# Inflow Design Flood Control System Plan

For Compliance with the Coal Combustion Residuals Rule
(40 CFR Part 257)

Erickson Power Station - CCR Surface Impoundments
*Lansing Board of Water and Light*
*Lansing, Michigan*

June 9, 2020

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# Table of Abbreviations and Acronyms

| Abbreviation | Definition |
|---|---|
| CCR | Coal Combustion Residuals |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| CN | Curve Number |
| EPA | Environmental Protection Agency |
| HSG | Hydrologic Soil Group |
| BWL | Lansing Board of Water and Light |
| MGD | Million Gallons per Day |
| NOAA | National Oceanic and Atmospheric Administration |
| RCRA | Resource Conservation and Recovery Act |
| SCS | Soil Conservation Service |
| Tc | Time of Concentration |
| TR-20 | Technical Release 20 |
| TR-55 | Technical Release 55 |

# 1.0 Introduction

On April 17, 2015, the U.S. Environmental Protection Agency (EPA) published regulations under Subtitle D of the Resource Conservation and Recovery Act meant to control the safe disposal of coal combustion residuals (CCR) generated by coal-fired electric utilities. The rule defines a set of requirements for the disposal and handling of CCR within CCR units (defined as either landfills or surface impoundments). The requirements include preparation of an Inflow Design Flood Control System Plan to evaluate the inflow design flood control system for active surface impoundments.

This Inflow Design Flood Control System Plan was prepared for three (3) active CCR surface impoundments at the Erickson Power Station in accordance with the requirements of Title 40 of the Code of Federal Regulations (CFR) §257.82 - Hydrologic and hydraulic capacity requirements for CCR surface impoundments.

## 1.1 Facility Description

Erickson Power Station is owned and operated by Lansing Board of Water and Light (BWL) and is located at 3725 South Canal Road in Lansing, Michigan. Erickson Power Station, was constructed starting in 1970 and commercial operation began in 1973. Erickson Power Station and contains one (1) coal-fired generator capable of producing 165 megawatts of electricity and currently includes three (3) active CCR Surface Impoundments. A 33-acre impoundment was physically closed by removal of CCR in 2014 is now referred to as the Former Impoundment. Additionally, there is a 44-acre pond on-site, Lake Delta, which is occasionally used as a source of plant make-up water. See Figure 1 for a Site Location Map.

Bottom ash from Erickson Power Station is sluiced from the plant to dewatering tanks (hydro-bins) that remove the majority of the CCR prior to being directed to the surface impoundment system. Fly ash is handled dry and collected in on-site silos. Both bottom and fly ash are hauled off-site to facilities for either beneficial use or disposal.

Erickson Power Station's three (3) active CCR surface impoundments consist of the Forebay, Retention Basin and Clear Water Pond, which together make up a 9.5-acre system. The plant water is pumped directly to the Forebay from the plant sumps, the hydro-bins, and the coal pile sump via three (3) force mains. Large particles will quickly settle to the bottom of the Forebay. From the Forebay water flows via gravity to the Retention Basin where smaller particles settle and finally to the Clear Water Pond where the treated water is recirculated back to the plant where it is reused as plant process water. Figure 2 provides an aerial site view of the CCR Surface Impoundment System.

Per 40 CFR §257.53, each of the surface impoundments are defined as diked CCR surface impoundments because they were constructed using an embankment, berm, or ridge of either natural or man-made materials used to prevent the movement of liquids, sludges, solids, or other materials. The Forebay, Retention Basin, Clear Water Pond and the Former Impoundment were constructed with clay liners. The primary discharges from the impoundment system are from evaporation and recirculation. Secondary outlet include emergency outfall pipes located at the Retention Basin and Clear Water Pond. The Retention Basin emergency outfall pipe discharges to the Former Impoundment. The Clear Water Pond Emergency Outfall Structure discharges to a swale that directs flow north to Carrier Creek, then north to Holly Drain, then to Clements Underhill Drain, and ultimately to the Grand River.

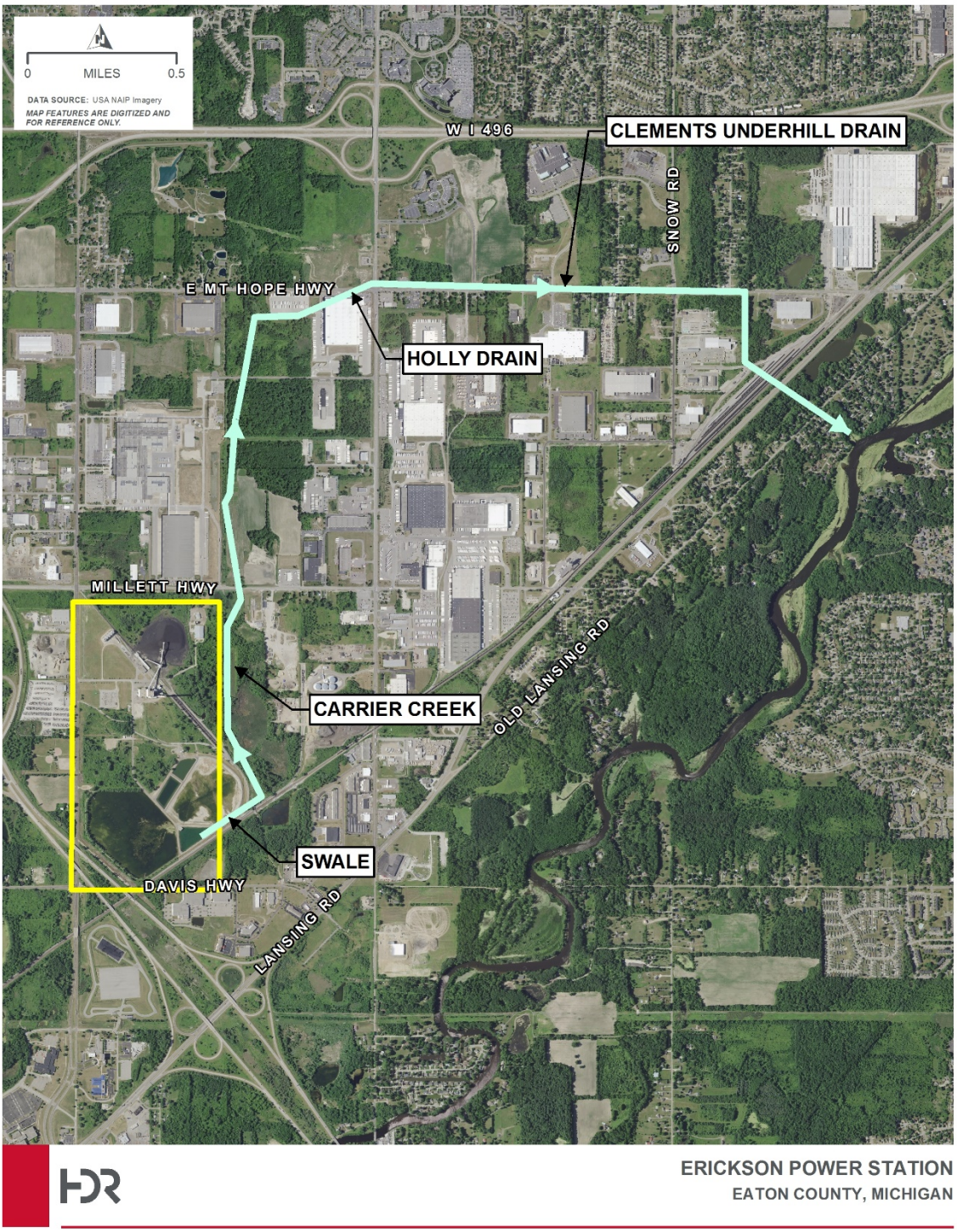



**Figure 1. Site Location Map**


Figure provided by NTH Consultants Ltd. August 2019

**Figure 2. CCR Surface Impoundment System Aerial Site View**

## 1.2 Regulatory Requirements

Title 40 CFR §257.82 requires that an owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to design, construct, operate, and maintain an inflow design flood control system per the requirements below:

1. The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood (specified in item 3) below);
2. The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood (specified in item 3) below);
3. The Michigan Department of Environment, Great Lakes, and Energy (EGLE) assigned a "low hazard" potential rating for the Former Impoundment in 2009 and GZA GeoEnvironmental, Inc. (GZA) opined in 2012 that under the EPA classification system the Former Impoundment would be considered a "low hazard potential."[1]

According to 40 CFR §257.82(a)(3)(iii) the CCR Surface Impoundments and surrounding areas that drain to the impoundments must be modelled using the 100-year; 24-hour storm event (5.83-inches of rain in a 24-hour period).

In addition, discharge from the CCR Surface Impoundments must not cause a discharge of pollutants to waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System under Section 402 of the Clean Water Act.

# 2.0 Hydrologic and Hydraulic Analysis for CCR Impoundments

A hydrologic and hydraulic analysis was completed for the three (3) active CCR surface impoundments. The evaluation was completed in accordance with 40 CFR §257.82 and identifies the drainage system for each impoundment and evaluates the capacity of the outfalls to model the potential impacts of stormwater during a 100-year, 24-hour storm event.

The evaluation included preparation of a surface water run-off model using HydroCAD® 10.00-11 to determine whether existing outfalls are sufficient to manage inflow from the 100-year, 24-hour storm event.

The evaluation was completed based on the best available information provided by BWL at the time of this report. The most recent survey of the CCR surface impoundments was completed in September 2018. Information on the existing impoundment systems are based on three (3) reports:

- NTH Consultants, Ltd., *"Closure Plan CCR Surface Impoundment System Erickson Power Station"* August 16, 2019;
- Mayotte Design & Engineering, P.C "*Construction Documentation Report, Ash Impoundment Reconfiguration*" May 2015; and

[1] GZA GeoEnvironmental, Inc., Final Round 10 Dam Assessment Report, Lansing Board Of Water & Light, Erickson Station Ash Pond, August 17, 2012.

- GZA GeoEnvironmental, Inc., "*Final Round 10 Dam Assessment Report, Lansing Board Of Water & Light, Erickson Station Ash Pond*" August 17, 2012

Because some of the elevations in the aforementioned reports were reported in National Geodetic Vertical Datum 1929 (NGVD29), for consistency, all elevations were converted to North American Vertical Datum 1988 (NAVD88) by subtracting 0.40-feet. All elevations identified in this report are provided in NAVD88 unless otherwise stated.

## 2.1 Description of CCR Surface Impoundments

A description of the CCR impoundments is presented below. Figure 3 shows the Surface Impoundment System Design Layout.

### 2.1.1 Forebay

The Forebay is an irregularly shaped quadrangle approximately 475 feet long by 260 feet wide that provides a storage capacity of approximately 932,837 cubic feet. The basin consists of a clay-rich engineered fill, lined with a geosynthetic clay liner (GCL), overlain with a 40 mil thick polyvinylchloride (PVC) flexible membrane liner (FML). The Forebay is designated to capture the heaviest suspended particles allowing them to settle to the bottom of the impoundment.

Plant water flows via gravity from the Forebay to the Retention Basin through three (3) 24-inch diameter corrugate plastic pipes (CPP).

### 2.1.2 Retention Basin

The second surface impoundment is the Retention Basin. The Retention Basin is relatively rectangular in shape approximately 560 feet long by 260 feet wide and provides a storage capacity of 1,298,407 cubic feet. Like the Forebay, the Retention Basin was constructed with a clay-rich engineered fill, lined with a GCL, overlain with a 40 mil thick PVC FML. The Retention Basin is designated to provide a longer retention time to allow for the settlement of smaller suspended particles.

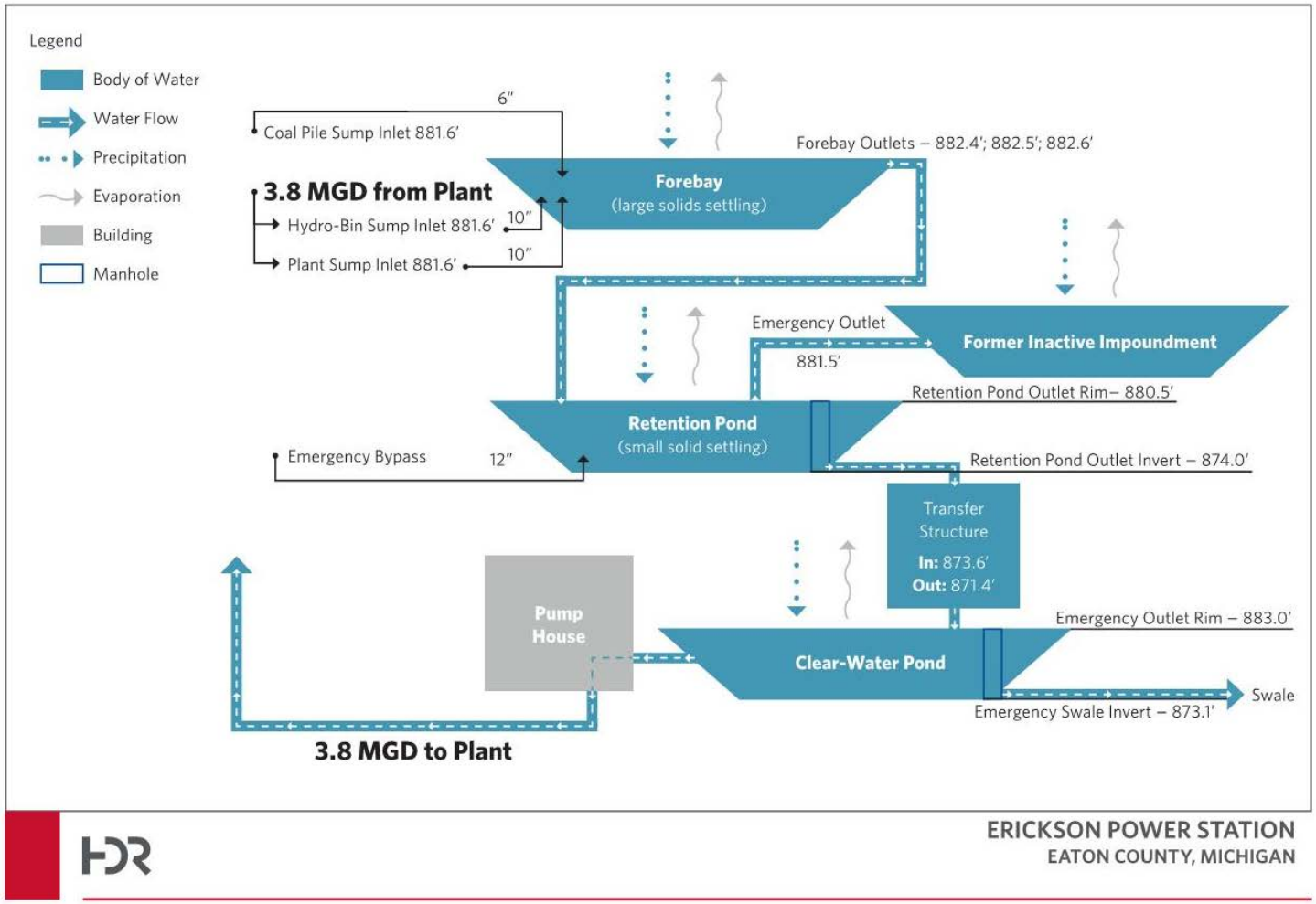
The Retention Basin discharges to the Clear Water Pond through a 72-inch diameter pre-cast concrete overflow riser pipe structure at the Retention Basin's southern corner. At the bottom of the riser pipe structure lies a 36-inch diameter corrugated plastic pipe (CPP) pipe that directs flow to the Clear Water Pond.

The secondary outlet is a 24-inch CPP emergency outfall pipe that discharges to the Former Impoundment.

### 2.1.3 Clear Water Pond

The last of the surface impoundments is the Clear Water Pond, which is triangular in shape with sides approximately 425 feet, 730 feet, and 640 feet in length and with an area of 189,200 square feet. The storage capacity is approximately 1,772,913 cubic feet. The Clear Water Pond was constructed in 1970 (prior to the Forebay and Retention Basin) with a compacted clay liner to limit infiltration. When the plant is in operation, water from the Clear Water Pond is continuously recycled back to the Erickson Power Station at a rate of 3.8 million gallons per day (MGD) where it is recycled as plant water.

The primary discharge from the Clear Water Pond is the Pump House. The Clear Water Pond also has an Emergency Outfall Structure on the northeast corner that discharges to a swale that directs flow north to Carrier Creek, then north to Holly Drain, then to Clements Underhill Drain, and ultimately to the Grand River (see Figure 1).




Notes:

1) Inverts shown in NAVD88.

**Figure 3. CCR Surface Impoundment System Design Layout**

### 2.1.4 Former Impoundment

The Former Impoundment was decommissioned in October of 2014 by removing the CCR materials while leaving the existing clay liner intact. The decommissioning provided the necessary area to construct the current CCR surface impoundment system. The surrounding area of the ponds includes vegetated and paved areas with a top elevation of approximately 886.5 feet that limits stormwater from entering into the pond system via overland flow. The primary water exfiltration from the Former Impoundment is evaporation. However, there is an emergency outlet that drains to the Retention Basin. Given the size of the Former Impoundment and its approximate 10.5-feet of available freeboard, it is highly unlikely that the emergency outlet will ever be utilized.

### 2.1.5 Lake Delta

Lake Delta is a man-made 44-acre lake that is occasionally used to supply Erickson Power Station with make-up water. It is not considered a CCR Impoundment.

## 2.2 Existing Inflow/Outflow Design Flood Controls

### 2.2.1 Inlets

The Forebay receives water via three (3) force mains all with inlet invert elevations of 881.6 feet that provide a combined daily flow of 3.8 MGD or 5.88 cubic feet per second (cfs) when the plant is operational.[2] Two (2) 10-inch force mains deliver plant water from the ash hydro-bins and plant sumps which operate continuously when the plant is operating. A third 6-inch force main conveys water to the Forebay from the coal pile runoff sump; which is manually operated by the Erickson Power Station staff.[3,4] The flow can vary from the coal pile runoff based on rain events and pump operation. During a 100-year storm event the peak runoff flow from the coal pile is 7.03 cfs.

The Forebay outlets consists of three (3) 24-inch CPPs with inverts of 882.4 feet, 882.5 feet, and 882.6 feet; west, center, east, respectively. When the Forebay water surface elevation exceeds the outlet invert elevation it flows south via gravity into the Retention Basin. Based on BWL information, under normal plant operating conditions, water is constantly flowing into the Forebay at a rate of 3.8 MGD.

### 2.2.2 Retention Basin

Water enters the Retention Basin at invert elevations of 884.6 feet, 881.4 feet and 881.7 feet (west center, east, respectively) from the Forebay via three (3) 24-inch diameter CPPs at a flow consistent with Forebay inflow. Additional process water from the plant sumps can be directly diverted to this basin via a 12-inch diameter by-pass operated by two (2) valves at the northwest corner of the retention basin. This by-pass is used only under emergency conditions and was excluded from the system hydraulic model.

The primary outlet from the Retention Basin is a 72-inch pre-cast concrete outlet riser with a rim elevation of 880.5 feet. The bottom of the riser is fitted with a 36-inch diameter CPP with an invert elevation of 874.0 feet. The 36-inch pipe conveys water southeast for 941 feet from the Retention Basin to the Retention Transfer Structure, which is then transferred to the Old Ash Impoundment Transfer Structure. Water is then conveyed from the Old Ash Impoundment Transfer Structure to the Clear Water Pond via a 36-inch pipe at an invert elevation of 871.4 feet.

The Retention Basin also has a 24-inch diameter emergency outfall pipe that discharges into the Former Impoundment at an invert elevation of 881.5 feet. Under design conditions, no water flows to the Former Impoundment.

[2] Ibid 1
[3] NTH Consulting Ltd. Closure Plan, CCR Surface Water Impoundment System, Erickson Power System, August 16, 2019
[4] Mayotte Design & Engineering, P.C, Construction Documentation Report, Ash Impoundment Reconfiguration dated May 2015

It should be noted that the emergency outfall pipe inverts indicate that the pipe was installed to flow from the Former Impoundment (invert 881.5 feet) to the Retention Pond (invert 880.8 feet). However, because the diameter of the pipe exceeds the difference in the inverts, the pipe will carry water from the Retention Pond to the Former Impoundment when the water surface elevation exceeds an elevation of 881.5 feet. To best model this situation, the model assumes a flat pipe with inverts of 881.5 feet on both sides.

### 2.2.3 Clear Water Pond

The Clear Water Pond, receives water via the Old Ash Impoundment Transfer Structure located at northeast corner of the Clear Water Pond which was retrofitted in 2014 to discharge Retention Basin Water into the Clear Water Pond at an elevation of 871.4 feet.

The Clear Water Pond feeds the Pump House via pipe that pumps water via force main back to Erickson Power Station for reuse. Occasionally, plant make-up water is drawn from Lake Delta.

The elevation of the Clear Water Pond varies seasonally. The actual flow out of the Clear Water Pond depends on the water demand needed at the plant; the normal flow being 3.8 MGD. The model assumes the plant will be operating during the 100-year, 24-hour storm event.

The Clear Water Pond is equipped with an Emergency Outfall Structure that discharges to a swale located between the Clear Water Pond and the Canadian National Railroad right-of way. The Emergency Outfall Structure is a steel stand-pipe that was recently extended to raise the rim elevation to 883.0 feet.

### 2.2.4 Carrier Creek and Holly Drain

The Clear Water Pond Emergency Outfall Structure discharges to a grass swale at an elevation of 873.1 feet. The swale varies in width but is estimated to be approximately 15-feet wide at the bottom with 3H:1V sideslopes that provide 3-feet of potential flow depth. The swale lies between BWL property and the Canadian National Railroad right-of-way. Any water that is received by the swale flows northeast and then north approximately 1,270 feet and eventually discharges to the large wetland on the eastern side of the BWL property via culvert (invert elevation ~871 feet) that crosses the railroad tracks. The wetland flows north to Carrier Creek, then continues north to Holly Drain, then to Clements Underhill Drain, and ultimately to the Grand River. BWL has indicated that the Clear Water Pond has, to its knowledge, never discharged any water to the swale via the Emergency Outfall Structure.

### 2.2.5 Lake Delta

Lake Delta is a man-made 44-acre lake that is occasionally used to supply the plant with make-up water. It is not considered a CCR Impoundment. While there is an emergency overflow from Lake Delta to the Clear Water Pond, based on 2012 GZA Report it was determined that even during the 1000-year, 24-hour storm event, the surface water elevation will not reach the emergency spillway into Clear Water Pond.[5] As such, this inflow analysis excludes any inflow from Lake Delta.

## 2.3 Hydrologic and Hydraulic Model and Results

A surface water run-off model was prepared using HydroCAD®, which utilizes procedures outlined in the Soil Conservation Service (SCS) Technical Release 55 (TR-55) for computing curve numbers and times of concentration and SCS TR-20 for calculating and generating run-off hydrographs and modeling the existing outfall structures. A discussion of the model's input data is provided below.

### 2.3.1 Drainage Areas

To accurately model the impoundment system, the model must take into account inflow from both water entering the system for treatment and stormwater entering the system via direct precipitation and stormwater

[5] Ibid 1

run-off flowing into the system impoundments. On days when the plant is operating at a typical capacity, 3.8 MGD flow into the system via pumps. During precipitation events, water enters the ponds mostly from direct precipitation as there is a relatively small area that contributes stormwater runoff to the impoundments. Runoff is limited to the berm areas that slope into the impoundments. The impoundments themselves encompass a large area.

The table below shows the Drainage Areas contributing to the CCR Impoundment System during the 100-year, 24-hour storm event.

**Table 1. Inflow and Drainage Areas**

| Pond or Drainage Area Name | Source/Area* | Peak Flow During 100-year; 24-Hour Storm Event |
|---|---|---|
| Coal Pile Sump | 26.0 acres | 7.03 CFS |
| Inflow from Erickson Power Station | | |
| Hydro-Bins | 10” Force Main | 5.88 CFS (combined) |
| Plant Sumps | 10” Force Main | |
| Coal Pile Sump Pump | 6” Force Main | 7.03 CFS |
| Forebay and Berm | 2.76 acres | 24.31 CFS |
| Retention Basin and Berm | 3.73 acres | 32.61 CFS |
| Clear Water Pond | 5.74 acres | 40.82 CFS |
| Former Impoundment | 25.20 acres | 223.77 CFS |

*Note the source/areas are drainage areas that include the impoundments and portions of berm/roadways.

### 2.3.2 Rainfall Data

Rainfall events for the Lansing Michigan area were available from the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Data Server. Rainfall data inputted into the model included the 2-year, 25-year, 50-year, 100-year, and 1,000-year 24-hour storm events. The precipitation amounts are summarized below in **Table 2.**

**Table 2. Rainfall Data**

| 24-Hour Rainfall Event | Precipitation (inches) |
|---|---|
| 2-year | 2.42 |
| 25-year | 4.08 |
| 50-year | 4.70 |
| 100-year | 5.38 |
| 1,000-year | 8.11 |

### 2.3.3 Weighted Curve Number

The weighted curve number (CN) is determined according to a hydrologic soil group (HSG) and ground cover for a delineated drainage basin. The majority of drainage areas were identified as water surfaces with an impervious coverage which correlates to a CN number of 98. The surrounding embankments/berms are considered fallow, bare soil, in the HSG B soil group based on the Soil Conservation District Soil Survey which provides a CN number of 89. Based on the areas the model calculated a weighted CN number of 94-96 for the drainage subcatchment areas. The exception was the Coal Pile, to which a CN number of 79 was assigned to match the previous MD&E modeling.

The Soil Conservation District Web Soil Survey was consulted to identify the hydrologic soil groups for the native soils.

### 2.3.4 Time of Concentration

The time of concentration (Tc) is defined as the time required for run-off to travel from the most hydrologically distant point of a sub-catchment to the point of collection. It is determined by summing the travel time for consecutive flow segments along the sub-catchment's hydraulic path. The top of the impoundment embankment is the furthest point of travel. Because of the short distance and fairly steep slope of the of flow path, the Tc is estimated between 0.4 to 0.7 minute.

### 2.3.5 Pond Model Inputs

As previously stated, the evaluation was completed based on the best available information provided by BWL at the time of this report. Existing pond elevations and inlet/outlet structures information were taken from previous design and closure reports. Elevation data in the report were converted from NGVD29 to NAVD88. Secondary sources of information used were as-built and construction drawings, which were used when survey data was unavailable. In some instances, there was no information on pipe slopes and inverts. At these locations, pipe inverts were estimated based on the available local topography. A summary of the HydroCAD® model inputs are summarized in **Table 3**.

| Table 3. Inflow/Outflow Structure Information | | |
|---|---|---|
| **Outfall Structure & Type** | | **Elevation (feet) (NAVD88)** |
| Forebay | Top Embankment Crest | 886.5 |
| | Assumed Pool Elevation | 883.0 |
| | Inlets:<br>• 6” diameter DIP from plant sump pump<br>• 10” diameter DIP from hydrobins<br>• 10” diameter DIP from coal pile runoff | <br>881.6<br>881.6<br>881.6 |
| | Outlets:<br>• Three (3) 24” diameter CPP | <br>882.4 (west)<br>882.5 (center)<br>882.6 (east) |
| Retention Basin | Top Embankment Crest | 886.5 |
| | Inlets:<br>• Forebay Inlets (three (3)24-inch CPP)<br>• 12” diameter emergency by-pass pipe from plant sump pump (excluded from model) | <br>881.6 (west)<br>881.4 (center)<br>881.7 (east)<br>NA |
| | Outlets:<br>• Primary: 72” Pre-cast Concrete Stand Pipe Rim Elevation<br>36” diameter CPP to Clear Water Pond<br>• Secondary: 24” diameter CPP to the Former Impoundment (assumed flat for model) | <br>880.5<br>874.0<br>881.5 |
| Clear Water Pond | Top Embankment | 886.5 |
| | Recorded Pool Elevation (on May 7, 2020) | 881.7 |
| | Inlets:<br>• From Retrofitted Former Impoundment Transfer Structure)<br>• Lake Delta emergency weir spillway | <br>8714<br>886.1 |
| | Outlets:<br>• Primary: Pump/Force Main back to Erickson Power Station at steady flow rate of 5.88 cfs<br>• Secondary: 36” Ductile Iron Stand Pipe<br>36” Ductile Iron emergency outlet to swale | <br>870.6<br>883.0 (rim)<br>873.1 (outlet) |
| Former Impoundment | Inlets:<br>• 24” Retention Basin Emergency Outlet Pipe<br>• Precipitation | <br>881.5 |
| | Outlets:<br>• 24” Retention Basin Emergency Outlet<br>• Evaporation | <br>880.8 |

## 2.4 Evaluation of Existing Inflow/Outflow Design Controls

To comply with 40 CFR §257.82, the inflow and outflow design flood control systems must adequately manage flow into and out of the CCR unit during the 100-year, 24-hour storm event.

The HydroCAD® model was used to evaluate the inflow, outflow, and peak elevations observed for the 100-year, 24-hour storm event for the impoundments in their current conditions. Based on the model results, the outflow design control systems for both impoundments are capable of managing flows from the 100-year, 24-hour storm event and meet the requirements of 40 CFR §257.82(a)(2). Table 4 summarizes the peak elevations of each pond during the 100 year, 24-hour storm event.

**Table 4. Elevations during 100-year, 24-hour storm event**

| Pond | Peak Elevation (ft) | Peak Inflow (cfs) | Peak Outflow (cfs) | Remaining Pond Freeboard (ft) |
|---|---|---|---|---|
| Forebay | 883.54 | 30.24 | 12.67 | 2.96 |
| Retention Basin | 882.51 | 41.69 | 10.07 | 3.99 |
| Clear Water Pond | 882.41 | 55.21 | 5.88[(1)] | 4.09 |
| Former Impoundment | 871.78 | 224.36 | 0.01[(2)] | 14.72 |

Notes: [(1)] Based on the model, the only discharge from Clear Water Pond during the 100-year; 24-hour storm event is via the Pump House.
[(2)] Based on the model, the only discharge from Former Impoundment during the 100-year; 24-hour storm event is via evaporation.

Based on the modelling results, at no time during a 100-year, 24-hour storm event will water elevations rise above the CCR Impoundment System berms, nor does the Clear Water Pond water elevation discharge to the Emergency Outfall Structure.

It should be noted that the model was also run for the 1,000 year; 24-hour storm event (8.11 inches) and again the model predicted that water elevations will not rise above the embankments, nor will water discharge from the Clear Water Pond Emergency Outfall Structure.

## 2.5 Improvements to Existing Inflow/Outflow Design Controls

Based on the available information and the model results, the existing inflow design flood control systems in place for the Forebay, Retention Basin, and Clear Water Pond meet the requirements of 40 CFR §257.82 and will adequately manage flow into and out of the CCR Impoundment System during the 100-year, 24-hour storm event.

# 3.0 Professional Engineer Certification

**Erickson Power Station CCR Unit Initial Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundments Compliance with the Federal Coal Combustion Residuals Rule**

The undersigned Registered Professional Engineer is familiar with the requirements of Part 257 of Title 40 of the Code of Federal Regulations (40 CFR §257) and has supervised examination of the facility by appropriately qualified personnel. The undersigned Registered Professional Engineer attests that this Run-on and Run-off Controls System Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR §257.

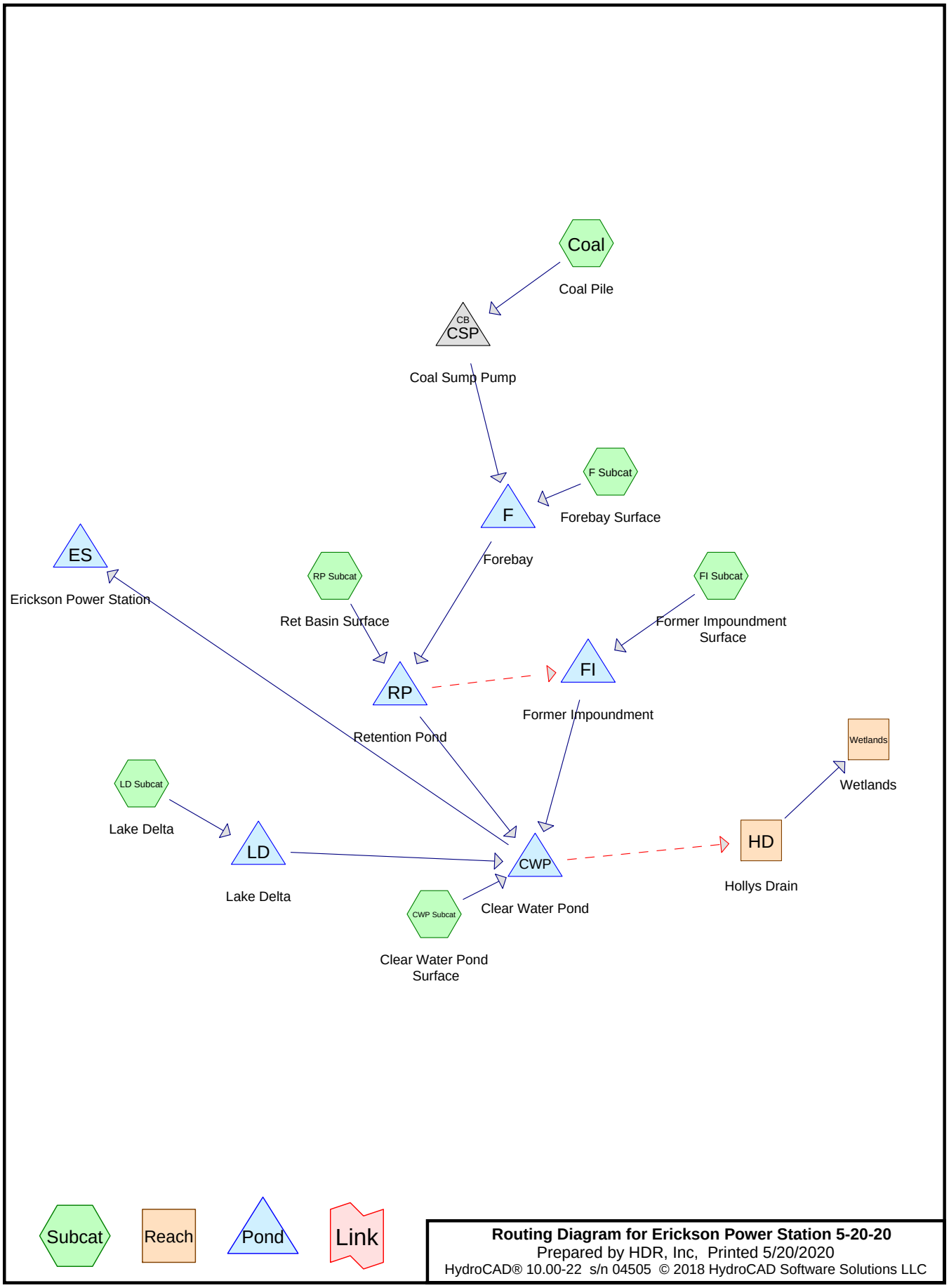
This Plan is valid only to the extent that the facility owner or operator maintains existing inflow design flood control systems described in this Plan.

STAMP and SIGNATURE:


Date: 06/09/2020
Lara Zawaideh-Syrocki, PE ENV SP
Michigan PE #6201065363
License Renewal Date 10/31/2021

# 4.0 Appendix

## APPENDIX A - HYDROCAD® MODEL RESULTS




**Routing Diagram for Erickson Power Station 5-20-20**
Prepared by HDR, Inc, Printed 5/20/2020

## Project Notes

The overall drainage flow was based primarily on, "Closure Plan, CCR Surface Impoundment System, Erickson Power Stattion" by NTH Consultants. (Sheet Reference Number 2)

For drainage areas ;

The Forebay recieves water from
1) Ericosn Power Stations roof
2) Coal Pile manual value
3) Forebay surface area
4) Hydrobins (used a base flow of 5.88cfs (3.8 MGD coverted to cfs from GZA report)

Retention Pond recieves water from
1) The 3 outlets from the Forebay
2) Retention Pond surface area
3) Emergency Value from Erickson Station (not modeled)

Clear Watwater Pond recieves water from
1) Retention Pond outlet
2) Clear Water Pond surafce area
3) Lake Delta (does not spill over in 100-yr event)

Old Ash Impoundment recieves watwater from
1) Retention Pond overflow
2) Old Ash Impoundment surface area

Hollys Drain recieves watwater from
1) Clear Water Pond emergency overflow (does not spill over in 100-yr event)

Lake Delta recieves watwater from
1) Lake Delta surface area

Erickson Power Station
1) Recycled water from Clear Water Pond

Drainage Area appears larger in model than discribed in report. This is due to the coal pile (26 acres), Lake Delta (46 acres) and the facilities roof (.24 acres) being incoroperated into the model. CCR impoundment area is approoximately 11.2 acres and Former Ash Impoundment is approximately 25 acres.

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 72.565 | 98 | (CWP Subcat, F Subcat, FI Subcat, LD Subcat, RP Subcat) |
| 8.229 | 86 | Fallow, bare soil, HSG B (CWP Subcat, F Subcat, FI Subcat, RP Subcat) |
| 26.000 | 79 | Pasture/grassland/range, Poor, HSG B (Coal) |
| **106.794** | **92** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 34.229 | HSG B | Coal, CWP Subcat, F Subcat, FI Subcat, RP Subcat |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 72.565 | Other | CWP Subcat, F Subcat, FI Subcat, LD Subcat, RP Subcat |
| **106.794** | | **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 | 72.565 | 72.565 | | CWP Subcat, F Subcat, FI Subcat, LD Subcat, RP Subcat |
| 0.000 | 8.229 | 0.000 | 0.000 | 0.000 | 8.229 | Fallow, bare soil | CWP Subcat, F Subcat, FI Subcat, RP Subcat |
| 0.000 | 26.000 | 0.000 | 0.000 | 0.000 | 26.000 | Pasture/grassland/range, Poor | Coal |
| **0.000** | **34.229** | **0.000** | **0.000** | **72.565** | **106.794** | **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 | CSP | 883.00 | 881.60 | 1,700.0 | 0.0008 | 0.012 | 6.0 | 0.0 | 0.0 |
| 2 | F | 882.40 | 881.60 | 57.3 | 0.0140 | 0.025 | 24.0 | 0.0 | 0.0 |
| 3 | F | 882.50 | 881.40 | 57.3 | 0.0192 | 0.025 | 24.0 | 0.0 | 0.0 |
| 4 | F | 882.60 | 881.70 | 57.3 | 0.0157 | 0.025 | 24.0 | 0.0 | 0.0 |
| 5 | FI | 880.80 | 871.40 | 15.0 | 0.6267 | 0.012 | 24.0 | 0.0 | 0.0 |
| 6 | RP | 881.50 | 881.50 | 69.8 | 0.0000 | 0.012 | 24.0 | 0.0 | 0.0 |

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 5
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment Coal: Coal Pile** Runoff Area=26.000 ac 0.00% Impervious Runoff Depth>0.45"
Flow Length=1,780' Tc=629.8 min CN=79 Runoff=1.66 cfs 0.978 af

**Subcatchment CWP Subcat: Clear Water** Runoff Area=5.739 ac 62.73% Impervious Runoff Depth>1.79"
Flow Length=15' Tc=0.4 min CN=94 Runoff=20.58 cfs 0.858 af

**Subcatchment F Subcat: Forebay Surface** Runoff Area=2.760 ac 72.46% Impervious Runoff Depth>1.89"
Flow Length=15' Tc=0.4 min CN=95 Runoff=10.22 cfs 0.434 af

**Subcatchment FI Subcat: Former** Runoff Area=25.200 ac 83.33% Impervious Runoff Depth>1.98"
Flow Length=15' Tc=0.4 min CN=96 Runoff=96.05 cfs 4.164 af

**Subcatchment LD Subcat: Lake Delta** Runoff Area=1,889,000 sf 100.00% Impervious Runoff Depth>2.19"
Flow Length=15' Tc=0.4 min CN=98 Runoff=172.77 cfs 7.918 af

**Subcatchment RP Subcat: Ret Basin** Runoff Area=3.730 ac 69.71% Impervious Runoff Depth>1.79"
Flow Length=15' Tc=0.7 min CN=94 Runoff=13.40 cfs 0.557 af

**Reach HD: Hollys Drain** Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.100 L=1,500.0' S=0.0023 '/' Capacity=88.54 cfs Outflow=0.00 cfs 0.000 af

**Reach Wetlands: Wetlands** Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

**Pond CSP: Coal Sump Pump** Peak Elev=1,012.87' Inflow=1.66 cfs 0.978 af
6.0" Round Culvert n=0.012 L=1,700.0' S=0.0008 '/' Outflow=1.66 cfs 0.978 af

**Pond CWP: Clear Water Pond** Peak Elev=881.95' Storage=1,284,463 cf Inflow=26.20 cfs 12.630 af
Primary=5.88 cfs 11.671 af Secondary=0.00 cfs 0.000 af Outflow=5.88 cfs 11.671 af

**Pond ES: Erickson Power Station** Inflow=5.88 cfs 11.671 af
Primary=5.88 cfs 11.671 af

**Pond F: Forebay** Peak Elev=883.27' Storage=862,483 cf Inflow=16.10 cfs 13.080 af
Outflow=7.54 cfs 12.496 af

**Pond FI: Former Impoundment** Peak Elev=871.33' Storage=204,668 cf Inflow=96.24 cfs 4.719 af
Discarded=0.01 cfs 0.020 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.020 af

**Pond LD: Lake Delta** Peak Elev=882.69' Storage=1,267,114 cf Inflow=172.77 cfs 7.918 af
Outflow=0.00 cfs 0.000 af

**Pond RP: Retention Pond** Peak Elev=882.03' Storage=909,911 cf Inflow=20.47 cfs 13.054 af
Primary=7.32 cfs 11.772 af Secondary=0.65 cfs 0.555 af Outflow=7.49 cfs 12.327 af

**Total Runoff Area = 106.794 ac Runoff Volume = 14.910 af Average Runoff Depth = 1.68"**
**32.05% Pervious = 34.229 ac 67.95% Impervious = 72.565 ac**

## Summary for Subcatchment Coal: Coal Pile

Information from MD & E

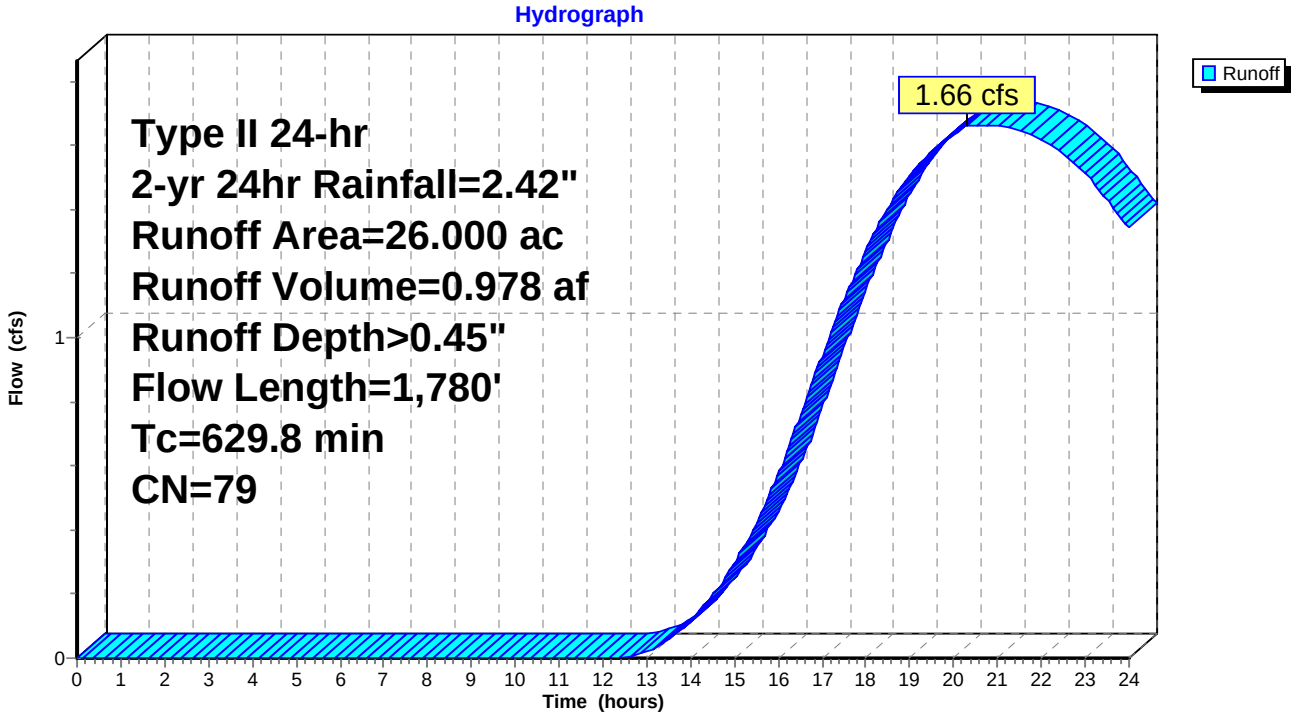
Runoff = 1.66 cfs @ 20.30 hrs, Volume= 0.978 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr 24hr Rainfall=2.42"

| Area (ac) | CN | Description |
|---|---|---|
| 26.000 | 79 | Pasture/grassland/range, Poor, HSG B |
| 26.000 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 629.8 | 1,780 | | 0.05 | | **Direct Entry, Coal Pile Runoff** |

## Subcatchment Coal: Coal Pile



## Summary for Subcatchment CWP Subcat: Clear Water Pond Surface

[49] Hint: Tc<2dt may require smaller dt

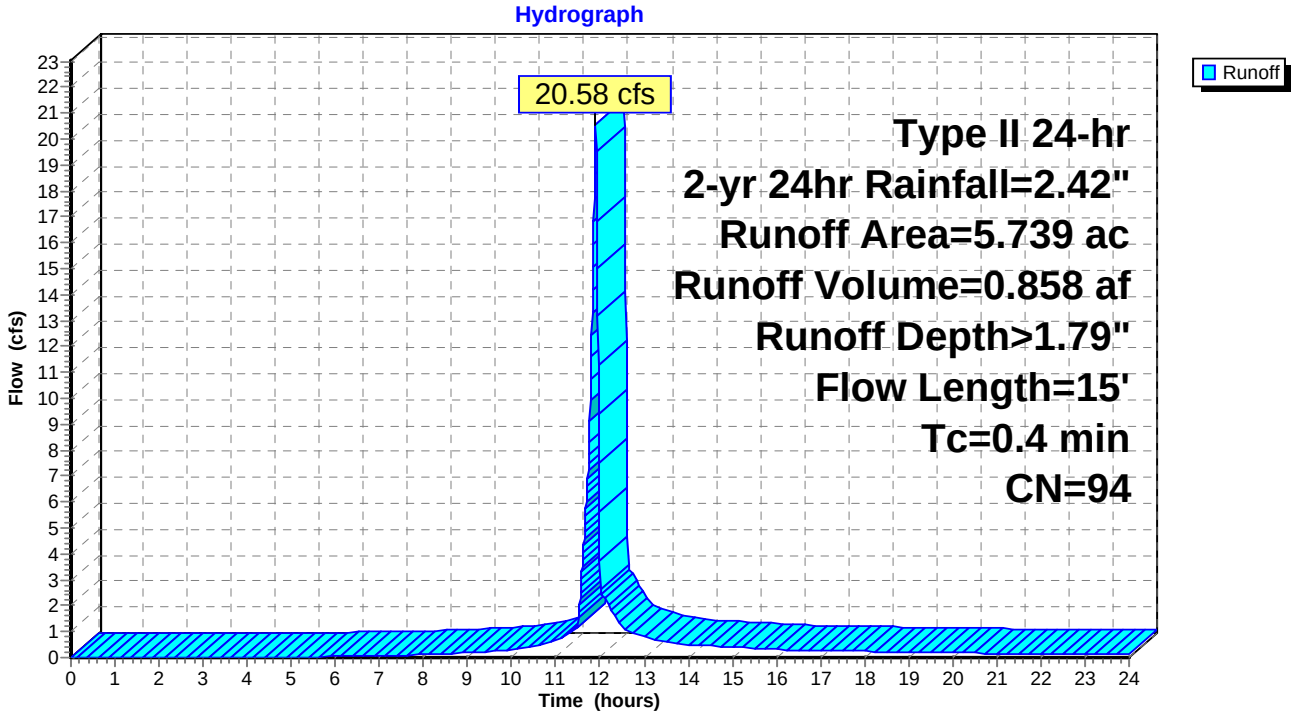
Runoff = 20.58 cfs @ 11.90 hrs, Volume= 0.858 af, Depth> 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr 24hr Rainfall=2.42"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 3.600 | 98 | |
| | 2.139 | 86 | Fallow, bare soil, HSG B |
| | 5.739 | 94 | Weighted Average |
| | 2.139 | | 37.27% Pervious Area |
| | 3.600 | | 62.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Clear Water Pond Subcat** |

## Subcatchment CWP Subcat: Clear Water Pond Surface



## Summary for Subcatchment F Subcat: Forebay Surface

[49] Hint: Tc<2dt may require smaller dt

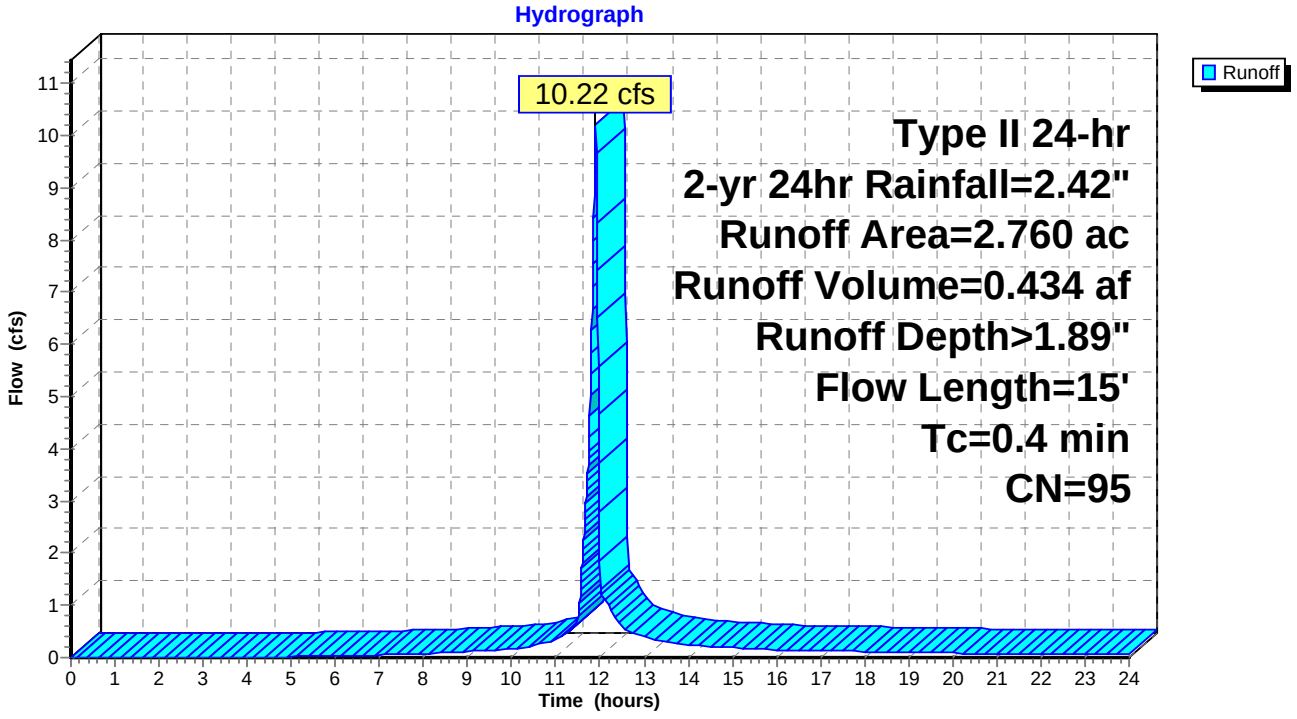
Runoff = 10.22 cfs @ 11.90 hrs, Volume= 0.434 af, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr 24hr Rainfall=2.42"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.000 | 98 | |
| | 0.760 | 86 | Fallow, bare soil, HSG B |
| | 2.760 | 95 | Weighted Average |
| | 0.760 | | 27.54% Pervious Area |
| | 2.000 | | 72.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Forebay Surface** |

## Subcatchment F Subcat: Forebay Surface



## Summary for Subcatchment FI Subcat: Former Impoundment Surface

[49] Hint: Tc<2dt may require smaller dt

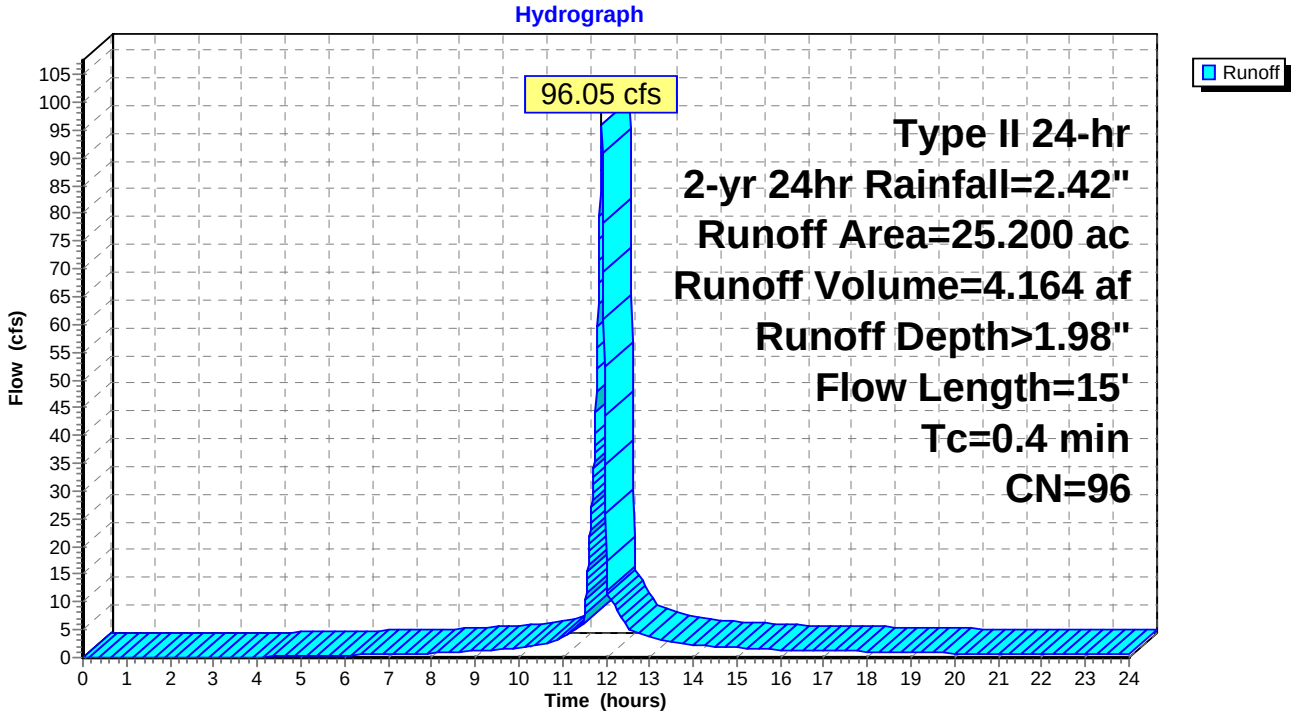
Runoff = 96.05 cfs @ 11.90 hrs, Volume= 4.164 af, Depth> 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr 24hr Rainfall=2.42"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 21.000 | 98 | |
| | 4.200 | 86 | Fallow, bare soil, HSG B |
| | 25.200 | 96 | Weighted Average |
| | 4.200 | | 16.67% Pervious Area |
| | 21.000 | | 83.33% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, OAI Subcat** |

## Subcatchment FI Subcat: Former Impoundment Surface



## Summary for Subcatchment LD Subcat: Lake Delta

[49] Hint: Tc<2dt may require smaller dt

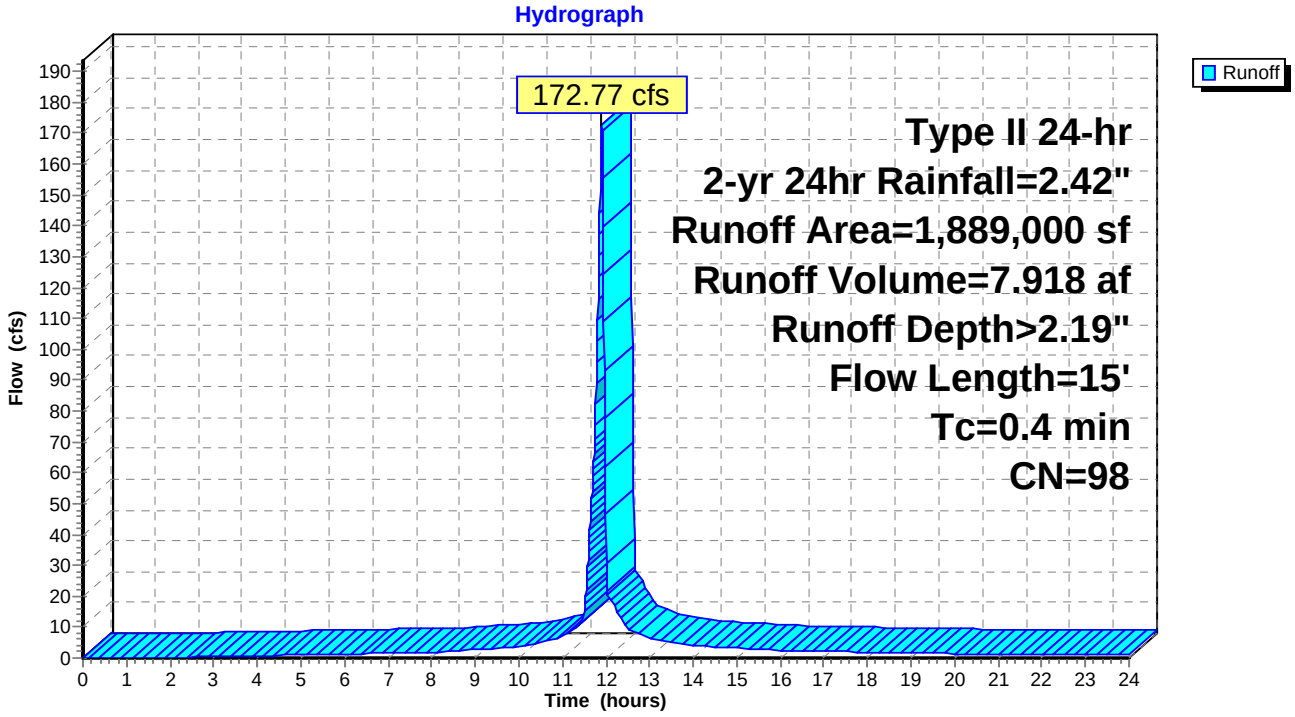
Runoff = 172.77 cfs @ 11.90 hrs, Volume= 7.918 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr 24hr Rainfall=2.42"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,889,000 | 98 | |
| | 1,889,000 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry,** |

### Subcatchment LD Subcat: Lake Delta



## Summary for Subcatchment RP Subcat: Ret Basin Surface

[49] Hint: Tc<2dt may require smaller dt

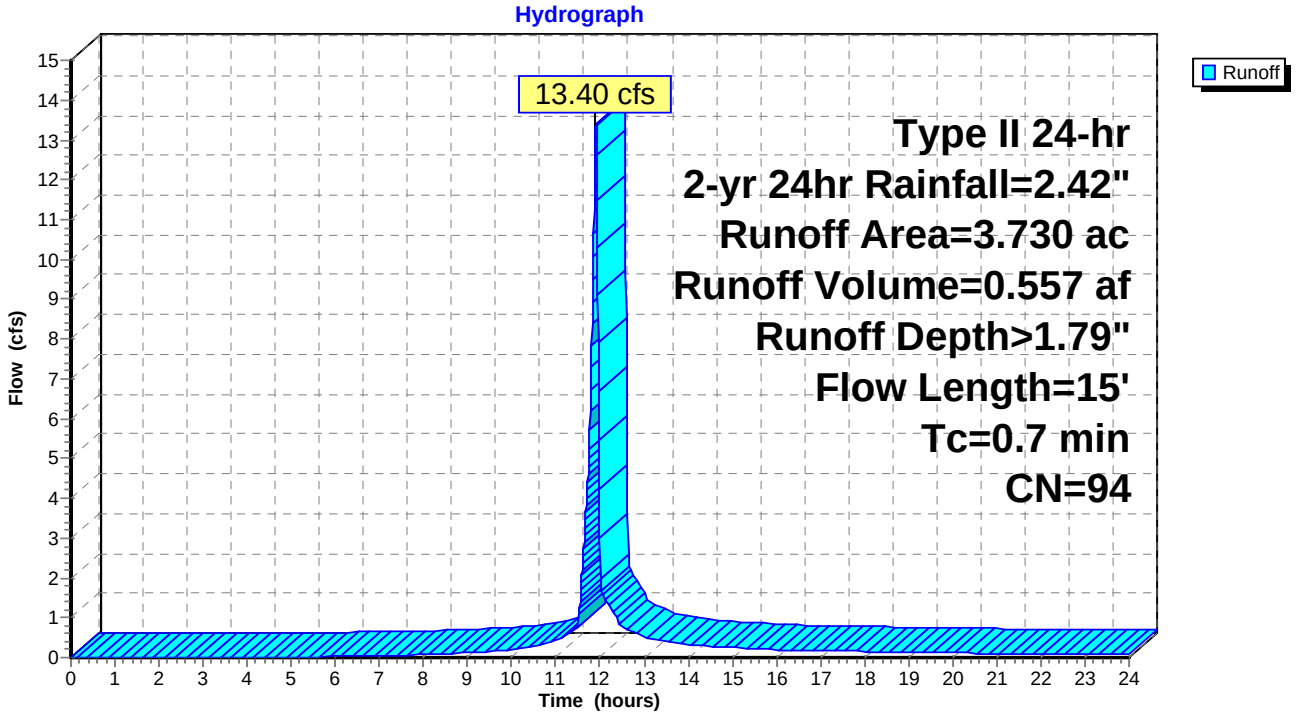
Runoff = 13.40 cfs @ 11.91 hrs, Volume= 0.557 af, Depth> 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr 24hr Rainfall=2.42"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.600 | 98 | |
| | 1.130 | 86 | Fallow, bare soil, HSG B |
| | 3.730 | 94 | Weighted Average |
| | 1.130 | | 30.29% Pervious Area |
| | 2.600 | | 69.71% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.7 | 15 | | 0.36 | | **Direct Entry, Ret Basin Surface** |

### Subcatchment RP Subcat: Ret Basin Surface



## Summary for Reach HD: Hollys Drain

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

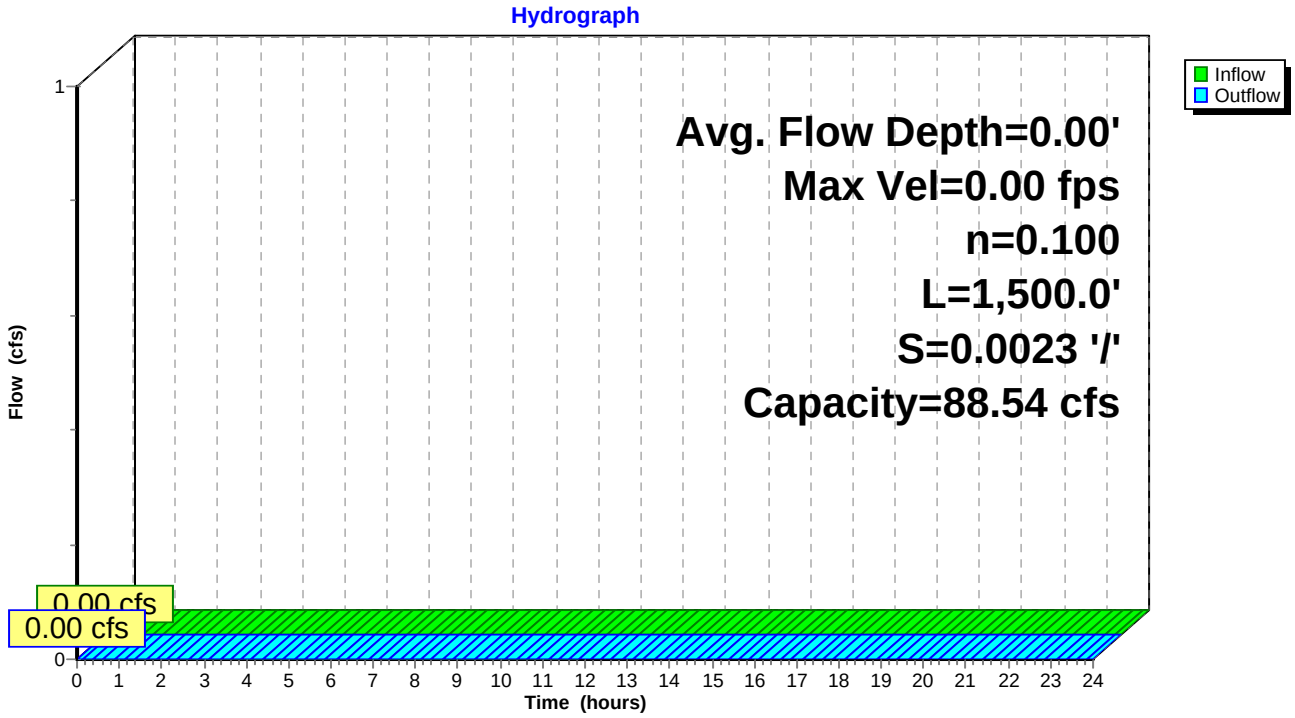
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00' Flow Area= 72.0 sf, Capacity= 88.54 cfs

18.00' x 3.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 '/' Top Width= 30.00'
Length= 1,500.0' Slope= 0.0023 '/'
Inlet Invert= 874.90', Outlet Invert= 871.50'

‡

## Reach HD: Hollys Drain



## Summary for Reach Wetlands: Wetlands

No flow reaches this point

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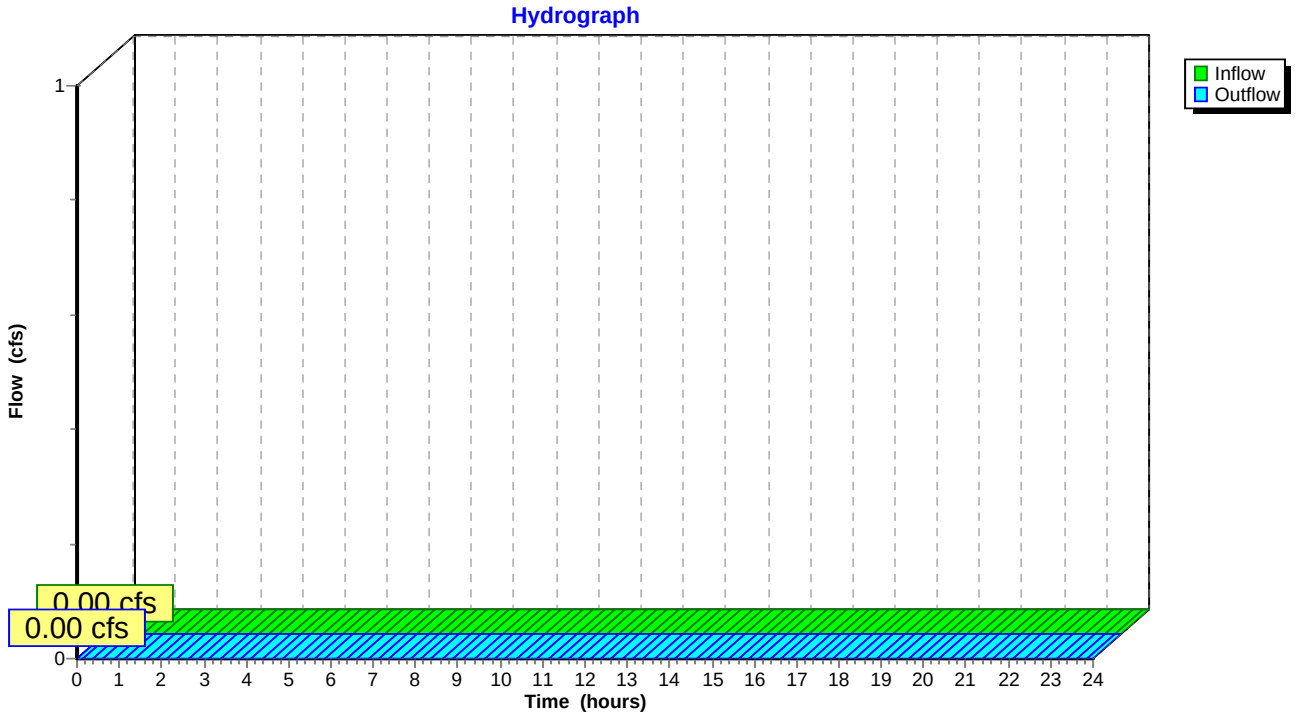
[40] Hint: Not Described (Outflow=Inflow)

| | | | | | |
|---|---|---|---|---|---|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Reach Wetlands: Wetlands



## Summary for Pond CSP: Coal Sump Pump

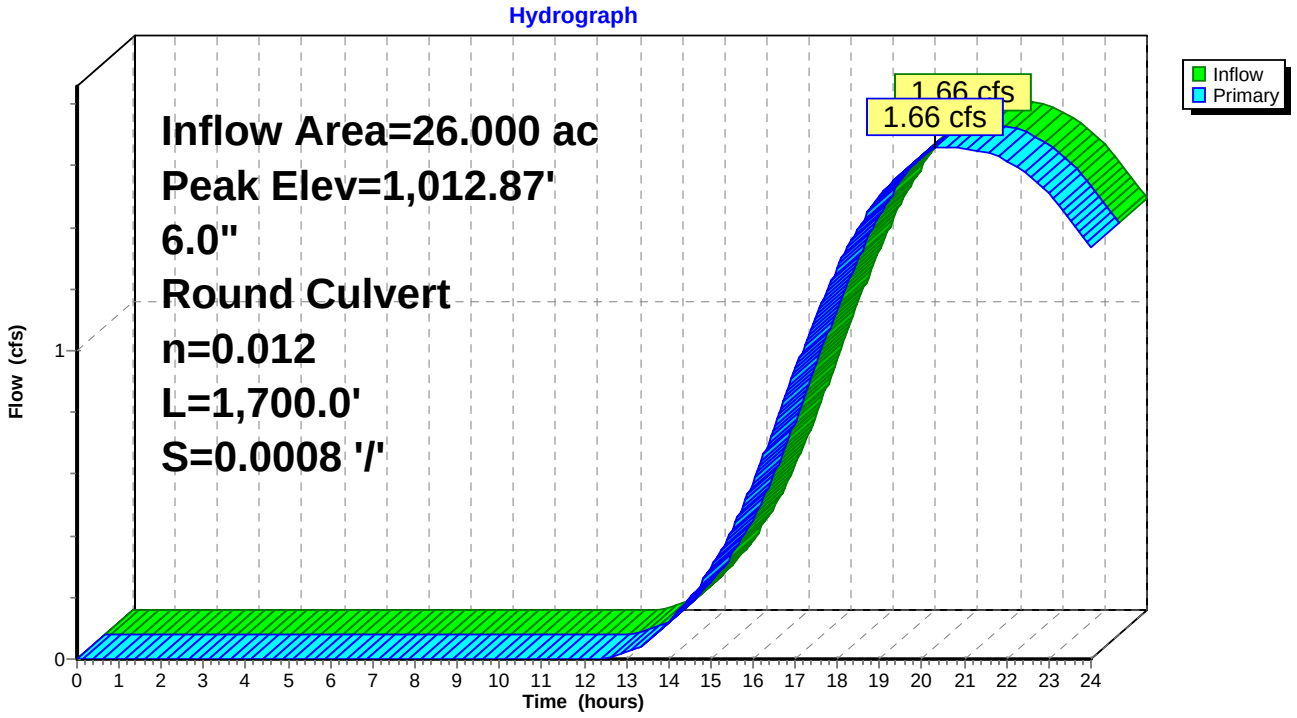
Inflow Area = 26.000 ac, 0.00% Impervious, Inflow Depth > 0.45" for 2-yr 24hr event
Inflow = 1.66 cfs @ 20.30 hrs, Volume= 0.978 af
Outflow = 1.66 cfs @ 20.31 hrs, Volume= 0.978 af, Atten= 0%, Lag= 0.6 min
Primary = 1.66 cfs @ 20.31 hrs, Volume= 0.978 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 1,012.87' @ 20.53 hrs
Flood Elev= 3,000.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 883.00' | **6.0" Round Culvert**<br>L= 1,700.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 883.00' / 881.60' S= 0.0008 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.20 sf |

**Primary OutFlow** Max=1.66 cfs @ 20.31 hrs HW=1,012.87' TW=883.26' (Dynamic Tailwater)
**1=Culvert** (Outlet Controls 1.66 cfs @ 8.47 fps)

## Pond CSP: Coal Sump Pump



## Summary for Pond CWP: Clear Water Pond

[80] Warning: Exceeded Pond Fl by 10.71' @ 0.31 hrs (3.53 cfs 8.044 af)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.42" for 2-yr 24hr event
Inflow = 26.20 cfs @ 11.90 hrs, Volume= 12.630 af
Outflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 78%, Lag= 0.0 min
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.70' Surf.Area= 163,599 sf Storage= 1,242,582 cf
Peak Elev= 881.95' @ 24.00 hrs Surf.Area= 165,143 sf Storage= 1,284,463 cf (41,881 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 870.00' | 2,000,903 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

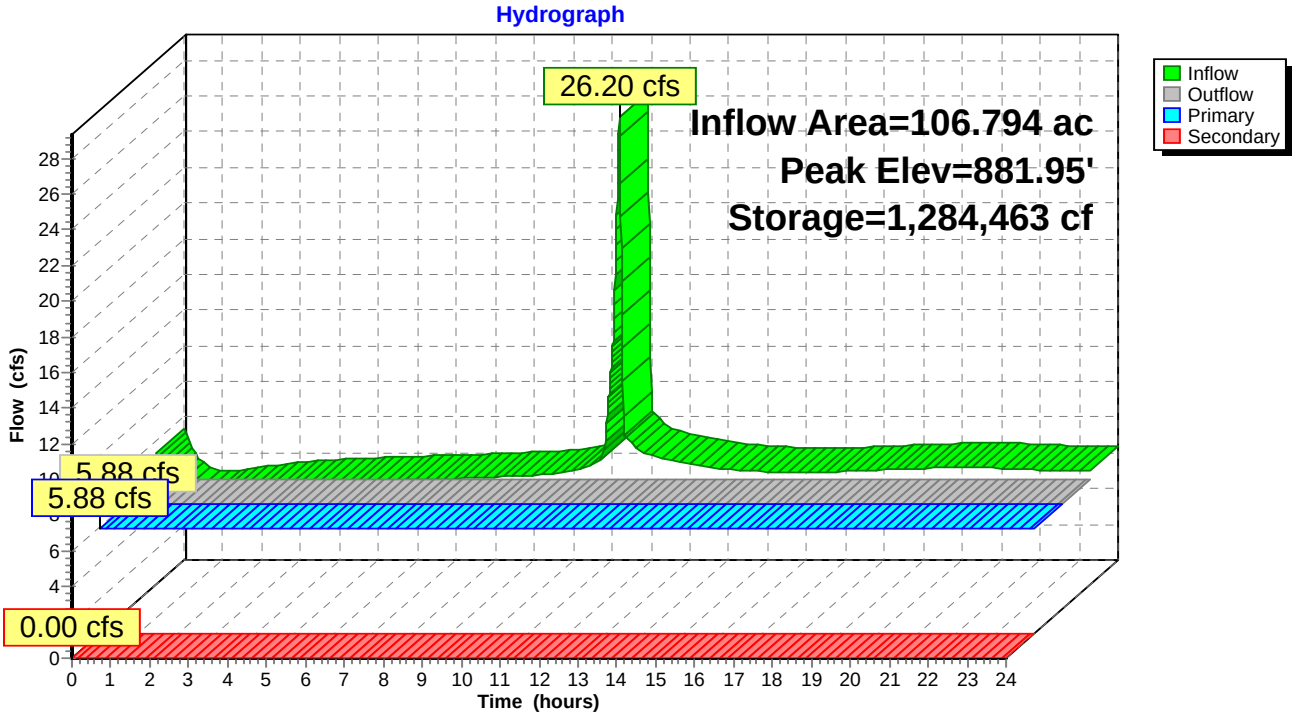
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 870.00 | 38,520 | 825.0 | 0 | 0 | 38,520 |
| 873.00 | 68,125 | 1,325.0 | 157,872 | 157,872 | 124,127 |
| 874.00 | 72,131 | 1,433.2 | 70,118 | 227,990 | 147,915 |
| 875.00 | 98,274 | 1,367.7 | 84,866 | 312,856 | 162,582 |
| 876.00 | 116,945 | 1,983.7 | 107,474 | 420,331 | 326,875 |
| 877.00 | 131,376 | 1,724.1 | 124,091 | 544,421 | 403,494 |
| 878.00 | 139,814 | 1,693.0 | 135,573 | 679,994 | 412,122 |
| 879.00 | 146,808 | 1,706.5 | 143,297 | 823,291 | 416,150 |
| 880.00 | 153,167 | 1,730.0 | 149,976 | 973,267 | 422,802 |
| 881.00 | 159,394 | 1,754.5 | 156,270 | 1,129,538 | 429,816 |
| 882.00 | 165,418 | 1,777.3 | 162,397 | 1,291,934 | 436,463 |
| 883.00 | 171,176 | 1,796.5 | 168,289 | 1,460,223 | 442,208 |
| 884.00 | 177,068 | 1,818.2 | 174,114 | 1,634,337 | 448,706 |
| 885.00 | 183,257 | 1,842.6 | 180,154 | 1,814,490 | 456,046 |
| 886.00 | 189,586 | 1,885.9 | 186,413 | 2,000,903 | 469,028 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 870.60' | **Pump**<br>Discharges@880.00' Turns Off@870.10'<br>36.0" Diam. x 2,900.0' Long Discharge, Hazen-Williams C= 130<br>Flow (gpm)= 2,640.0<br>Head (feet)= 50.00<br>-Loss (feet)= 0.21<br>=Lift (feet)= 49.79 |
| #2 | Secondary | 875.90' | **Tube/Siphon/Float Valve** Discharges@872.80'<br>36.000" Diameter, C= 0.600<br>62.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 883.60' | **36.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=5.88 cfs @ 0.00 hrs HW=881.70' TW=0.00' (Dynamic Tailwater)
└─**1=Pump** (Pump Controls 5.88 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=881.70' TW=874.90' (Dynamic Tailwater)
└─**2=Tube/Siphon/Float Valve** (Passes 0.00 cfs of 84.57 cfs potential flow)
└─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond CWP: Clear Water Pond



## Summary for Pond ES: Erickson Power Station

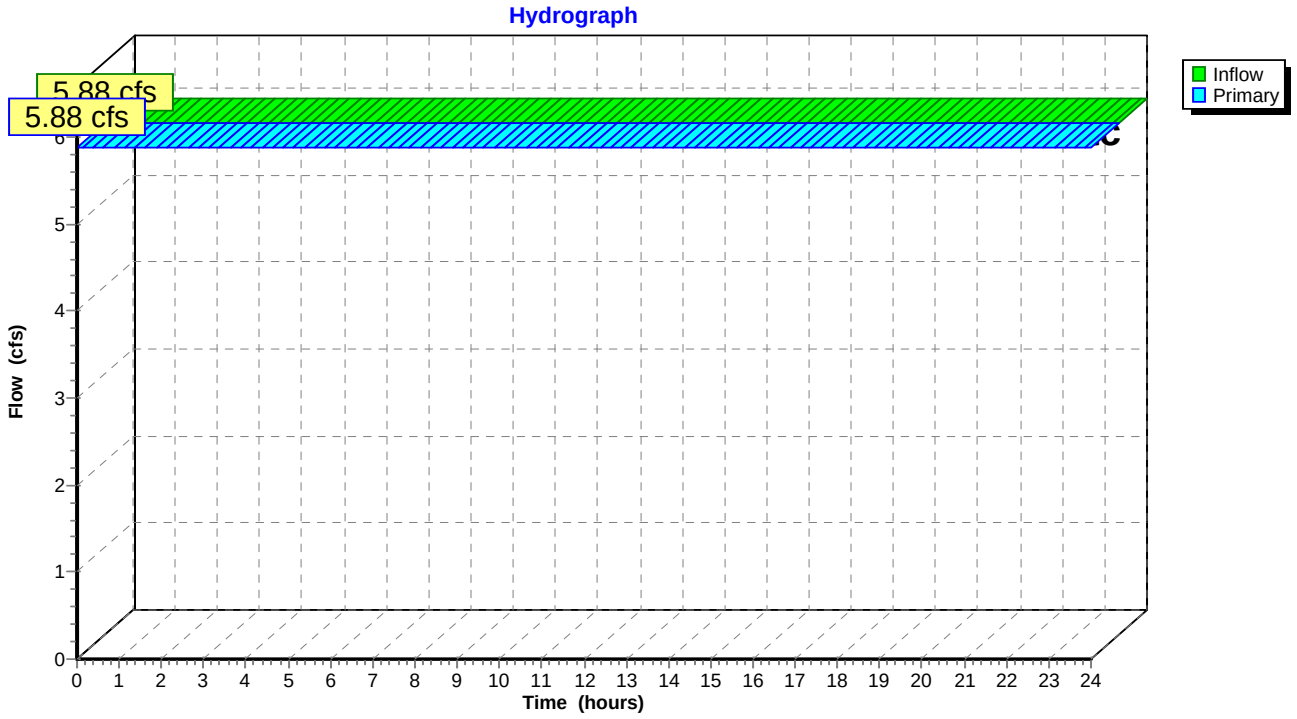
Shows flow back to Power Station

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.31" for 2-yr 24hr event
Inflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Pond ES: Erickson Power Station



## Summary for Pond F: Forebay

[80] Warning: Exceeded Pond CSP by 0.25' @ 12.06 hrs (0.02 cfs 0.008 af)

Inflow Area = 28.760 ac, 6.95% Impervious, Inflow Depth > 5.46" for 2-yr 24hr event
Inflow = 16.10 cfs @ 11.90 hrs, Volume= 13.080 af, Incl. 5.88 cfs Base Flow
Outflow = 7.54 cfs @ 22.39 hrs, Volume= 12.496 af, Atten= 53%, Lag= 629.4 min
Primary = 7.54 cfs @ 22.39 hrs, Volume= 12.496 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 883.00' Surf.Area= 0 sf Storage= 836,526 cf
Peak Elev= 883.27' @ 22.39 hrs Surf.Area= 0 sf Storage= 862,483 cf (25,957 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 18.2 min ( 776.4 - 758.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 932,837 cf | **Custom Stage Data** Listed below |

| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 14,201 |
| 872.50 | 42,819 |
| 873.00 | 72,222 |
| 873.50 | 102,366 |
| 874.00 | 133,337 |
| 874.50 | 165,092 |
| 875.00 | 197,675 |
| 875.50 | 231,086 |
| 876.00 | 265,324 |
| 876.50 | 300,433 |
| 877.00 | 336,327 |
| 877.50 | 373,135 |
| 878.00 | 410,771 |
| 878.50 | 449,278 |
| 879.00 | 488,700 |
| 879.50 | 528,949 |
| 880.00 | 570,157 |
| 880.50 | 612,236 |
| 881.00 | 655,230 |
| 881.50 | 699,138 |
| 882.00 | 744,005 |
| 882.50 | 789,786 |
| 883.00 | 836,526 |
| 883.50 | 884,181 |
| 884.00 | 932,837 |

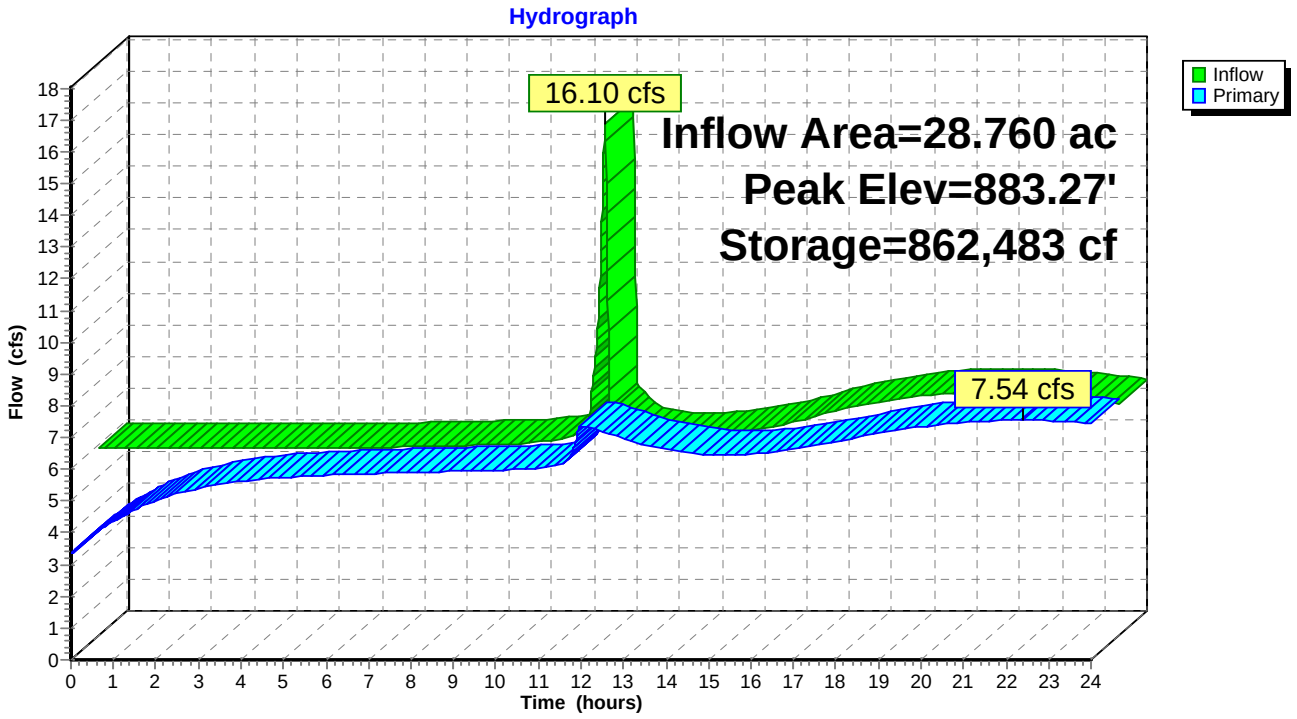
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 882.40' | **24.0" Round CMP_Round 24" (West)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.40' / 881.60' S= 0.0140 '/' Cc= 0.900 |

n= 0.025, Flow Area= 3.14 sf

| | | | |
|---|---|---|---|
| #2 | Primary | 882.50' | **24.0" Round CMP_Round 24" (Center)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.50' / 881.40' S= 0.0192 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |
| #3 | Primary | 882.60' | **24.0" Round CMP_Round 24" (East)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.60' / 881.70' S= 0.0157 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |

**Primary OutFlow** Max=7.54 cfs @ 22.39 hrs HW=883.27' TW=882.01' (Dynamic Tailwater)
- **1=CMP_Round 24" (West)** (Barrel Controls 2.98 cfs @ 3.34 fps)
- **2=CMP_Round 24" (Center)** (Inlet Controls 2.64 cfs @ 2.36 fps)
- **3=CMP_Round 24" (East)** (Barrel Controls 1.92 cfs @ 3.09 fps)

## Pond F: Forebay



## Summary for Pond FI: Former Impoundment

Evaporation losses are smaller than HydroCAD will allow

Inflow Area = 25.200 ac, 83.33% Impervious, Inflow Depth > 2.25" for 2-yr 24hr event
Inflow = 96.24 cfs @ 11.90 hrs, Volume= 4.719 af
Outflow = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af, Atten= 100%, Lag= 0.0 min
Discarded = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 871.33' @ 24.00 hrs Surf.Area= 655,021 sf Storage= 204,668 cf

Plug-Flow detention time= 666.0 min calculated for 0.020 af (0% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.00' | 15,127,104 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

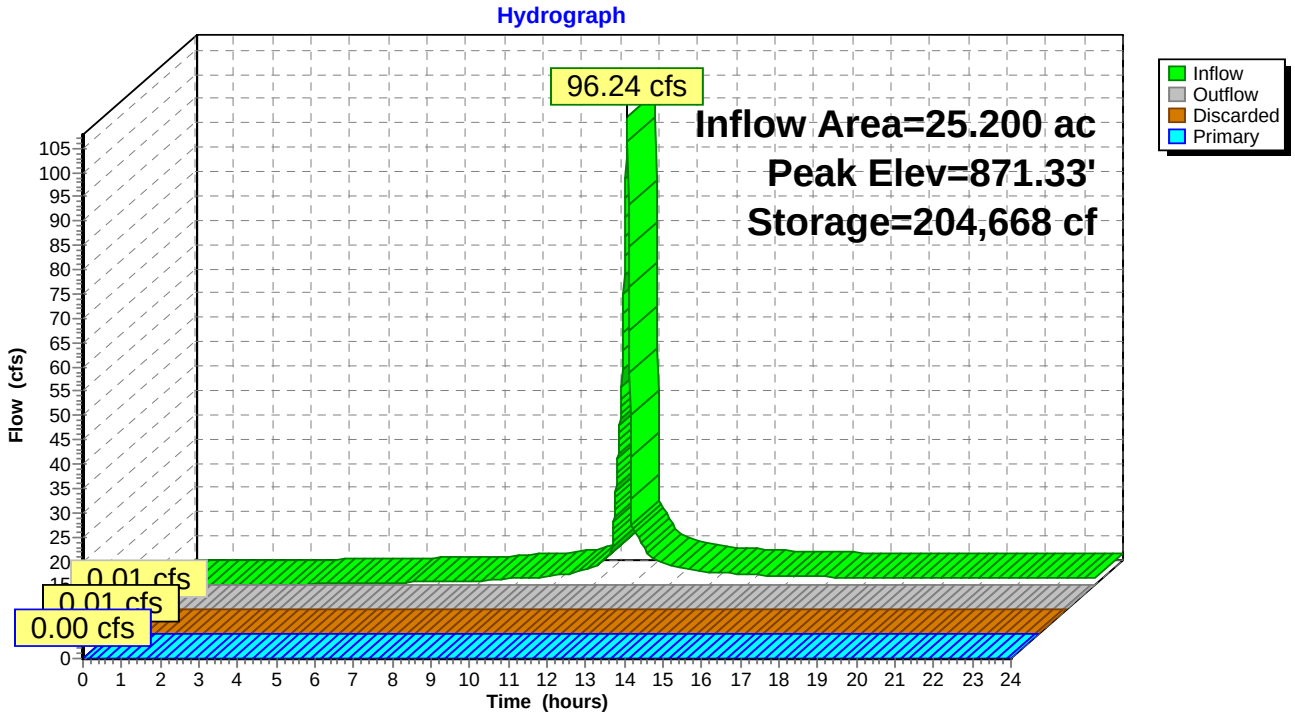
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 871.00 | 589,714 | 5,113.4 | 0 | 0 | 589,714 |
| 872.00 | 798,841 | 3,687.0 | 691,638 | 691,638 | 1,588,651 |
| 873.00 | 874,915 | 3,740.0 | 836,590 | 1,528,227 | 1,620,194 |
| 874.00 | 931,119 | 3,806.0 | 902,871 | 2,431,099 | 1,660,006 |
| 875.00 | 974,344 | 3,749.0 | 952,650 | 3,383,748 | 1,694,483 |
| 876.00 | 997,423 | 3,777.0 | 985,861 | 4,369,609 | 1,711,669 |
| 877.00 | 1,013,146 | 3,800.0 | 1,005,274 | 5,374,884 | 1,726,045 |
| 878.00 | 1,027,210 | 3,824.0 | 1,020,170 | 6,395,054 | 1,741,096 |
| 879.00 | 1,042,705 | 3,854.0 | 1,034,948 | 7,430,001 | 1,759,824 |
| 880.00 | 1,062,406 | 3,898.0 | 1,052,540 | 8,482,542 | 1,787,242 |
| 881.00 | 1,080,953 | 3,922.0 | 1,071,666 | 9,554,208 | 1,802,681 |
| 882.00 | 1,094,577 | 3,944.0 | 1,087,758 | 10,641,966 | 1,817,002 |
| 883.00 | 1,107,455 | 3,964.0 | 1,101,010 | 11,742,975 | 1,830,195 |
| 884.00 | 1,121,020 | 3,989.0 | 1,114,231 | 12,857,206 | 1,846,509 |
| 886.00 | 1,148,935 | 4,048.0 | 2,269,898 | 15,127,104 | 1,885,090 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 871.00' | **0.01 cfs Exfiltration at all elevations** |
| #2 | Primary | 880.80' | **24.0" Round CMP_Round 24"**<br>L= 15.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 880.80' / 871.40' S= 0.6267 '/' Cc= 0.900<br>n= 0.012, Flow Area= 3.14 sf |

**Discarded OutFlow** Max=0.01 cfs @ 0.01 hrs HW=871.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=871.00' TW=881.70' (Dynamic Tailwater)
↑**2=CMP_Round 24"** ( Controls 0.00 cfs)

## Pond FI: Former Impoundment



## Summary for Pond LD: Lake Delta

Inflow Area = 43.365 ac,100.00% Impervious, Inflow Depth > 2.19" for 2-yr 24hr event
Inflow = 172.77 cfs @ 11.90 hrs, Volume= 7.918 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 882.50' Surf.Area= 1,845,931 sf Storage= 922,206 cf
Peak Elev= 882.69' @ 24.00 hrs Surf.Area= 1,847,067 sf Storage= 1,267,114 cf (344,908 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

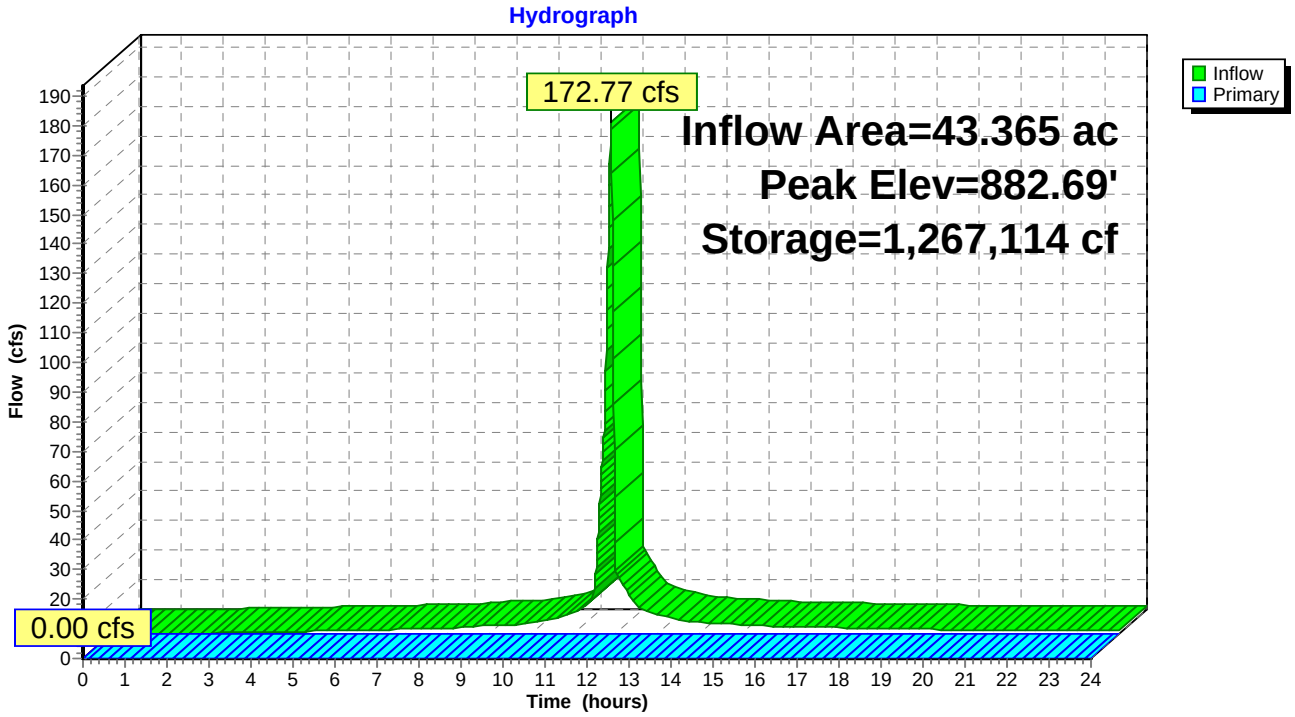
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 882.00' | 7,455,884 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 882.00 | 1,842,892 | 5,054.0 | 0 | 0 | 1,842,892 |
| 883.00 | 1,848,973 | 5,062.1 | 1,845,932 | 1,845,932 | 1,851,144 |
| 884.00 | 1,863,004 | 5,083.3 | 1,855,984 | 3,701,916 | 1,868,996 |
| 885.00 | 1,877,648 | 5,107.6 | 1,870,321 | 5,572,237 | 1,889,351 |
| 886.00 | 1,889,653 | 5,131.1 | 1,883,647 | 7,455,884 | 1,909,170 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 886.10' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>3.0' Crest Height |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=882.50' TW=881.70' (Dynamic Tailwater)
↳**1=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond LD: Lake Delta



## Summary for Pond RP: Retention Pond

Inflow Area = 32.490 ac, 14.16% Impervious, Inflow Depth > 4.82" for 2-yr 24hr event
Inflow = 20.47 cfs @ 11.91 hrs, Volume= 13.054 af
Outflow = 7.49 cfs @ 0.00 hrs, Volume= 12.327 af, Atten= 63%, Lag= 0.0 min
Primary = 7.32 cfs @ 0.00 hrs, Volume= 11.772 af
Secondary = 0.65 cfs @ 24.00 hrs, Volume= 0.555 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.80' Surf.Area= 0 sf Storage= 878,134 cf
Peak Elev= 882.03' @ 24.00 hrs Surf.Area= 0 sf Storage= 909,911 cf (31,777 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 1,298,407 cf | **Custom Stage Data** Listed below |

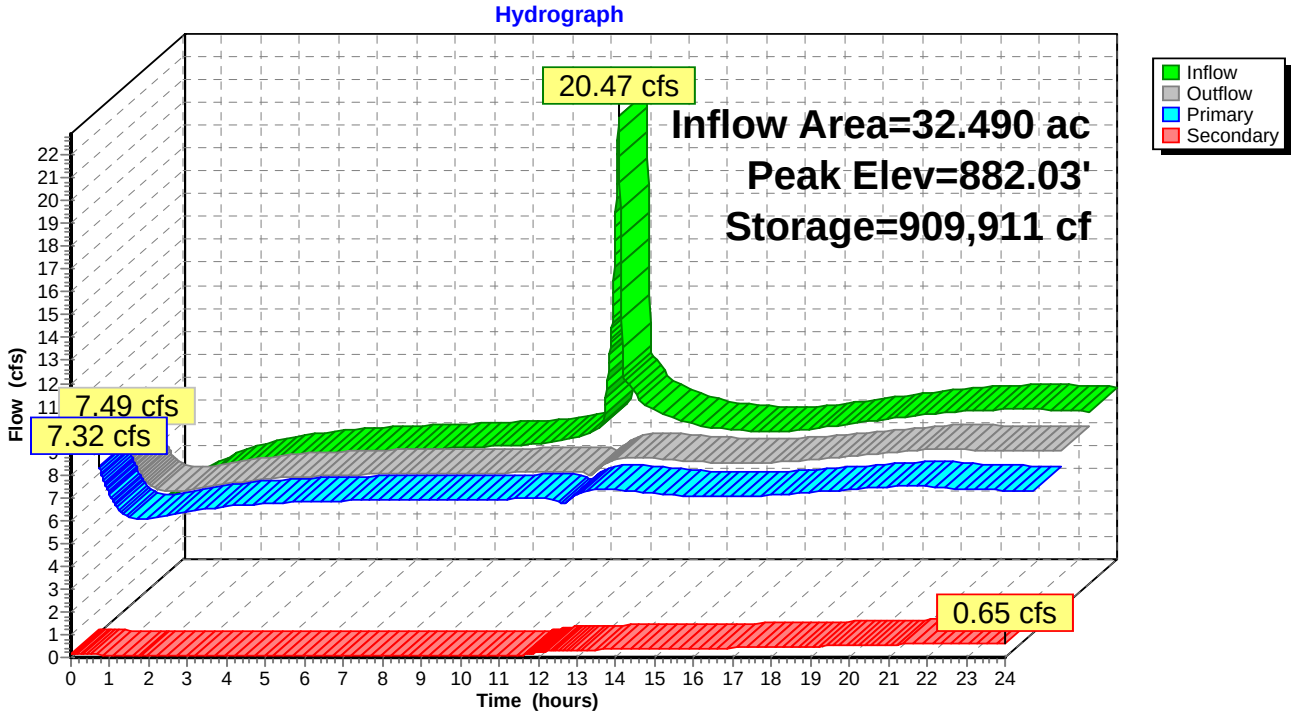
| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 20,136 |
| 872.50 | 52,477 |
| 873.00 | 85,710 |
| 873.50 | 119,843 |
| 874.00 | 154,886 |
| 874.50 | 190,848 |
| 875.00 | 227,738 |
| 875.50 | 265,563 |
| 876.00 | 304,335 |
| 876.50 | 344,061 |
| 877.00 | 384,750 |
| 877.50 | 426,412 |
| 878.00 | 469,055 |
| 878.50 | 512,689 |
| 879.00 | 554,027 |
| 879.50 | 604,982 |
| 880.00 | 662,312 |
| 880.50 | 720,757 |
| 881.00 | 780,327 |
| 881.50 | 841,028 |
| 882.00 | 902,872 |
| 882.50 | 1,030,019 |
| 883.00 | 1,095,341 |
| 883.50 | 1,161,840 |
| 884.00 | 1,161,841 |
| 884.50 | 1,229,526 |
| 885.00 | 1,298,407 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Secondary | 881.50' | **24.0" Round Culvert**<br>L= 69.8' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 881.50' / 881.50' S= 0.0000 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf |
| #2 | Primary | 874.00' | **Tube/Siphon/Float Valve** Discharges@871.40'<br>36.000" Diameter, C= 0.600<br>491.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 880.50' | **72.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=7.32 cfs @ 0.00 hrs HW=881.80' TW=881.70' (Dynamic Tailwater)
└─**2=Tube/Siphon/Float Valve** (Tube Controls 7.32 cfs @ 1.04 fps)
└─**3=Orifice/Grate** (Passes 7.32 cfs of 39.45 cfs potential flow)

**Secondary OutFlow** Max=0.65 cfs @ 24.00 hrs HW=882.03' TW=871.33' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.65 cfs @ 1.48 fps)

## Pond RP: Retention Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 5
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment Coal: Coal Pile** Runoff Area=26.000 ac 0.00% Impervious Runoff Depth>1.24"
Flow Length=1,780' Tc=629.8 min CN=79 Runoff=4.50 cfs 2.684 af

**Subcatchment CWP Subcat: Clear Water** Runoff Area=5.739 ac 62.73% Impervious Runoff Depth>3.40"
Flow Length=15' Tc=0.4 min CN=94 Runoff=37.22 cfs 1.627 af

**Subcatchment F Subcat: Forebay Surface** Runoff Area=2.760 ac 72.46% Impervious Runoff Depth>3.51"
Flow Length=15' Tc=0.4 min CN=95 Runoff=18.17 cfs 0.807 af

**Subcatchment FI Subcat: Former** Runoff Area=25.200 ac 83.33% Impervious Runoff Depth>3.62"
Flow Length=15' Tc=0.4 min CN=96 Runoff=168.02 cfs 7.600 af

**Subcatchment LD Subcat: Lake Delta** Runoff Area=1,889,000 sf 100.00% Impervious Runoff Depth>3.84"
Flow Length=15' Tc=0.4 min CN=98 Runoff=294.55 cfs 13.894 af

**Subcatchment RP Subcat: Ret Basin** Runoff Area=3.730 ac 69.71% Impervious Runoff Depth>3.40"
Flow Length=15' Tc=0.7 min CN=94 Runoff=24.24 cfs 1.058 af

**Reach HD: Hollys Drain** Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.100 L=1,500.0' S=0.0023 '/' Capacity=88.54 cfs Outflow=0.00 cfs 0.000 af

**Reach Wetlands: Wetlands** Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

**Pond CSP: Coal Sump Pump** Peak Elev=1,834.01' Inflow=4.50 cfs 2.684 af
6.0" Round Culvert n=0.012 L=1,700.0' S=0.0008 '/' Outflow=4.50 cfs 2.684 af

**Pond CWP: Clear Water Pond** Peak Elev=882.21' Storage=1,326,000 cf Inflow=42.68 cfs 13.584 af
Primary=5.88 cfs 11.671 af Secondary=0.00 cfs 0.000 af Outflow=5.88 cfs 11.671 af

**Pond ES: Erickson Power Station** Inflow=5.88 cfs 11.671 af
Primary=5.88 cfs 11.671 af

**Pond F: Forebay** Peak Elev=883.42' Storage=876,482 cf Inflow=24.06 cfs 15.159 af
Outflow=10.25 cfs 14.281 af

**Pond FI: Former Impoundment** Peak Elev=871.58' Storage=378,509 cf Inflow=168.41 cfs 8.710 af
Discarded=0.01 cfs 0.020 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.020 af

**Pond LD: Lake Delta** Peak Elev=882.83' Storage=1,527,414 cf Inflow=294.55 cfs 13.894 af
Outflow=0.00 cfs 0.000 af

**Pond RP: Retention Pond** Peak Elev=882.29' Storage=977,220 cf Inflow=32.41 cfs 15.339 af
Primary=7.32 cfs 11.957 af Secondary=1.58 cfs 1.110 af Outflow=8.42 cfs 13.066 af

**Total Runoff Area = 106.794 ac Runoff Volume = 27.671 af Average Runoff Depth = 3.11"**
**32.05% Pervious = 34.229 ac 67.95% Impervious = 72.565 ac**

## Summary for Subcatchment Coal: Coal Pile

Information from MD & E

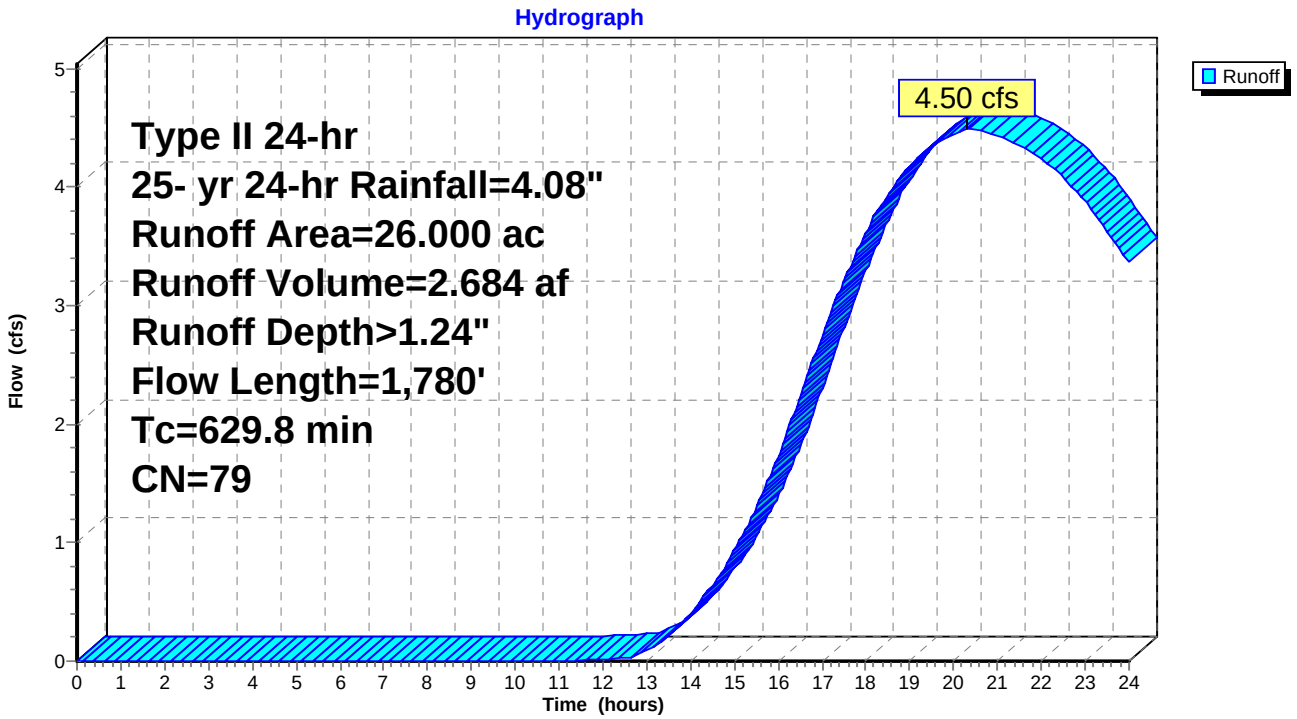
Runoff = 4.50 cfs @ 20.30 hrs, Volume= 2.684 af, Depth> 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25- yr 24-hr Rainfall=4.08"

| Area (ac) | CN | Description |
|---|---|---|
| 26.000 | 79 | Pasture/grassland/range, Poor, HSG B |
| 26.000 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 629.8 | 1,780 | | 0.05 | | **Direct Entry, Coal Pile Runoff** |

### Subcatchment Coal: Coal Pile



## Summary for Subcatchment CWP Subcat: Clear Water Pond Surface

[49] Hint: Tc<2dt may require smaller dt

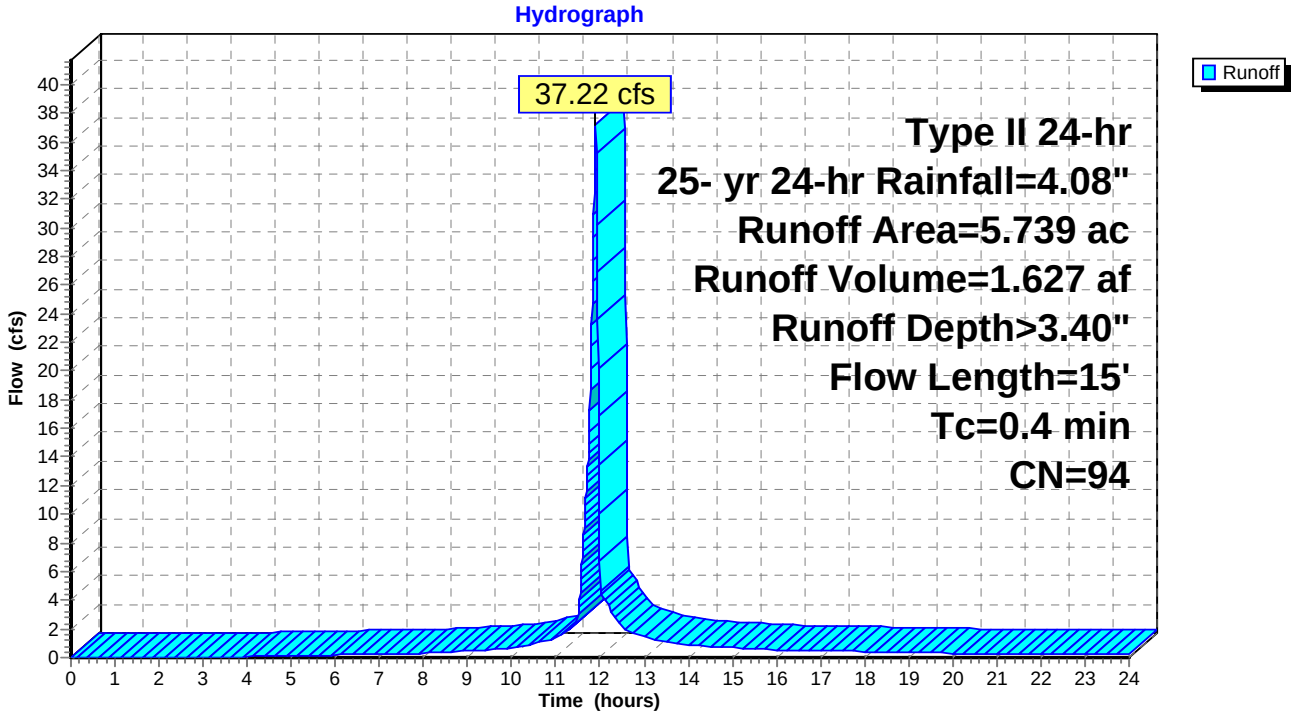
Runoff = 37.22 cfs @ 11.90 hrs, Volume= 1.627 af, Depth> 3.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25- yr 24-hr Rainfall=4.08"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 3.600 | 98 | |
| | 2.139 | 86 | Fallow, bare soil, HSG B |
| | 5.739 | 94 | Weighted Average |
| | 2.139 | | 37.27% Pervious Area |
| | 3.600 | | 62.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Clear Water Pond Subcat** |

## Subcatchment CWP Subcat: Clear Water Pond Surface



## Summary for Subcatchment F Subcat: Forebay Surface

[49] Hint: Tc<2dt may require smaller dt

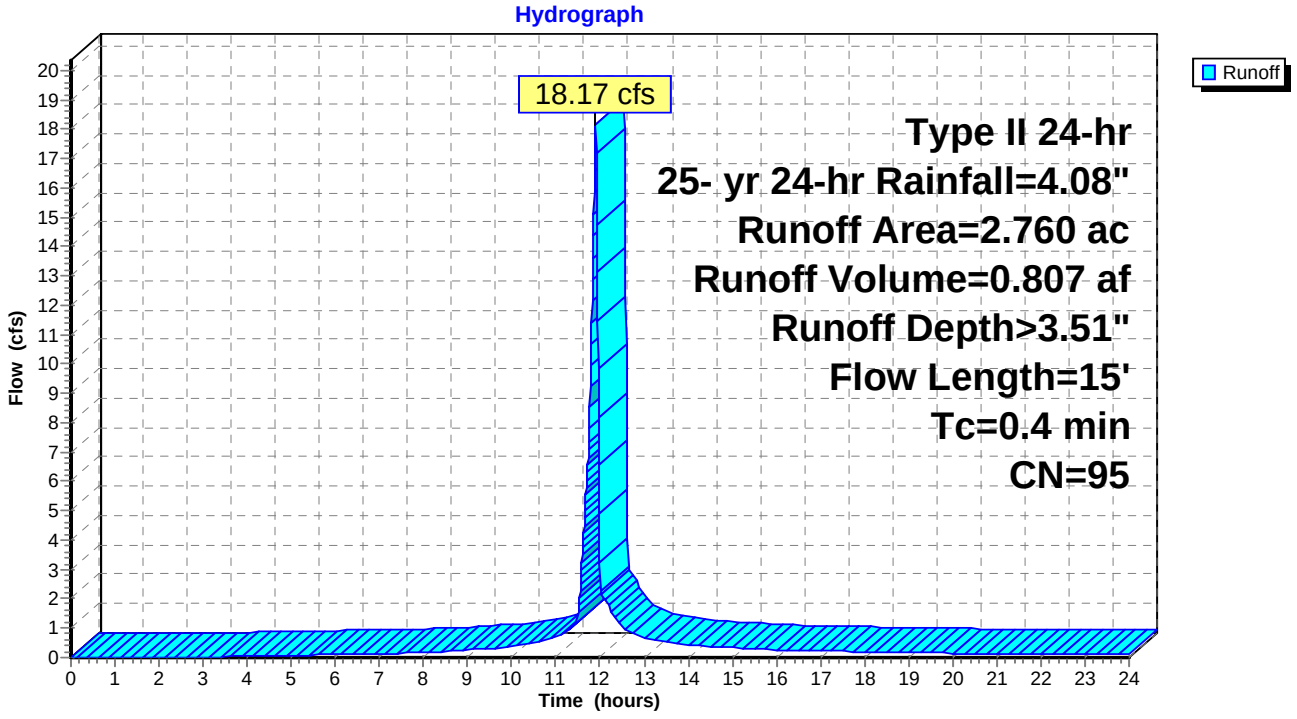
Runoff = 18.17 cfs @ 11.90 hrs, Volume= 0.807 af, Depth> 3.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25- yr 24-hr Rainfall=4.08"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.000 | 98 | |
| | 0.760 | 86 | Fallow, bare soil, HSG B |
| | 2.760 | 95 | Weighted Average |
| | 0.760 | | 27.54% Pervious Area |
| | 2.000 | | 72.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Forebay Surface** |

### Subcatchment F Subcat: Forebay Surface



## Summary for Subcatchment FI Subcat: Former Impoundment Surface

[49] Hint: Tc<2dt may require smaller dt

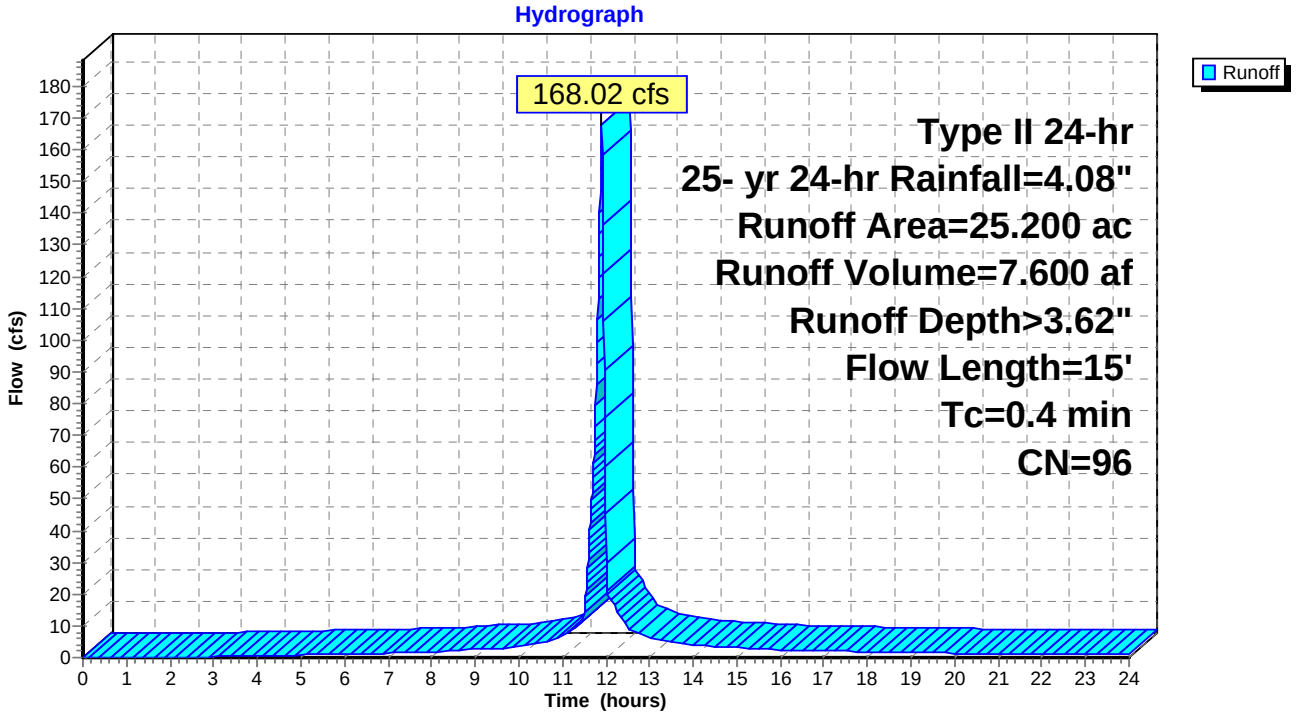
Runoff = 168.02 cfs @ 11.90 hrs, Volume= 7.600 af, Depth> 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25- yr 24-hr Rainfall=4.08"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 21.000 | 98 | |
| | 4.200 | 86 | Fallow, bare soil, HSG B |
| | 25.200 | 96 | Weighted Average |
| | 4.200 | | 16.67% Pervious Area |
| | 21.000 | | 83.33% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, OAI Subcat** |

## Subcatchment FI Subcat: Former Impoundment Surface



## Summary for Subcatchment LD Subcat: Lake Delta

[49] Hint: Tc<2dt may require smaller dt

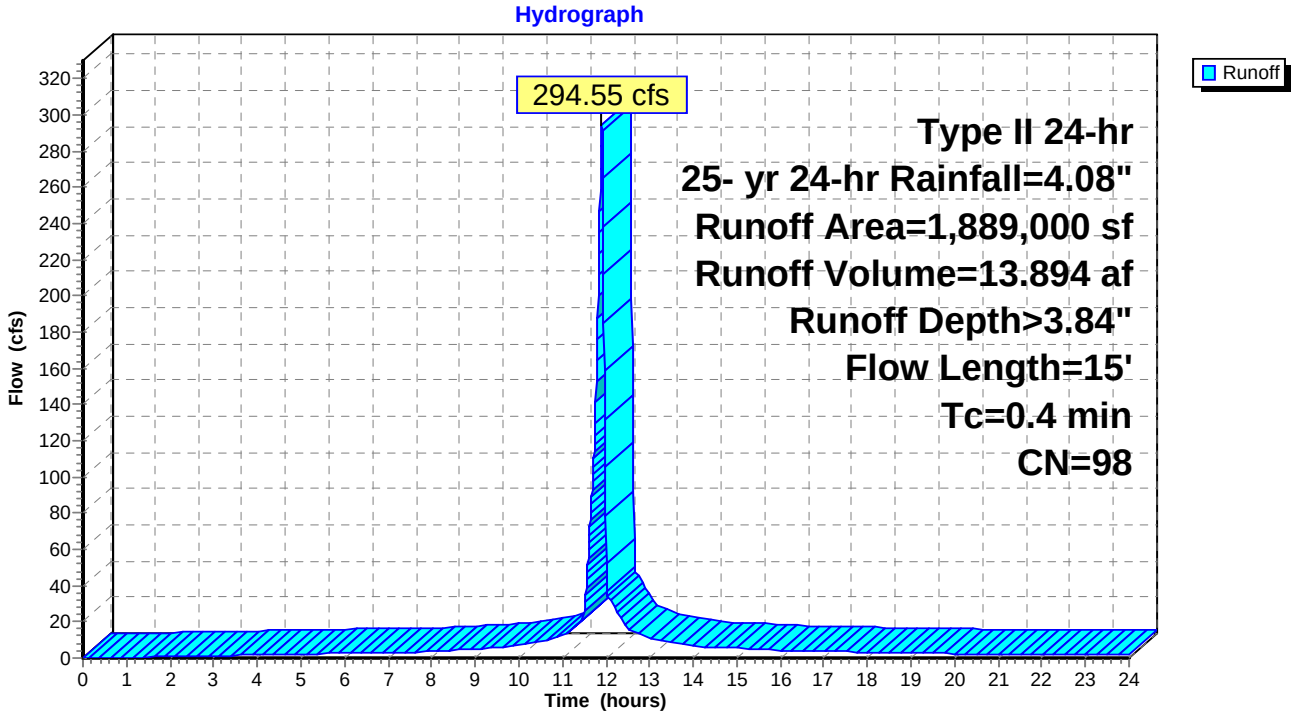
Runoff = 294.55 cfs @ 11.90 hrs, Volume= 13.894 af, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25- yr 24-hr Rainfall=4.08"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,889,000 | 98 | |
| | 1,889,000 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry,** |

### Subcatchment LD Subcat: Lake Delta



## Summary for Subcatchment RP Subcat: Ret Basin Surface

[49] Hint: Tc<2dt may require smaller dt

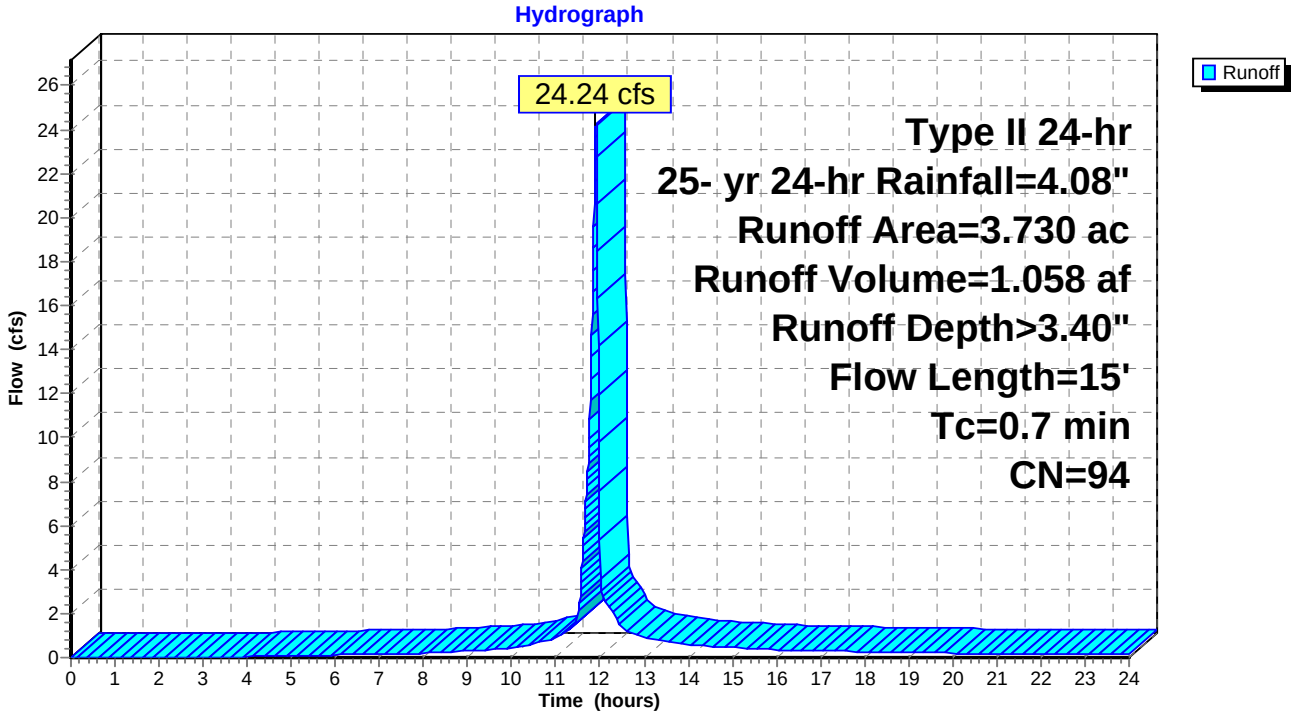
Runoff = 24.24 cfs @ 11.91 hrs, Volume= 1.058 af, Depth> 3.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 25- yr 24-hr Rainfall=4.08"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.600 | 98 | |
| | 1.130 | 86 | Fallow, bare soil, HSG B |
| | 3.730 | 94 | Weighted Average |
| | 1.130 | | 30.29% Pervious Area |
| | 2.600 | | 69.71% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.7 | 15 | | 0.36 | | **Direct Entry, Ret Basin Surface** |

## Subcatchment RP Subcat: Ret Basin Surface



## Summary for Reach HD: Hollys Drain

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

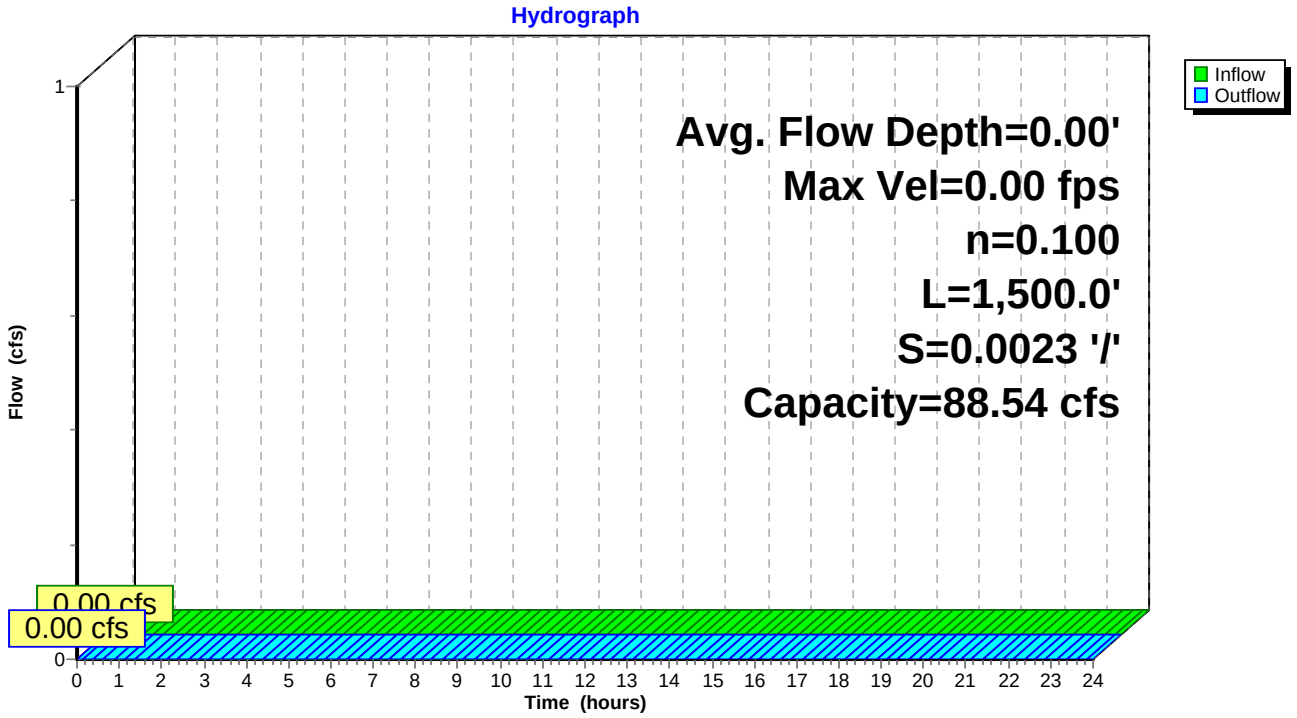
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00' Flow Area= 72.0 sf, Capacity= 88.54 cfs

18.00' x 3.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 '/' Top Width= 30.00'
Length= 1,500.0' Slope= 0.0023 '/'
Inlet Invert= 874.90', Outlet Invert= 871.50'

‡

## Reach HD: Hollys Drain



## Summary for Reach Wetlands: Wetlands

No flow reaches this point

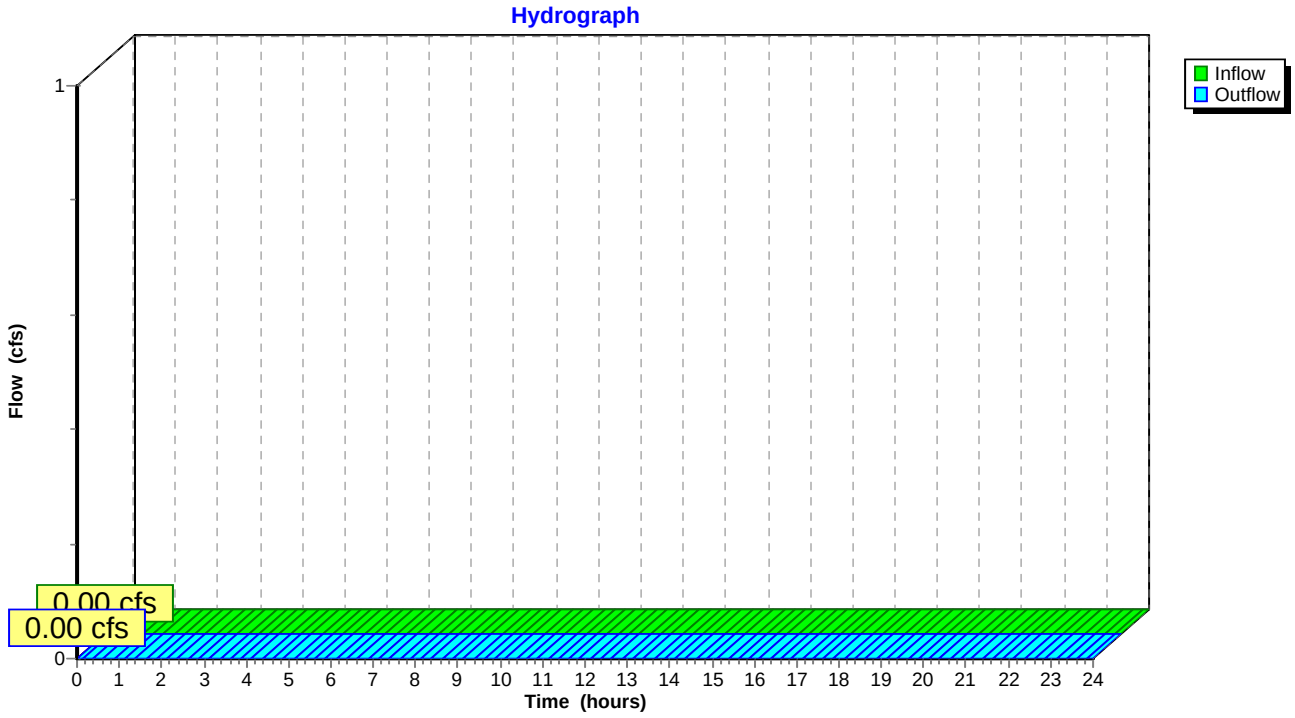
---

[40] Hint: Not Described (Outflow=Inflow)

| | | | | | |
|---|---|---|---|---|---|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Reach Wetlands: Wetlands



## Summary for Pond CSP: Coal Sump Pump

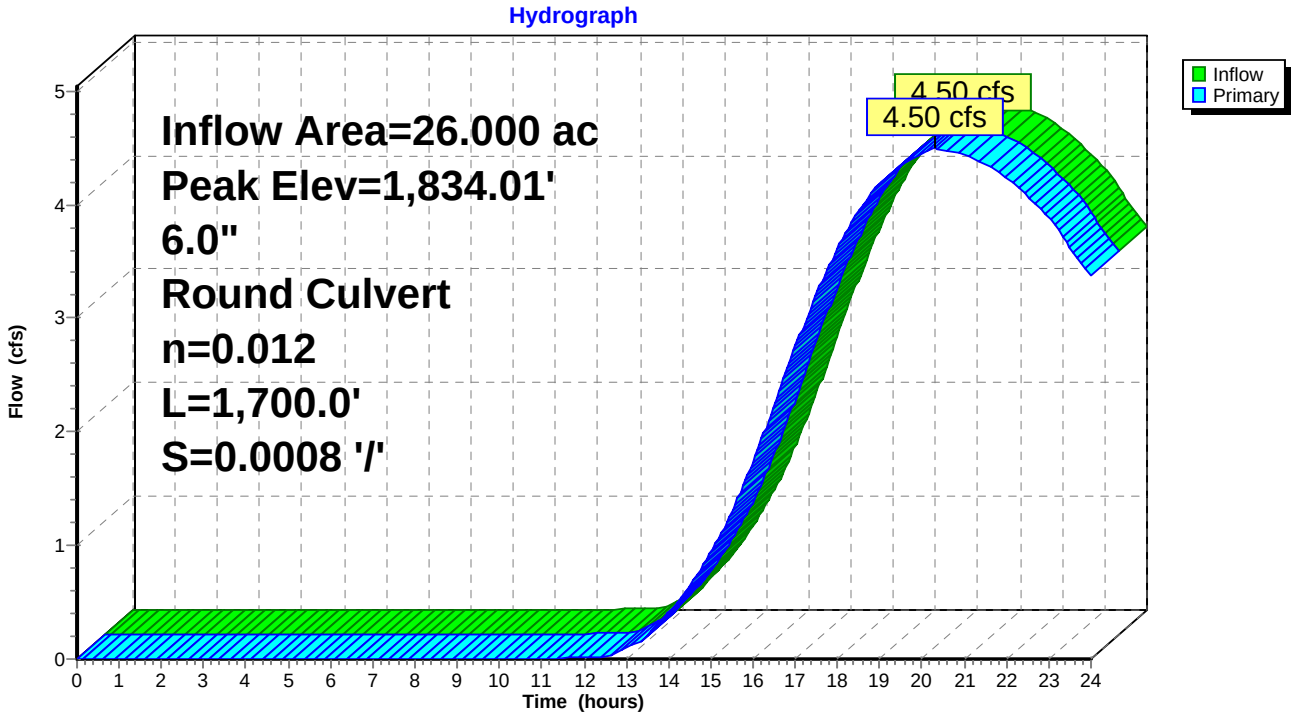
Inflow Area = 26.000 ac, 0.00% Impervious, Inflow Depth > 1.24" for 25- yr 24-hr event
Inflow = 4.50 cfs @ 20.30 hrs, Volume= 2.684 af
Outflow = 4.50 cfs @ 20.30 hrs, Volume= 2.684 af, Atten= 0%, Lag= 0.1 min
Primary = 4.50 cfs @ 20.30 hrs, Volume= 2.684 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 1,834.01' @ 20.30 hrs
Flood Elev= 3,000.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 883.00' | **6.0" Round Culvert**<br>L= 1,700.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 883.00' / 881.60' S= 0.0008 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.20 sf |

**Primary OutFlow** Max=4.50 cfs @ 20.30 hrs HW=1,833.95' TW=883.40' (Dynamic Tailwater)
└**1=Culvert** (Outlet Controls 4.50 cfs @ 22.93 fps)

## Pond CSP: Coal Sump Pump



## Summary for Pond CWP: Clear Water Pond

[80] Warning: Exceeded Pond Fl by 10.71' @ 0.31 hrs (3.53 cfs 9.596 af)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.53" for 25- yr 24-hr event
Inflow = 42.68 cfs @ 11.90 hrs, Volume= 13.584 af
Outflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 86%, Lag= 0.0 min
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.70' Surf.Area= 163,599 sf Storage= 1,242,582 cf
Peak Elev= 882.21' @ 24.00 hrs Surf.Area= 166,592 sf Storage= 1,326,000 cf (83,419 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 870.00' | 2,000,903 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

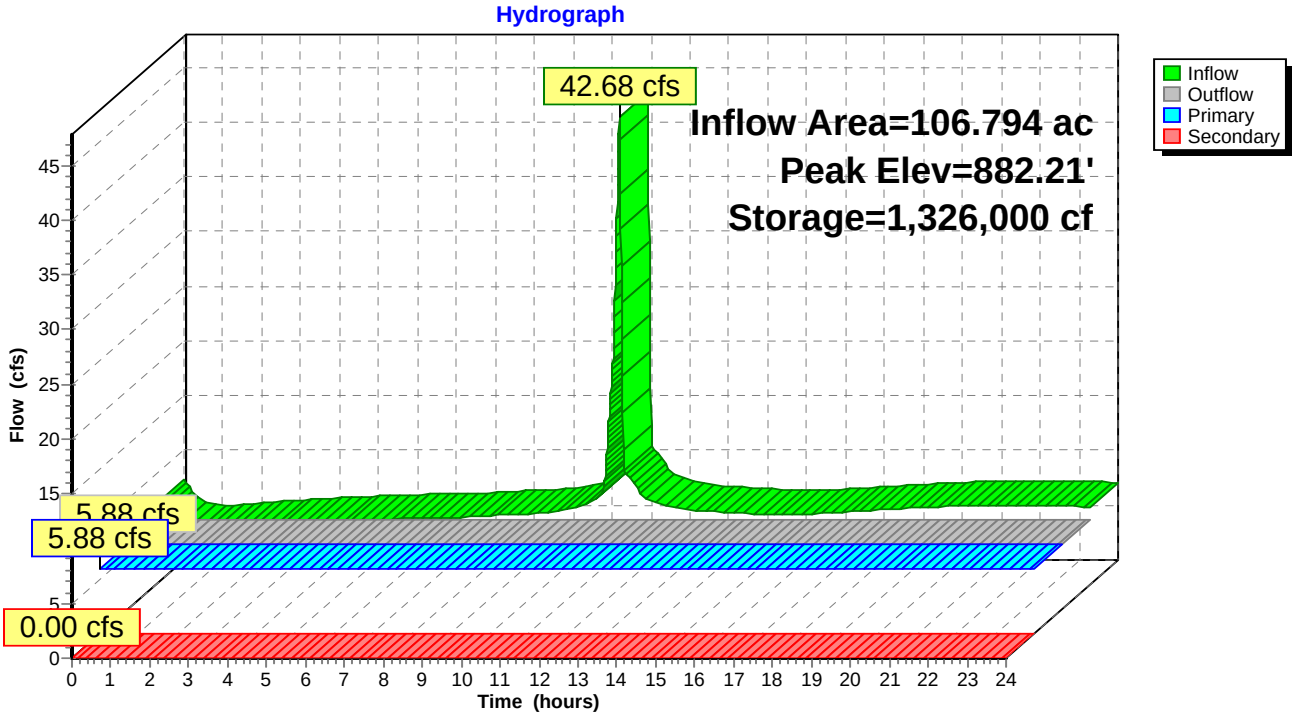
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 870.00 | 38,520 | 825.0 | 0 | 0 | 38,520 |
| 873.00 | 68,125 | 1,325.0 | 157,872 | 157,872 | 124,127 |
| 874.00 | 72,131 | 1,433.2 | 70,118 | 227,990 | 147,915 |
| 875.00 | 98,274 | 1,367.7 | 84,866 | 312,856 | 162,582 |
| 876.00 | 116,945 | 1,983.7 | 107,474 | 420,331 | 326,875 |
| 877.00 | 131,376 | 1,724.1 | 124,091 | 544,421 | 403,494 |
| 878.00 | 139,814 | 1,693.0 | 135,573 | 679,994 | 412,122 |
| 879.00 | 146,808 | 1,706.5 | 143,297 | 823,291 | 416,150 |
| 880.00 | 153,167 | 1,730.0 | 149,976 | 973,267 | 422,802 |
| 881.00 | 159,394 | 1,754.5 | 156,270 | 1,129,538 | 429,816 |
| 882.00 | 165,418 | 1,777.3 | 162,397 | 1,291,934 | 436,463 |
| 883.00 | 171,176 | 1,796.5 | 168,289 | 1,460,223 | 442,208 |
| 884.00 | 177,068 | 1,818.2 | 174,114 | 1,634,337 | 448,706 |
| 885.00 | 183,257 | 1,842.6 | 180,154 | 1,814,490 | 456,046 |
| 886.00 | 189,586 | 1,885.9 | 186,413 | 2,000,903 | 469,028 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 870.60' | **Pump**<br>Discharges@880.00' Turns Off@870.10'<br>36.0" Diam. x 2,900.0' Long Discharge, Hazen-Williams C= 130<br>Flow (gpm)= 2,640.0<br>Head (feet)= 50.00<br>-Loss (feet)= 0.21<br>=Lift (feet)= 49.79 |
| #2 | Secondary | 875.90' | **Tube/Siphon/Float Valve** Discharges@872.80'<br>36.000" Diameter, C= 0.600<br>62.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 883.60' | **36.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=5.88 cfs @ 0.00 hrs HW=881.70' TW=0.00' (Dynamic Tailwater)
└**1=Pump** (Pump Controls 5.88 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=881.70' TW=874.90' (Dynamic Tailwater)
└**2=Tube/Siphon/Float Valve** (Passes 0.00 cfs of 84.57 cfs potential flow)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond CWP: Clear Water Pond



## Summary for Pond ES: Erickson Power Station

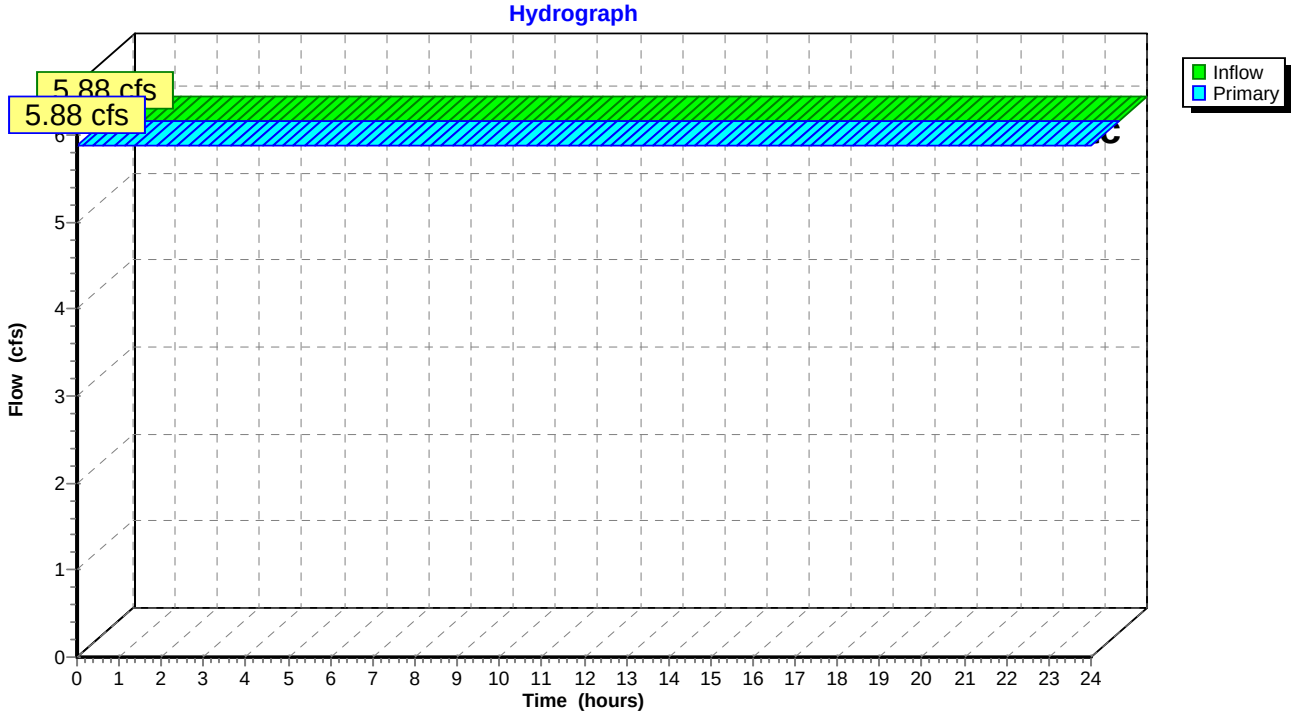
Shows flow back to Power Station

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.31" for 25- yr 24-hr event
Inflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Pond ES: Erickson Power Station



## Summary for Pond F: Forebay

[80] Warning: Exceeded Pond CSP by 0.19' @ 9.79 hrs (0.01 cfs 0.006 af)

Inflow Area = 28.760 ac, 6.95% Impervious, Inflow Depth > 6.32" for 25- yr 24-hr event
Inflow = 24.06 cfs @ 11.90 hrs, Volume= 15.159 af, Incl. 5.88 cfs Base Flow
Outflow = 10.25 cfs @ 21.79 hrs, Volume= 14.281 af, Atten= 57%, Lag= 593.0 min
Primary = 10.25 cfs @ 21.79 hrs, Volume= 14.281 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 883.00' Surf.Area= 0 sf Storage= 836,526 cf
Peak Elev= 883.42' @ 22.01 hrs Surf.Area= 0 sf Storage= 876,482 cf (39,956 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 15.9 min ( 822.2 - 806.3 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 932,837 cf | **Custom Stage Data** Listed below |

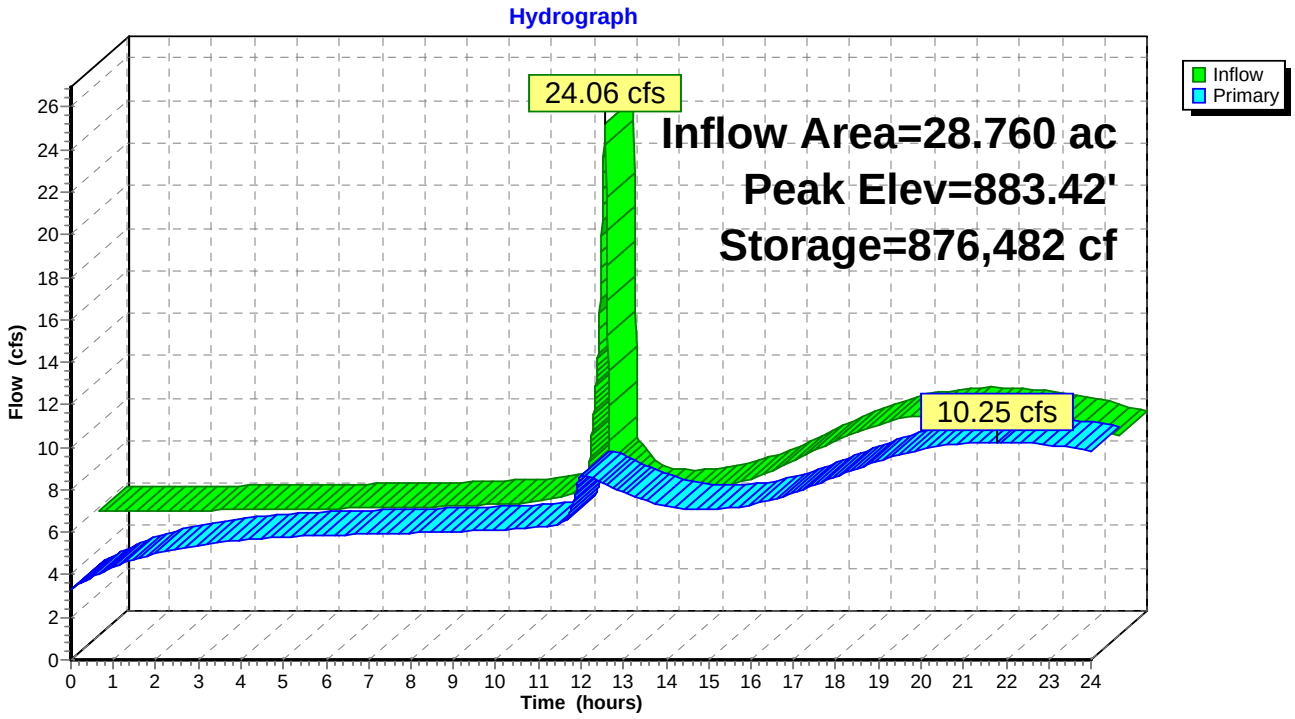
| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 14,201 |
| 872.50 | 42,819 |
| 873.00 | 72,222 |
| 873.50 | 102,366 |
| 874.00 | 133,337 |
| 874.50 | 165,092 |
| 875.00 | 197,675 |
| 875.50 | 231,086 |
| 876.00 | 265,324 |
| 876.50 | 300,433 |
| 877.00 | 336,327 |
| 877.50 | 373,135 |
| 878.00 | 410,771 |
| 878.50 | 449,278 |
| 879.00 | 488,700 |
| 879.50 | 528,949 |
| 880.00 | 570,157 |
| 880.50 | 612,236 |
| 881.00 | 655,230 |
| 881.50 | 699,138 |
| 882.00 | 744,005 |
| 882.50 | 789,786 |
| 883.00 | 836,526 |
| 883.50 | 884,181 |
| 884.00 | 932,837 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 882.40' | **24.0" Round CMP_Round 24" (West)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.40' / 881.60' S= 0.0140 '/' Cc= 0.900 |

| | | | |
|---|---|---|---|
| | | | n= 0.025, Flow Area= 3.14 sf |
| #2 | Primary | 882.50' | **24.0" Round CMP_Round 24" (Center)** |
| | | | L= 57.3' CPP, projecting, no headwall, Ke= 0.900 |
| | | | Inlet / Outlet Invert= 882.50' / 881.40' S= 0.0192 '/' Cc= 0.900 |
| | | | n= 0.025, Flow Area= 3.14 sf |
| #3 | Primary | 882.60' | **24.0" Round CMP_Round 24" (East)** |
| | | | L= 57.3' CPP, projecting, no headwall, Ke= 0.900 |
| | | | Inlet / Outlet Invert= 882.60' / 881.70' S= 0.0157 '/' Cc= 0.900 |
| | | | n= 0.025, Flow Area= 3.14 sf |

**Primary OutFlow** Max=10.25 cfs @ 21.79 hrs HW=883.42' TW=882.23' (Dynamic Tailwater)
- **1=CMP_Round 24" (West)** (Barrel Controls 3.95 cfs @ 3.58 fps)
- **2=CMP_Round 24" (Center)** (Outlet Controls 3.52 cfs @ 3.67 fps)
- **3=CMP_Round 24" (East)** (Barrel Controls 2.78 cfs @ 3.39 fps)

## Pond F: Forebay



## Summary for Pond FI: Former Impoundment

Evaporation losses are smaller than HydroCAD will allow

Inflow Area = 25.200 ac, 83.33% Impervious, Inflow Depth > 4.15" for 25- yr 24-hr event
Inflow = 168.41 cfs @ 11.90 hrs, Volume= 8.710 af
Outflow = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af, Atten= 100%, Lag= 0.0 min
Discarded = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 871.58' @ 24.00 hrs Surf.Area= 708,027 sf Storage= 378,509 cf

Plug-Flow detention time= 666.1 min calculated for 0.020 af (0% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.00' | 15,127,104 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

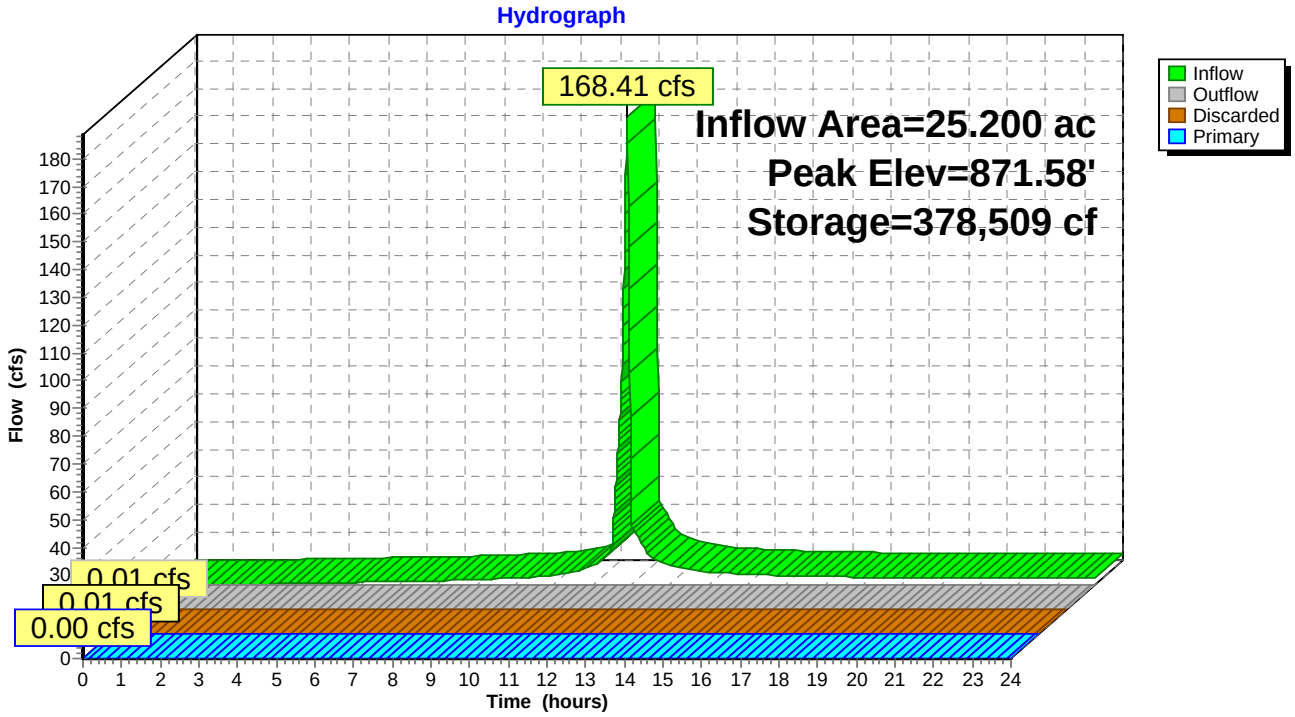
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 871.00 | 589,714 | 5,113.4 | 0 | 0 | 589,714 |
| 872.00 | 798,841 | 3,687.0 | 691,638 | 691,638 | 1,588,651 |
| 873.00 | 874,915 | 3,740.0 | 836,590 | 1,528,227 | 1,620,194 |
| 874.00 | 931,119 | 3,806.0 | 902,871 | 2,431,099 | 1,660,006 |
| 875.00 | 974,344 | 3,749.0 | 952,650 | 3,383,748 | 1,694,483 |
| 876.00 | 997,423 | 3,777.0 | 985,861 | 4,369,609 | 1,711,669 |
| 877.00 | 1,013,146 | 3,800.0 | 1,005,274 | 5,374,884 | 1,726,045 |
| 878.00 | 1,027,210 | 3,824.0 | 1,020,170 | 6,395,054 | 1,741,096 |
| 879.00 | 1,042,705 | 3,854.0 | 1,034,948 | 7,430,001 | 1,759,824 |
| 880.00 | 1,062,406 | 3,898.0 | 1,052,540 | 8,482,542 | 1,787,242 |
| 881.00 | 1,080,953 | 3,922.0 | 1,071,666 | 9,554,208 | 1,802,681 |
| 882.00 | 1,094,577 | 3,944.0 | 1,087,758 | 10,641,966 | 1,817,002 |
| 883.00 | 1,107,455 | 3,964.0 | 1,101,010 | 11,742,975 | 1,830,195 |
| 884.00 | 1,121,020 | 3,989.0 | 1,114,231 | 12,857,206 | 1,846,509 |
| 886.00 | 1,148,935 | 4,048.0 | 2,269,898 | 15,127,104 | 1,885,090 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 871.00' | **0.01 cfs Exfiltration at all elevations** |
| #2 | Primary | 880.80' | **24.0" Round CMP_Round 24"**<br>L= 15.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 880.80' / 871.40' S= 0.6267 '/' Cc= 0.900<br>n= 0.012, Flow Area= 3.14 sf |

**Discarded OutFlow** Max=0.01 cfs @ 0.01 hrs HW=871.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=871.00' TW=881.70' (Dynamic Tailwater)
↑**2=CMP_Round 24"** ( Controls 0.00 cfs)

## Pond FI: Former Impoundment



## Summary for Pond LD: Lake Delta

Inflow Area = 43.365 ac,100.00% Impervious, Inflow Depth > 3.84" for 25- yr 24-hr event
Inflow = 294.55 cfs @ 11.90 hrs, Volume= 13.894 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 882.50' Surf.Area= 1,845,931 sf Storage= 922,206 cf
Peak Elev= 882.83' @ 24.00 hrs Surf.Area= 1,847,924 sf Storage= 1,527,414 cf (605,209 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

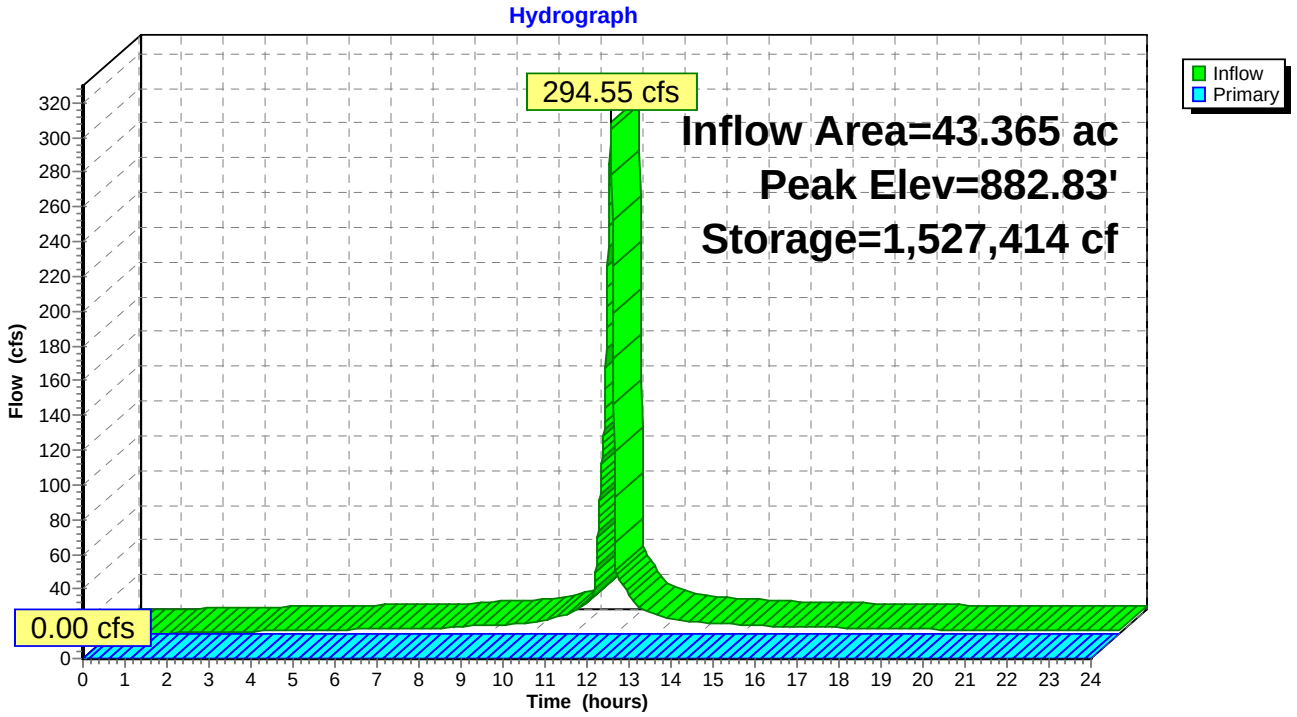
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 882.00' | 7,455,884 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 882.00 | 1,842,892 | 5,054.0 | 0 | 0 | 1,842,892 |
| 883.00 | 1,848,973 | 5,062.1 | 1,845,932 | 1,845,932 | 1,851,144 |
| 884.00 | 1,863,004 | 5,083.3 | 1,855,984 | 3,701,916 | 1,868,996 |
| 885.00 | 1,877,648 | 5,107.6 | 1,870,321 | 5,572,237 | 1,889,351 |
| 886.00 | 1,889,653 | 5,131.1 | 1,883,647 | 7,455,884 | 1,909,170 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 886.10' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>3.0' Crest Height |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=882.50' TW=881.70' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond LD: Lake Delta



## Summary for Pond RP: Retention Pond

Inflow Area = 32.490 ac, 14.16% Impervious, Inflow Depth > 5.67" for 25- yr 24-hr event
Inflow = 32.41 cfs @ 11.91 hrs, Volume= 15.339 af
Outflow = 8.42 cfs @ 23.39 hrs, Volume= 13.066 af, Atten= 74%, Lag= 689.0 min
Primary = 7.32 cfs @ 0.00 hrs, Volume= 11.957 af
Secondary = 1.58 cfs @ 24.00 hrs, Volume= 1.110 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.80' Surf.Area= 0 sf Storage= 878,134 cf
Peak Elev= 882.29' @ 24.00 hrs Surf.Area= 0 sf Storage= 977,220 cf (99,085 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 1,298,407 cf | **Custom Stage Data** Listed below |

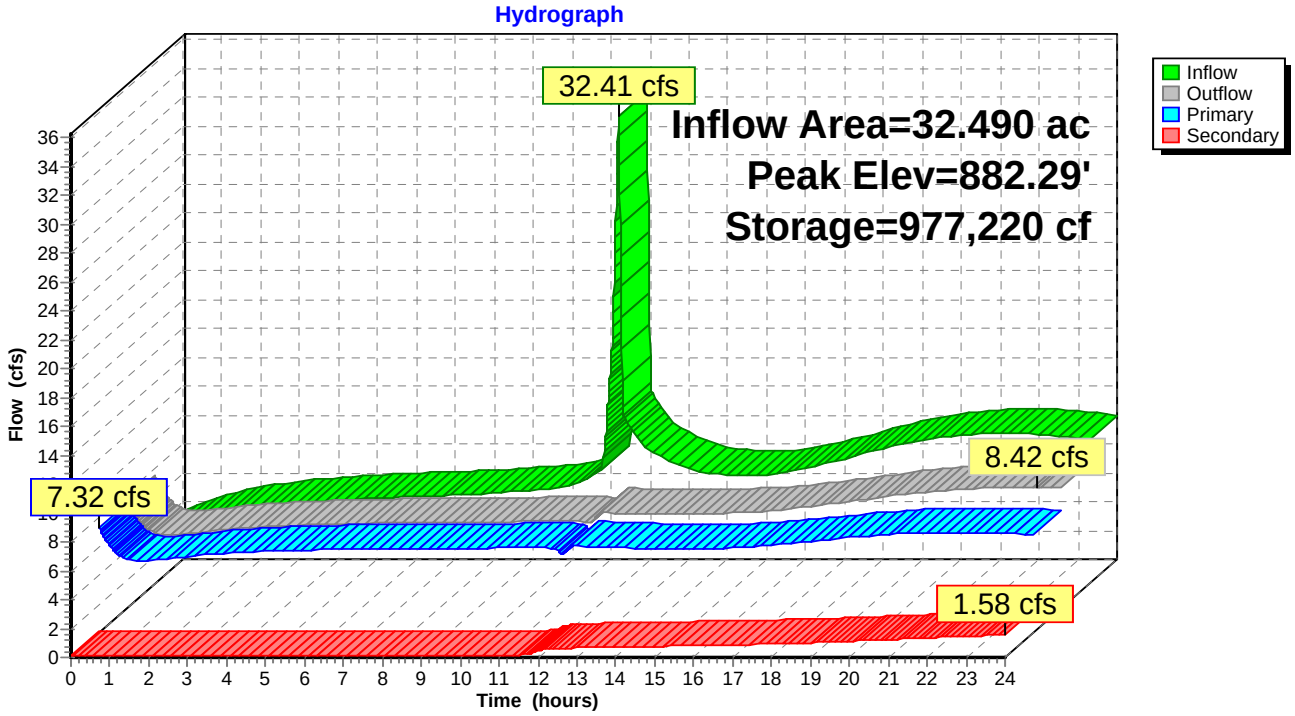
| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 20,136 |
| 872.50 | 52,477 |
| 873.00 | 85,710 |
| 873.50 | 119,843 |
| 874.00 | 154,886 |
| 874.50 | 190,848 |
| 875.00 | 227,738 |
| 875.50 | 265,563 |
| 876.00 | 304,335 |
| 876.50 | 344,061 |
| 877.00 | 384,750 |
| 877.50 | 426,412 |
| 878.00 | 469,055 |
| 878.50 | 512,689 |
| 879.00 | 554,027 |
| 879.50 | 604,982 |
| 880.00 | 662,312 |
| 880.50 | 720,757 |
| 881.00 | 780,327 |
| 881.50 | 841,028 |
| 882.00 | 902,872 |
| 882.50 | 1,030,019 |
| 883.00 | 1,095,341 |
| 883.50 | 1,161,840 |
| 884.00 | 1,161,841 |
| 884.50 | 1,229,526 |
| 885.00 | 1,298,407 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Secondary | 881.50' | **24.0" Round Culvert**<br>L= 69.8' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 881.50' / 881.50' S= 0.0000 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf |
| #2 | Primary | 874.00' | **Tube/Siphon/Float Valve** Discharges@871.40'<br>36.000" Diameter, C= 0.600<br>491.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 880.50' | **72.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=7.32 cfs @ 0.00 hrs HW=881.80' TW=881.70' (Dynamic Tailwater)
└─**2=Tube/Siphon/Float Valve** (Tube Controls 7.32 cfs @ 1.04 fps)
└─**3=Orifice/Grate** (Passes 7.32 cfs of 39.45 cfs potential flow)

**Secondary OutFlow** Max=1.58 cfs @ 24.00 hrs HW=882.29' TW=871.58' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 1.58 cfs @ 2.01 fps)

## Pond RP: Retention Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 5
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment Coal: Coal Pile** Runoff Area=26.000 ac 0.00% Impervious Runoff Depth>1.57"
Flow Length=1,780' Tc=629.8 min CN=79 Runoff=5.69 cfs 3.409 af

**Subcatchment CWP Subcat: Clear Water** Runoff Area=5.739 ac 62.73% Impervious Runoff Depth>4.01"
Flow Length=15' Tc=0.4 min CN=94 Runoff=43.36 cfs 1.919 af

**Subcatchment F Subcat: Forebay Surface** Runoff Area=2.760 ac 72.46% Impervious Runoff Depth>4.12"
Flow Length=15' Tc=0.4 min CN=95 Runoff=21.10 cfs 0.948 af

**Subcatchment FI Subcat: Former** Runoff Area=25.200 ac 83.33% Impervious Runoff Depth>4.23"
Flow Length=15' Tc=0.4 min CN=96 Runoff=194.65 cfs 8.892 af

**Subcatchment LD Subcat: Lake Delta** Runoff Area=1,889,000 sf 100.00% Impervious Runoff Depth>4.46"
Flow Length=15' Tc=0.4 min CN=98 Runoff=339.86 cfs 16.130 af

**Subcatchment RP Subcat: Ret Basin** Runoff Area=3.730 ac 69.71% Impervious Runoff Depth>4.01"
Flow Length=15' Tc=0.7 min CN=94 Runoff=28.24 cfs 1.247 af

**Reach HD: Hollys Drain** Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.100 L=1,500.0' S=0.0023 '/' Capacity=88.54 cfs Outflow=0.00 cfs 0.000 af

**Reach Wetlands: Wetlands** Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

**Pond CSP: Coal Sump Pump** Peak Elev=2,401.17' Inflow=5.69 cfs 3.409 af
6.0" Round Culvert n=0.012 L=1,700.0' S=0.0008 '/' Outflow=5.69 cfs 3.409 af

**Pond CWP: Clear Water Pond** Peak Elev=882.30' Storage=1,342,300 cf Inflow=48.77 cfs 13.958 af
Primary=5.88 cfs 11.671 af Secondary=0.00 cfs 0.000 af Outflow=5.88 cfs 11.671 af

**Pond ES: Erickson Power Station** Inflow=5.88 cfs 11.671 af
Primary=5.88 cfs 11.671 af

**Pond F: Forebay** Peak Elev=883.48' Storage=882,100 cf Inflow=27.01 cfs 16.025 af
Outflow=11.40 cfs 15.028 af

**Pond FI: Former Impoundment** Peak Elev=871.68' Storage=445,747 cf Inflow=195.14 cfs 10.254 af
Discarded=0.01 cfs 0.020 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.020 af

**Pond LD: Lake Delta** Peak Elev=882.88' Storage=1,624,809 cf Inflow=339.86 cfs 16.130 af
Outflow=0.00 cfs 0.000 af

**Pond RP: Retention Pond** Peak Elev=882.40' Storage=1,003,417 cf Inflow=36.84 cfs 16.275 af
Primary=7.32 cfs 12.039 af Secondary=2.03 cfs 1.362 af Outflow=9.10 cfs 13.401 af

**Total Runoff Area = 106.794 ac Runoff Volume = 32.546 af Average Runoff Depth = 3.66"**
**32.05% Pervious = 34.229 ac 67.95% Impervious = 72.565 ac**

## Summary for Subcatchment Coal: Coal Pile

Information from MD & E

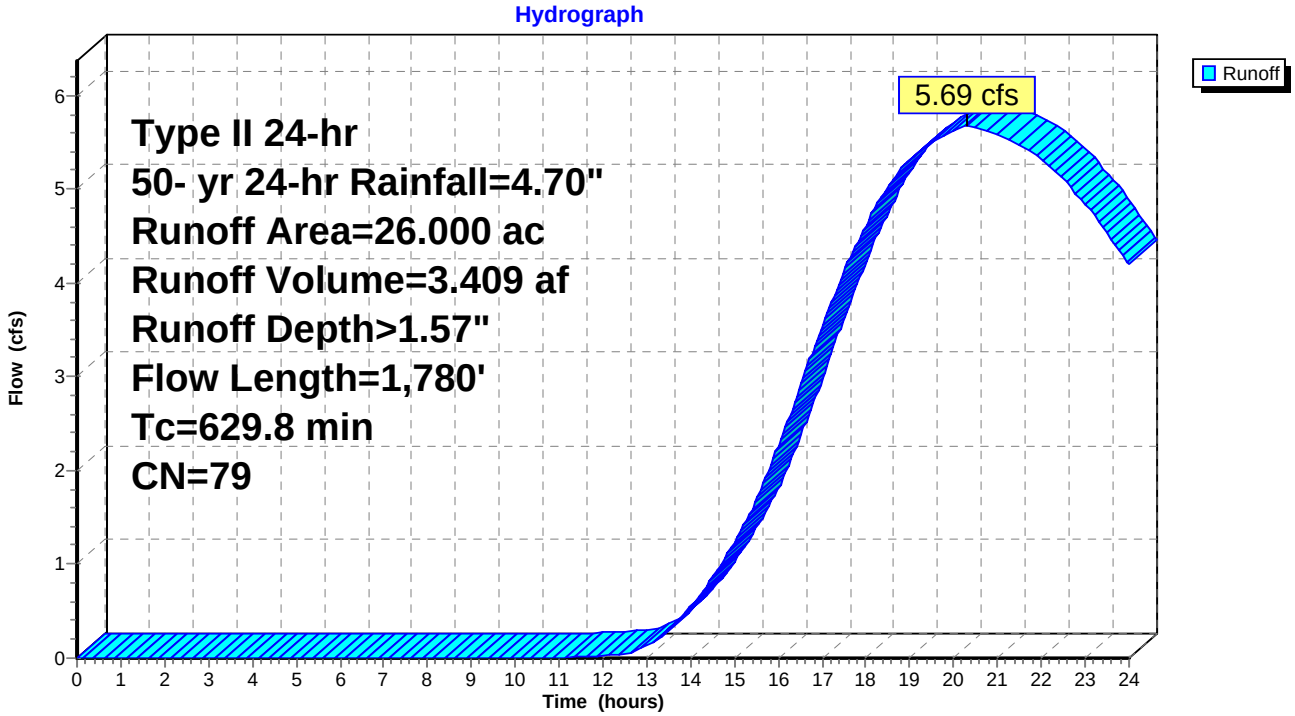
Runoff = 5.69 cfs @ 20.29 hrs, Volume= 3.409 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 50- yr 24-hr Rainfall=4.70"

| Area (ac) | CN | Description |
|---|---|---|
| 26.000 | 79 | Pasture/grassland/range, Poor, HSG B |
| 26.000 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 629.8 | 1,780 | | 0.05 | | **Direct Entry, Coal Pile Runoff** |

### Subcatchment Coal: Coal Pile



## Summary for Subcatchment CWP Subcat: Clear Water Pond Surface

[49] Hint: Tc<2dt may require smaller dt

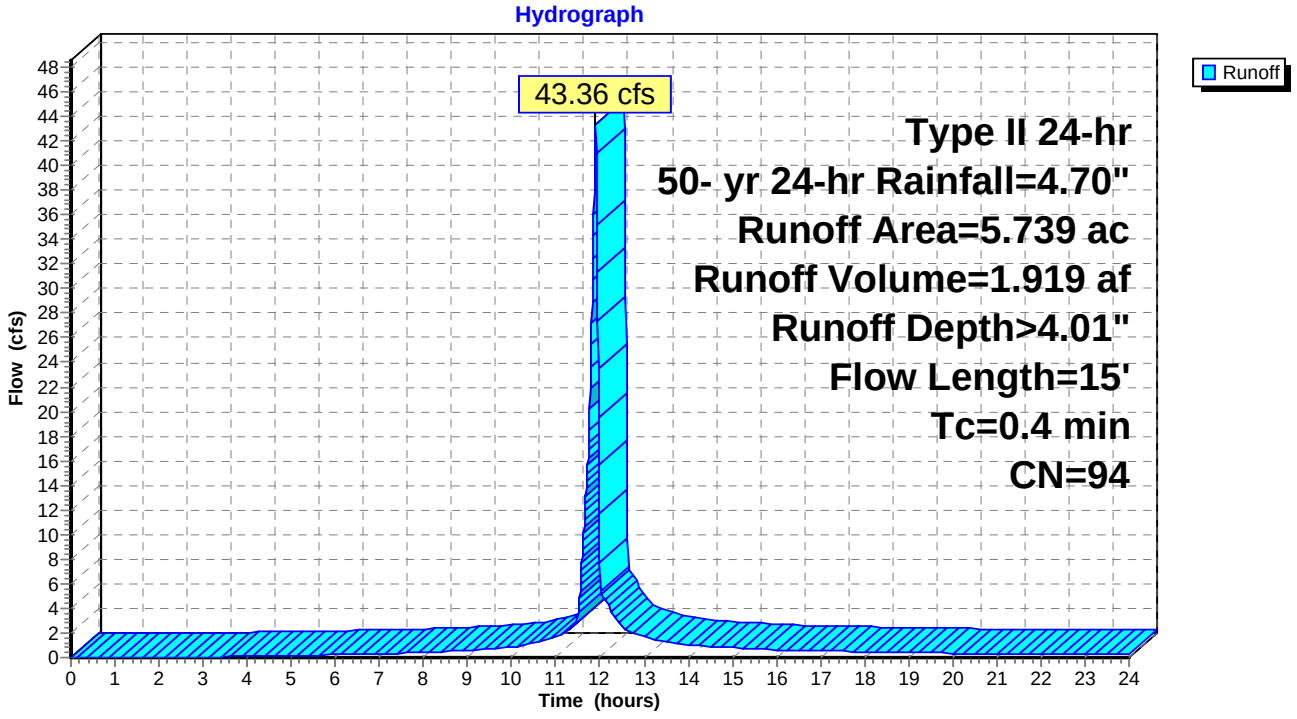
Runoff = 43.36 cfs @ 11.90 hrs, Volume= 1.919 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 50- yr 24-hr Rainfall=4.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 3.600 | 98 | |
| | 2.139 | 86 | Fallow, bare soil, HSG B |
| | 5.739 | 94 | Weighted Average |
| | 2.139 | | 37.27% Pervious Area |
| | 3.600 | | 62.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Clear Water Pond Subcat** |

## Subcatchment CWP Subcat: Clear Water Pond Surface



## Summary for Subcatchment F Subcat: Forebay Surface

[49] Hint: Tc<2dt may require smaller dt

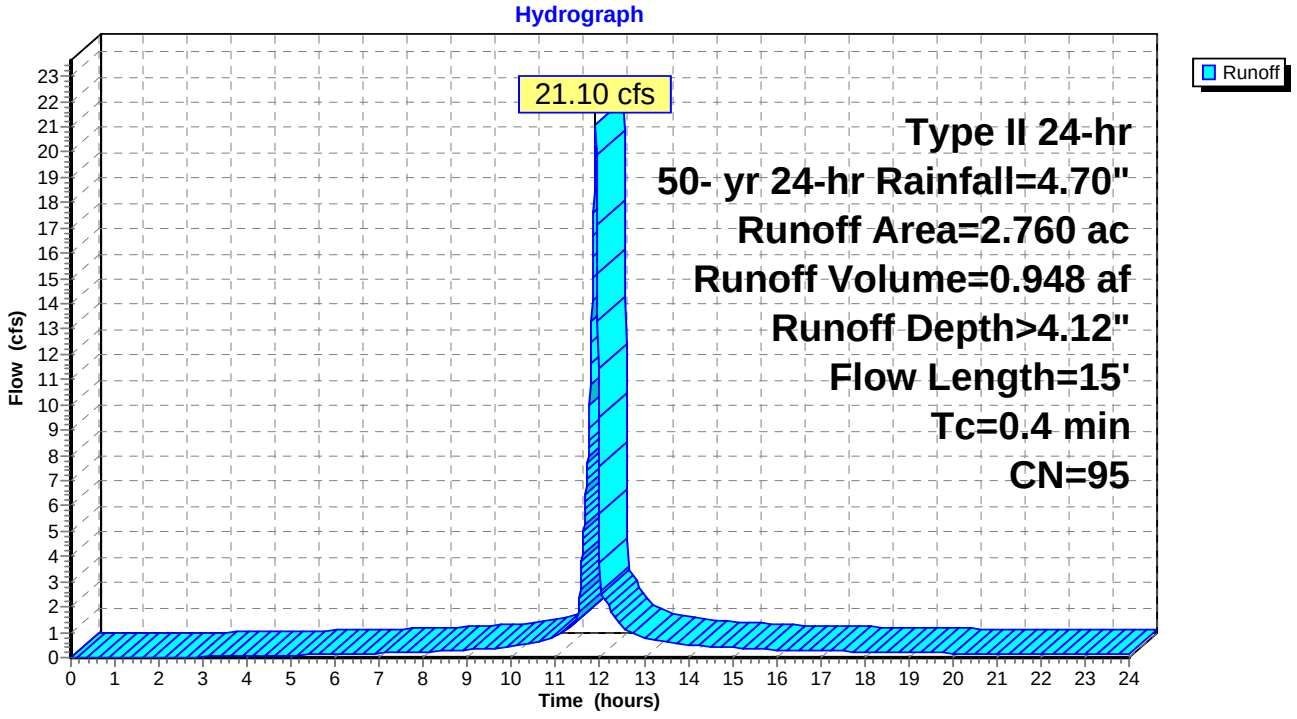
Runoff = 21.10 cfs @ 11.90 hrs, Volume= 0.948 af, Depth> 4.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 50- yr 24-hr Rainfall=4.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.000 | 98 | |
| | 0.760 | 86 | Fallow, bare soil, HSG B |
| | 2.760 | 95 | Weighted Average |
| | 0.760 | | 27.54% Pervious Area |
| | 2.000 | | 72.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Forebay Surface** |

## Subcatchment F Subcat: Forebay Surface



## Summary for Subcatchment FI Subcat: Former Impoundment Surface

[49] Hint: Tc<2dt may require smaller dt

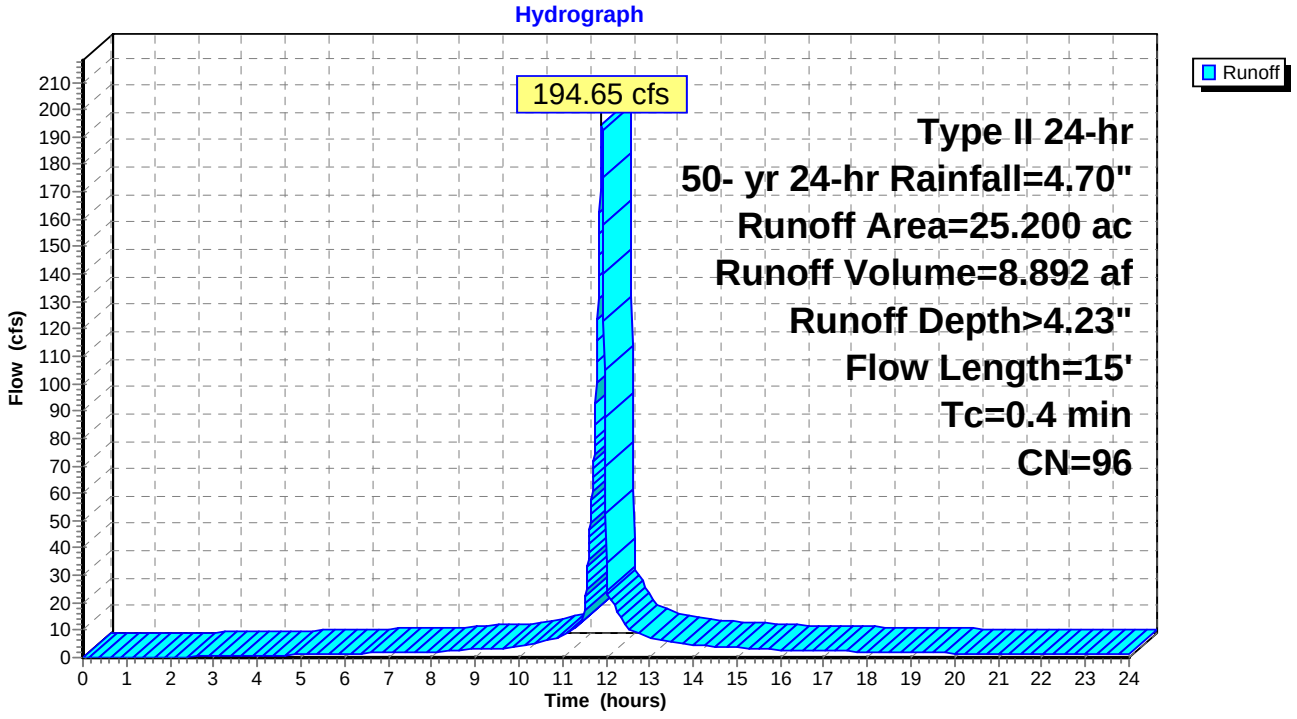
Runoff = 194.65 cfs @ 11.90 hrs, Volume= 8.892 af, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 50- yr 24-hr Rainfall=4.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 21.000 | 98 | |
| | 4.200 | 86 | Fallow, bare soil, HSG B |
| | 25.200 | 96 | Weighted Average |
| | 4.200 | | 16.67% Pervious Area |
| | 21.000 | | 83.33% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, OAI Subcat** |

## Subcatchment FI Subcat: Former Impoundment Surface



## Summary for Subcatchment LD Subcat: Lake Delta

[49] Hint: Tc<2dt may require smaller dt

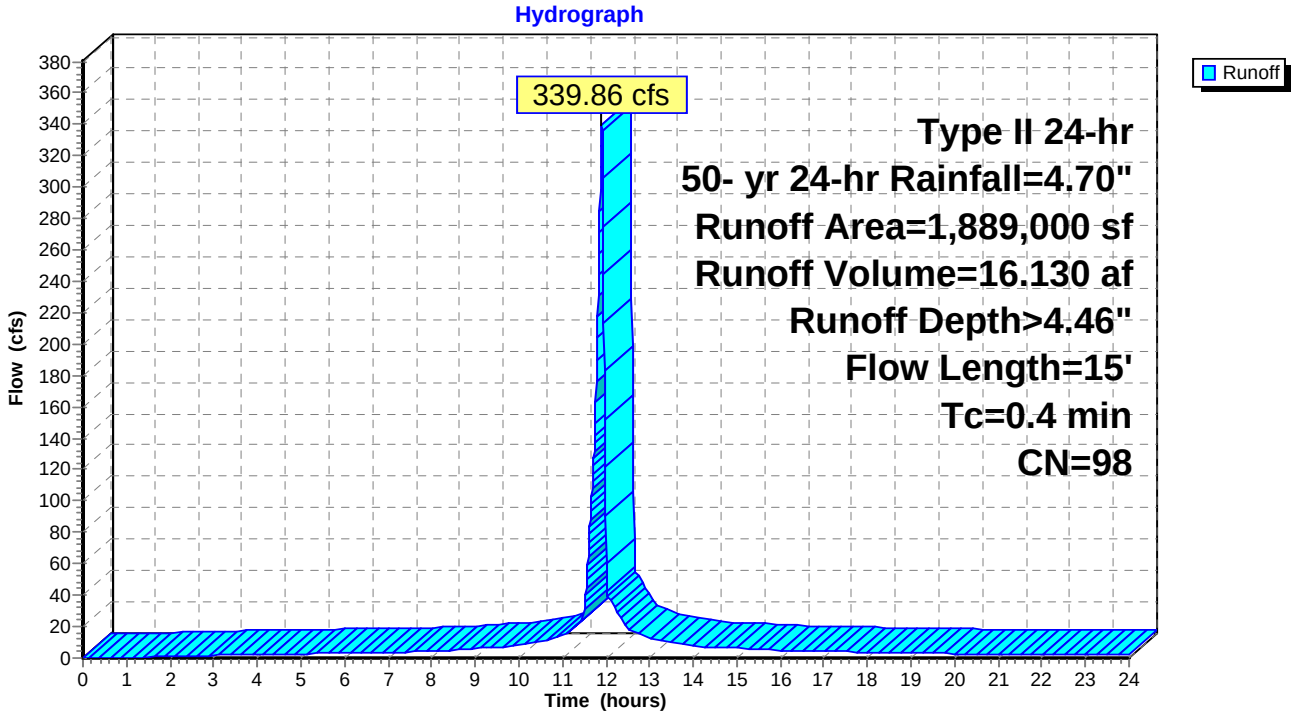
Runoff = 339.86 cfs @ 11.90 hrs, Volume= 16.130 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 50- yr 24-hr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,889,000 | 98 | |
| | 1,889,000 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry,** |

### Subcatchment LD Subcat: Lake Delta



## Summary for Subcatchment RP Subcat: Ret Basin Surface

[49] Hint: Tc<2dt may require smaller dt

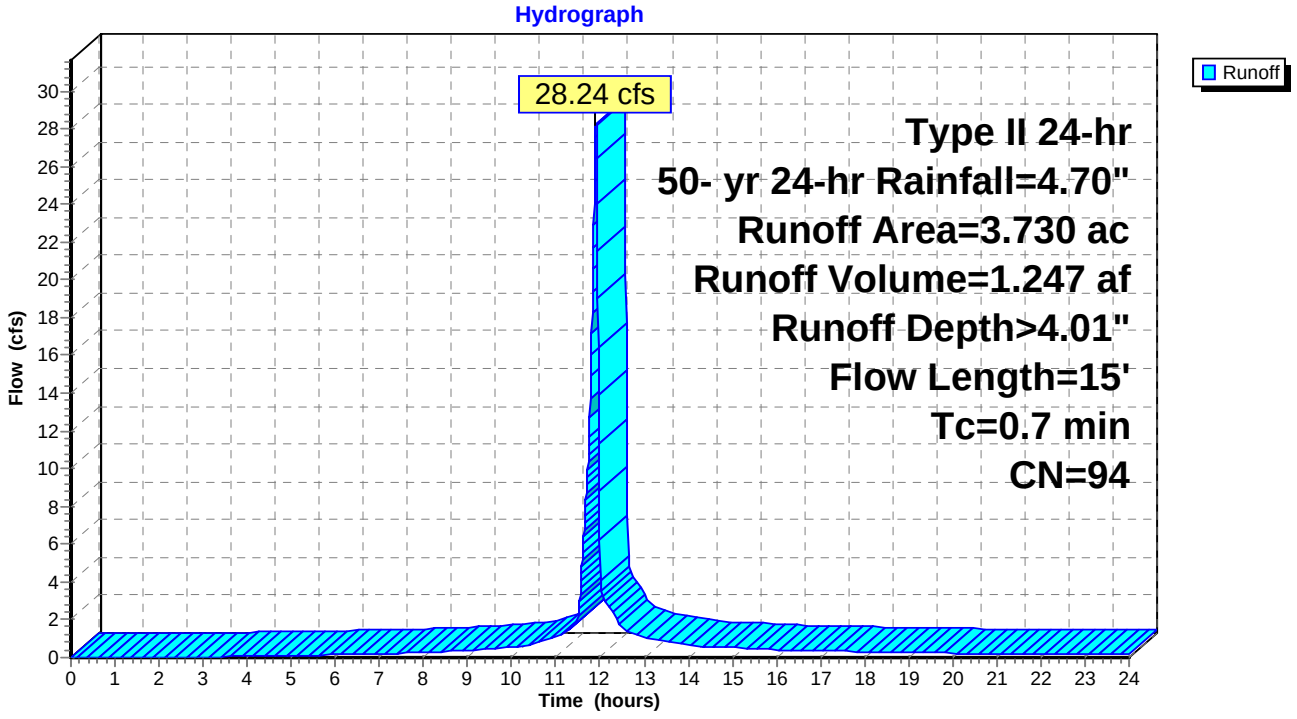
Runoff = 28.24 cfs @ 11.91 hrs, Volume= 1.247 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 50- yr 24-hr Rainfall=4.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.600 | 98 | |
| | 1.130 | 86 | Fallow, bare soil, HSG B |
| | 3.730 | 94 | Weighted Average |
| | 1.130 | | 30.29% Pervious Area |
| | 2.600 | | 69.71% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.7 | 15 | | 0.36 | | **Direct Entry, Ret Basin Surface** |

## Subcatchment RP Subcat: Ret Basin Surface



## Summary for Reach HD: Hollys Drain

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

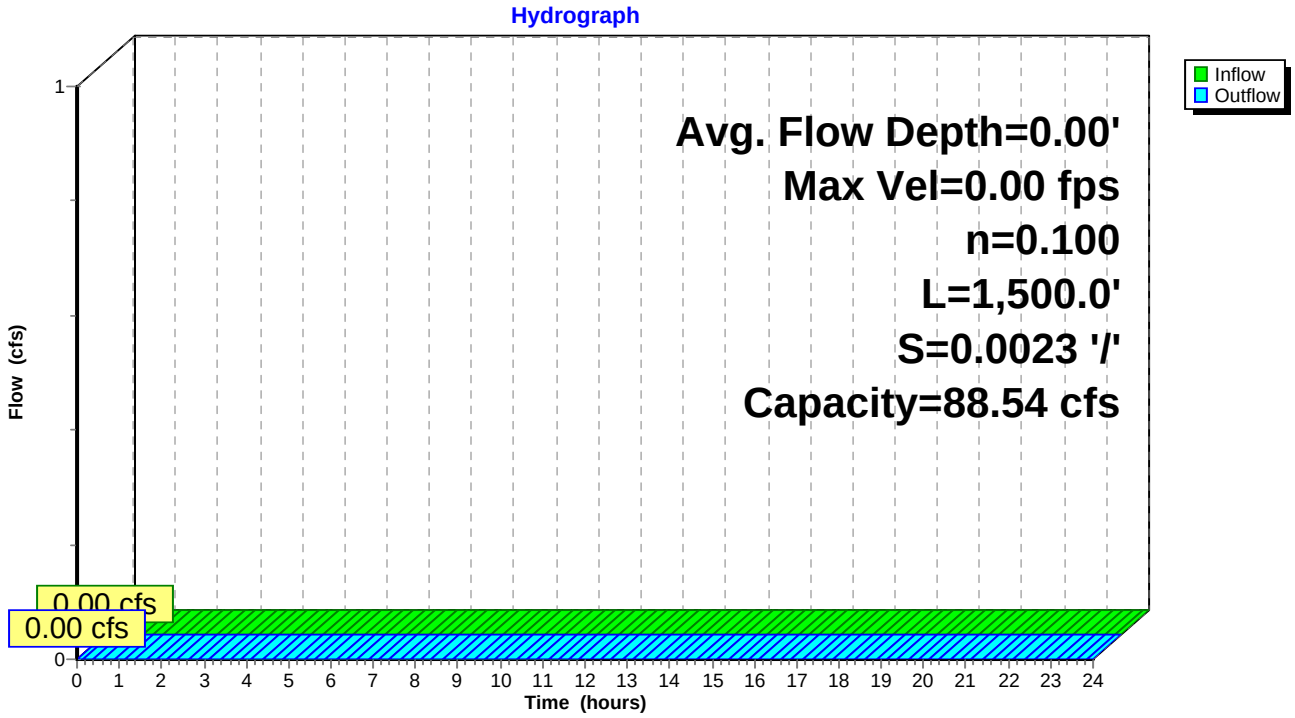
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00' Flow Area= 72.0 sf, Capacity= 88.54 cfs

18.00' x 3.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 '/' Top Width= 30.00'
Length= 1,500.0' Slope= 0.0023 '/'
Inlet Invert= 874.90', Outlet Invert= 871.50'

‡

## Reach HD: Hollys Drain



## Summary for Reach Wetlands: Wetlands

No flow reaches this point

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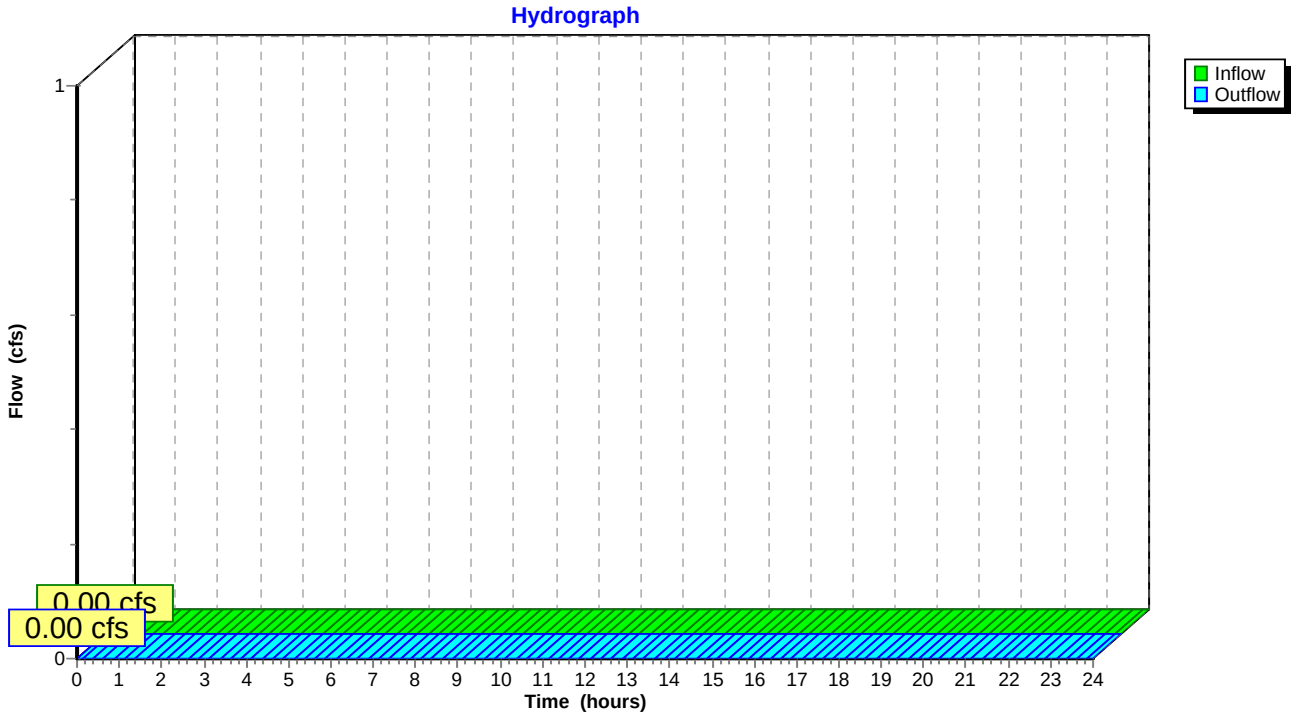
[40] Hint: Not Described (Outflow=Inflow)

| | | | | | |
|---|---|---|---|---|---|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Reach Wetlands: Wetlands



## Summary for Pond CSP: Coal Sump Pump

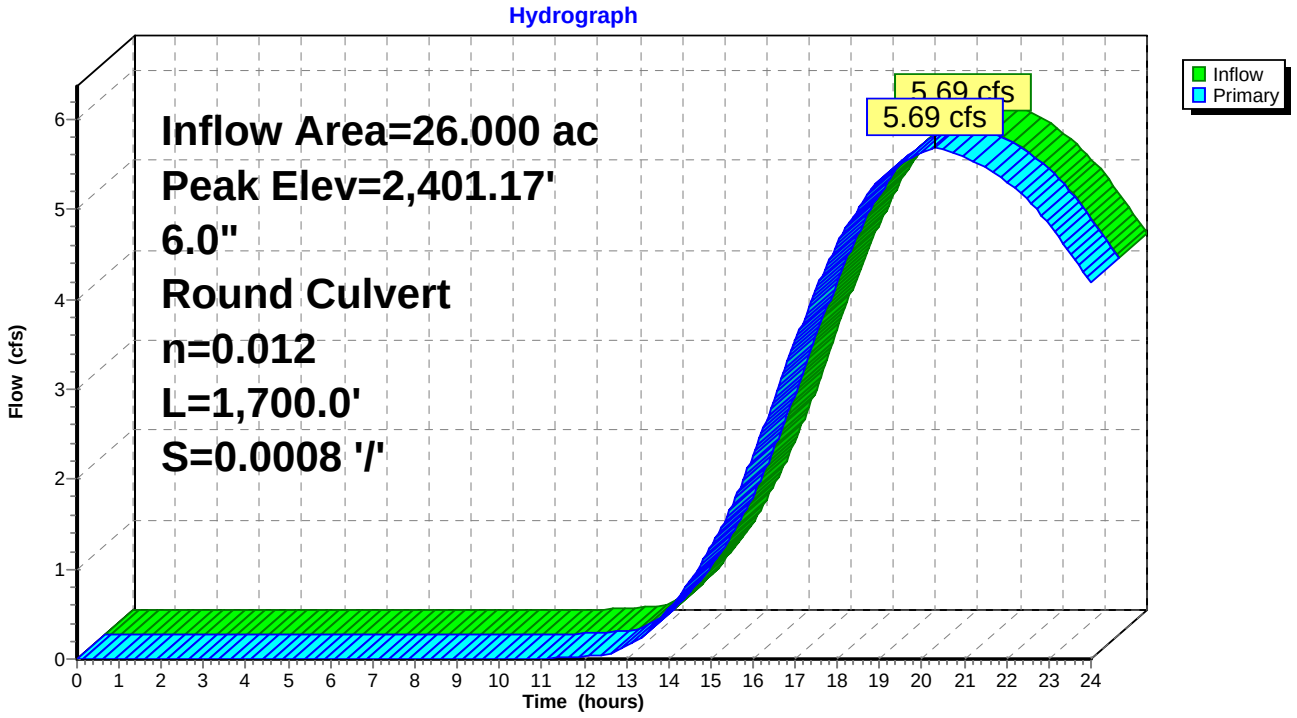
Inflow Area = 26.000 ac, 0.00% Impervious, Inflow Depth > 1.57" for 50- yr 24-hr event
Inflow = 5.69 cfs @ 20.29 hrs, Volume= 3.409 af
Outflow = 5.69 cfs @ 20.30 hrs, Volume= 3.409 af, Atten= 0%, Lag= 0.2 min
Primary = 5.69 cfs @ 20.30 hrs, Volume= 3.409 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 2,401.17' @ 20.30 hrs
Flood Elev= 3,000.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 883.00' | **6.0" Round Culvert**<br>L= 1,700.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 883.00' / 881.60' S= 0.0008 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.20 sf |

**Primary OutFlow** Max=5.69 cfs @ 20.30 hrs HW=2,401.01' TW=883.46' (Dynamic Tailwater)
**1=Culvert** (Outlet Controls 5.69 cfs @ 28.97 fps)

### Pond CSP: Coal Sump Pump



## Summary for Pond CWP: Clear Water Pond

[80] Warning: Exceeded Pond Fl by 10.71' @ 0.31 hrs (3.53 cfs 10.171 af)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.57" for 50- yr 24-hr event
Inflow = 48.77 cfs @ 11.90 hrs, Volume= 13.958 af
Outflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 88%, Lag= 0.0 min
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.70' Surf.Area= 163,599 sf Storage= 1,242,582 cf
Peak Elev= 882.30' @ 24.00 hrs Surf.Area= 167,152 sf Storage= 1,342,300 cf (99,718 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 870.00' | 2,000,903 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

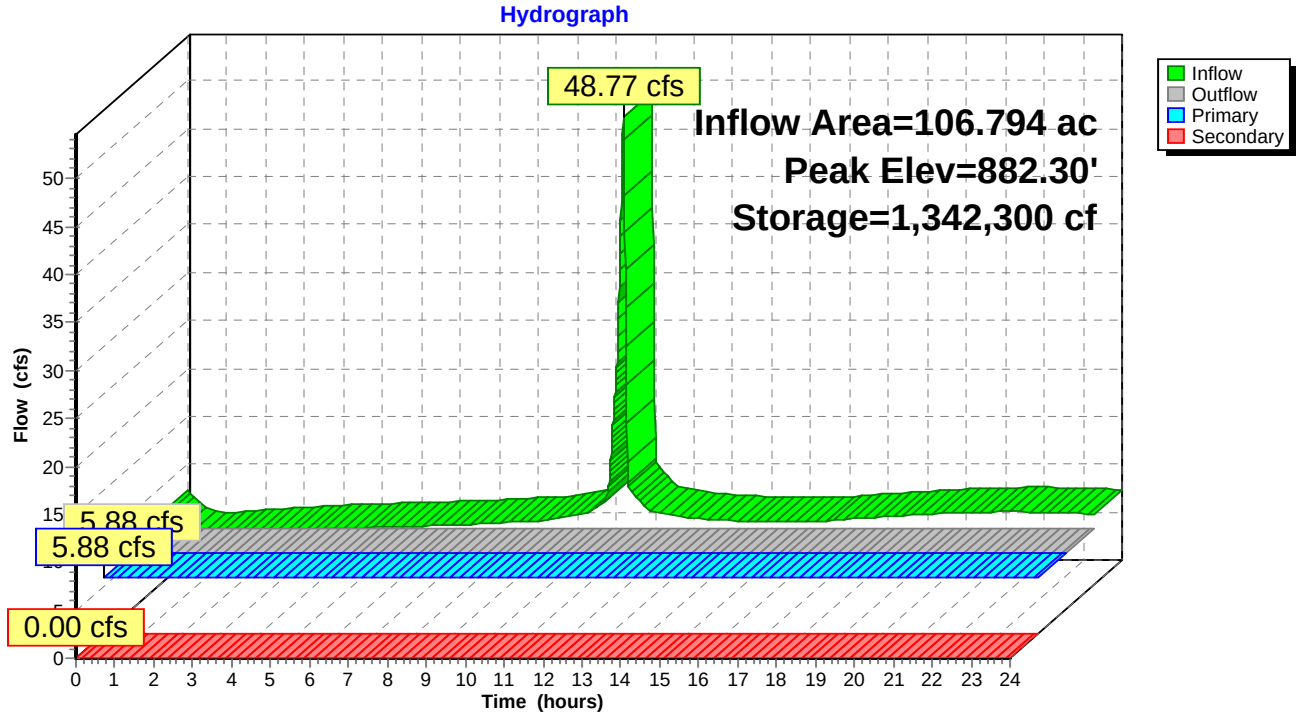
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 870.00 | 38,520 | 825.0 | 0 | 0 | 38,520 |
| 873.00 | 68,125 | 1,325.0 | 157,872 | 157,872 | 124,127 |
| 874.00 | 72,131 | 1,433.2 | 70,118 | 227,990 | 147,915 |
| 875.00 | 98,274 | 1,367.7 | 84,866 | 312,856 | 162,582 |
| 876.00 | 116,945 | 1,983.7 | 107,474 | 420,331 | 326,875 |
| 877.00 | 131,376 | 1,724.1 | 124,091 | 544,421 | 403,494 |
| 878.00 | 139,814 | 1,693.0 | 135,573 | 679,994 | 412,122 |
| 879.00 | 146,808 | 1,706.5 | 143,297 | 823,291 | 416,150 |
| 880.00 | 153,167 | 1,730.0 | 149,976 | 973,267 | 422,802 |
| 881.00 | 159,394 | 1,754.5 | 156,270 | 1,129,538 | 429,816 |
| 882.00 | 165,418 | 1,777.3 | 162,397 | 1,291,934 | 436,463 |
| 883.00 | 171,176 | 1,796.5 | 168,289 | 1,460,223 | 442,208 |
| 884.00 | 177,068 | 1,818.2 | 174,114 | 1,634,337 | 448,706 |
| 885.00 | 183,257 | 1,842.6 | 180,154 | 1,814,490 | 456,046 |
| 886.00 | 189,586 | 1,885.9 | 186,413 | 2,000,903 | 469,028 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 870.60' | **Pump**<br>Discharges@880.00' Turns Off@870.10'<br>36.0" Diam. x 2,900.0' Long Discharge, Hazen-Williams C= 130<br>Flow (gpm)= 2,640.0<br>Head (feet)= 50.00<br>-Loss (feet)= 0.21<br>=Lift (feet)= 49.79 |
| #2 | Secondary | 875.90' | **Tube/Siphon/Float Valve** Discharges@872.80'<br>36.000" Diameter, C= 0.600<br>62.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 883.60' | **36.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=5.88 cfs @ 0.00 hrs HW=881.70' TW=0.00' (Dynamic Tailwater)
└**1=Pump** (Pump Controls 5.88 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=881.70' TW=874.90' (Dynamic Tailwater)
└**2=Tube/Siphon/Float Valve** (Passes 0.00 cfs of 84.57 cfs potential flow)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond CWP: Clear Water Pond



## Summary for Pond ES: Erickson Power Station

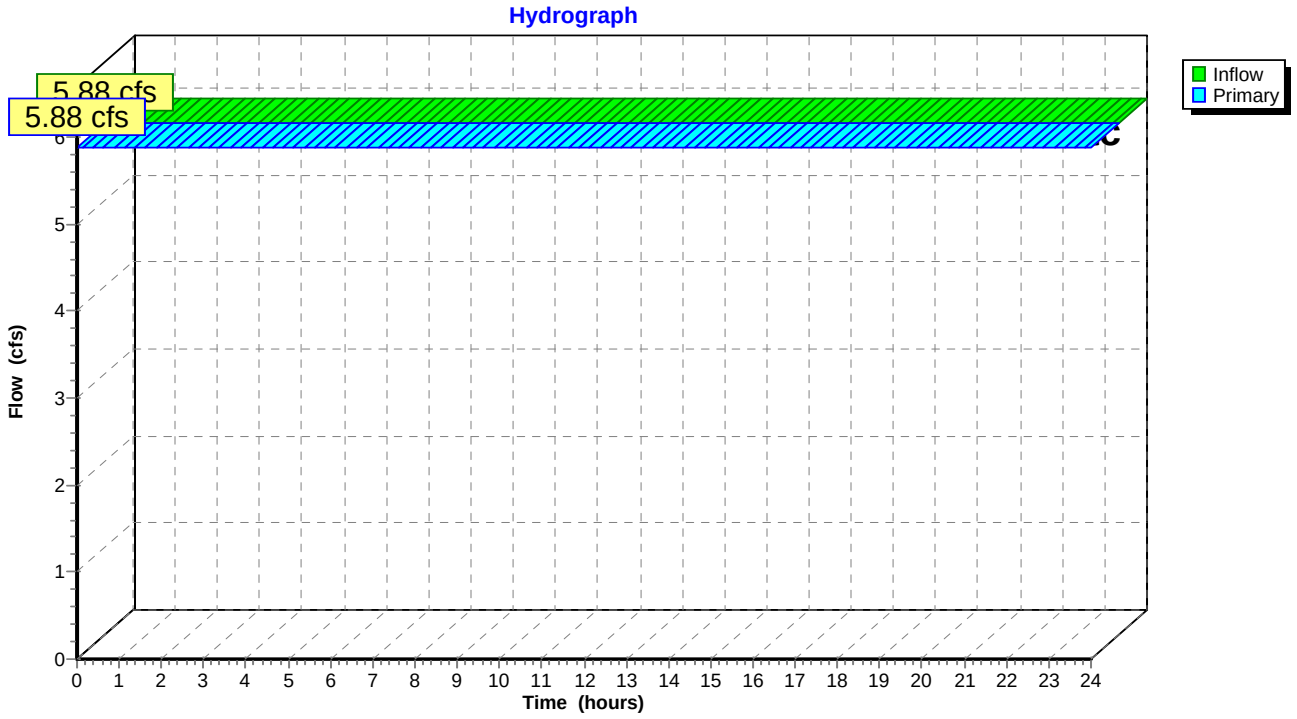
Shows flow back to Power Station

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.31" for 50- yr 24-hr event
Inflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Pond ES: Erickson Power Station



## Summary for Pond F: Forebay

[80] Warning: Exceeded Pond CSP by 0.18' @ 8.39 hrs (0.01 cfs 0.005 af)

Inflow Area = 28.760 ac, 6.95% Impervious, Inflow Depth > 6.69" for 50- yr 24-hr event
Inflow = 27.01 cfs @ 11.90 hrs, Volume= 16.025 af, Incl. 5.88 cfs Base Flow
Outflow = 11.40 cfs @ 21.63 hrs, Volume= 15.028 af, Atten= 58%, Lag= 583.6 min
Primary = 11.40 cfs @ 21.63 hrs, Volume= 15.028 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 883.00' Surf.Area= 0 sf Storage= 836,526 cf
Peak Elev= 883.48' @ 21.89 hrs Surf.Area= 0 sf Storage= 882,100 cf (45,574 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 15.5 min ( 838.2 - 822.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 932,837 cf | **Custom Stage Data** Listed below |

| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 14,201 |
| 872.50 | 42,819 |
| 873.00 | 72,222 |
| 873.50 | 102,366 |
| 874.00 | 133,337 |
| 874.50 | 165,092 |
| 875.00 | 197,675 |
| 875.50 | 231,086 |
| 876.00 | 265,324 |
| 876.50 | 300,433 |
| 877.00 | 336,327 |
| 877.50 | 373,135 |
| 878.00 | 410,771 |
| 878.50 | 449,278 |
| 879.00 | 488,700 |
| 879.50 | 528,949 |
| 880.00 | 570,157 |
| 880.50 | 612,236 |
| 881.00 | 655,230 |
| 881.50 | 699,138 |
| 882.00 | 744,005 |
| 882.50 | 789,786 |
| 883.00 | 836,526 |
| 883.50 | 884,181 |
| 884.00 | 932,837 |

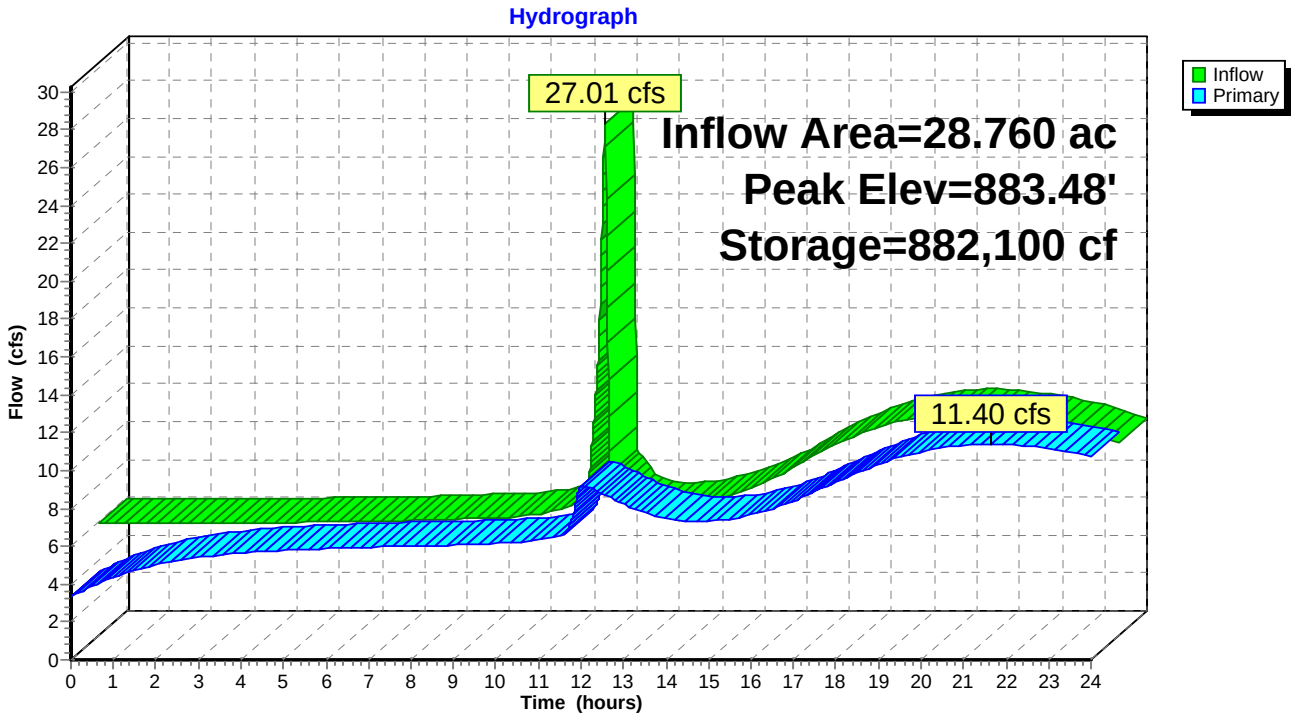
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 882.40' | **24.0" Round CMP_Round 24" (West)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.40' / 881.60' S= 0.0140 '/' Cc= 0.900 |

n= 0.025, Flow Area= 3.14 sf

| | | | |
|---|---|---|---|
| #2 | Primary | 882.50' | **24.0" Round CMP_Round 24" (Center)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.50' / 881.40' S= 0.0192 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |
| #3 | Primary | 882.60' | **24.0" Round CMP_Round 24" (East)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.60' / 881.70' S= 0.0157 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |

**Primary OutFlow** Max=11.39 cfs @ 21.63 hrs HW=883.48' TW=882.32' (Dynamic Tailwater)
- **1=CMP_Round 24" (West)** (Barrel Controls 4.37 cfs @ 3.67 fps)
- **2=CMP_Round 24" (Center)** (Outlet Controls 3.87 cfs @ 3.70 fps)
- **3=CMP_Round 24" (East)** (Barrel Controls 3.16 cfs @ 3.51 fps)

## Pond F: Forebay



## Summary for Pond FI: Former Impoundment

Evaporation losses are smaller than HydroCAD will allow

Inflow Area = 25.200 ac, 83.33% Impervious, Inflow Depth > 4.88" for 50- yr 24-hr event
Inflow = 195.14 cfs @ 11.90 hrs, Volume= 10.254 af
Outflow = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af, Atten= 100%, Lag= 0.0 min
Discarded = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 871.68' @ 24.00 hrs Surf.Area= 728,000 sf Storage= 445,747 cf

Plug-Flow detention time= 666.6 min calculated for 0.020 af (0% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.00' | 15,127,104 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

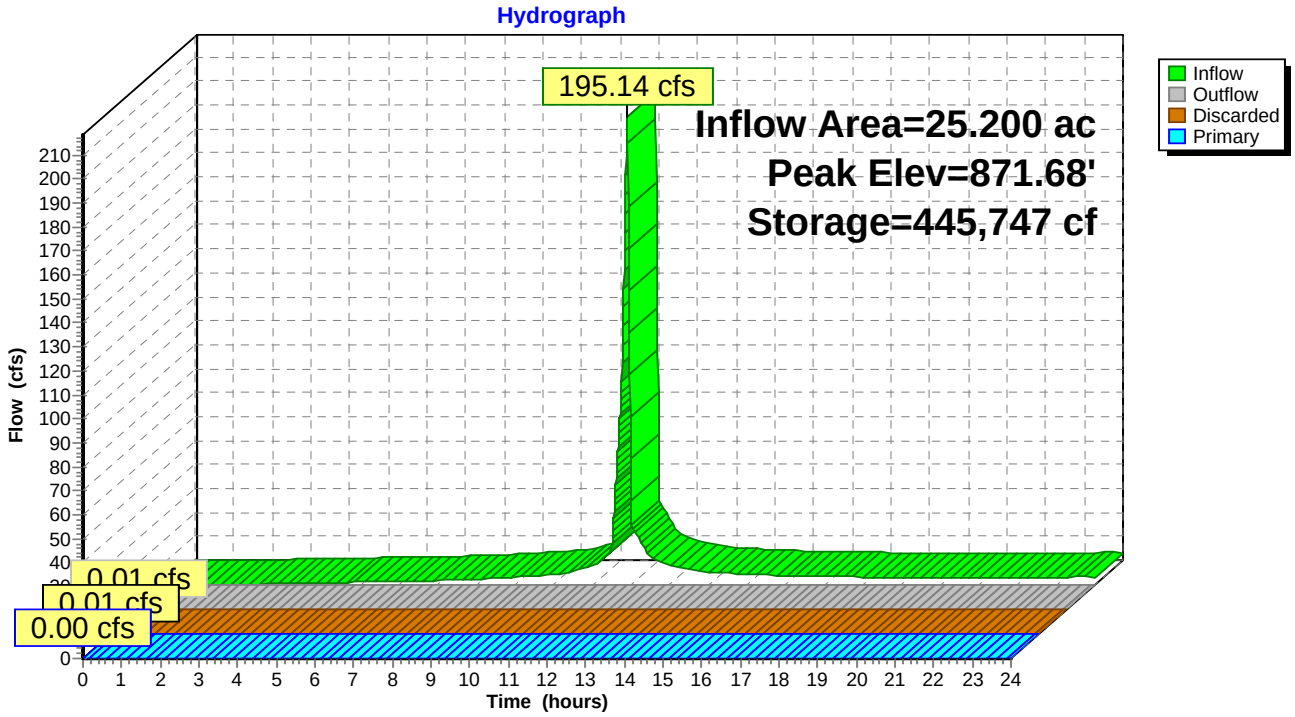
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 871.00 | 589,714 | 5,113.4 | 0 | 0 | 589,714 |
| 872.00 | 798,841 | 3,687.0 | 691,638 | 691,638 | 1,588,651 |
| 873.00 | 874,915 | 3,740.0 | 836,590 | 1,528,227 | 1,620,194 |
| 874.00 | 931,119 | 3,806.0 | 902,871 | 2,431,099 | 1,660,006 |
| 875.00 | 974,344 | 3,749.0 | 952,650 | 3,383,748 | 1,694,483 |
| 876.00 | 997,423 | 3,777.0 | 985,861 | 4,369,609 | 1,711,669 |
| 877.00 | 1,013,146 | 3,800.0 | 1,005,274 | 5,374,884 | 1,726,045 |
| 878.00 | 1,027,210 | 3,824.0 | 1,020,170 | 6,395,054 | 1,741,096 |
| 879.00 | 1,042,705 | 3,854.0 | 1,034,948 | 7,430,001 | 1,759,824 |
| 880.00 | 1,062,406 | 3,898.0 | 1,052,540 | 8,482,542 | 1,787,242 |
| 881.00 | 1,080,953 | 3,922.0 | 1,071,666 | 9,554,208 | 1,802,681 |
| 882.00 | 1,094,577 | 3,944.0 | 1,087,758 | 10,641,966 | 1,817,002 |
| 883.00 | 1,107,455 | 3,964.0 | 1,101,010 | 11,742,975 | 1,830,195 |
| 884.00 | 1,121,020 | 3,989.0 | 1,114,231 | 12,857,206 | 1,846,509 |
| 886.00 | 1,148,935 | 4,048.0 | 2,269,898 | 15,127,104 | 1,885,090 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 871.00' | **0.01 cfs Exfiltration at all elevations** |
| #2 | Primary | 880.80' | **24.0" Round CMP_Round 24"**<br>L= 15.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 880.80' / 871.40' S= 0.6267 '/' Cc= 0.900<br>n= 0.012, Flow Area= 3.14 sf |

**Discarded OutFlow** Max=0.01 cfs @ 0.01 hrs HW=871.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=871.00' TW=881.70' (Dynamic Tailwater)
↑**2=CMP_Round 24"** ( Controls 0.00 cfs)

## Pond FI: Former Impoundment



## Summary for Pond LD: Lake Delta

Inflow Area = 43.365 ac,100.00% Impervious, Inflow Depth > 4.46" for 50- yr 24-hr event
Inflow = 339.86 cfs @ 11.90 hrs, Volume= 16.130 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 882.50' Surf.Area= 1,845,931 sf Storage= 922,206 cf
Peak Elev= 882.88' @ 24.00 hrs Surf.Area= 1,848,245 sf Storage= 1,624,809 cf (702,603 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

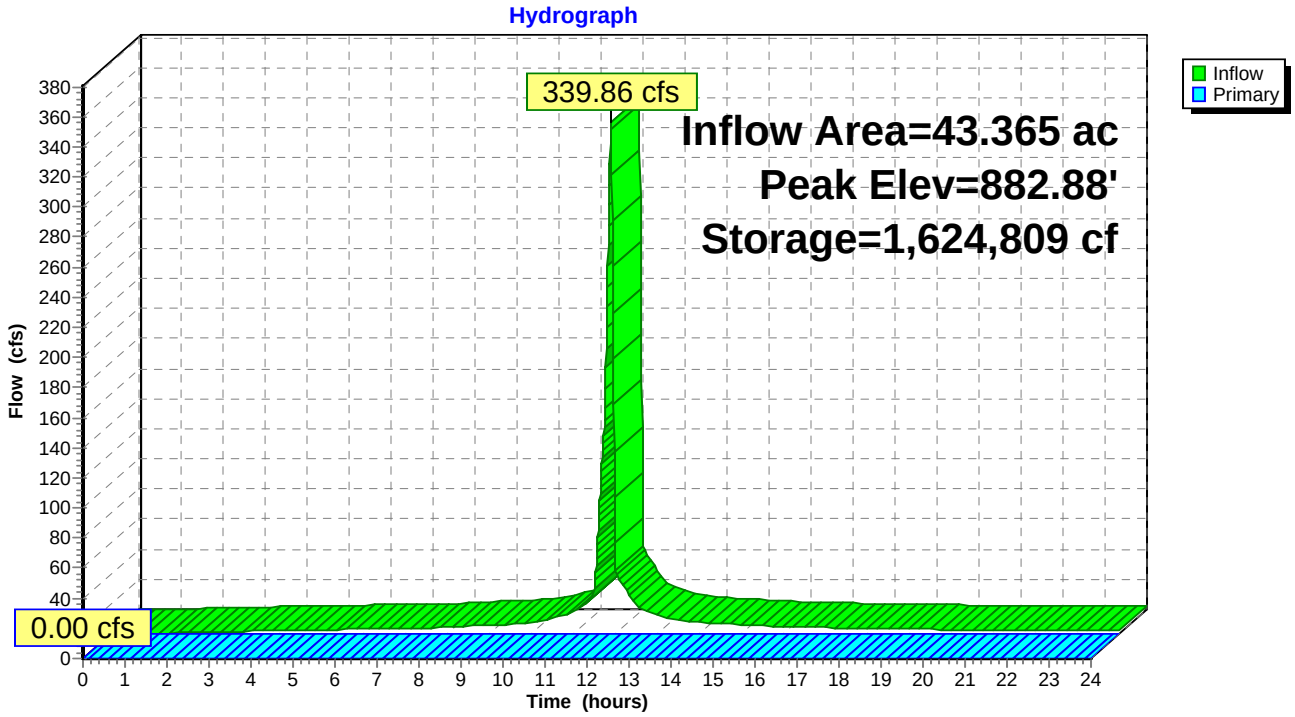
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 882.00' | 7,455,884 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 882.00 | 1,842,892 | 5,054.0 | 0 | 0 | 1,842,892 |
| 883.00 | 1,848,973 | 5,062.1 | 1,845,932 | 1,845,932 | 1,851,144 |
| 884.00 | 1,863,004 | 5,083.3 | 1,855,984 | 3,701,916 | 1,868,996 |
| 885.00 | 1,877,648 | 5,107.6 | 1,870,321 | 5,572,237 | 1,889,351 |
| 886.00 | 1,889,653 | 5,131.1 | 1,883,647 | 7,455,884 | 1,909,170 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 886.10' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>3.0' Crest Height |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=882.50' TW=881.70' (Dynamic Tailwater)
↳**1=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond LD: Lake Delta



## Summary for Pond RP: Retention Pond

Inflow Area = 32.490 ac, 14.16% Impervious, Inflow Depth > 6.01" for 50- yr 24-hr event
Inflow = 36.84 cfs @ 11.91 hrs, Volume= 16.275 af
Outflow = 9.10 cfs @ 23.26 hrs, Volume= 13.401 af, Atten= 75%, Lag= 681.2 min
Primary = 7.32 cfs @ 0.00 hrs, Volume= 12.039 af
Secondary = 2.03 cfs @ 24.00 hrs, Volume= 1.362 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.80' Surf.Area= 0 sf Storage= 878,134 cf
Peak Elev= 882.40' @ 24.00 hrs Surf.Area= 0 sf Storage= 1,003,417 cf (125,283 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 1,298,407 cf | **Custom Stage Data** Listed below |

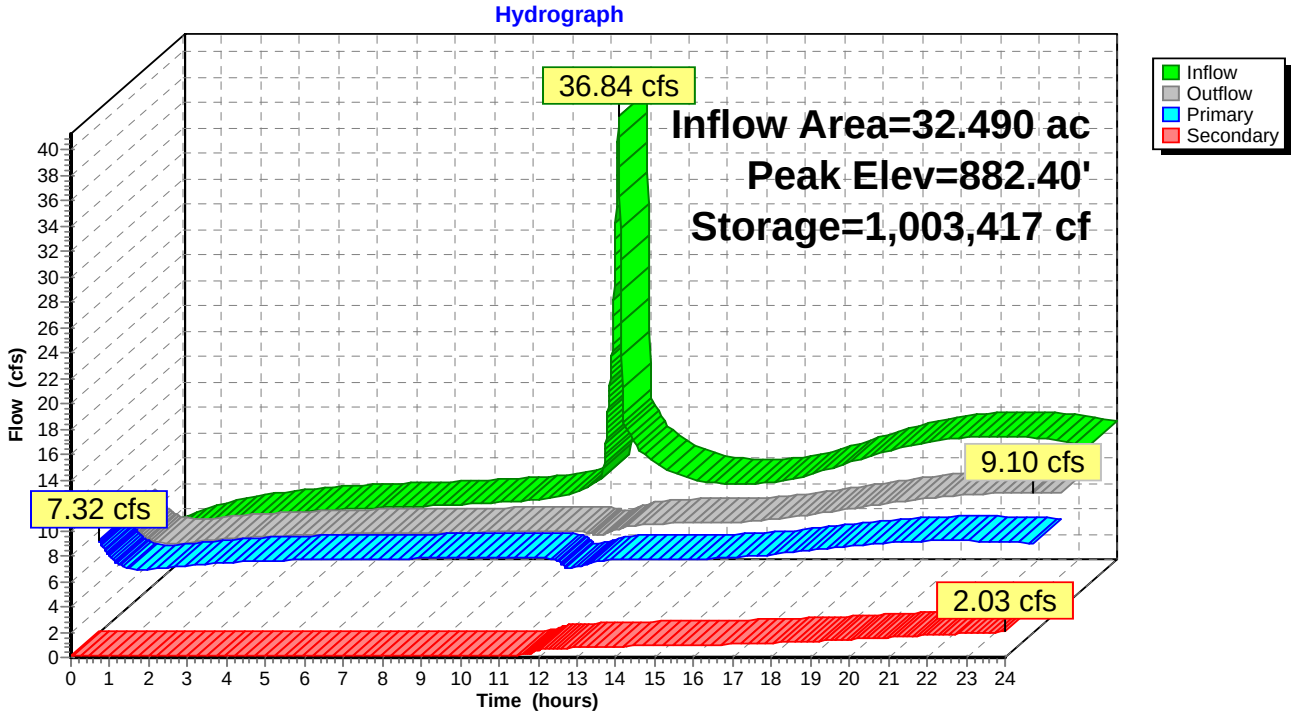
| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 20,136 |
| 872.50 | 52,477 |
| 873.00 | 85,710 |
| 873.50 | 119,843 |
| 874.00 | 154,886 |
| 874.50 | 190,848 |
| 875.00 | 227,738 |
| 875.50 | 265,563 |
| 876.00 | 304,335 |
| 876.50 | 344,061 |
| 877.00 | 384,750 |
| 877.50 | 426,412 |
| 878.00 | 469,055 |
| 878.50 | 512,689 |
| 879.00 | 554,027 |
| 879.50 | 604,982 |
| 880.00 | 662,312 |
| 880.50 | 720,757 |
| 881.00 | 780,327 |
| 881.50 | 841,028 |
| 882.00 | 902,872 |
| 882.50 | 1,030,019 |
| 883.00 | 1,095,341 |
| 883.50 | 1,161,840 |
| 884.00 | 1,161,841 |
| 884.50 | 1,229,526 |
| 885.00 | 1,298,407 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Secondary | 881.50' | **24.0" Round Culvert**<br>L= 69.8' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 881.50' / 881.50' S= 0.0000 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf |
| #2 | Primary | 874.00' | **Tube/Siphon/Float Valve** Discharges@871.40'<br>36.000" Diameter, C= 0.600<br>491.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 880.50' | **72.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=7.32 cfs @ 0.00 hrs HW=881.80' TW=881.70' (Dynamic Tailwater)
└─**2=Tube/Siphon/Float Valve** (Tube Controls 7.32 cfs @ 1.04 fps)
└─**3=Orifice/Grate** (Passes 7.32 cfs of 39.45 cfs potential flow)

**Secondary OutFlow** Max=2.03 cfs @ 24.00 hrs HW=882.40' TW=871.68' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 2.03 cfs @ 2.20 fps)

## Pond RP: Retention Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 5
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment Coal: Coal Pile** Runoff Area=26.000 ac 0.00% Impervious Runoff Depth>1.96"
Flow Length=1,780' Tc=629.8 min CN=79 Runoff=7.03 cfs 4.240 af

**Subcatchment CWP Subcat: Clear Water** Runoff Area=5.739 ac 62.73% Impervious Runoff Depth>4.68"
Flow Length=15' Tc=0.4 min CN=94 Runoff=50.07 cfs 2.240 af

**Subcatchment F Subcat: Forebay Surface** Runoff Area=2.760 ac 72.46% Impervious Runoff Depth>4.80"
Flow Length=15' Tc=0.4 min CN=95 Runoff=24.31 cfs 1.103 af

**Subcatchment FI Subcat: Former** Runoff Area=25.200 ac 83.33% Impervious Runoff Depth>4.91"
Flow Length=15' Tc=0.4 min CN=96 Runoff=223.77 cfs 10.312 af

**Subcatchment LD Subcat: Lake Delta** Runoff Area=1,889,000 sf 100.00% Impervious Runoff Depth>5.14"
Flow Length=15' Tc=0.4 min CN=98 Runoff=389.50 cfs 18.584 af

**Subcatchment RP Subcat: Ret Basin** Runoff Area=3.730 ac 69.71% Impervious Runoff Depth>4.68"
Flow Length=15' Tc=0.7 min CN=94 Runoff=32.61 cfs 1.456 af

**Reach HD: Hollys Drain** Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.100 L=1,500.0' S=0.0023 '/' Capacity=88.54 cfs Outflow=0.00 cfs 0.000 af

**Reach Wetlands: Wetlands** Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

**Pond CSP: Coal Sump Pump** Peak Elev=3,203.63' Inflow=7.03 cfs 4.240 af
6.0" Round Culvert n=0.012 L=1,700.0' S=0.0008 '/' Outflow=7.03 cfs 4.240 af

**Pond CWP: Clear Water Pond** Peak Elev=882.41' Storage=1,360,282 cf Inflow=55.21 cfs 14.371 af
Primary=5.88 cfs 11.671 af Secondary=0.00 cfs 0.000 af Outflow=5.88 cfs 11.671 af

**Pond ES: Erickson Power Station** Inflow=5.88 cfs 11.671 af
Primary=5.88 cfs 11.671 af

**Pond F: Forebay** Peak Elev=883.54' Storage=888,395 cf Inflow=30.24 cfs 17.010 af
Outflow=12.67 cfs 15.870 af

**Pond FI: Former Impoundment** Peak Elev=871.78' Storage=520,956 cf Inflow=224.36 cfs 11.981 af
Discarded=0.01 cfs 0.020 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.020 af

**Pond LD: Lake Delta** Peak Elev=882.94' Storage=1,731,679 cf Inflow=389.50 cfs 18.584 af
Outflow=0.00 cfs 0.000 af

**Pond RP: Retention Pond** Peak Elev=882.51' Storage=1,031,792 cf Inflow=41.69 cfs 17.326 af
Primary=7.59 cfs 12.131 af Secondary=2.62 cfs 1.669 af Outflow=10.07 cfs 13.801 af

**Total Runoff Area = 106.794 ac Runoff Volume = 37.933 af Average Runoff Depth = 4.26"**
**32.05% Pervious = 34.229 ac 67.95% Impervious = 72.565 ac**

## Summary for Subcatchment Coal: Coal Pile

Information from MD & E

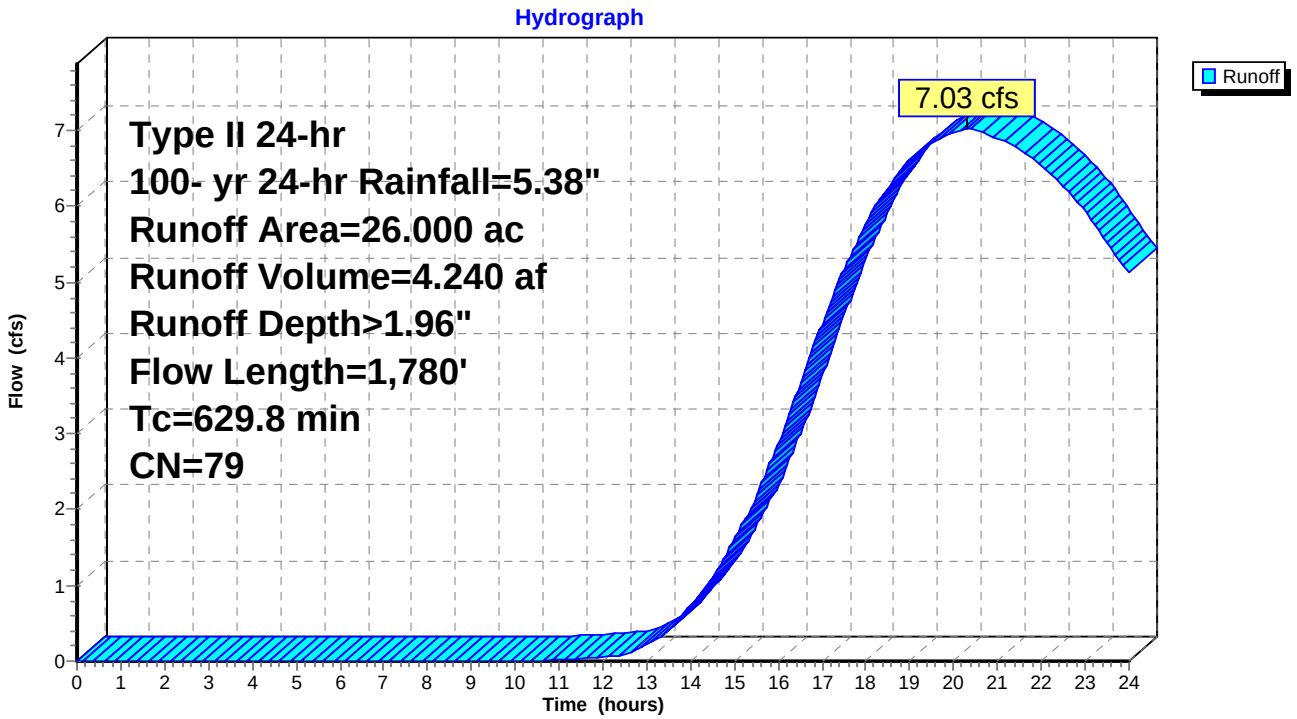
Runoff = 7.03 cfs @ 20.29 hrs, Volume= 4.240 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

| Area (ac) | CN | Description |
|---|---|---|
| 26.000 | 79 | Pasture/grassland/range, Poor, HSG B |
| 26.000 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 629.8 | 1,780 | | 0.05 | | **Direct Entry, Coal Pile Runoff** |

### Subcatchment Coal: Coal Pile



## Summary for Subcatchment CWP Subcat: Clear Water Pond Surface

[49] Hint: Tc<2dt may require smaller dt

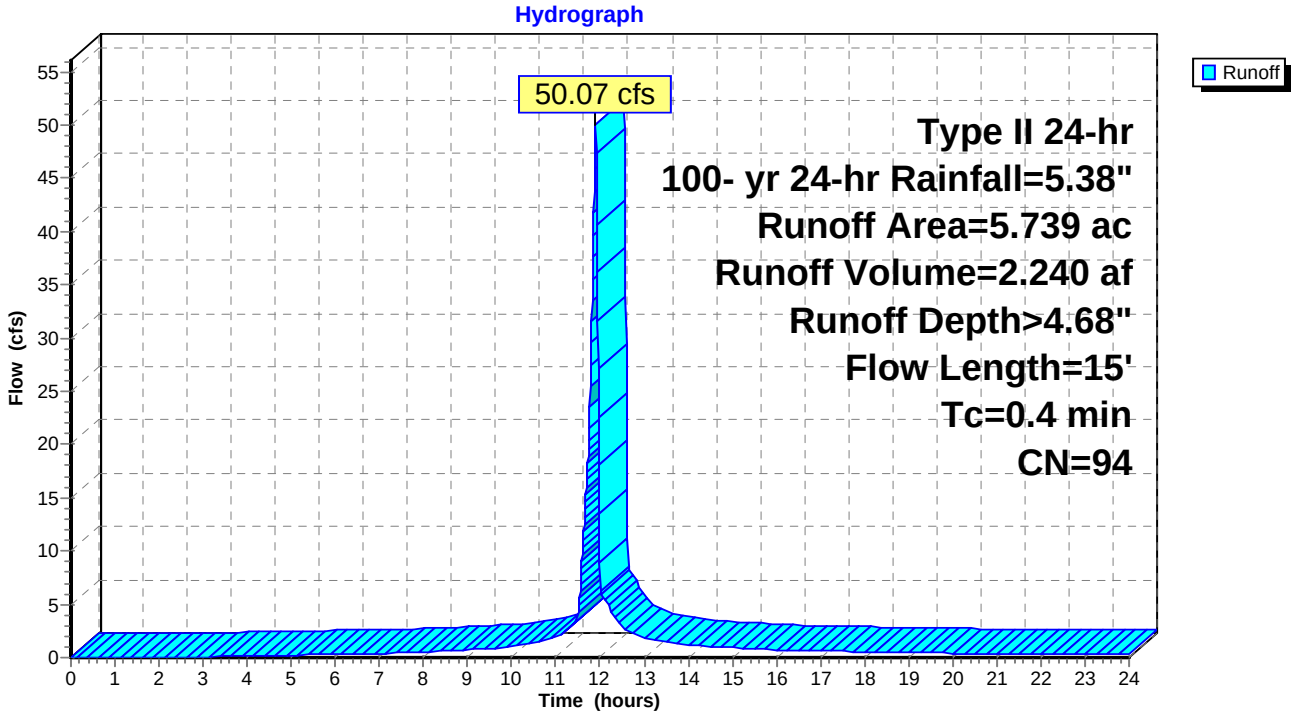
Runoff = 50.07 cfs @ 11.90 hrs, Volume= 2.240 af, Depth> 4.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 3.600 | 98 | |
| | 2.139 | 86 | Fallow, bare soil, HSG B |
| | 5.739 | 94 | Weighted Average |
| | 2.139 | | 37.27% Pervious Area |
| | 3.600 | | 62.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Clear Water Pond Subcat** |

## Subcatchment CWP Subcat: Clear Water Pond Surface



## Summary for Subcatchment F Subcat: Forebay Surface

[49] Hint: Tc<2dt may require smaller dt

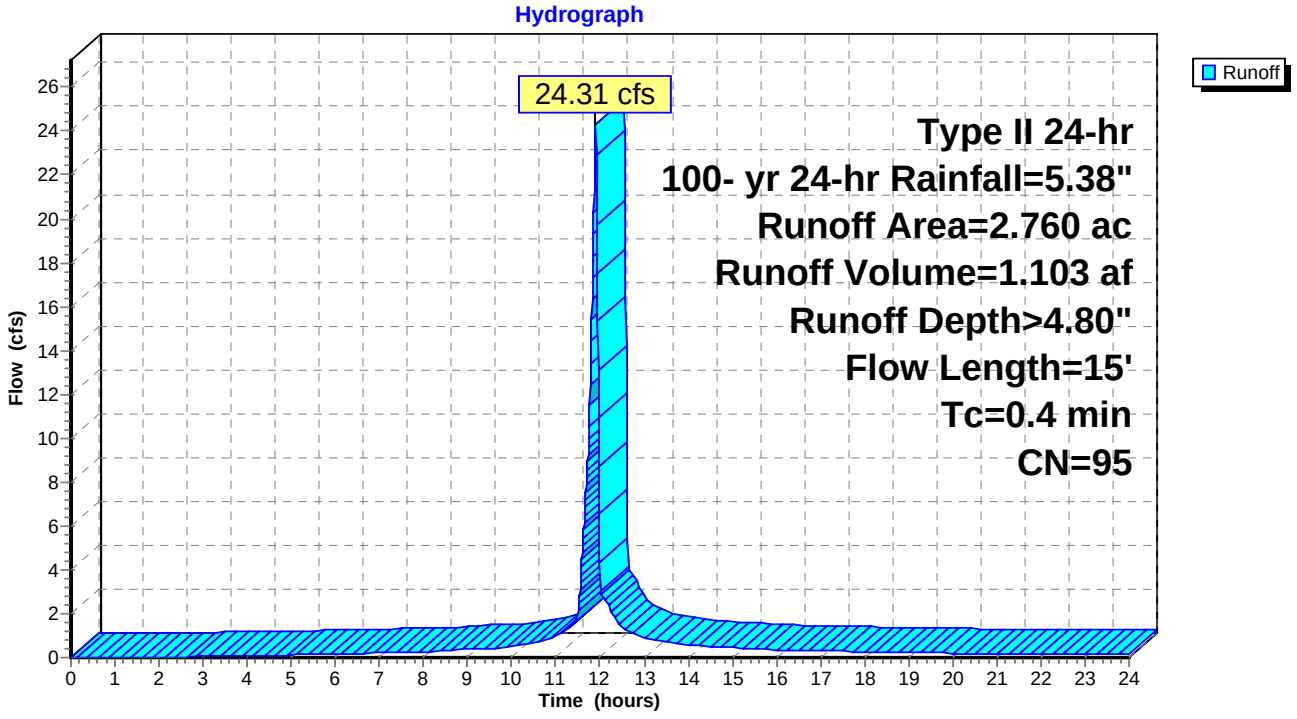
Runoff = 24.31 cfs @ 11.90 hrs, Volume= 1.103 af, Depth> 4.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.000 | 98 | |
| | 0.760 | 86 | Fallow, bare soil, HSG B |
| | 2.760 | 95 | Weighted Average |
| | 0.760 | | 27.54% Pervious Area |
| | 2.000 | | 72.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Forebay Surface** |

## Subcatchment F Subcat: Forebay Surface



## Summary for Subcatchment FI Subcat: Former Impoundment Surface

[49] Hint: Tc<2dt may require smaller dt

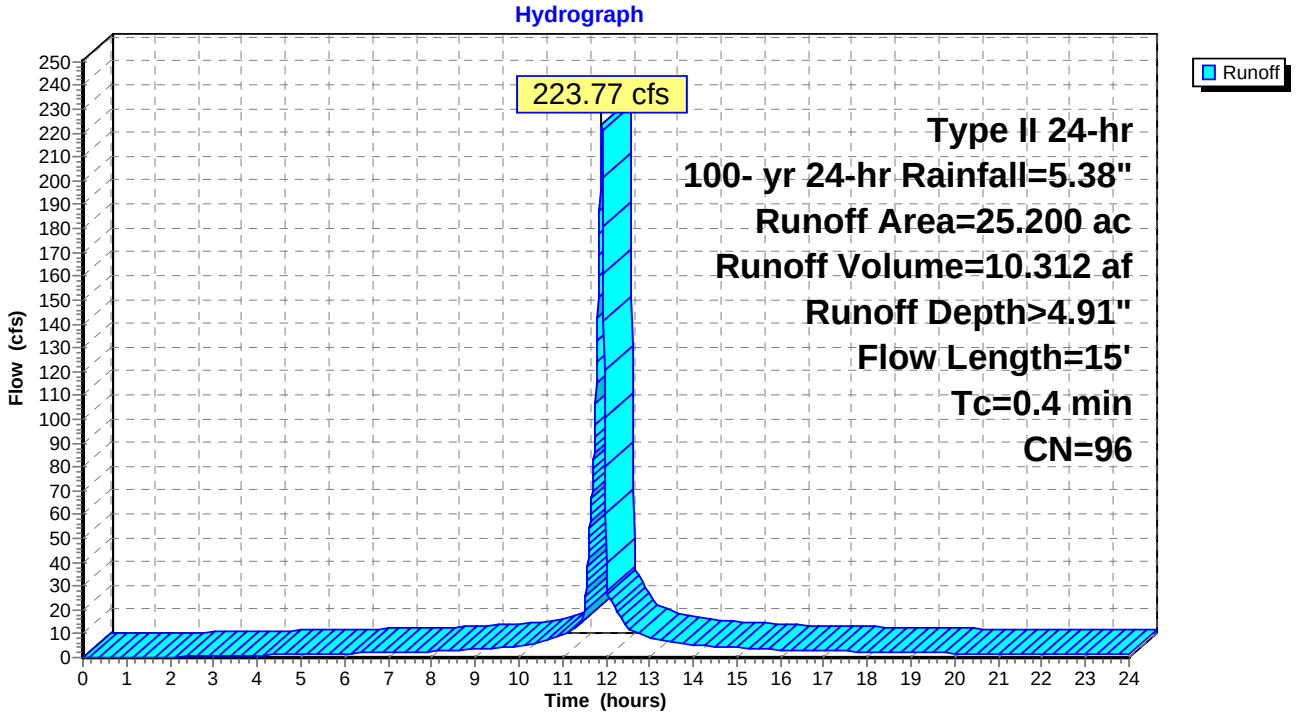
Runoff = 223.77 cfs @ 11.90 hrs, Volume= 10.312 af, Depth> 4.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 21.000 | 98 | |
| | 4.200 | 86 | Fallow, bare soil, HSG B |
| | 25.200 | 96 | Weighted Average |
| | 4.200 | | 16.67% Pervious Area |
| | 21.000 | | 83.33% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, OAI Subcat** |

## Subcatchment FI Subcat: Former Impoundment Surface



## Summary for Subcatchment LD Subcat: Lake Delta

[49] Hint: Tc<2dt may require smaller dt

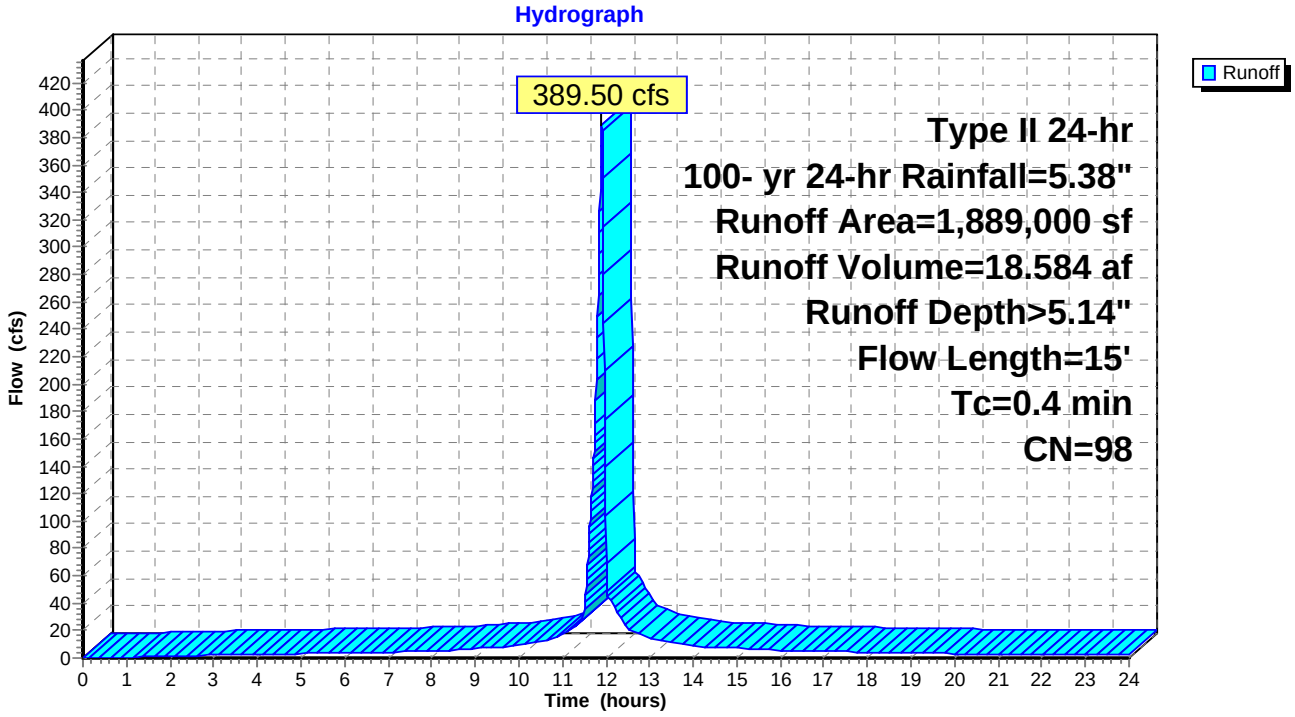
Runoff = 389.50 cfs @ 11.90 hrs, Volume= 18.584 af, Depth> 5.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,889,000 | 98 | |
| | 1,889,000 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry,** |

## Subcatchment LD Subcat: Lake Delta



## Summary for Subcatchment RP Subcat: Ret Basin Surface

[49] Hint: Tc<2dt may require smaller dt

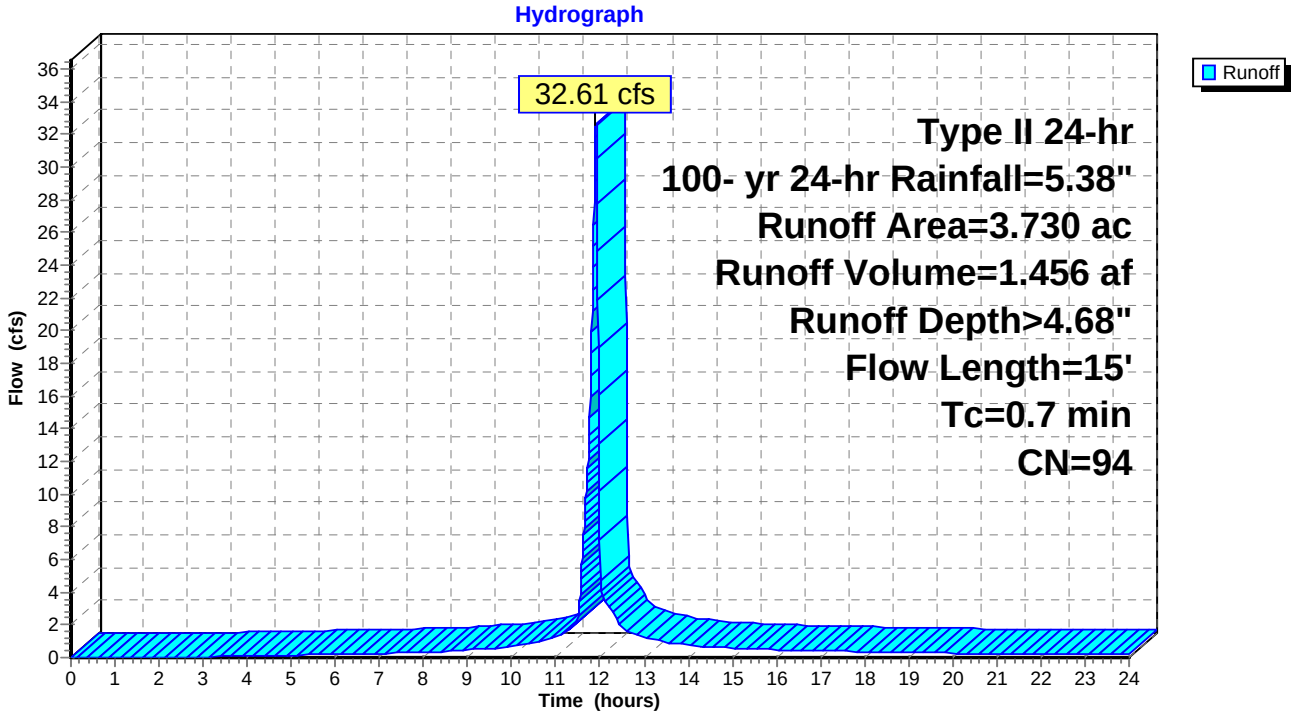
Runoff = 32.61 cfs @ 11.91 hrs, Volume= 1.456 af, Depth> 4.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.600 | 98 | |
| | 1.130 | 86 | Fallow, bare soil, HSG B |
| | 3.730 | 94 | Weighted Average |
| | 1.130 | | 30.29% Pervious Area |
| | 2.600 | | 69.71% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.7 | 15 | | 0.36 | | **Direct Entry, Ret Basin Surface** |

## Subcatchment RP Subcat: Ret Basin Surface



## Summary for Reach HD: Hollys Drain

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

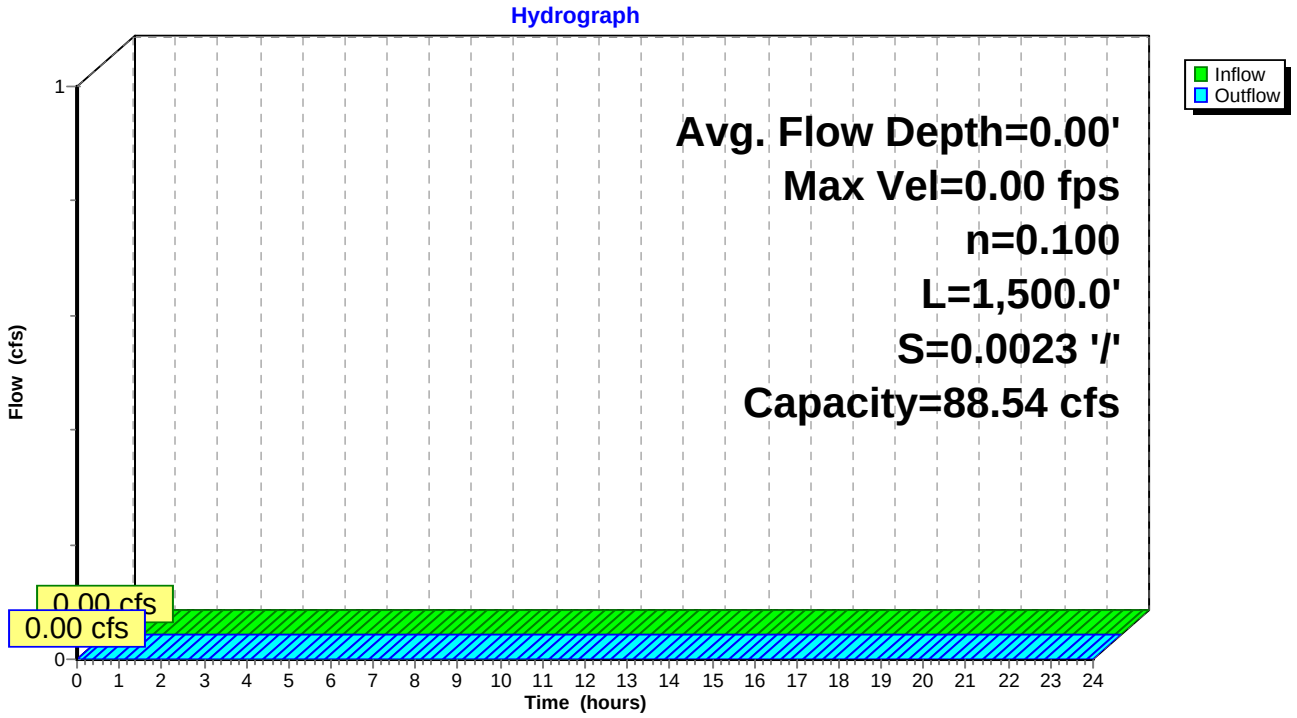
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00' Flow Area= 72.0 sf, Capacity= 88.54 cfs

18.00' x 3.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 '/' Top Width= 30.00'
Length= 1,500.0' Slope= 0.0023 '/'
Inlet Invert= 874.90', Outlet Invert= 871.50'

‡

## Reach HD: Hollys Drain



## Summary for Reach Wetlands: Wetlands

No flow reaches this point

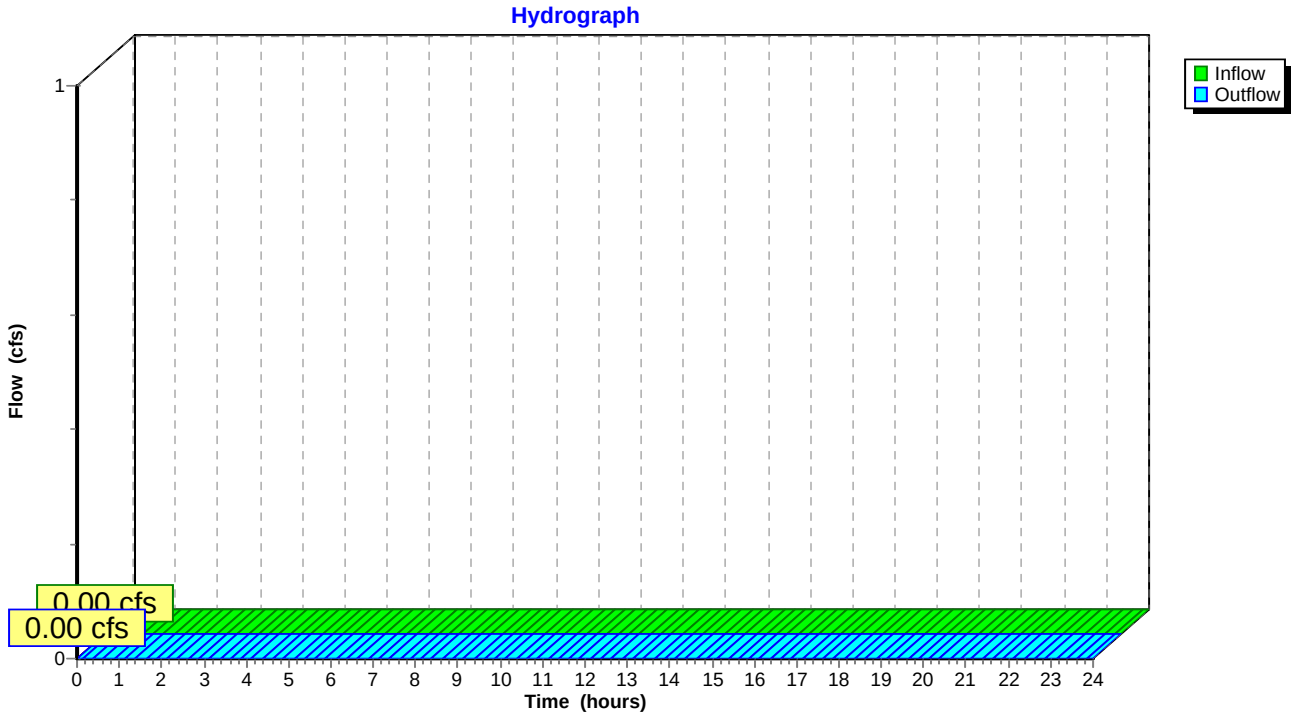
---

[40] Hint: Not Described (Outflow=Inflow)

| | | | | | |
|---|---|---|---|---|---|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Reach Wetlands: Wetlands



## Summary for Pond CSP: Coal Sump Pump

[58] Hint: Peaked 203.63' above defined flood level

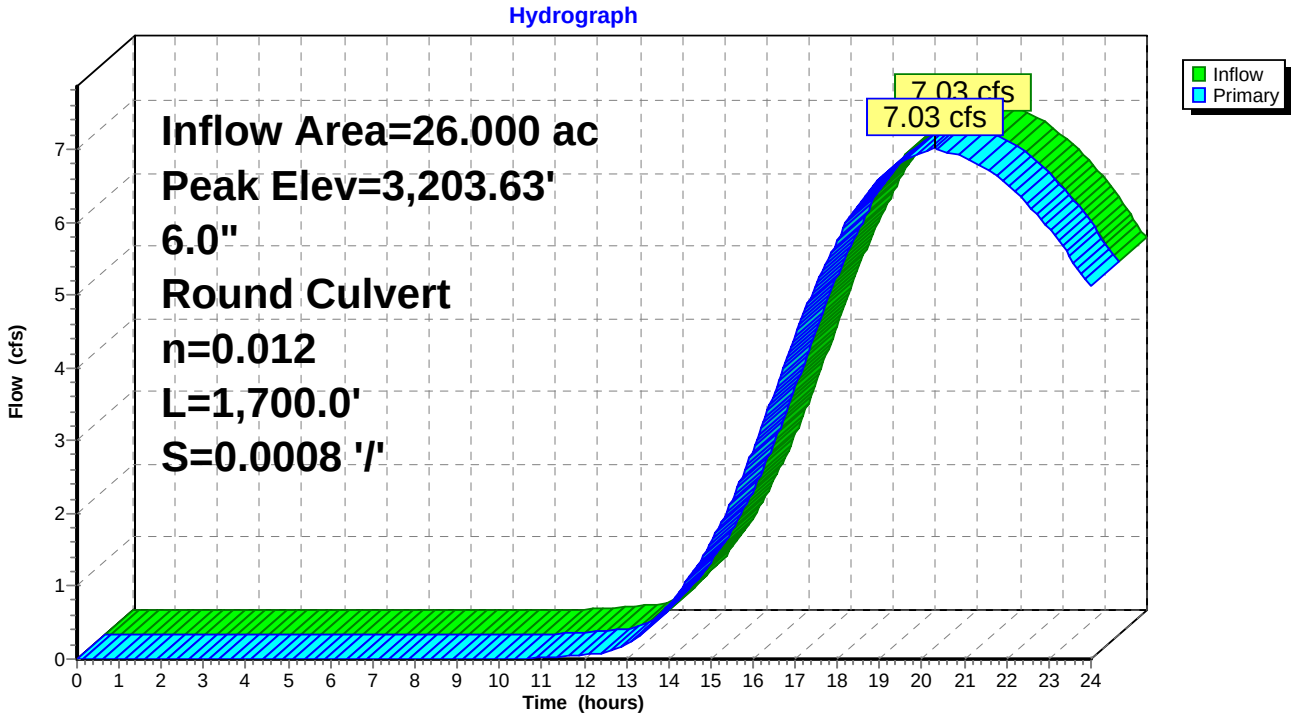
Inflow Area = 26.000 ac, 0.00% Impervious, Inflow Depth > 1.96" for 100- yr 24-hr event
Inflow = 7.03 cfs @ 20.29 hrs, Volume= 4.240 af
Outflow = 7.03 cfs @ 20.29 hrs, Volume= 4.240 af, Atten= 0%, Lag= 0.0 min
Primary = 7.03 cfs @ 20.29 hrs, Volume= 4.240 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 3,203.63' @ 20.29 hrs
Flood Elev= 3,000.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 883.00' | **6.0" Round Culvert**<br>L= 1,700.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 883.00' / 881.60' S= 0.0008 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.20 sf |

**Primary OutFlow** Max=7.03 cfs @ 20.29 hrs HW=3,203.37' TW=883.52' (Dynamic Tailwater)
└**1=Culvert** (Outlet Controls 7.03 cfs @ 35.81 fps)

## Pond CSP: Coal Sump Pump



## Summary for Pond CWP: Clear Water Pond

[80] Warning: Exceeded Pond Fl by 10.71' @ 0.31 hrs (3.53 cfs 10.810 af)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.61" for 100- yr 24-hr event
Inflow = 55.21 cfs @ 11.90 hrs, Volume= 14.371 af
Outflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 89%, Lag= 0.0 min
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.70' Surf.Area= 163,599 sf Storage= 1,242,582 cf
Peak Elev= 882.41' @ 24.00 hrs Surf.Area= 167,768 sf Storage= 1,360,282 cf (117,700 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 870.00' | 2,000,903 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

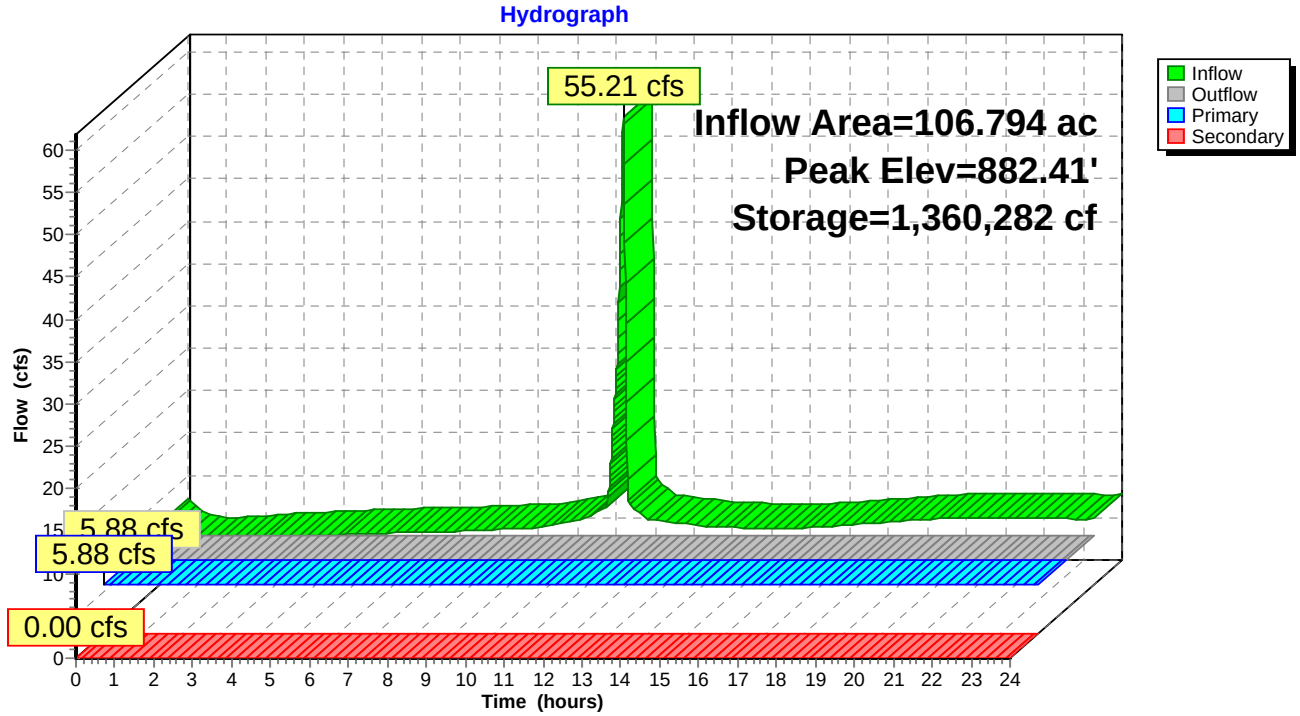
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 870.00 | 38,520 | 825.0 | 0 | 0 | 38,520 |
| 873.00 | 68,125 | 1,325.0 | 157,872 | 157,872 | 124,127 |
| 874.00 | 72,131 | 1,433.2 | 70,118 | 227,990 | 147,915 |
| 875.00 | 98,274 | 1,367.7 | 84,866 | 312,856 | 162,582 |
| 876.00 | 116,945 | 1,983.7 | 107,474 | 420,331 | 326,875 |
| 877.00 | 131,376 | 1,724.1 | 124,091 | 544,421 | 403,494 |
| 878.00 | 139,814 | 1,693.0 | 135,573 | 679,994 | 412,122 |
| 879.00 | 146,808 | 1,706.5 | 143,297 | 823,291 | 416,150 |
| 880.00 | 153,167 | 1,730.0 | 149,976 | 973,267 | 422,802 |
| 881.00 | 159,394 | 1,754.5 | 156,270 | 1,129,538 | 429,816 |
| 882.00 | 165,418 | 1,777.3 | 162,397 | 1,291,934 | 436,463 |
| 883.00 | 171,176 | 1,796.5 | 168,289 | 1,460,223 | 442,208 |
| 884.00 | 177,068 | 1,818.2 | 174,114 | 1,634,337 | 448,706 |
| 885.00 | 183,257 | 1,842.6 | 180,154 | 1,814,490 | 456,046 |
| 886.00 | 189,586 | 1,885.9 | 186,413 | 2,000,903 | 469,028 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 870.60' | **Pump**<br>Discharges@880.00' Turns Off@870.10'<br>36.0" Diam. x 2,900.0' Long Discharge, Hazen-Williams C= 130<br>Flow (gpm)= 2,640.0<br>Head (feet)= 50.00<br>-Loss (feet)= 0.21<br>=Lift (feet)= 49.79 |
| #2 | Secondary | 875.90' | **Tube/Siphon/Float Valve** Discharges@872.80'<br>36.000" Diameter, C= 0.600<br>62.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 883.60' | **36.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=5.88 cfs @ 0.00 hrs HW=881.70' TW=0.00' (Dynamic Tailwater)
└**1=Pump** (Pump Controls 5.88 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=881.70' TW=874.90' (Dynamic Tailwater)
└**2=Tube/Siphon/Float Valve** (Passes 0.00 cfs of 84.57 cfs potential flow)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond CWP: Clear Water Pond



## Summary for Pond ES: Erickson Power Station

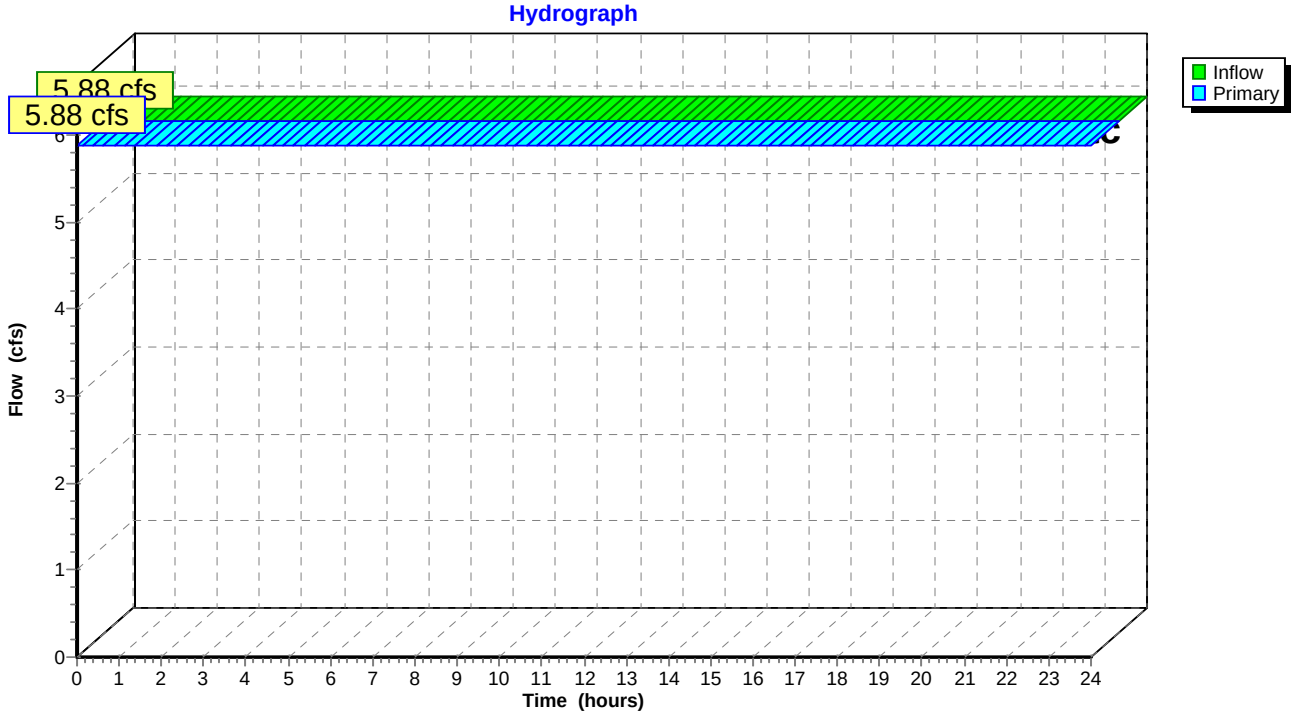
Shows flow back to Power Station

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.31" for 100- yr 24-hr event
Inflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Pond ES: Erickson Power Station



## Summary for Pond F: Forebay

[80] Warning: Exceeded Pond CSP by 0.19' @ 8.39 hrs (0.01 cfs 0.005 af)

Inflow Area = 28.760 ac, 6.95% Impervious, Inflow Depth > 7.10" for 100- yr 24-hr event
Inflow = 30.24 cfs @ 11.90 hrs, Volume= 17.010 af, Incl. 5.88 cfs Base Flow
Outflow = 12.67 cfs @ 21.55 hrs, Volume= 15.870 af, Atten= 58%, Lag= 578.7 min
Primary = 12.67 cfs @ 21.55 hrs, Volume= 15.870 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 883.00' Surf.Area= 0 sf Storage= 836,526 cf
Peak Elev= 883.54' @ 21.90 hrs Surf.Area= 0 sf Storage= 888,395 cf (51,869 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 14.9 min ( 854.2 - 839.3 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 932,837 cf | **Custom Stage Data** Listed below |

| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 14,201 |
| 872.50 | 42,819 |
| 873.00 | 72,222 |
| 873.50 | 102,366 |
| 874.00 | 133,337 |
| 874.50 | 165,092 |
| 875.00 | 197,675 |
| 875.50 | 231,086 |
| 876.00 | 265,324 |
| 876.50 | 300,433 |
| 877.00 | 336,327 |
| 877.50 | 373,135 |
| 878.00 | 410,771 |
| 878.50 | 449,278 |
| 879.00 | 488,700 |
| 879.50 | 528,949 |
| 880.00 | 570,157 |
| 880.50 | 612,236 |
| 881.00 | 655,230 |
| 881.50 | 699,138 |
| 882.00 | 744,005 |
| 882.50 | 789,786 |
| 883.00 | 836,526 |
| 883.50 | 884,181 |
| 884.00 | 932,837 |

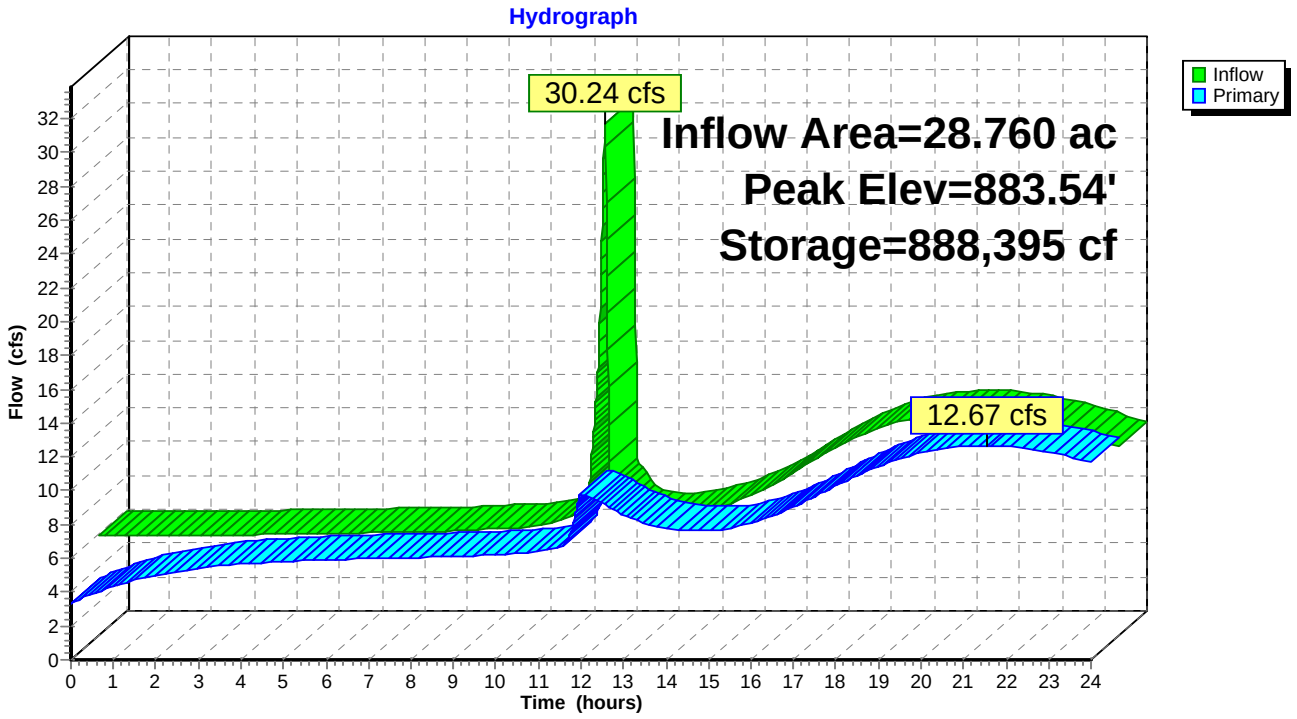
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 882.40' | **24.0" Round CMP_Round 24" (West)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.40' / 881.60' S= 0.0140 '/' Cc= 0.900 |

n= 0.025, Flow Area= 3.14 sf

| | | | |
|---|---|---|---|
| #2 | Primary | 882.50' | **24.0" Round CMP_Round 24" (Center)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.50' / 881.40' S= 0.0192 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |
| #3 | Primary | 882.60' | **24.0" Round CMP_Round 24" (East)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.60' / 881.70' S= 0.0157 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |

**Primary OutFlow** Max=12.67 cfs @ 21.55 hrs HW=883.54' TW=882.41' (Dynamic Tailwater)
- **1=CMP_Round 24" (West)** (Barrel Controls 4.84 cfs @ 3.76 fps)
- **2=CMP_Round 24" (Center)** (Outlet Controls 4.25 cfs @ 3.73 fps)
- **3=CMP_Round 24" (East)** (Outlet Controls 3.59 cfs @ 3.61 fps)

## Pond F: Forebay



## Summary for Pond FI: Former Impoundment

Evaporation losses are smaller than HydroCAD will allow

Inflow Area = 25.200 ac, 83.33% Impervious, Inflow Depth > 5.71" for 100- yr 24-hr event
Inflow = 224.36 cfs @ 11.90 hrs, Volume= 11.981 af
Outflow = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af, Atten= 100%, Lag= 0.0 min
Discarded = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 871.78' @ 24.00 hrs Surf.Area= 750,021 sf Storage= 520,956 cf

Plug-Flow detention time= 667.7 min calculated for 0.020 af (0% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.00' | 15,127,104 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

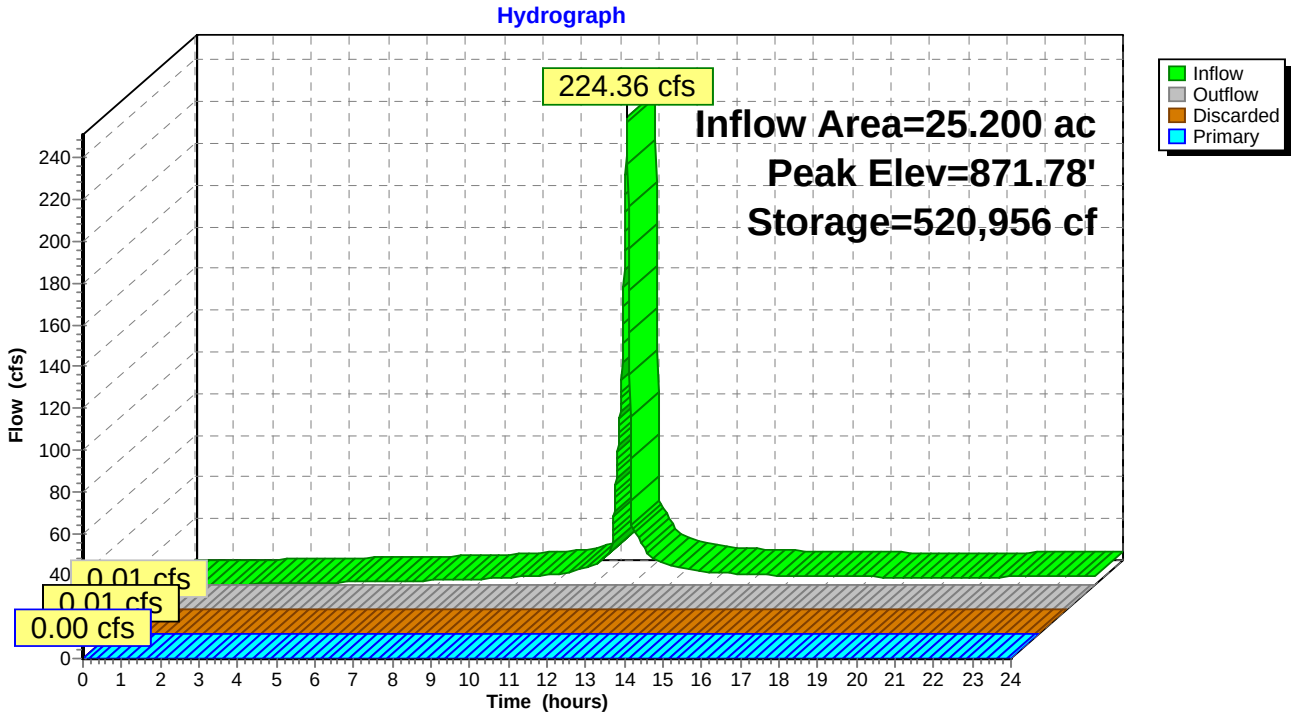
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 871.00 | 589,714 | 5,113.4 | 0 | 0 | 589,714 |
| 872.00 | 798,841 | 3,687.0 | 691,638 | 691,638 | 1,588,651 |
| 873.00 | 874,915 | 3,740.0 | 836,590 | 1,528,227 | 1,620,194 |
| 874.00 | 931,119 | 3,806.0 | 902,871 | 2,431,099 | 1,660,006 |
| 875.00 | 974,344 | 3,749.0 | 952,650 | 3,383,748 | 1,694,483 |
| 876.00 | 997,423 | 3,777.0 | 985,861 | 4,369,609 | 1,711,669 |
| 877.00 | 1,013,146 | 3,800.0 | 1,005,274 | 5,374,884 | 1,726,045 |
| 878.00 | 1,027,210 | 3,824.0 | 1,020,170 | 6,395,054 | 1,741,096 |
| 879.00 | 1,042,705 | 3,854.0 | 1,034,948 | 7,430,001 | 1,759,824 |
| 880.00 | 1,062,406 | 3,898.0 | 1,052,540 | 8,482,542 | 1,787,242 |
| 881.00 | 1,080,953 | 3,922.0 | 1,071,666 | 9,554,208 | 1,802,681 |
| 882.00 | 1,094,577 | 3,944.0 | 1,087,758 | 10,641,966 | 1,817,002 |
| 883.00 | 1,107,455 | 3,964.0 | 1,101,010 | 11,742,975 | 1,830,195 |
| 884.00 | 1,121,020 | 3,989.0 | 1,114,231 | 12,857,206 | 1,846,509 |
| 886.00 | 1,148,935 | 4,048.0 | 2,269,898 | 15,127,104 | 1,885,090 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 871.00' | **0.01 cfs Exfiltration at all elevations** |
| #2 | Primary | 880.80' | **24.0" Round CMP_Round 24"**<br>L= 15.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 880.80' / 871.40' S= 0.6267 '/' Cc= 0.900<br>n= 0.012, Flow Area= 3.14 sf |

**Discarded OutFlow** Max=0.01 cfs @ 0.01 hrs HW=871.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=871.00' TW=881.70' (Dynamic Tailwater)
↑**2=CMP_Round 24"** ( Controls 0.00 cfs)

## Pond FI: Former Impoundment



## Summary for Pond LD: Lake Delta

Inflow Area = 43.365 ac,100.00% Impervious, Inflow Depth > 5.14" for 100- yr 24-hr event
Inflow = 389.50 cfs @ 11.90 hrs, Volume= 18.584 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 882.50' Surf.Area= 1,845,931 sf Storage= 922,206 cf
Peak Elev= 882.94' @ 24.00 hrs Surf.Area= 1,848,597 sf Storage= 1,731,679 cf (809,473 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

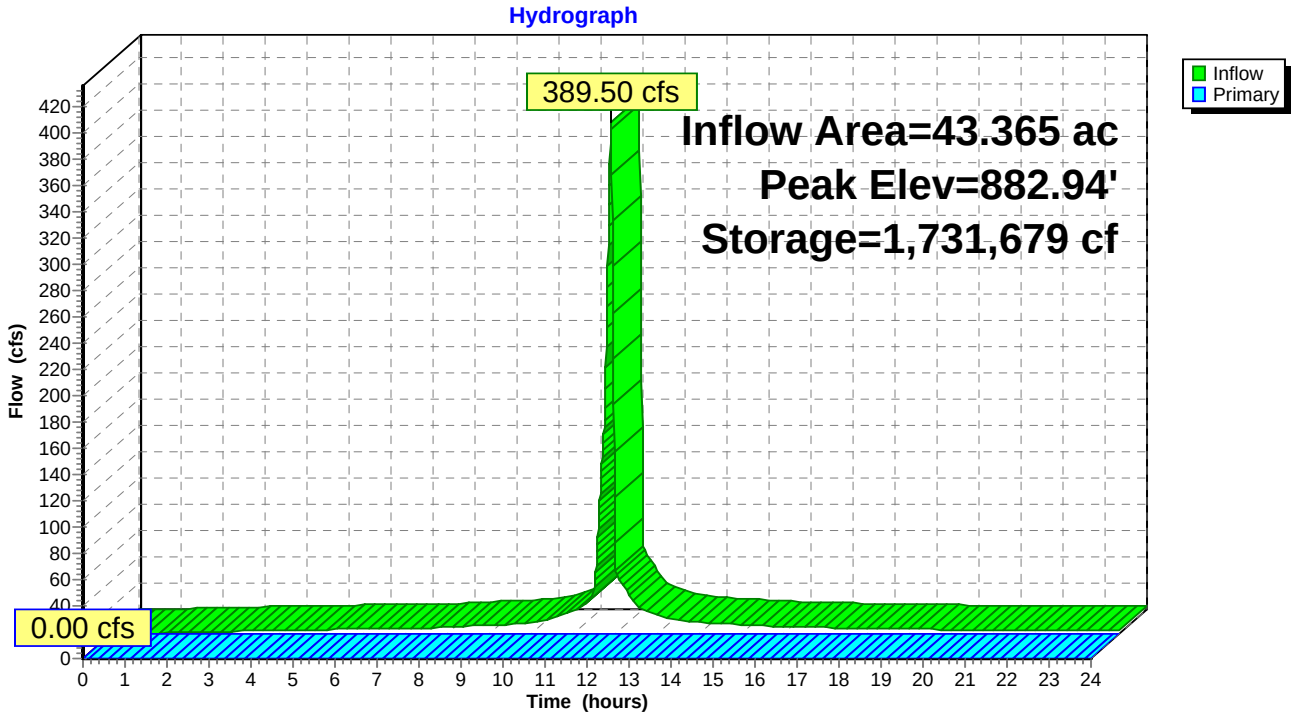
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 882.00' | 7,455,884 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 882.00 | 1,842,892 | 5,054.0 | 0 | 0 | 1,842,892 |
| 883.00 | 1,848,973 | 5,062.1 | 1,845,932 | 1,845,932 | 1,851,144 |
| 884.00 | 1,863,004 | 5,083.3 | 1,855,984 | 3,701,916 | 1,868,996 |
| 885.00 | 1,877,648 | 5,107.6 | 1,870,321 | 5,572,237 | 1,889,351 |
| 886.00 | 1,889,653 | 5,131.1 | 1,883,647 | 7,455,884 | 1,909,170 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 886.10' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>3.0' Crest Height |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=882.50' TW=881.70' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond LD: Lake Delta



## Summary for Pond RP: Retention Pond

Inflow Area = 32.490 ac, 14.16% Impervious, Inflow Depth > 6.40" for 100- yr 24-hr event
Inflow = 41.69 cfs @ 11.91 hrs, Volume= 17.326 af
Outflow = 10.07 cfs @ 24.00 hrs, Volume= 13.801 af, Atten= 76%, Lag= 725.5 min
Primary = 7.59 cfs @ 21.74 hrs, Volume= 12.131 af
Secondary = 2.62 cfs @ 24.00 hrs, Volume= 1.669 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.80' Surf.Area= 0 sf Storage= 878,134 cf
Peak Elev= 882.51' @ 24.00 hrs Surf.Area= 0 sf Storage= 1,031,792 cf (153,658 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 1,298,407 cf | **Custom Stage Data** Listed below |

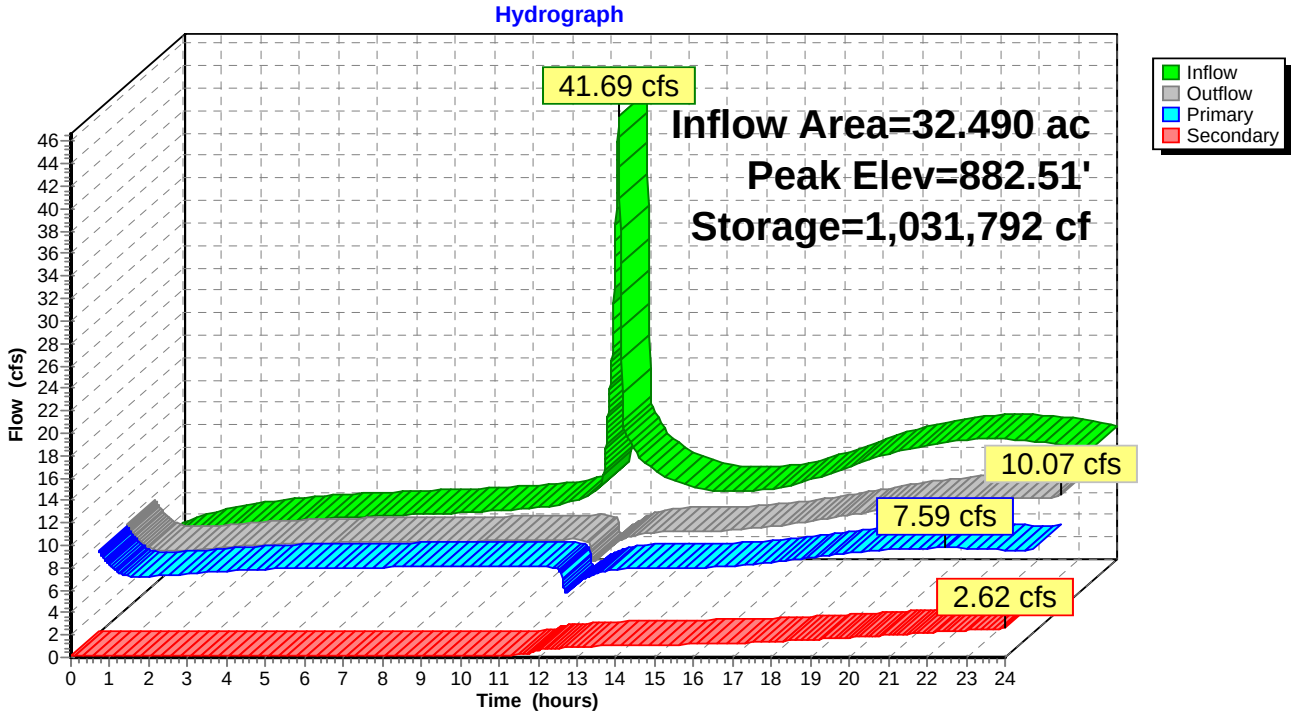
| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 20,136 |
| 872.50 | 52,477 |
| 873.00 | 85,710 |
| 873.50 | 119,843 |
| 874.00 | 154,886 |
| 874.50 | 190,848 |
| 875.00 | 227,738 |
| 875.50 | 265,563 |
| 876.00 | 304,335 |
| 876.50 | 344,061 |
| 877.00 | 384,750 |
| 877.50 | 426,412 |
| 878.00 | 469,055 |
| 878.50 | 512,689 |
| 879.00 | 554,027 |
| 879.50 | 604,982 |
| 880.00 | 662,312 |
| 880.50 | 720,757 |
| 881.00 | 780,327 |
| 881.50 | 841,028 |
| 882.00 | 902,872 |
| 882.50 | 1,030,019 |
| 883.00 | 1,095,341 |
| 883.50 | 1,161,840 |
| 884.00 | 1,161,841 |
| 884.50 | 1,229,526 |
| 885.00 | 1,298,407 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Secondary | 881.50' | **24.0" Round Culvert**<br>L= 69.8' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 881.50' / 881.50' S= 0.0000 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf |
| #2 | Primary | 874.00' | **Tube/Siphon/Float Valve** Discharges@871.40'<br>36.000" Diameter, C= 0.600<br>491.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 880.50' | **72.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=7.59 cfs @ 21.74 hrs HW=882.42' TW=882.32' (Dynamic Tailwater)
└─**2=Tube/Siphon/Float Valve** (Tube Controls 7.59 cfs @ 1.07 fps)
└─**3=Orifice/Grate** (Passes 7.59 cfs of 44.50 cfs potential flow)

**Secondary OutFlow** Max=2.62 cfs @ 24.00 hrs HW=882.51' TW=871.78' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 2.62 cfs @ 2.39 fps)

## Pond RP: Retention Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 5
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment Coal: Coal Pile** Runoff Area=26.000 ac 0.00% Impervious Runoff Depth>3.60"
Flow Length=1,780' Tc=629.8 min CN=79 Runoff=12.69 cfs 7.809 af

**Subcatchment CWP Subcat: Clear Water** Runoff Area=5.739 ac 62.73% Impervious Runoff Depth>7.39"
Flow Length=15' Tc=0.4 min CN=94 Runoff=76.79 cfs 3.535 af

**Subcatchment F Subcat: Forebay Surface** Runoff Area=2.760 ac 72.46% Impervious Runoff Depth>7.51"
Flow Length=15' Tc=0.4 min CN=95 Runoff=37.10 cfs 1.727 af

**Subcatchment FI Subcat: Former** Runoff Area=25.200 ac 83.33% Impervious Runoff Depth>7.63"
Flow Length=15' Tc=0.4 min CN=96 Runoff=340.11 cfs 16.024 af

**Subcatchment LD Subcat: Lake Delta** Runoff Area=1,889,000 sf 100.00% Impervious Runoff Depth>7.87"
Flow Length=15' Tc=0.4 min CN=98 Runoff=588.46 cfs 28.440 af

**Subcatchment RP Subcat: Ret Basin** Runoff Area=3.730 ac 69.71% Impervious Runoff Depth>7.39"
Flow Length=15' Tc=0.7 min CN=94 Runoff=50.00 cfs 2.297 af

**Reach HD: Hollys Drain** Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.100 L=1,500.0' S=0.0023 '/' Capacity=88.54 cfs Outflow=0.00 cfs 0.000 af

**Reach Wetlands: Wetlands** Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

**Pond CSP: Coal Sump Pump** Peak Elev=8,433.48' Inflow=12.69 cfs 7.809 af
6.0" Round Culvert n=0.012 L=1,700.0' S=0.0008 '/' Outflow=12.69 cfs 7.809 af

**Pond CWP: Clear Water Pond** Peak Elev=882.95' Storage=1,451,480 cf Inflow=76.80 cfs 16.465 af
Primary=5.88 cfs 11.671 af Secondary=0.00 cfs 0.000 af Outflow=5.88 cfs 11.671 af

**Pond ES: Erickson Power Station** Inflow=5.88 cfs 11.671 af
Primary=5.88 cfs 11.671 af

**Pond F: Forebay** Peak Elev=883.87' Storage=919,842 cf Inflow=43.22 cfs 21.204 af
Outflow=17.64 cfs 19.337 af

**Pond FI: Former Impoundment** Peak Elev=872.19' Storage=848,352 cf Inflow=340.99 cfs 19.499 af
Discarded=0.01 cfs 0.020 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.020 af

**Pond LD: Lake Delta** Peak Elev=883.17' Storage=2,161,006 cf Inflow=588.46 cfs 28.440 af
Outflow=0.00 cfs 0.000 af

**Pond RP: Retention Pond** Peak Elev=883.08' Storage=1,106,014 cf Inflow=61.14 cfs 21.634 af
Primary=9.83 cfs 12.930 af Secondary=6.12 cfs 3.475 af Outflow=14.97 cfs 16.405 af

**Total Runoff Area = 106.794 ac Runoff Volume = 59.833 af Average Runoff Depth = 6.72"**
**32.05% Pervious = 34.229 ac 67.95% Impervious = 72.565 ac**

## Summary for Subcatchment Coal: Coal Pile

Information from MD & E

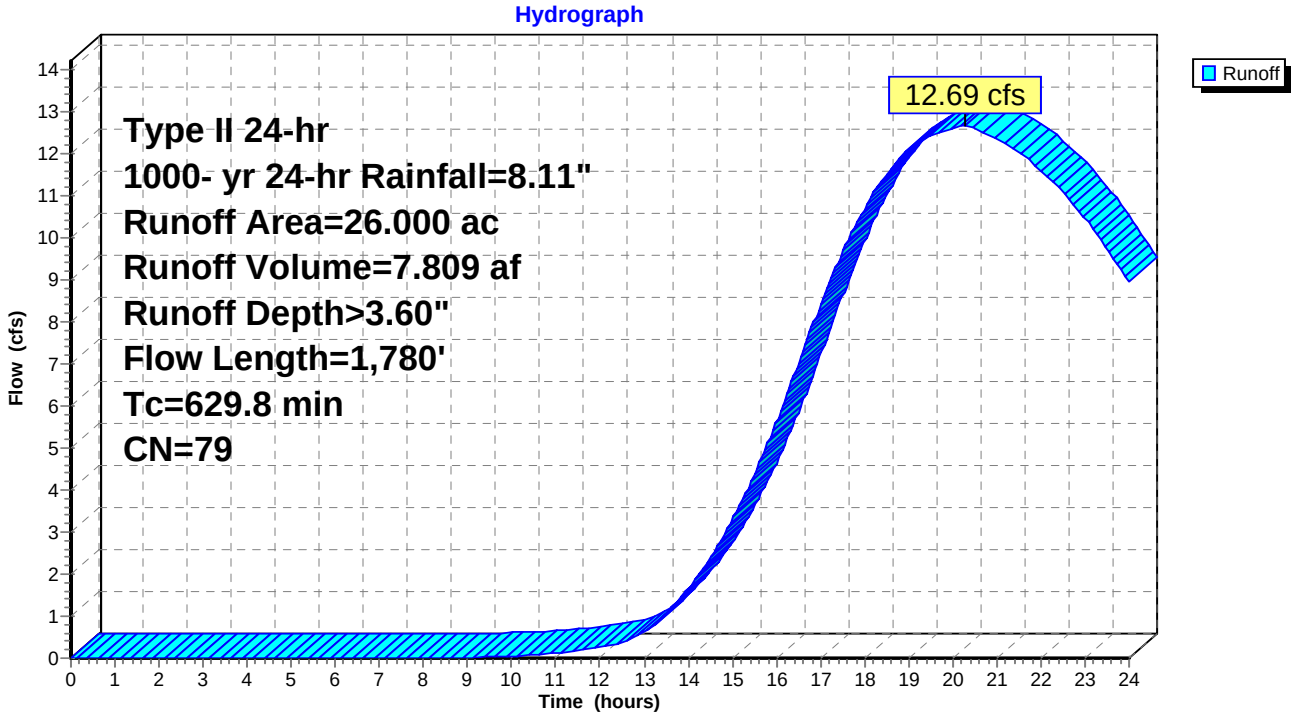
Runoff = 12.69 cfs @ 20.29 hrs, Volume= 7.809 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000- yr 24-hr Rainfall=8.11"

| Area (ac) | CN | Description |
|---|---|---|
| 26.000 | 79 | Pasture/grassland/range, Poor, HSG B |
| 26.000 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 629.8 | 1,780 | | 0.05 | | **Direct Entry, Coal Pile Runoff** |

### Subcatchment Coal: Coal Pile



## Summary for Subcatchment CWP Subcat: Clear Water Pond Surface

[49] Hint: Tc<2dt may require smaller dt

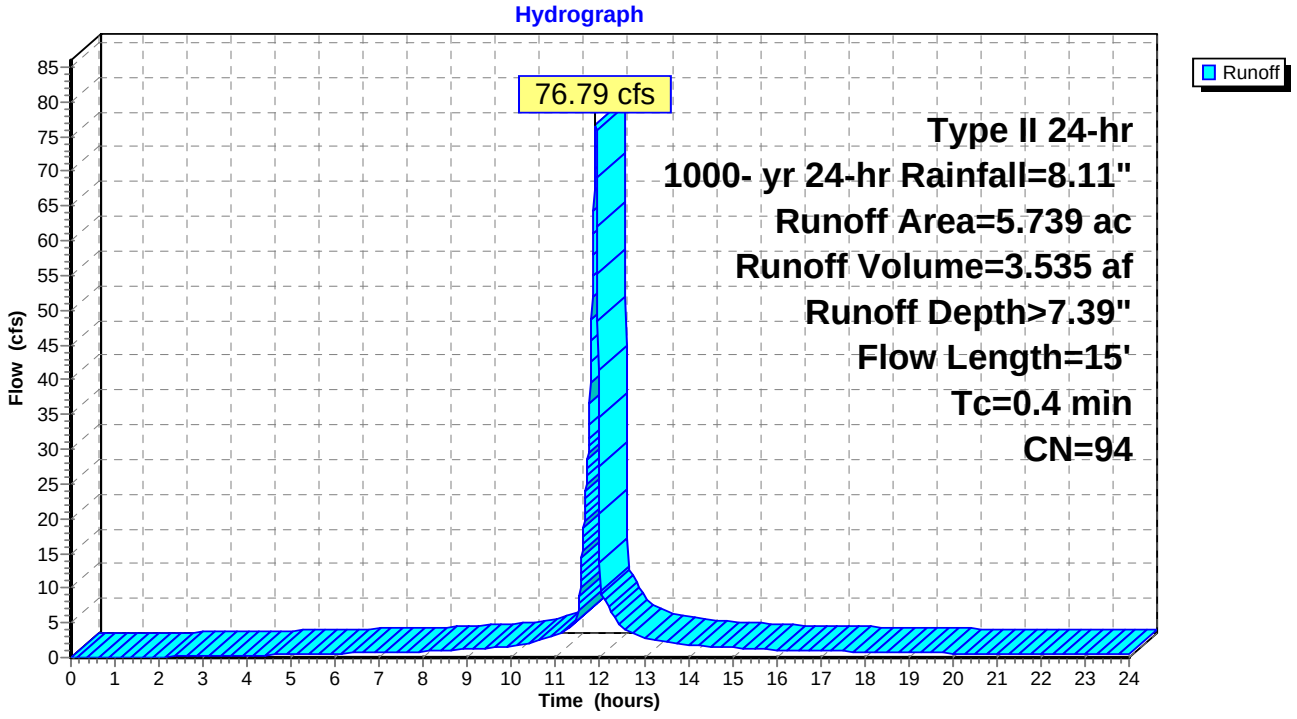
Runoff = 76.79 cfs @ 11.90 hrs, Volume= 3.535 af, Depth> 7.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000- yr 24-hr Rainfall=8.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 3.600 | 98 | |
| | 2.139 | 86 | Fallow, bare soil, HSG B |
| | 5.739 | 94 | Weighted Average |
| | 2.139 | | 37.27% Pervious Area |
| | 3.600 | | 62.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Clear Water Pond Subcat** |

## Subcatchment CWP Subcat: Clear Water Pond Surface



## Summary for Subcatchment F Subcat: Forebay Surface

[49] Hint: Tc<2dt may require smaller dt

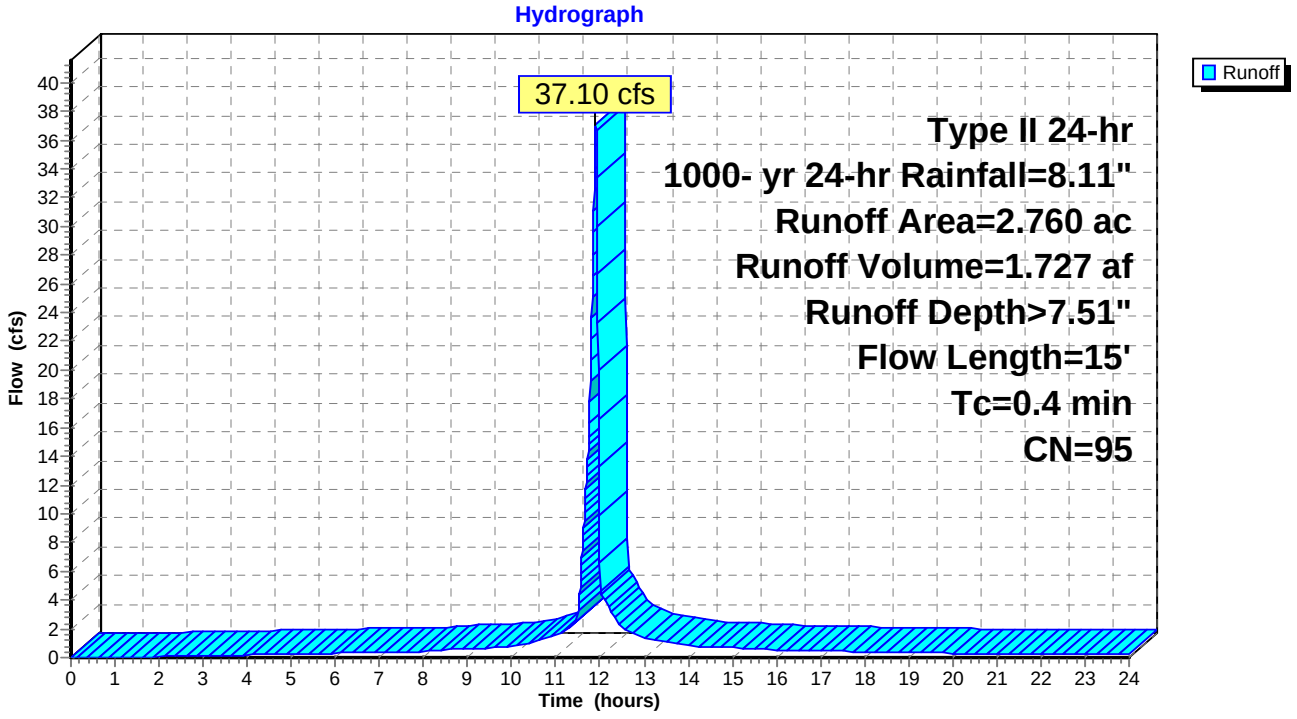
Runoff = 37.10 cfs @ 11.90 hrs, Volume= 1.727 af, Depth> 7.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000- yr 24-hr Rainfall=8.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.000 | 98 | |
| | 0.760 | 86 | Fallow, bare soil, HSG B |
| | 2.760 | 95 | Weighted Average |
| | 0.760 | | 27.54% Pervious Area |
| | 2.000 | | 72.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, Forebay Surface** |

## Subcatchment F Subcat: Forebay Surface



## Summary for Subcatchment FI Subcat: Former Impoundment Surface

[49] Hint: Tc<2dt may require smaller dt

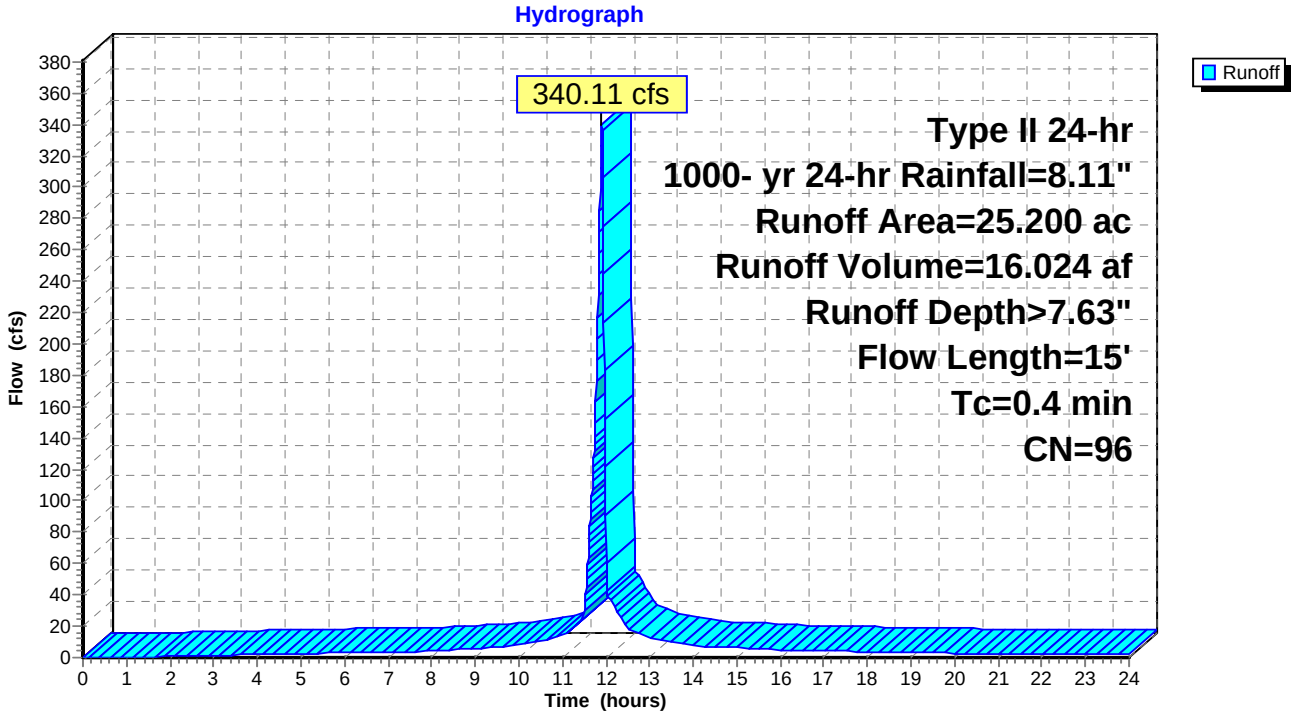
Runoff = 340.11 cfs @ 11.90 hrs, Volume= 16.024 af, Depth> 7.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000- yr 24-hr Rainfall=8.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 21.000 | 98 | |
| | 4.200 | 86 | Fallow, bare soil, HSG B |
| | 25.200 | 96 | Weighted Average |
| | 4.200 | | 16.67% Pervious Area |
| | 21.000 | | 83.33% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry, OAI Subcat** |

## Subcatchment FI Subcat: Former Impoundment Surface



## Summary for Subcatchment LD Subcat: Lake Delta

[49] Hint: Tc<2dt may require smaller dt

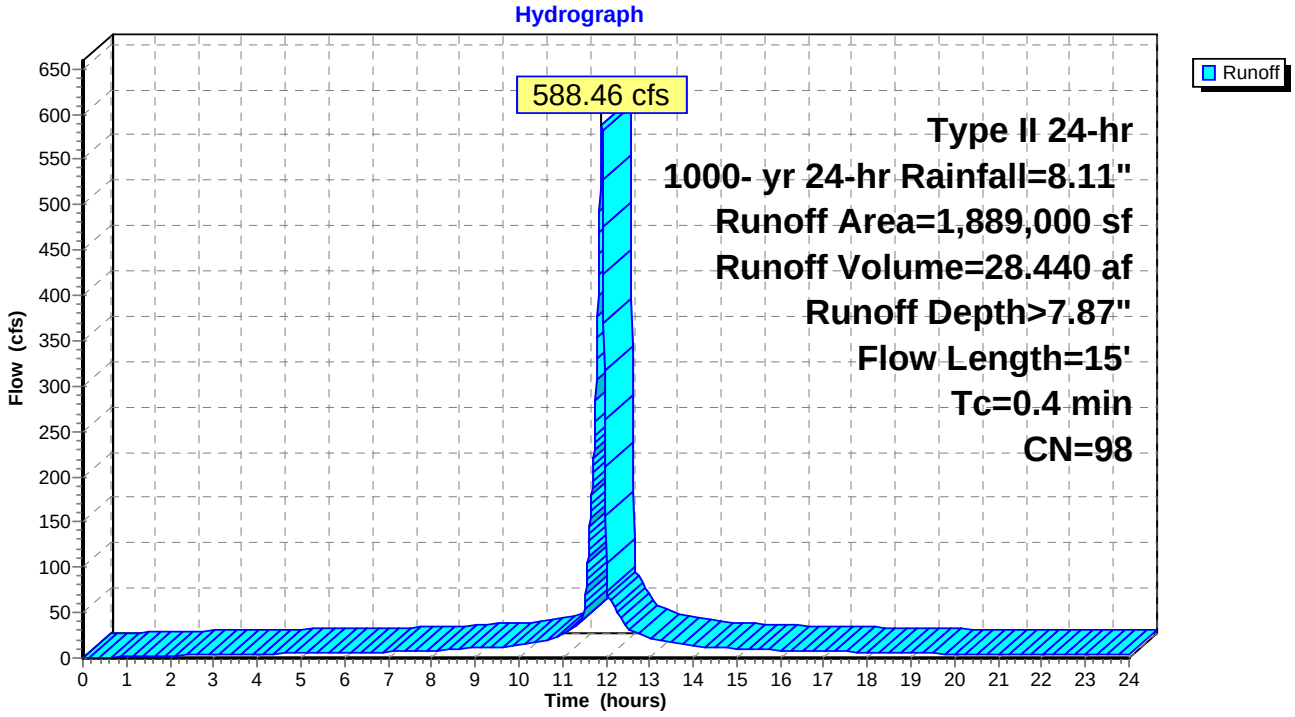
Runoff = 588.46 cfs @ 11.90 hrs, Volume= 28.440 af, Depth> 7.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000- yr 24-hr Rainfall=8.11"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 1,889,000 | 98 | |
| | 1,889,000 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.4 | 15 | | 0.63 | | **Direct Entry,** |

## Subcatchment LD Subcat: Lake Delta



## Summary for Subcatchment RP Subcat: Ret Basin Surface

[49] Hint: Tc<2dt may require smaller dt

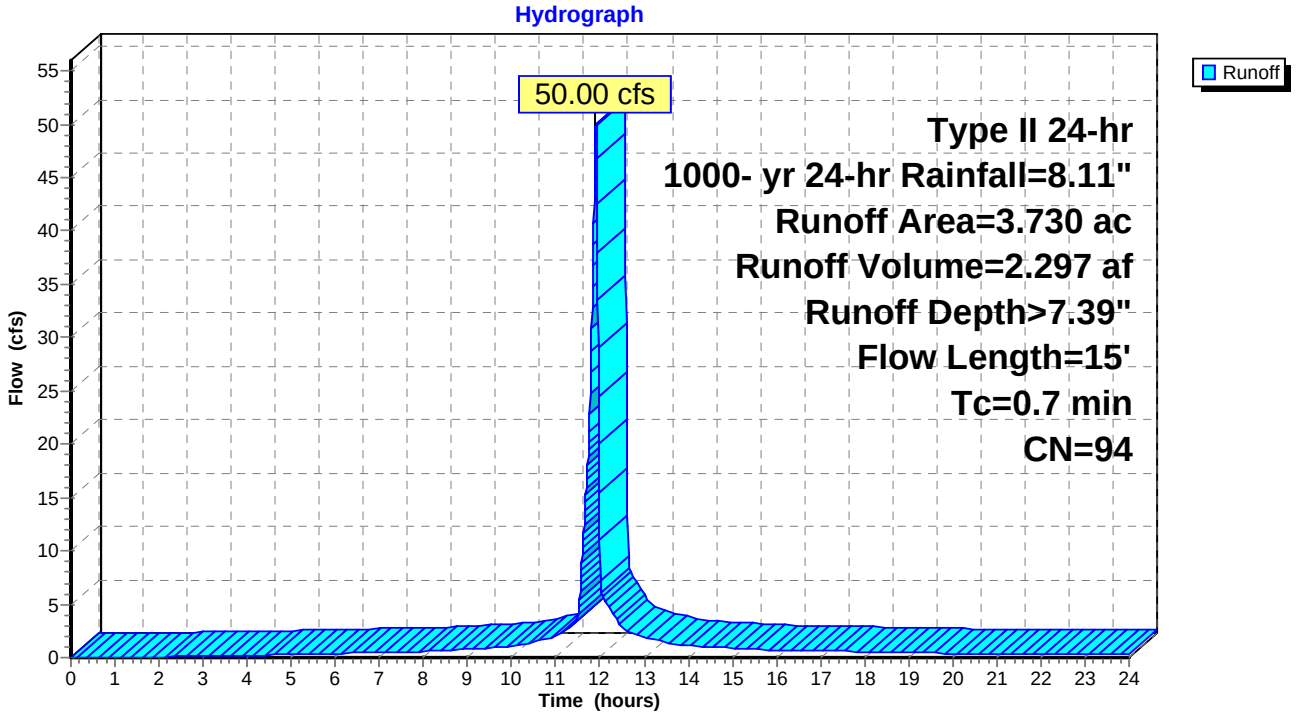
Runoff = 50.00 cfs @ 11.91 hrs, Volume= 2.297 af, Depth> 7.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000- yr 24-hr Rainfall=8.11"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 2.600 | 98 | |
| | 1.130 | 86 | Fallow, bare soil, HSG B |
| | 3.730 | 94 | Weighted Average |
| | 1.130 | | 30.29% Pervious Area |
| | 2.600 | | 69.71% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.7 | 15 | | 0.36 | | **Direct Entry, Ret Basin Surface** |

## Subcatchment RP Subcat: Ret Basin Surface



## Summary for Reach HD: Hollys Drain

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

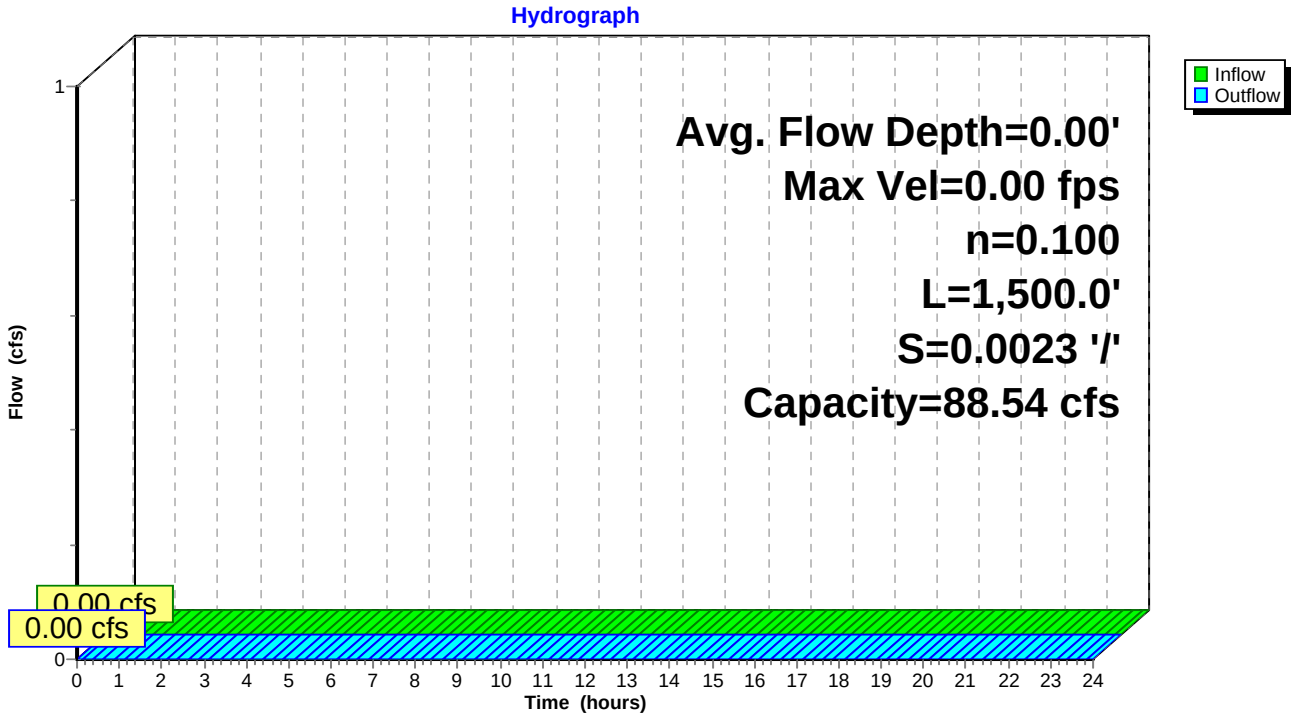
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00' Flow Area= 72.0 sf, Capacity= 88.54 cfs

18.00' x 3.00' deep channel, n= 0.100 Earth, dense brush, high stage
Side Slope Z-value= 2.0 '/' Top Width= 30.00'
Length= 1,500.0' Slope= 0.0023 '/'
Inlet Invert= 874.90', Outlet Invert= 871.50'

‡

## Reach HD: Hollys Drain



## Summary for Reach Wetlands: Wetlands

No flow reaches this point

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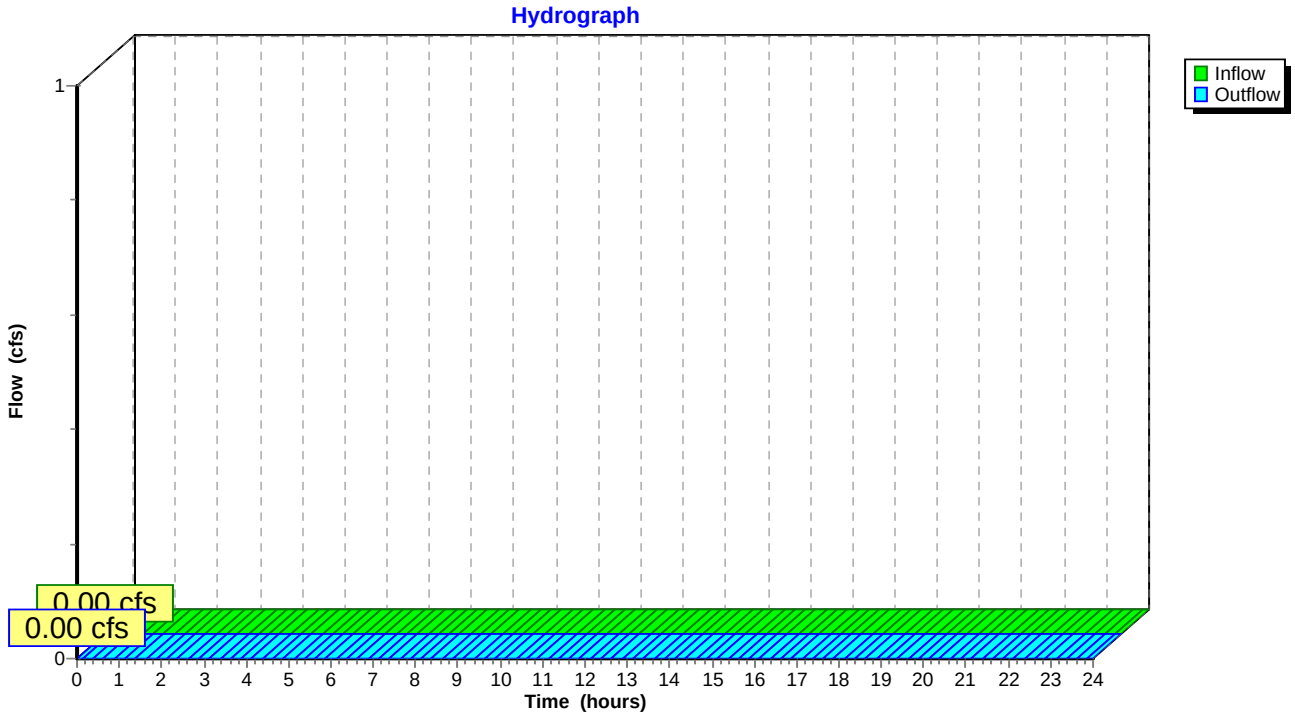
[40] Hint: Not Described (Outflow=Inflow)

| | | | | | |
|---|---|---|---|---|---|
| Inflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af |
| Outflow | = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af, Atten= 0%, Lag= 0.0 min |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Reach Wetlands: Wetlands



## Summary for Pond CSP: Coal Sump Pump

[58] Hint: Peaked 5,433.48' above defined flood level

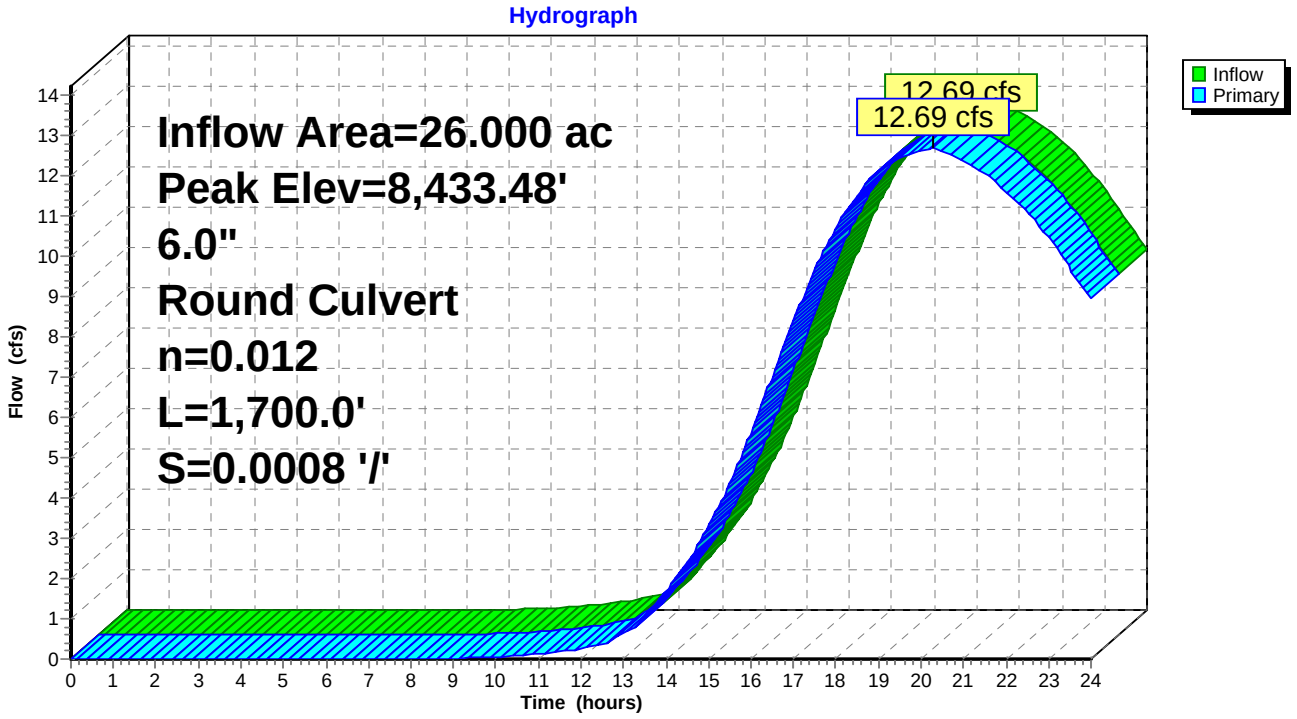
Inflow Area = 26.000 ac, 0.00% Impervious, Inflow Depth > 3.60" for 1000- yr 24-hr event
Inflow = 12.69 cfs @ 20.29 hrs, Volume= 7.809 af
Outflow = 12.69 cfs @ 20.29 hrs, Volume= 7.809 af, Atten= 0%, Lag= 0.0 min
Primary = 12.69 cfs @ 20.29 hrs, Volume= 7.809 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 8,433.48' @ 20.29 hrs
Flood Elev= 3,000.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 883.00' | **6.0" Round Culvert**<br>L= 1,700.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 883.00' / 881.60' S= 0.0008 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.20 sf |

**Primary OutFlow** Max=12.69 cfs @ 20.29 hrs HW=8,433.18' TW=883.81' (Dynamic Tailwater)
└**1=Culvert** (Outlet Controls 12.69 cfs @ 64.61 fps)

## Pond CSP: Coal Sump Pump



## Summary for Pond CWP: Clear Water Pond

[80] Warning: Exceeded Pond FI by 10.75' @ 23.99 hrs (12.80 cfs 13.483 af)
[80] Warning: Exceeded Pond RP by 0.06' @ 11.98 hrs (5.67 cfs 0.154 af)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.85" for 1000- yr 24-hr event
Inflow = 76.80 cfs @ 11.90 hrs, Volume= 16.465 af
Outflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 92%, Lag= 0.0 min
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.70' Surf.Area= 163,599 sf Storage= 1,242,582 cf
Peak Elev= 882.95' @ 24.00 hrs Surf.Area= 170,879 sf Storage= 1,451,480 cf (208,898 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 870.00' | 2,000,903 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

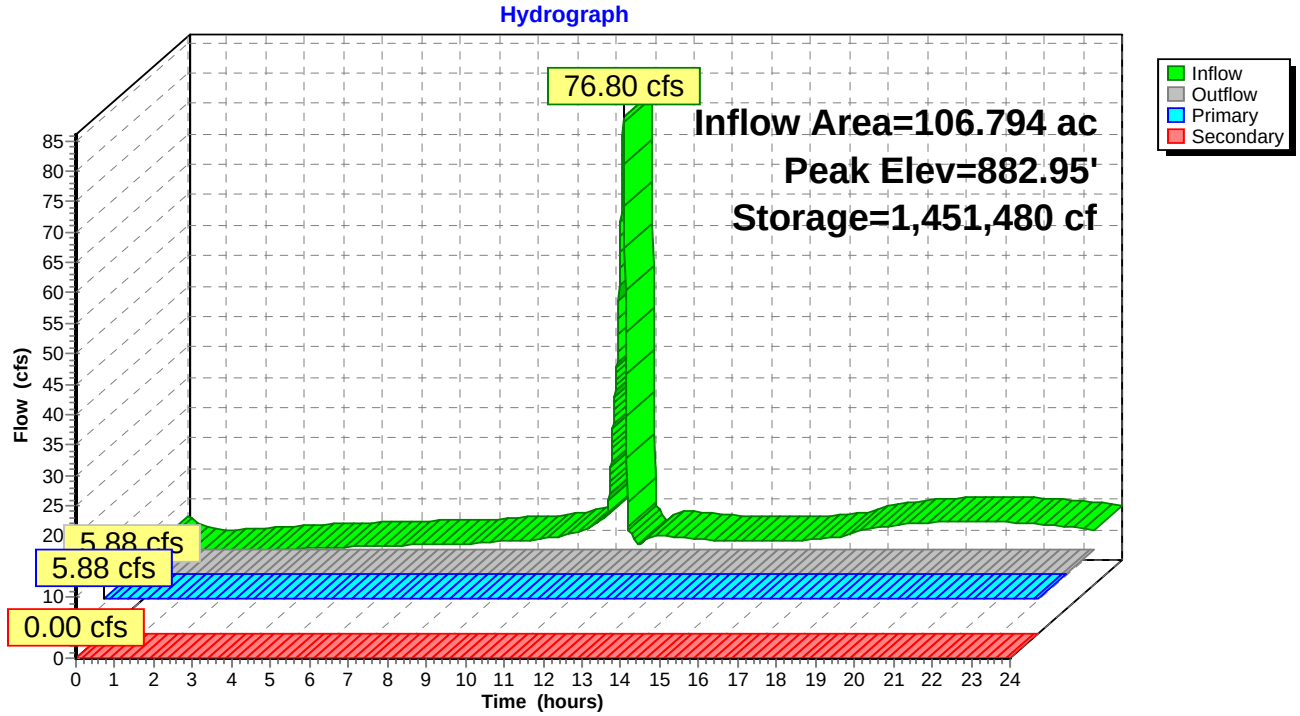
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 870.00 | 38,520 | 825.0 | 0 | 0 | 38,520 |
| 873.00 | 68,125 | 1,325.0 | 157,872 | 157,872 | 124,127 |
| 874.00 | 72,131 | 1,433.2 | 70,118 | 227,990 | 147,915 |
| 875.00 | 98,274 | 1,367.7 | 84,866 | 312,856 | 162,582 |
| 876.00 | 116,945 | 1,983.7 | 107,474 | 420,331 | 326,875 |
| 877.00 | 131,376 | 1,724.1 | 124,091 | 544,421 | 403,494 |
| 878.00 | 139,814 | 1,693.0 | 135,573 | 679,994 | 412,122 |
| 879.00 | 146,808 | 1,706.5 | 143,297 | 823,291 | 416,150 |
| 880.00 | 153,167 | 1,730.0 | 149,976 | 973,267 | 422,802 |
| 881.00 | 159,394 | 1,754.5 | 156,270 | 1,129,538 | 429,816 |
| 882.00 | 165,418 | 1,777.3 | 162,397 | 1,291,934 | 436,463 |
| 883.00 | 171,176 | 1,796.5 | 168,289 | 1,460,223 | 442,208 |
| 884.00 | 177,068 | 1,818.2 | 174,114 | 1,634,337 | 448,706 |
| 885.00 | 183,257 | 1,842.6 | 180,154 | 1,814,490 | 456,046 |
| 886.00 | 189,586 | 1,885.9 | 186,413 | 2,000,903 | 469,028 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 870.60' | **Pump**<br>Discharges@880.00' Turns Off@870.10'<br>36.0" Diam. x 2,900.0' Long Discharge, Hazen-Williams C= 130<br>Flow (gpm)= 2,640.0<br>Head (feet)= 50.00<br>-Loss (feet)= 0.21<br>=Lift (feet)= 49.79 |
| #2 | Secondary | 875.90' | **Tube/Siphon/Float Valve** Discharges@872.80'<br>36.000" Diameter, C= 0.600<br>62.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 883.60' | **36.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=5.88 cfs @ 0.00 hrs HW=881.70' TW=0.00' (Dynamic Tailwater)
└**1=Pump** (Pump Controls 5.88 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=881.70' TW=874.90' (Dynamic Tailwater)
└**2=Tube/Siphon/Float Valve** (Passes 0.00 cfs of 84.57 cfs potential flow)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond CWP: Clear Water Pond



## Summary for Pond ES: Erickson Power Station

Shows flow back to Power Station

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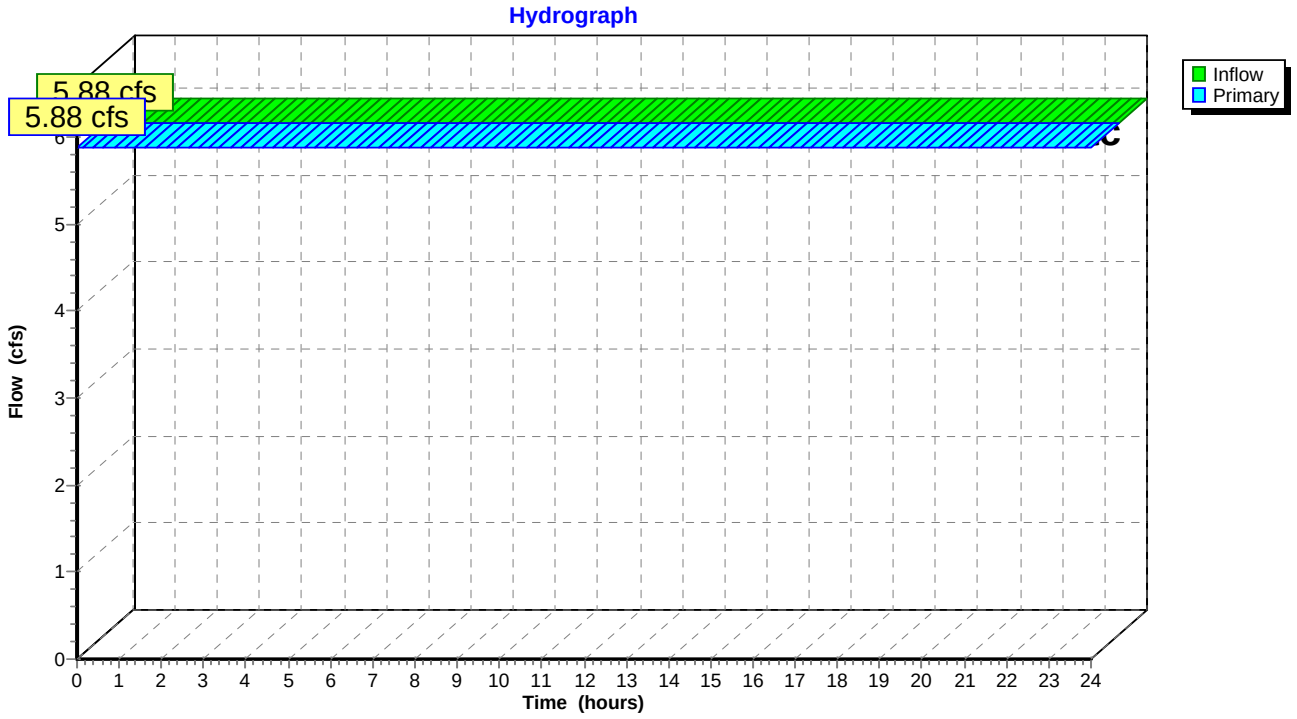
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 106.794 ac, 67.95% Impervious, Inflow Depth > 1.31" for 1000- yr 24-hr event
Inflow = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af
Primary = 5.88 cfs @ 0.00 hrs, Volume= 11.671 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5

### Pond ES: Erickson Power Station



## Summary for Pond F: Forebay

[80] Warning: Exceeded Pond CSP by 0.18' @ 5.59 hrs (0.01 cfs 0.003 af)

Inflow Area = 28.760 ac, 6.95% Impervious, Inflow Depth > 8.85" for 1000- yr 24-hr event
Inflow = 43.22 cfs @ 11.90 hrs, Volume= 21.204 af, Incl. 5.88 cfs Base Flow
Outflow = 17.64 cfs @ 21.12 hrs, Volume= 19.337 af, Atten= 59%, Lag= 553.3 min
Primary = 17.64 cfs @ 21.12 hrs, Volume= 19.337 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 883.00' Surf.Area= 0 sf Storage= 836,526 cf
Peak Elev= 883.87' @ 22.59 hrs Surf.Area= 0 sf Storage= 919,842 cf (83,316 cf above start)

Plug-Flow detention time= 1,429.5 min calculated for 0.131 af (1% of inflow)
Center-of-Mass det. time= 12.4 min ( 904.2 - 891.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 932,837 cf | **Custom Stage Data** Listed below |

| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 14,201 |
| 872.50 | 42,819 |
| 873.00 | 72,222 |
| 873.50 | 102,366 |
| 874.00 | 133,337 |
| 874.50 | 165,092 |
| 875.00 | 197,675 |
| 875.50 | 231,086 |
| 876.00 | 265,324 |
| 876.50 | 300,433 |
| 877.00 | 336,327 |
| 877.50 | 373,135 |
| 878.00 | 410,771 |
| 878.50 | 449,278 |
| 879.00 | 488,700 |
| 879.50 | 528,949 |
| 880.00 | 570,157 |
| 880.50 | 612,236 |
| 881.00 | 655,230 |
| 881.50 | 699,138 |
| 882.00 | 744,005 |
| 882.50 | 789,786 |
| 883.00 | 836,526 |
| 883.50 | 884,181 |
| 884.00 | 932,837 |

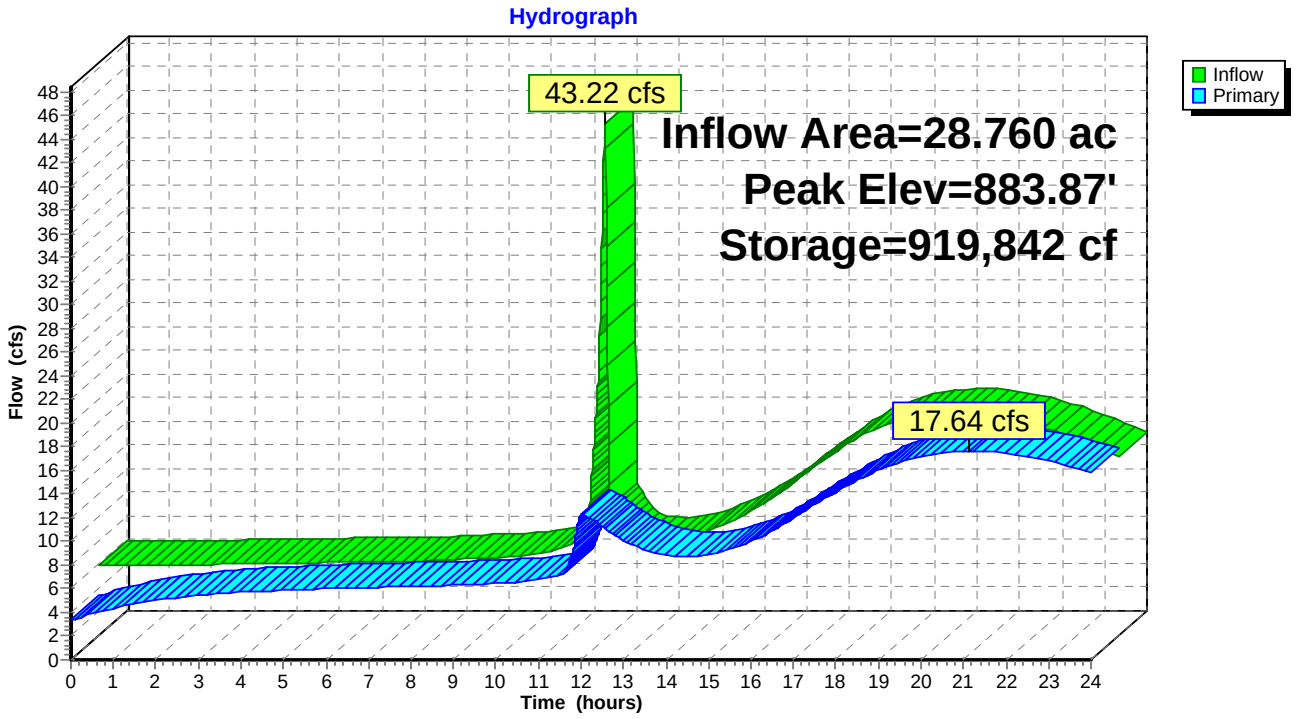
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 882.40' | **24.0" Round CMP_Round 24" (West)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.40' / 881.60' S= 0.0140 '/' Cc= 0.900 |

n= 0.025, Flow Area= 3.14 sf

| | | | |
|---|---|---|---|
| #2 | Primary | 882.50' | **24.0" Round CMP_Round 24" (Center)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.50' / 881.40' S= 0.0192 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |
| #3 | Primary | 882.60' | **24.0" Round CMP_Round 24" (East)**<br>L= 57.3' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 882.60' / 881.70' S= 0.0157 '/' Cc= 0.900<br>n= 0.025, Flow Area= 3.14 sf |

**Primary OutFlow** Max=17.64 cfs @ 21.12 hrs HW=883.85' TW=882.88' (Dynamic Tailwater)
- **1=CMP_Round 24" (West)** (Outlet Controls 6.54 cfs @ 3.76 fps)
- **2=CMP_Round 24" (Center)** (Outlet Controls 5.88 cfs @ 3.70 fps)
- **3=CMP_Round 24" (East)** (Outlet Controls 5.22 cfs @ 3.63 fps)

## Pond F: Forebay



## Summary for Pond FI: Former Impoundment

Evaporation losses are smaller than HydroCAD will allow

Inflow Area = 25.200 ac, 83.33% Impervious, Inflow Depth > 9.29" for 1000- yr 24-hr event
Inflow = 340.99 cfs @ 11.90 hrs, Volume= 19.499 af
Outflow = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af, Atten= 100%, Lag= 0.0 min
Discarded = 0.01 cfs @ 0.01 hrs, Volume= 0.020 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Peak Elev= 872.19' @ 24.00 hrs Surf.Area= 813,360 sf Storage= 848,352 cf

Plug-Flow detention time= 674.3 min calculated for 0.020 af (0% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.00' | 15,127,104 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

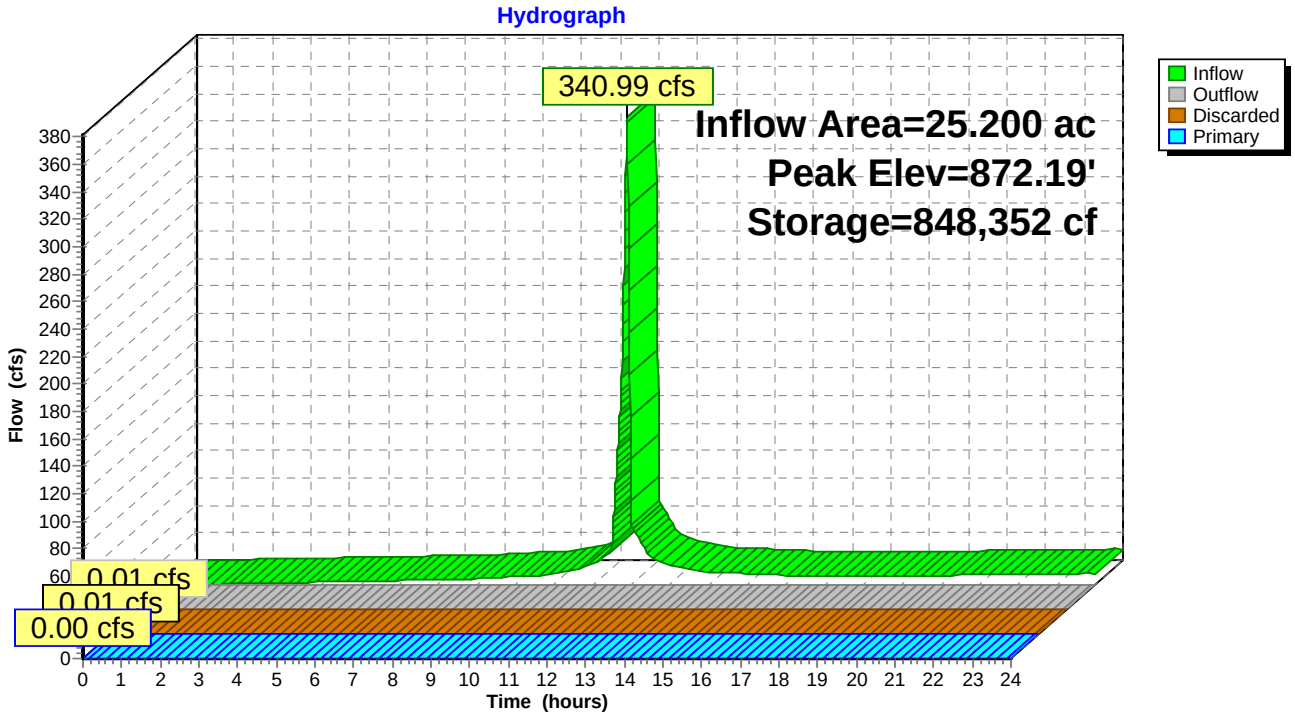
| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 871.00 | 589,714 | 5,113.4 | 0 | 0 | 589,714 |
| 872.00 | 798,841 | 3,687.0 | 691,638 | 691,638 | 1,588,651 |
| 873.00 | 874,915 | 3,740.0 | 836,590 | 1,528,227 | 1,620,194 |
| 874.00 | 931,119 | 3,806.0 | 902,871 | 2,431,099 | 1,660,006 |
| 875.00 | 974,344 | 3,749.0 | 952,650 | 3,383,748 | 1,694,483 |
| 876.00 | 997,423 | 3,777.0 | 985,861 | 4,369,609 | 1,711,669 |
| 877.00 | 1,013,146 | 3,800.0 | 1,005,274 | 5,374,884 | 1,726,045 |
| 878.00 | 1,027,210 | 3,824.0 | 1,020,170 | 6,395,054 | 1,741,096 |
| 879.00 | 1,042,705 | 3,854.0 | 1,034,948 | 7,430,001 | 1,759,824 |
| 880.00 | 1,062,406 | 3,898.0 | 1,052,540 | 8,482,542 | 1,787,242 |
| 881.00 | 1,080,953 | 3,922.0 | 1,071,666 | 9,554,208 | 1,802,681 |
| 882.00 | 1,094,577 | 3,944.0 | 1,087,758 | 10,641,966 | 1,817,002 |
| 883.00 | 1,107,455 | 3,964.0 | 1,101,010 | 11,742,975 | 1,830,195 |
| 884.00 | 1,121,020 | 3,989.0 | 1,114,231 | 12,857,206 | 1,846,509 |
| 886.00 | 1,148,935 | 4,048.0 | 2,269,898 | 15,127,104 | 1,885,090 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 871.00' | **0.01 cfs Exfiltration at all elevations** |
| #2 | Primary | 880.80' | **24.0" Round CMP_Round 24"**<br>L= 15.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 880.80' / 871.40' S= 0.6267 '/' Cc= 0.900<br>n= 0.012, Flow Area= 3.14 sf |

**Discarded OutFlow** Max=0.01 cfs @ 0.01 hrs HW=871.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=871.00' TW=881.70' (Dynamic Tailwater)
↑**2=CMP_Round 24"** ( Controls 0.00 cfs)

## Pond FI: Former Impoundment



## Summary for Pond LD: Lake Delta

Inflow Area = 43.365 ac,100.00% Impervious, Inflow Depth > 7.87" for 1000- yr 24-hr event
Inflow = 588.46 cfs @ 11.90 hrs, Volume= 28.440 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 882.50' Surf.Area= 1,845,931 sf Storage= 922,206 cf
Peak Elev= 883.17' @ 24.00 hrs Surf.Area= 1,851,359 sf Storage= 2,161,006 cf (1,238,800 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

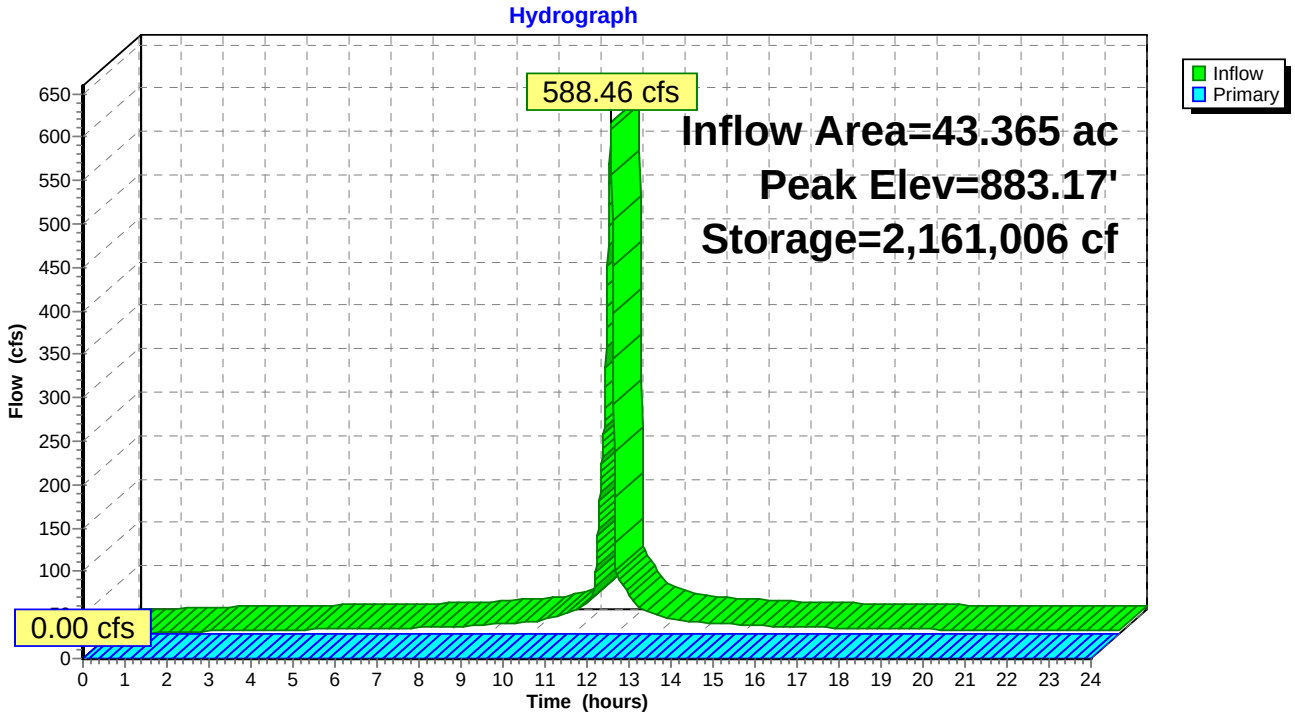
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 882.00' | 7,455,884 cf | **Custom Stage Data (Irregular)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Perim. (feet) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 882.00 | 1,842,892 | 5,054.0 | 0 | 0 | 1,842,892 |
| 883.00 | 1,848,973 | 5,062.1 | 1,845,932 | 1,845,932 | 1,851,144 |
| 884.00 | 1,863,004 | 5,083.3 | 1,855,984 | 3,701,916 | 1,868,996 |
| 885.00 | 1,877,648 | 5,107.6 | 1,870,321 | 5,572,237 | 1,889,351 |
| 886.00 | 1,889,653 | 5,131.1 | 1,883,647 | 7,455,884 | 1,909,170 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 886.10' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>3.0' Crest Height |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=882.50' TW=881.70' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond LD: Lake Delta



## Summary for Pond RP: Retention Pond

Inflow Area = 32.490 ac, 14.16% Impervious, Inflow Depth > 7.99" for 1000- yr 24-hr event
Inflow = 61.14 cfs @ 11.91 hrs, Volume= 21.634 af
Outflow = 14.97 cfs @ 22.55 hrs, Volume= 16.405 af, Atten= 76%, Lag= 638.3 min
Primary = 9.83 cfs @ 20.92 hrs, Volume= 12.930 af
Secondary = 6.12 cfs @ 24.00 hrs, Volume= 3.475 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 5
Starting Elev= 881.80' Surf.Area= 0 sf Storage= 878,134 cf
Peak Elev= 883.08' @ 24.00 hrs Surf.Area= 0 sf Storage= 1,106,014 cf (227,880 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 871.50' | 1,298,407 cf | **Custom Stage Data** Listed below |

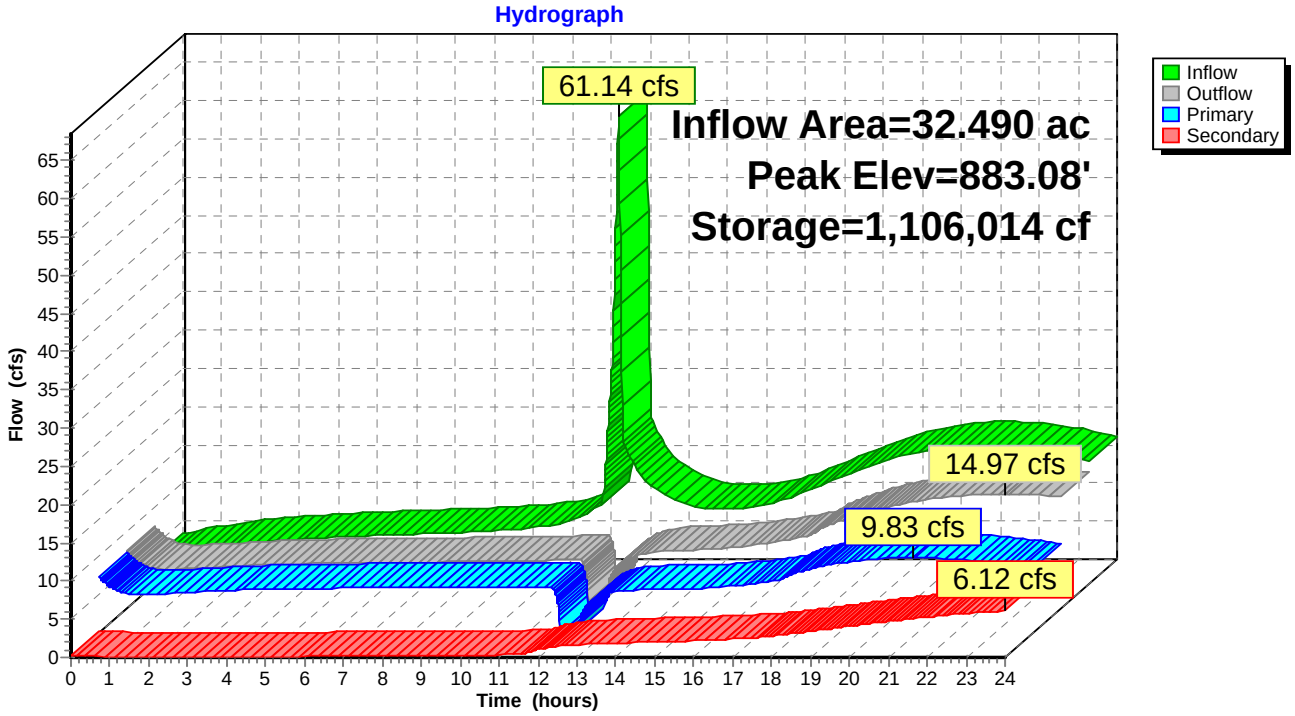
| Elevation (feet) | Cum.Store (cubic-feet) |
|---|---|
| 871.50 | 0 |
| 872.00 | 20,136 |
| 872.50 | 52,477 |
| 873.00 | 85,710 |
| 873.50 | 119,843 |
| 874.00 | 154,886 |
| 874.50 | 190,848 |
| 875.00 | 227,738 |
| 875.50 | 265,563 |
| 876.00 | 304,335 |
| 876.50 | 344,061 |
| 877.00 | 384,750 |
| 877.50 | 426,412 |
| 878.00 | 469,055 |
| 878.50 | 512,689 |
| 879.00 | 554,027 |
| 879.50 | 604,982 |
| 880.00 | 662,312 |
| 880.50 | 720,757 |
| 881.00 | 780,327 |
| 881.50 | 841,028 |
| 882.00 | 902,872 |
| 882.50 | 1,030,019 |
| 883.00 | 1,095,341 |
| 883.50 | 1,161,840 |
| 884.00 | 1,161,841 |
| 884.50 | 1,229,526 |
| 885.00 | 1,298,407 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Secondary | 881.50' | **24.0" Round Culvert**<br>L= 69.8' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 881.50' / 881.50' S= 0.0000 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf |
| #2 | Primary | 874.00' | **Tube/Siphon/Float Valve** Discharges@871.40'<br>36.000" Diameter, C= 0.600<br>491.0' Long Tube, Hazen-Williams C= 130 |
| #3 | Device 2 | 880.50' | **72.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=9.83 cfs @ 20.92 hrs HW=882.86' TW=882.69' (Dynamic Tailwater)
└─**2=Tube/Siphon/Float Valve** (Tube Controls 9.83 cfs @ 1.39 fps)
└─**3=Orifice/Grate** (Passes 9.83 cfs of 57.10 cfs potential flow)

**Secondary OutFlow** Max=6.12 cfs @ 24.00 hrs HW=883.08' TW=872.19' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 6.12 cfs @ 3.16 fps)

## Pond RP: Retention Pond



# APPENDIX B - NOAA RAINFALL DATA

NOAA Atlas 14, Volume 8, Version 2 Location name: Lansing, Michigan, USA* Latitude: 42.6946°, Longitude: -84.662°

**Elevation: 882.49 ft****

* source: ESRI Maps

** source: USGS

**POINT PRECIPIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

| PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Duration | Average recurrence interval (years) | | | | | | | | | |
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.291** (0.236-0.366) | **0.340** (0.274-0.427) | **0.423** (0.341-0.533) | **0.497** (0.398-0.628) | **0.605** (0.471-0.791) | **0.693** (0.526-0.913) | **0.785** (0.576-1.06) | **0.883** (0.622-1.21) | **1.02** (0.691-1.43) | **1.13** (0.743-1.59) |
| 10-min | **0.426** (0.345-0.536) | **0.497** (0.402-0.625) | **0.620** (0.499-0.781) | **0.728** (0.583-0.920) | **0.885** (0.690-1.16) | **1.01** (0.770-1.34) | **1.15** (0.844-1.54) | **1.29** (0.911-1.77) | **1.49** (1.01-2.09) | **1.65** (1.09-2.33) |
| 15-min | **0.520** (0.421-0.653) | **0.606** (0.490-0.762) | **0.756** (0.609-0.952) | **0.887** (0.711-1.12) | **1.08** (0.841-1.41) | **1.24** (0.940-1.63) | **1.40** (1.03-1.88) | **1.58** (1.11-2.16) | **1.82** (1.23-2.55) | **2.02** (1.33-2.84) |
| 30-min | **0.744** (0.602-0.935) | **0.866** (0.700-1.09) | **1.08** (0.869-1.36) | **1.27** (1.01-1.60) | **1.54** (1.20-2.02) | **1.77** (1.34-2.33) | **2.01** (1.47-2.70) | **2.26** (1.59-3.10) | **2.61** (1.77-3.66) | **2.89** (1.90-4.08) |
| 60-min | **0.934** (0.756-1.17) | **1.11** (0.898-1.40) | **1.42** (1.14-1.79) | **1.69** (1.35-2.13) | **2.08** (1.62-2.72) | **2.40** (1.82-3.16) | **2.73** (2.00-3.67) | **3.08** (2.17-4.23) | **3.57** (2.42-5.01) | **3.96** (2.61-5.60) |
| 2-hr | **1.12** (0.918-1.40) | **1.36** (1.11-1.69) | **1.76** (1.43-2.19) | **2.11** (1.70-2.63) | **2.61** (2.05-3.38) | **3.02** (2.32-3.95) | **3.45** (2.56-4.59) | **3.91** (2.78-5.31) | **4.54** (3.11-6.29) | **5.04** (3.35-7.04) |
| 3-hr | **1.23** (1.01-1.52) | **1.50** (1.23-1.85) | **1.96** (1.60-2.42) | **2.36** (1.92-2.93) | **2.95** (2.33-3.79) | **3.42** (2.64-4.44) | **3.92** (2.92-5.18) | **4.45** (3.18-6.00) | **5.18** (3.57-7.14) | **5.76** (3.86-8.00) |
| 6-hr | **1.47** (1.22-1.80) | **1.76** (1.46-2.15) | **2.26** (1.87-2.77) | **2.72** (2.23-3.34) | **3.39** (2.71-4.33) | **3.94** (3.08-5.08) | **4.53** (3.42-5.95) | **5.17** (3.75-6.92) | **6.06** (4.23-8.28) | **6.77** (4.59-9.32) |
| 12-hr | **1.82** (1.52-2.19) | **2.07** (1.73-2.50) | **2.54** (2.11-3.07) | **2.98** (2.47-3.62) | **3.66** (2.97-4.64) | **4.24** (3.36-5.42) | **4.88** (3.74-6.36) | **5.58** (4.10-7.42) | **6.59** (4.66-8.95) | **7.42** (5.09-10.1) |
| 24-hr | **2.16** (1.82-2.58) | **2.42** (2.04-2.89) | **2.90** (2.44-3.48) | **3.36** (2.81-4.04) | **4.08** (3.35-5.12) | **4.70** (3.76-5.94) | **5.38** (4.17-6.94) | **6.13** (4.56-8.07) | **7.22** (5.17-9.70) | **8.11** (5.63-10.9) |
| 2-day | **2.45** (2.09-2.89) | **2.81** (2.39-3.31) | **3.43** (2.91-4.06) | **4.00** (3.37-4.74) | **4.84** (3.99-5.97) | **5.54** (4.46-6.89) | **6.29** (4.90-7.98) | **7.09** (5.32-9.19) | **8.23** (5.95-10.9) | **9.14** (6.42-12.2) |
| 3-day | **2.69** (2.31-3.16) | **3.07** (2.63-3.59) | **3.72** (3.18-4.37) | **4.31** (3.66-5.09) | **5.20** (4.31-6.36) | **5.93** (4.81-7.32) | **6.71** (5.27-8.45) | **7.55** (5.70-9.73) | **8.74** (6.36-11.5) | **9.69** (6.86-12.9) |
| 4-day | **2.91** (2.50-3.39) | **3.28** (2.82-3.83) | **3.94** (3.38-4.61) | **4.54** (3.87-5.33) | **5.44** (4.54-6.63) | **6.20** (5.05-7.62) | **7.00** (5.52-8.78) | **7.87** (5.97-10.1) | **9.09** (6.65-11.9) | **10.1** (7.17-13.3) |
| 7-day | **3.42** (2.97-3.95) | **3.81** (3.31-4.41) | **4.52** (3.90-5.23) | **5.15** (4.43-5.99) | **6.11** (5.14-7.37) | **6.91** (5.67-8.41) | **7.76** (6.18-9.64) | **8.68** (6.65-11.0) | **9.99** (7.38-13.0) | **11.0** (7.93-14.5) |
| 10-day | **3.87** (3.37-4.43) | **4.29** (3.74-4.93) | **5.05** (4.38-5.81) | **5.72** (4.95-6.61) | **6.73** (5.69-8.05) | **7.57** (6.25-9.14) | **8.46** (6.77-10.4) | **9.41** (7.25-11.9) | **10.8** (8.00-13.9) | **11.8** (8.56-15.4) |
| 20-day | **5.19** (4.57-5.88) | **5.72** (5.04-6.49) | **6.64** (5.83-7.55) | **7.43** (6.49-8.48) | **8.58** (7.30-10.1) | **9.50** (7.91-11.3) | **10.5** (8.45-12.7) | **11.5** (8.93-14.3) | **12.9** (9.66-16.4) | **14.0** (10.2-18.0) |
| 30-day | **6.36** (5.64-7.16) | **6.99** (6.20-7.88) | **8.05** (7.11-9.09) | **8.94** (7.86-10.1) | **10.2** (8.71-11.9) | **11.2** (9.35-13.2) | **12.2** (9.87-14.6) | **13.2** (10.3-16.2) | **14.6** (11.0-18.4) | **15.6** (11.5-20.0) |
| 45-day | **7.91** (7.05-8.84) | **8.68** (7.74-9.71) | **9.93** (8.82-11.1) | **10.9** (9.67-12.3) | **12.3** (10.5-14.1) | **13.3** (11.2-15.5) | **14.3** (11.7-17.1) | **15.3** (12.1-18.7) | **16.6** (12.6-20.8) | **17.6** (13.1-22.4) |
| 60-day | **9.28** (8.32-10.3) | **10.2** (9.11-11.3) | **11.6** (10.3-12.9) | **12.7** (11.3-14.2) | **14.2** (12.2-16.1) | **15.2** (12.8-17.6) | **16.2** (13.3-19.2) | **17.2** (13.6-20.8) | **18.4** (14.0-22.8) | **19.2** (14.4-24.4) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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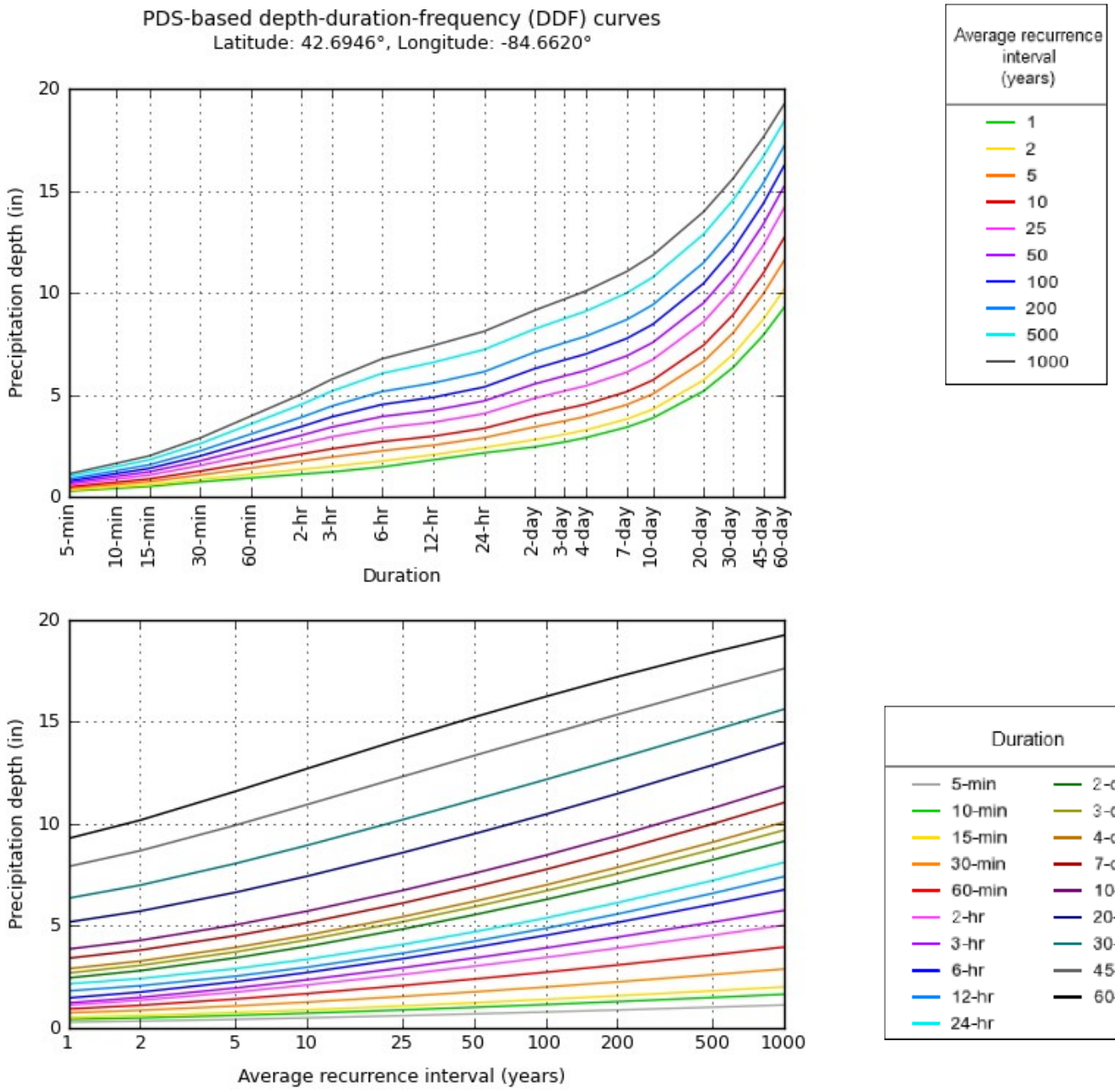
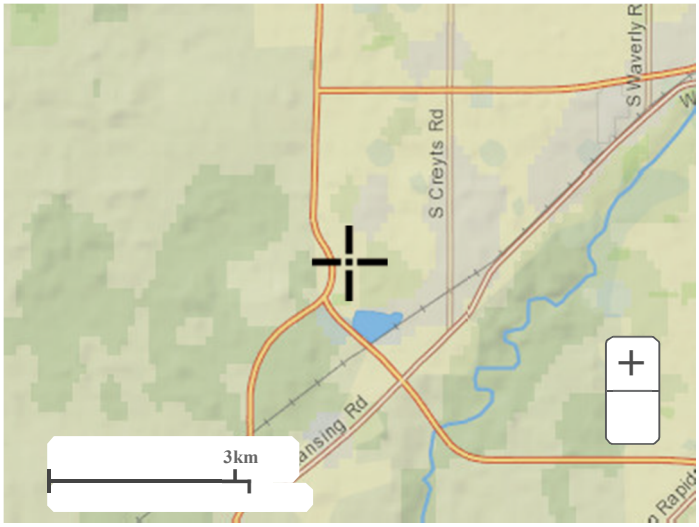
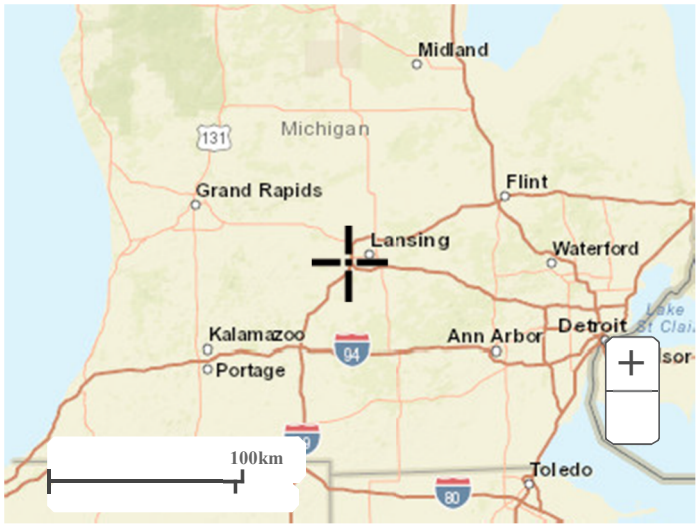
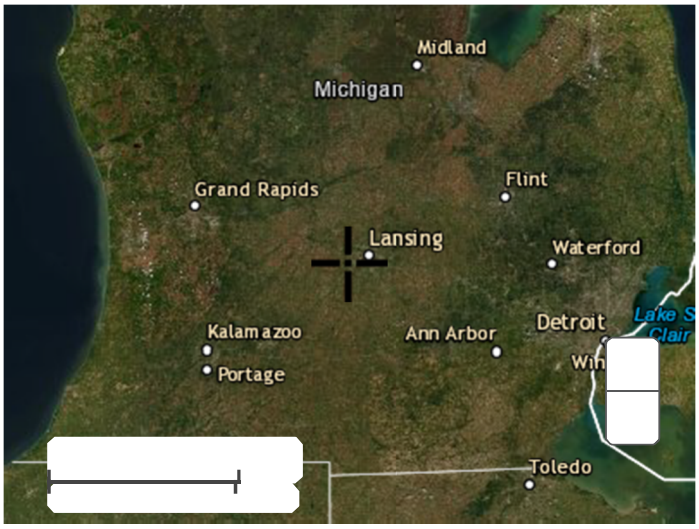









**Large scale terrain**
**Large scale map**
**Large scale aerial**

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US Department of Commerce National Oceanic and Atmospheric Administration National Weather Service

National Water Center 1325
East West Highway Silver
Spring, MD 20910

Questions?: HDSC.Questions@noaa.gov

**APPENDIX C - SOILS REPORT**

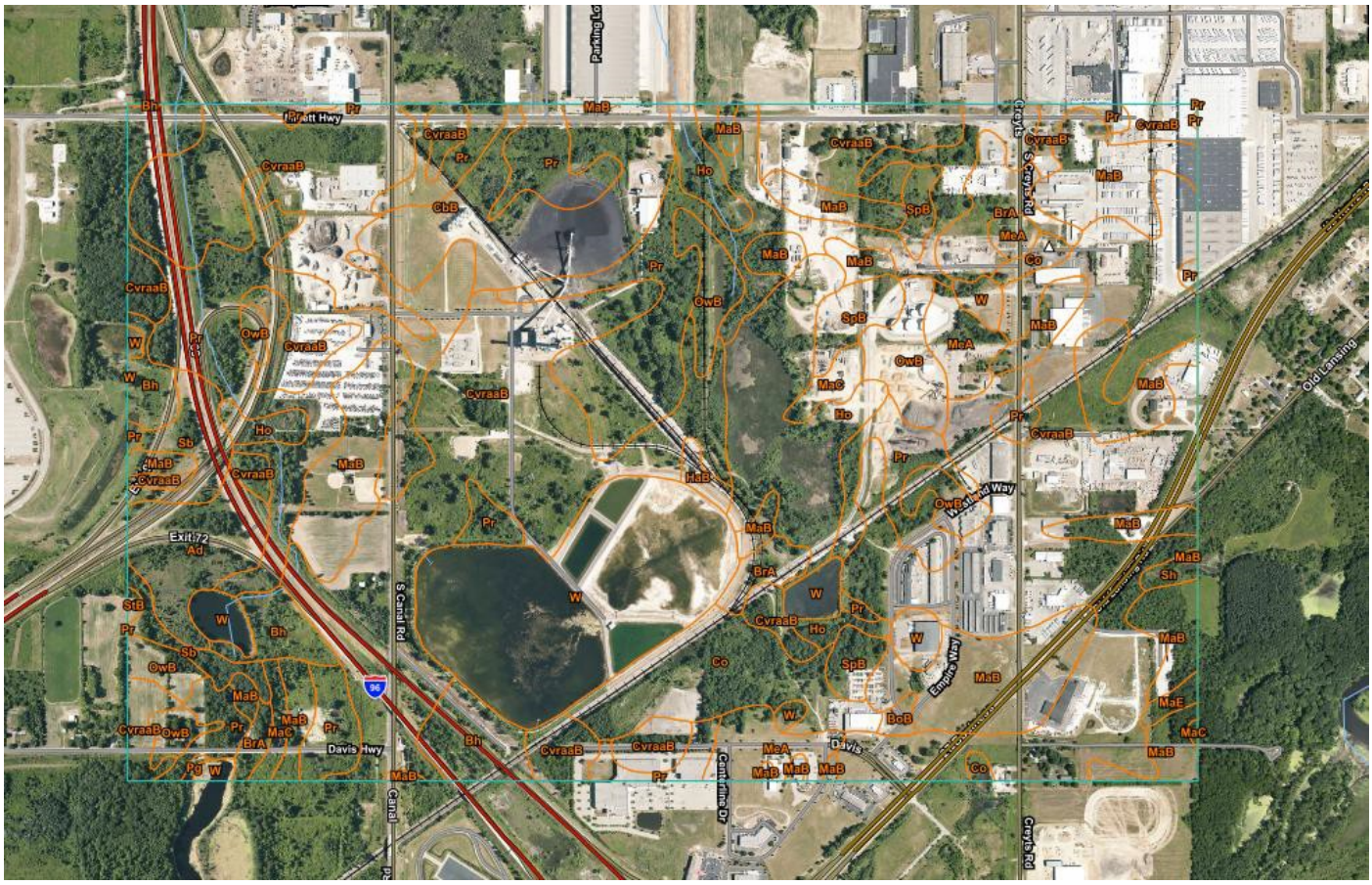
United States Department of Agriculture

Natural Resources Conservation

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Eaton County, Michigan. Custom Report


February 26, 2020




February 26, 2020

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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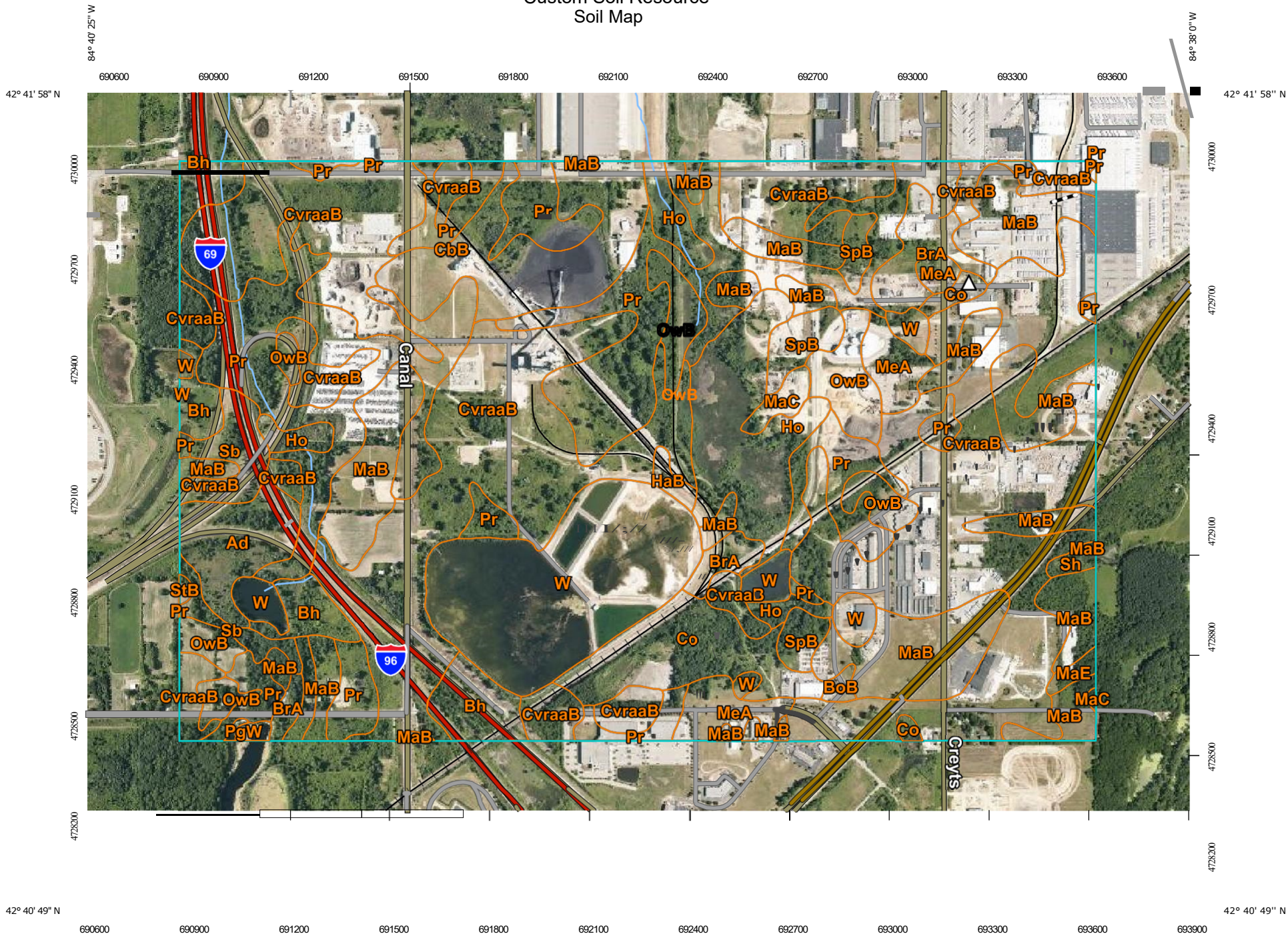
# Contents

# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource
## Soil Map



## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**

- Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Eaton County, Michigan
Survey Area Data: Version 16, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 6, 2018—Jul 8, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# MAP UNIT LEGEND

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| Ad | Adrian muck, 0 to 1 percent slopes | 22.4 | 1.9% |
| Bh | Borrow land | 27.3 | 2.3% |
| BoB | Boyer sandy loam, 0 to 6 percent slopes | 1.8 | 0.2% |
| BrA | Brady-Bronson sandy loams, 0 to 3 percent slopes | 22.0 | 1.9% |
| CbB | Capac-Marlette loams, 1 to 6 percent slopes | 49.6 | 4.2% |
| Co | Colwood loam | 37.7 | 3.2% |
| CvraaB | Conover loam, 0 to 4 percent slopes | 405.7 | 34.2% |
| HaB | Hillsdale sandy loam, 2 to 6 percent slopes | 2.8 | 0.2% |
| Ho | Houghton muck, 0 to 1 percent slopes | 58.6 | 4.9% |
| MaB | Marlette loam, 2 to 6 percent slopes | 139.2 | 11.7% |
| MaC | Filer loam, 6 to 12 percent slopes | 8.2 | 0.7% |
| MaE | Filer loam, 18 to 35 percent slopes | 2.2 | 0.2% |
| MeA | Metamora-Capac sandy loams, 0 to 4 percent slopes | 22.8 | 1.9% |
| OwB | Owosso-Marlette sandy loams, 1 to 6 percent slopes | 37.4 | 3.2% |
| Pg | Pits, gravel | 0.4 | 0.0% |
| Pr | Parkhill loam, non dense till subsoil, 0 to 2 percent slopes | 209.7 | 17.7% |
| Sb | Sebewa loam, 0 to 2 percent slopes | 17.3 | 1.5% |
| Sh | Shoals-Sloan loams | 2.0 | 0.2% |
| SpB | Spinks loamy sand, 0 to 6 percent slopes | 17.4 | 1.5% |
| StB | Spinks-Metea loamy sands, 0 to 6 percent slopes | 0.7 | 0.1% |
| W | Water | 100.3 | 8.5% |
| **Totals for Area of Interest** | | **1,185.6** | **100.0%** |

# Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas

shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# Eaton County, Michigan

## Ad—Adrian muck, 0 to 1 percent slopes

### Map Unit Setting

*National map unit symbol:* 2rfgz
*Elevation:* 630 to 1,110 feet
*Mean annual precipitation:* 31 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 125 to 205 days
*Farmland classification:* Farmland of local importance

### Map Unit Composition

*Adrian and similar soils:* 92 percent
*Minor components:* 8 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of

### Adrian Setting

*Landform:* Depressions on outwash plains, depressions on moraines on outwash plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope, dip
*Down-slope shape:* Concave
*Across-slope shape:* Linear
*Parent material:* Herbaceous organic material over sandy glaciofluvial deposits

### Typical profile

*Oa1 - 0 to 12 inches:* muck
*Oa2 - 12 to 34 inches:* muck
*Cg - 34 to 80 inches:* sand

### Properties and qualities

*Slope:* 0 to 1 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Very poorly drained
*Runoff class:* Negligible
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high (0.14 to 14.17 in/hr)
*Depth to water table:* About 0 inches
*Frequency of flooding:* None
*Frequency of ponding:* Frequent
*Calcium carbonate, maximum in profile:* 15 percent
*Salinity, maximum in profile:* Nonsaline (0.3 to 1.9 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 0.2
*Available water storage in profile:* Very high (about 15.1 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 5w
*Hydrologic Soil Group:* A/D
*Ecological site:* Mucky Depressions (F098XA006MI), Mucky Depression (F096XB027MI)
*Hydric soil rating:* Yes

**Minor Components**

**Kingsville**

*Percent of map unit:* 3 percent
*Landform:* Outwash plains, nearshore zones (relict)
*Landform position (three-dimensional):* Dip
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Edwards**

*Percent of map unit:* 2 percent
*Landform:* Depressions on moraines on outwash plains, depressions on outwash plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Houghton**

*Percent of map unit:* 2 percent
*Landform:* Depressions on moraines on outwash plains, depressions on outwash plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope, dip
*Down-slope shape:* Concave
*Across-slope shape:* Linear
*Ecological site:* Mucky Depression (F097XA030MI), Mucky Depressions (F098XA006MI), Snowy Mucky Depression (F096XA014MI), Mucky Depression (F096XB027MI)
*Hydric soil rating:* Yes

**Gilford, gravelly subsoil**

*Percent of map unit:* 1 percent
*Landform:* Glacial drainage channels, glacial drainage channels
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

## Bh—Borrow land

**Map Unit Setting**

*National map unit symbol:* 67rz
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**
*Borrow land and similar soils:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Borrow Land**

**Properties and**

**qualities**
*Slope:* 0 to 30 percent
*Depth to restrictive feature:* More than 80 inches
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None

## BoB—Boyer sandy loam, 0 to 6 percent slopes

**Map Unit Setting**
*National map unit symbol:* 67s2
*Elevation:* 600 to 1,200 feet
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* Farmland of local importance

**Map Unit Composition**
*Boyer and similar soils:* 88 percent
*Minor components:* 12 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description**

**of Boyer**

**Setting**
*Landform:* Outwash plains, moraines, terraces
*Landform position (three-dimensional):* Interfluve, head slope, base slope, nose slope, side slope, crest, rise
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy and/or sandy over sandy and gravelly outwash

**Typical profile**
*Ap - 0 to 8 inches:* sandy loam
*E - 8 to 12 inches:* sandy loam
*Bt - 12 to 38 inches:* sandy clay loam
*2C - 38 to 60 inches:* gravelly coarse sand

**Properties and qualities**
*Slope:* 0 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr

*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 25 percent
*Available water storage in profile:* Low (about 5.3 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3s
*Hydrologic Soil Group:* A
*Ecological site:* Loamy Drift Plains (F098XA015MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts**

**Oshtemo**
*Percent of map unit:* 3 percent
*Hydric soil rating:* No

**Matherton**
*Percent of map unit:* 3 percent
*Hydric soil rating:* No

**Wasepi**
*Percent of map unit:* 3 percent
*Hydric soil rating:* No

**Kibbie**
*Percent of map unit:* 3 percent
*Hydric soil rating:* No

## BrA—Brady-Bronson sandy loams, 0 to 3 percent slopes

**Map Unit Setting**
*National map unit symbol:* 67s5
*Elevation:* 360 to 1,200 feet
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**
*Brady and similar soils:* 50 percent
*Bronson and similar soils:* 35 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description**

**of Brady**

**Setting**
*Landform:* Outwash plains
*Landform position (three-dimensional):* Rise

*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy and/or sandy outwash

**Typical profile**
*Ap - 0 to 9 inches:* sandy loam
*Bt - 9 to 37 inches:* sandy loam
*BC - 37 to 56 inches:* loamy sand
*2C - 56 to 60 inches:* coarse sand

**Properties and qualities**
*Slope:* 0 to 3 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Somewhat poorly drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
*Depth to water table:* About 12 to 36 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 25 percent
*Available water storage in profile:* Moderate (about 7.7 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* B
*Ecological site:* Till Flats (F098XA011MI)
*Hydric soil rating:* No

**Description of**

**Bronson Setting**
*Landform:* Outwash plains
*Down-slope shape:* Linear
*Across-slope shape:* Linear

**Typical profile**
*Ap - 0 to 8 inches:* sandy loam *Bt - 8 to 38 inches:* sandy loam *B - 38 to 47 inches:* loamy sand *2BC - 47 to 60 inches:* sand

**Properties and qualities**
*Slope:* 0 to 3 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Moderately well drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
*Depth to water table:* About 24 to 42 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 25 percent
*Available water storage in profile:* Moderate (about 6.6 inches)

**Interpretive groups**
*Land capability classification (irrigated):* 2s

*Land capability classification (nonirrigated):* 2s
*Hydrologic Soil Group:* B
*Ecological site:* Till Flats (F098XA011MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts Kibbie**
*Percent of map unit:* 4 percent
*Hydric soil rating:* No

**Gilford**
*Percent of map unit:* 4 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Matherton**
*Percent of map unit:* 4 percent
*Hydric soil rating:* No

**Sebewa**
*Percent of map unit:* 3 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

## CbB—Capac-Marlette loams, 1 to 6 percent slopes

**Map Unit Setting**
*National map unit symbol:* 2w63s
*Elevation:* 710 to 990 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 140 to 200 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**
*Capac and similar soils:* 46 percent
*Marlette and similar soils:* 41 percent
*Minor components:* 13 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description**

**of Capac**

**Setting**
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy till

**Typical profile**
*Ap - 0 to 9 inches:* loam
*B/E - 9 to 16 inches:* clay loam
*Bt - 16 to 31 inches:* clay loam
*C - 31 to 80 inches:* loam

**Properties and qualities**
*Slope:* 1 to 4 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Somewhat poorly drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low (0.01 to 0.14 in/hr)
*Depth to water table:* About 6 to 12 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Salinity, maximum in profile:* Nonsaline (0.1 to 0.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 2.0
*Available water storage in profile:* High (about 9.5 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C/D
*Ecological site:* Till Flats (F098XA011MI)
*Hydric soil rating:* No

**Description of**

**Marlette**

**Setting**
*Landform:* Till plains, moraines
*Landform position (two-dimensional):* Summit, backslope, shoulder
*Landform position (three-dimensional):* Interfluve, side slope, head slope, nose slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy till

**Typical profile**
*Ap - 0 to 9 inches:* loam
*B/E - 9 to 16 inches:* clay loam
*Bt - 16 to 36 inches:* clay loam
*C - 36 to 80 inches:* loam

**Properties and qualities**
*Slope:* 1 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low (0.01 to 0.14 in/hr)
*Depth to water table:* About 18 to 24 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent

*Salinity, maximum in profile:* Nonsaline (0.1 to 0.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 2.0
*Available water storage in profile:* High (about 9.4 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C/D
*Ecological site:* Till Flats (F098XA011MI)
*Hydric soil rating:* No

**Minor Components**

**Parkhill, non dense till subsoil**
*Percent of map unit:* 10 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Metea**
*Percent of map unit:* 3 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Head slope, nose slope, interfluve, side slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## Co—Colwood loam

**Map Unit Setting**
*National map unit symbol:* 67s9
*Elevation:* 360 to 1,500 feet
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**
*Colwood and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Colwood**

**Setting**

*Landform:* Lake plains
*Landform position (three-dimensional):* Talf
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy glaciolacustrine deposits

**Typical profile**

*Ap - 0 to 11 inches:* loam
*Bg - 11 to 36 inches:* silty clay loam
*2Cg - 36 to 60 inches:* stratified fine sand to silt loam

**Properties and qualities**

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* About 0 inches
*Frequency of flooding:* None
*Frequency of ponding:* Frequent
*Calcium carbonate, maximum in profile:* 20 percent
*Available water storage in profile:* High (about 11.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* C/D
*Ecological site:* Wet Till Depressions (F098XA012MI)
*Hydric soil rating:* Yes

**Minor**

**Componen**

**ts Parkhill**

*Percent of map unit:* 4 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Metamora**

*Percent of map unit:* 4 percent
*Hydric soil rating:* No

**Gilford**

*Percent of map unit:* 4 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Sebewa**

*Percent of map unit:* 3 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

## CvraaB—Conover loam, 0 to 4 percent slopes

**Map Unit Setting**

*National map unit symbol:* 2yct3
*Elevation:* 600 to 960 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 140 to 200 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**

*Conover and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Conover**

**Setting**

*Landform:* Ground moraines, end moraines
*Landform position (two-dimensional):* Backslope, shoulder, footslope, summit
*Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear, concave, convex
*Parent material:* Loamy till over dense loamy till

**Typical profile**

*Ap - 0 to 10 inches:* loam
*Bt1 - 10 to 20 inches:* clay loam
*Bt2 - 20 to 26 inches:* clay loam
*BC - 26 to 44 inches:* loam
*Cd - 44 to 80 inches:* loam

**Properties and qualities**

*Slope:* 0 to 4 percent
*Depth to restrictive feature:* 32 to 80 inches to densic material
*Natural drainage class:* Somewhat poorly drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to low (0.00 to 0.01 in/hr)
*Depth to water table:* About 6 to 18 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 33 percent
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 2.0
*Available water storage in profile:* Low (about 4.8 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* C/D
*Ecological site:* Till Flats (F098XA011MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts Miami**
*Percent of map unit:* 6 percent
*Landform:* Ground moraines, end moraines
*Landform position (two-dimensional):* Shoulder, backslope
*Landform position (three-dimensional):* Nose slope, side slope
*Down-slope shape:* Convex
*Across-slope shape:* Linear, convex
*Ecological site:* Fine Till Knolls (F098XA010MI), Fine Till (F097XA021MI)
*Hydric soil rating:* No

**Parkhill**
*Percent of map unit:* 5 percent
*Landform:* Ground moraines, end moraines
*Landform position (two-dimensional):* Backslope, footslope
*Landform position (three-dimensional):* Base slope, side slope, head slope
*Down-slope shape:* Concave
*Across-slope shape:* Concave, linear
*Hydric soil rating:* Yes

**Matherton**
*Percent of map unit:* 4 percent
*Landform:* Ground moraines, end moraines
*Landform position (two-dimensional):* Backslope, shoulder, footslope, summit
*Landform position (three-dimensional):* Side slope, nose slope, head slope, base slope, interfluve
*Down-slope shape:* Linear
*Across-slope shape:* Linear, concave, convex
*Ecological site:* Drift Flats (F098XA019MI)
*Hydric soil rating:* No

## HaB—Hillsdale sandy loam, 2 to 6 percent slopes

**Map Unit Setting**
*National map unit symbol:* 67sf
*Elevation:* 600 to 1,200 feet
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**
*Hillsdale and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Hillsdale**

**Setting**
*Landform:* Moraines, till plains
*Landform position (three-dimensional):* Rise
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy till

**Typical profile**
*Ap - 0 to 9 inches:* sandy loam
*B/E - 9 to 33 inches:* sandy loam
*Bt1 - 33 to 50 inches:* sandy loam
*Bt2 - 50 to 60 inches:* fine sandy loam

**Properties and qualities**
*Slope:* 2 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 10 percent
*Available water storage in profile:* Moderate (about 8.0 inches)

**Interpretive groups**
*Land capability classification (irrigated):* 2e
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* B
*Ecological site:* Loamy Drift Plains (F098XA015MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts**

**Oshtemo**
*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Owosso**
*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Spinks**
*Percent of map unit:* 5 percent
*Hydric soil rating:* No

## Ho—Houghton muck, 0 to 1 percent slopes

### Map Unit Setting

*National map unit symbol:* 2rfgy
*Elevation:* 580 to 1,360 feet
*Mean annual precipitation:* 31 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 125 to 205 days
*Farmland classification:* Farmland of local importance

### Map Unit Composition

*Houghton and similar soils:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of

### Houghton

### Setting

*Landform:* Depressions on outwash plains, depressions on moraines on outwash plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope, dip
*Down-slope shape:* Concave
*Across-slope shape:* Linear
*Parent material:* Herbaceous organic material

### Typical profile

*Oa1 - 0 to 12 inches:* muck
*Oa2 - 12 to 35 inches:* muck
*Oa3 - 35 to 80 inches:* muck

### Properties and qualities

*Slope:* 0 to 1 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Very poorly drained
*Runoff class:* Negligible
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high (0.14 to 14.17 in/hr)
*Depth to water table:* About 0 inches
*Frequency of flooding:* None
*Frequency of ponding:* Frequent
*Calcium carbonate, maximum in profile:* 3 percent
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.4 to 2.7 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 0.8
*Available water storage in profile:* Very high (about 23.9 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 5w

*Hydrologic Soil Group:* A/D
*Ecological site:* Mucky Depressions (F098XA006MI)
*Hydric soil rating:* Yes

**Minor**

**Componen**

**ts Adrian**
*Percent of map unit:* 4 percent
*Landform:* Depressions on outwash plains, depressions on moraines on outwash plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope, dip
*Down-slope shape:* Concave
*Across-slope shape:* Linear
*Ecological site:* Mucky Depression (F097XA030MI), Mucky Depressions (F098XA006MI), Snowy Mucky Depression (F096XA014MI), Mucky Depression (F096XB027MI)
*Hydric soil rating:* Yes

**Edwards**
*Percent of map unit:* 3 percent
*Landform:* Depressions on moraines on outwash plains, depressions on outwash plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Palms**
*Percent of map unit:* 2 percent
*Landform:* Drainageways on moraines, drainageways on outwash plains, depressions on outwash plains, depressions on till plains, swamps on outwash plains, swamps on till plains, depressions on moraines, swamps on moraines, drainageways on till plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Ecological site:* Mucky Depressions (F098XA006MI), Mucky Depression (F097XA030MI)
*Hydric soil rating:* Yes

**Gilford, gravelly subsoil**
*Percent of map unit:* 1 percent
*Landform:* Glacial drainage channels, glacial drainage channels
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

## MaB—Marlette loam, 2 to 6 percent slopes

**Map Unit Setting**

*National map unit symbol:* 2tpkl
*Elevation:* 750 to 990 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 140 to 200 days
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Marlette and similar soils:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Marlette**

**Setting**

*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope, head slope, nose slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy till

**Typical profile**

*Ap - 0 to 9 inches:* loam
*B/E - 9 to 16 inches:* clay loam
*Bt - 16 to 36 inches:* clay loam
*C - 36 to 80 inches:* loam

**Properties and qualities**

*Slope:* 2 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low (0.01 to 0.14 in/hr)
*Depth to water table:* About 18 to 24 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Salinity, maximum in profile:* Nonsaline (0.1 to 0.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 2.0
*Available water storage in profile:* High (about 9.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e

*Hydrologic Soil Group:* C/D
*Ecological site:* Till Flats (F098XA011MI), Loamy Depression (F096XB017MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts Capac**
*Percent of map unit:* 6 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Parkhill, non dense till subsoil**
*Percent of map unit:* 2 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Metea**
*Percent of map unit:* 1 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Head slope, nose slope, interfluve, side slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Spinks**
*Percent of map unit:* 1 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear
*Hydric soil rating:* No

## MaC—Filer loam, 6 to 12 percent slopes

**Map Unit Setting**
*National map unit symbol:* 2tpkn
*Elevation:* 720 to 990 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F

*Frost-free period:* 140 to 200 days
*Farmland classification:* Farmland of local importance

**Map Unit Composition**
*Filer and similar soils:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description**

**of Filer**

**Setting**
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope, head slope, nose slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear *Parent material:* Loamy till

**Typical profile**
*Ap - 0 to 8 inches:* loam
*B/E - 8 to 16 inches:* clay loam
*Bt - 16 to 36 inches:* clay loam
*C - 36 to 80 inches:* loam

**Properties and qualities**
*Slope:* 6 to 12 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* High
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low (0.02 to 0.14 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Salinity, maximum in profile:* Nonsaline (0.1 to 0.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 2.0
*Available water storage in profile:* High (about 9.3 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* C
*Ecological site:* Loamy Drift Plains (F098XA015MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts Capac**
*Percent of map unit:* 6 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Parkhill, non dense till subsoil**

*Percent of map unit:* 2 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Metea**

*Percent of map unit:* 1 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Head slope, nose slope, side slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Oshtemo**

*Percent of map unit:* 1 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope, head slope, nose slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear
*Hydric soil rating:* No

## MaE—Filer loam, 18 to 35 percent slopes

**Map Unit Setting**

*National map unit symbol:* 2x2sx
*Elevation:* 660 to 1,000 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 140 to 230 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Filer and similar soils:* 92 percent
*Minor components:* 8 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description**

**of Filer**

**Setting**

*Landform:* Moraines
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope, head slope, nose slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear, convex

*Parent material:* Loamy till

**Typical profile**
*A - 0 to 3 inches:* loam
*E - 3 to 7 inches:* loam
*B/E - 7 to 15 inches:* clay loam
*Bt - 15 to 35 inches:* clay loam
*C - 35 to 80 inches:* loam

**Properties and qualities**
*Slope:* 18 to 35 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low (0.02 to 0.14 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Salinity, maximum in profile:* Nonsaline (0.1 to 0.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 2.0
*Available water storage in profile:* High (about 9.3 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7e
*Hydrologic Soil Group:* C
*Ecological site:* Loamy Ravines (F097XA017MI), Loamy Till Knolls (F098XA009MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts**
*Percent of map unit:* 3 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope, head slope, nose slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear, convex
*Hydric soil rating:* No

**Spinks**
*Percent of map unit:* 3 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Head slope, nose slope, side slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Capac**
*Percent of map unit:* 1 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Base slope

*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Boyer**
*Percent of map unit:* 1 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope, head slope, nose slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

## MeA—Metamora-Capac sandy loams, 0 to 4 percent slopes

**Map Unit Setting**
*National map unit symbol:* 67st
*Elevation:* 600 to 1,500 feet
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**
*Metamora and similar soils:* 50 percent
*Capac and similar soils:* 30 percent
*Minor components:* 20 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Metamora Setting**
*Landform:* Till plains
*Landform position (three-dimensional):* Rise
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy till

**Typical profile**
*Ap - 0 to 13 inches:* sandy loam
*B - 13 to 29 inches:* sandy loam
*2Bt - 29 to 43 inches:* clay loam
*2C - 43 to 60 inches:* loam

**Properties and qualities**
*Slope:* 0 to 4 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Somewhat poorly drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)

*Depth to water table:* About 12 to 24 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Available water storage in profile:* High (about 9.2 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C/D
*Ecological site:* Till Flats (F098XA011MI)
*Hydric soil rating:* No

**Description of**

**Capac Setting**
*Landform:* Knolls, till plains
*Landform position (three-dimensional):* Rise
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy till

**Typical profile**
*Ap - 0 to 9 inches:* sandy loam
*Bt - 9 to 30 inches:* clay loam
*C - 30 to 60 inches:* loam

**Properties and qualities**
*Slope:* 0 to 4 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Somewhat poorly drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* About 12 to 24 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Available water storage in profile:* High (about 9.5 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C/D
*Ecological site:* Till Flats (F098XA011MI)
*Hydric soil rating:* No

**Minor**

**Components**

**Colwood**
*Percent of map unit:* 10 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Parkhill**
*Percent of map unit:* 10 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

## OwB—Owosso-Marlette sandy loams, 1 to 6 percent slopes

**Map Unit Setting**
*National map unit symbol:* 67sx
*Elevation:* 600 to 1,200 feet
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**
*Owosso and similar soils:* 45 percent
*Marlette and similar soils:* 40 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Owosso Setting**
*Landform:* Till plains
*Landform position (three-dimensional):* Rise
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy glaciofluvial deposits over loamy till

**Typical profile**
*Ap - 0 to 9 inches:* sandy loam
*Bt - 9 to 31 inches:* sandy loam
*2C - 31 to 60 inches:* loam

**Properties and qualities**
*Slope:* 1 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 10 percent
*Available water storage in profile:* High (about 9.2 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C
*Ecological site:* Loamy Drift Plains (F098XA015MI)
*Hydric soil rating:* No

**Description of Marlette**

**Setting**

*Landform:* End moraines
*Landform position (three-dimensional):* Crest, side slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy till

**Typical profile**

*Ap - 0 to 9 inches:* sandy loam
*B/E - 9 to 17 inches:* clay loam
*Bt - 17 to 38 inches:* clay loam
*C - 38 to 60 inches:* loam

**Properties and qualities**

*Slope:* 1 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Available water storage in profile:* High (about 10.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C
*Ecological site:* Loamy Drift Plains (F098XA015MI)
*Hydric soil rating:* No

**Minor**

**Components**

**Hillsdale**

*Percent of map unit:* 3 percent
*Hydric soil rating:* No

**Metamora**

*Percent of map unit:* 3 percent
*Hydric soil rating:* No

**Capac**

*Percent of map unit:* 3 percent
*Hydric soil rating:* No

**Parkhill**

*Percent of map unit:* 3 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Metea**

*Percent of map unit:* 3 percent
*Hydric soil rating:* No

## Pg—Pits, gravel

**Map Unit Setting**
*National map unit symbol:* 1jf7r
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**
*Pits, gravel:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

## Pr—Parkhill loam, non dense till subsoil, 0 to 2 percent slopes

**Map Unit Setting**
*National map unit symbol:* 2w5mp
*Elevation:* 680 to 940 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 41 to 52 degrees F
*Frost-free period:* 110 to 200 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**
*Parkhill, non dense till subsoil, and similar soils:* 92 percent
*Minor components:* 8 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Parkhill, Non Dense Till Subsoil**

**Setting**
*Landform:* Drainageways on moraines, depressions on till plains, drainageways on till plains, depressions on moraines
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Loamy till

**Typical profile**
*Ap - 0 to 9 inches:* loam
*Bg - 9 to 30 inches:* clay loam
*Cg - 30 to 80 inches:* loam

**Properties and qualities**

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Runoff class:* Negligible
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)
*Depth to water table:* About 0 inches
*Frequency of flooding:* None
*Frequency of ponding:* Frequent
*Calcium carbonate, maximum in profile:* 30 percent
*Salinity, maximum in profile:* Nonsaline (0.1 to 0.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 4.0
*Available water storage in profile:* High (about 9.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* C/D
*Ecological site:* Wet Till Depressions (F098XA012MI)
*Hydric soil rating:* Yes

**Minor**

**Components**

**Capac**

*Percent of map unit:* 3 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Belleville**

*Percent of map unit:* 2 percent
*Landform:* Drainageways on till plains, drainageways on moraines, depressions on moraines, depressions on till plains
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

**Gilford, gravelly subsoil**

*Percent of map unit:* 2 percent
*Landform:* Glacial drainage channels
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Selfridge**

*Percent of map unit:* 1 percent
*Landform:* Moraines, till plains
*Landform position (two-dimensional):* Footslope

*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## Sb—Sebewa loam, 0 to 2 percent slopes

**Map Unit Setting**
*National map unit symbol:* 2v2c9
*Elevation:* 700 to 1,050 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 140 to 200 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**
*Sebewa and similar soils:* 93 percent
*Minor components:* 7 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Sebewa Setting**
*Landform:* Drainageways on moraines, drainageways on outwash plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Parent material:* Loamy drift over sandy and gravelly outwash

**Typical profile**
*Ap - 0 to 11 inches:* loam
*Btg1 - 11 to 21 inches:* clay loam
*Btg2 - 21 to 33 inches:* clay loam
*2Cg - 33 to 80 inches:* sand

**Properties and qualities**
*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Runoff class:* Negligible
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.01 to 1.42 in/hr)
*Depth to water table:* About 0 inches
*Frequency of flooding:* None
*Frequency of ponding:* Frequent
*Calcium carbonate, maximum in profile:* 45 percent
*Salinity, maximum in profile:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 3.0
*Available water storage in profile:* Moderate (about 7.1 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* B/D
*Ecological site:* Wet Till Depressions (F098XA012MI)
*Hydric soil rating:* Yes

**Minor**

**Components**

**Matherton**
*Percent of map unit:* 5 percent
*Landform:* Drainageways on outwash plains, drainageways on moraines
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Gilford**
*Percent of map unit:* 2 percent
*Landform:* Drainageways on moraines, drainageways on outwash plains
*Landform position (two-dimensional):* Toeslope, footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

## Sh—Shoals-Sloan loams

**Map Unit Setting**
*National map unit symbol:* 67t3
*Mean annual precipitation:* 30 to 36 inches
*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* Prime farmland if drained

**Map Unit Composition**
*Shoals and similar soils:* 55 percent
*Sloan and similar soils:* 45 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Shoals Setting**
*Landform:* Flood plains
*Landform position (three-dimensional):* Rise
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Fine-loamy alluvium

**Typical profile**
*A - 0 to 9 inches:* loam
*C - 9 to 52 inches:* silt loam
*2C - 52 to 60 inches:* fine sand

**Properties and qualities**
*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Somewhat poorly drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
*Depth to water table:* About 6 to 18 inches
*Frequency of flooding:* Occasional
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 10 percent
*Available water storage in profile:* High (about 11.1 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* B/D
*Ecological site:* Floodplains (F098XA003MI)
*Hydric soil rating:* No

**Description of**

**Sloan Setting**
*Landform:* Depressions
*Landform position (three-dimensional):* Talf
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Loamy alluvium

**Typical profile**
*A - 0 to 11 inches:* loam
*Bg - 11 to 41 inches:* silt loam
*2Cg - 41 to 60 inches:* coarse sand

**Properties and qualities**
*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Very poorly drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.20 to 1.98 in/hr)
*Depth to water table:* About 0 to 12 inches
*Frequency of flooding:* Occasional
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 8.3 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3w
*Hydrologic Soil Group:* B/D
*Ecological site:* Wet Floodplains (F098XA004MI)
*Hydric soil rating:* Yes

## SpB—Spinks loamy sand, 0 to 6 percent slopes

### Map Unit Setting

*National map unit symbol:* 2tpkp
*Elevation:* 670 to 1,050 feet
*Mean annual precipitation:* 30 to 41 inches
*Mean annual air temperature:* 43 to 52 degrees F
*Frost-free period:* 140 to 200 days
*Farmland classification:* Farmland of local importance

### Map Unit Composition

*Spinks and similar soils:* 92 percent
*Minor components:* 8 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of

### Spinks Setting

*Landform:* Glacial drainage channels, outwash plains, moraines
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, tread
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear *Parent material:* Sandy drift

### Typical profile

*Ap - 0 to 9 inches:* loamy sand
*Bw - 9 to 28 inches:* sand
*E and Bt - 28 to 69 inches:* loamy sand
*C - 69 to 80 inches:* sand

### Properties and qualities

*Slope:* 0 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (1.42 to 14.17 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 20 percent
*Salinity, maximum in profile:* Nonsaline (0.0 to 0.4 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 2.0
*Available water storage in profile:* Low (about 5.2 inches)

### Interpretive groups

*Land capability classification (irrigated):* 3s
*Land capability classification (nonirrigated):* 3s

*Hydrologic Soil Group:* A
*Ecological site:* Pine Sandy Drift Plains (F098XA013MI), Rich Sandy Drift (F096XB019MI), Snowy Sandy Drift (F094AA006MI)
*Hydric soil rating:* No

**Minor**

**Components**

**Thetford**
*Percent of map unit:* 3 percent
*Landform:* Moraines, outwash plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Tekenink**
*Percent of map unit:* 2 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Summit, shoulder
*Landform position (three-dimensional):* Interfluve
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Oshtemo**
*Percent of map unit:* 2 percent
*Landform:* Moraines, outwash plains, glacial drainage channels
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, head slope, nose slope, side slope, tread
*Down-slope shape:* Linear, convex
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Metea**
*Percent of map unit:* 1 percent
*Landform:* Moraines
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Head slope, nose slope, interfluve, side slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## StB—Spinks-Metea loamy sands, 0 to 6 percent slopes

**Map Unit Setting**
*National map unit symbol:* 67t6
*Elevation:* 500 to 1,500 feet
*Mean annual precipitation:* 30 to 36 inches

*Mean annual air temperature:* 45 to 48 degrees F
*Frost-free period:* 140 to 150 days
*Farmland classification:* Farmland of local importance

**Map Unit Composition**
*Spinks and similar soils:* 50 percent
*Metea and similar soils:* 25 percent
*Minor components:* 25 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of**

**Spinks Setting**
*Landform:* Beach ridges
*Landform position (three-dimensional):* Riser
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Sandy drift

**Typical profile**
*Ap - 0 to 9 inches:* loamy sand *B*
*- 9 to 26 inches:* loamy sand *E*
*and Bt - 26 to 58 inches:* sand *C*
*- 58 to 60 inches:* coarse sand

**Properties and qualities**
*Slope:* 0 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Negligible
*Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Low (about 4.2 inches)

**Interpretive groups**
*Land capability classification (irrigated):* 3s
*Land capability classification (nonirrigated):* 3s
*Hydrologic Soil Group:* A
*Ecological site:* Sandy Drift Plains (F098XA014MI)
*Hydric soil rating:* No

**Description of**

**Metea Setting**
*Landform:* Moraines
*Landform position (three-dimensional):* Rise
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Sandy and/or loamy till

**Typical profile**
*Ap - 0 to 9 inches:* loamy sand *B*
*- 9 to 31 inches:* loamy sand *2Bt*
*- 31 to 43 inches:* clay loam *2C - 43 to 60 inches:* loam

**Properties and qualities**
*Slope:* 0 to 6 percent

*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Runoff class:* Very low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 40 percent
*Available water storage in profile:* Moderate (about 6.9 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* B
*Ecological site:* Loamy Drift Plains (F098XA015MI)
*Hydric soil rating:* No

**Minor**

**Componen**

**ts**

**Colwood**
*Percent of map unit:* 5 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Metamora**
*Percent of map unit:* 4 percent
*Hydric soil rating:* No

**Marlette**
*Percent of map unit:* 4 percent
*Hydric soil rating:* No

**Kibbie**
*Percent of map unit:* 4 percent
*Hydric soil rating:* No

**Parkhill**

*Percent of map unit:* 4 percent
*Landform:* Depressions
*Hydric soil rating:* Yes

**Tuscola**

*Percent of map unit:* 4 percent
*Hydric soil rating:* No

## W—Water

**Map Unit Composition**

*Water:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

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