Section 12
Stormwater Management

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

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12.0 STORMWATER MANAGEMENT PLAN

12.1 Overview

The Canton Mountain Wind Project (Project) is an eight-turbine, 22-megawatt (MW) wind energy generation project located in the municipality of Canton, Oxford County, Maine. The Project includes approximately 7,175 linear feet of gravel road improvement and temporary widening on Ludden Lane; 8,600 linear feet improvement and temporary widening on a private, unnamed logging road; and approximately 10,600 linear feet of new roads, including (i) a 3,425-foot-long access road to the ridgeline, (ii) an approximately 7,175-linear-foot ridgeline road that will connect the wind turbine tower foundations, and (iii) a 360-foot-long access road to the operations and maintenance (O&M) building. Along the ridgeline road, eight wind turbines and associated electrical collection infrastructure will be installed. The Project also includes a 3,500-square-foot O&M building, and an approximately 7,500-square-foot parking lot. All new impervious areas will be treated pursuant to the Maine Stormwater Management Law (38 M.R.S.A. § 420 et al. and Chapter 500 Rules). When construction of the Project is complete, the total impervious area will be 9.0 acres, and the total developed area will be 9.6 acres.

Power from the turbines will be collected in a 34.5-kilovolt (kV) underground collector line system buried within the ridgeline road work limits, which will transition to an aboveground transmission line approximately 3,425 feet down from where the access road meets the ridgeline road. From there it will continue aboveground roadside, mounted on wood poles, for approximately 1.59 miles to the intersection with the existing right-of-way built for the Saddleback Ridge Wind Project (Maine Department of Environmental Protection [Maine DEP] licenseL-25137-24-A-N/L-25137- TG-B-N). The proposed transmission line will travel an additional 1.1 miles south sharing a transmission right-of-way with the Saddleback Ridge Wind Project until it reaches Central Maine Power Company's (CMP) Ludden Lane Substation, which will connect the Project to the existing 115-kV regional transmission grid.

Because the Project consists primarily of linear features, it is regarded as a linear project pursuant to Maine's Stormwater Law. These linear features are required to meet 75 percent stormwater treatment as described in the General Standards. Turbine pads and the O&M building are not considered linear and are required to meet 95 percent stormwater treatment. Disturbed areas not considered part of permanent project facilities will be restored and revegetated following construction. The existing roads will be widened only temporarily for construction before being revegetated. The new access road to the ridge will be built 24 feet wide to allow access for construction equipment. The ridgeline road will be constructed at 32 feet wide to allow for the large construction equipment and cranes needed to assemble the turbines. In an effort to minimize project impacts, the access road and ridgeline road will be reduced to a final width of only 12 feet for operation of the Project, with the exception of periodic turnouts to allow for passing vehicles. The road base and cross sections will remain in place, but the temporary gravel road surfaces (12 feet and 20 feet wide, respectively) will be loamed and seeded and/or treated with an erosion control mulch to maintain these areas as vegetated meadow buffers. During operation of the Project, a crane or other heavy equipment may need to access the turbines for maintenance or repairs; however, if meadow buffer areas are disturbed during these maintenance activities, they will be restored following completion of the necessary repairs or maintenance.

The Project requires a Maine DEP Site Location of Development Act permit and is required to meet the Basic Standards, General Standards, and the Flooding Standard of the Maine Stormwater Law (38 M.R.S.A. § 420-D.1, *Standards*, and Chapter 500-Rules).

Presently, the project area is wooded and used as commercial timber land. Adjacent properties are generally undeveloped and used primarily for commercial timber harvesting operations, like the project site. Disturbed areas, excluding permanent facilities, will be reseeded and revegetated in a manner that will allow these areas to revert to natural conditions (refer to Section 14 – Basic Standards). Although construction of the facility will involve the disturbance of approximately 33.4 acres of land, 9.6 acres of developed area will remain following construction, of which 9.0 acres will be impervious area.

This site is not located in the direct watershed of an Urban Impaired Stream listed in Chapter 502, Appendix B. The project area drains to Ridley Brook and Ludden Brook, which both drain to the Androscoggin River, and parts of the project area also drain directly to the Androscoggin River (see Figure 12-1). Eventually, the Androscoggin River flows into the Atlantic Ocean.

Canton Mountain Wind, LLC (CMW) is proposing low-impact design methods using natural buffers to treat stormwater runoff from the Project. These natural buffers will convey treated stormwater runoff from impervious areas as sheet flow, similar to existing site conditions. Stormwater calculations for the project site demonstrate that there will be an insignificant increase in peak flow rates or runoff volume from the Project. With the exception of the underdrained soil filter near the O&M building (see Section 12.9), stormwater detention facilities are not warranted for the Project since there will be insignificant increases in peak flows associated with storm events. A small portion of Ludden Lane is located within the 100-year flood plain; however, the upgrading of this section of Ludden Lane will not result in a net decrease in flood storage capacity. As a result, CMW is requesting a waiver from the Flooding Standard pursuant to Chapter 500(4)(E)(2).

Each natural buffer area or other stormwater feature was designed in relation to the affected area to be treated. These features were sized using the proposed site conditions and amount of impervious area draining to each buffer, based on *Stormwater Management for Maine* and Chapter 500 buffer standards. Attachment 12-1 includes the HydroCAD® stormwater calculation reports, including modeling assumptions, sub-catchment areas, flow paths, drainage reaches, etc. Attachment 12-2 includes the Pre- and Post-development Drainage Plans. Runoff calculations were performed for a 25-year storm event for the existing and developed conditions.

12.2 Methodology

Natural Resources Conservation Service (NRCS) maps were used to obtain regional rainfall data. The Soil Conservation Services' (SCS) Technical Release (TR)-20 computer modeling method was used within HydroCAD® 9.10 to perform hydrologic and hydraulic calculations. This method accounts for existing soils and land use, topography, vegetative cover and proposed land use. The conditions of the project site were evaluated to determine pre-development and post-development peak stormwater flows, drainage patterns, flow velocities, and other attributes of the site. These conditions were analyzed using data for a Type III, 24-hour storm distribution, with a frequency of occurrence of 25 years. Rainfall amounts for this storm are 4.8 inches. The hydrologic calculations can be found in Attachment 12-1.

Figure 12-1
Watershed Areas

Canton Mountain Wind Project
Canton and Dixfield, Maine

TETRA TECH EC, INC.

December 2011

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

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12.3 Topography and Vegetation

The majority of the project area is comprised of undeveloped forest land and commercial forestry operations with moderately steep to steep mountainside slopes. Elevations generally range between 490 feet above sea level in the vicinity of the O&M building to 1,600 feet above sea level in the vicinity of the highest turbine site located along the ridgeline. Slopes range from 0 percent to 60 percent but mostly occur at 30 percent or less in the vicinity of the ridgeline access road and turbine sites. Forest stands in the project area are typical of lands subject to commercial forestry operations. The project area was assumed to be in good condition for the purpose of runoff calculations.

Wetlands, state and federal jurisdictional waterbodies, and numerous non-jurisdictional drainages were field delineated and mapped in the project vicinity and impacts to these resources were avoided and minimized where possible.

12.4 Site Soils

Site-specific soils mapping, in conformance with Class B (High Intensity), Class D (Modified) and Class L (Linear) standards, was performed for the project site (see Section 11 of this application). According to these surveys, the project site primarily includes forested side slopes and mountain top ridges. Soil landforms generally consist of loam and sandy loam soils derived from glacial till. The tops of the mountain and ridgelines are generally bedrock controlled, and consequently exhibit shallow to bedrock soil conditions. The side slopes tend to be comprised of deeper soils (i.e., +40 inches in depth), which are loam to sandy loam textured soils generally derived from glacial till sediments. These soils commonly exhibit a firm substratum that produces a perched groundwater table. The soil mapping units produced as a result of this soil survey were overlaid on the engineering drawings and used for the stormwater analysis and design. For stormwater calculation purposes, the soils were grouped by Hydrologic Soils Group (HSG), drainage classifications defined by the NRCS. These groups are shown on the drainage plans in Attachment 12-2. The soils on the site are predominantly HSG C and D. The ridgeline is mostly HSG C and D soils, while the side slopes and lower elevation areas are generally HSG C soils.

12.5 Stormwater Quality Best Management Practices

The Project was designed to comply with the requirements of Maine DEP's best management practices (BMPs) for stormwater, identified in the *Stormwater Management for Maine* manual, published by the Maine DEP in January 2006. The project design incorporates many of the BMPs contained in this manual, including level spreaders, ditch turnouts, and stone berms. The design also integrates features geared towards minimizing the effects on ground and surface water flow.

The General Standards, Section 4(B)(2) of the Chapter 500 Rules require that runoff from no less than 95 percent of the impervious area and no less than 80 percent of the developed area that is impervious or landscaped is controlled and treated using accredited BMPs. The linear features of the Project – the roads – in accordance with Section 4(B)(3)(c) of the General Standards will require treatment for no less than 75 percent of the runoff volume from the impervious area and no less than 50 percent of the developed area that is impervious or landscaped. The turbine pads and O&M building are not considered linear and are required to meet 95 percent stormwater treatment. This Project achieves treatment for 100 percent of all impervious non-linear areas and over 77 percent of impervious linear features (see Attachment 12-1).

The existing utility corridor would include only negligible new impervious areas associated with the additional proposed power poles, and the roadside transmission line will be built and operated in compliance with the criteria specified in Section 4(B)(3)(d) of the General Standards. Consequently, the electric transmission line portion of the Project is not subject to the Chapter 500 General Standards. In addition, the utility corridor will be maintained in accordance with Maine DEP's Chapter 375, *Minimum Performance Standards for Electric Utility Corridors.* CMW has prepared a Post-Construction Vegetation Management Plan (Attachment 10-1, Section 10 of this application) that will be reviewed by Maine DEP as part of this permit application.

12.6 Pre-Development Conditions

With the exception of Ludden Lane, logging roads and associated landings, the project site is currently wooded and undeveloped, though used for commercial timber harvest. Like a typical logged forest, it is vegetated with a mix of mature deciduous and coniferous trees, well-established medium and young trees, and thick brush, grasses and meadow vegetation. Stormwater runoff from the existing project site is grouped into three large subcatchments, covering approximately 2,978 acres, as described below and shown on Figure 12-1.

Subcatchment A is located east of the ridgeline and access road. This drainage area includes approximately 530 acres of wooded mountainside controlled by CMW. The area contains primarily HSG C and D soils. There are a few existing dirt roads, but otherwise the area is undeveloped. The runoff curve number for this subcatchment is 70 with a 25-year storm peak flow rate of 530 cubic feet per second (cfs).

Subcatchment B is located west of the ridgeline. This drainage area includes approximately 2,441 acres of wooded mountainside controlled by CMW. The area contains primarily HSG C soils with smaller areas of D soils at the highest elevations. There are a few existing dirt roads in this drainage area including Ludden Lane, but otherwise the area is undeveloped. The runoff curve number for this subcatchment is 70 with a 25-year storm peak flow rate of 2,441 cfs.

Subcatchment C is located southwest of Canton Mountain, adjacent to Ludden Lane. This drainage area includes approximately 6.8 acres of wooded mountainside controlled by CMW. The area contains primarily C soils. There are a few existing dirt roads, but otherwise the area is undeveloped. The runoff curve number for this subcatchment is 70 with a 25-year storm peak flow rate of 6.8 cfs.

Refer to Attachments 12-1 and 12-2 for a further description of the various subcatchment areas.

12.7 Stormwater Calculations and Results

A post-development drainage analysis was performed to determine if the Project would increase runoff from the site and, therefore, require stormwater detention for a 25-year storm event.

Hydrologic soil group areas were identified for each watershed based upon the soil surveys performed by Albert Frick Associates, Inc. and detailed in Section 11 of this application. The most distant hydraulic travel length was identified for each of the three watersheds. Length and width of all existing roadways within the watershed boundaries were estimated and assumed to have a runoff curve number (RCN) of 89, assuming gravel roadways (HSG C). All wooded areas were assumed to be in good condition.

Stormwater calculations assumed 12-foot-wide impervious roads, a 50- by 80-foot area for each gravel crane pad surrounding turbine foundations, an approximately 1,135-square-foot concrete area for each turbine base, and a 3,500-square-foot O&M building with a 7,500-square-foot parking lot. The post-development watershed areas are the same as the pre-development watershed areas. The time of concentration was assumed to remain the same in both pre- and post-development. Results of the stormwater runoff calculations are shown in Table 12-1.

Table 12-1. Existing and Post-Development Peak Flow Rates and Runoff Volumes

	Watershed A	Watershed B	Watershed C
Watershed Area within Project Area (acres)	530	2,441	6.8
Increase in Impervious Area (acres)	2.30	2.07	0.38
Increase in Impervious Area (% of Total Watershed)	0.4%	0.1%	5.6%
Existing Peak Flow Rate (cubic feet per second)	530	2,441	6.8
Existing Runoff Volume (acre-feet)	75	348	1
Post-Development Peak Flow Rate (cubic feet per second)	530	2,441	6.8
Post-Development Runoff Volume (acre-feet)	75	348	1

12.8 Post-Development Conditions

The Project's stormwater management low-impact development system was designed to mitigate the impacts of the proposed gravel roadways while maintaining simplicity in the design. This simplicity is important because it requires a minimum amount of maintenance to ensure its proper function, which in turn provides a higher probability of long-term effectiveness.

In general, there will be very little change in the runoff characteristics of the site after completion of the Project. Stormwater runoff of upgradient undisturbed areas will be intercepted by either a riprap ditch or riprap shoulder. This runoff will be encouraged to infiltrate through the blasted rock sub-base of the road. During larger storms, the stormwater is directed to culverts that outlet to level spreaders. The level spreaders then redistribute the water to resemble natural sheet flow. Pre-developed mountain side slopes have an approximate grade of 20 to 60 percent; however, the proposed roadside ditches will have a maximum slope of only 13 percent, enabling them to slow the upstream flow, thereby decreasing the runoff for areas intercepted by the roadway. While there will be a slight increase in overall runoff due to the roadway, it will generally be mitigated by this decrease in upstream runoff.

No significant changes in runoff are expected following development of the site. This is primarily due to the impervious area proposed in each subcatchment being a relatively small percentage of the whole. For example, in Subcatchment B, 2.07 acres of impervious surface are proposed, but that represents less than 0.1 percent of the 2,441 acres of the watershed within the project area, as shown in Table 12-1.

Much of the project site has thin soils over bedrock, which are typically conducive to producing large volumes of stormwater runoff. Because large mountainside watersheds already have large volumes of runoff, the increase in runoff due to construction of gravel roadways and turbine foundations would be minimal. Both the relatively small increase in impervious area and the minimal change in runoff volumes following construction contribute to insignificant changes in runoff characteristics post-construction. The

HydroCAD® calculations in Attachment 12-1 also demonstrate that no significant changes to the rate or volume of runoff are anticipated from post-development site conditions.

Low-Impact Development (LID) is the general term used to describe a design strategy that minimizes disturbance and aims to maintain the pre-development hydrologic regime through the use of design techniques and BMPs. A combination of hydrologic functions such as runoff storage, infiltration, groundwater recharge, vegetation and buffer filtration, time of concentration, and sheet flow are preserved through the use of stormwater management BMPs, buffers, reduction of impervious surfaces, conservation of natural areas and control of runoff close to the source.

Traditionally, the impact of development to a watershed is measured in terms of increases in peak flow rates and changes in flow regimes. Conventional stormwater management methods direct all stormwater to channel-like flow. Through the use of ditches, storm drains, and other "end-of-pipe" controls, the stormwater is carried to detention ponds and other point sources of discharge as quickly as possible. The end-of-pipe system is designed for the larger and more infrequent events such as the 10- and 25-year storms. Such a system is not designed to manage smaller, more frequent events such as the 1- and 2-year events that make up 90 to 95 percent of all rainfall events. As a result, these smaller, more frequent storms over-drain a site managed by conventional stormwater practices and eventually erode natural streams, causing downstream pollution due to the rapidly transported pollutants. In contrast to conventional stormwater management methods, LID methods control stormwater at the point of collection. Instead of channeling the water to a detention pond, stormwater runoff is discharged in a more natural condition, as sheet flow. The project objectives are to minimize disturbance and maintain a pre-development hydrology regime. The Project will replicate existing runoff conditions and drainage patterns through the use of a LID system, instead of using more conventional end-of-pipe systems.

The provisions of the Maine Stormwater Law and Site Location of Development Act typically require stormwater detention practices in order to meet the flooding standard required for large projects such as this. Results of these analyses indicate that the Project will produce little or no increase in peak flow rates; therefore, CMW is requesting a waiver of the Flooding Standard per the General Standards, Section 4(E)(2)(b) of the Chapter 500 Rules.

12.9 Stormwater Quantity Management

The primary concept of the Project's stormwater management system is to minimize the amount of water traveling over the newly created roadway. This will be accomplished by first intercepting the surface water flow on the uphill side of the roadway with a ditch that will be constructed along the upper edge of the road. Water will flow from the ditch through a culvert system, allowing the water to pass under the roadway. At the outlet of the culverts, level spreader systems will be provided to allow the flow to be disbursed downstream. In addition, at the naturally-occurring low points in the roadway where a fill is present, a stone and geotextile filtering system (commonly referred to as a rock sandwich) will be installed under the roadway sub-base to allow upgradient ground and surface waters to travel under the roadway unimpeded by the new construction. Similar to the rock sandwich, a rock maki section will be used in cut sections showing high water table or high runoff potential. In these sections, an additional foot of stone will be placed under the sub-base of the road and connected to the ditch's sub-base. This extra layer of stone will encourage infiltration of the groundwater and surface water under the road. The rock sandwich and rock maki are examples of LID systems that take the focus away from concentrated flow.

These two systems have the ability to deal with smaller runoff more naturally, but they are also capable of handling larger storm events. This system will maintain flows as close to sheet flow as possible.

Frequent culverts, level spreaders, buffers and other erosion control measures will be used throughout the Project in order to control runoff and erosion. Culvert sizes, locations, and elevations are specified on the design drawings (Exhibit 1); however, final culvert locations may need to be adjusted slightly in the field based on site-specific conditions. The final locations and elevations of culverts will be noted and included on the as-built plans for the Project. Culvert sizing calculations and a Schedule of Proposed Culverts can be found in Attachments 12-3 and 12-4, respectively.

Runoff from the final gravel roadway system will be directed through an artificially created meadow buffer. The artificial meadow buffer will be 12 feet wide for the access road and 20 feet wide for the ridgeline road. The runoff will then travel through a forested buffer at least 35 feet wide, with the upslope edges of these buffers beginning at the clearing limits or further downslope (see Exhibit 1). Buffers outside of the clearing limits will be protected with deed restrictions. Meadow buffers within the original road widths will not be deed restricted as a crane may be needed at some point during the operation of the Project; any meadow buffers within the original road widths that are disturbed by a crane will be restored after the crane leaves the project site. A sample deed restriction for forested buffers can be found in Attachment 12-5. Buffers were sized using the *Stormwater Management for Maine* manual and in consultation with Maine DEP.

Distribution berms and treatment berms will also be implemented in steeper buffer areas to slow flows and guarantee proper treatment. The distribution and treatment berms will be composed of an erosion control mix material. The distribution berms will be placed at the upslope end of specified buffers to ensure that stormwater will enter the buffers in sheet flow and gain maximum treatment. The treatment berms will be placed at the downslope end of specified buffers to slow flows and maintain sheet flow. This filtering system will also remove sediment before the surface water travels downstream.

Runoff from the O&M building pad will be treated by a vegetated, underdrained soil filter system where the runoff is captured and retained, then passed through a filter bed comprised of a specific soil media. This soil filter will have a mixture of silty sand and organic matter to achieve the highest removal rates. Once through the soil media, the runoff is collected in a perforated underdrain pipe and discharged downstream. The filter structure provides for the slow release of smaller storm events, minimizing channel erosion, and cooling the discharge. Calculations for the underdrained soil filter can be found in Attachment 12-6.

Results of the stormwater runoff calculations are shown in Table 12-1. Complete printouts for stormwater data, calculations, modeling assumptions and HydroCAD® reports for the pre-development and post-development conditions can be found in Attachment 12-1. The peak flow rates and runoff volumes from the pre-development site conditions are not significantly affected by the proposed development as indicated by the post-development calculations. Based on these results, no flooding or adverse stormwater-related impacts are anticipated in association with development of the site. Although the project will add impervious area, the overall runoff curve number remains the same for the pre-development and post-development conditions of the site. The increase in peak flow post-development will be insignificant for all storm events. Therefore, stormwater mitigation for water quantity is not required for this Project, per the *Stormwater Management for Maine* manual.

12.10 Erosion and Sedimentation Control

Erosion and sedimentation control plans were prepared for the Project and are incorporated into the civil design plans (Exhibit 1). During construction, a variety of stabilization measures will be used to prevent sedimentation from soils due to wind and water action. The locations and details of proposed stabilization measures are illustrated in the drawings in Exhibit 1. All erosion control and stabilization measures have been designed to adequately address the requirements of the basic stabilization standards as defined in Chapter 500, *Stormwater Management Rules*. See Section 14, Basic Standards, of this application for a detailed description of proposed erosion and sedimentation control practices.

12.11 Water Quality

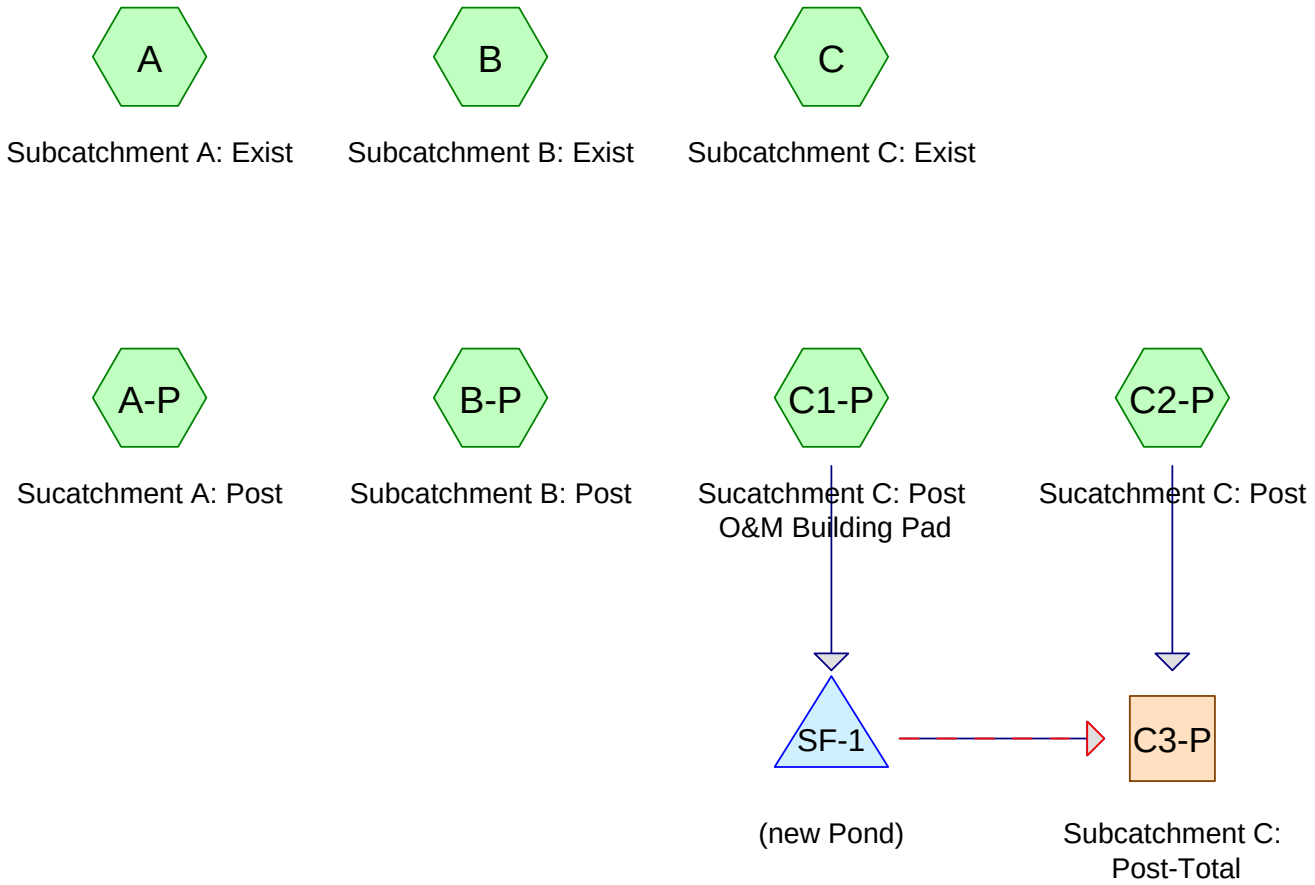
This Project is not located in the watershed of a great pond; therefore, no phosphorus analysis is required.

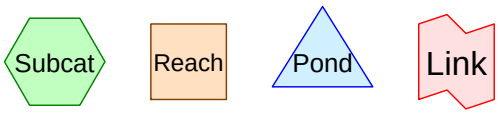
12.12 Conclusions

The Project was designed to comply with the Basic Standards and General Standards of Maine's Stormwater Law. The post-development drainage analysis shows a negligible increase in runoff volume for a 25-year storm event. A series of BMPs and buffers have been incorporated into the design to replicate pre-development conditions. The Project's post-development drainage analysis shows no increase in peak flow rates; therefore, CMW is requesting a waiver from the Flooding Standard. The proposed LID BMPs, natural buffers, and underdrained soil filter (designed to accommodate runoff from the O&M area) will provide sufficient stormwater quantity and quality management without producing adverse impacts. A schedule of the proposed Project BMPs is provided in Attachment 12-7. The proposed stormwater management system will be constructed and maintained in accordance with Maine DEP Standards and is designed to closely replicate pre-development stormwater conditions at the site and, therefore, will not result in flooding or degradation of existing water quality in the project area.

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 12-1
HydroCAD® Calculations





Drainage Diagram for Canton Mountain Wind Site Stormwater Analysis Rev 1

Prepared by {enter your company name here}, Printed 12/14/2011

HydroCAD® 9.10 s/n 02179 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5,951.131	70	Woods, Good, HSG C (A, A-P, B, B-P, C, C2-P)
4.603	89	Gravel roads, HSG C (A-P, B-P, C1-P)
0.138	91	Gravel roads, HSG D (C2-P)
5,955.872		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
5,955.734	HSG C	A, A-P, B, B-P, C, C1-P, C2-P
0.138	HSG D	C2-P
0.000	Other	
5,955.872		**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A: Subcatchment A: Exist Runoff Area=530.094 ac 0.00% Impervious Runoff Depth>1.71"
Tc=45.0 min CN=70 Runoff=529.57 cfs 75.497 af

Subcatchment A-P: Sucatchment A: Post Runoff Area=530.094 ac 0.00% Impervious Runoff Depth>1.71"
Tc=45.0 min CN=70 Runoff=529.57 cfs 75.497 af

Subcatchment B: Subcatchment B: Exist Runoff Area=2,441.000 ac 0.00% Impervious Runoff Depth>1.71"
Tc=45.0 min CN=70 Runoff=2,438.57 cfs 347.652 af

Subcatchment B-P: Subcatchment B: Runoff Area=2,441.000 ac 0.00% Impervious Runoff Depth>1.71"
Tc=45.0 min CN=70 Runoff=2,438.57 cfs 347.652 af

Subcatchment C: Subcatchment C: Exist Runoff Area=6.842 ac 0.00% Impervious Runoff Depth>1.71"
Tc=45.0 min CN=70 Runoff=6.84 cfs 0.974 af

Subcatchment C1-P: Sucatchment C: Post Runoff Area=0.241 ac 0.00% Impervious Runoff Depth>3.34"
Tc=45.0 min CN=89 Runoff=0.46 cfs 0.067 af

Subcatchment C2-P: Sucatchment C: Post Runoff Area=6.601 ac 0.00% Impervious Runoff Depth>1.71"
Tc=45.0 min CN=70 Runoff=6.59 cfs 0.940 af

Reach C3-P: Subcatchment C: Post-Total Inflow=6.84 cfs 1.005 af
Outflow=6.84 cfs 1.005 af

Pond SF-1: (new Pond) Peak Elev=485.13' Storage=686 cf Inflow=0.46 cfs 0.067 af
Primary=0.00 cfs 0.000 af Secondary=0.29 cfs 0.065 af Outflow=0.29 cfs 0.065 af

Total Runoff Area = 5,955.872 ac Runoff Volume = 848.279 af Average Runoff Depth = 1.71"
100.00% Pervious = 5,955.872 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment A: Subcatchment A: Exist

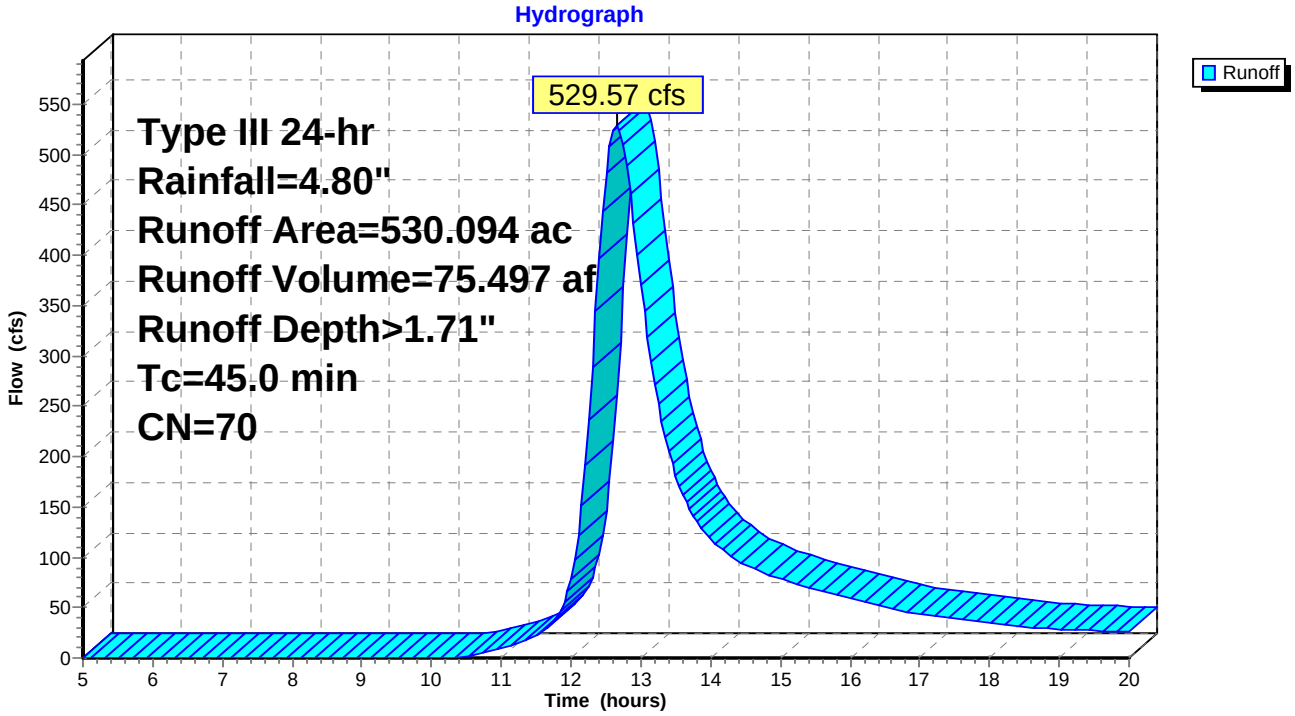
Runoff = 529.57 cfs @ 12.65 hrs, Volume= 75.497 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.80"

Area (ac)	CN	Description
530.094	70	Woods, Good, HSG C
530.094		100.00% Pervious Area

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

Subcatchment A: Subcatchment A: Exist



Summary for Subcatchment A-P: Sucatchment A: Post

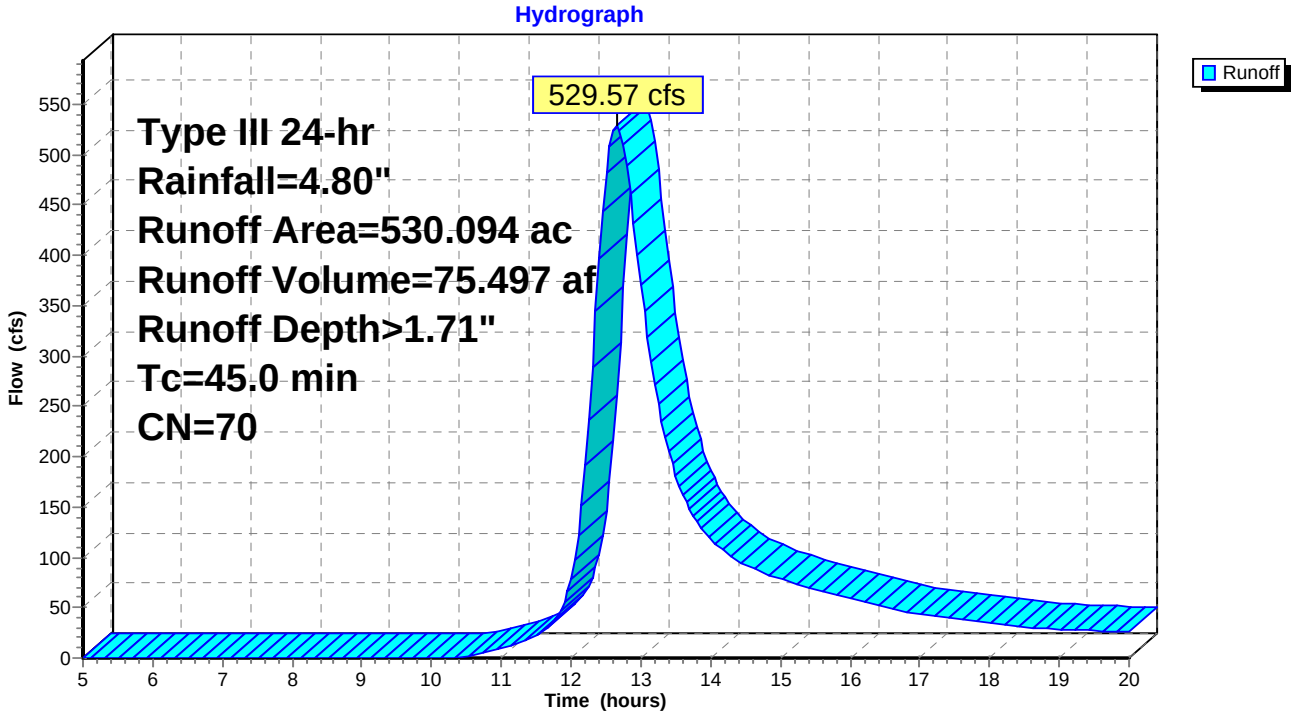
Runoff = 529.57 cfs @ 12.65 hrs, Volume= 75.497 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.80"

Area (ac)	CN	Description
527.798	70	Woods, Good, HSG C
2.296	89	Gravel roads, HSG C
530.094	70	Weighted Average
530.094		100.00% Pervious Area

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

Subcatchment A-P: Sucatchment A: Post



Summary for Subcatchment B: Subcatchment B: Exist

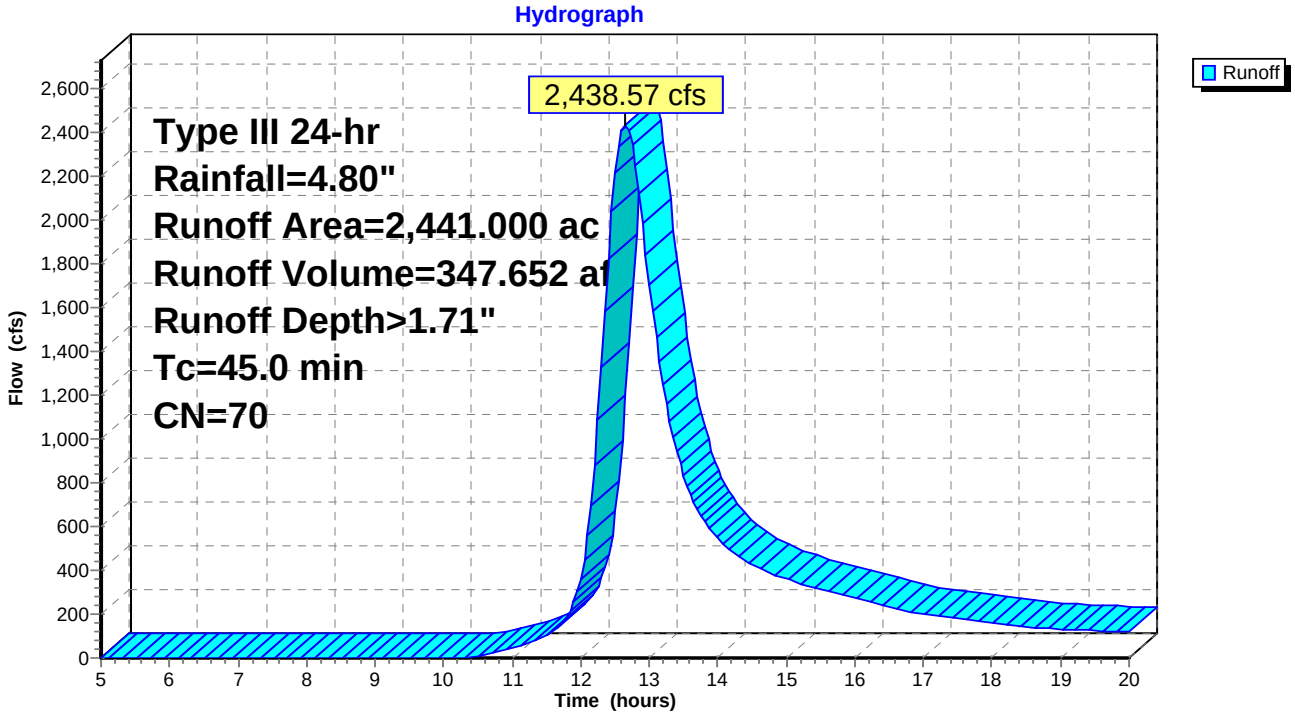
Runoff = 2,438.57 cfs @ 12.65 hrs, Volume= 347.652 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.80"

Area (ac)	CN	Description
2,441.000	70	Woods, Good, HSG C
2,441.000		100.00% Pervious Area

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

Subcatchment B: Subcatchment B: Exist



Summary for Subcatchment B-P: Subcatchment B: Post

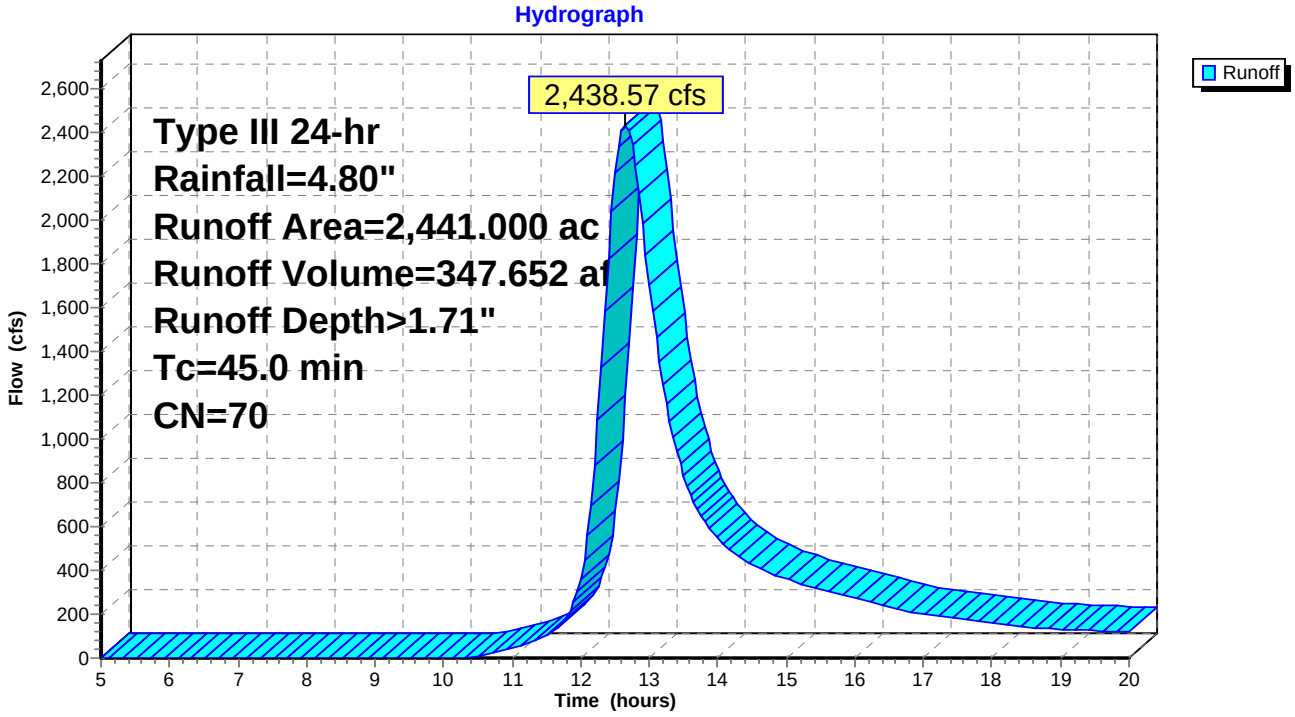
Runoff = 2,438.57 cfs @ 12.65 hrs, Volume= 347.652 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.80"

Area (ac)	CN	Description
2,438.934	70	Woods, Good, HSG C
2.066	89	Gravel roads, HSG C
2,441.000	70	Weighted Average
2,441.000		100.00% Pervious Area

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

Subcatchment B-P: Subcatchment B: Post



Summary for Subcatchment C: Subcatchment C: Exist

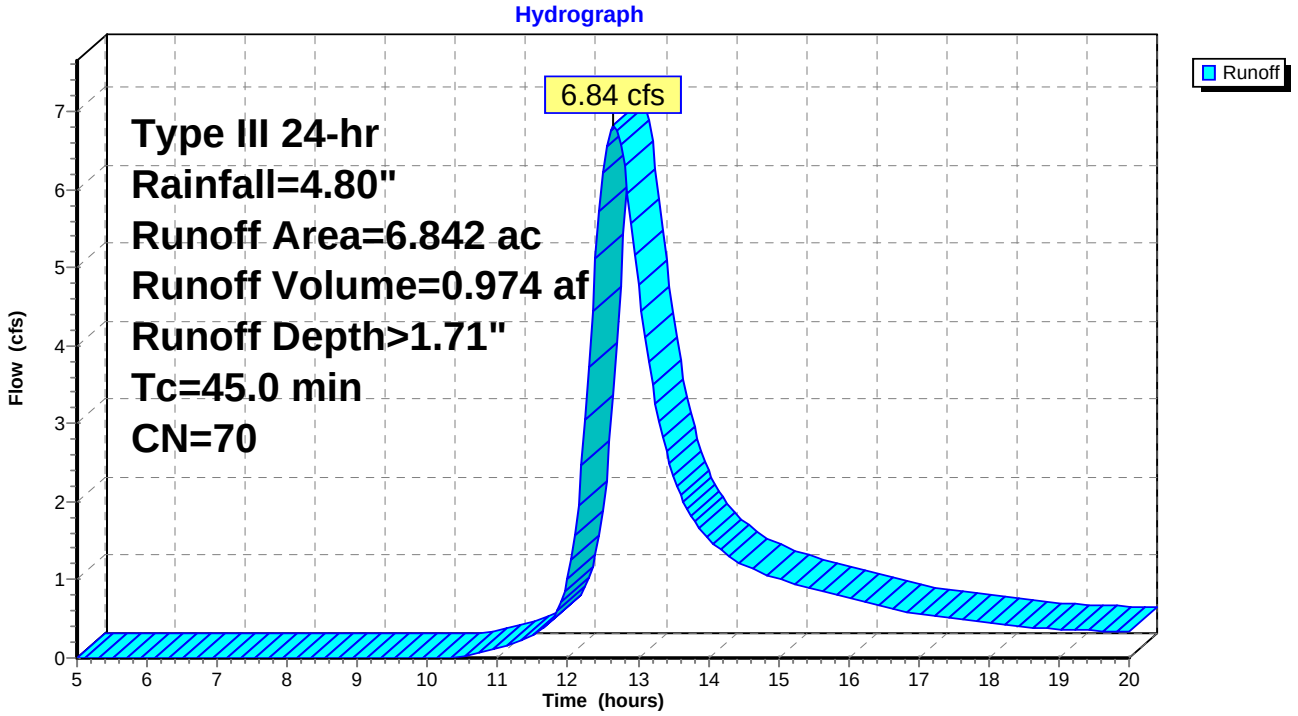
Runoff = 6.84 cfs @ 12.65 hrs, Volume= 0.974 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.80"

Area (ac)	CN	Description
6.842	70	Woods, Good, HSG C
6.842		100.00% Pervious Area

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

Subcatchment C: Subcatchment C: Exist



Summary for Subcatchment C1-P: Sucatchment C: Post O&M Building Pad

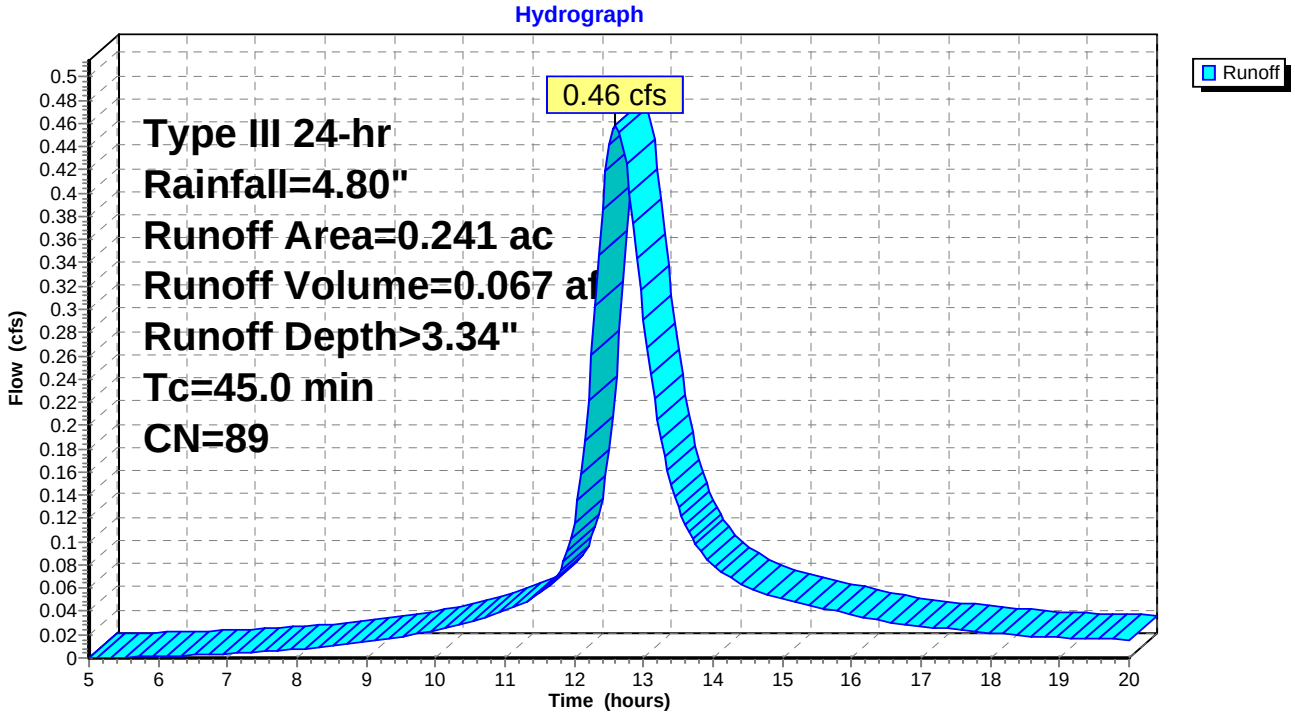
Runoff = 0.46 cfs @ 12.60 hrs, Volume= 0.067 af, Depth> 3.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.80"

Area (ac)	CN	Description
0.241	89	Gravel roads, HSG C
0.241		100.00% Pervious Area

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

Subcatchment C1-P: Sucatchment C: Post O&M Building Pad



Summary for Subcatchment C2-P: Sucatchment C: Post

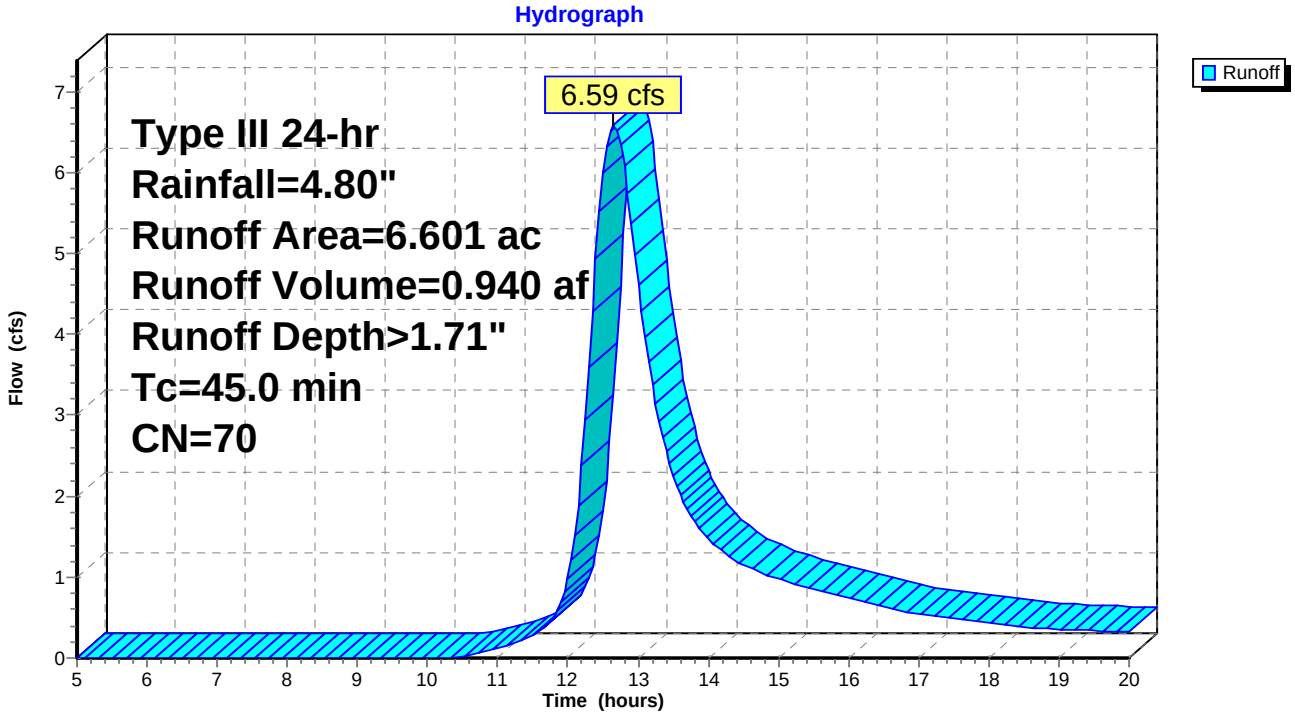
Runoff = 6.59 cfs @ 12.65 hrs, Volume= 0.940 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.80"

Area (ac)	CN	Description
6.463	70	Woods, Good, HSG C
0.138	91	Gravel roads, HSG D
6.601	70	Weighted Average
6.601		100.00% Pervious Area

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

Subcatchment C2-P: Sucatchment C: Post



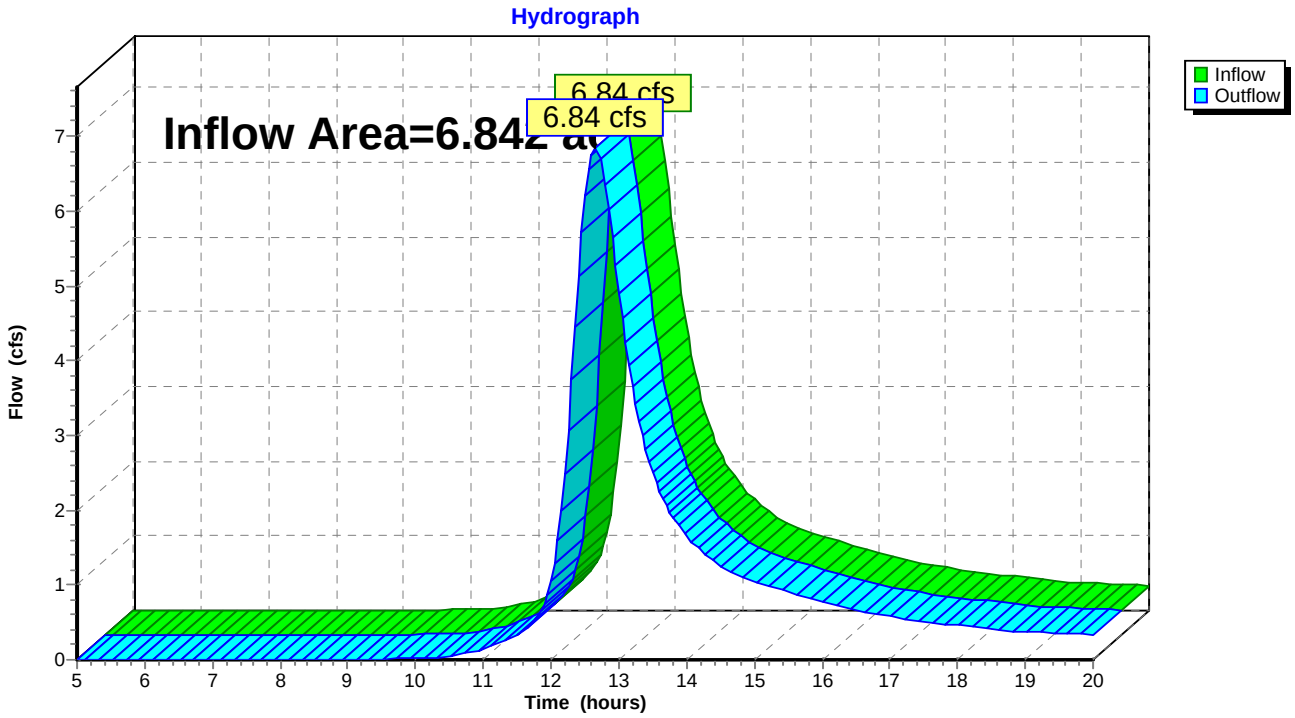
Summary for Reach C3-P: Subcatchment C: Post-Total

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

Inflow Area =	6.842 ac,	0.00% Impervious,	Inflow Depth >	1.76"	
Inflow =	6.84 cfs @	12.65 hrs,	Volume=	1.005 af	
Outflow =	6.84 cfs @	12.65 hrs,	Volume=	1.005 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach C3-P: Subcatchment C: Post-Total



Summary for Pond SF-1: (new Pond)

Inflow Area =	0.241 ac,	0.00% Impervious,	Inflow Depth >	3.34"
Inflow =	0.46 cfs @	12.60 hrs,	Volume=	0.067 af
Outflow =	0.29 cfs @	13.01 hrs,	Volume=	0.065 af, Atten= 38%, Lag= 24.6 min
Primary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Secondary =	0.29 cfs @	13.01 hrs,	Volume=	0.065 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 485.13' @ 13.01 hrs Surf.Area= 1,235 sf Storage= 686 cf

Plug-Flow detention time= 43.5 min calculated for 0.065 af (97% of inflow)
Center-of-Mass det. time= 33.3 min (829.7 - 796.4)

Volume	Invert	Avail.Storage	Storage Description
#1	484.50'	1,941 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

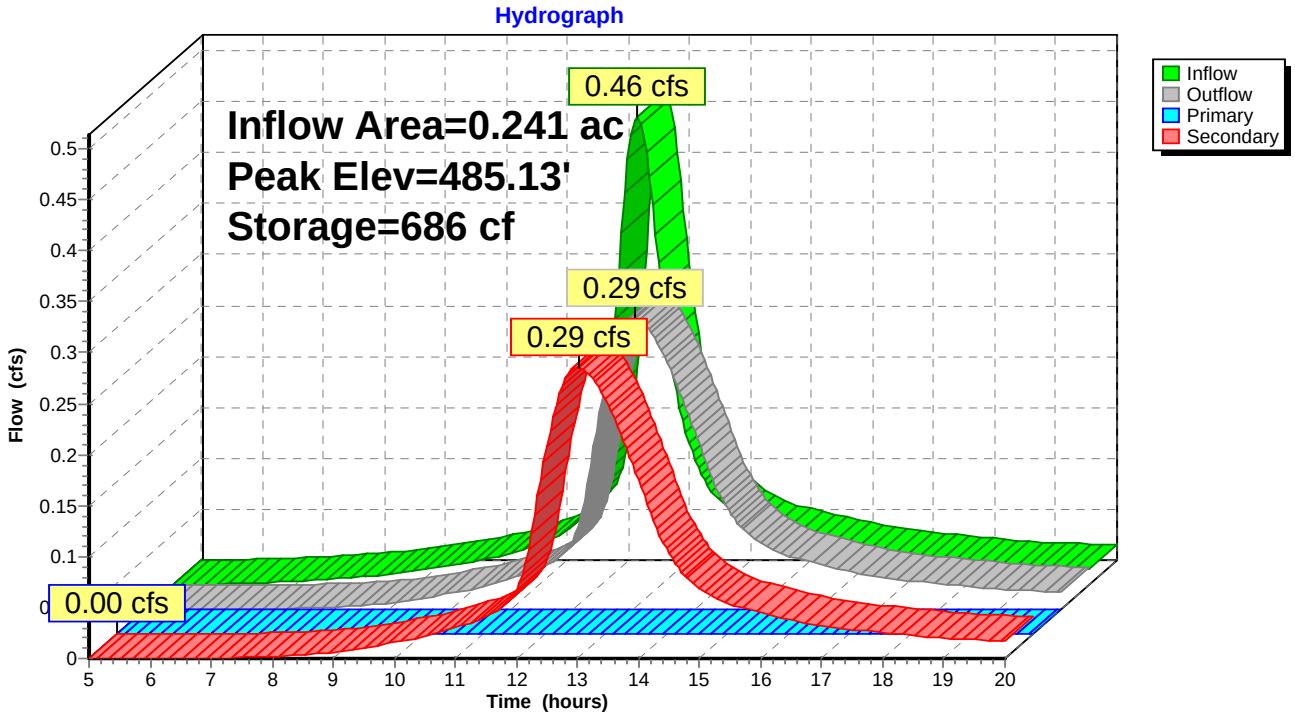
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
484.50	943	0	0
485.50	1,406	1,175	1,175
486.00	1,660	767	1,941

Device	Routing	Invert	Outlet Devices
#1	Secondary	484.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	485.50'	**6.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=484.50' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

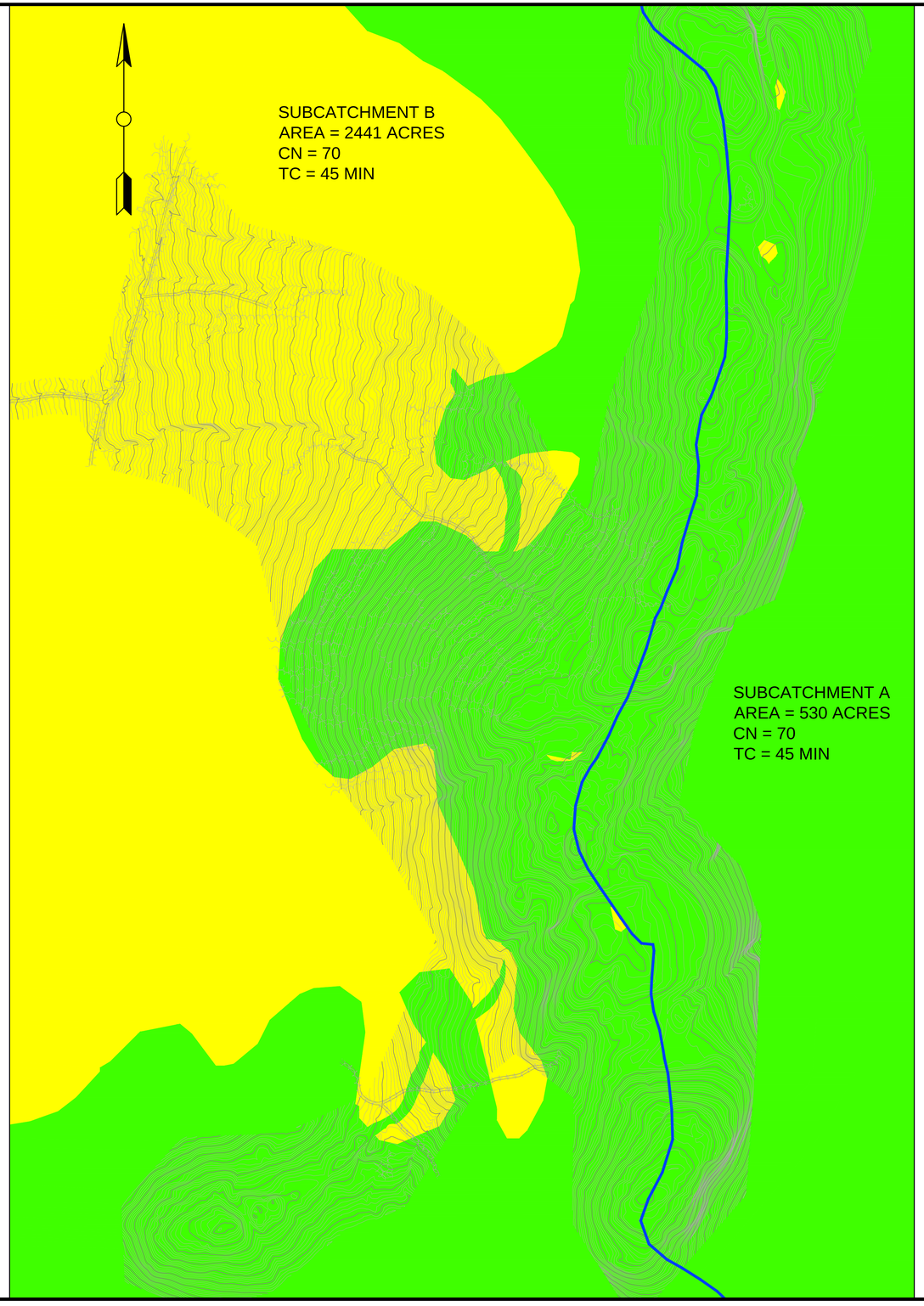
Secondary OutFlow Max=0.29 cfs @ 13.01 hrs HW=485.13' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.29 cfs @ 3.28 fps)

Pond SF-1: (new Pond)



PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 12-2
Pre-development and Post-development Stormwater Drainage Basins



HYDROLOGIC SOIL GROUP A
HYDROLOGIC SOIL GROUP B
HYDROLOGIC SOIL GROUP C
HYDROLOGIC SOIL GROUP C/D
HYDROLOGIC SOIL GROUP D
PROPERTY BOUNDARY
WATERSHED BOUNDARY

0 250' 500'

GENERAL NOTES:

1. SCALES NOTED ARE APPLICABLE TO FULL SIZE (24"X36") DRAWINGS ONLY. SCALE REDUCED DRAWINGS ACCORDINGLY.2. NORTH AS SHOWN HEREON IS REFERENCED TO GRID NORTH. NAD83 Maine State Planes, West Zone, US Foot.

3. ELEVATIONS AS SHOWN HEREON ARE REFERENECED TO NAD 83.

4. EXISITNG TOPOGRAPHIC AND PLANNNIMETRIC SURVEY INFORMATION AS SHOWN HEREON IS THE RESULT OF AERIAL TOPOGRAPHIC MAPPING COMPLETED BY PHOTOGRAMMETRIC TECHNOLOGY, INC. DEVELOPED FROM AERIAL PHOTOGRAPHY COMPLETED BY PHOTOGRAMMETRIC TECHNOLOGY. INC.

5. SOIL MAPPING AS SHOWN HEREON COMPLETE BY PHILLIPS ECOSERVICES.

6. ENVIRONMENTAL RESOURCE MAPPING (WETLANDS, STREAMS, VERNAL POOLS, ETC.) AS SHOWN HEREON BY TETRA TECH.

7. PROPERTY LINES AS SHOWN HEREON ARE THE RESULT OF ACTUAL SURVEY LINES SURVEYED BY KENNEBEC RIVER COMPANY, INC.

8. INVERTS SHOWN ON PROPOSED CULVERTS MAY BE ADJUSTED BASED ON FIELD CONDITIONS.

No.	Revision/Issue	Date

PATRIOT RENEWABLES

EMS
ENGINEERING & MANAGEMENT SERVICES, INC.
7 ALLEN ROAD, ROCHESTER, MA 02770
TEL:(508) 763-8800 FAX (508) 763-2020

Stamp:

Drawing Title:

CANTON MOUNTAIN
PRE-DEVELOPMENT
DRAINAGE AREAS

Date:	Scale:
11/11/11	AS SHOWN
Drawn By: GAD	Chk'd By: RSC

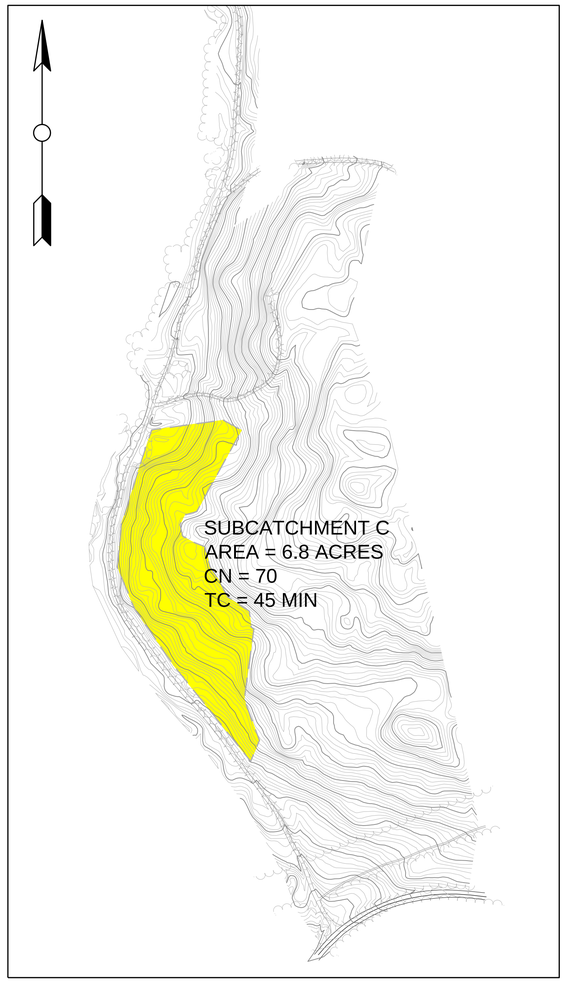
Project: CANTON MOUNTAIN WIND PROJECT
CANTON, ME

Client: CANTON MOUNTAIN WIND, LLC

Sheet Number: 1 OF 4

Dwg No.: SK-101

HYDROLOGIC SOIL GROUP A
HYDROLOGIC SOIL GROUP B
HYDROLOGIC SOIL GROUP C
HYDROLOGIC SOIL GROUP C/D
HYDROLOGIC SOIL GROUP D
PROPERTY BOUNDARY
WATERSHED BOUNDARY



0 250' 500'

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No.	Revision/Issue	Date

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ENGINEERING & MANAGEMENT SERVICES, INC.
7 ALLEN ROAD, ROCHESTER, MA 02770
TEL:(508) 763-8800 FAX (508) 763-2020

Stamp:

Drawing Title:
CANTON MOUNTAIN PRE-DEVELOPMENT DRAINAGE AREAS

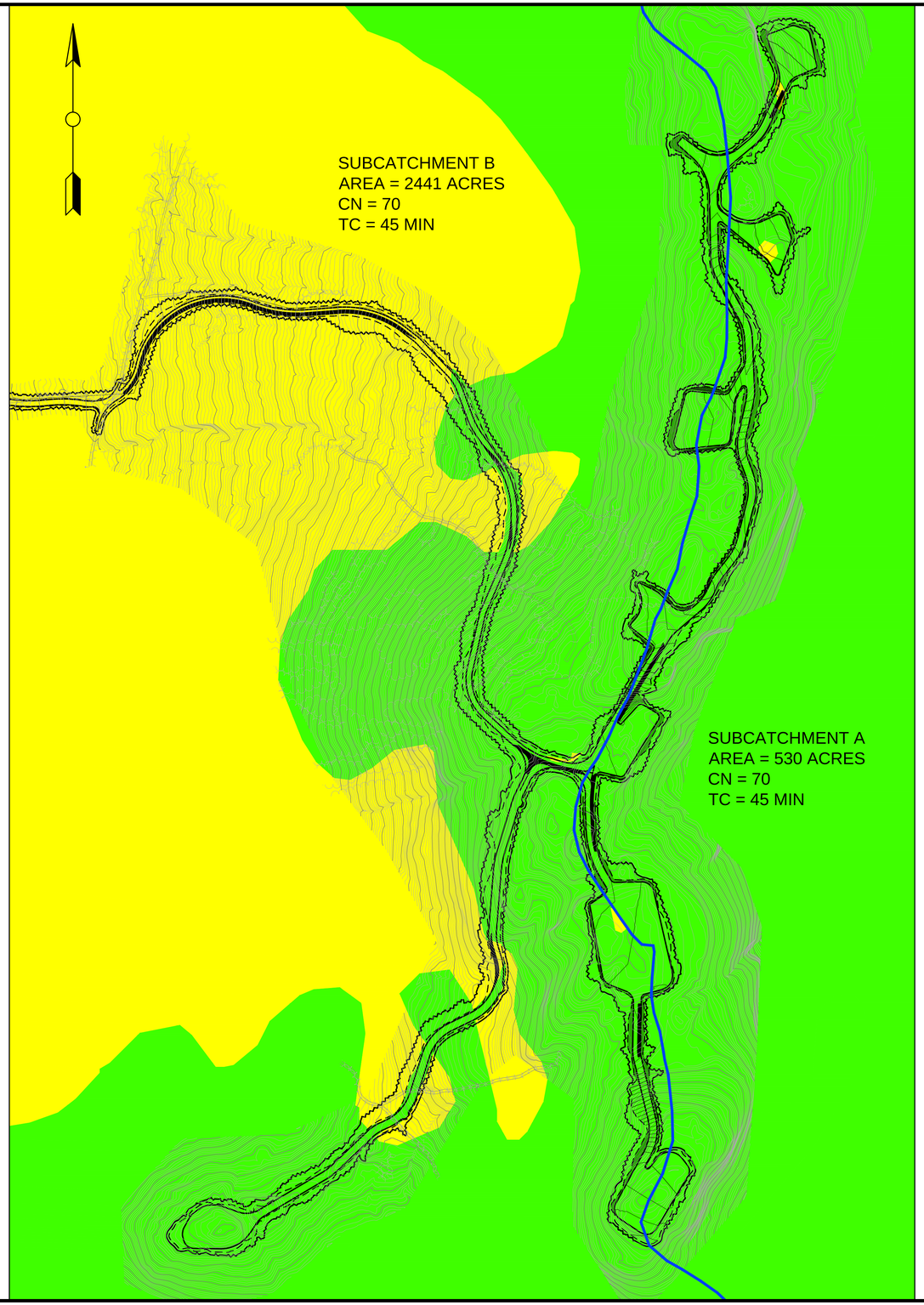
Date:	Scale:
11/11/11	AS SHOWN
Drawn By: GAD	Chk'd By: RSC

Project: CANTON MOUNTAIN WIND PROJECT CANTON, ME

Client: CANTON MOUNTAIN WIND, LLC

Sheet Number: 2 OF 4

Dwg No.: SK-102



HYDROLOGIC SOIL GROUP A
HYDROLOGIC SOIL GROUP B
HYDROLOGIC SOIL GROUP C
HYDROLOGIC SOIL GROUP C/D
HYDROLOGIC SOIL GROUP D
PROPERTY BOUNDARY
WATERSHED BOUNDARY

0 250' 500'

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No.	Revision/Issue	Date

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EMS
ENGINEERING & MANAGEMENT SERVICES, INC.
7 ALLEN ROAD, ROCHESTER, MA 02770
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Stamp:

Drawing Title:

CANTON MOUNTAIN
POST-DEVELOPMENT
DRAINAGE AREAS

Date:	Scale:
11/11/11	AS SHOWN
Drawn By: GAD	Chk'd By: RSC

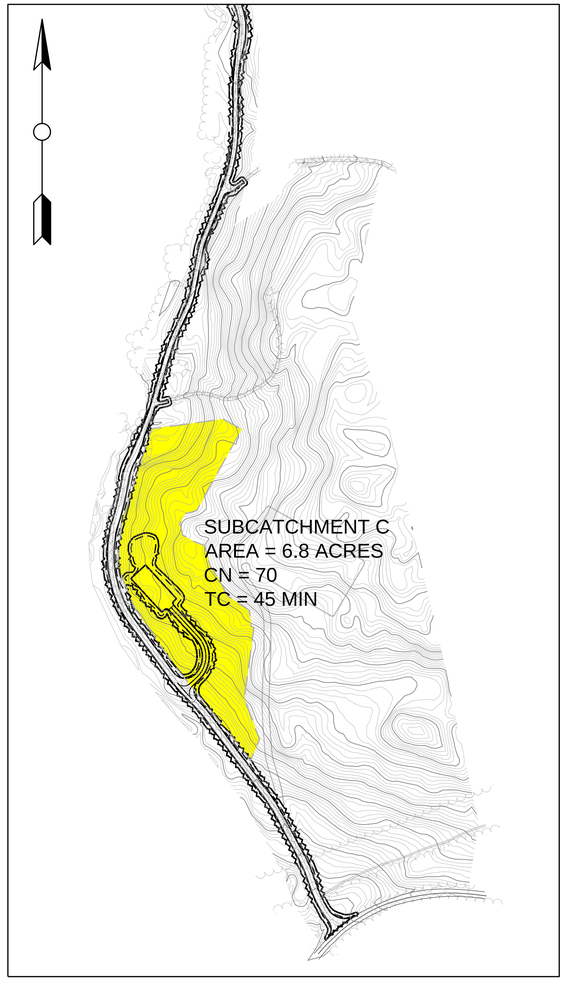
Project: CANTON MOUNTAIN WIND PROJECT
CANTON, ME

Client: CANTON MOUNTAIN WIND, LLC

Sheet Number: 3 OF 4

Dwg No.: SK-103

HYDROLOGIC SOIL GROUP A
HYDROLOGIC SOIL GROUP B
HYDROLOGIC SOIL GROUP C
HYDROLOGIC SOIL GROUP C/D
HYDROLOGIC SOIL GROUP D
PROPERTY BOUNDARY
WATERSHED BOUNDARY



0 250' 500'

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No.	Revision/Issue	Date

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ENGINEERING & MANAGEMENT SERVICES, INC.
7 ALLEN ROAD, ROCHESTER, MA 02770
TEL:(508) 763-8800 FAX (508) 763-2020

Stamp:

Drawing Title:

CANTON MOUNTAIN
POST-DEVELOPMENT
DRAINAGE AREAS

Date:	Scale:
11/11/11	AS SHOWN
Drawn By: GAD	Chk'd By: RSC

Project: CANTON MOUNTAIN WIND PROJECT
CANTON, ME

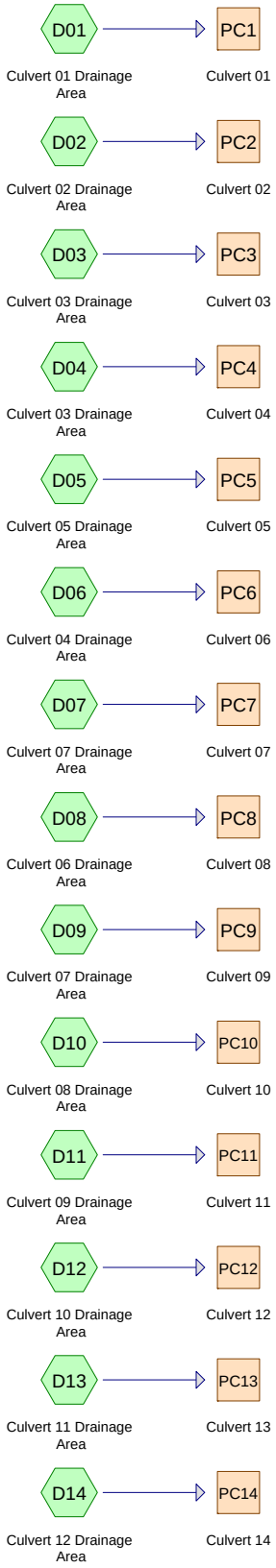
Client: CANTON MOUNTAIN WIND, LLC

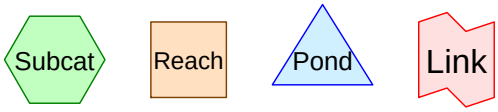
Sheet Number: 4 OF 4

Dwg No.: SK-104

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 12-3
Culvert Sizing Calculations and Related HydroCAD® Reports





Drainage Diagram for Canton Mountain Wind Site Stormwater AnalysiS-HYDRAULICS

Prepared by {enter your company name here}, Printed 12/11/2011

HydroCAD® 9.10 s/n 02179 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
42.769	77	Woods, Good, HSG D (D01, D02, D03, D04, D05, D06, D07, D08, D09, D10, D11, D12, D13, D14)
0.230	91	Gravel roads, HSG D (D01)
42.998		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
42.998	HSG D	D01, D02, D03, D04, D05, D06, D07, D08, D09, D10, D11, D12, D13, D14
0.000	Other	
42.998		**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)	Fill (inches)
1	PC1	1,183.00	1,182.00	40.0	0.0250	0.013	12.0	0.0	0.0
2	PC10	1,409.00	1,406.00	48.0	0.0625	0.010	18.0	0.0	0.0
3	PC11	1,334.50	1,333.00	52.0	0.0288	0.010	18.0	0.0	0.0
4	PC12	1,509.00	1,508.00	55.0	0.0182	0.010	12.0	0.0	0.0
5	PC13	1,509.00	1,508.00	55.0	0.0182	0.010	12.0	0.0	0.0
6	PC14	1,506.00	1,504.00	37.0	0.0541	0.010	12.0	0.0	0.0
7	PC2	1,238.00	1,234.00	50.0	0.0800	0.013	12.0	0.0	0.0
8	PC3	1,256.50	1,255.50	38.0	0.0263	0.010	24.0	0.0	0.0
9	PC4	1,349.00	1,348.00	47.0	0.0213	0.010	24.0	0.0	0.0
10	PC5	1,427.00	1,426.00	40.0	0.0250	0.010	12.0	0.0	0.0
11	PC6	1,472.00	1,469.00	72.0	0.0417	0.010	18.0	0.0	0.0
12	PC7	1,476.00	1,472.00	76.0	0.0526	0.010	12.0	0.0	0.0
13	PC8	1,456.00	1,455.00	63.0	0.0159	0.010	12.0	0.0	0.0
14	PC9	1,433.00	1,432.00	50.0	0.0200	0.010	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment D01: Culvert 01 Drainage Runoff Area=60,000 sf 0.00% Impervious Runoff Depth>2.63"
Tc=5.0 min CN=79 Runoff=4.25 cfs 0.302 af

Subcatchment D02: Culvert 02 Drainage Runoff Area=62,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=4.10 cfs 0.291 af

Subcatchment D03: Culvert 03 Drainage Runoff Area=678,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=44.84 cfs 3.184 af

Subcatchment D04: Culvert 03 Drainage Runoff Area=360,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=23.81 cfs 1.691 af

Subcatchment D05: Culvert 05 Drainage Runoff Area=36,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=2.38 cfs 0.169 af

Subcatchment D06: Culvert 04 Drainage Runoff Area=110,000 sf 0.00% Impervious Runoff Depth>2.45"
Flow Length=1,200' Slope=0.3000 '/' Tc=7.3 min CN=77 Runoff=6.86 cfs 0.516 af

Subcatchment D07: Culvert 07 Drainage Runoff Area=36,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=2.38 cfs 0.169 af

Subcatchment D08: Culvert 06 Drainage Runoff Area=44,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=2.91 cfs 0.207 af

Subcatchment D09: Culvert 07 Drainage Runoff Area=24,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=1.59 cfs 0.113 af

Subcatchment D10: Culvert 08 Drainage Runoff Area=125,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=8.27 cfs 0.587 af

Subcatchment D11: Culvert 09 Drainage Runoff Area=225,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=14.88 cfs 1.057 af

Subcatchment D12: Culvert 10 Drainage Runoff Area=23,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=1.52 cfs 0.108 af

Subcatchment D13: Culvert 11 Drainage Runoff Area=60,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=3.97 cfs 0.282 af

Subcatchment D14: Culvert 12 Drainage Runoff Area=30,000 sf 0.00% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=77 Runoff=1.98 cfs 0.141 af

Reach PC1: Culvert 01 Avg. Flow Depth=0.65' Max Vel=7.85 fps Inflow=4.25 cfs 0.302 af
12.0" Round Pipe n=0.013 L=40.0' S=0.0250 '/' Capacity=5.63 cfs Outflow=4.24 cfs 0.302 af

Reach PC10: Culvert 10 Avg. Flow Depth=0.50' Max Vel=15.82 fps Inflow=8.27 cfs 0.587 af
18.0" Round Pipe n=0.010 L=48.0' S=0.0625 '/' Capacity=34.14 cfs Outflow=8.25 cfs 0.587 af

Reach PC11: Culvert 11 Avg. Flow Depth=0.87' Max Vel=13.87 fps Inflow=14.88 cfs 1.057 af
18.0" Round Pipe n=0.010 L=52.0' S=0.0288 '/' Capacity=23.19 cfs Outflow=14.86 cfs 1.057 af

Reach PC12: Culvert 12 Avg. Flow Depth=0.34' Max Vel=6.53 fps Inflow=1.52 cfs 0.108 af
12.0" Round Pipe n=0.010 L=55.0' S=0.0182 '/' Capacity=6.25 cfs Outflow=1.52 cfs 0.108 af

Reach PC13: Culvert 13 Avg. Flow Depth=0.58' Max Vel=8.39 fps Inflow=3.97 cfs 0.282 af
12.0" Round Pipe n=0.010 L=55.0' S=0.0182 '/' Capacity=6.25 cfs Outflow=3.96 cfs 0.282 af

Reach PC14: Culvert 14 Avg. Flow Depth=0.29' Max Vel=10.40 fps Inflow=1.98 cfs 0.141 af
12.0" Round Pipe n=0.010 L=37.0' S=0.0541 '/' Capacity=10.77 cfs Outflow=1.98 cfs 0.141 af

Reach PC2: Culvert 02 Avg. Flow Depth=0.44' Max Vel=12.11 fps Inflow=4.10 cfs 0.291 af
12.0" Round Pipe n=0.013 L=50.0' S=0.0800 '/' Capacity=10.08 cfs Outflow=4.09 cfs 0.291 af

Reach PC3: Culvert 03 Avg. Flow Depth=1.54' Max Vel=17.23 fps Inflow=44.84 cfs 3.184 af
24.0" Round Pipe n=0.010 L=38.0' S=0.0263 '/' Capacity=47.71 cfs Outflow=44.80 cfs 3.184 af

Reach PC4: Culvert 04 Avg. Flow Depth=1.07' Max Vel=13.94 fps Inflow=23.81 cfs 1.691 af
24.0" Round Pipe n=0.010 L=47.0' S=0.0213 '/' Capacity=42.90 cfs Outflow=23.77 cfs 1.691 af

Reach PC5: Culvert 05 Avg. Flow Depth=0.39' Max Vel=8.29 fps Inflow=2.38 cfs 0.169 af
12.0" Round Pipe n=0.010 L=40.0' S=0.0250 '/' Capacity=7.32 cfs Outflow=2.38 cfs 0.169 af

Reach PC6: Culvert 06 Avg. Flow Depth=0.51' Max Vel=13.04 fps Inflow=6.86 cfs 0.516 af
18.0" Round Pipe n=0.010 L=72.0' S=0.0417 '/' Capacity=27.87 cfs Outflow=6.83 cfs 0.516 af

Reach PC7: Culvert 07 Avg. Flow Depth=0.32' Max Vel=10.85 fps Inflow=2.38 cfs 0.169 af
12.0" Round Pipe n=0.010 L=76.0' S=0.0526 '/' Capacity=10.63 cfs Outflow=2.37 cfs 0.169 af

Reach PC8: Culvert 08 Avg. Flow Depth=0.34' Max Vel=6.15 fps Inflow=2.91 cfs 0.207 af
12.0" Round Pipe x 2.00 n=0.010 L=63.0' S=0.0159 '/' Capacity=11.67 cfs Outflow=2.90 cfs 0.207 af

Reach PC9: Culvert 09 Avg. Flow Depth=0.34' Max Vel=6.84 fps Inflow=1.59 cfs 0.113 af
12.0" Round Pipe n=0.010 L=50.0' S=0.0200 '/' Capacity=6.55 cfs Outflow=1.58 cfs 0.113 af

Total Runoff Area = 42.998 ac Runoff Volume = 8.816 af Average Runoff Depth = 2.46"
100.00% Pervious = 42.998 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment D01: Culvert 01 Drainage Area

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

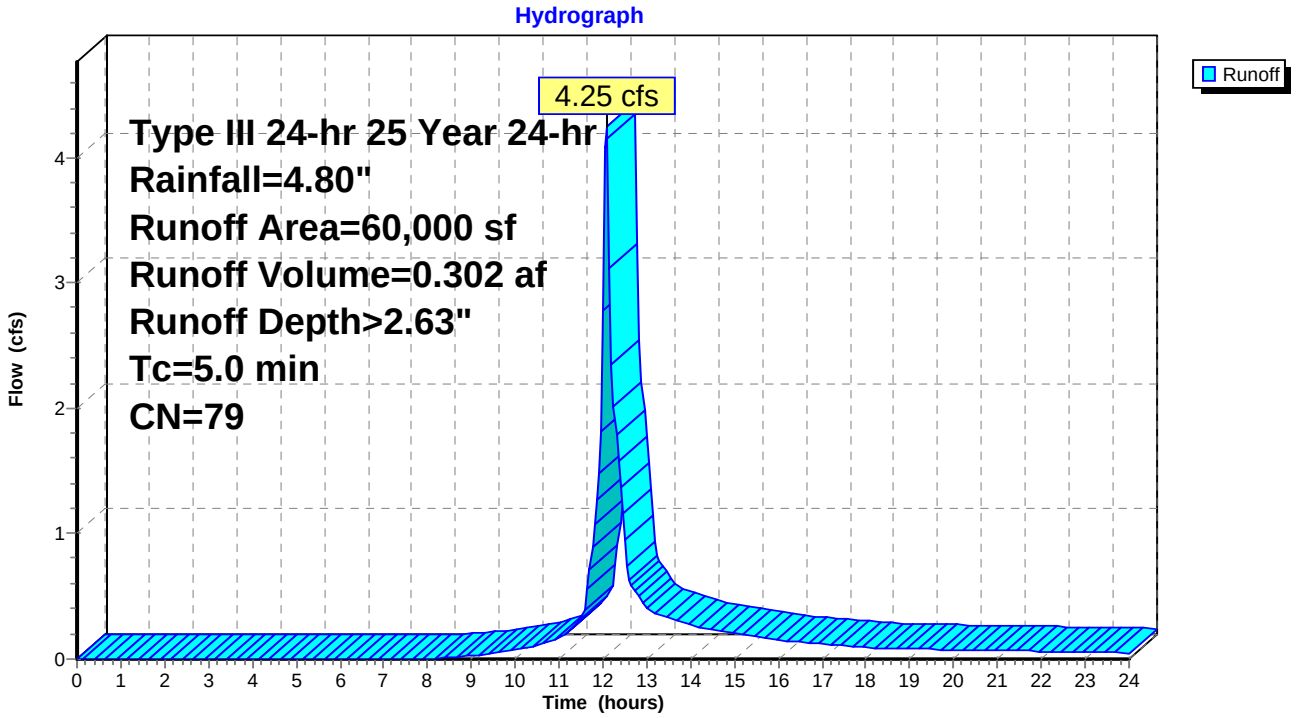
Runoff = 4.25 cfs @ 12.08 hrs, Volume= 0.302 af, Depth> 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
50,000	77	Woods, Good, HSG D
10,000	91	Gravel roads, HSG D
60,000	79	Weighted Average
60,000		100.00% Pervious Area

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

Subcatchment D01: Culvert 01 Drainage Area



Summary for Subcatchment D02: Culvert 02 Drainage Area

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

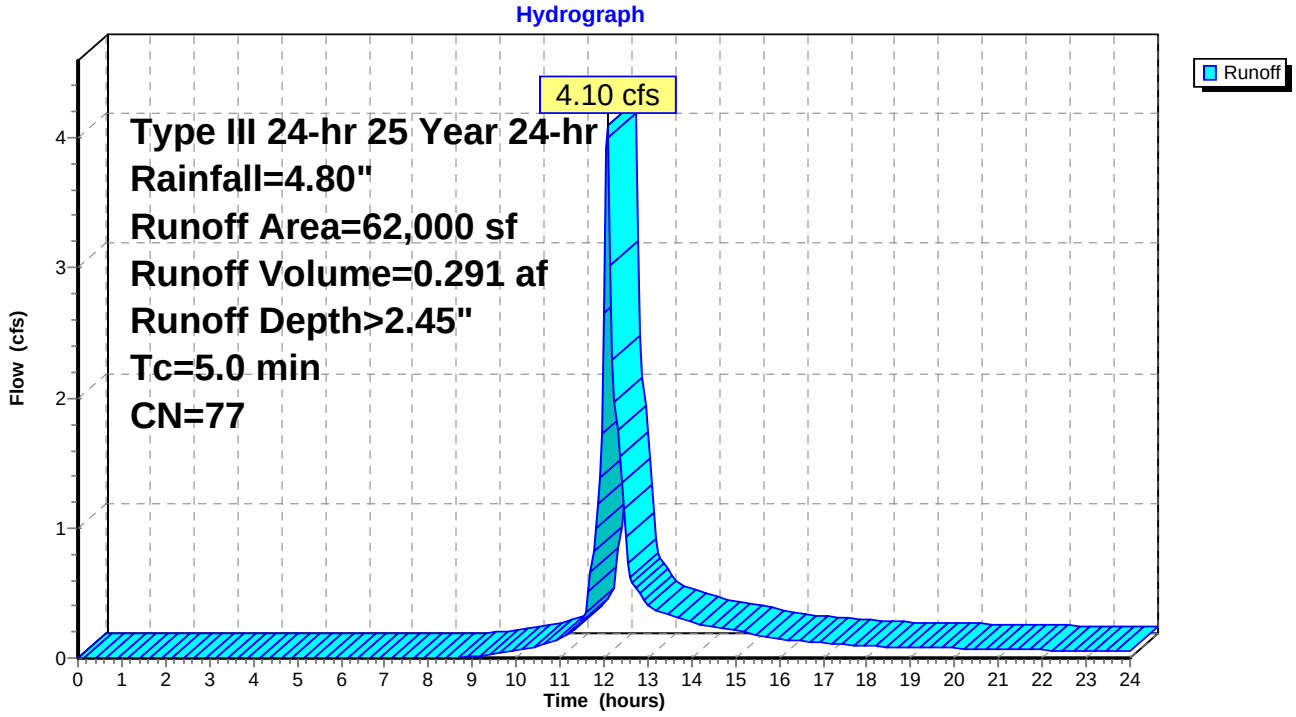
Runoff = 4.10 cfs @ 12.08 hrs, Volume= 0.291 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
62,000	77	Woods, Good, HSG D
62,000		100.00% Pervious Area

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

Subcatchment D02: Culvert 02 Drainage Area



Summary for Subcatchment D03: Culvert 03 Drainage Area

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

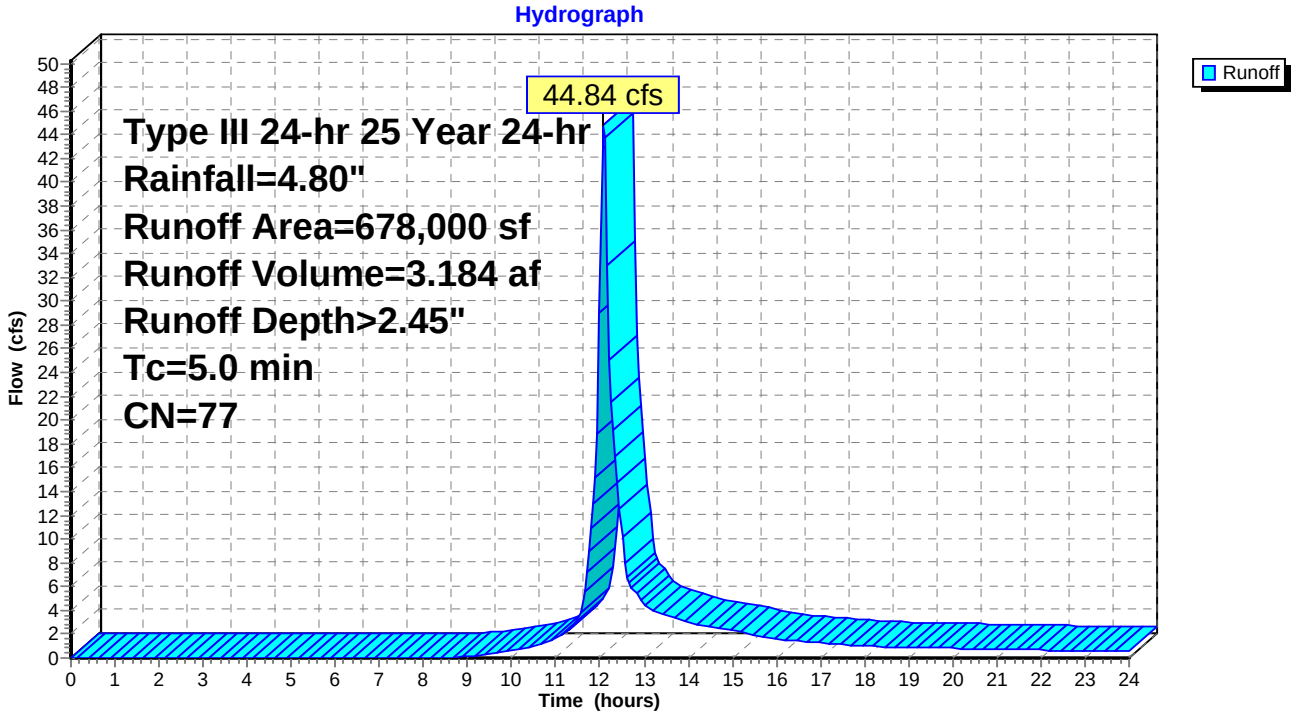
Runoff = 44.84 cfs @ 12.08 hrs, Volume= 3.184 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
678,000	77	Woods, Good, HSG D
678,000		100.00% Pervious Area

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

Subcatchment D03: Culvert 03 Drainage Area



Summary for Subcatchment D04: Culvert 03 Drainage Area

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

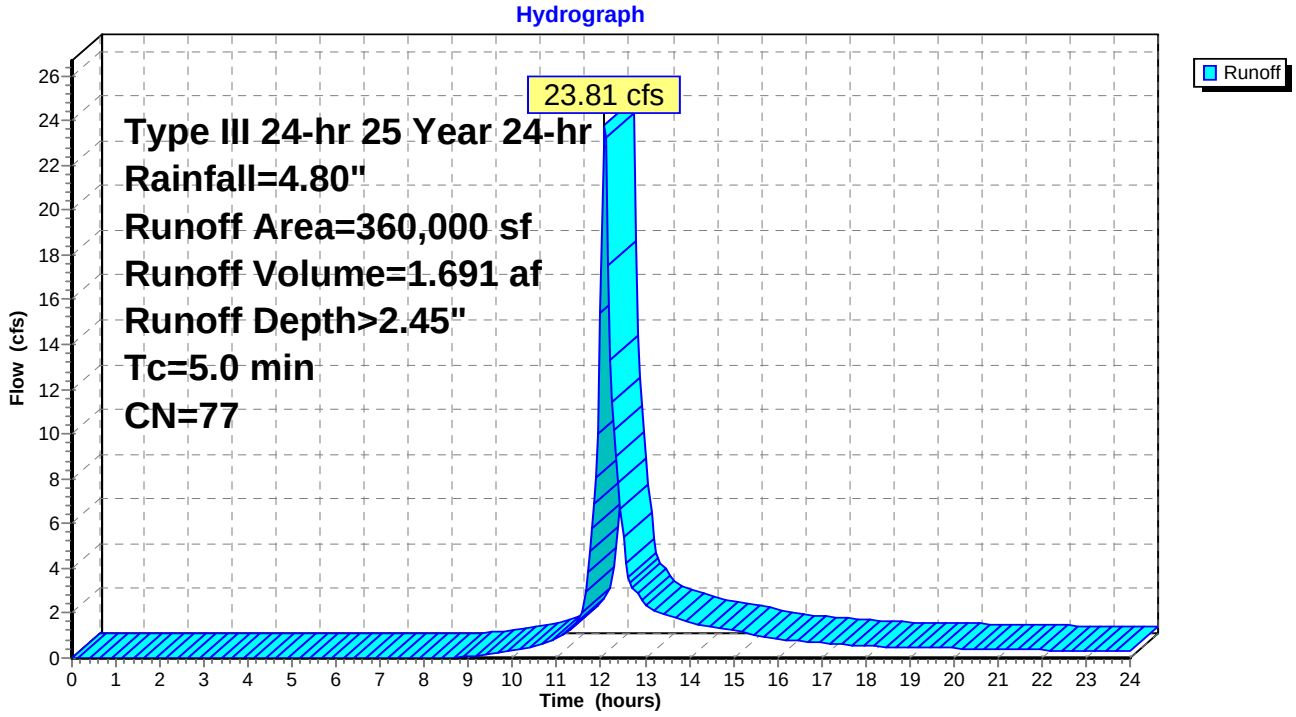
Runoff = 23.81 cfs @ 12.08 hrs, Volume= 1.691 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
360,000	77	Woods, Good, HSG D
360,000		100.00% Pervious Area

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

Subcatchment D04: Culvert 03 Drainage Area



Summary for Subcatchment D05: Culvert 05 Drainage Area

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

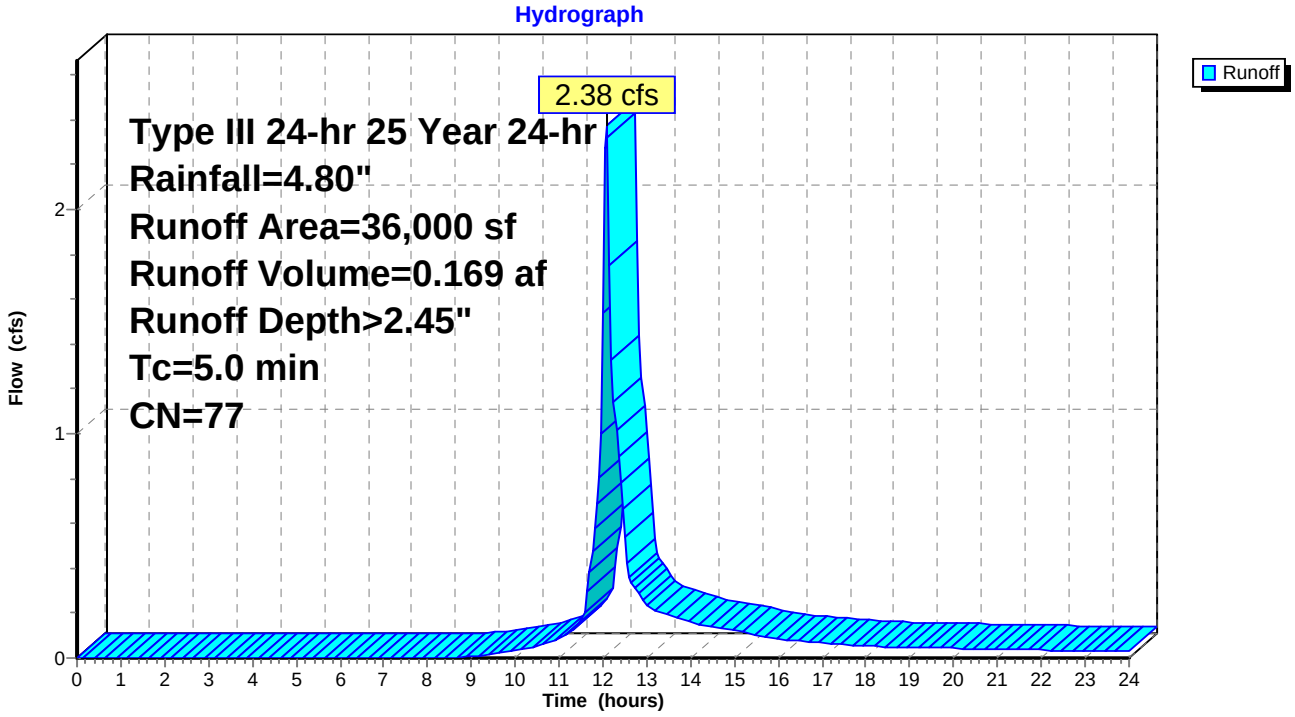
Runoff = 2.38 cfs @ 12.08 hrs, Volume= 0.169 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
36,000	77	Woods, Good, HSG D
36,000		100.00% Pervious Area

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

Subcatchment D05: Culvert 05 Drainage Area



Summary for Subcatchment D06: Culvert 04 Drainage Area

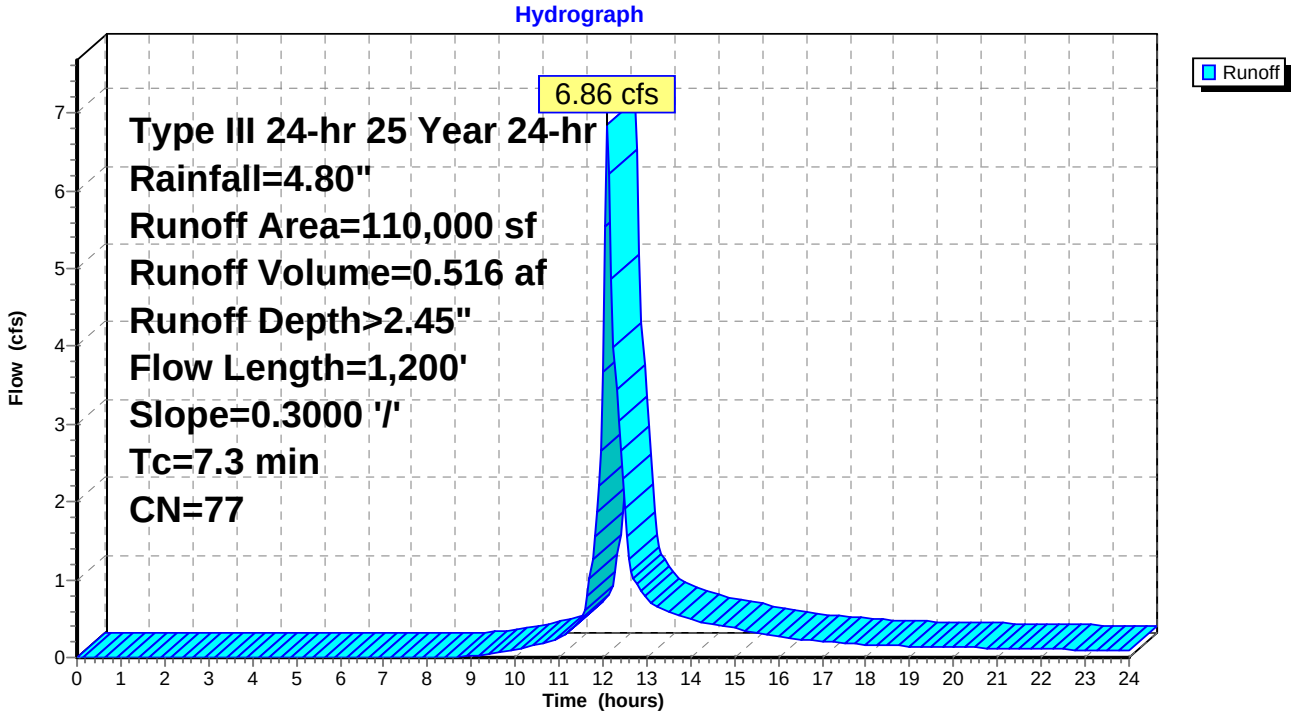
Runoff = 6.86 cfs @ 12.11 hrs, Volume= 0.516 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
110,000	77	Woods, Good, HSG D
110,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	1,200	0.3000	2.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment D06: Culvert 04 Drainage Area



Summary for Subcatchment D07: Culvert 07 Drainage Area

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

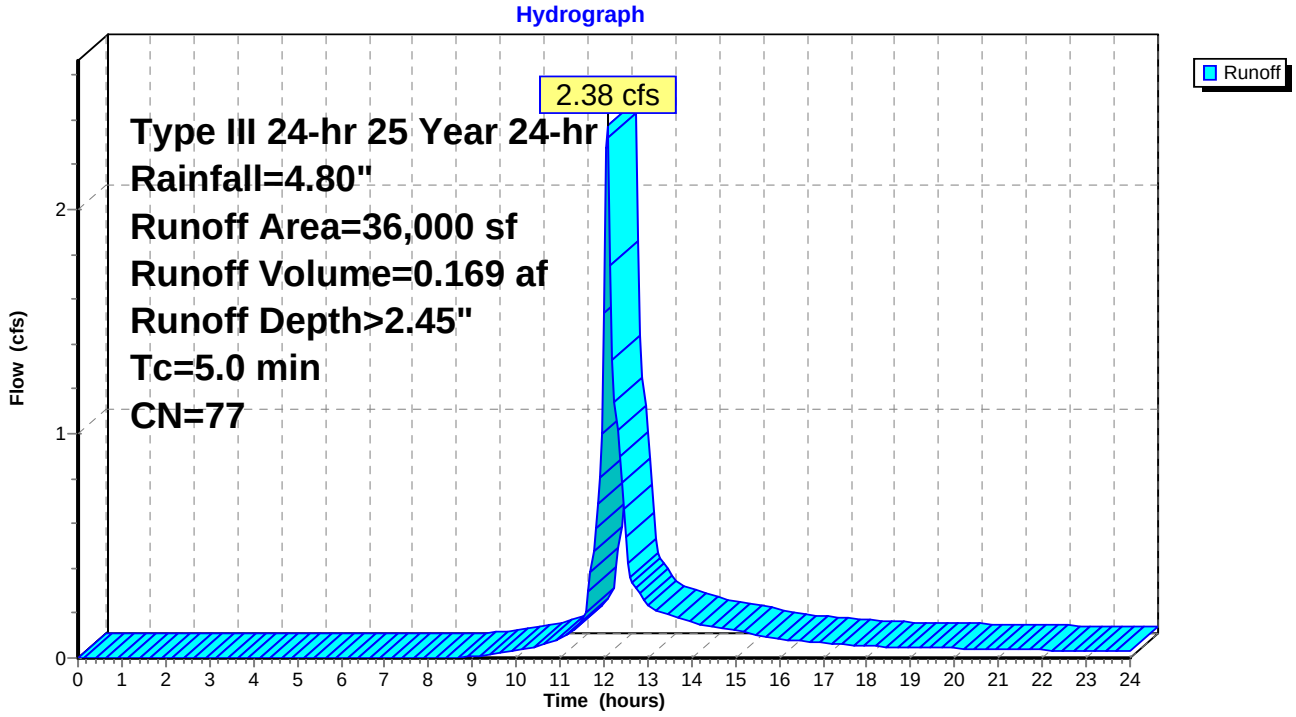
Runoff = 2.38 cfs @ 12.08 hrs, Volume= 0.169 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
36,000	77	Woods, Good, HSG D
36,000		100.00% Pervious Area

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

Subcatchment D07: Culvert 07 Drainage Area



Summary for Subcatchment D08: Culvert 06 Drainage Area

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

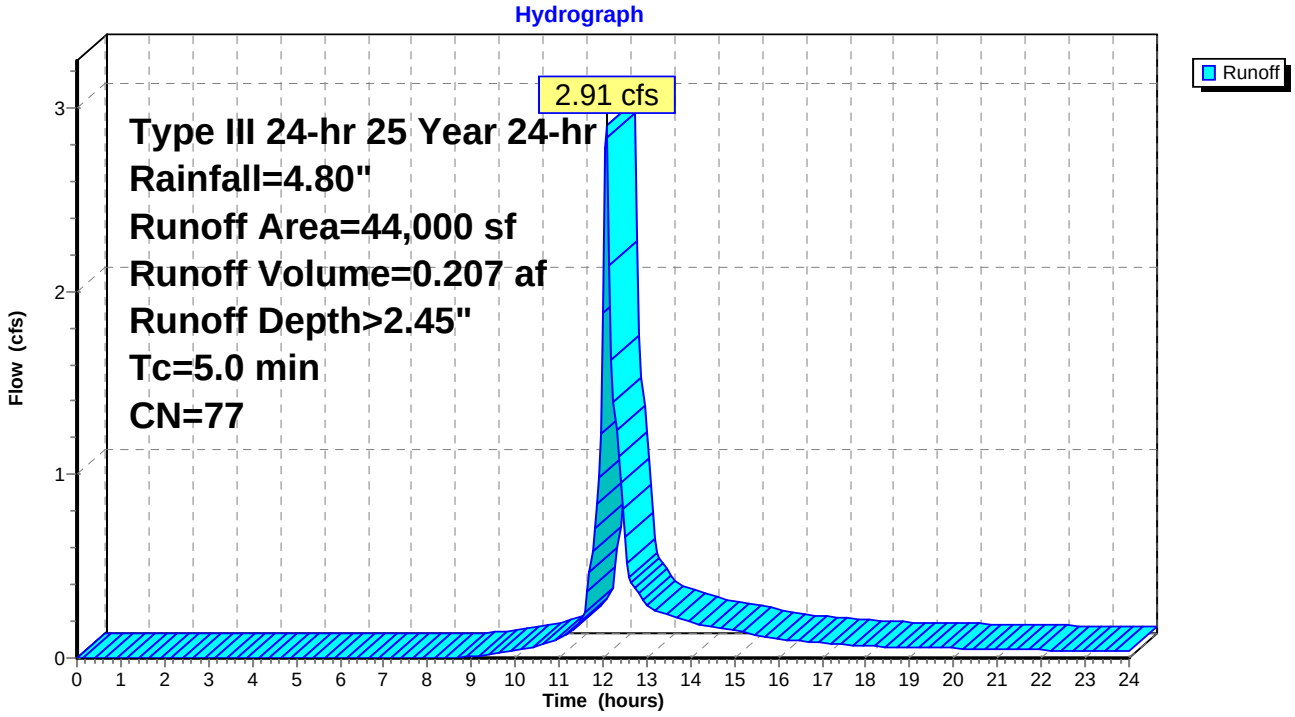
Runoff = 2.91 cfs @ 12.08 hrs, Volume= 0.207 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
44,000	77	Woods, Good, HSG D
44,000		100.00% Pervious Area

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

Subcatchment D08: Culvert 06 Drainage Area



Summary for Subcatchment D09: Culvert 07 Drainage Area

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

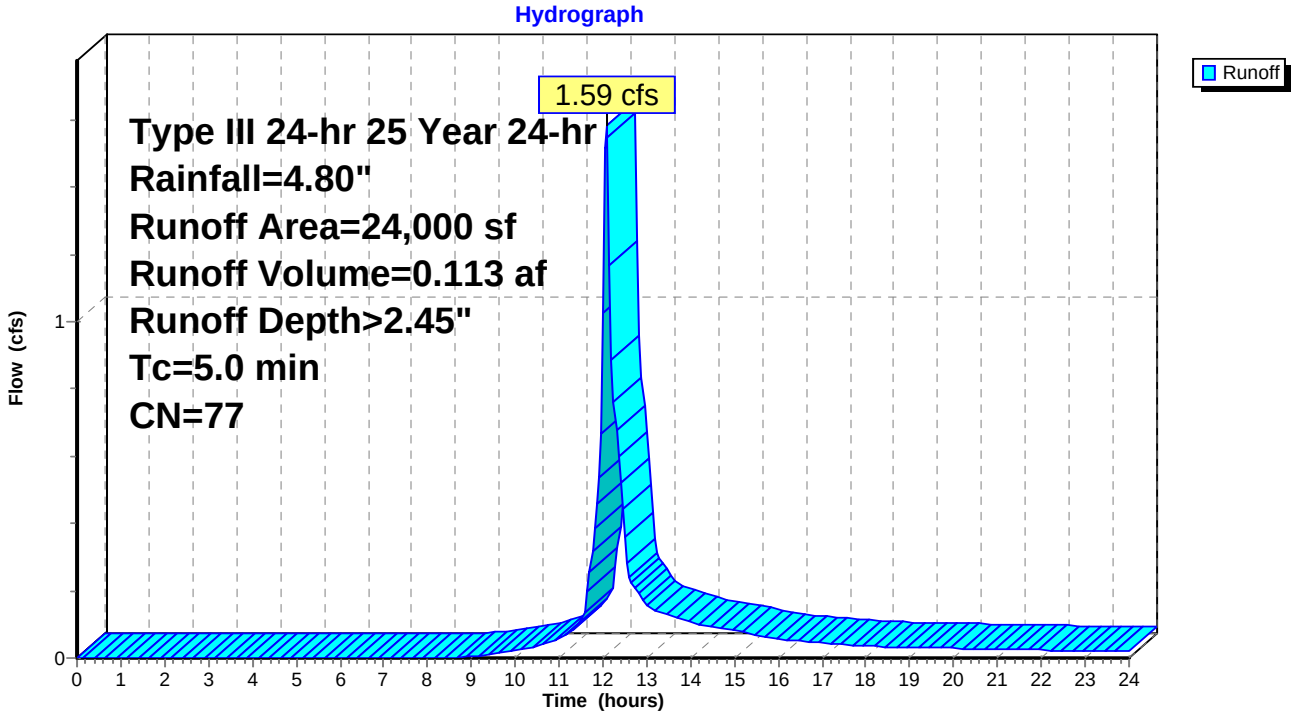
Runoff = 1.59 cfs @ 12.08 hrs, Volume= 0.113 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
24,000	77	Woods, Good, HSG D
24,000		100.00% Pervious Area

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

Subcatchment D09: Culvert 07 Drainage Area



Summary for Subcatchment D10: Culvert 08 Drainage Area

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

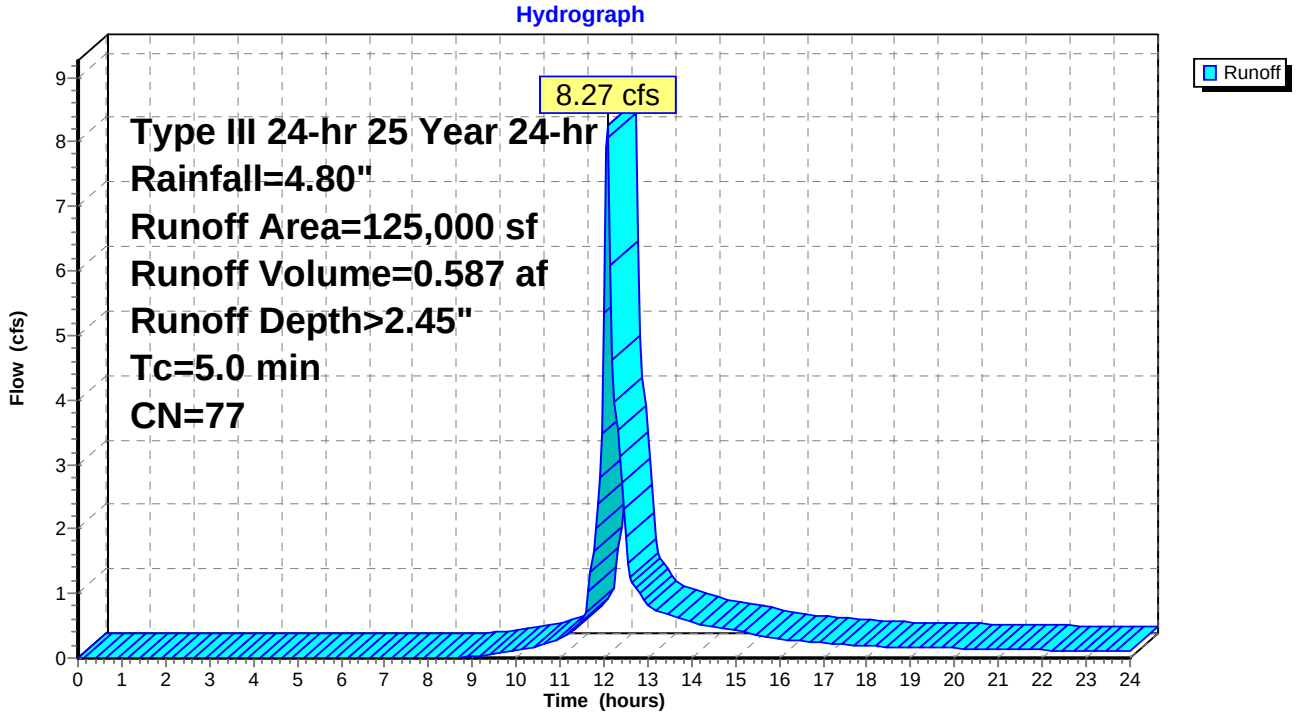
Runoff = 8.27 cfs @ 12.08 hrs, Volume= 0.587 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
125,000	77	Woods, Good, HSG D
125,000		100.00% Pervious Area

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

Subcatchment D10: Culvert 08 Drainage Area



Summary for Subcatchment D11: Culvert 09 Drainage Area

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

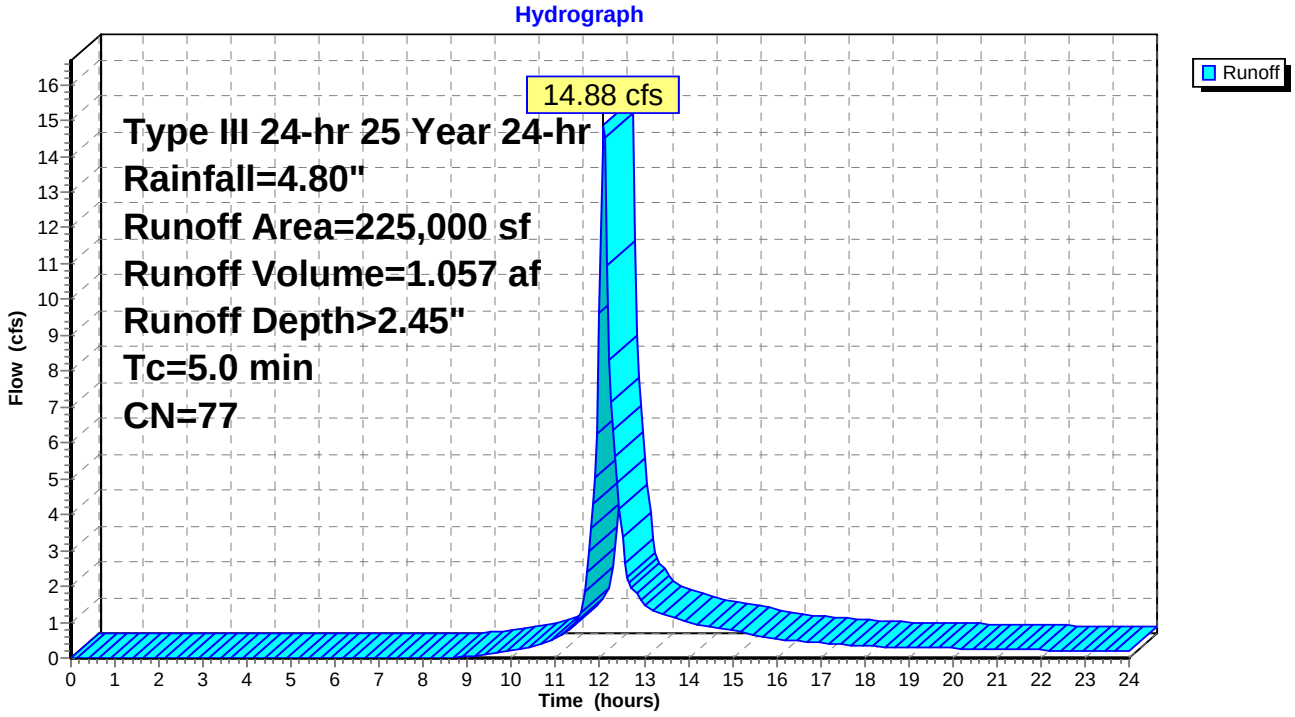
Runoff = 14.88 cfs @ 12.08 hrs, Volume= 1.057 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
225,000	77	Woods, Good, HSG D
225,000		100.00% Pervious Area

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

Subcatchment D11: Culvert 09 Drainage Area



Summary for Subcatchment D12: Culvert 10 Drainage Area

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

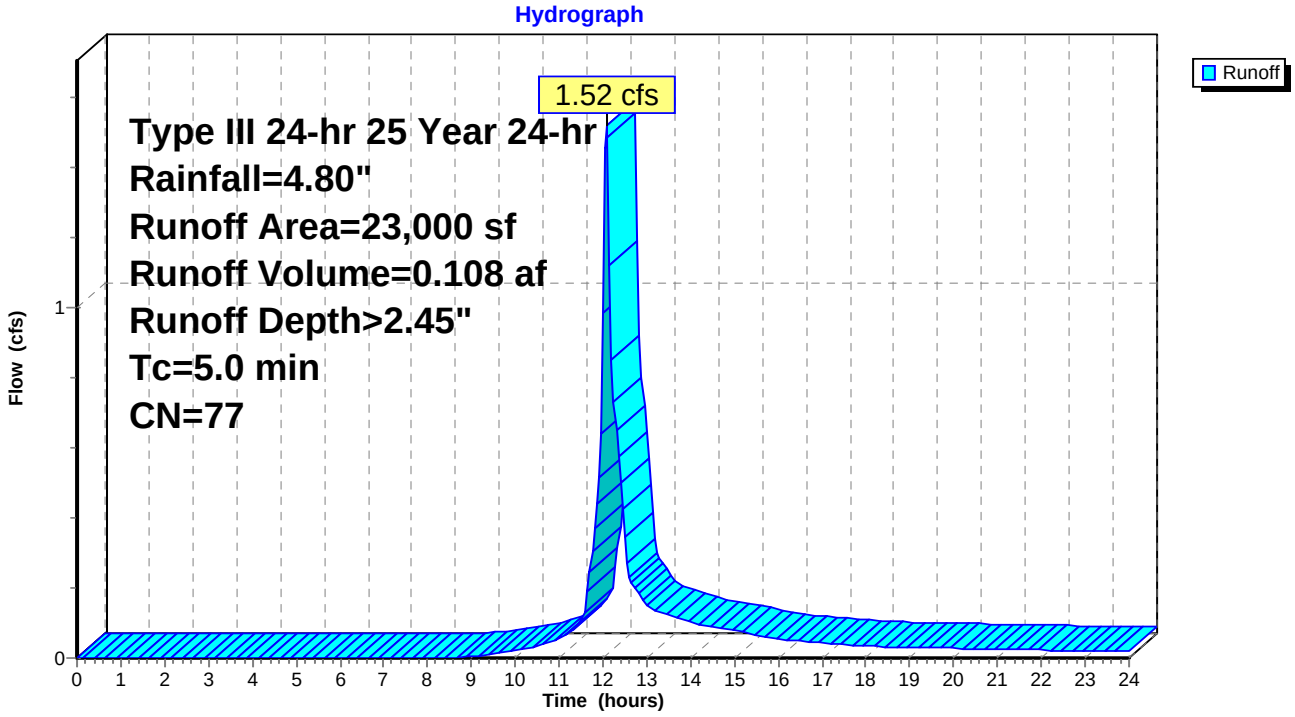
Runoff = 1.52 cfs @ 12.08 hrs, Volume= 0.108 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
23,000	77	Woods, Good, HSG D
23,000		100.00% Pervious Area

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

Subcatchment D12: Culvert 10 Drainage Area



Summary for Subcatchment D13: Culvert 11 Drainage Area

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

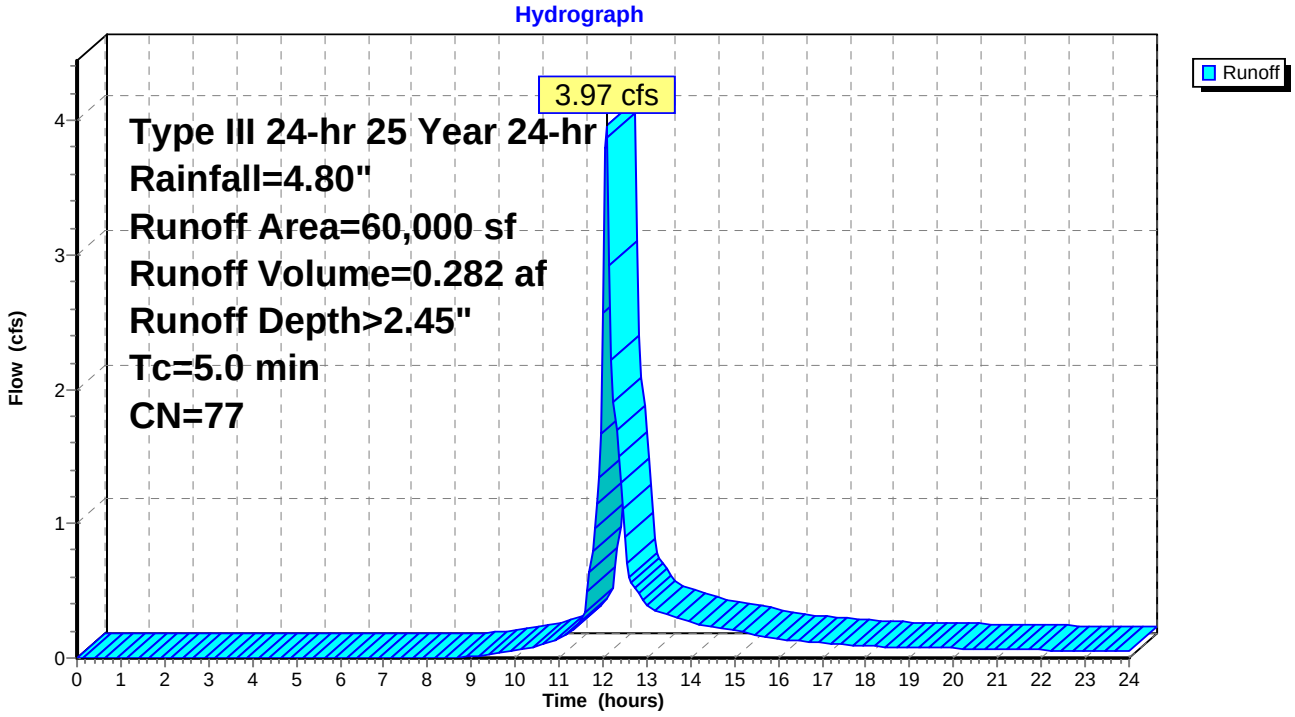
Runoff = 3.97 cfs @ 12.08 hrs, Volume= 0.282 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
60,000	77	Woods, Good, HSG D
60,000		100.00% Pervious Area

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

Subcatchment D13: Culvert 11 Drainage Area



Summary for Subcatchment D14: Culvert 12 Drainage Area

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

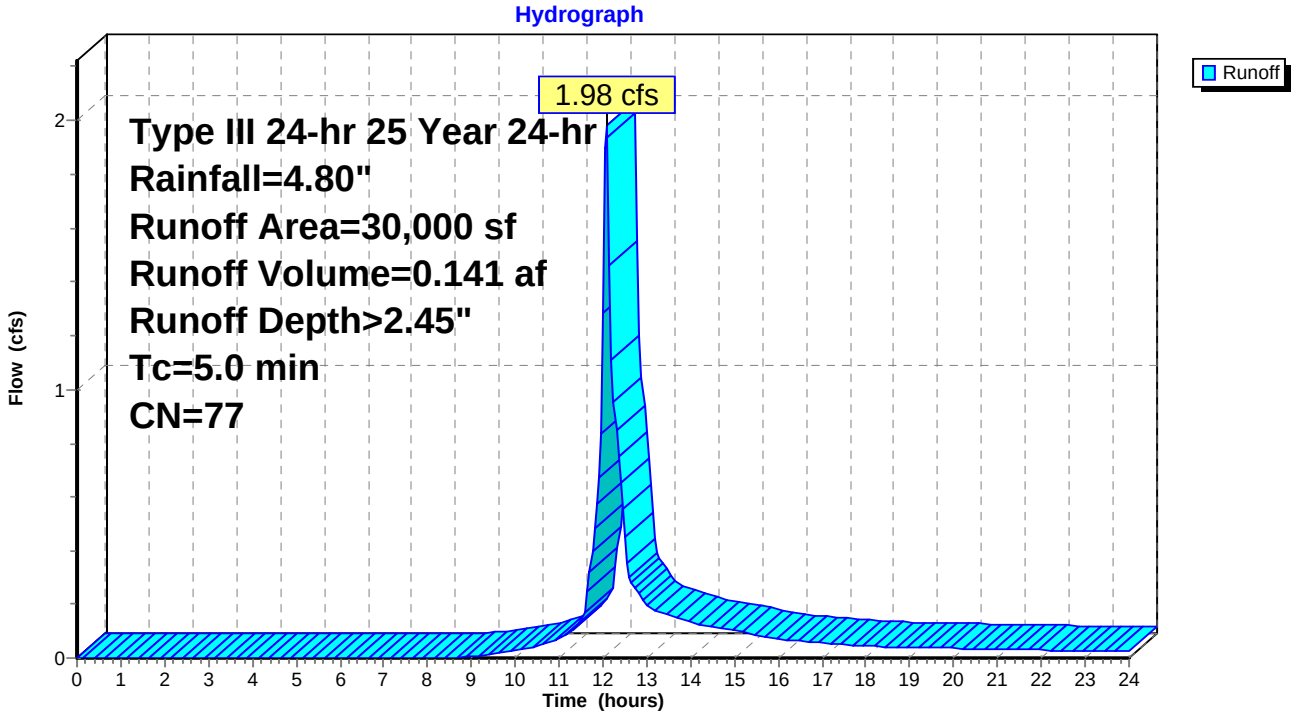
Runoff = 1.98 cfs @ 12.08 hrs, Volume= 0.141 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year 24-hr Rainfall=4.80"

Area (sf)	CN	Description
30,000	77	Woods, Good, HSG D
30,000		100.00% Pervious Area

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

Subcatchment D14: Culvert 12 Drainage Area



Summary for Reach PC1: Culvert 01

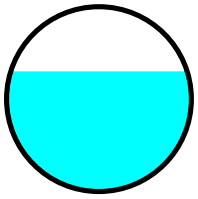
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.377 ac, 0.00% Impervious, Inflow Depth > 2.63" for 25 Year 24-hr event
Inflow = 4.25 cfs @ 12.08 hrs, Volume= 0.302 af
Outflow = 4.24 cfs @ 12.08 hrs, Volume= 0.302 af, Atten= 0%, Lag= 0.2 min

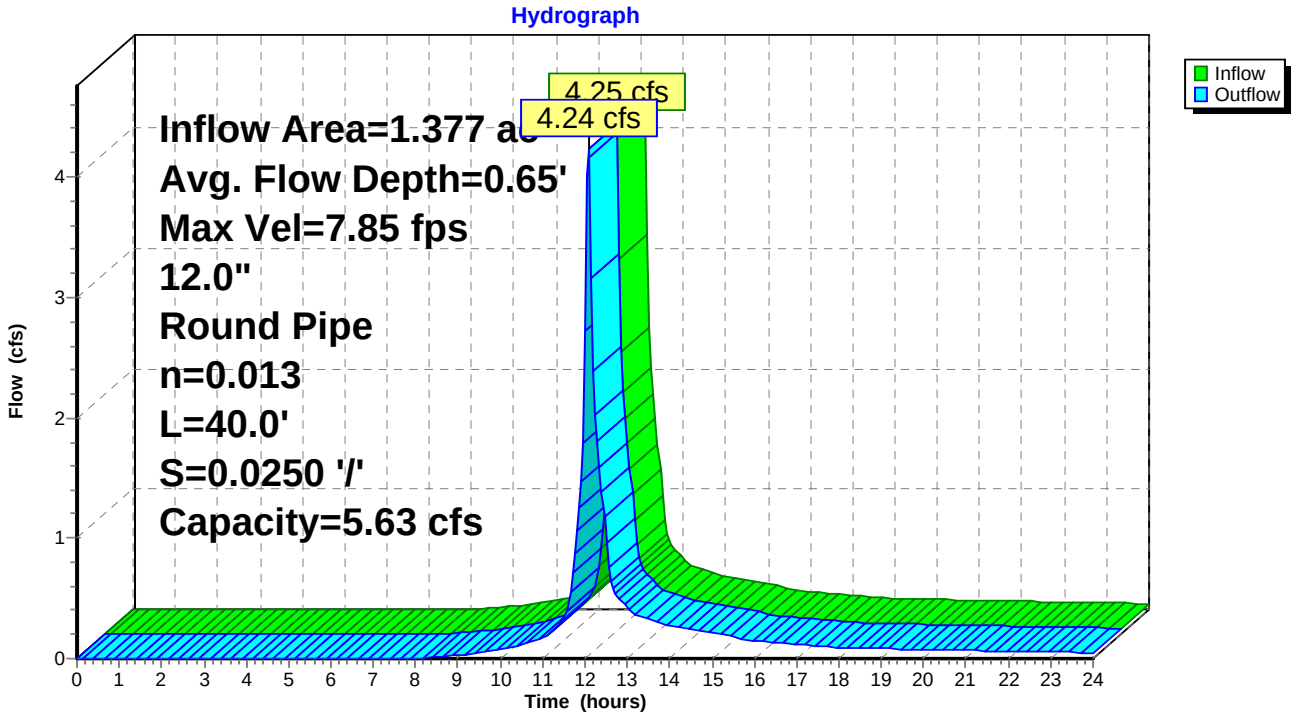
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.85 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.96 fps, Avg. Travel Time= 0.2 min

Peak Storage= 22 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.63 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 40.0' Slope= 0.0250 '/'
Inlet Invert= 1,183.00', Outlet Invert= 1,182.00'



Reach PC1: Culvert 01



Summary for Reach PC10: Culvert 10

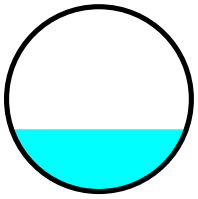
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.870 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 8.27 cfs @ 12.08 hrs, Volume= 0.587 af
Outflow = 8.25 cfs @ 12.08 hrs, Volume= 0.587 af, Atten= 0%, Lag= 0.1 min

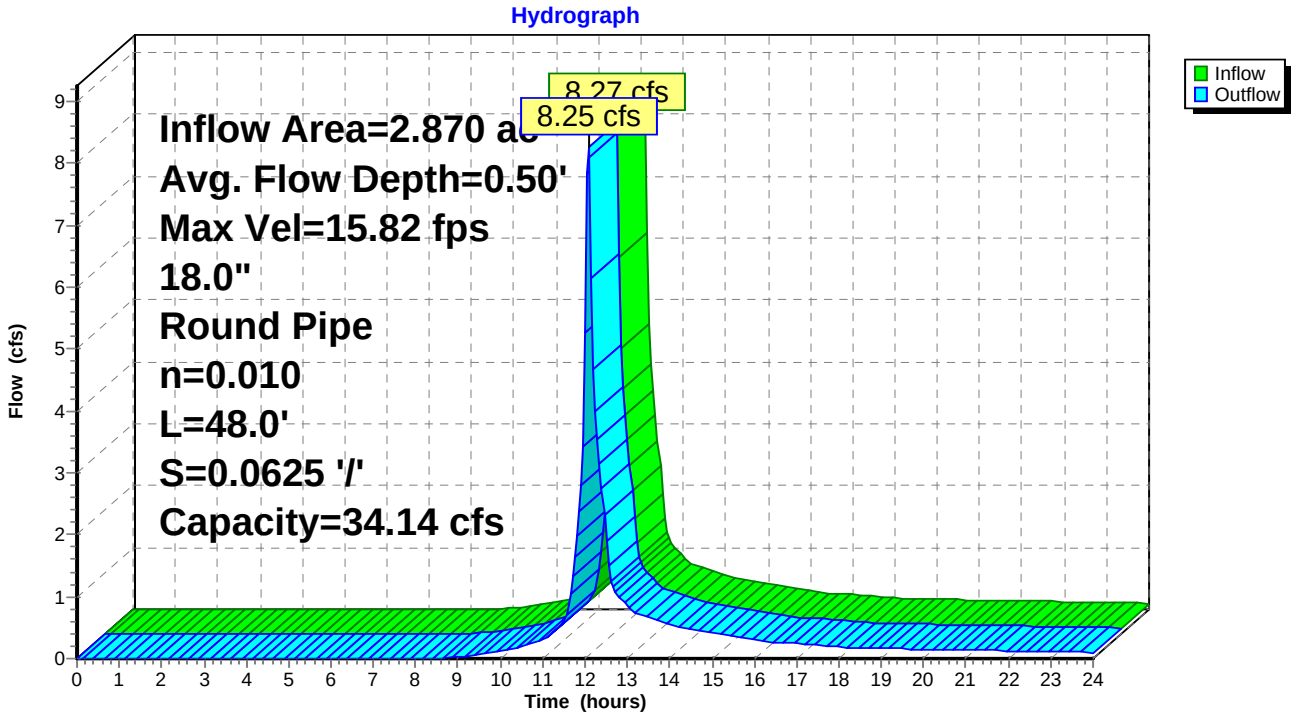
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 15.82 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 5.76 fps, Avg. Travel Time= 0.1 min

Peak Storage= 25 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 34.14 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 48.0' Slope= 0.0625 '/'
Inlet Invert= 1,409.00', Outlet Invert= 1,406.00'



Reach PC10: Culvert 10



Summary for Reach PC11: Culvert 11

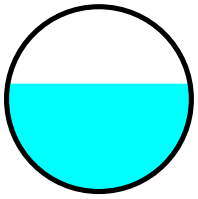
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 5.165 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 14.88 cfs @ 12.08 hrs, Volume= 1.057 af
Outflow = 14.86 cfs @ 12.08 hrs, Volume= 1.057 af, Atten= 0%, Lag= 0.1 min

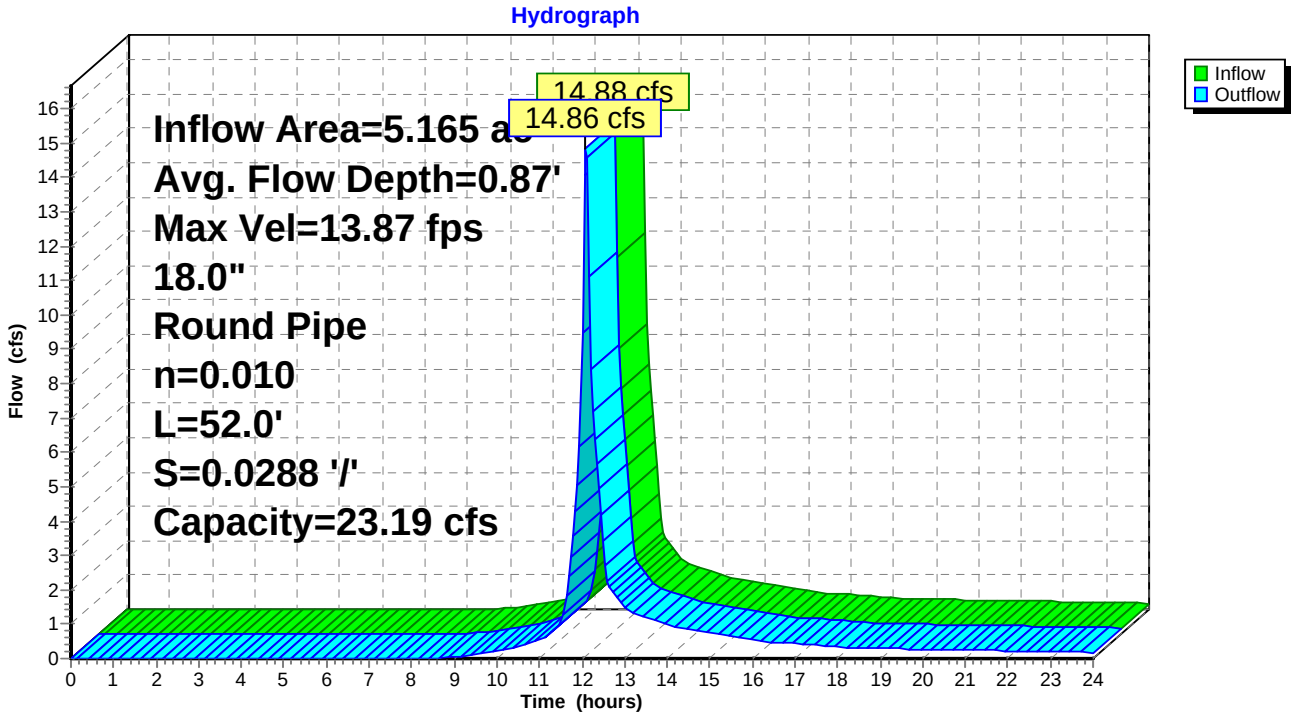
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.87 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 5.23 fps, Avg. Travel Time= 0.2 min

Peak Storage= 56 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 23.19 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 52.0' Slope= 0.0288 '/'
Inlet Invert= 1,334.50', Outlet Invert= 1,333.00'



Reach PC11: Culvert 11



Summary for Reach PC12: Culvert 12

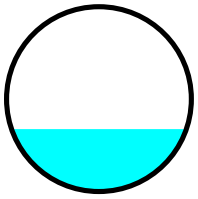
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.528 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 1.52 cfs @ 12.08 hrs, Volume= 0.108 af
Outflow = 1.52 cfs @ 12.08 hrs, Volume= 0.108 af, Atten= 0%, Lag= 0.3 min

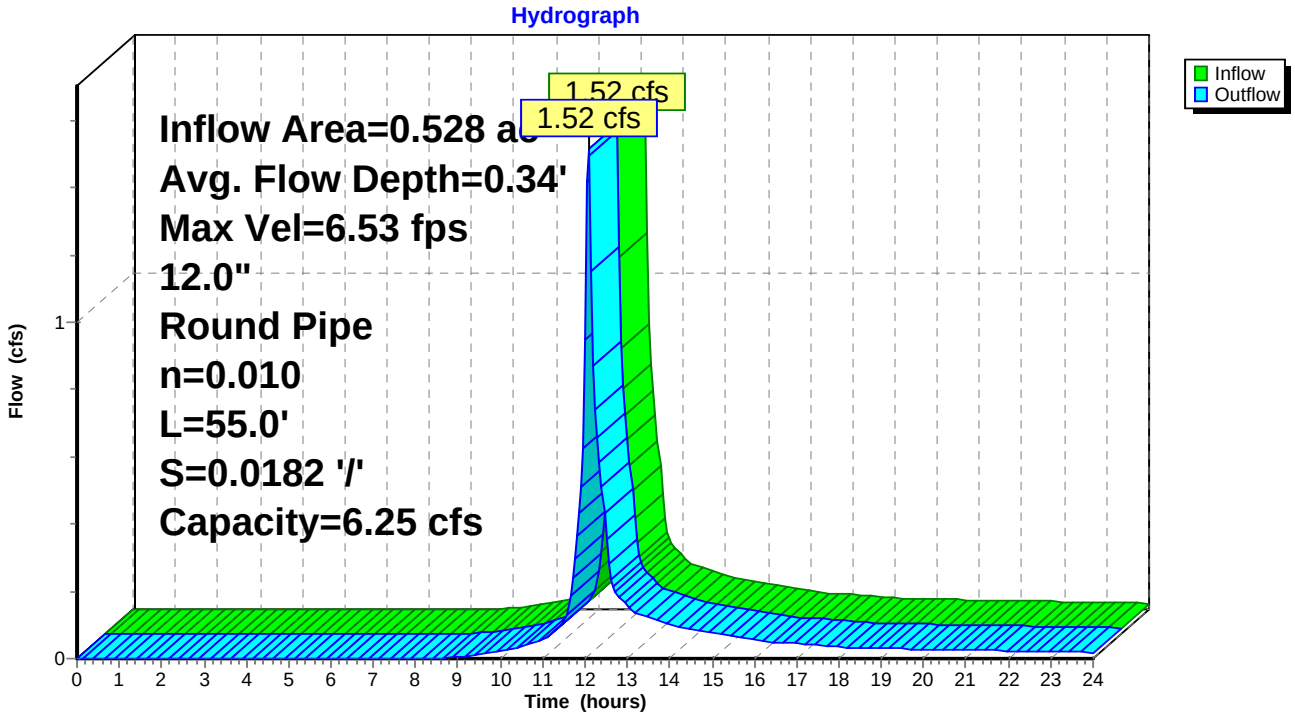
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.53 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.38 fps, Avg. Travel Time= 0.4 min

Peak Storage= 13 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 6.25 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 55.0' Slope= 0.0182 '/'
Inlet Invert= 1,509.00', Outlet Invert= 1,508.00'



Reach PC12: Culvert 12



Summary for Reach PC13: Culvert 13

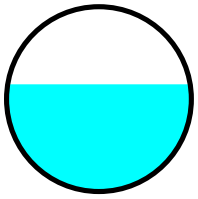
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.377 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 3.97 cfs @ 12.08 hrs, Volume= 0.282 af
Outflow = 3.96 cfs @ 12.08 hrs, Volume= 0.282 af, Atten= 0%, Lag= 0.3 min

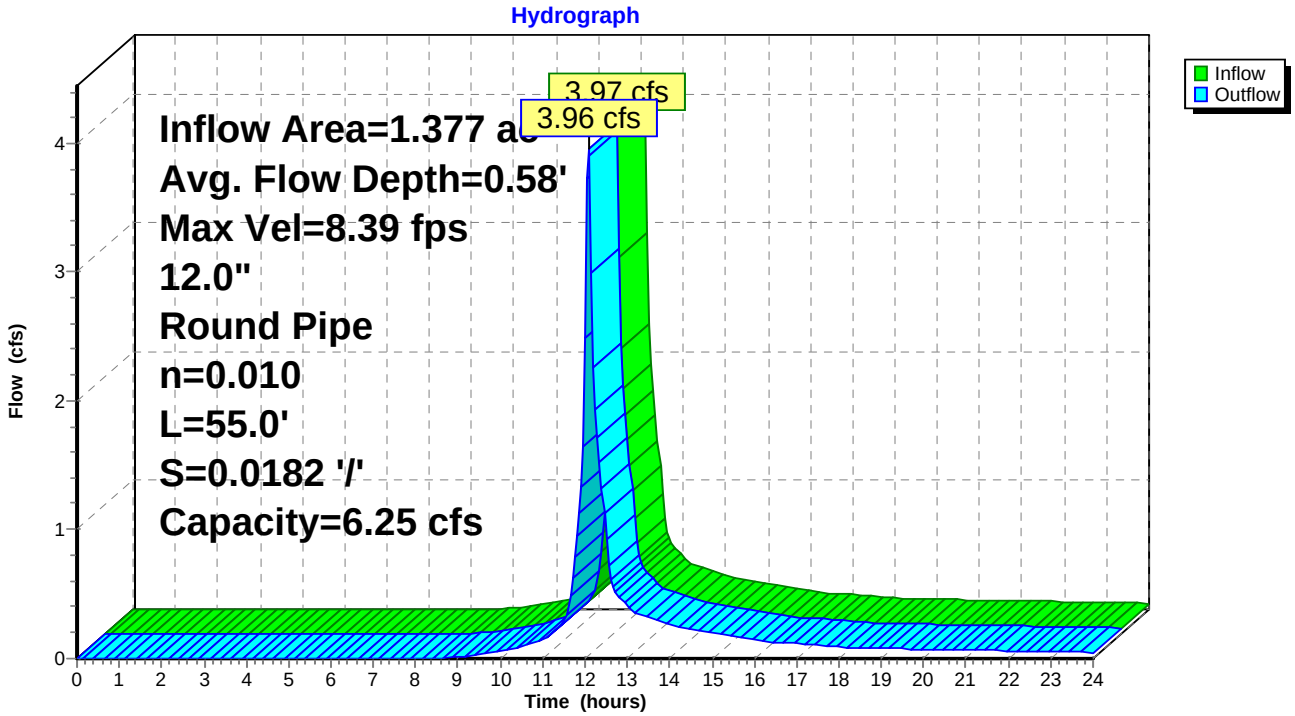
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.39 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.16 fps, Avg. Travel Time= 0.3 min

Peak Storage= 26 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 6.25 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 55.0' Slope= 0.0182 '/'
Inlet Invert= 1,509.00', Outlet Invert= 1,508.00'



Reach PC13: Culvert 13



Summary for Reach PC14: Culvert 14

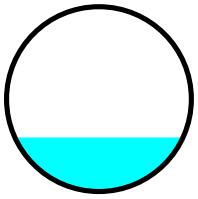
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.689 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 1.98 cfs @ 12.08 hrs, Volume= 0.141 af
Outflow = 1.98 cfs @ 12.08 hrs, Volume= 0.141 af, Atten= 0%, Lag= 0.1 min

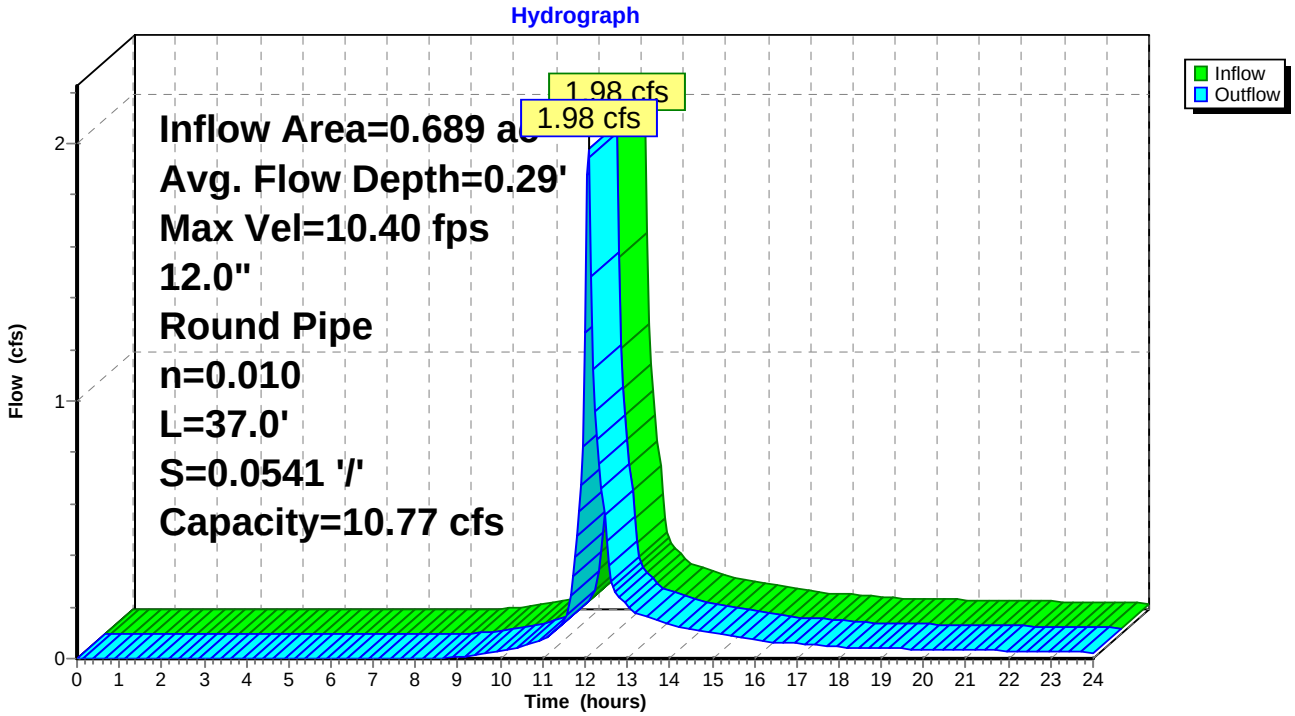
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.40 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.77 fps, Avg. Travel Time= 0.2 min

Peak Storage= 7 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 10.77 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 37.0' Slope= 0.0541 '/'
Inlet Invert= 1,506.00', Outlet Invert= 1,504.00'



Reach PC14: Culvert 14



Summary for Reach PC2: Culvert 02

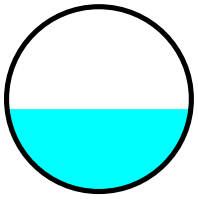
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.423 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 4.10 cfs @ 12.08 hrs, Volume= 0.291 af
Outflow = 4.09 cfs @ 12.08 hrs, Volume= 0.291 af, Atten= 0%, Lag= 0.2 min

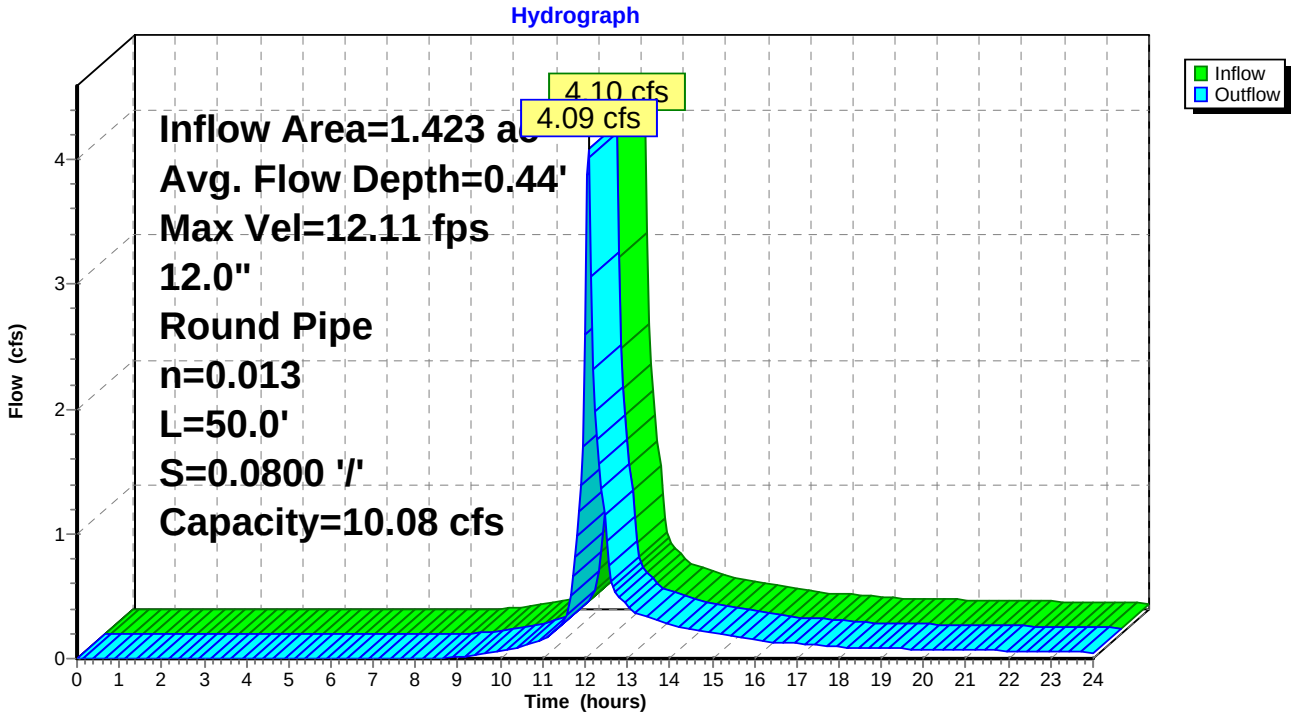
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.11 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.47 fps, Avg. Travel Time= 0.2 min

Peak Storage= 17 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 10.08 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 50.0' Slope= 0.0800 '/'
Inlet Invert= 1,238.00', Outlet Invert= 1,234.00'



Reach PC2: Culvert 02



Summary for Reach PC3: Culvert 03

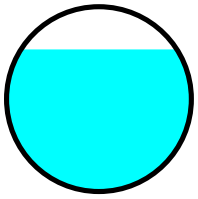
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 15.565 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 44.84 cfs @ 12.08 hrs, Volume= 3.184 af
Outflow = 44.80 cfs @ 12.08 hrs, Volume= 3.184 af, Atten= 0%, Lag= 0.1 min

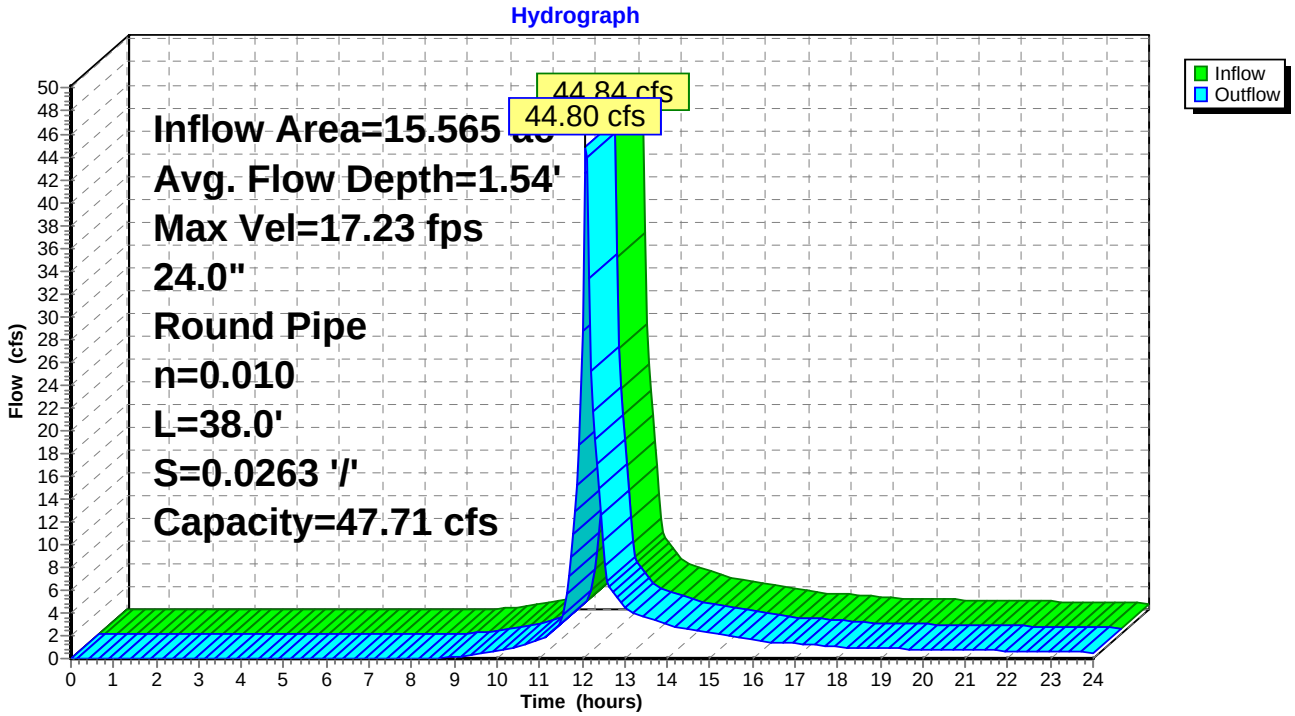
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 17.23 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 6.77 fps, Avg. Travel Time= 0.1 min

Peak Storage= 99 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.54'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 47.71 cfs

24.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 38.0' Slope= 0.0263 '/'
Inlet Invert= 1,256.50', Outlet Invert= 1,255.50'



Reach PC3: Culvert 03



Summary for Reach PC4: Culvert 04

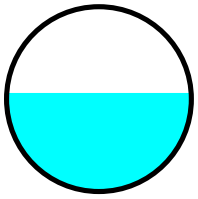
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 8.264 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 23.81 cfs @ 12.08 hrs, Volume= 1.691 af
Outflow = 23.77 cfs @ 12.08 hrs, Volume= 1.691 af, Atten= 0%, Lag= 0.1 min

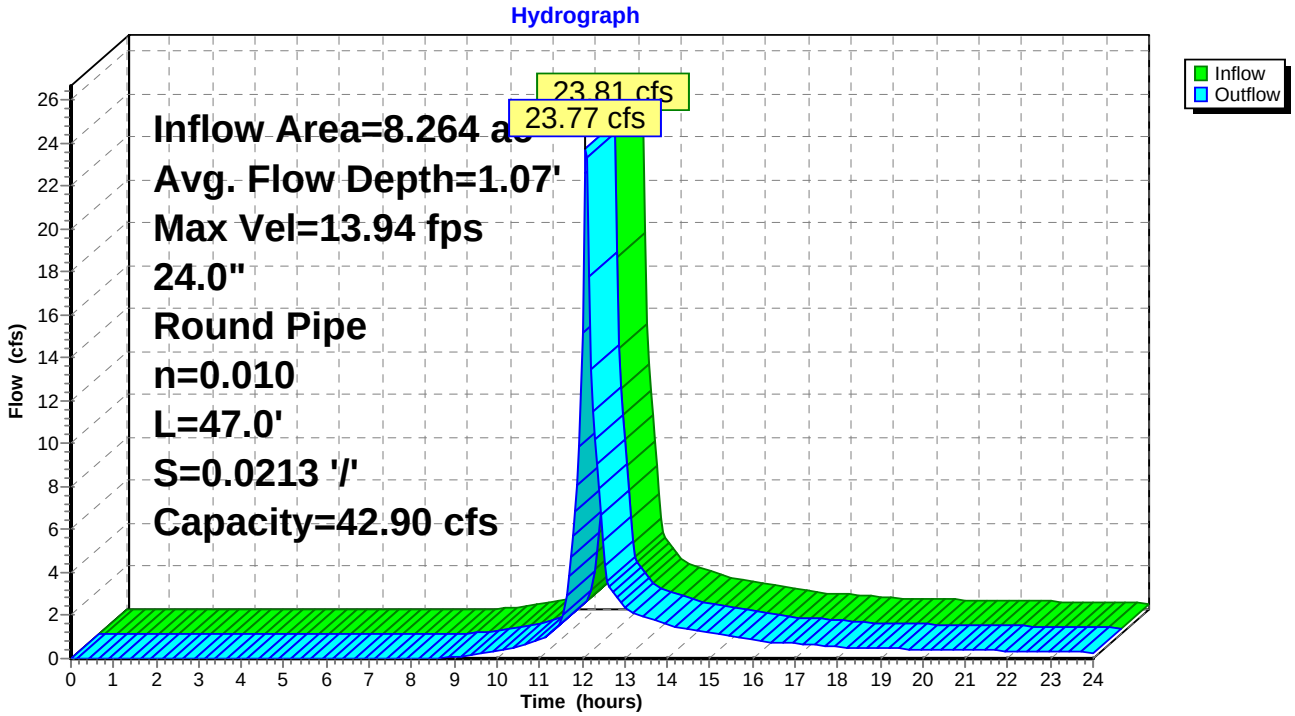
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.94 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 5.21 fps, Avg. Travel Time= 0.2 min

Peak Storage= 80 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.07'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 42.90 cfs

24.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 47.0' Slope= 0.0213 '/'
Inlet Invert= 1,349.00', Outlet Invert= 1,348.00'



Reach PC4: Culvert 04



Summary for Reach PC5: Culvert 05

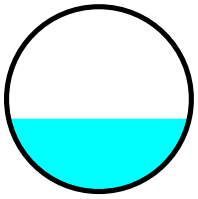
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.826 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 2.38 cfs @ 12.08 hrs, Volume= 0.169 af
Outflow = 2.38 cfs @ 12.08 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.2 min

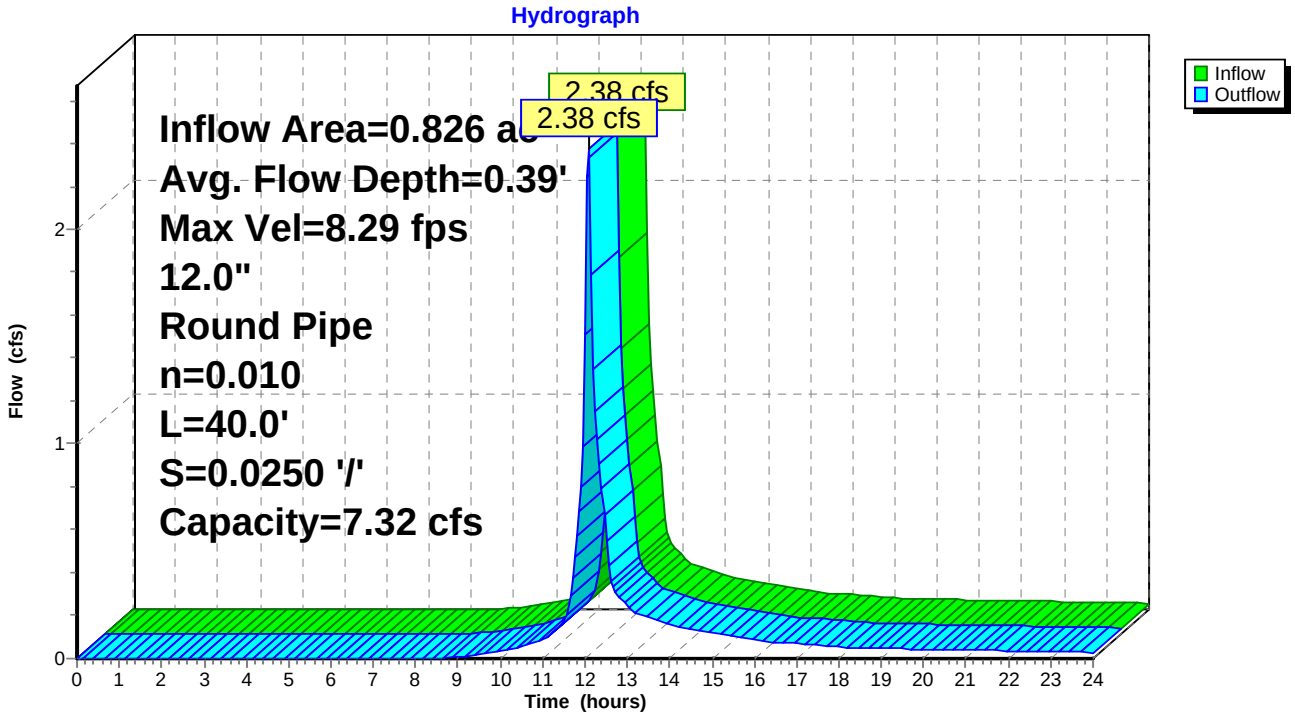
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.29 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.03 fps, Avg. Travel Time= 0.2 min

Peak Storage= 11 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 7.32 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 40.0' Slope= 0.0250 '/'
Inlet Invert= 1,427.00', Outlet Invert= 1,426.00'



Reach PC5: Culvert 05



Summary for Reach PC6: Culvert 06

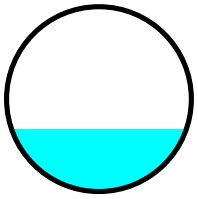
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.525 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 6.86 cfs @ 12.11 hrs, Volume= 0.516 af
Outflow = 6.83 cfs @ 12.11 hrs, Volume= 0.516 af, Atten= 0%, Lag= 0.1 min

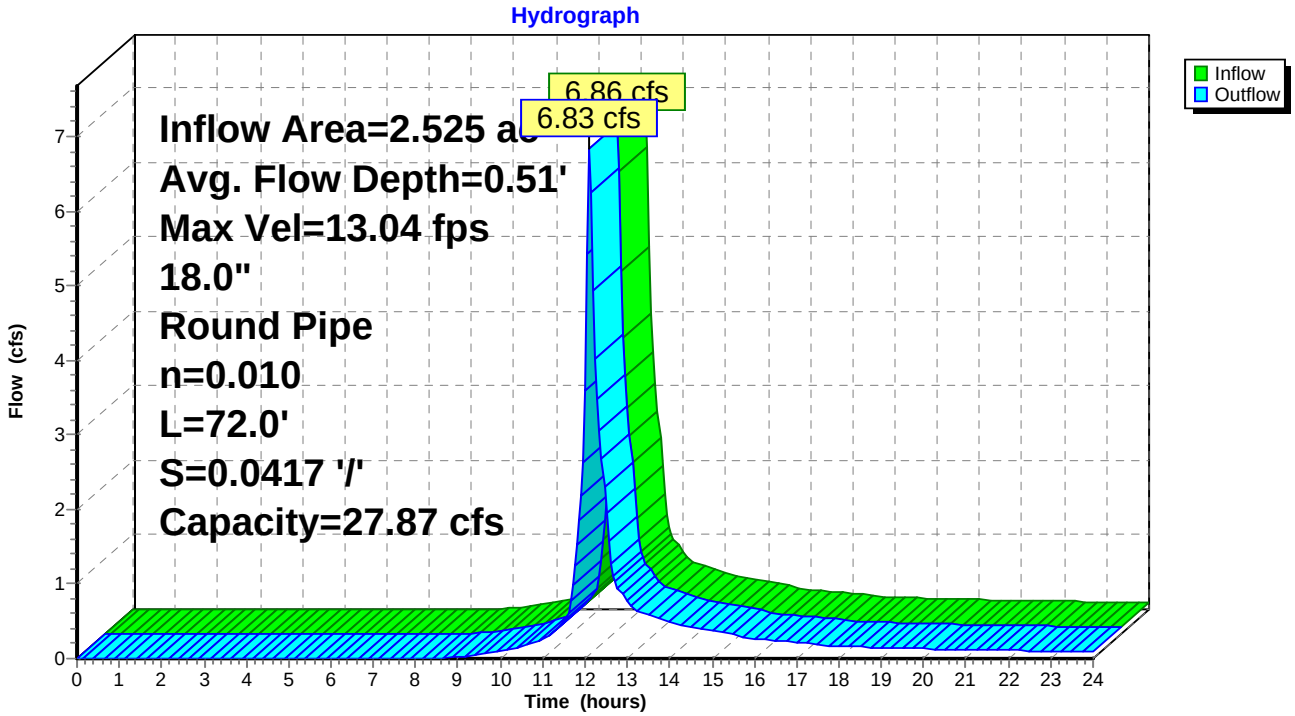
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.04 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.81 fps, Avg. Travel Time= 0.2 min

Peak Storage= 38 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 27.87 cfs

18.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 72.0' Slope= 0.0417 '/'
Inlet Invert= 1,472.00', Outlet Invert= 1,469.00'



Reach PC6: Culvert 06



Summary for Reach PC7: Culvert 07

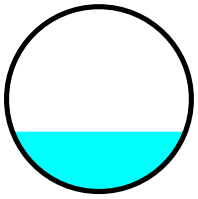
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.826 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 2.38 cfs @ 12.08 hrs, Volume= 0.169 af
Outflow = 2.37 cfs @ 12.08 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.3 min

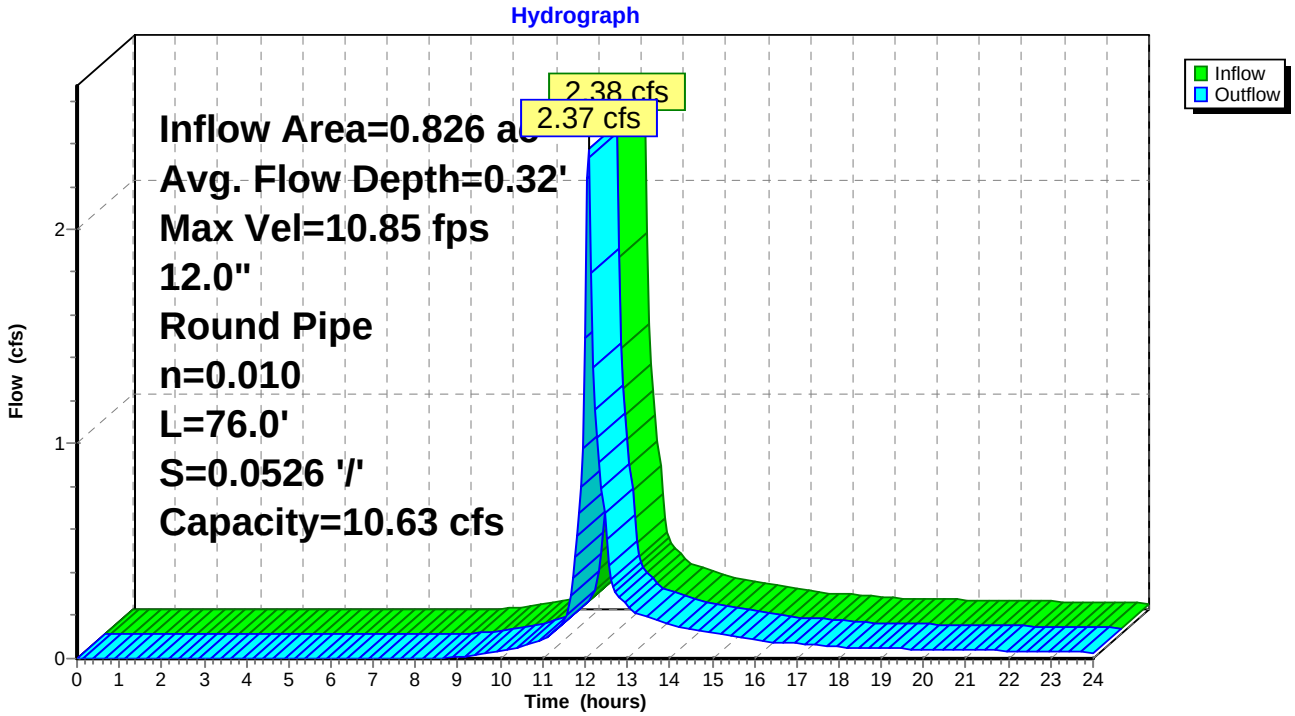
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.85 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.95 fps, Avg. Travel Time= 0.3 min

Peak Storage= 17 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 10.63 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 76.0' Slope= 0.0526 '/'
Inlet Invert= 1,476.00', Outlet Invert= 1,472.00'



Reach PC7: Culvert 07



Summary for Reach PC8: Culvert 08

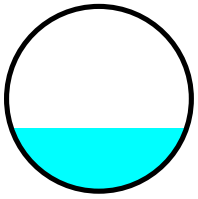
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.010 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 2.91 cfs @ 12.08 hrs, Volume= 0.207 af
Outflow = 2.90 cfs @ 12.09 hrs, Volume= 0.207 af, Atten= 0%, Lag= 0.4 min

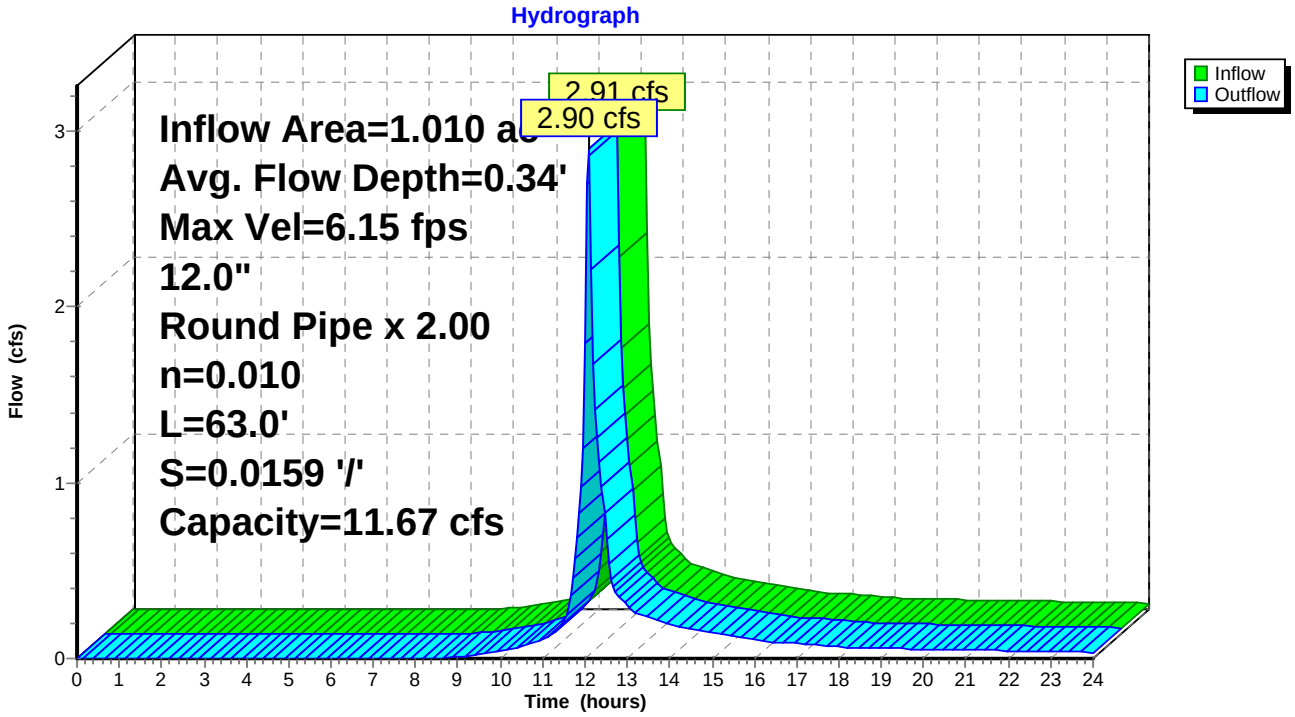
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.15 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.23 fps, Avg. Travel Time= 0.5 min

Peak Storage= 30 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 11.67 cfs

A factor of 2.00 has been applied to the storage and discharge capacity
12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 63.0' Slope= 0.0159 '/'
Inlet Invert= 1,456.00', Outlet Invert= 1,455.00'



Reach PC8: Culvert 08



Summary for Reach PC9: Culvert 09

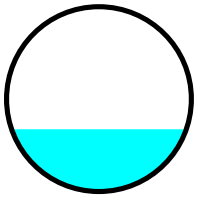
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.551 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25 Year 24-hr event
Inflow = 1.59 cfs @ 12.08 hrs, Volume= 0.113 af
Outflow = 1.58 cfs @ 12.08 hrs, Volume= 0.113 af, Atten= 0%, Lag= 0.3 min

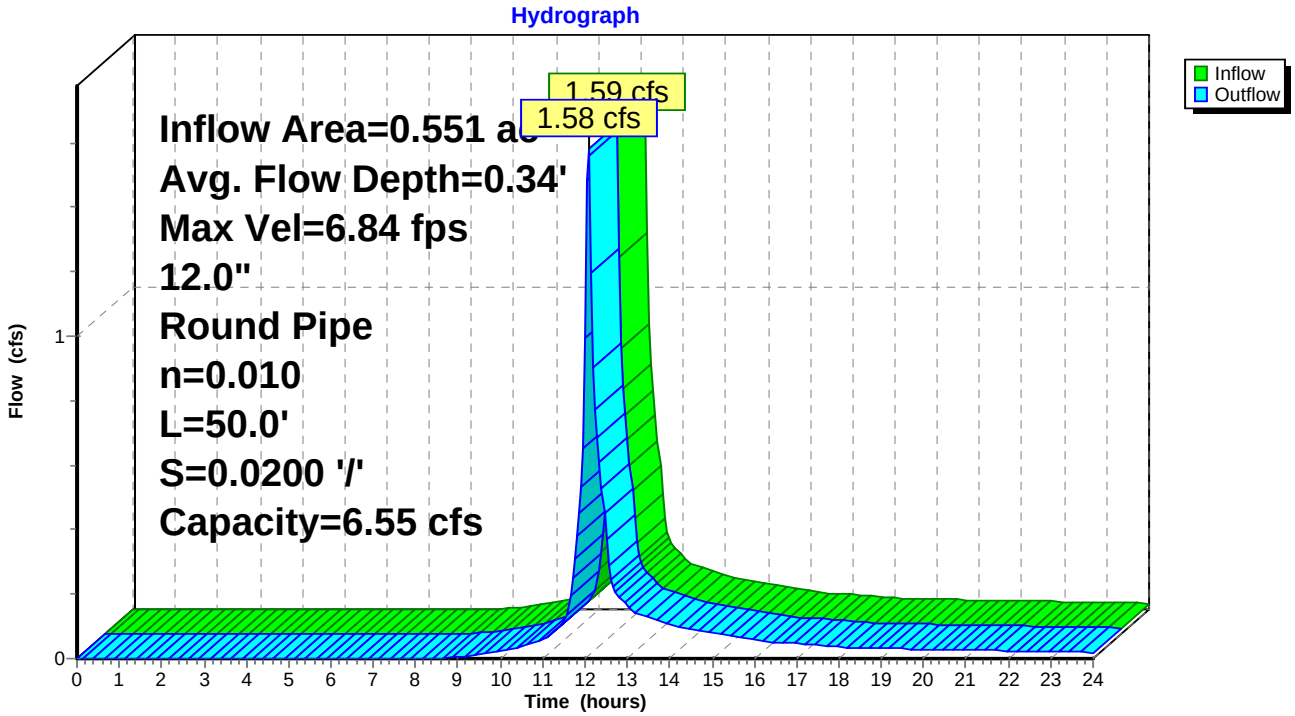
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.84 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.49 fps, Avg. Travel Time= 0.3 min

Peak Storage= 12 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 6.55 cfs

12.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 50.0' Slope= 0.0200 '/'
Inlet Invert= 1,433.00', Outlet Invert= 1,432.00'



Reach PC9: Culvert 09



Attachment 12-4
Schedule of Proposed Culverts

Canton Mountain Wind Project

Stormwater Culvert Schedule:

Culvert ID	Road/Site ID	Station Location	Drainage Area (acres)	Q25 (cfs)	Culvert Diameter (in.)	Length (ft.)	Inv. In (ft.)	Inv. Out (ft.)	Slope (ft./ft.)
RC-1	Ludden Lane	00+11	-	-	18	-	-	-	-
RC-2	Ludden Lane	07+80	-	-	15	-	-	-	-
RC-3	Ludden Lane	08+20	-	-	15	-	-	-	-
RC-4	Ludden Lane	10+91	-	-	15	-	-	-	-
RC-5	Ludden Lane	12+55	-	-	15	-	-	-	-
RC-6	Ludden Lane	15+25	-	-	12	-	-	-	-
RC-7	Ludden Lane	17+08	-	-	12	-	-	-	-
RC-9	Ludden Lane	19+95	-	-	15	-	-	-	-
RC-10	SIDE ROAD	-	-	-	12	-	-	-	-
RC-11	Ludden Lane	22+40	-	-	12	-	-	-	-
RC-12	Ludden Lane	26+40	-	-	15	-	-	-	-
RC-13	Ludden Lane	26+82	-	-	12	-	-	-	-
RC-14	Ludden Lane	30+25	-	-	15	-	-	-	-
RC-15	Ludden Lane	34+82	-	-	15	-	-	-	-
RC-16	Ludden Lane	37+64	-	-	15	-	-	-	-
RC-17	Ludden Lane	41+22	-	-	15	-	-	-	-
RC-18	Ludden Lane	47+55	-	-	18	-	-	-	-
RC-19	Ludden Lane	49+70	-	-	15	-	-	-	-
RC-20	Ludden Lane	59+50	-	-	15	-	-	-	-
RC-21	Ludden Lane	64+20	-	-	18	-	-	-	-
RC-23	Ludden Lane	66+61	-	-	15	-	-	-	-
RC-24	Ludden Lane	68+64	-	-	18	-	-	-	-
RC-25	Logging road	00+48	-	-	24	-	-	-	-
RC-26	Logging road	10+82	-	-	18	-	-	-	-
RC-27	Logging road	12+16	-	-	15	-	-	-	-
RC-28	Logging road	14+90	-	-	15	-	-	-	-
RC-29	Logging road	19+20	-	-	15	-	-	-	-
RC-30	Logging road	25+25	-	-	15	-	-	-	-
RC-31	Logging road	36+30	-	-	18	-	-	-	-
RC-32	Logging road	53+72	-	-	30	-	-	-	-
RC-33	SIDE ROAD	-	-	-	24	-	-	-	-
PC-1	Access Road	84+50	1.38	4.25	12	40	1183	1182	0.025
PC-1	Access Road	96+53	1.42	4.1	12	50	1238	1234	0.080
PC-1	Access Road	97+95	15.57	44.84	24	38	1256.5	1255.5	0.026
PC-1	Access Road	105+20	8.26	23.81	24	47	1349	1348	0.021
PC-1	Access Road	111+10	0.83	2.38	12	40	1427	1426	0.025
PC-1	Access Road	115+92	2.53	6.86	18	72	1472	1469	0.042
PC-1	Lower Ridge Road	00+62	0.83	2.38	12	76	1476	1472	0.053
PC-1	Lower Ridge Road	04+12	1.01	2.91	12	63	1456	1455	0.016
PC-1	Lower Ridge Road	06+70	0.55	1.59	12	50	1433	1432	0.020
PC-1	Lower Ridge Road	08+60	2.87	8.27	18	48	1409	1406	0.063
PC-1	Lower Ridge Road	15+95	5.17	14.88	18	52	1334.5	1333	0.029
PC-1	T02 PAD	-	0.53	1.52	12	55	1509	1508	0.018
PC-1	Upper Ridge Road	16+75	1.38	3.97	12	55	1509	1508	0.018
PC-1	Upper Ridge Road	20+25	0.69	1.98	12	37	1506	1504	0.054

RC: Replacement Culvert
PC: Proposed Culvert

Notes:
1. Provide minimum 2% slope on all culverts.
2. Culvert lengths are approximate. May require adjustment to fit field conditions

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 12-5
Sample Declaration of Restrictions for Forested Buffers

SAMPLE DECLARATION OF RESTRICTIONS FOR FORESTED BUFFERS

THIS DECLARATION OF RESTRICTIONS is made this _____ day of _____, 2010, by Saddleback Ridge Wind, LLC, 549 South Street, Quincy, Norfolk County, Massachusetts, 02169 (hereinafter referred to as the "Declarant"), pursuant to a permit received from the Maine Department of Environmental Protection (hereinafter the "MDEP") under the Site Location of Development Act, to preserve a buffer area on a parcel of land around the Saddleback Ridge Wind Project (hereinafter referred to as the "Project"), near Winter Hill Road in Carthage, Maine, for as long as the Project is operational.

WHEREAS the Declarant holds certain rights and interests through long-term leases to certain real property situated in Carthage, Maine, described in a deed from _____ to dated _____, and recorded in Book ____ Page _____ at the Franklin County Registry of Deeds (herein after referred to as the "Property"); and

WHEREAS Declarant desires to place certain restrictions, under the terms and conditions herein, over a portion of said real property (hereinafter referred to as the "Restricted Buffer") described as follows:
_____

WHEREAS pursuant to the Site Location of Development Act, 38 M.R.S.A. §§ 481-490 and Department Rules for stormwater management (Chapter 500) promulgated by the Maine Board of Environmental Protection, Declarant has agreed to impose certain restrictions on the Restricted Buffer Area as more particularly set forth herein and has agreed that these restrictions may be enforced by the MDEP during the life of the Project,

NOW, THEREFORE, the Declarant hereby declares that the Restricted Buffer Area is and shall be maintained subject to the conditions and restrictions set forth herein. The Restrictions shall run with the Restricted Buffer Area for as long as the Project is operational and shall be binding on all parties having any right, title or interest in and to the Restricted Buffer Area, or any portion thereof, and their heirs, personal representatives, successors, and assigns. Any present or future owner or occupant of the Restricted Buffer Area or any portion thereof, by the acceptance of a deed of conveyance of all or part of the Covenant Area or an instrument conveying any interest therein, whether or not the deed or instrument shall so express, shall be deemed to have accepted the Restricted Buffer Area subject to the Restrictions and shall agree to be bound by, to comply with, and to be subject to each and every one of the Restrictions hereinafter set forth.

1. Restrictions on Restricted Buffer Area. Unless the owner of the Restricted Buffer Area, or any successors or assigns, obtains the prior written approval of the MDEP, the Restricted Buffer Area

must remain undeveloped for as long as the Project is operational. To maintain the ability of the Restricted Buffer Area to filter and absorb stormwater, and to maintain compliance with the Site Location of Development Act and the permit issued thereunder to the Declarant, the use of the Restricted Buffer Area is hereinafter limited as follows:

a. No soil, loam, peat, sand, gravel, concrete, rock or other mineral substance, refuse, trash, vehicle bodies or parts, rubbish, debris, junk waste, pollutants or other fill material will be places, stored, or dumped on the Restricted Buffer Area, nor may the topography or the natural mineral soil of the area be altered or manipulated in any way;
b. Any removal of trees or other vegetation within the Restricted Buffer Area must be limited to the following:
    i. No purposefully cleared openings may be created and an evenly distributed stand of trees and other vegetation must be maintained. An "evenly distributed stand of trees" is defined as maintaining a minimum rating score of 24 points in any 25 foot by 50 foot square (2500 square feet) area, as determined by the following rating scheme:

Diameter of tree at 4½ feet above ground level	Points
2-4 inches	1
4-8 inches	2
8-12 inches	4
>12 inches	8

    Where existing trees and other vegetation result in a rating score less than 24 points, no trees may be cut or sprayed with biocides except for the normal maintenance of dead, windblown or damaged trees and for pruning of tree branches below a height of 12 feet provided two thirds of the tree's canopy is maintained;
    ii. No undergrowth, ground cover vegetation, leaf litter, organic duff layer or mineral soil may be disturbed except that one winding path, that is no wider than six feet and that does not provide a downhill channel for runoff, is allowed through the area;
c. No building or other temporary or permanent structure may be constructed, placed, or permitted to remain on the Restricted Buffer Area, except for a sign, utility pole, or fence;
d. No trucks, cars, dirt bikes, ATVs, bulldozers, backhoes, or other motorized vehicles or mechanical equipment may be permitted on the Restricted Buffer Area, except for vehicles used for limited tree removal;

e. Any level lip spreader directing flow to the Restricted Buffer Area must be regularly inspected and adequately maintained to preserve the function of the level spreader.

Any activity on or use of the Restricted Buffer Area inconsistent with the purpose of these Restrictions is prohibited. Any future alterations or changes in use of the Restricted Buffer Area must receive prior approval in writing from the MDEP. The MDEP may approve such alterations and changes in use if such alterations and uses do not impede the stormwater control and treatment capability of the Restricted Buffer Area or if adequate and appropriate alternative means of stormwater control and treatment are provided.

2. Time Period. This deed restriction will run for the life of the Project. This deed restriction will immediately terminate upon decommissioning of the Project.

3. Enforcement. The MDEP may enforce any of the Restrictions set forth in Section 1 above.

4. Binding Effect. The restrictions set forth herein shall be binding on any present or future owner of the Restricted Buffer Area for as long as the Project is operational. If the Restricted Buffer Area is at any time owned by more than one owner, each owner shall be bound by the foregoing restrictions to the extent that any of the Restricted Buffer Area is included within such owner's property.

5. Amendment. Any provision contained in this Declaration may be amended or revoked only by the recording of a written instrument or instruments specifying the amendment or the revocation signed by the owner or owners of the Restricted Buffer Area and by the MDEP.

6. Effective Provisions of Declaration. Each provision of this Declaration, and any agreement, promise, covenant and undertaking to comply with each provision of this Declaration, shall be deemed a land use restriction running with the land as a burden and upon the title to the Restricted Buffer Area for as long as the Project is operational.

7. Severability. Invalidity or unenforceability of any provision of this Declaration in whole or in part shall not affect the validity or enforceability of any other provision or any valid and enforceable part of a provision of this Declaration.

8. Governing Law. This Declaration shall be governed by and interpreted in accordance with the laws of the State of Maine.

_____ _____

(NAME) (DATE)

COMMONWEALTH OF MASSACHUSETTS, _____ County, dated _____, 2010.

Personally appeared before me the above named _____, who swore to the truth of the foregoing to the best of his knowledge, information and belief and acknowledged the foregoing instrument to be his free act and deed.

_____

Notary Public

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 12-6
Underdrained Soil Filter Calculations

Canton Mountain Wind Project

Underdrained Soil filter Sizing Calculations

O&M Building Pad Soil Filter		
(Plan Sheets C-401-33 & C-512-33		
Area Draining to Soil Filter		
Impervious Area	10,500	(gravel road surface)
Developed Area	11,500	(road side ditch and cut slopes)
Treatment Volume		
Impervious Area x 1.0 in. =	875	cf
Developed Area x 0.4 in. =	384	cf
Volume Required =	1259	cf
Surface area elev. 485.5 =	1406	sf
Surface area elev. 484.5 =	942	sf
Volume Provided =	2348	sf
Filter Area at Soil Filter Base Elevation 1006.0		
Impervious Area x 0.05 =	525	sf
Developed Area x 0.02 =	230	sf
Area Required =	755	sf
Area Provided =	942	sf

PATRIOT RENEWABLES
Canton Mountain Wind, LLC

Attachment 12-7
Schedule of Stormwater Best Management Practices

File: Canton Mountain-Model
Date: 11/11/2011

Canton Mountain Wind Project

Stormwater Treatment Calculations:
Watersheds draining to the Androscoggin River, Webb River and Sevenmile Stream Watershed
Chapter 500, Stormwater Management, Section 4.B.(3).(c) describes a linear project.
Required stormwater treatment of impervious area = 75%

BMP ID Legend
BF = Forested buffer adjacent to road/small impervious area
BM = Meadow buffer adjacent to road/small impervious area
LSF = Forested level lip spreader buffer
LSM = Meadow level lip spreader buffer
DTF = Forested Ditch Turnout
DTM = Meadow Ditch Turnout

Road ID	Station Location				BMP ID	Soil HSG	Buffer Slope	Buffer Length	Impervious Area	Impervious Area Treated (acres)
Access Road	82+06	to	95+68	-	-	-	-	-	0.375	0.000
Access Road	95+68	to	97+90	R	BF 1	C	< 0.24	35	0.061	0.061
Access Road	97+90	to	99+95	R	BF 2	C	< 0.24	35	0.056	0.056
Access Road	99+95	to	100+65	R	BF 3	C	< 0.24	35	0.019	0.019
Access Road	100+65	to	101+65	R	BF 4	C/D	< 0.30	35	0.028	0.028
Access Road	101+65	to	102+35	-	-	-	-	-	0.019	0.000
Access Road	102+35	to	105+15	R	BF 5	C/D	< 0.24	35	0.077	0.077
Access Road	105+15	to	105+60	-	-	-	-	-	0.012	0.000
Access Road	105+60	to	108+20	R	BF 6	C/D	< 0.30	35	0.072	0.000
Access Road	108+20	to	109+10	R	BF 7	C/D	> 0.30	35	0.025	0.025
Access Road	109+10	to	110+35	R	BF 8	C/D	> 0.30	35	0.034	0.034
Access Road	110+35	to	111+58	R	BF 9	C/D	< 0.30	35	0.034	0.034
Access Road	111+58	to	113+35	R	BF 10	C/D	> 0.30	35	0.049	0.049
Access Road	113+35	to	114+80	R	BF 11	C/D	< 0.30	35	0.040	0.040
Access Road	114+80	to	115+30	R	BF 12	C/D	< 0.24	35	0.014	0.014
Access Road	115+30	to	117+65	-	-	-	-	-	0.062	0.000
Access Road	117+65	to	118+82	L	BF 13	C/D	< 0.24	35	0.036	0.036
Crane Road 1	00+00	to	00+80	R	-	-	-	-	0.039	0.000
Crane Road 1	00+80	to	02+40	R	BF 14	C/D	> 0.30	35	0.044	0.044
Crane Road 1	02+40	to	05+20	R	BF 15	C/D	> 0.30	35	0.077	0.077
Crane Road 1	05+20	to	08+20	R	BF 16	C	> 0.30	35	0.083	0.083
Crane Road 1	08+20	to	10+15	-	-	-	-	-	0.054	0.000
Crane Road 1	10+15	to	11+75	R	BF 17	C/D	< 0.24	35	0.044	0.044
Crane Road 1	11+75	to	12+65	R	BF 18	C/D	< 0.24	35	0.025	0.025
Crane Road 1	12+65	to	13+20	R	BF 19	C	< 0.24	35	0.015	0.015
Crane Road 1	13+20	to	14+40	R	BF 20	C	< 0.24	35	0.033	0.033
Crane Road 1	14+40	to	16+00	R	BF 21	C	< 0.24	35	0.044	0.044
Crane Road 1	16+00	to	18+60	R	BF 22	C/D	< 0.24	35	0.072	0.072
Crane Road 1	18+60	to	22+05	R	BF 23	C/D	< 0.24	35	0.095	0.095
Crane Road 1	22+05	to	23+84	R	BF 24	C/D	< 0.24	35	0.049	0.049
Crane Road 2	00+00	to	00+95	-	-	-	-	-	0.026	0.000
Crane Road 2	00+95	to	03+10	L	BF 25	C/D	< 0.24	35	0.059	0.059
Crane Road 2	03+10	to	03+80	-	-	-	-	-	0.019	0.000
Crane Road 2	03+80	to	07+80	R	BF 26	C/D	< 0.24	35	0.110	0.110
Crane Road 2	07+80	to	09+80	R	BF 27	C/D	< 0.24	35	0.055	0.055
Crane Road 2	09+80	to	11+15	R	BF 28	C/D	< 0.24	35	0.037	0.037
Crane Road 2	11+15	to	11+95	L	BF 29	C/D	< 0.30	35	0.022	0.022
Crane Road 2	11+95	to	15+30	L	BF 30	C/D	< 0.30	35	0.092	0.092
Crane Road 2	15+30	to	18+50	L	BF 31	C/D	< 0.30	35	0.088	0.088
Crane Road 2	18+50	to	22+20	L	BF 32	C/D	> 0.30	35	0.102	0.102
Crane Road 2	22+20	to	25+50	L	BF 33	C/D	< 0.30	35	0.091	0.091
Crane Road 2	25+50	to	29+00	-	-	-	-	-	0.096	0.000
Crane Road 2	29+00	to	31+25	L	BF 43	C/D	< 0.24	35	0.062	0.062
Crane Road 2	31+25	to	34+60	-	-	-	-	-	0.092	0.000
Crane Road 2	34+60	to	36+30	L	BF 34	C/D	< 0.24	35	0.047	0.047
Crane Road 2	36+30	to	39+25	L	BF 44	C/D	< 0.24	35	0.081	0.081
Crane Road 2	39+25	to	41+15	L	BF 35	C/D	< 0.24	35	0.052	0.052
Crane Road 2	41+15	to	43+35	-	-	-	-	-	0.061	0.000
Crane Road 2	43+35	to	47+35	R	BF 37	C/D	< 0.24	35	0.110	0.110
Crane Road 2	47+35	to	47+85	R	BF 38	C/D	< 0.24	35	0.014	0.014
T01	Turbine Pad Access				BF 39	C/D	< 0.24	150	0.032	0.032
T01	Crane Pad				BF 39	C/D	< 0.24	150	0.092	0.092
T01	Turbine Gravel Ring				BF 39	C/D	< 0.24	150	0.016	0.016
T01	Turbine Foundation				BF 39	C/D	< 0.24	150	0.010	0.010
T02	Turbine Pad Access				BF 40	C/D	< 0.24	150	0.059	0.059
T02	Crane Pad				BF 40	C/D	< 0.24	150	0.092	0.092
T02	Turbine Gravel Ring				BF 40	C/D	< 0.24	150	0.016	0.016
T02	Turbine Foundation				BF 40	C/D	< 0.24	150	0.010	0.010
T03	Turbine Pad Access				BF 41	C/D	< 0.30	150	0.069	0.069
T03	Crane Pad				BF 41	C/D	< 0.30	150	0.092	0.092
T03	Turbine Gravel Ring				BF 41	C/D	< 0.30	150	0.016	0.016
T03	Turbine Foundation				BF 41	C/D	< 0.30	150	0.010	0.010
T04	Turbine Pad Access				BF 42	C/D	< 0.30	150	0.013	0.013
T04	Crane Pad				BF 42	C/D	< 0.30	150	0.092	0.092
T04	Turbine Gravel Ring				BF 42	C/D	< 0.30	150	0.016	0.016
T04	Turbine Foundation				BF 42	C/D	< 0.30	150	0.010	0.010
T05	Turbine Pad Access				BF 43	C/D	> 0.30	150	0.013	0.013
T05	Crane Pad				BF 43	C/D	> 0.30	150	0.092	0.092
T05	Turbine Gravel Ring				BF 43	C/D	> 0.30	150	0.016	0.016

T05	Turbine Foundation	BF 43	C/D	> 0.30	150	0.010	0.010
T06	Turbine Pad Access	BF 44	C/D	< 0.24	150	0.008	0.008
T06	Crane Pad	BF 44	C/D	< 0.24	150	0.092	0.092
T06	Turbine Gravel Ring	BF 44	C/D	< 0.24	150	0.016	0.016
T06	Turbine Foundation	BF 44	C/D	< 0.24	150	0.010	0.010
T07	Turbine Pad Access	BF 45	C/D	< 0.24	150	0.041	0.041
T07	Crane Pad	BF 45	C/D	< 0.24	150	0.092	0.092
T07	Turbine Gravel Ring	BF 45	C/D	< 0.24	150	0.016	0.016
T07	Turbine Foundation	BF 45	C/D	< 0.24	150	0.010	0.010
T08	Turbine Pad Access	BF 46	C/D	< 0.30	150	0.044	0.044
T08	Crane Pad	BF 46	C/D	< 0.30	150	0.092	0.092
T08	Turbine Gravel Ring	BF 46	C/D	< 0.30	150	0.016	0.016
T08	Turbine Foundation	BF 46	C/D	< 0.30	150	0.010	0.010
O&M Building	O&M Building Pad Access	LSF 26	C/D	0.110	-	0.110	0.000
O&M Building	O&M Building Pad	LSF 26	C/D	0.110	-	0.260	0.260
					Totals:	**4.597**	**3.560**

Percentage Impervious Area Treated:	**77.42%**
Percentage Required:	**75.00%**