

# Project Narrative & Stormwater Reprot

**Proposed Single Family Dwelling  
31 Newton Rd,  
Amesbury, MA**

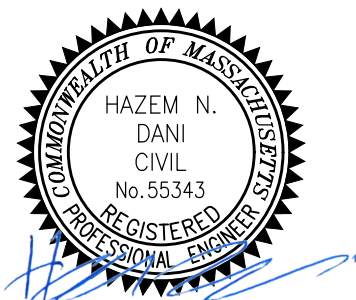
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***Submitted To:***  
*Amesbury Conservation Commission  
62 Friend St, Amesbury, MA 01913*

***Applicant:***  
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**July 10, 2024**





***Project Narrative & Stormwater Report  
Proposed Single Family Dwelling  
31 Newton Road, Amesbury MA***

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This narrative aims to assess the Project's proposed stormwater management system and BMPs in accordance with MA Stormwater Regulations and the City of Amesbury Regulations. The site referenced above is located on a 1.95 acre +/- vacant residential lot. The result of the stormwater assessment is indicated below.

**A. EXISTING CONDITIONS:**

The lot fronts on Newton Road, in Amesbury MA on the north side and is currently undeveloped vacant lot located in the Residential R-80 Zoning District. The site is situated on a hillside/ steep uniform slope (greater than 15%) that drains toward the southern property line/ Newton Road. The property has the highest elevation near the northern property boundary with an elevation of 212 feet and the lowest elevation of 112 (NAVD 88) near Newton Road to the south. The property includes wooded area to the north, brush areas, and a bordering vegetated wetland Series A, that spans the entire property frontage, located to the south at the lowest area of the site. The water overflows from Wetland A through an outflow pipe that runs under Newton Road and discharges to a downstream channel with defined banks. BVW A was delineated in the field by Environmental Consulting & Restoration LLC and surveyed by Norde-East Survey. The extent of BVW A and the outflow pipe are shown on the attached site plans. The site is currently stabilized, and the wetland buffers are established. A review of the City of Amesbury Zoning Map indicate that the southern portion of the site is located in the Water Resource Protection District (WRPD) overlay Districts Zone A while the northern portion of the site is located in WRPD Zone B. The 200 ft of wetland A defines the boundary of the WRPD Zone A per the Zoning Definition.

A review of MassGIS indicates that:

1. The site is not located within mapped Priority or Estimated Habitat according to MANHESP.
2. The site does not contain Land Subject to Flooding (FEMA flood zone).
3. The site is not located near a USGS-mapped stream.
4. The site is not located near a mapped Vernal Pool.
5. The site is not located within an Area of Critical Environmental Concern (ACEC).
6. The site is located in the Powwow River Public Water Supply Watershed.

## **B. PROPOSED PROJECT:**

The applicant proposes to clear and regrade a portion of the lot that is approximately 40,000 s.f. in area. This cleared area will be utilized to accommodate the new driveway, 5-bedroom single-family dwelling, new septic system, and a new stormwater management system. The site design has located the new building and septic components outside of the WRPD Zone A as required by the Zoning Regulations. The proposed grading generally follows the existing topography and has no significant changes to the existing drainage patterns. Stormwater runoff from the proposed house and driveway is collected through the use of a drainage channel and directed to a new bioretention area (Low Impact Development) to mitigate the increased stormwater runoff and flows as required by the Zoning Ordinance. Disturbed areas will be loamed and seeded and converted into landscape/lawn areas associated with the proposed house.

According to the NRCS, the onsite soils consist of Hinckley Loamy Sand (Hydraulic Soil Group A) on the southern portion of the site, while the northern portion of the site consists of Paxton fine sandy loam (Hydraulic Soil Group C). Given the natural topography sloping towards the wetland area to the South the infiltration practice (bioretention) was located on the southern portion of the site. Per the MA Stormwater Regulations, Table 2.3.3. 1982 Rawls Rates, an infiltration rate of 2.41 inch per hour was utilized for the infiltration BMPs. Previous Test pits conducted for this site indicate the presence of Hydraulic Soil Group A, where the infiltration practice is proposed (refer to the attached soil testing by Cammett Engineering).

As part of this project the proposed driveway connection will cross wetland A at the narrowest section, to the west, leading to the least possible impact to the wetland resource area. The wetland alteration area is approximately 600 square feet. Per the MA Wetland Protection Act a wetland replication area with ratio of 2:1 is proposed.

## **C. WETLAND IMPACT ALTERNATIVE ANALYSIS**

Alternatives were considered to avoid and/or minimize impacts to the Bordering Vegetated Wetland A. One alternative is the no-build option. However, maintaining the status quo option causes financial hardship to the owner, will deny the lot the development, and will lead to the loss of potential property tax that will be generated after the house is built. Subsequently, the following alternatives were examined:

### **1- Constructing the Driveway as approved by the City in 2017:**

This alternative will locate the driveway on the east side of the lot as approved in 2017, leading to crossing the BVW at the widest section. This alternative is the least preferred alternative as it will lead to the most impact to BVW A. Therefore, this alternative is not environmentally viable.

### **2- Utilizing the abutters driveway on 29 Newton Road:**

This alternative will require the applicant to obtain an access easement on the abutter's lot, which would lead to financial encumbrance and property use restriction for both property owners. This alternative is not financially feasible for both owners and will impose undesired property use restrictions in perpetuity. Therefore, it is not viable, causing hardship to two property owners.

### **3- Preferred Alternative – Proposed Site Plans:**

The preferred alternative, as submitted, will meet the project objective by providing a safe and effective driveway entrance for the future homeowner as well as emergency vehicles. This location also results in the smallest impact to the wetland area (600 s.f.), by locating the proposed driveway at the narrowest wetland section. This project will result in improving the water quality based on the implemented BMPs and Low Impact Development Techniques. The project also complies with the required wetland impact mitigation by replicating the lost wetland area with a ratio of 2:1 as required under the Wetland Protection Act. Additionally, the driveway connection will incorporate an equalizer pipe/culvert to maintain the hydraulic connection throughout the wetland area.

## **D. OBJECTIVE OF STORMWATER CALCULATIONS**

This stormwater analysis aims to examine the stormwater runoff from the proposed site based on the MA Stormwater Regulations and the City of Amesbury Zoning ordinance. Stormwater management will be provided according to the latest policy and regulations established by the Massachusetts Department of Environmental Protection Stormwater Management Regulations, and the applicable requirements of the City. The goal of the stormwater management system design on this project is to improve water quality, mitigate any increase in stormwater runoff, and protect the surrounding area from any potential flooding and/or environmental impacts associated with the unmitigated condition.

## **E. STORMWATER CALCULATIONS METHODOLOGY**

The HydroCAD Stormwater Modeling computer program, version 10.0, by Applied Microcomputer Systems, Inc., is used to develop stormwater runoff rates and volumes for the existing and proposed conditions at the project site. The HydroCAD software is a hydrograph generation and routing program similar to TR-20. The software uses Soil Conservation Service (SCS) Unit Hydrograph Methodology. This drainage analysis was developed utilizing a Type III, 24-hour storm developed by the Soil Conservation Service (SCS). Information regarding the equations and calculation procedures utilized in HydroCAD will be made available upon request. The following basic steps are employed in the procedure:

A rainfall distribution, which indicates how the storm depth will be distributed over time, is selected. This is the standardized Type III SCS distribution based on the project's location.

The design storm depth is determined from the rainfall frequency atlas based on the modeled return period. Combined with the rainfall distribution, it will yield the cumulative depth at each period during the storm.

Based on the Time of Concentration ( $T_c$ ), the storm is divided into bursts of equal duration. For each burst, the SCS runoff equation and the average Curve Number determine the portion of that burst that will appear as runoff.

A unit hydrograph representing the runoff resulting from one inch of precipitation excess generated uniformly over the watershed in conjunction with the Time of Concentration is used to determine how

the runoff from a burst is distributed over time. The result is a runoff hydrograph for a single burst. Individual hydrographs are added together for all bursts in the storm, yielding the complete runoff hydrograph for each storm.

The SCS rainfall distributions are derived from observations used to develop the Intensity-Duration-Frequency relationship or IDF curve. By studying the Weather Bureau's Rainfall Frequency Atlases, the SCS developed four "mass curves" that could represent the characteristics of the rainfall distribution throughout the continental United States. The mass curve is a dimensionless distribution of rainfall over time, which indicates the fraction of the rainfall event that occurs at a given time within a 24-hour precipitation event. This synthetic distribution develops peak rates for storms of varying durations and intensities. The SCS distribution provides a cumulative rainfall at any point and allows volume-dependent routing runoff calculations to occur.

The HydroCAD software has the additional capability to describe shallow concentrated flow. The "NEH-4 Upland Method" included in the HydroCAD software applies to conditions in the watershed's headwaters up to 2,000 acres. The NEH-4 Upland Method allows the Time of Concentration ( $T_c$ ) to reflect ground conditions such as overland flow, grassed waterways, paved areas, and upland gullies. This results in a model that more accurately reflects the ground surface for shallow concentrated flow conditions than TR-20, which is limited to distinguishing only paved and unpaved surfaces.  $T_c$  is the time required for water to flow from the most distant point in a watershed area to the measurement or collection point.  $T_c$  has been directly entered as a 5-minute minimum when the watersheds are small and impervious. This is consistent with standard engineering practice and the Technical Release (TR-55) Urban Hydrology for Small Watersheds graphical method. A lower boundary of 5 minutes will yield a conservative yet practical measure of stormwater runoff flow for small watersheds within the development.

The curve number or CN is a land-sensitive coefficient that dictates the relationship between total rainfall depth and direct stormwater runoff. A weighted average CN value was determined based on the cover in each sub-watershed. The area, CN values, and time of concentration were entered into HydroCAD to develop hydrographs for the pre- and post-developed conditions. The USDA Natural Resource Conservation Service (NRCS) assigns each soil series to a hydrologic soil group (HSG) as part of their soil classification system. The HSG is a four-letter index (A-D) that shows soil's relative potential to generate runoff. Hydrologic soil groups (HSG) are used primarily in engineering calculations to estimate runoff from precipitation. HSG designations vary from "A" to "D," with "A" having the highest infiltration rate and "D" the slowest. Weighted average CN values for the site are indicated in the attached hydroCAD calculations and shown on the attached drainage area maps.

The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 precipitation frequency estimates are used to develop the rainfall values for the design events.

## **F. SUMMARY OF STORMWATER CALCULATIONS**

The proposed stormwater management system, utilizing Low Impact Development techniques, reduces the amount of stormwater runoff discharge rates and volumes toward Newton Road and mitigates. The system is designed to prevent untreated discharges to wetland resource areas and surface water, prevent flooding by managing peak discharges and volumes of runoff, minimize erosion and sedimentation, resulting in an improvement to groundwater quality; reduce suspended solids and other pollutants to improve water quality and provide increased protection of sensitive natural resources as required for the WRPD.

The southern property line/ Wetland A was designated as Design Point 1 (DP-1) in the HydroCAD model, and peak flow rates and volumes were analyzed at DP-1 for existing and proposed conditions. The proposed system reduces the peak discharge rates and volumes, complying with the Sudbury Stormwater Regulations. Table-1 below summarizes the stormwater runoff peak discharge rates and volumes at DP-1.

Table-1

| DESIGN POINT 1 (DP-1) |                 |                 |                 |                 |                 |                 |
|-----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                       | Existing        |                 | Proposed        |                 | Difference      |                 |
| Storm                 | Peak Flow (CFS) | Volume (ac.ft.) | Peak Flow (CFS) | Volume (ac.ft.) | Peak Flow (CFS) | Volume (ac.ft.) |
| 2yr                   | 0.58            | 0.075           | 0.57            | 0.059           | -0.01           | -0.016          |
| 10yr                  | 2.34            | 0.216           | 1.79            | 0.154           | -0.55           | -0.062          |
| 25yr                  | 3.51            | 0.357           | 2.93            | 0.249           | -0.58           | -0.108          |
| 100yr                 | 5.30            | 0.697           | 4.91            | 0.578           | -0.39           | -0.119          |

As indicated in Table-1 above, the proposed BMPs mitigate the increase in peak discharge rates and volumes; no impact to abutters or areas downstream will result from this Project as required by the applicable regulations. For additional information, refer to the attached stormwater calculations, hydroCAD model, and hydrology plans.

In addition to the compliance with the Stormwater Regulations, the site design complies with the requirement Section XIV(I) for the Uses requiring a Special Permit in the WRPD by providing the necessary 150% compensatory stormwater storage of new impervious areas in Zone A in a Low Impact Development Technique and resorting such area into a natural vegetated surface.

## **G. STORMWATER MANAGEMENT PERFORMANCE STANDARDS:**

This section explains how the proposed Project would address the 2008 MassDEP Stormwater Management Policy and the City's Stormwater Management Performance Standards. It should be noted that as a single-family development, the project is exempt from the MA Stormwater Regulations; however, it is subject to stormwater regulations as it is located in the WRPD Zoning District. Below is a summary of compliance with the MA Stormwater Management Standards.

*Standard 1: No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

**Stormwater runoff generated from the site area is collected through the utilization of the proposed drainage channel and directed to the proposed bioretention area, which provides the required treatment and infiltration. The proposed stormwater system has sufficient retention volume to mitigate the increase in stormwater peak flows and volumes. The bioretention area is equipped with an overflow gravel spillway. All outlets have been designed with non-erosive velocities, and no new stormwater system conveyances will discharge untreated runoff; thus, this standard is fully met.**

*Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.*

**The post-development discharge rates do not exceed the pre-development peak discharge rates. The Project reduces the peak discharge rates and volumes, as summarized in Table-1 above (refer to the attached hydroCAD report and Hydrology plans for more information). This standard is fully met.**

*Standard 3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.*

**The Project's stormwater management system satisfies Standard 3 of the Mass DEP Stormwater Regulations. The Project provides the required recharge volume in the proposed bioretention area using a Low-Impact Development Technique where the recharge volume is retained and infiltrated. Refer to the recharge narrative and calculations enclosed within this report.**

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

- a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained.
- b) Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and
- c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

**The proposed stormwater system consists of infiltration BMPs that provide the required TSS removal as required by the Massachusetts Stormwater Regulations. Refer to the attached TSS Removal worksheet for additional information.**

Standard 5: 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 the maximum extent practicable.

**This Standard is not applicable to this site. The Project is not considered a LUHPL (Land Use with Higher Potential Pollutant Load).**

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or directed to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply...

**This project discharges to Zone A. Stormwater runoff to Zone A is treated for the required 1 inch of water quality volume via the proposed bioretention area equipped with a sediment forebay. Total TSS removal for the entire impervious impact on site is 93%, exceeding the required removal of 80%. Additionally, the sediment forebay and drainage channel provide 44% TSS removal prior to discharging to the infiltration practice as required. There is a small section of the driveway of impervious area (700 square feet) located in Zone (A) that does not get treated due to the steep topography of the site and the existence of the BVW along the entity of the frontage of the property. It is infeasible to construct additional stormwater control measures and impact additional wetland areas in Zone A to treat such a small portion of the driveway connection. Therefore, the project has met this standard.**

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

**The Project is not a redevelopment project. The Project is designed to meet the MA Stormwater Standards. All reasonable efforts were explored to achieve compliance with MA Stormwater Standards.**

Standard 8: *A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.*

**The attached site plans address construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction.**

Standard 9: *A long-term operation and maintenance plan shall be developed and implemented to ensure that Stormwater Management Systems function as designed.*

**The proposed BMPs will be inspected and maintained periodically by the homeowner or a landscaping contractor. For the first year, debris and sediment accumulation shall be checked every six months. A Long-Term Stormwater Pollution Prevention and Operation and maintenance Plan is included in this report.**

Standard 10: *All illicit discharges to the stormwater management system are prohibited.*

**The Project is designed to avoid illicit discharge into the stormwater system. An illicit discharge compliance statement is attached.**

## **H. Long-Term Stormwater Pollution Prevention and Operation & Maintenance Plan to Comply with Stormwater Standards 4, 6, & 9:**

This section identifies constituents of concern that have the potential to contaminate stormwater runoff from the proposed project site and provides a framework of Best Management Practices (BMPs) for handling stormwater runoff. It also outlines an inspection and maintenance program to ensure the continued effectiveness of the stormwater management system. The utilized BMPs are shown on the site plans attached.

### **OWNER AND RESPONSIBLE PARTY:**

*Owner:*

*Day-to-day Operation and Maintenance:*

### **1) CONSTRUCTION MANAGEMENT:**

A construction manager with adequate knowledge and experience on projects of similar size and scope shall be employed to oversee all site work-related construction. The Contractor shall incorporate the appropriate techniques to control sediment and erosion pollution during construction in accordance with the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas and any conditions of approval from the local conservation commission.

The design incorporates measures to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities. The information contained herein and within the engineering drawings identifies construction period pollution prevention measures, responsible parties, erosion control measures (straw bales and silt fence, etc.), BMPs for collecting and treating runoff and groundwater during construction<sup>1</sup>, site stabilization measures (i.e., gravel, seed, pavement, etc.), an operations and maintenance plan & long-term pollution prevention plan contained herein.

Care should be taken when constructing stormwater control structures. Light earth-moving equipment shall be used when operating over buried utilities, drains, or chambers.

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<sup>1</sup> Should the need for de-watering arise during construction at the site, groundwater will be pumped directly from the work area into geotextile filter bags, temporary settling basins, or portable fractionation tanks (depending on the nature and volume of water encountered) which will act as sediment traps during construction. Discharge points will be setback outside of all resource areas and buffers monitored by qualified personnel (wetland scientist, licensed site professional, civil engineer, etc.) to ensure no impacts to resource areas and compliance with applicable Federal and state regulations. All discharges will be free from visible floating, suspended, and settleable solids that would impair the functions of the nearby drainage systems, wetlands, or downstream rivers. Refer to the details provided on the drawing set for additional information.

## **2) ON-GOING MAINTENANCE CONTRACT:**

The non-structural and structural approaches recommended below in sections 8 & 9, as well as the required BMP maintenance, will be completed by an appropriate contractor. Adequate personnel with appropriate training and access to proper equipment will be available to complete the tasks. Future responsible parties must be notified of their responsibility to perpetually operate and maintain the system.

## **3) LIVING DOCUMENT PROVISIONS:**

This document shall be updated as necessary to reflect new procedures, technologies, or requirements.

## **4) MAINTENANCE LOG:**

The Responsible Party shall develop and maintain a log of inspections, maintenance, repairs, and disposal (including the location of disposal) during the life of the Project. Records will be maintained for at least three years and be made available for viewing to the Massachusetts Department of Environmental Protection under the provisions of the Massachusetts Stormwater Handbook.

## **5) GOOD HOUSEKEEPING PRACTICES DURING CONSTRUCTION:**

The Responsible Party shall maintain good housekeeping practices by maintaining a clean and orderly facility to prevent potential pollution sources, including debris, from coming into contact with stormwater and degrading water quality. It includes establishing protocols to reduce the possibility of mishandling materials or equipment and training employees in good housekeeping techniques. Common areas where good housekeeping practices should be followed shall include material storage, vehicle and equipment maintenance, and loading areas. Good housekeeping practices must include a designated and secure location for garbage. A schedule for regular pickup and disposal of garbage and waste materials and routine inspections of containers for leaks and structural integrity shall be developed.

Specific good housekeeping practices that will be implemented include routine trash removal. Items including scrap, metal, wood, plastic, miscellaneous trash, paper, glass, insulation, misc. Building materials and packaging. Additional practices include securing and covering any containers, supplies, or equipment that could become sources of stormwater pollution.

## **6) MINIMIZING EXPOSURE DURING CONSTRUCTION:**

The Responsible Party will minimize exposure of potential pollutant sources, including debris, from coming into contact with precipitation and being picked up by stormwater and carried into drains and surface waters using the following steps:

- Storing all containerized materials in a protected, secure location away from drains and plainly labeled.
- Containing all activities that can generate sources of contaminants from reaching the receiving water or the stormwater management system.
- Securing any equipment or supplies so they are not transported into receiving waters or stormwater management systems during storm events.

## **7) BEST MANAGEMENT PRACTICES MAINTENANCE POST-CONSTRUCTION:**

The following Best Management Practices are proposed to be incorporated into the stormwater management system treatment train design to reduce source runoff and improve stormwater runoff discharge quality. A description of the non-structural and structural approaches to be incorporated are indicated below. The Responsible Party will regularly inspect all BMPs to ensure they are operating properly. If any deficiencies are identified during these inspections, action to resolve it will be initiated and documented on the maintenance log.

## **8) NON-STRUCTURAL BEST MANAGEMENT PRACTICES (BMPs):**

### *GRADING:*

Steep slopes will be permanently vegetated to dissipate energy and reduce potential erosion. No constructed vegetated slopes should exceed 2H: 1V without providing additional reinforcement. Steep slopes may require soil reinforcement and additional vegetation.

### *SNOW STORAGE AND DEICING:*

Snow storage is anticipated to occur around the perimeter of the paved areas. The landscaping has been designed accordingly. During larger snow events, the use of a snow pile area within the less utilized portion of the main parking area shall be utilized.

### *FERTILIZER:*

Slow-release organic fertilizers are recommended to be used in landscape areas to limit nutrient transport to groundwater and the wetland area. The application should be limited to 5 lbs. per 1,000 square feet of lawn area.

## **9) STRUCTURAL BEST MANAGEMENT PRACTICES:**

Prior to the final completion of the Project, it is recommended that a representative of the Contractor or Engineer either designing or building the facility for the Owner properly instruct the Responsible Party as to the maintenance practices required to maintain the effectiveness of the drainage system responsibly. These frequencies and requirements are recommendations to maintain minimum effectiveness in most typical environments. The Responsible Party will implement the procedures and frequencies as they see fit under their current plan and inspect the systems as needed to maintain minimum effectiveness as the manufacturer recommends. The following maintenance of structural BMPs will be implemented:

### *Bioretention Area:*

Premature failure of Bioretention areas is a significant issue caused by lack of regular maintenance. Ensuring long-term maintenance involves sustained public education and deed restrictions or covenants for privately owned cells. Rain gardens require careful attention while plants are being established and seasonal landscaping maintenance thereafter. Inspect pretreatment devices and bio-retention cells regularly for sediment build-up, structural damage, and standing water. Inspect soil and repair eroded areas monthly. Re-mulch void areas as needed. Remove litter and debris monthly. Treat diseased vegetation as needed. Remove and replace dead vegetation twice per year (spring and fall). Remove invasive species as needed to prevent these species from spreading into the rain garden area. Never store snow in bioretention areas.



## LONG TERM STRUCTURAL BEST MANAGEMENT PRACTICE INSPECTION & MAINTENANCE MATRIX AFTER CONSTRUCTION

Note: BMP's shall be visually inspected and repaired by a qualified party in accordance with the following chart. Note these are minimum inspection criteria/frequencies and should be adjusted throughout the project lifespan as required to maintain effectiveness. Refer to maintenance standards for drainage facilities and structural best management practices in the "Recommended Long-Term Stormwater Pollution Prevention Plan."

| Conventional & LID Best Management Practices | Recommended Minimum Inspection & Maintenance Frequency | Erosion/Scouring                    | Tree Growth Hazards                 | Differential Settlement/Seepage     | Structural Damage/Obstructions      | Trash & Debris                      | Removal of Accumulated Sediment     | Slope Integrity                     | Mow Vegetation/Poor Vegetation Coverage | Remove/Reset Filter Fabric & Stone As Required | Remove & Replace Hardwood mulch/media | Vac Truck Sediment & Contaminants | Remove/Reset Riprap as Required     |
|----------------------------------------------|--------------------------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----------------------------------------|------------------------------------------------|---------------------------------------|-----------------------------------|-------------------------------------|
| Bioretention Area                            | Semiannually                                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>     | <input checked="" type="checkbox"/>            |                                       |                                   |                                     |
| Gravel Spillway                              | Semiannually                                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |                                         |                                                | <input checked="" type="checkbox"/>   |                                   | <input checked="" type="checkbox"/> |



# Stormwater BMP Inspection and Maintenance Log

|               |          |
|---------------|----------|
| Facility Name |          |
| Address       |          |
| Begin Date    | End Date |

| Date | BMP ID# | BMP Description | Inspected by: | Cause for Inspection | Exceptions Noted | Comments and Actions Taken |
|------|---------|-----------------|---------------|----------------------|------------------|----------------------------|
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |

Instructions: Record all inspections and maintenance for all treatment BMPs on this form. Use additional log sheets and/or attach extended comments or documentation as necessary.

- BMP ID# — Always use ID# from the Operation and Maintenance Manual or Approved Plans.
- Inspected by — Note all inspections and maintenance on this form, including the required independent annual inspection.
- Cause for inspection — Note if the inspection is routine, pre-rainy-season, post-storm, annual, or in response to a noted problem or complaint.
- Exceptions noted — Note any condition that requires correction or indicates a need for maintenance.
- Comments and actions taken — Describe any maintenance done and need for follow-up.



## ***Illicit Discharge Statement***

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## **ILLICIT DISCHARGE COMPLIANCE STATEMENT**

### **Standard 10: Massachusetts Stormwater Standards Handbook**

Illicit discharges are defined as discharges into waters of the State or municipal separate stormwater system (MS4) that are not entirely comprised of stormwater. Exclusions for non-stormwater discharges into drainage systems include activities or facilities for firefighting, water line flushing, landscape irrigation, uncontaminated groundwater discharge, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, water used to clean residential buildings without detergents, water used for street washing, and flows from riparian habitats/wetlands. These exclusions are subject to change and are under the discretion of the local governing authority.

To the best of our knowledge and professional belief, no illicit discharges to the stormwater system, surface waters, or wetland resource areas will remain on the site after construction. We will agree to implement a pollution prevention plan to prevent illicit discharges into the stormwater management system. The design of the site based on the plans prepared by HD Design show a separation and no direct connection between the stormwater management systems and the wastewater and/ or groundwater on the site. To the maximum extent practicable, the design prevents entry of illicit discharges into the stormwater management system.

Engineer's Name: Hazem Dani, PE  
(please print)

Engineer's Signature:  Date: 07/15/2024





## ***Stormwater Checklist***

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# Checklist for Stormwater Report

## A. Introduction

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.<sup>1</sup> This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8<sup>2</sup>
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

<sup>1</sup> The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

<sup>2</sup> For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



# Checklist for Stormwater Report

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## B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

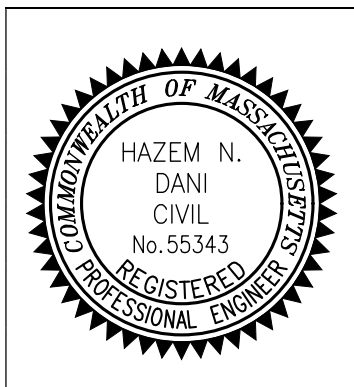
A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

---

### Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



07/16/2024

Signature and Date

---

## Checklist

**Project Type:** Is the application for new development, redevelopment, or a mix of new and redevelopment?

- ☒ New development
- ☐ Redevelopment
- ☐ Mix of New Development and Redevelopment



# Checklist for Stormwater Report

---

## Checklist (continued)

**LID Measures:** Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☒ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): \_\_\_\_\_

### Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 2: Peak Rate Attenuation

- ☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

### Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☒ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.
  - ☒ Static
  - ☐ Simple Dynamic
  - ☐ Dynamic Field<sup>1</sup>
- ☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
  - ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
  - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
  - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
  - ☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

---

<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 3: Recharge (continued)

- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☒ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

### Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
  - Provisions for storing materials and waste products inside or under cover;
  - Vehicle washing controls;
  - Requirements for routine inspections and maintenance of stormwater BMPs;
  - Spill prevention and response plans;
  - Provisions for maintenance of lawns, gardens, and other landscaped areas;
  - Requirements for storage and use of fertilizers, herbicides, and pesticides;
  - Pet waste management provisions;
  - Provisions for operation and management of septic systems;
  - Provisions for solid waste management;
  - Snow disposal and plowing plans relative to Wetland Resource Areas;
  - Winter Road Salt and/or Sand Use and Storage restrictions;
  - Street sweeping schedules;
  - Provisions for prevention of illicit discharges to the stormwater management system;
  - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
  - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
  - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
  - ☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
    - ☒ is within the Zone II or Interim Wellhead Protection Area
    - ☐ is near or to other critical areas
    - ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
    - ☐ involves runoff from land uses with higher potential pollutant loads.
  - ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
  - ☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 4: Water Quality (continued)

- ☒ The BMP is sized (and calculations provided) based on:
  - ☒ The ½" or 1" Water Quality Volume or
  - ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

### Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- ☐ The NPDES Multi-Sector General Permit does **not** cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

### Standard 6: Critical Areas

- ☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☒ Critical areas and BMPs are identified in the Stormwater Report.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- ☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
  - ☐ Limited Project
  - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
  - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
  - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
  - ☐ Bike Path and/or Foot Path
  - ☐ Redevelopment Project
  - ☐ Redevelopment portion of mix of new and redevelopment.
- ☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
  - Construction Period Operation and Maintenance Plan;
  - Names of Persons or Entity Responsible for Plan Compliance;
  - Construction Period Pollution Prevention Measures;
  - Erosion and Sedimentation Control Plan Drawings;
  - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
  - Vegetation Planning;
  - Site Development Plan;
  - Construction Sequencing Plan;
  - Sequencing of Erosion and Sedimentation Controls;
  - Operation and Maintenance of Erosion and Sedimentation Controls;
  - Inspection Schedule;
  - Maintenance Schedule;
  - Inspection and Maintenance Log Form.
- ☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



# Checklist for Stormwater Report

---

## Checklist (continued)

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☒ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

### Standard 9: Operation and Maintenance Plan

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - ☒ Name of the stormwater management system owners;
  - ☒ Party responsible for operation and maintenance;
  - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
  - ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
  - ☒ Description and delineation of public safety features;
  - ☒ Estimated operation and maintenance budget; and
  - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

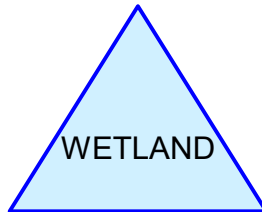
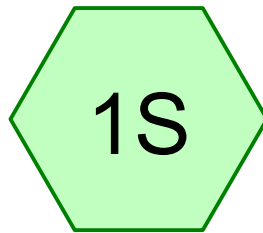
### Standard 10: Prohibition of Illicit Discharges

- ☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

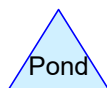
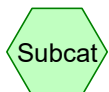
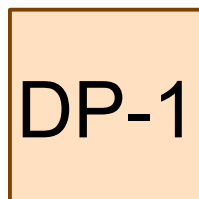
***Pre-Development  
HydroCAD Model Calculations***

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WETLAND A



**31 Newtown Rd Existing HydroCAD**

Type III 24-hr 2-Year Rainfall=3.15"

Prepared by CHA Consulting, Inc

Printed 7/10/2024

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Page 2

**Summary for Subcatchment 1S:**

Runoff = 0.58 cfs @ 12.21 hrs, Volume= 0.075 af, Depth= 0.46"  
 Routed to Pond WETLAND : WETLAND A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.15"

|   | Area (sf) | CN | Description           |
|---|-----------|----|-----------------------|
| * | 5,240     | 98 | Wetland Area          |
|   | 34,510    | 73 | Woods, Fair, HSG C    |
|   | 26,149    | 35 | Brush, Fair, HSG A    |
|   | 18,831    | 70 | Brush, Fair, HSG C    |
|   | 84,730    | 62 | Weighted Average      |
|   | 79,490    |    | 93.82% Pervious Area  |
|   | 5,240     |    | 6.18% Impervious Area |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description                                |
|-------------|------------------|------------------|----------------------|-------------------|--------------------------------------------|
| 8.5         | 100              | 0.2600           | 0.20                 |                   | <b>Sheet Flow, A-B</b>                     |
|             |                  |                  |                      |                   | Woods: Light underbrush n= 0.400 P2= 2.61" |
| 0.4         | 75               | 0.3200           | 2.83                 |                   | <b>Shallow Concentrated Flow, B-C</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 1.7         | 232              | 0.2100           | 2.29                 |                   | <b>Shallow Concentrated Flow, C-D</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 0.1         | 57               |                  | 8.02                 |                   | <b>Lake or Reservoir, D-E</b>              |
|             |                  |                  |                      |                   | Mean Depth= 2.00'                          |
| 10.7        | 464              | Total            |                      |                   |                                            |

# 31 Newtown Rd Existing HydroCAD

Prepared by CHA Consulting, Inc

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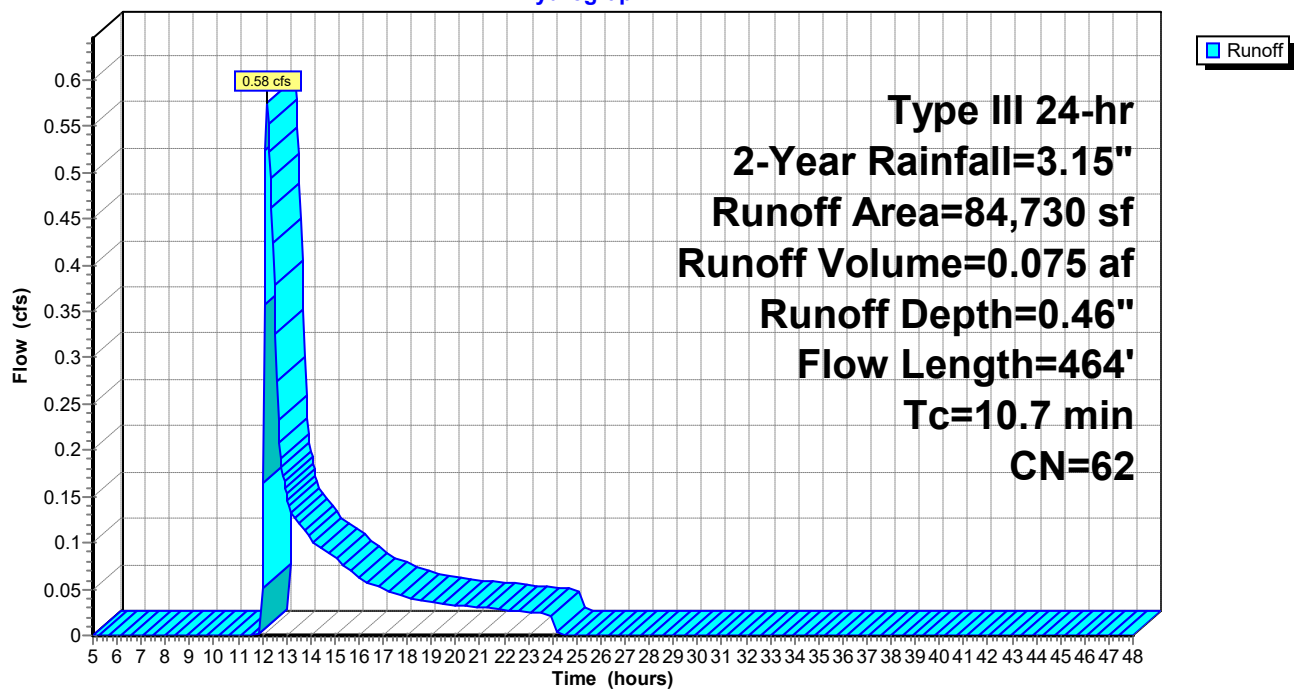
Type III 24-hr 2-Year Rainfall=3.15"

Printed 7/10/2024

Page 3

## Subcatchment 1S:

### Hydrograph



## 31 Newtown Rd Existing HydroCAD

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Type III 24-hr 2-Year Rainfall=3.15"

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Page 4

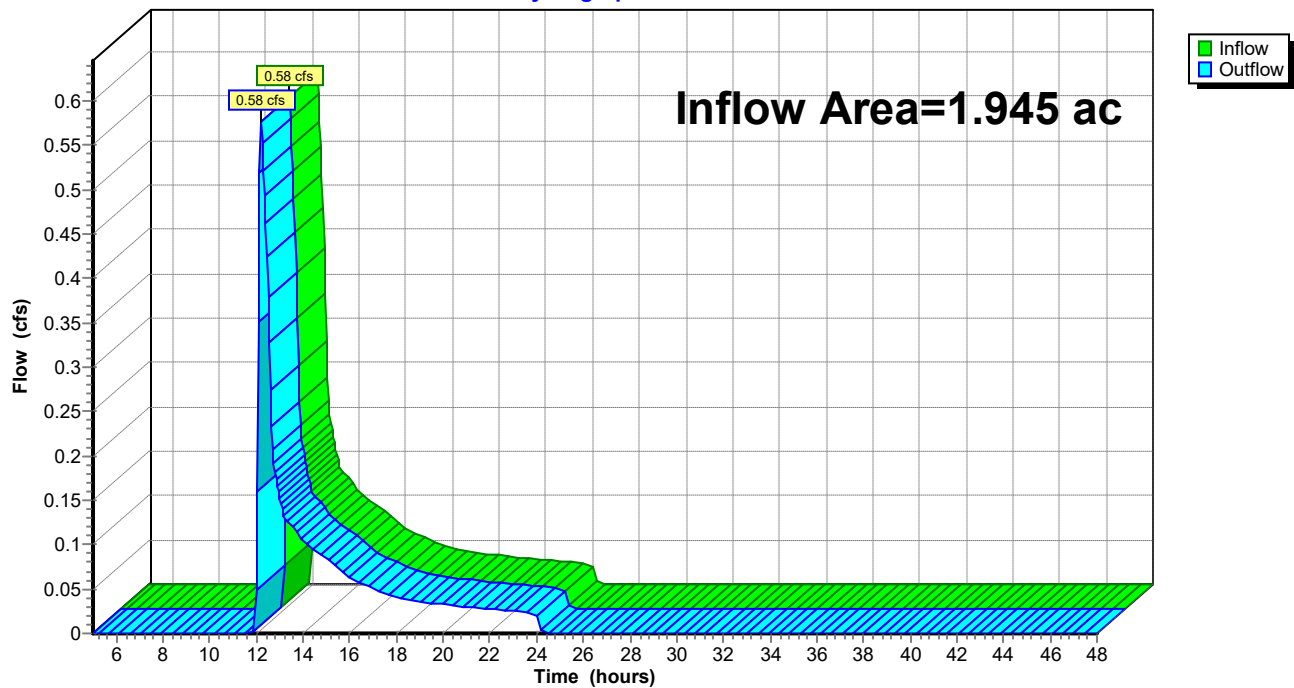
### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 0.46" for 2-Year event  
Inflow = 0.58 cfs @ 12.21 hrs, Volume= 0.075 af  
Outflow = 0.58 cfs @ 12.21 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:

Hydrograph



### 31 Newtown Rd Existing HydroCAD

Type III 24-hr 2-Year Rainfall=3.15"

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Page 5

### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 0.46" for 2-Year event  
Inflow = 0.58 cfs @ 12.21 hrs, Volume= 0.075 af  
Outflow = 0.58 cfs @ 12.21 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.1 min  
Primary = 0.58 cfs @ 12.21 hrs, Volume= 0.075 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.00' @ 12.21 hrs Surf.Area= 1,684 sf Storage= 3 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

Plug-Flow detention time= 0.1 min calculated for 0.074 af (100% of inflow)  
Center-of-Mass det. time= 0.1 min ( 915.9 - 915.8 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=3.01 cfs @ 12.21 hrs HW=111.00' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 3.01 cfs @ 4.04 fps)

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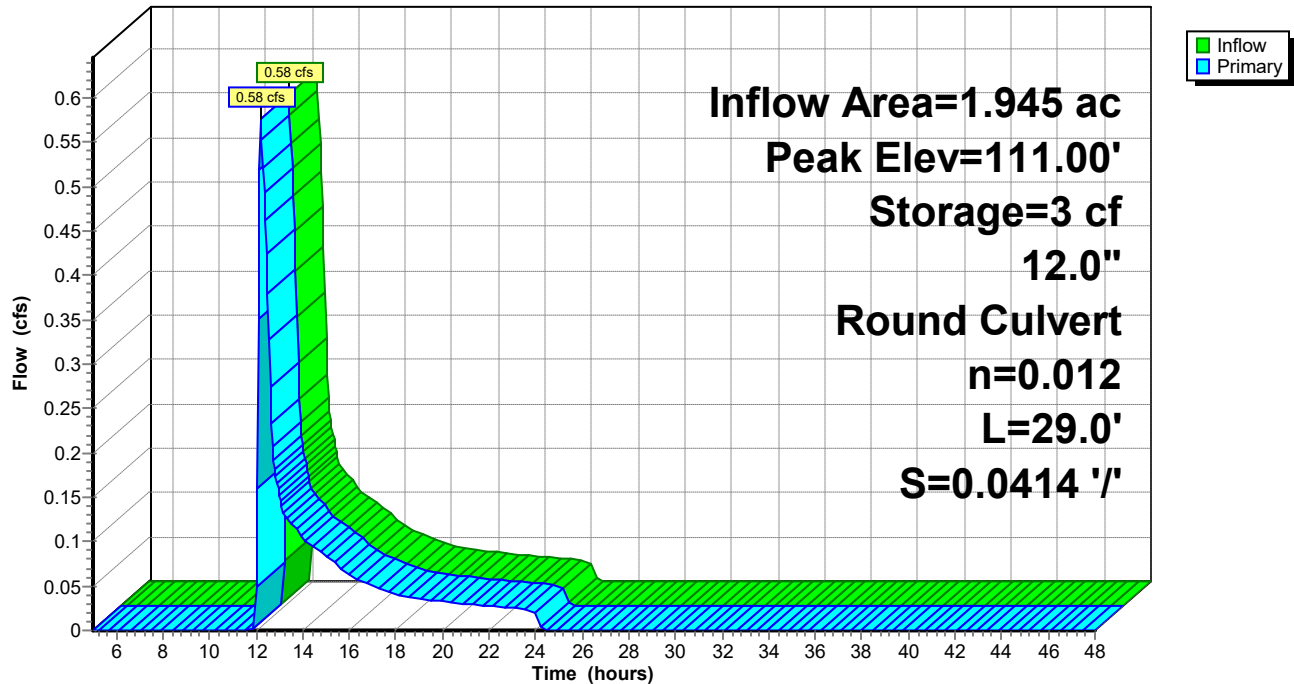
Type III 24-hr 2-Year Rainfall=3.15"

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## Pond WETLAND: WETLAND A

Hydrograph



**31 Newtown Rd Existing HydroCAD**

Type III 24-hr 10-Year Rainfall=4.83"

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Page 7

**Summary for Subcatchment 1S:**

Runoff = 2.34 cfs @ 12.17 hrs, Volume= 0.216 af, Depth= 1.33"  
 Routed to Pond WETLAND : WETLAND A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=4.83"

|   | Area (sf) | CN | Description           |
|---|-----------|----|-----------------------|
| * | 5,240     | 98 | Wetland Area          |
|   | 34,510    | 73 | Woods, Fair, HSG C    |
|   | 26,149    | 35 | Brush, Fair, HSG A    |
|   | 18,831    | 70 | Brush, Fair, HSG C    |
|   | 84,730    | 62 | Weighted Average      |
|   | 79,490    |    | 93.82% Pervious Area  |
|   | 5,240     |    | 6.18% Impervious Area |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description                                |
|-------------|------------------|------------------|----------------------|-------------------|--------------------------------------------|
| 8.5         | 100              | 0.2600           | 0.20                 |                   | <b>Sheet Flow, A-B</b>                     |
|             |                  |                  |                      |                   | Woods: Light underbrush n= 0.400 P2= 2.61" |
| 0.4         | 75               | 0.3200           | 2.83                 |                   | <b>Shallow Concentrated Flow, B-C</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 1.7         | 232              | 0.2100           | 2.29                 |                   | <b>Shallow Concentrated Flow, C-D</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 0.1         | 57               |                  | 8.02                 |                   | <b>Lake or Reservoir, D-E</b>              |
|             |                  |                  |                      |                   | Mean Depth= 2.00'                          |
| 10.7        | 464              | Total            |                      |                   |                                            |

# 31 Newtown Rd Existing HydroCAD

Prepared by CHA Consulting, Inc

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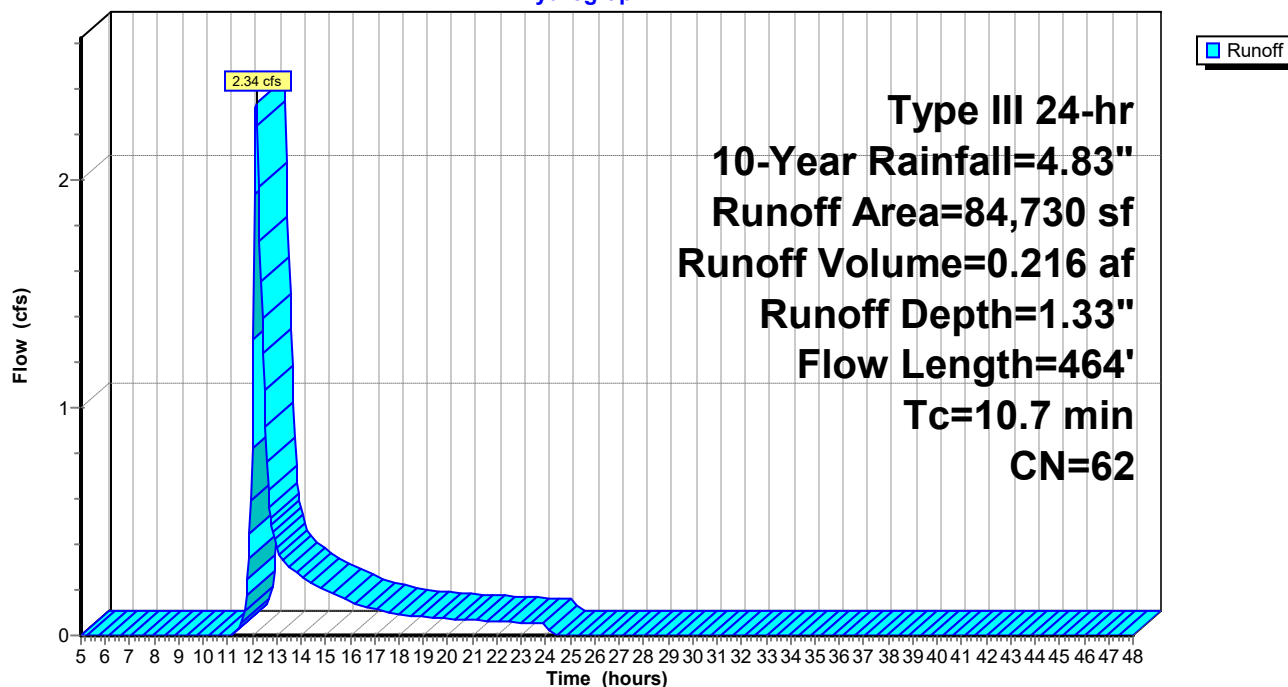
Type III 24-hr 10-Year Rainfall=4.83"

Printed 7/10/2024

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## Subcatchment 1S:

Hydrograph



## 31 Newtown Rd Existing HydroCAD

Prepared by CHA Consulting, Inc

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Type III 24-hr 10-Year Rainfall=4.83"

Printed 7/10/2024

Page 9

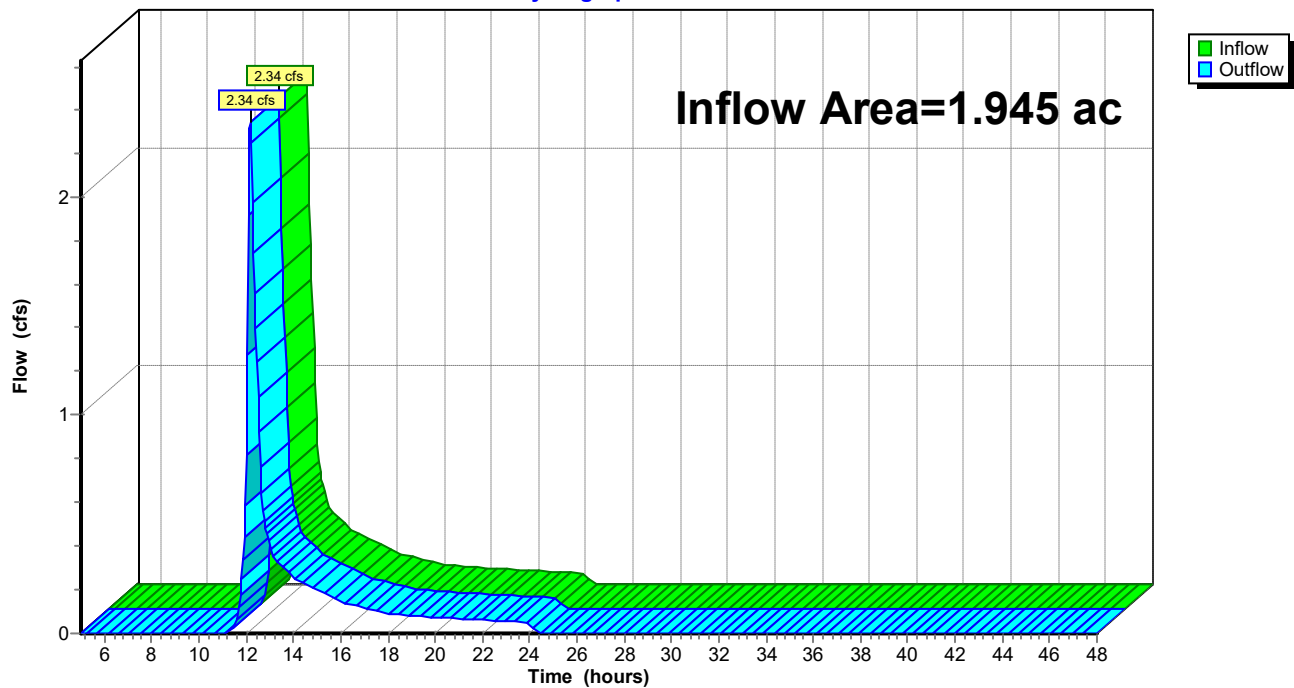
### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 1.33" for 10-Year event  
Inflow = 2.34 cfs @ 12.17 hrs, Volume= 0.216 af  
Outflow = 2.34 cfs @ 12.17 hrs, Volume= 0.216 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:

Hydrograph



### 31 Newtown Rd Existing HydroCAD

Type III 24-hr 10-Year Rainfall=4.83"

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### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 1.33" for 10-Year event  
Inflow = 2.34 cfs @ 12.17 hrs, Volume= 0.216 af  
Outflow = 2.34 cfs @ 12.17 hrs, Volume= 0.216 af, Atten= 0%, Lag= 0.1 min  
Primary = 2.34 cfs @ 12.17 hrs, Volume= 0.216 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.01' @ 12.17 hrs Surf.Area= 1,697 sf Storage= 13 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

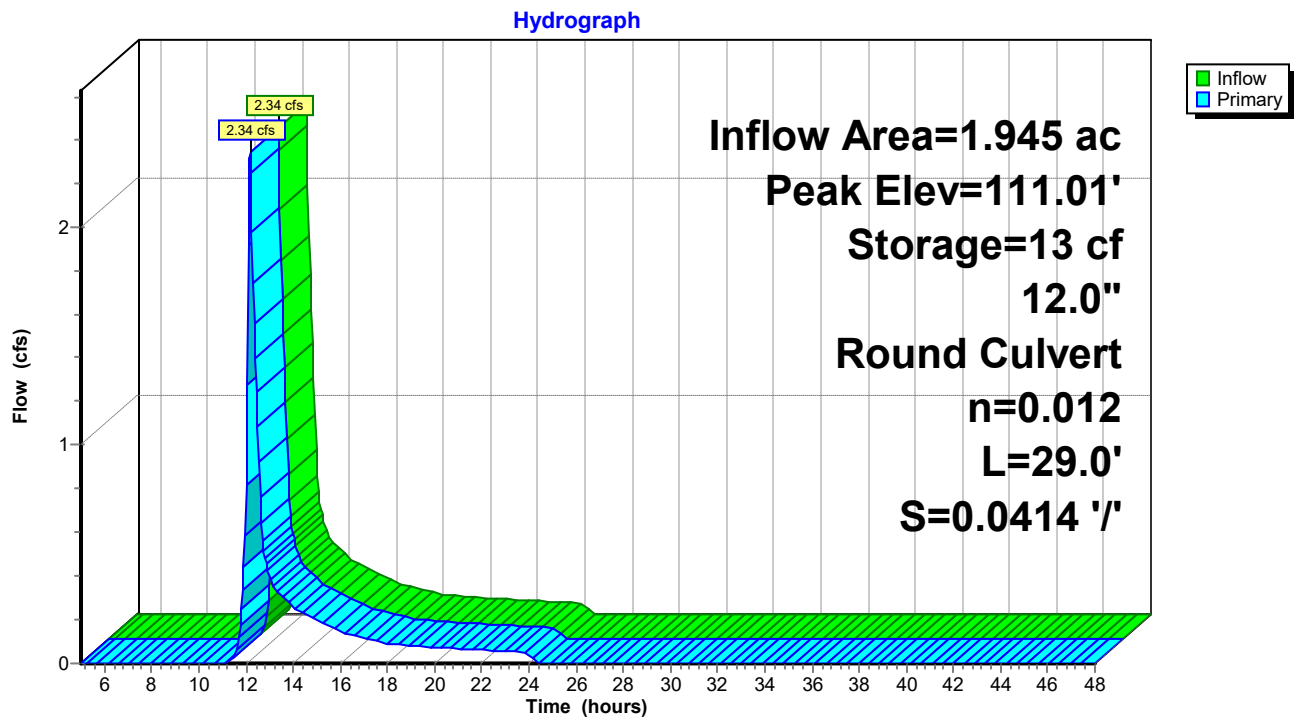
Plug-Flow detention time= 0.1 min calculated for 0.216 af (100% of inflow)  
Center-of-Mass det. time= 0.1 min ( 876.2 - 876.1 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=3.04 cfs @ 12.17 hrs HW=111.01' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 3.04 cfs @ 4.05 fps)

Pond WETLAND: WETLAND A



**31 Newtown Rd Existing HydroCAD**

Type III 24-hr 25-Year Rainfall=6.16"

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**Summary for Subcatchment 1S:**

Runoff = 4.09 cfs @ 12.16 hrs, Volume= 0.357 af, Depth= 2.20"  
 Routed to Pond WETLAND : WETLAND A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

|   | Area (sf) | CN | Description           |
|---|-----------|----|-----------------------|
| * | 5,240     | 98 | Wetland Area          |
|   | 34,510    | 73 | Woods, Fair, HSG C    |
|   | 26,149    | 35 | Brush, Fair, HSG A    |
|   | 18,831    | 70 | Brush, Fair, HSG C    |
|   | 84,730    | 62 | Weighted Average      |
|   | 79,490    |    | 93.82% Pervious Area  |
|   | 5,240     |    | 6.18% Impervious Area |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description                                |
|-------------|------------------|------------------|----------------------|-------------------|--------------------------------------------|
| 8.5         | 100              | 0.2600           | 0.20                 |                   | <b>Sheet Flow, A-B</b>                     |
|             |                  |                  |                      |                   | Woods: Light underbrush n= 0.400 P2= 2.61" |
| 0.4         | 75               | 0.3200           | 2.83                 |                   | <b>Shallow Concentrated Flow, B-C</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 1.7         | 232              | 0.2100           | 2.29                 |                   | <b>Shallow Concentrated Flow, C-D</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 0.1         | 57               |                  | 8.02                 |                   | <b>Lake or Reservoir, D-E</b>              |
|             |                  |                  |                      |                   | Mean Depth= 2.00'                          |
| 10.7        | 464              | Total            |                      |                   |                                            |

# 31 Newtown Rd Existing HydroCAD

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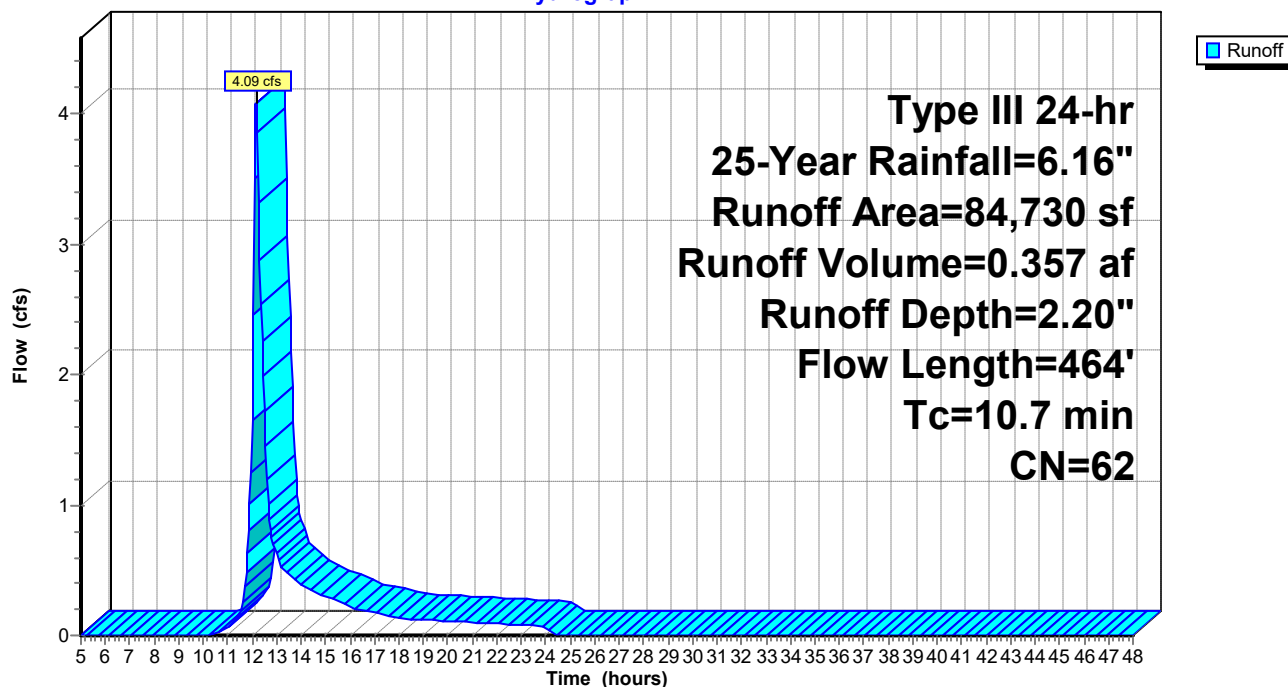
Type III 24-hr 25-Year Rainfall=6.16"

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## Subcatchment 1S:

Hydrograph



## 31 Newtown Rd Existing HydroCAD

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Type III 24-hr 25-Year Rainfall=6.16"

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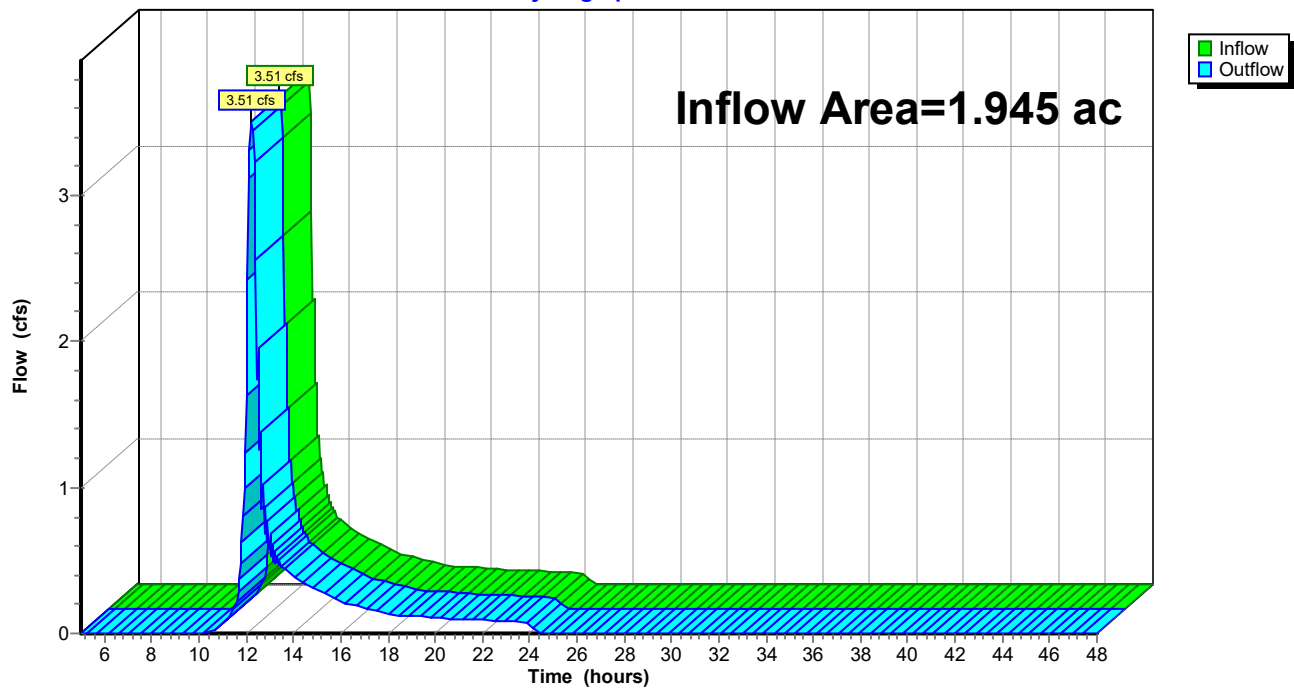
### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 2.20" for 25-Year event  
Inflow = 3.51 cfs @ 12.24 hrs, Volume= 0.357 af  
Outflow = 3.51 cfs @ 12.24 hrs, Volume= 0.357 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:

Hydrograph



### 31 Newtown Rd Existing HydroCAD

Type III 24-hr 25-Year Rainfall=6.16"

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### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 2.20" for 25-Year event  
Inflow = 4.09 cfs @ 12.16 hrs, Volume= 0.357 af  
Outflow = 3.51 cfs @ 12.24 hrs, Volume= 0.357 af, Atten= 14%, Lag= 4.5 min  
Primary = 3.51 cfs @ 12.24 hrs, Volume= 0.357 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.15' @ 12.24 hrs Surf.Area= 2,028 sf Storage= 278 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

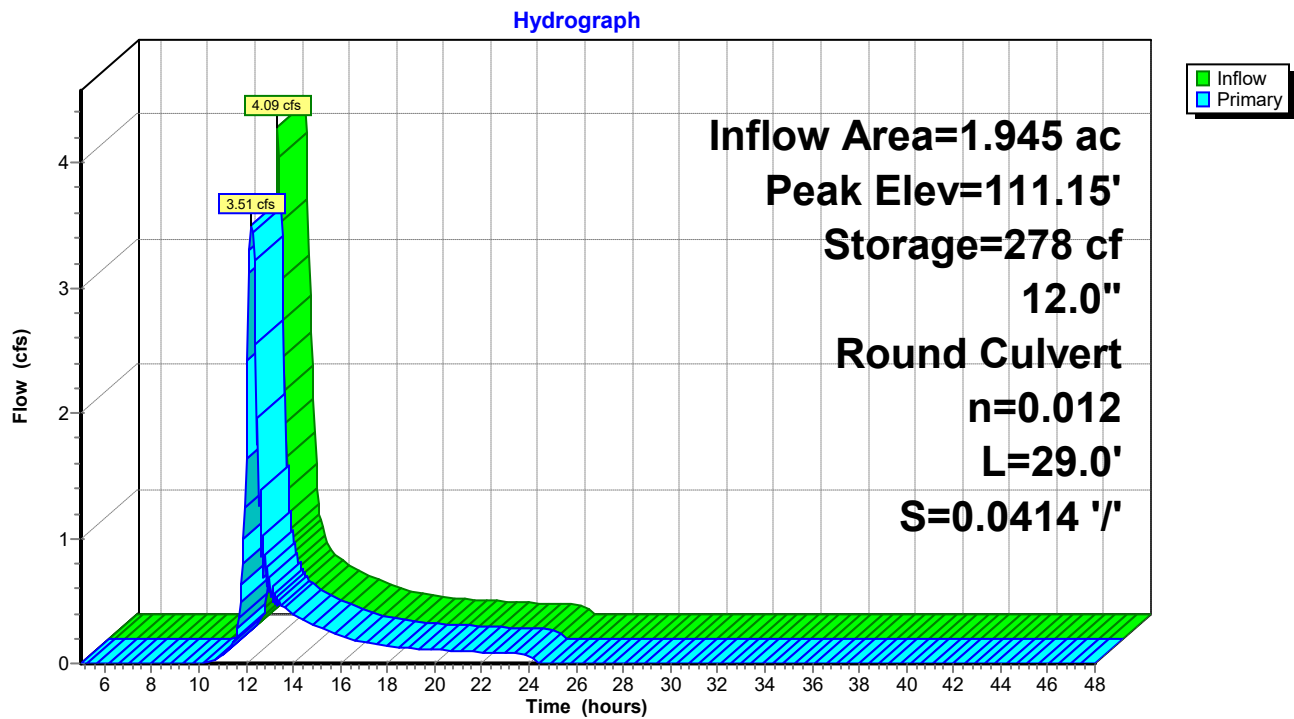
Plug-Flow detention time= (not calculated: outflow precedes inflow)  
Center-of-Mass det. time= 0.3 min ( 860.7 - 860.4 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=3.49 cfs @ 12.24 hrs HW=111.15' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 3.49 cfs @ 4.45 fps)

Pond WETLAND: WETLAND A



**31 Newtown Rd Existing HydroCAD**

Type III 24-hr 100-Year Rainfall=8.94"

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**Summary for Subcatchment 1S:**

Runoff = 8.27 cfs @ 12.16 hrs, Volume= 0.697 af, Depth= 4.30"  
 Routed to Pond WETLAND : WETLAND A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-Year Rainfall=8.94"

|   | Area (sf) | CN | Description           |
|---|-----------|----|-----------------------|
| * | 5,240     | 98 | Wetland Area          |
|   | 34,510    | 73 | Woods, Fair, HSG C    |
|   | 26,149    | 35 | Brush, Fair, HSG A    |
|   | 18,831    | 70 | Brush, Fair, HSG C    |
|   | 84,730    | 62 | Weighted Average      |
|   | 79,490    |    | 93.82% Pervious Area  |
|   | 5,240     |    | 6.18% Impervious Area |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description                                |
|-------------|------------------|------------------|----------------------|-------------------|--------------------------------------------|
| 8.5         | 100              | 0.2600           | 0.20                 |                   | <b>Sheet Flow, A-B</b>                     |
|             |                  |                  |                      |                   | Woods: Light underbrush n= 0.400 P2= 2.61" |
| 0.4         | 75               | 0.3200           | 2.83                 |                   | <b>Shallow Concentrated Flow, B-C</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 1.7         | 232              | 0.2100           | 2.29                 |                   | <b>Shallow Concentrated Flow, C-D</b>      |
|             |                  |                  |                      |                   | Woodland Kv= 5.0 fps                       |
| 0.1         | 57               |                  | 8.02                 |                   | <b>Lake or Reservoir, D-E</b>              |
|             |                  |                  |                      |                   | Mean Depth= 2.00'                          |
| 10.7        | 464              | Total            |                      |                   |                                            |

## 31 Newtown Rd Existing HydroCAD

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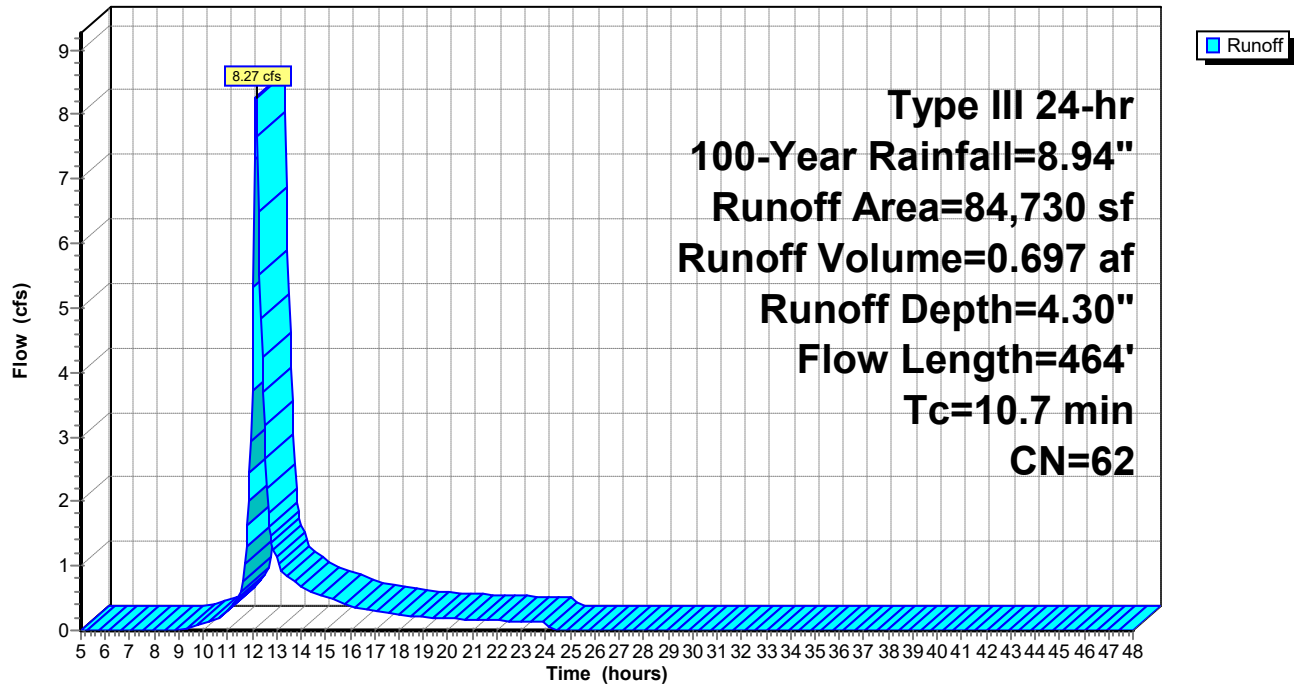
Type III 24-hr 100-Year Rainfall=8.94"

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### Subcatchment 1S:

#### Hydrograph



## 31 Newtown Rd Existing HydroCAD

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Type III 24-hr 100-Year Rainfall=8.94"

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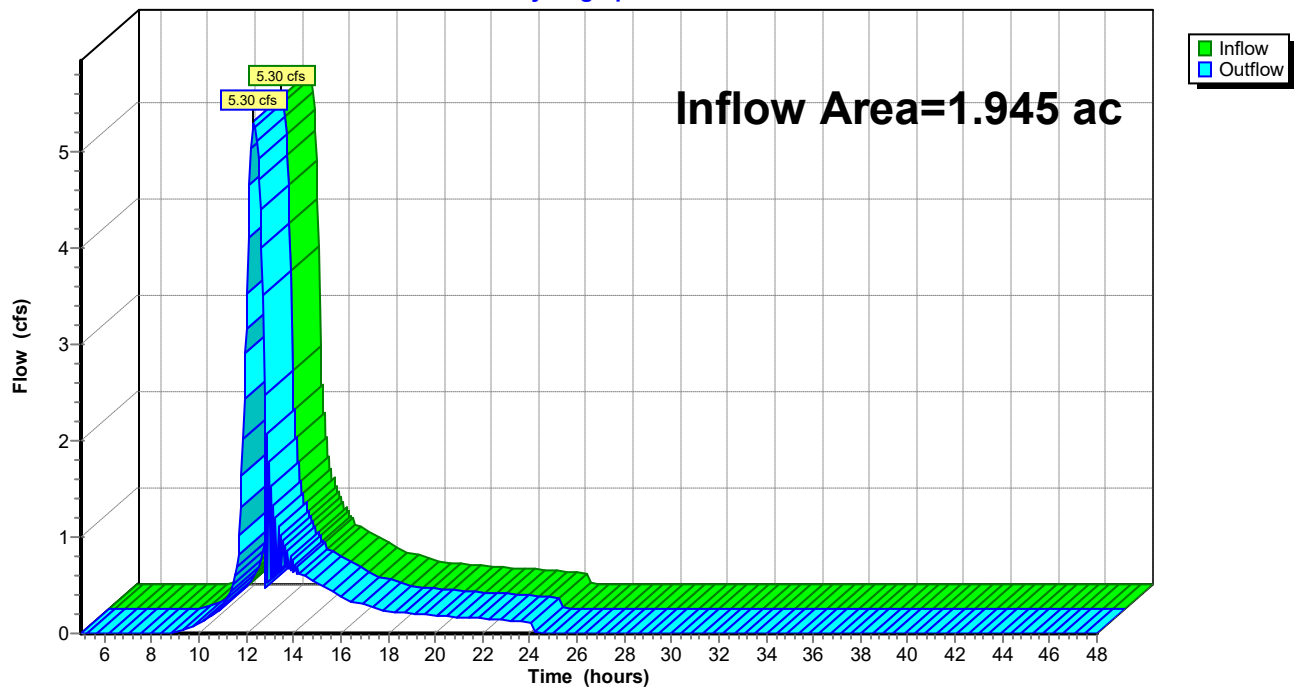
### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 4.30" for 100-Year event  
Inflow = 5.30 cfs @ 12.32 hrs, Volume= 0.697 af  
Outflow = 5.30 cfs @ 12.32 hrs, Volume= 0.697 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:

Hydrograph



### 31 Newtown Rd Existing HydroCAD

Type III 24-hr 100-Year Rainfall=8.94"

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### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 6.18% Impervious, Inflow Depth = 4.30" for 100-Year event  
Inflow = 8.27 cfs @ 12.16 hrs, Volume= 0.697 af  
Outflow = 5.30 cfs @ 12.32 hrs, Volume= 0.697 af, Atten= 36%, Lag= 9.8 min  
Primary = 5.30 cfs @ 12.32 hrs, Volume= 0.697 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.86' @ 12.32 hrs Surf.Area= 4,114 sf Storage= 2,405 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
Center-of-Mass det. time= 2.1 min ( 842.7 - 840.6 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=5.29 cfs @ 12.32 hrs HW=111.85' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 5.29 cfs @ 6.74 fps)

# 31 Newtown Rd Existing HydroCAD

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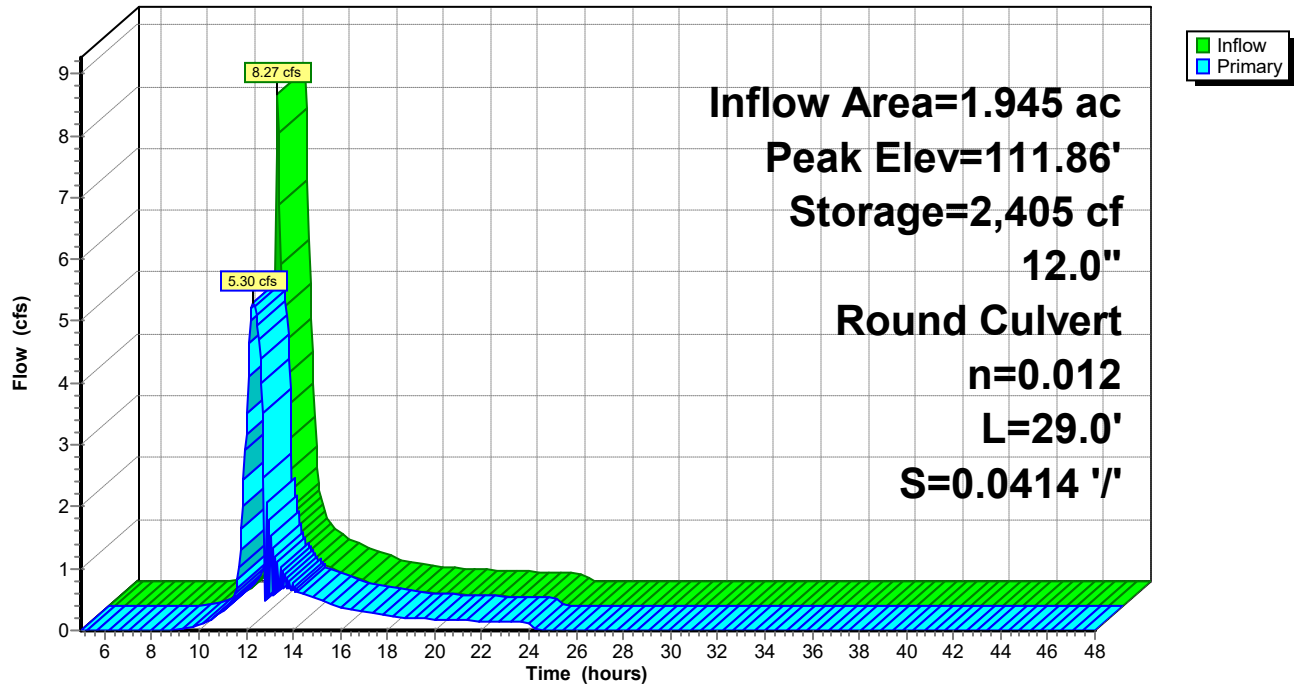
Type III 24-hr 100-Year Rainfall=8.94"

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## Pond WETLAND: WETLAND A

Hydrograph

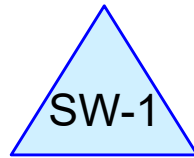
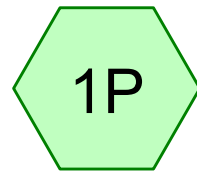




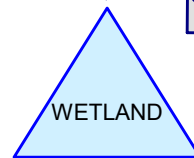
***Post-Development  
HydroCAD Model Calculations***

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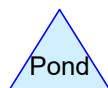
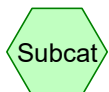
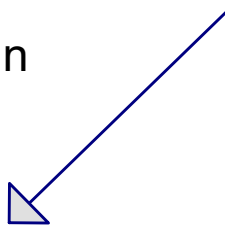
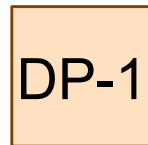




SW Basin



WETLAND A



**Routing Diagram for 31 Newtown Rd Proposed HydroCAD**

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**31 Newtown Rd Proposed HydroCAD**

Type III 24-hr 2-Year Rainfall=3.15"

Prepared by CHA Consulting, Inc

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**Summary for Subcatchment 1P:**

Runoff = 0.52 cfs @ 12.17 hrs, Volume= 0.050 af, Depth= 0.75"  
 Routed to Pond SW-1 : SW Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-Year Rainfall=3.15"

| Area (sf) | CN | Description                   |
|-----------|----|-------------------------------|
| * 5,490   | 98 | Impervious Surfaces           |
| 10,790    | 73 | Woods, Fair, HSG C            |
| 8,890     | 39 | >75% Grass cover, Good, HSG A |
| 9,590     | 74 | >75% Grass cover, Good, HSG C |
| 34,760    | 69 | Weighted Average              |
| 29,270    |    | 84.21% Pervious Area          |
| 5,490     |    | 15.79% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                                              |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b><br>Woods: Light underbrush n= 0.400 P2= 2.61"     |
| 0.5      | 115           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b><br>Short Grass Pasture Kv= 7.0 fps |
| 1.0      | 199           | 0.1600        | 3.29              | 16.45          | <b>Channel Flow, C-D</b><br>Area= 5.0 sf Perim= 6.0' r= 0.83' n= 0.160   |
| 0.3      | 128           |               | 8.02              |                | <b>Lake or Reservoir, E-F</b><br>Mean Depth= 2.00'                       |
| 10.3     | 542           | Total         |                   |                |                                                                          |

## 31 Newtown Rd Proposed HydroCAD

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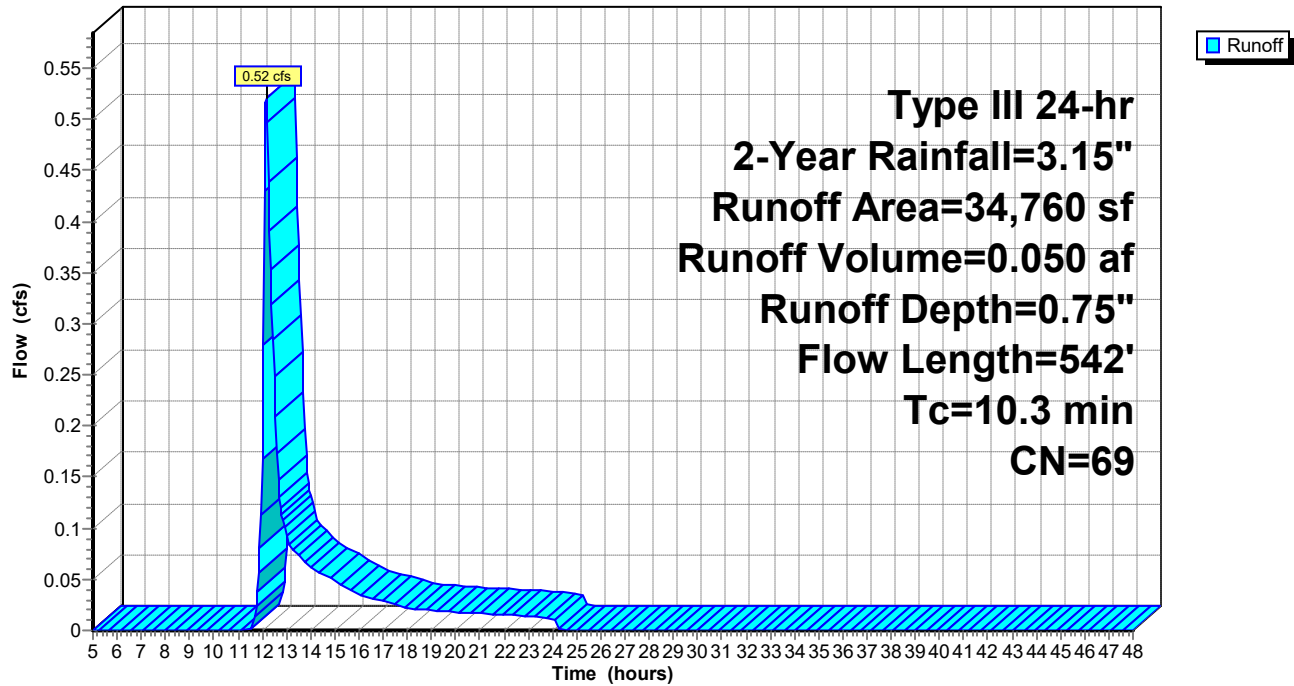
Type III 24-hr 2-Year Rainfall=3.15"

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### Subcatchment 1P:

#### Hydrograph



# 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 2-Year Rainfall=3.15"

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## Summary for Subcatchment 2P:

Runoff = 0.57 cfs @ 12.17 hrs, Volume= 0.059 af, Depth= 0.62"  
Routed to Pond WETLAND : WETLAND A

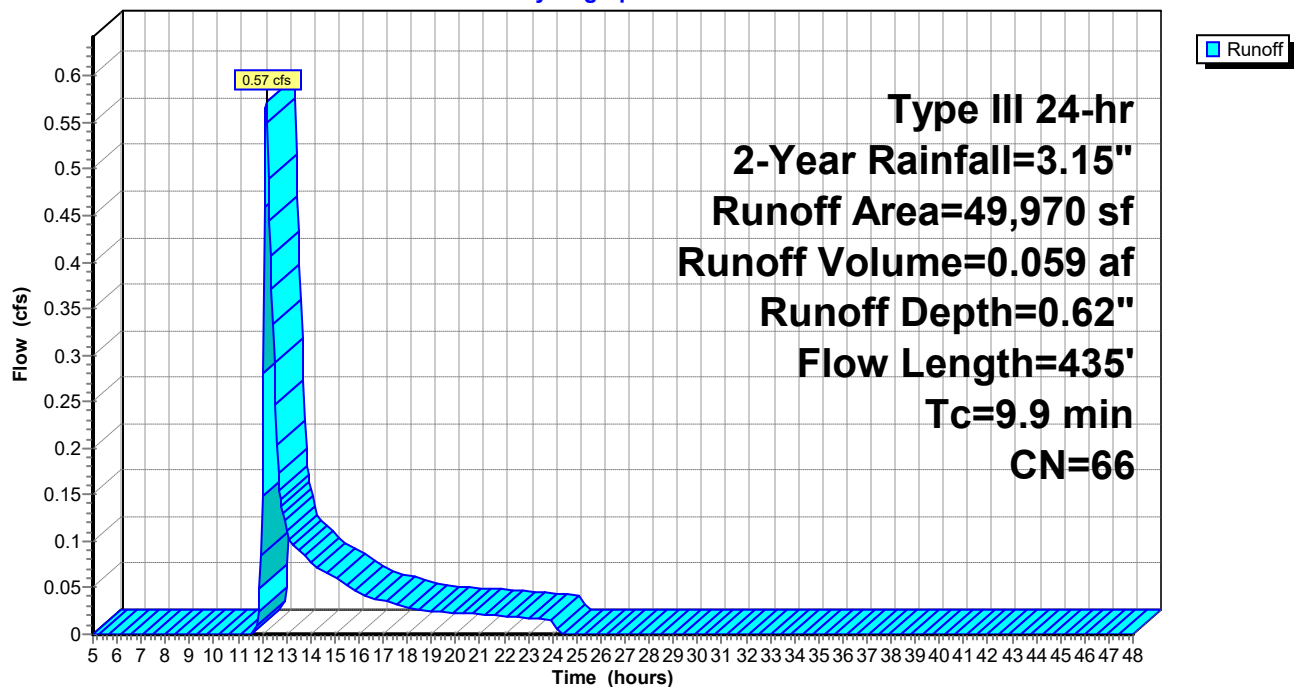
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.15"

|   | Area (sf) | CN | Description                   |
|---|-----------|----|-------------------------------|
| * | 5,240     | 98 | Wetland Area                  |
|   | 12,720    | 73 | Woods, Fair, HSG C            |
|   | 14,805    | 39 | >75% Grass cover, Good, HSG A |
|   | 17,205    | 74 | >75% Grass cover, Good, HSG C |
|   | 49,970    | 66 | Weighted Average              |
|   | 44,730    |    | 89.51% Pervious Area          |
|   | 5,240     |    | 10.49% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                                              |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b><br>Woods: Light underbrush n= 0.400 P2= 2.61"     |
| 1.2      | 243           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b><br>Short Grass Pasture Kv= 7.0 fps |
| 0.2      | 92            |               | 8.02              |                | <b>Lake or Reservoir, E-F</b><br>Mean Depth= 2.00'                       |
| 9.9      | 435           | Total         |                   |                |                                                                          |

## Subcatchment 2P:

### Hydrograph



## 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 2-Year Rainfall=3.15"

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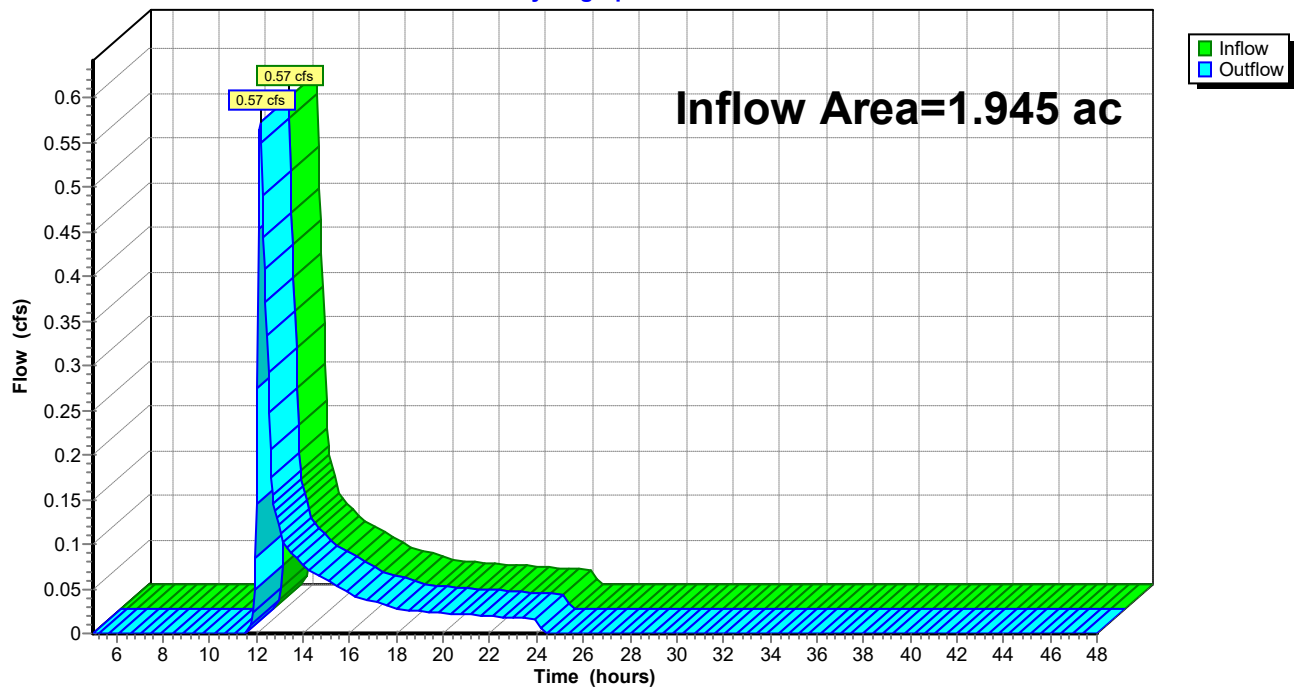
### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 0.36" for 2-Year event  
Inflow = 0.57 cfs @ 12.17 hrs, Volume= 0.059 af  
Outflow = 0.57 cfs @ 12.17 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:

Hydrograph



### 31 Newtown Rd Proposed HydroCAD

Type III 24-hr 2-Year Rainfall=3.15"

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#### Summary for Pond SW-1: SW Basin

Inflow Area = 0.798 ac, 15.79% Impervious, Inflow Depth = 0.75" for 2-Year event  
Inflow = 0.52 cfs @ 12.17 hrs, Volume= 0.050 af  
Outflow = 0.07 cfs @ 13.67 hrs, Volume= 0.050 af, Atten= 87%, Lag= 90.3 min  
Discarded = 0.07 cfs @ 13.67 hrs, Volume= 0.050 af  
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af  
Routed to Pond WETLAND : WETLAND A

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 116.44' @ 13.67 hrs Surf.Area= 1,013 sf Storage= 801 cf  
Flood Elev= 112.00' Storage= 0 cf

Plug-Flow detention time= 148.7 min calculated for 0.050 af (100% of inflow)  
Center-of-Mass det. time= 148.7 min ( 1,033.3 - 884.6 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 115.00'              | 5,728 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 115.00              | 125                  | 100.0            | 0                                                          | 0                         | 125                 |
| 116.00              | 780                  | 180.0            | 406                                                        | 406                       | 1,913               |
| 117.00              | 1,350                | 200.0            | 1,052                                                      | 1,458                     | 2,547               |
| 118.00              | 1,796                | 215.0            | 1,568                                                      | 3,026                     | 3,084               |
| 119.25              | 2,550                | 228.0            | 2,703                                                      | 5,728                     | 3,619               |

| Device | Routing   | Invert  | Outlet Devices                                                                 |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|--------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Primary   | 118.50' | <b>4.0' long + 4.0 ' ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)                                                                    | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |                                                                                | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)                                                                | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |                                                                                | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |
| #2     | Discarded | 115.00' | <b>2.410 in/hr Exfiltration over Surface area</b>                              |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Conductivity to Groundwater Elevation = 112.00'                                |      |      |      |      |      |      |      |      |      |      |  |

**Discarded OutFlow** Max=0.07 cfs @ 13.67 hrs HW=116.44' (Free Discharge)

↑ **2=Exfiltration** ( Controls 0.07 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=115.00' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

# 31 Newtown Rd Proposed HydroCAD

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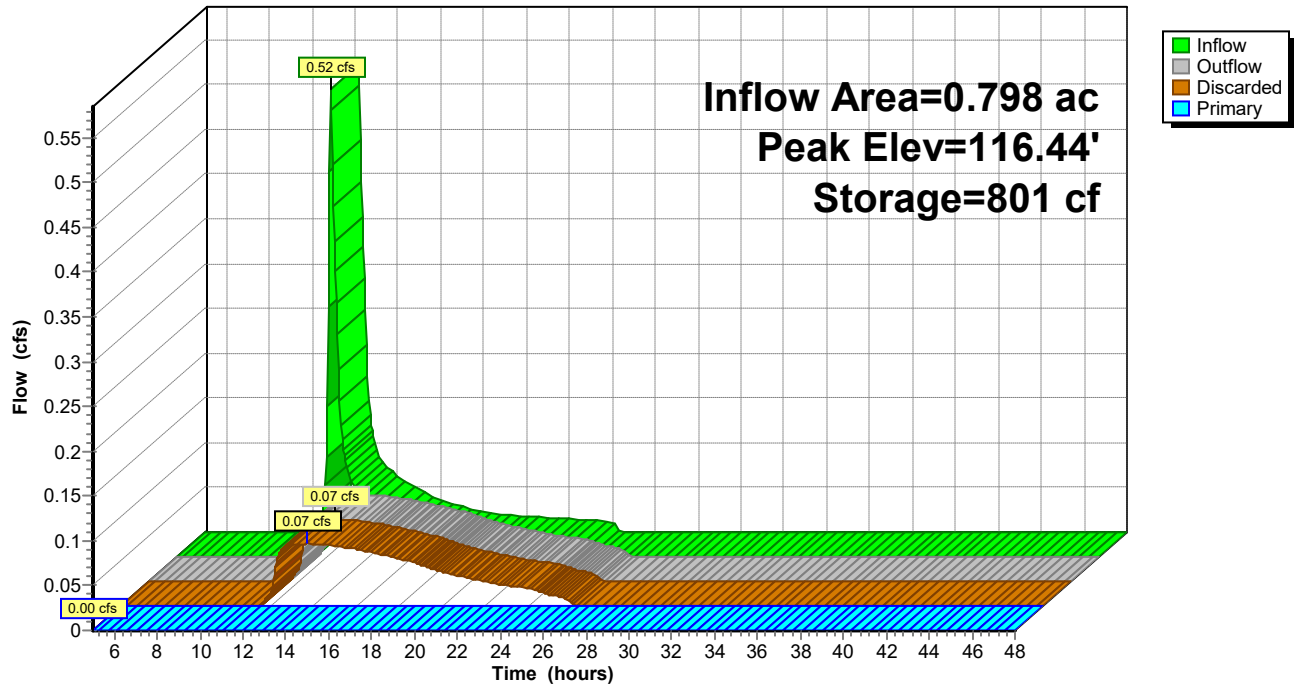
Type III 24-hr 2-Year Rainfall=3.15"

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## Pond SW-1: SW Basin

### Hydrograph



### 31 Newtown Rd Proposed HydroCAD

Type III 24-hr 2-Year Rainfall=3.15"

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#### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 0.36" for 2-Year event  
Inflow = 0.57 cfs @ 12.17 hrs, Volume= 0.059 af  
Outflow = 0.57 cfs @ 12.17 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.1 min  
Primary = 0.57 cfs @ 12.17 hrs, Volume= 0.059 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.00' @ 12.17 hrs Surf.Area= 1,684 sf Storage= 3 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

Plug-Flow detention time= 0.1 min calculated for 0.059 af (100% of inflow)  
Center-of-Mass det. time= 0.1 min ( 896.3 - 896.2 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=3.01 cfs @ 12.17 hrs HW=111.00' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 3.01 cfs @ 4.04 fps)

# 31 Newtown Rd Proposed HydroCAD

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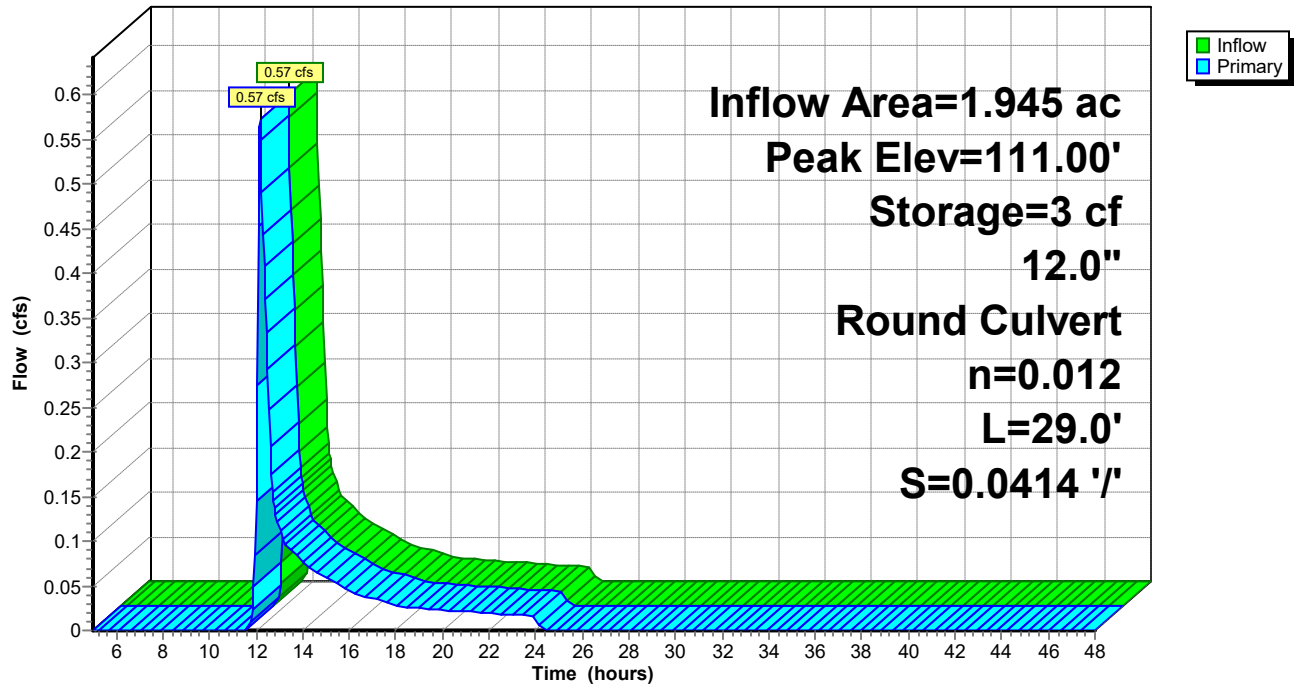
Type III 24-hr 2-Year Rainfall=3.15"

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## Pond WETLAND: WETLAND A

Hydrograph



**31 Newtown Rd Proposed HydroCAD**

Type III 24-hr 10-Year Rainfall=4.83"

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**Summary for Subcatchment 1P:**

Runoff = 1.43 cfs @ 12.15 hrs, Volume= 0.122 af, Depth= 1.83"  
 Routed to Pond SW-1 : SW Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-Year Rainfall=4.83"

| Area (sf) | CN | Description                   |
|-----------|----|-------------------------------|
| * 5,490   | 98 | Impervious Surfaces           |
| 10,790    | 73 | Woods, Fair, HSG C            |
| 8,890     | 39 | >75% Grass cover, Good, HSG A |
| 9,590     | 74 | >75% Grass cover, Good, HSG C |
| 34,760    | 69 | Weighted Average              |
| 29,270    |    | 84.21% Pervious Area          |
| 5,490     |    | 15.79% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                                              |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b><br>Woods: Light underbrush n= 0.400 P2= 2.61"     |
| 0.5      | 115           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b><br>Short Grass Pasture Kv= 7.0 fps |
| 1.0      | 199           | 0.1600        | 3.29              | 16.45          | <b>Channel Flow, C-D</b><br>Area= 5.0 sf Perim= 6.0' r= 0.83' n= 0.160   |
| 0.3      | 128           |               | 8.02              |                | <b>Lake or Reservoir, E-F</b><br>Mean Depth= 2.00'                       |
| 10.3     | 542           | Total         |                   |                |                                                                          |

# 31 Newtown Rd Proposed HydroCAD

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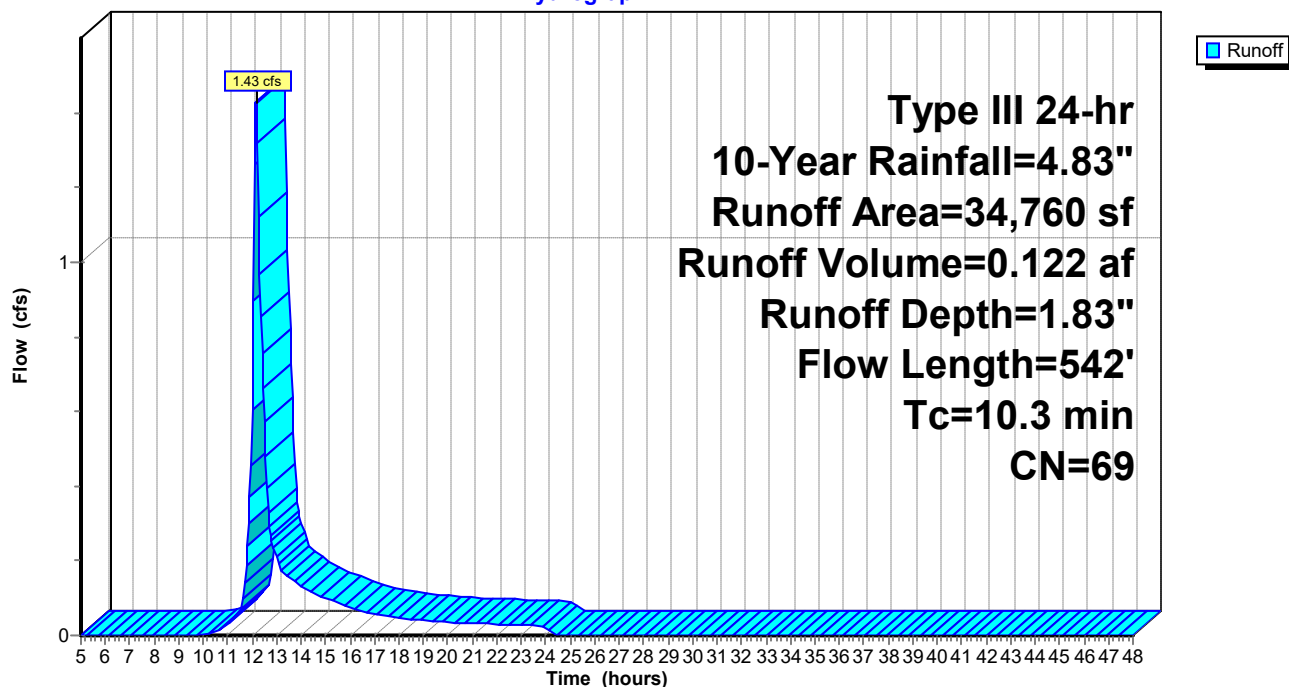
Type III 24-hr 10-Year Rainfall=4.83"

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## Subcatchment 1P:

Hydrograph



# 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 10-Year Rainfall=4.83"

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## Summary for Subcatchment 2P:

Runoff = 1.79 cfs @ 12.15 hrs, Volume= 0.154 af, Depth= 1.61"  
Routed to Pond WETLAND : WETLAND A

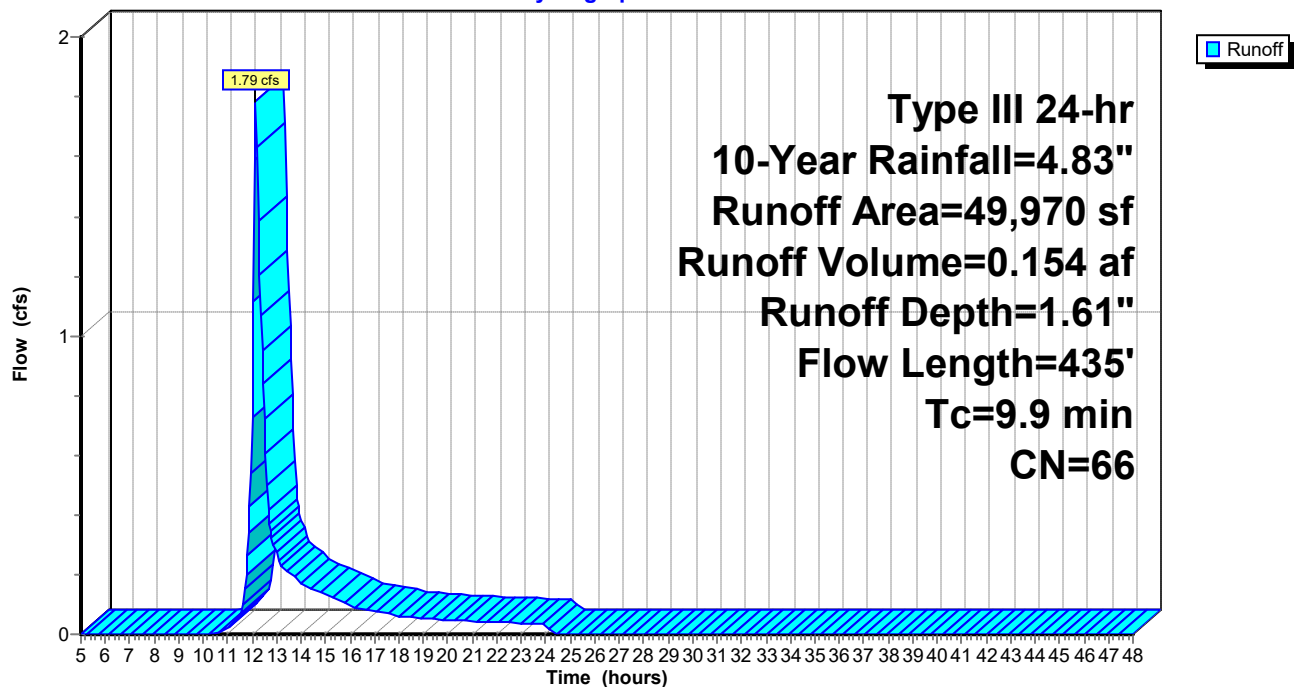
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.83"

|   | Area (sf) | CN | Description                   |
|---|-----------|----|-------------------------------|
| * | 5,240     | 98 | Wetland Area                  |
|   | 12,720    | 73 | Woods, Fair, HSG C            |
|   | 14,805    | 39 | >75% Grass cover, Good, HSG A |
|   | 17,205    | 74 | >75% Grass cover, Good, HSG C |
|   | 49,970    | 66 | Weighted Average              |
|   | 44,730    |    | 89.51% Pervious Area          |
|   | 5,240     |    | 10.49% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                                              |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b><br>Woods: Light underbrush n= 0.400 P2= 2.61"     |
| 1.2      | 243           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b><br>Short Grass Pasture Kv= 7.0 fps |
| 0.2      | 92            |               | 8.02              |                | <b>Lake or Reservoir, E-F</b><br>Mean Depth= 2.00'                       |
| 9.9      | 435           | Total         |                   |                |                                                                          |

## Subcatchment 2P:

Hydrograph



## 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 10-Year Rainfall=4.83"

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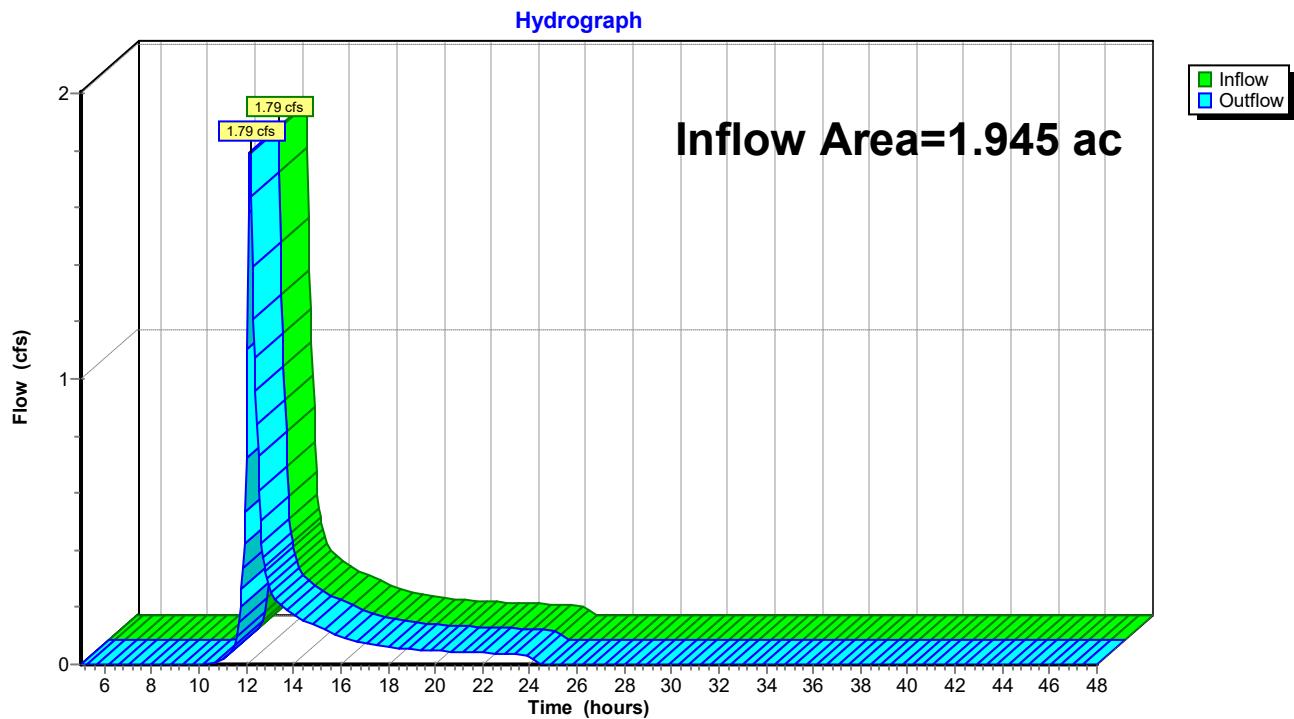
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### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 0.95" for 10-Year event  
Inflow = 1.79 cfs @ 12.15 hrs, Volume= 0.154 af  
Outflow = 1.79 cfs @ 12.15 hrs, Volume= 0.154 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:



### 31 Newtown Rd Proposed HydroCAD

Type III 24-hr 10-Year Rainfall=4.83"

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#### Summary for Pond SW-1: SW Basin

Inflow Area = 0.798 ac, 15.79% Impervious, Inflow Depth = 1.83" for 10-Year event  
Inflow = 1.43 cfs @ 12.15 hrs, Volume= 0.122 af  
Outflow = 0.13 cfs @ 14.03 hrs, Volume= 0.122 af, Atten= 91%, Lag= 112.5 min  
Discarded = 0.13 cfs @ 14.03 hrs, Volume= 0.122 af  
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af  
Routed to Pond WETLAND : WETLAND A

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 117.69' @ 14.03 hrs Surf.Area= 1,653 sf Storage= 2,497 cf  
Flood Elev= 112.00' Storage= 0 cf

Plug-Flow detention time= 252.0 min calculated for 0.122 af (100% of inflow)  
Center-of-Mass det. time= 252.1 min ( 1,108.3 - 856.2 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 115.00'              | 5,728 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 115.00              | 125                  | 100.0            | 0                                                          | 0                         | 125                 |
| 116.00              | 780                  | 180.0            | 406                                                        | 406                       | 1,913               |
| 117.00              | 1,350                | 200.0            | 1,052                                                      | 1,458                     | 2,547               |
| 118.00              | 1,796                | 215.0            | 1,568                                                      | 3,026                     | 3,084               |
| 119.25              | 2,550                | 228.0            | 2,703                                                      | 5,728                     | 3,619               |

| Device | Routing   | Invert  | Outlet Devices                                                               |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Primary   | 118.50' | <b>4.0' long + 4.0 ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)                                                                  | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |                                                                              | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)                                                              | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |                                                                              | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |
| #2     | Discarded | 115.00' | <b>2.410 in/hr Exfiltration over Surface area</b>                            |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Conductivity to Groundwater Elevation = 112.00'                              |      |      |      |      |      |      |      |      |      |      |  |

**Discarded OutFlow** Max=0.13 cfs @ 14.03 hrs HW=117.69' (Free Discharge)

↑ **2=Exfiltration** ( Controls 0.13 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=115.00' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

# 31 Newtown Rd Proposed HydroCAD

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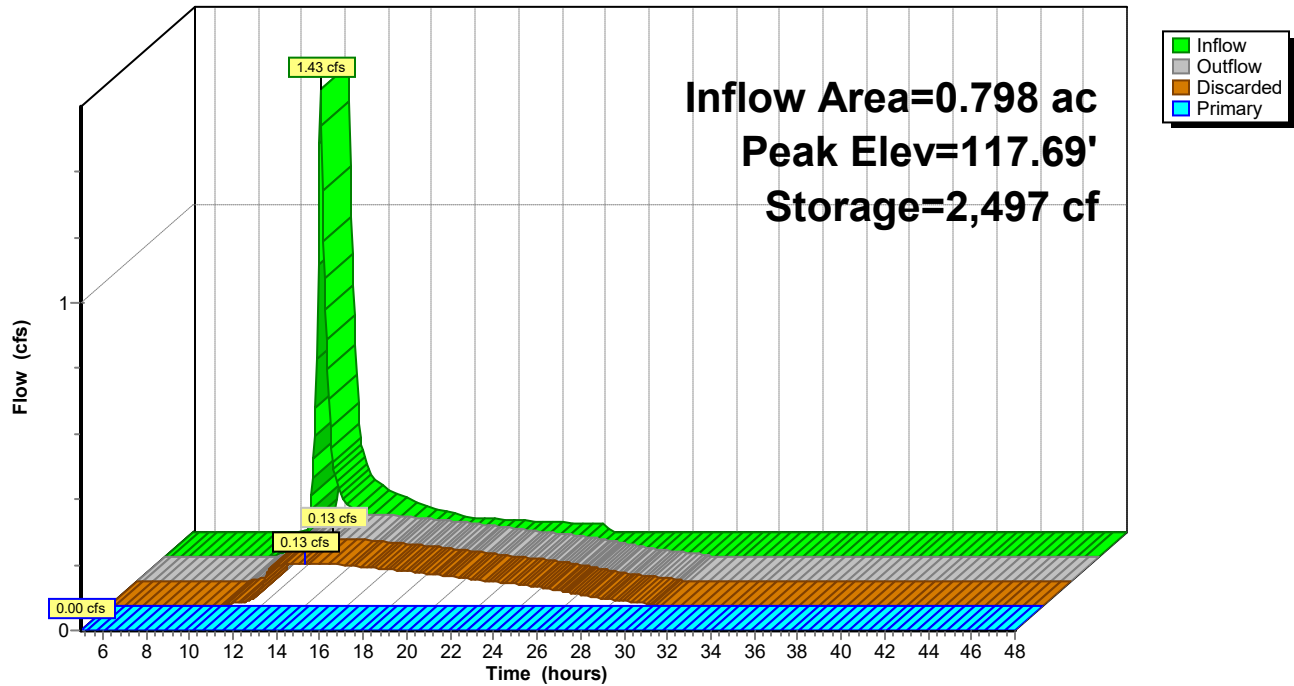
Type III 24-hr 10-Year Rainfall=4.83"

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## Pond SW-1: SW Basin

### Hydrograph



### 31 Newtown Rd Proposed HydroCAD

Type III 24-hr 10-Year Rainfall=4.83"

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### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 0.95" for 10-Year event  
Inflow = 1.79 cfs @ 12.15 hrs, Volume= 0.154 af  
Outflow = 1.79 cfs @ 12.15 hrs, Volume= 0.154 af, Atten= 0%, Lag= 0.1 min  
Primary = 1.79 cfs @ 12.15 hrs, Volume= 0.154 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.01' @ 12.15 hrs Surf.Area= 1,693 sf Storage= 10 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

Plug-Flow detention time= 0.1 min calculated for 0.154 af (100% of inflow)  
Center-of-Mass det. time= 0.1 min ( 864.0 - 863.9 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=3.03 cfs @ 12.15 hrs HW=111.01' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 3.03 cfs @ 4.05 fps)

# 31 Newtown Rd Proposed HydroCAD

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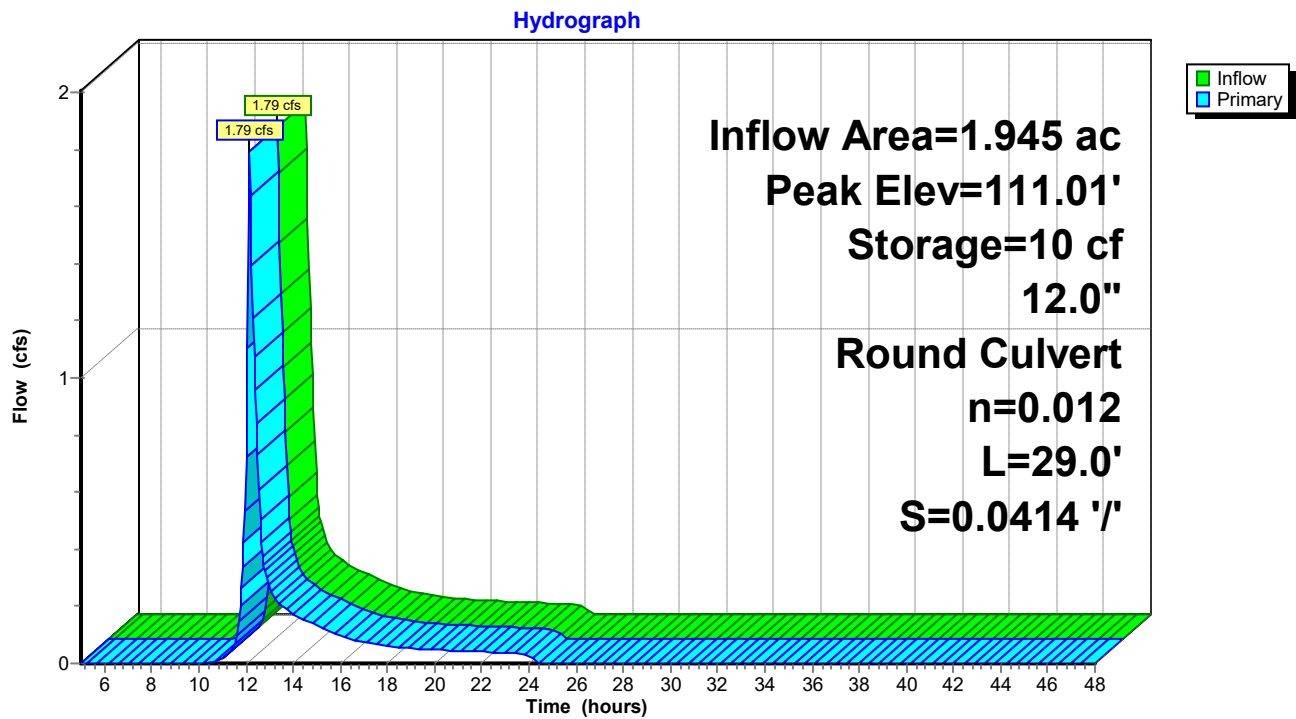
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Type III 24-hr 10-Year Rainfall=4.83"

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## Pond WETLAND: WETLAND A



**31 Newtown Rd Proposed HydroCAD**

Type III 24-hr 25-Year Rainfall=6.16"

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**Summary for Subcatchment 1P:**

Runoff = 2.26 cfs @ 12.15 hrs, Volume= 0.189 af, Depth= 2.84"  
 Routed to Pond SW-1 : SW Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

| Area (sf) | CN | Description                   |
|-----------|----|-------------------------------|
| * 5,490   | 98 | Impervious Surfaces           |
| 10,790    | 73 | Woods, Fair, HSG C            |
| 8,890     | 39 | >75% Grass cover, Good, HSG A |
| 9,590     | 74 | >75% Grass cover, Good, HSG C |
| 34,760    | 69 | Weighted Average              |
| 29,270    |    | 84.21% Pervious Area          |
| 5,490     |    | 15.79% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                                              |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b><br>Woods: Light underbrush n= 0.400 P2= 2.61"     |
| 0.5      | 115           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b><br>Short Grass Pasture Kv= 7.0 fps |
| 1.0      | 199           | 0.1600        | 3.29              | 16.45          | <b>Channel Flow, C-D</b><br>Area= 5.0 sf Perim= 6.0' r= 0.83' n= 0.160   |
| 0.3      | 128           |               | 8.02              |                | <b>Lake or Reservoir, E-F</b><br>Mean Depth= 2.00'                       |
| 10.3     | 542           | Total         |                   |                |                                                                          |

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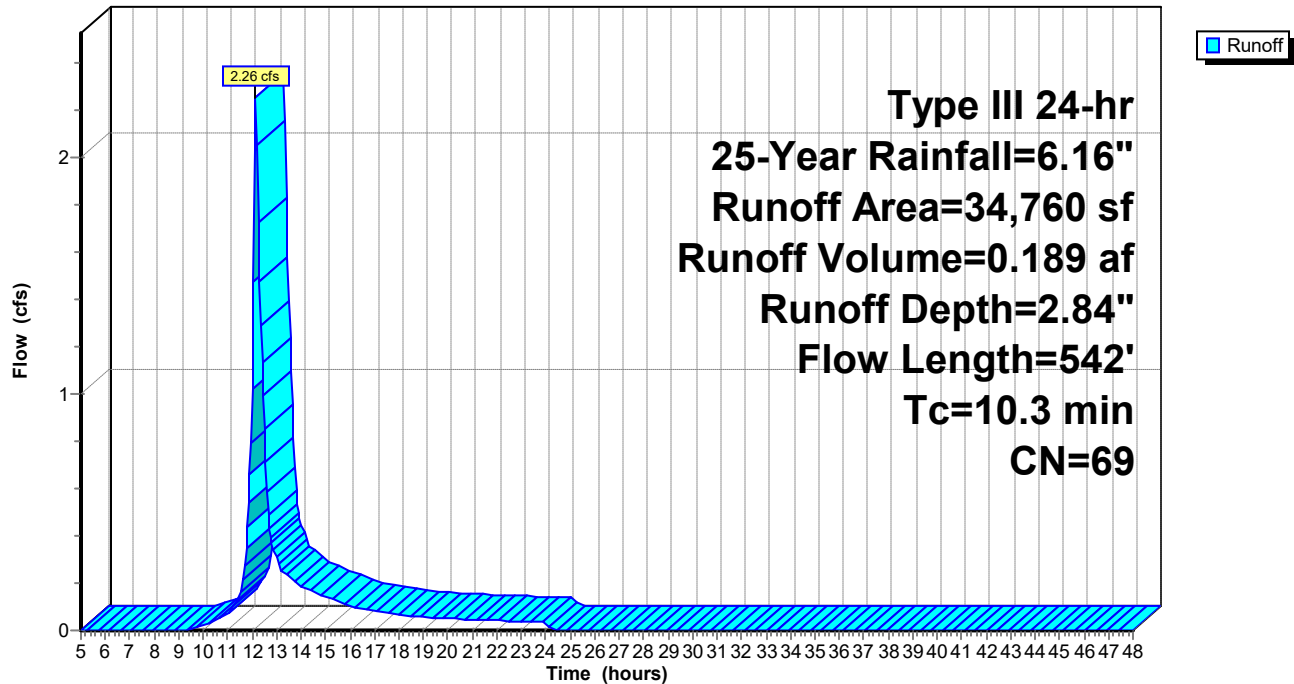
Type III 24-hr 25-Year Rainfall=6.16"

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### Subcatchment 1P:

Hydrograph



# 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 25-Year Rainfall=6.16"

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## Summary for Subcatchment 2P:

Runoff = 2.93 cfs @ 12.15 hrs, Volume= 0.245 af, Depth= 2.56"  
Routed to Pond WETLAND : WETLAND A

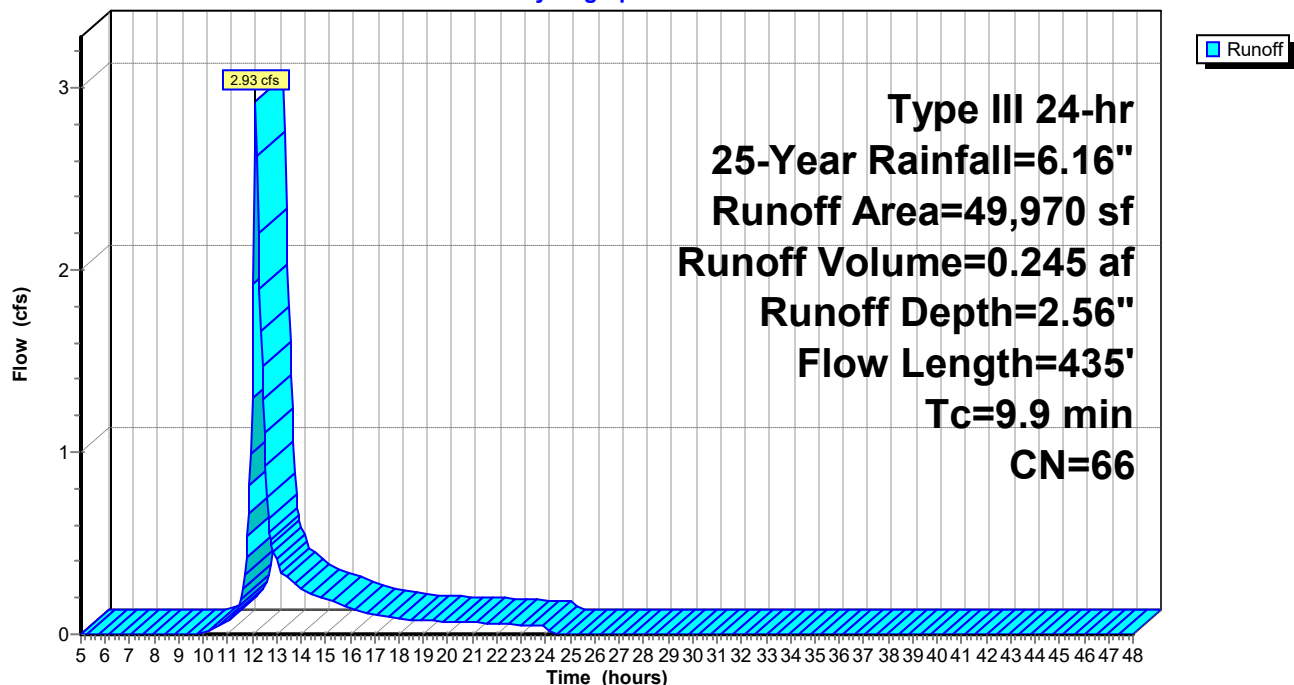
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=6.16"

| Area (sf) | CN | Description                   |
|-----------|----|-------------------------------|
| * 5,240   | 98 | Wetland Area                  |
| 12,720    | 73 | Woods, Fair, HSG C            |
| 14,805    | 39 | >75% Grass cover, Good, HSG A |
| 17,205    | 74 | >75% Grass cover, Good, HSG C |
| 49,970    | 66 | Weighted Average              |
| 44,730    |    | 89.51% Pervious Area          |
| 5,240     |    | 10.49% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                                              |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b><br>Woods: Light underbrush n= 0.400 P2= 2.61"     |
| 1.2      | 243           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b><br>Short Grass Pasture Kv= 7.0 fps |
| 0.2      | 92            |               | 8.02              |                | <b>Lake or Reservoir, E-F</b><br>Mean Depth= 2.00'                       |
| 9.9      | 435           | Total         |                   |                |                                                                          |

## Subcatchment 2P:

### Hydrograph



## 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 25-Year Rainfall=6.16"

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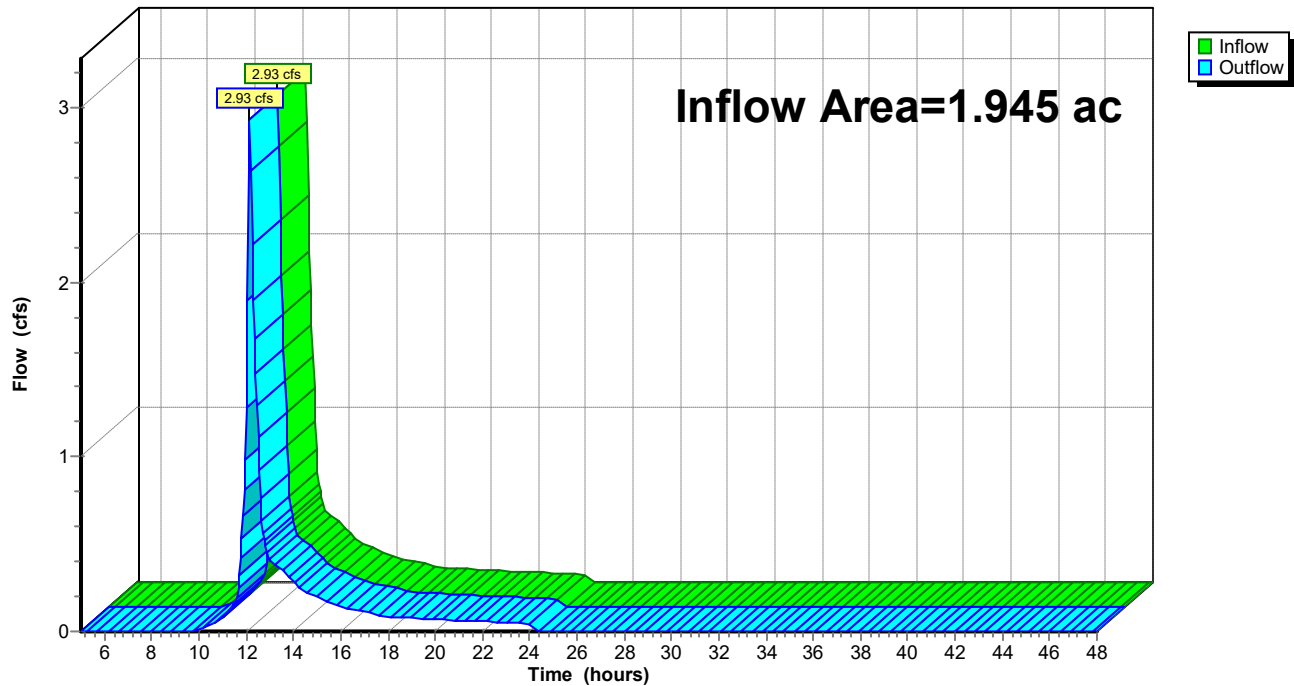
### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 1.54" for 25-Year event  
Inflow = 2.93 cfs @ 12.15 hrs, Volume= 0.249 af  
Outflow = 2.93 cfs @ 12.15 hrs, Volume= 0.249 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:

Hydrograph



### 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 25-Year Rainfall=6.16"

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#### Summary for Pond SW-1: SW Basin

Inflow Area = 0.798 ac, 15.79% Impervious, Inflow Depth = 2.84" for 25-Year event  
Inflow = 2.26 cfs @ 12.15 hrs, Volume= 0.189 af  
Outflow = 0.23 cfs @ 13.47 hrs, Volume= 0.189 af, Atten= 90%, Lag= 79.1 min  
Discarded = 0.17 cfs @ 13.47 hrs, Volume= 0.184 af  
Primary = 0.06 cfs @ 13.47 hrs, Volume= 0.004 af  
Routed to Pond WETLAND : WETLAND A

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 118.53' @ 13.47 hrs Surf.Area= 2,100 sf Storage= 4,059 cf  
Flood Elev= 112.00' Storage= 0 cf

Plug-Flow detention time= 301.2 min calculated for 0.189 af (100% of inflow)  
Center-of-Mass det. time= 301.4 min ( 1,144.7 - 843.3 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 115.00'              | 5,728 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 115.00              | 125                  | 100.0            | 0                                                          | 0                         | 125                 |
| 116.00              | 780                  | 180.0            | 406                                                        | 406                       | 1,913               |
| 117.00              | 1,350                | 200.0            | 1,052                                                      | 1,458                     | 2,547               |
| 118.00              | 1,796                | 215.0            | 1,568                                                      | 3,026                     | 3,084               |
| 119.25              | 2,550                | 228.0            | 2,703                                                      | 5,728                     | 3,619               |

| Device | Routing   | Invert  | Outlet Devices                                                                 |  |  |  |  |  |  |  |  |  |  |  |
|--------|-----------|---------|--------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|
| #1     | Primary   | 118.50' | <b>4.0' long + 4.0 ' ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir</b> |  |  |  |  |  |  |  |  |  |  |  |
|        |           |         | Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00                  |  |  |  |  |  |  |  |  |  |  |  |
|        |           |         | 2.50 3.00 3.50 4.00 4.50 5.00 5.50                                             |  |  |  |  |  |  |  |  |  |  |  |
|        |           |         | Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66                   |  |  |  |  |  |  |  |  |  |  |  |
|        |           |         | 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32                                        |  |  |  |  |  |  |  |  |  |  |  |
| #2     | Discarded | 115.00' | <b>2.410 in/hr Exfiltration over Surface area</b>                              |  |  |  |  |  |  |  |  |  |  |  |
|        |           |         | Conductivity to Groundwater Elevation = 112.00'                                |  |  |  |  |  |  |  |  |  |  |  |

**Discarded OutFlow** Max=0.17 cfs @ 13.47 hrs HW=118.53' (Free Discharge)

↑ **2=Exfiltration** ( Controls 0.17 cfs)

**Primary OutFlow** Max=0.05 cfs @ 13.47 hrs HW=118.53' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.42 fps)

# 31 Newtown Rd Proposed HydroCAD

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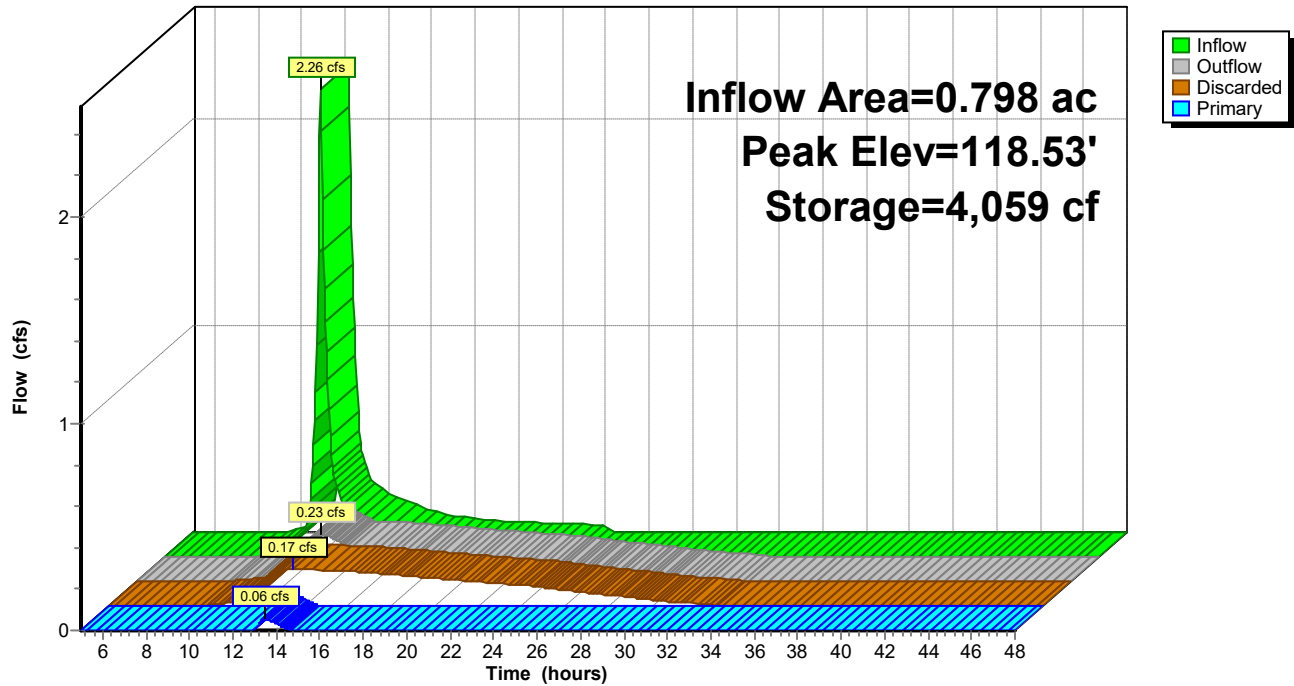
Type III 24-hr 25-Year Rainfall=6.16"

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## Pond SW-1: SW Basin

### Hydrograph



### 31 Newtown Rd Proposed HydroCAD

Type III 24-hr 25-Year Rainfall=6.16"

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### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 1.54" for 25-Year event  
Inflow = 2.93 cfs @ 12.15 hrs, Volume= 0.249 af  
Outflow = 2.93 cfs @ 12.15 hrs, Volume= 0.249 af, Atten= 0%, Lag= 0.1 min  
Primary = 2.93 cfs @ 12.15 hrs, Volume= 0.249 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.01' @ 12.15 hrs Surf.Area= 1,701 sf Storage= 16 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

Plug-Flow detention time= 0.1 min calculated for 0.249 af (100% of inflow)  
Center-of-Mass det. time= 0.1 min ( 849.5 - 849.4 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=3.04 cfs @ 12.15 hrs HW=111.01' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 3.04 cfs @ 4.06 fps)

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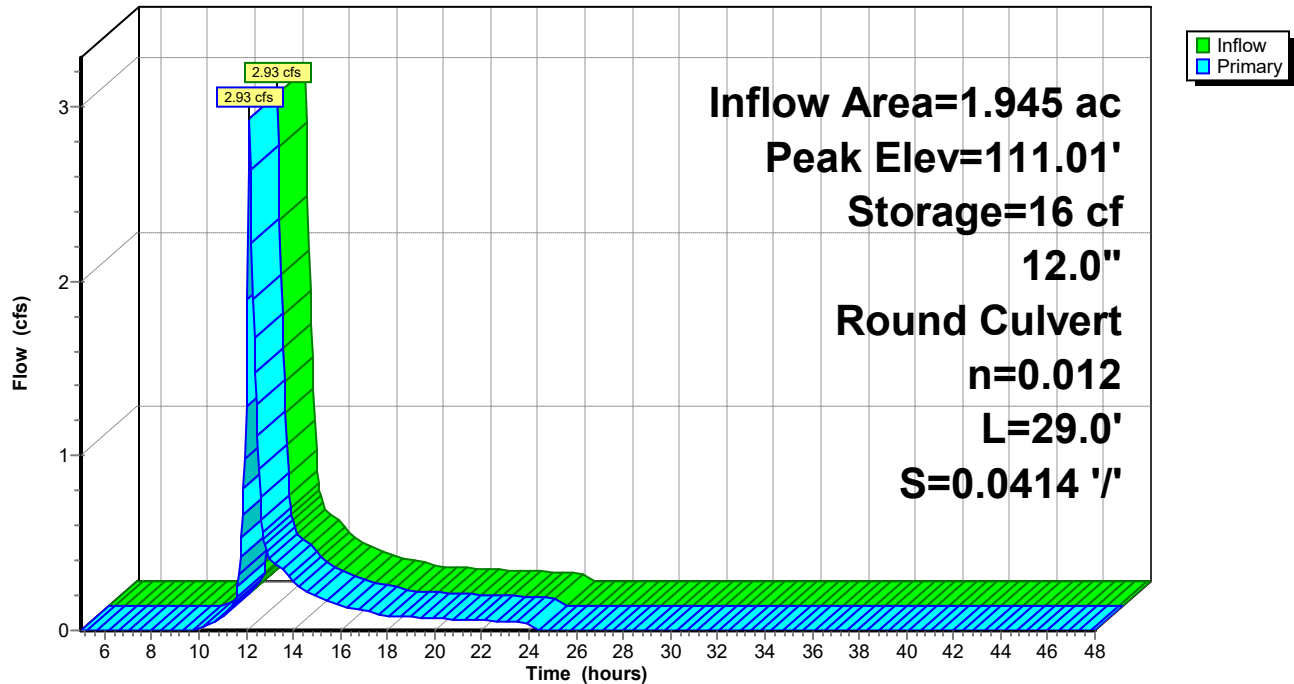
Type III 24-hr 25-Year Rainfall=6.16"

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## Pond WETLAND: WETLAND A

Hydrograph



**31 Newtown Rd Proposed HydroCAD**

Type III 24-hr 100-Year Rainfall=8.94"

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**Summary for Subcatchment 1P:**

Runoff = 4.13 cfs @ 12.15 hrs, Volume= 0.343 af, Depth= 5.16"  
 Routed to Pond SW-1 : SW Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-Year Rainfall=8.94"

| Area (sf) | CN | Description                   |
|-----------|----|-------------------------------|
| * 5,490   | 98 | Impervious Surfaces           |
| 10,790    | 73 | Woods, Fair, HSG C            |
| 8,890     | 39 | >75% Grass cover, Good, HSG A |
| 9,590     | 74 | >75% Grass cover, Good, HSG C |
| 34,760    | 69 | Weighted Average              |
| 29,270    |    | 84.21% Pervious Area          |
| 5,490     |    | 15.79% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b>                     |
|          |               |               |                   |                | Woods: Light underbrush n= 0.400 P2= 2.61" |
| 0.5      | 115           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b>      |
|          |               |               |                   |                | Short Grass Pasture Kv= 7.0 fps            |
| 1.0      | 199           | 0.1600        | 3.29              | 16.45          | <b>Channel Flow, C-D</b>                   |
|          |               |               |                   |                | Area= 5.0 sf Perim= 6.0' r= 0.83' n= 0.160 |
| 0.3      | 128           |               | 8.02              |                | <b>Lake or Reservoir, E-F</b>              |
|          |               |               |                   |                | Mean Depth= 2.00'                          |
| 10.3     | 542           | Total         |                   |                |                                            |

## 31 Newtown Rd Proposed HydroCAD

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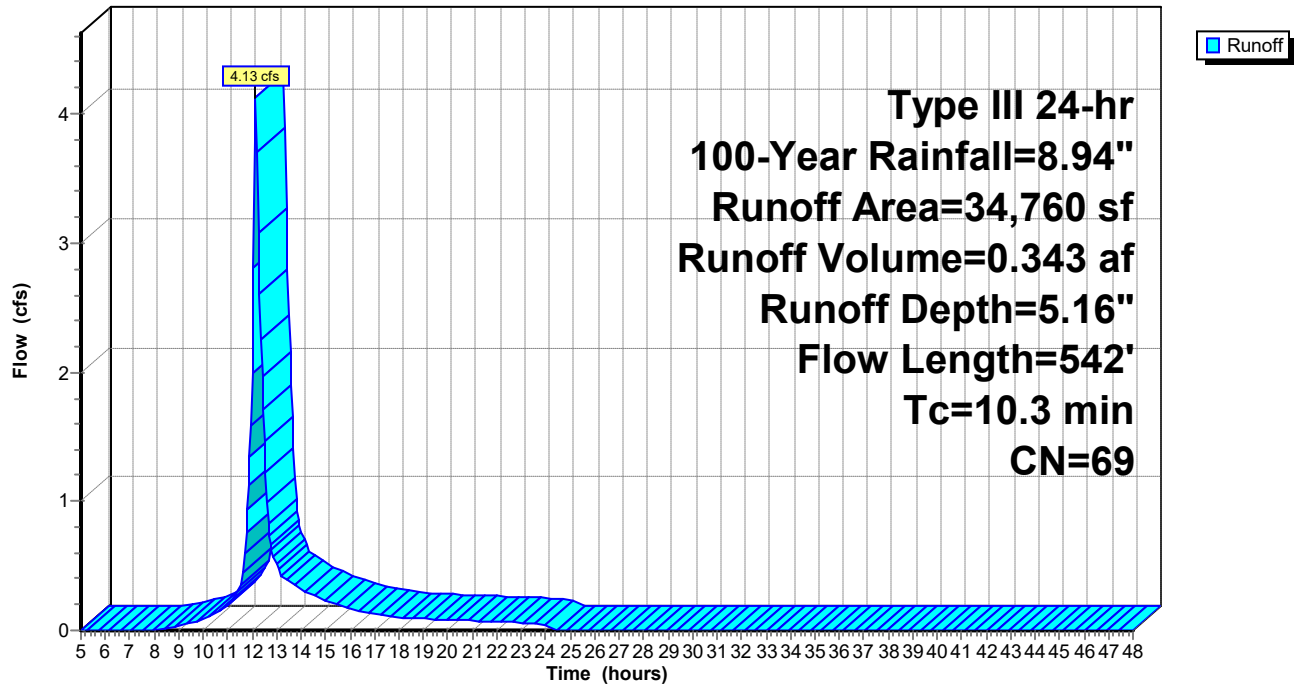
Type III 24-hr 100-Year Rainfall=8.94"

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### Subcatchment 1P:

Hydrograph



# 31 Newtown Rd Proposed HydroCAD

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Type III 24-hr 100-Year Rainfall=8.94"

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## Summary for Subcatchment 2P:

Runoff = 5.58 cfs @ 12.14 hrs, Volume= 0.458 af, Depth= 4.79"  
Routed to Pond WETLAND : WETLAND A

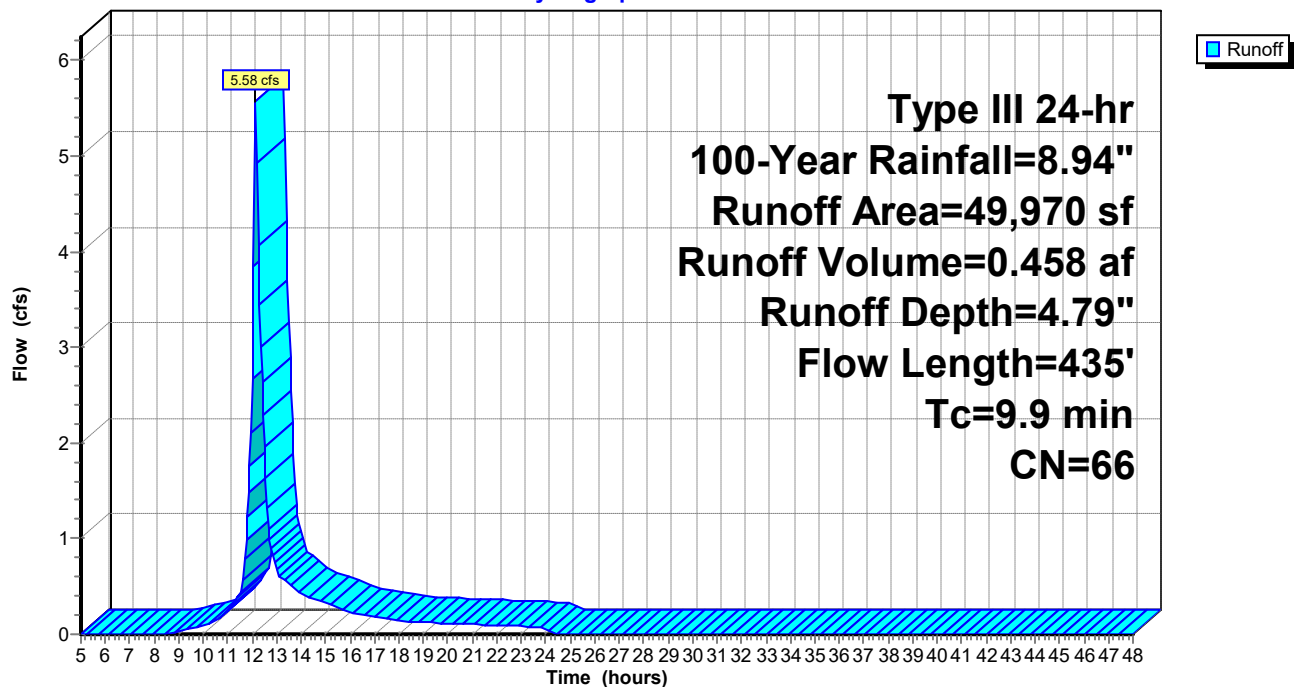
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.94"

|   | Area (sf) | CN | Description                   |
|---|-----------|----|-------------------------------|
| * | 5,240     | 98 | Wetland Area                  |
|   | 12,720    | 73 | Woods, Fair, HSG C            |
|   | 14,805    | 39 | >75% Grass cover, Good, HSG A |
|   | 17,205    | 74 | >75% Grass cover, Good, HSG C |
|   | 49,970    | 66 | Weighted Average              |
|   | 44,730    |    | 89.51% Pervious Area          |
|   | 5,240     |    | 10.49% Impervious Area        |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description                                |
|----------|---------------|---------------|-------------------|----------------|--------------------------------------------|
| 8.5      | 100           | 0.2600        | 0.20              |                | <b>Sheet Flow, A-B</b>                     |
|          |               |               |                   |                | Woods: Light underbrush n= 0.400 P2= 2.61" |
| 1.2      | 243           | 0.2500        | 3.50              |                | <b>Shallow Concentrated Flow, B-C</b>      |
|          |               |               |                   |                | Short Grass Pasture Kv= 7.0 fps            |
| 0.2      | 92            |               | 8.02              |                | <b>Lake or Reservoir, E-F</b>              |
|          |               |               |                   |                | Mean Depth= 2.00'                          |
| 9.9      | 435           | Total         |                   |                |                                            |

## Subcatchment 2P:

### Hydrograph



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Type III 24-hr 100-Year Rainfall=8.94"

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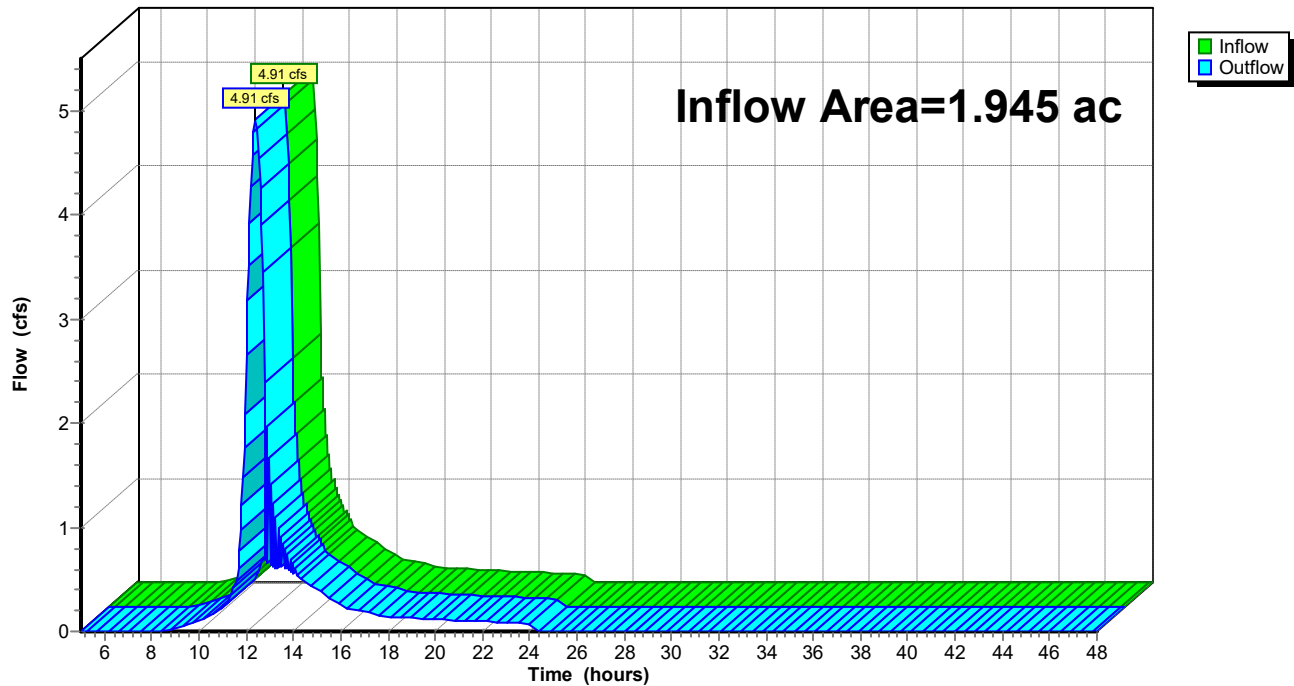
### Summary for Reach DP-1:

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 3.56" for 100-Year event  
Inflow = 4.91 cfs @ 12.39 hrs, Volume= 0.578 af  
Outflow = 4.91 cfs @ 12.39 hrs, Volume= 0.578 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs

### Reach DP-1:

Hydrograph



### 31 Newtown Rd Proposed HydroCAD

Type III 24-hr 100-Year Rainfall=8.94"

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#### Summary for Pond SW-1: SW Basin

Inflow Area = 0.798 ac, 15.79% Impervious, Inflow Depth = 5.16" for 100-Year event  
Inflow = 4.13 cfs @ 12.15 hrs, Volume= 0.343 af  
Outflow = 2.80 cfs @ 12.29 hrs, Volume= 0.343 af, Atten= 32%, Lag= 8.6 min  
Discarded = 0.19 cfs @ 12.29 hrs, Volume= 0.223 af  
Primary = 2.61 cfs @ 12.29 hrs, Volume= 0.120 af  
Routed to Pond WETLAND : WETLAND A

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 118.85' @ 12.29 hrs Surf.Area= 2,292 sf Storage= 4,751 cf  
Flood Elev= 112.00' Storage= 0 cf

Plug-Flow detention time= 208.1 min calculated for 0.343 af (100% of inflow)  
Center-of-Mass det. time= 208.6 min ( 1,034.6 - 826.0 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 115.00'              | 5,728 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 115.00              | 125                  | 100.0            | 0                                                          | 0                         | 125                 |
| 116.00              | 780                  | 180.0            | 406                                                        | 406                       | 1,913               |
| 117.00              | 1,350                | 200.0            | 1,052                                                      | 1,458                     | 2,547               |
| 118.00              | 1,796                | 215.0            | 1,568                                                      | 3,026                     | 3,084               |
| 119.25              | 2,550                | 228.0            | 2,703                                                      | 5,728                     | 3,619               |

| Device | Routing   | Invert  | Outlet Devices                                                               |      |      |      |      |      |      |      |      |      |      |  |
|--------|-----------|---------|------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|--|
| #1     | Primary   | 118.50' | <b>4.0' long + 4.0 ' SideZ x 4.0' breadth Broad-Crested Rectangular Weir</b> |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Head (feet)                                                                  | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 |  |
|        |           |         |                                                                              | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |      |      |      |  |
|        |           |         | Coef. (English)                                                              | 2.38 | 2.54 | 2.69 | 2.68 | 2.67 | 2.67 | 2.65 | 2.66 | 2.66 |      |  |
|        |           |         |                                                                              | 2.68 | 2.72 | 2.73 | 2.76 | 2.79 | 2.88 | 3.07 | 3.32 |      |      |  |
| #2     | Discarded | 115.00' | <b>2.410 in/hr Exfiltration over Surface area</b>                            |      |      |      |      |      |      |      |      |      |      |  |
|        |           |         | Conductivity to Groundwater Elevation = 112.00'                              |      |      |      |      |      |      |      |      |      |      |  |

**Discarded OutFlow** Max=0.19 cfs @ 12.29 hrs HW=118.84' (Free Discharge)

↑ **2=Exfiltration** ( Controls 0.19 cfs)

**Primary OutFlow** Max=2.57 cfs @ 12.29 hrs HW=118.84' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 2.57 cfs @ 1.39 fps)

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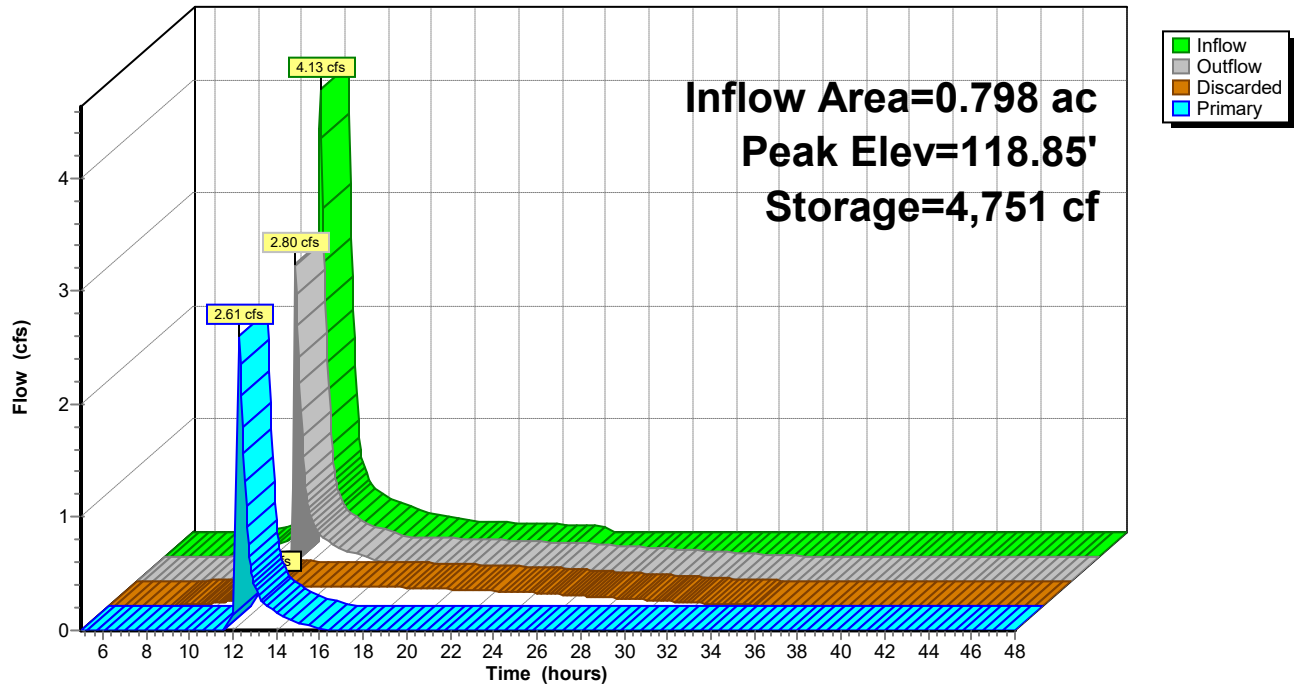
Type III 24-hr 100-Year Rainfall=8.94"

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## Pond SW-1: SW Basin

### Hydrograph



### 31 Newtown Rd Proposed HydroCAD

Type III 24-hr 100-Year Rainfall=8.94"

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### Summary for Pond WETLAND: WETLAND A

Inflow Area = 1.945 ac, 12.66% Impervious, Inflow Depth = 3.56" for 100-Year event  
Inflow = 6.55 cfs @ 12.25 hrs, Volume= 0.578 af  
Outflow = 4.91 cfs @ 12.39 hrs, Volume= 0.578 af, Atten= 25%, Lag= 8.4 min  
Primary = 4.91 cfs @ 12.39 hrs, Volume= 0.578 af  
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
Peak Elev= 111.68' @ 12.39 hrs Surf.Area= 3,522 sf Storage= 1,729 cf  
Flood Elev= 112.00' Surf.Area= 4,625 sf Storage= 3,031 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
Center-of-Mass det. time= 1.7 min ( 821.1 - 819.4 )

| Volume              | Invert               | Avail.Storage    | Storage Description                                        |                           |                     |
|---------------------|----------------------|------------------|------------------------------------------------------------|---------------------------|---------------------|
| #1                  | 111.00'              | 3,031 cf         | <b>Custom Stage Data (Irregular)</b> Listed below (Recalc) |                           |                     |
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Perim.<br>(feet) | Inc.Store<br>(cubic-feet)                                  | Cum.Store<br>(cubic-feet) | Wet.Area<br>(sq-ft) |
| 111.00              | 1,680                | 480.0            | 0                                                          | 0                         | 1,680               |
| 112.00              | 4,625                | 530.0            | 3,031                                                      | 3,031                     | 5,730               |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                           |
|--------|---------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 110.10' | <b>12.0" Round Culvert</b><br>L= 29.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 110.10' / 108.90' S= 0.0414 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

**Primary OutFlow** Max=4.90 cfs @ 12.39 hrs HW=111.68' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 4.90 cfs @ 6.24 fps)

# 31 Newtown Rd Proposed HydroCAD

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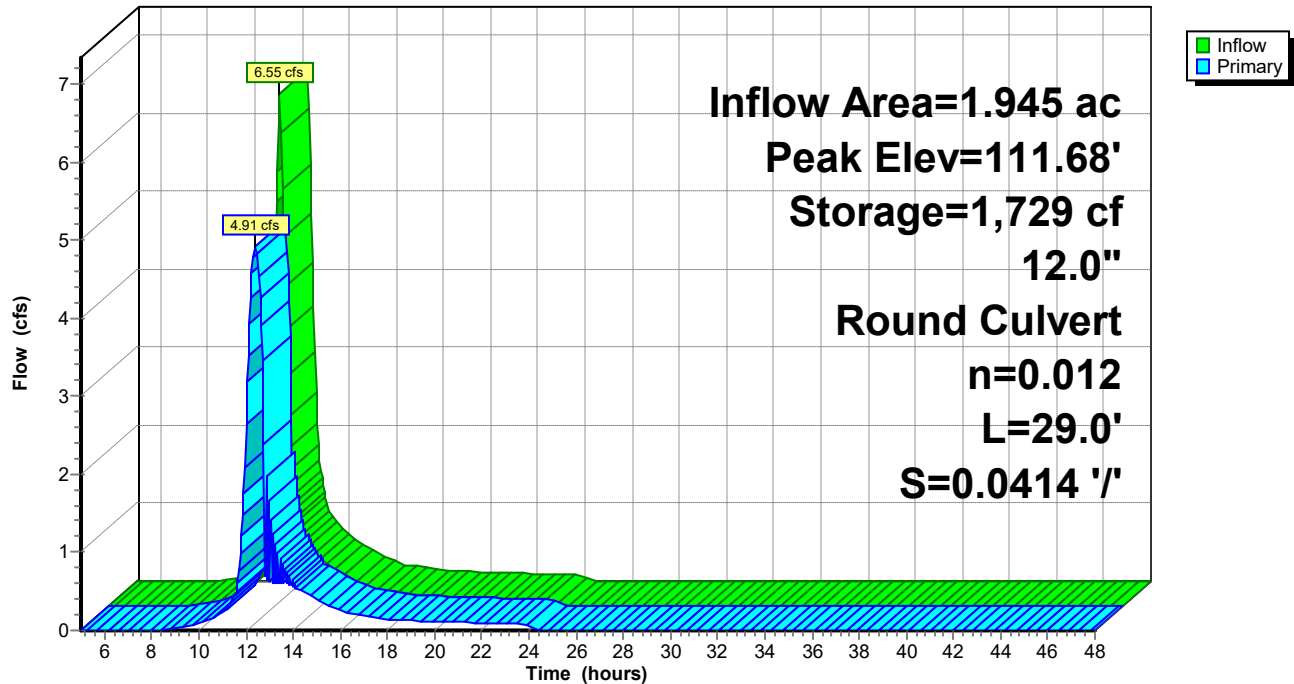
Type III 24-hr 100-Year Rainfall=8.94"

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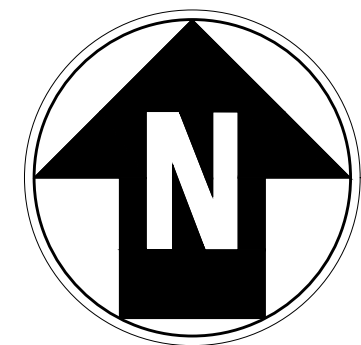
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## Pond WETLAND: WETLAND A

Hydrograph



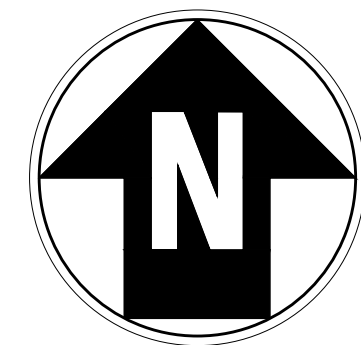




0 30 60  
Scale in feet



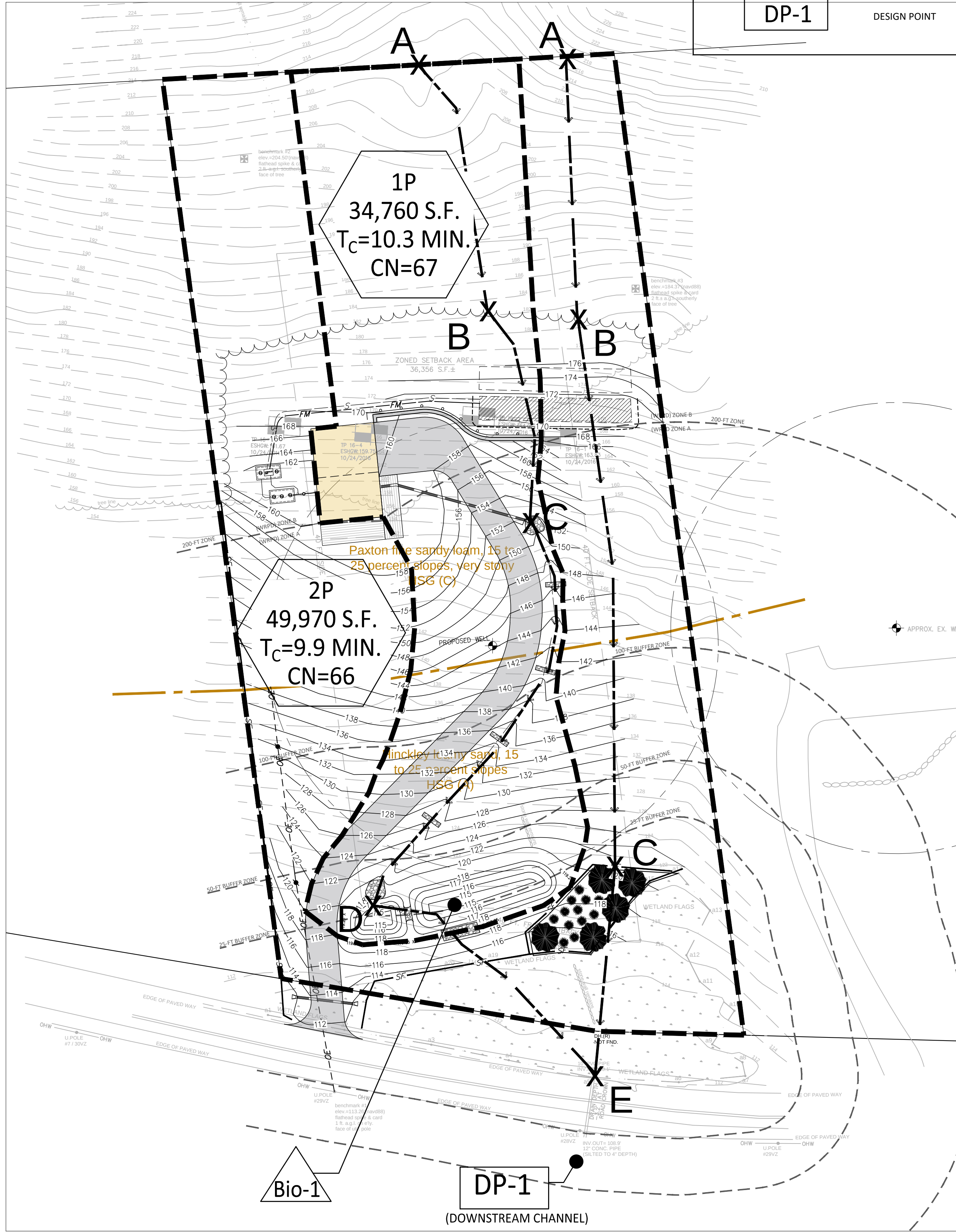
EXISTING CONDITIONS - DRAINAGE AREA MAP



0 30 60  
Scale in feet

LEGEND

- PROPERTY LINE
- SUBCATCHMENT AREA BOUNDARY
- SUBCATCHMENT AREA
- Bio
- STORMWATER MANAGEMENT PRACTICE
- DP-1
- DESIGN POINT



PROPOSED CONDITIONS - DRAINAGE AREA MAP

HD Design

161 W. High Street,  
Avon, MA 02322  
Cell: (508) 840-1045  
Email: [hazem.dani87@gmail.com](mailto:hazem.dani87@gmail.com)

| No. | Submit / Revision          | App'd. By | Date     |
|-----|----------------------------|-----------|----------|
| 0   | FOR PRICING AND DISCUSSION | HD HD     | 10/14/23 |
|     |                            |           |          |
|     |                            |           |          |
|     |                            |           |          |
|     |                            |           |          |
|     |                            |           |          |
|     |                            |           |          |

PREPARED FOR:

AC LAND LLC



AC Land LLC  
AC Homes LLC

15 LINCOLN STREET,  
SUITE 325,  
WAKEFIELD, MA 01880

**SITE PLANS**  
**5-BEDROOM**  
**SINGLE-FAMILY**  
**DWELLING**

31 NEWTON ROAD,  
AMESBURY, MA

DRAINAGE  
AREA MAP

|                           |                      |                    |
|---------------------------|----------------------|--------------------|
| Designed By:<br>HD        | Drawn By:<br>HD      | Checked By:<br>-   |
| Issue Date:<br>07/01/2024 | Project No:<br>13023 | Scale:<br>1" = 30' |

Drawing No:

**DA-MAP**



## ***Drawdown Time Calculations***

---



## 72-HOUR DRAWDOWN NARRATIVE & CALCULATIONS

Use the same infiltration rate that is used for sizing the infiltration BMP to confirm that the infiltration BMP will drain completely within 72 hours. For the "Static" and "Simple Dynamic" Methods, the Rawls Rates associated with the slowest of the Hydrologic Soil Groups determined to exist at the point where recharge is proposed shall be used. For the "Dynamic Field" Method, 50% of the lowest value obtained from the test results for *saturated hydraulic conductivity* measured in the field at the actual location and soil layer where recharge is proposed shall be used.

To determine whether an infiltration BMP will drain within 72 hours, the following formula must be used<sup>1</sup>:

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Where:

*Rv* = Storage Volume

*K* = Saturated Hydraulic Conductivity For "Static" and "Simple Dynamic" Methods, use Rawls Rate (see Table 2.3.3). For "Dynamic Field" Method, use 50% of the in-situ saturated hydraulic conductivity.

*Bottom Area* = Bottom Area of Recharge Structure<sup>2</sup>

### 1. Rain Garden Drawdown Calculation:

*Rv* = 4,440 cu. ft.,

Previous test pits conducted for the installed septic system indicate that the onsite soils consist of sand and gravel. However, a *K* of 2.41 in/hr for Loamy Sand was selected for the design. This rate is conservative since previous test pits for septic show that the onsite soils consist of sand and gravel.

Bottom Area = 350 sq. ft.

Time = 4,400 cu. ft. / [(2.41 in/hr (1ft/12in)) \* 350 sq. ft.]

**Time = 64 Hours**

---

<sup>1</sup> In some cases, the infiltration structure may be designed to treat the *Required Water Quality Volume* and/or to attenuate peak discharges in addition to infiltrating the *Required Recharge Volume*. In that event, the storage volume of the structure must be used in the formula for determining drawdown time in place of the *Required Recharge Volume*.

<sup>2</sup> To account for the porosity of the stone, a different formula is required to determine whether the Required Recharge Volume drains within 72 hours if the infiltration structure is a trench filled with stone. In that event, the drawdown time would be calculated as follows with *n* = porosity of the stone:

$$Time_{drawdown} = \frac{Rv}{(K)(Trench\ Bottom\ Area)(n)}$$

**Conclusion:**

The drawdown calculations for the infiltration BMPs show that each BMP will drain within the required 72-hour timeframe. The project satisfies Standard 3 of the Mass DEP Stormwater Regulations.

## ***Recharge Calculations***

---



## RECHARGE Calculation Sheet

The calculation for the *Required Recharge Volume* is calculated using the equation in the 2008 Massachusetts Stormwater Handbook. The *Required Recharge Volume* equals a depth of runoff corresponding to the soil type multiplied by the new impervious areas covering that soil type at the post-development site. The *Required Recharge Volume* is based on the *Static* method.

The project consists of a site regrading and no additional impervious areas are proposed. Therefore, there is no required recharge volume. A rain garden is proposed to mitigate any increase in the stormwater runoff. The provided rain garden includes 688 cubic feet of recharge volume far exceeding the 0 cubic feet.

The delineated soil boundaries from the Natural Resources Conservation Service (NRCS) soil survey, attached, show that the site consists of **Hinckley Loamy Sand**. We have utilized an HSG "A."

$$Rv = F \times \text{impervious area} \quad (\text{Equation 1) Volume 3, Ch 1, page 15}$$

where;

*Rv* = *Required Recharge Volume*, expressed in cubic feet, cubic yards, or acre-feet

*F* = Target Depth Factor associated with each Hydrologic Soil Group (HSG)

*Impervious Area* = new pavement and new rooftop area

***F* for A soils = 0.60 inches** (Table 2.3.2) Volume 3, Ch 1, page 16

*F* for B soils = 0.35 inches

*F* for C soils = 0.25 inches

*F* for D soils = 0.10 inches

Using the formula above, the following table shows the site's proposed impervious surface area overlying particular Hydrologic Soil Groups and the calculated *Required Recharge Volume*.

Net increase of Proposed Impervious = 0 sq. ft.

*Required Recharge Volume*

$Rv = F \times \text{Imp}$

$Rv = 0.60 \text{ in} \times (1/12) \times (5490 \text{ s.f.})$

$Rv = 275 \text{ cu. ft.}$

*Storage volumes provided in the proposed infiltration practices (Rain Garden) = 688 c.f. (refer to the attached hydroCAD report for additional information)*

The storage available exceeds the Required Recharge Volume.

**4,400 cu. ft. >> 275 cu. ft.**

**Conclusion:**

The recharge provided exceeds the required recharge volume. The project's stormwater management system satisfies Standard 3 of the Mass DEP Stormwater Regulations.

## ***TSS Removal Calculations***

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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: Infiltration Practices (Bioretention Area)

TSS Removal Calculation  
Worksheet

| A<br>BMP <sup>1</sup>               | B<br>TSS Removal<br>Rate <sup>1</sup> | C<br>Starting TSS<br>Load* | D<br>Amount<br>Removed (B*C) | E<br>Remaining<br>Load (C-D) |
|-------------------------------------|---------------------------------------|----------------------------|------------------------------|------------------------------|
| Sediment Forebays                   | 0.25                                  | 1.00                       | 0.25                         | 0.75                         |
| Bioretention Area<br>(Infiltration) | 0.90                                  | 0.75                       | 0.68                         | 0.08                         |
|                                     |                                       |                            |                              |                              |
|                                     |                                       |                            |                              |                              |
|                                     |                                       |                            |                              |                              |

Total TSS Removal =

93%

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

Project: 31 Newton Road,  
Amesbury MA  
Prepared By: HD  
Date: 7/10/2024

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



## ***Water Quality Volume Calculations***

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## WATER QUALITY

This design proposes the treatment of all impervious surfaces. The stormwater runoff volume that requires treatment equals 1.0" of rainfall over the new impervious areas. The required stormwater runoff volume has been calculated below.

$$\text{Total Proposed Impervious Areas} = 5,490 \text{ sq. ft.} = 0.126 \text{ ac.}$$

WQV required to be treated based on 1.0-inch:

$$\text{WQV} = (1"/12") \text{ ft.} \times (5,490) \text{ sq. ft.} = 458 \text{ cu. ft.}$$

The Infiltration practice (Bioretention Area) provides treated volume that will be infiltrated through the bottom areas. Below is a table that shows the provided treated storage for every proposed BMP component:

| Proposed BMP Component                       | Storage Volume (Cubic feet)<br>Below the Outlet Invert* |
|----------------------------------------------|---------------------------------------------------------|
| Bioretention Area                            | 4,400                                                   |
| <b>Total Treated Volume<br/>(Cubic feet)</b> | <b>4,400</b>                                            |

\* Storage volumes were obtained from the attached HydroCAD Model

In Conclusion:

The project exceeds the required water quality volume and complies with the MA Stormwater Regulations and standards.



## ***Soil Data***

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Commonwealth of Massachusetts

City/Town of AMESBURY

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

MassDEP has provided this form for use by on-site professionals and local Boards of Health. Other forms may be used, but the information must be substantially the same as provided here. Before using this form, check with your local Board of Health to determine the form they use.

### A. Facility Information

RONALD EATON

Owner Name

31 NEWTON ROAD

Street Address

AMESBURY

City

MA

State

33/32

Map/Lot #

1913

Zip Code

### B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade

☐ Repair

2. Published Soil Survey Available? ☒ Yes ☐ No

If yes: 1981  
Year Published

1:15840  
Publication Scale

HfD  
Soil Map Unit

HINCKLEY

Soil Name

STEEP SLOPE, SEEPAGE  
Soil Limitations

3. Surficial Geological Report Available? ☐ Yes ☐ No

If yes: \_\_\_\_\_  
Year Published

\_\_\_\_\_  
Publication Scale

\_\_\_\_\_  
Map Unit

Geologic Material

Landform

4. Flood Rate Insurance Map

Above the 500-year flood boundary? ☒ Yes ☐ No

Within the 100-year flood boundary? ☐ Yes ☒ No

Within the 500-year flood boundary? ☐ Yes ☒ No

Within a velocity zone? ☐ Yes ☒ No

5. Wetland Area: National Wetland Inventory Map

Map Unit

Name

Wetlands Conservancy Program Map

Map Unit

Name



Commonwealth of Massachusetts

City/Town of AMESBURY

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

B. Site Information (Continued)

6. Current Water Resource Conditions (USGS): \_\_\_\_\_ Month/Year Range: ☐ Above Normal ☐ Normal ☐ Below Normal

7. Other references reviewed: \_\_\_\_\_

C. On-Site Review (minimum of two holes required at every proposed primary and reserved disposal area)

Deep Observation Hole Number: 1 Date: 7-28-14 Time: 8:00 AM Weather: OVERCAST, DRIZZLE

1. Location

Ground Elevation at Surface of Hole: \_\_\_\_\_ Location (identify on plan): SEE SKETCH

2. Land Use WOODLAND FEW 10 %  
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)  
OAK & PINE TREES, BRUSH STEEP SLOPE SEE PLAN  
Vegetation Landform Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200 feet Drainage Way >100 feet Possible Wet Area >100 feet  
Property Line >30 feet Drinking Water Well >125 feet Other \_\_\_\_\_ feet

4. Parent Material: WATER SORTED Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit \_\_\_\_\_ Depth Standing Water in Hole \_\_\_\_\_  
Estimated Depth to High Groundwater: NONE inches elevation \_\_\_\_\_



Commonwealth of Massachusetts

City/Town of AMESBURY

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### C. On-Site Review (Continued)

Deep Observation Hole Number: 1

| Depth (in.) | Soil Horizon/<br>Layer | Soil Matrix: Color-<br>Moist (Munsell) | Redoximorphic Features<br>(mottles) |       |         | Soil Texture<br>(USDA) | Coarse Fragments<br>% by Volume |                     | Soil<br>Structure | Soil<br>Consistence<br>(Moist) | Other |
|-------------|------------------------|----------------------------------------|-------------------------------------|-------|---------|------------------------|---------------------------------|---------------------|-------------------|--------------------------------|-------|
|             |                        |                                        | Depth                               | Color | Percent |                        | Gravel                          | Cobbles &<br>Stones |                   |                                |       |
| 0-12        | A                      | 10YR3-4                                |                                     |       |         | FSL                    |                                 | 5%                  | G                 | VF                             |       |
| 12-34       | Bw                     | 10YR4-4                                |                                     |       |         | GSL                    | 10%                             | 10%                 | G                 | F                              |       |
| 34-120      | C1                     | 10YR6-4                                |                                     |       |         | GCS                    | 20%                             | 20%                 | SG                | L                              |       |
|             |                        |                                        |                                     |       |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |       |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |       |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |       |         |                        |                                 |                     |                   |                                |       |

Additional Notes:

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Commonwealth of Massachusetts

City/Town of AMESBURY

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (Continued)

Deep Observation Hole Number:

2

7-28-14

Date

8:30 AM

Time

OVERCAST DRIZZLE

Weather

1. Location

Ground Elevation at Surface of Hole:

Location (identify on plan):

SEE SKETCH

2. Land Use

EDGE OF WOODLAND

(e.g., woodland, agricultural field, vacant lot, etc.)

FEW

Surface Stones

10%

Slope (%)

OAK, PINE & BRUSH

Vegetation

MODERATE SLOPE

Landform

SEE PLAN

Position on Landscape (attach sheet)

3. Distances from:

Open Water Body

>200  
feet

Drainage Way

>100  
feet

Possible Wet Area

>100  
feet

Property Line

>35  
feet

Drinking Water Well

>125  
feet

Other

feet

4. Parent Material:

WATER SORTED

Unsuitable Materials Present:

☐ Yes

☒ No

If Yes:

☐ Disturbed Soil

☐ Fill Material

☐ Impervious Layer(s)

☐ Weathered/Fractured Rock

☐ Bedrock

5. Groundwater Observed:

☐ Yes

☒ No

If yes:

Depth Weeping from Pit

Depth Standing Water in Hole

Estimated Depth to High Groundwater:

64  
inches

elevation



Commonwealth of Massachusetts

City/Town of AMESBURY

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### C. On-Site Review (Continued)

Deep Observation Hole Number: 2

| Depth (in.) | Soil Horizon/<br>Layer | Soil Matrix: Color-<br>Moist (Munsell) | Redoximorphic Features<br>(mottles) |         |         | Soil Texture<br>(USDA) | Coarse Fragments<br>% by Volume |                     | Soil<br>Structure | Soil<br>Consistence<br>(Moist) | Other |
|-------------|------------------------|----------------------------------------|-------------------------------------|---------|---------|------------------------|---------------------------------|---------------------|-------------------|--------------------------------|-------|
|             |                        |                                        | Depth                               | Color   | Percent |                        | Gravel                          | Cobbles &<br>Stones |                   |                                |       |
| 0-10        | A                      | 10YR3-4                                |                                     |         |         | FSL                    |                                 |                     | G                 | VF                             |       |
| 10-30       | Bw                     | 10YR4-4                                |                                     |         |         | SL                     | 10%                             | 5%                  | G                 | F                              |       |
| 30-80       | C1                     | 10YR6-3                                | 64"                                 | 2.5Y6-3 | 10%     | GCS                    | 10%                             | 20%                 | SG                | L                              |       |
| 80-120      | C2                     | 2.5Y5-3                                |                                     |         |         | LM                     |                                 |                     | BL                | FIRM                           |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |

Additional Notes:

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## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### D. Determination of High Groundwater Elevation

1. Method Used:

☐ Depth observed standing water in observation hole

A. \_\_\_\_\_  
inches

B. \_\_\_\_\_  
inches

☐ Depth weeping from side of observation hole

A. \_\_\_\_\_  
inches

B. \_\_\_\_\_  
inches

☒ Depth to soil redoximorphic features (mottles)

A. NONE  
inches

B. >64  
inches

☐ Groundwater adjustment (USGS methodology)

A. \_\_\_\_\_  
inches

B. \_\_\_\_\_  
inches

2.

Index Well Number \_\_\_\_\_

Reading Date \_\_\_\_\_

Index Well Level \_\_\_\_\_

Adjustment Factor \_\_\_\_\_

Adjusted Groundwater Level \_\_\_\_\_

### E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed?

Upper boundary: 10  
inches

Lower boundary: 80  
inches



Commonwealth of Massachusetts

City/Town of AMESBURY

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

B. Site Information (Continued)

6. Current Water Resource Conditions (USGS): \_\_\_\_\_ Month/Year Range: ☐ Above Normal ☐ Normal ☐ Below Normal

7. Other references reviewed: \_\_\_\_\_

C. On-Site Review (minimum of two holes required at every proposed primary and reserved disposal area)

Deep Observation Hole Number: 3 Date: 7-28-14 Time: 9:30 AM Weather: OVERCAST LIGHT RAIN

1. Location

Ground Elevation at Surface of Hole: \_\_\_\_\_ Location (identify on plan): SEE SKETCH

2. Land Use WOODLAND FEW 10 %  
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)  
PINE & BRUSH ON SLOPE SEE PLAN  
Vegetation Landform Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200 feet Drainage Way >100 feet Possible Wet Area >100 feet  
Property Line >60 feet Drinking Water Well >140 feet Other \_\_\_\_\_ feet

4. Parent Material: WATER SORTED Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit \_\_\_\_\_ Depth Standing Water in Hole \_\_\_\_\_  
Estimated Depth to High Groundwater: >60 inches elevation \_\_\_\_\_



Commonwealth of Massachusetts

City/Town of AMESBURY

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### C. On-Site Review (Continued)

Deep Observation Hole Number: 3

| Depth (in.) | Soil Horizon/<br>Layer | Soil Matrix: Color-<br>Moist (Munsell) | Redoximorphic Features<br>(mottles) |         |         | Soil Texture<br>(USDA) | Coarse Fragments<br>% by Volume |                     | Soil<br>Structure | Soil<br>Consistence<br>(Moist) | Other |
|-------------|------------------------|----------------------------------------|-------------------------------------|---------|---------|------------------------|---------------------------------|---------------------|-------------------|--------------------------------|-------|
|             |                        |                                        | Depth                               | Color   | Percent |                        | Gravel                          | Cobbles &<br>Stones |                   |                                |       |
| 0-15        | A                      | 10YR3-3                                |                                     |         |         | FSL                    |                                 | 5%                  | G                 | VF                             |       |
| 15-46       | Bw                     | 10YR5-6                                |                                     |         |         | SL                     |                                 | 10%                 | G                 | F                              |       |
| 46-84       | C1                     | 2.5Y6-4                                | 60"                                 | 2.5Y6-3 | 10%     | MS                     | 5%                              | 10%                 | M                 | F                              |       |
| 84-120      | C2                     | 2.5Y6-6                                |                                     |         |         | LFS                    | 5%                              | 10%                 | M                 | F                              |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |

Additional Notes:

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Commonwealth of Massachusetts

City/Town of AMESBURY

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (Continued)

Deep Observation Hole Number:

4

7-28-14

Date

9:30 AM

Time

OVERCAST, LIGHT RAIN

Weather

1. Location

Ground Elevation at Surface of Hole:

Location (identify on plan):

2. Land Use

EDGE OF WOODLAND

(e.g., woodland, agricultural field, vacant lot, etc.)

FEW

Surface Stones

6%

Slope (%)

GRASS & BRUSH

Vegetation

GENTLE SLOPE

Landform

SEE PLAN

Position on Landscape (attach sheet)

3. Distances from:

Open Water Body

>200  
feet

Drainage Way

>100  
feet

Possible Wet Area

>100  
feet

Property Line

>85  
feet

Drinking Water Well

>200  
feet

Other

feet

4. Parent Material:

WATER SORTED

Unsuitable Materials Present:

☐ Yes

☒ No

If Yes:

☐ Disturbed Soil

☐ Fill Material

☐ Impervious Layer(s)

☐ Weathered/Fractured Rock

☐ Bedrock

5. Groundwater Observed:

☐ Yes

☒ No

If yes:

Depth Weeping from Pit

Depth Standing Water in Hole

Estimated Depth to High Groundwater:

>72  
inches

elevation



Commonwealth of Massachusetts

City/Town of AMESBURY

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### C. On-Site Review (Continued)

Deep Observation Hole Number: 4

| Depth (in.) | Soil Horizon/<br>Layer | Soil Matrix: Color-<br>Moist (Munsell) | Redoximorphic Features<br>(mottles) |         |         | Soil Texture<br>(USDA) | Coarse Fragments<br>% by Volume |                     | Soil<br>Structure | Soil<br>Consistence<br>(Moist) | Other |
|-------------|------------------------|----------------------------------------|-------------------------------------|---------|---------|------------------------|---------------------------------|---------------------|-------------------|--------------------------------|-------|
|             |                        |                                        | Depth                               | Color   | Percent |                        | Gravel                          | Cobbles &<br>Stones |                   |                                |       |
| 0-15        | A                      | 10YR3-4                                |                                     |         |         | FSL                    |                                 |                     | G                 | VF                             |       |
| 15-44       | Bw                     | 10YR3-4                                |                                     |         |         | GSL                    | 10%                             | 5%                  | G                 | F                              |       |
| 44-78       | C1                     | 10YR6-4                                | 72"                                 | 2.5Y6-3 | 10%     | GMS                    | 10%                             | 20%                 | M                 | F                              |       |
| 78-120      | C2                     | 10YR6-3                                |                                     |         |         | GFS                    | 5%                              | 10%                 | M                 | F                              |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |
|             |                        |                                        |                                     |         |         |                        |                                 |                     |                   |                                |       |

Additional Notes:

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Commonwealth of Massachusetts

City/Town of AMESBURY

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### D. Determination of High Groundwater Elevation

1. Method Used:

☐ Depth observed standing water in observation hole

A.  
inches

B.  
inches

☐ Depth weeping from side of observation hole

A.  
inches

B.  
inches

☒ Depth to soil redoximorphic features (mottles)

A. >60  
inches

B. >72  
inches

☐ Groundwater adjustment (USGS methodology)

A.  
inches

B.  
inches

2.

Index Well Number

Reading Date

Index Well Level

Adjustment Factor

Adjusted Groundwater Level

### E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes

☐ No

b. If yes, at what depth was it observed?

Upper boundary:

15  
inches

Lower boundary:

120  
inches



Commonwealth of Massachusetts

City/Town of AMESBURY

## Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

### F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator

DENNIS G. QUINTAL, PE

Typed or Printed Name of Soil Evaluator / License #

JACK MORRIS

Name of Board of Health Witness

7-28-14

Date

JULY 1995

Date of Soil Evaluator Exam

AMESBURY

Board of Health

**Note:** In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.



**Commonwealth of Massachusetts**

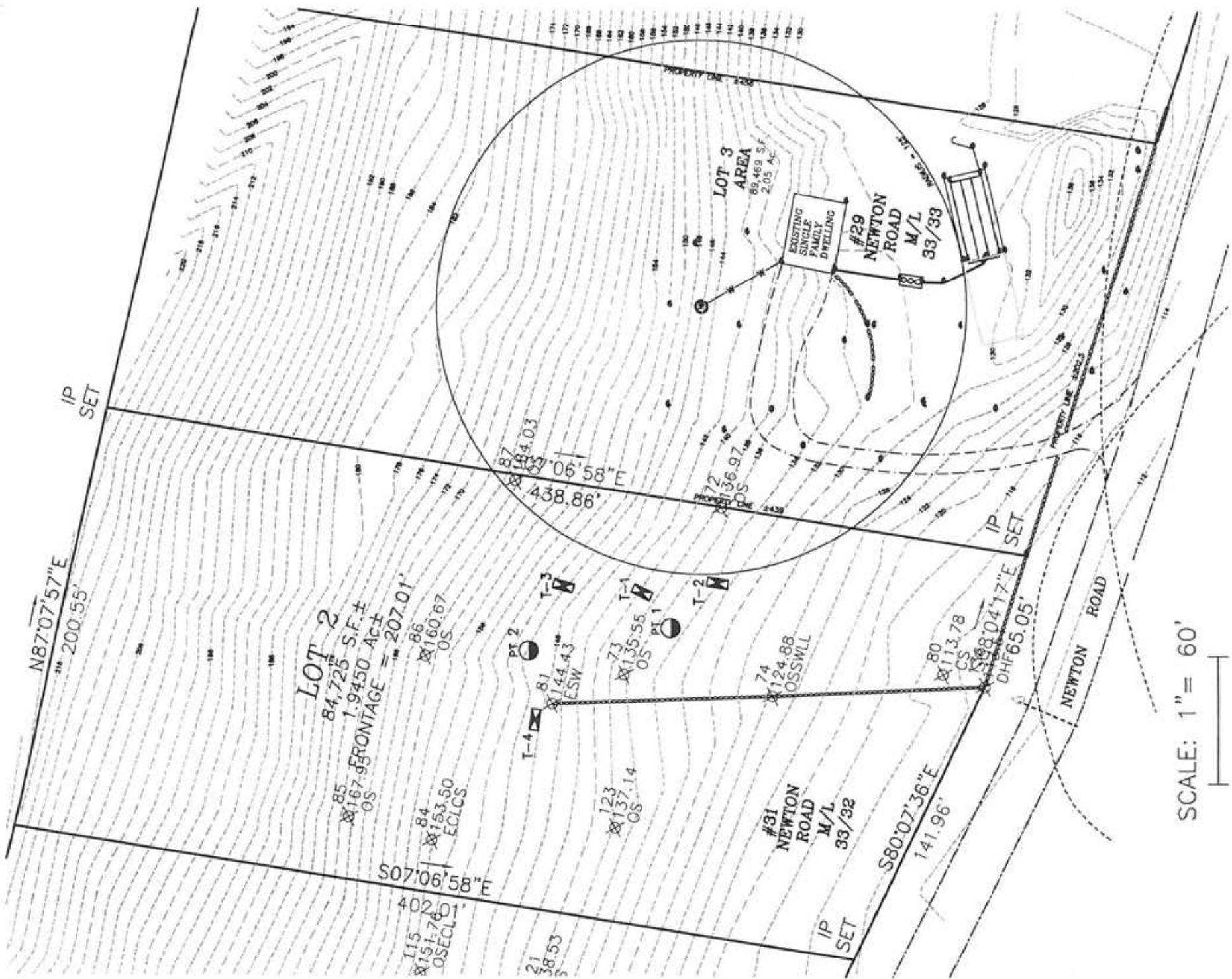
City/Town of AMESBURY

## **Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal**

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### **Field Diagrams**

Use this sheet for field diagrams:



SCALE: 1" = 60'