

# PROJECT NARRATIVE & STORMWATER REPORT

*For the Proposed:*

## COFFEE SHOP REDEVELOPMENT

*Located At:*  
788 Main Street  
Holden, Massachusetts

*Prepared On:*  
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## **INTRODUCTION**

Solli Engineering (Solli) has prepared this Project Narrative & Stormwater Report (Report) to provide an analysis of the zoning regulations, stormwater management, utility design and coordination, soil erosion and sediment control measures, and subsurface conditions for the proposed Coffee Shop Redevelopment located at 788 Main Street in Holden, Massachusetts. The proposed redevelopment has been designed in compliance with the Town of Holden Zoning Bylaw, the Town of Holden Stormwater Rules & Regulations, the Massachusetts Stormwater Handbook updated February 2008, as well as all other applicable state and federal requirements and regulations.

## **EXISTING CONDITIONS**

### **PROJECT SITE**

#### **SITE LOCATION**

The “Project Site” (Site) is at 788 Main Street (Route 122A) that consists of a 0.715± acre parcel situated along the northern corridor of Main Street within the Commercial (C) Zoning District of the Town of Holden, Massachusetts. The Site is bound by Main Street to the south, commercially developed properties to the east and west, and undeveloped land to the north. The Site is currently improved by a retail shop and parking lot. The Site is accessible off Main Street (Route 122A) via a 30’ wide curb cut. For more information regarding the existing site location and site access refer to Appendix A, Figure 1 - Site Location, and Existing Conditions Plan, Appendix D.

#### **SITE CHARACTERISTICS**

The Site is improved with paved parking areas, drive aisles, retaining walls, landscape islands, utility structures, and stormwater structures to support the existing retail shop. The Site contains minimal stormwater management systems and majority of the Site’s stormwater sheet flows off-site. An existing dry-well structure is located within the front parking area that captures a portion of the Site’s stormwater runoff. Elevations range within the Site from approximately 716’ to 727’.

According to soil survey mapping, obtained from the Natural Resource Conservation Service (NRCS), the surface soils on the Site include “Udorthents” and “Walpole Sandy Loam”. Udorthents do not have a specified hydrologic soil rating. Walpole sandy loam soils have a hydraulic soil rating of B/D. For more information regarding the surface soil conditions of the Site, refer to Appendix A, Figure 2 - Soil Survey Map.

### **REGULATED AREAS**

#### **FEMA FLOODPLAIN**

According to FEMA Flood Insurance Rate Map, Map Number 2503090015B, effective date 07/02/1981, the Site is not located within an area of flood hazard. For more information regarding the FEMA floodplains refer to Appendix A, Figure 3 - FEMA Flood Map.

#### **ENDANGERED AND RARE SPECIES PROTECTION AREA**

According to online mapping provided from the Massachusetts Department of Environmental Protection (MassDEP) ArcGIS Endangered and Rare Species Protection areas, the Site is not located with a Endangered and Rare Species Protection Area. For more information, refer to Appendix A, Figure 4 – Endangered and Rare Species Protection Map.

### WELLHEAD PROTECTION AREA

According to online mapping provided from the Massachusetts Department of Environmental Protection (MassDEP) ArcGIS Wellhead Protection areas, the Site is not located within a Zone I or II Wellhead Protection Area. For more information, refer to Appendix A, Figure 5 – Wellhead Protection Map.

### SURFACE WATER PROTECTION AREA

According to online mapping provided from the Massachusetts Department of Environmental Protection (MassDEP) ArcGIS Surface Water Protection areas, the Site is located within a Zone A Surface Water Protection Area of the Wachusett Reservoir. For more information, refer to Appendix A, Figure 6 – Surface Water Protection Area Map.

### WETLAND RESOURCE AREAS

According to the State of Massachusetts' Geographical Information System (MassMapper), to the north of the property a hydrologic connection exists. Based on field verification / observations made by the Applicant's representatives as well as the Town of Holden Conservation Agent, an intermittent stream and surrounding bordering vegetative wetlands (BVW) exists approximately 75' to the north of the rear property line.

### **ZONING ASSESSMENT**

As shown in the Town of Holden, Massachusetts' Zoning Map, the Site is located within the Commercial (C) Zoning District. The Site is bound by similarly zoned properties to the north, south, east, and west.

### COMMERCIAL ZONING DISTRICT

All developments within the C Zoning District are required to comply with the dimensional requirements set forth in Chapter 7.1 Section 6 – Area, Height and Bulk Regulations within the Town of Holden Zoning Regulations. The C Zoning District dimensional requirements are provided below:

**Table 1: Commercial Zoning District Dimensional Requirements**

Zoning District	Min. Lot Area	Min. Lot Width	Min. Lot Frontage	Min. Front Yard	Min. Side Yard	Min. Rear Yard	Min. Front Yard Landscape	Min. Side and Rear Landscape	Max. Building Height	Max. FAR
C	10,000 SF	80 ft	64 ft	30 ft	15 ft	15 ft	15 ft	5ft	30 ft	50 %

### PARKING REGULATIONS

According to Chapter 7.1 Section 8 – Parking and Loading Regulations, of the Town of Holden Zoning Regulations, the parking requirement for a restaurant use is 1 space per 4 seats.

### PROPOSED CONDITIONS

#### **PROJECT DESCRIPTION**

The Applicant, DDMNS Realty, LLC, is proposing to construct a 2,410± square foot, slab on grade, coffee shop with a drive-through with both interior and exterior seating, located at 788 Main Street (Route 122A) in Holden, Massachusetts. The construction will include various site improvements including associated parking, drives, drainage, utilities, landscaping, and lighting features to support the proposed use.

#### SITE ACCESS / EGRESS

The redevelopment proposes a 30-foot-wide driveway off Main Street (Route 122A) in the general location of the existing driveway. The driveway has been designed with a 12-foot-wide access lane and two (2) 9-foot-wide dedicated left and right turn egress lanes. Traffic signage and painted markings are proposed throughout the Site to improve traffic flow and vehicular safety.

#### PARKING, LOADING & OPERATIONS

The project proposes the construction of a 2,410± square foot, slab on grade, coffee shop. The proposed redevelopment includes the construction of a drive-through stacking lane and associated by-pass lane, drive-through window, dumpster pad, and enclosure and various parking improvements to support the proposed use. The project proposes minor off-parcel improvements to better accommodate the proposed flow of traffic, parking, and operations.

The redevelopment proposes a 24-foot-wide drive aisle within the parking area to the east of the building. The proposed drive-through entrance is at the northeast corner of the Site and includes a 12-foot-wide drive-through stacking lane and a 10-foot-wide emergency by-pass lane. A clearance bar, pre-order menu, digital order screen with canopy, and menu board are proposed to be installed adjacent to the drive-through. Painted traffic arrows are proposed throughout the site to improve traffic flow and vehicular safety. Stop signs and stop bars have been proposed at the exit of the drive-through to improve traffic flow and safety.

The project proposes a 450± square-foot concrete patio and outdoor seating area along the western side of the building. In addition to the outdoor seating area, three (3) time-limited, curb side parking spaces are proposed adjacent to the patio. These spaces will be utilized by customers using mobile ordering and larger drive-through purchases.

The redevelopment proposes a total of twenty-three (23) parking spaces and two (2) bicycle racks. The bicycle racks are proposed along the Main Street (Route 122A) frontage providing connectivity to the Main Street (Route 122A) sidewalks. Refer to Table 2 below for more information regarding the proposed parking summary.

**Table 2: Proposed Parking Summary**

Proposed Development	GSF / Seats	Town Minimum Parking Requirement	Town Maximum Parking Requirement	Required	Proposed
Coffee Shop	2, 410 SF / 62 Seats	1 Space / 4 Seats	1 Space / 4 Seats	16 Spaces	23 Spaces
Total				16 Spaces	23 Spaces

\*For more information refer to the Site Layout Plan (Sheet 2.11) located within the Permitting Plan Set, submitted in conjunction with this Report.

The coffee shop's parking spaces have been designed with a width of 9-feet and a depth of 18-feet consistent with industry standards. Two (2) ADA accessible parking spaces (1 standard and 1 van space) are proposed adjacent to the coffee shop's front doors. The ADA accessible parking spaces are accompanied by a shared designated loading area. The proposed parking spaces have been designed to provide efficient and adequate access to all of the proposed building entrances. The project proposes a concrete dumpster pad with a chain link fence enclosure at the end of the front drive aisle.

For more information regarding the proposed site work and improvements associated with the outparcel redevelopment refer to the Site Layout Plan (Sheet 2.11) located within the Permitting Plan Set, submitted in conjunction with this Report.

## **STORMWATER MANAGEMENT**

The redevelopment of the Site proposes an increase to the overall impervious area of the existing development by approximately 2,360± square feet. To mitigate the increase in impervious area and manage the stormwater runoff, the Site has been designed with a subsurface infiltration system. The proposed stormwater conveyance system consists of a series of catch basins with 4-foot sumps and hooded outlets, manholes, two (2) water quality units, and said subsurface infiltration system. The on-site hydraulic system has been analyzed for the 25-year storm event without surcharging the proposed structure's rim/grate.

The underground stormwater system has been designed as a 3.5-foot concrete chamber system with a total storage volume of 1,598± cubic feet. The system has been designed with an outlet riser that controls the rate of runoff and also provides a recharge volume of 936± cubic feet. The proposed stormwater management system has been designed in accordance with the Massachusetts Stormwater Handbook, updated February 2008, and Section 3.0 – Stormwater Management and Erosion Control of the Town of Holden Stormwater Management Rules and Regulations. Refer to the Stormwater Management & Soil Erosion Control section of this Report for more details regarding the proposed best management practices and drainage features being implemented as part of this project.

## **SITE UTILITIES**

### **WATER**

The water provider for this property is the Town of Holden Water Department. The existing property has a 1" plastic water service off an existing 10-inch water main located within the eastbound lane of Main Street (122A). The proposed coffee shop requires a 2-inch domestic water service and proposes to tap the 10-inch water main in the general vicinity of the existing service. The tap and installation shall be performed in accordance with the Town of Holden Water Department standards and requirements.

The building is proposed to be 2,410 square feet and will not need an automatic sprinkler system; under the Massachusetts General Laws any building totaling more than 7,500 gross square feet is required to have an automatic sprinkler system. The Site is within proximity to one (1) existing fire hydrant, located to the west of the Site.

For more information pertaining to the proposed utility layout refer to the Grading, Drainage and Utility Plan (Sheet 2.21) within the Permitting Plan Set, submitted in conjunction with this Report.

### **SANITARY**

The sanitary sewer provider in the Town of Holden is the Town of Holden Water Department. When the 8" sewer main was installed within Main Street (Route 122A) a 6" PVC lateral was capped at the property line for the property. The project proposes to utilize the existing sewer stub assuming the integrity of the lateral is in the operating condition. In accordance with tenant specifications, the coffee shop's sanitary system has been designed with 4-inch and 6-inch PVC laterals; one for kitchen waste and the other for domestic effluent. The kitchen waste lateral is proposed to convey effluent towards a 1,500-gallon grease tank to facilitate the settling of fats, oils, and grease. The outlet of the grease tank and the domestic sanitary lateral are proposed to combine within the sewer manhole. From this manhole the effluent will convey through a 6" gravity main towards Main Street (Route 122A) and connect to the existing sewer main through a manhole. The conditions of the proposed discharge location are unknown and in accordance with the Town of Holden upgrades to the existing structure may be required.

In accordance with rates taken from the Massachusetts Department of Environmental Protection 310 CMR 15.000, the proposed coffee shop is expected to generate approximately 1,240 gallons per day of domestic effluent and the grease trap is to be sized with a minimum capacity of 930 gallons. Tenant specifications require a grease trap of 1,500 gallons.

**Table 3: Sewer Flow Design**

Type of Establishment	Total Square Footage / Seats	Unit	Gallons Per Day Per Unit	Total Gallons Per Day
Coffee Shop (Fast-Food)	2,410 SF / 62 Seats	1 Seat	20 GPD	1,240 GPD
<b>Total</b>				1,240 GPD

**Table 4: Grease Trap Flow Design**

Type of Establishment	Total Square Footage / Seats	Unit	Gallons Per Day Per Unit	Total Gallons Per Day	Recommended Grease Trap Size
Coffee Shop (Fast-Food)	2,410 SF / 62 Seats	1 Seat	15 GPD	930 GPD	1,500 Gallons

For more information pertaining to the proposed utility layout refer to the Grading, Drainage and Utility Plan (Sheet 2.21) within the Permitting Plan Set, submitted in conjunction with this Report.

#### ELECTRIC / CABLE / TELECOMMUNICATIONS

The electric provider in this location is Holden Municipal Light Plan (HMLP). In accordance with tenant specifications, the coffee shop requires a 600-amp, 208/120 volt, 3 phase, 4 wire service. In coordination with HMLP, the electrical service will be provided via a pad mounted transformer on the parcel. Electrical service will be provided to the building via underground electrical conduit. Prior to construction the Site general contractor will coordinate with the utility provider to confirm the preliminary design and service connection, if any upgrades to the existing service are required the civil engineer of record will be contacted.

The project proposes cable and telecommunications to be fed underground from telecommunication manhole #1006, located along Main Street (Route 122A). The cable and telecommunications service will tie into the rear of the building in the location of the electrical meter. At this point of design, it is assumed that cable and telecommunications can be fed from the same manhole located along Main Street (State Route 122A). Prior to construction, detailed conduit plans will be designed in accordance with utility providers standards and requirements following approvals from the Town of Holden.

For more information pertaining to the proposed utility layout refer to the Grading, Drainage and Utility Plan (Sheet 2.21) within the Permitting Plan Set, submitted in conjunction with this Report.

#### **SITE LANDSCAPING & LIGHTING**

A comprehensive landscape plan has been provided. The proposed landscaping improvements include a variety of native species containing trees, shrubs, ground cover, and seed mixes. The landscaping plan has been designed to provide vegetative screening surrounding the dumpster enclosure and provide as much shade within the proposed parking areas as possible. The landscape plan has been designed in compliance with Chapter 7.1 Section 8 of the Town of Holden Zoning Bylaws.

The proposed Site lighting plan is comprised of pole-mounted light fixtures, wall-mounted building lights, and canopy lights. The proposed wall-mounted building lights and canopy lights are consistent with prototypical light fixtures for a coffee shop. All fixtures are proposed to be LED and meet “dark sky” principles. The Lighting Plan has been designed to ensure the Site has adequate light levels within parking areas, sidewalks, pedestrian areas, and in the area of the drive-through.

For more information pertaining to the landscape and lighting for the Site refer to the Landscape Plan (Sheet 2.61) and Lighting Plan (Sheet 2.71) within the Permitting Plan Set, submitted in conjunction with this Report.

## **STORMWATER MANAGEMENT & SOIL EROSION CONTROL**

The Stormwater Management & Soil Erosion Control section of this Report has been designed for the proposed commercial redevelopment located on 788 Main Street (Route 122A) in Holden, Massachusetts. This section is intended to be in compliance with the Massachusetts Stormwater Handbook, updated February 2008, and Town of Holden Stormwater Management Rules and Regulations. The project was designed to meet the stormwater management standards and best management practices defined in the Massachusetts Stormwater Handbook, while taking prevailing site conditions and practical considerations into account.

### **METHODOLOGY**

Stormwater runoff analysis, for both existing and proposed conditions, was performed using the software package HydroCAD. This software uses a computer implementation of the SCS / NRCS – TR-55 methodology to compute volumes and rates of runoff. The watershed area, rainfall depths and intensity, curve number, and time of concentration are factors that influence the computed results.

Rainfall depths for the Site were used for calculating the volumes and rates of runoff for this project. The depths were taken from the NOAA Atlas documents (Latitude: 42.3423°, Longitude: -71.8442°) and the rainfall values are listed in Table 5 below.

**Table 5: Rainfall Data**

<b>Return Period (Storm Event)</b>	<b>24-hr Rainfall Depth (inches)</b>
2-Year	3.18
10-Year	4.89
25-Year	5.96
50-Year	6.75
100-Year	7.60

HydroCAD automatically computes the rainfall intensity from its own IDF curves when the rainfall intensity data is provided. This information was taken from the NOAA Atlas documents (Latitude: 42.3423°, Longitude: -71.8442°) and the rainfall values are listed in Table 6 below.

**Table 6: IDF Table**

<b>Intermediate Intensity Values (in/hr)</b>				
<b>Return Period (Storm Event)</b>	<b>5-Minute</b>	<b>15-Minute</b>	<b>30-Minute</b>	<b>60-Minute</b>
2-Year	4.85	2.70	1.82	1.14
10-Year	6.91	3.84	2.60	1.64
25-Year	8.20	4.56	3.08	1.94
50-Year	9.17	5.10	3.45	2.18
100-Year	10.2	5.66	3.83	2.42

SCS / NRCS uses the runoff curve number (CN) method to estimate runoff from storm rainfall. The major factors that determine CN are the watershed's soil and cover conditions, cover type, treatment, and hydrologic condition. The higher percentage of impervious cover within a watershed will result in a higher curve number. A composite curve number was calculated for each analyzed watershed. Refer to Appendix C for the calculations used in determining the existing and proposed curve numbers, for the individual drainage areas.



The time of concentration is the time it takes for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. The time of concentration is calculated by adding the travel times of sheet flow, shallow concentrated flow, and open channel flow, or some combination of these depending on the watershed and its features. Refer to Appendix C for the calculations used in determining the existing and proposed time of concentrations, for the individual drainage areas.

#### STANDARD 1: DISCHARGE PROTECTION

No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The project proposes a single discharge outfall in the rear of the Site. The outfall proposes to discharge **treated** stormwater with appropriate apron protection to avoid erosion at such location. The proposed riprap apron / splash pad has been designed in accordance with the U.S. Department of Transportation Hydraulic Design of Energy Dissipators for Culverts and Channels. For more information refer to the Riprap Apron Calculations provided below:

##### Riprap Apron Calculations

$$D_{50} = 0.2D \left( \frac{Q}{\sqrt{g}D^{2.5}} \right)^{4/3} * \frac{D}{TW}$$

$$D_{50} = \text{Riprap Size (ft)}$$

$$D = \text{Culvert Diameter (ft)}$$

$$Q = \text{Design Discharge} \left( \frac{\text{ft}^3}{\text{s}} \right) (25 - \text{year storm event})$$

$$g = \text{Acceleration due to Gravity} \left( \frac{32.2 \text{ ft}}{\text{s}^2} \right)$$

$$TW = \text{Tailwater Depth (ft), if unknown use } 0.4D$$

Outlet	Culvert Diameter (D)	Design Discharge (Q)	Tailwater Depth (TW)	Riprap Size (D <sub>50</sub> )	Riprap Class	Apron Length (4D)	Apron Depth (3.5D <sub>50</sub> )
#1	1 ft	3.31 cfs	0.4 ft	0.244 ft / 5 inches (min.)	Class 1	4 ft	17.5 inches

#### STANDARD 2: ATTENUATION

Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates.

#### EXISTING CONDITIONS

The Site currently drains away from Main Street (Route 122A) towards the rear of the parcel from south to north. The Site contains minimal stormwater management systems and majority of the Site's stormwater sheet flows off-site. An existing dry-well structure is located within the front parking area that captures a portion of the Site's stormwater runoff. Elevations range within the Site from approximately 716' to 727'.

Approximately 0.77± acres of the Site and surrounding areas were analyzed for stormwater management purposes. The areas analyzed contain the contributing areas directly impacted by the proposed redevelopment. Based on existing drainage patterns, the 0.77-acre area was divided into two (2) contributing drainage areas, labeled Existing Drainage Area 1 (EDA-1) and Existing Drainage Area 2 (EDA-2).

EDA-1 has a contributing drainage area of approximately 0.59 acres. The majority of the runoff from EDA-1 sheet flows north away from the existing building towards the northern property line. A majority of the area is improved with drive aisles and parking areas. EDA-1 contains no existing stormwater infrastructure and for the purposes of the analysis an assumed overland discharge location was chosen. EDA-2 has a contributing drainage area of approximately 0.18 acres. The runoff from EDA-2 is captured by a dry-well structure. The dry-well structure is located southeastern region of the Site. The conditions of the existing structure are currently unknown.

**Table 7: Existing Drainage Areas**

Drainage Area Label	Drainage Area	Curve Number	Time of Concentration
Existing Drainage Area 1 (EDA-1)	0.59 AC	83	6.0 Mins.
Existing Drainage Area 2 (EDA-2)	0.18 AC	93	6.0 Mins.
<b>Total</b>	<b>0.77 AC</b>	<b>-</b>	<b>-</b>

For more information regarding the existing drainage conditions of the Site refer to the Drainage Area Map (DA-1) within Appendix D of this Report.

#### PROPOSED CONDITIONS

The Site, in existing conditions, contains limited stormwater management structures and no stormwater management system. The redevelopment proposes to convey stormwater runoff through a underground infiltration system that will allow runoff to infiltrate and attenuate prior to overflowing to a proposed headwall discharge point in the rear of the site with a riprap splashpad to dissipate anticipated flows. Dissipated runoff from the headwall discharge is proposed to flow off site and mimic existing drainage patterns. Based on the proposed grading of the redevelopment, the 0.77-acre area was divided into two (2) contributing drainage areas labeled Proposed Drainage Area 1 (PDA-1) and Proposed Drainage Area 2 (PDA-2).

PDA-1 has a contributing drainage area of approximately 0.63 acres and was divided into two (2) sub-drainage areas, labeled Proposed Drainage Area 1A (PDA-1A) and Proposed Drainage Area 1B (PDA-1B). PDA-1A has a contributing drainage area of approximately 0.44 acres. The contributing drainage area of PDA-1A is majority of the drive-thru lanes, drive aisles, parking, and grass areas. PDA-1B has a contributing drainage area of approximately 0.19 acres. The contributing drainage area of PDA-1B is the proposed coffee shop roof, a portion of the drive-thru lanes, parking area, and driveway. The runoff will be captured by proposed drainage structures and conveyed to the Site's underground stormwater management system. Mimicking existing conditions, the runoff from PDA-1A and PDA-1B eventually discharge to the northern side of the Site, into the proposed rip-rap splash pad.

PDA-2 has a contributing drainage area of approximately 0.14 acres. The contributing drainage area of PDA-2 is grass areas and a portion of the driveway. The runoff will mimic existing conditions, and will eventually be captured by Main Street (Route 122A) conveyance system.

**Table 8: Proposed Drainage Areas**

Drainage Area Label	Drainage Area	Curve Number	Time of Concentration
Proposed Drainage Area 1 (PDA-1)	0.630 AC	-	-
Proposed Drainage Area 1A (PDA-1A)	0.440 AC	89	6.0 Mins.
Proposed Drainage Area 1B (PDA-1B)	0.190 AC	96	6.0 Mins.
Proposed Drainage Area 2 (PDA-2)	0.14 AC	75	6.0 Mins.
<b>Total</b>	<b>0.770 AC</b>	<b>-</b>	<b>-</b>



For more information regarding the proposed drainage conditions of the Site refer to the Drainage Area Map (DA-1) within Appendix D of this Report.

The project will result in an increase of impervious area, from that of existing conditions, by approximately 2,360± square feet. The proposed stormwater management system will attenuate and infiltrate the stormwater runoff associated with a majority of the outparcel and provide a reduction in peak flow rate compared to existing conditions in the 2-, 10-, 25-, 50- and 100-year storm events. Refer to Table 9 for the peak flow comparison between existing and proposed hydrologic conditions.

**Table 9: Peak Flow Reduction Table**

Peak Flow (cfs)			
Storm Event	Total Drainage Areas		Percent Reduction in Peak Flow
	EDA	PDA	
2-Year	1.56	1.21	22.4%
10-Year	4.22	3.80	10.0%
25-Year	5.42	4.93	9.0%
50-Year	6.31	5.88	6.8%
100-Year	7.26	7.23	0.4%

Refer to Appendix C for more information regarding the drainage areas and hydrologic analysis of the pre- and post-development Site conditions.

The proposed subsurface stormwater management system has been designed to attenuate the peak discharge rates for the 2-, 10-, 25-, 50- and 100-year storm events. The underground stormwater system has been designed as a 3.5-foot concrete chamber system with a total storage volume of 1,598± cubic feet. For more information pertaining to the proposed stormwater system refer to the Grading, and Drainage Plan (Sheet 2.21) within the Permitting Plan Set, submitted in conjunction with this Report.

### **STANDARD 3: RECHARGE**

At a minimum, the annual recharge from post-development site shall be approximate the same as the annual recharge from pre-development conditions based on soil type. This is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

According to soil survey mapping, obtained from the Natural Resource Conservation Service (NRCS), the surface soils on the Site include “Udorthents” and “Walpole Sandy Loam”. Udorthents does not have a specified hydrologic soil rating, but the site is surrounded by soils with Hydrologic Soil Group (HSG) A. Walpole Sandy Loam has Hydrologic Soil Group of B/D.

In July 2023, the Applicant performed a complete environmental assessment of the Site and had five (5) borings performed throughout the Site. The borings observed soil horizons of a top layer of Human Transported Material (HTM), above layers of fine to medium sand, above layers of silty sand and gravel. The borings observed groundwater elevations were consistent throughout the Site between 9’ and 10’ below ground surface (approximate elevation of 714’). For the purposes of analysis, it has been assumed that the underlying soils on-site have a hydrologic rating of “B” with an approximate infiltration rate of 0.52 inches / hour in accordance with the 1982 Rawl’s Rates (loam). In Solli’s professional opinion, the utilized infiltration rate and hydrologic rating is consistent with the soils observed on-site.

The redevelopment Site will provide approximately 21,960± square feet of impervious surfaces. The overall Site redevelopment results in an increase of 2,360± square feet in the overall impervious areas of the Site.

To mitigate the increase in impervious area and manage the stormwater runoff, the redevelopment has been designed with a subsurface infiltration system. The underground stormwater system has been designed as a 3.5-foot concrete chamber system with a total storage volume of 1,598± cubic feet. The system has been designed with an outlet riser that controls the rate of runoff and also provides the site with the required recharge volume of 936± cubic feet.

**Table 10: UG Stormwater System**

Storm Event	Maximum Elevation (ft)	Maximum Storage (cf)	Peak Discharge (cfs)
2-yr	721.62	1,010	0.10
10-yr	722.30	1,300	0.74
25-yr	722.71	1,473	0.96
50-yr	722.86	1,538	1.35
100-yr	722.95	1,577	1.99

As previously mentioned, the underground stormwater management system has a total storage volume of capacity of 1,598± cubic feet and a total recharge volume of 936± cubic feet. The recharge volume is the capacity beneath the outlet allowing the stormwater to recharge back into the ground. See below for the required recharge volume calculations. For more information regarding the subsurface stormwater system refer to the Hydrograph Reporting within Appendix D of this Report.

Total Impervious Area of Redevelopment = 21,960± square feet  
Total Impervious Area Conveyed to Basin = 8,000± square feet

**Required Recharge Volume Calculations**

$$R_v = F * A_{Imp}$$

$$R_v = \text{Required Minimum Recharge Volume (cf)}$$

$$F = \text{Target Depth Factor (in)}$$

$$A_{Imp} = \text{Area of Impervious Surfaces to Stormwater System (sf)}$$

$$233.33 \text{ cf} = \frac{0.35 - \text{inch}}{12"} * 8,000 \text{ sf}$$

**Adjusted Minimum Required Recharge Volume Calculations**

$$R_{va} = R_v * \frac{A_{IA}}{A_{Imp}}$$

$$R_{va} = \text{Adjusted Minimum Recharge Volume (cf)}$$

$$A_{IA} = \text{Total Area of Impervious Surfaces in Redevelopment}$$

$$640.5 \text{ cf} = 233.33 \text{ cf} * \frac{21,960 \text{ sf}}{8,000 \text{ sf}}$$

In accordance with Standard 3 of the Massachusetts Stormwater Handbook the proposed subsurface stormwater system is designed with a recharge volume of 936± cubic feet satisfying the required recharge volume. Based upon the calculations below the proposed system will have a drawdown time of 42.2 hours; 42.2 hours is below the required 72 hours.

#### Drawdown Calculations

$$Time_{Drawdown} = \frac{R_v}{K * A_b}$$

$$Time_{Drawdown} = Drawdown\ Time\ (hours)$$

$$K = Infiltration\ Rate\ \left(\frac{inches}{hour}\right)$$

$$A_b = Area\ of\ Bottom\ of\ System$$

$$42.2\ hours = \frac{936\ cf}{0.52\ \left(\frac{in}{hr}\right) * \frac{1'}{12''} * 512\ sf}$$

$$42.2\ hours < 72\ hours$$

#### STANDARD 4: WATER QUALITY

The proposed development has been designed with stormwater treatment that incorporates structural best-management practices designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

In accordance with the MassDEP Stormwater Handbook the stormwater infiltration system is required to provide a water quality treatment volume (WQV) greater than 907± cubic feet (refer to calculation below). The stormwater infiltration system proposes a recharge volume of 936± cubic feet, exceeding the required WQV.

#### Water Quality Treatment Volume

$$V_{WQ} = \frac{0.5 - inch}{12\ \frac{inches}{foot}} * \left(A_{IMP} * 43,560\ \frac{sf}{acre}\right)$$

$$V_{WQ} = Required\ Water\ Quality\ Volume\ (cubic\ feet)$$

$$D_{WQ} = Water\ Quality\ Depth\ (0.5 - inch)$$

$$A_{IMP} = Impervious\ Area\ (in\ acres)$$

$$907 \pm cf = \frac{0.5 - inch}{12\ \frac{inches}{foot}} * \left(0.50 * 43,560\ \frac{sf}{acre}\right)$$

In an effort to improve the quality of stormwater discharge associated with the proposed parking area and driveways, the project has been designed with catch basins with 4-foot-deep sumps and hooded outlets, and a Contech hydrodynamic separator upgradient of the stormwater management system, as well as a Contech hydrodynamic separator to the north of the drive-thru lane to collect and treat the stormwater runoff not getting routed through the underground infiltration system. A hydrodynamic separator uses swirl concentration and continuous deflective separation to screen, separate and trap trash, debris, sediment, oil, and grease from stormwater runoff. The hydrodynamic separator will capture and retain 100% of floatables; effectively removing sediment. The hydrodynamic separator has been sized based on the 1" water quality volume. For more information regarding the TSS removal calculations refer to Appendix C, Drainage Calculations, TSS Removal Calculations.

All proposed stormwater best management practices will require maintenance throughout the lifetime of the measure. Solli has included as part of this Report, in Appendix E, a Long-Term Operations and Maintenance Plan as required by the Massachusetts Stormwater Handbook and Stormwater Standards.

#### **STANDARD 5: POLLUTION PREVENTION**

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to maximum extent practical.

The proposed redevelopment is a coffee shop. This use is not considered a higher potential pollutant load use, such as auto fueling facility, exterior fleet storage areas, exterior vehicle service and equipment cleaning areas, marinas and boatyards, parking lots with high-intensity-use, confined disposal facilities, and disposal sites. The proposed use does not contain higher potential pollutant loads included in industrial facilities such as manufacturing, landfills, recycling facilities, steam electric plants, transportation facilities, treatment works, and light industrial activities.

#### **STANDARD 6: ZONE II / WELLHEAD PROTECTION AREA**

Stormwater discharge within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area required the use of specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

According to the State of Massachusetts' online GIS mapping, the Site is **NOT** located within the Zone I, Zone II or Interim Wellhead Protection area of a public water supply watershed. For more information, refer to Appendix A, Figure 5 – Wellhead Protection Map.

#### **STANDARD 7: REDEVELOPMENT PROJECT**

A redevelopment project is required to meet the following Stormwater Management Standards only to maximum extent practical: Standard 2, Standard 3, Standard 4, Standard 5, and Standard 6.

The redevelopment of the Site proposes an increase in impervious area compared to existing conditions of the Site. This project does not qualify as a "Redevelopment Project" and has been designed to meet Standard 2, Standard 3, Standard 4, Standard 5, and Standard 6.

#### **STANDARD 8: SOIL EROSION & SEDIMENT CONTROL**

A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant source during construction and land disturbance activities shall be developed and implemented.

The proposed plans for soil erosion and sediment control prepared for this project have been developed in accordance with the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, prepared by the Department of Environmental Protection, Bureau of Resource Protection.

The soil erosion and sediment control practices that will be implemented during the construction of this project include geotextile silt fences, straw bales, straw wattles, a construction entrance, dust control measures, and inlet protection for drainage inlets.

**STANDARD 9: LONG-TERM OPERATION & MAINTENANCE PLAN**

A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

An Operation & Maintenance Plan was prepared for this project and can be found in Appendix E of this Report.

**STANDARD 10: ILLICIT DISCHARGES**

All illicit discharges to the stormwater management system are prohibited.

Based upon record research, mapping and site walks performed by both the surveyor of record (Northeast Survey Consultants) and Solli, this site has no observed illicit discharges. The proposed redevelopment will **NOT** produce illicit discharges, such as wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. Refer to Appendix B, Supporting Documents, Illicit Discharge Statement for more information.

## **APPENDICES**

Appendix A – Figures

Appendix B – Supporting Documents

Appendix C – Stormwater Calculations

Appendix D – Detailed Design Plans

Appendix E – Long-Term Operation & Maintenance

### **Appendix A – Figures**

Figure 1 – Site Location Map

Figure 2 – Soil Survey Map

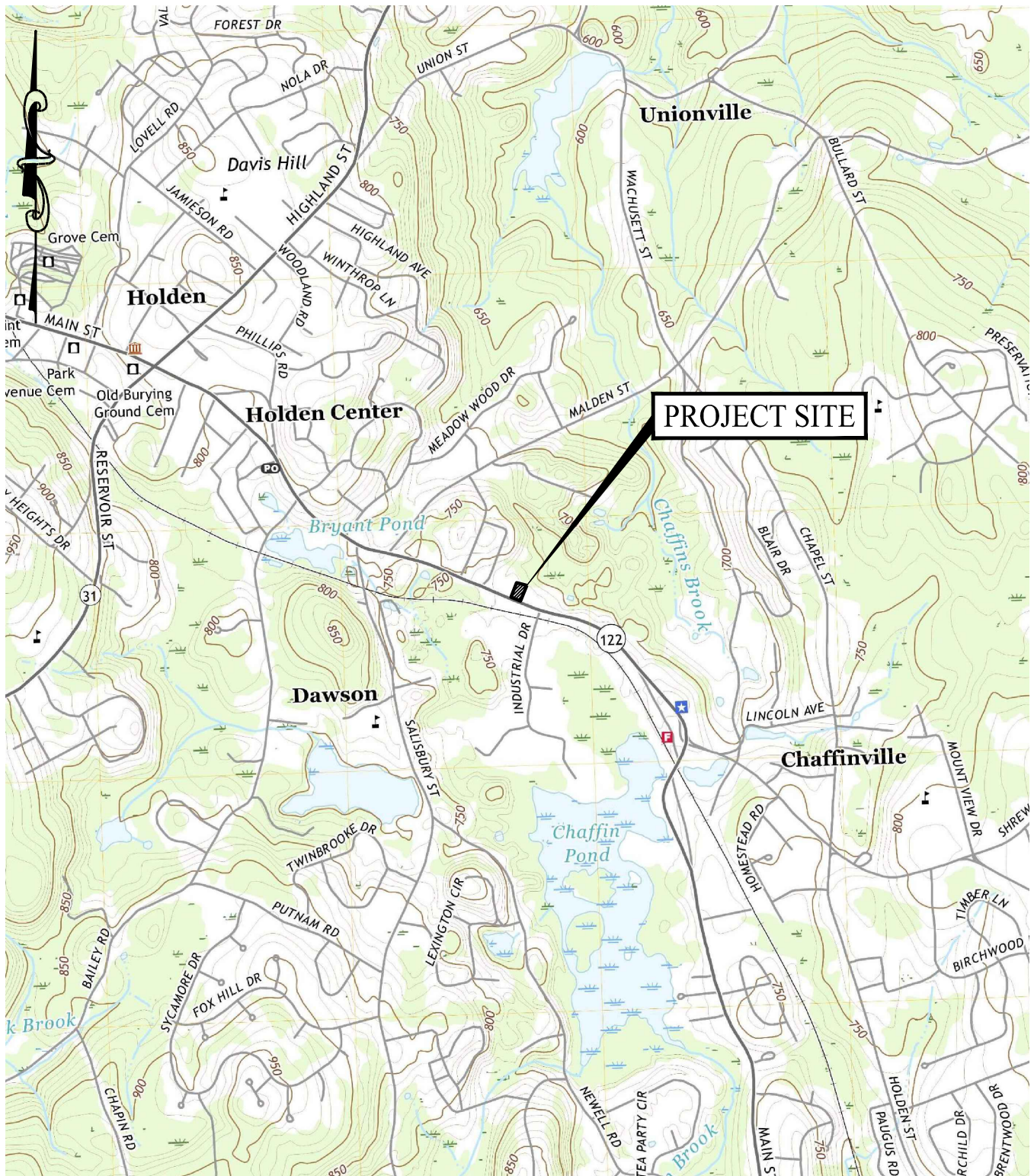
Figure 3 – FEMA Flood Map

Figure 4 – Surface Water Protection Map

Figure 5 – Wellhead Protection Map

Figure 6 – Surface Water Protection Map





NOTE: BASE MAP INFORMATION TAKEN FROM  
[MAPS.MASSGIS.DIGITAL.MASS.GOV/MASSMAPPER](https://maps.massgis.digital.mass.gov/massmapper)



11 Vanderbilt Ave, Norwood, MA 02062  
 T: (781) 352-8491 | F: (203) 880-9695

## SITE LOCATION MAP

788 MAIN STREET  
 HOLDEN, MASSACHUSETTS

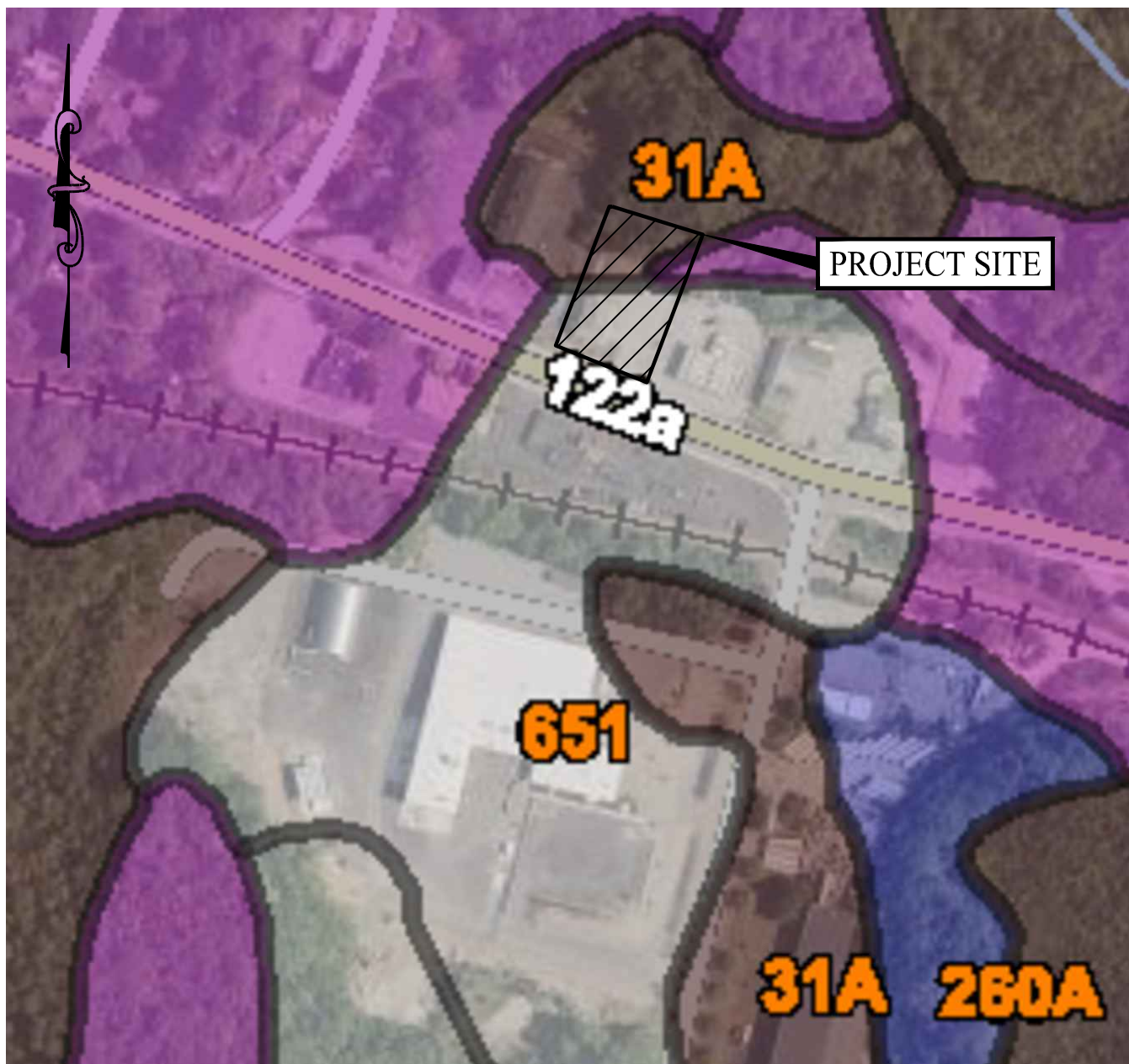
Project #: 23204001

Plan Date: 10/06/2023

Scale: 1" = 2,000'

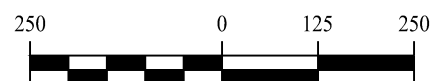
Figure: 1





Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
31A	Walpole sandy loam, 0 to 3 percent slopes	B/D	14.3	4.2%
245C	Hinckley loamy sand, 8 to 15 percent slopes	A	79.8	23.6%
651	Udorthents, smoothed		23.8	7.1%

NOTE: BASE MAP RESOURCES TAKEN FROM THE  
NATURAL RESOURCES CONSERVATION SERVICE, URL:  
<https://websoilsurvey.sc.egov.usda.gov>



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## SOIL SURVEY MAP

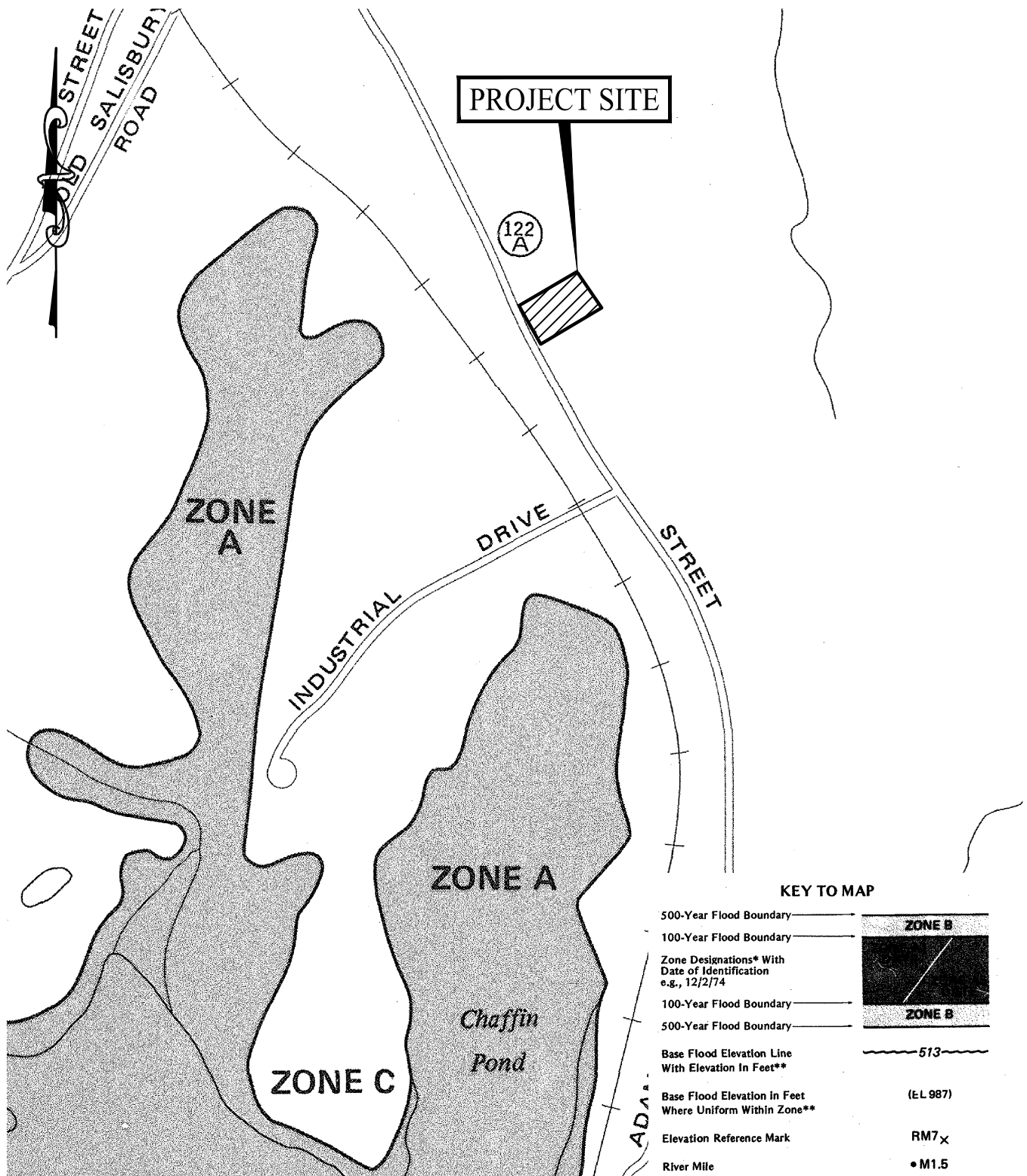
788 MAIN STREET  
HOLDEN, MASSACHUSETTS

Project #: 23204001

Plan Date: 10/06/2023

Scale: 1" = 250'

Figure: 2



NOTE: BASE MAP INFORMATION TAKEN FROM  
FEMA FLOOD INSURANCE RATE MAP, MAP  
NUMBER 2503090015B, EFFECTIVE 07/02/1981.



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## FEMA FLOOD MAP

788 MAIN STREET  
HOLDEN, MASSACHUSETTS

Project #: 23204001  
Plan Date: 10/06/2023  
Scale: 1" = 500'  
Figure: 3





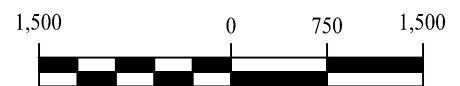
## NHESP Estimated Habitats of Rare Wildlife



## NHESP Priority Habitats of Rare Species



NOTE: BASE MAP INFORMATION TAKEN FROM THE 14TH EDITION  
NATURAL HERITAGE ATLAS, URL:  
[MAPS.MASSGIS.DIGITAL.MASS.GOV/MASSMAPPER](https://maps.massgis.digital.mass.gov/massmapper)



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## ENDANGERED AND RARE SPECIES MAP

788 MAIN STREET  
HOLDEN, MASSACHUSETTS

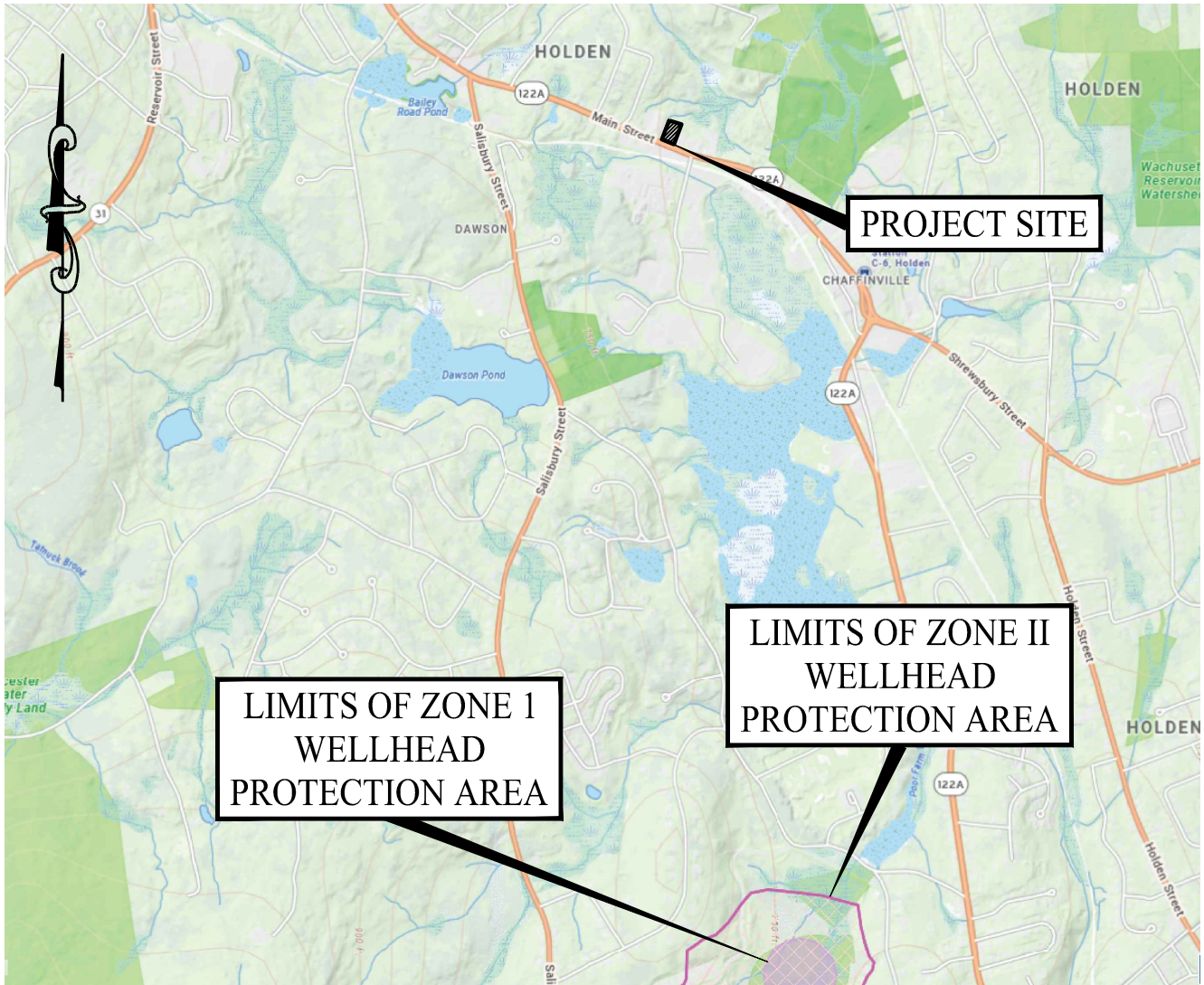
Project #: 23204001

Plan Date: 10/06/2023

Scale: 1" = 1,500'

Figure: 4





Zone IIs Dissolved



Zone IIs



Zone Is Dissolved



Zone Is



NOTE: BASE MAP INFORMATION TAKEN FROM  
[MAPS.MASSGIS.DIGITAL.MASS.GOV/MASSMAPPER](https://maps.massgis.digital.mass.gov/massmapper)



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## WELLHEAD PROTECTION MAP

788 MAIN STREET  
 HOLDEN, MASSACHUSETTS

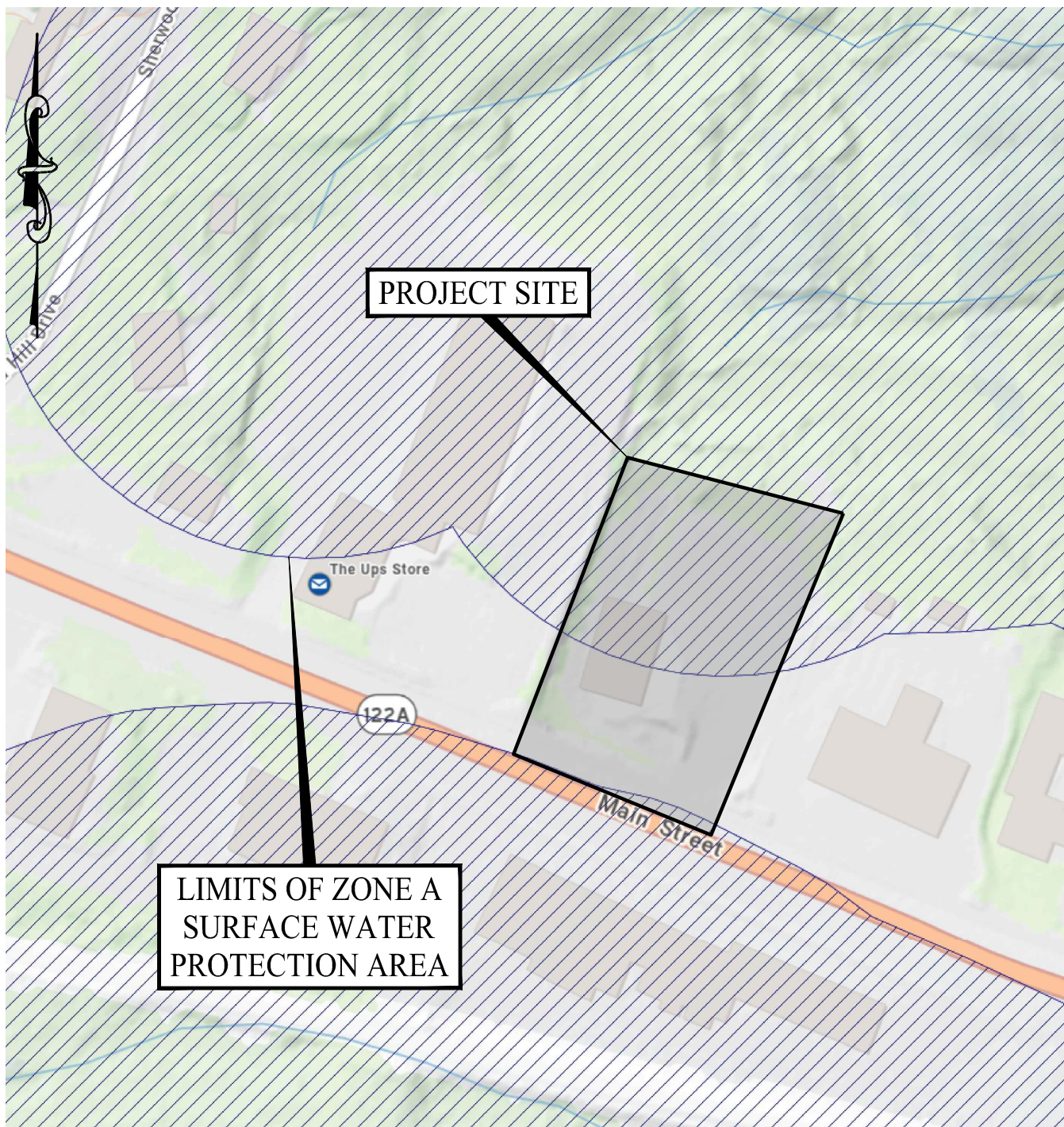
Project #: 23204001

Plan Date: 10/06/2023

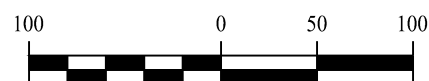
Scale: 1" = 2,000'

Figure: 5





NOTE: BASE MAP INFORMATION TAKEN FROM  
[MAPS.MASSGIS.DIGITAL.MASS.GOV/MASSMAPPER](https://maps.massgis.digital.mass.gov/massmapper)



11 Vanderbilt Ave, Norwood, MA 02062  
 T: (781) 352-8491 | F: (203) 880-9695

## SURFACE WATER PROTECTION MAP

788 MAIN STREET  
 HOLDEN, MASSACHUSETTS

Project #: 23204001

Plan Date: 10/06/2023

Scale: 1" = 100'

Figure: 6

## **Appendix B – Supporting Documents**

Property Record Card

Boring Logs & Plan

Illicit Discharge Statement

788 MAIN ST

Location	788 MAIN ST	Mblu	175/ 35/ / /
Acct#	10543	Owner	LEINONEN REALTY INC
Assessment	\$346,900	Appraisal	\$346,900
PID	3949	Building Count	1

Current Value

Appraisal			
Valuation Year	Improvements	Land	Total
2023	\$235,500	\$111,400	\$346,900
Assessment			
Valuation Year	Improvements	Land	Total
2023	\$235,500	\$111,400	\$346,900

Owner of Record

Owner	LEINONEN REALTY INC	Sale Price	\$162,500
Co-Owner		Certificate	
Address	54R JONES RD	Book & Page	16370/0174
	SPENCER, MA 01562	Sale Date	06/17/1994

Ownership History

Ownership History				
Owner	Sale Price	Certificate	Book & Page	Sale Date
LEINONEN REALTY INC	\$162,500		16370/0174	06/17/1994

Building Information

Building 1 : Section 1	
Year Built:	1880
Living Area:	4,908
Replacement Cost:	\$452,811
Building Percent Good:	50
Replacement Cost	
Less Depreciation:	\$226,400
Building Attributes	
Field	Description
Style:	Commercial

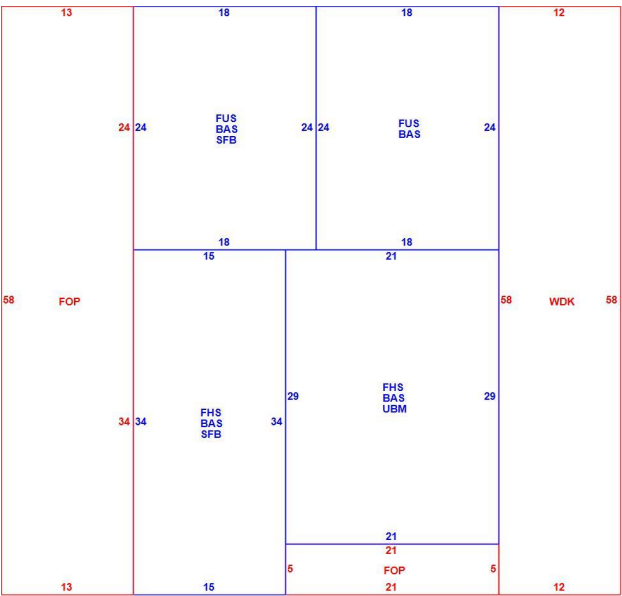
Model	Commercial
Grade	Average
Stories:	1
Occupancy	6.00
Exterior Wall 1	Clapboard
Exterior Wall 2	
Roof Structure	Gable/Hip
Roof Cover	Asph/F Gls/Cmp
Interior Wall 1	Plastered
Interior Wall 2	Plywood Panel
Interior Floor 1	Pine/Soft Wood
Interior Floor 2	Carpet
Heating Fuel	Gas
Heating Type	Hot Air-no Duc
AC Type	None
Struct Class	
Bldg Use	STORE/SHOP MDL-94
Total Rooms	
Total Bedrms	00
Total Baths	0
Condo Heat Type	
1st Floor Use:	3220
Heat/AC	NONE
Frame Type	WOOD FRAME
Baths/Plumbing	AVERAGE
Ceiling/Wall	CEIL & WALLS
Rooms/Prtns	ABOVE AVERAGE
Wall Height	7.00
% Comn Wall	0.00

### Building Photo



(https://images.vgsi.com/photos2/HoldenMAPPhotos//0021\788%20main%20

### Building Layout



(ParcelSketch.ashx?pid=3949&bid=3949)

Building Sub-Areas (sq ft)			Legend
Code	Description	Gross Area	Living Area
BAS	First Floor	1,983	1,983
FHS	Half Story, Finished	1,119	1,119
SFB	Base, Semi-Finished	942	942
FUS	Upper Story, Finished	864	864
FOP	Porch, Open, Finished	859	0
UBM	Basement, Unfinished	609	0
WDK	Deck, Wood	696	0
		7,072	4,908

### Extra Features

Extra Features	Legend
----------------	--------



## Land

## Land Use

**Use Code** 3220  
**Description** STORE/SHOP MDL-94  
**Zone** C  
**Neighborhood** L  
**Alt Land Appr** No  
**Category**

## Land Line Valuation

**Size (Acres)** 0.77  
**Frontage** 0  
**Depth** 0  
**Assessed Value** \$111,400  
**Appraised Value** \$111,400

## Outbuildings

Outbuildings						<u>Legend</u>
Code	Description	Sub Code	Sub Description	Size	Value	Bldg #
SGN2	DOUBLE SIDED			24.00 S.F.&HGT	\$400	1
SGN3	W/INT LIGHTS			16.00 S.F.&HGT	\$600	1
SHD2	W/LIGHTS ETC			96.00 S.F.	\$700	1
GRN3	COMM PLASTIC			1260.00 S.F.	\$3,200	1
SGN1	SIGN-1 SD W/M			48.00 S.F.&HGT	\$500	1
PAV1	PAVING-ASPHALT			4000.00 S.F.	\$3,000	1
FN2	FENCE-5' CHAIN			40.00 L.F.	\$100	1
FN1	FENCE-4' CHAIN			200.00 L.F.	\$600	1

## Valuation History

Appraisal			
Valuation Year	Improvements	Land	Total
2023	\$235,500	\$111,400	\$346,900
2022	\$221,800	\$106,200	\$328,000
2021	\$217,200	\$106,200	\$323,400

Assessment			
Valuation Year	Improvements	Land	Total
2023	\$235,500	\$111,400	\$346,900
2022	\$221,800	\$106,200	\$328,000
2021	\$217,200	\$106,200	\$323,400

SB-1  
MW-1

**Boring Identification**

Boring Identification  
Date: 7/5 Time: 1201

Sheet \_\_\_\_\_ of \_\_\_\_\_

Client: Inspector:

Client: Inspector:  
Project/Location: Holden

Weather:

Weather: \_\_\_\_\_  
Soil Sampling Method: Direct Push, AMS Power Probe 9120-SK  
\_\_\_\_\_ Geoprobe Macro Core

Soil Sampling Method: Direct  
Sampler Type: Geoprobe Macro Core

[illegible]

# Soil Boring Log

[illegible]



# Soil Boring Log

[illegible]

# Soil Boring Log

**Environmental Risk Advisors, LLC**  
P.O. Box 743  
Wilbraham, MA

**Boring Identification** 38-21  
Date: 7/5 Time: 1409  
Sheet \_\_\_\_ of \_\_\_\_  
Client: Inspector:  
Project/Location: Holden

Weather:

Soil Sampling Method: Direct Push, AMS Power Probe 9120-SK

Sampler Type: Geoprobe Macro Core

[illegible]



## Soil Boring Log

[illegible]



P.O. Box 743  
Wilbraham, MA 01095

Date	29/7/23
Author	MGT
Client	

Title	Site Plan
Project	788 Main St, Holden MA
Address	788 Main St, Holden MA

Latitude	42.342328
Longitude	-71.844033
Project ID	Scale





## ILLICIT DISCHARGE STATEMENT

**Project:**       **Proposed Coffee Shop Redevelopment**  
                      **788 Main Street (Route 122A), Holden, Massachusetts**  
                      **Project No.: 23204001**

**Date:**           **October 6, 2023**

This statement is provided in accordance with the provisions of the Massachusetts Stormwater Management Standard 10 and of the Massachusetts Stormwater Management handbook.

- All existing and proposed stormwater management systems contain no connection to the site's wastewater sewer system or to any other non-stormwater collection system.
- Existing groundwater collection systems on the site are not connected to the site's wastewater sewer system or to any other non-stormwater collection system.
- The facility's Operation & Maintenance Plan is designed to prevent any discharge of non-stormwater to the drainage system.
- No known existing illicit discharges are on-site, any and all illicit discharge identified during or after construction will be immediately disconnected.
- The proposed modifications and redevelopment will **NOT** produce illicit discharges, such as wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease.

**Solli Engineering, LLC**

A handwritten signature in black ink, appearing to read 'KS Solli'.

Kevin Solli, PE, PTOE, CPESC, CDP, LEED AP BD+C  
Founder / Principal



## **Appendix C – Stormwater Calculations**

Hydrology Calculations (2-, 10-, 25-, 50-, 100-year storm events)

NOAA Atlas Precipitation Data

Watershed Model Schematic

HydroCAD Reporting – Existing Conditions

HydroCAD Reporting – Proposed Conditions

Hydraulic Calculations (25-year storm event)

Storm Sewer Model Schematic & Reporting

Hydraulic Profiles

Best Management Practices

Water Quality Volume Calculation Worksheet

TSS Calculation Worksheets

MassDEP treatment Train Worksheets



**NOAA Atlas 14, Volume 10, Version 3**  
**Location name: Holden, Massachusetts, USA\***  
**Latitude: 42.3423°, Longitude: -71.8442°**  
**Elevation: 724 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



## POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

### PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.347 (0.274-0.431)	0.404 (0.319-0.503)	0.498 (0.392-0.623)	0.576 (0.451-0.724)	0.683 (0.516-0.897)	0.764 (0.564-1.02)	0.848 (0.605-1.18)	0.939 (0.635-1.34)	1.06 (0.691-1.58)	1.16 (0.737-1.77)
10-min	0.491 (0.389-0.611)	0.573 (0.452-0.713)	0.706 (0.555-0.882)	0.816 (0.638-1.03)	0.968 (0.730-1.27)	1.08 (0.799-1.45)	1.20 (0.857-1.67)	1.33 (0.900-1.91)	1.51 (0.980-2.24)	1.65 (1.04-2.51)
15-min	0.578 (0.457-0.719)	0.674 (0.532-0.839)	0.831 (0.654-1.04)	0.960 (0.751-1.21)	1.14 (0.859-1.49)	1.27 (0.940-1.71)	1.41 (1.01-1.97)	1.56 (1.06-2.24)	1.78 (1.15-2.64)	1.94 (1.23-2.95)
30-min	0.778 (0.615-0.968)	0.908 (0.718-1.13)	1.12 (0.883-1.40)	1.30 (1.02-1.63)	1.54 (1.16-2.02)	1.73 (1.27-2.32)	1.92 (1.36-2.66)	2.12 (1.44-3.04)	2.40 (1.56-3.58)	2.63 (1.66-4.00)
60-min	0.978 (0.774-1.22)	1.14 (0.903-1.42)	1.41 (1.11-1.77)	1.64 (1.28-2.06)	1.94 (1.47-2.55)	2.18 (1.61-2.92)	2.42 (1.72-3.36)	2.68 (1.81-3.84)	3.03 (1.97-4.51)	3.32 (2.10-5.04)
2-hr	1.23 (0.980-1.52)	1.45 (1.16-1.80)	1.82 (1.44-2.26)	2.12 (1.67-2.65)	2.54 (1.94-3.33)	2.85 (2.13-3.83)	3.19 (2.30-4.45)	3.57 (2.43-5.10)	4.14 (2.70-6.13)	4.62 (2.94-6.99)
3-hr	1.40 (1.12-1.73)	1.67 (1.34-2.06)	2.11 (1.68-2.60)	2.47 (1.96-3.07)	2.97 (2.27-3.88)	3.34 (2.50-4.47)	3.74 (2.72-5.22)	4.22 (2.87-5.99)	4.94 (3.22-7.28)	5.55 (3.53-8.35)
6-hr	1.76 (1.42-2.16)	2.12 (1.71-2.59)	2.70 (2.17-3.32)	3.19 (2.54-3.93)	3.85 (2.97-5.00)	4.34 (3.28-5.79)	4.88 (3.58-6.79)	5.53 (3.78-7.80)	6.52 (4.27-9.55)	7.37 (4.70-11.0)
12-hr	2.20 (1.78-2.66)	2.66 (2.16-3.23)	3.42 (2.76-4.16)	4.04 (3.25-4.96)	4.91 (3.81-6.33)	5.55 (4.21-7.34)	6.24 (4.60-8.62)	7.08 (4.86-9.92)	8.34 (5.48-12.1)	9.43 (6.03-14.0)
24-hr	2.61 (2.14-3.14)	3.18 (2.60-3.83)	4.12 (3.35-4.98)	4.89 (3.96-5.95)	5.96 (4.65-7.63)	6.75 (5.15-8.86)	7.60 (5.63-10.4)	8.63 (5.95-12.0)	10.2 (6.72-14.7)	11.5 (7.40-17.0)
2-day	2.96 (2.44-3.53)	3.63 (2.99-4.34)	4.72 (3.87-5.66)	5.62 (4.58-6.79)	6.87 (5.40-8.74)	7.79 (5.99-10.2)	8.79 (6.55-12.0)	10.0 (6.92-13.8)	11.9 (7.87-17.1)	13.5 (8.70-19.8)
3-day	3.22 (2.66-3.82)	3.94 (3.26-4.68)	5.11 (4.21-6.10)	6.09 (4.98-7.32)	7.43 (5.87-9.42)	8.42 (6.50-11.0)	9.50 (7.12-12.9)	10.8 (7.51-14.9)	12.9 (8.54-18.4)	14.7 (9.45-21.4)
4-day	3.45 (2.87-4.09)	4.21 (3.49-4.99)	5.44 (4.50-6.48)	6.47 (5.31-7.75)	7.88 (6.24-9.96)	8.92 (6.91-11.6)	10.1 (7.54-13.6)	11.5 (7.96-15.7)	13.6 (9.02-19.4)	15.5 (9.98-22.5)
7-day	4.12 (3.45-4.85)	4.94 (4.13-5.83)	6.29 (5.23-7.44)	7.40 (6.12-8.82)	8.94 (7.11-11.2)	10.1 (7.83-13.0)	11.3 (8.50-15.2)	12.8 (8.92-17.5)	15.0 (10.0-21.3)	17.0 (11.0-24.6)
10-day	4.78 (4.02-5.61)	5.64 (4.74-6.63)	7.05 (5.89-8.31)	8.21 (6.81-9.74)	9.81 (7.83-12.2)	11.0 (8.56-14.1)	12.3 (9.22-16.4)	13.8 (9.65-18.7)	16.0 (10.7-22.6)	17.9 (11.6-25.8)
20-day	6.84 (5.79-7.96)	7.75 (6.56-9.03)	9.24 (7.78-10.8)	10.5 (8.75-12.3)	12.2 (9.75-14.9)	13.5 (10.5-16.9)	14.8 (11.0-19.3)	16.2 (11.4-21.8)	18.1 (12.2-25.4)	19.7 (12.8-28.2)
30-day	8.57 (7.29-9.93)	9.51 (8.08-11.0)	11.0 (9.34-12.9)	12.3 (10.3-14.4)	14.1 (11.3-17.1)	15.4 (12.0-19.2)	16.8 (12.5-21.6)	18.1 (12.8-24.2)	19.8 (13.3-27.6)	21.1 (13.7-30.0)
45-day	10.7 (9.17-12.4)	11.7 (9.99-13.5)	13.3 (11.3-15.4)	14.6 (12.3-17.0)	16.4 (13.2-19.9)	17.9 (14.0-22.0)	19.2 (14.3-24.4)	20.5 (14.5-27.2)	22.0 (14.8-30.4)	23.0 (15.0-32.6)
60-day	12.5 (10.8-14.4)	13.5 (11.6-15.6)	15.2 (13.0-17.5)	16.5 (14.0-19.2)	18.4 (14.9-22.2)	19.9 (15.6-24.5)	21.3 (15.9-26.9)	22.5 (16.0-29.9)	23.9 (16.2-33.0)	24.7 (16.3-35.0)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

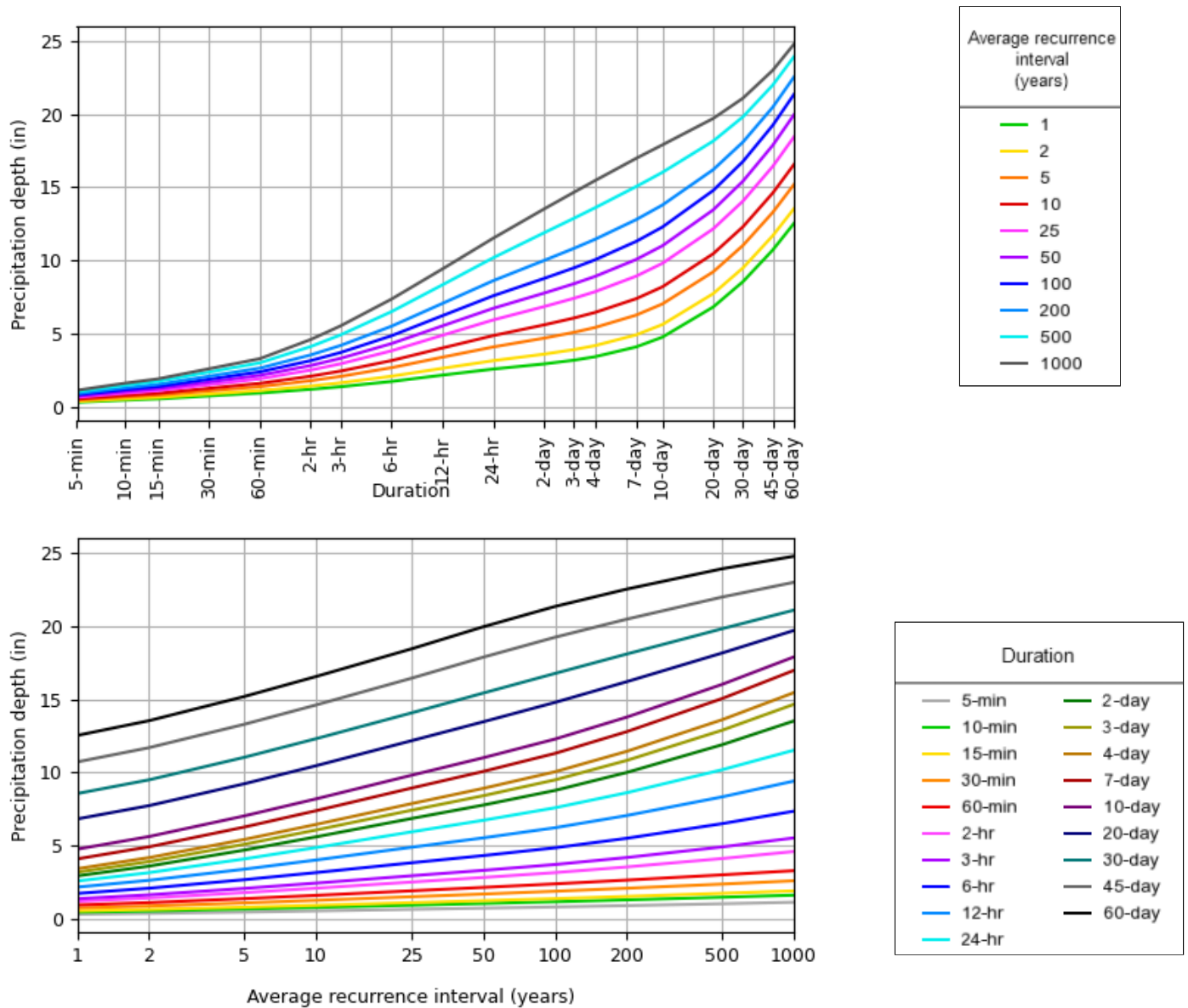
Please refer to NOAA Atlas 14 document for more information.

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### PF graphical

## PDS-based depth-duration-frequency (DDF) curves

Latitude: 42.3423°, Longitude: -71.8442°



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Wed Sep 13 15:48:10 2023

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**NOAA Atlas 14, Volume 10, Version 3**  
**Location name: Holden, Massachusetts, USA\***  
**Latitude: 42.3423°, Longitude: -71.8442°**  
**Elevation: 724 ft\*\***

\* source: ESRI Maps  
 \*\* source: USGS



**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

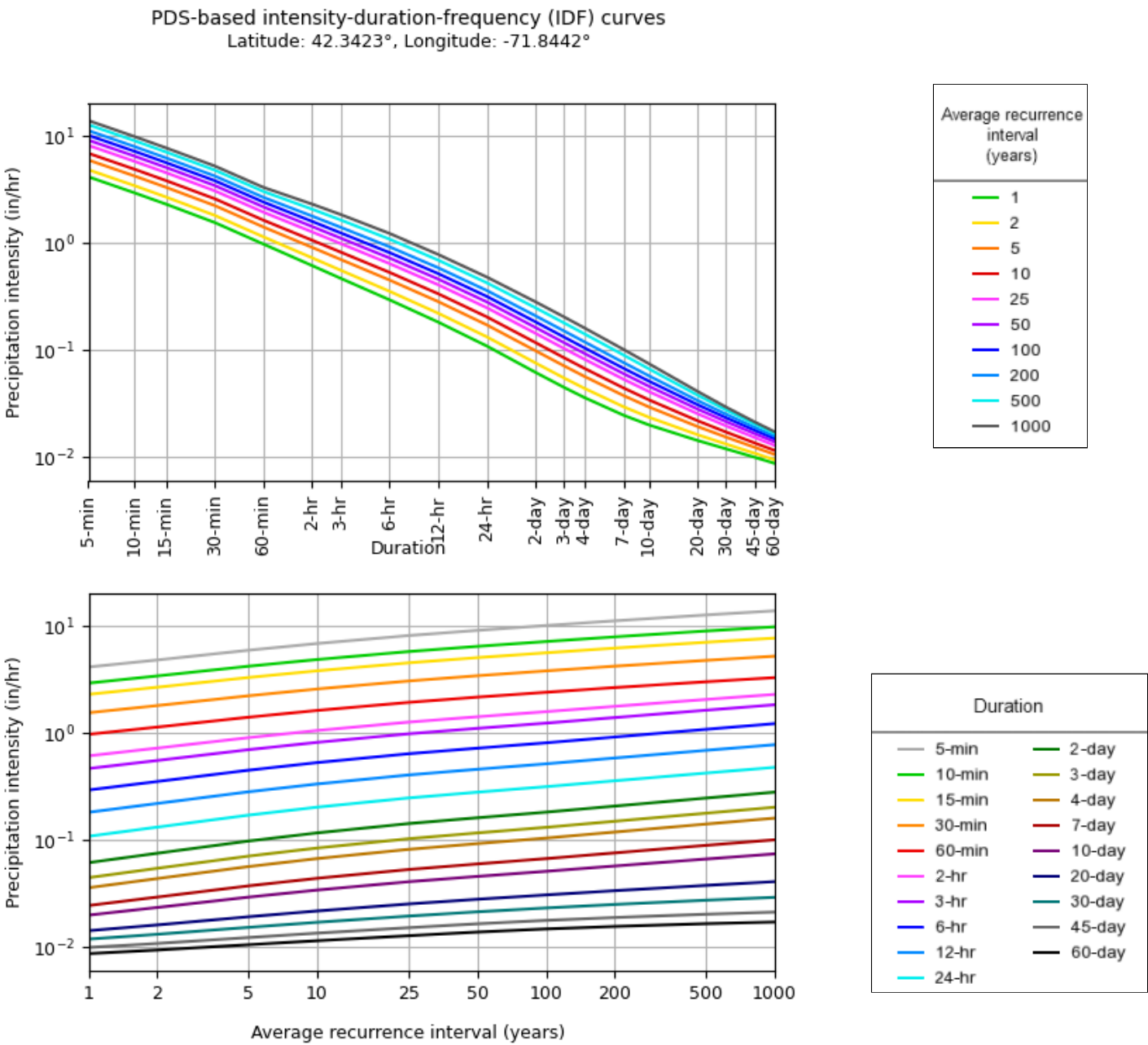
**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)<sup>1</sup></b>										
<b>Duration</b>	<b>Average recurrence interval (years)</b>									
	<b>1</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>1000</b>
<b>5-min</b>	<b>4.16</b> (3.29-5.17)	<b>4.85</b> (3.83-6.04)	<b>5.98</b> (4.70-7.48)	<b>6.91</b> (5.41-8.69)	<b>8.20</b> (6.19-10.8)	<b>9.17</b> (6.77-12.3)	<b>10.2</b> (7.26-14.2)	<b>11.3</b> (7.62-16.1)	<b>12.8</b> (8.29-19.0)	<b>14.0</b> (8.84-21.3)
<b>10-min</b>	<b>2.95</b> (2.33-3.67)	<b>3.44</b> (2.71-4.28)	<b>4.24</b> (3.33-5.29)	<b>4.90</b> (3.83-6.16)	<b>5.81</b> (4.38-7.62)	<b>6.50</b> (4.79-8.72)	<b>7.21</b> (5.14-10.0)	<b>7.98</b> (5.40-11.4)	<b>9.05</b> (5.88-13.5)	<b>9.90</b> (6.27-15.1)
<b>15-min</b>	<b>2.31</b> (1.83-2.88)	<b>2.70</b> (2.13-3.36)	<b>3.32</b> (2.62-4.16)	<b>3.84</b> (3.00-4.83)	<b>4.56</b> (3.44-5.98)	<b>5.10</b> (3.76-6.84)	<b>5.66</b> (4.03-7.87)	<b>6.26</b> (4.24-8.97)	<b>7.10</b> (4.61-10.6)	<b>7.77</b> (4.92-11.8)
<b>30-min</b>	<b>1.56</b> (1.23-1.94)	<b>1.82</b> (1.44-2.26)	<b>2.24</b> (1.77-2.80)	<b>2.60</b> (2.03-3.26)	<b>3.08</b> (2.33-4.05)	<b>3.45</b> (2.55-4.63)	<b>3.83</b> (2.73-5.33)	<b>4.24</b> (2.87-6.08)	<b>4.81</b> (3.12-7.15)	<b>5.26</b> (3.33-8.00)
<b>60-min</b>	<b>0.978</b> (0.774-1.22)	<b>1.14</b> (0.903-1.42)	<b>1.41</b> (1.11-1.77)	<b>1.64</b> (1.28-2.06)	<b>1.94</b> (1.47-2.55)	<b>2.18</b> (1.61-2.92)	<b>2.42</b> (1.72-3.36)	<b>2.68</b> (1.81-3.84)	<b>3.03</b> (1.97-4.51)	<b>3.32</b> (2.10-5.04)
<b>2-hr</b>	<b>0.615</b> (0.490-0.759)	<b>0.727</b> (0.578-0.899)	<b>0.910</b> (0.721-1.13)	<b>1.06</b> (0.836-1.32)	<b>1.27</b> (0.968-1.66)	<b>1.43</b> (1.06-1.91)	<b>1.59</b> (1.15-2.22)	<b>1.79</b> (1.21-2.55)	<b>2.07</b> (1.35-3.07)	<b>2.31</b> (1.47-3.49)
<b>3-hr</b>	<b>0.467</b> (0.374-0.575)	<b>0.556</b> (0.445-0.685)	<b>0.702</b> (0.559-0.867)	<b>0.822</b> (0.651-1.02)	<b>0.988</b> (0.756-1.29)	<b>1.11</b> (0.832-1.49)	<b>1.24</b> (0.905-1.74)	<b>1.40</b> (0.954-1.99)	<b>1.64</b> (1.07-2.42)	<b>1.85</b> (1.18-2.78)
<b>6-hr</b>	<b>0.294</b> (0.237-0.359)	<b>0.354</b> (0.285-0.432)	<b>0.451</b> (0.362-0.553)	<b>0.532</b> (0.424-0.656)	<b>0.643</b> (0.495-0.835)	<b>0.725</b> (0.547-0.966)	<b>0.814</b> (0.597-1.13)	<b>0.922</b> (0.630-1.30)	<b>1.09</b> (0.712-1.59)	<b>1.23</b> (0.785-1.84)
<b>12-hr</b>	<b>0.182</b> (0.148-0.220)	<b>0.220</b> (0.179-0.267)	<b>0.283</b> (0.229-0.345)	<b>0.335</b> (0.269-0.411)	<b>0.407</b> (0.316-0.525)	<b>0.460</b> (0.349-0.609)	<b>0.518</b> (0.381-0.715)	<b>0.587</b> (0.403-0.823)	<b>0.692</b> (0.454-1.01)	<b>0.782</b> (0.500-1.16)
<b>24-hr</b>	<b>0.108</b> (0.089-0.130)	<b>0.132</b> (0.108-0.159)	<b>0.171</b> (0.139-0.207)	<b>0.203</b> (0.164-0.247)	<b>0.248</b> (0.193-0.317)	<b>0.281</b> (0.214-0.369)	<b>0.316</b> (0.234-0.434)	<b>0.359</b> (0.247-0.500)	<b>0.424</b> (0.279-0.613)	<b>0.480</b> (0.308-0.708)
<b>2-day</b>	<b>0.061</b> (0.050-0.073)	<b>0.075</b> (0.062-0.090)	<b>0.098</b> (0.080-0.117)	<b>0.117</b> (0.095-0.141)	<b>0.143</b> (0.112-0.182)	<b>0.162</b> (0.124-0.211)	<b>0.183</b> (0.136-0.250)	<b>0.208</b> (0.144-0.288)	<b>0.247</b> (0.163-0.355)	<b>0.281</b> (0.181-0.412)
<b>3-day</b>	<b>0.044</b> (0.037-0.053)	<b>0.054</b> (0.045-0.065)	<b>0.071</b> (0.058-0.084)	<b>0.084</b> (0.069-0.101)	<b>0.103</b> (0.081-0.130)	<b>0.116</b> (0.090-0.152)	<b>0.131</b> (0.098-0.179)	<b>0.150</b> (0.104-0.207)	<b>0.178</b> (0.118-0.255)	<b>0.203</b> (0.131-0.297)
<b>4-day</b>	<b>0.035</b> (0.029-0.042)	<b>0.043</b> (0.036-0.051)	<b>0.056</b> (0.046-0.067)	<b>0.067</b> (0.055-0.080)	<b>0.082</b> (0.065-0.103)	<b>0.092</b> (0.071-0.120)	<b>0.104</b> (0.078-0.142)	<b>0.119</b> (0.082-0.163)	<b>0.141</b> (0.094-0.201)	<b>0.160</b> (0.103-0.234)
<b>7-day</b>	<b>0.024</b> (0.020-0.028)	<b>0.029</b> (0.024-0.034)	<b>0.037</b> (0.031-0.044)	<b>0.044</b> (0.036-0.052)	<b>0.053</b> (0.042-0.066)	<b>0.059</b> (0.046-0.077)	<b>0.067</b> (0.050-0.090)	<b>0.076</b> (0.053-0.103)	<b>0.089</b> (0.059-0.126)	<b>0.100</b> (0.065-0.146)
<b>10-day</b>	<b>0.019</b> (0.016-0.023)	<b>0.023</b> (0.019-0.027)	<b>0.029</b> (0.024-0.034)	<b>0.034</b> (0.028-0.040)	<b>0.040</b> (0.032-0.050)	<b>0.045</b> (0.035-0.058)	<b>0.051</b> (0.038-0.068)	<b>0.057</b> (0.040-0.078)	<b>0.066</b> (0.044-0.094)	<b>0.074</b> (0.048-0.107)
<b>20-day</b>	<b>0.014</b> (0.012-0.016)	<b>0.016</b> (0.013-0.018)	<b>0.019</b> (0.016-0.022)	<b>0.021</b> (0.018-0.025)	<b>0.025</b> (0.020-0.031)	<b>0.028</b> (0.021-0.035)	<b>0.030</b> (0.023-0.040)	<b>0.033</b> (0.023-0.045)	<b>0.037</b> (0.025-0.052)	<b>0.041</b> (0.026-0.058)
<b>30-day</b>	<b>0.011</b> (0.010-0.013)	<b>0.013</b> (0.011-0.015)	<b>0.015</b> (0.012-0.017)	<b>0.017</b> (0.014-0.020)	<b>0.019</b> (0.015-0.023)	<b>0.021</b> (0.016-0.026)	<b>0.023</b> (0.017-0.029)	<b>0.025</b> (0.017-0.033)	<b>0.027</b> (0.018-0.038)	<b>0.029</b> (0.019-0.041)
<b>45-day</b>	<b>0.009</b> (0.008-0.011)	<b>0.010</b> (0.009-0.012)	<b>0.012</b> (0.010-0.014)	<b>0.013</b> (0.011-0.015)	<b>0.015</b> (0.012-0.018)	<b>0.016</b> (0.012-0.020)	<b>0.017</b> (0.013-0.022)	<b>0.018</b> (0.013-0.025)	<b>0.020</b> (0.013-0.028)	<b>0.021</b> (0.013-0.030)
<b>60-day</b>	<b>0.008</b> (0.007-0.010)	<b>0.009</b> (0.008-0.010)	<b>0.010</b> (0.008-0.012)	<b>0.011</b> (0.009-0.013)	<b>0.012</b> (0.010-0.015)	<b>0.013</b> (0.010-0.016)	<b>0.014</b> (0.011-0.018)	<b>0.015</b> (0.011-0.020)	<b>0.016</b> (0.011-0.022)	<b>0.017</b> (0.011-0.024)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).  
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.  
 Please refer to NOAA Atlas 14 document for more information.

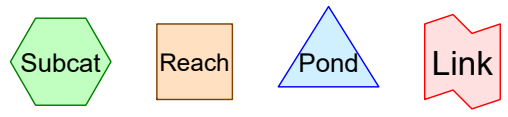
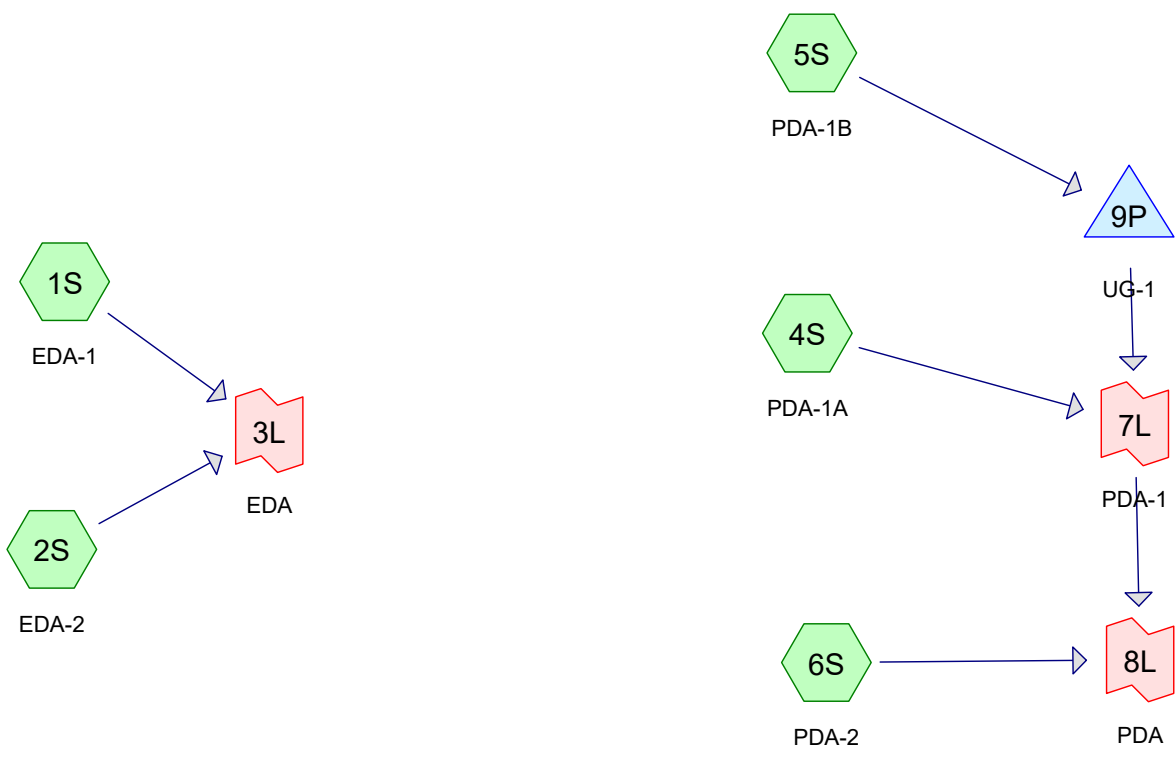
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**PF graphical**



**Maps & aerials**

**Small scale terrain**





## Stormwater Analysis (Rev)

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Printed 2/8/2024

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### Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.18	2
2	10-yr	Type II 24-hr		Default	24.00	1	4.89	2
3	25-yr	Type II 24-hr		Default	24.00	1	5.96	2
4	50-yr	Type II 24-hr		Default	24.00	1	6.75	2
5	100-yr	Type II 24-hr		Default	24.00	1	7.60	2

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### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.510	69	50-75% Grass cover, Fair, HSG B (1S, 2S, 4S, 5S, 6S)
0.970	98	Paved parking, HSG A (1S, 2S, 4S, 5S, 6S)
0.060	60	Woods, Fair, HSG B (1S)
<b>1.540</b>	<b>87</b>	<b>TOTAL AREA</b>

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### Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.970	HSG A	1S, 2S, 4S, 5S, 6S
0.570	HSG B	1S, 2S, 4S, 5S, 6S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
<b>1.540</b>		<b>TOTAL AREA</b>

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### Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.510	0.000	0.000	0.000	0.510	50-75% Grass cover, Fair	1S, 2S, 4S, 5S, 6S
0.970	0.000	0.000	0.000	0.000	0.970	Paved parking	1S, 2S, 4S, 5S, 6S
0.000	0.060	0.000	0.000	0.000	0.060	Woods, Fair	1S
<b>0.970</b>	<b>0.570</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>1.540</b>	<b>TOTAL AREA</b>	

**Stormwater Analysis (Rev)**

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*Type III 24-hr 2-yr Rainfall=3.18"*

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

<b>Subcatchment1S: EDA-1</b>	Runoff Area=0.590 ac 50.85% Impervious Runoff Depth>1.48" Tc=6.0 min CN=83 Runoff=1.08 cfs 0.073 af
<b>Subcatchment2S: EDA-2</b>	Runoff Area=0.180 ac 83.33% Impervious Runoff Depth>2.29" Tc=6.0 min CN=93 Runoff=0.48 cfs 0.034 af
<b>Subcatchment4S: PDA-1A</b>	Runoff Area=0.440 ac 70.45% Impervious Runoff Depth>1.94" Tc=6.0 min CN=89 Runoff=1.04 cfs 0.071 af
<b>Subcatchment5S: PDA-1B</b>	Runoff Area=0.190 ac 94.74% Impervious Runoff Depth>2.58" Tc=6.0 min CN=96 Runoff=0.55 cfs 0.041 af
<b>Subcatchment6S: PDA-2</b>	Runoff Area=0.140 ac 21.43% Impervious Runoff Depth>0.99" Tc=6.0 min CN=75 Runoff=0.17 cfs 0.012 af
<b>Pond 9P: UG-1</b>	Peak Elev=721.62' Storage=1,010 cf Inflow=0.55 cfs 0.041 af Outflow=0.10 cfs 0.019 af
<b>Link 3L: EDA</b>	Inflow=1.56 cfs 0.107 af Primary=1.56 cfs 0.107 af
<b>Link 7L: PDA-1</b>	Inflow=1.04 cfs 0.090 af Primary=1.04 cfs 0.090 af
<b>Link 8L: PDA</b>	Inflow=1.21 cfs 0.102 af Primary=1.21 cfs 0.102 af

**Total Runoff Area = 1.540 ac Runoff Volume = 0.230 af Average Runoff Depth = 1.80"**  
**37.01% Pervious = 0.570 ac 62.99% Impervious = 0.970 ac**

## Stormwater Analysis (Rev)

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Type III 24-hr 2-yr Rainfall=3.18"

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

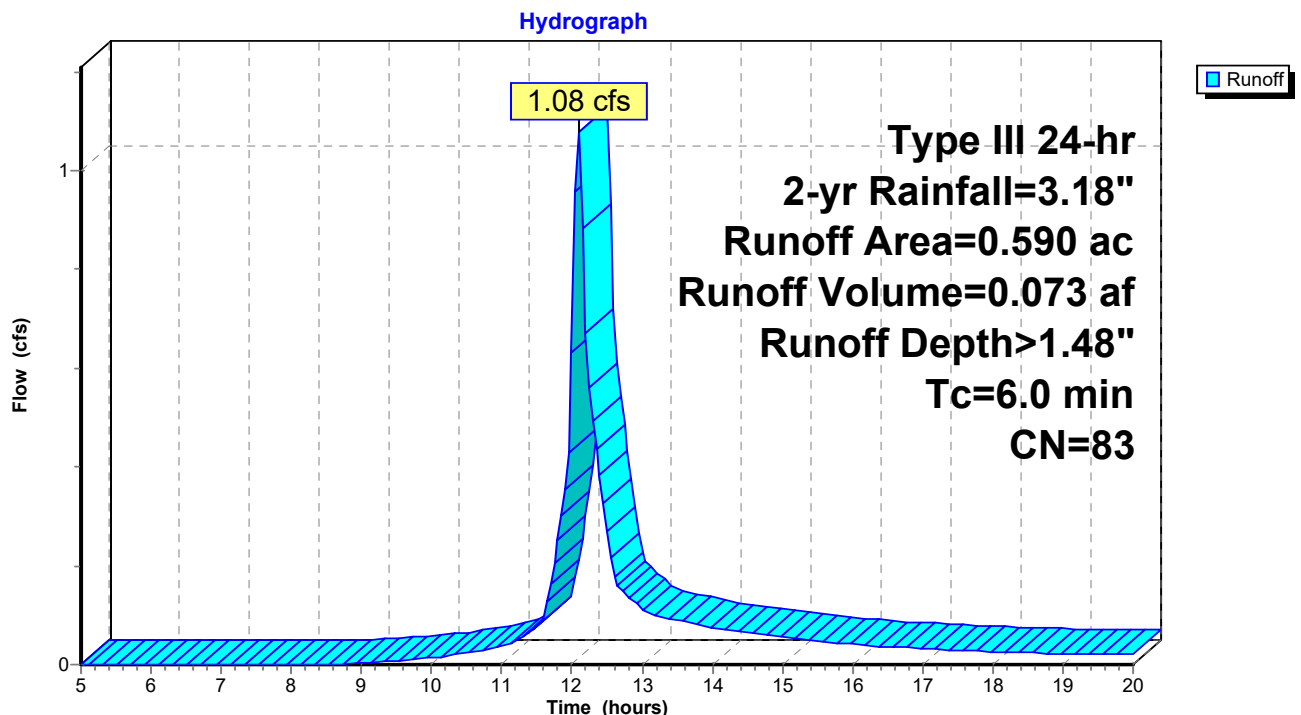
Runoff = 1.08 cfs @ 12.09 hrs, Volume= 0.073 af, Depth> 1.48"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.300	98	Paved parking, HSG A
0.060	60	Woods, Fair, HSG B
0.230	69	50-75% Grass cover, Fair, HSG B
0.590	83	Weighted Average
0.290		49.15% Pervious Area
0.300		50.85% Impervious Area

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

### Subcatchment 1S: EDA-1





## Stormwater Analysis (Rev)

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Type III 24-hr 2-yr Rainfall=3.18"

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

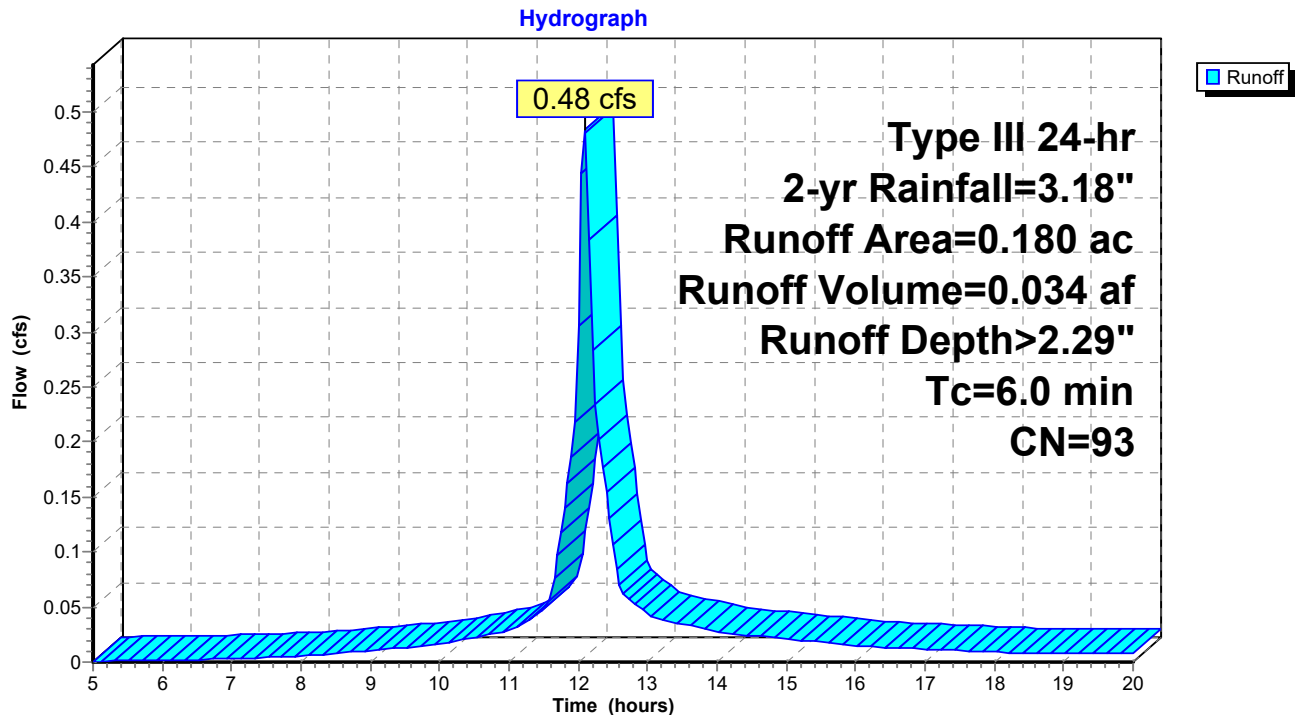
Runoff = 0.48 cfs @ 12.09 hrs, Volume= 0.034 af, Depth> 2.29"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.030	69	50-75% Grass cover, Fair, HSG B
0.180	93	Weighted Average
0.030		16.67% Pervious Area
0.150		83.33% Impervious Area

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

### Subcatchment 2S: EDA-2



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Type III 24-hr 2-yr Rainfall=3.18"

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### Summary for Subcatchment 4S: PDA-1A

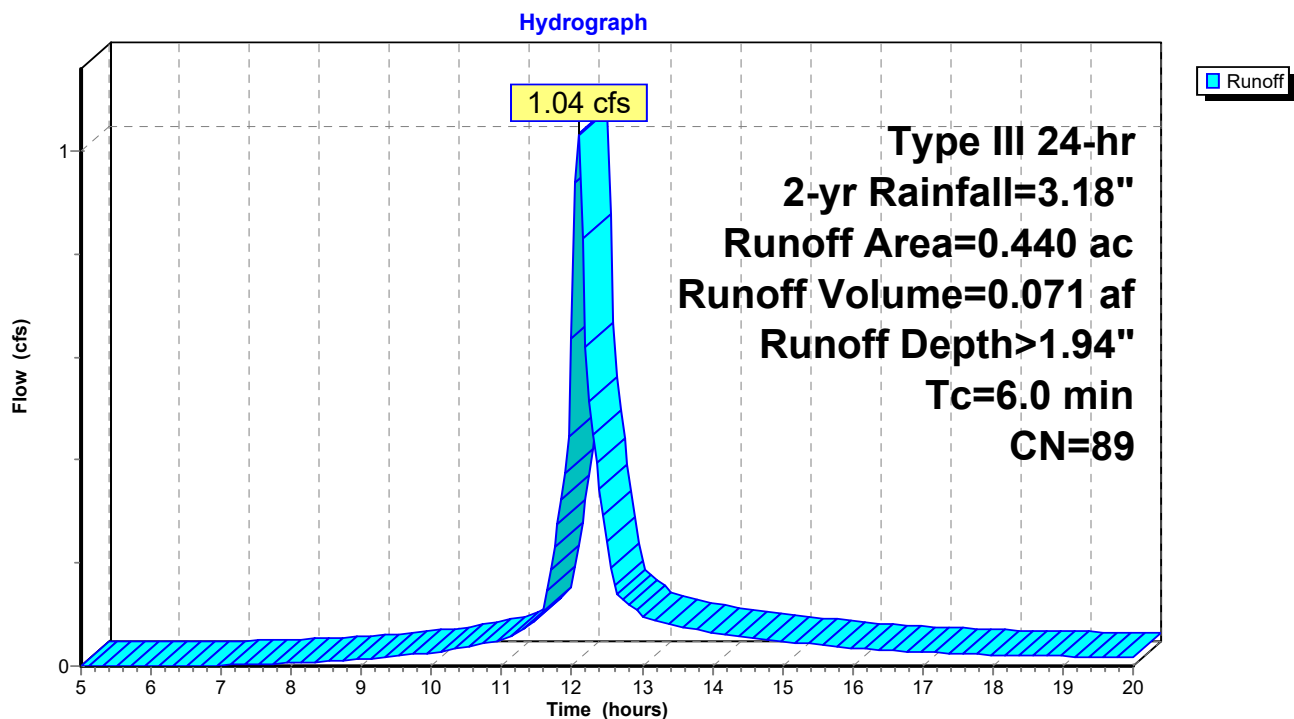
Runoff = 1.04 cfs @ 12.09 hrs, Volume= 0.071 af, Depth> 1.94"  
Routed to Link 7L : PDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.130	69	50-75% Grass cover, Fair, HSG B
0.440	89	Weighted Average
0.130		29.55% Pervious Area
0.310		70.45% Impervious Area

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

### Subcatchment 4S: PDA-1A



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Type III 24-hr 2-yr Rainfall=3.18"

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### Summary for Subcatchment 5S: PDA-1B

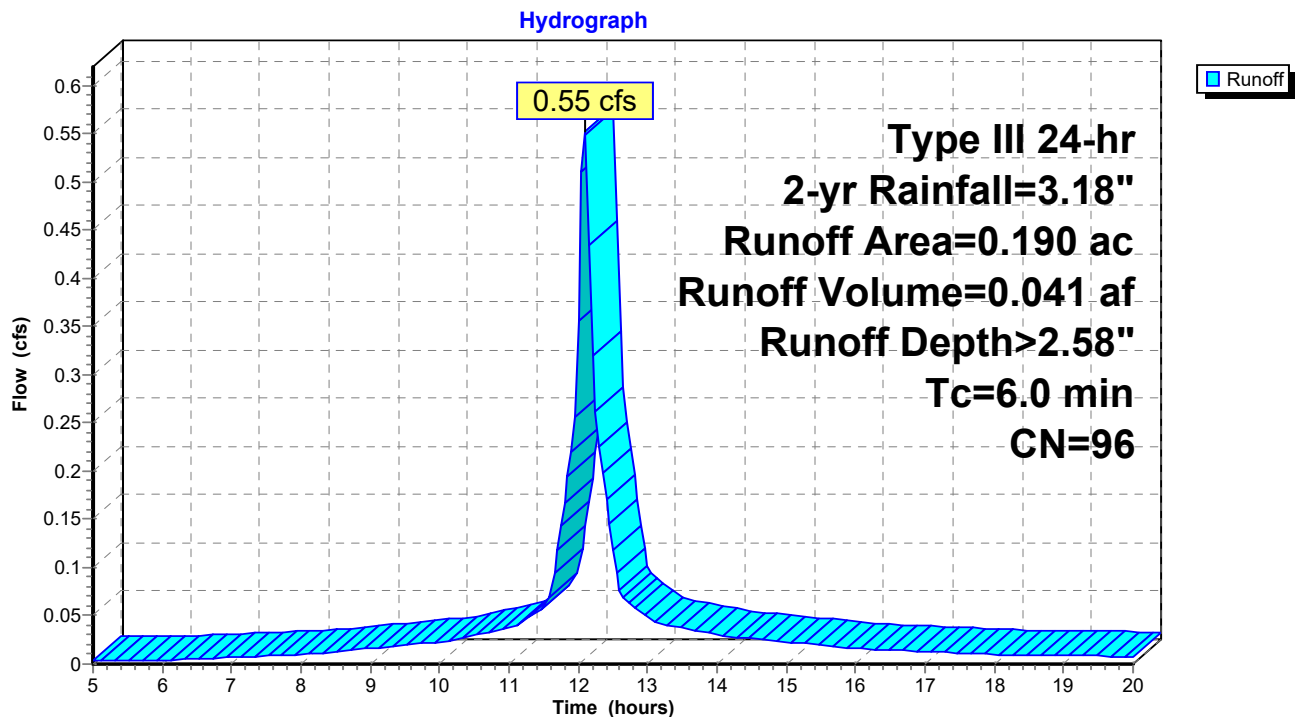
Runoff = 0.55 cfs @ 12.09 hrs, Volume= 0.041 af, Depth> 2.58"  
Routed to Pond 9P : UG-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG A
0.010	69	50-75% Grass cover, Fair, HSG B
0.190	96	Weighted Average
0.010		5.26% Pervious Area
0.180		94.74% Impervious Area

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

### Subcatchment 5S: PDA-1B



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Type III 24-hr 2-yr Rainfall=3.18"

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### Summary for Subcatchment 6S: PDA-2

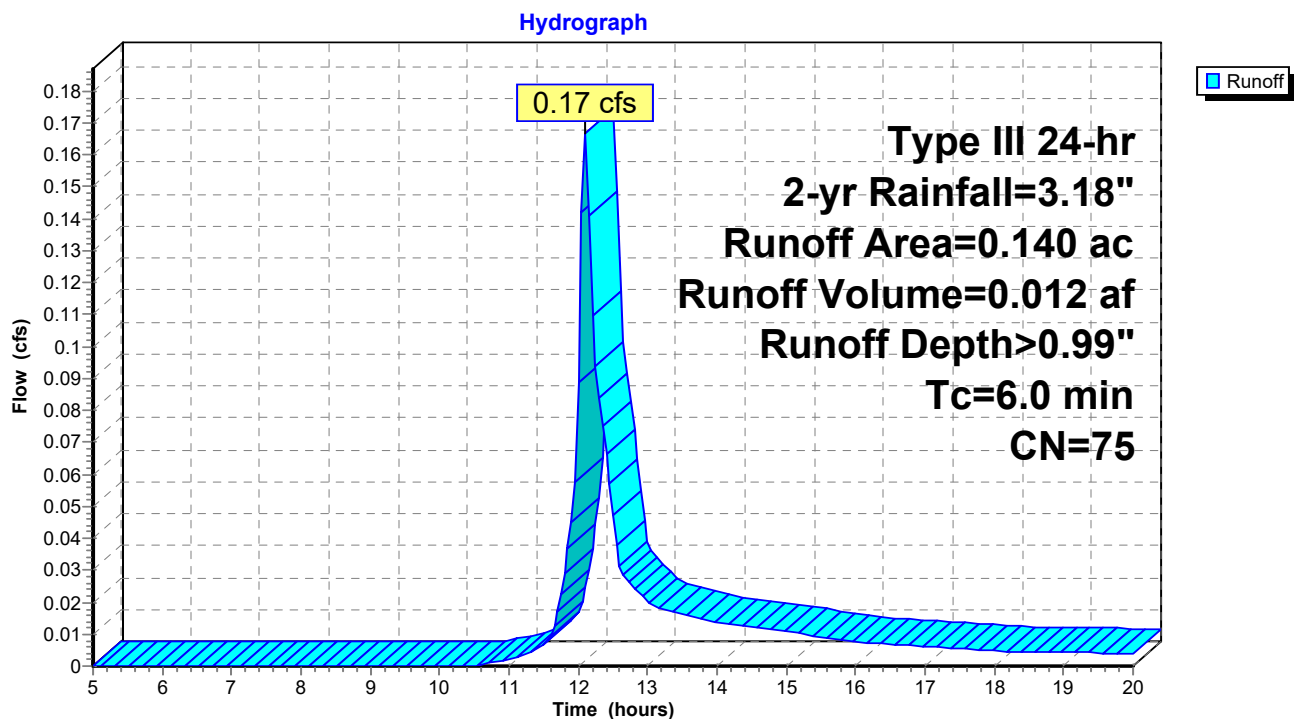
Runoff = 0.17 cfs @ 12.10 hrs, Volume= 0.012 af, Depth> 0.99"  
Routed to Link 8L : PDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.110	69	50-75% Grass cover, Fair, HSG B
0.140	75	Weighted Average
0.110		78.57% Pervious Area
0.030		21.43% Impervious Area

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

### Subcatchment 6S: PDA-2



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Type III 24-hr 2-yr Rainfall=3.18"

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**Summary for Pond 9P: UG-1**

Inflow Area = 0.190 ac, 94.74% Impervious, Inflow Depth > 2.58" for 2-yr event  
 Inflow = 0.55 cfs @ 12.09 hrs, Volume= 0.041 af  
 Outflow = 0.10 cfs @ 12.55 hrs, Volume= 0.019 af, Atten= 83%, Lag= 28.0 min  
 Primary = 0.10 cfs @ 12.55 hrs, Volume= 0.019 af  
 Routed to Link 7L : PDA-1

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 721.62' @ 12.55 hrs Surf.Area= 512 sf Storage= 1,010 cf

Plug-Flow detention time= 170.0 min calculated for 0.019 af (47% of inflow)  
 Center-of-Mass det. time= 77.2 min ( 825.9 - 748.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	719.00'	102 cf	<b>8.00'W x 64.00'L x 4.67'H Field A</b> 2,389 cf Overall - 2,133 cf Embedded = 256 cf x 40.0% Voids
#2A	719.50'	1,496 cf	<b>retain_it retain_it 3.5' x 8 Inside #1</b> Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 1 Rows adjusted for 110.5 cf perimeter wall
		1,598 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	718.25'	<b>12.0" Round Culvert</b> L= 122.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 718.25' / 715.85' S= 0.0197 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	722.75'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	721.45'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	719.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 715.00'

Primary OutFlow Max=0.10 cfs @ 12.55 hrs HW=721.62' (Free Discharge)

- 1=Culvert (Passes 0.09 cfs of 5.06 cfs potential flow)
- 2=Orifice/Grate ( Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.09 cfs @ 1.41 fps)
- 4=Exfiltration ( Controls 0.01 cfs)

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Type III 24-hr 2-yr Rainfall=3.18"

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### Pond 9P: UG-1 - Chamber Wizard Field A

#### Chamber Model = retain\_it retain\_it 3.5' (retain-it®)

Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf

Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf

1 Rows adjusted for 110.5 cf perimeter wall

8 Chambers/Row x 8.00' Long = 64.00' Row Length

1 Rows x 96.0" Wide = 8.00' Base Width

6.0" Stone Base + 50.0" Chamber Height = 4.67' Field Height

6.1 cf Sidewall x 8 x 2 + 6.1 cf Endwall x 1 x 2 = 110.5 cf Perimeter Wall

8 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 1,495.7 cf Chamber Storage

8 Chambers x 266.7 cf = 2,133.3 cf Displacement

2,389.3 cf Field - 2,133.3 cf Chambers = 256.0 cf Stone x 40.0% Voids = 102.4 cf Stone Storage

Chamber Storage + Stone Storage = 1,598.1 cf = 0.037 af

Overall Storage Efficiency = 66.9%

Overall System Size = 64.00' x 8.00' x 4.67'

8 Chambers

88.5 cy Field

9.5 cy Stone





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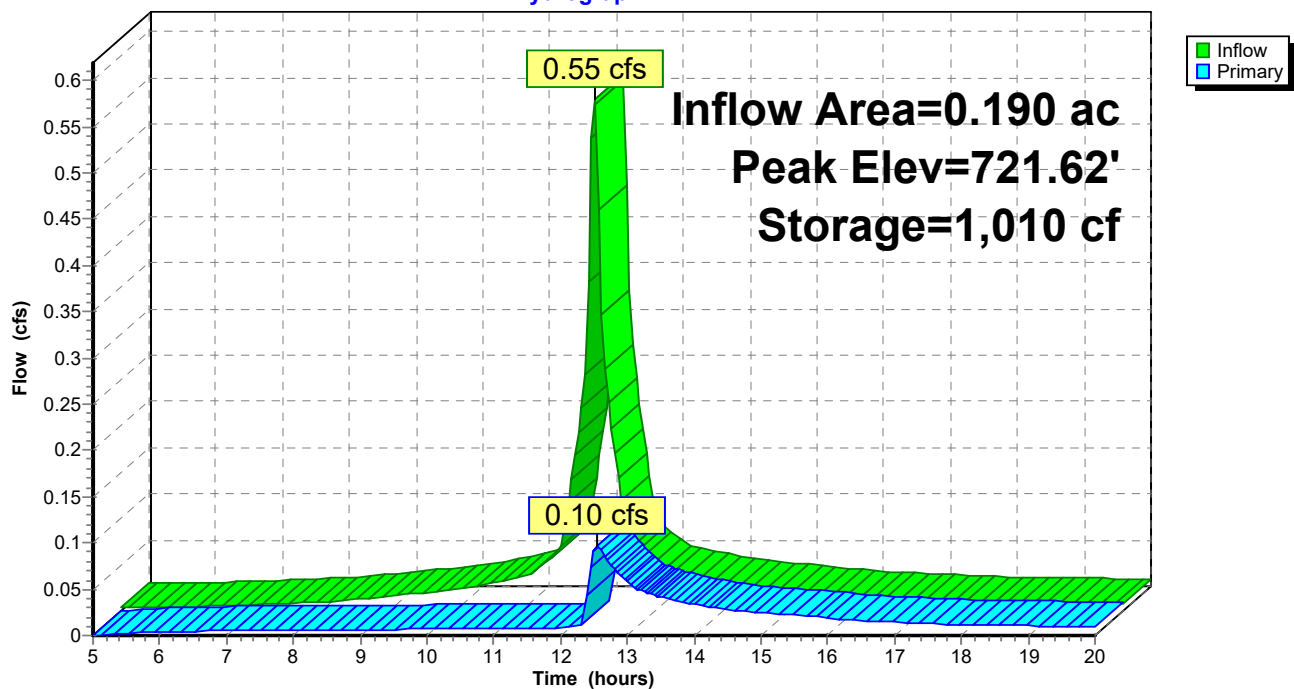
Type III 24-hr 2-yr Rainfall=3.18"

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## Pond 9P: UG-1

### Hydrograph



**Stormwater Analysis (Rev)**

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Type III 24-hr 2-yr Rainfall=3.18"

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**Stage-Discharge for Pond 9P: UG-1**

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
719.00	0.00	721.65	0.12
719.05	0.01	721.70	0.18
719.10	0.01	721.75	0.24
719.15	0.01	721.80	0.31
719.20	0.01	721.85	0.37
719.25	0.01	721.90	0.44
719.30	0.01	721.95	0.48
719.35	0.01	722.00	0.53
719.40	0.01	722.05	0.57
719.45	0.01	722.10	0.61
719.50	0.01	722.15	0.65
719.55	0.01	722.20	0.68
719.60	0.01	722.25	0.71
719.65	0.01	722.30	0.74
719.70	0.01	722.35	0.77
719.75	0.01	722.40	0.80
719.80	0.01	722.45	0.83
719.85	0.01	722.50	0.86
719.90	0.01	722.55	0.88
719.95	0.01	722.60	0.91
720.00	0.01	722.65	0.93
720.05	0.01	722.70	0.96
720.10	0.01	722.75	0.98
720.15	0.01	722.80	1.12
720.20	0.01	722.85	1.35
720.25	0.01	722.90	1.64
720.30	0.01	722.95	1.99
720.35	0.01	723.00	2.37
720.40	0.01	723.05	2.80
720.45	0.01	723.10	3.26
720.50	0.01	723.15	3.54
720.55	0.01	723.20	3.71
720.60	0.01	723.25	3.86
720.65	0.01	723.30	4.01
720.70	0.01	723.35	4.16
720.75	0.01	723.40	4.29
720.80	0.01	723.45	4.43
720.85	0.01	723.50	4.56
720.90	0.01	723.55	4.68
720.95	0.01	723.60	4.80
721.00	0.01	723.65	<b>4.92</b>
721.05	0.01		
721.10	0.01		
721.15	0.01		
721.20	0.01		
721.25	0.01		
721.30	0.01		
721.35	0.01		
721.40	0.01		
721.45	0.01		
721.50	0.02		
721.55	0.04		
721.60	0.08		

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Type III 24-hr 2-yr Rainfall=3.18"

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**Stage-Area-Storage for Pond 9P: UG-1**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
719.00	512	0	721.65	512	1,021
719.05	512	10	721.70	512	1,043
719.10	512	20	721.75	512	1,064
719.15	512	31	721.80	512	1,085
719.20	512	41	721.85	512	1,107
719.25	512	51	721.90	512	1,128
719.30	512	61	721.95	512	1,149
719.35	512	72	722.00	512	1,171
719.40	512	82	722.05	512	1,192
719.45	512	92	722.10	512	1,214
719.50	512	102	722.15	512	1,235
719.55	512	124	722.20	512	1,256
719.60	512	145	722.25	512	1,278
719.65	512	167	722.30	512	1,299
719.70	512	188	722.35	512	1,320
719.75	512	209	722.40	512	1,342
719.80	512	231	722.45	512	1,363
719.85	512	252	722.50	512	1,384
719.90	512	273	722.55	512	1,406
719.95	512	295	722.60	512	1,427
720.00	512	316	722.65	512	1,449
720.05	512	337	722.70	512	1,470
720.10	512	359	722.75	512	1,491
720.15	512	380	722.80	512	1,513
720.20	512	402	722.85	512	1,534
720.25	512	423	722.90	512	1,555
720.30	512	444	722.95	512	1,577
720.35	512	466	723.00	512	1,598
720.40	512	487	723.05	512	1,598
720.45	512	508	723.10	512	1,598
720.50	512	530	723.15	512	1,598
720.55	512	551	723.20	512	1,598
720.60	512	572	723.25	512	1,598
720.65	512	594	723.30	512	1,598
720.70	512	615	723.35	512	1,598
720.75	512	637	723.40	512	1,598
720.80	512	658	723.45	512	1,598
720.85	512	679	723.50	512	1,598
720.90	512	701	723.55	512	1,598
720.95	512	722	723.60	512	1,598
721.00	512	743	723.65	512	1,598
721.05	512	765			
721.10	512	786			
721.15	512	808			
721.20	512	829			
721.25	512	850			
721.30	512	872			
721.35	512	893			
721.40	512	914			
721.45	512	936			
721.50	512	957			
721.55	512	978			
721.60	512	1,000			

## Stormwater Analysis (Rev)

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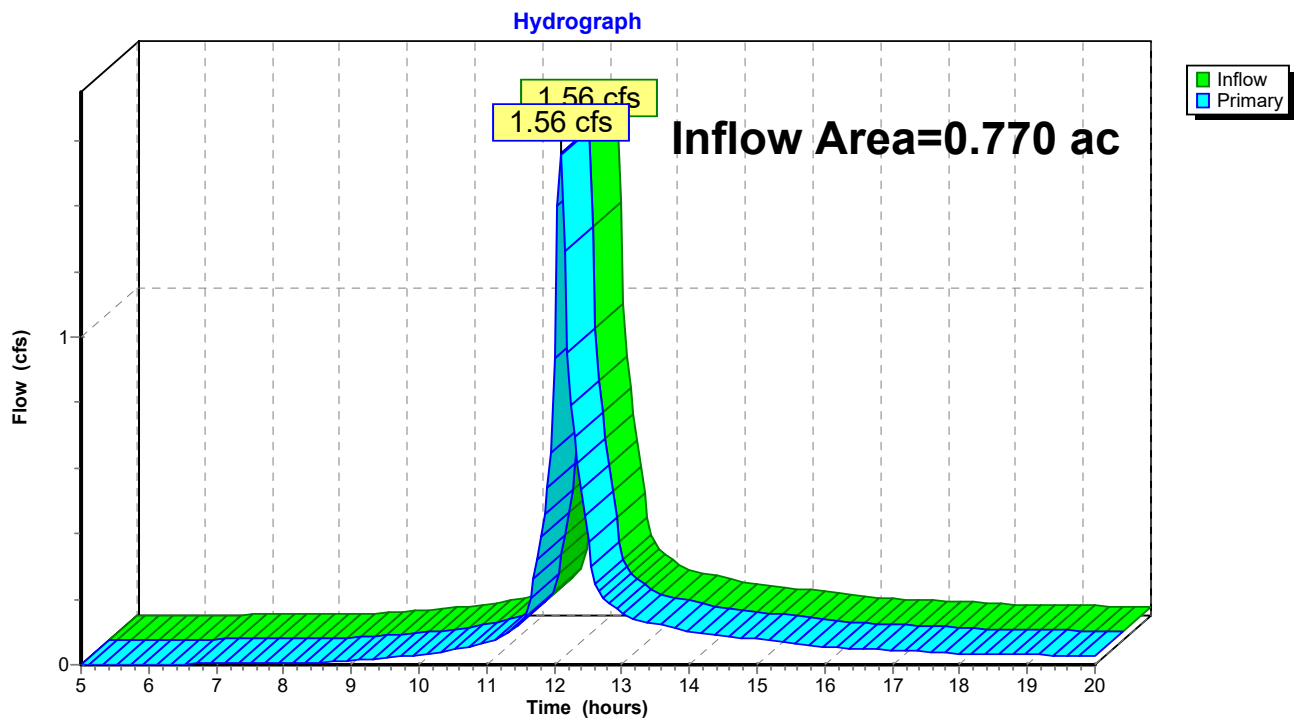
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### Summary for Link 3L: EDA

Inflow Area = 0.770 ac, 58.44% Impervious, Inflow Depth > 1.67" for 2-yr event  
Inflow = 1.56 cfs @ 12.09 hrs, Volume= 0.107 af  
Primary = 1.56 cfs @ 12.09 hrs, Volume= 0.107 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: EDA



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Type III 24-hr 2-yr Rainfall=3.18"

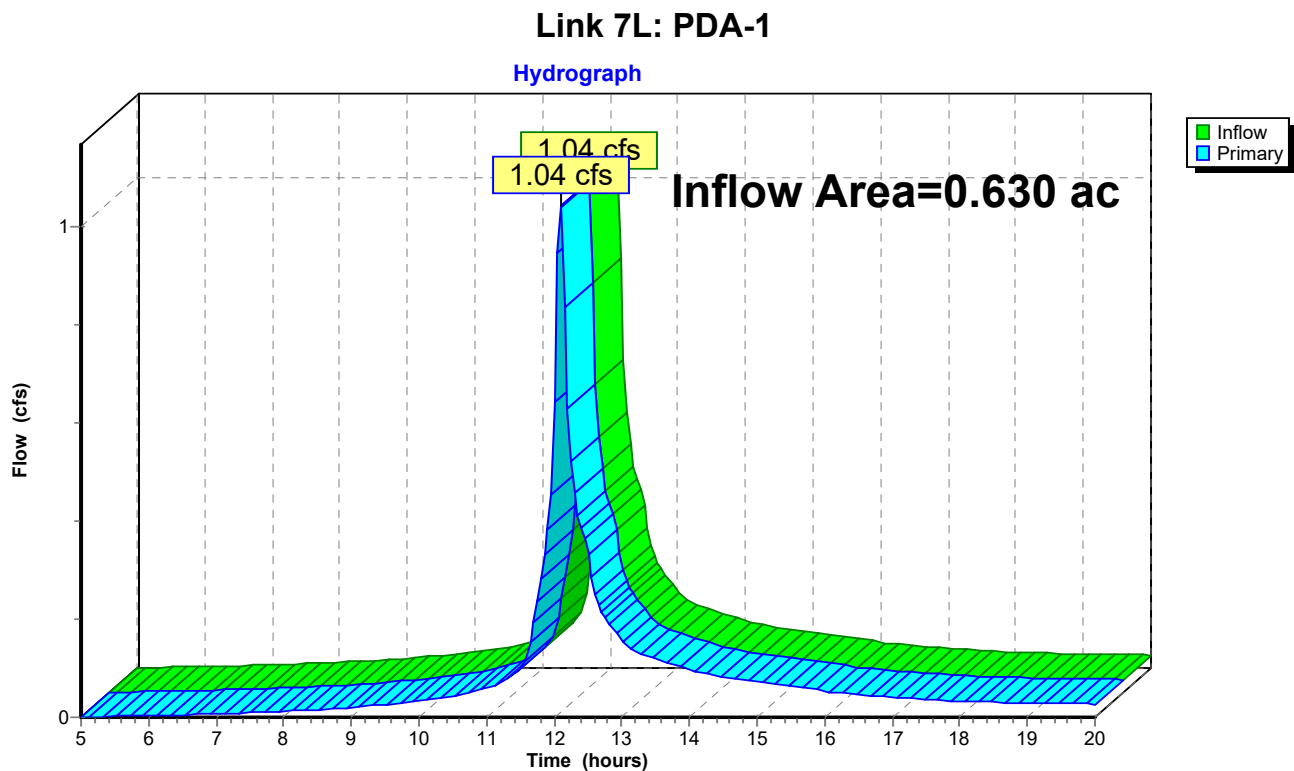
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### Summary for Link 7L: PDA-1

Inflow Area = 0.630 ac, 77.78% Impervious, Inflow Depth > 1.72" for 2-yr event  
Inflow = 1.04 cfs @ 12.09 hrs, Volume= 0.090 af  
Primary = 1.04 cfs @ 12.09 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min  
Routed to Link 8L : PDA

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



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Type III 24-hr 2-yr Rainfall=3.18"

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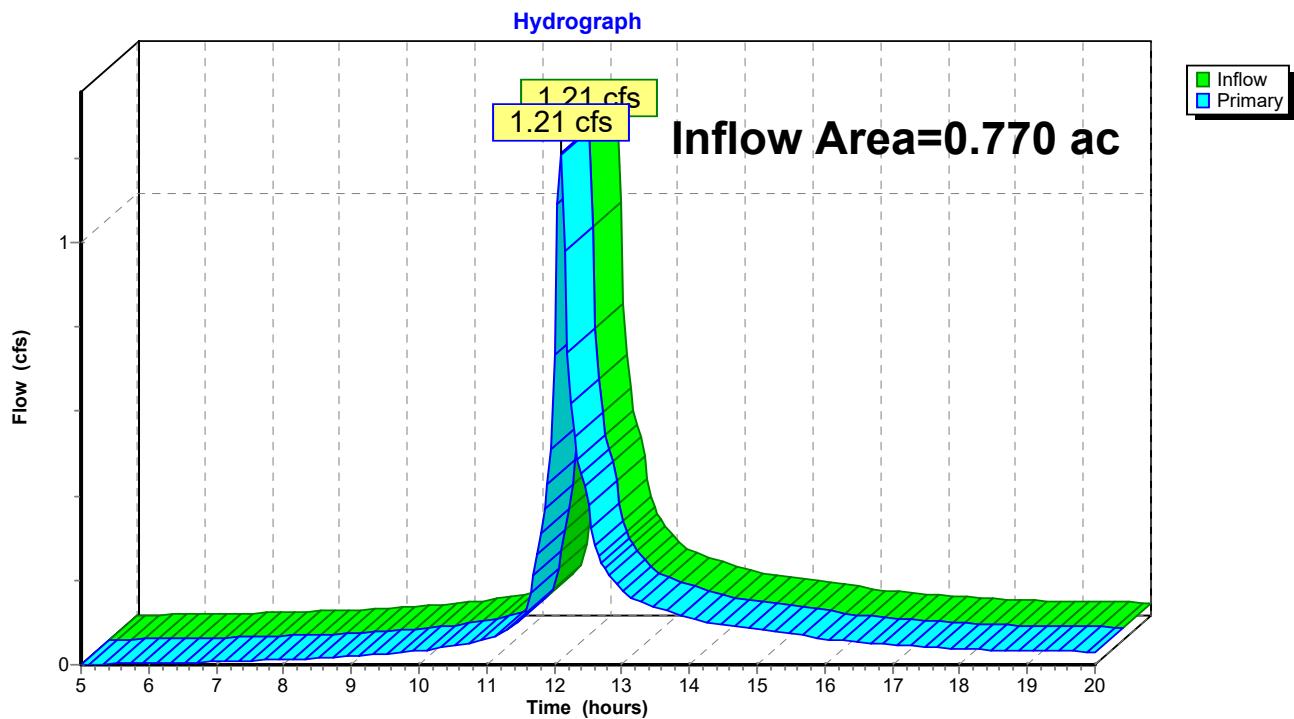
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### Summary for Link 8L: PDA

Inflow Area = 0.770 ac, 67.53% Impervious, Inflow Depth > 1.59" for 2-yr event  
Inflow = 1.21 cfs @ 12.09 hrs, Volume= 0.102 af  
Primary = 1.21 cfs @ 12.09 hrs, Volume= 0.102 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 8L: PDA





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*Type II 24-hr 10-yr Rainfall=4.89"*

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

<b>Subcatchment1S: EDA-1</b>	Runoff Area=0.590 ac 50.85% Impervious Runoff Depth>2.86" Tc=6.0 min CN=83 Runoff=3.06 cfs 0.141 af
<b>Subcatchment2S: EDA-2</b>	Runoff Area=0.180 ac 83.33% Impervious Runoff Depth>3.83" Tc=6.0 min CN=93 Runoff=1.16 cfs 0.057 af
<b>Subcatchment4S: PDA-1A</b>	Runoff Area=0.440 ac 70.45% Impervious Runoff Depth>3.44" Tc=6.0 min CN=89 Runoff=2.63 cfs 0.126 af
<b>Subcatchment5S: PDA-1B</b>	Runoff Area=0.190 ac 94.74% Impervious Runoff Depth>4.11" Tc=6.0 min CN=96 Runoff=1.27 cfs 0.065 af
<b>Subcatchment6S: PDA-2</b>	Runoff Area=0.140 ac 21.43% Impervious Runoff Depth>2.17" Tc=6.0 min CN=75 Runoff=0.57 cfs 0.025 af
<b>Pond 9P: UG-1</b>	Peak Elev=722.30' Storage=1,300 cf Inflow=1.27 cfs 0.065 af Outflow=0.74 cfs 0.043 af
<b>Link 3L: EDA</b>	Inflow=4.22 cfs 0.198 af Primary=4.22 cfs 0.198 af
<b>Link 7L: PDA-1</b>	Inflow=3.22 cfs 0.169 af Primary=3.22 cfs 0.169 af
<b>Link 8L: PDA</b>	Inflow=3.80 cfs 0.195 af Primary=3.80 cfs 0.195 af

**Total Runoff Area = 1.540 ac Runoff Volume = 0.415 af Average Runoff Depth = 3.23"**  
**37.01% Pervious = 0.570 ac 62.99% Impervious = 0.970 ac**

## Stormwater Analysis (Rev)

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Type II 24-hr 10-yr Rainfall=4.89"

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

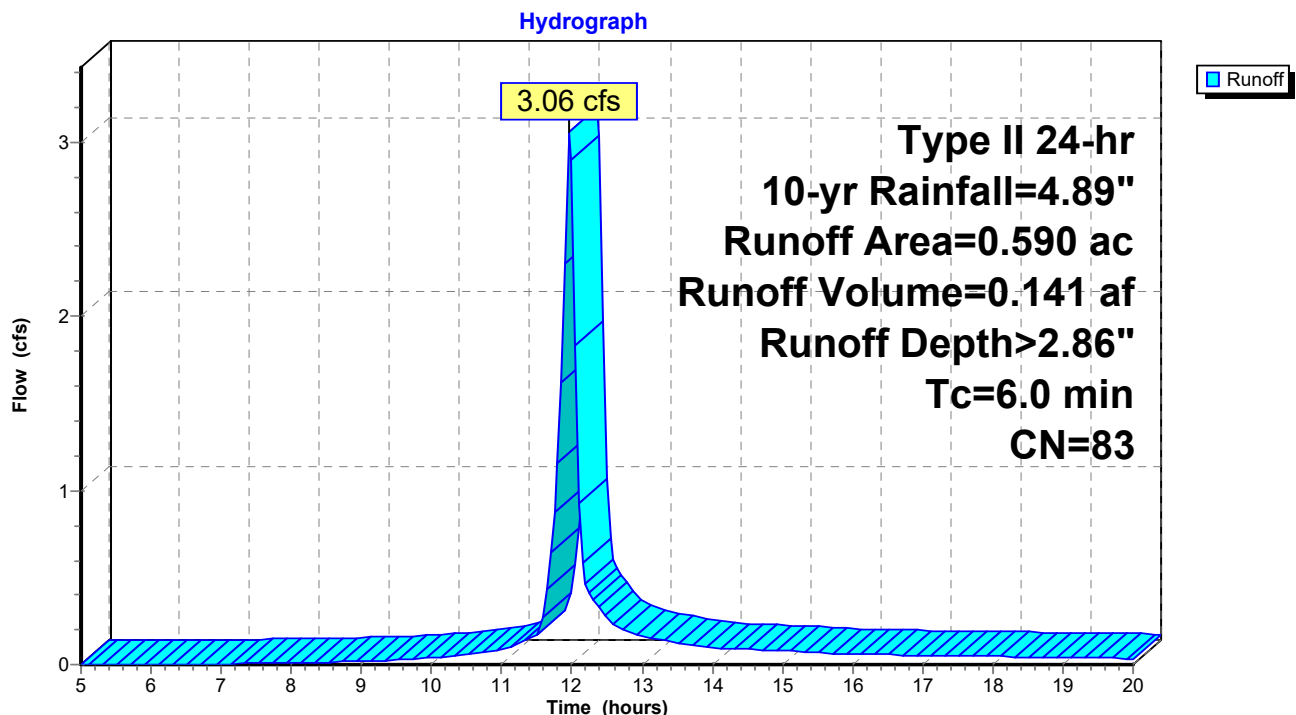
Runoff = 3.06 cfs @ 11.97 hrs, Volume= 0.141 af, Depth> 2.86"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.89"

Area (ac)	CN	Description
0.300	98	Paved parking, HSG A
0.060	60	Woods, Fair, HSG B
0.230	69	50-75% Grass cover, Fair, HSG B
0.590	83	Weighted Average
0.290		49.15% Pervious Area
0.300		50.85% Impervious Area

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

### Subcatchment 1S: EDA-1



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Type II 24-hr 10-yr Rainfall=4.89"

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

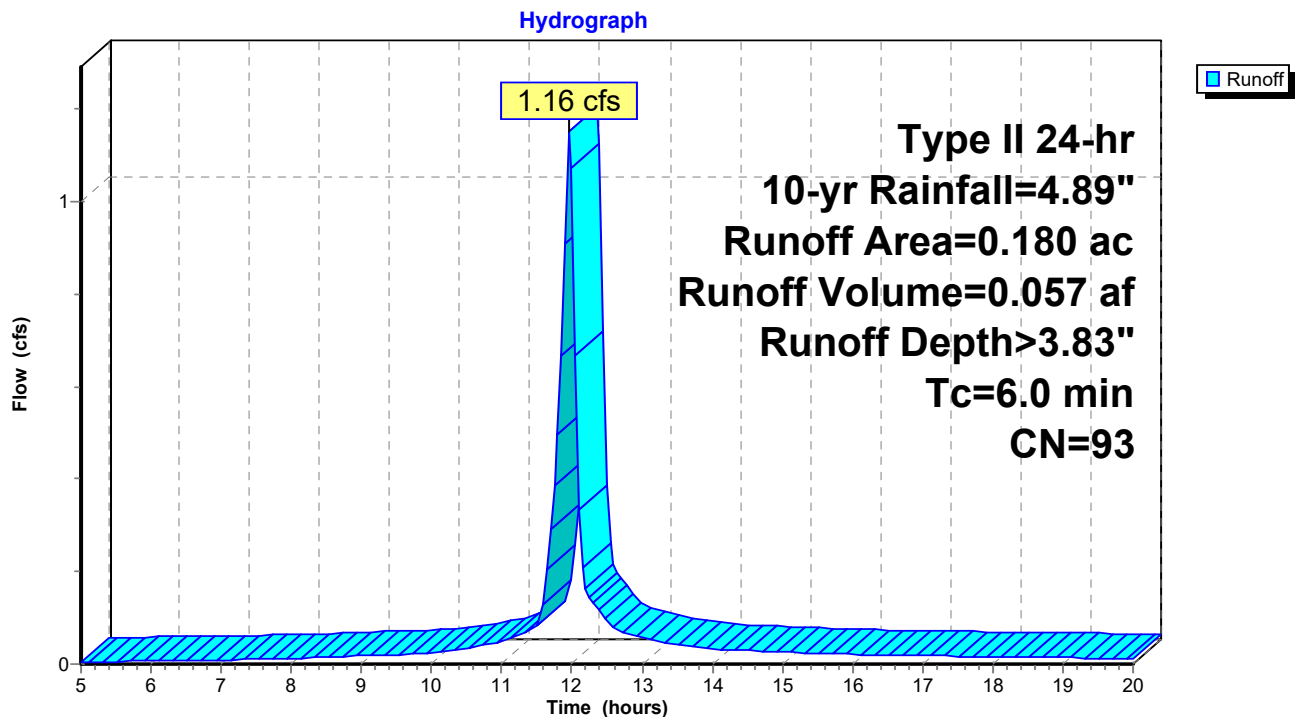
Runoff = 1.16 cfs @ 11.96 hrs, Volume= 0.057 af, Depth> 3.83"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.89"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.030	69	50-75% Grass cover, Fair, HSG B
0.180	93	Weighted Average
0.030		16.67% Pervious Area
0.150		83.33% Impervious Area

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

### Subcatchment 2S: EDA-2



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Type II 24-hr 10-yr Rainfall=4.89"

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### Summary for Subcatchment 4S: PDA-1A

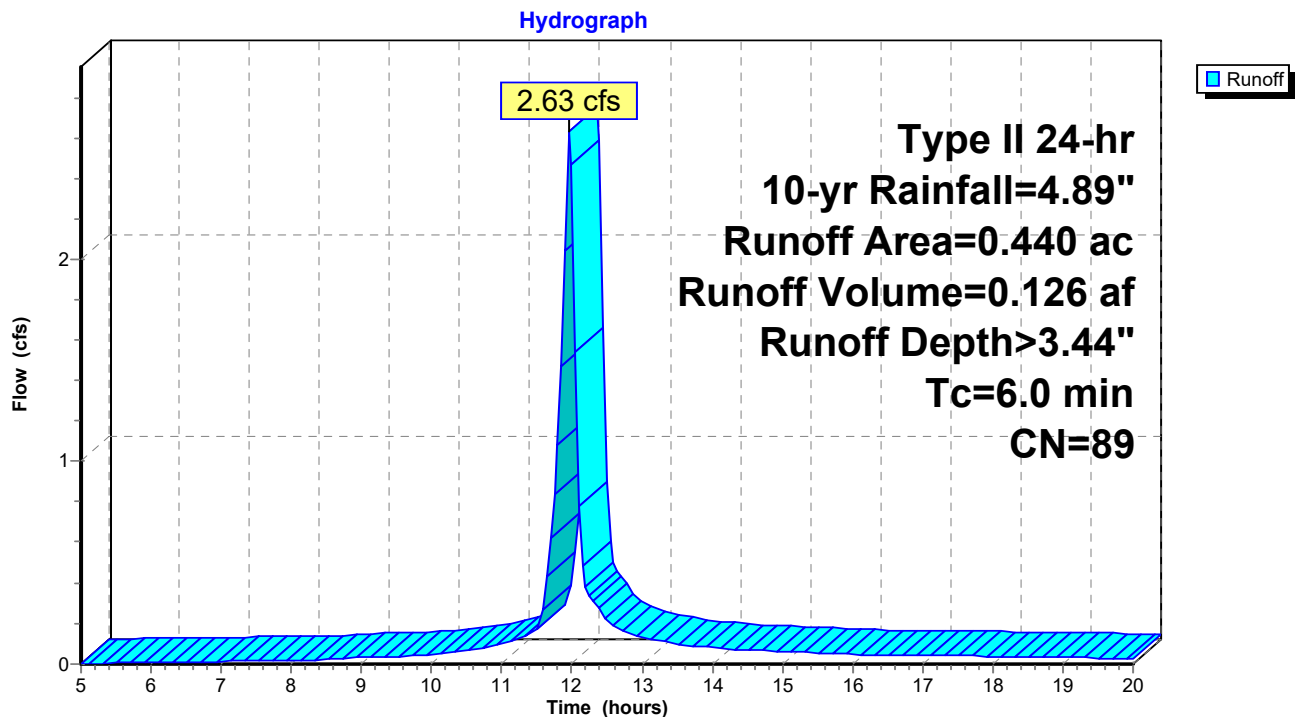
Runoff = 2.63 cfs @ 11.96 hrs, Volume= 0.126 af, Depth> 3.44"  
Routed to Link 7L : PDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.89"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.130	69	50-75% Grass cover, Fair, HSG B
0.440	89	Weighted Average
0.130		29.55% Pervious Area
0.310		70.45% Impervious Area

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

### Subcatchment 4S: PDA-1A



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Type II 24-hr 10-yr Rainfall=4.89"

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### Summary for Subcatchment 5S: PDA-1B

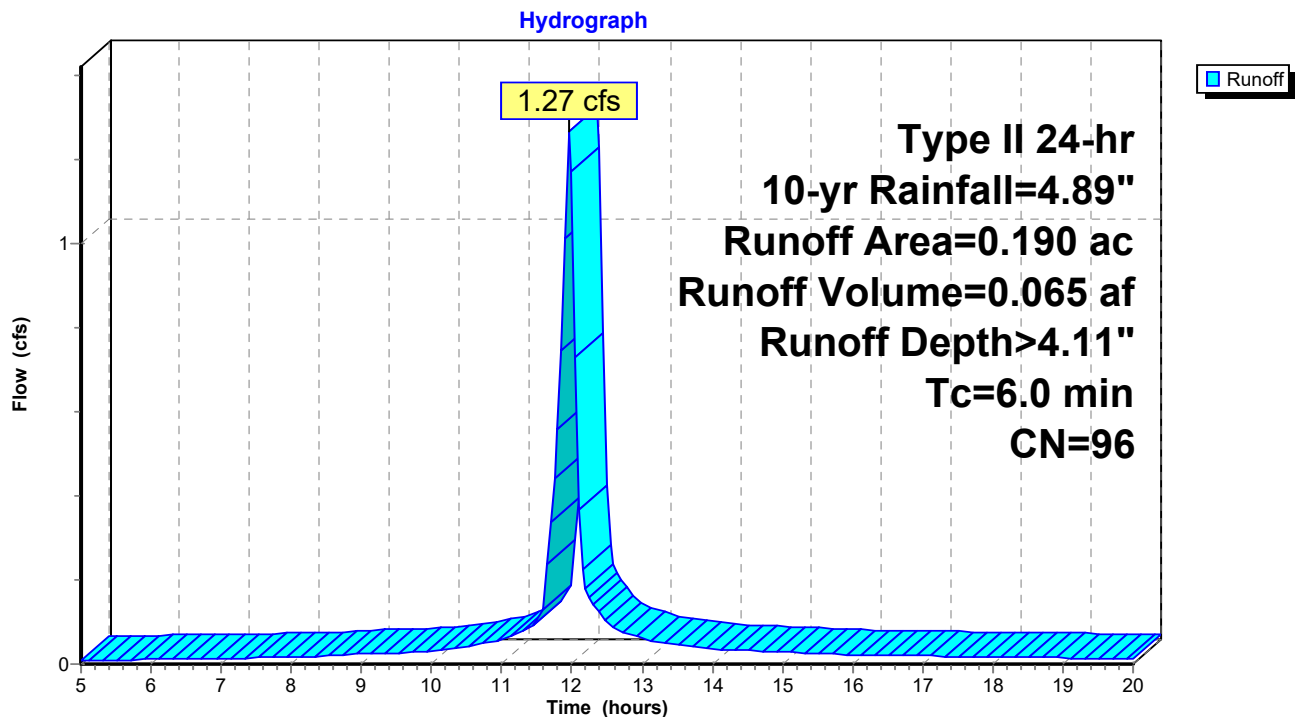
Runoff = 1.27 cfs @ 11.96 hrs, Volume= 0.065 af, Depth> 4.11"  
Routed to Pond 9P : UG-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.89"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG A
0.010	69	50-75% Grass cover, Fair, HSG B
0.190	96	Weighted Average
0.010		5.26% Pervious Area
0.180		94.74% Impervious Area

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

### Subcatchment 5S: PDA-1B





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Type II 24-hr 10-yr Rainfall=4.89"

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### Summary for Subcatchment 6S: PDA-2

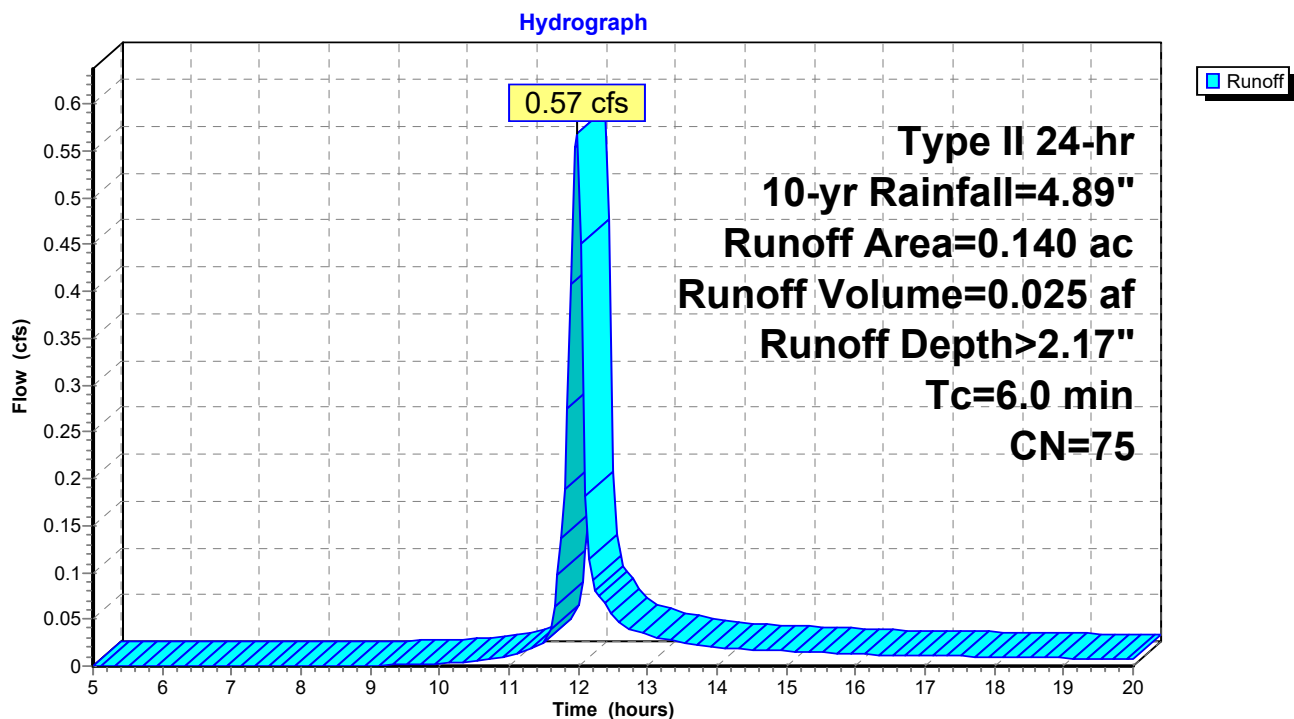
Runoff = 0.57 cfs @ 11.97 hrs, Volume= 0.025 af, Depth> 2.17"  
Routed to Link 8L : PDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.89"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.110	69	50-75% Grass cover, Fair, HSG B
0.140	75	Weighted Average
0.110		78.57% Pervious Area
0.030		21.43% Impervious Area

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

### Subcatchment 6S: PDA-2



**Stormwater Analysis (Rev)**

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Type II 24-hr 10-yr Rainfall=4.89"

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**Summary for Pond 9P: UG-1**

Inflow Area = 0.190 ac, 94.74% Impervious, Inflow Depth > 4.11" for 10-yr event  
 Inflow = 1.27 cfs @ 11.96 hrs, Volume= 0.065 af  
 Outflow = 0.74 cfs @ 12.05 hrs, Volume= 0.043 af, Atten= 41%, Lag= 5.5 min  
 Primary = 0.74 cfs @ 12.05 hrs, Volume= 0.043 af  
 Routed to Link 7L : PDA-1

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 722.30' @ 12.05 hrs Surf.Area= 512 sf Storage= 1,300 cf

Plug-Flow detention time= 120.4 min calculated for 0.043 af (67% of inflow)  
 Center-of-Mass det. time= 51.1 min ( 787.3 - 736.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	719.00'	102 cf	<b>8.00'W x 64.00'L x 4.67'H Field A</b> 2,389 cf Overall - 2,133 cf Embedded = 256 cf x 40.0% Voids
#2A	719.50'	1,496 cf	<b>retain_it retain_it 3.5' x 8 Inside #1</b> Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 1 Rows adjusted for 110.5 cf perimeter wall
		1,598 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	718.25'	<b>12.0" Round Culvert</b> L= 122.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 718.25' / 715.85' S= 0.0197 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	722.75'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	721.45'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	719.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 715.00'

Primary OutFlow Max=0.74 cfs @ 12.05 hrs HW=722.30' (Free Discharge)

- 1=Culvert (Passes 0.73 cfs of 5.62 cfs potential flow)
- 2=Orifice/Grate ( Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.73 cfs @ 3.72 fps)
- 4=Exfiltration ( Controls 0.01 cfs)

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Type II 24-hr 10-yr Rainfall=4.89"

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### Pond 9P: UG-1 - Chamber Wizard Field A

#### Chamber Model = retain\_it retain\_it 3.5' (retain-it®)

Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf

Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf

1 Rows adjusted for 110.5 cf perimeter wall

8 Chambers/Row x 8.00' Long = 64.00' Row Length

1 Rows x 96.0" Wide = 8.00' Base Width

6.0" Stone Base + 50.0" Chamber Height = 4.67' Field Height

6.1 cf Sidewall x 8 x 2 + 6.1 cf Endwall x 1 x 2 = 110.5 cf Perimeter Wall

8 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 1,495.7 cf Chamber Storage

8 Chambers x 266.7 cf = 2,133.3 cf Displacement

2,389.3 cf Field - 2,133.3 cf Chambers = 256.0 cf Stone x 40.0% Voids = 102.4 cf Stone Storage

Chamber Storage + Stone Storage = 1,598.1 cf = 0.037 af

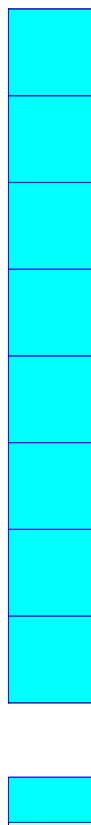
Overall Storage Efficiency = 66.9%

Overall System Size = 64.00' x 8.00' x 4.67'

8 Chambers

88.5 cy Field

9.5 cy Stone



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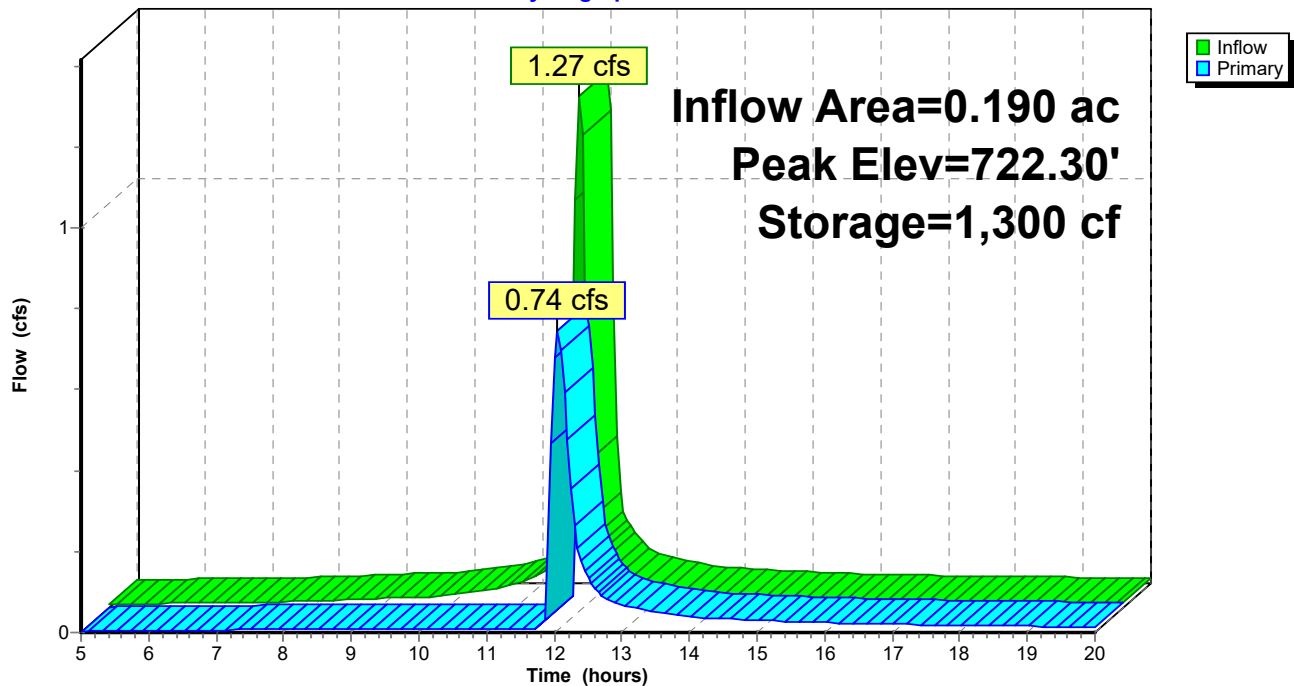
Type II 24-hr 10-yr Rainfall=4.89"

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## Pond 9P: UG-1

Hydrograph



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**Stage-Discharge for Pond 9P: UG-1**

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
719.00	0.00	721.65	0.12
719.05	0.01	721.70	0.18
719.10	0.01	721.75	0.24
719.15	0.01	721.80	0.31
719.20	0.01	721.85	0.37
719.25	0.01	721.90	0.44
719.30	0.01	721.95	0.48
719.35	0.01	722.00	0.53
719.40	0.01	722.05	0.57
719.45	0.01	722.10	0.61
719.50	0.01	722.15	0.65
719.55	0.01	722.20	0.68
719.60	0.01	722.25	0.71
719.65	0.01	722.30	0.74
719.70	0.01	722.35	0.77
719.75	0.01	722.40	0.80
719.80	0.01	722.45	0.83
719.85	0.01	722.50	0.86
719.90	0.01	722.55	0.88
719.95	0.01	722.60	0.91
720.00	0.01	722.65	0.93
720.05	0.01	722.70	0.96
720.10	0.01	722.75	0.98
720.15	0.01	722.80	1.12
720.20	0.01	722.85	1.35
720.25	0.01	722.90	1.64
720.30	0.01	722.95	1.99
720.35	0.01	723.00	2.37
720.40	0.01	723.05	2.80
720.45	0.01	723.10	3.26
720.50	0.01	723.15	3.54
720.55	0.01	723.20	3.71
720.60	0.01	723.25	3.86
720.65	0.01	723.30	4.01
720.70	0.01	723.35	4.16
720.75	0.01	723.40	4.29
720.80	0.01	723.45	4.43
720.85	0.01	723.50	4.56
720.90	0.01	723.55	4.68
720.95	0.01	723.60	4.80
721.00	0.01	723.65	<b>4.92</b>
721.05	0.01		
721.10	0.01		
721.15	0.01		
721.20	0.01		
721.25	0.01		
721.30	0.01		
721.35	0.01		
721.40	0.01		
721.45	0.01		
721.50	0.02		
721.55	0.04		
721.60	0.08		



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**Stage-Area-Storage for Pond 9P: UG-1**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
719.00	512	0	721.65	512	1,021
719.05	512	10	721.70	512	1,043
719.10	512	20	721.75	512	1,064
719.15	512	31	721.80	512	1,085
719.20	512	41	721.85	512	1,107
719.25	512	51	721.90	512	1,128
719.30	512	61	721.95	512	1,149
719.35	512	72	722.00	512	1,171
719.40	512	82	722.05	512	1,192
719.45	512	92	722.10	512	1,214
719.50	512	102	722.15	512	1,235
719.55	512	124	722.20	512	1,256
719.60	512	145	722.25	512	1,278
719.65	512	167	722.30	512	1,299
719.70	512	188	722.35	512	1,320
719.75	512	209	722.40	512	1,342
719.80	512	231	722.45	512	1,363
719.85	512	252	722.50	512	1,384
719.90	512	273	722.55	512	1,406
719.95	512	295	722.60	512	1,427
720.00	512	316	722.65	512	1,449
720.05	512	337	722.70	512	1,470
720.10	512	359	722.75	512	1,491
720.15	512	380	722.80	512	1,513
720.20	512	402	722.85	512	1,534
720.25	512	423	722.90	512	1,555
720.30	512	444	722.95	512	1,577
720.35	512	466	723.00	512	1,598
720.40	512	487	723.05	512	1,598
720.45	512	508	723.10	512	1,598
720.50	512	530	723.15	512	1,598
720.55	512	551	723.20	512	1,598
720.60	512	572	723.25	512	1,598
720.65	512	594	723.30	512	1,598
720.70	512	615	723.35	512	1,598
720.75	512	637	723.40	512	1,598
720.80	512	658	723.45	512	1,598
720.85	512	679	723.50	512	1,598
720.90	512	701	723.55	512	1,598
720.95	512	722	723.60	512	1,598
721.00	512	743	723.65	512	1,598
721.05	512	765			
721.10	512	786			
721.15	512	808			
721.20	512	829			
721.25	512	850			
721.30	512	872			
721.35	512	893			
721.40	512	914			
721.45	512	936			
721.50	512	957			
721.55	512	978			
721.60	512	1,000			

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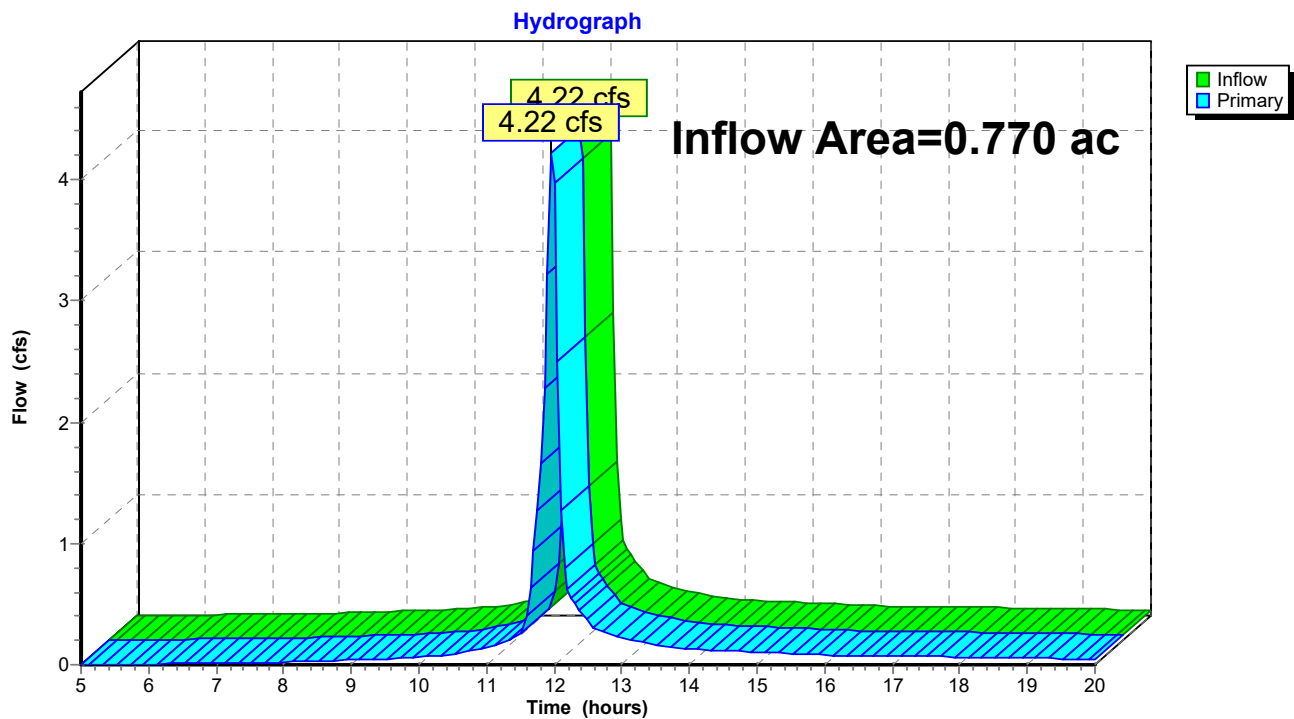
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### Summary for Link 3L: EDA

Inflow Area = 0.770 ac, 58.44% Impervious, Inflow Depth > 3.09" for 10-yr event  
Inflow = 4.22 cfs @ 11.97 hrs, Volume= 0.198 af  
Primary = 4.22 cfs @ 11.97 hrs, Volume= 0.198 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: EDA



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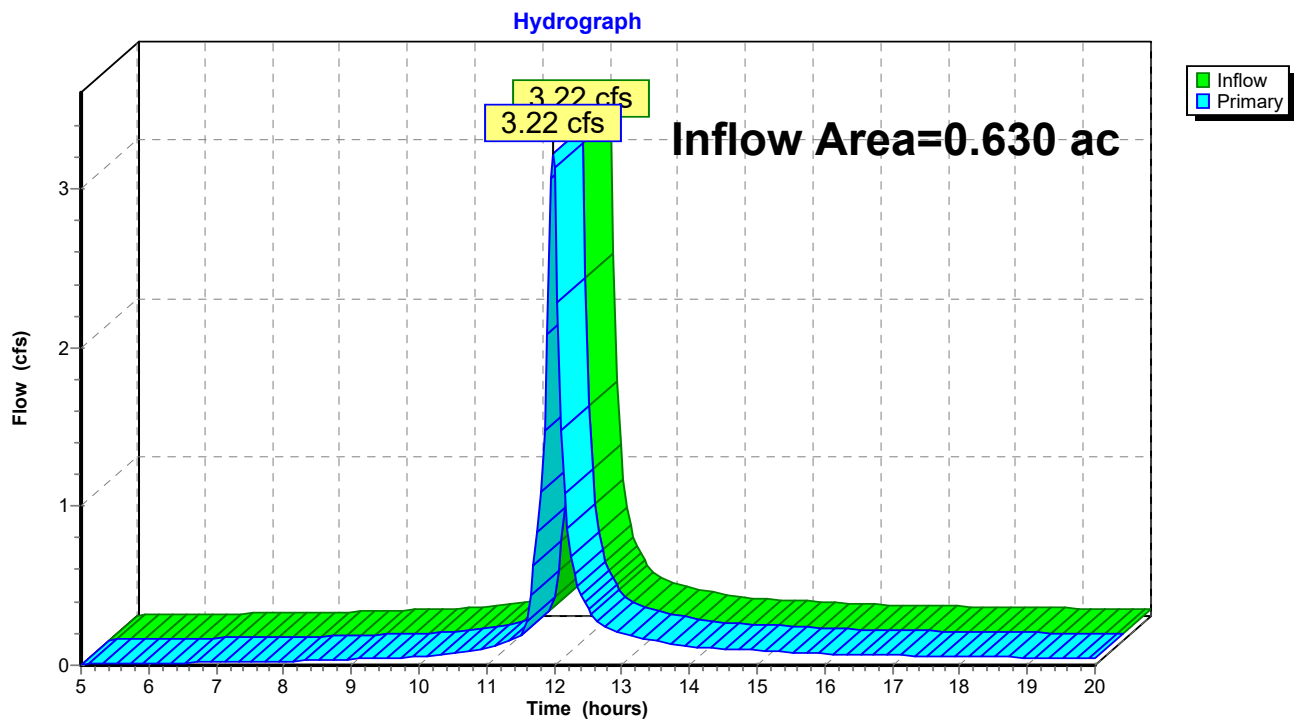
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### Summary for Link 7L: PDA-1

Inflow Area = 0.630 ac, 77.78% Impervious, Inflow Depth > 3.23" for 10-yr event  
Inflow = 3.22 cfs @ 11.98 hrs, Volume= 0.169 af  
Primary = 3.22 cfs @ 11.98 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.0 min  
Routed to Link 8L : PDA

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 7L: PDA-1



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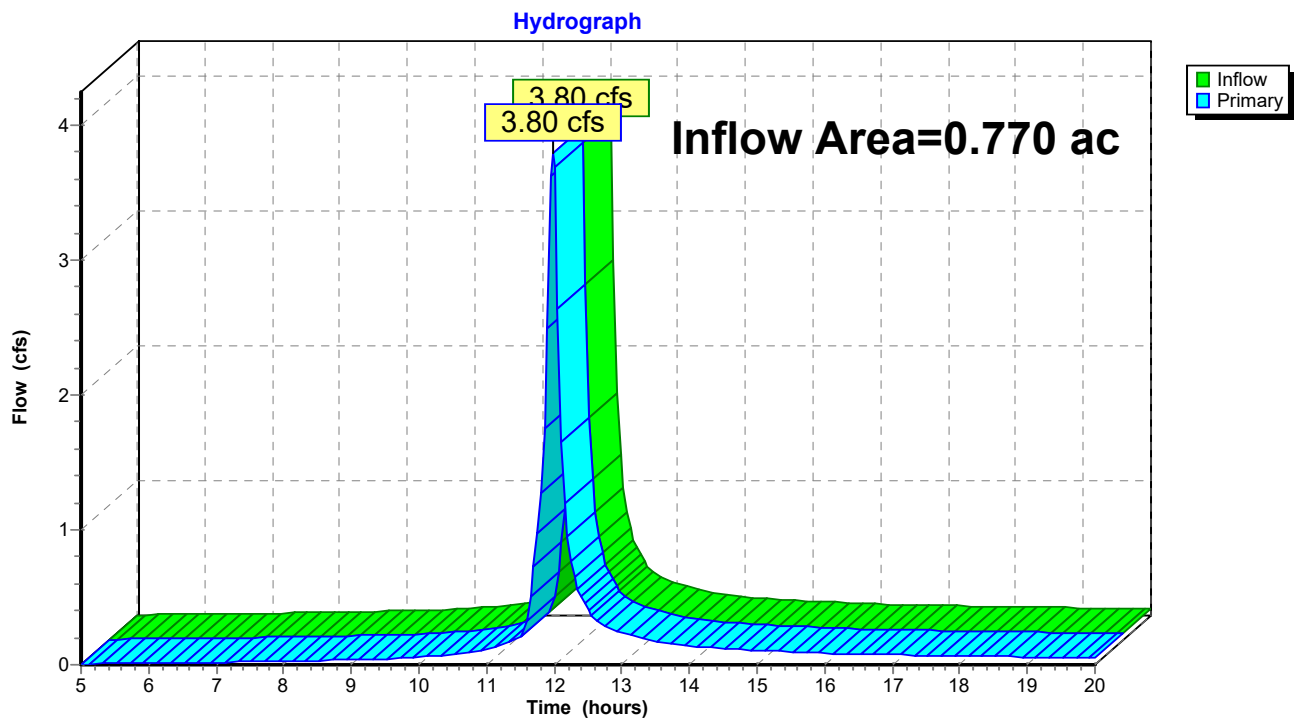
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### Summary for Link 8L: PDA

Inflow Area = 0.770 ac, 67.53% Impervious, Inflow Depth > 3.03" for 10-yr event  
Inflow = 3.80 cfs @ 11.98 hrs, Volume= 0.195 af  
Primary = 3.80 cfs @ 11.98 hrs, Volume= 0.195 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 8L: PDA



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*Type II 24-hr 25-yr Rainfall=5.96"*

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

<b>Subcatchment1S: EDA-1</b>	Runoff Area=0.590 ac 50.85% Impervious Runoff Depth>3.78" Tc=6.0 min CN=83 Runoff=3.99 cfs 0.186 af
<b>Subcatchment2S: EDA-2</b>	Runoff Area=0.180 ac 83.33% Impervious Runoff Depth>4.81" Tc=6.0 min CN=93 Runoff=1.43 cfs 0.072 af
<b>Subcatchment4S: PDA-1A</b>	Runoff Area=0.440 ac 70.45% Impervious Runoff Depth>4.40" Tc=6.0 min CN=89 Runoff=3.32 cfs 0.162 af
<b>Subcatchment5S: PDA-1B</b>	Runoff Area=0.190 ac 94.74% Impervious Runoff Depth>5.08" Tc=6.0 min CN=96 Runoff=1.55 cfs 0.081 af
<b>Subcatchment6S: PDA-2</b>	Runoff Area=0.140 ac 21.43% Impervious Runoff Depth>3.00" Tc=6.0 min CN=75 Runoff=0.78 cfs 0.035 af
<b>Pond 9P: UG-1</b>	Peak Elev=722.71' Storage=1,473 cf Inflow=1.55 cfs 0.081 af Outflow=0.96 cfs 0.059 af
<b>Link 3L: EDA</b>	Inflow=5.42 cfs 0.258 af Primary=5.42 cfs 0.258 af
<b>Link 7L: PDA-1</b>	Inflow=4.15 cfs 0.220 af Primary=4.15 cfs 0.220 af
<b>Link 8L: PDA</b>	Inflow=4.93 cfs 0.255 af Primary=4.93 cfs 0.255 af

**Total Runoff Area = 1.540 ac Runoff Volume = 0.535 af Average Runoff Depth = 4.17"**  
**37.01% Pervious = 0.570 ac 62.99% Impervious = 0.970 ac**

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Type II 24-hr 25-yr Rainfall=5.96"

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

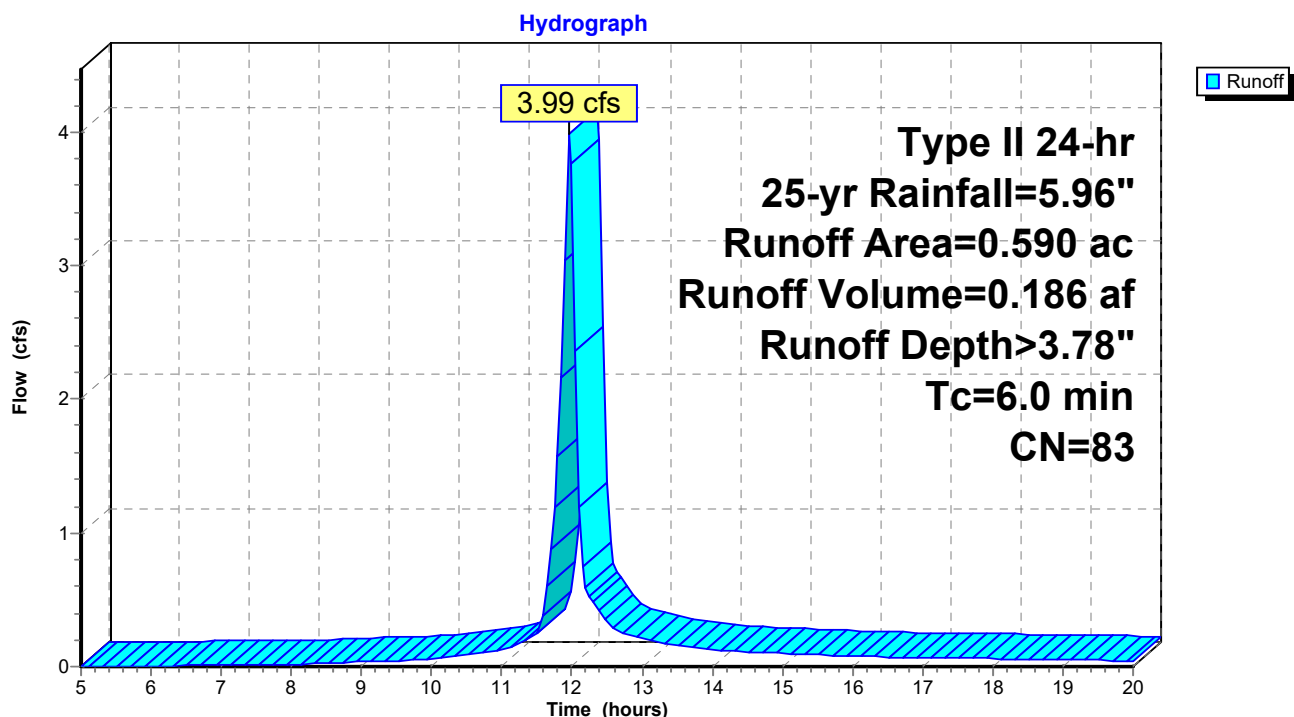
Runoff = 3.99 cfs @ 11.97 hrs, Volume= 0.186 af, Depth> 3.78"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 25-yr Rainfall=5.96"

Area (ac)	CN	Description
0.300	98	Paved parking, HSG A
0.060	60	Woods, Fair, HSG B
0.230	69	50-75% Grass cover, Fair, HSG B
0.590	83	Weighted Average
0.290		49.15% Pervious Area
0.300		50.85% Impervious Area

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

### Subcatchment 1S: EDA-1





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Type II 24-hr 25-yr Rainfall=5.96"

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

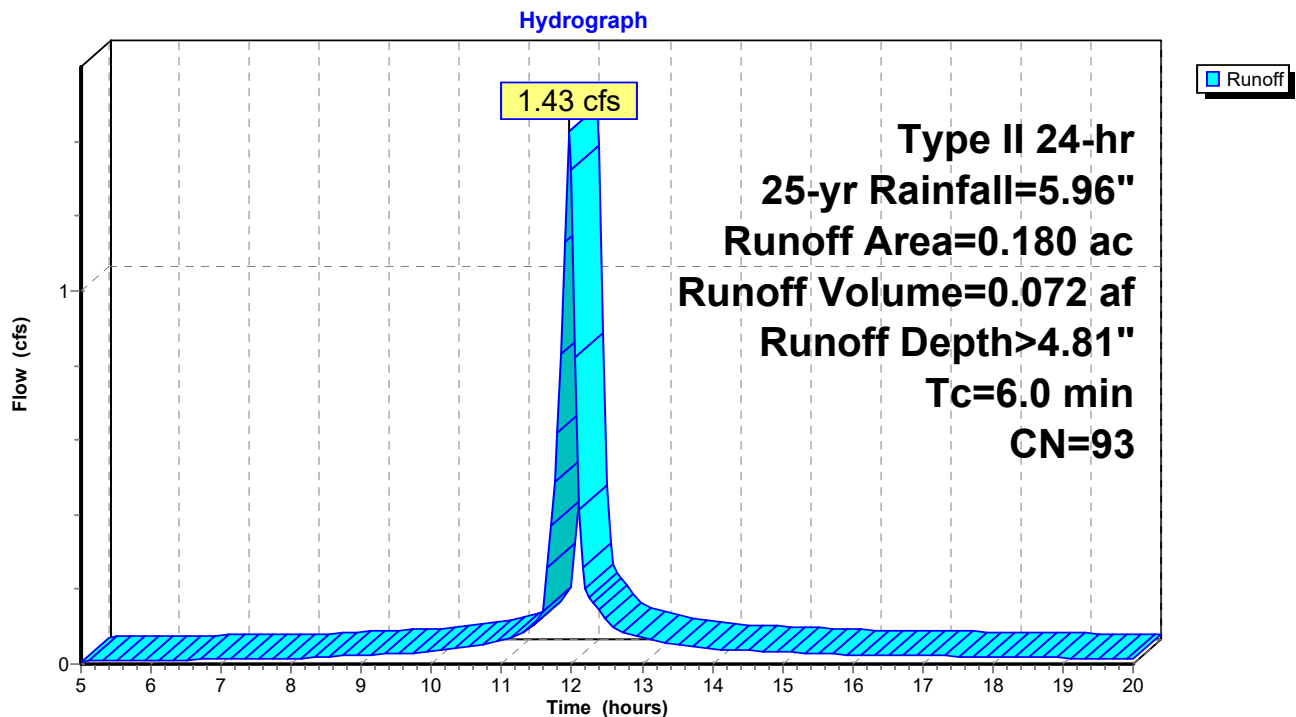
Runoff = 1.43 cfs @ 11.96 hrs, Volume= 0.072 af, Depth> 4.81"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 25-yr Rainfall=5.96"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.030	69	50-75% Grass cover, Fair, HSG B
0.180	93	Weighted Average
0.030		16.67% Pervious Area
0.150		83.33% Impervious Area

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

### Subcatchment 2S: EDA-2



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Type II 24-hr 25-yr Rainfall=5.96"

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### Summary for Subcatchment 4S: PDA-1A

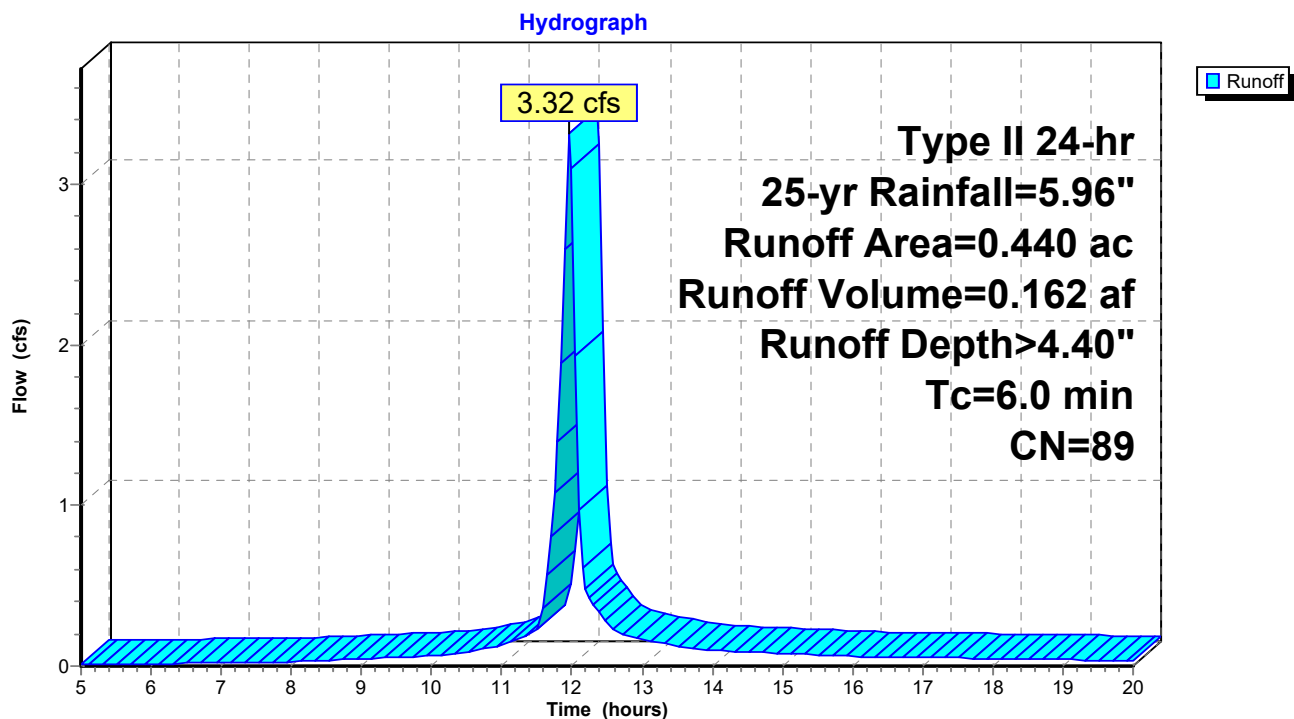
Runoff = 3.32 cfs @ 11.96 hrs, Volume= 0.162 af, Depth> 4.40"  
Routed to Link 7L : PDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 25-yr Rainfall=5.96"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.130	69	50-75% Grass cover, Fair, HSG B
0.440	89	Weighted Average
0.130		29.55% Pervious Area
0.310		70.45% Impervious Area

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

### Subcatchment 4S: PDA-1A



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Type II 24-hr 25-yr Rainfall=5.96"

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### Summary for Subcatchment 5S: PDA-1B

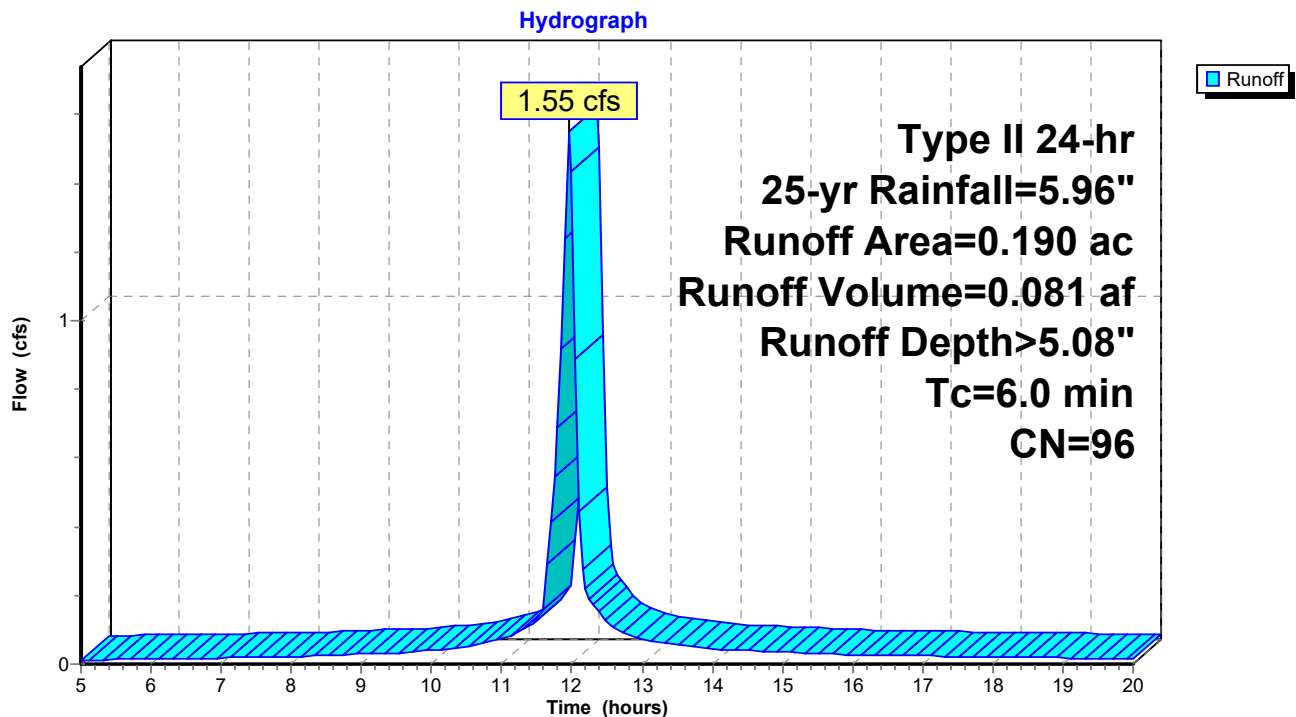
Runoff = 1.55 cfs @ 11.96 hrs, Volume= 0.081 af, Depth> 5.08"  
Routed to Pond 9P : UG-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 25-yr Rainfall=5.96"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG A
0.010	69	50-75% Grass cover, Fair, HSG B
0.190	96	Weighted Average
0.010		5.26% Pervious Area
0.180		94.74% Impervious Area

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

### Subcatchment 5S: PDA-1B



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Type II 24-hr 25-yr Rainfall=5.96"

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### Summary for Subcatchment 6S: PDA-2

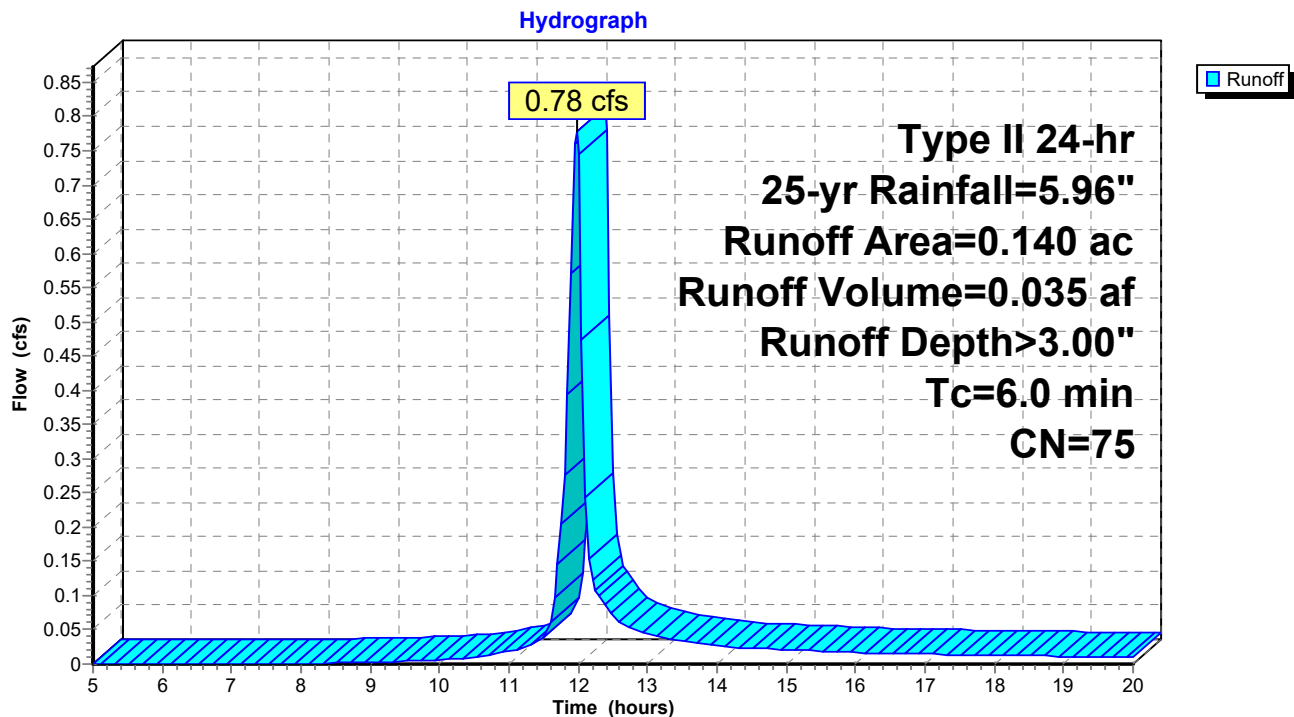
Runoff = 0.78 cfs @ 11.97 hrs, Volume= 0.035 af, Depth> 3.00"  
Routed to Link 8L : PDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 25-yr Rainfall=5.96"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.110	69	50-75% Grass cover, Fair, HSG B
0.140	75	Weighted Average
0.110		78.57% Pervious Area
0.030		21.43% Impervious Area

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

### Subcatchment 6S: PDA-2



**Stormwater Analysis (Rev)**

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Type II 24-hr 25-yr Rainfall=5.96"

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**Summary for Pond 9P: UG-1**

Inflow Area = 0.190 ac, 94.74% Impervious, Inflow Depth > 5.08" for 25-yr event  
 Inflow = 1.55 cfs @ 11.96 hrs, Volume= 0.081 af  
 Outflow = 0.96 cfs @ 12.05 hrs, Volume= 0.059 af, Atten= 38%, Lag= 5.2 min  
 Primary = 0.96 cfs @ 12.05 hrs, Volume= 0.059 af  
 Routed to Link 7L : PDA-1

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 722.71' @ 12.05 hrs Surf.Area= 512 sf Storage= 1,473 cf

Plug-Flow detention time= 112.0 min calculated for 0.059 af (73% of inflow)  
 Center-of-Mass det. time= 48.6 min ( 782.7 - 734.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	719.00'	102 cf	<b>8.00'W x 64.00'L x 4.67'H Field A</b> 2,389 cf Overall - 2,133 cf Embedded = 256 cf x 40.0% Voids
#2A	719.50'	1,496 cf	<b>retain_it retain_it 3.5' x 8 Inside #1</b> Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 1 Rows adjusted for 110.5 cf perimeter wall
		1,598 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	718.25'	<b>12.0" Round Culvert</b> L= 122.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 718.25' / 715.85' S= 0.0197 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	722.75'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	721.45'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	719.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 715.00'

Primary OutFlow Max=0.96 cfs @ 12.05 hrs HW=722.70' (Free Discharge)

- 1=Culvert (Passes 0.95 cfs of 5.94 cfs potential flow)
- 2=Orifice/Grate ( Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.95 cfs @ 4.82 fps)
- 4=Exfiltration ( Controls 0.01 cfs)

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Type II 24-hr 25-yr Rainfall=5.96"

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### Pond 9P: UG-1 - Chamber Wizard Field A

#### Chamber Model = retain\_it retain\_it 3.5' (retain-it®)

Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf

Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf

1 Rows adjusted for 110.5 cf perimeter wall

8 Chambers/Row x 8.00' Long = 64.00' Row Length

1 Rows x 96.0" Wide = 8.00' Base Width

6.0" Stone Base + 50.0" Chamber Height = 4.67' Field Height

6.1 cf Sidewall x 8 x 2 + 6.1 cf Endwall x 1 x 2 = 110.5 cf Perimeter Wall

8 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 1,495.7 cf Chamber Storage

8 Chambers x 266.7 cf = 2,133.3 cf Displacement

2,389.3 cf Field - 2,133.3 cf Chambers = 256.0 cf Stone x 40.0% Voids = 102.4 cf Stone Storage

Chamber Storage + Stone Storage = 1,598.1 cf = 0.037 af

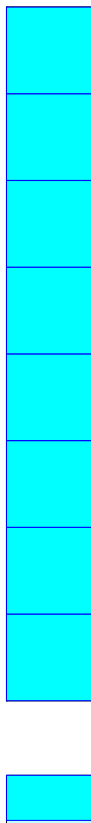
Overall Storage Efficiency = 66.9%

Overall System Size = 64.00' x 8.00' x 4.67'

8 Chambers

88.5 cy Field

9.5 cy Stone





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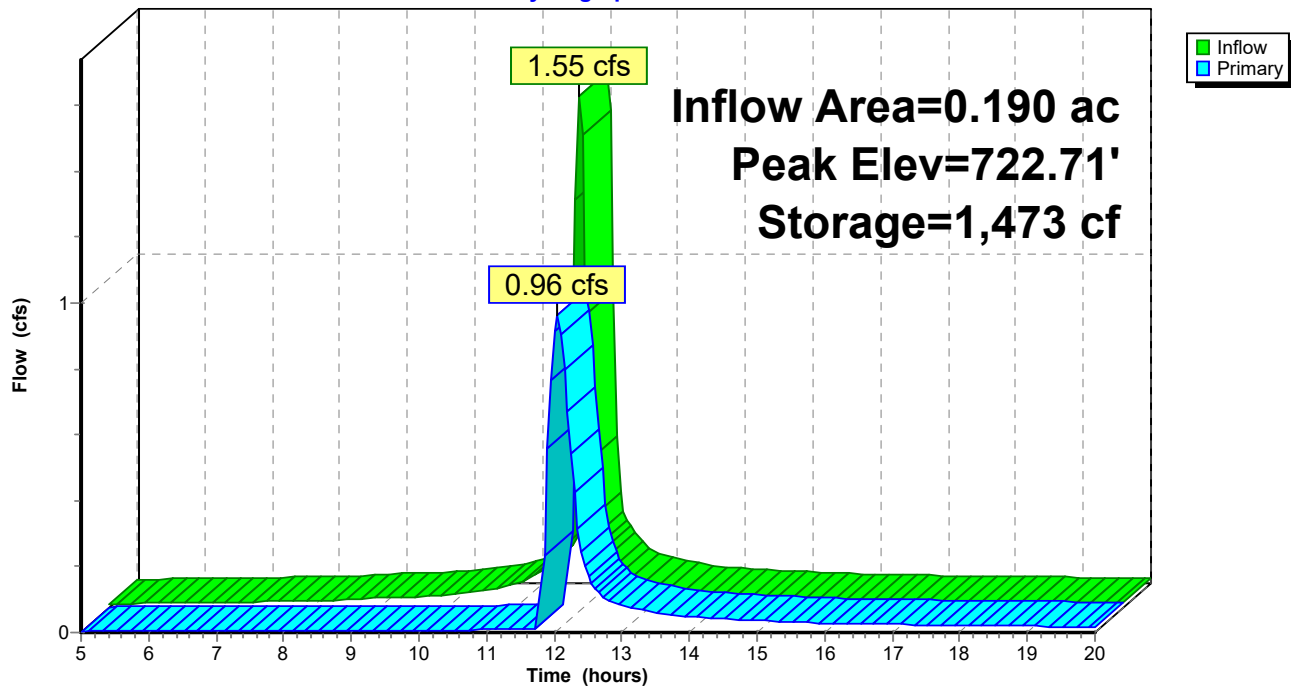
Type II 24-hr 25-yr Rainfall=5.96"

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## Pond 9P: UG-1

Hydrograph



**Stormwater Analysis (Rev)**

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Type II 24-hr 25-yr Rainfall=5.96"

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**Stage-Discharge for Pond 9P: UG-1**

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
719.00	0.00	721.65	0.12
719.05	0.01	721.70	0.18
719.10	0.01	721.75	0.24
719.15	0.01	721.80	0.31
719.20	0.01	721.85	0.37
719.25	0.01	721.90	0.44
719.30	0.01	721.95	0.48
719.35	0.01	722.00	0.53
719.40	0.01	722.05	0.57
719.45	0.01	722.10	0.61
719.50	0.01	722.15	0.65
719.55	0.01	722.20	0.68
719.60	0.01	722.25	0.71
719.65	0.01	722.30	0.74
719.70	0.01	722.35	0.77
719.75	0.01	722.40	0.80
719.80	0.01	722.45	0.83
719.85	0.01	722.50	0.86
719.90	0.01	722.55	0.88
719.95	0.01	722.60	0.91
720.00	0.01	722.65	0.93
720.05	0.01	722.70	0.96
720.10	0.01	722.75	0.98
720.15	0.01	722.80	1.12
720.20	0.01	722.85	1.35
720.25	0.01	722.90	1.64
720.30	0.01	722.95	1.99
720.35	0.01	723.00	2.37
720.40	0.01	723.05	2.80
720.45	0.01	723.10	3.26
720.50	0.01	723.15	3.54
720.55	0.01	723.20	3.71
720.60	0.01	723.25	3.86
720.65	0.01	723.30	4.01
720.70	0.01	723.35	4.16
720.75	0.01	723.40	4.29
720.80	0.01	723.45	4.43
720.85	0.01	723.50	4.56
720.90	0.01	723.55	4.68
720.95	0.01	723.60	4.80
721.00	0.01	723.65	<b>4.92</b>
721.05	0.01		
721.10	0.01		
721.15	0.01		
721.20	0.01		
721.25	0.01		
721.30	0.01		
721.35	0.01		
721.40	0.01		
721.45	0.01		
721.50	0.02		
721.55	0.04		
721.60	0.08		

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Type II 24-hr 25-yr Rainfall=5.96"

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**Stage-Area-Storage for Pond 9P: UG-1**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
719.00	512	0	721.65	512	1,021
719.05	512	10	721.70	512	1,043
719.10	512	20	721.75	512	1,064
719.15	512	31	721.80	512	1,085
719.20	512	41	721.85	512	1,107
719.25	512	51	721.90	512	1,128
719.30	512	61	721.95	512	1,149
719.35	512	72	722.00	512	1,171
719.40	512	82	722.05	512	1,192
719.45	512	92	722.10	512	1,214
719.50	512	102	722.15	512	1,235
719.55	512	124	722.20	512	1,256
719.60	512	145	722.25	512	1,278
719.65	512	167	722.30	512	1,299
719.70	512	188	722.35	512	1,320
719.75	512	209	722.40	512	1,342
719.80	512	231	722.45	512	1,363
719.85	512	252	722.50	512	1,384
719.90	512	273	722.55	512	1,406
719.95	512	295	722.60	512	1,427
720.00	512	316	722.65	512	1,449
720.05	512	337	722.70	512	1,470
720.10	512	359	722.75	512	1,491
720.15	512	380	722.80	512	1,513
720.20	512	402	722.85	512	1,534
720.25	512	423	722.90	512	1,555
720.30	512	444	722.95	512	1,577
720.35	512	466	723.00	512	1,598
720.40	512	487	723.05	512	1,598
720.45	512	508	723.10	512	1,598
720.50	512	530	723.15	512	1,598
720.55	512	551	723.20	512	1,598
720.60	512	572	723.25	512	1,598
720.65	512	594	723.30	512	1,598
720.70	512	615	723.35	512	1,598
720.75	512	637	723.40	512	1,598
720.80	512	658	723.45	512	1,598
720.85	512	679	723.50	512	1,598
720.90	512	701	723.55	512	1,598
720.95	512	722	723.60	512	1,598
721.00	512	743	723.65	512	1,598
721.05	512	765			
721.10	512	786			
721.15	512	808			
721.20	512	829			
721.25	512	850			
721.30	512	872			
721.35	512	893			
721.40	512	914			
721.45	512	936			
721.50	512	957			
721.55	512	978			
721.60	512	1,000			

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Type II 24-hr 25-yr Rainfall=5.96"

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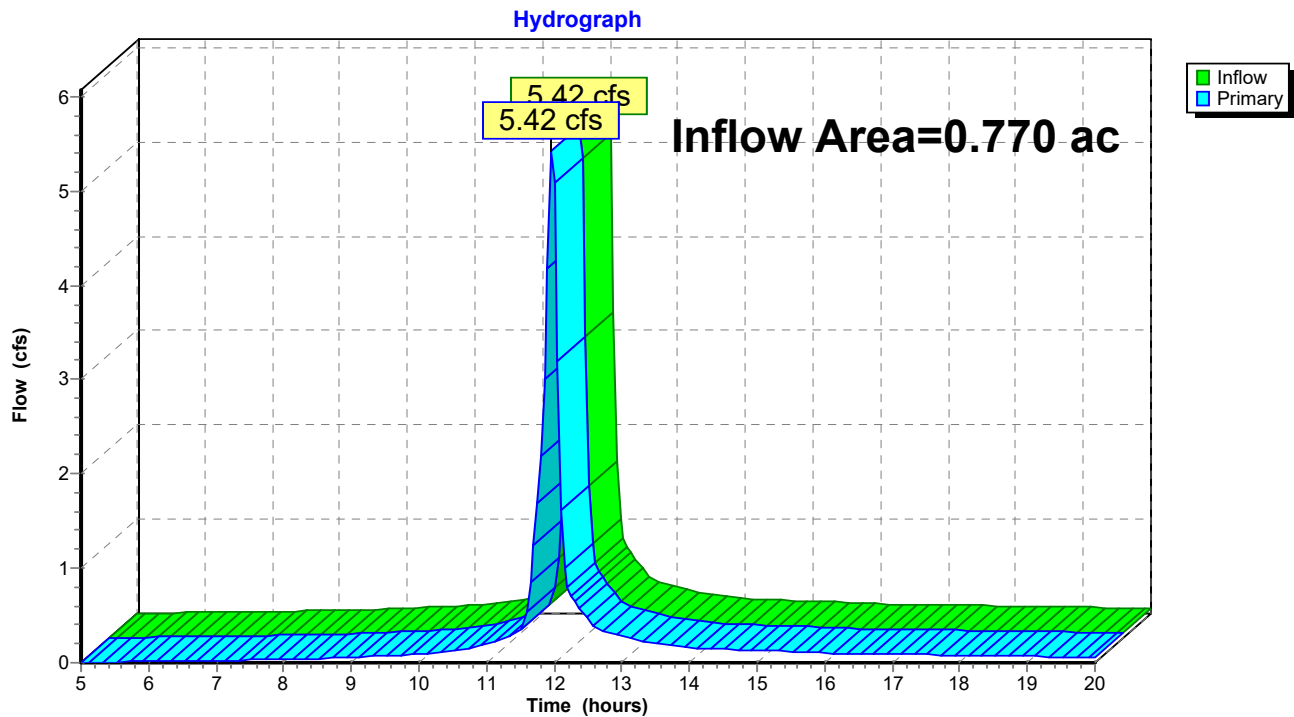
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### Summary for Link 3L: EDA

Inflow Area = 0.770 ac, 58.44% Impervious, Inflow Depth > 4.02" for 25-yr event  
Inflow = 5.42 cfs @ 11.97 hrs, Volume= 0.258 af  
Primary = 5.42 cfs @ 11.97 hrs, Volume= 0.258 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: EDA



## Stormwater Analysis (Rev)

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Type II 24-hr 25-yr Rainfall=5.96"

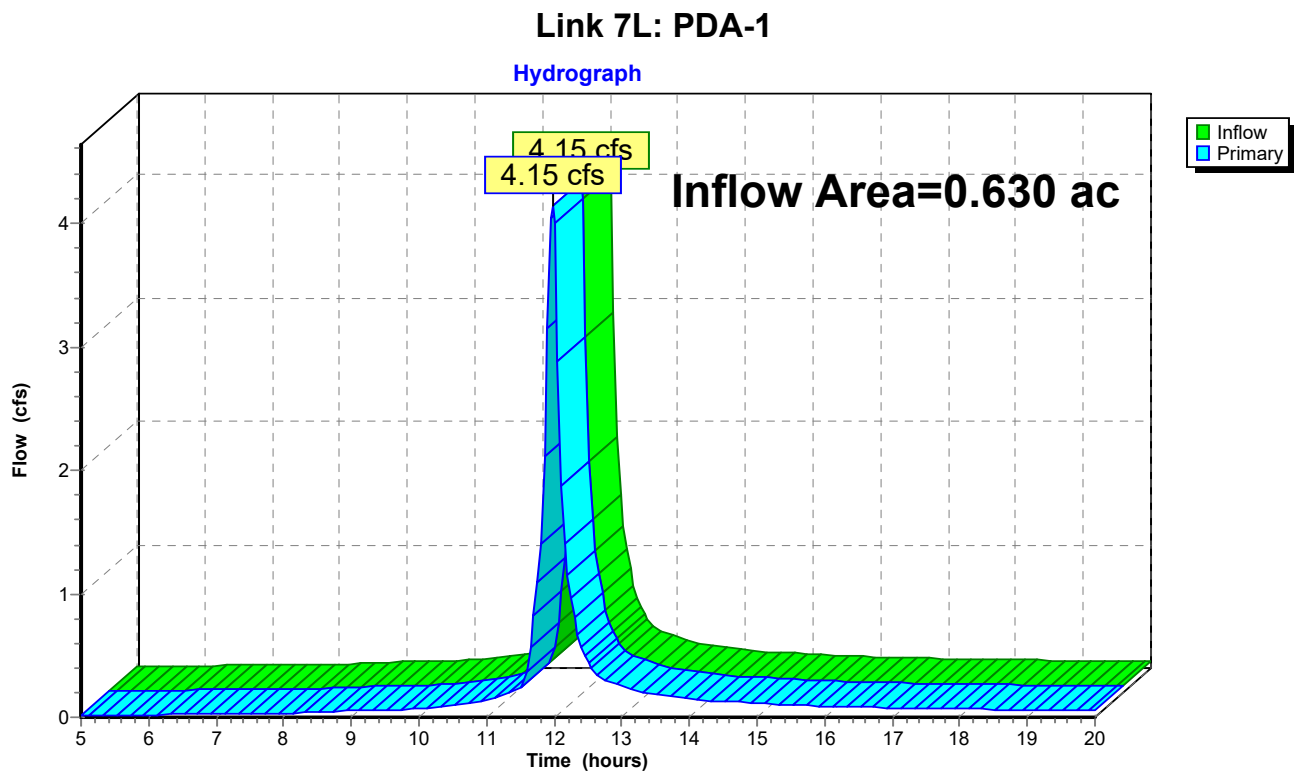
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### Summary for Link 7L: PDA-1

Inflow Area = 0.630 ac, 77.78% Impervious, Inflow Depth > 4.19" for 25-yr event  
Inflow = 4.15 cfs @ 11.97 hrs, Volume= 0.220 af  
Primary = 4.15 cfs @ 11.97 hrs, Volume= 0.220 af, Atten= 0%, Lag= 0.0 min  
Routed to Link 8L : PDA

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



## Stormwater Analysis (Rev)

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Type II 24-hr 25-yr Rainfall=5.96"

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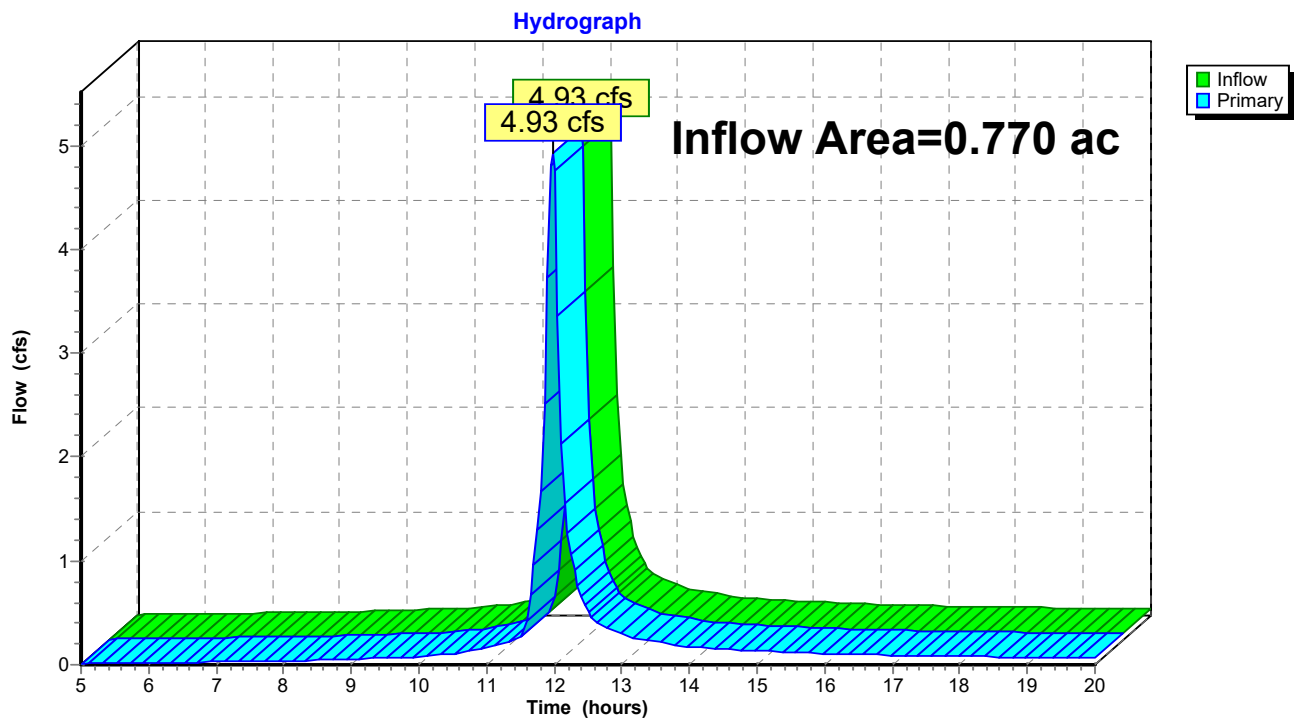
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### Summary for Link 8L: PDA

Inflow Area = 0.770 ac, 67.53% Impervious, Inflow Depth > 3.98" for 25-yr event  
Inflow = 4.93 cfs @ 11.97 hrs, Volume= 0.255 af  
Primary = 4.93 cfs @ 11.97 hrs, Volume= 0.255 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 8L: PDA





**Stormwater Analysis (Rev)**

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*Type II 24-hr 50-yr Rainfall=6.75"*

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

<b>Subcatchment1S: EDA-1</b>	Runoff Area=0.590 ac 50.85% Impervious Runoff Depth>4.48" Tc=6.0 min CN=83 Runoff=4.67 cfs 0.220 af
<b>Subcatchment2S: EDA-2</b>	Runoff Area=0.180 ac 83.33% Impervious Runoff Depth>5.53" Tc=6.0 min CN=93 Runoff=1.63 cfs 0.083 af
<b>Subcatchment4S: PDA-1A</b>	Runoff Area=0.440 ac 70.45% Impervious Runoff Depth>5.12" Tc=6.0 min CN=89 Runoff=3.82 cfs 0.188 af
<b>Subcatchment5S: PDA-1B</b>	Runoff Area=0.190 ac 94.74% Impervious Runoff Depth>5.80" Tc=6.0 min CN=96 Runoff=1.76 cfs 0.092 af
<b>Subcatchment6S: PDA-2</b>	Runoff Area=0.140 ac 21.43% Impervious Runoff Depth>3.64" Tc=6.0 min CN=75 Runoff=0.94 cfs 0.042 af
<b>Pond 9P: UG-1</b>	Peak Elev=722.86' Storage=1,538 cf Inflow=1.76 cfs 0.092 af Outflow=1.35 cfs 0.070 af
<b>Link 3L: EDA</b>	Inflow=6.31 cfs 0.303 af Primary=6.31 cfs 0.303 af
<b>Link 7L: PDA-1</b>	Inflow=4.94 cfs 0.258 af Primary=4.94 cfs 0.258 af
<b>Link 8L: PDA</b>	Inflow=5.88 cfs 0.300 af Primary=5.88 cfs 0.300 af

**Total Runoff Area = 1.540 ac Runoff Volume = 0.626 af Average Runoff Depth = 4.87"**  
**37.01% Pervious = 0.570 ac 62.99% Impervious = 0.970 ac**

## Stormwater Analysis (Rev)

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Type II 24-hr 50-yr Rainfall=6.75"

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

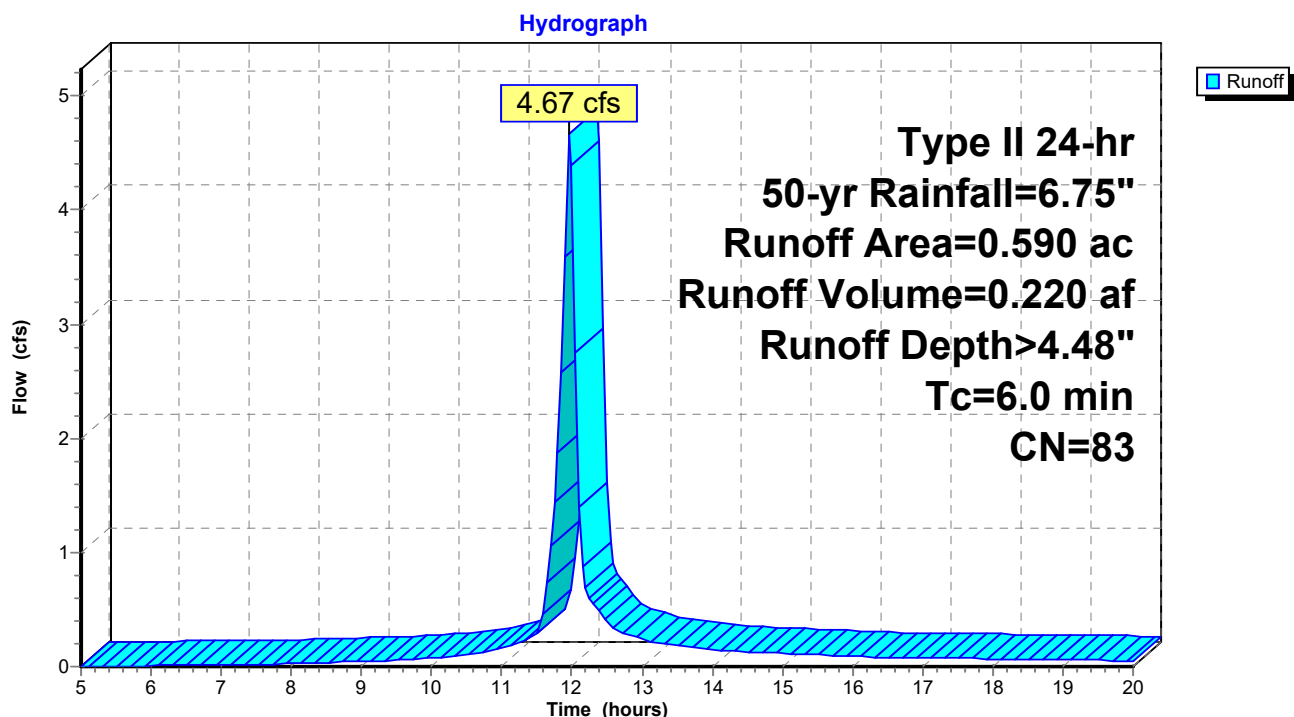
Runoff = 4.67 cfs @ 11.97 hrs, Volume= 0.220 af, Depth> 4.48"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 50-yr Rainfall=6.75"

Area (ac)	CN	Description
0.300	98	Paved parking, HSG A
0.060	60	Woods, Fair, HSG B
0.230	69	50-75% Grass cover, Fair, HSG B
0.590	83	Weighted Average
0.290		49.15% Pervious Area
0.300		50.85% Impervious Area

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

### Subcatchment 1S: EDA-1



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Type II 24-hr 50-yr Rainfall=6.75"

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

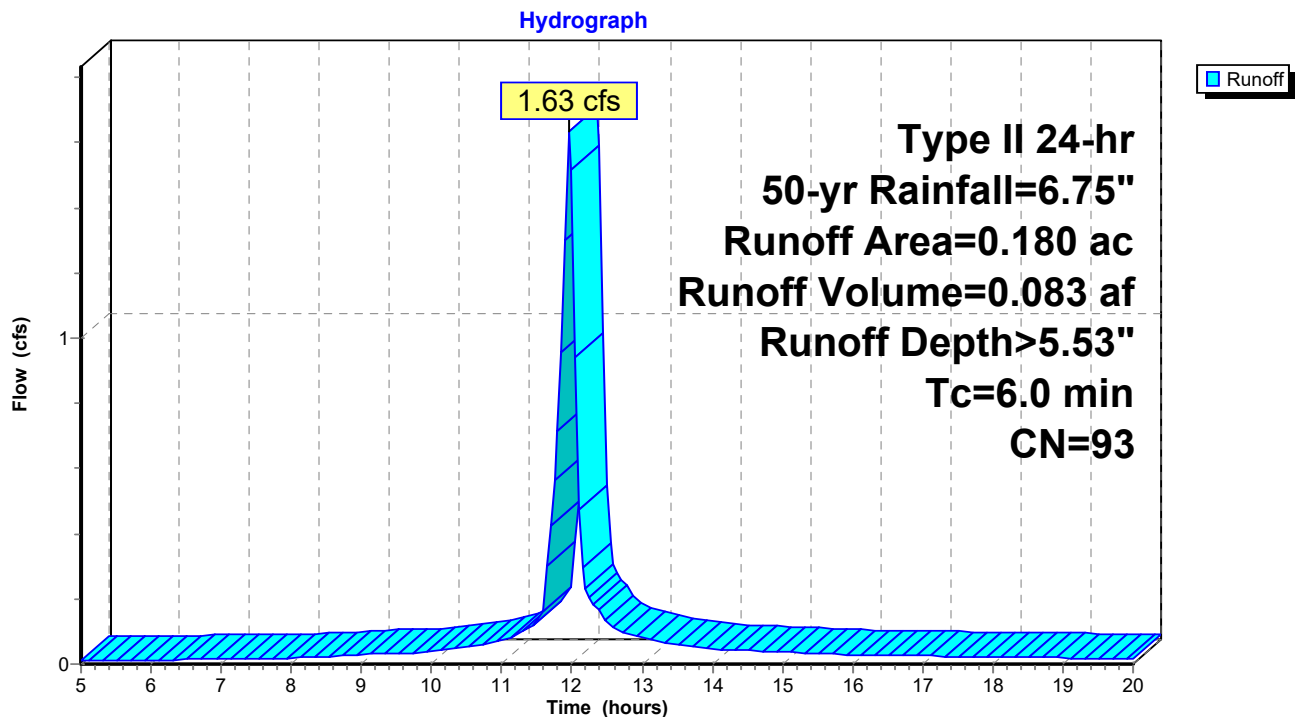
Runoff = 1.63 cfs @ 11.96 hrs, Volume= 0.083 af, Depth> 5.53"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 50-yr Rainfall=6.75"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.030	69	50-75% Grass cover, Fair, HSG B
0.180	93	Weighted Average
0.030		16.67% Pervious Area
0.150		83.33% Impervious Area

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

### Subcatchment 2S: EDA-2



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Type II 24-hr 50-yr Rainfall=6.75"

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### Summary for Subcatchment 4S: PDA-1A

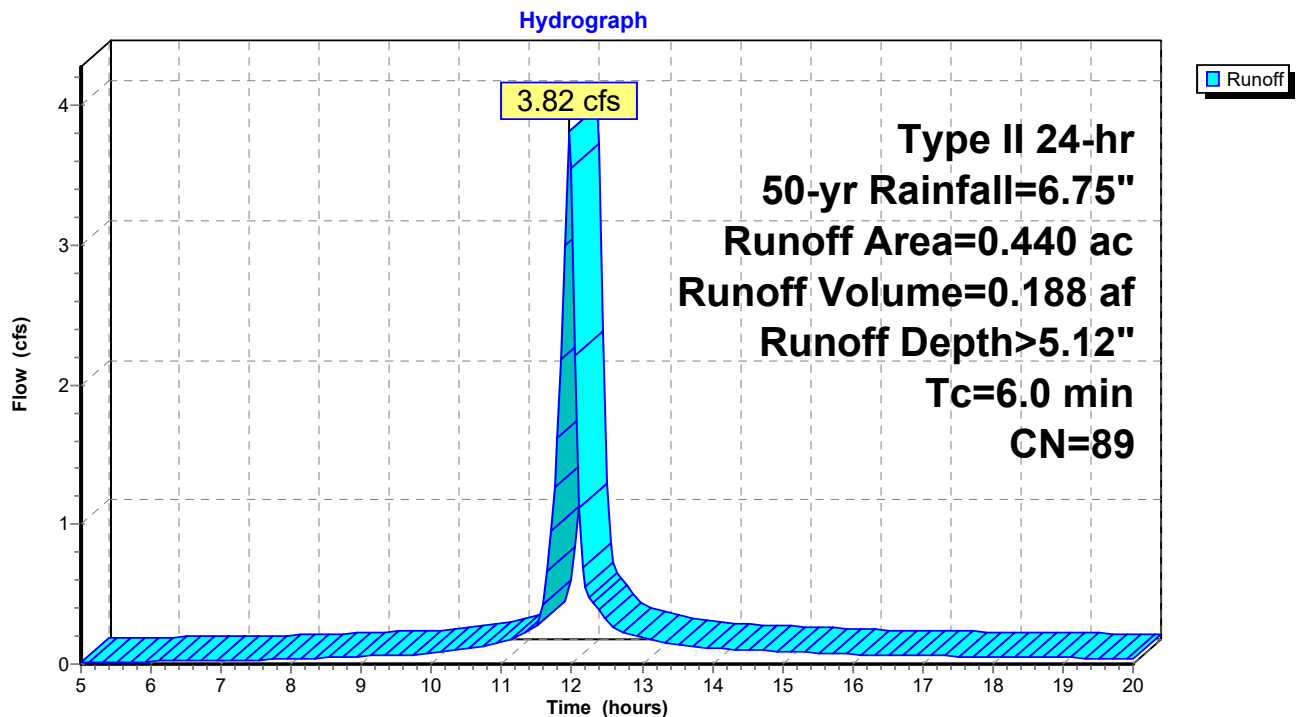
Runoff = 3.82 cfs @ 11.96 hrs, Volume= 0.188 af, Depth> 5.12"  
Routed to Link 7L : PDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 50-yr Rainfall=6.75"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.130	69	50-75% Grass cover, Fair, HSG B
0.440	89	Weighted Average
0.130		29.55% Pervious Area
0.310		70.45% Impervious Area

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

### Subcatchment 4S: PDA-1A



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Type II 24-hr 50-yr Rainfall=6.75"

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### Summary for Subcatchment 5S: PDA-1B

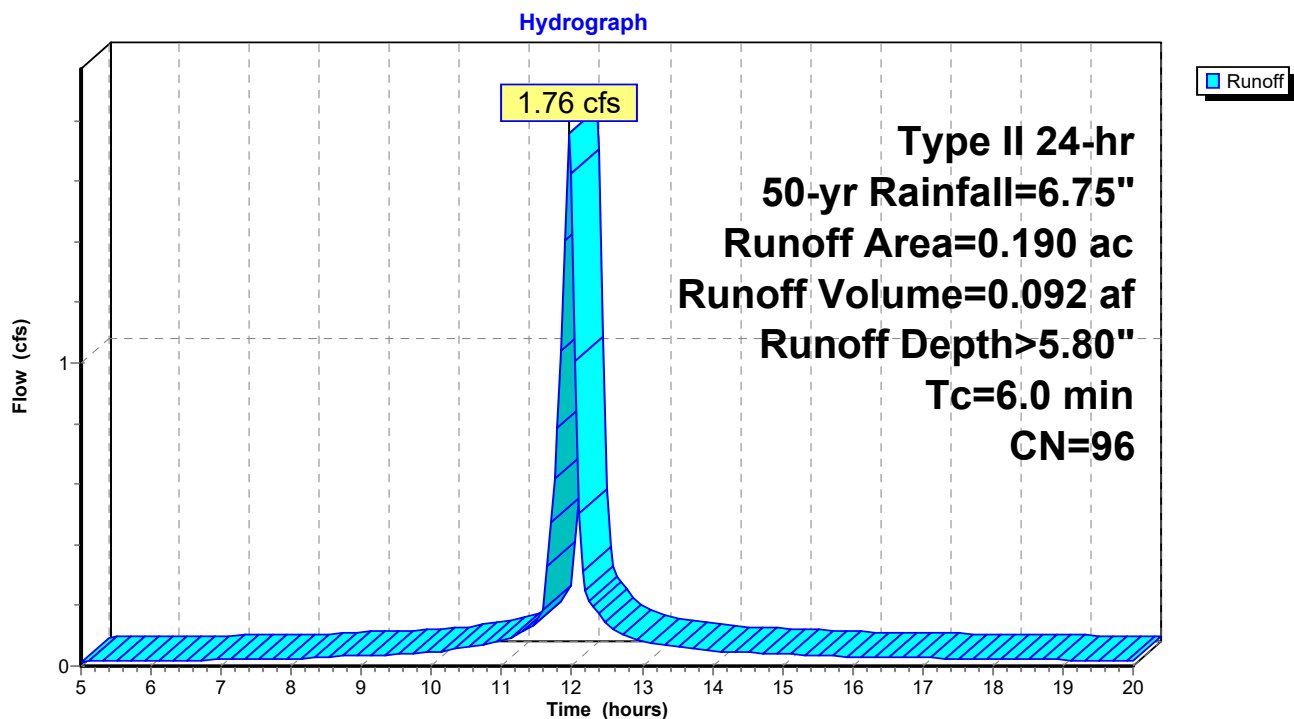
Runoff = 1.76 cfs @ 11.96 hrs, Volume= 0.092 af, Depth> 5.80"  
Routed to Pond 9P : UG-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 50-yr Rainfall=6.75"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG A
0.010	69	50-75% Grass cover, Fair, HSG B
0.190	96	Weighted Average
0.010		5.26% Pervious Area
0.180		94.74% Impervious Area

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

### Subcatchment 5S: PDA-1B



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Type II 24-hr 50-yr Rainfall=6.75"

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### Summary for Subcatchment 6S: PDA-2

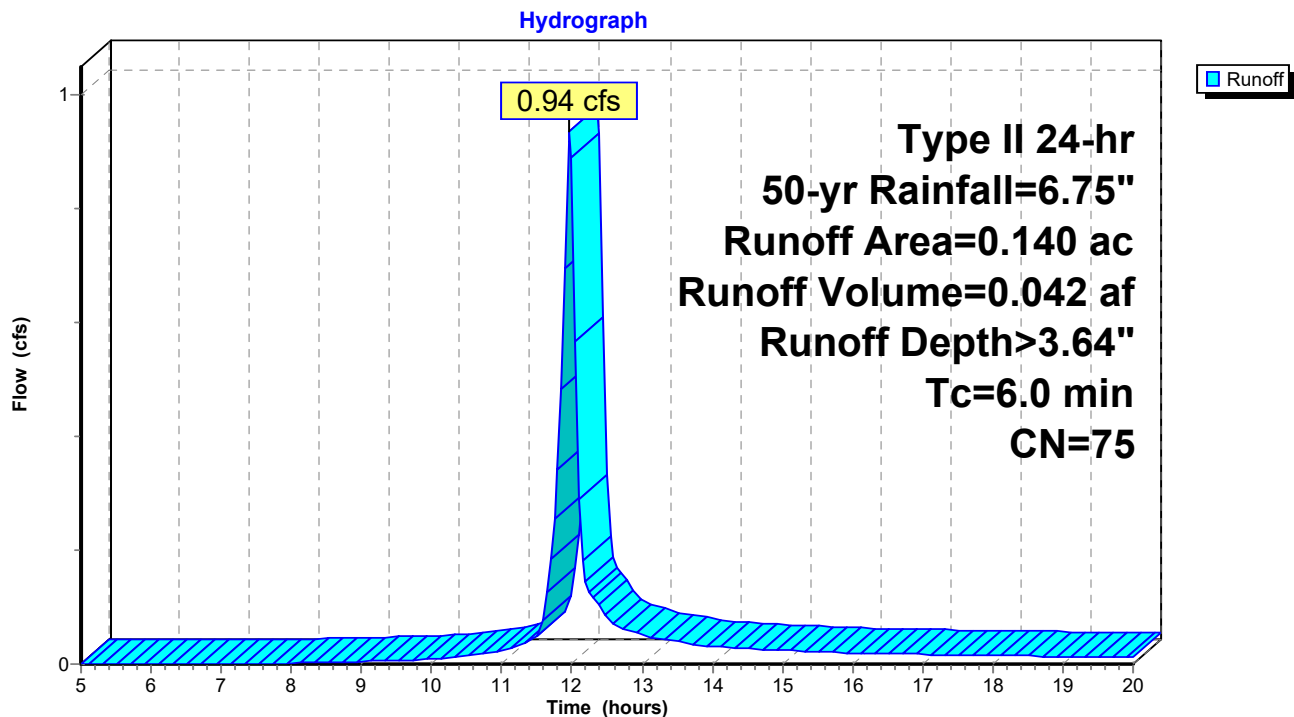
Runoff = 0.94 cfs @ 11.97 hrs, Volume= 0.042 af, Depth> 3.64"  
Routed to Link 8L : PDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 50-yr Rainfall=6.75"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.110	69	50-75% Grass cover, Fair, HSG B
0.140	75	Weighted Average
0.110		78.57% Pervious Area
0.030		21.43% Impervious Area

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

### Subcatchment 6S: PDA-2





**Stormwater Analysis (Rev)**

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Type II 24-hr 50-yr Rainfall=6.75"

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**Summary for Pond 9P: UG-1**

Inflow Area = 0.190 ac, 94.74% Impervious, Inflow Depth > 5.80" for 50-yr event  
 Inflow = 1.76 cfs @ 11.96 hrs, Volume= 0.092 af  
 Outflow = 1.35 cfs @ 12.03 hrs, Volume= 0.070 af, Atten= 23%, Lag= 4.2 min  
 Primary = 1.35 cfs @ 12.03 hrs, Volume= 0.070 af  
 Routed to Link 7L : PDA-1

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 722.86' @ 12.03 hrs Surf.Area= 512 sf Storage= 1,538 cf

Plug-Flow detention time= 106.0 min calculated for 0.070 af (76% of inflow)  
 Center-of-Mass det. time= 47.2 min ( 780.1 - 732.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	719.00'	102 cf	<b>8.00'W x 64.00'L x 4.67'H Field A</b> 2,389 cf Overall - 2,133 cf Embedded = 256 cf x 40.0% Voids
#2A	719.50'	1,496 cf	<b>retain_it retain_it 3.5' x 8 Inside #1</b> Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 1 Rows adjusted for 110.5 cf perimeter wall
		1,598 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	718.25'	<b>12.0" Round Culvert</b> L= 122.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 718.25' / 715.85' S= 0.0197 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	722.75'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	721.45'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	719.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 715.00'

Primary OutFlow Max=1.30 cfs @ 12.03 hrs HW=722.84' (Free Discharge)

- 1=Culvert (Passes 1.28 cfs of 6.04 cfs potential flow)
- 2=Orifice/Grate (Weir Controls 0.27 cfs @ 0.98 fps)
- 3=Orifice/Grate (Orifice Controls 1.01 cfs @ 5.14 fps)
- 4=Exfiltration ( Controls 0.01 cfs)

## Stormwater Analysis (Rev)

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Type II 24-hr 50-yr Rainfall=6.75"

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### Pond 9P: UG-1 - Chamber Wizard Field A

#### Chamber Model = retain\_it retain\_it 3.5' (retain-it®)

Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf

Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf

1 Rows adjusted for 110.5 cf perimeter wall

8 Chambers/Row x 8.00' Long = 64.00' Row Length

1 Rows x 96.0" Wide = 8.00' Base Width

6.0" Stone Base + 50.0" Chamber Height = 4.67' Field Height

6.1 cf Sidewall x 8 x 2 + 6.1 cf Endwall x 1 x 2 = 110.5 cf Perimeter Wall

8 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 1,495.7 cf Chamber Storage

8 Chambers x 266.7 cf = 2,133.3 cf Displacement

2,389.3 cf Field - 2,133.3 cf Chambers = 256.0 cf Stone x 40.0% Voids = 102.4 cf Stone Storage

Chamber Storage + Stone Storage = 1,598.1 cf = 0.037 af

Overall Storage Efficiency = 66.9%

Overall System Size = 64.00' x 8.00' x 4.67'

8 Chambers

88.5 cy Field

9.5 cy Stone



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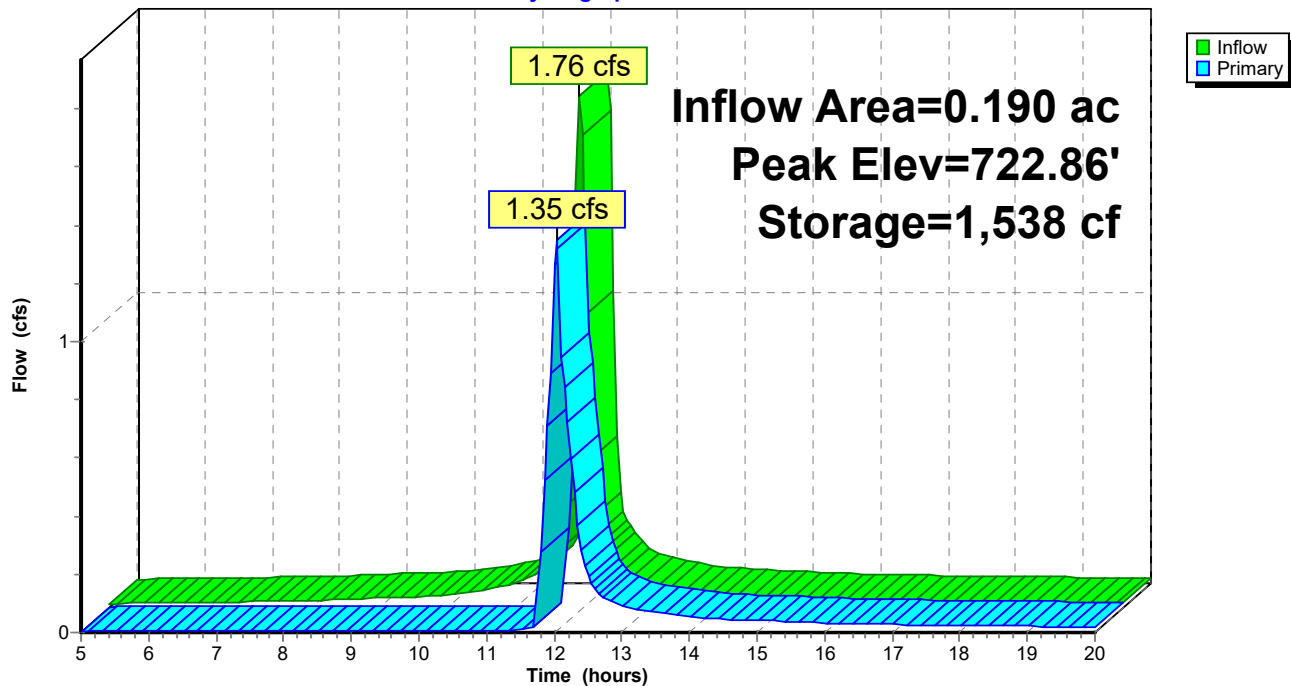
Type II 24-hr 50-yr Rainfall=6.75"

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## Pond 9P: UG-1

Hydrograph



**Stormwater Analysis (Rev)**

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Type II 24-hr 50-yr Rainfall=6.75"

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**Stage-Discharge for Pond 9P: UG-1**

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
719.00	0.00	721.65	0.12
719.05	0.01	721.70	0.18
719.10	0.01	721.75	0.24
719.15	0.01	721.80	0.31
719.20	0.01	721.85	0.37
719.25	0.01	721.90	0.44
719.30	0.01	721.95	0.48
719.35	0.01	722.00	0.53
719.40	0.01	722.05	0.57
719.45	0.01	722.10	0.61
719.50	0.01	722.15	0.65
719.55	0.01	722.20	0.68
719.60	0.01	722.25	0.71
719.65	0.01	722.30	0.74
719.70	0.01	722.35	0.77
719.75	0.01	722.40	0.80
719.80	0.01	722.45	0.83
719.85	0.01	722.50	0.86
719.90	0.01	722.55	0.88
719.95	0.01	722.60	0.91
720.00	0.01	722.65	0.93
720.05	0.01	722.70	0.96
720.10	0.01	722.75	0.98
720.15	0.01	722.80	1.12
720.20	0.01	722.85	1.35
720.25	0.01	722.90	1.64
720.30	0.01	722.95	1.99
720.35	0.01	723.00	2.37
720.40	0.01	723.05	2.80
720.45	0.01	723.10	3.26
720.50	0.01	723.15	3.54
720.55	0.01	723.20	3.71
720.60	0.01	723.25	3.86
720.65	0.01	723.30	4.01
720.70	0.01	723.35	4.16
720.75	0.01	723.40	4.29
720.80	0.01	723.45	4.43
720.85	0.01	723.50	4.56
720.90	0.01	723.55	4.68
720.95	0.01	723.60	4.80
721.00	0.01	723.65	<b>4.92</b>
721.05	0.01		
721.10	0.01		
721.15	0.01		
721.20	0.01		
721.25	0.01		
721.30	0.01		
721.35	0.01		
721.40	0.01		
721.45	0.01		
721.50	0.02		
721.55	0.04		
721.60	0.08		

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Type II 24-hr 50-yr Rainfall=6.75"

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**Stage-Area-Storage for Pond 9P: UG-1**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
719.00	512	0	721.65	512	1,021
719.05	512	10	721.70	512	1,043
719.10	512	20	721.75	512	1,064
719.15	512	31	721.80	512	1,085
719.20	512	41	721.85	512	1,107
719.25	512	51	721.90	512	1,128
719.30	512	61	721.95	512	1,149
719.35	512	72	722.00	512	1,171
719.40	512	82	722.05	512	1,192
719.45	512	92	722.10	512	1,214
719.50	512	102	722.15	512	1,235
719.55	512	124	722.20	512	1,256
719.60	512	145	722.25	512	1,278
719.65	512	167	722.30	512	1,299
719.70	512	188	722.35	512	1,320
719.75	512	209	722.40	512	1,342
719.80	512	231	722.45	512	1,363
719.85	512	252	722.50	512	1,384
719.90	512	273	722.55	512	1,406
719.95	512	295	722.60	512	1,427
720.00	512	316	722.65	512	1,449
720.05	512	337	722.70	512	1,470
720.10	512	359	722.75	512	1,491
720.15	512	380	722.80	512	1,513
720.20	512	402	722.85	512	1,534
720.25	512	423	722.90	512	1,555
720.30	512	444	722.95	512	1,577
720.35	512	466	723.00	512	1,598
720.40	512	487	723.05	512	1,598
720.45	512	508	723.10	512	1,598
720.50	512	530	723.15	512	1,598
720.55	512	551	723.20	512	1,598
720.60	512	572	723.25	512	1,598
720.65	512	594	723.30	512	1,598
720.70	512	615	723.35	512	1,598
720.75	512	637	723.40	512	1,598
720.80	512	658	723.45	512	1,598
720.85	512	679	723.50	512	1,598
720.90	512	701	723.55	512	1,598
720.95	512	722	723.60	512	1,598
721.00	512	743	723.65	512	1,598
721.05	512	765			
721.10	512	786			
721.15	512	808			
721.20	512	829			
721.25	512	850			
721.30	512	872			
721.35	512	893			
721.40	512	914			
721.45	512	936			
721.50	512	957			
721.55	512	978			
721.60	512	1,000			

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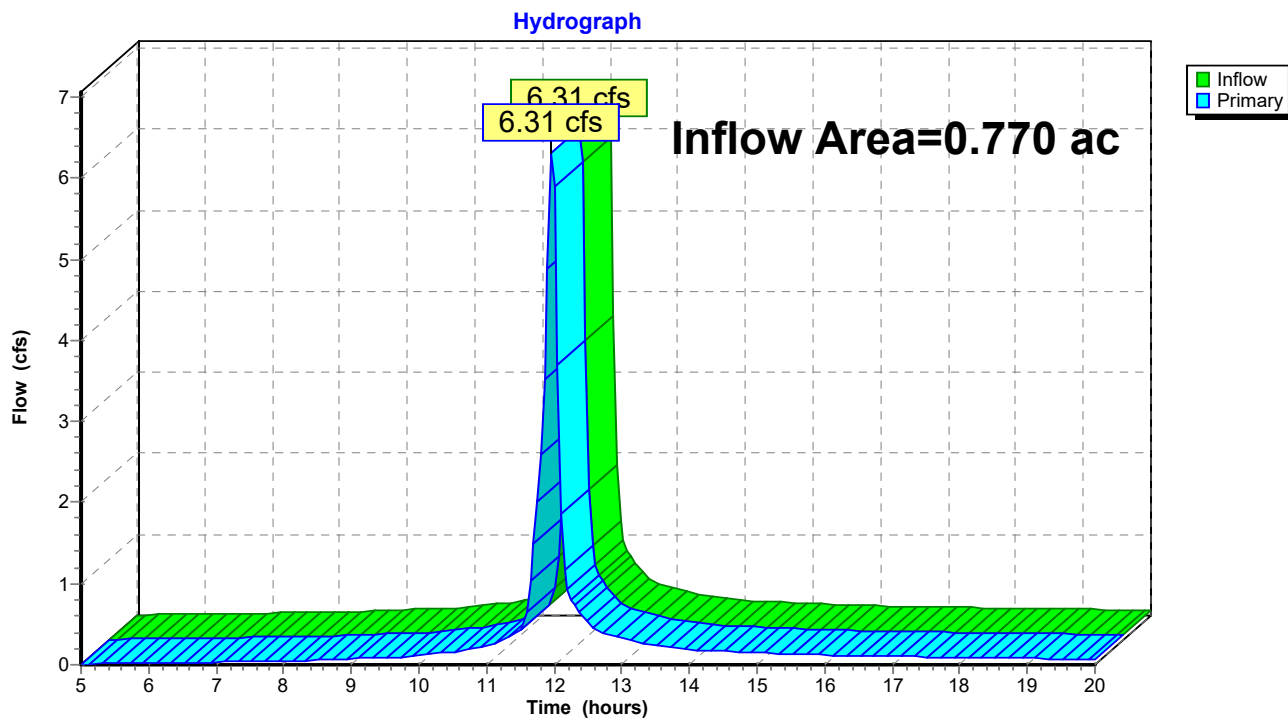
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### Summary for Link 3L: EDA

Inflow Area = 0.770 ac, 58.44% Impervious, Inflow Depth > 4.73" for 50-yr event  
Inflow = 6.31 cfs @ 11.97 hrs, Volume= 0.303 af  
Primary = 6.31 cfs @ 11.97 hrs, Volume= 0.303 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: EDA



## Stormwater Analysis (Rev)

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Type II 24-hr 50-yr Rainfall=6.75"

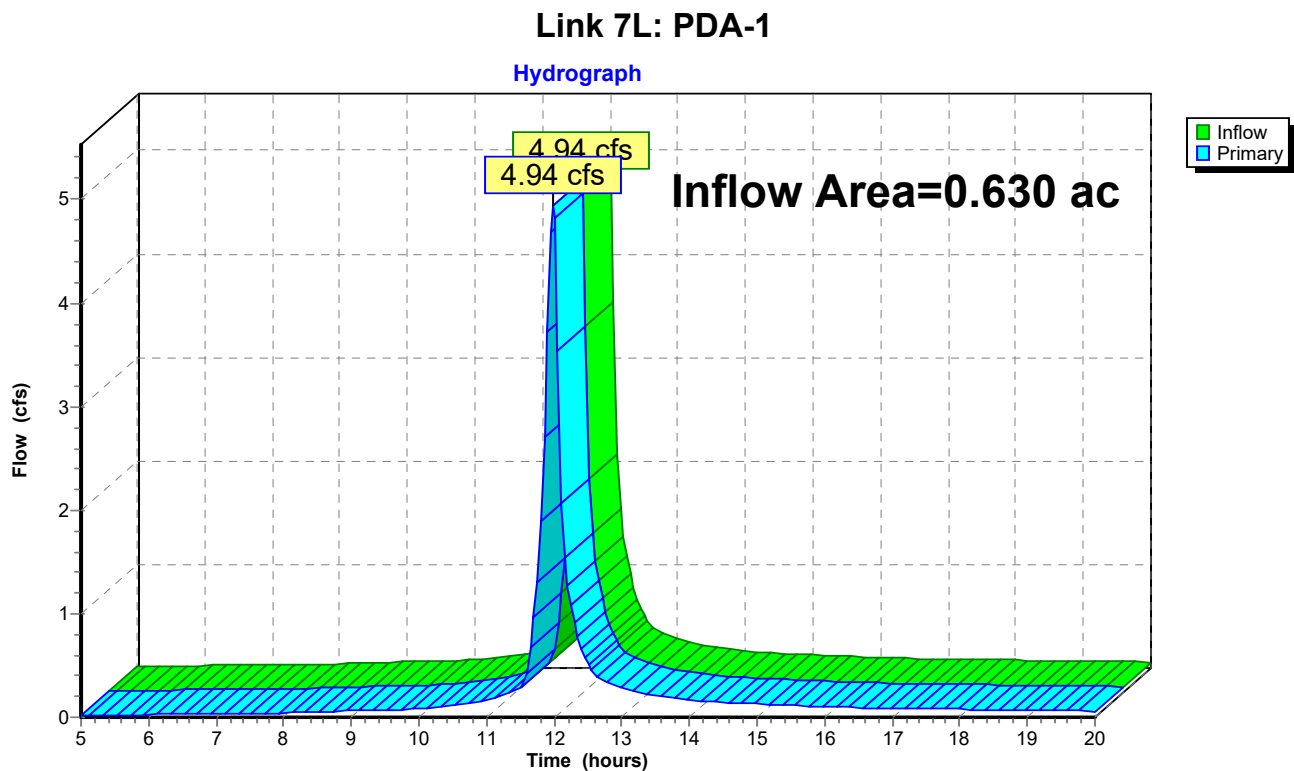
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### Summary for Link 7L: PDA-1

Inflow Area = 0.630 ac, 77.78% Impervious, Inflow Depth > 4.91" for 50-yr event  
Inflow = 4.94 cfs @ 11.98 hrs, Volume= 0.258 af  
Primary = 4.94 cfs @ 11.98 hrs, Volume= 0.258 af, Atten= 0%, Lag= 0.0 min  
Routed to Link 8L : PDA

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs





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Type II 24-hr 50-yr Rainfall=6.75"

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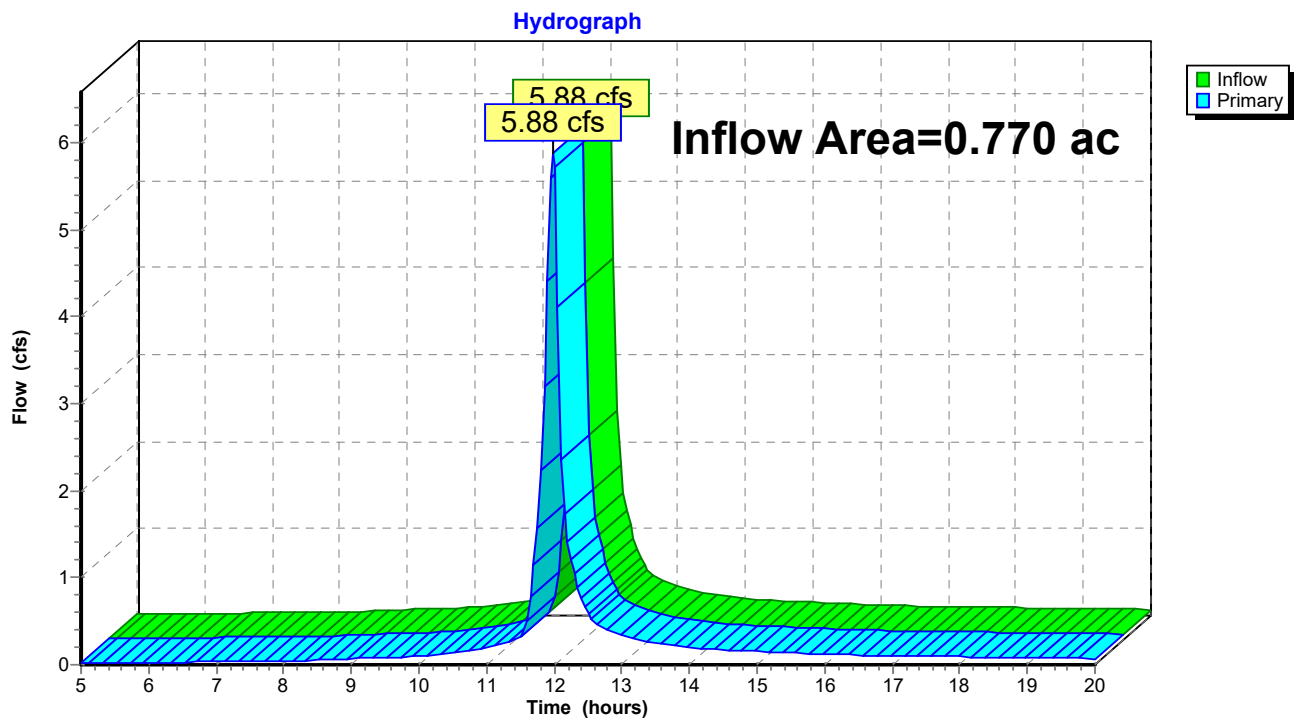
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### Summary for Link 8L: PDA

Inflow Area = 0.770 ac, 67.53% Impervious, Inflow Depth > 4.68" for 50-yr event  
Inflow = 5.88 cfs @ 11.98 hrs, Volume= 0.300 af  
Primary = 5.88 cfs @ 11.98 hrs, Volume= 0.300 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 8L: PDA



**Stormwater Analysis (Rev)**

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*Type II 24-hr 100-yr Rainfall=7.60"*

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

<b>Subcatchment1S: EDA-1</b>	Runoff Area=0.590 ac 50.85% Impervious Runoff Depth>5.24" Tc=6.0 min CN=83 Runoff=5.41 cfs 0.258 af
<b>Subcatchment2S: EDA-2</b>	Runoff Area=0.180 ac 83.33% Impervious Runoff Depth>6.31" Tc=6.0 min CN=93 Runoff=1.85 cfs 0.095 af
<b>Subcatchment4S: PDA-1A</b>	Runoff Area=0.440 ac 70.45% Impervious Runoff Depth>5.90" Tc=6.0 min CN=89 Runoff=4.36 cfs 0.216 af
<b>Subcatchment5S: PDA-1B</b>	Runoff Area=0.190 ac 94.74% Impervious Runoff Depth>6.57" Tc=6.0 min CN=96 Runoff=1.99 cfs 0.104 af
<b>Subcatchment6S: PDA-2</b>	Runoff Area=0.140 ac 21.43% Impervious Runoff Depth>4.35" Tc=6.0 min CN=75 Runoff=1.11 cfs 0.051 af
<b>Pond 9P: UG-1</b>	Peak Elev=722.95' Storage=1,577 cf Inflow=1.99 cfs 0.104 af Outflow=1.99 cfs 0.082 af
<b>Link 3L: EDA</b>	Inflow=7.26 cfs 0.352 af Primary=7.26 cfs 0.352 af
<b>Link 7L: PDA-1</b>	Inflow=6.13 cfs 0.298 af Primary=6.13 cfs 0.298 af
<b>Link 8L: PDA</b>	Inflow=7.23 cfs 0.349 af Primary=7.23 cfs 0.349 af

**Total Runoff Area = 1.540 ac Runoff Volume = 0.723 af Average Runoff Depth = 5.64"**  
**37.01% Pervious = 0.570 ac 62.99% Impervious = 0.970 ac**

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Type II 24-hr 100-yr Rainfall=7.60"

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

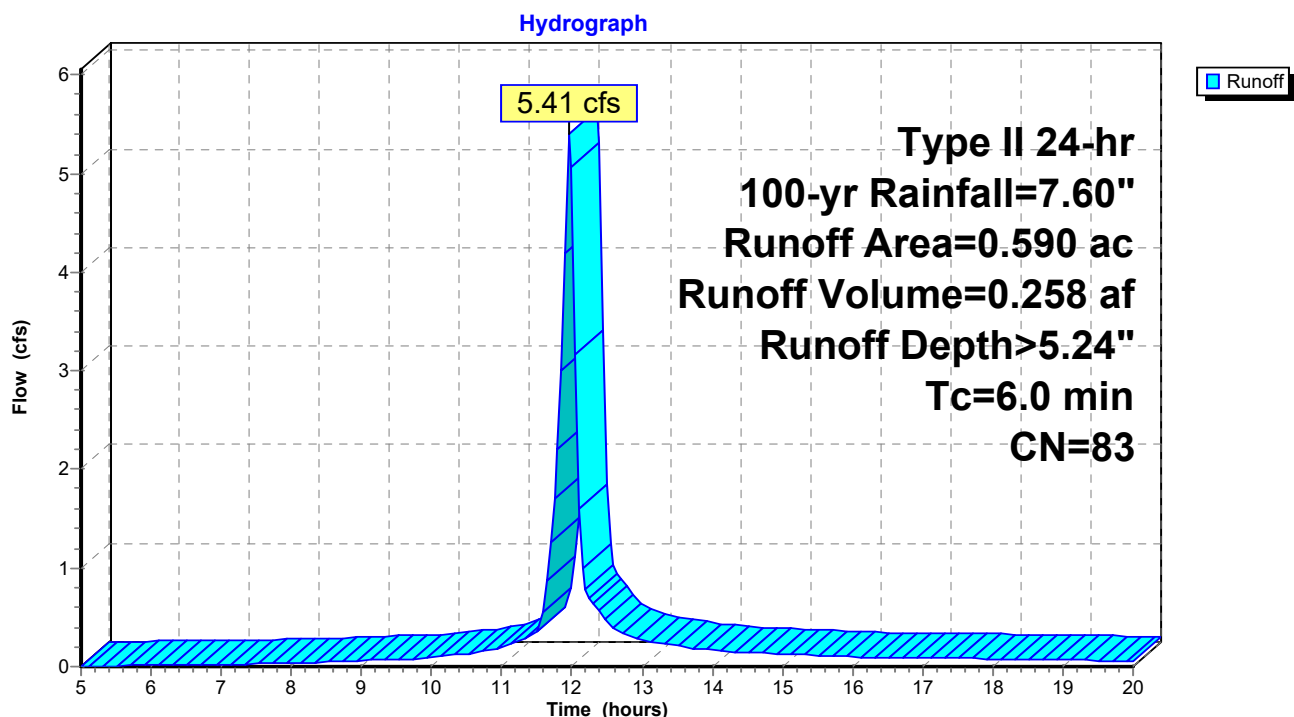
Runoff = 5.41 cfs @ 11.97 hrs, Volume= 0.258 af, Depth> 5.24"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.300	98	Paved parking, HSG A
0.060	60	Woods, Fair, HSG B
0.230	69	50-75% Grass cover, Fair, HSG B
0.590	83	Weighted Average
0.290		49.15% Pervious Area
0.300		50.85% Impervious Area

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

### Subcatchment 1S: EDA-1



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Type II 24-hr 100-yr Rainfall=7.60"

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

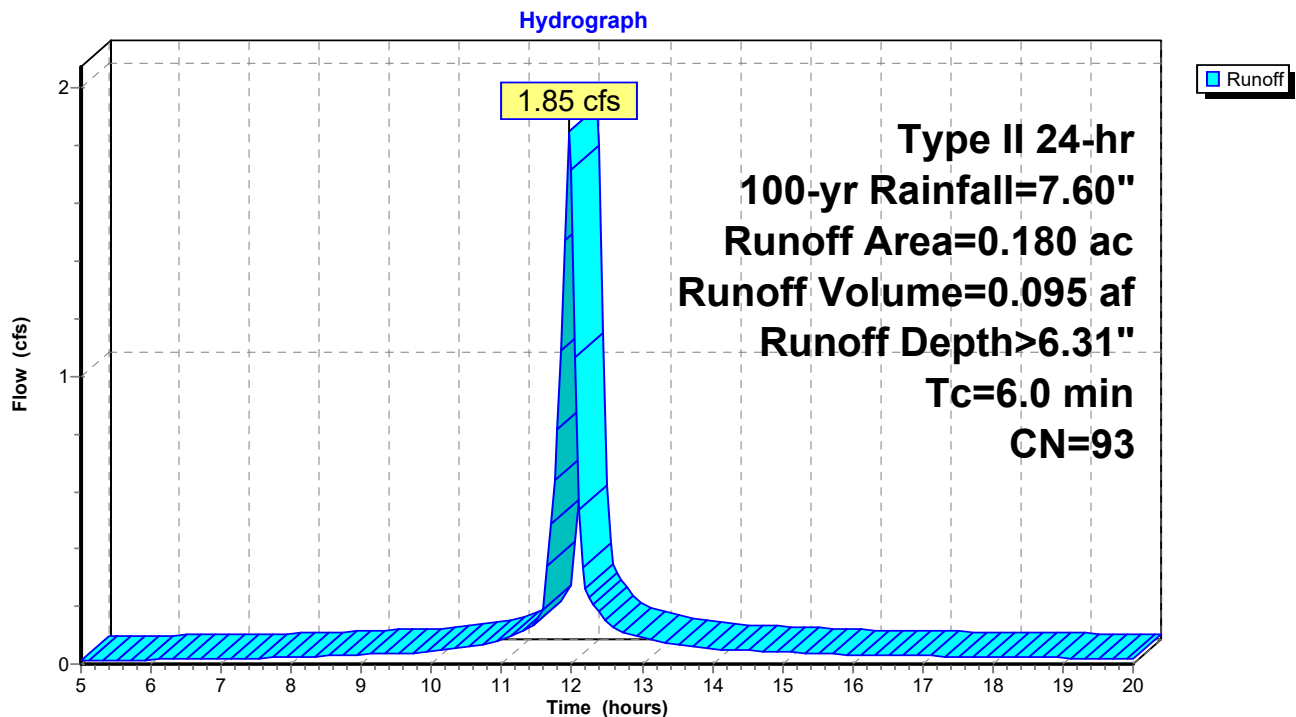
Runoff = 1.85 cfs @ 11.96 hrs, Volume= 0.095 af, Depth> 6.31"  
Routed to Link 3L : EDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.030	69	50-75% Grass cover, Fair, HSG B
0.180	93	Weighted Average
0.030		16.67% Pervious Area
0.150		83.33% Impervious Area

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

### Subcatchment 2S: EDA-2



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Type II 24-hr 100-yr Rainfall=7.60"

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### Summary for Subcatchment 4S: PDA-1A

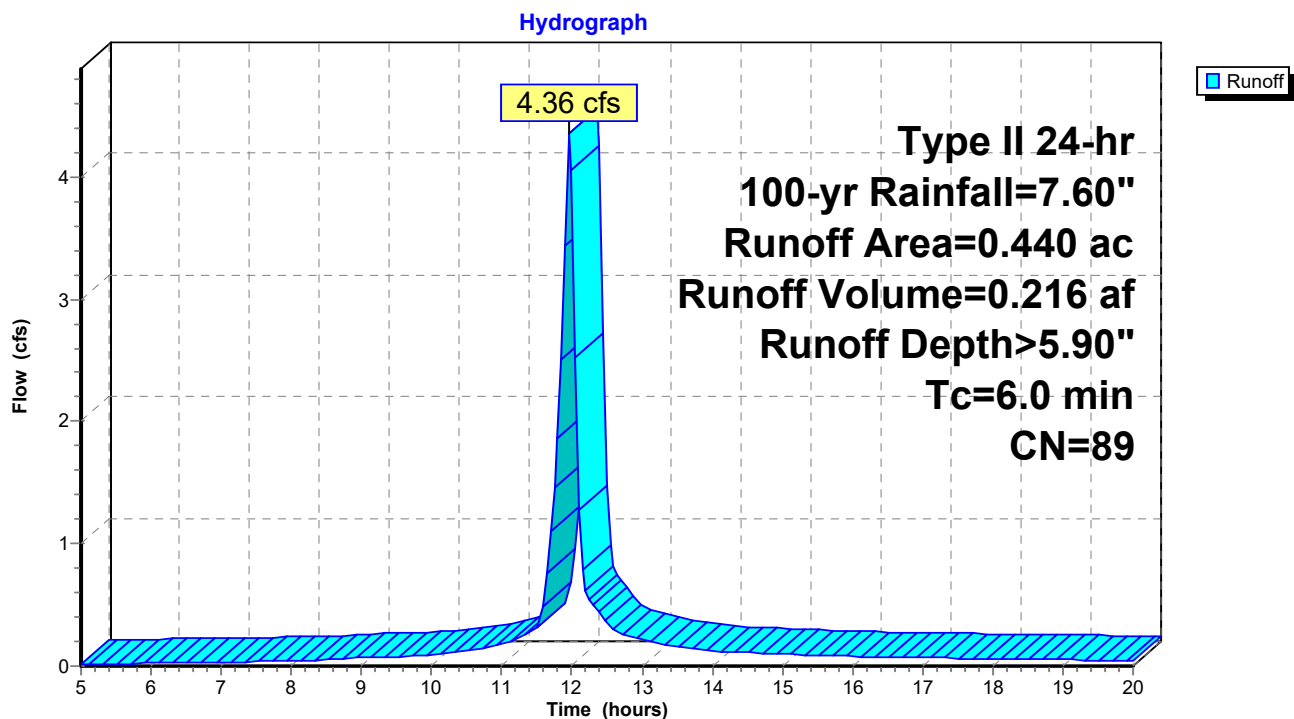
Runoff = 4.36 cfs @ 11.96 hrs, Volume= 0.216 af, Depth> 5.90"  
Routed to Link 7L : PDA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.130	69	50-75% Grass cover, Fair, HSG B
0.440	89	Weighted Average
0.130		29.55% Pervious Area
0.310		70.45% Impervious Area

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

### Subcatchment 4S: PDA-1A



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Type II 24-hr 100-yr Rainfall=7.60"

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### Summary for Subcatchment 5S: PDA-1B

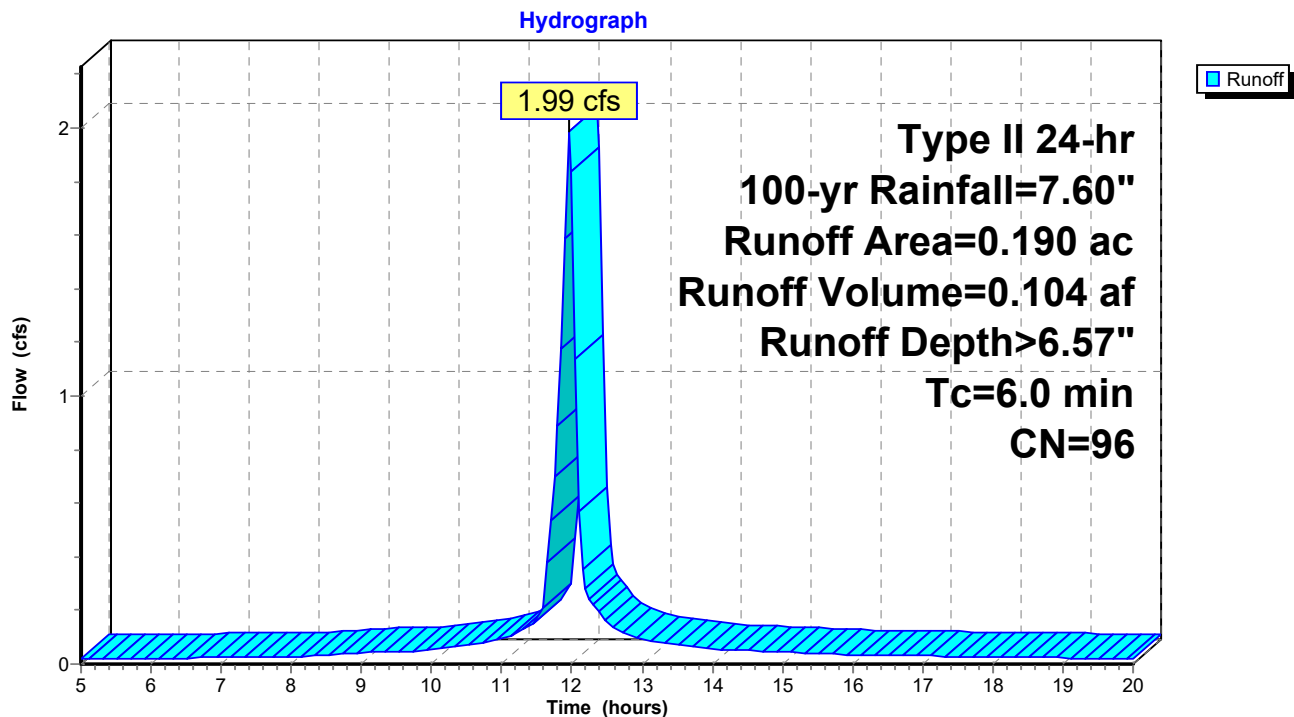
Runoff = 1.99 cfs @ 11.96 hrs, Volume= 0.104 af, Depth> 6.57"  
Routed to Pond 9P : UG-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG A
0.010	69	50-75% Grass cover, Fair, HSG B
0.190	96	Weighted Average
0.010		5.26% Pervious Area
0.180		94.74% Impervious Area

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

### Subcatchment 5S: PDA-1B



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### Summary for Subcatchment 6S: PDA-2

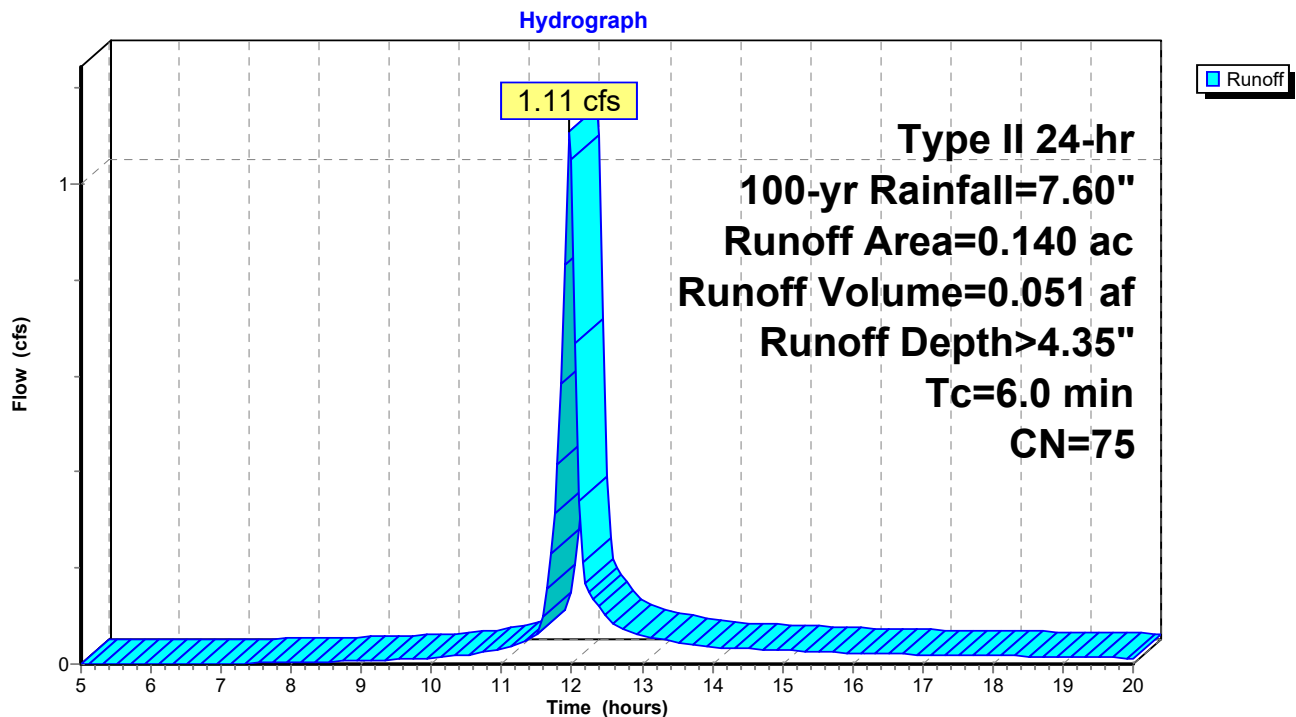
Runoff = 1.11 cfs @ 11.97 hrs, Volume= 0.051 af, Depth> 4.35"  
Routed to Link 8L : PDA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.110	69	50-75% Grass cover, Fair, HSG B
0.140	75	Weighted Average
0.110		78.57% Pervious Area
0.030		21.43% Impervious Area

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

### Subcatchment 6S: PDA-2



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Type II 24-hr 100-yr Rainfall=7.60"

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**Summary for Pond 9P: UG-1**

Inflow Area = 0.190 ac, 94.74% Impervious, Inflow Depth > 6.57" for 100-yr event  
 Inflow = 1.99 cfs @ 11.96 hrs, Volume= 0.104 af  
 Outflow = 1.99 cfs @ 12.01 hrs, Volume= 0.082 af, Atten= 0%, Lag= 2.6 min  
 Primary = 1.99 cfs @ 12.01 hrs, Volume= 0.082 af  
 Routed to Link 7L : PDA-1

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 722.95' @ 12.01 hrs Surf.Area= 512 sf Storage= 1,577 cf

Plug-Flow detention time= 101.3 min calculated for 0.082 af (79% of inflow)  
 Center-of-Mass det. time= 45.8 min ( 777.7 - 731.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	719.00'	102 cf	<b>8.00'W x 64.00'L x 4.67'H Field A</b> 2,389 cf Overall - 2,133 cf Embedded = 256 cf x 40.0% Voids
#2A	719.50'	1,496 cf	<b>retain_it retain_it 3.5' x 8 Inside #1</b> Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 1 Rows adjusted for 110.5 cf perimeter wall
		1,598 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	718.25'	<b>12.0" Round Culvert</b> L= 122.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 718.25' / 715.85' S= 0.0197 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	722.75'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	721.45'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	719.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 715.00'

Primary OutFlow Max=1.90 cfs @ 12.01 hrs HW=722.94' (Free Discharge)

- 1=Culvert (Passes 1.89 cfs of 6.11 cfs potential flow)
- 2=Orifice/Grate (Weir Controls 0.84 cfs @ 1.42 fps)
- 3=Orifice/Grate (Orifice Controls 1.05 cfs @ 5.36 fps)
- 4=Exfiltration ( Controls 0.01 cfs)



## Stormwater Analysis (Rev)

Prepared by Solli Engineering - Norwood, MA

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Type II 24-hr 100-yr Rainfall=7.60"

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### Pond 9P: UG-1 - Chamber Wizard Field A

#### Chamber Model = retain\_it retain\_it 3.5' (retain-it®)

Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf

Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf

1 Rows adjusted for 110.5 cf perimeter wall

8 Chambers/Row x 8.00' Long = 64.00' Row Length

1 Rows x 96.0" Wide = 8.00' Base Width

6.0" Stone Base + 50.0" Chamber Height = 4.67' Field Height

6.1 cf Sidewall x 8 x 2 + 6.1 cf Endwall x 1 x 2 = 110.5 cf Perimeter Wall

8 Chambers x 200.8 cf - 110.5 cf Perimeter wall = 1,495.7 cf Chamber Storage

8 Chambers x 266.7 cf = 2,133.3 cf Displacement

2,389.3 cf Field - 2,133.3 cf Chambers = 256.0 cf Stone x 40.0% Voids = 102.4 cf Stone Storage

Chamber Storage + Stone Storage = 1,598.1 cf = 0.037 af

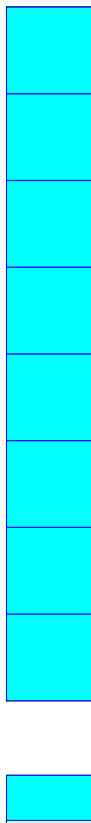
Overall Storage Efficiency = 66.9%

Overall System Size = 64.00' x 8.00' x 4.67'

8 Chambers

88.5 cy Field

9.5 cy Stone



# Stormwater Analysis (Rev)

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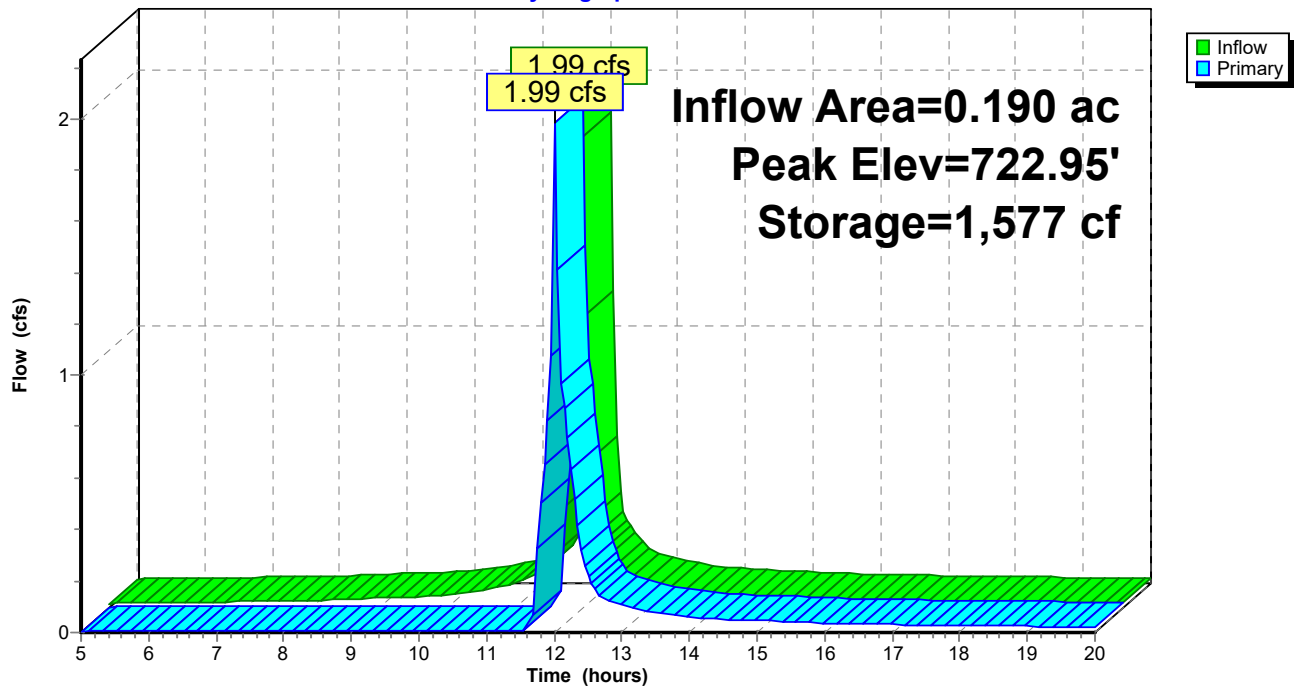
Type II 24-hr 100-yr Rainfall=7.60"

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## Pond 9P: UG-1

Hydrograph



**Stormwater Analysis (Rev)**

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Type II 24-hr 100-yr Rainfall=7.60"

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**Stage-Discharge for Pond 9P: UG-1**

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
719.00	0.00	721.65	0.12
719.05	0.01	721.70	0.18
719.10	0.01	721.75	0.24
719.15	0.01	721.80	0.31
719.20	0.01	721.85	0.37
719.25	0.01	721.90	0.44
719.30	0.01	721.95	0.48
719.35	0.01	722.00	0.53
719.40	0.01	722.05	0.57
719.45	0.01	722.10	0.61
719.50	0.01	722.15	0.65
719.55	0.01	722.20	0.68
719.60	0.01	722.25	0.71
719.65	0.01	722.30	0.74
719.70	0.01	722.35	0.77
719.75	0.01	722.40	0.80
719.80	0.01	722.45	0.83
719.85	0.01	722.50	0.86
719.90	0.01	722.55	0.88
719.95	0.01	722.60	0.91
720.00	0.01	722.65	0.93
720.05	0.01	722.70	0.96
720.10	0.01	722.75	0.98
720.15	0.01	722.80	1.12
720.20	0.01	722.85	1.35
720.25	0.01	722.90	1.64
720.30	0.01	722.95	1.99
720.35	0.01	723.00	2.37
720.40	0.01	723.05	2.80
720.45	0.01	723.10	3.26
720.50	0.01	723.15	3.54
720.55	0.01	723.20	3.71
720.60	0.01	723.25	3.86
720.65	0.01	723.30	4.01
720.70	0.01	723.35	4.16
720.75	0.01	723.40	4.29
720.80	0.01	723.45	4.43
720.85	0.01	723.50	4.56
720.90	0.01	723.55	4.68
720.95	0.01	723.60	4.80
721.00	0.01	723.65	<b>4.92</b>
721.05	0.01		
721.10	0.01		
721.15	0.01		
721.20	0.01		
721.25	0.01		
721.30	0.01		
721.35	0.01		
721.40	0.01		
721.45	0.01		
721.50	0.02		
721.55	0.04		
721.60	0.08		

**Stormwater Analysis (Rev)**

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Type II 24-hr 100-yr Rainfall=7.60"

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**Stage-Area-Storage for Pond 9P: UG-1**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
719.00	512	0	721.65	512	1,021
719.05	512	10	721.70	512	1,043
719.10	512	20	721.75	512	1,064
719.15	512	31	721.80	512	1,085
719.20	512	41	721.85	512	1,107
719.25	512	51	721.90	512	1,128
719.30	512	61	721.95	512	1,149
719.35	512	72	722.00	512	1,171
719.40	512	82	722.05	512	1,192
719.45	512	92	722.10	512	1,214
719.50	512	102	722.15	512	1,235
719.55	512	124	722.20	512	1,256
719.60	512	145	722.25	512	1,278
719.65	512	167	722.30	512	1,299
719.70	512	188	722.35	512	1,320
719.75	512	209	722.40	512	1,342
719.80	512	231	722.45	512	1,363
719.85	512	252	722.50	512	1,384
719.90	512	273	722.55	512	1,406
719.95	512	295	722.60	512	1,427
720.00	512	316	722.65	512	1,449
720.05	512	337	722.70	512	1,470
720.10	512	359	722.75	512	1,491
720.15	512	380	722.80	512	1,513
720.20	512	402	722.85	512	1,534
720.25	512	423	722.90	512	1,555
720.30	512	444	722.95	512	1,577
720.35	512	466	723.00	512	1,598
720.40	512	487	723.05	512	1,598
720.45	512	508	723.10	512	1,598
720.50	512	530	723.15	512	1,598
720.55	512	551	723.20	512	1,598
720.60	512	572	723.25	512	1,598
720.65	512	594	723.30	512	1,598
720.70	512	615	723.35	512	1,598
720.75	512	637	723.40	512	1,598
720.80	512	658	723.45	512	1,598
720.85	512	679	723.50	512	1,598
720.90	512	701	723.55	512	1,598
720.95	512	722	723.60	512	1,598
721.00	512	743	723.65	512	1,598
721.05	512	765			
721.10	512	786			
721.15	512	808			
721.20	512	829			
721.25	512	850			
721.30	512	872			
721.35	512	893			
721.40	512	914			
721.45	512	936			
721.50	512	957			
721.55	512	978			
721.60	512	1,000			

## Stormwater Analysis (Rev)

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Type II 24-hr 100-yr Rainfall=7.60"

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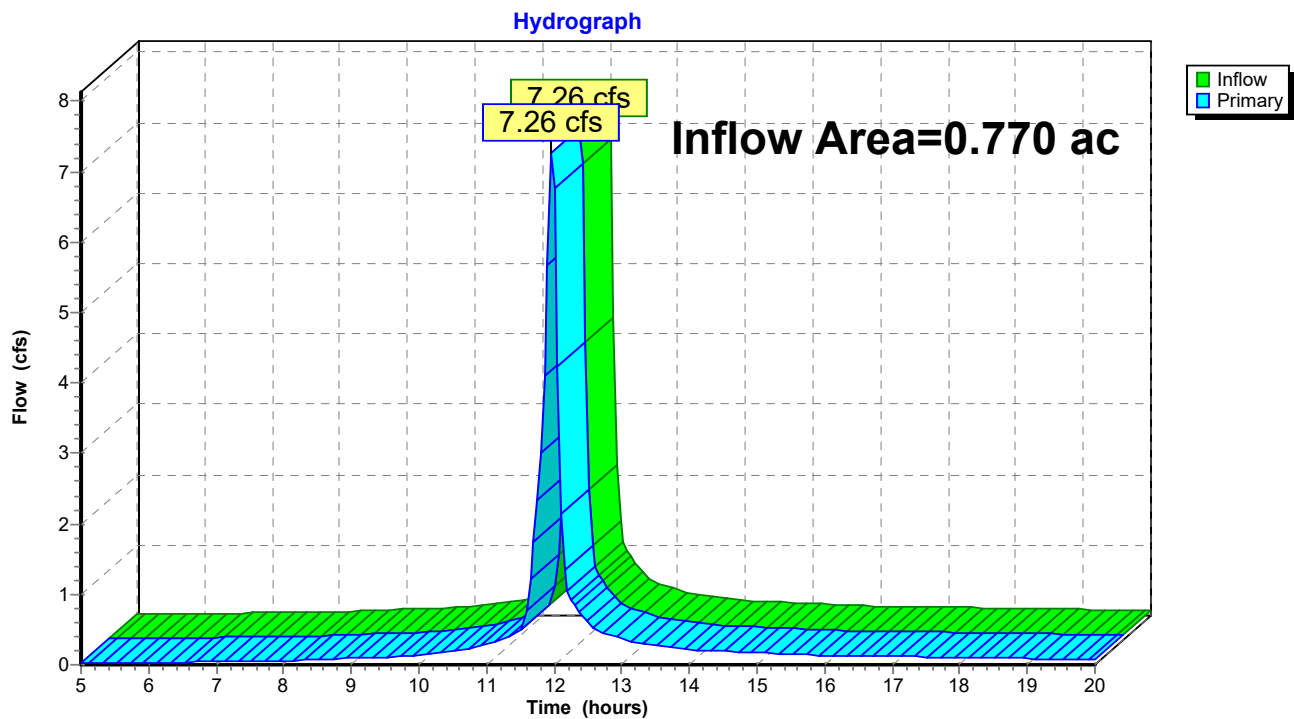
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### Summary for Link 3L: EDA

Inflow Area = 0.770 ac, 58.44% Impervious, Inflow Depth > 5.49" for 100-yr event  
Inflow = 7.26 cfs @ 11.96 hrs, Volume= 0.352 af  
Primary = 7.26 cfs @ 11.96 hrs, Volume= 0.352 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 3L: EDA



## Stormwater Analysis (Rev)

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Type II 24-hr 100-yr Rainfall=7.60"

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### Summary for Link 7L: PDA-1

Inflow Area = 0.630 ac, 77.78% Impervious, Inflow Depth > 5.68" for 100-yr event

Inflow = 6.13 cfs @ 11.99 hrs, Volume= 0.298 af

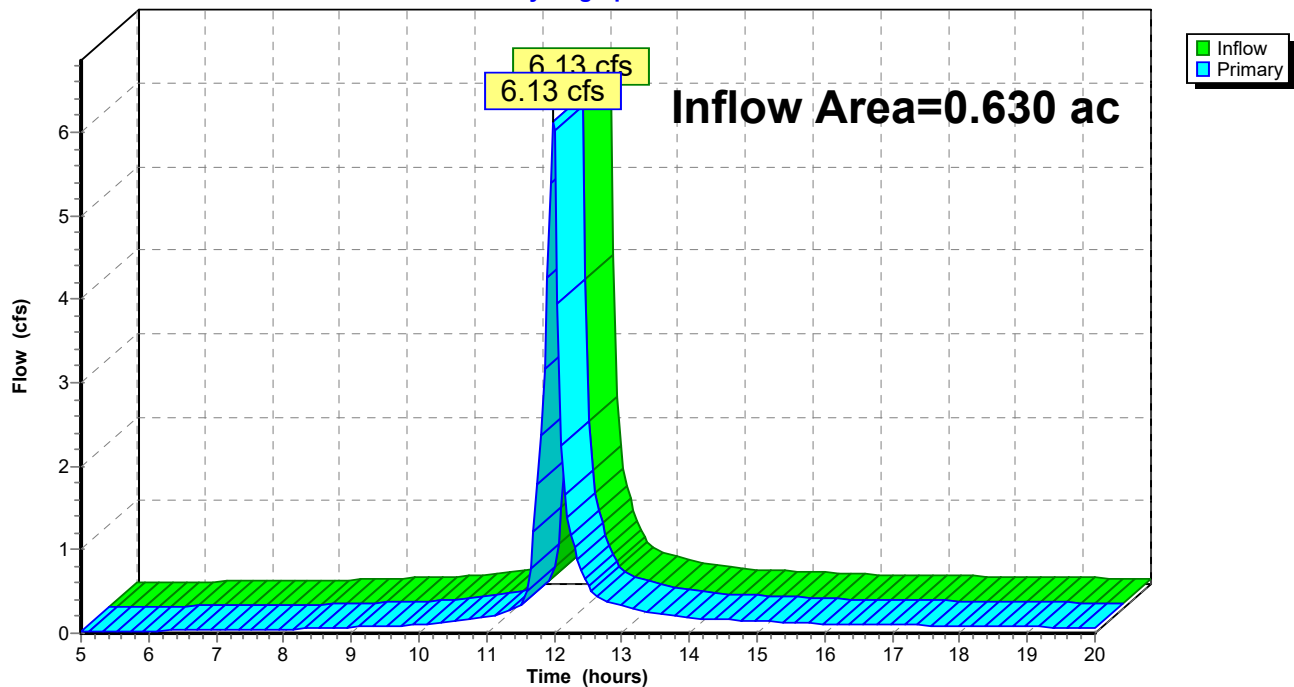
Primary = 6.13 cfs @ 11.99 hrs, Volume= 0.298 af, Atten= 0%, Lag= 0.0 min

Routed to Link 8L : PDA

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 7L: PDA-1

Hydrograph



## Stormwater Analysis (Rev)

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Type II 24-hr 100-yr Rainfall=7.60"

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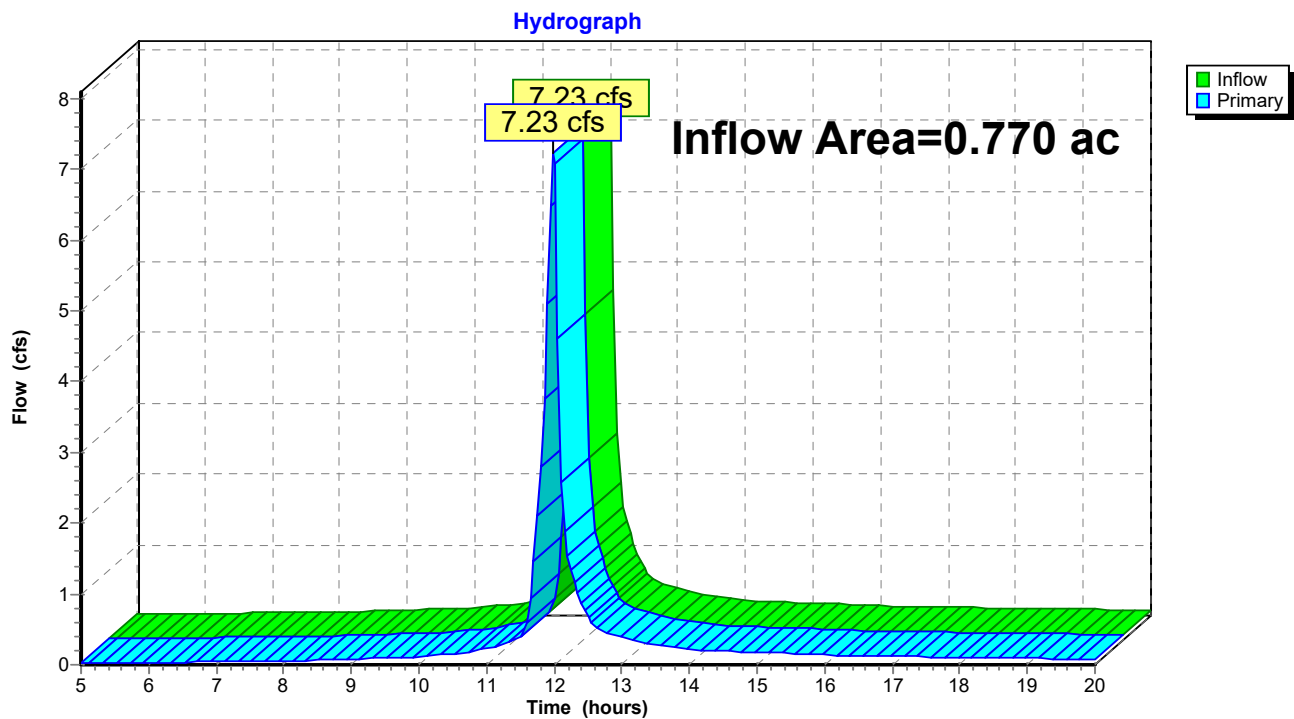
Page 75

### Summary for Link 8L: PDA

Inflow Area = 0.770 ac, 67.53% Impervious, Inflow Depth > 5.44" for 100-yr event  
Inflow = 7.23 cfs @ 11.98 hrs, Volume= 0.349 af  
Primary = 7.23 cfs @ 11.98 hrs, Volume= 0.349 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link 8L: PDA



Project Proposed Coffee ShopBy OSKDate 10/03/23Location 788 Main Street, Holden, MAChecked STMDate 10/03/23Bold one: Present **Developed**CBDA-11. Runoff Coefficient @

Soil Name and hydrologic group  (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	C <sup>1</sup>			Area  <input checked="" type="checkbox"/> acres <input type="checkbox"/> mi <sup>2</sup> <input type="checkbox"/> %	Product of C x area
	<b>Impervious Area</b>	<b>0.95</b>			<b>0.35</b>	<b>0.33</b>
	<b>Landscaped Area</b>	<b>0.35</b>			<b>0.04</b>	<b>0.01</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
Totals =					<b>0.39</b>	<b>0.35</b>

<sup>1</sup> Use only one C source per line

$$C \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{0.35}{0.39} = 0.89 \quad \text{Use } C = \boxed{0.89}$$



Project Proposed Coffee ShopBy OSKDate 10/03/23Location 788 Main Street, Holden, MAChecked STMDate 10/03/23Bold one: Present **Developed****CBDA-2**1. Runoff Coefficient @

Soil Name and hydrologic group  (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	C <sup>1</sup>			Area  <input checked="" type="checkbox"/> acres <input type="checkbox"/> mi <sup>2</sup> <input type="checkbox"/> %	Product of C x area
	<b>Impervious Area</b>	<b>0.95</b>			<b>0.07</b>	<b>0.07</b>
	<b>Landscaped Area</b>	<b>0.35</b>			<b>0.00</b>	<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
Totals =					<b>0.07</b>	<b>0.07</b>

<sup>1</sup> Use only one C source per line

$$C \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{0.07}{0.07} = 0.95 \quad \text{Use } C = \boxed{0.95}$$

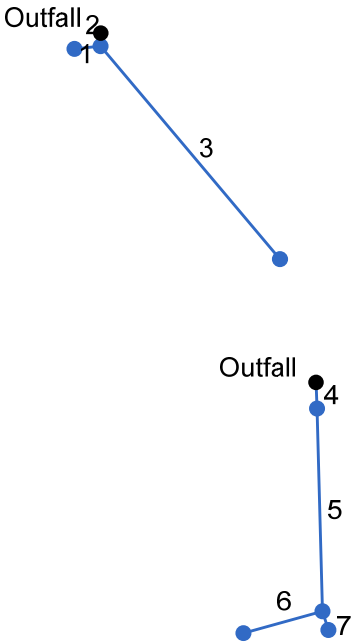
Project Proposed Coffee ShopBy OSKDate 10/03/23Location 788 Main Street, Holden, MAChecked STMDate 10/03/23Bold one: Present **Developed****CBDA-3**1. Runoff Coefficient @

Soil Name and hydrologic group  (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	C <sup>1</sup>			Area  <input checked="" type="checkbox"/> acres <input type="checkbox"/> mi <sup>2</sup> <input type="checkbox"/> %	Product of C x area
	<b>Impervious Area</b>	<b>0.95</b>			<b>0.05</b>	<b>0.05</b>
	<b>Landscaped Area</b>	<b>0.35</b>			<b>0.00</b>	<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
						<b>0.00</b>
Totals =					<b>0.05</b>	<b>0.05</b>

<sup>1</sup> Use only one C source per line

$$C \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{0.05}{0.05} = 0.95 \quad \text{Use } C = \boxed{0.95}$$

# Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Structure Report

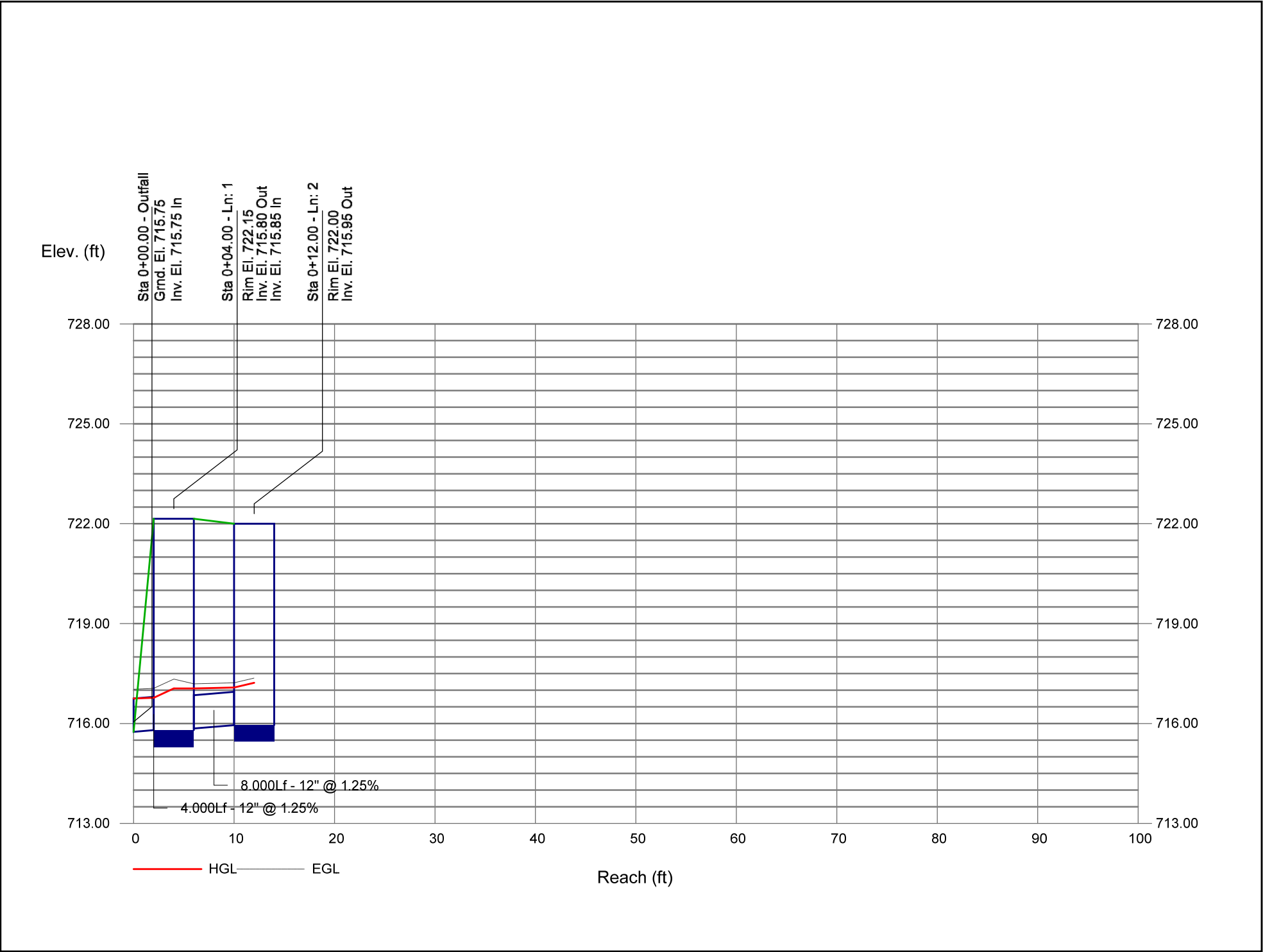
Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1		Manhole	722.15	Cir	4.00	4.00	12	Cir	715.80	12	Cir	715.85
2		Grate	722.00	Cir	4.00	4.00	12	Cir	715.95	12	Cir	715.85
3		Manhole	723.67	Cir	4.00	4.00	12	Cir	718.25			
4		Manhole	725.80	Cir	4.00	4.00	12	Cir	721.05	12	Cir	721.05
5		Manhole	724.25	Cir	4.00	4.00	12	Cir	721.36	12	Cir	721.40
6		Grate	724.93	Cir	4.00	4.00	12	Cir	721.53	12	Cir	721.40
7		Grate	724.05	Cir	4.00	4.00	12	Cir	721.43			
Project File: Stormsewer Analysis.stm							Number of Structures: 7			Run Date: 2/8/2024		

# Storm Sewer Summary Report

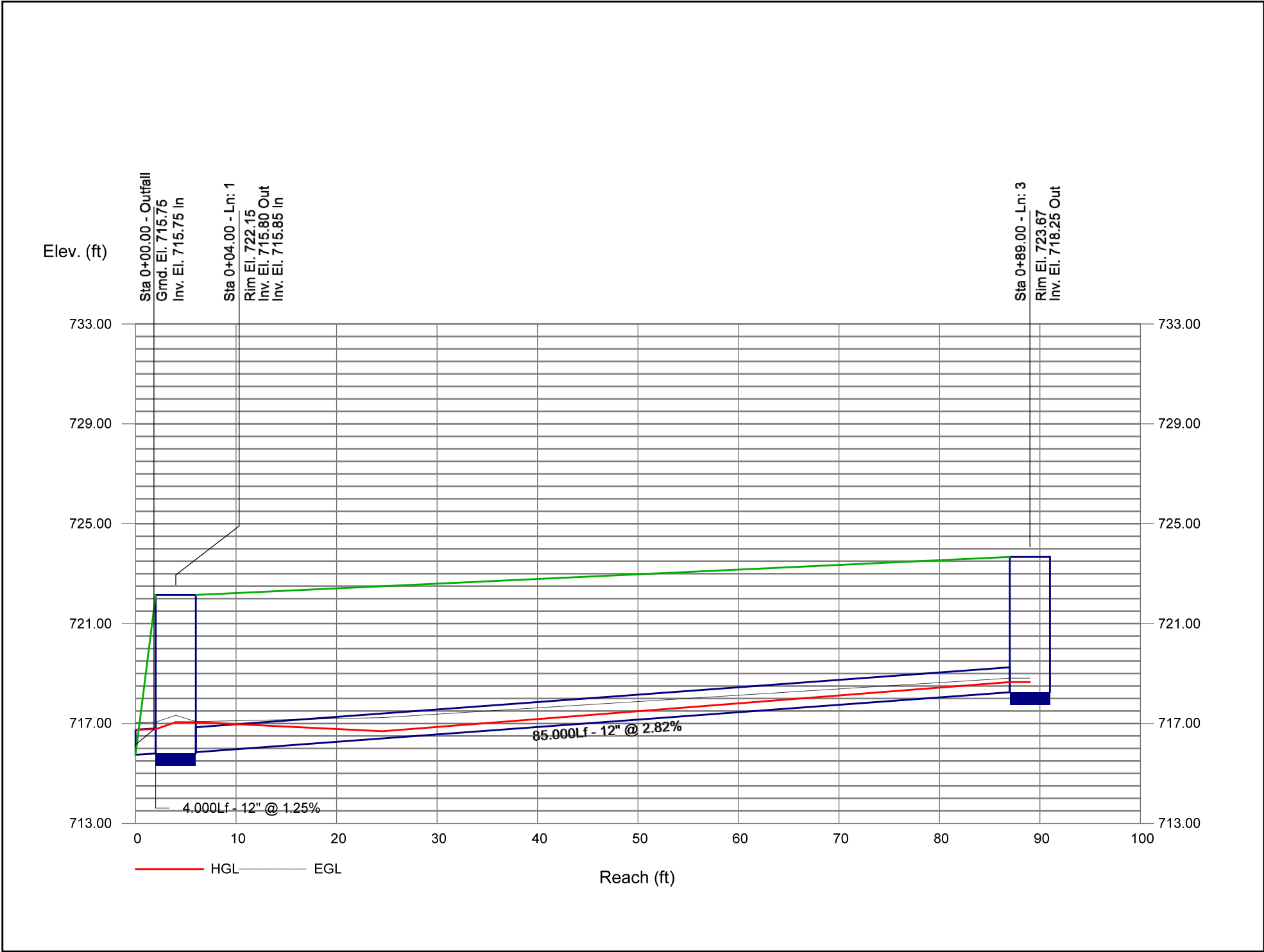
Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1		3.31	12	Cir	4.000	715.75	715.80	1.250	716.75	716.77	0.28	717.05	End	Manhole
2		2.36	12	Cir	8.000	715.85	715.95	1.250	717.05*	717.08*	0.14	717.22	1	Grate
3		0.96	12	Cir	85.000	715.85	718.25	2.824	717.05	718.66	n/a	718.66 j	1	Manhole
4		0.76	12	Cir	8.000	721.00	721.05	0.625	722.71*	722.71*	0.00	722.72	End	Manhole
5		0.81	12	Cir	62.000	721.05	721.36	0.500	722.72*	722.74*	0.02	722.76	4	Manhole
6		0.36	12	Cir	25.000	721.40	721.53	0.520	722.76*	722.76*	0.00	722.76	5	Grate
7		0.50	12	Cir	6.000	721.40	721.43	0.499	722.76*	722.76*	0.01	722.77	5	Grate
Project File: Stormsewer Analysis.stm									Number of lines: 7			Run Date: 2/8/2024		
NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.														

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (l)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	4.000	0.00	0.35	0.00	0.00	0.31	0.0	6.0	7.6	3.31	4.31	4.24	12	1.25	715.75	715.80	716.75	716.77	715.75	722.15	
2	1	8.000	0.35	0.35	0.89	0.31	0.31	6.0	6.0	7.6	2.36	4.31	3.01	12	1.25	715.85	715.95	717.05	717.08	722.15	722.00	
3	1	85.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.96	6.48	2.19	12	2.82	715.85	718.25	717.05	718.66	722.15	723.67	
4	End	8.000	0.00	0.12	0.00	0.00	0.11	0.0	7.9	6.7	0.76	3.05	0.97	12	0.62	721.00	721.05	722.71	722.71	725.80	725.80	
5	4	62.000	0.00	0.12	0.00	0.00	0.11	0.0	6.9	7.1	0.81	2.73	1.03	12	0.50	721.05	721.36	722.72	722.74	725.80	724.25	
6	5	25.000	0.05	0.05	0.95	0.05	0.05	6.0	6.0	7.6	0.36	2.78	0.46	12	0.52	721.40	721.53	722.76	722.76	724.25	724.93	
7	5	6.000	0.07	0.07	0.95	0.07	0.07	6.0	6.0	7.6	0.50	2.73	0.64	12	0.50	721.40	721.43	722.76	722.76	724.25	724.05	
Project File: Stormsewer Analysis.stm																Number of lines: 7				Run Date: 2/8/2024		
NOTES:Intensity = 39.90 / (Inlet time + 3.80) ^ 0.73; Return period =Yrs. 25 ; c = cir e = ellip b = box																						

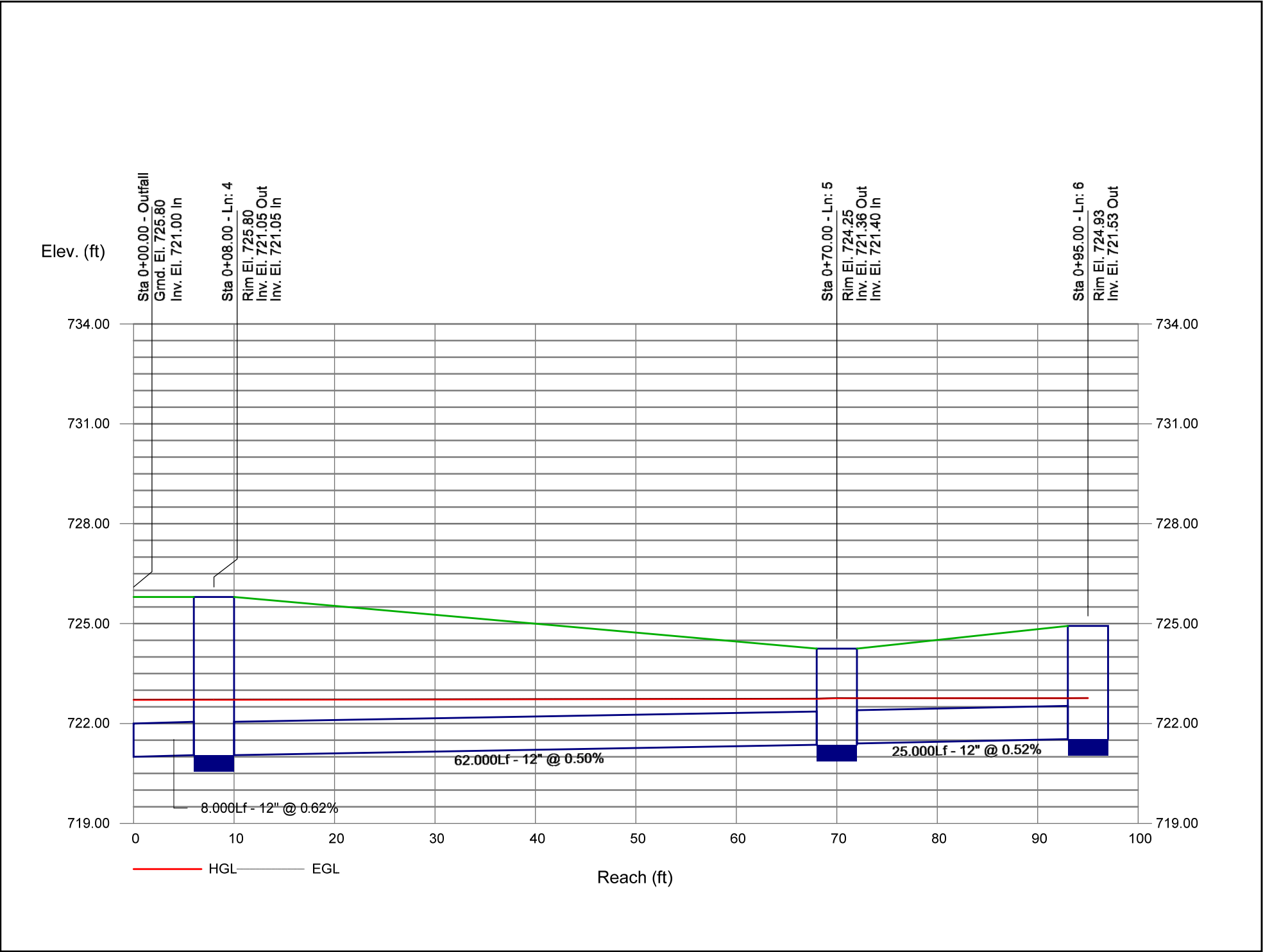


Storm Sewer Profile

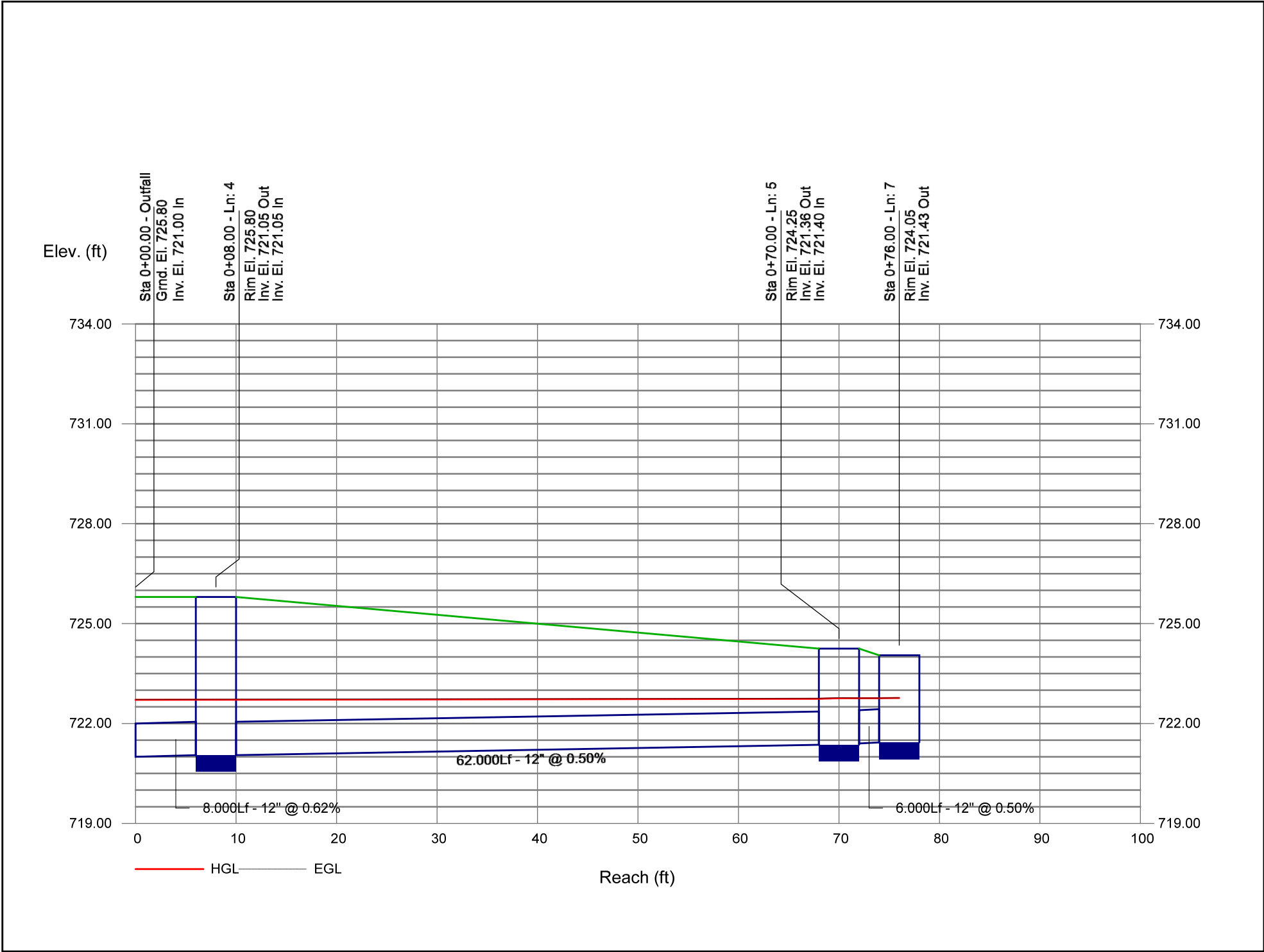




# Storm Sewer Profile



Storm Sewer Profile



**Project:** 788 Main St  
**Location:** Holden, MA  
**Prepared For:** Solli Eng / Sam Malafronte



**Purpose:** To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

**Reference:** Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

**Procedure:** Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the  $t_c$ , read the unit peak discharge ( $q_u$ ) from Figure 1 or Table in Figure 2.  $q_u$  is expressed in the following units: cfs/mi<sup>2</sup>/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (q_u) (A) (WQV)$$

where:

Q = flow rate associated with first 1" of runoff

$q_u$  = the unit peak discharge, in csm/in.

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles <sup>2</sup> )	$t_c$ (min)	$t_c$ (hr)	WQV (in)	$q_u$ (csm/in.)	Q (cfs)
WQU 1	0.13	0.0001953	5.0	0.083	1.00	795.00	0.16
WQU 2	0.31	0.0004844	5.0	0.083	1.00	795.00	0.39

The WQf sizing calculation selects the minimum size CDS/Cascade/StormCeptor model capable of operating at the computed WQf peak flowrate prior to bypassing. It assumes free discharge of the WQf through the unit and ignores the routing effect of any upstream storm drain piping. As with all hydrodynamic separators, there will be some impact to the Hydraulic Gradient of the corresponding drainage system, and evaluation of this impact should be considered in the design.

## CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

**788 MAIN ST  
HOLDEN, MA**

Area **0.13 ac**  
Weighted C **0.9**  
 $t_c$  **5 min**  
CDS Model **1515-3**

Unit Site Designation **WQU 1**  
Rainfall Station # **71**

CDS Treatment Capacity **1.0 cfs**

<u>Rainfall Intensity<sup>1</sup></u> <u>(in/hr)</u>	<u>Percent Rainfall Volume<sup>1</sup></u>	<u>Cumulative Rainfall Volume</u>	<u>Total Flowrate (cfs)</u>	<u>Treated Flowrate (cfs)</u>	<u>Incremental Removal (%)</u>
0.08	37.6%	37.6%	0.01	0.01	37.6
0.16	22.6%	60.2%	0.02	0.02	22.6
0.24	11.9%	72.1%	0.03	0.03	11.9
0.32	7.6%	79.7%	0.04	0.04	7.6
0.40	4.3%	84.1%	0.05	0.05	4.3
0.48	2.3%	86.4%	0.05	0.05	2.3
0.56	1.8%	88.2%	0.06	0.06	1.8
0.64	1.4%	89.6%	0.07	0.07	1.3
0.72	0.9%	90.4%	0.08	0.08	0.8
0.80	1.2%	91.6%	0.09	0.09	1.1
0.88	1.5%	93.1%	0.10	0.10	1.4
0.96	0.9%	94.0%	0.11	0.11	0.9
1.04	0.4%	94.4%	0.12	0.12	0.4
1.12	0.4%	94.8%	0.13	0.13	0.4
1.20	0.6%	95.4%	0.14	0.14	0.5
1.28	0.3%	95.7%	0.14	0.14	0.3
1.36	0.2%	95.9%	0.15	0.15	0.2
1.44	0.9%	96.7%	0.16	0.16	0.8
1.52	0.6%	97.3%	0.17	0.17	0.5
1.60	0.4%	97.7%	0.18	0.18	0.4
1.80	0.2%	97.9%	0.20	0.20	0.2
					98.2
Removal Efficiency Adjustment <sup>2</sup> =					0.0%
Predicted % Annual Rainfall Treated =					98.8%
<b>Predicted Net Annual Load Removal Efficiency =</b>					<b>98.2%</b>

1 - Based on 13 years of 15 minute precipitation data for Station 0666, Birch Hill Dam, Worcester County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

## CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

**788 MAIN ST  
HOLDEN, MA**

Area **0.31 ac**  
Weighted C **0.9**  
 $t_c$  **5 min**  
CDS Model **1515-3**

Unit Site Designation **WQU 2**  
Rainfall Station # **71**

CDS Treatment Capacity **1.0 cfs**

<u>Rainfall Intensity<sup>1</sup></u> <u>(in/hr)</u>	<u>Percent Rainfall Volume<sup>1</sup></u>	<u>Cumulative Rainfall Volume</u>	<u>Total Flowrate (cfs)</u>	<u>Treated Flowrate (cfs)</u>	<u>Incremental Removal (%)</u>
0.08	37.6%	37.6%	0.02	0.02	37.6
0.16	22.6%	60.2%	0.04	0.04	22.5
0.24	11.9%	72.1%	0.07	0.07	11.7
0.32	7.6%	79.7%	0.09	0.09	7.4
0.40	4.3%	84.1%	0.11	0.11	4.2
0.48	2.3%	86.4%	0.13	0.13	2.2
0.56	1.8%	88.2%	0.16	0.16	1.7
0.64	1.4%	89.6%	0.18	0.18	1.3
0.72	0.9%	90.4%	0.20	0.20	0.8
0.80	1.2%	91.6%	0.22	0.22	1.1
0.88	1.5%	93.1%	0.25	0.25	1.3
0.96	0.9%	94.0%	0.27	0.27	0.8
1.04	0.4%	94.4%	0.29	0.29	0.3
1.12	0.4%	94.8%	0.31	0.31	0.4
1.20	0.6%	95.4%	0.33	0.33	0.5
1.28	0.3%	95.7%	0.36	0.36	0.3
1.36	0.2%	95.9%	0.38	0.38	0.1
1.44	0.9%	96.7%	0.40	0.40	0.7
1.52	0.6%	97.3%	0.42	0.42	0.4
1.60	0.4%	97.7%	0.45	0.45	0.3
1.80	0.2%	97.9%	0.50	0.50	0.2
					96.4
Removal Efficiency Adjustment <sup>2</sup> =					0.0%
Predicted % Annual Rainfall Treated =					98.8%
<b>Predicted Net Annual Load Removal Efficiency =</b>					<b>96.4%</b>

1 - Based on 13 years of 15 minute precipitation data for Station 0666, Birch Hill Dam, Worcester County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: 788 Main Street, Holden, MA (Train 1)

TSS Removal Calculation Worksheet	A	B	C	D	E
	BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (B*C)	Remaining Load (C-D)
	4-Foot Sump with Hooded Outlet	0.25	1.00	0.25	0.75
	Water Quality Unit	0.90	0.75	0.675	0.075

Total TSS Removal =

92.5%

Separate Form Needs to  
be Completed for Each  
Outlet or BMP Train

Project: Proposed Coffee Shop  
Prepared By: OSK  
Date: 10/05/2023

\*Equals remaining load from previous BMP (E)  
which enters the BMP

## INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: 788 Main Street, Holden, MA (Train 2)

TSS Removal Calculation Worksheet	A	B	C	D	E
	BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (B*C)	Remaining Load (C-D)
	4-Foot Sump with Hooded Outlet	0.25	1.00	0.25	0.75
	Water Quality Unit	0.90	0.75	0.675	0.075
	Infiltration Basin	0.80	0.075	0.060	0.015

Total TSS Removal =

98.5%

Separate Form Needs to  
be Completed for Each  
Outlet or BMP Train

Project: Proposed Coffee Shop  
Prepared By: OSK  
Date: 10/05/2023

\*Equals remaining load from previous BMP (E)  
which enters the BMP

**Appendix D – Detailed Design Plans**

Existing Conditions Plan

*Prepared by Northeast Survey Consultants*

Drainage Area Map (DA-1)

Catch Basin Drainage Area Map (CBDA-1)

*For more information regarding the Design Plans refer to the  
Permitting Plan Set, prepared by Solli Engineering, submitted in  
conjunction with this Report.*



LEGEND		
⊞	CATCH BASIN	123-456-001 ASSESSORS ID
⊙	DRAIN MANHOLE	BIT. BITUMINOUS CONCRETE
⊙	SEWER MANHOLE	CONC. CONCRETE
⊙	ELECTRIC MANHOLE	BC. BITUMINOUS CURB
⊙	TELEPHONE MANHOLE	
⊞	COMMUNICATION BOX	----- CONTOUR LINE
☆	LIGHT POLE	----- UNDERGROUND UTILITY LINE
▼	FLOOD LIGHT	----- PAINTED WHITE LINE
⊙	POST/BOLLARD	----- PAINTED YELLOW LINE
⊙	MANHOLE	----- CHAIN LINK FENCE
◆	TEMPORARY BENCHMARK (TBM)	----- HIGHWAY CENTERLINE
◆	BORING (BOR.)	
⊙	ROOF DRAIN	
⊞	GAS GATE VALVE	
⊞	WATER GATE VALVE	
⊞	HYDRANT	
⊞	DECIDUOUS TREE	

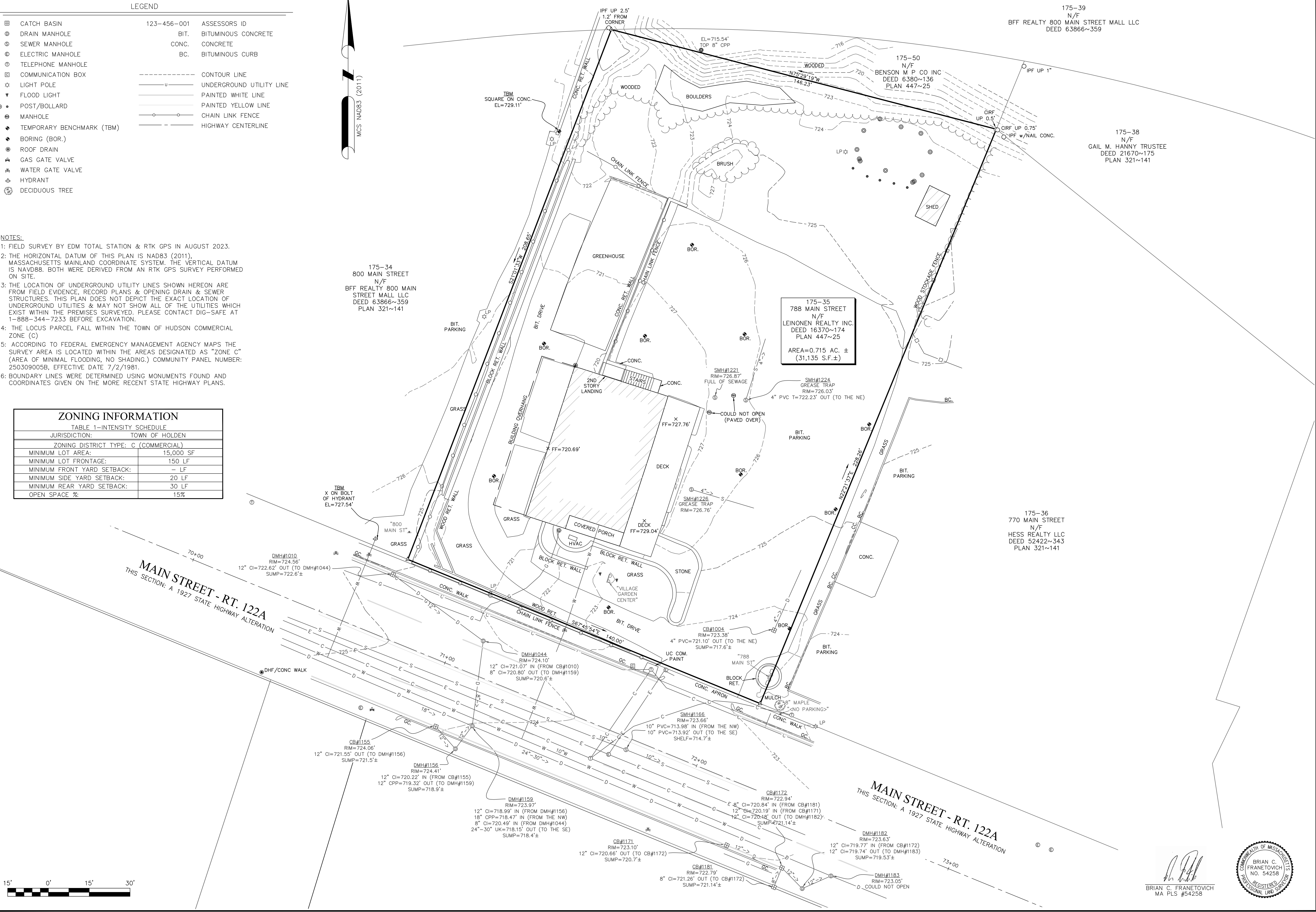
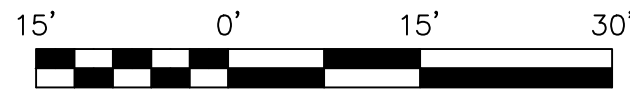
NOTES:

- 1: FIELD SURVEY BY EDM TOTAL STATION & RTK GPS IN AUGUST 2023.
- 2: THE HORIZONTAL DATUM OF THIS PLAN IS NAD83 (2011), MASSACHUSETTS MAINLAND COORDINATE SYSTEM. THE VERTICAL DATUM IS NAVD88. BOTH WERE DERIVED FROM AN RTK GPS SURVEY PERFORMED ON SITE.
- 3: THE LOCATION OF UNDERGROUND UTILITY LINES SHOWN HEREON ARE FROM FIELD EVIDENCE, RECORD PLANS & OPENING DRAIN & SEWER STRUCTURES. THIS PLAN DOES NOT DEPICT THE EXACT LOCATION OF UNDERGROUND UTILITIES & MAY NOT SHOW ALL OF THE UTILITIES WHICH EXIST WITHIN THE PREMISES SURVEYED. PLEASE CONTACT DIG-SAFE AT 1-888-344-7233 BEFORE EXCAVATION.
- 4: THE LOCUS PARCEL FALL WITHIN THE TOWN OF HUDSON COMMERCIAL ZONE (C)
- 5: ACCORDING TO FEDERAL EMERGENCY MANAGEMENT AGENCY MAPS THE SURVEY AREA IS LOCATED WITHIN THE AREAS DESIGNATED AS "ZONE C" (AREA OF MINIMAL FLOODING, NO SHADING.) COMMUNITY PANEL NUMBER: 250309005B, EFFECTIVE DATE 7/2/1981.
- 6: BOUNDARY LINES WERE DETERMINED USING MONUMENTS FOUND AND COORDINATES GIVEN ON THE MORE RECENT STATE HIGHWAY PLANS.

ZONING INFORMATION

TABLE 1-INTENSITY SCHEDULE

JURISDICTION:	TOWN OF HOLDEN
ZONING DISTRICT TYPE:	C (COMMERCIAL)
MINIMUM LOT AREA:	15,000 SF
MINIMUM LOT FRONTAGE:	150 LF
MINIMUM FRONT YARD SETBACK:	- LF
MINIMUM SIDE YARD SETBACK:	20 LF
MINIMUM REAR YARD SETBACK:	30 LF
OPEN SPACE %:	15%



BRIAN C. FRANETOVICH  
MA PLS #54258



NORTHEAST  
SURVEY  
CONSULTANTS

3 FERRY STREET  
STUDIO LEAST  
EASTHAMPTON, MA 01027  
(413) 203-5144

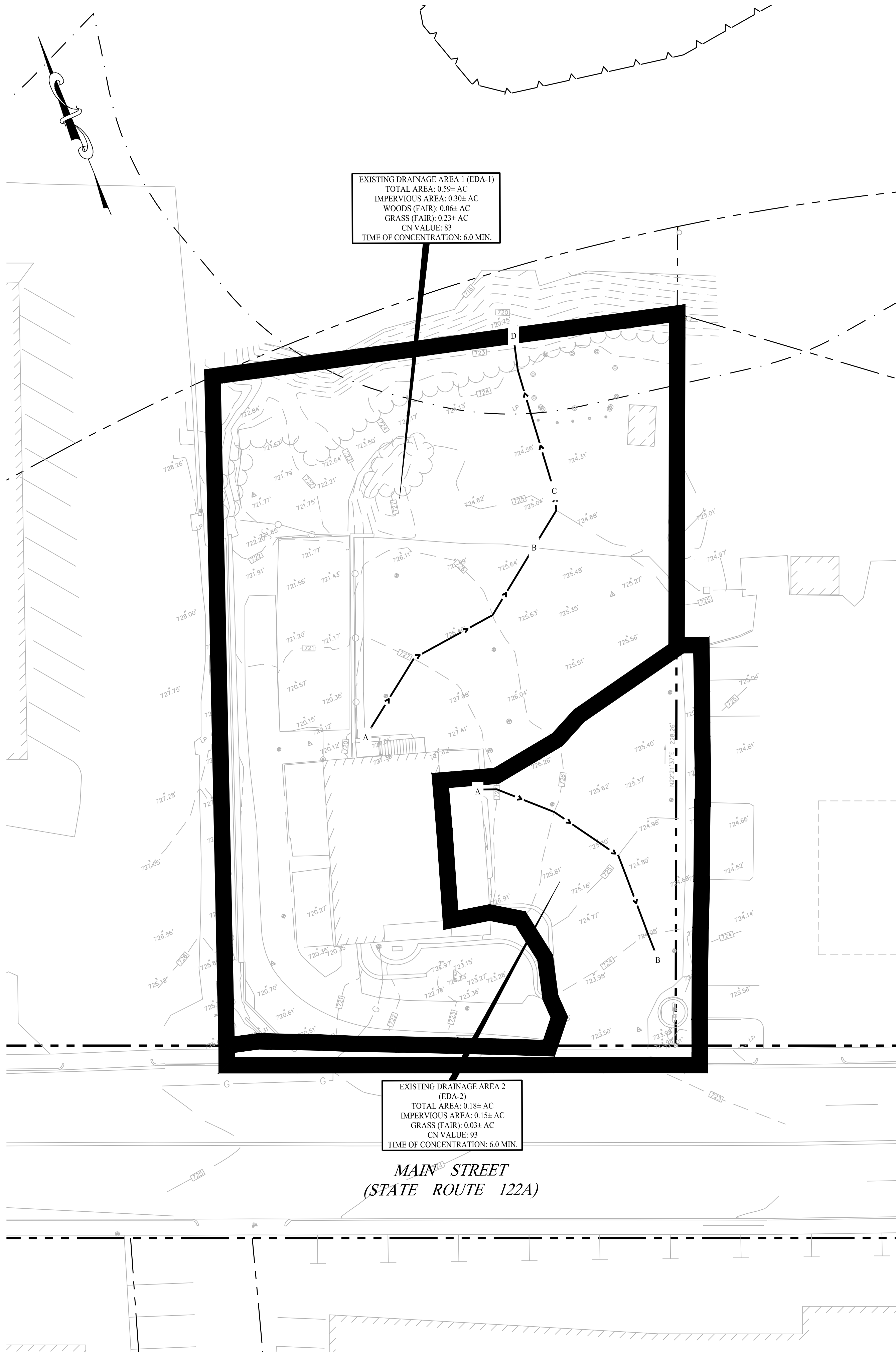
EXISTING  
CONDITIONS

SURVEYOR:	BCF	ENGINEER:	-
DRAFTING:	JED	DESIGN:	-
FIELD WORK:	NAE	HORZ. SCALE:	1"=15'
PROJECT NUMBER:	23-190	VERT. SCALE:	-
DRAWING NAME:	23-190.DWG	DATE:	08-28-2023

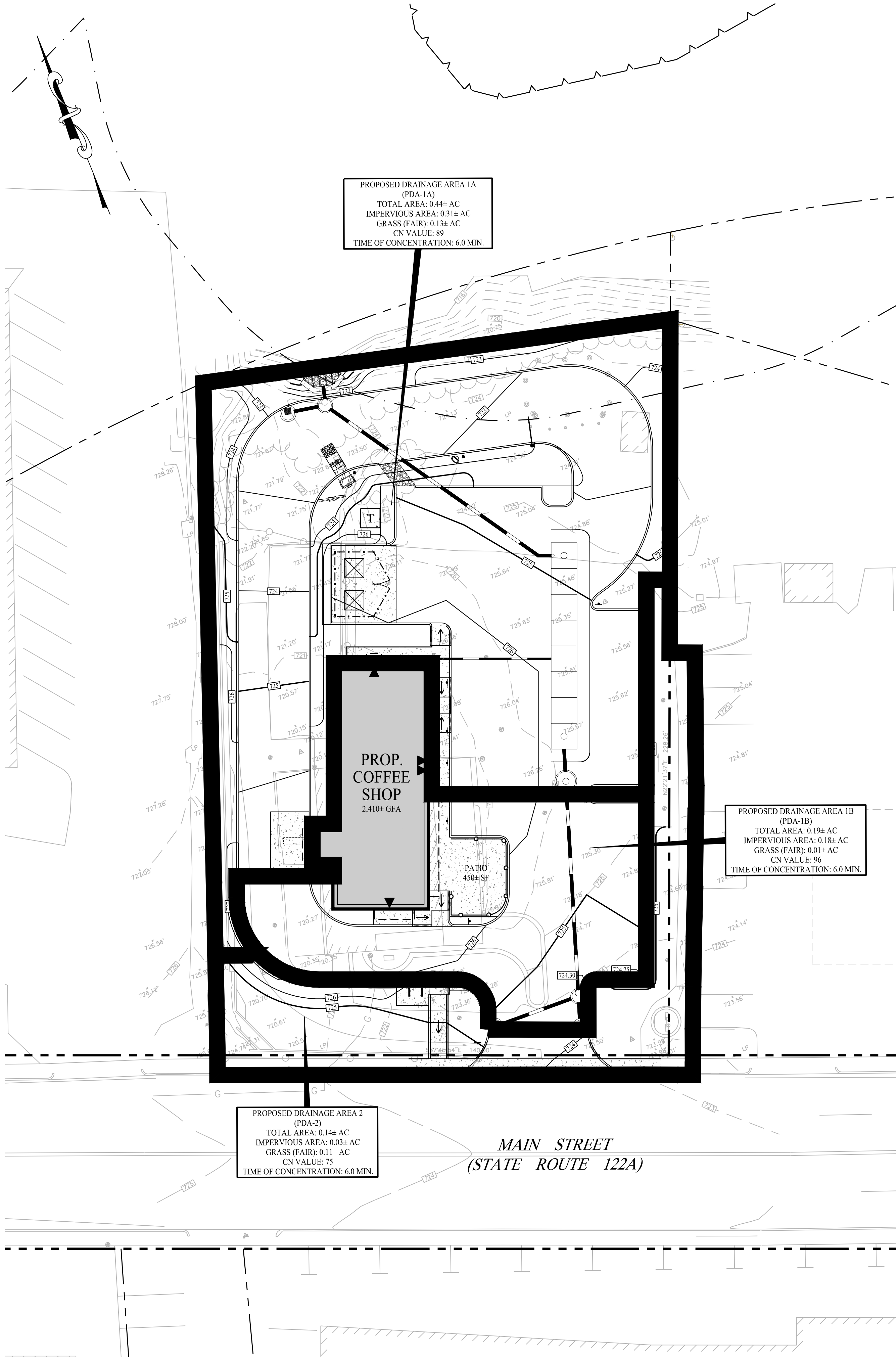
PLAN OF LAND IN HOLDEN, MA  
788 MAIN STREET  
PREPARED FOR  
SOLLI ENGINEERING LLC

SHEET NO.  
1 OF 1





EXISTING DRAINAGE AREA MAP (EDA)



PROPOSED DRAINAGE AREA MAP (PDA)

## GENERAL NOTES

- THESE PLANS ARE FOR PERMITTING PURPOSES ONLY AND ARE NOT FOR CONSTRUCTION. NO CONSTRUCTION OR DEMOLITION SHALL BEGIN UNTIL APPROVAL OF THE FINAL PLANS IS GRANTED BY ALL GOVERNING AND REGULATORY AGENCIES.
- ALL SITE WORK TO BE COMPLETED IN ACCORDANCE WITH ALL PERMITS, APPROVALS, AND CONDITIONS OF APPROVALS ISSUED BY THE TOWN OF HOLDEN FOR THIS PROJECT.
- EXISTING SITE CONDITIONS AND BOUNDARY INFORMATION TAKEN FROM A PLAN TITLED "PLAN OF LAND", DATED AUGUST 22, 2023, SCALE: 1"=15', PREPARED BY NORTHEAST SURVEY CONSULTANTS.
  - THE HORIZONTAL DATUM IS NAD83 (MASS. MAINLAND).
  - FIELD SURVEY BY EDM TOTAL STATION & RTK GPS IN AUGUST 2023.
  - THE VERTICAL DATUM IS NAVD88.
- THE STORMWATER MANAGEMENT PLAN AND DESIGN IS INTENDED TO BE IN COMPLIANCE WITH THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION'S STORMWATER MANAGEMENT HANDBOOK AND THE CITY OF HOLDEN MASSACHUSETTS STORMWATER REGULATIONS.
- STORMWATER RUNOFF ANALYSIS WAS CALCULATED USING THE SCS TR-55 METHODOLOGY.
- BASED ON SOIL MAPPING PRODUCED BY THE USDA NATURAL RESOURCES CONSERVATION SERVICE & ON-SITE BORINGS PERFORMED BY THE APPLICANT, THE SITE IS LOCATED WITHIN AN AREA OF "HINKLEY LOAMY SAND". FOR THE PURPOSES OF STORMWATER ANALYSIS THE A HYDROLOGIC SOIL RATING OF "B" WAS UTILIZED.

## LEGEND

	PROPERTY LINE
	RIGHT-OF-WAY LINE
	ADJOINING LOT LINE
	LIMIT OF DRAINAGE AREA
	FLOW PATH

Rev. #:	Date	Description
---------	------	-------------

Graphic Scale:



501 Main Street, Monro, CT 06468 T: (203) 880-5455 F: (203) 880-9695  
11 Vanderbilt Ave, Norwood, MA 02062 T: (781) 352-8491 F: (203) 880-9695

Drawn By: OSK

Checked By: CJB

Approved By: KMS

Project #: 23204001

Plan Date: 10/06/23

Scale: 1" = 20'

Kevin Solli, P.E.  
MA 51952

Project:  
**PROPOSED  
COFFEE SHOP  
REDEVELOPMENT**  
788 MAIN STREET  
HOLDEN, MASSACHUSETTS

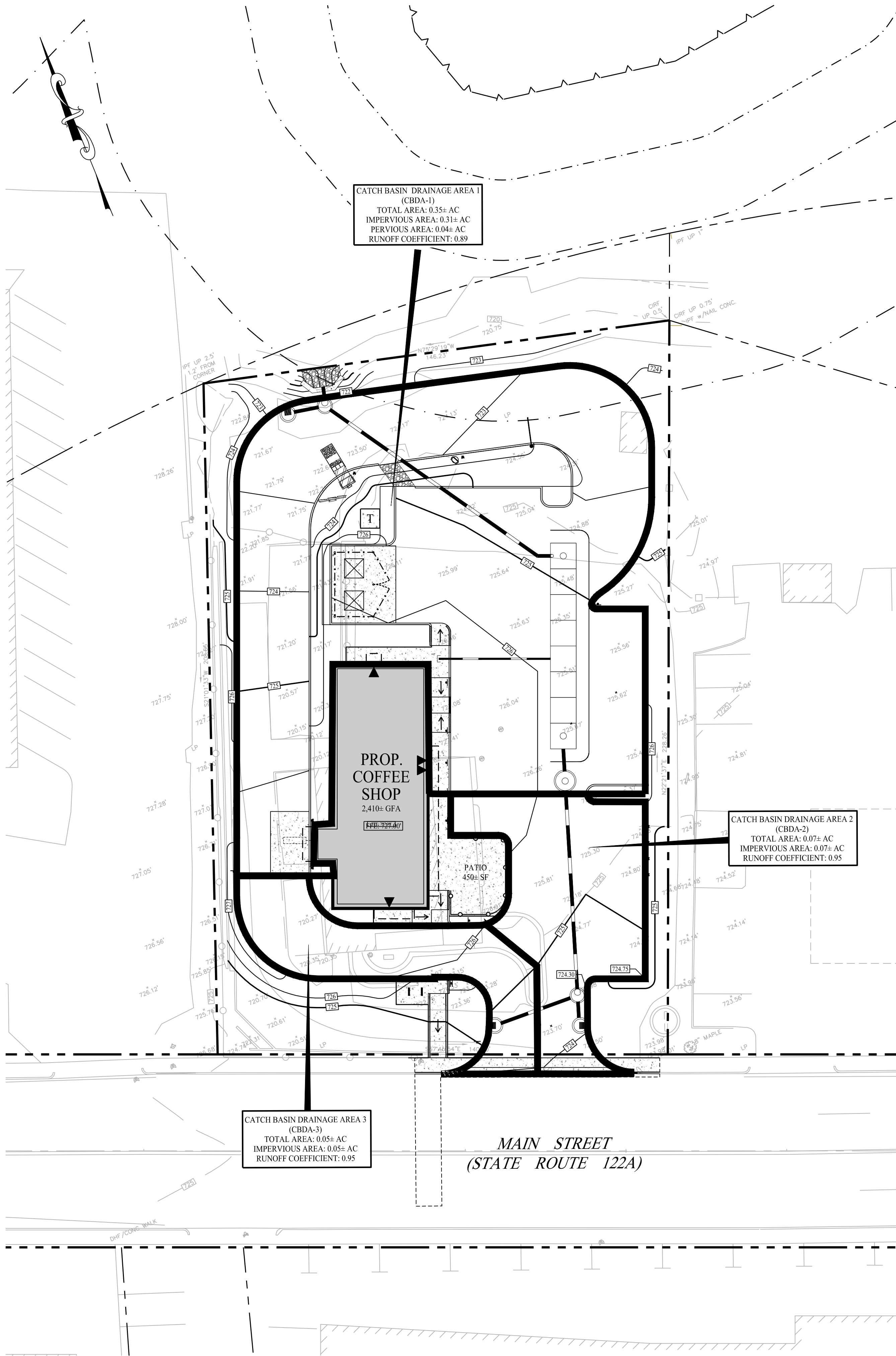
Sheet Title:

DRAINAGE  
AREA MAP

Sheet #:

DA-1





## GENERAL NOTES

- THESE PLANS ARE FOR PERMITTING PURPOSES ONLY AND ARE NOT FOR CONSTRUCTION. NO CONSTRUCTION OR DEMOLITION SHALL BEGIN UNTIL APPROVAL OF THE FINAL PLANS IS GRANTED BY ALL GOVERNING AND REGULATORY AGENCIES.
- ALL SITE WORK TO BE COMPLETED IN ACCORDANCE WITH ALL PERMITS, APPROVALS, AND CONDITIONS OF APPROVALS ISSUED BY THE TOWN OF HOLDEN FOR THIS PROJECT.
- EXISTING SITE CONDITIONS AND BOUNDARY INFORMATION TAKEN FROM A PLAN TITLED "PLAN OF LAND", DATED AUGUST 22, 2023, SCALE: 1"=15', PREPARED BY NORTHEAST SURVEY CONSULTANTS.
  - THE HORIZONTAL DATUM IS NAD83 (MASS. MAINLAND).
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- THE STORMWATER MANAGEMENT PLAN AND DESIGN IS INTENDED TO BE IN COMPLIANCE WITH THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION'S STORMWATER MANAGEMENT HANDBOOK AND THE CITY OF HOLDEN MASSACHUSETTS STORMWATER REGULATIONS.
- STORMWATER RUNOFF ANALYSIS WAS CALCULATED USING THE SCS TR-55 METHODOLOGY.
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## LEGEND

	PROPERTY LINE
	RIGHT-OF-WAY LINE
	ADJOINING LOT LINE
	LIMIT OF DRAINAGE AREA
	FLOW PATH

Rev. #:      Date      Description

Graphic Scale:



501 Main Street, Monroeville, CT 06468 T: (203) 880-5455 F: (203) 880-9695  
11 Vanderbilt Ave., Norwood, MA 02062 T: (781) 352-8491 F: (203) 880-9695

Drawn By: OSK

Checked By: CJB

Approved By: KMS

Project #: 23204001

Plan Date: 10/06/23

Scale: 1" = 20'

Kevin Solli, P.E.  
MA 51952

Project:  
**PROPOSED  
COFFEE SHOP  
REDEVELOPMENT**  
789 MAIN STREET  
HOLDEN, MASSACHUSETTS

Sheet Title:

CATCH BASIN  
DRAINAGE  
AREA MAP

Sheet #:

**CBDA-1**

**Appendix E – Long-Term Operation & Maintenance**  
Operation & Maintenance Manual

# **LONG-TERM OPERATION & MAINTENANCE MANUAL**

*For the Proposed:*

## **Coffee Shop Redevelopment**

*Located At:*

788 Main Street (Route 122A)  
Holden, Massachusetts 01520

*Prepared On:*

October 6, 2023

*Prepared For:*

Town of Holden

*Prepared By:*



11 Vanderbilt Avenue, Suite 240  
Norwood, Massachusetts 02062  
T: (781) 352-8491

*Prepared For:*

### **DDMNS Realty, LLC**

166 South Boulevard, Unit C  
West Springfield, Massachusetts 01089  
T: (413) 313-5067

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INTRODUCTION ..... 2

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    DOCUMENTATION ..... 2

MAINTENANCE PROGRAM ..... 3

    SUBSURFACE STORMWATER SYSTEM ..... 3

    HYDRODYNAMIC SEPARATOR UNIT ..... 4

    DEEP SUMP CATCH BASIN ..... 4

    SNOW REMOVAL ..... 5

EMERGENCY SPILL CONTAINMENT ..... 5

## **INTRODUCTION**

Solli Engineering (Solli) has prepared this Operations and Maintenance Manual in accordance with Standard 9 of the Massachusetts Stormwater Handbook. The Long-Term Operations and Maintenance (O&M) Manual, filed with the town of Holden, shall be implemented at the proposed Coffee Shop redevelopment at 788 Main Street (Route 122A) in Holden, Massachusetts to ensure that the stormwater management functions as designed. The owner possesses the primary responsibility for overseeing and implementing the O&M plan and assigning a Property Manager who will be responsible for the proper operation and maintenance of the stormwater structures. In case of transfer of property ownership, future property owners shall be notified of the presence of the stormwater management system and the requirements for proper implementation of the O&M plan. Included in the O&M plan identifying key components of the stormwater system as well as a log for tracking inspections & maintenance.

The stormwater management system protects and enhances the stormwater runoff water quality through the removal of sediment and pollutants, and source control significantly reduces the amount of pollutants entering the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular vacuuming and litter removal, prohibitions on the use of pesticides and maintenance of designated waste and recycling. All inspections and maintenance shall be performed in accordance with the Massachusetts Stormwater Handbook and Stormwater Standards.

## **RESPONSIBILITY**

The purpose of the Long-Term Operation and Maintenance (O&M) Manual is to ensure inspection of the system, removal of accumulated sediments, oils, and debris and implementation of corrective action and record keeping activities. The below O&M activities associated with the site will be performed by a Contract Operator for the scope of maintenance. The Contract Operator will be a professional engineer or other technical professional with expertise and experience with stormwater management facilities operation and maintenance.

The ongoing responsibility is the Owner, its successors, and assigns. Adequate maintenance is defined in this document as good working condition.

### **Responsibility for O&M (to be transferred upon sale of property / development):**

Contact: Danny Hannoush  
Company: DDMNS Realty, LLC.  
Number: 413-313-5067  
Address: 166 South Boulevard, Unit C  
City, State: West Springfield, Massachusetts 01089

## **DOCUMENTATION**

An inspection and maintenance record log and schedule will be kept by the Owner or Property Manager summarizing inspections, maintenance, repairs, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. Inspection & Maintenance Logs will be kept on file at the on-site Property Management office.

## **MAINTENANCE PROGRAM**

The Owner, Property Manager and maintenance staff will conduct the Operation and Maintenance program set forth in this document. The Owner or Property Manager will ensure that inspections and record keeping are timely and accurate, and that cleaning and maintenance are performed in accordance with the recommended frequency for each stormwater component. Inspection & Maintenance Log Forms shall include the date and the amount of the last significant storm event in excess of 1-inch of rain in a 24-hour period, physical conditions of the structures, depth of sediment in structures, evidence of overtopping or debris blockage and maintenance required of each structure. The following areas, facilities and measures will be inspected by the Owner or Property Manager and maintained as specified below. Identified deficiencies will be corrected. Accumulated sediments and debris will be properly handled and disposed of off-site, in accordance with local, state, and federal guidelines and regulations.

All inspections and maintenance performed shall be in accordance with specifications outlined in the Massachusetts Stormwater Handbook.

## **SUBSURFACE STORMWATER SYSTEM**

Subsurface infiltration / detention systems are used widely for controlling the quantity of stormwater runoff as well as the quality where space is limited. Subsurface infiltration systems' performance varies by manufacturer and system design. The stormwater management system proposes the installation of a subsurface system incorporating 3.5' Retain-it chambers (Or approved equal). According to the Owners Maintenance Manual provided by Retain-It, the infiltration / detention chambers are "self-sufficient and operate without requiring any outside assistance, except for periodic inspection to verify optimal performance and maintenance for removal of collected pollutants." The chambers should be inspected periodically with a greater number of inspections to take place during the system start up (just after installation). To successfully maintain the design parameters the following will be required for upkeep:

Periodically:

- Inspector shall visually inspect the system to help identify issues of concern. The inspector should look for signs of slow flows, backed up water, visible oil, trash and debris or an excessive amount of sediment in the storage area.
- During periodic inspections the inspector should visibly inspect the outlet control structure for issues of concern.
- If sediment is observed to be causing issues of concern, a vacuum truck should be used to suck the accumulated sediments, oils and greases and trash and debris from the system.
- Sediments, trash, and debris shall be removed and disposed of in an approved manner.
- Any indications of hazardous material, determined by visual inspection, testing, smell or abnormality, should be reported and handled per appropriate regulations.

According to the Massachusetts Stormwater Handbook and Stormwater Standards a backup underdrain pipe can be installed beneath the infiltration basin to prevent the case of standing water problems.

For more information regarding the Retain-It Owners Maintenance Guide visit:

<http://retain-it.com/library/retain-it-sms-owners-maintenance-guide.pdf>



## **HYDRODYNAMIC SEPARATOR UNIT**

Hydrodynamic separators protect the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captures pollutants is essential to the continuous, long-term functioning of the separator. The units will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the structures will no longer be able to store removed sediment and oil.

The stormwater management system proposes to incorporate two (2) Contech water quality units. According to the Contech Guide Operation, Design, Performance and Maintenance, inspections shall take place at regular intervals to ensure optimum performance. At a minimum, inspections shall be performed twice a year (Ex.: spring & fall) however more frequent inspections may be required depending on several things one being severity of winter (excessive sanding/salting). The frequency of cleanout is determined in the field after installation. During the first year of operation, the units should be inspected regularly and then after, every six months (twice a year) to determine the rate of sediment and floatables accumulation. A simple probe can be used to determine the level of accumulated solids stored in the sump. This information should be recorded in the inspection logs. On the log it is important to note the date, location of structure (or identification), estimated volume of floatables, and depth of sediment. Securely replace the top of the structure and take down any safety equipment. Then notify the engineer of record for any irregularities in the structure's performance if any. The systems should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. Sediment and debris removal can be done manually or with approved sumpvac (or equal).

For more information regarding the CDS Guide Operation, Design, Performance and Maintenance visit: <https://www.conteches.com/Portals/0/Documents/Design%20Guides/CDSDesign%20Guide.pdf?ver=2018-05-16-083621-907>

## **DEEP SUMP CATCH BASIN**

Deep sump catch basins are underground concrete structures which are designed to retain removed trash, debris, and coarse sediment from stormwater runoff and serve as temporary spill containment devices for floatables such as oil and greases prior to discharge into a storm sewer pipe. The functions of a deep sump catch basin include:

- A grate and/or vertical notch found in the curbing that allow stormwater to enter the structure while filtering out larger objects such as trash and leaves.
- A four-foot (minimum) sump below the invert of the storm sewer pipe provides an area for detention time which allows sands and other sediments to settle out of the runoff prior discharge.
- An attached hooded outlet, that prevents floatables and sediment from entering the storm sewer pipes.

At a minimum, deep sump catch basins and drain manholes shall be inspected quarterly (four times per year). Ideally, inspections should be conducted in the fall, at the end of the leaf-drop, in the spring following snowmelt and following heavy rain falls, defined as a storm event exceeding 1-inch of rain fall within a twenty-four-hour period to verify that inlet openings are not clogged by debris. Each structure should be cleaned whenever the depth of sediment deposits is greater than or equal to one half the depth of the sump from the bottom of the structure to the bottom of the lowest pipe invert. Structures shall be inspected for a buildup of sediments, oils, debris, cracks, breaks, or deformations. Any function of the catch basin and

drain manhole that is not in working order will be replaced with similar materials, as per detail, to prevent the storm sewer system from failing.

If floating hydrocarbons are observed during an inspection, the material should be removed immediately by skimming, absorbent materials, or other method and disposed in conformance with applicable state and federal regulations.

The catch basins shall be cleaned by means of handheld shovels, scallop shovel and/or vacuum truck. Vacuum truck may be required instead of shovels to avoid damage to structure. The grate opening shall be clear of any foreign or lodged object. If floating hydrocarbons are observed during an inspection, the material should be removed immediately by skimming, absorbent materials or other methods and salts used in the winter will be removed from the catch basin sumps in the early spring. Leaves, pine needles and branches brought down by autumn winds, rain, and cold weather will be removed from the catch basin sumps in the late fall. Collected sediment, debris and hydrocarbons will be properly disposed of per local, state and federal requirements.

Damaged Hoods should be replaced when noted by inspection.

## **SNOW REMOVAL**

Snow accumulations removed from the driveway, parking areas and other impervious surfaces should be placed in landscape islands and designated snow storage areas. Designated snow storage areas are shown on the Site Layout Plan (Sheet 2.11). Excess snow should be removed from the site and properly disposed of in an approved snow disposal facility. Care must be exercised not to deposit snow in the following areas: on top of storm drain catch basins, in natural depressions and where sand and debris can directly get into the watercourse or within a detention / infiltration basin.

## **EMERGENCY SPILL CONTAINMENT**

The Owner, along with the on-site Property Manager is responsible for educating staff and informing tenants on the environmental benefits associated with the use of pavement at the site. Staff must be trained, and tenants informed via the community website as to the proper spill prevention control and response procedures should a spill occur on the pavement surface. Proper spill control products, such as a granular dry absorbent, must be kept on-site at the property management office in a clean, dry chemical and corrosion resistant container.

A spill of greater than 10 gallons of oil or a spill of any quantity that has reached a surface water, into a sewer, storm drain, ditch, or culvert leading to a surface water, is immediately reported to one or more municipal, state, or federal authority. In the event of a hazardous waste spill on-site, the following protocol should be followed.

- If it is safe to do so, maintenance staff or tenants detecting an oil spill should immediately stop the release and use available materials to prevent the spread of oil.
- If there is a potentially flammable, toxic, or explosive condition, evacuate the vicinity of the spill.
- If it's believed that a reportable or dangerous condition exists, immediately call your local Fire Department to notify them of the release.
- If it is believed that a reportable condition exists, immediately call the Massachusetts Department of Environmental Protection (DEP) to notify them of the release.

- Call the DEP Emergency Response Section toll free statewide number, 1-888-304-1133. Be prepared to provide the following information to the DEP and the Fire Department:
  - Identity of the caller
  - Contact phone number Location of the spill
  - Type of product spilled
  - Approximate quantity or product spilled Extent of actual and/or potential water pollution
  - Date and time of spill
  - Cause of spill
  - Contact a Licensed Site Professional (LSP) to assist in further handling of the material(s) and DEP.

Title:

Location:

Inspection #:

Project #:

Field Date:

INSPECTION & MAINTENANCE LOG

Name(s) & Title(s) of Individual(s) performing inspection: \_\_\_\_\_

Week of Inspection: \_\_\_\_\_

Type of Inspection:  
☐ Monthly    ☐ Quarterly    ☐ Biannually    ☐ Annually    ☐ Emergency

Weather (during inspection)  
☐ Clear    ☐ Cloudy    ☐ Rain    ☐ Snow    ☐ Sunny    ☐ Windy    ☐ Fog

Other: \_\_\_\_\_

Time of Inspection:

Temp. during inspection:

°F

Start Time:                      a.m.                      End Time:                      a.m.

Precip. since last inspection:

"

Site Specific BMP's

#	BMP	Maintenance Required		Corrective Action Needed & Notes	
1		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
2		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
3		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
4		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
5		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
6		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
7		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
8		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
9		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
10		<input type="checkbox"/>	Yes	<input type="checkbox"/>	No

Overall Site Maintenance Concerns

BMP/Activity	Maintenance Required		Corrective Action Needed & Notes	
Are discharge points & receiving waters free of any sediment deposits?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
Are storm drain inlets properly working?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
Is trash/litter from site areas collected & placed in covered dumpsters?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
What is the level of sediment within infiltration basin?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
What is the level of sediment within the hydrodynamic separators?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
What is the levels of oil/grit/trash within the infiltration basin or hydrodynamic separators?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
(Other)	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No

Inspector(s) Signature(s): \_\_\_\_\_