATION AND WEATHER DATA
                -----------------------------------

      NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
               PITTSBURGH            PENNSYLVANIA

          STATION LATITUDE                  =  40.50 DEGREES
          MAXIMUM LEAF AREA INDEX           =   0.00
          START OF GROWING SEASON (JULIAN DATE) =   114
          END OF GROWING SEASON (JULIAN DATE)   =   288
          EVAPORATIVE ZONE DEPTH            =   8.0  INCHES
          AVERAGE ANNUAL WIND SPEED         =   9.20 MPH
          AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  67.00 %
          AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  63.00 %
          AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  71.00 %
          AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  70.00 %


      NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
               COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       2.86        2.40        3.58        3.28        3.54        3.30
       3.83        3.31        2.80        2.49        2.34        2.57


      NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
               COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       26.70       28.80       38.50       50.10       59.70       68.10
       72.00       70.60       64.10       52.50       41.60       31.40


      NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
               COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA
                 AND STATION LATITUDE  =  40.50 DEGREES


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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 3.33     3.14     4.20     2.96     2.68     2.99
                           3.16     3.73     3.70     2.78     2.36     2.71

    STD. DEVIATIONS        0.67     1.06     0.65     0.91     1.22     0.43
                           1.09     1.44     2.42     1.41     0.85     1.13

  RUNOFF
  ------
    TOTALS                 1.984    1.817    3.929    0.411    0.023    0.021
                           0.021    0.139    0.056    0.009    0.001    0.217

    STD. DEVIATIONS        1.555    0.909    2.471    0.464    0.052    0.029
                           0.030    0.135    0.084    0.019    0.002    0.221

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.479    0.493    0.547    2.936    2.088    2.518
                           3.391    2.561    2.171    2.132    1.794    0.747

    STD. DEVIATIONS        0.144    0.158    0.114    0.790    1.294    0.744
                           1.237    0.633    0.787    0.904    0.149    0.274

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  -----------------------------------------
    TOTALS                 0.6922   0.6334   0.5907   0.4721   0.6197   0.7518
                           0.7772   0.6813   0.5682   0.6243   0.5996   0.5999

    STD. DEVIATIONS        0.2207   0.2805   0.3406   0.2872   0.1983   0.1578
                           0.1423   0.2084   0.2180   0.2137   0.1310   0.1693

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  -------------------------------------
    TOTALS                 0.0022   0.0020   0.0018   0.0015   0.0019   0.0023
                           0.0024   0.0021   0.0018   0.0019   0.0019   0.0019

    STD. DEVIATIONS        0.0007   0.0009   0.0011   0.0009   0.0006   0.0005
                           0.0004   0.0007   0.0007   0.0007   0.0004   0.0005

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  -------------------------------------
    TOTALS                 0.0015   0.0013   0.0018   0.0021   0.0017   0.0012
                           0.0013   0.0017   0.0019   0.0018   0.0018   0.0019

    STD. DEVIATIONS        0.0010   0.0011   0.0011   0.0009   0.0007   0.0005
                           0.0007   0.0008   0.0008   0.0008   0.0007   0.0007

-------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  -------------------------------------
    AVERAGES               2.9779   3.0110   2.5411   2.0986   2.6662   3.3423
                           3.3435   2.9311   2.5259   2.6857   2.6657   2.5808

    STD. DEVIATIONS        0.9496   1.3480   1.4652   1.2766   0.8530   0.7016
                           0.6124   0.8964   0.9690   0.9196   0.5822   0.7284
*************************************************************************


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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------

                                INCHES            CU. FEET        PERCENT
                          --------------------   -------------   ---------
 PRECIPITATION             37.74    (   0.555)     136996.2      100.00
```

| | | | | | |
|---|---|---|---|---|---|
| RUNOFF | 8.629 | ( 2.6381) | 31321.67 | 22.863 |
| EVAPOTRANSPIRATION | 21.860 | ( 1.9291) | 79351.94 | 57.923 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 7.61043 | ( 1.72326) | 27625.873 | 20.16543 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.02363 | ( 0.00539) | 85.787 | 0.06262 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 2.781 | ( 0.634) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.02004 | ( 0.00693) | 72.741 | 0.05310 |
| CHANGE IN WATER STORAGE | -0.379 | ( 2.7890) | -1376.01 | -1.004 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.97 | 7151.100 |
| RUNOFF | 3.147 | 11424.2100 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.03448 | 125.17932 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000108 | 0.39054 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 4.599 | |
| MAXIMUM HEAD ON TOP OF LAYER 3 | 9.091 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.000107 | 0.38779 |
| SNOW WATER | 4.87 | 17677.5410 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4714 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0470 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 225.4732 | 0.1879 |
| 2 | 2.6186 | 0.1455 |
| 3 | 0.0000 | 0.0000 |
| 4 | 0.1875 | 0.7500 |
| 5 | 2.3580 | 0.3930 |
| 6 | 0.6652 | 0.1109 |
| SNOW WATER | 0.000 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
**************************************************************************
**************************************************************************
```

```
PRECIPITATION DATA FILE:    C:\HELP\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL4SSI1.D10
OUTPUT DATA FILE:           C:\HELP\GCL4SSI1.OUT
```

```
TIME:  16:48     DATE:   1/ 3/2019
```

```
**************************************************************************

     TITLE:  AEP Mitchell - GCL, 10' waste, 25% slopes

**************************************************************************
```

```
     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.
```

```
                              LAYER  1
                              --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =    120.00   INCHES
     POROSITY                     =      0.5410 VOL/VOL
     FIELD CAPACITY               =      0.1870 VOL/VOL
     WILTING POINT                =      0.0470 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.2025 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.130000000000E-02 CM/SEC
```

```
                              LAYER  2
                              --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =     18.00   INCHES
     POROSITY                     =      0.5780 VOL/VOL
     FIELD CAPACITY               =      0.0760 VOL/VOL
     WILTING POINT                =      0.0250 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.1532 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.700000022000E-02 CM/SEC
     SLOPE                        =     25.00   PERCENT
     DRAINAGE LENGTH              =    900.0    FEET
```

```
                              LAYER  3
                              --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  37
     THICKNESS                    =      0.03   INCHES
     POROSITY                     =      0.0000 VOL/VOL
     FIELD CAPACITY               =      0.0000 VOL/VOL
     WILTING POINT                =      0.0000 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.199999999000E-10 CM/SEC
     FML PINHOLE DENSITY          =      2.00   HOLES/ACRE
     FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
     FML PLACEMENT QUALITY        =  3 - GOOD
```

```
                              LAYER  4
                              --------

                TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =      0.25   INCHES
     POROSITY                     =      0.7500 VOL/VOL
     FIELD CAPACITY               =      0.7470 VOL/VOL
     WILTING POINT                =      0.4000 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC
```

```
                              LAYER  5
                              --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =      6.00   INCHES
     POROSITY                     =      0.4450 VOL/VOL
     FIELD CAPACITY               =      0.3930 VOL/VOL
     WILTING POINT                =      0.2770 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.3930 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC
```

```
                              LAYER  6
                              --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   4
     THICKNESS                    =      6.00   INCHES
     POROSITY                     =      0.4370 VOL/VOL
     FIELD CAPACITY               =      0.1050 VOL/VOL
     WILTING POINT                =      0.0470 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.1068 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.170000002000E-02 CM/SEC
```

```
            GENERAL DESIGN AND EVAPORATIVE ZONE DATA
            ---------------------------------------

   NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

  SCS RUNOFF CURVE NUMBER             =     86.00
  FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
  EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
  INITIAL WATER IN EVAPORATIVE ZONE   =      2.332  INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.328  INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.376  INCHES
  INITIAL SNOW WATER                  =      0.000  INCHES
  INITIAL WATER IN LAYER MATERIALS    =     30.249  INCHES
  TOTAL INITIAL WATER                 =     30.249  INCHES
  TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

```
                EVAPOTRANSPIRATION AND WEATHER DATA
                -----------------------------------

   NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            PITTSBURGH            PENNSYLVANIA

       STATION LATITUDE                      =  40.50 DEGREES
       MAXIMUM LEAF AREA INDEX               =   0.00
       START OF GROWING SEASON (JULIAN DATE) =    114
       END OF GROWING SEASON (JULIAN DATE)   =    288
       EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
       AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
       AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
       AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
       AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
       AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %
```

```
   NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

   JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
   -------     -------     -------     -------     -------     -------
     2.86        2.40        3.58        3.28        3.54        3.30
     3.83        3.31        2.80        2.49        2.34        2.57
```

```
   NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

            NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

   JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
   -------     -------     -------     -------     -------     -------
    26.70       28.80       38.50       50.10       59.70       68.10
    72.00       70.60       64.10       52.50       41.60       31.40
```

```
   NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA
              AND STATION LATITUDE  =  40.50 DEGREES
```

```
**************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
--------------------------------------------------------------------------------
                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 3.33     3.14     4.20     2.96     2.68     2.99
                           3.16     3.73     3.70     2.78     2.36     2.71

    STD. DEVIATIONS        0.67     1.06     0.65     0.91     1.22     0.43
                           1.09     1.44     2.42     1.41     0.85     1.13

  RUNOFF
  ------
    TOTALS                 1.984    1.817    3.929    0.411    0.023    0.021
                           0.021    0.139    0.056    0.009    0.001    0.217

    STD. DEVIATIONS        1.555    0.909    2.471    0.464    0.052    0.029
                           0.030    0.135    0.084    0.019    0.002    0.221

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.479    0.493    0.547    2.936    2.088    2.518
                           3.391    2.561    2.171    2.132    1.794    0.747

    STD. DEVIATIONS        0.144    0.158    0.114    0.790    1.294    0.744
                           1.237    0.633    0.787    0.904    0.149    0.274

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  -----------------------------------------
    TOTALS                 0.7829   0.4485   0.3263   0.4278   0.9562   0.8328
                           0.6253   0.4313   0.4677   0.7214   0.7404   0.7600

    STD. DEVIATIONS        0.3378   0.2241   0.2258   0.4180   0.3379   0.2586
                           0.0969   0.1038   0.1611   0.1757   0.4503   0.4349

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  -------------------------------------
    TOTALS                 0.0018   0.0010   0.0007   0.0010   0.0021   0.0019
                           0.0014   0.0010   0.0010   0.0016   0.0017   0.0017

    STD. DEVIATIONS        0.0008   0.0005   0.0005   0.0009   0.0008   0.0006
                           0.0002   0.0002   0.0004   0.0004   0.0010   0.0010

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  -------------------------------------
    TOTALS                 0.0010   0.0015   0.0020   0.0017   0.0007   0.0009
                           0.0014   0.0018   0.0016   0.0011   0.0011   0.0011

    STD. DEVIATIONS        0.0008   0.0005   0.0006   0.0010   0.0004   0.0005
                           0.0004   0.0003   0.0004   0.0006   0.0008   0.0009

--------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
--------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  -------------------------------------
    AVERAGES               2.4342   1.5411   1.0146   1.3744   2.9730   2.6758
                           1.9442   1.3410   1.5025   2.2428   2.3788   2.3631

    STD. DEVIATIONS        1.0502   0.7765   0.7019   1.3430   1.0505   0.8310
                           0.3014   0.3226   0.5175   0.5462   1.4469   1.3523
**************************************************************************
```

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**************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
--------------------------------------------------------------------------------
                                 INCHES            CU. FEET        PERCENT
                          --------------------   -------------   ---------
 PRECIPITATION             37.74    (   0.555)     136996.2      100.00
```

| | | | | | |
|---|---|---|---|---|---|
| RUNOFF | 8.629 | ( 2.6381) | 31321.67 | 22.863 |
| EVAPOTRANSPIRATION | 21.860 | ( 1.9291) | 79351.94 | 57.923 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 7.52055 | ( 1.70338) | 27299.588 | 19.92726 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.01685 | ( 0.00385) | 61.161 | 0.04464 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 1.982 | ( 0.452) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.01580 | ( 0.00361) | 57.358 | 0.04187 |
| CHANGE IN WATER STORAGE | -0.285 | ( 1.8385) | -1034.34 | -0.755 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.97 | 7151.100 |
| RUNOFF | 3.147 | 11424.2100 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.05233 | 189.97421 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000118 | 0.42893 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 5.044 | |
| MAXIMUM HEAD ON TOP OF LAYER 3 | 9.912 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.000085 | 0.30778 |
| SNOW WATER | 4.87 | 17677.5410 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4714 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0470 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 23.4007 | 0.1950 |
| 2 | 2.2322 | 0.1240 |
| 3 | 0.0000 | 0.0000 |
| 4 | 0.1875 | 0.7500 |
| 5 | 2.3580 | 0.3930 |
| 6 | 0.6459 | 0.1077 |
| SNOW WATER | 0.000 | |

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**                                                                     **
**                                                                     **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE            **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)             **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                 **
**                 USAE WATERWAYS EXPERIMENT STATION                   **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                     **
**                                                                     **
*************************************************************************
*************************************************************************

PRECIPITATION DATA FILE:    C:\HELP\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL4SSI2.D10
OUTPUT DATA FILE:           C:\HELP\GCL4SSI2.OUT

TIME:  16:50     DATE:   1/ 3/2019

*************************************************************************

     TITLE:  AEP Mitchell - GCL, 100' waste, 25% slopes

*************************************************************************

     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =   1200.00   INCHES
          POROSITY                     =      0.5410 VOL/VOL
          FIELD CAPACITY               =      0.1870 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1892 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.130000000000E-02 CM/SEC


                                LAYER  2
                                --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =    18.00   INCHES
          POROSITY                     =      0.5780 VOL/VOL
          FIELD CAPACITY               =      0.0760 VOL/VOL
          WILTING POINT                =      0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1627 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999989000E-02 CM/SEC
          SLOPE                        =     25.00   PERCENT
          DRAINAGE LENGTH              =    900.0    FEET


                                LAYER  3
                                --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  37
          THICKNESS                    =      0.03   INCHES
          POROSITY                     =      0.0000 VOL/VOL
          FIELD CAPACITY               =      0.0000 VOL/VOL
          WILTING POINT                =      0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY          =      2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS     =      4.00   HOLES/ACRE
          FML PLACEMENT QUALITY        =  3 - GOOD


                                LAYER  4
                                --------

                  TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =      0.25   INCHES
          POROSITY                     =      0.7500 VOL/VOL
          FIELD CAPACITY               =      0.7470 VOL/VOL
          WILTING POINT                =      0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC


                                LAYER  5
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =      6.00   INCHES
          POROSITY                     =      0.4450 VOL/VOL
          FIELD CAPACITY               =      0.3930 VOL/VOL
          WILTING POINT                =      0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC


                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   4
          THICKNESS                    =      6.00   INCHES
          POROSITY                     =      0.4370 VOL/VOL
          FIELD CAPACITY               =      0.1050 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1079 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.170000002000E-02 CM/SEC


               GENERAL DESIGN AND EVAPORATIVE ZONE DATA
               ---------------------------------------

      NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

     SCS RUNOFF CURVE NUMBER             =     86.00
     FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE   =      2.332  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.328  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.376  INCHES
     INITIAL SNOW WATER                  =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS    =    233.217  INCHES
     TOTAL INITIAL WATER                 =    233.217  INCHES
     TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

      NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
               PITTSBURGH            PENNSYLVANIA

          STATION LATITUDE                    =  40.50 DEGREES
          MAXIMUM LEAF AREA INDEX             =   0.00
          START OF GROWING SEASON (JULIAN DATE) =    114
          END OF GROWING SEASON (JULIAN DATE)   =    288
          EVAPORATIVE ZONE DEPTH              =   8.0  INCHES
          AVERAGE ANNUAL WIND SPEED           =   9.20 MPH
          AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  67.00 %
          AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  63.00 %
          AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  71.00 %
          AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  70.00 %

      NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
               COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

                NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       2.86        2.40        3.58        3.28        3.54        3.30
       3.83        3.31        2.80        2.49        2.34        2.57

      NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
               COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA

            NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      26.70       28.80       38.50       50.10       59.70       68.10
      72.00       70.60       64.10       52.50       41.60       31.40

      NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
               COEFFICIENTS FOR    PITTSBURGH          PENNSYLVANIA
                 AND STATION LATITUDE  =  40.50 DEGREES

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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 3.33     3.14     4.20     2.96     2.68     2.99
                           3.16     3.73     3.70     2.78     2.36     2.71

    STD. DEVIATIONS        0.67     1.06     0.65     0.91     1.22     0.43
                           1.09     1.44     2.42     1.41     0.85     1.13

  RUNOFF
  ------
    TOTALS                 1.984    1.817    3.929    0.411    0.023    0.021
                           0.021    0.139    0.056    0.009    0.001    0.217

    STD. DEVIATIONS        1.555    0.909    2.471    0.464    0.052    0.029
                           0.030    0.135    0.084    0.019    0.002    0.221

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.479    0.493    0.547    2.936    2.088    2.518
                           3.391    2.561    2.171    2.132    1.794    0.747

    STD. DEVIATIONS        0.144    0.158    0.114    0.790    1.294    0.744
                           1.237    0.633    0.787    0.904    0.149    0.274

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  ----------------------------------------
    TOTALS                 0.6917   0.6331   0.5915   0.4735   0.6193   0.7502
                           0.7761   0.6816   0.5691   0.6246   0.5999   0.6002

    STD. DEVIATIONS        0.2193   0.2788   0.3388   0.2864   0.1987   0.1584
                           0.1424   0.2073   0.2172   0.2130   0.1299   0.1682

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  --------------------------------------
    TOTALS                 0.0022   0.0020   0.0019   0.0015   0.0019   0.0024
                           0.0024   0.0021   0.0018   0.0020   0.0019   0.0019

    STD. DEVIATIONS        0.0007   0.0009   0.0011   0.0009   0.0006   0.0005
                           0.0005   0.0007   0.0007   0.0007   0.0004   0.0005

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  --------------------------------------
    TOTALS                 0.0015   0.0014   0.0018   0.0021   0.0017   0.0012
                           0.0013   0.0017   0.0019   0.0019   0.0018   0.0019

    STD. DEVIATIONS        0.0010   0.0011   0.0011   0.0010   0.0007   0.0006
                           0.0007   0.0009   0.0008   0.0008   0.0007   0.0007

-------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  -------------------------------------
    AVERAGES               3.0111   3.0451   2.5747   2.1297   2.6958   3.3744
                           3.3785   2.9669   2.5599   2.7187   2.6981   2.6125

    STD. DEVIATIONS        0.9546   1.3556   1.4749   1.2884   0.8651   0.7124
                           0.6200   0.9025   0.9768   0.9273   0.5842   0.7322

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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------

                                INCHES              CU. FEET        PERCENT
                          --------------------   -------------   ---------
 PRECIPITATION             37.74    (   0.555)     136996.2      100.00
```

| | | | | | |
|---|---|---|---|---|---|
| RUNOFF | 8.629 | ( 2.6381) | 31321.67 | 22.863 |
| EVAPOTRANSPIRATION | 21.860 | ( 1.9291) | 79351.94 | 57.923 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 7.61080 | ( 1.72319) | 27627.213 | 20.16641 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.02392 | ( 0.00545) | 86.814 | 0.06337 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 2.814 | ( 0.641) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.02023 | ( 0.00706) | 73.445 | 0.05361 |
| CHANGE IN WATER STORAGE | -0.380 | ( 2.7902) | -1378.04 | -1.006 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 1.97 | 7151.100 |
| RUNOFF | 3.147 | 11424.2100 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.03443 | 124.97035 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000109 | 0.39455 |
| AVERAGE HEAD ON TOP OF LAYER 3 | 4.646 | |
| MAXIMUM HEAD ON TOP OF LAYER 3 | 9.147 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 6 | 0.000108 | 0.39155 |
| SNOW WATER | 4.87 | 17677.5410 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4714 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0470 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 225.4732 | 0.1879 |
| 2 | 2.6339 | 0.1463 |
| 3 | 0.0000 | 0.0000 |
| 4 | 0.1875 | 0.7500 |
| 5 | 2.3580 | 0.3930 |
| 6 | 0.6659 | 0.1110 |
| SNOW WATER | 0.000 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
**************************************************************************
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PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCLFLF1.D10
OUTPUT DATA FILE:           C:\HELP\GCLFLF1.OUT


TIME:  16:54     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 10' waste, 5% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =   120.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1916 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.4170 VOL/VOL
          FIELD CAPACITY              =     0.0450 VOL/VOL
          WILTING POINT               =     0.0180 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0944 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.124999997000E-02 CM/SEC
          SLOPE                       =     5.00   PERCENT
          DRAINAGE LENGTH             =    60.0    FEET



                                LAYER  4
                                --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD



                                LAYER  5
                                --------

                    TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1055 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC



                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =     37.626  INCHES
          TOTAL INITIAL WATER                 =     37.626  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2723   0.3085   0.2615   0.2424   0.3157   0.2447
                           0.1812   0.1249   0.0920   0.0834   0.0915   0.1533

    STD. DEVIATIONS        0.1699   0.2352   0.2415   0.1660   0.1550   0.1363
                           0.0984   0.0689   0.0590   0.0629   0.0733   0.1043

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0011   0.0012   0.0010   0.0010   0.0012   0.0010
                           0.0007   0.0005   0.0004   0.0003   0.0004   0.0006

    STD. DEVIATIONS        0.0007   0.0009   0.0010   0.0007   0.0006   0.0005
                           0.0004   0.0003   0.0002   0.0002   0.0003   0.0004

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0006   0.0004   0.0006   0.0007   0.0007   0.0009
                           0.0010   0.0011   0.0010   0.0009   0.0008   0.0007

    STD. DEVIATIONS        0.0004   0.0004   0.0005   0.0004   0.0004   0.0004
                           0.0005   0.0006   0.0007   0.0008   0.0007   0.0005

------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.4910   1.8516   1.4322   1.3715   1.7286   1.3846
                           0.9920   0.6842   0.5206   0.4566   0.5178   0.8397
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.9305 | 1.4082 | 1.3223 | 0.9392 | 0.8488 | 0.7710 |
| | 0.5389 | 0.3773 | 0.3339 | 0.3442 | 0.4146 | 0.5712 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37136 | ( 1.12867) | 8608.032 | 6.45768 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.00934 | ( 0.00447) | 33.902 | 0.02543 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 1.106 | ( 0.529) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00937 | ( 0.00362) | 34.012 | 0.02552 |
| CHANGE IN WATER STORAGE | -0.009 | ( 1.5727) | -30.97 | -0.023 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.03943 | 143.11752 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000158 | 0.57195 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 6.693 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.174 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 18.8 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000079 | 0.28500 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 22.4400 | 0.1870 |
| 3 | 1.3395 | 0.0744 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
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PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCLFLF2.D10
OUTPUT DATA FILE:           C:\HELP\GCLFLF2.OUT


TIME:  17:11     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 100' waste, 5% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =  1200.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1875 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.4170 VOL/VOL
          FIELD CAPACITY              =     0.0450 VOL/VOL
          WILTING POINT               =     0.0180 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1068 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
          SLOPE                       =     5.00   PERCENT
          DRAINAGE LENGTH             =    60.0    FEET



                                LAYER  4
                                --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD



                                LAYER  5
                                --------

                    TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1059 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC



                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =    239.819  INCHES
          TOTAL INITIAL WATER                 =    239.819  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
--------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2099   0.2488   0.2574   0.2488   0.3075   0.2652
                           0.2130   0.1582   0.1180   0.1035   0.1010   0.1396

    STD. DEVIATIONS        0.1141   0.1505   0.1965   0.1729   0.1508   0.1518
                           0.1327   0.1053   0.0784   0.0696   0.0675   0.0822

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0010   0.0012   0.0013   0.0012   0.0015   0.0013
                           0.0010   0.0008   0.0006   0.0005   0.0005   0.0007

    STD. DEVIATIONS        0.0006   0.0007   0.0010   0.0009   0.0008   0.0008
                           0.0007   0.0005   0.0004   0.0003   0.0003   0.0004

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0009   0.0006   0.0007   0.0008   0.0007   0.0008
                           0.0011   0.0013   0.0013   0.0013   0.0011   0.0011

    STD. DEVIATIONS        0.0006   0.0006   0.0006   0.0005   0.0005   0.0005
                           0.0005   0.0006   0.0006   0.0007   0.0007   0.0007

--------------------------------------------------------------------------
        AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
--------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.4369   1.8676   1.7618   1.7599   2.1045   1.8761
                           1.4581   1.0830   0.8344   0.7082   0.7142   0.9557
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.7811 | 1.1272 | 1.3452 | 1.2233 | 1.0324 | 1.0738 |
| | 0.9084 | 0.7211 | 0.5542 | 0.4762 | 0.4778 | 0.5628 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37083 | ( 1.12136) | 8606.123 | 6.45625 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.01168 | ( 0.00556) | 42.395 | 0.03180 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 1.380 | ( 0.653) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.01174 | ( 0.00448) | 42.601 | 0.03196 |
| CHANGE IN WATER STORAGE | -0.010 | ( 1.5938) | -37.65 | -0.028 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.03174 | 115.20315 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000159 | 0.57556 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 6.734 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.219 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 18.8 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000098 | 0.35659 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 224.4000 | 0.1870 |
| 3 | 1.3880 | 0.0771 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
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PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCLFLF3.D10
OUTPUT DATA FILE:           C:\HELP\GCLFLF3.OUT


TIME:  17:13     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 250' waste, 5% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =  3000.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1872 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.4170 VOL/VOL
          FIELD CAPACITY              =     0.0450 VOL/VOL
          WILTING POINT               =     0.0180 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1071 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
          SLOPE                       =     5.00   PERCENT
          DRAINAGE LENGTH             =    60.0    FEET



                                LAYER  4
                                --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD



                                LAYER  5
                                --------

                  TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1059 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC



                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =    576.423  INCHES
          TOTAL INITIAL WATER                 =    576.423  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
--------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2084   0.2464   0.2560   0.2481   0.3072   0.2663
                           0.2141   0.1598   0.1192   0.1043   0.1015   0.1395

    STD. DEVIATIONS        0.1132   0.1476   0.1928   0.1707   0.1500   0.1523
                           0.1328   0.1101   0.0823   0.0717   0.0684   0.0822

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0010   0.0012   0.0013   0.0012   0.0015   0.0013
                           0.0011   0.0008   0.0006   0.0005   0.0005   0.0007

    STD. DEVIATIONS        0.0006   0.0007   0.0010   0.0008   0.0007   0.0008
                           0.0007   0.0005   0.0004   0.0004   0.0003   0.0004

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0009   0.0006   0.0007   0.0008   0.0007   0.0008
                           0.0011   0.0013   0.0013   0.0013   0.0011   0.0011

    STD. DEVIATIONS        0.0006   0.0006   0.0006   0.0005   0.0005   0.0005
                           0.0005   0.0006   0.0006   0.0007   0.0007   0.0007

--------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
--------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.4266   1.8497   1.7522   1.7551   2.1026   1.8836
                           1.4657   1.0939   0.8432   0.7141   0.7177   0.9552
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.7747 | 1.1058 | 1.3196 | 1.2074 | 1.0267 | 1.0771 |
| | 0.9090 | 0.7533 | 0.5825 | 0.4909 | 0.4836 | 0.5624 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37087 | ( 1.12015) | 8606.268 | 6.45636 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.01168 | ( 0.00555) | 42.395 | 0.03180 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 1.380 | ( 0.652) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.01174 | ( 0.00451) | 42.600 | 0.03196 |
| CHANGE IN WATER STORAGE | -0.010 | ( 1.5936) | -37.79 | -0.028 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.03117 | 113.14462 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000156 | 0.56507 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 6.614 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.086 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 18.7 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000099 | 0.35764 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 561.0000 | 0.1870 |
| 3 | 1.3884 | 0.0771 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**           FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                      **
**                                                                      **
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PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL3SSF1.D10
OUTPUT DATA FILE:           C:\HELP\GCL3SSF1.OUT


TIME:  17:17     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 10' waste, 33% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =   120.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1916 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.5780 VOL/VOL
          FIELD CAPACITY              =     0.0760 VOL/VOL
          WILTING POINT               =     0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1233 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.449999981000E-02 CM/SEC
          SLOPE                       =    33.00   PERCENT
          DRAINAGE LENGTH             =   900.0    FEET



                                LAYER  4
                                --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD



                                LAYER  5
                                --------

                    TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1051 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC



                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =     38.144  INCHES
          TOTAL INITIAL WATER                 =     38.144  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
--------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2794   0.3152   0.2623   0.2428   0.3190   0.2437
                           0.1772   0.1200   0.0879   0.0803   0.0904   0.1556

    STD. DEVIATIONS        0.1761   0.2438   0.2470   0.1667   0.1569   0.1378
                           0.0985   0.0683   0.0590   0.0639   0.0755   0.1080

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0008   0.0009   0.0007   0.0007   0.0009   0.0007
                           0.0005   0.0003   0.0002   0.0002   0.0002   0.0004

    STD. DEVIATIONS        0.0005   0.0007   0.0007   0.0005   0.0004   0.0004
                           0.0003   0.0002   0.0002   0.0002   0.0002   0.0003

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0005   0.0004   0.0005   0.0006   0.0007   0.0007
                           0.0007   0.0006   0.0005   0.0004   0.0004   0.0005

    STD. DEVIATIONS        0.0003   0.0003   0.0004   0.0004   0.0003   0.0004
                           0.0005   0.0006   0.0005   0.0005   0.0004   0.0004

--------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
--------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.0685   1.3210   1.0031   0.9594   1.2198   0.9628
                           0.6778   0.4591   0.3473   0.3073   0.3572   0.5952
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.6736 | 1.0191 | 0.9447 | 0.6589 | 0.6000 | 0.5446 |
| | 0.3767 | 0.2611 | 0.2332 | 0.2445 | 0.2984 | 0.4129 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37389 | ( 1.13098) | 8617.235 | 6.46459 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.00652 | ( 0.00312) | 23.663 | 0.01775 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 0.773 | ( 0.370) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00653 | ( 0.00297) | 23.694 | 0.01777 |
| CHANGE IN WATER STORAGE | -0.008 | ( 1.5701) | -29.85 | -0.022 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.04043 | 146.76697 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000112 | 0.40726 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 4.793 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.466 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000068 | 0.24637 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 22.4400 | 0.1870 |
| 3 | 1.8880 | 0.1049 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
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**************************************************************************


PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL3SSF2.D10
OUTPUT DATA FILE:           C:\HELP\GCL3SSF2.OUT


TIME:  17:22     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 100' waste, 33% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =    24.00   INCHES
          POROSITY                      =     0.4450 VOL/VOL
          FIELD CAPACITY                =     0.3930 VOL/VOL
          WILTING POINT                 =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT    =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =  1200.00   INCHES
          POROSITY                      =     0.5410 VOL/VOL
          FIELD CAPACITY                =     0.1870 VOL/VOL
          WILTING POINT                 =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT    =     0.1875 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =    18.00   INCHES
          POROSITY                      =     0.5780 VOL/VOL
          FIELD CAPACITY                =     0.0760 VOL/VOL
          WILTING POINT                 =     0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT    =     0.1367 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.350000011000E-02 CM/SEC
          SLOPE                         =    33.00   PERCENT
          DRAINAGE LENGTH               =   900.0    FEET



                                LAYER  4
                                --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  37
          THICKNESS                     =     0.03   INCHES
          POROSITY                      =     0.0000 VOL/VOL
          FIELD CAPACITY                =     0.0000 VOL/VOL
          WILTING POINT                 =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT    =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY           =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS      =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY         =  3 - GOOD



                                LAYER  5
                                --------

                     TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =     0.25   INCHES
          POROSITY                      =     0.7500 VOL/VOL
          FIELD CAPACITY                =     0.7470 VOL/VOL
          WILTING POINT                 =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT    =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                     =     6.00   INCHES
          POROSITY                      =     0.4450 VOL/VOL
          FIELD CAPACITY                =     0.3930 VOL/VOL
          WILTING POINT                 =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT    =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   4
          THICKNESS                     =     6.00   INCHES
          POROSITY                      =     0.4370 VOL/VOL
          FIELD CAPACITY                =     0.1050 VOL/VOL
          WILTING POINT                 =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT    =     0.1052 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.170000002000E-02 CM/SEC



                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =    240.351  INCHES
          TOTAL INITIAL WATER                 =    240.351  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2119   0.2517   0.2592   0.2501   0.3098   0.2660
                           0.2120   0.1562   0.1158   0.1016   0.0998   0.1398

    STD. DEVIATIONS        0.1162   0.1536   0.2001   0.1751   0.1522   0.1534
                           0.1336   0.1055   0.0780   0.0695   0.0681   0.0835

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0007   0.0009   0.0009   0.0009   0.0011   0.0009
                           0.0007   0.0006   0.0004   0.0004   0.0004   0.0005

    STD. DEVIATIONS        0.0004   0.0005   0.0007   0.0006   0.0005   0.0005
                           0.0005   0.0004   0.0003   0.0002   0.0002   0.0003

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0007   0.0005   0.0006   0.0006   0.0007   0.0007
                           0.0008   0.0008   0.0008   0.0008   0.0007   0.0007

    STD. DEVIATIONS        0.0004   0.0004   0.0005   0.0004   0.0003   0.0004
                           0.0004   0.0006   0.0006   0.0007   0.0006   0.0005

------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.0421   1.3567   1.2742   1.2708   1.5231   1.3513
                           1.0425   0.7681   0.5885   0.4994   0.5072   0.6876
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.5713 | 0.8262 | 0.9838 | 0.8896 | 0.7482 | 0.7793 |
| | 0.6568 | 0.5187 | 0.3964 | 0.3417 | 0.3461 | 0.4106 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37397 | ( 1.12548) | 8617.527 | 6.46481 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.00838 | ( 0.00399) | 30.435 | 0.02283 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 0.993 | ( 0.471) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00839 | ( 0.00347) | 30.471 | 0.02286 |
| CHANGE IN WATER STORAGE | -0.010 | ( 1.5949) | -36.92 | -0.028 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.03203 | 116.26259 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000114 | 0.41490 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 4.882 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.625 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000071 | 0.25935 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 224.4000 | 0.1870 |
| 3 | 1.9404 | 0.1078 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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**************************************************************************
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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
**************************************************************************
**************************************************************************


PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL3SSF3.D10
OUTPUT DATA FILE:           C:\HELP\GCL3SSF3.OUT


TIME:  17:25     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 250' waste, 33% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =  3000.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1872 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.5780 VOL/VOL
          FIELD CAPACITY              =     0.0760 VOL/VOL
          WILTING POINT               =     0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1369 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.350000011000E-02 CM/SEC
          SLOPE                       =    33.00   PERCENT
          DRAINAGE LENGTH             =   900.0    FEET



                                LAYER  4
                                --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD



                                LAYER  5
                                --------

                   TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1052 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC



                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =    576.956  INCHES
          TOTAL INITIAL WATER                 =    576.956  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                     EVAPOTRANSPIRATION AND WEATHER DATA
                     -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                    =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX             =   0.00
              START OF GROWING SEASON (JULIAN DATE) =   114
              END OF GROWING SEASON (JULIAN DATE)   =   288
              EVAPORATIVE ZONE DEPTH              =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED           =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2104   0.2492   0.2577   0.2495   0.3095   0.2671
                           0.2132   0.1579   0.1171   0.1024   0.1003   0.1397

    STD. DEVIATIONS        0.1152   0.1506   0.1963   0.1729   0.1514   0.1539
                           0.1337   0.1104   0.0821   0.0716   0.0689   0.0834

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0007   0.0009   0.0009   0.0009   0.0011   0.0009
                           0.0008   0.0006   0.0004   0.0004   0.0004   0.0005

    STD. DEVIATIONS        0.0004   0.0005   0.0007   0.0006   0.0005   0.0005
                           0.0005   0.0004   0.0003   0.0003   0.0002   0.0003

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0007   0.0005   0.0006   0.0006   0.0007   0.0007
                           0.0008   0.0008   0.0008   0.0008   0.0007   0.0007

    STD. DEVIATIONS        0.0004   0.0004   0.0005   0.0004   0.0003   0.0004
                           0.0004   0.0006   0.0006   0.0007   0.0006   0.0005

------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.0345   1.3435   1.2672   1.2674   1.5218   1.3569
                           1.0481   0.7761   0.5949   0.5036   0.5097   0.6871
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.5666 | 0.8104 | 0.9650 | 0.8782 | 0.7442 | 0.7820 |
| | 0.6573 | 0.5428 | 0.4171 | 0.3522 | 0.3501 | 0.4102 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37402 | ( 1.12436) | 8617.676 | 6.46492 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.00838 | ( 0.00399) | 30.435 | 0.02283 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 0.993 | ( 0.470) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00839 | ( 0.00348) | 30.470 | 0.02286 |
| CHANGE IN WATER STORAGE | -0.010 | ( 1.5948) | -37.07 | -0.028 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.03145 | 114.17583 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000112 | 0.40734 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 4.794 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.470 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000072 | 0.25997 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 561.0000 | 0.1870 |
| 3 | 1.9408 | 0.1078 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
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PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL4SSF1.D10
OUTPUT DATA FILE:           C:\HELP\GCL4SSF1.OUT

TIME:  17:28     DATE:   1/ 3/2019

**************************************************************************

     TITLE:  AEP Mitchell - GCL, 10' waste, 25% slopes, cap

**************************************************************************

     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                              LAYER  1
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC


                              LAYER  2
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =   120.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1916 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC


                              LAYER  3
                              --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.5780 VOL/VOL
          FIELD CAPACITY              =     0.0760 VOL/VOL
          WILTING POINT               =     0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1214 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.600000005000E-02 CM/SEC
          SLOPE                       =    25.00   PERCENT
          DRAINAGE LENGTH             =   900.0    FEET


                              LAYER  4
                              --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD


                              LAYER  5
                              --------

                    TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC


                              LAYER  6
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC


                              LAYER  7
                              --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1051 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC


                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =     38.111  INCHES
          TOTAL INITIAL WATER                 =     38.111  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


                    EVAPOTRANSPIRATION AND WEATHER DATA
                    -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



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        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2858   0.3209   0.2625   0.2428   0.3216   0.2423
                           0.1734   0.1155   0.0842   0.0777   0.0895   0.1578

    STD. DEVIATIONS        0.1817   0.2514   0.2517   0.1670   0.1586   0.1392
                           0.0986   0.0677   0.0591   0.0650   0.0776   0.1113

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0007   0.0008   0.0007   0.0006   0.0008   0.0006
                           0.0005   0.0003   0.0002   0.0002   0.0002   0.0004

    STD. DEVIATIONS        0.0005   0.0007   0.0007   0.0004   0.0004   0.0004
                           0.0003   0.0002   0.0002   0.0002   0.0002   0.0003

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0005   0.0004   0.0005   0.0006   0.0007   0.0007
                           0.0007   0.0006   0.0004   0.0003   0.0003   0.0004

    STD. DEVIATIONS        0.0003   0.0003   0.0004   0.0004   0.0003   0.0004
                           0.0005   0.0006   0.0005   0.0005   0.0004   0.0003

------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.0368   1.2758   0.9520   0.9100   1.1666   0.9081
                           0.6289   0.4188   0.3156   0.2819   0.3355   0.5725
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.6592 | 0.9969 | 0.9128 | 0.6261 | 0.5751 | 0.5216 |
| | 0.3575 | 0.2457 | 0.2216 | 0.2357 | 0.2908 | 0.4037 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37398 | ( 1.13170) | 8617.535 | 6.46481 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.00618 | ( 0.00296) | 22.446 | 0.01684 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 0.734 | ( 0.351) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00619 | ( 0.00284) | 22.474 | 0.01686 |
| CHANGE IN WATER STORAGE | -0.008 | ( 1.5670) | -28.93 | -0.022 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.04129 | 149.89175 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000109 | 0.39436 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 4.643 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.135 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000067 | 0.24473 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 22.4400 | 0.1870 |
| 3 | 1.8798 | 0.1044 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
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PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL4SSF2.D10
OUTPUT DATA FILE:           C:\HELP\GCL4SSF2.OUT


TIME:  17:32     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 100' waste, 25% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =    24.00   INCHES
          POROSITY                     =     0.4450 VOL/VOL
          FIELD CAPACITY               =     0.3930 VOL/VOL
          WILTING POINT                =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT   =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =  1200.00   INCHES
          POROSITY                     =     0.5410 VOL/VOL
          FIELD CAPACITY               =     0.1870 VOL/VOL
          WILTING POINT                =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =     0.1875 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =    18.00   INCHES
          POROSITY                     =     0.5780 VOL/VOL
          FIELD CAPACITY               =     0.0760 VOL/VOL
          WILTING POINT                =     0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT   =     0.1361 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.449999981000E-02 CM/SEC
          SLOPE                        =    25.00   PERCENT
          DRAINAGE LENGTH              =   900.0    FEET



                                LAYER  4
                                --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  37
          THICKNESS                    =     0.03   INCHES
          POROSITY                     =     0.0000 VOL/VOL
          FIELD CAPACITY               =     0.0000 VOL/VOL
          WILTING POINT                =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT   =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY          =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS     =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY        =  3 - GOOD



                                LAYER  5
                                --------

                  TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =     0.25   INCHES
          POROSITY                     =     0.7500 VOL/VOL
          FIELD CAPACITY               =     0.7470 VOL/VOL
          WILTING POINT                =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT   =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =     6.00   INCHES
          POROSITY                     =     0.4450 VOL/VOL
          FIELD CAPACITY               =     0.3930 VOL/VOL
          WILTING POINT                =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT   =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   4
          THICKNESS                    =     6.00   INCHES
          POROSITY                     =     0.4370 VOL/VOL
          FIELD CAPACITY               =     0.1050 VOL/VOL
          WILTING POINT                =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =     0.1052 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.170000002000E-02 CM/SEC



                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =    240.340  INCHES
          TOTAL INITIAL WATER                 =    240.340  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



**************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2130   0.2531   0.2599   0.2507   0.3108   0.2662
                           0.2113   0.1550   0.1146   0.1005   0.0992   0.1399

    STD. DEVIATIONS        0.1173   0.1552   0.2019   0.1762   0.1528   0.1542
                           0.1340   0.1055   0.0778   0.0694   0.0684   0.0842

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0007   0.0009   0.0009   0.0009   0.0011   0.0009
                           0.0007   0.0005   0.0004   0.0003   0.0003   0.0005

    STD. DEVIATIONS        0.0004   0.0005   0.0007   0.0006   0.0005   0.0005
                           0.0005   0.0004   0.0003   0.0002   0.0002   0.0003

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0007   0.0005   0.0006   0.0006   0.0007   0.0007
                           0.0008   0.0008   0.0008   0.0007   0.0006   0.0007

    STD. DEVIATIONS        0.0004   0.0004   0.0005   0.0004   0.0003   0.0004
                           0.0004   0.0006   0.0006   0.0007   0.0006   0.0005

------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.0300   1.3420   1.2572   1.2528   1.5034   1.3302
                           1.0221   0.7497   0.5727   0.4859   0.4956   0.6766
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.5673 | 0.8212 | 0.9766 | 0.8804 | 0.7390 | 0.7705 |
| | 0.6479 | 0.5103 | 0.3887 | 0.3358 | 0.3419 | 0.4072 |

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37403 | ( 1.12686) | 8617.722 | 6.46495 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.00825 | ( 0.00393) | 29.939 | 0.02246 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 0.976 | ( 0.464) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00826 | ( 0.00344) | 29.974 | 0.02249 |
| CHANGE IN WATER STORAGE | -0.010 | ( 1.5949) | -36.62 | -0.027 |

**********

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.03216 | 116.75305 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000113 | 0.40978 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 4.822 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.482 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000071 | 0.25644 |
| SNOW WATER | 5.36 | 19474.3164 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4442 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.2770 |

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

**********

**********

FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 224.4000 | 0.1870 |
| 3 | 1.9374 | 0.1076 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

**********
**********

```
**************************************************************************
**************************************************************************
**                                                                      **
**                                                                      **
**            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**               DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                 USAE WATERWAYS EXPERIMENT STATION                    **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                      **
**                                                                      **
**************************************************************************
**************************************************************************


PRECIPITATION DATA FILE:    C:\HELP\PITBGH.D4
TEMPERATURE DATA FILE:      C:\HELP\PITBGH.D7
SOLAR RADIATION DATA FILE:  C:\HELP\PITBGH.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\PITBGH.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\GCL4SSF3.D10
OUTPUT DATA FILE:           C:\HELP\GCL4SSF3.OUT


TIME:  17:37     DATE:   1/ 3/2019


**************************************************************************

     TITLE:  AEP Mitchell - GCL, 250' waste, 25% slopes, cap

**************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    24.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.4065 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  2
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =  3000.00   INCHES
          POROSITY                    =     0.5410 VOL/VOL
          FIELD CAPACITY              =     0.1870 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1872 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.130000000000E-02 CM/SEC



                                LAYER  3
                                --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =    18.00   INCHES
          POROSITY                    =     0.5780 VOL/VOL
          FIELD CAPACITY              =     0.0760 VOL/VOL
          WILTING POINT               =     0.0250 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1363 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.449999981000E-02 CM/SEC
          SLOPE                       =    25.00   PERCENT
          DRAINAGE LENGTH             =   900.0    FEET



                                LAYER  4
                                --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =     0.03   INCHES
          POROSITY                    =     0.0000 VOL/VOL
          FIELD CAPACITY              =     0.0000 VOL/VOL
          WILTING POINT               =     0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =     2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =     4.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  3 - GOOD



                                LAYER  5
                                --------

                  TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     0.25   INCHES
          POROSITY                    =     0.7500 VOL/VOL
          FIELD CAPACITY              =     0.7470 VOL/VOL
          WILTING POINT               =     0.4000 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.7500 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



                                LAYER  6
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4450 VOL/VOL
          FIELD CAPACITY              =     0.3930 VOL/VOL
          WILTING POINT               =     0.2770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.3930 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC



                                LAYER  7
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   4
          THICKNESS                   =     6.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.1050 VOL/VOL
          WILTING POINT               =     0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.1052 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC



                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ---------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

          SCS RUNOFF CURVE NUMBER             =     86.00
          FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE   =      3.468  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.560  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE  =      2.216  INCHES
          INITIAL SNOW WATER                  =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS    =    576.945  INCHES
          TOTAL INITIAL WATER                 =    576.945  INCHES
          TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                   PITTSBURGH            PENNSYLVANIA

              STATION LATITUDE                      =  40.50 DEGREES
              MAXIMUM LEAF AREA INDEX               =   0.00
              START OF GROWING SEASON (JULIAN DATE) =    114
              END OF GROWING SEASON (JULIAN DATE)   =    288
              EVAPORATIVE ZONE DEPTH                =   8.0  INCHES
              AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
              AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
              AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  63.00 %
              AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  71.00 %
              AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  70.00 %


          NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                   NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
          2.86        2.40        3.58        3.28        3.54        3.30
          3.83        3.31        2.80        2.49        2.34        2.57


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA

                NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

        JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
        -------     -------     -------     -------     -------     -------
         26.70       28.80       38.50       50.10       59.70       68.10
         72.00       70.60       64.10       52.50       41.60       31.40


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR    PITTSBURGH           PENNSYLVANIA
                     AND STATION LATITUDE  =  40.50 DEGREES



**************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH  100
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.88     2.32     3.65     3.47     3.44     3.30
                           3.84     3.44     2.68     2.56     2.43     2.71

    STD. DEVIATIONS        1.10     0.89     1.06     1.28     1.56     1.20
                           1.61     1.77     1.45     1.23     0.95     1.00

  RUNOFF
  ------
    TOTALS                 1.269    2.055    3.449    0.887    0.874    0.883
                           1.375    1.332    0.948    0.645    0.365    0.500

    STD. DEVIATIONS        1.207    1.393    1.791    0.754    0.660    0.629
                           1.037    1.103    0.836    0.582    0.411    0.661

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.603    0.467    1.022    2.826    2.477    2.315
                           2.485    2.087    1.607    1.633    1.349    0.896

    STD. DEVIATIONS        0.184    0.144    0.610    0.765    1.029    0.890
                           0.901    0.811    0.806    0.600    0.327    0.246

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  -----------------------------------------
    TOTALS                 0.2114   0.2506   0.2585   0.2500   0.3106   0.2673
                           0.2125   0.1567   0.1158   0.1013   0.0996   0.1398

    STD. DEVIATIONS        0.1163   0.1522   0.1981   0.1739   0.1520   0.1547
                           0.1341   0.1105   0.0819   0.0715   0.0692   0.0841

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  -------------------------------------
    TOTALS                 0.0007   0.0009   0.0009   0.0009   0.0011   0.0009
                           0.0007   0.0005   0.0004   0.0004   0.0003   0.0005

    STD. DEVIATIONS        0.0004   0.0005   0.0007   0.0006   0.0005   0.0005
                           0.0005   0.0004   0.0003   0.0002   0.0002   0.0003

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  -------------------------------------
    TOTALS                 0.0007   0.0005   0.0006   0.0006   0.0007   0.0007
                           0.0008   0.0008   0.0008   0.0007   0.0006   0.0007

    STD. DEVIATIONS        0.0004   0.0004   0.0005   0.0004   0.0003   0.0004
                           0.0004   0.0006   0.0006   0.0007   0.0006   0.0005

------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               1.0223   1.3289   1.2503   1.2495   1.5021   1.3358
                           1.0277   0.7577   0.5790   0.4901   0.4980   0.6761
```

| | | | | | | |
|---|---|---|---|---|---|---|
| STD. DEVIATIONS | 0.5625 | 0.8055 | 0.9580 | 0.8691 | 0.7351 | 0.7732 |
| | 0.6485 | 0.5345 | 0.4093 | 0.3460 | 0.3457 | 0.4066 |

**********

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 36.72 | ( 4.356) | 133299.0 | 100.00 |
| RUNOFF | 14.582 | ( 2.9123) | 52931.12 | 39.709 |
| EVAPOTRANSPIRATION | 19.768 | ( 2.2736) | 71756.85 | 53.831 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 3 | 2.37407 | ( 1.12580) | 8617.873 | 6.46507 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.00825 | ( 0.00393) | 29.939 | 0.02246 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 0.976 | ( 0.463) | | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.00826 | ( 0.00345) | 29.973 | 0.02249 |
| CHANGE IN WATER STORAGE | -0.010 | ( 1.5948) | -36.77 | -0.028 |

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.44 | 16117.200 |
| RUNOFF | 4.061 | 14741.8955 |
| DRAINAGE COLLECTED FROM LAYER 3 | 0.03158 | 114.65276 |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.000111 | 0.40231 |
| AVERAGE HEAD ON TOP OF LAYER 4 | 4.736 | |
| MAXIMUM HEAD ON TOP OF LAYER 4 | 9.320 | |
| LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN) | 0.0 FEET | |
| PERCOLATION/LEAKAGE THROUGH LAYER 7 | 0.000071 | 0.25705 |
| SNOW WATER | 5.36 | 19474.3164 |

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4442

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2770

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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**********

FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 9.8034 | 0.4085 |
| 2 | 561.0000 | 0.1870 |
| 3 | 1.9378 | 0.1077 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.1875 | 0.7500 |
| 6 | 2.3580 | 0.3930 |
| 7 | 0.6300 | 0.1050 |
| SNOW WATER | 0.015 | |

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# APPENDIX C

# SUPPORTING FIGURES

**(Select drawings taken from the Solid Waste/NPDES Permit Application for the Mitchell Landfill)**

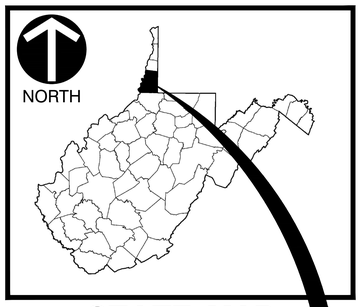
DWG NO: 12-30110-01-B

# MITCHELL LANDFILL
# MARSHALL COUNTY, WEST VIRGINIA

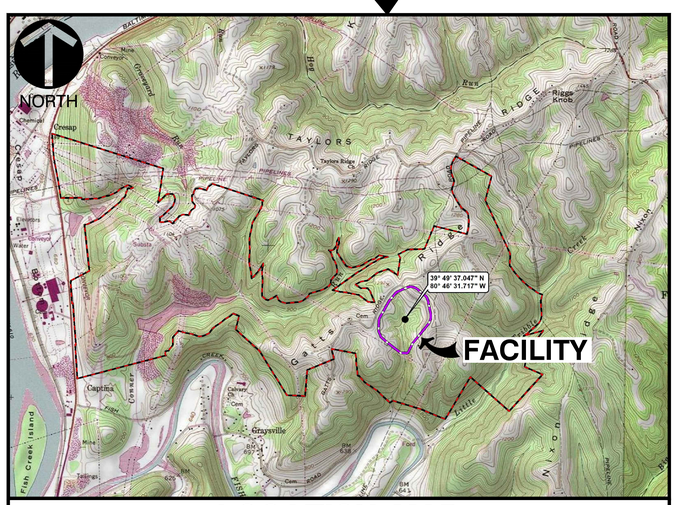
# RUN-ON, RUN-OFF CONTROL PLAN

## REVISION NO. 1

| SHEET INDEX | |
|---|---|
| DRAWING NO. | SHEET TITLE |
| 12-30110-01-B | TITLE SHEET |
| 12-30110-13-B | GENERAL PHASING PLAN |
| 12-30110-15-B | LINER PLAN WITH LEACHATE COLLECTION SYSTEM |
| 12-30110-16-A | LEACHATE COLLECTION SYSTEM LAYOUT |
| 12-30110-18-B | TOP OF FINAL COVER PLAN |
| 12-30110-21-B | PHASE 1 TOP OF LINER PLAN |
| 12-30110-22-B | PHASE 1 TOP OF WASTE AND PHASE 2 TOP OF LINER |
| 12-30110-23-B | PHASE 2 TOP OF WASTE AND PHASE 3 TOP OF LINER |
| 12-30110-24-B | PHASE 3 TOP OF WASTE AND PHASE 4 TOP OF LINER |
| 12-30110-25-B | PHASE 4 TOP OF WASTE |
| 12-30110-26-B | PHASE 5 TOP OF WASTE |
| 12-30110-27-A | WEST POND PLAN AND SECTIONS |
| 12-30110-28-B | EAST SEDIMENT POND PLAN AND PROFILE |
| 12-30110-40-A | SOUTHWEST DRAINAGE SWALE PLAN AND PROFILE |
| 12-30110-41-A | SOUTHEAST DRAINAGE SWALE PLAN AND PROFILE |
| 12-30110-43-A | EROSION AND SEDIMENTATION CONTROL DETAILS AND NOTES |
| 12-30110-44-A | DOWNCHUTE, CATCH BASIN, AND HEADWALL DETAILS |
| 12-30110-45-B | STORM AND DRAINAGE DETAILS |
| 12-30110-46-B | TYPICAL PERIMETER SECTION AND LINER TERMINATION DETAILS |
| 12-30110-47-B | LEACHATE COLLECTION AND UNDERDRAIN DETAILS |
| 12-30110-48-B | LANDFILL LINER AND CAP DETAILS |
| 12-30110-49-B | SEDIMENTATION POND DETAILS |
| 12-30110-50-B | LEACHATE STORAGE POND AND SEDIMENTATION POND DETAILS |
| DR-1-A | SOUTH POND PLAN |
| DR-2-B | POND DETAILS |
| DR-4-A | LEACHATE STORAGE PLAN |
| DR-5-B | LEACHATE STORAGE POND DETAILS |




STATE MAP
N.T.S.




LOCATION MAP SCALE: 1" = 2000'

PREPARED FOR:

AEP AMERICAN ELECTRIC POWER

APPLICANT/OWNER/OPERATOR :

OHIO POWER COMPANY
d/b/a AMERICAN ELECTRIC POWER, INC.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PREPARED BY:

CEC
Civil & Environmental Consultants, Inc.

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
5899 MONTCLAIR BOULEVARD
CINCINNATI, OHIO 45150

**DECEMBER 2019**

CEC PROJECT NO. 195-858

## GENERAL NOTES

1. DRAWINGS PRESENTED IN THIS RUN-ON, RUN-OFF CONTROL PLAN WERE SELECTED FROM THE EXISTING PERMIT DRAWING SET ASSOCIATED ORIGINALLY SUBMITTED IN APRIL 2012 AND AMENDED WITH DESIGN REVISIONS IN JANUARY 2013. WITH THE EXCEPTION OF THIS TITLE SHEET, AND DRAWINGS DENOTED AS REVISION NO. 1, THESE DRAWINGS REMAIN UNCHANGED FROM THEIR ORIGINAL FORM.
2. THESE DRAWINGS WILL BE REVISED/REPLACED AS-NEEDED DURING PERIODIC REVIEWS OF THE RUN-ON, RUN-OFF CONTROL PLAN.

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/12 | A | ISSUED FOR PERMIT | APA |

REVISIONS

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OHIO POWER COMPANY
MITCHELL PLANT
MARSHALL COUNTY WEST VIRGINIA
MITCHELL LANDFILL
TITLE SHEET

DWG NO: 12-30110-01-B

SCALE: AS NOTED | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY: .

*HAND SIGNATURE ON FILE

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5899 Montclair Blvd. - Cincinnati, OH 45150
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.cecinc.com

| DRAWN BY: | JHG | CHECKED BY: | TDM | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | DECEMBER 2019 | DWG SCALE: | AS NOTED | PROJECT NO: | 195-858 |

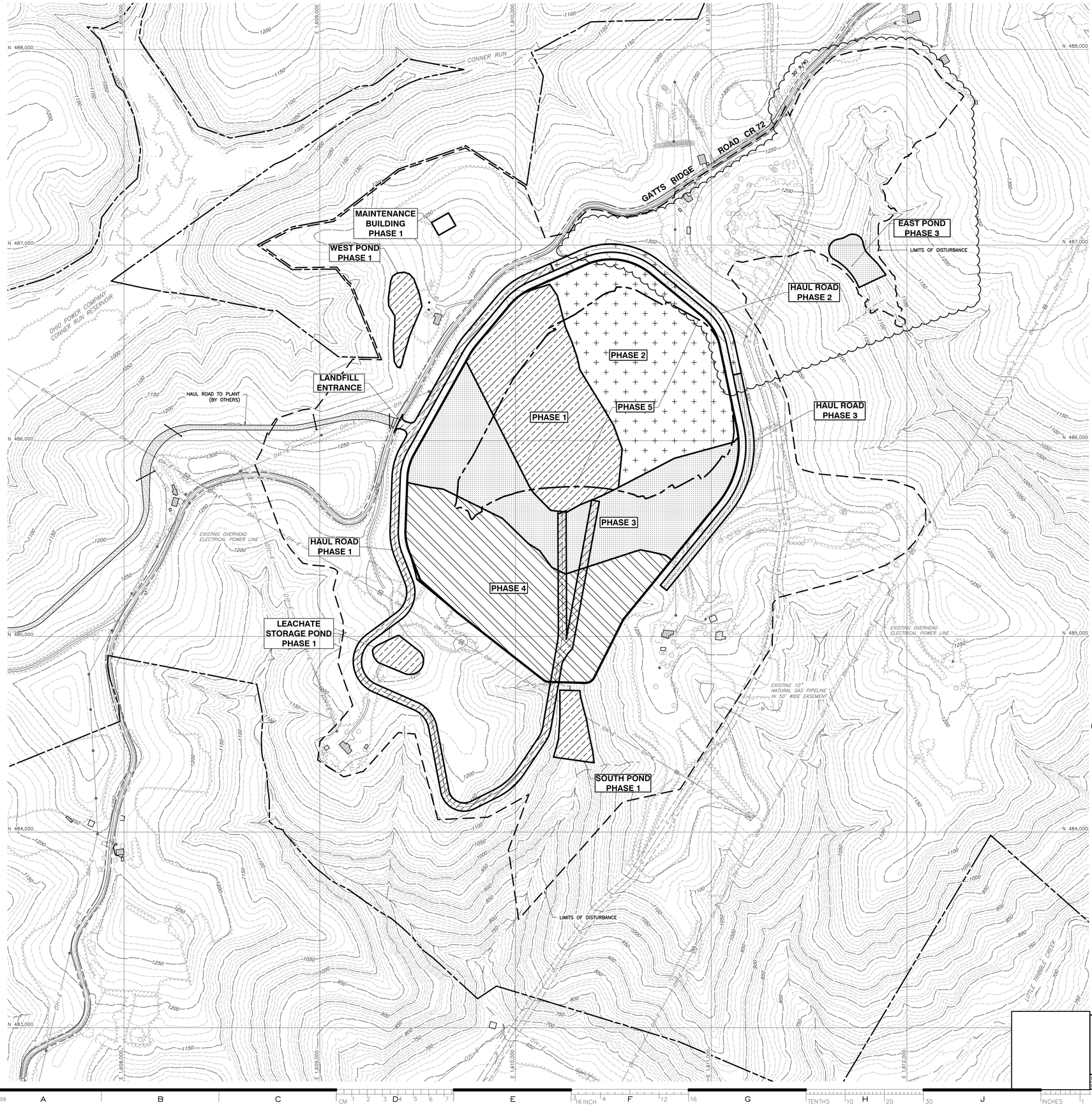
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: DEC-NOV-19 YY
PLOT TIME: 08:30:54
BY: USERPLOT

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IGS0506

DWG NO: 12-30110-13-B




## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED HAUL ROAD
- LIMITS OF PHASE 1 DEVELOPMENT
- LIMITS OF PHASE 2 DEVELOPMENT
- LIMITS OF PHASE 3 DEVELOPMENT
- LIMITS OF PHASE 4 DEVELOPMENT
- LIMITS OF PHASE 5 DEVELOPMENT (TO BE LOCATED ABOVE PHASES 1 THRU 4)

## NOTES:

1. THE HAUL ROAD AND DITCH LINES ARE SHOWN TO REFERENCE THE PROPOSED PHASE LINES TO EXISTING CONDITIONS.
2. FOR STOCKPILE LOCATIONS SEE DRAWING 12-3011-042. STOCKPILES TO BE PHASED AS NECESSARY.
3. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW.

NORTH

SCALE IN FEET
0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/12 | A | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## GENERAL PHASING PLAN

DWG NO: 12-30110-13-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: | CH: | SUP: | ENG: | DATE: | APPROVED BY:

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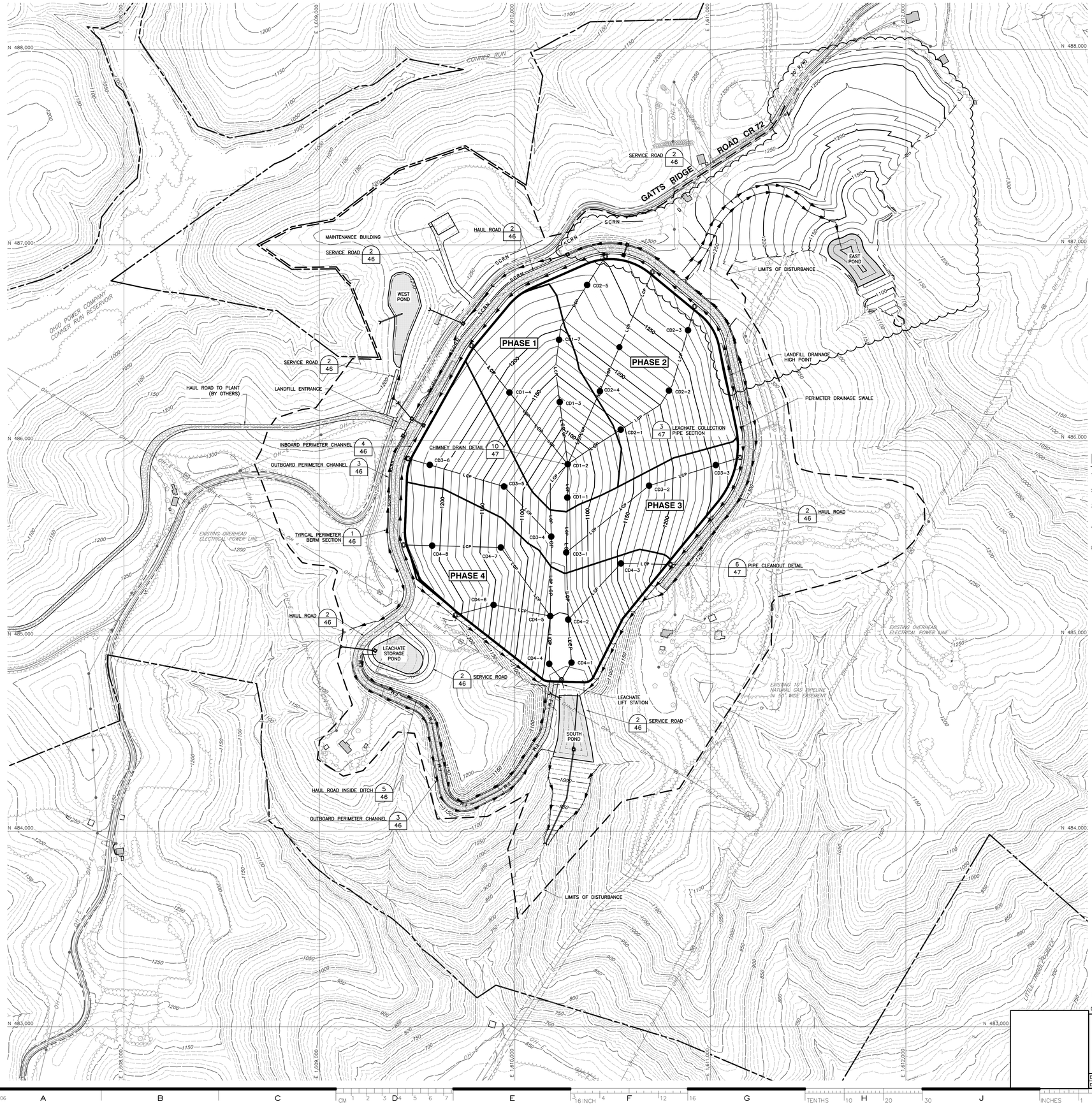
| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

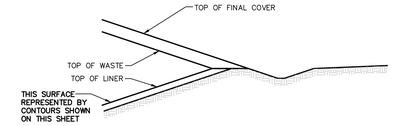
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 1/7/2020 8:33 AM
PLOTTED BY: USERPLOT

I:\SH-civil\projects\12\110\193-456\2400\Dwg\SM01\12300_12-30110-13-B.dwg[12-30110-13-B] 1/7/2020 - 08:33 AM - ploted - LP: 1/7/2020 8:33 AM

DWG NO: 12-30110-15-B




## TYPICAL LANDFILL ID KEY

N.T.S.

## NOTES:

1. THIS DRAWING DEPICTS THE LINER AND LEACHATE COLLECTION SYSTEM ACROSS THE ENTIRE LANDFILL FOOTPRINT. REFER TO PHASE DRAWINGS FOR SEQUENCING AND CONSTRUCTION DETAILS.
2. REFER TO DRAWING 12-30110-16 FOR THE NUMBER OF LEACHATE COLLECTION PIPES BETWEEN CHIMNEY DRAINS AND THE LEACHATE COLLECTION PIPE SIZES.
3. ALL LEACHATE THAT DRAINS FROM THE MITCHELL LANDFILL WILL BE DIRECTED TO THE LEACHATE LIFT STATION AT THE SOUTH END OF THE LANDFILL. THE LIFT STATION WILL BE EQUIPPED WITH A PUMP SYSTEM AND ASSOCIATED PIPING TO CONVEY LEACHATE TO THE LEACHATE STORAGE POND. DETAILED DESIGN OF THE LIFT STATION, PUMPS, PUMP CONTROLS, AND DISCHARGE PIPELINE WILL BE COMPLETED BY OTHERS.
4. THE CHIMNEY DRAINS WILL BE LOCATED ABOVE DESIGNATED LEACHATE COLLECTION PIPES AND WILL BE CONSTRUCTED VERTICALLY FROM THE LINER TO THE ULTIMATE TOP OF WASTE ELEVATION. PROTECTION OF TEMPORARILY ABANDONED CHIMNEY DRAINS WILL BE REQUIRED TO FACILITATE USE AND EXTENSION OF THE CHIMNEY DRAINS IN SUBSEQUENT PHASES.
5. TEMPORARY PROTECTION TO BE PROVIDED OVER CHIMNEY DRAINS PRIOR TO PLACEMENT OF ANY TEMPORARY COVER SOIL.

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONTOUR
- PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- CHIMNEY DRAIN AND NUMBER
- CHIMNEY DRAIN AND NUMBER PREVIOUSLY BUILT
- LEACHATE COLLECTION PIPE
- CLEANOUT
- PROPOSED LEACHATE FORCE MAIN

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/13 | A | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## LINER PLAN WITH LEACHATE COLLECTION SYSTEM

DWG NO: 12-30110-15-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: | CH: | SUP: | ENG: | DATE: | APPROVED BY:

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www.ceainc.com

| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

AEP AMERICAN ELECTRIC POWER

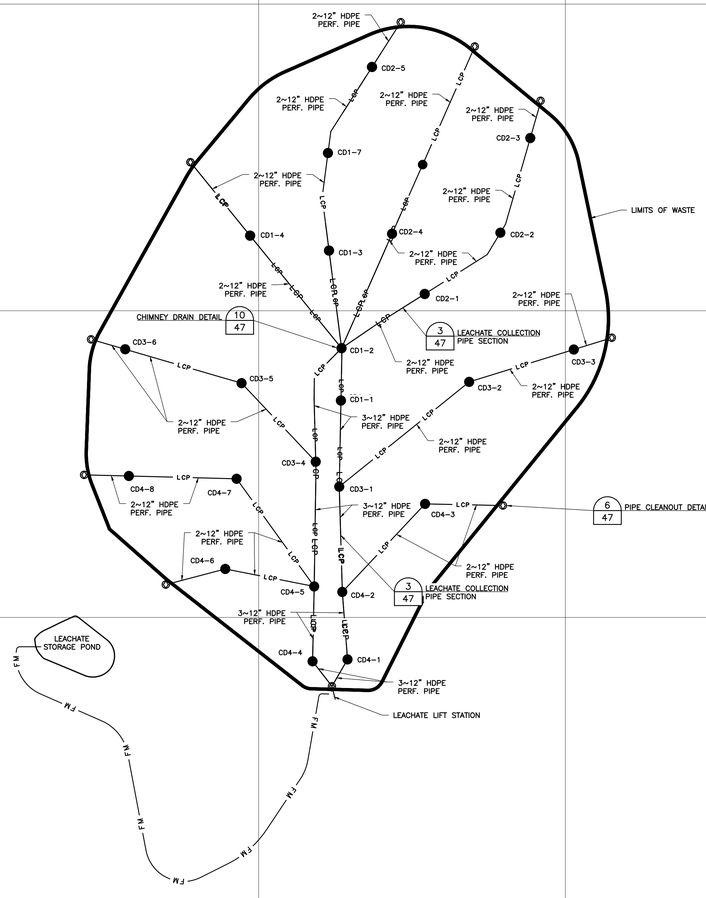
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 05-MAR-19
PLOTTED BY: MICHAEL
BY: USERPLOT

\\ceinc-dsc\projects\2019\195-4581-CAD\dwg\SWD\195458_12-30110-15-B.dwg[12-30110-15-B] LS(1/7/2020 - 2:00pm) - LS 1/7/2020 8:36 AM

IGS0506

DWG NO: 12-30110-16-A




## LEGEND

- LIMITS OF WASTE
- CD1-1 — CHIMNEY DRAIN AND NUMBER
- LCP — LEACHATE COLLECTION PIPE
- CLEANOUT
- FM — PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. MINIMUM LINER SLOPES SHALL BE 2% AND MAXIMUM LINER SLOPES SHALL BE 33.33% (3H:1V)
2. FOR LEACHATE COLLECTION SYSTEM AND LINER SYSTEM DETAILS, SEE DRAWINGS 12-30110-46 AND 12-30110-47.
3. LEACHATE COLLECTION SYSTEM PIPES ARE TO BE LAID AT A 2% MINIMUM SLOPE.

NORTH

SCALE IN FEET

0 200 400

*HAND SIGNATURE ON FILE


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|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

| DATE | NO. | DESCRIPTION | APP. |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## LEACHATE COLLECTION SYSTEM LAYOUT

DWG NO: 12-30110-16-A

| SCALE: 1"=200' | CIVIL ENGINEERING |
|---|---|
| DR: | APPROVED BY: |
| CH: | |
| SUP: | |
| ENG: | |
| DATE: | |

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

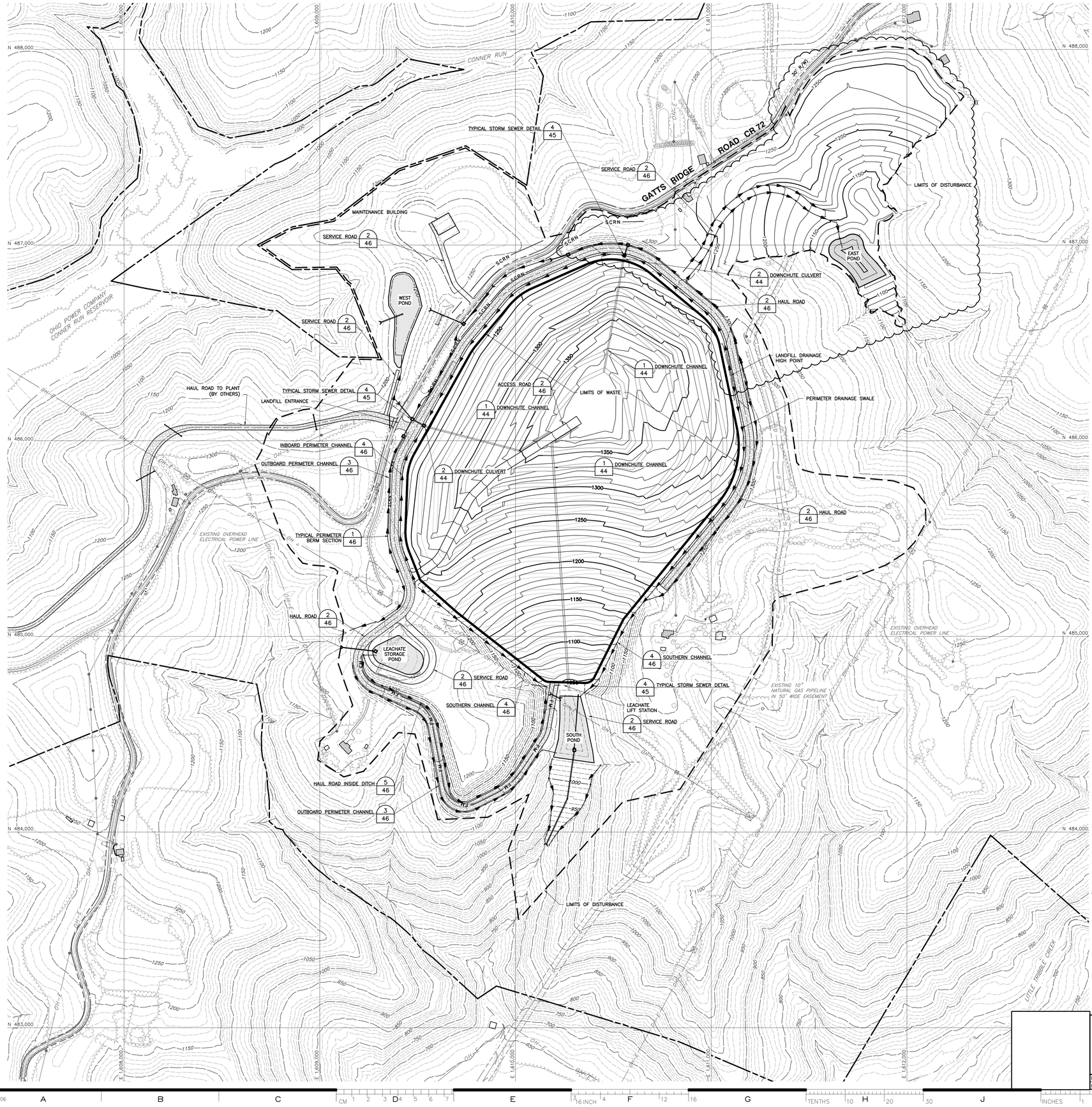

PLOT DATE: 05-MAR-19
PLOT TIME: 08:49:46 AM
BY: USERPLOT



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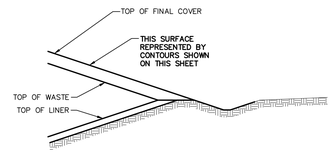

IGS0506

DWG NO: 12-30110-18-B




## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONTOUR
- PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- CROSS SECTION LOCATION IDENTIFIER AND DRAWING NUMBER
- FM PROPOSED LEACHATE FORCE MAIN




## TYPICAL LANDFILL ID KEY

N.T.S.

## NOTES:

1. SCREENING SHALL BE PROVIDED BY NATURAL OBJECTS, PLANTINGS, FENCES OR OTHER APPROPRIATE MEANS SO THAT THE LANDFILL IS NOT READILY VISIBLE FROM GATTS RIDGE ROAD.
2. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
3. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.

NORTH

SCALE IN FEET
0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
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| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## TOP OF FINAL COVER PLAN

DWG NO: 12-30110-18-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: | CH: | SUP: | ENG: | DATE: | APPROVED BY:

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| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
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| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

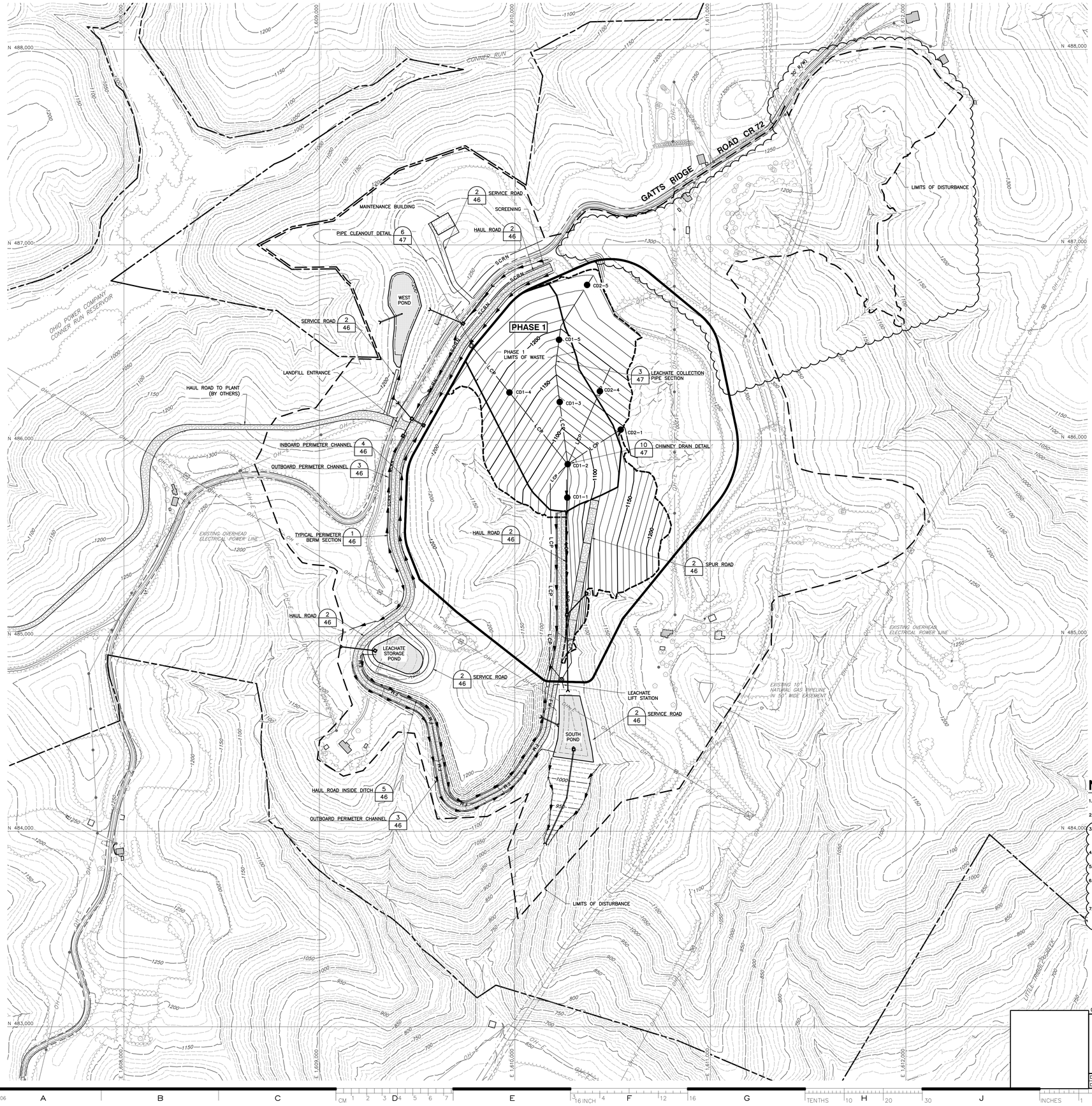
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

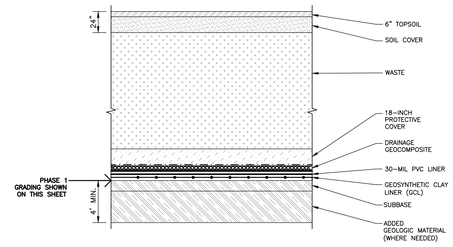
PLOT DATE: 05-MAR-19
PLOTTED BY: USERPLOT

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IGS0506

DWG NO: 12-30110-21-B




## COMPONENT DETAIL

N.T.S.

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- C EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONSTRUCTION PHASELINE
- 580 PROPOSED CONTOUR
- 580 PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- CD1-1 CHIMNEY DRAIN AND NUMBER
- CD1-1 CHIMNEY DRAIN AND NUMBER PREVIOUSLY BUILT
- LCP LEACHATE COLLECTION PIPE
- CLEANOUT
- FM PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SEE DRAWING 12-30110-16 FOR LEACHATE PIPING OVERALL LAYOUT, PIPE QUANTITIES AND PIPE SIZE INFORMATION.
2. SCREENING SHALL BE PROVIDED BY NATURAL OBJECTS, PLANTINGS, FENCES OR OTHER APPROPRIATE MEANS SO THAT THE LANDFILL IS NOT READILY VISIBLE FROM GATTS RIDGE ROAD.
3. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
4. TEMPORARY PROTECTION TO BE PROVIDED OVER CHIMNEY DRAINS PRIOR TO PLACEMENT OF ANY TEMPORARY COVER SOIL.
5. ALL PIPE WITHIN ACTIVE PHASE WILL BE PERFORATED AND PIPE BEYOND THE CONTAINMENT BERM WILL BE DUAL CONTAINED. SEE DETAILS ON 12-30110-47.
6. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.
7. THE LEACHATE COLLECTION PIPES THAT ARE TO BE EXTENDED INTO PHASE 2 SHALL BE CAPPED AND PROTECTED FROM DAMAGE PRIOR TO PHASE 2 CONSTRUCTION.

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## PHASE 1 TOP OF LINER PLAN

DWG NO: 12-30110-21-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED: BY

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|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

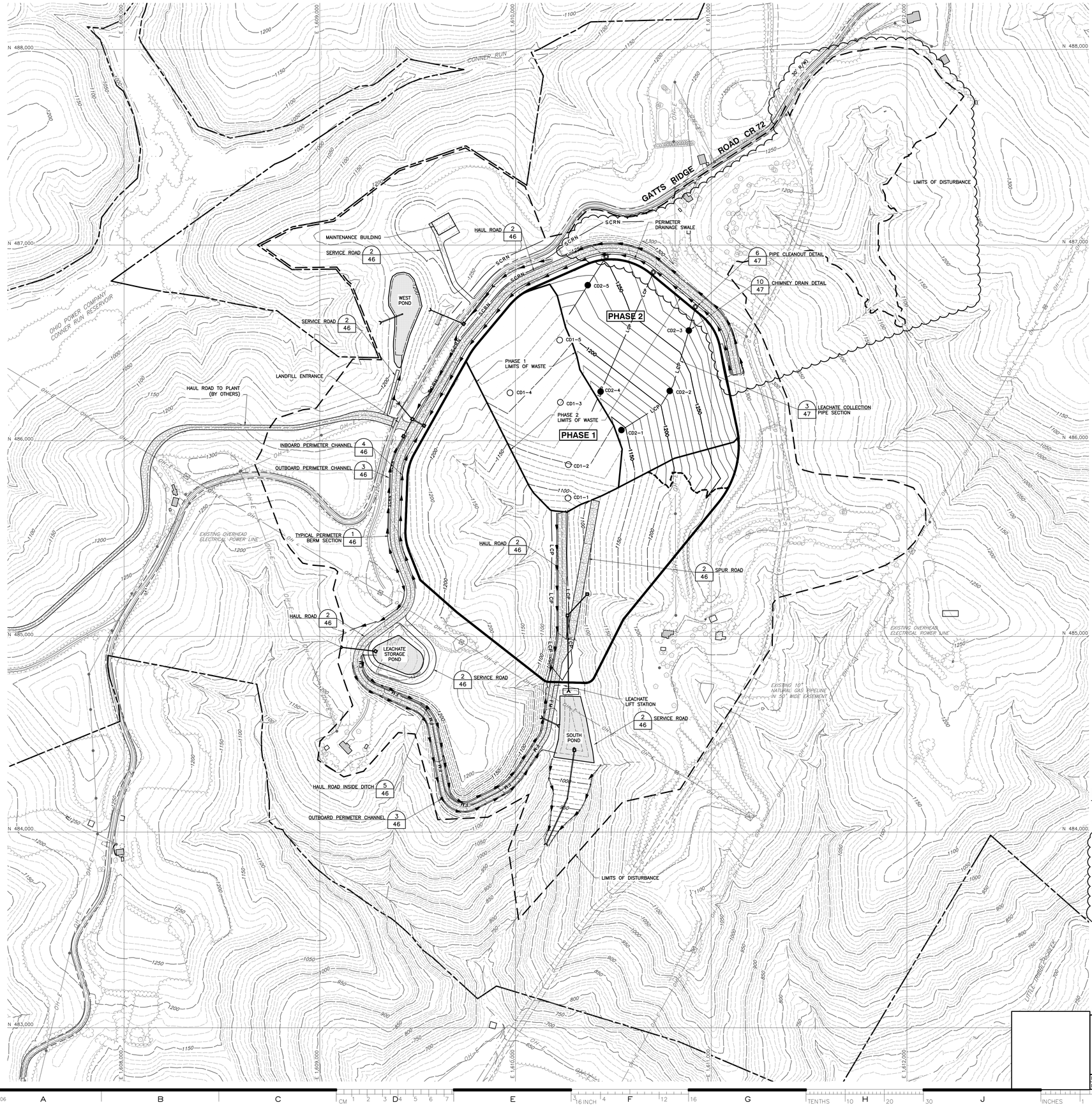
AEP AMERICAN ELECTRIC POWER

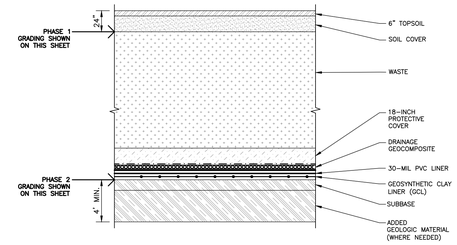
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 01/07/2020 8:35 AM
PLOTTED BY: USERPLOT

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DWG NO: 12-30110-22-B




## COMPONENT DETAIL

N.T.S.

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONSTRUCTION PHASELINE
- 580 PROPOSED CONTOUR
- 580 PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- CD1-1 CHIMNEY DRAIN AND NUMBER
- CD1-1 CHIMNEY DRAIN AND NUMBER PREVIOUSLY BUILT
- LCP LEACHATE COLLECTION PIPE
- CLEANOUT
- FM PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SEE DRAWING 12-30110-16 FOR LEACHATE PIPING OVERALL LAYOUT, PIPE QUANTITIES AND PIPE SIZE INFORMATION.
2. SCREENING SHALL BE PROVIDED BY NATURAL OBJECTS, PLANTINGS, FENCES OR OTHER APPROPRIATE MEANS SO THAT THE LANDFILL IS NOT READILY VISIBLE FROM GATTS RIDGE ROAD.
3. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
4. TEMPORARY PROTECTION TO BE PROVIDED OVER CHIMNEY DRAINS PRIOR TO PLACEMENT OF ANY TEMPORARY COVER SOIL.
5. ALL PIPE WITHIN ACTIVE PHASE WILL BE PERFORATED AND PIPE BEYOND THE CONTAINMENT BERM WILL BE DUAL CONTAINED. SEE DETAILS ON 12-30110-47.
6. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/12 | A | ISSUED FOR PERMIT | APA |

REVISIONS

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## PHASE 1 TOP OF WASTE PHASE 2 TOP OF LINER

DWG NO: 12-30110-22-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY:

CEC
Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 - 800.759.5614 - Fax: 513.985.0228
www.cecinc.com

| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

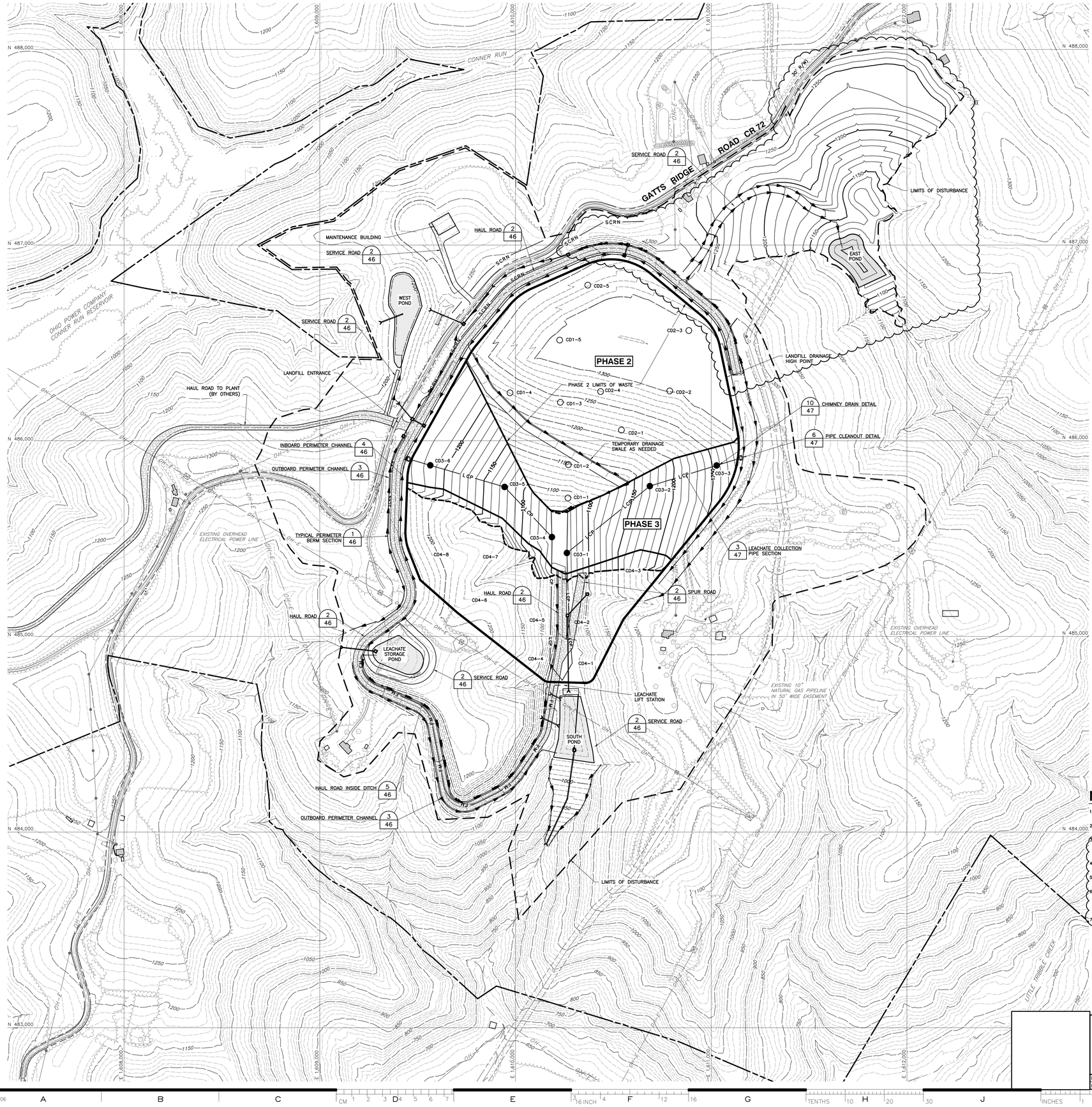
AEP AMERICAN ELECTRIC POWER

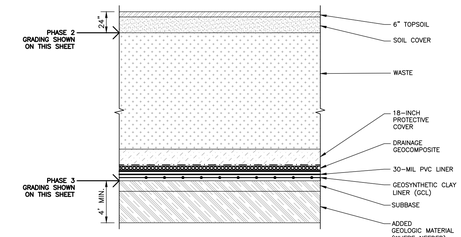
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 01/07/2020 - 8:39 AM
PLOTTED BY: USERNAME

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DWG NO: 12-30110-23-B




## COMPONENT DETAIL

N.T.S.

## NOTE:

1. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER, PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFICALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET, THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONSTRUCTION PHASELINE
- 580 PROPOSED CONTOUR
- 580 PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- CD1-1 CHIMNEY DRAIN AND NUMBER
- CD1-1 CHIMNEY DRAIN AND NUMBER PREVIOUSLY BUILT
- LCP LEACHATE COLLECTION PIPE
- CLEANOUT
- FM PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SEE DRAWING 12-30110-16 FOR LEACHATE PIPING OVERALL LAYOUT, PIPE QUANTITIES AND PIPE SIZE INFORMATION.
2. SCREENING SHALL BE PROVIDED BY NATURAL OBJECTS, PLANTINGS, FENCES OR OTHER APPROPRIATE MEANS SO THAT THE LANDFILL IS NOT READILY VISIBLE FROM GATTS RIDGE ROAD.
3. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
4. TEMPORARY PROTECTION TO BE PROVIDED OVER CHIMNEY DRAINS PRIOR TO PLACEMENT OF ANY TEMPORARY COVER SOIL.
5. ALL PIPE WITHIN ACTIVE PHASE WILL BE PERFORATED AND PIPE BEYOND THE CONTAINMENT BERM WILL BE DUAL CONTAINED. SEE DETAILS ON 12-30110-47.
6. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.
7. ACCESS ROAD LOCATION IN WASTE MAY VARY TO SUIT FIELD CONDITIONS.

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
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OHIO POWER COMPANY

MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

PHASE 2 TOP OF WASTE
PHASE 3 TOP OF LINER

DWG NO: 12-30110-23-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: . APPROVED BY: .

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Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.ceainc.com

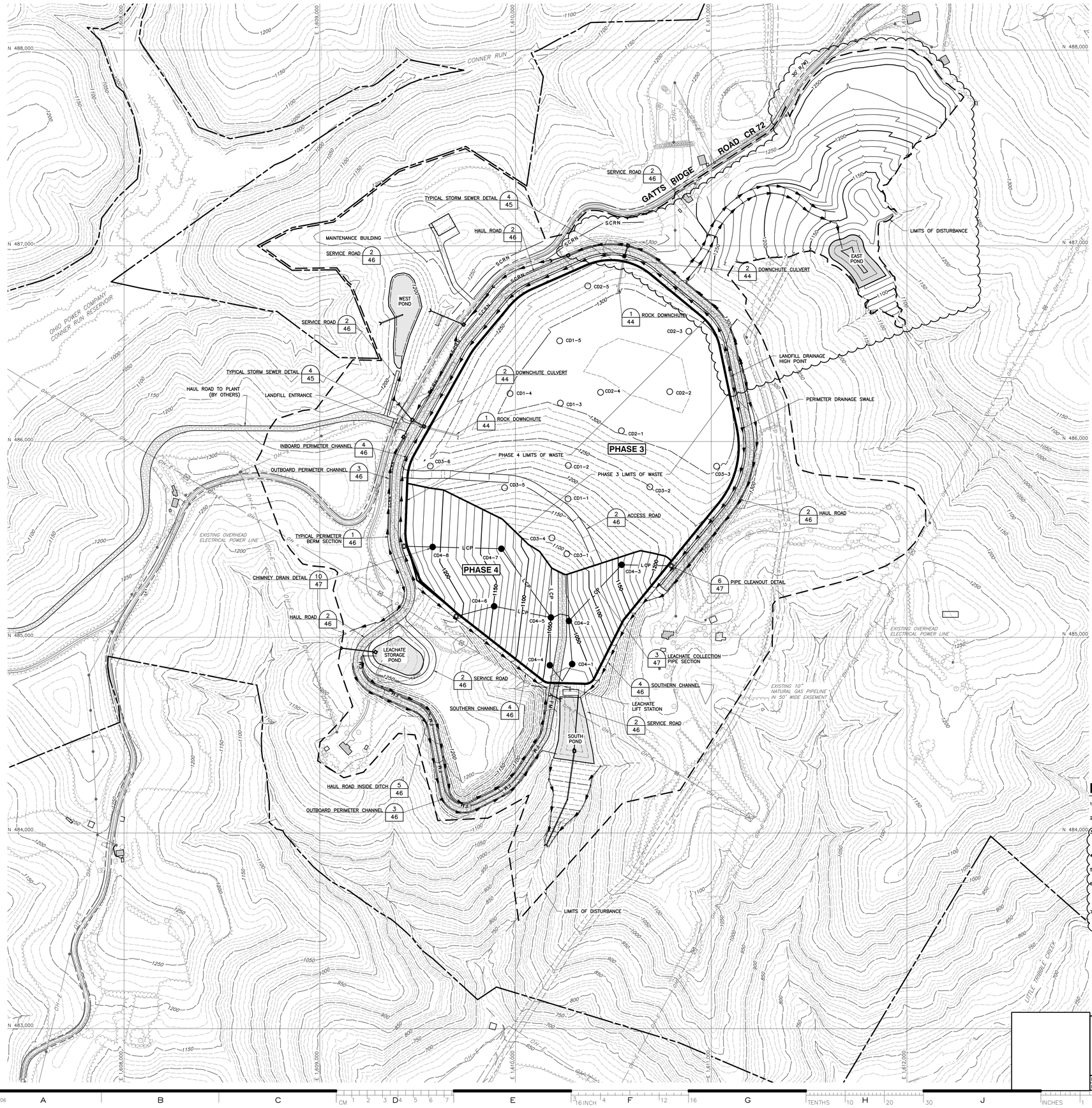
DRAWN BY: DAR | CHECKED BY: JSF | APPROVED BY: *APA
DATE: APRIL 2012 | DWG SCALE: AS NOTED | PROJECT NO: 110-416

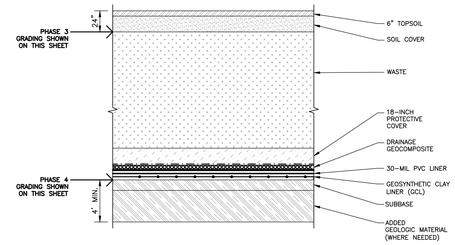
AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: DD-MMM-YY*
PLOTTED BY: USERNAME*
IGS0506

DWG NO: 12-30110-24-B




## COMPONENT DETAIL

N.T.S.

## NOTE:

1. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER, PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFICALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET, THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONSTRUCTION PHASELINE
- 580 PROPOSED CONTOUR
- 580 PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- CD1-1 CHIMNEY DRAIN AND NUMBER
- CD1-1 CHIMNEY DRAIN AND NUMBER PREVIOUSLY BUILT
- LCP LEACHATE COLLECTION PIPE
- CLEANOUT
- FM PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SEE DRAWING 12-30110-16 FOR LEACHATE PIPING OVERALL LAYOUT, PIPE QUANTITIES AND PIPE SIZE INFORMATION.
2. SCREENING SHALL BE PROVIDED BY NATURAL OBJECTS, PLANTINGS, FENCES OR OTHER APPROPRIATE MEANS SO THAT THE LANDFILL IS NOT READILY VISIBLE FROM GATTS RIDGE ROAD.
3. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
4. TEMPORARY PROTECTION TO BE PROVIDED OVER CHIMNEY DRAINS PRIOR TO PLACEMENT OF ANY TEMPORARY COVER SOIL.
5. ALL PIPE WITHIN ACTIVE PHASE WILL BE PERFORATED AND PIPE BEYOND THE CONTAINMENT BERM WILL BE DUAL CONTAINED. SEE DETAILS ON 12-30110-47.
6. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.
7. DOWNCHUTE LOCATIONS SHOWN FOR INFORMATIONAL PURPOSES ONLY. DOWNCHUTES TO BE CONSTRUCTED WITHIN THE FINAL CAP SYSTEM.

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

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|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## PHASE 3 TOP OF WASTE PHASE 4 TOP OF LINER

DWG NO: 12-30110-24-B

SCALE: 1"=200'

CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY: .

Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.ceciinc.com

| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

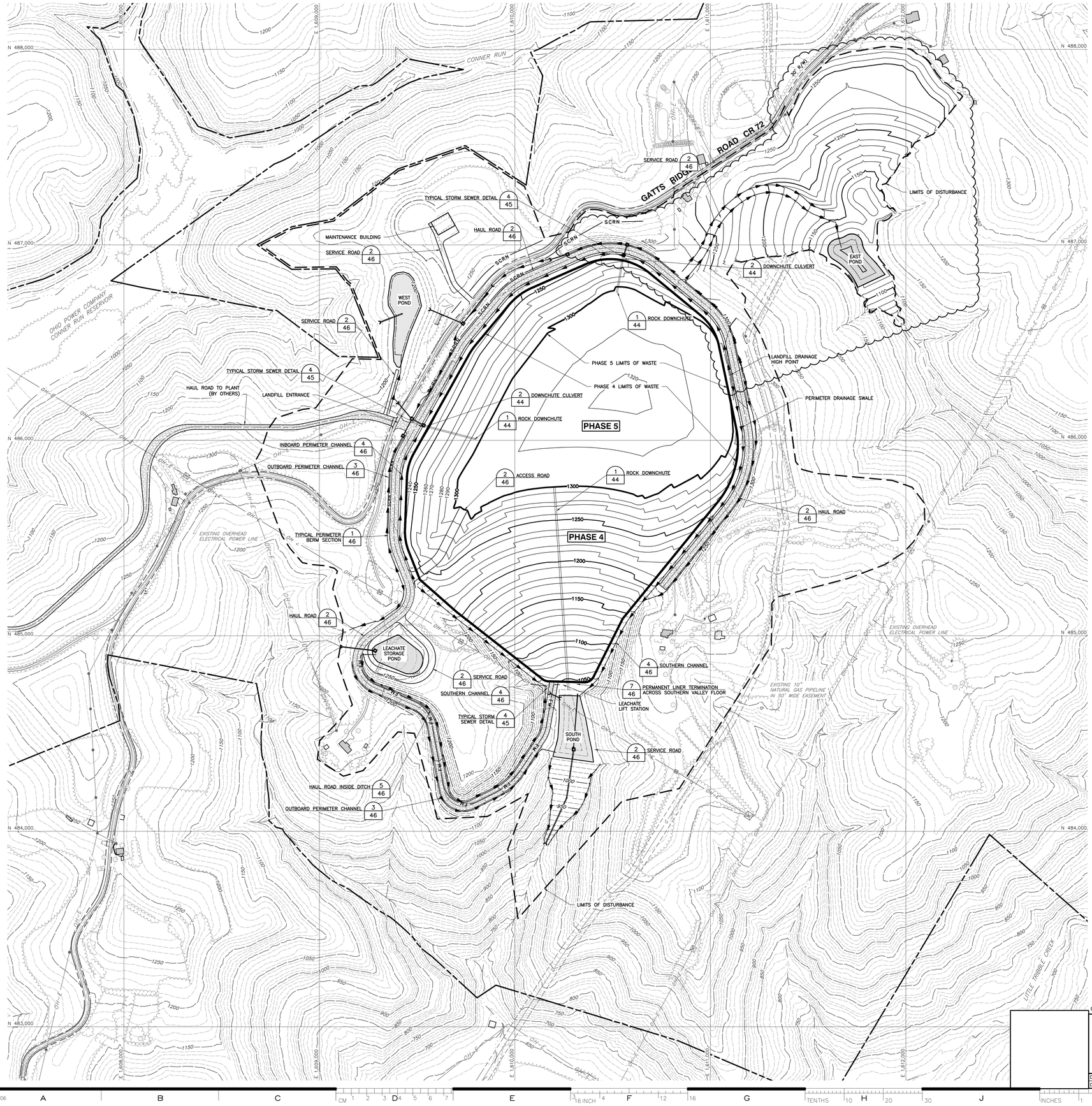
AEP AMERICAN ELECTRIC POWER

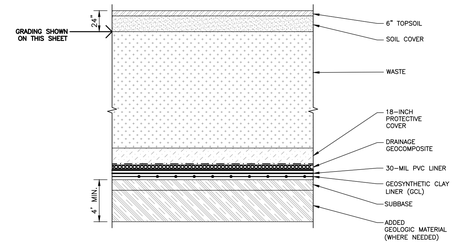
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 1/7/2020 8:41 AM
PLOT BY: JSF
BY: USERPLOT

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DWG NO: 12-30110-25-B




## COMPONENT DETAIL

N.T.S.

## NOTE:

1. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER, PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFICALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET, THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONSTRUCTION PHASELINE
- 580 PROPOSED CONTOUR
- 580 PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- FM PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SCREENING SHALL BE PROVIDED BY NATURAL OBJECTS, PLANTINGS, FENCES OR OTHER APPROPRIATE MEANS SO THAT THE LANDFILL IS NOT READILY VISIBLE FROM GATTS RIDGE ROAD.
2. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
3. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.
4. DOWNCHUTE LOCATIONS SHOWN FOR INFORMATIONAL PURPOSES ONLY. DOWNCHUTES TO BE CONSTRUCTED WITHIN THE FINAL CAP SYSTEM.

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## PHASE 4 TOP OF WASTE

DWG NO: 12-30110-25-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY: .

Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.cecinc.com

| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

AEP AMERICAN ELECTRIC POWER

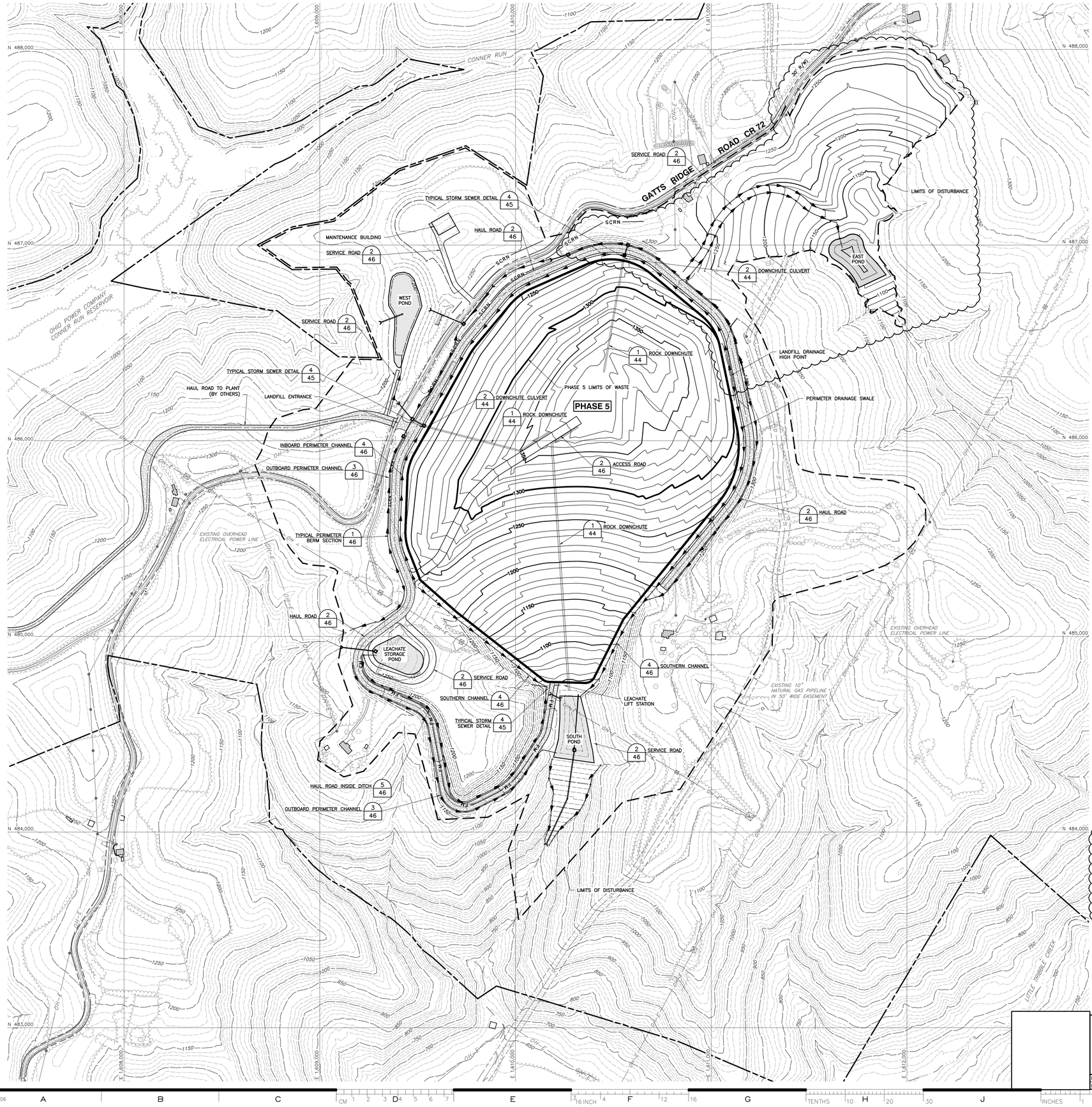
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

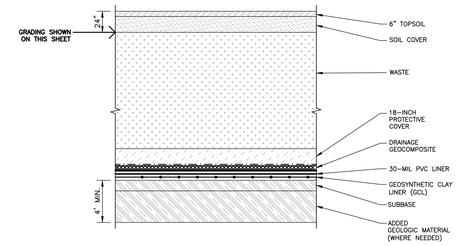
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PLOTTED BY: USERNAME

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IGS0506

DWG NO: 12-30110-26-B




## COMPONENT DETAIL

N.T.S.

## NOTE:

1. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER, PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFICALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET, THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONSTRUCTION PHASELINE
- 580 PROPOSED CONTOUR
- 580 PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- CD1-1 CHIMNEY DRAIN AND NUMBER
- CD1-1 CHIMNEY DRAIN AND NUMBER PREVIOUSLY BUILT
- LEACHATE COLLECTION PIPE
- CLEANOUT
- FM PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SCREENING SHALL BE PROVIDED BY NATURAL OBJECTS, PLANTINGS, FENCES OR OTHER APPROPRIATE MEANS SO THAT THE LANDFILL IS NOT READILY VISIBLE FROM GATTS RIDGE ROAD.
2. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
3. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.
4. PHASE 5 TO BE CONSTRUCTED ON TOP OF PREVIOUSLY CONSTRUCTED PHASES 1 THOUGH 4.
5. DOWNCHUTE LOCATIONS SHOWN FOR INFORMATIONAL PURPOSES ONLY. DOWNCHUTES TO BE CONSTRUCTED WITHIN THE FINAL CAP SYSTEM.

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
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| 01/07/26 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/13 | A | ISSUED FOR PERMIT | APA |

REVISIONS

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## PHASE 5 TOP OF WASTE

DWG NO: 12-30110-26-B

SCALE: 1"=200' | CIVIL ENGINEERING

DR: | CH: | SUP: | ENG: | DATE: | APPROVED BY:

Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road · Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.4614 · Fax: 513.985.0228
www.ceainc.com

| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

AEP AMERICAN ELECTRIC POWER

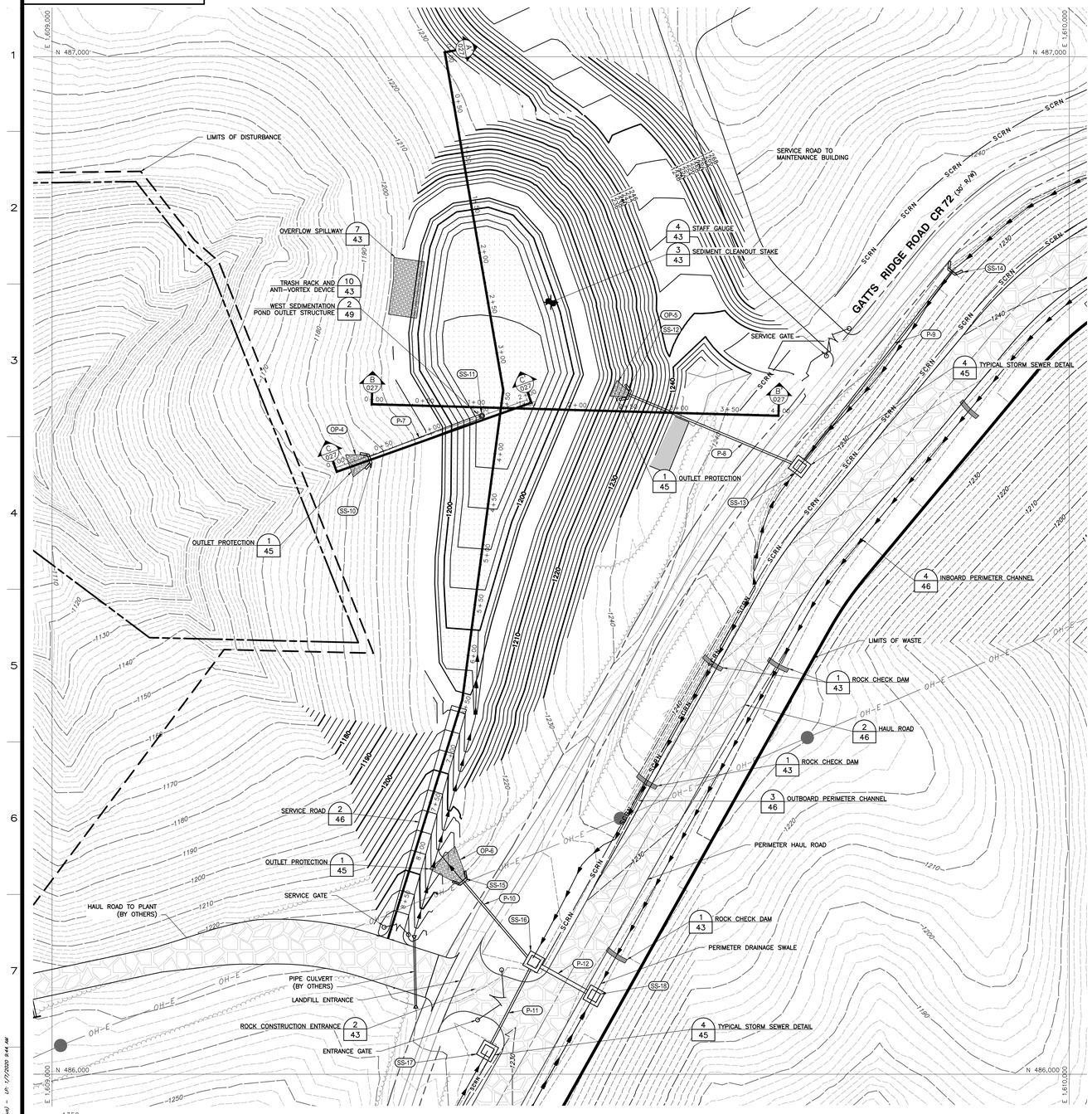
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: DD-MMM-YY*
PLOTTED BY: USERPLOT
*HAND SIGNATURE ON FILE

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DWG NO: 12-30110-27-A

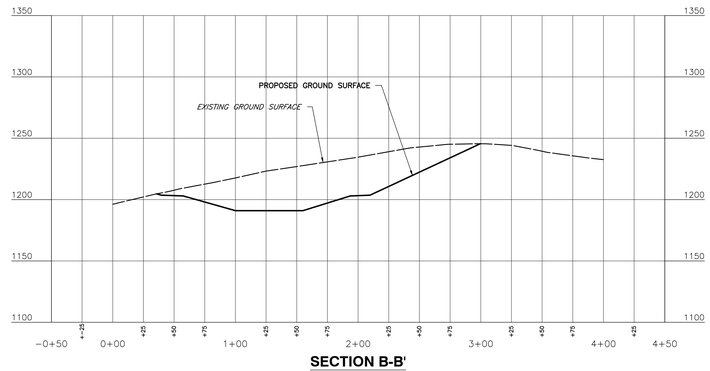



| WEST POND | | |
|---|---|---|
| NAME | VOLUME (CU FT) | ELEVATION (FT) |
| SEDIMENTATION | 64,580 | 1195.10 |
| CLEANOUT | 38,748 | 1193.93 |
| 2-YEAR RUNOFF | 218,805 | 1201.67 |
| PRINCIPAL SPILLWAY | 283,385 | 1201.67 |
| 10-YEAR RUNOFF | 238,122 | 1202.06 |
| EMERGENCY SPILLWAY | | 1202.67 |
| 25-YEAR RUNOFF | 260,747 | 1202.53 |
| 100-YEAR RUNOFF | 277,832 | 1202.89 |
| TOP OF BERM* | 347,395 | 1204.00 |

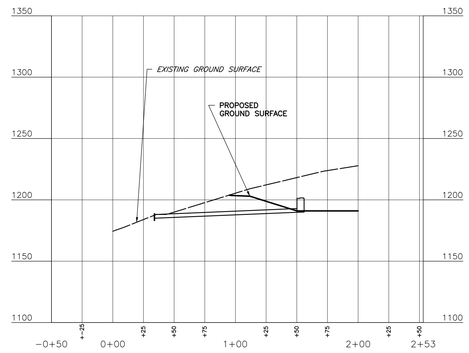
* TOTAL VOLUME OF POND INCLUDING SEDIMENT AND STORMWATER STORAGE.

## LEGEND

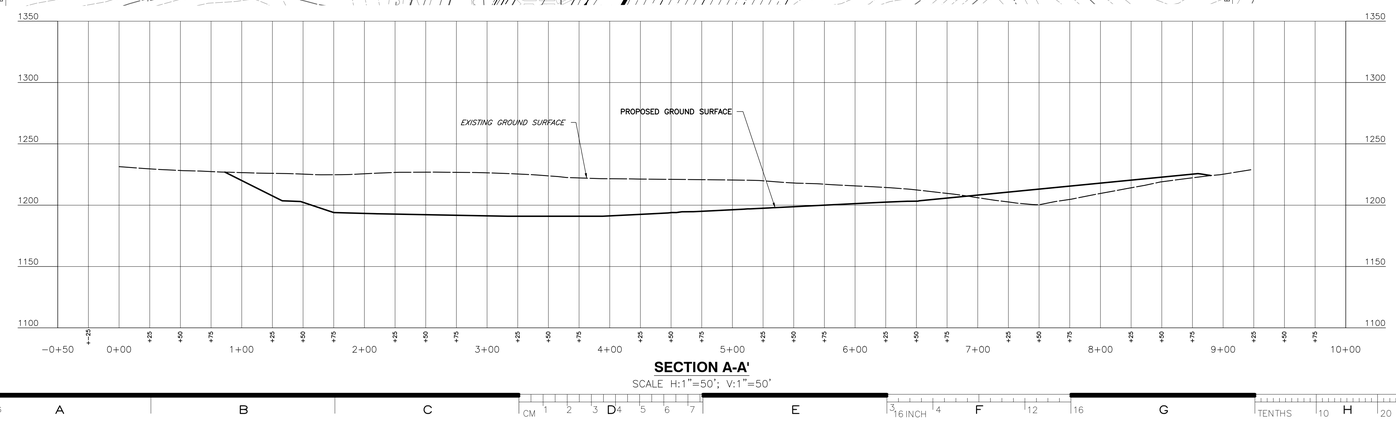
- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- 580 PROPOSED CONTOUR
- 580 PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- SCRN SCREENING
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- PROPOSED RIP RAP
- PROPOSED ROCK CHECK DAM
- C 20 CROSS SECTION LOCATION IDENTIFIER AND DRAWING NUMBER
- SS-# PROPOSED STORM FEATURE NAME
- STAFF GAUGE




**SECTION B-B'**
SCALE H:1"=50'; V:1"=50'




**SECTION C-C'**
SCALE H:1"=50'; V:1"=50'




**SECTION A-A'**
SCALE H:1"=50'; V:1"=50'

## NOTES:

1. SEE DRAWING 12-30110-45 FOR STORM AND DRAINAGE DETAILS.
2. SEE DRAWING 12-30110-49 FOR POND DETAILS.
3. ADD 1-FT OF MARKER STONE ON BOTTOM AND SIDE SLOPES OF POND. GRADING SHOWN IN THE POND REPRESENTS THE TOP OF THE MARKER STONE. OVER-EXCAVATION WILL BE NECESSARY IN POND TO INSTALL ANY LINER SYSTEM THAT MAY BE REQUIRED AND THE MARKER STONE (SEE DETAIL 3/49).
4. THIS POND IS LOCATED MAINLY IN A CUT CONDITION. A LINER MAY OR MAY NOT BE NECESSARY. THE NEED FOR A LINER SYSTEM AND THE COMPONENTS OF THE LINER SYSTEM WILL BE DETERMINED IN THE FIELD BY THE ENGINEER AFTER EXCAVATION OF THE POND HAS BEEN COMPLETED.
5. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.

NORTH
HORZ. SCALE: 1"=50'
VERT. SCALE: 1"=50'
CONTOUR INTERVAL = 2 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## WEST POND PLAN AND SECTIONS

DWG NO: 12-30110-27-A

SCALE: 1"=50' | CIVIL ENGINEERING

DR: . | CH: . | SUP: . | ENG: . | DATE: .

APPROVED BY:

Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.cecinc.com

DRAWN BY: DAR | CHECKED BY: JSF | APPROVED BY: *APA
DATE: APRIL 2012 | DWG SCALE: AS NOTED | PROJECT NO.: 110-416

AEP AMERICAN ELECTRIC POWER

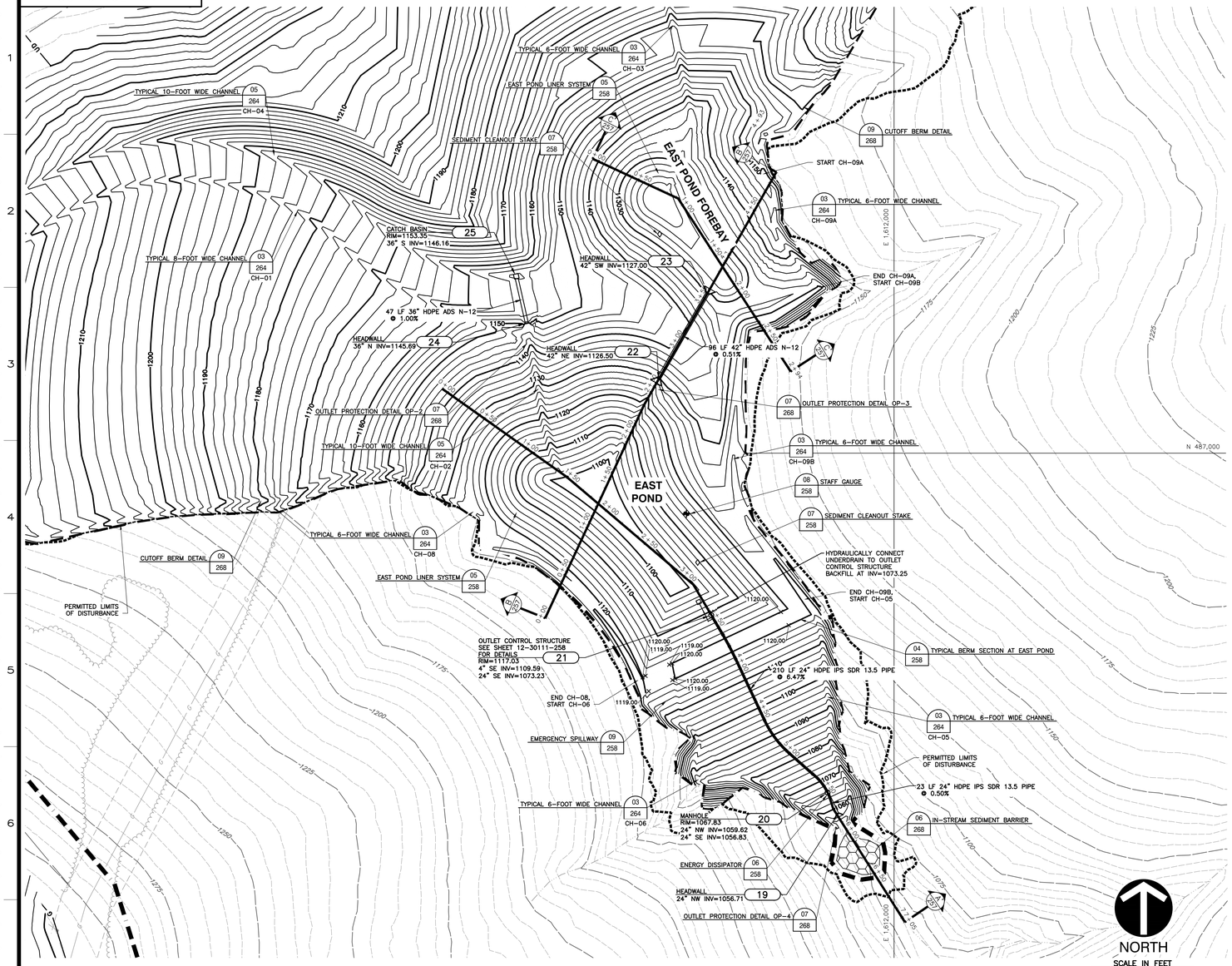
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 05-MAR-20 BY USERPLOT

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IGS0506

DWG NO: 12-30110-28-B




## LEGEND

- FACILITY BOUNDARY / PROPERTY LINE
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STABILIZED CHANNEL
- EXISTING STRUCTURE
- PERMANENT BENCHMARK
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING HAUL ROAD
- TEST PIT LOCATION
- EXISTING LIMITS OF DISTURBANCE
- PROPOSED LIMITS OF DISTURBANCE
- PERMITTED LIMITS OF DISTURBANCE
- PROPOSED CONTOUR
- PROPOSED IN-STREAM SEDIMENT BARRIER
- PROPOSED EMERGENCY SPILLWAY
- PROPOSED ACCESS ROAD
- PROPOSED STOCKPILE LOCATION
- PROPOSED CATCH BASIN
- PROPOSED RISER
- PROPOSED STORM SEWER
- PROPOSED HEADWALL
- PROPOSED STABILIZED CHANNEL
- PROPOSED UNDERDRAIN
- PROPOSED STORM STRUCTURE NUMBER
- STAFF GAUGE
- CLEANOUT STAKE
- SPOT ELEVATION
- CROSS SECTION LOCATION IDENTIFIER AND DRAWING NUMBER
- PROPOSED POND LINER LIMITS
- PROPOSED RIP RAP APRON
- PROPOSED GAS PIPELINE
- PROPOSED SAFETY BERM

**EAST POND FOREBAY DESIGN DETAILS**

| NAME | STORAGE VOLUME (CU FT) | ELEVATION (FT) |
|---|---|---|
| SEDIMENTATION | 16,434 | 1127.00 |
| CLEANOUT | 9,860 | 1125.63 |

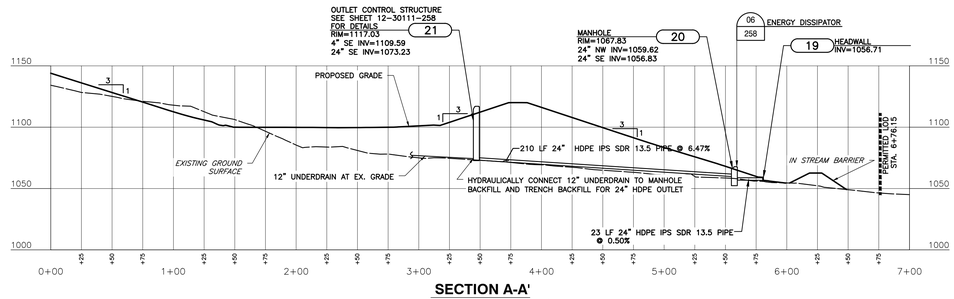
**EAST POND DESIGN DETAILS**

| NAME | STORAGE VOLUME (CU FT) | ELEVATION (FT) |
|---|---|---|
| SEDIMENTATION | 101,071 | 1109.59 |
| CLEANOUT | 60,642 | 1107.12 |
| 2-YEAR RUNOFF | 194,687 | 1116.54 |
| PRINCIPAL SPILLWAY | 295,758 | 1117.03 |
| 10-YEAR RUNOFF | 214,373 | 1117.49 |
| EMERGENCY SPILLWAY | 270,215 | 1119.00 |
| 25-YEAR RUNOFF | 231,608 | 1117.98 |
| 100-YEAR RUNOFF | 260,601 | 1118.75 |
| TOP OF BERM* | 310,559 | 1120.00 |

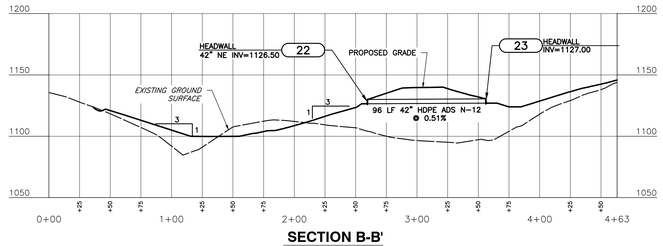
* TOTAL VOLUME OF POND INCLUDING SEDIMENT AND STORMWATER STORAGE.

## NOTES:

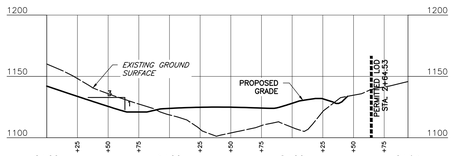
1. SEE DRAWINGS 12-30111-264 AND 12-30111-265 FOR STORM AND DRAINAGE DETAILS.
2. SEE DRAWING 12-30111-258 FOR EAST POND DETAILS.
3. CONTRACTOR TO COORDINATE DESIRED MARKINGS AND EXACT LOCATION OF THE STAFF GAUGE WITH THE OWNER PRIOR TO INSTALLATION.
4. EAST POND TO BE CLEANED OUT WHEN THE SEDIMENT LOAD REACHES ELEVATION 1107.12 AND EAST POND FOREBAY TO BE CLEANED OUT WHEN THE SEDIMENT LOAD REACHES ELEVATION 1125.63.
5. ALL MANHOLE STRUCTURES SHALL BE BACKFILLED WITH NO. 57 DRAINAGE AGGREGATE EXTENDING A MINIMUM 2 FEET LATERALLY FROM THE OUTSIDE OF THE MANHOLE UNLESS OTHERWISE SPECIFIED.
6. ALL EMBANKMENT FILLS MUST BE PROPERLY BENCHED INTO EXISTING SLOPES PER SPECIFICATION CE-006 AND DETAIL 03/266.
7. STORM PIPE BEDDING AND BACKFILL SHALL BE CONSTRUCTED PER DETAIL 06/264 UNLESS OTHERWISE SPECIFIED.




**SECTION A-A'**
SCALE H:1"=50'; V:1"=50'




**SECTION B-B'**
SCALE H:1"=50'; V:1"=50'




**SECTION C-C'**
SCALE H:1"=50'; V:1"=50'

HORZ. SCALE: 1"=50'
VERT. SCALE: 1"=50'
*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APP'D |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/20 | A | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## EAST SEDIMENT POND PLAN AND PROFILE

DWG NO: 12-30110-28-B

| | |
|---|---|
| SCALE: | CIVIL ENGINEERING |
| DR: | |
| CH: | |
| SUP: | |
| ENG: | |
| DATE: | |

APPROVED BY:

**Civil & Environmental Consultants, Inc.**
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 - 800.759.5614 - Fax: 513.985.0228
www.ceinc.com

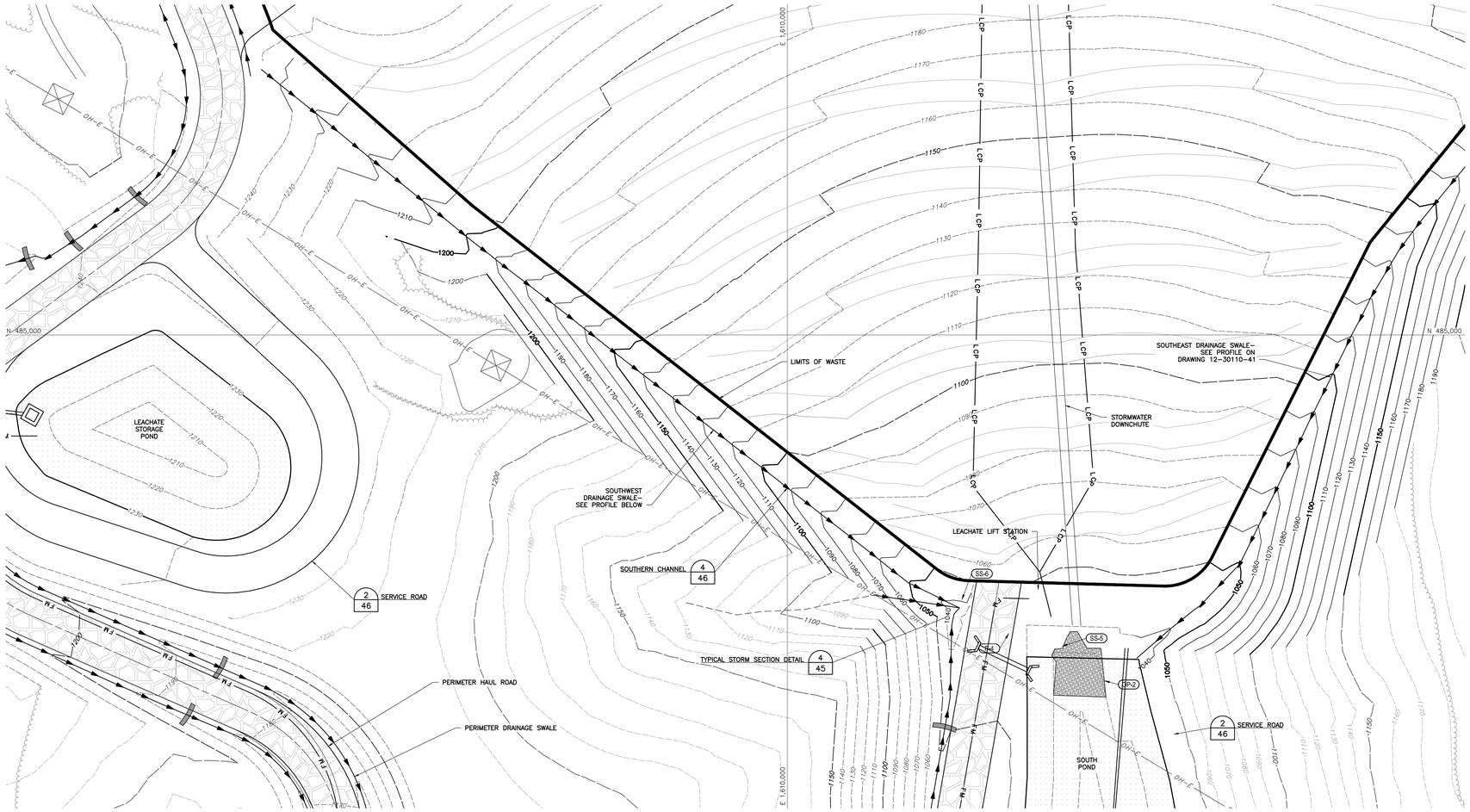
| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

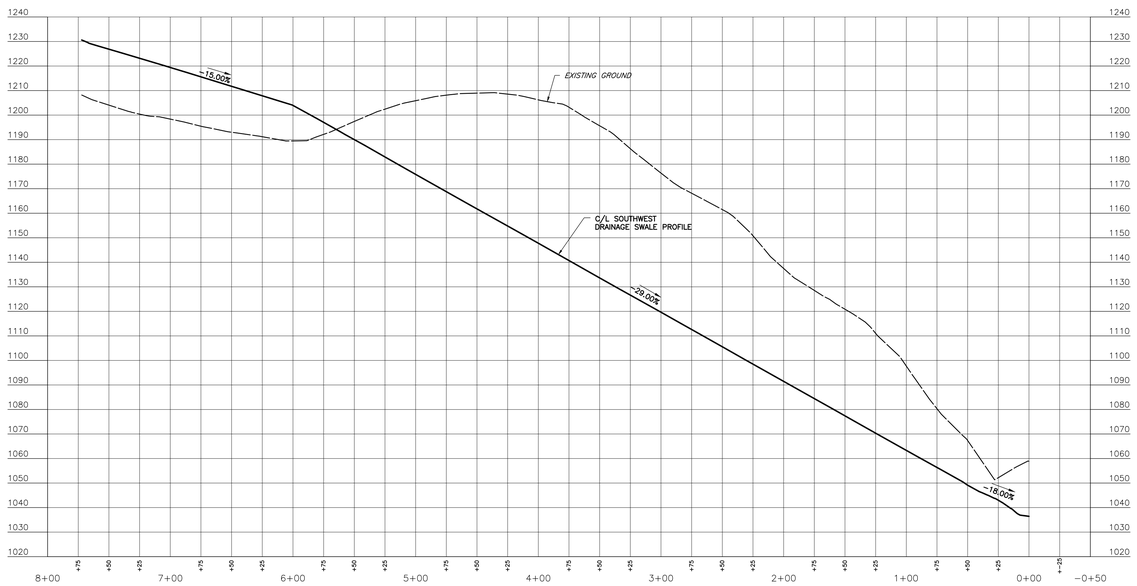
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

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IGS0506

DWG NO: 12-30110-40-A




**SOUTHWEST DRAINAGE SWALE PROFILE**

SCALE H:1"=50'; V:1"=25'

## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONTOUR
- PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- PROPOSED RIP RAP
- PROPOSED ROCK CHECK DAM
- PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SEE DRAWING 12-30110-45 FOR STORM AND DRAINAGE DETAILS.
2. SEE DRAWING 12-30110-50 FOR POND DETAILS.
3. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
4. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.

NORTH

0 50 100 HORZ. SCALE: 1"=50'

0 25 50 VERT. SCALE: 1"=25'

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE


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www.cecinc.com


| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

| DATE | NO. | DESCRIPTION | APP'D |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## SOUTHWEST DRAINAGE SWALE PLAN AND PROFILE

DWG NO: 12-30110-40-A

| SCALE: 1"=50' | CIVIL ENGINEERING |
|---|---|
| DR: | APPROVED BY: |
| CH: | |
| SUP: | |
| ENG: | |
| DATE: | |


AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215



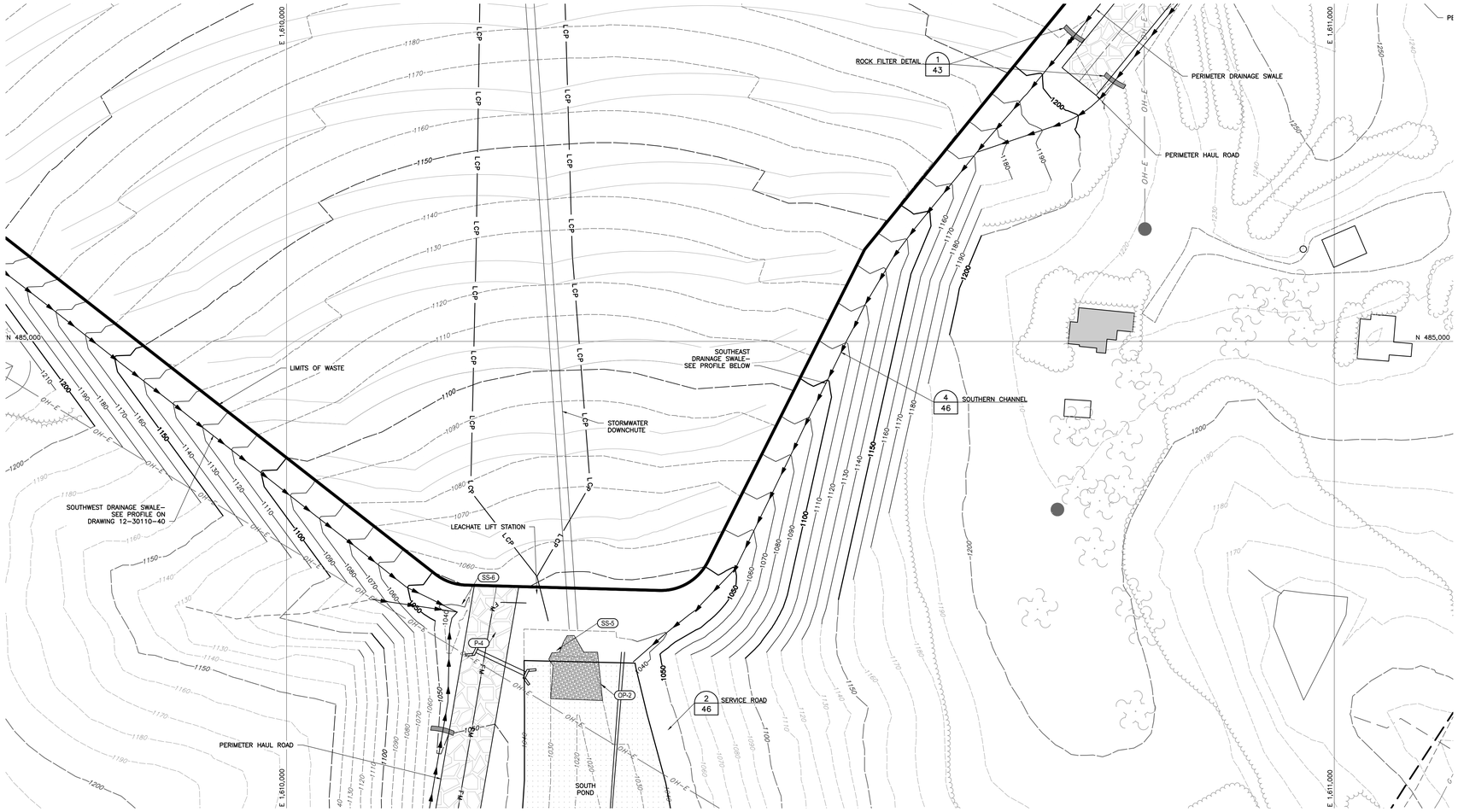
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PLOTTED BY: MICHAEL YOTT
DRAWING NAME:
BY USERPLOT



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DWG NO: 12-30110-41-A

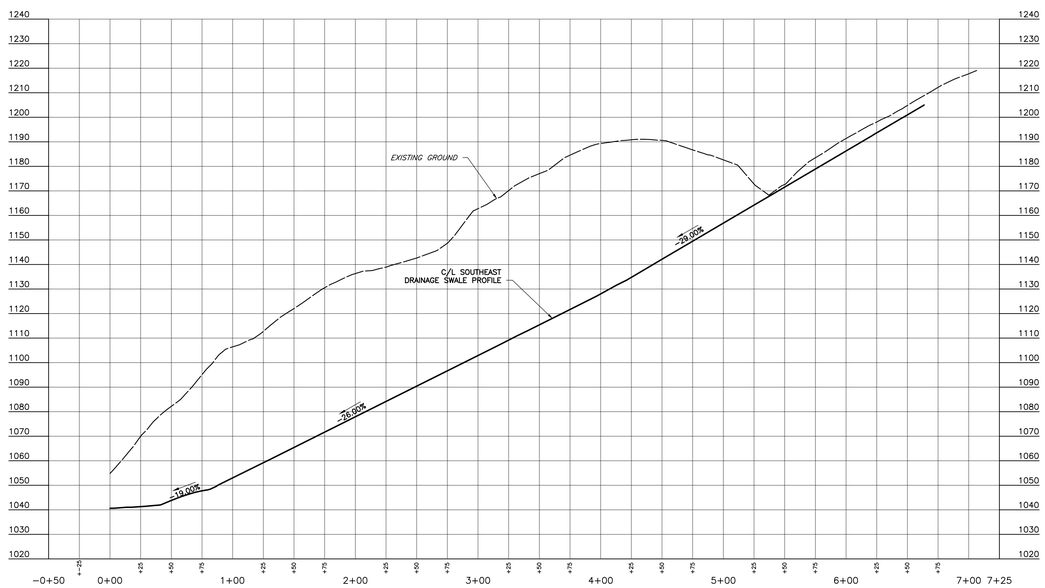



## LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF DISTURBANCE
- LIMITS OF WASTE
- PROPOSED CONTOUR
- PREVIOUSLY CONSTRUCTED CONTOUR
- PERIMETER DRAINAGE SWALE
- PROPOSED WATER SURFACE
- PROPOSED HAUL ROAD
- PROPOSED RIP RAP
- PROPOSED ROCK CHECK DAM
- PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. SEE DRAWING 12-30110-45 FOR STORM AND DRAINAGE DETAILS.
2. SEE DRAWING 12-30110-50 FOR POND DETAILS.
3. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
4. THE HAUL ROADS AS DEPICTED ON THESE DRAWINGS PROVIDE TWO-WAY TRAFFIC FOR VEHICLES OPERATING ON THE MITCHELL LANDFILL SITE. THE OWNER MAY CHOOSE TO CONSTRUCT ROAD BASE AND PAVEMENT FOR A SINGLE LANE OF ON-SITE TRAFFIC WITH APPROPRIATE PULL-OFFS TO FACILITATE TWO-WAY VEHICLE FLOW. CONSTRUCTION OF THE SINGLE LANE ROADWAY WILL CORRESPONDINGLY REDUCE THE LIMITS OF EXCAVATION.




**SOUTHEAST DRAINAGE SWALE PROFILE**

SCALE H:1"=50'; V:1"=25'

NORTH

0 50 100

HORZ. SCALE: 1"= 50'

0 25 50

VERT. SCALE: 1"= 25'

CONTOUR INTERVAL = 10 FEET

*HAND SIGNATURE ON FILE

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## SOUTHEAST DRAINAGE SWALE PLAN AND PROFILE

DWG NO: 12-30110-41-A

SCALE: 1"=50' | CIVIL ENGINEERING

DR: . | CH: . | SUP: . | ENG: . | DATE: . | APPROVED BY: .

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DRAWN BY: DAR | CHECKED BY: JSF | APPROVED BY: *APA

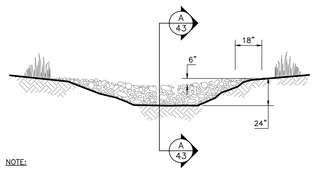
DATE: APRIL 2012 | DWG SCALE: AS NOTED | PROJECT NO: 110-416

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 01/13/2020 8:43 AM
PLOTTED BY: USERNAME
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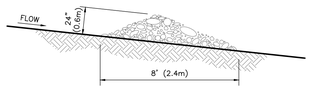
DWG NO: 12-3011-43-A




NOTE:

1. ROCK CHECK DAMS TO BE CONSTRUCTED IN ACCORDANCE WITH THE WEST VIRGINIA EROSION AND SEDIMENT CONTROL BMP MANUAL.
2. KEY STONE INTO CHANNEL BANKS AND EXTEND IT BEYOND THE ABUTMENTS A MINIMUM OF 18" TO PREVENT FLOW AROUND DAM.

## VIEW LOOKING UPSTREAM

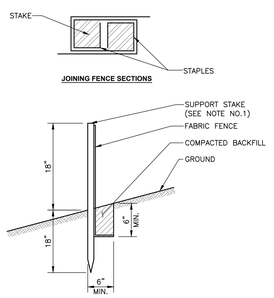



A 4.3 **SECTION**

NOTE:

SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH 1/3 THE HEIGHT OF THE OUTLET.

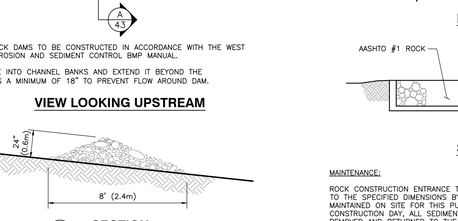
1 / 4.3 **ROCK CHECK DAM**
N.T.S.

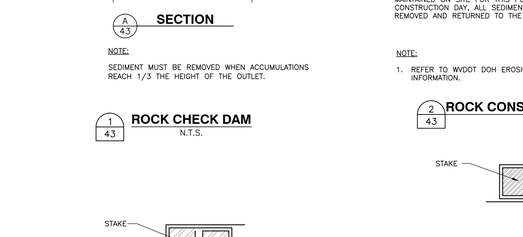



NOTES:

1. * STAKES SPACED @ 8' MAXIMUM. USE 2" X 2" WOOD OR EQUIVALENT STEEL STAKES.
2. FILTER FABRIC FENCE MUST BE PLACED AT LEVEL EXISTING GRADE. BOTH ENDS OF THE BARRIER MUST BE EXTENDED AT LEAST 8 FEET UP SLOPE AT 45 DEGREES TO THE MAIN BARRIER ALIGNMENT.
3. SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH 1/2 THE ABOVE GROUND HEIGHT OF THE FENCE.
4. ANY SECTION OF FILTER FABRIC FENCE WHICH HAS BEEN UNDERMINED OR TOPPED MUST BE IMMEDIATELY REPLACED WITH A ROCK FILTER OUTLET. SEE ROCK FILTER DETAIL.
5. STANDARD FILTER FABRIC FENCE TO BE CONSTRUCTED IN ACCORDANCE WITH THE WEST VIRGINIA EROSION AND SEDIMENT CONTROL BMP MANUAL.

5 / 043 **STANDARD FILTER FABRIC FENCE (18" HIGH)**
N.T.S.



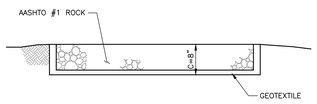

NOTES:

1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING APPLICATION OF LIME, FERTILIZER,AND SEED.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE BLANKET IN 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
3. ROLL THE BLANKETS (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE.
4. THE EDGES OF PARALLEL BLANKETS MUST BE STAPLED WITH APPROXIMATELY 2" OVERLAP.
5. WHEN BLANKETS MUST BE SPLICED DOWN THE SLOPE, PLACE BLANKETS END OVER END (SHINGLE STYLE) WITH APPROXIMATELY 12" OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" APART.
6. EROSION CONTROL BLANKETS SHALL BE INSTALLED ON ALL 3:1 OR STEEPER SLOPES WITH A MINIMUM OF 6 INCHES OF TOPSOIL.

8 / 43 **EROSION CONTROL BLANKET**
N.T.S.




## PLAN VIEW




## SECTION A-A

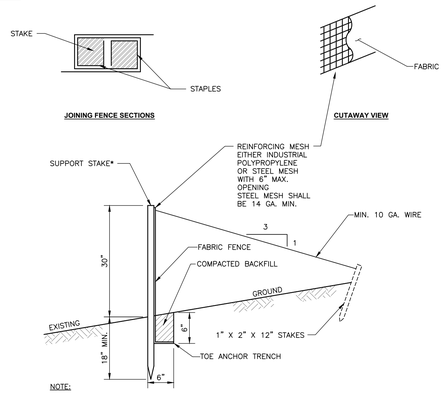
MAINTENANCE:

ROCK CONSTRUCTION ENTRANCE THICKNESS SHALL BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING ROCK. A STOCKPILE SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE. AT THE END OF EACH CONSTRUCTION DAY, ALL SEDIMENT DEPOSITED ON PAVED ROADWAYS SHALL BE REMOVED AND RETURNED TO THE CONSTRUCTION SITE.

NOTE:

1. REFER TO WVDOT DOH EROSION AND SEDIMENT CONTROL MANUAL FOR MORE INFORMATION.

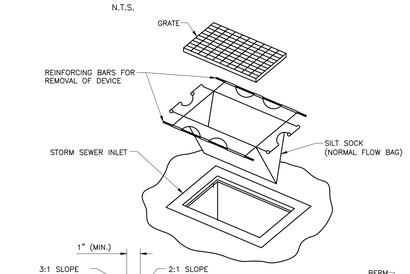
2 / 43 **ROCK CONSTRUCTION ENTRANCE**
N.T.S.

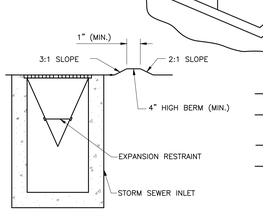



NOTE:

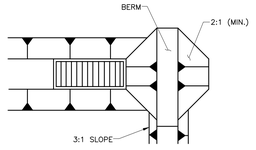
1. SHOW ALL DETAILS AND CONSTRUCTION DIMENSIONS ON PLAN DRAWINGS.
2. FILTER FABRIC FENCE MUST BE INSTALLED AT EXISTING LEVEL GRADE. BOTH ENDS OF EACH FENCE SECTION MUST BE EXTENDED AT LEAST 8 FEET UPSLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.
3. SEDIMENT MUST BE REMOVED WHERE ACCUMULATIONS REACH 1/2 THE ABOVE GROUND HEIGHT OF THE FENCE.
4. ANY FENCE SECTION WHICH HAS BEEN UNDERMINED OR TOPPED MUST BE IMMEDIATELY REPLACED WITH A ROCK FILTER OUTLET. SEE ROCK FILTER DETAIL.
5. REINFORCED FILTER FABRIC FENCE TO BE CONSTRUCTED IN ACCORDANCE WITH THE WEST VIRGINIA EROSION AND SEDIMENT CONTROL BMP MANUAL.
6. STAKES SPACED @ 8' MAX. USE 2" X 2" WOOD OR EQUIVALENT STEEL STAKES.

6 / 43 **REINFORCED FILTER FABRIC FENCE (30" HIGH)**
N.T.S.




## ELEVATION VIEW



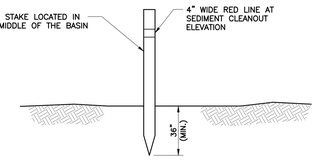

## PLAN VIEW

NOTES:

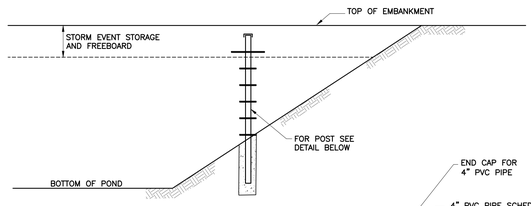
1. THE CONTRACTOR SHALL INSTALL NORMAL FLOW BAGS WHERE SILT SOCKS ARE USED FOR INLET PROTECTION.
2. THE SILT SOCKS SHALL BE THE PRODUCTS DANDY BAG, SILTSACK, OR EQUIVALENT.
3. EARTHEN BERM IN CHANNEL SHALL BE MAINTAINED UNTIL PERMANENT STABILIZATION IS COMPLETED OR TO REMAIN PERMANENTLY.
4. DO NOT USE ON MAJOR PAVED ROADWAYS WHERE PONDING MAY CAUSE TRAFFIC HAZARDS.

9 / 43 **INLET PROTECTION**
N.T.S.

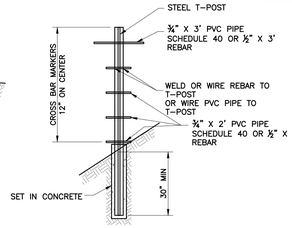
| SEDIMENT CLEANOUT | |
|---|---|
| NAME | ELEVATION (FT) |
| SOUTH POND | 1026.70 |
| WEST POND | 1193.93 |
| NORTH POND | 1243.70 |
| LEACHATE POND | 1214.50 |

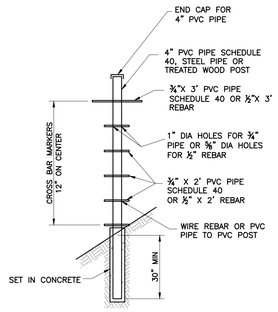



3 / 43 **SEDIMENT CLEANOUT STAKE**
N.T.S.




## SECTION




NOTE:

1. STAFF GAUGE CAN BE FABRICATED AS ABOVE OR OBTAINED FROM BEN MEADOWS, MODEL NO. 99005, FIBERGLASS STREAM GAUGE, 4" WIDE, ENGLISH, 16-20' OR OWNER APPROVED EQUAL.
2. STAFF GAUGE LOCATED IN LEACHATE STORAGE POND SHALL NOT PENETRATE LINER. FOUNDATION TO BE PREFABRICATED PEDESTAL BASE PLATE TO SIT BETWEEN SOIL AND RIP RAP LAYER.

4 / 43 **STAFF GAUGE**
N.T.S.

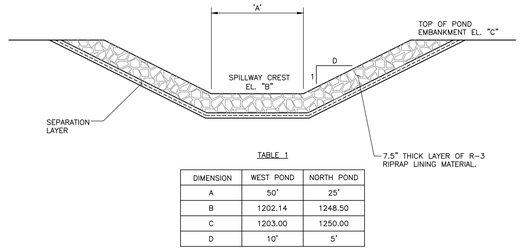
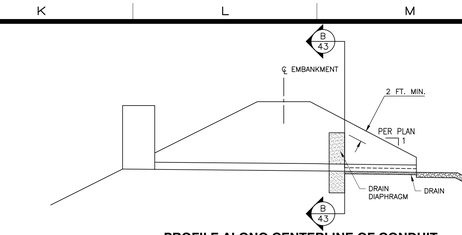



TABLE 1

| DIMENSION | WEST POND | NORTH POND |
|---|---|---|
| A | 50' | 25' |
| B | 1202.14 | 1248.50 |
| C | 1203.00 | 1250.00 |
| D | 10' | 5' |

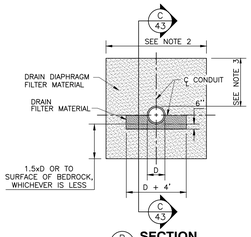
7 / 43 **OVERFLOW SPILLWAY**
NOT TO SCALE



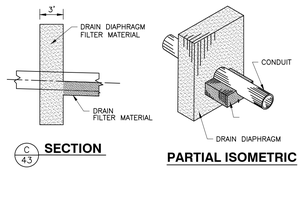

| FILTER MATERIAL GRADATION | |
|---|---|
| SIEVE SIZE | % PASSING BY WEIGHT |
| 3/8 IN. | 100 |
| NO. 4 | 95-100 |
| NO. 16 | 45-85 |
| NO. 50 | 5-30 |
| NO. 100 | 0-10 |

ASTM, C-33 FINE AGGREGATE

## PROFILE ALONG CENTERLINE OF CONDUIT




B 4.3 **SECTION**

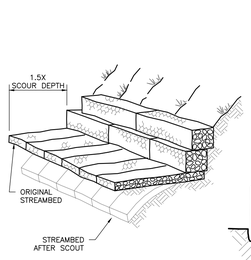



C 4.3 **SECTION** — **PARTIAL ISOMETRIC**

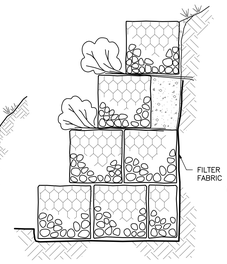
CONSTRUCTION NOTES:

1. THE FILTER MATERIAL SHALL BE PLACED IN 12 INCH LIFTS AND EACH LIFT SATURATED UNIFORMLY WITH APPROXIMATELY 1.2 GALLONS OF WATER PER CUBIC FOOT OF LOOSE FILTER MATERIAL. IN LIEU OF WATER APPLICATION, THE FILTER MATERIAL SHALL BE PLACED IN 9 INCH LIFTS AND COMPACTED WITH ONE PASS OF A PLATE VIBRATOR.
2. EXTEND FILTER DIAPHRAGM (3 X D) BEYOND LATERAL DIMENSION OF PIPE UNLESS OTHERWISE NOTED ON PLANS.
3. NORTH POND AND LEACHATE STORAGE POND = 3 x D
SOUTH POND = TO WITHIN 2-FT OF GROUND SURFACE.

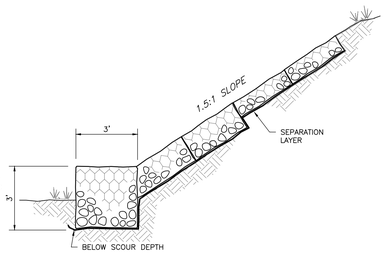
12 / 43 **FILTER DIAPHRAGM DETAIL**
N.T.S.




## TYPICAL GABION APRON

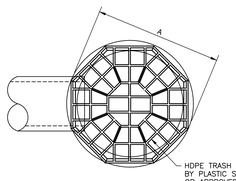



## TYPICAL VEGETATED ROCK GABION

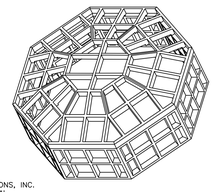



## TYPICAL GABION AND GABION MATTRESS

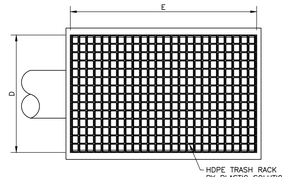
11 / 43 **GABION DETAILS**
N.T.S.



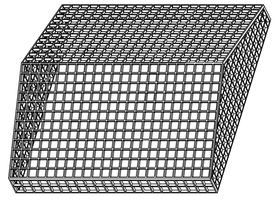

## PLAN



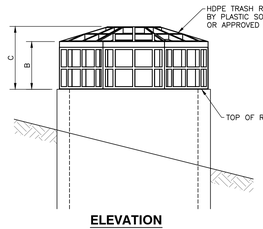
## TRASH RACK ASSEMBLY



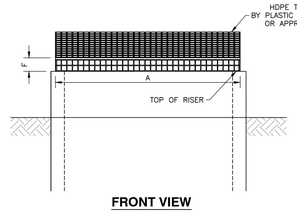

## PLAN



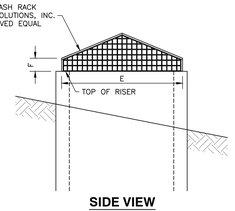
## TRASH RACK ASSEMBLY




## ELEVATION




## FRONT VIEW




## SIDE VIEW

| PYRAMID TYPE TRASH RACK | | | |
|---|---|---|---|
| RISER I.D. | A | B | C |
| 24" | 33-1/2" | 15-3/4" | 12-1/2" |
| 60" | 68-1/2" | 20-1/2" | 12-1/2" |
| 96" | 113" | 39-1/2" | 23" |

## PYRAMID TYPE TRASH RACK

NOTE:
ALL TRASH RACKS TO CONTAIN A REMOVABLE ACCESS PANEL AND CONTAIN ANTI-VORTEX DEVICE.

| PEAK ROOF TYPE TRASH RACK | | | |
|---|---|---|---|
| RISER I.D. | D | E | F |
| 4' | 54-3/8" | 54-3/8" | 16-7/8" |
| 13' | 162-3/8" | 162-3/8" | 22" |

## PEAK ROOF TYPE TRASH RACK

NOTE:
ALL TRASH RACKS TO CONTAIN A REMOVABLE ACCESS PANEL AND CONTAIN ANTI-VORTEX DEVICE.

10 / 43 **TRASH RACK AND ANTI-VORTEX DEVICE**
N.T.S.

**NOTES:**

1. DETAILS STANDARD FILTER FABRIC FENCE 5/43 AND EROSION CONTROL BLANKET 8/43 TO BE USED BY CONTRACTOR AS DEEMED NECESSARY.

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
| 04/16/12 | A | ISSUED FOR PERMIT | APA |

REVISIONS

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

EROSION AND SEDIMENTATION CONTROL DETAILS AND NOTES

DWG NO: 12-3011-43-A

SCALE: AS NOTED | CIVIL ENGINEERING

DR: . | CH: . | SUP: . | ENG: . | DATE: .

APPROVED BY: .

*HAND SIGNATURE ON FILE

Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.cecinc.com

| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

AEP AMERICAN ELECTRIC POWER

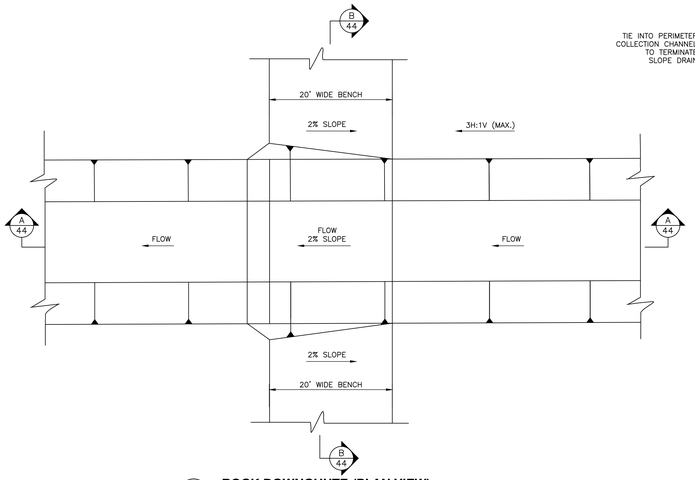
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 05-30MAY-19
PLOTTED BY: USERNAME
BY USERLOFT

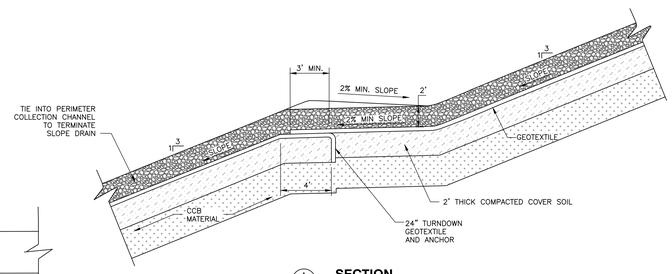
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IGS0506

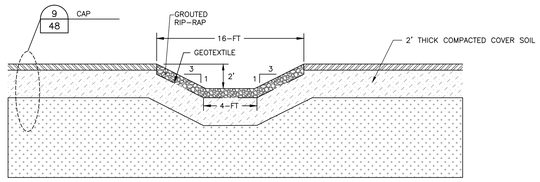
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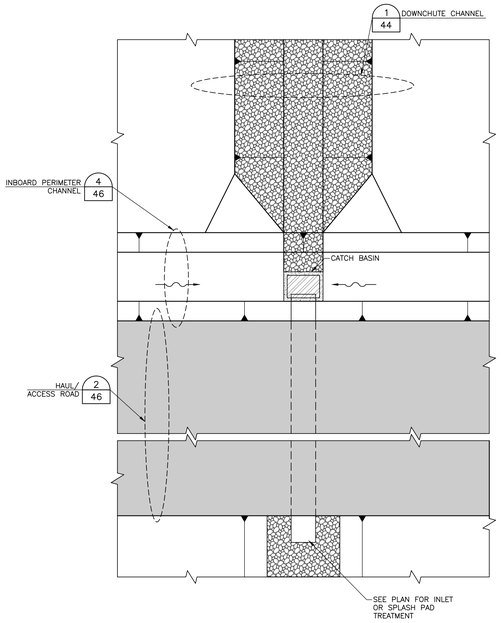

1 / 44 **ROCK DOWNCHUTE (PLAN VIEW)**
NOT TO SCALE



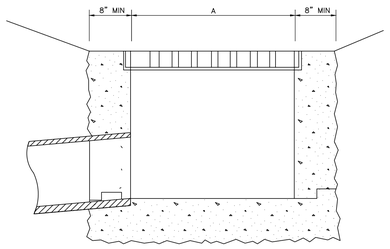

A / 44 **SECTION**
NOT TO SCALE



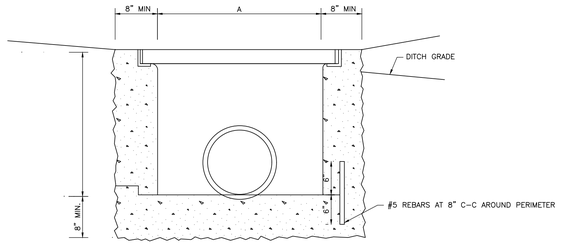

B / 44 **SECTION**
NOT TO SCALE



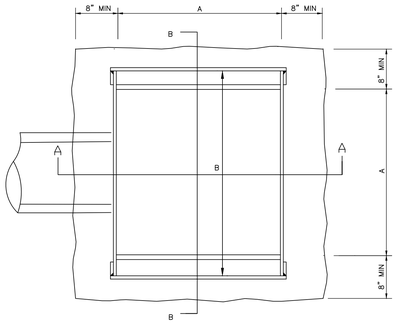

2 / 44 **DOWNCHUTE CULVERT (PLAN VIEW)**
NOT TO SCALE



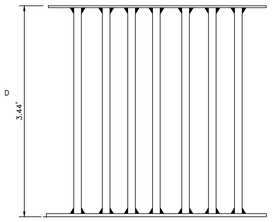

**SECTION A-A**



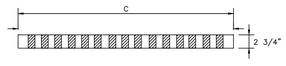

**SECTION B-B**

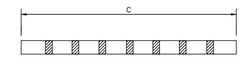



**PLAN**




**PLAN VIEW**

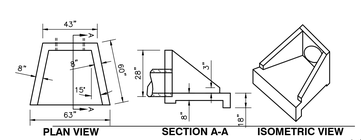


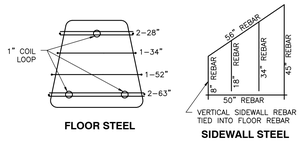

**SECTION THROUGH TYPE 2 GRATE**

| DIMENSIONS | | | | | |
|---|---|---|---|---|---|
| PIPE SIZE | A | B | C | D | H(MIN) |
| 18" | 2'-8" | 3'-2" | 2'-7 3/4" | 3'-1 3/4" | 2'-0" |
| 21" | 2'-8" | 3'-2" | 2'-7 3/4" | 3'-1 3/4" | 2'-3" |
| 24" | 2'-8" | 3'-2" | 2'-7 3/4" | 3'-1 3/4" | 2'-6" |
| 27" | 3'-0" | 3'-6" | 2'-11 3/4" | 3'-5 3/4" | 2'-9" |
| 30" | 3'-6" | 4'-0" | 3'-5 3/4" | 3'-11 3/4" | 3'-0" |
| 33" | 3'-9" | 4'-3" | 3'-8 3/4" | 4'-2 3/4" | 3'-3" |
| 36" | 4'-0" | 4'-6" | 3'-11 3/4" | 4'-5 3/4" | 3'-6" |
| 42" | 4'-6" | 5'-0" | 4'-5 3/4" | 4'-11 3/4" | 4'-0" |
| 48" | 5'-0" | 5'-6" | 4'-11 3/4" | 5'-5 3/4" | 4'-6" |

3 / 44 **CATCH BASIN**
N.T.S.



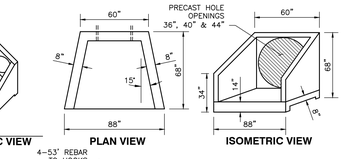

PLAN VIEW | SECTION A-A | ISOMETRIC VIEW



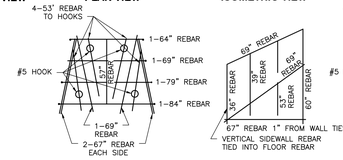

FLOOR STEEL | SIDEWALL STEEL

NOTES:
1. CONCRETE DESIGN STRENGTH 4,000 P.S.I. @ 28 DAYS
2. ALL REINFORCING BARS ARE #4'S
3. 3/4" CHAMFER ON ALL EXPOSED EDGES.
4. PRECAST HOLE SIZES FROM 9"-24".

**HEADWALL 9"-24"**



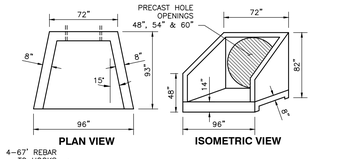

PLAN VIEW | ISOMETRIC VIEW



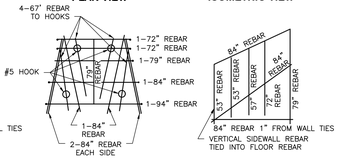

FLOOR STEEL | SIDEWALL STEEL

NOTES:
1. CONCRETE DESIGN STRENGTH 4,000 P.S.I. @ 28 DAYS
2. ALL REINFORCING BARS ARE #4'S
3. ALL LIFT HOOKS ARE #5'S.

**HEADWALL 36"-44"**




PLAN VIEW | ISOMETRIC VIEW




FLOOR STEEL | SIDEWALL STEEL

NOTES:
1. CONCRETE DESIGN STRENGTH 4,000 P.S.I. @ 28 DAYS
2. ALL REINFORCING BARS ARE #4'S
3. ALL LIFT HOOKS ARE #5'S.

**HEADWALL 48"-60"**

4 / 44 **REINFORCED CONCRETE HEADWALL**
NOT TO SCALE

NOTE:
1. WYDOT STANDARD PIPE CULVERT HEADWALLS AND WINGWALLS, AS DEPICTED ON STANDARD SHEET DR1 AND DR2 MAY BE USED IN LIEU OF DETAIL PROVIDED..
2. ANIMAL GUARDS TO BE PROVIDED AT ALL OUTLETS.

| DATE | NO. | DESCRIPTION | APP. |
|---|---|---|---|
| 04/16/13 | A | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## DOWNCHUTE, CATCH BASIN, AND HEADWALL DETAILS

DWG NO: 12-30110-44-A

SCALE: AS NOTED | CIVIL ENGINEERING

DR: . | CH: . | SUP: . | ENG: . | DATE: . | APPROVED BY: .

*HAND SIGNATURE ON FILE

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4274 Glendale-Milford Road · Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.cecinc.com

| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

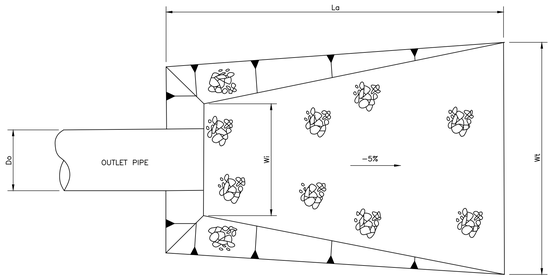
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: DEC-NOV-1-YY
PLOT BY: ANDREW PRICE
BYT:USERPLOT

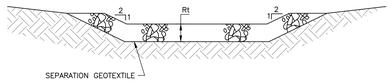
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IGS0506

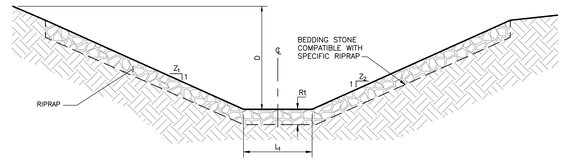
DWG NO: 12-30110-45-B




1/45 **OUTLET PROTECTION**
NOT TO SCALE




2/45 **SECTION**
NOT TO SCALE



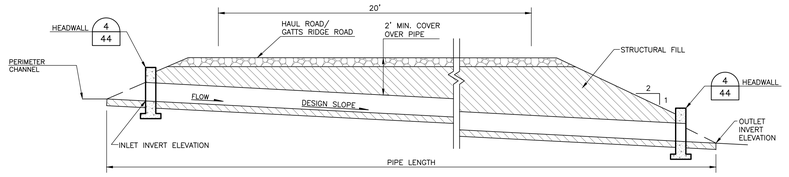

3/45 **CHANNEL DETAILS**
NOT TO SCALE

| OUTLET PROTECTION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID | STORM STRUCTURE | Do (IN) | Wi (FT) | Wt (FT) | La (FT) | D50 | RIPRAP CLASS/ GROUTED CLASS | Rt (IN) |
| OP-1 | SS-1 | 48 | 12.0 | 44.0 | 40 | 18 | G-7 | 27.0 |
| OP-2 | SS-5 | 42 | 10.5 | 48.5 | 45 | 24 | G-8 | 36.0 |
| OP-3 | SS-7 | 36 | 9.0 | 33.0 | 30 | 15 | G-6 | 24.0 |
| OP-4 | SS-10 | 36 | 9.0 | 23.0 | 20 | 9 | R-5 | 13.5 |
| OP-5 | SS-12 | 24 | 6.0 | 17.0 | 15 | 6 | R-4 | 9.0 |
| OP-6 | SS-15 | 42 | 10.5 | 33.5 | 30 | 15 | G-6 | 24.0 |
| OP-7 | SS-19 | 12 | 3.0 | 6.0 | 5 | 6 | R-4 | 9.0 |
| OP-8 | SS-21 | 24 | 6.0 | 12.0 | 10 | 6 | R-4 | 9.0 |
| OP-9 | SS-23 | 30 | 7.5 | 22.5 | 20 | 6 | R-4 | 9.0 |
| OP-10 | SS-26 | 36 | 9.0 | 45 | 42 | 15 | R-6 | 24.0 |

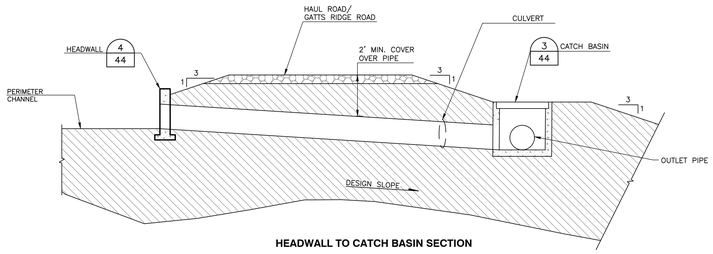
NOTE:
1. RIPRAP SIZES SPECIFIED IN THIS TABLE REPRESENT NATIONAL CRUSHED STONE ASSOCIATION RIPRAP CLASSIFICATIONS.
2. RIPRAP WITH "G" DESIGNATION IS TO BE GROUTED RIPRAP OR OTHER APPROVED HARD ARMOR EROSION CONTROL PRODUCT.
3. GROUTED RIPRAP AND/OR OTHER HARD ARMOUR EROSION CONTROL PRODUCTS WILL NOT REQUIRE BEDDING STONE.
4. REFER TO CONSTRUCTION DRAWINGS FOR PHASES 1, 2, 3, 4, AND/OR 5 DEVELOPMENT FOR UPDATES TO THE OUTLET PROTECTION SCHEDULE.

| CHANNEL SCHEDULE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CHANNEL LOCATION | DRAINAGE AREA ID | AREA (ACRES) | DESCRIPTION | DOWNSTREAM STRUCTURE ID | RIPRAP CLASS/ GROUTED CLASS | Z1 | Z2 | L1 (FT) | D (FT) | D50 | Rt (IN) |
| SOUTH | CH-1 | 9.8 | SOUTHEAST CHANNEL | SOUTH POND | G-6 | 3 | 3 | 2 | 3 | 15 | 24.0 |
| EAST | CH-2 | 2.4 | EAST OUTBOARD CHANNEL | CH-1 | R-6 | 1 | 2 | 2 | 2 | 15 | 24.0 |
| EAST | CH-3 | 2.5 | EAST INBOARD CHANNEL | CH-1 | R-5 | 3 | 3 | 2 | 3 | 9 | 13.5 |
| SOUTH | CH-4 | 6.0 | SOUTHWEST CHANNEL | P-4 | G-6 | 3 | 3 | 2 | 3 | 15 | 24.0 |
| SOUTH | CH-5 | 6.1 | SOUTH INBOARD CHANNEL | P-4 | G-6 | 1 | 2 | 4 | 2 | 15 | 24.0 |
| SOUTH | CH-6 | 35.7 | SOUTH MIDDLE SWALE | P-4 | R-7 | 2 | 1 | 4 | 4 | 18 | 27.0 |
| SOUTH | CH-7 | 1.4 | SOUTH OUTBOARD CHANNEL | SOUTH POND | R-5 | 2.5 | 1 | 2 | 3 | 9 | 13.5 |
| SOUTH | CH-9 | 33.3 | SOUTH DOWNCHUTE CHANNEL | SOUTH POND | G-6 | 3 | 3 | 4 | 2 | 15 | 24.0 |
| NORTH | CH-10 | 3.8 | NORTH OUTBOARD CHANNEL | P-9 | R-5 | 2 | 1 | 2 | 2 | 9 | 13.5 |
| WEST | CH-11 | 13.9 | WEST DOWNCHUTE | P-12 | G-7 | 3 | 3 | 4 | 4 | 18 | 27.0 |
| NORTH | CH-12 | 1.2 | NORTH OUTBOARD CHANNEL | P-15 | R-4 | 2 | 1 | 2 | 2 | 6 | 9.0 |
| NORTH | CH-13 | 2.7 | NORTH OUTBOARD CHANNEL | P-16 | R-5 | 3 | 3 | 2 | 3 | 9 | 13.5 |
| NORTH | CH-14 | 3.8 | NORTH DOWNCHUTE CHANNEL | P-16 | G-6 | 3 | 3 | 4 | 2 | 15 | 24.0 |
| WEST | CH-15 | 3.8 | WEST INBOARD CHANNEL | P-12 | R-4 | 3 | 3 | 2 | 3 | 6 | 9.0 |
| WEST | CH-16 | 4.5 | WEST INBOARD CHANNEL | P-12 | R-4 | 3 | 3 | 2 | 3 | 6 | 9.0 |
| WEST | CH-17 | 4.1 | WEST OUTBOARD CHANNEL – SOUTH | P-11 | R-3 | 2.5 | 3 | 2 | 4 | 3 | 4.5 |
| WEST | CH-18 | 0.9 | WEST OUTBOARD CHANNEL – NORTH | P-11 | R-3 | 2 | 1 | 2 | 2 | 3 | 4.5 |
| WEST | CH-19 | 27.9 | WEST SWALE | WEST POND | G-6 | 3 | 3 | 3 | 2 | 15 | 24.0 |

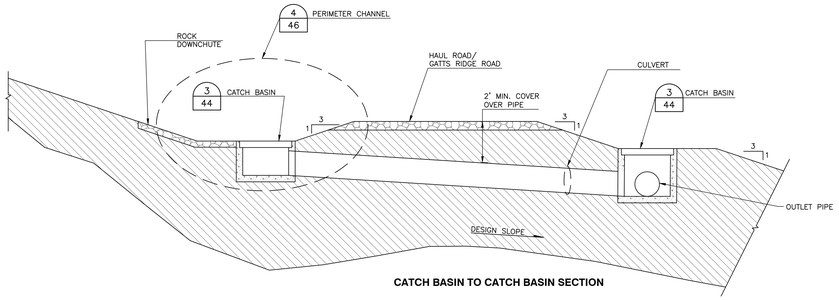
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4. REFER TO CONSTRUCTION DRAWINGS FOR PHASES 1, 2, 3, 4, AND/OR 5 DEVELOPMENT FOR UPDATES TO THE CHANNEL SCHEDULE.



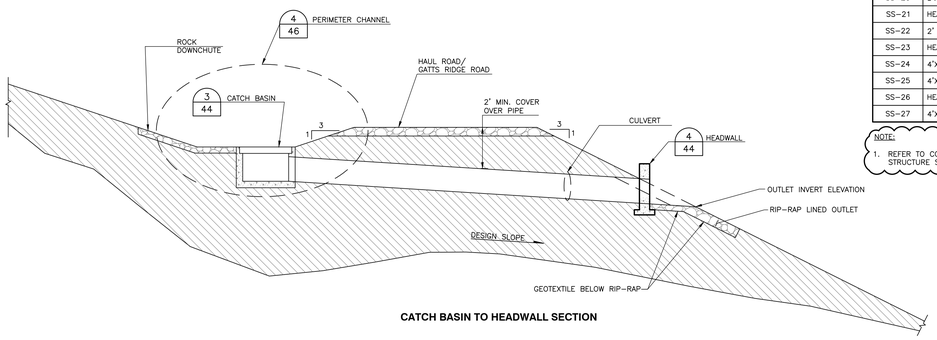

**HEADWALL TO HEADWALL SECTION**




**HEADWALL TO CATCH BASIN SECTION**




**CATCH BASIN TO CATCH BASIN SECTION**



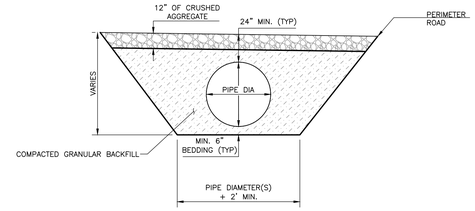

**CATCH BASIN TO HEADWALL SECTION**

4/45 **TYPICAL STORM SEWER DETAIL**
NOT TO SCALE

NOTE:
1. REFER TO PLAN SHEETS AND STORM STRUCTURE SCHEDULE FOR SPECIFIC END TREATMENTS.
2. THIS DETAIL SHOWS WHERE A PIPE CROSSES UNDER A ROAD.

| STORM STRUCTURE SCHEDULE | | | | | |
|---|---|---|---|---|---|
| STRUCTURE NAME | STRUCTURE TYPE | RIM ELEVATION | INCOMING PIPES | OUTGOING PIPES | STRUCTURE DEPTH |
| SS-1 | HEADWALL | | P-1, 48" INV IN=867.38 | | |
| SS-2 | CLEANOUT | 966.71 | P-2, 48" INV IN=950.71 | P-1, 48" INV OUT=950.71 | 16.00 |
| SS-3 | 13'X13' CATCH BASIN | 1038.88 | P-3, 48" INV IN=1015.00<br>P-18, 36" INV IN=1000.00 | P-2, 48" INV OUT=980.00 | 58.88 |
| SS-4 | 8' DIA. RISER | 1039.88 | | P-3, 48" INV OUT=1016.00 | 23.88 |
| SS-5 | HEADWALL | | P-4, 42" INV IN=1034.00 | | |
| SS-6 | HEADWALL | | | P-4, 42" INV OUT=1036.00 | |
| SS-7 | HEADWALL | | P-5, 36" INV IN=1035.33 | | |
| SS-8 | CATCH BASIN | 1055.04 | P-6, 12" INV IN=1045.00 | P-5, 36" INV OUT=1045.00 | 10.04 |
| SS-9 | 3'X3' CATCH BASIN | 1091.99 | | P-6, 12" INV OUT=1070.00 | 21.99 |
| SS-10 | HEADWALL | | P-7, 36" INV IN=1185.00 | | |
| SS-11 | 6' DIA. RISER | 1201.56 | | P-7, 36" INV OUT=1190.00 | 11.56 |
| SS-12 | HEADWALL | | P-8, 24" INV IN=1214.00 | | |
| SS-13 | 3'X3' CATCH BASIN | 1222.98 | P-9, 18" INV IN=1219.00 | P-8, 24" INV OUT=1218.00 | 4.98 |
| SS-14 | HEADWALL | | | P-9, 18" INV OUT=1223.90 | |
| SS-15 | HEADWALL | | P-10, 42" INV IN=1215.16 | | |
| SS-16 | 4' X 4' CATCH BASIN | 1224.50 | P-12, 36" INV IN=1217.00<br>P-11, 18" INV IN=1218.00 | P-10, 42" INV OUT=1217.00 | 7.50 |
| SS-17 | 3'X3' CATCH BASIN | 1226.53 | | P-11, 18" INV OUT=1220.00 | 6.53 |
| SS-18 | 6'X6' CATCH BASIN | 1224.81 | | P-12, 36" INV OUT=1218.00 | 6.81 |
| SS-19 | HEADWALL | | P-13, 12" INV IN=1238.92 | | |
| SS-20 | 3'X3' CATCH BASIN | 1244.49 | | P-13, 12" INV OUT=1240.00 | 4.49 |
| SS-21 | HEADWALL | | P-14, 24" INV IN=1193.29 | | |
| SS-22 | 2' DIA. RISER | 1247.57 | | P-14, 24" INV OUT=1241.00 | 6.57 |
| SS-23 | HEADWALL | | P-15, 30" INV IN=1245.00 | | |
| SS-24 | 4'X4' CATCH BASIN | 1258.06 | P-16, 30" INV IN=1247.42 | P-15, 30" INV OUT=1247.42 | 10.64 |
| SS-25 | 4'X4' CATCH BASIN | 1254.94 | | P-16, 30" INV OUT=1248.00 | 6.94 |
| SS-26 | HEADWALL | | | P-17, 36" INV OUT=1201.00 | |
| SS-27 | 4'X4' CATCH BASIN | 1229.00 | P-17, 36" INV IN=1210.00 | | 19.00 |

NOTE:
1. REFER TO CONSTRUCTION DRAWINGS FOR PHASES 1, 2, 3, 4, AND/OR 5 DEVELOPMENT FOR UPDATES TO THE STORM STRUCTURE SCHEDULE.




5/45 **TYPICAL PIPE BEDDING DETAIL**
NOT TO SCALE

| PIPE SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| CULVERT NAME | DIAMETER | PIPE MATERIAL | NO. OF BARRELS | INLET EL. | OUTLET EL. | LENGTH |
| P-1 | 48 | RCP | 1 | 950.71 | 867.38 | 257 |
| P-2 | 48 | RCP | 1 | 980.00 | 950.71 | 251 |
| P-3 | 48 | HDPE | 1 | 1016.00 | 1015.00 | 12 |
| P-4 | 42 | HDPE | 2 | 1036.00 | 1034.00 | 92 |
| P-5 | 36 | HDPE | 1 | 1045.00 | 1035.33 | 388 |
| P-6 | 12 | HDPE | 1 | 1070.00 | 1045.00 | 147 |
| P-7 | 36 | HDPE | 1 | 1190.00 | 1185.00 | 119 |
| P-8 | 24 | HDPE | 1 | 1218.00 | 1214.00 | 183 |
| P-9 | 18 | HDPE | 1 | 1223.90 | 1219.00 | 244 |
| P-10 | 42 | HDPE | 1 | 1217.00 | 1215.16 | 106 |
| P-11 | 18 | HDPE | 1 | 1220.00 | 1218.00 | 99 |
| P-12 | 36 | HDPE | 1 | 1218.00 | 1217.00 | 68 |
| P-13 | 12 | HDPE | 1 | 1240.00 | 1238.92 | 91 |
| P-14 | 24 | HDPE | 1 | 1241.00 | 1193.29 | 214 |
| P-15 | 30 | HDPE | 1 | 1247.42 | 1245.00 | 161 |
| P-16 | 30 | HDPE | 1 | 1248.00 | 1247.42 | 57 |
| P-17 | 36 | HDPE | 1 | 1201.00 | 1210.00 | 173 |
| P-18 | 36 | HDPE | 1 | 1016.50 | 1000.00 | 330 |

NOTE:
1. REFER TO CONSTRUCTION DRAWINGS FOR PHASES 1, 2, 3, 4, AND/OR 5 DEVELOPMENT FOR UPDATES TO THE PIPE SCHEDULE.

| DATE | NO. | DESCRIPTION | APPD |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/12 | A | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## STORM AND DRAINAGE DETAILS

DWG NO: 12-30110-45-B

SCALE: AS NOTED | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY: .

*HAND SIGNATURE ON FILE

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4274 Glendale-Milford Road · Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
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| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

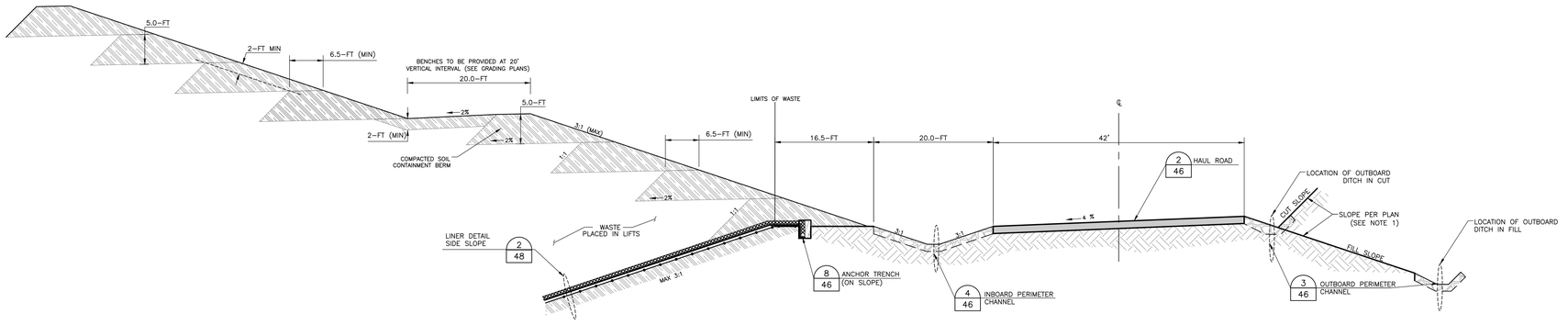
AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: DEC-NOVA-12(Y)
PLOT TIME: 08:44:44 AM
BY: USERPLOT

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IGS0506

DWG NO: 12-30110-46-B

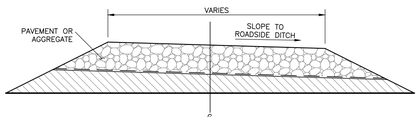



**1/46 TYPICAL PERIMETER BERM SECTION**
NOT TO SCALE

| SYSTEM COMPONENT SUMMARY TABLE | | |
|---|---|---|
| COMPONENT NAME | SYMBOL | REQUIRED MATERIAL PROPERTY SUMMARY (SEE INDIVIDUAL DETAILS AND CQA/QC PLAN FOR DETAILED INFORMATION) |
| VEGETATIVE COVER | | MIN. 6" ORGANIC MATERIAL |
| FINAL PROTECTIVE COVER | | MIN. THICKNESS 24" |
| DRAINAGE GEOCOMPOSITE | | (OMITTED FROM PHASE 3 & 4 LINER AREAS) |
| COHESIVE SOIL | | THICKNESS VARIES |
| WASTE MATERIAL | | |
| PROTECTIVE COVER | | ~~MIN. THICKNESS 18"~~ |
| LEACHATE COLLECTION | | MIN. PERMEABILITY $7X10^{-3}$ cm/sec. |
| GEOTEXTILE | | |
| FLEXIBLE MEMBRANE LINER | | PVC LINER |
| GEOSYNTHETIC CLAY LINER (GCL) | | |
| COMPACTED SOIL, SUBBASE AND/OR ADDED GEOLOGIC MATERAIL | | -SUBBASE TO BE PREPARED PER GCL MANUFACTURER'S RECOMMENDATIONS<br>-ADDED GEOLOGIC MATERIAL USED TO PROVIDE BEDROCK ISOLATION MUST BE A MIN OF 4 FT THICK |
| STRUCTURAL FILL | | MIN. THICKNESS 12" |
| IN-SITU SOIL | | |
| COARSE AGGREGATE | | THICKNESS VARIES |
| BEDROCK | | |
| ROCK CHANNEL PROTECTION | | |

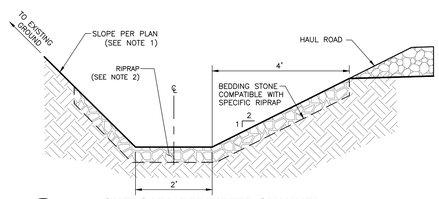
## NOTES:

1. HILLSIDE EXCAVATIONS WILL BE TYPICALLY IN ROCK WITH SOME SOIL EXCAVATION. EXCAVATIONS IN SOIL SHALL BE AT A MAXIMUM 2H:1V. EXCAVATION IN ROCK SHALL BE AT A MAXIMUM 1H:2V, DEPENDING ON ROCK QUALITY AND CONDITION. THE STEEPNESS OF ROCK CUTS SHALL BE DETERMINED IN THE FIELD BY A QUALIFIED GEOTECHNICAL ENGINEER. FOR LAYOUT PURPOSES, HILLSIDE CUTS ARE SHOWN AS 1H:1V.
2. SEE RIPRAP CHANNEL SIZING CHART ON SHEET 12-30110-45 FOR RIPRAP SIZES.
3. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER. PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFCALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET, THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.

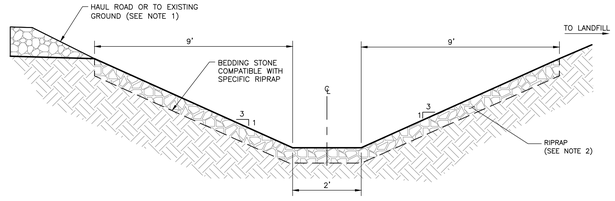



**2/46 HAUL/ACCESS/SERVICE ROAD**
NOT TO SCALE
(VERTICAL SCALE EXAGGERATED)

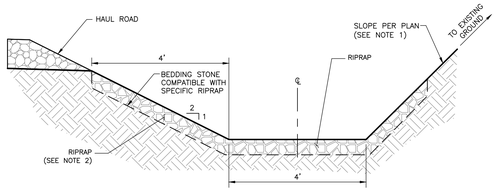
NOTE:
HAUL ROAD TO HAVE ASPHALT SURFACE OUTSIDE OF LIMITS OF WASTE AND GRAVEL SURFACE INSIDE OF LIMITS OF WASTE.




**3/46 OUTBOARD PERIMETER CHANNEL**
NOT TO SCALE

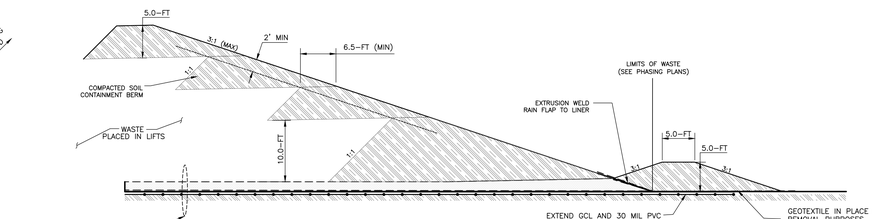



**4/46 INBOARD PERIMETER CHANNEL / SOUTHERN CHANNEL**
NOT TO SCALE



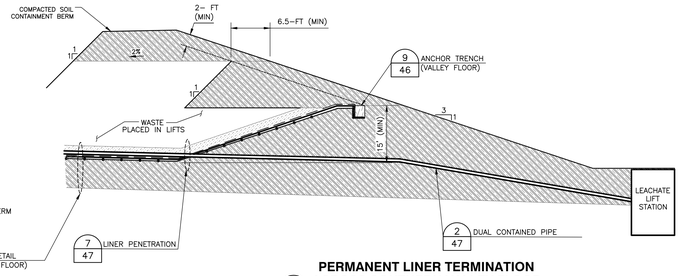

**5/46 HAUL ROAD INSIDE DITCH**
NOT TO SCALE

NOTE:
TRANSITION FROM HAUL ROAD INSIDE DITCH TO INSIDE PERIMETER CHANNEL BETWEEN STA. 33+51 AND 35+50.

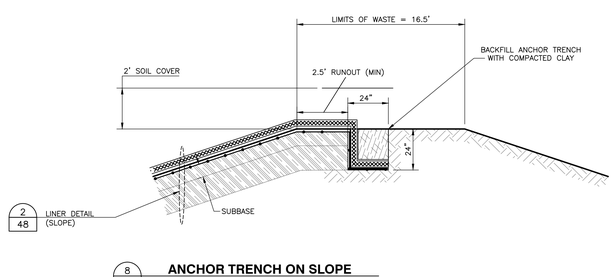



**6/46 INTERIOR PHASING BERMS**
SCALE: NTS

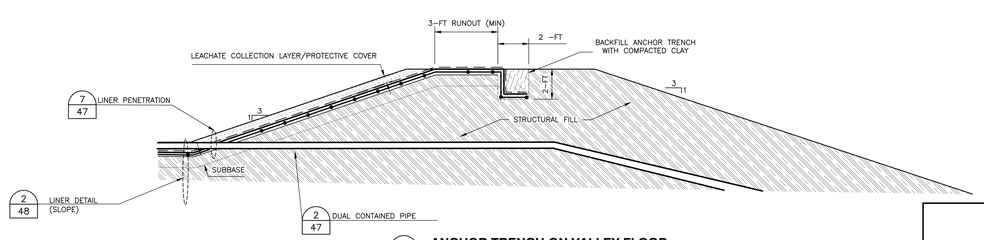
NOTE:
PIPE PENETRATION THRU RAIN FLAP TO BE PROVIDED FOR LEACHATE PIPING. SEE DETAIL 7/47.




**PERMANENT LINER TERMINATION ACROSS SOUTHERN VALLEY FLOOR**
7/46
NOT TO SCALE




**8/46 ANCHOR TRENCH ON SLOPE**
NOT TO SCALE




**9/46 ANCHOR TRENCH ON VALLEY FLOOR**
NOT TO SCALE

| REVISIONS | | | |
|---|---|---|---|
| DATE | NO. | DESCRIPTION | APPD. |
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/12 | A | ISSUED FOR PERMIT | APA |
| . | | | |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## TYPICAL PERIMETER SECTION AND LINER TERMINATION DETAILS

DWG NO: 12-30110-46-B

SCALE: AS NOTED | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: . APPROVED BY: .

*HAND SIGNATURE ON FILE

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4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 · 800.759.5614 · Fax: 513.985.0228
www.cecinc.com

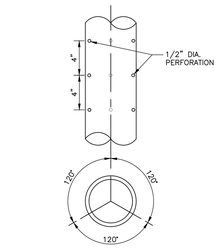
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|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 1/7/2020 8:44 AM
PLOTTED BY: USERPLOT

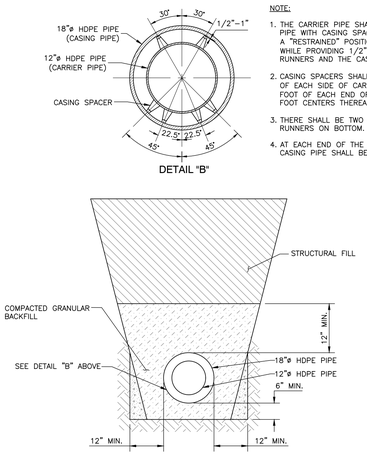
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DWG NO: 12-30110-47-B



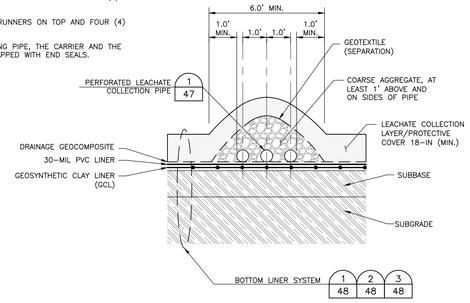

NOTE:
1. 12" DIAMETER SDR-11 HDPE PIPE

## 1/47 PERFORATED LEACHATE COLLECTION PIPE
NOT TO SCALE



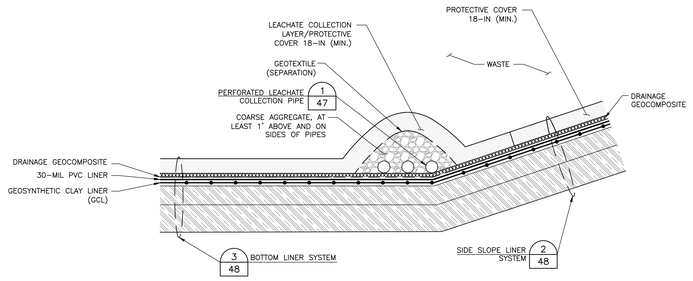

## 2/47 DUAL CONTAINED PIPE DETAIL
NOT TO SCALE

NOTE:
1. THE CARRIER PIPE SHALL BE BRACED WITHIN THE CASING PIPE WITH CASING SPACERS THAT PLACE THE CARRIER PIPE IN A "RESTRAINED" POSITION TO PRECLUDE POSSIBLE FLOTATION WHILE PROVIDING 1/2"-1" CLEARANCE BETWEEN THE TOP RUNNERS AND THE CASING PIPE.
2. CASING SPACERS SHALL BE INSTALLED WITHIN ONE (1) FOOT OF EACH SIDE OF CARRIER PIPE JOINTS, WITHIN ONE (1) FOOT OF EACH END OF THE CASING PIPE AND ON SIX (6) FOOT CENTERS THEREAFTER.
3. THERE SHALL BE TWO (2) RUNNERS ON TOP AND FOUR (4) RUNNERS ON BOTTOM.
4. AT EACH END OF THE CASING PIPE, THE CARRIER AND THE CASING PIPE SHALL BE WRAPPED WITH END SEALS.




## 3/47 LEACHATE COLLECTION PIPE SECTION
NOT TO SCALE

NOTE:
1. SEE SHEET 16 FOR ACTUAL NUMBER OF LEACHATE PIPES IN EACH PHASE OF LEACHATE COLLECTION SYSTEM.
2. COARSE AGGREGATE TO BE NON-CALCAREOUS.



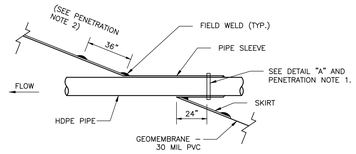

## 4/47 LEACHATE COLLECTION PIPE AT TOE OF SLOPE
NOT TO SCALE

NOTE:
1. SEE SHEET 16 FOR ACTUAL NUMBER OF LEACHATE PIPES IN EACH PHASE OF LEACHATE COLLECTION SYSTEM.
2. COARSE AGGREGATE TO BE NON-CALCAREOUS.

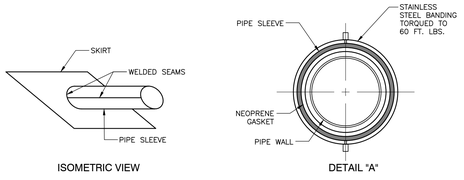
### SYSTEM COMPONENT SUMMARY TABLE

| COMPONENT NAME | SYMBOL | REQUIRED MATERIAL PROPERTY SUMMARY (SEE INDIVIDUAL DETAILS AND CQA/QC PLAN FOR DETAILED INFORMATION) |
|---|---|---|
| VEGETATIVE COVER | | MIN. 6" ORGANIC MATERIAL |
| FINAL PROTECTIVE COVER | | MIN. THICKNESS 24" |
| DRAINAGE GEOCOMPOSITE | | (OMITTED FROM PHASE 3 & 4 LINER AREAS) |
| COHESIVE SOIL | | THICKNESS VARIES |
| WASTE MATERIAL | | |
| PROTECTIVE COVER | | ~~MIN. THICKNESS 18"~~ |
| LEACHATE COLLECTION | | MIN. PERMEABILITY $7X10^{-3}$ cm/sec. |
| GEOTEXTILE | | |
| FLEXIBLE MEMBRANE LINER | | PVC LINER |
| GEOSYNTHETIC CLAY LINER (GCL) | | |
| COMPACTED SOIL, SUBBASE AND/OR ADDED GEOLOGIC MATERAIL | | -SUBBASE TO BE PREPARED PER GCL MANUFACTURER'S RECOMMENDATIONS<br>-ADDED GEOLOGIC MATERIAL USED TO PROVIDE BEDROCK ISOLATION MUST BE A MIN OF 4 FT THICK |
| STRUCTURAL FILL | | MIN. THICKNESS 12" |
| IN-SITU SOIL | | |
| COARSE AGGREGATE | | THICKNESS VARIES |
| BEDROCK | | |
| ROCK CHANNEL PROTECTION | | |

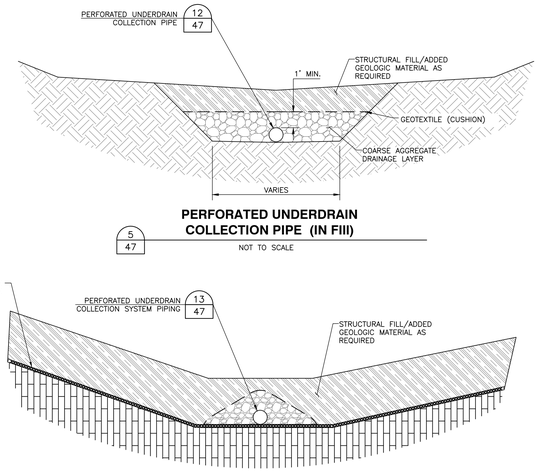
## NOTES:
1. SEE RIPRAP CHANNEL SIZING CHART ON SHEET 12-30110-45 FOR RIPRAP SIZES.
2. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER, PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFICALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET. THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.




PENETRATION NOTES:
1. USE ONE STAINLESS STEEL BAND PER PIPE PENETRATION SEAL.
2. SKIRT IS TO EXTEND 36 INCHES BEYOND PIPE IN ALL DIRECTIONS.




## 7/47 TYPICAL PIPE PENETRATION
NOT TO SCALE

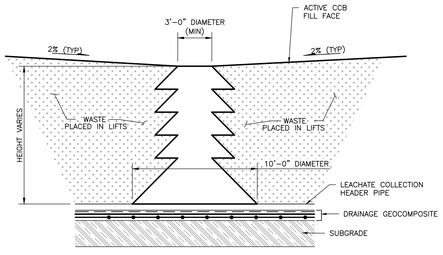



## 5/47 PERFORATED UNDERDRAIN COLLECTION PIPE (IN Fill)
NOT TO SCALE

## PERFORATED UNDERDRAIN COLLECTION PIPE (ON DRAINAGE GEOCOMPOSITE)
11/47
NOT TO SCALE



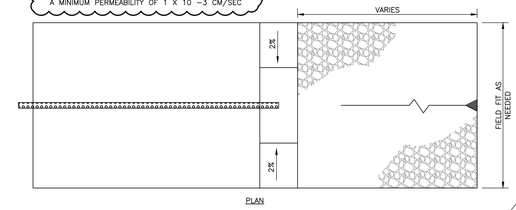

## PLAN VIEW



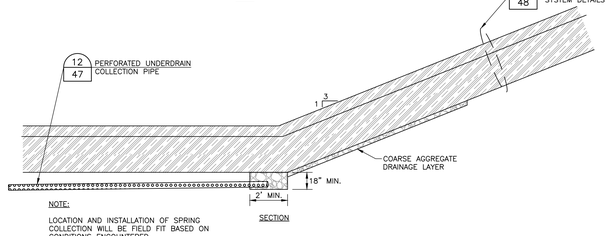

## SECTION VIEW

## 10/47 VERTICAL CHIMNEY DRAIN
NOT TO SCALE

NOTE:
1. SEE SHEET 16 FOR ACTUAL NUMBER OF LEACHATE PIPES IN EACH PHASE OF LEACHATE COLLECTION SYSTEM.
2. COARSE AGGREGATE TO BE NON-CALCAREOUS.
3. BOTTOM ASH OR SAND FOR CHIMNEY DRAIN TO HAVE A MINIMUM PERMEABILITY OF 1 X 10 -3 CM/SEC



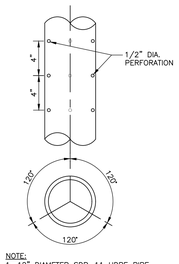

PLAN




NOTE:
LOCATION AND INSTALLATION OF SPRING COLLECTION WILL BE FIELD FIT BASED ON CONDITIONS ENCOUNTERED.

SECTION

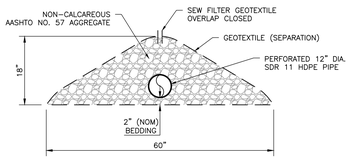
## 14/47 SPRING COLLECTION
NOT TO SCALE



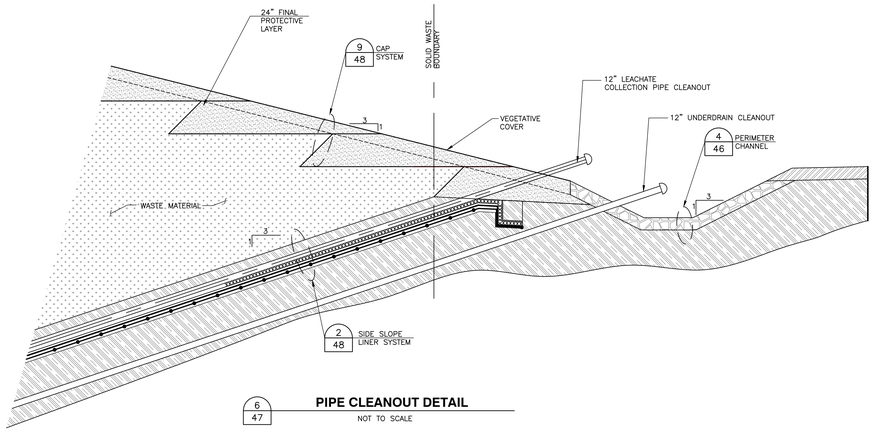

NOTE:
1. 12" DIAMETER SDR-11 HDPE PIPE

## 12/47 PERFORATED UNDERDRAIN COLLECTION PIPE
NOT TO SCALE

NOTE:
SIZE, NUMBER, AND EXACT LOCATION OF UNDERDRAIN PIPES TO BE DETERMINED BASED ON CONDITIONS ENCOUNTERED IN THE FIELD.




## 13/47 UNDERDRAIN COLLECTION SYSTEM PIPING
NOT TO SCALE




## 6/47 PIPE CLEANOUT DETAIL
NOT TO SCALE

REVISIONS

| DATE | NO. | DESCRIPTION | APPD |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/12 | A | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## LEACHATE COLLECTION AND UNDERDRAIN DETAILS

DWG NO: 12-30110-47-B

SCALE: AS NOTED | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY: .

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4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 - 800.759.5614 - Fax: 513.985.0228
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| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | *APA |
|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

AEP AMERICAN ELECTRIC POWER

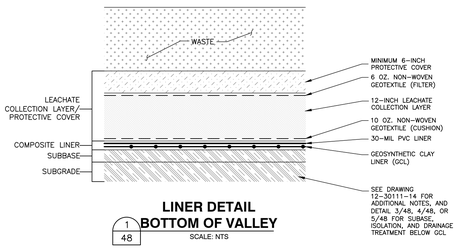
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 20-JANUARY-YY
PLOT SCALE: 1.0000
PLOT BY: LISERPLOT

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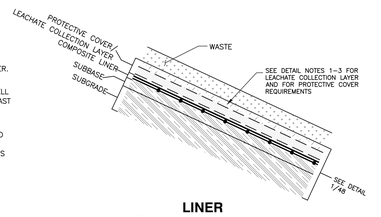
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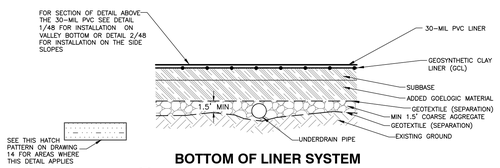

**LINER DETAIL BOTTOM OF VALLEY**
1/48 — SCALE: NTS

## NOTES:

1. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER.
2. LEACHATE COLLECTION LAYER SHALL BE AT LEAST 12 INCHES THICK, COMPRISED OF BOTTOM ASH FROM MITCHELL PLANT AND SHALL HAVE A PERMEABILTY VALUE OF AT LEAST 7 X $10^{-3}$ CM/SEC.
3. THE LEACHATE COLLECTION LAYER SHALL BE PROTECTED WITH A NON-WOVEN 6 OZ GEOTEXTILE FILTER FABRIC AND COVERED WITH AT LEAST 6 INCHES OF NON-SPECIFIED BOTTOM ASH TO ACHIEVE A MINIMUM COMBINED THICKNESS OF 18 INCHES TO SERVE AS THE PROTECTIVE COVER.

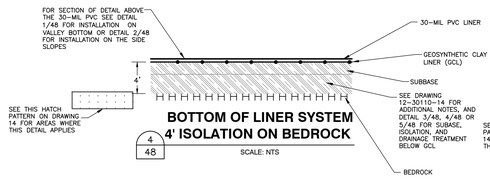



**LINER SIDE SLOPE**
2/48 — NOT TO SCALE

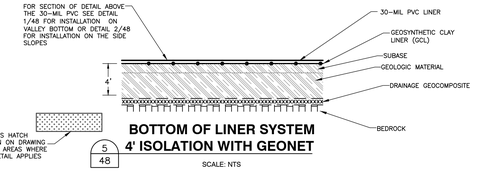



**BOTTOM OF LINER SYSTEM FILL WITH DRAINAGE BLANKET**
3/48 — SCALE: NTS

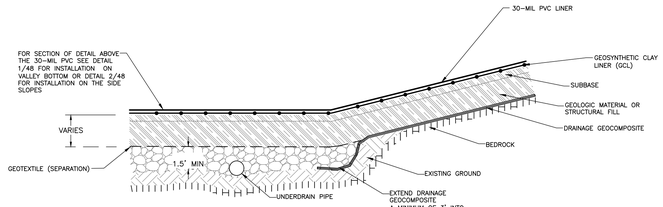
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| COHESIVE SOIL | | THICKNESS VARIES |
| WASTE MATERIAL | | |
| PROTECTIVE COVER | | ~~MIN. THICKNESS 18"~~ |
| LEACHATE COLLECTION | | MIN. PERMEABILITY 7X10$^{-3}$ cm/sec. |
| GEOTEXTILE | | |
| FLEXIBLE MEMBRANE LINER | | PVC LINER |
| GEOSYNTHETIC CLAY LINER (GCL) | | |
| COMPACTED SOIL, SUBBASE AND/OR ADDED GEOLOGIC MATERAIL | | -SUBBASE TO BE PREPARED PER GCL MANUFACTURER'S RECOMMENDATIONS<br>-ADDED GEOLOGIC MATERIAL USED TO PROVIDE BEDROCK ISOLATION MUST BE A MIN OF 4 FT THICK |
| STRUCTURAL FILL | | MIN. THICKNESS 12" |
| IN-SITU SOIL | | |
| COARSE AGGREGATE | | THICKNESS VARIES |
| BEDROCK | | |
| ROCK CHANNEL PROTECTION | | |




**BOTTOM OF LINER SYSTEM 4' ISOLATION ON BEDROCK**
4/48 — SCALE: NTS



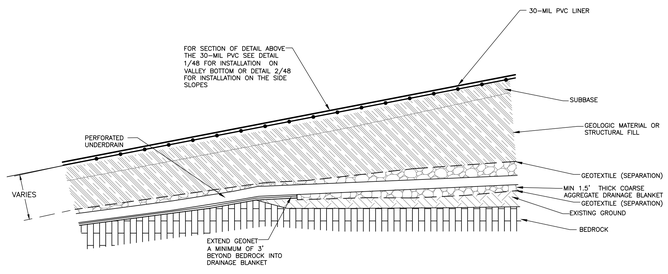

**BOTTOM OF LINER SYSTEM 4' ISOLATION WITH GEONET**
5/48 — SCALE: NTS



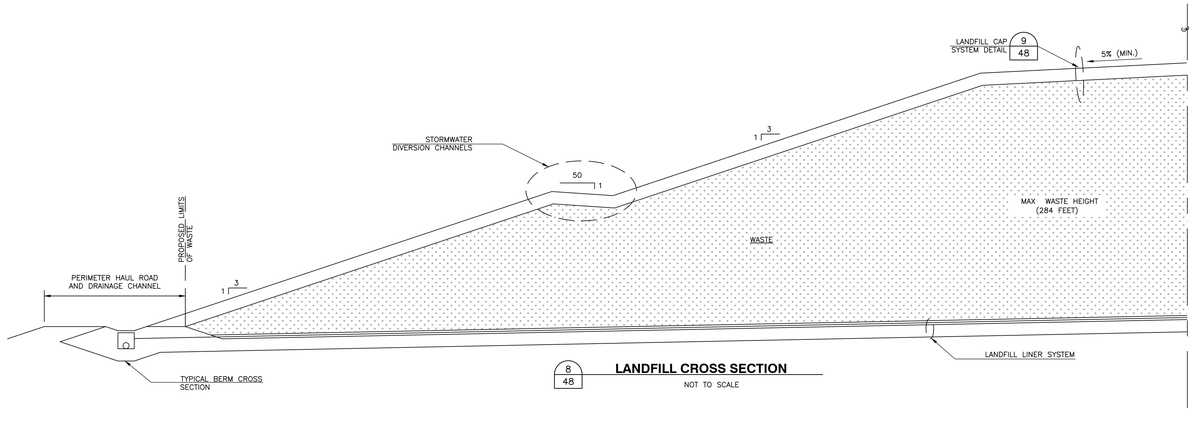

**TRANSITION BETWEEN GEONET AND DRAINAGE BLANKET**
6/48 — SCALE: NTS

## NOTES:

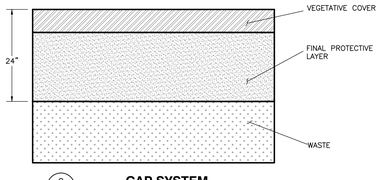
1. LEACHATE COLLECTION LAYER/PROTECTIVE COVER FOR BOTTOM OF VALLEY LINER SHALL BE COMPRISED OF EITHER BOTTOM ASH OR NATURAL SAND HAVING A MINIMUM PERMEABILITY OF 1 X 10 $^{-3}$ CM/SEC.
2. PROTECTIVE COVER FOR SIDE SLOPE LINER SHALL BE FLY ASH, SAND, BOTTOM ASH, GYPSUM WASTE, AND/OR NATURAL MATERIAL WITH LESS THAN 10% CLAY, PROVIDED DRAINAGE GEOCOMPOSITE GEOTEXTILE PROVIDES SUFFICIENT FILTRATION FOR ALL WASTE MATERIALS.
3. GCL SUBBASE SHALL BE A MINIMUM THICKNESS OF 6 INCHES AND MEET THE RECOMMENDED MATERIAL SPECIFICATIONS OF THE GCL MANUFACTURER.
4. IN AREAS THAT REQUIRE ISOLATION, MINIMUM COMBINED THICKNESS OF GCL SUBBASE AND GEOLOGIC MATERIAL SHALL BE 4 FEET.
5. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER, PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFCALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET, THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.




**UNDERDRAIN TRANSITION BETWEEN DRAINAGE BLANKET AND GEONET AREAS**
7/48 — SCALE: NTS




**LANDFILL CROSS SECTION**
8/48 — NOT TO SCALE




**CAP SYSTEM**
9/48 — NOT TO SCALE

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| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISON 1 | APA |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## LANDFILL LINER AND CAP DETAILS

DWG NO: 12-30110-48-B

SCALE: AS NOTED | CIVIL ENGINEERING

DR: . | CH: . | SUP: . | ENG: . | DATE: . | APPROVED BY: .

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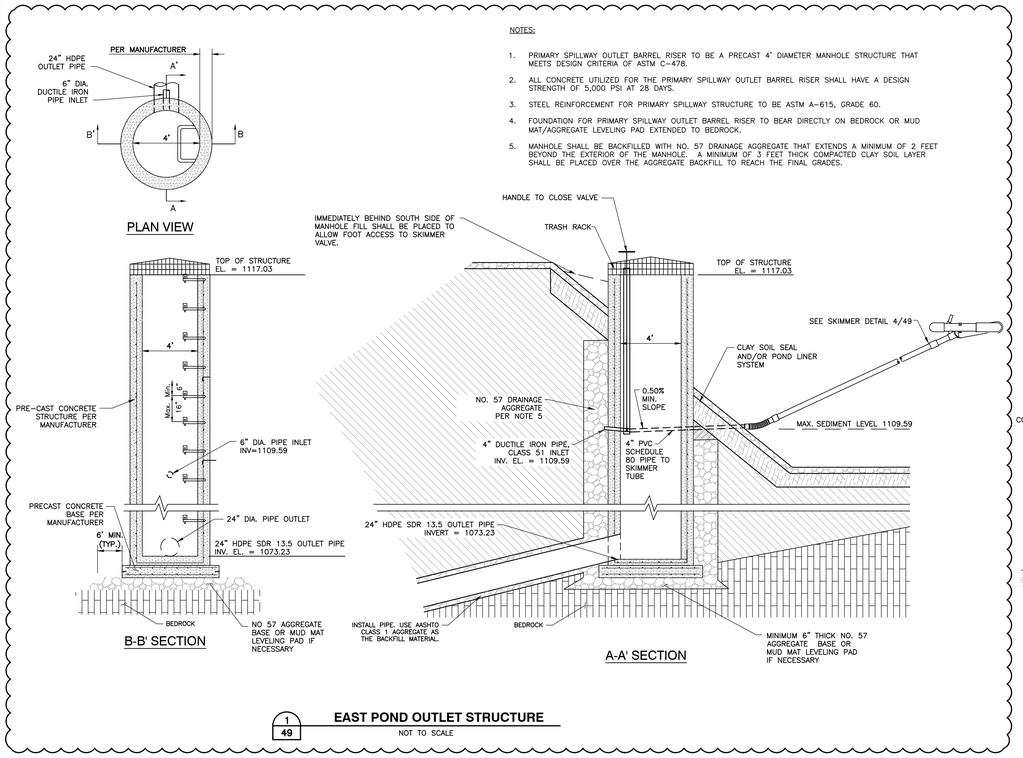
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|---|---|---|---|---|---|
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 20-JUNE-YY YY
PLOT BY: USERLOP
PLOT BY USERLOP

IGS0506

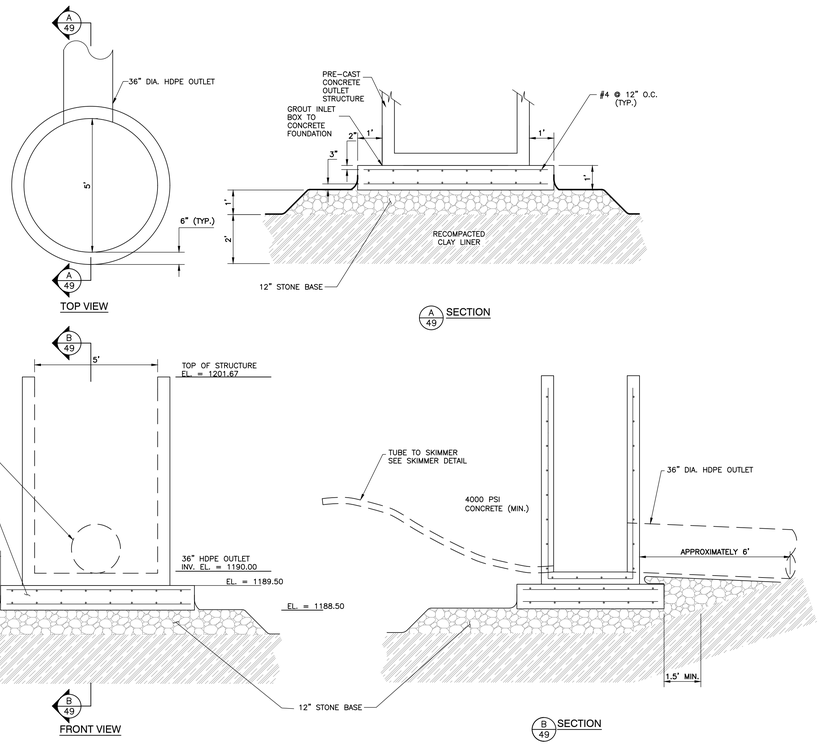
DWG NO: 12-30110-49-B




NOTES:

1. PRIMARY SPILLWAY OUTLET BARREL RISER TO BE A PRECAST 4' DIAMETER MANHOLE STRUCTURE THAT MEETS DESIGN CRITERIA OF ASTM C-478.
2. ALL CONCRETE UTILIZED FOR THE PRIMARY SPILLWAY OUTLET BARREL RISER SHALL HAVE A DESIGN STRENGTH OF 5,000 PSI AT 28 DAYS.
3. STEEL REINFORCEMENT FOR PRIMARY SPILLWAY STRUCTURE TO BE ASTM A-615, GRADE 60.
4. FOUNDATION FOR PRIMARY SPILLWAY OUTLET BARREL RISER TO BEAR DIRECTLY ON BEDROCK OR MUD MAT/AGGREGATE LEVELING PAD EXTENDED TO BEDROCK.
5. MANHOLE SHALL BE BACKFILLED WITH NO. 57 DRAINAGE AGGREGATE THAT EXTENDS A MINIMUM OF 2 FEET BEYOND THE EXTERIOR OF THE MANHOLE. A MINIMUM OF 3 FEET THICK COMPACTED CLAY SOIL LAYER SHALL BE PLACED OVER THE AGGREGATE BACKFILL TO REACH THE FINAL GRADES.

**1/49 EAST POND OUTLET STRUCTURE**
NOT TO SCALE



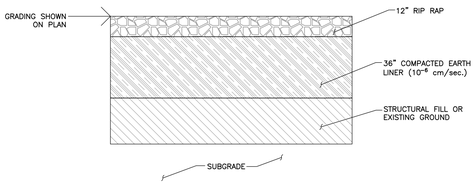

**2/49 WEST SEDIMENTATION POND OUTLET STRUCTURE**
NOT TO SCALE

## SYSTEM COMPONENT SUMMARY TABLE

| COMPONENT NAME | SYMBOL | REQUIRED MATERIAL PROPERTY SUMMARY (SEE INDIVIDUAL DETAILS AND CQA/QC PLAN FOR DETAILED INFORMATION) |
|---|---|---|
| VEGETATIVE COVER | | MIN. 6" ORGANIC MATERIAL |
| FINAL PROTECTIVE COVER | | MIN. THICKNESS 24" |
| DRAINAGE GEOCOMPOSITE | | ~~(OMITTED FROM PHASE 3 & 4 LINER AREAS)~~ |
| COHESIVE SOIL | | THICKNESS VARIES |
| WASTE MATERIAL | | |
| PROTECTIVE COVER | | ~~MIN. THICKNESS 18"~~ |
| LEACHATE COLLECTION | | MIN. PERMEABILITY $7X10^{-3}$ cm/sec. |
| GEOTEXTILE | | |
| FLEXIBLE MEMBRANE LINER | | PVC LINER |
| GEOSYNTHETIC CLAY LINER (GCL) | | |
| COMPACTED SOIL, SUBBASE AND/OR ADDED GEOLOGIC MATERAIL | | -SUBBASE TO BE PREPARED PER GCL MANUFACTURER'S RECOMMENDATIONS<br>-ADDED GEOLOGIC MATERIAL USED TO PROVIDE BEDROCK ISOLATION MUST BE A MIN OF 4 FT THICK |
| STRUCTURAL FILL | | MIN. THICKNESS 12" |
| IN-SITU SOIL | | |
| COARSE AGGREGATE | | THICKNESS VARIES |
| BEDROCK | | |
| ROCK CHANNEL PROTECTION | | |

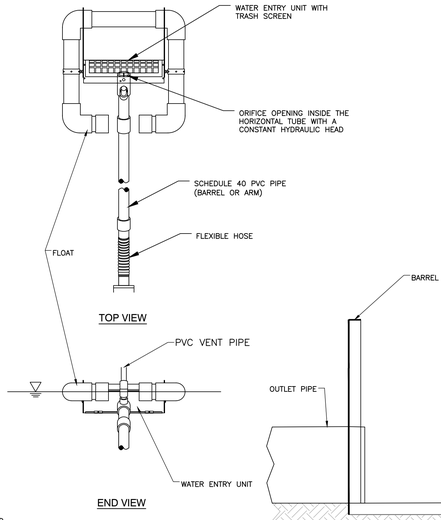
## NOTE:

1. THE LEACHATE COLLECTION SYSTEM IN THE BASE LINER DESIGN FOR PHASES 3 AND 4 HAS BEEN MODIFIED BY REPLACING THE DRAINAGE GEOCOMPOSITE WITH A NON-WOVEN GEOTEXTILE AND UTILIZING BOTTOM ASH AS THE LEACHATE COLLECTION LAYER AND PROTECTIVE COVER, PER DETAILS 1/224 AND 2/224. THESE CHANGES HAVE NOT BEEN SPECIFCALLY MADE NOR DEPICTED THROUGHOUT THIS PLAN SET, THEREFORE AEP AND THE CONTRACTOR SHALL BE RESPONSIBLE TO APPLY THESE CHANGES TO OTHER DETAILS WITHIN THE PHASE 3 AND 4 LINER AREAS AS APPLICABLE.



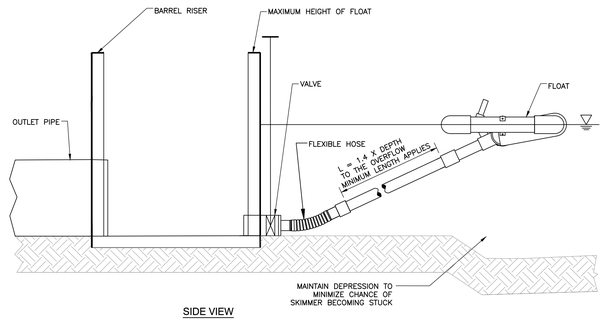

**3/49 SEDIMENTATION POND LINER SYSTEM**
NOT TO SCALE

NOTE:
A LINER MAY OR MAY NOT BE NECESSARY FOR THE NORTH AND WEST PONDS. THE NEED FOR A LINER SYSTEM AND THE COMPONENTS OF THE LINER SYSTEM WILL BE DETERMINED IN THE FIELD BY THE ENGINEER AFTER EXCAVATION OF THE POND HAS BEEN COMPLETED.

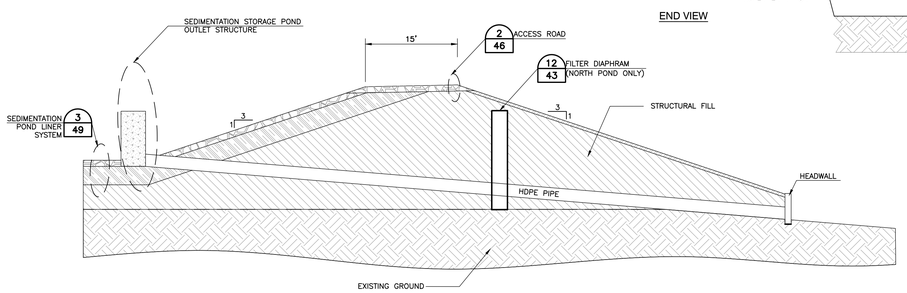



NORTH POND:
SKIMMER SIZE=3.0 INCHES
ORIFICE DIAMETER=2.8 INCHES

WEST POND:
SKIMMER SIZE=5.0 INCHES
ORIFICE DIAMETER=4.9 INCHES

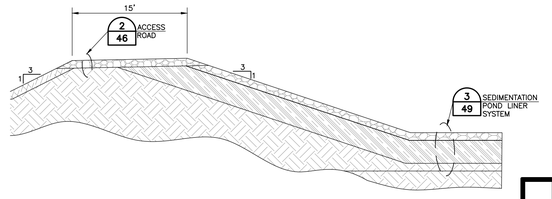



**4/49 FAIRCLOTH SKIMMER**
NOT TO SCALE




**6/49 PRINCIPAL SPILLWAY DETAIL**
NOT TO SCALE

NOTE: A WALKWAY WILL BE PROVIDED TO THE POND OUTLET STRUCTURE.




**5/49 TYPICAL PERIMETER BERM SECTION**
NOT TO SCALE

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## SEDIMENTATION POND DETAILS

DWG NO: 12-30110-49-B

SCALE: AS NOTED | CIVIL ENGINEERING

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DATE: APRIL 2012 | DWG SCALE: AS NOTED | PROJECT NO: 110-416

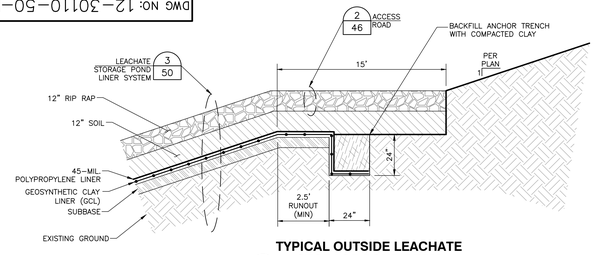
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PLOT DATE: DD-MMM-YY*
PLOTTED BY: USERNAME
BY: USERPLOT

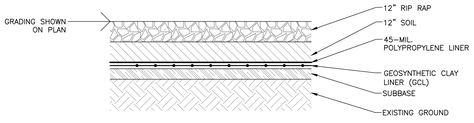
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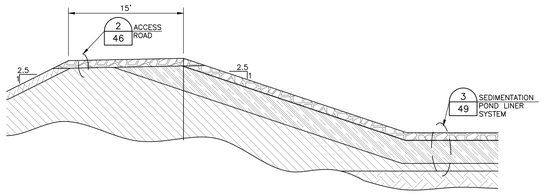
DWG NO: 12-30110-50-B



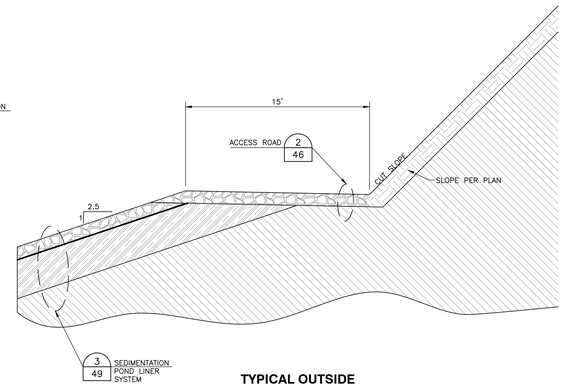

**TYPICAL OUTSIDE LEACHATE STORAGE POND BERM**
2/50 NOT TO SCALE



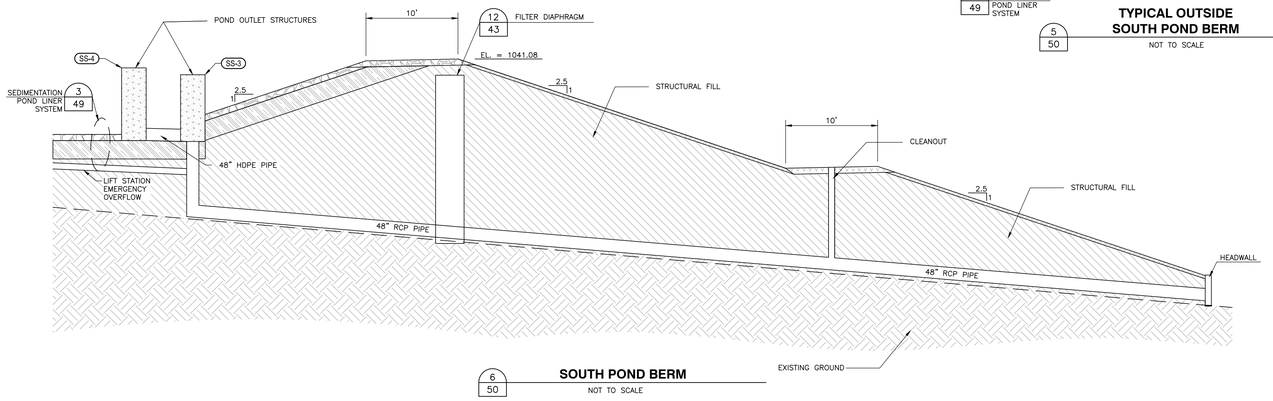

**LEACHATE STORAGE POND LINER SYSTEM**
3/50 NOT TO SCALE




**TYPICAL PERIMETER BERM SECTION AT SOUTH POND**
4/50 NOT TO SCALE




**TYPICAL OUTSIDE SOUTH POND BERM**
5/50 NOT TO SCALE

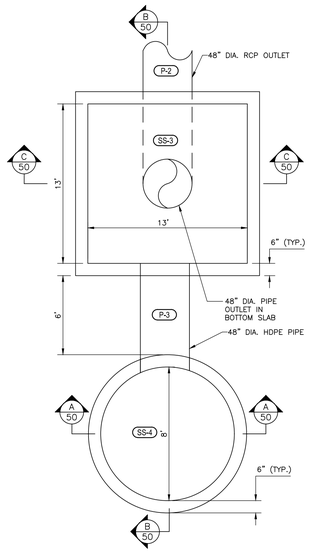



**SOUTH POND BERM**
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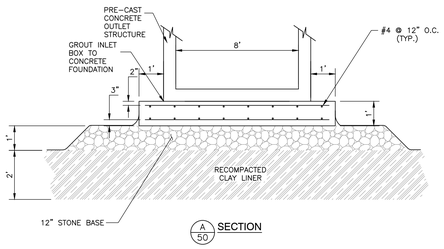
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| COHESIVE SOIL | | THICKNESS VARIES |
| WASTE MATERIAL | | |
| PROTECTIVE COVER | | ~~MIN. THICKNESS 18"~~ |
| LEACHATE COLLECTION | | MIN. PERMEABILITY $7X10^{-3}$ cm/sec. |
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| BEDROCK | | |
| ROCK CHANNEL PROTECTION | | |

**NOTE:**

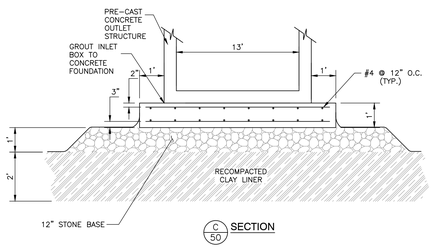
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TOP VIEW



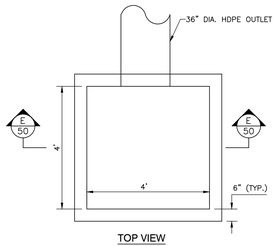

A/50 SECTION



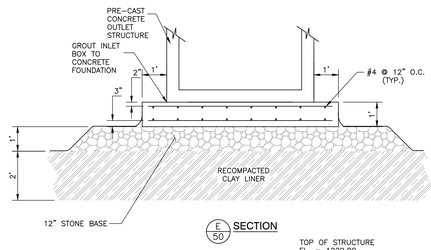

C/50 SECTION




**SOUTH SEDIMENTATION POND OUTLET STRUCTURES 1 AND 2**
1/50 NOT TO SCALE




TOP VIEW




E/50 SECTION




**LEACHATE STORAGE POND EMERGENCY OUTLET STRUCTURE**
7/50 NOT TO SCALE

| REVISIONS | | | |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## LEACHATE STORAGE POND AND SEDIMENTATION POND DETAILS

DWG NO: 12-30110-50-B

| | | |
|---|---|---|
| SCALE: AS NOTED | | CIVIL ENGINEERING |
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| CH: . | | |
| SUP: . | | |
| ENG: . | | |
| DATE: | | |

ANTHONY P. AMICON REGISTERED 19208 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

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| DRAWN BY: | DAR | CHECKED BY: | JSF | APPROVED BY: | APA |
| DATE: | APRIL 2012 | DWG SCALE: | AS NOTED | PROJECT NO: | 110-416 |

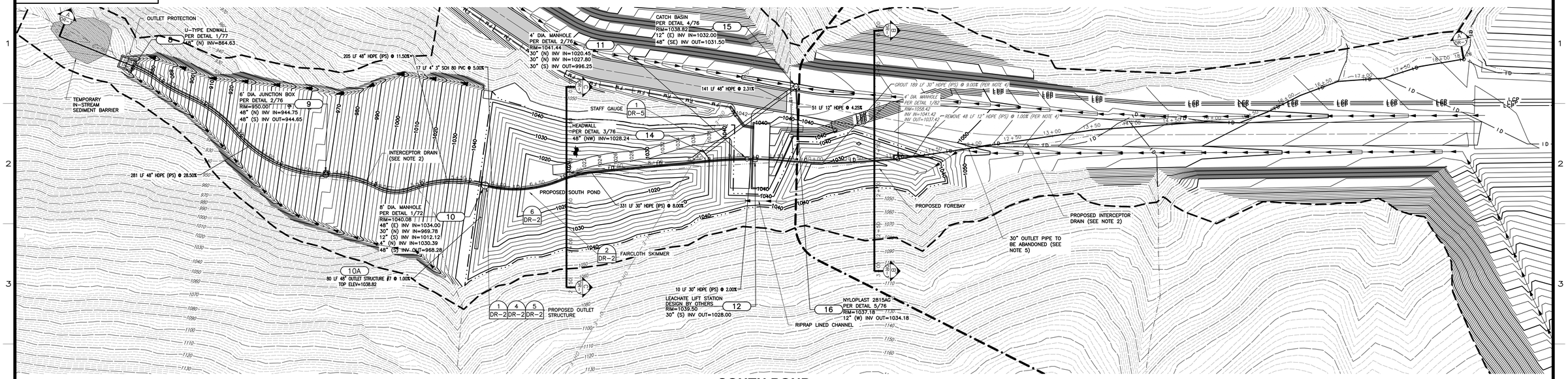
AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

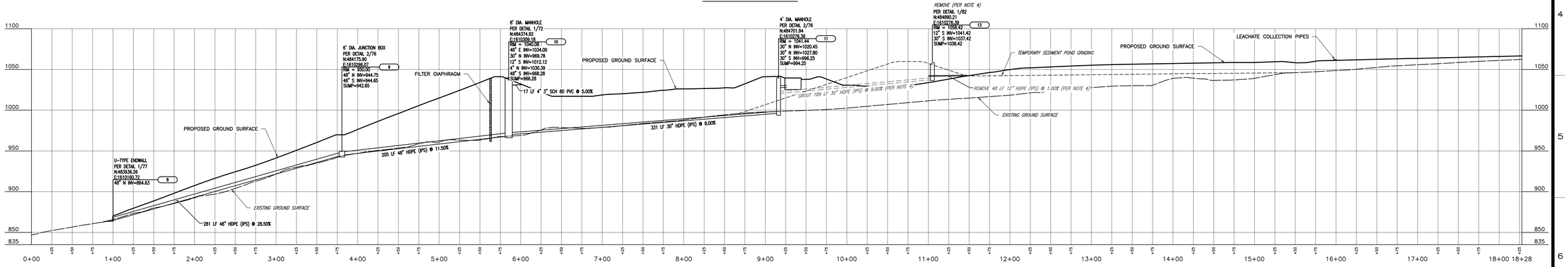
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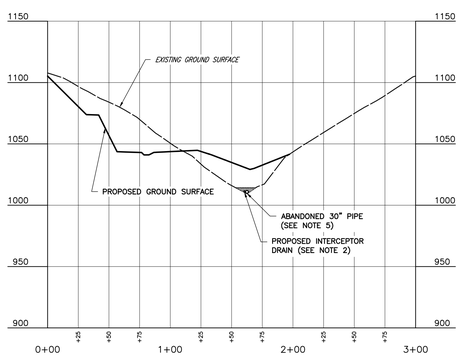
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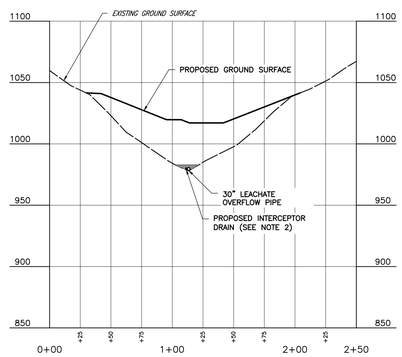

## SOUTH POND




**SECTION A-A'**
SCALE H:1"=50'; V:1"=50'




**SECTION B-B'**
SCALE H:1"=50'; V:1"=50'




**SECTION C-C'**
SCALE H:1"=50'; V:1"=50'

## NOTES:

1. DRAWING REPRESENTS SOUTH POND CONSTRUCTION AS PART OF THE PHASE 1 LANDFILL CONSTRUCTION.
2. INTERCEPTOR DRAIN TO FOLLOW EXISTING GROUND ALONG EXISTING CREEK BOTTOM.
3. ALL 30" PIPES SHOWN ARE TO BE HDPE SDR-17, ALL 48" PIPES SHOWN ARE TO BE HDPE SDR-21.
4. MANHOLE BASES ARE TO BE FOUNDED ON BEDROCK. IF COMPETENT ROCK IS NOT FOUND AT THE BASE ELEVATION OF THE PROPOSED STRUCTURE THE CONTRACTOR SHALL CONTACT CIVIL AND ENVIRONMENTAL CONSULTANTS, INC. FOR RECOMMENDATIONS ON SUBGRADE PREPARATION.
5. 4' DIAMETER MANHOLE AND 30" DIAMETER OUTLET PIPE FOR TEMPORARY SEDIMENT POND OUTLET SHALL BE REMOVED ABOVE GROUND, GROUTED AND ABANDONED IN-PLACE BELOW GRADE.

| SOUTH POND | | |
|---|---|---|
| NAME | VOLUME (CU FT) | ELEVATION (FT) |
| SEDIMENTATION | 206,910 | 1031.08 |
| CLEANOUT | 124,146 | 1027.63 |
| 2-YEAR RUNOFF | 319,027 | 1038.92 |
| PRINCIPAL SPILLWAY* | 526,317 | 1038.92 |
| 10-YEAR RUNOFF | 334,491 | 1039.20 |
| EMERGENCY SPILLWAY | | 1040.08 |
| 25-YEAR RUNOFF | 357,497 | 1039.60 |
| 100-YEAR RUNOFF | 374,723 | 1039.90 |
| TOP OF BERM* | 653,391 | 1041.08 |

* TOTAL VOLUME OF POND INCLUDING SEDIMENT AND STORMWATER STORAGE.

## LEGEND

- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- LIMITS OF EARTHWORK
- LIMITS OF WASTE (PHASE 1A)
- STABILIZED CHANNEL
- PROPOSED ROADWAY
- PROPOSED CONTOUR
- CROSS SECTION LOCATION IDENTIFIER AND DRAWING NUMBER
- PROPOSED HEADWALL
- PROPOSED STORM SEWER
- STAFF GAUGE
- PROPOSED INTERCEPTOR DRAIN PIPE
- LCP LEACHATE COLLECTION PIPE
- FM PROPOSED LEACHATE FORCE MAIN

NORTH
HORZ. SCALE: 1"=50
VERT. SCALE: 1"=50
CONTOUR INTERVAL = 2 FEET

| NO. | DATE | DESCRIPTION | APP. |
|---|---|---|---|
| A | 04/16/20 | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY
MITCHELL PLANT
MARSHALL COUNTY WEST VIRGINIA
MITCHELL LANDFILL

# SOUTH POND PLAN

DWG NO: DR-1-A

SCALE: 1"=50' | CIVIL ENGINEERING

DR: . | CH: . | SUP: . | ENG: . | DATE: .

APPROVED BY:

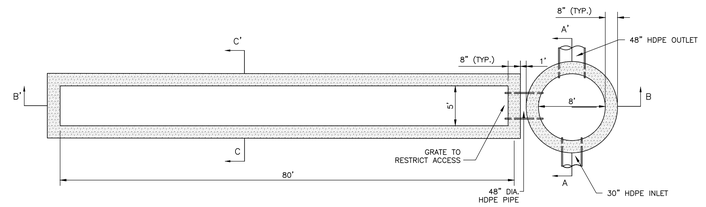
Civil & Environmental Consultants, Inc.
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 - 800.759.5614 - Fax: 513.985.0228
www.ceainc.com

DRAWN BY: MTF | CHECKED BY: JSF | APPROVED BY: APA
DATE: JANUARY 2013 | DWG SCALE: AS NOTED | PROJECT NO: 110-416

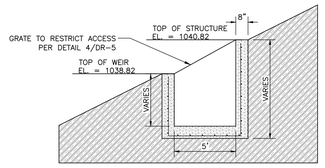
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

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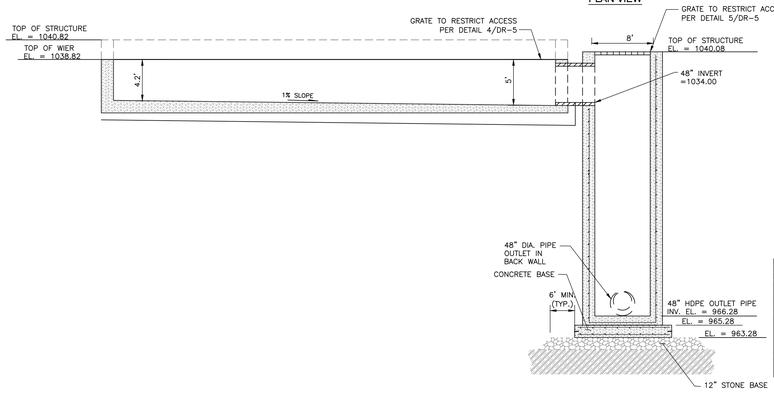
DWG NO: DR-2-B



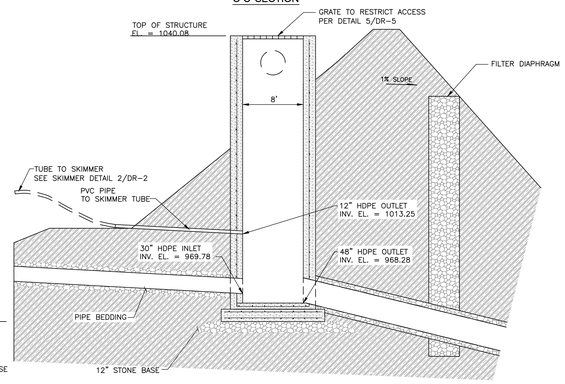

PLAN VIEW




C-C' SECTION

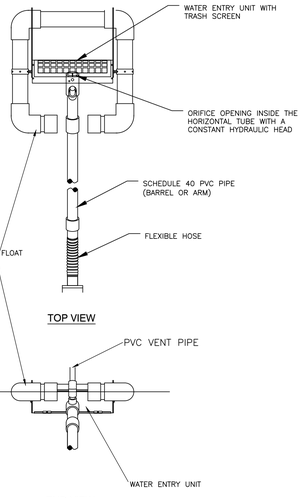



B-B' SECTION

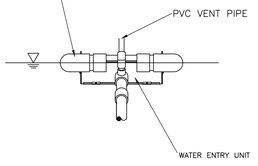



A-A' SECTION

**SOUTH POND OUTLET STRUCTURES 10 AND 10A**
1
NOT TO SCALE



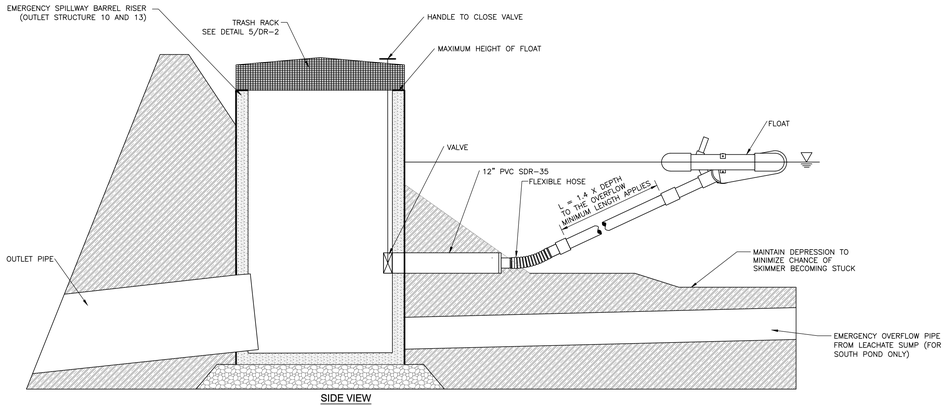

TOP VIEW




END VIEW

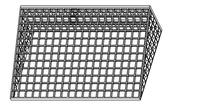
SOUTH POND:
SKIMMER SIZE = 6.0 INCHES
ORIFICE DIAMETER = 5.7 INCHES

TEMPORARY SEDIMENTATION POND:
SKIMMER SIZE = 6.0 INCHES
ORIFICE DIAMETER = 5.0 INCHES

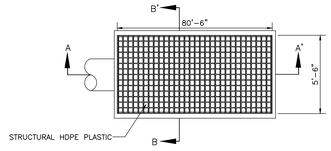



SIDE VIEW

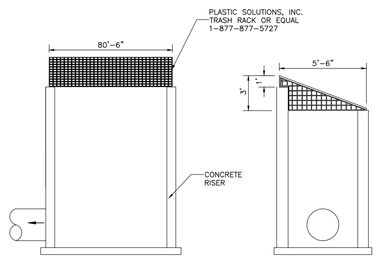
**FAIRCLOTH SKIMMER**
2
NOT TO SCALE



TRASH RACK ASSEMBLY




TOP VIEW

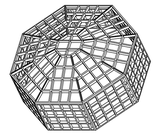



SECTION A-A'

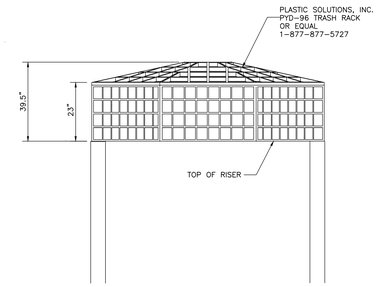



SECTION B-B'

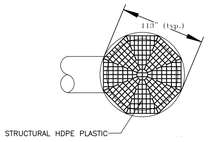
**PRIMARY WEIR - TRASH RACK**
4
N.T.S.



TRASH RACK ASSEMBLY

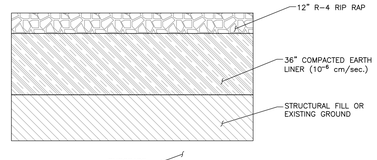



SECTION VIEW




TOP VIEW

**EMERGENCY OUTLET BARREL RISER - TRASH RACK**
5
N.T.S.




**SOUTH SEDIMENTATION POND AND FOREBAY LINER**
6
NOT TO SCALE

| DATE | NO. | DESCRIPTION | APP'D |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISION 1 | APA |
| 04/16/10 | A | ISSUED FOR PERMIT | APA |

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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## POND DETAILS

DWG NO: DR-2-B

SCALE: N.T.S. | CIVIL ENGINEERING

DR: . | CH: . | SUP: . | ENG: . | DATE: .

APPROVED BY: .

**Civil & Environmental Consultants, Inc.**
4274 Glendale-Milford Road - Cincinnati, OH 45242
Ph: 513.985.0226 - 800.759.5614 - Fax: 513.985.0228
www.cecinc.com

DRAWN BY: MTF | CHECKED BY: JSF | APPROVED BY: APA
DATE: JANUARY 2013 | DWG SCALE: AS NOTED | PROJECT NO: 110-416

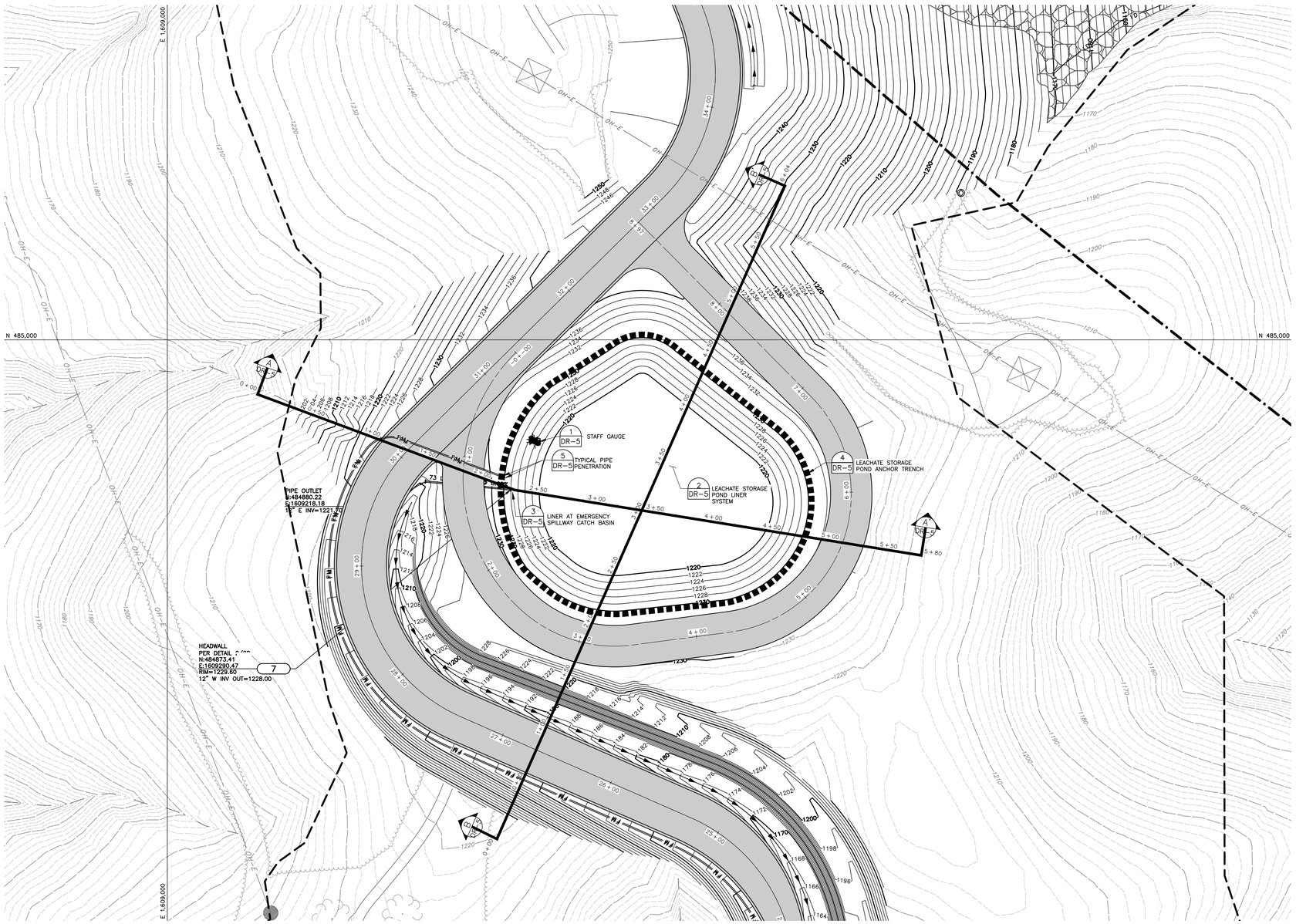
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COLUMBUS, OH 43215

PLOT DATE: 01/07/2020 9:47 AM
PLOTTED BY: USERPLOT

I:\civ-env\projects\2019\195-4581-0400\dwg\MAP\195458-DR-2-B POND DETAILS (2019).dwg - LP, 1/7/2020 9:47 AM

IGS0506

DWG NO: DR-4-A




LEACHATE STORAGE POND PLAN VIEW

## LEGEND

- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- PROPOSED CONTOUR
- PERIMETER DRAINAGE SWALE
- LIMITS OF WASTE
- LIMITS OF DISTURBANCE
- CROSS SECTION LOCATION IDENTIFIER AND DRAWING NUMBER
- PROPOSED HAUL ROAD
- STAFF GAUGE
- PROPOSED LEACHATE FORCE MAIN

## NOTES:

1. THE CONTRACTOR SHALL PREPARE THE SUBGRADE PER THE GEOSYNTHETIC CLAY LINER MANUFACTURES RECOMMENDATIONS. THE LEACHATE STORAGE PONDS SUBGRADE SHALL BE CERTIFIED AND APPROVED BY THE OWNER OR OWNER'S REPRESENTATIVE PRIOR TO PLACEMENT OF THE LINER SYSTEM.
2. CONTRACTOR TO COORDINATE DESIRED MARKINGS, BASE TYPE, AND EXACT LOCATION OF THE STAFF GAUGE WITH THE OWNER PRIOR TO INSTALLATION. CONTRACTOR TO ENSURE BASE OF STAFF GAUGE DOES NOT DAMAGE LEACHATE STORAGE POND LINER DURING INSTALLATION.

| LEACHATE STORAGE POND | | |
|---|---|---|
| NAME | VOLUME (CU FT) | ELEVATION (FT) |
| 60% CLEANOUT* | 190,851 | 1225.68 |
| EMERGENCY SPILLWAY | 318,085 | 1229.00 |
| TOTAL PROVIDED | 361,217 | 1230.00 |

* POND WILL BE CLEANED WHEN THESE LIMITS ARE REACHED (AS IDENTIFIED ON THE STAFF GAUGE).

| DATE | NO. | DESCRIPTION | APPD. |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## LEACHATE STORAGE POND PLAN

DWG NO: DR-4-A

SCALE: 1"=40' | CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY:

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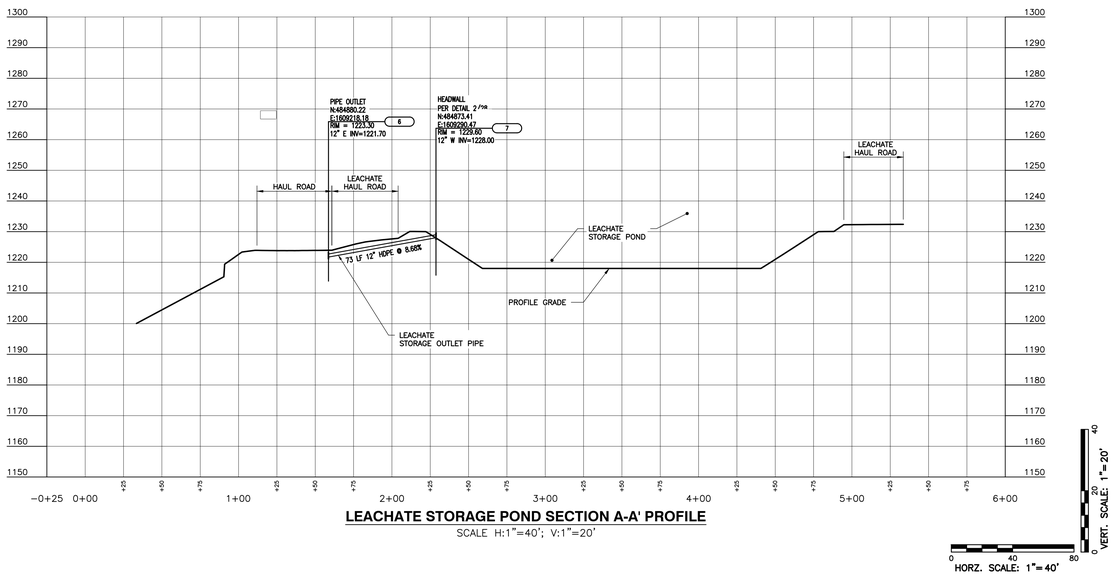
DRAWN BY: MTF | CHECKED BY: JSF | APPROVED BY: APA
DATE: JANUARY 2013 | DWG SCALE: AS NOTED | PROJECT NO: 110-416

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COLUMBUS, OH 43215

I:\Survey\projects\2019\195-8581-DAS\dwg\8581195DR-4-4 LEACHATE STORAGE POND PLAN.dwg[DR-4-4 LEACHATE STORAGE POND PLAN(1)]4/16/2019 - amaul - LP: 1/7/2020 8:48 AM

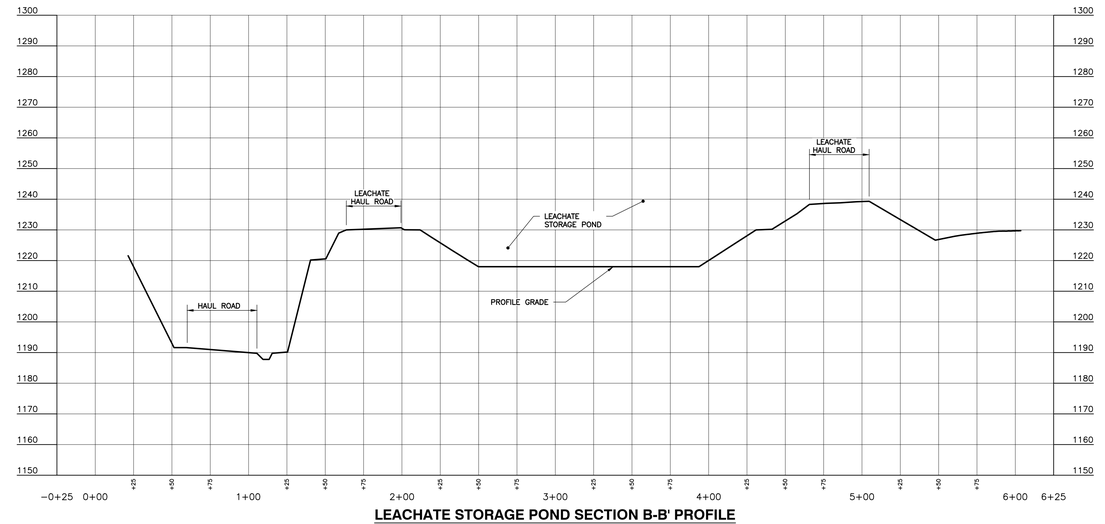
IGS0506

DWG NO: DR-5-B



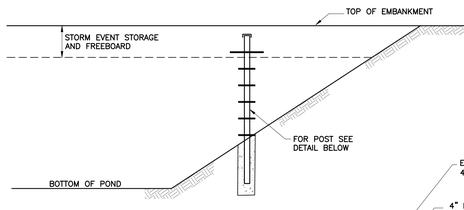

## LEACHATE STORAGE POND SECTION A-A' PROFILE

SCALE H:1"=40'; V:1"=20'

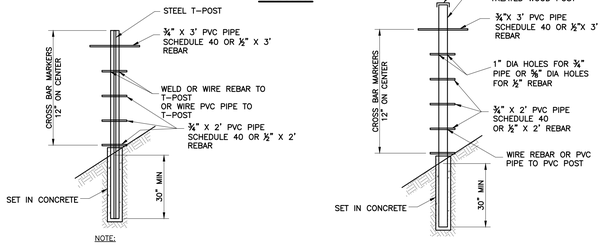



## LEACHATE STORAGE POND SECTION B-B' PROFILE

SCALE H:1"=40'; V:1"=20'




## SECTION

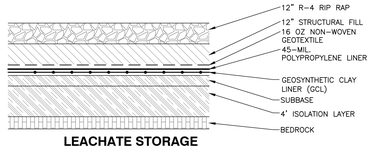



NOTE:

1. STAFF GAUGE CAN BE FABRICATED AS ABOVE OR OBTAINED FROM BEN MEADOWS, MODEL NO. 99005, FIBERGLASS STREAM GAUGE, 4" WIDE, ENGLISH, 16-20' OR OWNER APPROVED EQUAL.
2. STAFF GAUGE LOCATED IN LEACHATE STORAGE POND SHALL NOT PENETRATE LINER. FOUNDATION TO BE PREFABRICATED PEDESTAL BASE PLATE TO SIT BETWEEN SOIL AND RIP RAP LAYER.

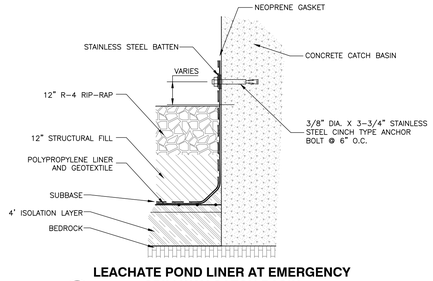
## 1 STAFF GAUGE

N.T.S.



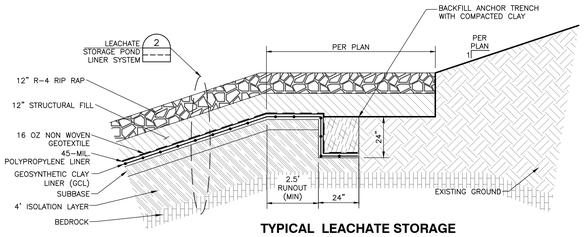

## 2 LEACHATE STORAGE POND LINER SYSTEM

NOT TO SCALE




## 3 LEACHATE POND LINER AT EMERGENCY SPILLWAY CATCH BASIN

NOT TO SCALE




## 4 TYPICAL LEACHATE STORAGE POND ANCHOR TRENCH

NOT TO SCALE

| DATE | NO. | DESCRIPTION | APPD. |
|---|---|---|---|
| 01/07/20 | B | RUN-ON, RUN-OFF CONTROL PLAN REVISON 1 | APA |
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OHIO POWER COMPANY

# MITCHELL PLANT

MARSHALL COUNTY WEST VIRGINIA

MITCHELL LANDFILL

## LEACHATE STORAGE POND DETAILS

DWG NO: DR-5-B

SCALE: N.T.S.

CIVIL ENGINEERING

DR: . CH: . SUP: . ENG: . DATE: .

APPROVED BY: .

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DATE: JANUARY 2013 DWG SCALE: AS NOTED PROJECT NO: 110-416

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AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 05-JUNE-YY
PLOT SCALE: 1.000000
PLOT BY: USERNAME

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IGS0506