# STORMWATER REPORT

**Proposed Starbucks Drive-Thru**
**37 Clark's Road**
**Amesbury, MA**

CHA Project Number: 081088

**June 2024**

**Prepared for:**
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I, the undersigned, certify that I am currently a Massachusetts registered professional engineer and that this Stormwater Report was prepared under my direct supervision.

**For CHA Consulting, Inc.**

(Professional Seal)

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| | |
|---|---|
| ASTM | American Society of Testing & Materials |
| ADA | Americans with Disabilities Act |
| BGS | Below the Ground Surface |
| CHA | CHA Consulting, Inc. |
| FER | Final Engineering Report |
| HASP | Health and Safety Plan |
| HVAC | Heating, Ventilation & Air-Conditioning |
| NYCRR | New York Code, Rules and Regulations |
| PPE | Personal Protective Equipment |
| PVC | Polyvinyl Chloride |
| QA | Quality Assurance |
| QC | Quality Control |
| SWPPP | Stormwater Pollution Prevention Plan |
| USDA | United States Department of Agriculture |
| USDOT | United States Department of Transportation |
| USGS | United States Geological Survey |

| | |
|---|---|
| BFE | Base Flood Elevation |
| BMP | Best Management Practice |
| BVW | Bordering Vegetated Wetland |
| FEMA | Federal Emergency Management Agency |
| FIRM | Flood Insurance Rate Map |
| HSG | Hydrologic Soil Group |
| IWPA | Interim Wellhead Protection Area |
| MAHW | Mean Annual High-Water |
| MassDEP | Massachusetts Department of Environmental Protection |
| NAVD | North American Vertical Datum |
| NRCS | Natural Resources Conservation Service |
| SHGW | Seasonal High Groundwater |
| SWMSH | Stormwater Management Standards Handbook |
| Tc | Time of Concentration |
| TSS | Total Suspended Solids |

## 1.0 EXECUTIVE SUMMARY

The Applicant, Amesbury Lodging Ventures LLC, proposes to develop a new Starbucks Drive-Thru restaurant on a 2.99-acre lot at 37 Clark's Road, Amesbury, MA. The site consists of two existing buildings, a closed Friendly's restaurant on the northwest corner of the lot, and a Fairfield Inn Hotel south of Friendly's. The existing lot contains paved parking, landscaping, a pool area, and other existing improvements supporting the existing uses. The proposed project consists of an approximate 2,374 square foot Starbucks and Drive-Thru that includes utility services consisting of water, electric, municipal sewer connection, and a drainage system. Additional improvements include modifying landscape areas, parking, and to remove a driveway resulting in one shared access driveway for the Starbucks restaurant and Fairfield Inn. The project results in a net reduction of impervious surface area of approximately 3,913 square-feet. The proposed drainage system is comprised of an infiltration basin for a portion of the parking lot and a closed-conveyance pipe system to collect and convey stormwater runoff. The existing stormwater system discharges to Amesbury's municipal stormwater system. It is intended to reuse the existing drainage connection for the proposed project. The site is not located nearby critical areas, and is located in FEMA Zone X, area of minimal flood hazard. The proposed drainage system will attenuate peak rates of runoff and provide the required treatment for stormwater runoff from impervious areas as required by the 2008 Massachusetts Stormwater Handbook. Refer to the site plans for additional information.

## 2.0 OBJECTIVE OF CALCULATIONS

The purpose of this stormwater analysis is to assess existing and proposed stormwater runoff conditions from the site based upon MassDEP Stormwater Management Standards.

The objectives of the stormwater management system designed for this project are to provide enhanced water quality, reduce post-development peak runoff rates compared to pre-development rates, maximize infiltration, and to protect surrounding areas from potential environmental impacts or flooding.

## 3.0 METHODOLOGY

The HydroCAD Stormwater Modeling System, version 10.20, by Applied Microcomputer Systems, Inc., is used to develop stormwater runoff rates and volumes for the existing and proposed development 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 completed utilizing a Type III, 24-hour storm as developed by the Soil Conservation Service, and stormwater routing calculations were performed using 2-year, 10-year, 25-year, and 100-year storm frequencies.

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:

1. A rainfall distribution is selected which indicates how the storm depth will be distributed over time. This is the standardized Type III SCS rainfall distribution based upon the project's location.
2. The design storm depth is determined from the rainfall frequency atlas (NOAA Atlas 14) based upon the return period being modeled. This data yields the cumulative depth at each period during the storm.
3. The storm is divided into bursts of equal duration based upon the Time of Concentration (Tc)—the time required for water to flow from the most distant point on a runoff area to the measurement or collection point. For each burst, the SCS runoff equation and the average Curve Number (CN) are used to determine the portion of that burst that will appear as runoff.
4. A unit hydrograph representing the runoff resulting from one inch of precipitation excess generated uniformly over the watershed in conduction 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.
5. 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 that were used to develop the Intensity-Duration-Frequency relationship or IDF curve. Using data from the Weather Bureau's Rainfall Frequency Atlases, the SCS develops four "mass curves" that represent the characteristics of the rainfall distribution patterns 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. SCS rainfall distributions provide peak rates for storms of varying durations and intensities and allow volume-dependent routing calculations for cumulative runoff at any point in time.

The HydroCAD software has the additional capability to describe shallow concentrated flow. The "NEH-4 Upland Method" included in the HydroCAD software is applicable for conditions which occur in the headwaters of a watershed up to 2000 acres. The NEH-4 Upland Method allows the Time of Concentration, Tc, to reflect ground conditions such as overland flow over grassed waterways, paved areas and upland gullies. This results in a model that more accurately reflects the ground surfaces on site for shallow concentrated flow conditions compared to TR-20 methodology, which is limited to distinguishing only paved and unpaved surfaces. In instances where the watersheds are small and impervious, the Tc is directly

entered as a minimum 6 minutes. This is consistent with standard engineering practice and Technical Release (TR-55) Urban Hydrology for Small Watersheds graphical method. A lower Tc of 6 minutes yields a conservative, 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. Based upon the surface cover in each sub-watershed, a weighted average CN value is determined. The surface area, CN and Tc values are entered into HydroCAD to develop and compare hydrographs for pre- and post-development conditions.

# 4.0 SITE HYDROLOGY

Hydrologic soil groups (HSG) are used primarily to estimate runoff from precipitation in engineering calculations. HSG designations vary from "A" to "D" with "A" having the fastest infiltration rate and "D" having the slowest. Based on the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), Soil Survey of Essex County, soils within the project area consist of hydrologic soil group "A" classified as Deerfield loamy fine sand (0 to 3 percent slopes). Refer to the Soil Data located in Appendix F for additional information.

Two design points were identified as the ultimate discharge points of the project drainage area to compare development conditions for each of the following SCS Type III 24-hour design storm events. The design storm frequencies and corresponding rainfall depths were determined from NOAA Atlas 14 Point Precipitation Frequency Estimates (listed below) and inputted to the HydroCAD model.

| Storm Frequency (Years) | Rainfall Depth (Inches) |
|---|---|
| 2 | 3.39 |
| 10 | 5.36 |
| 25 | 6.58 |
| 100 | 8.48 |

Drainage watershed plans for both pre- and post-development conditions are included in Appendix B of this report.

## 4.1 Pre-Development Hydrology

The project area consists of two existing buildings, paved parking, and landscape areas as well as utilities in support of the hotel and former Friendly's restaurant. The existing lot is divided

into two sub-watersheds of similar size depicted on the Pre-Development Drainage Area Plan (DR-1) within Appendix B of this report. The section below provides a brief description of the existing subcatchment areas of the watershed. Refer to the HydroCAD models (Appendix C) for additional information.

*Existing Conditions Subcatchment 1*

Subcatchment 1 consists of the western portion of the lot including the Friendly's restaurant, Fairfield Inn, and two existing driveways on Clark's Road. The majority of the area is paved with parking areas and walkways and includes landscaped islands. Subcatchment 1 drains to Design Point-1 (DP-1) identified as the existing drainage system within Clark's Road west of the lot. A 6-minute direct entry Tc was utilized.

*Existing Conditions Subcatchment 2*

Subcatchment 2 consists of a smaller portion of the site east of Subcatchment 1. About half of the subcatchment surface cover is pervious with well-maintained grass and scattered landscape areas. Stormwater runoff is directed off-site mostly north of the lot into abutting properties. A Tc of 6 minutes was utilized.

## 4.2 Post-Development Hydrology

The proposed project reduces the net area of impervious surface cover on the lot with the development of the proposed Starbucks Drive-Thru. The post-development subcatchment areas are delineated based on proposed drainage infrastructure for stormwater collection, treatment, and discharge. The sub-watershed areas are depicted on the Post-Development Drainage Area Plan (DR-2) included in Appendix B of this report. Refer to the appended HydroCAD model for additional information.

*Post Development Subcatchment 1A*

Subcatchment 1A consists of the area of the site which is either collected by the proposed catch basins or flows towards the municipal drainage system designated DP-1 (refer to Appendix B). The subcatchment includes the Starbucks restaurant and Fairfield hotel buildings and the shared driveway. A 6-minute direct entry Tc was utilized.

*Post Development Subcatchment 1B*

*Subcatchment 1B consists of the area tributary to the proposed infiltration basin. The basin has an overflow drain which then discharges to the collection system that ultimately discharges to DP-1. A 6-minute direct entry Tc was utilized.*

*Post Development Subcatchment 2*

Subcatchment 2 consists of areas tributary to the secondary design point, DP-2, located off-site. The area consists of paved parking and landscape areas. A 6-minute direct entry Tc was utilized.

## 5.0 STORMWATER MANAGEMENT

This project includes a Stormwater Management System that has been designed to satisfy and comply with the requirements of the MassDEP Stormwater Standards (2008). The following is an explanation on how the proposed project will address the 2008 MassDEP Stormwater Management Policy.

*Standard 1: No New Untreated Discharges* – *No new stormwater system conveyances will discharge untreated runoff or cause erosion in wetlands or waters of the Commonwealth.*

**All new stormwater system conveyances will be treated prior to discharge and will not cause erosion in wetlands or waters of the Commonwealth. Stormwater will be directed to various structural and non-structural Best Management Practices.**

*Standard 2: Peak Rate Attenuation* – *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

**The peak discharge rates are calculated with the aid of a hydrograph routing program using TR-20 methodology called HydroCAD. The HydroCAD calculations of the pre- and post-development runoff peak rates have been performed. The proposed stormwater system reduces post-development peak rates of runoff below that of pre-development levels at the Design Points. Refer to Appendix C for HydroCAD models.**

*Standard 3: Recharge* – *Loss of annual recharge to groundwater shall be eliminated or minimized using infiltration measures including 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 results in a reduction in impervious area of approximately 3,913 square feet. Recharge to groundwater will be provided through volume retained within infiltration**

**basin. The recharge provided satisfies Standard 3 and exceeds the recharge requirement. Please see Appendix E for the recharge calculations.**

*Standard 4: Water Quality* **–** *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 determined in accordance with the Massachusetts Stormwater Handbook;*
c. *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

**The redevelopment project proposes the use of deep sump hooded catch basins and an infiltration basin to promote recharge and enhance water quality by removing post-construction TSS loads to the extent practicable per the Massachusetts DEP Stormwater Management Standards. The project also proposes Best Management Practices (BMP's) to meet the City's design standards. Refer to the TSS removal worksheet in Appendix E. The Long-Term Pollution Prevention Plan is also included in conjunction with the Operation and Maintenance Plan required by Standard 9 (see Appendix D of this report).**

*Standard 5: Land Uses with Higher Potential Pollutant Loads* **–** *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. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated there under at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.*

**The project is not considered a LUHPL (Land Use with Higher Potential Pollutant Load).**

*Standard 6: Critical Areas – Critical areas are Outstanding Resource Waters as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02 (Zone Is, Zone IIs, and Interim Wellhead Protection Areas for groundwater sources and Zone (A)s for surface water sources.)*

**There will be no untreated stormwater discharge to a Critical Area.**

*Standard 7: Redevelopment Projects – 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 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.*

**This project is a redevelopment under the Stormwater Management Standards. The project has been designed to meet the Stormwater Management to the extent practicable.**

*Standard 8: Construction Period Pollution Prevention Plan and Erosion and Sedimentation Control – 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 project is not covered by a NPDES Construction General Permit as the project is less than an acre of disturbance. A Construction Period Pollution Plan is provided in Appendix D.**

*Standard 9: Operation and Maintenance Plan – A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

**A Long-Term Operation and Maintenance Plan has been prepared for the project (see Appendix D). Provisions to maintain runoff have been assured through non-structural, structural, and construction management approaches.**

*Standard 10: Prohibition of Illicit Discharges – All illicit discharges to the stormwater management system are prohibited.*

**The Operation and Maintenance plan required by Standard 9 includes measures to prevent illicit discharges (see Appendix D). An Illicit Discharge Compliance Statement is included in Appendix E.**

# 6.0 BEST MANAGEMENT PRACTICES

A treatment train of deep sump catch basins and an infiltration basin are proposed to treat stormwater runoff on the site. A description of the devices incorporated is indicated below.

## 6.1 Proposed BMP's

*DEEP SUMP HOODED CATCH BASINS*

Deep sump catch basins are modified versions of inlet structures installed to collect and convey stormwater on the site. The deep sumps, typically a 4-foot dimension below the outlet pipe invert, are most effective if placed "off-line" which means that they do not have inlet pipes. The catch basins contain traps or hoods on the outlet pipes and serve as pretreatment for other downstream BMPs. Deep sump catch basins will be installed throughout the site to remove trash, debris, sediment and a limited amount of oil and grease from stormwater runoff. To ensure maximum capacity and efficiency, the catch basins shall be inspected monthly and cleaned, in dry weather, when half of the sump capacity is filled or at a minimum quarterly or as required and at the end of construction.

*INFILTRATION BASIN*

An infiltration basin receives stormwater runoff and retains it before discharging to the closed conveyance pipe system and into the surrounding soil. The basin shall be inspected on a semi-annual basis in the early spring and fall. Regular maintenance shall include mowing, fertilizing, pruning, debris, trash and sediment removal, and weed/pest control.

# 7.0 HYDRAULICS AND PIPE SIZING

The closed-conveyance storm drain collection system was analyzed using the Rational Method. **Q = CiA,** for estimating runoff where "C" is a coefficient dependent on land cover, "i" is storm intensity in in/hr based upon published IDF curves, and "A" is area in acres. "Q" is flow in cubic-feet per second.

The project site is subdivided based upon drainage areas tributary to each drainage structure. A "C" value for each area was assigned based upon overall character of land. "C" values ranged from 0.9 in paved/impervious conditions to 0.3 for grass and landscaped areas. IDF curves from Amesbury, Massachusetts are used to establish the rainfall rate for the 10-year event. Pipe hydraulic design was completed using Manning's full flow capacity equation for circular pipe with an n-value of 0.013.

**$Q = 1.49/n\ AR^{2/3}\ S^{1/2}$,** where, n is coefficient depending on channel roughness, A is area of flow, R is the hydraulic radius, and S is the channel slope.

# 8.0 SUMMARY OF HYDROLOGY & STORMWATER CALCULATIONS

The results of the pre- and post-development hydrology calculations are summarized in the following tables. The table corresponds to the design points as indicated on the drainage area maps and hydrograph routing calculations.

## 8.1 Summary of Design Point 1 (DP-1):

**TOTAL RUNOFF PEAK FLOW RATE (CFS) - DESIGN POINT 1 (DP-1)**

| DESIGN STORM | EXISTING | PROPOSED | DIFFERENCE |
|---|---|---|---|
| 2-YEAR | 3.77 | 3.51 | -0.26 |
| 10-YEAR | 7.04 | 6.66 | -0.38 |
| 25-YEAR | 9.08 | 8.62 | -0.46 |
| 100-YEAR | 12.23 | 11.68 | -0.55 |

**TOTAL RUNOFF VOL. (AC-FT) - DESIGN POINT 1 (DP-1)**

| DESIGN STORM | EXISTING | PROPOSED | DIFFERENCE |
|---|---|---|---|
| 2-YEAR | 0.274 | 0.254 | -0.020 |
| 10-YEAR | 0.521 | 0.490 | -0.031 |
| 25-YEAR | 0.679 | 0.642 | -0.037 |
| 100-YEAR | 0.931 | 0.884 | -0.047 |

In summary, the project design reduces the peak flow rates and volumes in the post-development conditions at DP-1 during major storm events.

## 8.2 Summary of Design Point 2 (DP-2):

**TOTAL RUNOFF PEAK FLOW RATE (CFS) - DESIGN POINT 2 (DP-2)**

| DESIGN STORM | EXISTING | PROPOSED | DIFFERENCE |
|---|---|---|---|
| 2-YEAR | 1.44 | 1.23 | -0.21 |
| 10-YEAR | 3.68 | 3.26 | -0.42 |
| 25-YEAR | 5.23 | 4.67 | -0.56 |
| 100-YEAR | 7.74 | 6.97 | -0.77 |

**TOTAL RUNOFF VOL. (AC-FT) - DESIGN POINT 2 (DP-2)**

| DESIGN STORM | EXISTING | PROPOSED | DIFFERENCE |
|---|---|---|---|
| 2-YEAR | 0.112 | 0.098 | -0.014 |
| 10-YEAR | 0.269 | 0.239 | -0.030 |
| 25-YEAR | 0.379 | 0.339 | -0.040 |
| 100-YEAR | 0.562 | 0.506 | -0.056 |

The project design reduces the peak flow rates in the post-developed condition at the DP-2 in all major storm events.

## 9.0 CONCLUSION

In conclusion, the project incorporates a series of structural and non-structural Best Management Practices that are designed to reduce stormwater runoff rates and increase the detention time for the site and enhance the stormwater runoff quality by providing the required treatment. The stormwater system has been designed to control peak discharge rates up to and including the 100-year design storm event. The proposed stormwater system has been designed to meet Massachusetts Stormwater Management Standards for TSS removal and water quality treatment.

It is our professional opinion that the proposed development project does not adversely affect surrounding drainage patterns. The following routing calculations, Best Management Practices design, and associated documentation within this report proves reduced runoff discharge rates and sufficient recharge volume resulting from the project.

## 10.0 GENERAL CONSTRUCTION SEQUENCING

The following section provides construction details and highlights the construction sequence and timing of earthmoving activities. The overall project will be broken down into the following phases:

- Establish Erosion and Sediment Controls around the project site
- Demolition (ex. building, structures, driveways, septic systems)
- Site clearing and grading, drainage, utility, and roadway installation
- Building construction
- Final utility connections, and permanent stabilization

### A. Pre-Construction Meeting

An on-site meeting will be conducted by the Owner's Representative prior to the start of construction activity.

### B. Installation of Erosion Controls

Erosion and sedimentation controls (i.e. silt fence, filter sock, and inlet protection) will be installed at the limits of work and within the existing catch basins, as applicable. Tree protection will be installed around trees specified to remain within the limit of work. Structures to remain shall also be visibly flagged/protected.

### C. Installation of Construction Entrance

A construction entrance will be installed in the location as shown on the Erosion Control Plan in accordance with the construction detail provided in the plan set. Existing pavement will be removed within the limits of the proposed construction entrance to accommodate the crushed stone entrance.

### D. Installation of Temporary Sediment Basins

Temporary sediment basins will be installed as shown on the plans with vertical 12-inch perforated pipe wrapped with filter fabric and screen on top for overflow. Side slopes of the temporary sediment basins shall be 3-foot horizontal to 1-foot vertical. Sediment to be removed when accumulation is within 6-inch of the outlet elevation.

### E. Demolition

Any existing building, utilities services, and pavement within the project area will be demolished in accordance with the Construction Plans. Those utilities effected by construction activates shall be coordinated with the utility purveyors and Dig Safe procedures taken prior to implementation of agreed upon connections/disconnections/abandonment of services. Materials that are to be removed from the site will be transported to an appropriate facility or will be disposed of elsewhere according to Federal, State, and Local guidelines. Inactive stockpiles or areas of granular material or topsoil shall be temporarily secured in order to control sediment laden runoff.

### F. Site Clearing and Rough Grading

The site will be cleared and rough graded in accordance with the proposed grading as shown on the plans. If suitable topsoil is found, it will be removed and stockpiled within the project limits. Areas which have been cleared (outside of the right-of-way) will be stabilized.

### G. Installation of Drainage and Utilities

Utility relocations and modifications, including water, gas, and electric, are anticipated to occur in conjunction with the drainage work. Temporary sediment basins will be constructed at this time on an as-needed basis to collect stormwater runoff during construction. Stockpiles will be established in designated areas as shown on project plans. All temporary/inactive stockpile areas will be encompassed by filter sock and silt fence or other approved erosion control devices to control sediment laden runoff as necessary and will be temporarily seeded, mulched or covered with plastic, as necessary.

### H. Building Construction

This phase of construction will involve the installation of the building including the proposed foundation and vertical construction of the building. All building waste is to be properly disposed of in dumpsters. While this phase commences, other site construction activities will be taking place.

### I. Fine Grading, Paving, Etc.

The fine grading and shaping will commence along with the installation of curbing to prepare for paving operations. Areas outside of the parking lot will be shaped and prepped for loam, seed, or other treatments. Paving operations will begin with the installation of both binder and finish course layers.

### J. Permanent / Final Site Stabilization

The final phase of the project consists of landscaping and restoration and stabilization of all exposed surfaces. Final landscaping will be performed upon completion of earthwork and completion of all curbing and sidewalk construction. Disturbed areas will be landscaped, mulched or seeded in accordance with the landscape requirements. Permanent restoration and revegetation measures serve to control erosion and sedimentation by establishing a vegetative cover. In the event that weather conditions prevent final restoration, temporary erosion and sedimentation measures will be employed until the weather is suitable for final cleanup. A final inspection will ensure that the project site is cleared of all project debris and that erosion and sedimentation controls are functioning properly. Once the site has been stabilized, newly installed catch basins and the subsurface infiltration and detention systems will be inspected for sediment deposits and cleaned if necessary.

# Figure 1: Orthophoto Plan


**LEGEND:**

APPROXIMATE PROPERTY LINE

N

0 500 1000

Scale in feet



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# ORTHOPHOTO PLAN
# 37 CLARK'S ROAD
# AMESBURY, MA

PROJECT NO. 081088

DATE: 05/20/24

FIGURE 1

# APPENDIX A

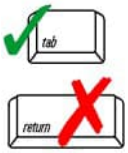
## Stormwater Checklist

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# 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.[1] 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[2]
- 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.

[1] 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.

[2] 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.

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## 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.

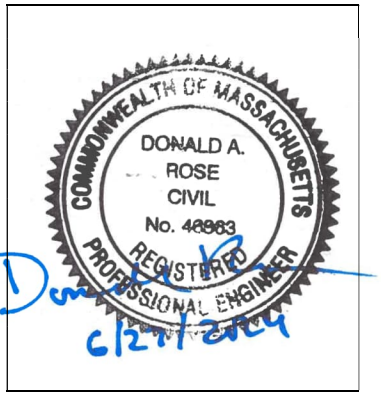
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that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




Donald Rose, P.E.
CHA Consulting, Inc.
141 Longwater Drive, Suite 104
Norwell, MA 02061
(781) 982-5400

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

## 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[1]

☐ 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.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

# Checklist for Stormwater Report

## 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

## 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

## 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**

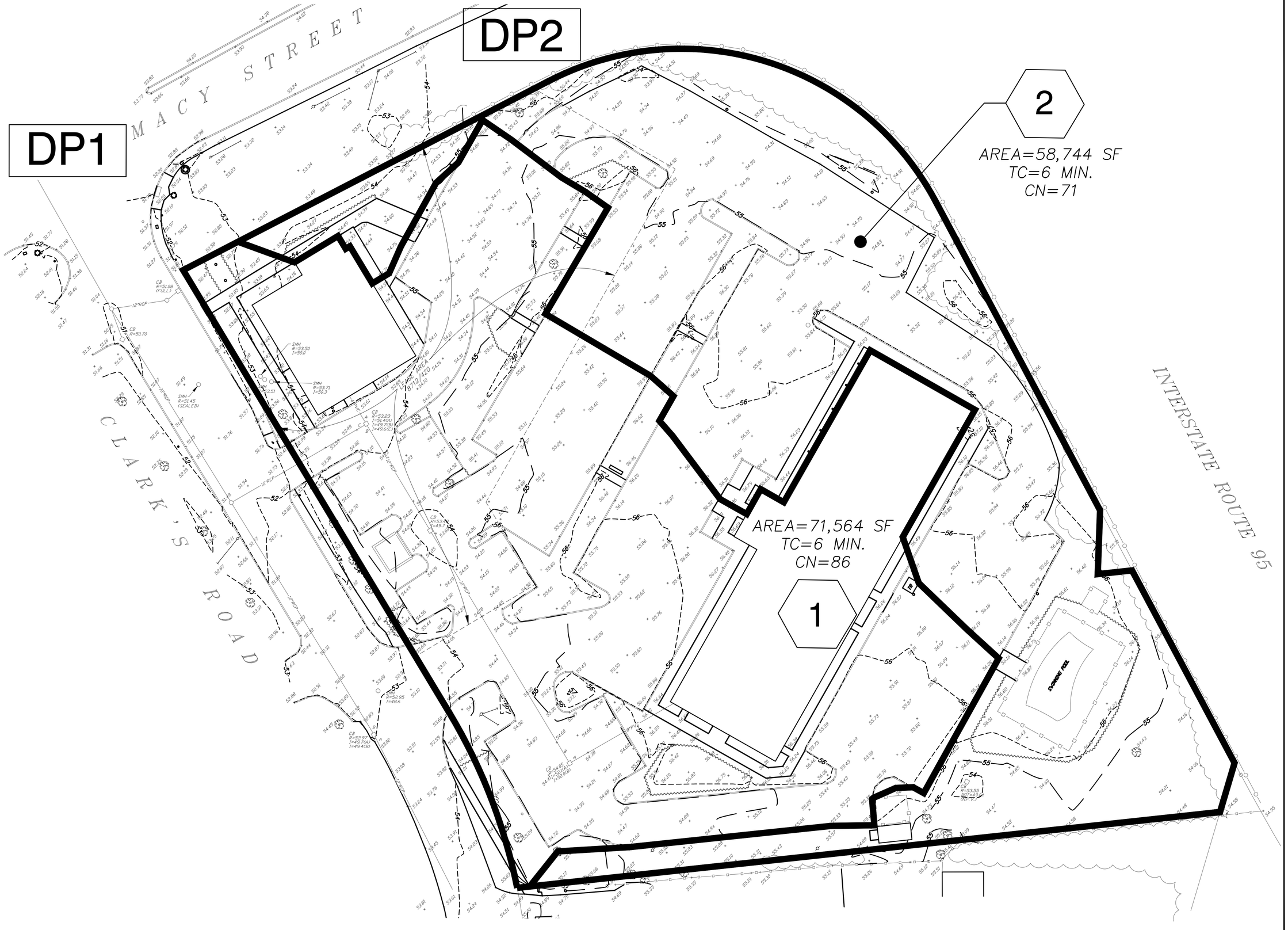
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ 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.

# APPENDIX B

# Pre- and Post-Development Drainage Area Plans

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CHA
141 Longwater Drive, Suite 104
Norwell, MA 02061-1620
781-982-5400 . www.chasolutions.com

0 20 40
Scale in feet

OWNER/ APPLICANT:

AMESBURY LODGING VENTURES LLC

11751 EAST CORNING ROAD
CORNING, NY 14830



PROPOSED
STARBUCKS
DRIVE-THRU

37 CLARK'S ROAD
AMESBURY, MA
01913

| No. | Submittal / Revision | App'd | By | Date |
|---|---|---|---|---|
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PRE-DEVELOPMENT
DRAINAGE AREA
PLAN

| Designed By: | Drawn By: | Checked By: |
|---|---|---|
| DR | JAS | DR |
| Issue Date: | Project No: | Scale: |
| 06/27/2024 | 081088 | 1" = 20' |

Drawing No.:
DR-1

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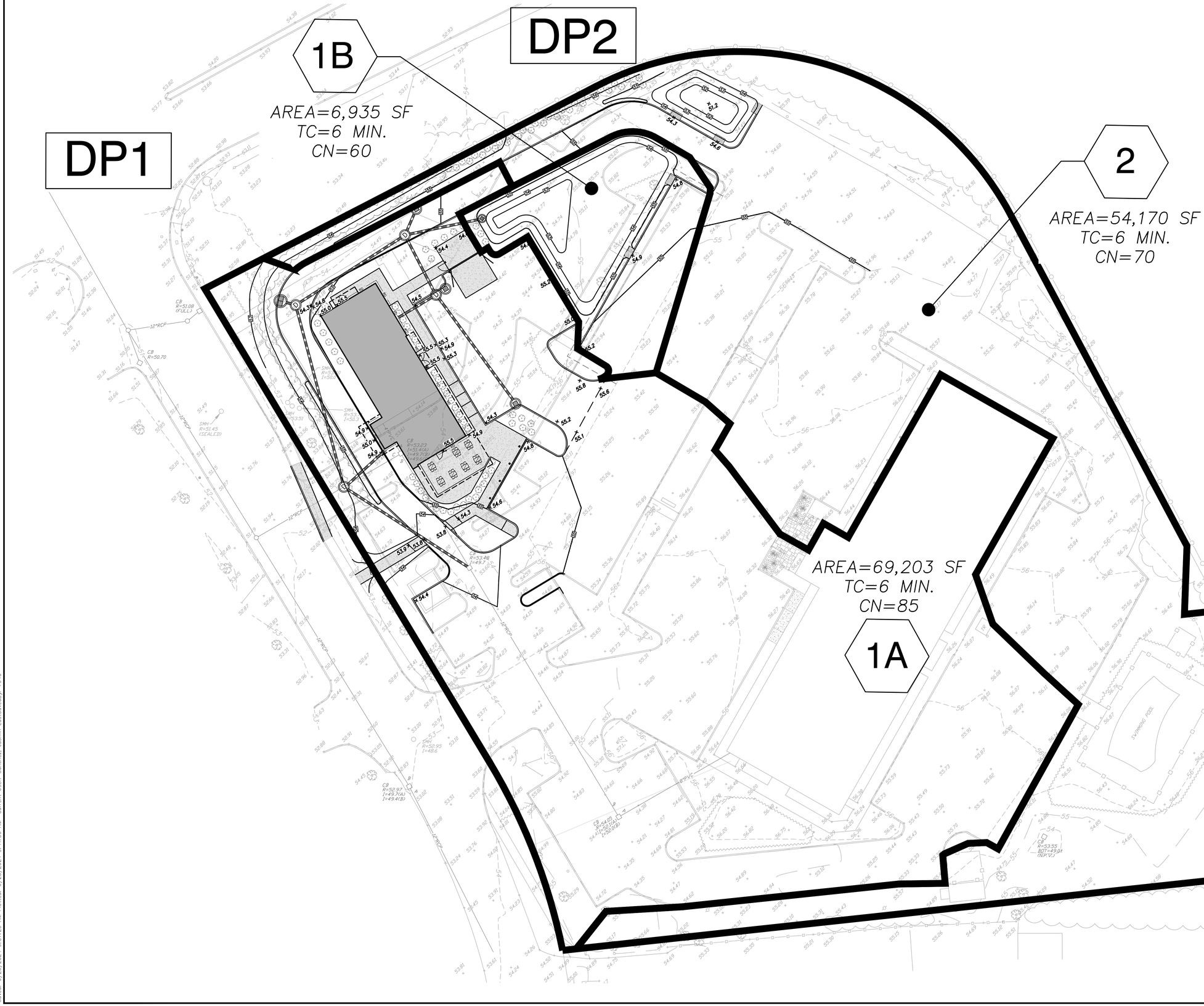


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0 20 40
Scale in feet

OWNER/ APPLICANT:

AMESBURY LODGING VENTURES LLC

11751 EAST CORNING ROAD
CORNING, NY 14830



PROPOSED
STARBUCKS
DRIVE-THRU

37 CLARK'S ROAD
AMESBURY, MA
01913

| No. | Submittal / Revision | App'd | By | Date |
|---|---|---|---|---|
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POST-DEVELOPMENT
DRAINAGE AREA
PLAN

| Designed By: | Drawn By: | Checked By: |
|---|---|---|
| DR | JAS | DR |
| Issue Date: | Project No: | Scale: |
| 06/27/2024 | 081088 | 1" = 20' |

Drawing No.:
DR-2

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CHA
141 Longwater Drive, Suite 104
Norwell, MA 02061-1620
781-982-5400 . www.chasolutions.com

0 20 40
Scale in feet

OWNER/ APPLICANT:

AMESBURY LODGING VENTURES LLC

11751 EAST CORNING ROAD
CORNING, NY 14830



PROPOSED
STARBUCKS
DRIVE-THRU

37 CLARK'S ROAD
AMESBURY, MA
01913

| No. | Submittal / Revision | App'd | By | Date |
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POST-DEVELOPMENT
CATCH BASIN
AREA PLAN

| Designed By: | Drawn By: | Checked By: |
|---|---|---|
| DR | JAS | DR |
| Issue Date: | Project No: | Scale: |
| 06/27/2024 | 081088 | 1" = 20' |

Drawing No.:

DR-3

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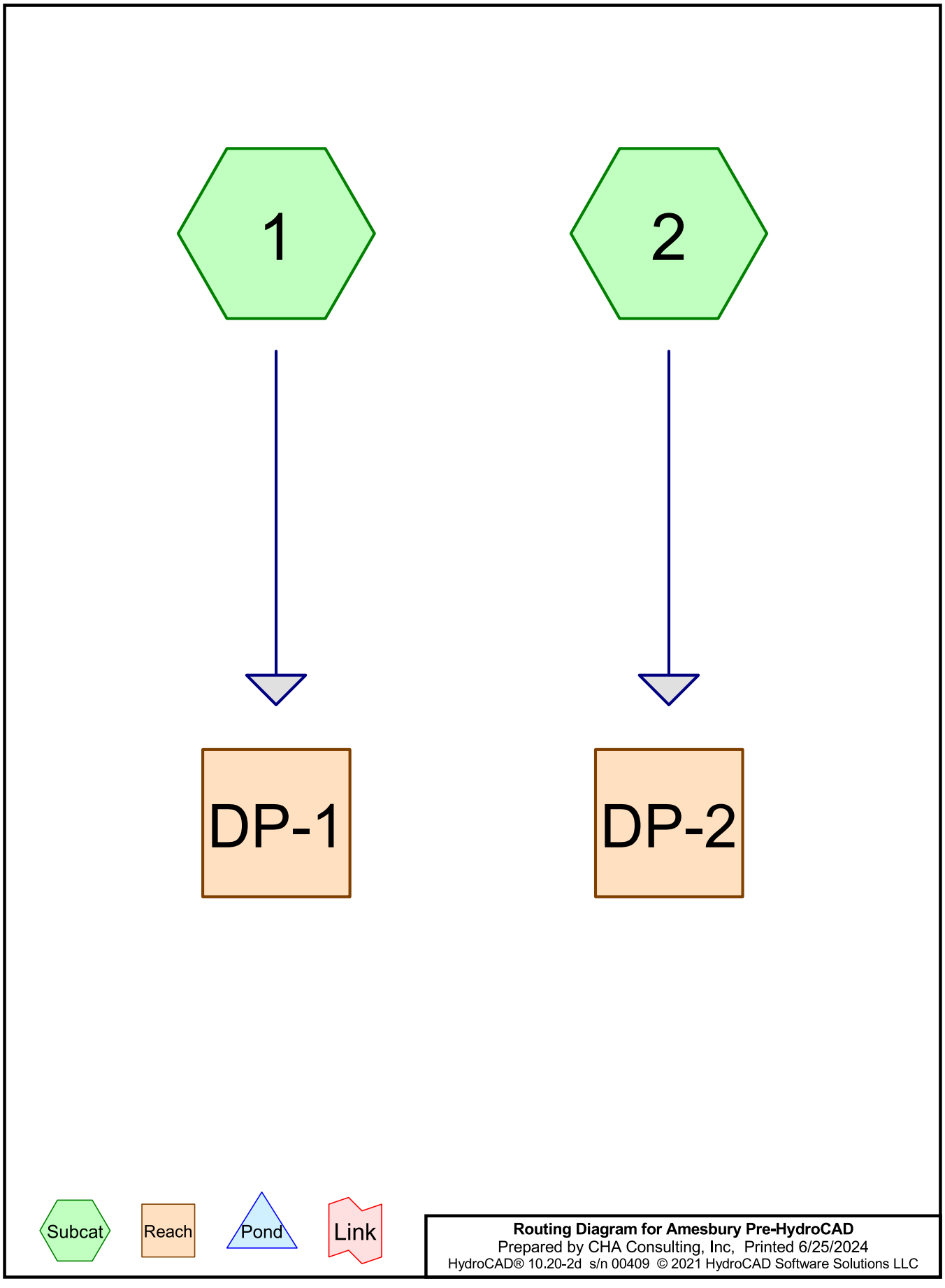
# APPENDIX C

# Pre- and Post-Development Hydrology and Hydraulic Modeling




**Routing Diagram for Amesbury Pre-HydroCAD**
Prepared by CHA Consulting, Inc, Printed 6/25/2024

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | Type III 24-hr | | Default | 24.00 | 1 | 3.39 | 2 |
| 2 | 10-Year | Type III 24-hr | | Default | 24.00 | 1 | 5.36 | 2 |
| 3 | 25-Year | Type III 24-hr | | Default | 24.00 | 1 | 6.58 | 2 |
| 4 | 100-Year | Type III 24-hr | | Default | 24.00 | 1 | 8.48 | 2 |

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1:** Runoff Area=71,564 sf 79.79% Impervious Runoff Depth=2.00"
Tc=6.0 min CN=86 Runoff=3.77 cfs 0.274 af

**Subcatchment 2:** Runoff Area=58,744 sf 54.30% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=71 Runoff=1.44 cfs 0.112 af

**Reach DP-1:** Inflow=3.77 cfs 0.274 af
Outflow=3.77 cfs 0.274 af

**Reach DP-2:** Inflow=1.44 cfs 0.112 af
Outflow=1.44 cfs 0.112 af

**Total Runoff Area = 2.991 ac Runoff Volume = 0.386 af Average Runoff Depth = 1.55"**
**31.70% Pervious = 0.948 ac 68.30% Impervious = 2.043 ac**

## Summary for Subcatchment 1:

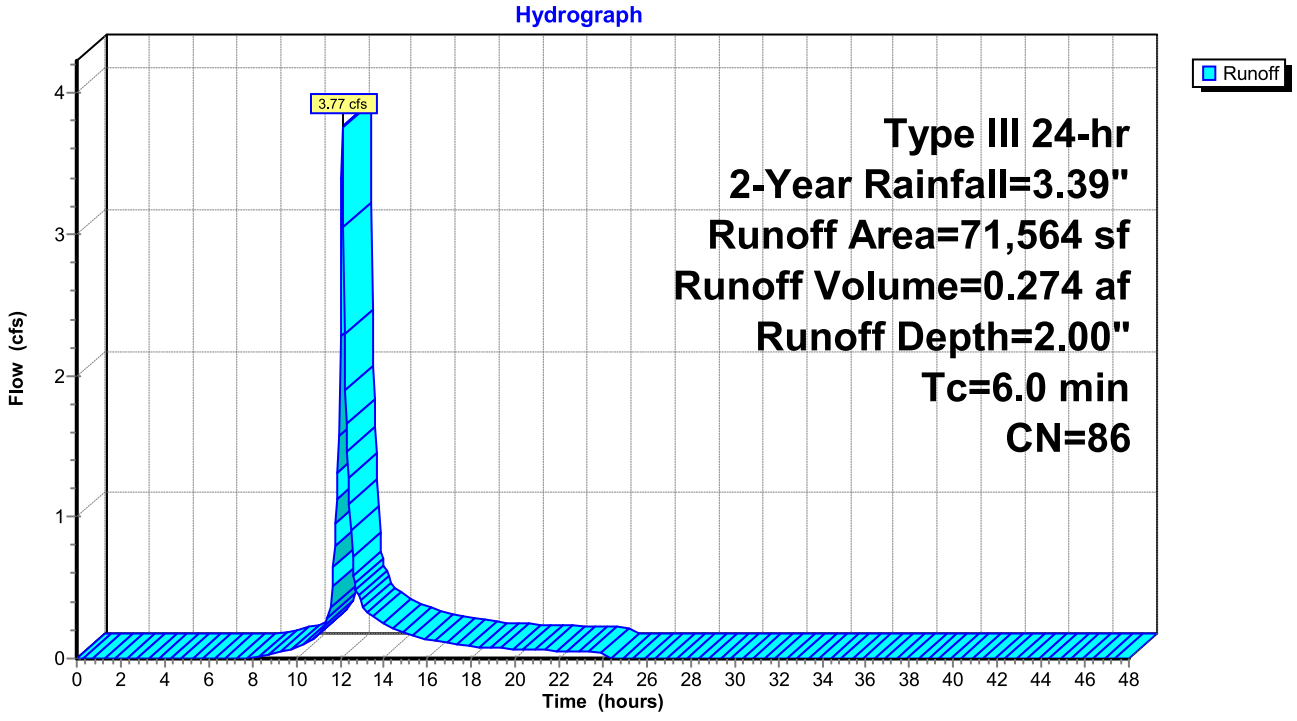
Runoff = 3.77 cfs @ 12.09 hrs, Volume= 0.274 af, Depth= 2.00"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.39"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 57,100 | 98 | Impervious |
| * | 14,464 | 39 | Pervious Landscape & Grass |
| | 71,564 | 86 | Weighted Average |
| | 14,464 | | 20.21% Pervious Area |
| | 57,100 | | 79.79% Impervious Area |

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

## Subcatchment 1:



## Summary for Subcatchment 2:

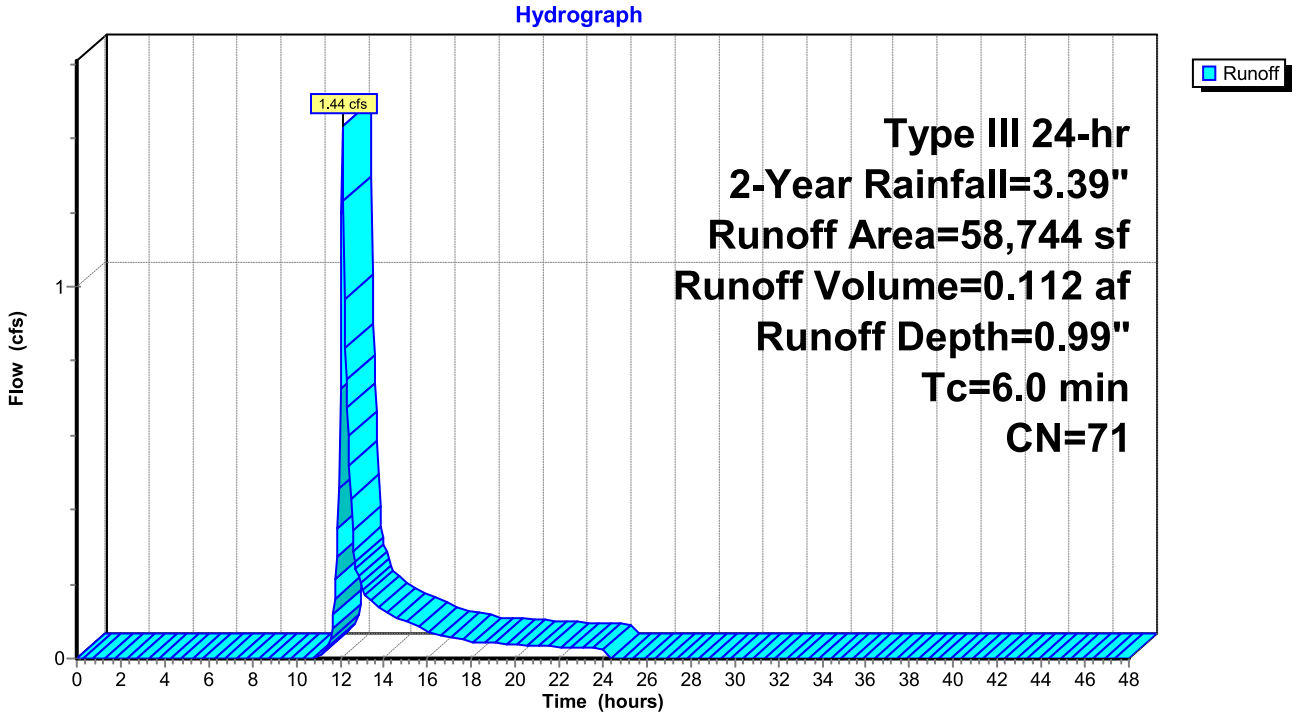
Runoff = 1.44 cfs @ 12.10 hrs, Volume= 0.112 af, Depth= 0.99"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.39"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 31,900 | 98 | Impervious |
| | 26,844 | 39 | Pervious Landscape & Grass |
| | 58,744 | 71 | Weighted Average |
| | 26,844 | | 45.70% Pervious Area |
| | 31,900 | | 54.30% Impervious Area |

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

## Subcatchment 2:

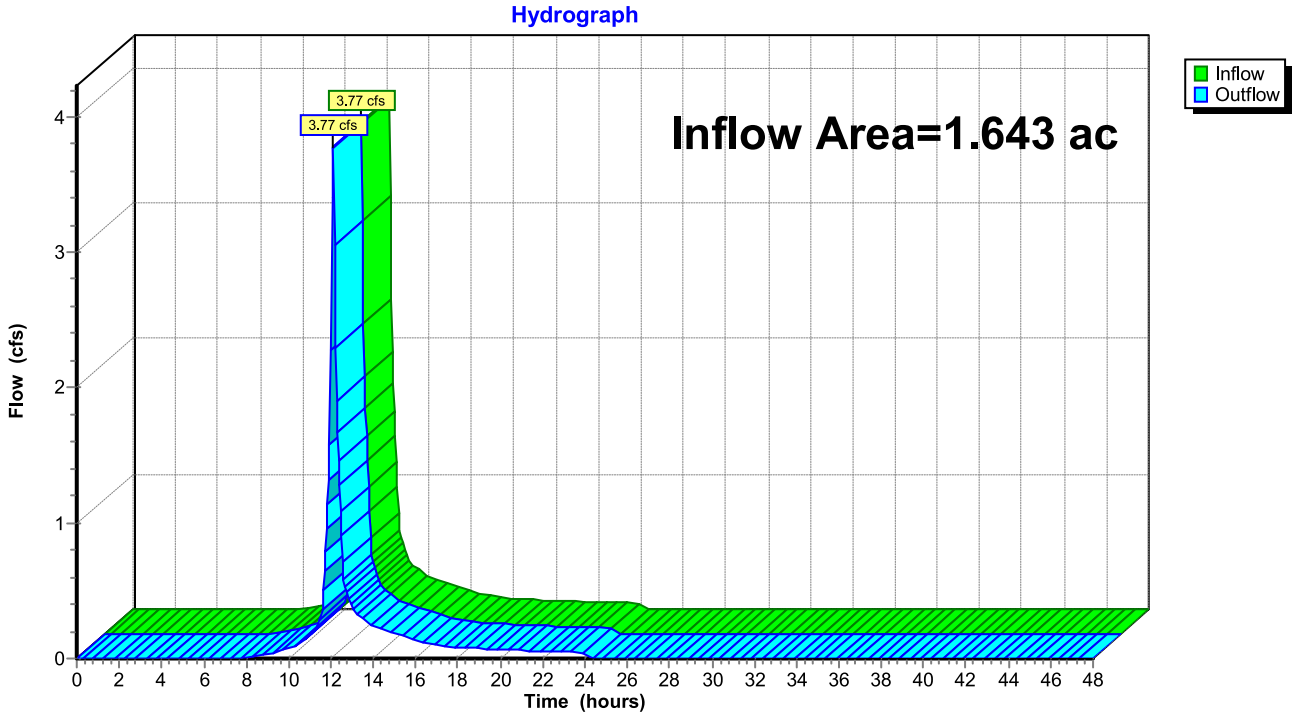


## Summary for Reach DP-1:

Inflow Area = 1.643 ac, 79.79% Impervious, Inflow Depth = 2.00" for 2-Year event
Inflow = 3.77 cfs @ 12.09 hrs, Volume= 0.274 af
Outflow = 3.77 cfs @ 12.09 hrs, Volume= 0.274 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

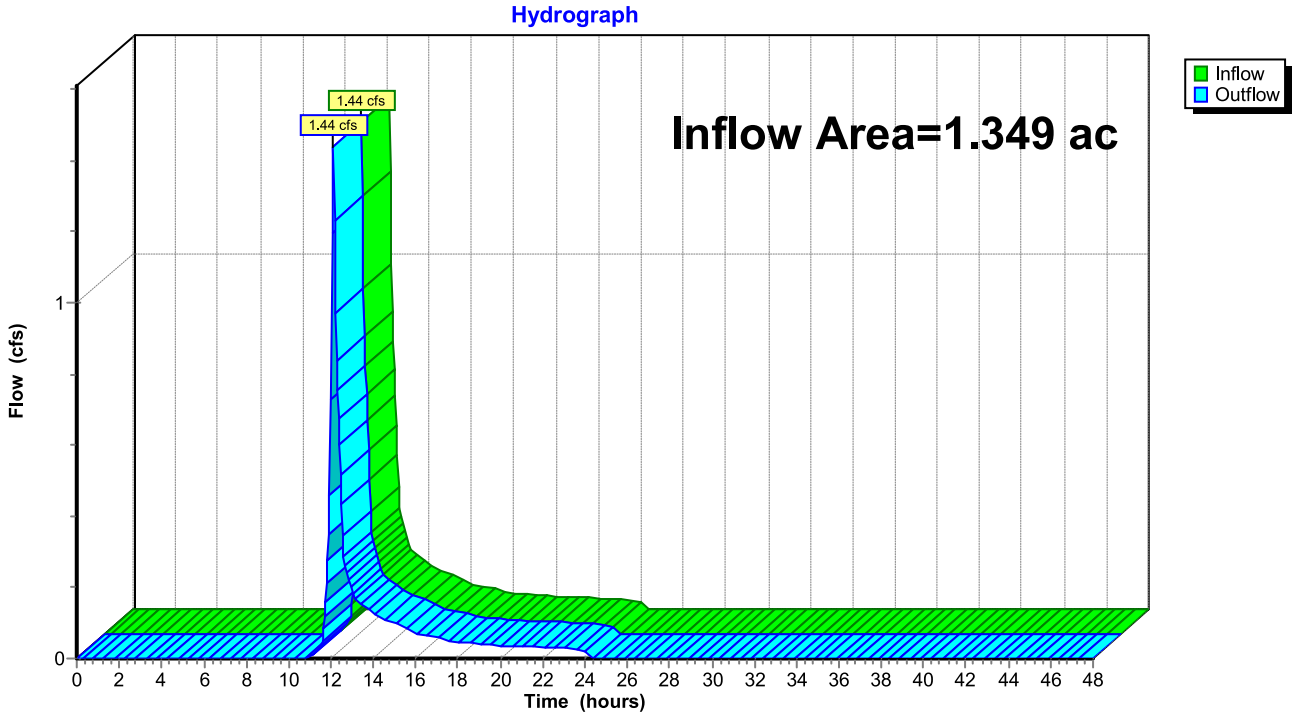


## Summary for Reach DP-2:

Inflow Area = 1.349 ac, 54.30% Impervious, Inflow Depth = 0.99" for 2-Year event
Inflow = 1.44 cfs @ 12.10 hrs, Volume= 0.112 af
Outflow = 1.44 cfs @ 12.10 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1:** Runoff Area=71,564 sf 79.79% Impervious Runoff Depth=3.80"
Tc=6.0 min CN=86 Runoff=7.04 cfs 0.521 af

**Subcatchment 2:** Runoff Area=58,744 sf 54.30% Impervious Runoff Depth=2.39"
Tc=6.0 min CN=71 Runoff=3.68 cfs 0.269 af

**Reach DP-1:** Inflow=7.04 cfs 0.521 af
Outflow=7.04 cfs 0.521 af

**Reach DP-2:** Inflow=3.68 cfs 0.269 af
Outflow=3.68 cfs 0.269 af

**Total Runoff Area = 2.991 ac Runoff Volume = 0.790 af Average Runoff Depth = 3.17"**
**31.70% Pervious = 0.948 ac 68.30% Impervious = 2.043 ac**

## Summary for Subcatchment 1:

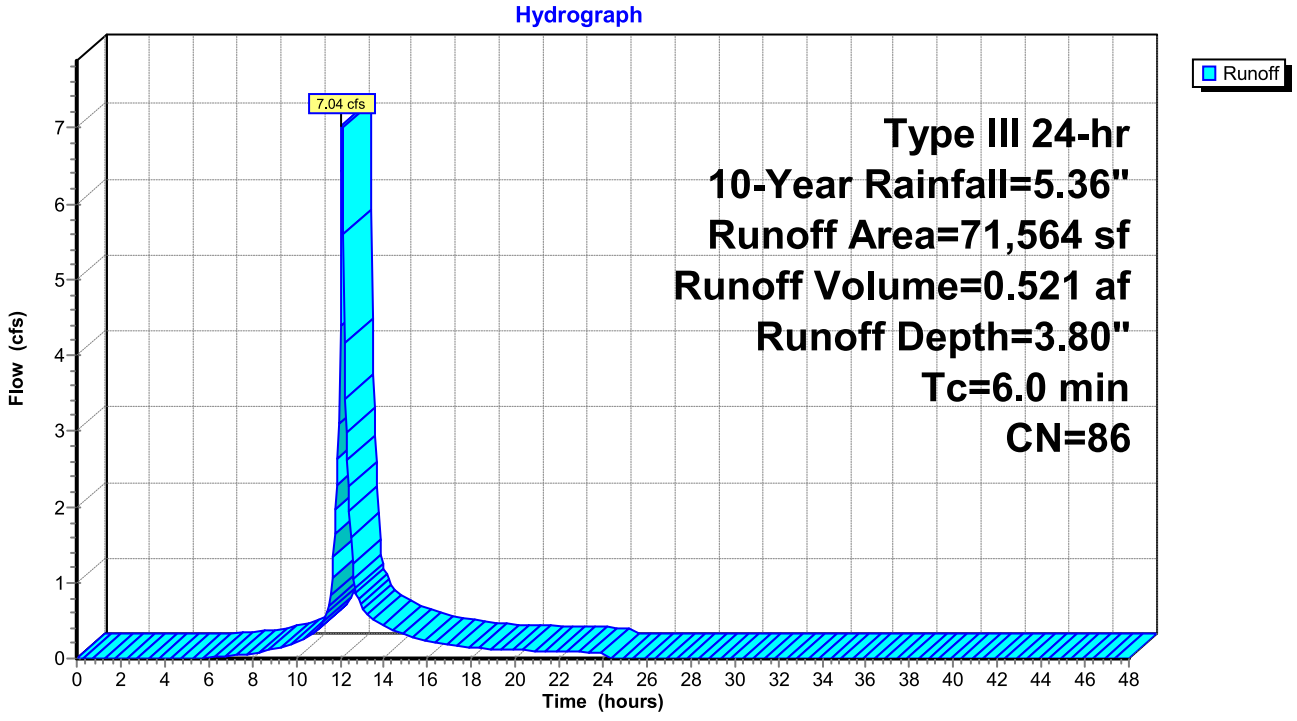
Runoff = 7.04 cfs @ 12.09 hrs, Volume= 0.521 af, Depth= 3.80"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 57,100 | 98 | Impervious |
| * | 14,464 | 39 | Pervious Landscape & Grass |
| | 71,564 | 86 | Weighted Average |
| | 14,464 | | 20.21% Pervious Area |
| | 57,100 | | 79.79% Impervious Area |

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

## Subcatchment 1:



## Summary for Subcatchment 2:

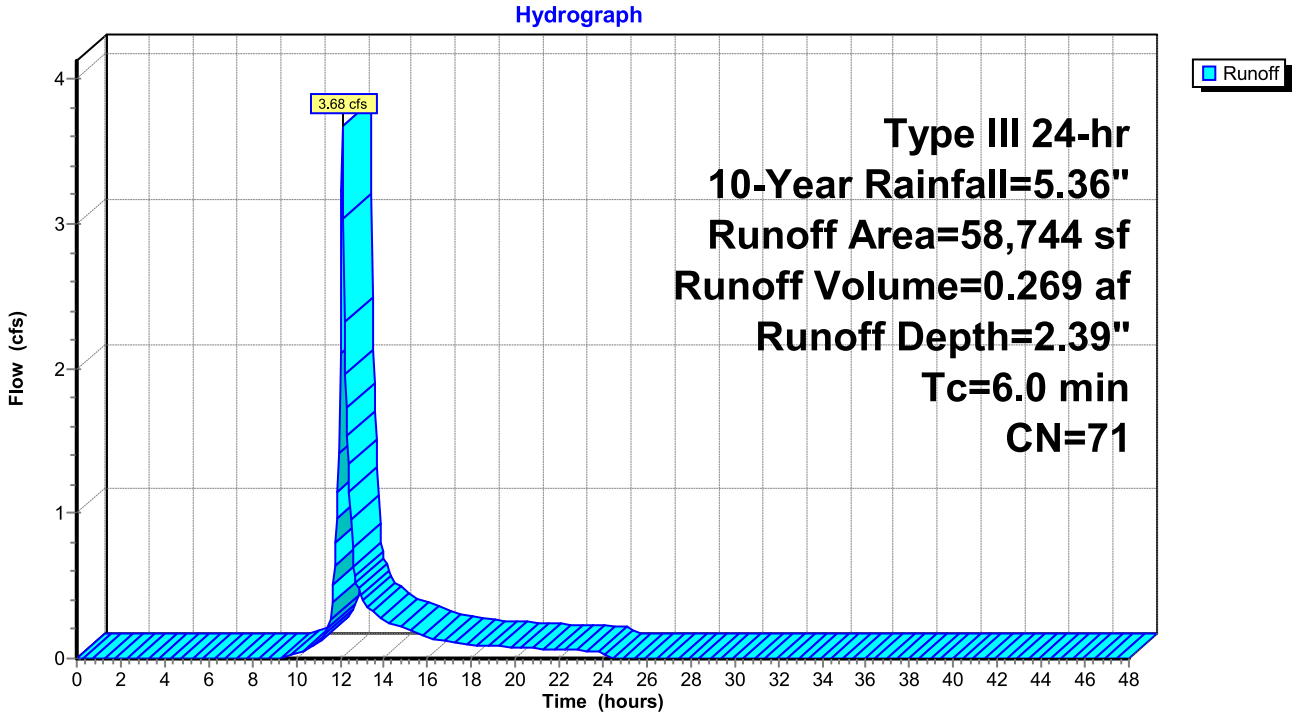
Runoff = 3.68 cfs @ 12.10 hrs, Volume= 0.269 af, Depth= 2.39"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 31,900 | 98 | Impervious |
| | 26,844 | 39 | Pervious Landscape & Grass |
| | 58,744 | 71 | Weighted Average |
| | 26,844 | | 45.70% Pervious Area |
| | 31,900 | | 54.30% Impervious Area |

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

## Subcatchment 2:

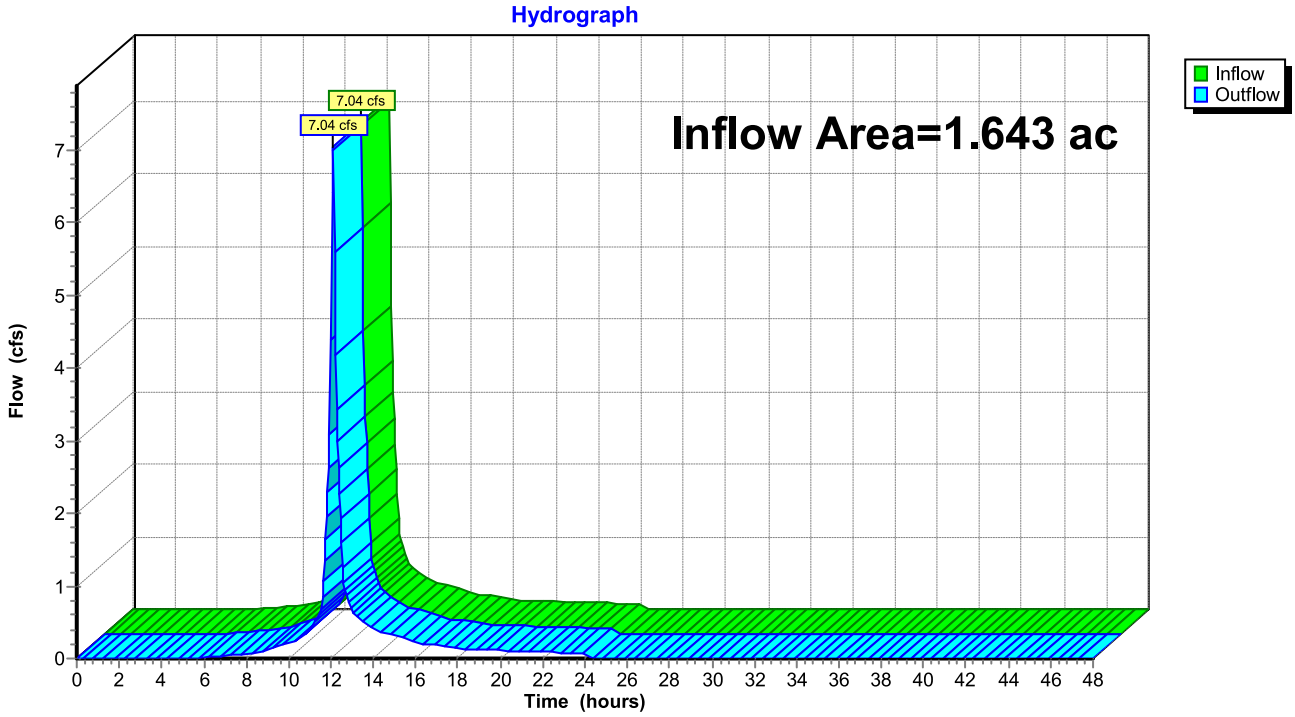


## Summary for Reach DP-1:

Inflow Area = 1.643 ac, 79.79% Impervious, Inflow Depth = 3.80" for 10-Year event
Inflow = 7.04 cfs @ 12.09 hrs, Volume= 0.521 af
Outflow = 7.04 cfs @ 12.09 hrs, Volume= 0.521 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

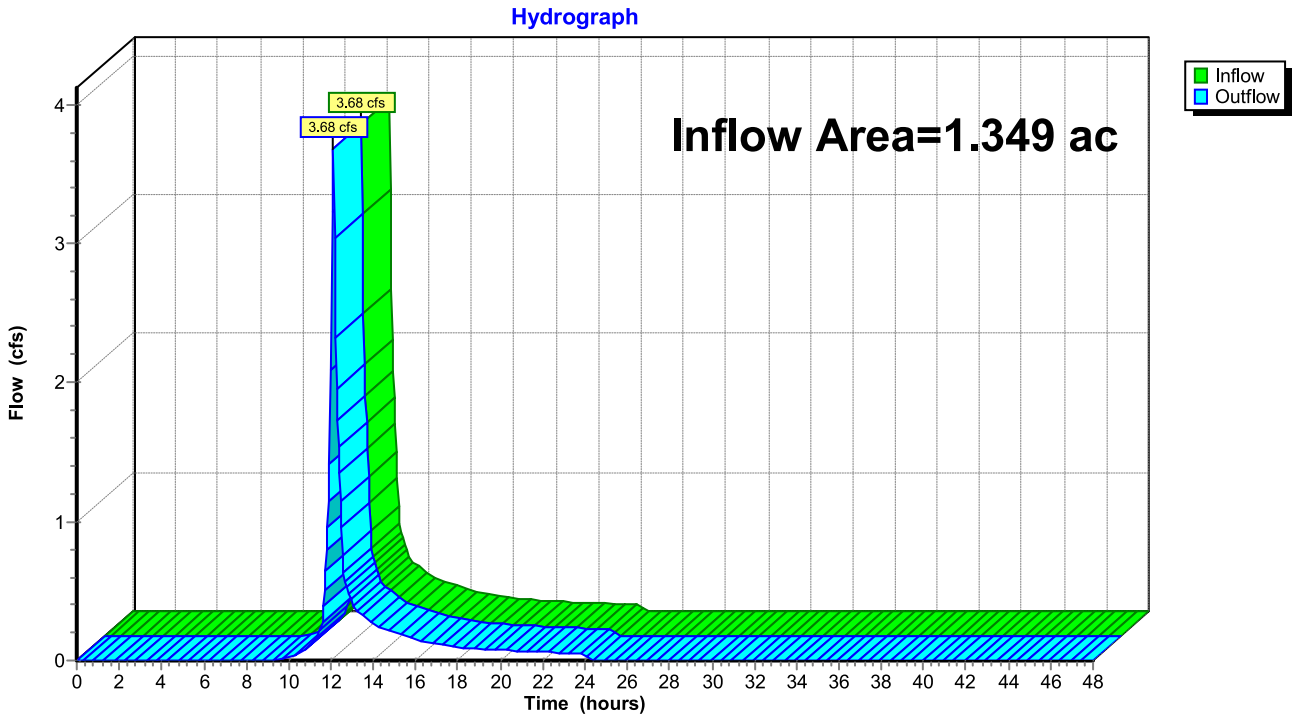


## Summary for Reach DP-2:

Inflow Area = 1.349 ac, 54.30% Impervious, Inflow Depth = 2.39" for 10-Year event
Inflow = 3.68 cfs @ 12.10 hrs, Volume= 0.269 af
Outflow = 3.68 cfs @ 12.10 hrs, Volume= 0.269 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1:** Runoff Area=71,564 sf 79.79% Impervious Runoff Depth=4.96"
Tc=6.0 min CN=86 Runoff=9.08 cfs 0.679 af

**Subcatchment 2:** Runoff Area=58,744 sf 54.30% Impervious Runoff Depth=3.37"
Tc=6.0 min CN=71 Runoff=5.23 cfs 0.379 af

**Reach DP-1:** Inflow=9.08 cfs 0.679 af
Outflow=9.08 cfs 0.679 af

**Reach DP-2:** Inflow=5.23 cfs 0.379 af
Outflow=5.23 cfs 0.379 af

**Total Runoff Area = 2.991 ac Runoff Volume = 1.058 af Average Runoff Depth = 4.25"**
**31.70% Pervious = 0.948 ac 68.30% Impervious = 2.043 ac**

## Summary for Subcatchment 1:

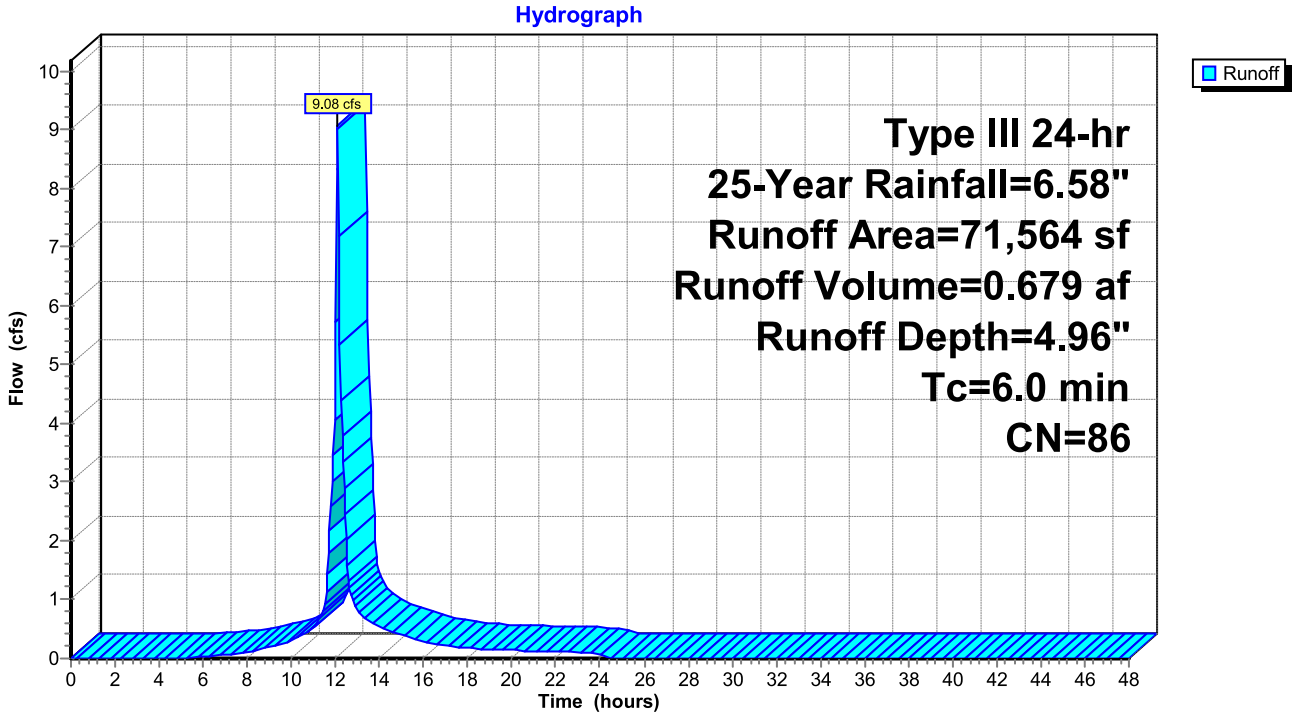
Runoff = 9.08 cfs @ 12.09 hrs, Volume= 0.679 af, Depth= 4.96"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.58"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 57,100 | 98 | Impervious |
| * | 14,464 | 39 | Pervious Landscape & Grass |
| | 71,564 | 86 | Weighted Average |
| | 14,464 | | 20.21% Pervious Area |
| | 57,100 | | 79.79% Impervious Area |

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

## Subcatchment 1:



## Summary for Subcatchment 2:

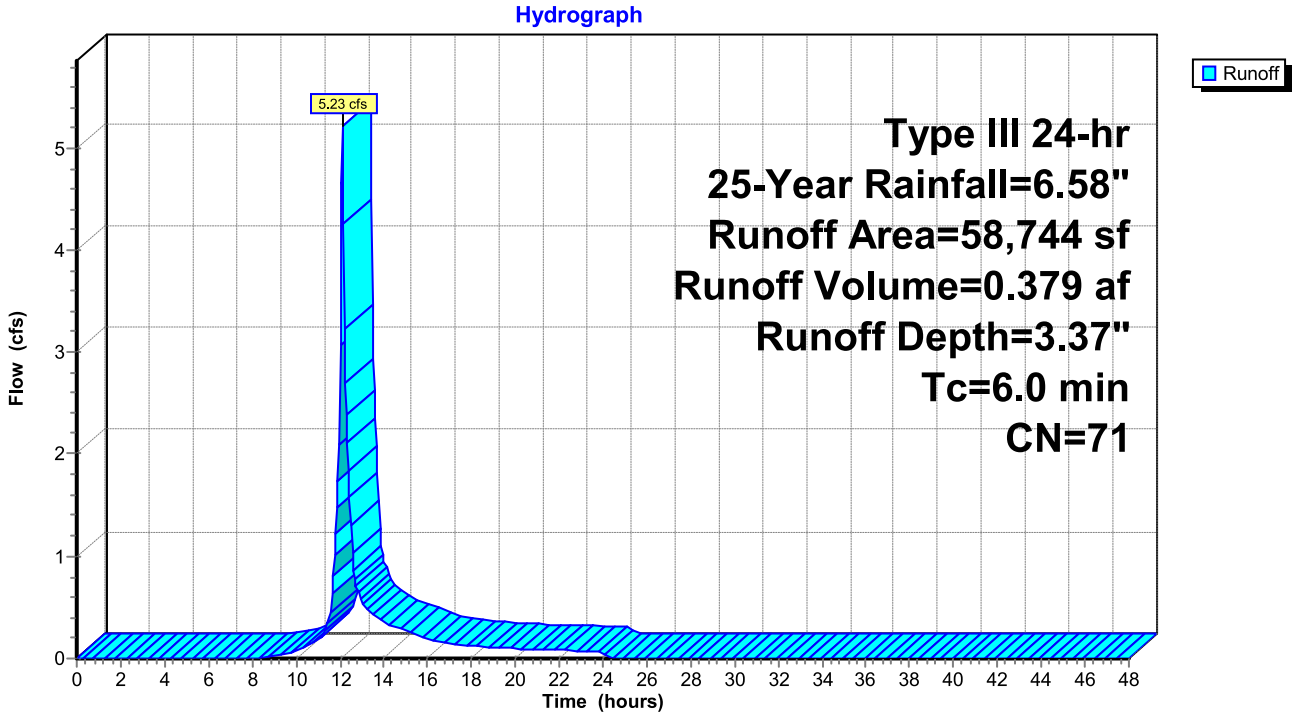
Runoff = 5.23 cfs @ 12.09 hrs, Volume= 0.379 af, Depth= 3.37"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.58"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 31,900 | 98 | Impervious |
| | 26,844 | 39 | Pervious Landscape & Grass |
| | 58,744 | 71 | Weighted Average |
| | 26,844 | | 45.70% Pervious Area |
| | 31,900 | | 54.30% Impervious Area |

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

## Subcatchment 2:

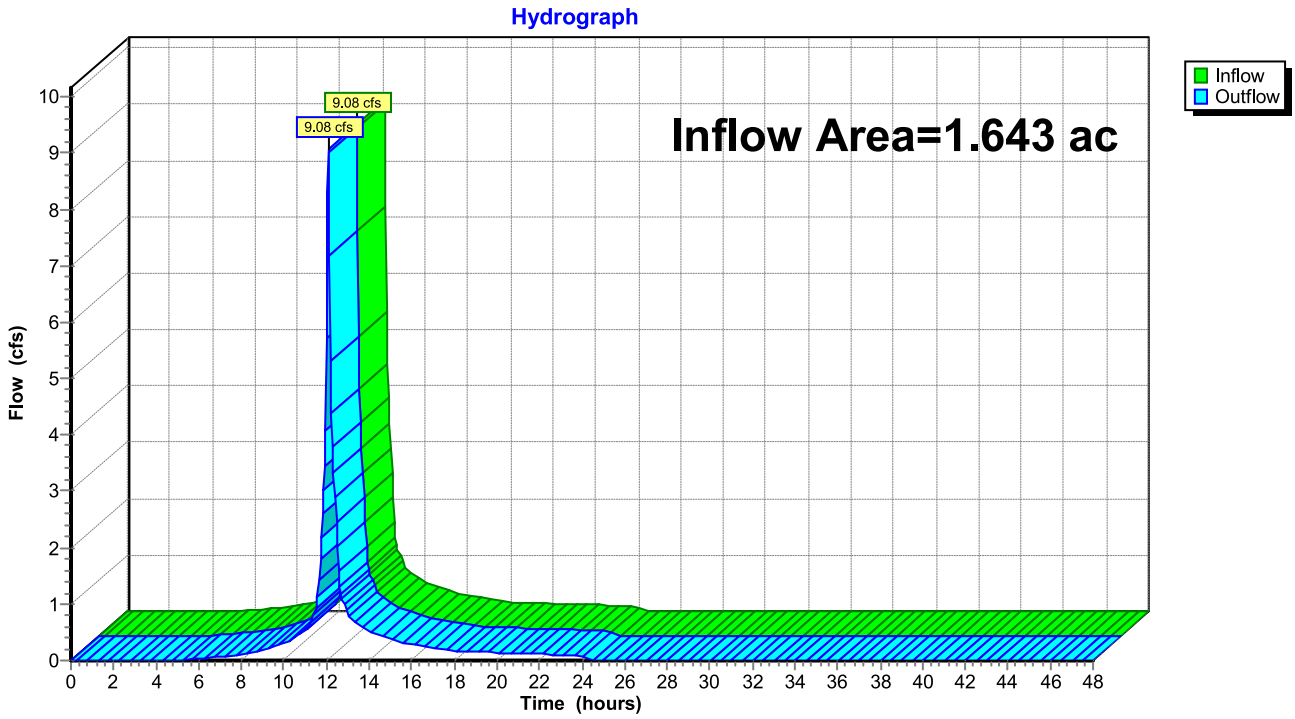


## Summary for Reach DP-1:

Inflow Area = 1.643 ac, 79.79% Impervious, Inflow Depth = 4.96" for 25-Year event
Inflow = 9.08 cfs @ 12.09 hrs, Volume= 0.679 af
Outflow = 9.08 cfs @ 12.09 hrs, Volume= 0.679 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

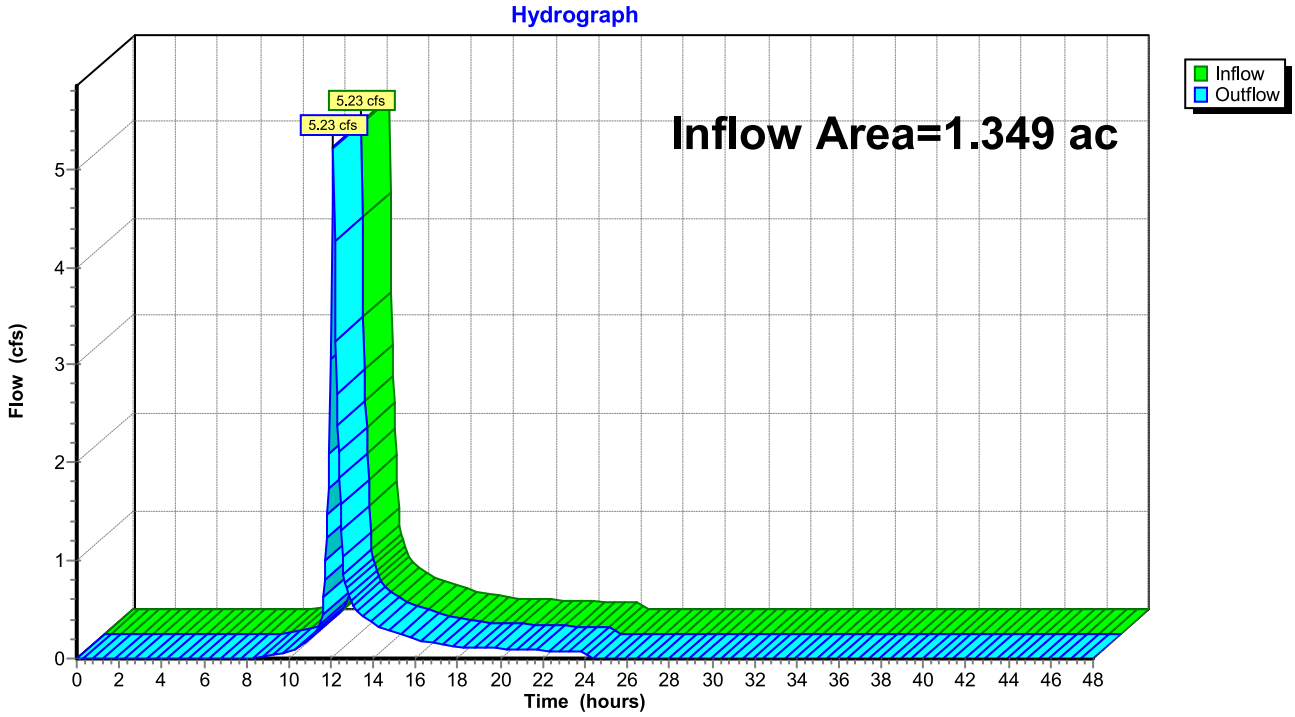


## Summary for Reach DP-2:

Inflow Area = 1.349 ac, 54.30% Impervious, Inflow Depth = 3.37" for 25-Year event
Inflow = 5.23 cfs @ 12.09 hrs, Volume= 0.379 af
Outflow = 5.23 cfs @ 12.09 hrs, Volume= 0.379 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1:** Runoff Area=71,564 sf 79.79% Impervious Runoff Depth=6.80"
Tc=6.0 min CN=86 Runoff=12.23 cfs 0.931 af

**Subcatchment 2:** Runoff Area=58,744 sf 54.30% Impervious Runoff Depth=5.00"
Tc=6.0 min CN=71 Runoff=7.74 cfs 0.562 af

**Reach DP-1:** Inflow=12.23 cfs 0.931 af
Outflow=12.23 cfs 0.931 af

**Reach DP-2:** Inflow=7.74 cfs 0.562 af
Outflow=7.74 cfs 0.562 af

**Total Runoff Area = 2.991 ac Runoff Volume = 1.492 af Average Runoff Depth = 5.99"**
**31.70% Pervious = 0.948 ac 68.30% Impervious = 2.043 ac**

## Summary for Subcatchment 1:

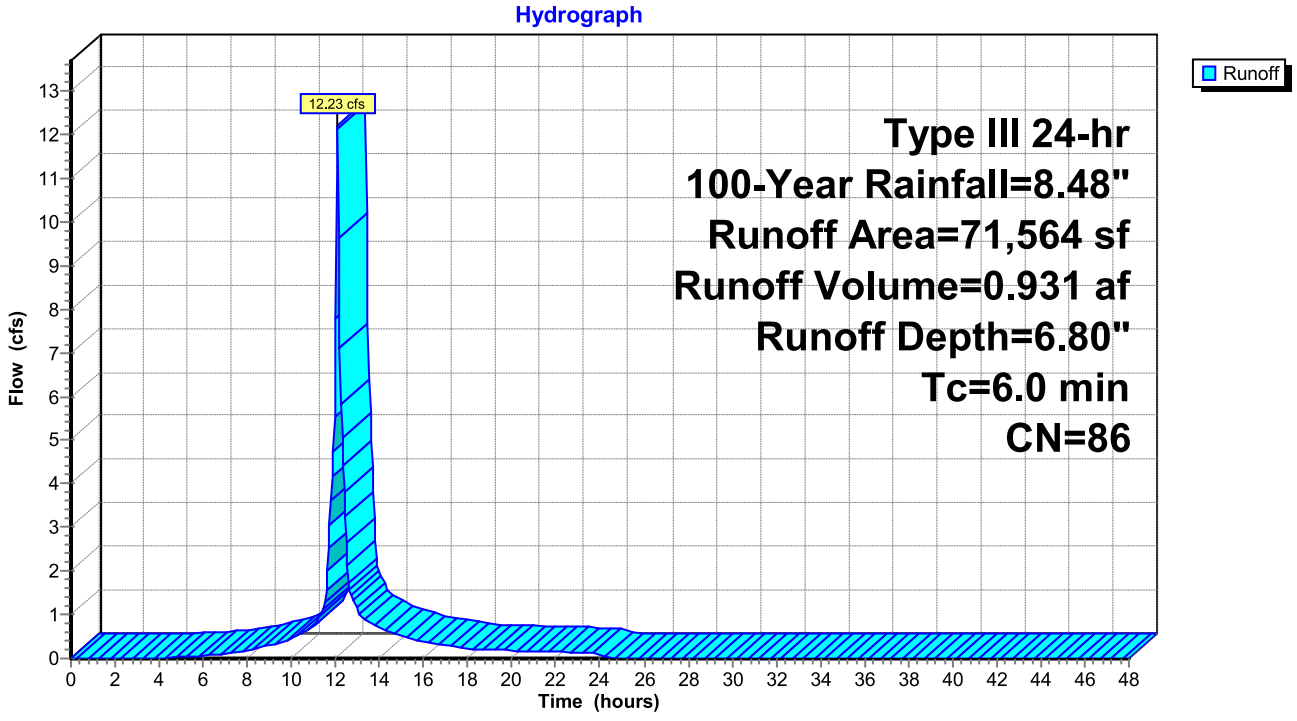
Runoff = 12.23 cfs @ 12.09 hrs, Volume= 0.931 af, Depth= 6.80"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.48"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 57,100 | 98 | Impervious |
| * | 14,464 | 39 | Pervious Landscape & Grass |
| | 71,564 | 86 | Weighted Average |
| | 14,464 | | 20.21% Pervious Area |
| | 57,100 | | 79.79% Impervious Area |

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

## Subcatchment 1:



## Summary for Subcatchment 2:

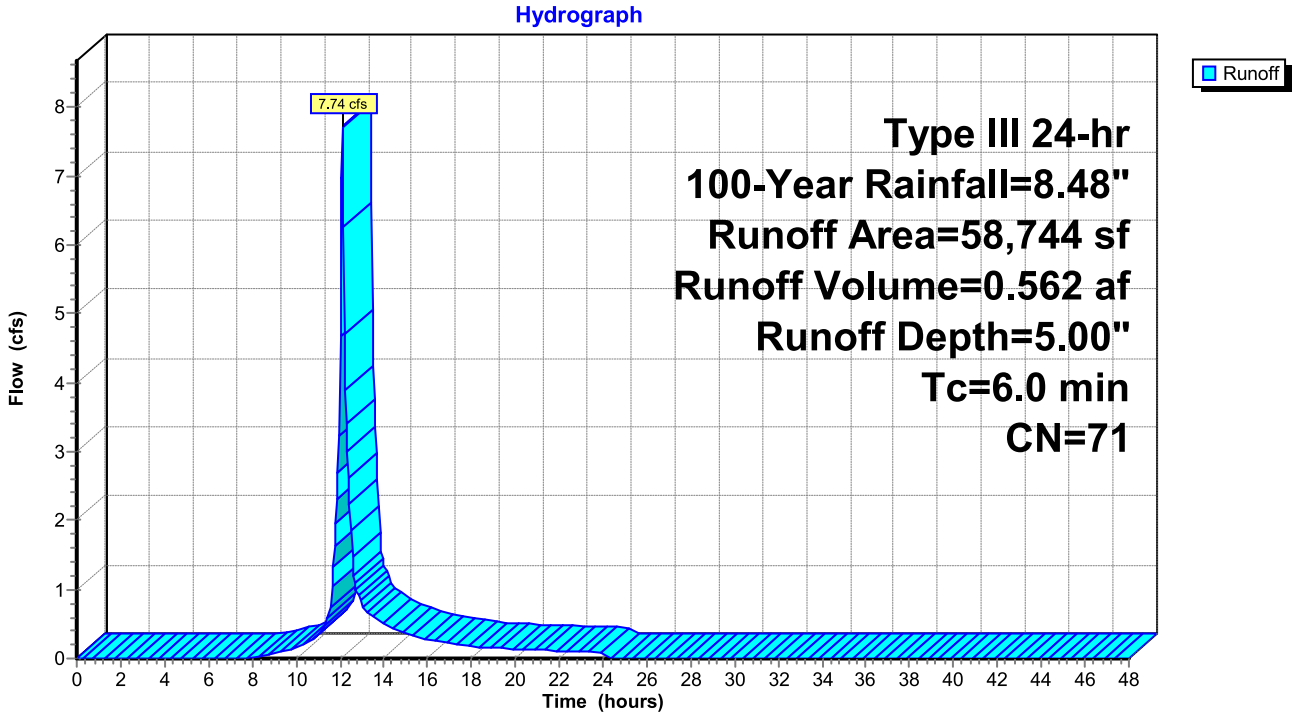
Runoff = 7.74 cfs @ 12.09 hrs, Volume= 0.562 af, Depth= 5.00"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.48"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 31,900 | 98 | Impervious |
| | 26,844 | 39 | Pervious Landscape & Grass |
| | 58,744 | 71 | Weighted Average |
| | 26,844 | | 45.70% Pervious Area |
| | 31,900 | | 54.30% Impervious Area |

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

## Subcatchment 2:

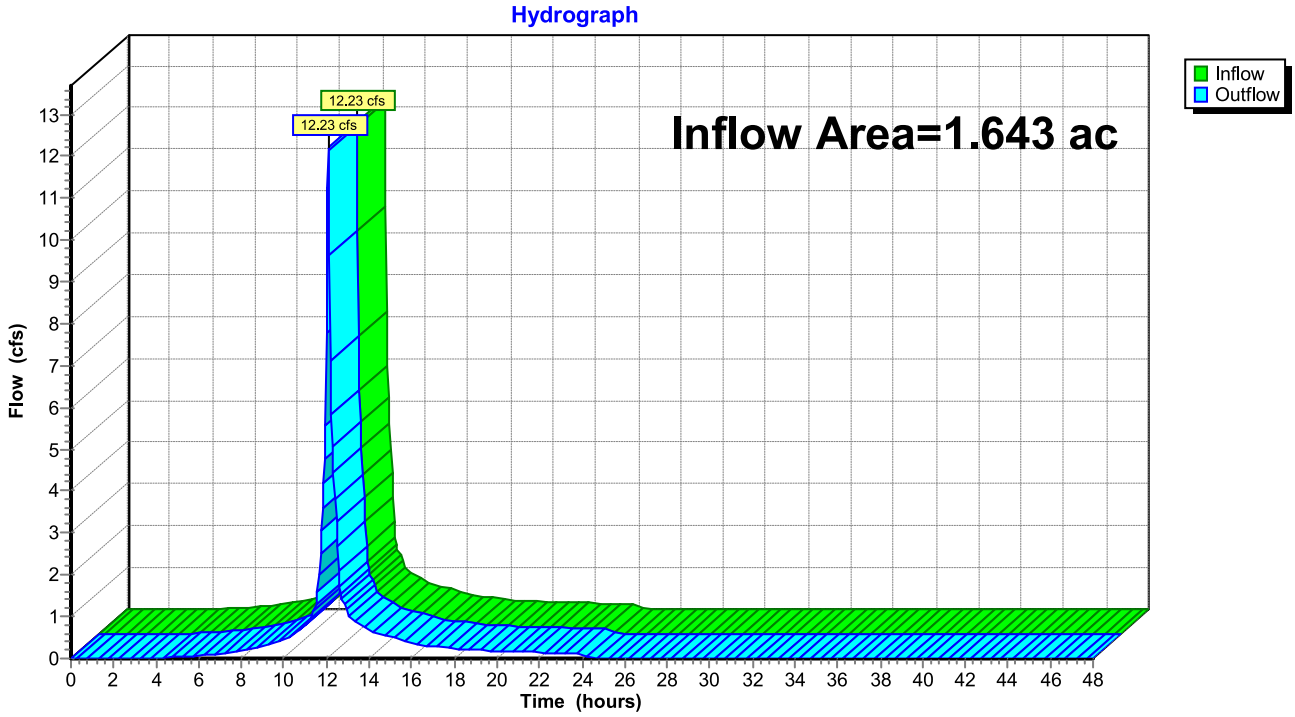


## Summary for Reach DP-1:

Inflow Area = 1.643 ac, 79.79% Impervious, Inflow Depth = 6.80" for 100-Year event
Inflow = 12.23 cfs @ 12.09 hrs, Volume= 0.931 af
Outflow = 12.23 cfs @ 12.09 hrs, Volume= 0.931 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

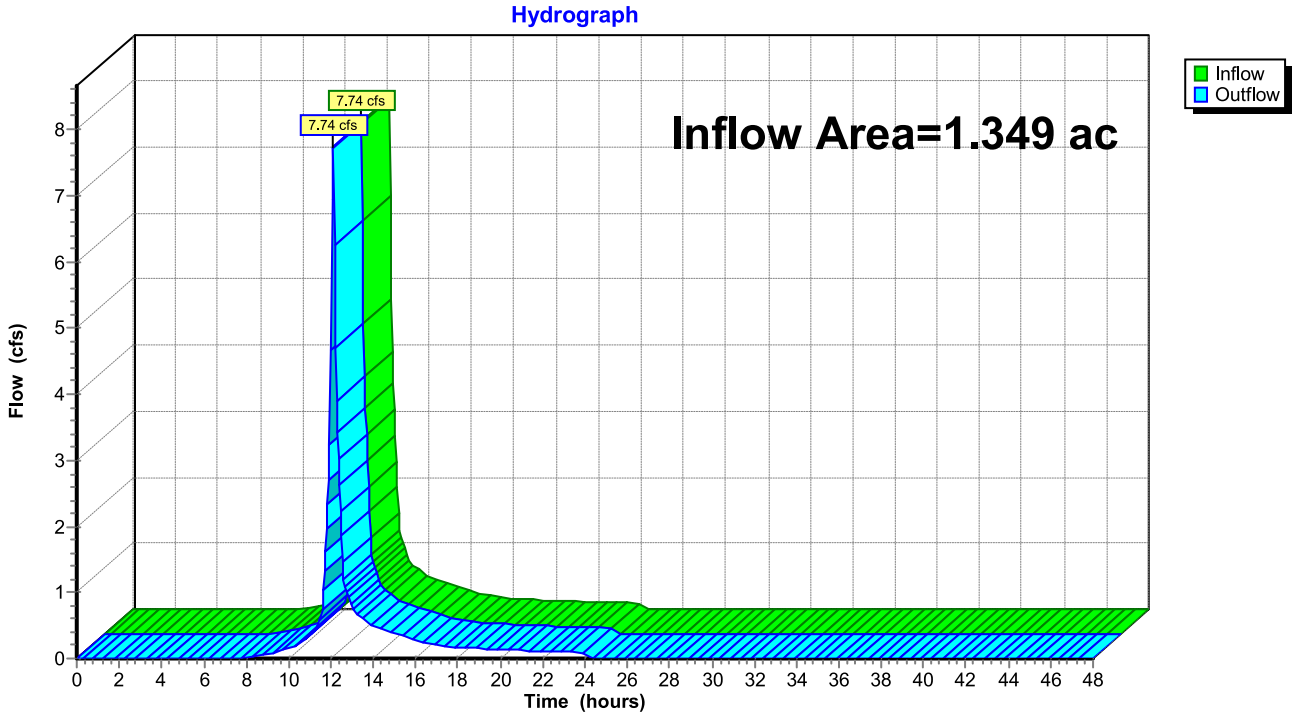


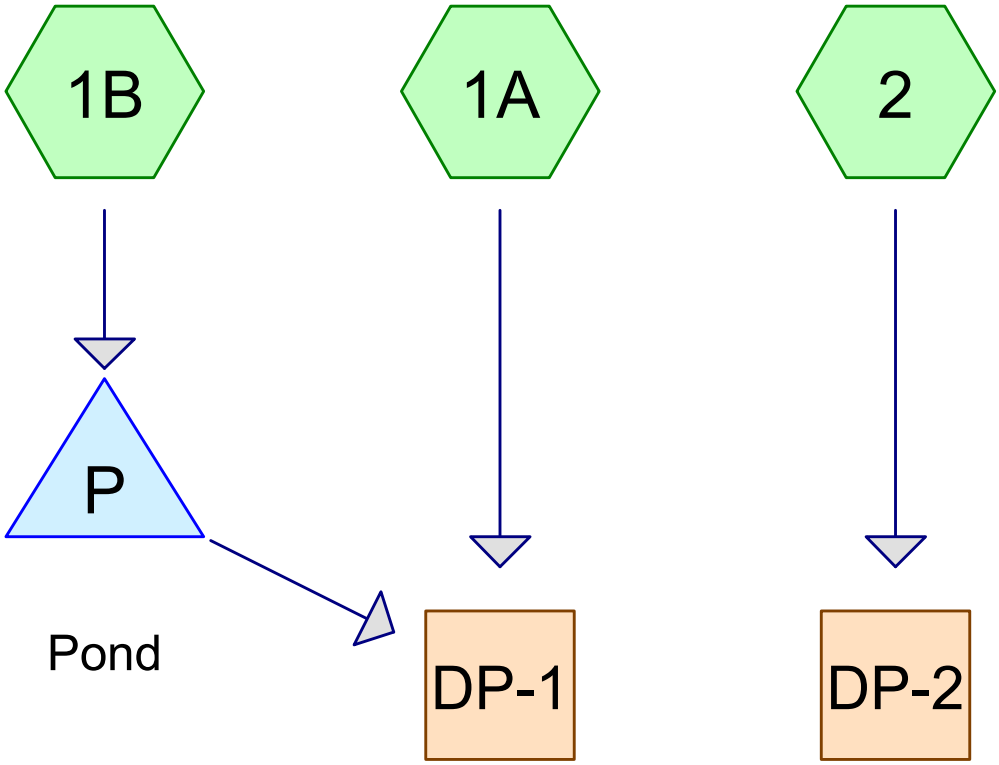
## Summary for Reach DP-2:

Inflow Area = 1.349 ac, 54.30% Impervious, Inflow Depth = 5.00" for 100-Year event
Inflow = 7.74 cfs @ 12.09 hrs, Volume= 0.562 af
Outflow = 7.74 cfs @ 12.09 hrs, Volume= 0.562 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:






Subcat Reach Pond Link

**Routing Diagram for Amesbury Post-HydroCAD**
Prepared by CHA Consulting, Inc, Printed 6/25/2024

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | Type III 24-hr | | Default | 24.00 | 1 | 3.39 | 2 |
| 2 | 10-Year | Type III 24-hr | | Default | 24.00 | 1 | 5.36 | 2 |
| 3 | 25-Year | Type III 24-hr | | Default | 24.00 | 1 | 6.58 | 2 |
| 4 | 100-Year | Type III 24-hr | | Default | 24.00 | 1 | 8.48 | 2 |

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1A:** Runoff Area=69,203 sf 78.59% Impervious Runoff Depth=1.92"
Tc=6.0 min CN=85 Runoff=3.51 cfs 0.254 af

**Subcatchment 1B:** Runoff Area=6,935 sf 36.14% Impervious Runoff Depth=0.48"
Tc=6.0 min CN=60 Runoff=0.06 cfs 0.006 af

**Subcatchment 2:** Runoff Area=54,170 sf 52.05% Impervious Runoff Depth=0.94"
Tc=6.0 min CN=70 Runoff=1.23 cfs 0.098 af

**Reach DP-1:** Inflow=3.51 cfs 0.254 af
Outflow=3.51 cfs 0.254 af

**Reach DP-2:** Inflow=1.23 cfs 0.098 af
Outflow=1.23 cfs 0.098 af

**Pond P: Pond** Peak Elev=53.22' Storage=280 cf Inflow=0.06 cfs 0.006 af
Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 2.991 ac Runoff Volume = 0.358 af Average Runoff Depth = 1.44"**
**34.70% Pervious = 1.038 ac 65.30% Impervious = 1.953 ac**

## Summary for Subcatchment 1A:

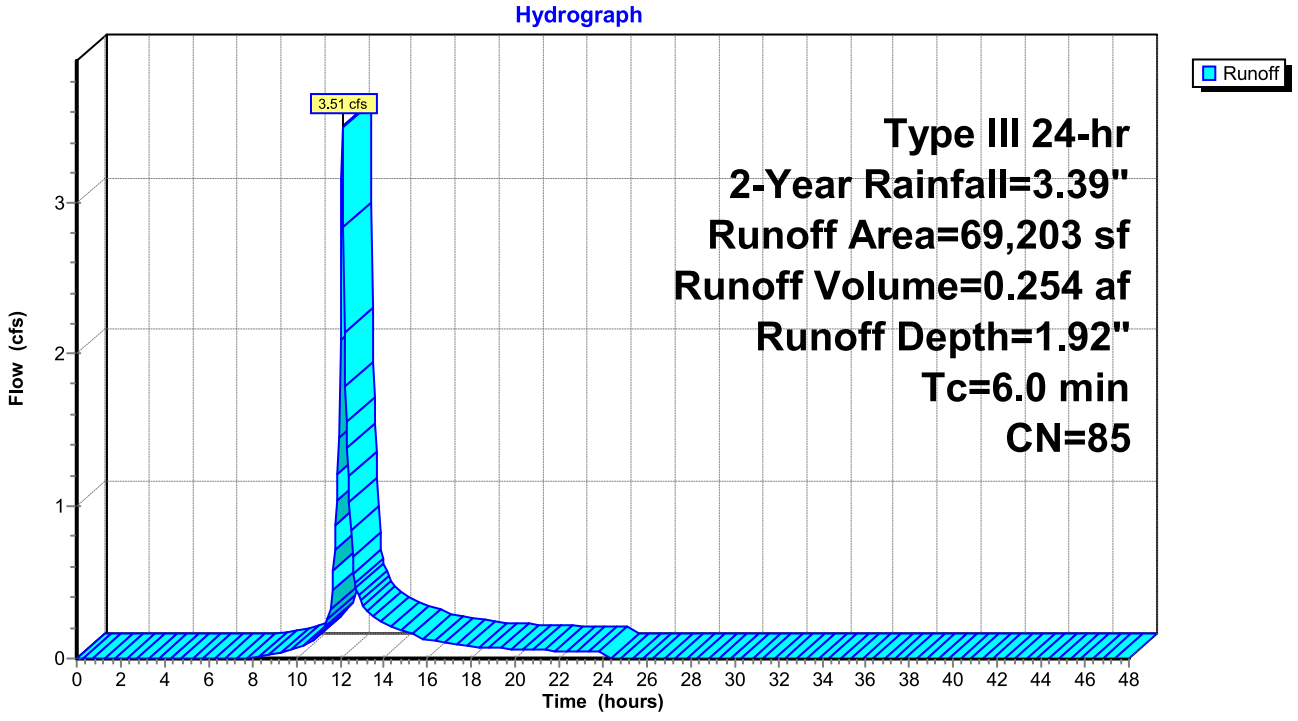
Runoff = 3.51 cfs @ 12.09 hrs, Volume= 0.254 af, Depth= 1.92"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.39"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 54,386 | 98 | Impervious |
| | 14,817 | 39 | Pervious Landscape & Grass |
| | 69,203 | 85 | Weighted Average |
| | 14,817 | | 21.41% Pervious Area |
| | 54,386 | | 78.59% Impervious Area |

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

## Subcatchment 1A:



## Summary for Subcatchment 1B:

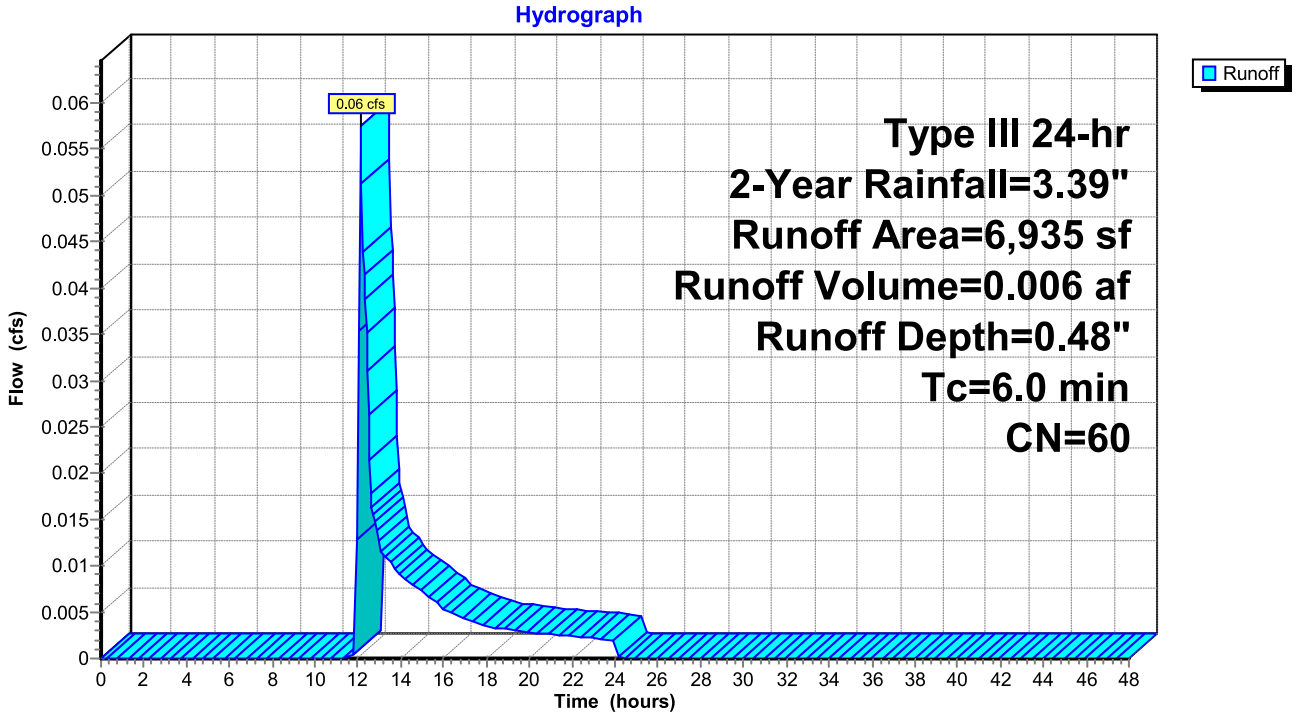
Runoff = 0.06 cfs @ 12.12 hrs, Volume= 0.006 af, Depth= 0.48"
Routed to Pond P : Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.39"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 4,429 | 39 | Pervious Landscape & Grass |
| * | 2,506 | 98 | Impervious |
| | 6,935 | 60 | Weighted Average |
| | 4,429 | | 63.86% Pervious Area |
| | 2,506 | | 36.14% Impervious Area |

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

## Subcatchment 1B:



## Summary for Subcatchment 2:

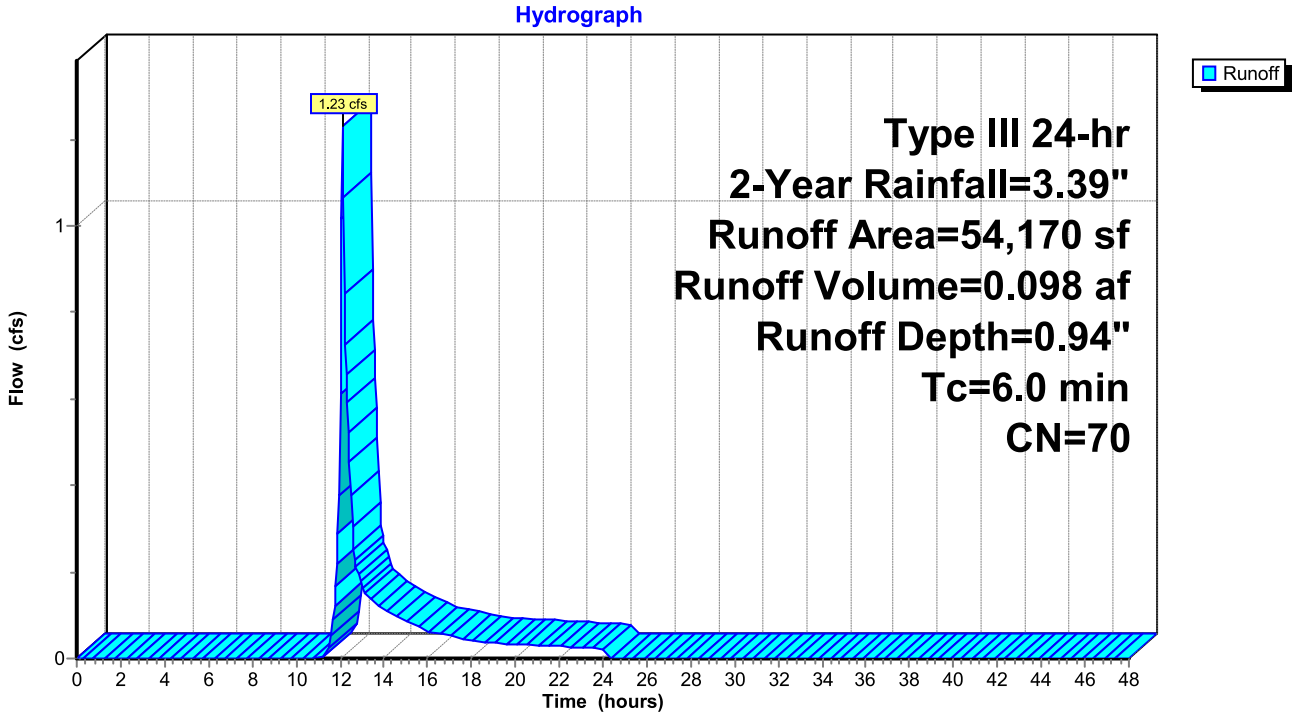
Runoff = 1.23 cfs @ 12.10 hrs, Volume= 0.098 af, Depth= 0.94"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.39"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,195 | 98 | Impervious |
| | 25,975 | 39 | Pervious Landscape & Grass |
| | 54,170 | 70 | Weighted Average |
| | 25,975 | | 47.95% Pervious Area |
| | 28,195 | | 52.05% Impervious Area |

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

## Subcatchment 2:

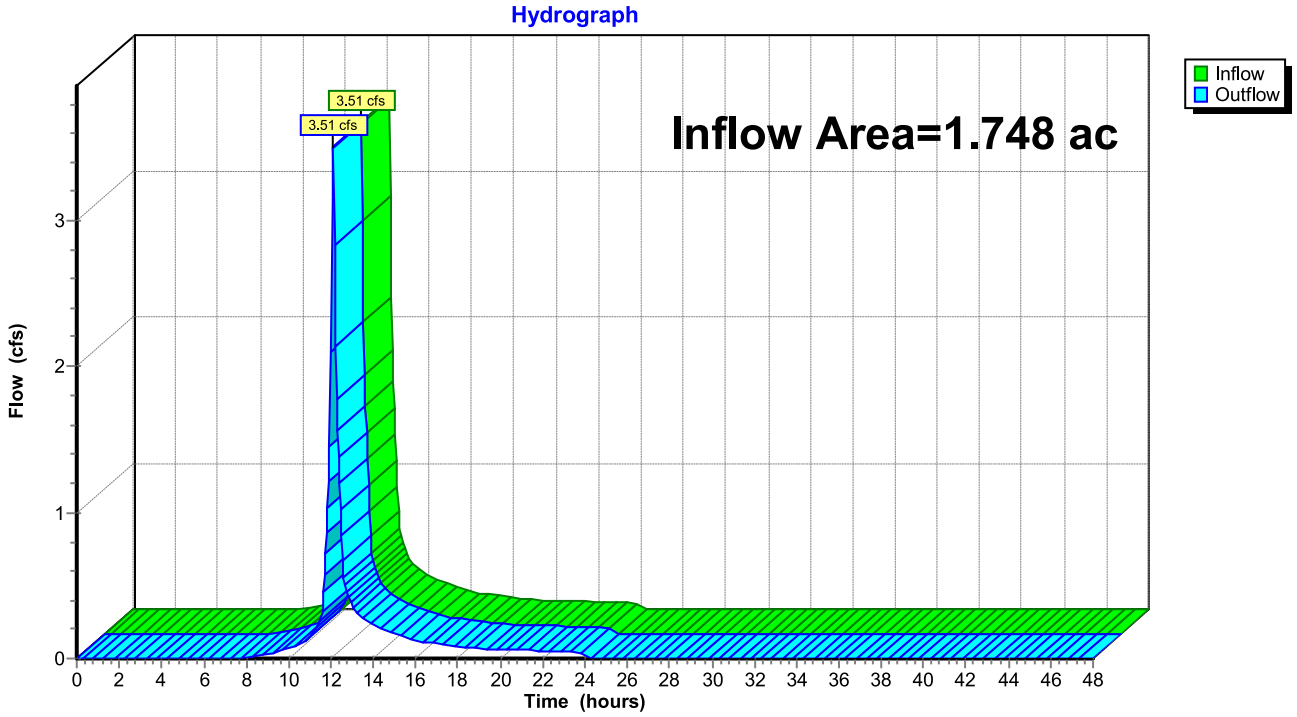


## Summary for Reach DP-1:

Inflow Area = 1.748 ac, 74.72% Impervious, Inflow Depth = 1.75" for 2-Year event
Inflow = 3.51 cfs @ 12.09 hrs, Volume= 0.254 af
Outflow = 3.51 cfs @ 12.09 hrs, Volume= 0.254 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

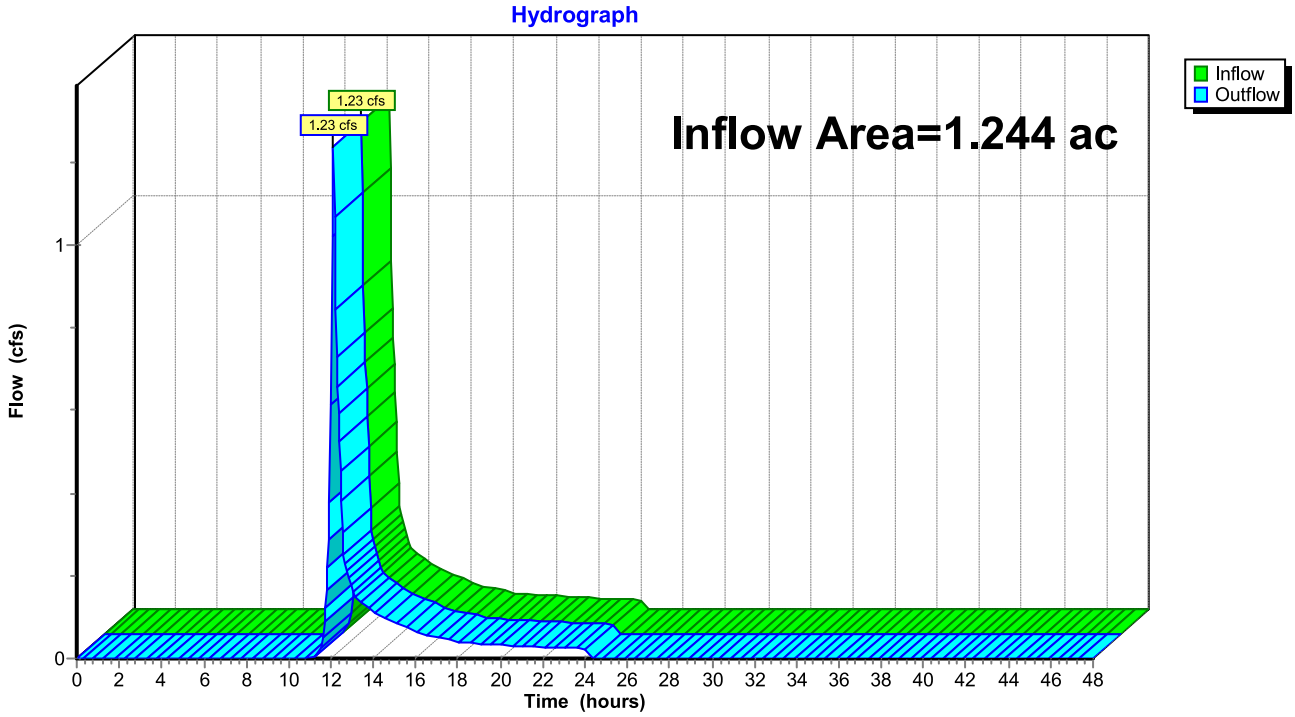


## Summary for Reach DP-2:

Inflow Area = 1.244 ac, 52.05% Impervious, Inflow Depth = 0.94" for 2-Year event
Inflow = 1.23 cfs @ 12.10 hrs, Volume= 0.098 af
Outflow = 1.23 cfs @ 12.10 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:



## Summary for Pond P: Pond

Inflow Area = 0.159 ac, 36.14% Impervious, Inflow Depth = 0.48" for 2-Year event
Inflow = 0.06 cfs @ 12.12 hrs, Volume= 0.006 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 53.22' @ 24.40 hrs Surf.Area= 976 sf Storage= 280 cf

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

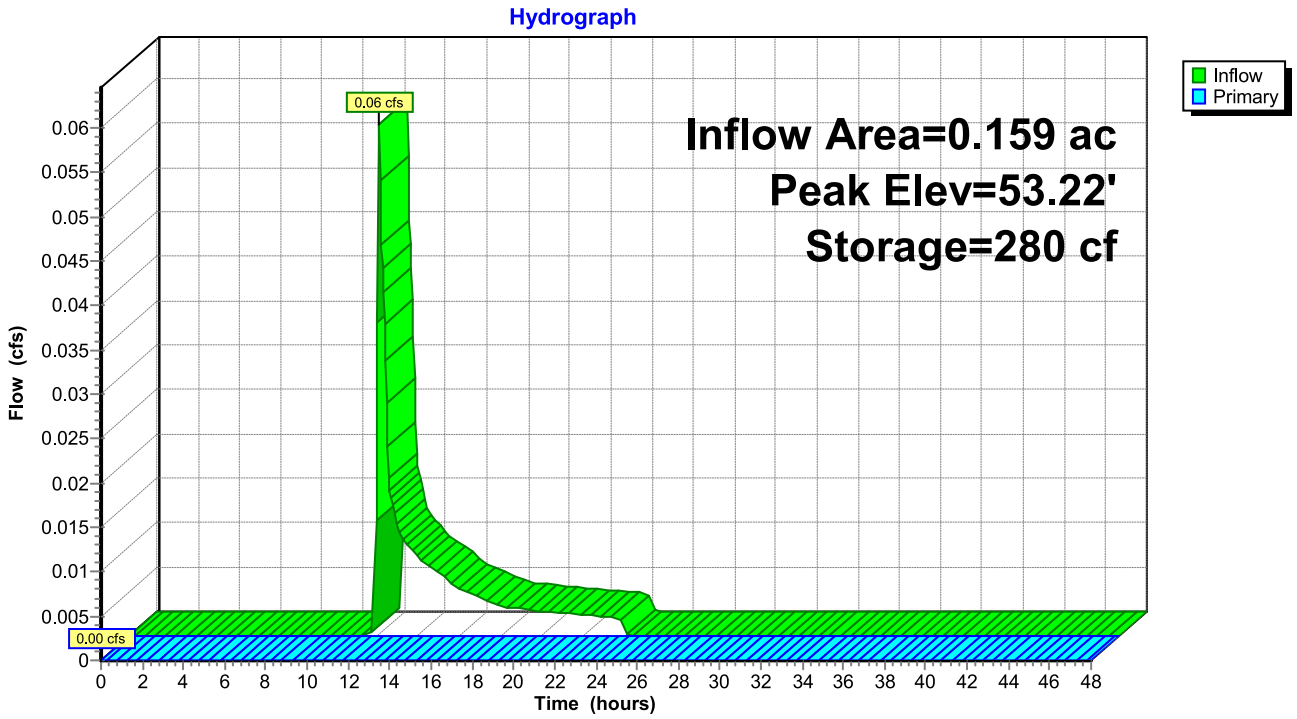
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 52.50' | 4,856 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 52.50 | 0 | 0 | 0 |
| 53.00 | 476 | 119 | 119 |
| 54.00 | 2,727 | 1,602 | 1,721 |
| 55.00 | 3,544 | 3,136 | 4,856 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 50.10' | **12.0" Round Culvert**<br>L= 33.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 50.10' / 49.90' S= 0.0061 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 54.60' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=52.50' (Free Discharge)
↑—**1=Culvert** (Passes 0.00 cfs of 5.21 cfs potential flow)
↑—**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond P: Pond


Hydrograph
Inflow
Primary
0.06 cfs
0.00 cfs
Inflow Area=0.159 ac
Peak Elev=53.22'
Storage=280 cf
Flow (cfs)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1A:** Runoff Area=69,203 sf 78.59% Impervious Runoff Depth=3.70"
Tc=6.0 min CN=85 Runoff=6.66 cfs 0.490 af

**Subcatchment 1B:** Runoff Area=6,935 sf 36.14% Impervious Runoff Depth=1.52"
Tc=6.0 min CN=60 Runoff=0.26 cfs 0.020 af

**Subcatchment 2:** Runoff Area=54,170 sf 52.05% Impervious Runoff Depth=2.31"
Tc=6.0 min CN=70 Runoff=3.26 cfs 0.239 af

**Reach DP-1:** Inflow=6.66 cfs 0.490 af
Outflow=6.66 cfs 0.490 af

**Reach DP-2:** Inflow=3.26 cfs 0.239 af
Outflow=3.26 cfs 0.239 af

**Pond P: Pond** Peak Elev=53.64' Storage=876 cf Inflow=0.26 cfs 0.020 af
Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 2.991 ac Runoff Volume = 0.749 af Average Runoff Depth = 3.01"**
**34.70% Pervious = 1.038 ac 65.30% Impervious = 1.953 ac**

## Summary for Subcatchment 1A:

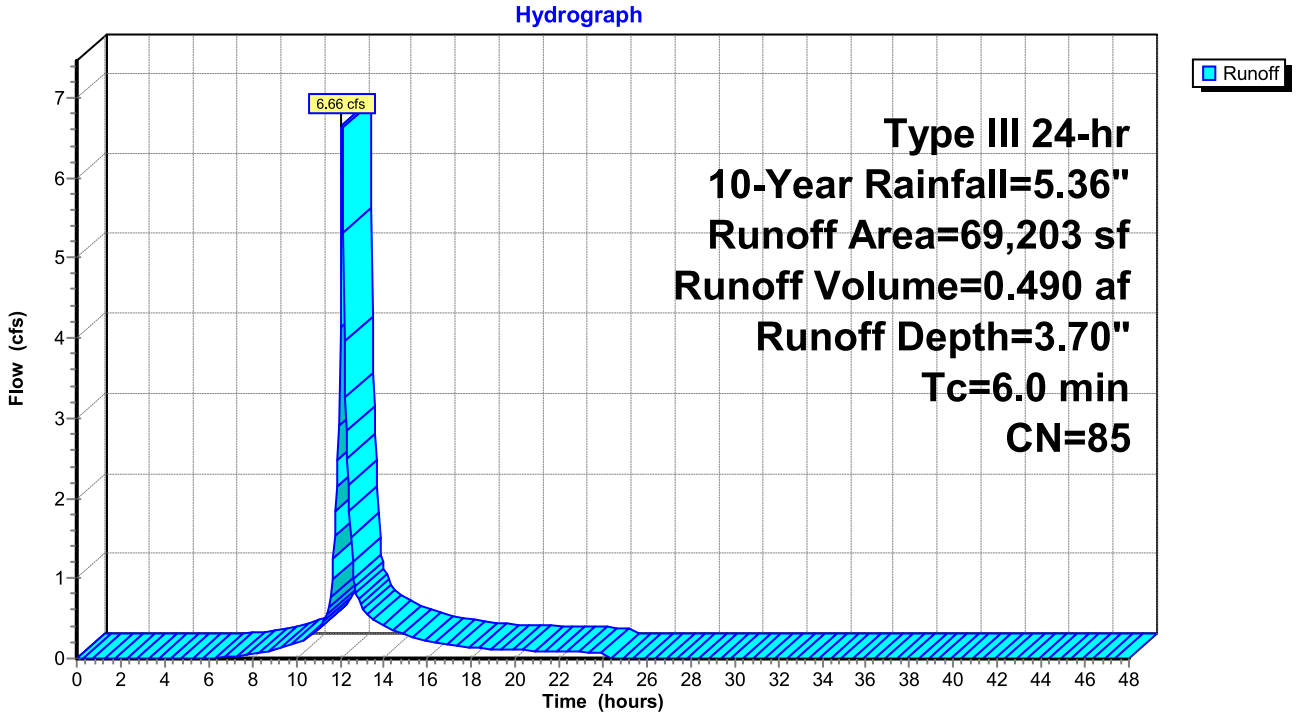
Runoff = 6.66 cfs @ 12.09 hrs, Volume= 0.490 af, Depth= 3.70"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 54,386 | 98 | Impervious |
| | 14,817 | 39 | Pervious Landscape & Grass |
| | 69,203 | 85 | Weighted Average |
| | 14,817 | | 21.41% Pervious Area |
| | 54,386 | | 78.59% Impervious Area |

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

## Subcatchment 1A:



## Summary for Subcatchment 1B:

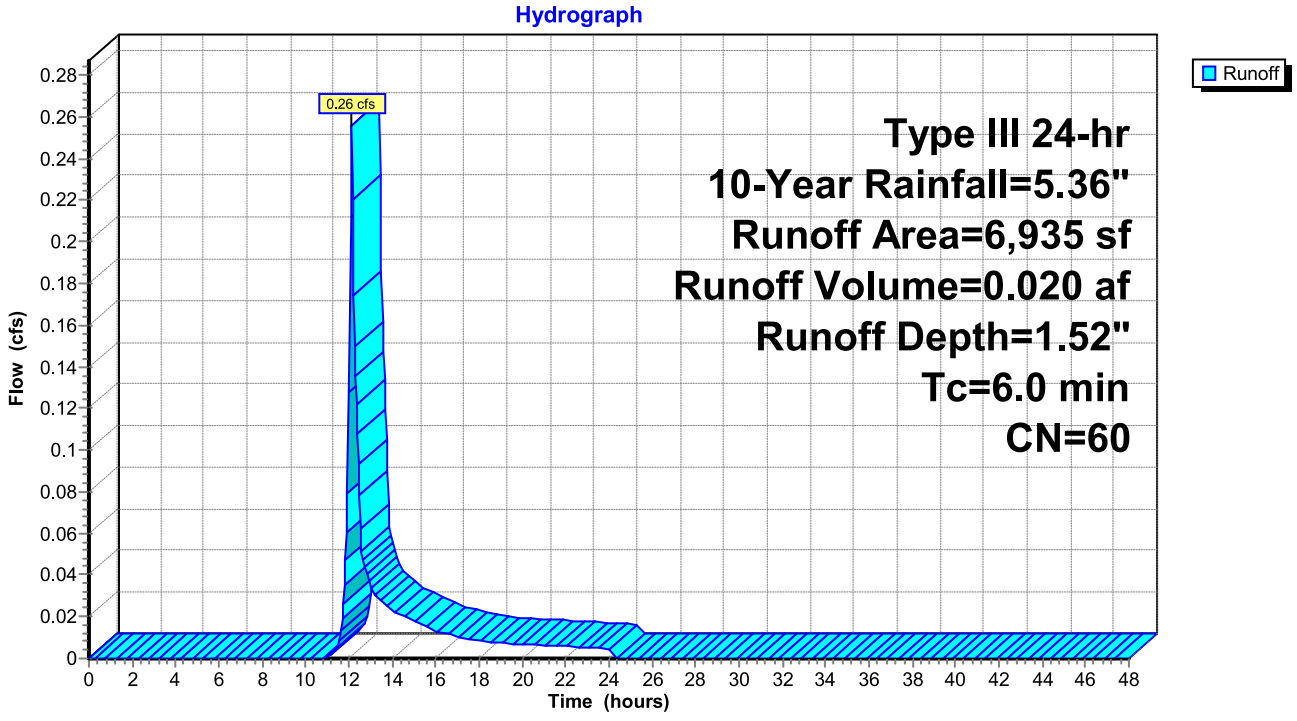
Runoff = 0.26 cfs @ 12.10 hrs, Volume= 0.020 af, Depth= 1.52"
Routed to Pond P : Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 4,429 | 39 | Pervious Landscape & Grass |
| * | 2,506 | 98 | Impervious |
| | 6,935 | 60 | Weighted Average |
| | 4,429 | | 63.86% Pervious Area |
| | 2,506 | | 36.14% Impervious Area |

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

## Subcatchment 1B:



## Summary for Subcatchment 2:

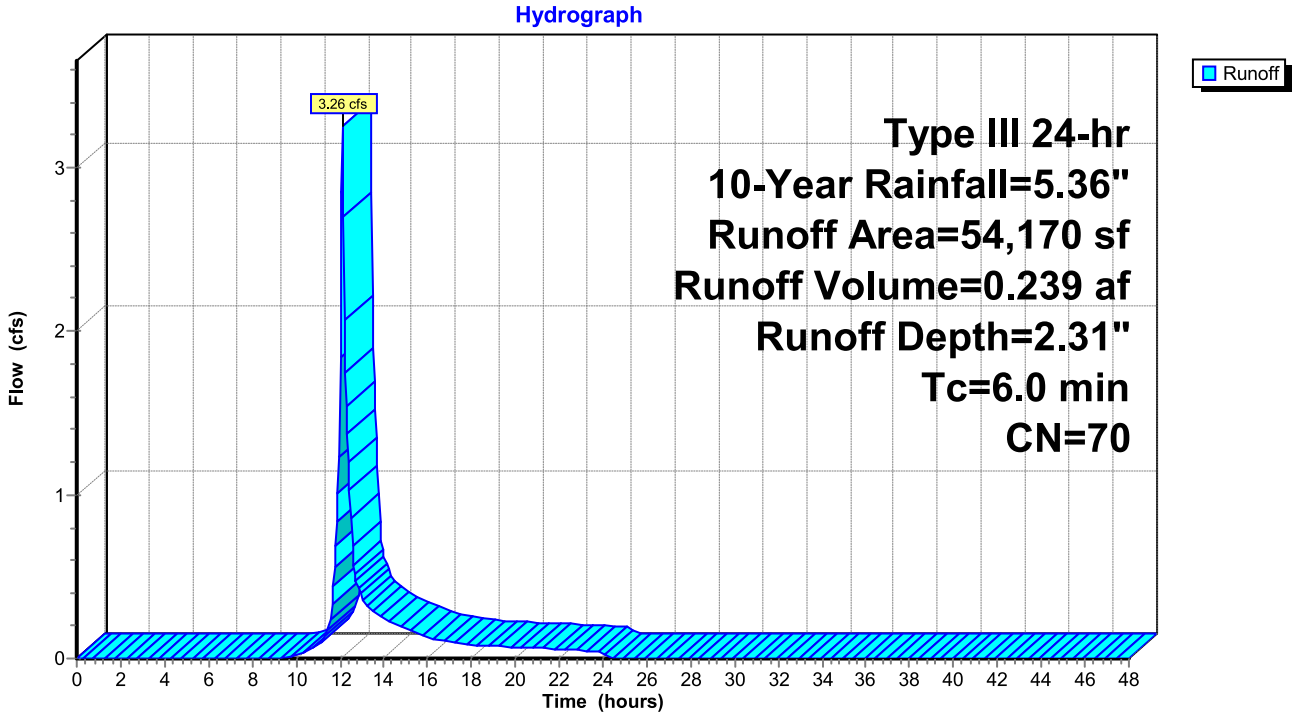
Runoff = 3.26 cfs @ 12.10 hrs, Volume= 0.239 af, Depth= 2.31"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,195 | 98 | Impervious |
| | 25,975 | 39 | Pervious Landscape & Grass |
| | 54,170 | 70 | Weighted Average |
| | 25,975 | | 47.95% Pervious Area |
| | 28,195 | | 52.05% Impervious Area |

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

## Subcatchment 2:

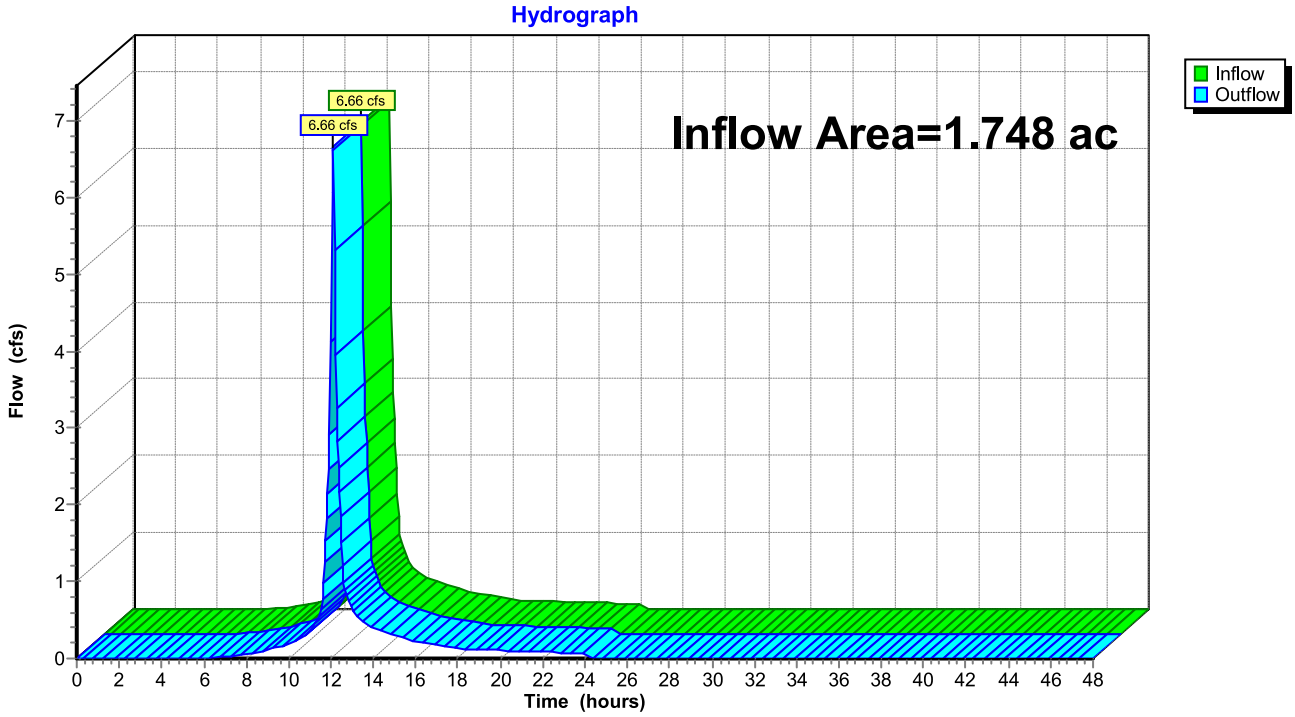


## Summary for Reach DP-1:

Inflow Area = 1.748 ac, 74.72% Impervious, Inflow Depth = 3.37" for 10-Year event
Inflow = 6.66 cfs @ 12.09 hrs, Volume= 0.490 af
Outflow = 6.66 cfs @ 12.09 hrs, Volume= 0.490 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

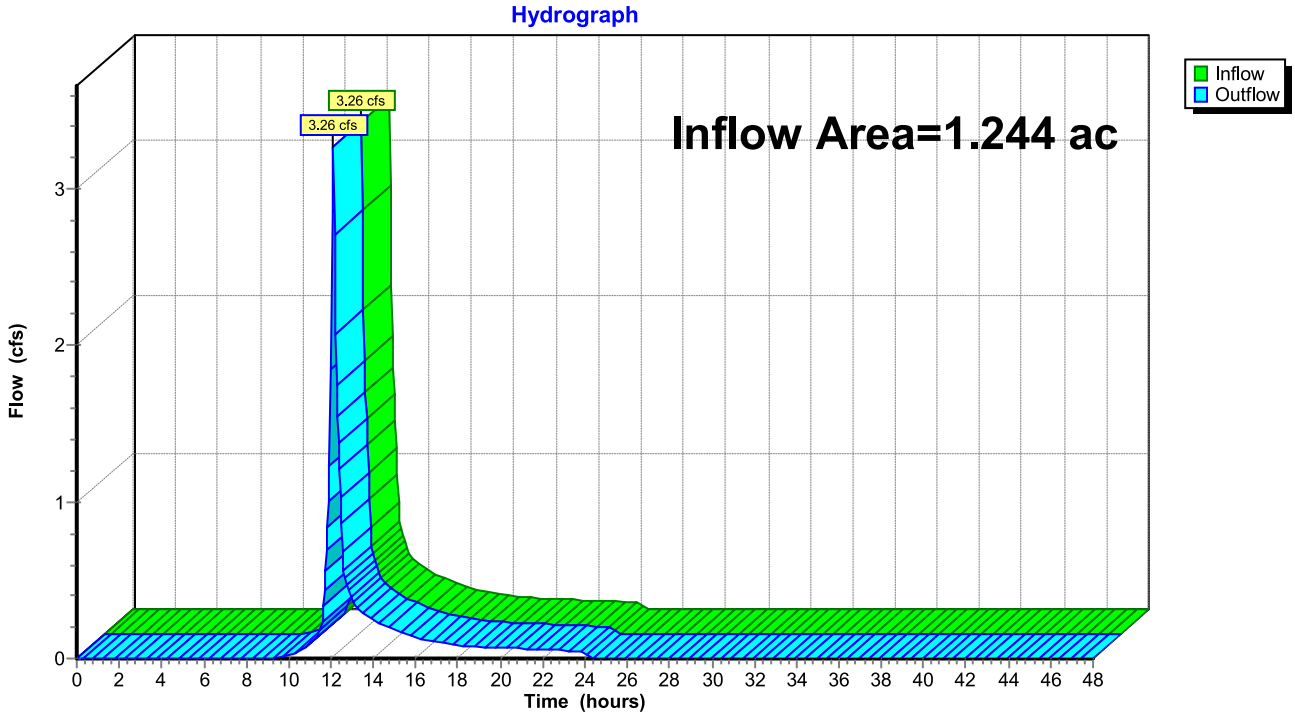


## Summary for Reach DP-2:

Inflow Area = 1.244 ac, 52.05% Impervious, Inflow Depth = 2.31" for 10-Year event
Inflow = 3.26 cfs @ 12.10 hrs, Volume= 0.239 af
Outflow = 3.26 cfs @ 12.10 hrs, Volume= 0.239 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:



## Summary for Pond P: Pond

Inflow Area = 0.159 ac, 36.14% Impervious, Inflow Depth = 1.52" for 10-Year event
Inflow = 0.26 cfs @ 12.10 hrs, Volume= 0.020 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 53.64' @ 24.40 hrs Surf.Area= 1,907 sf Storage= 876 cf

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

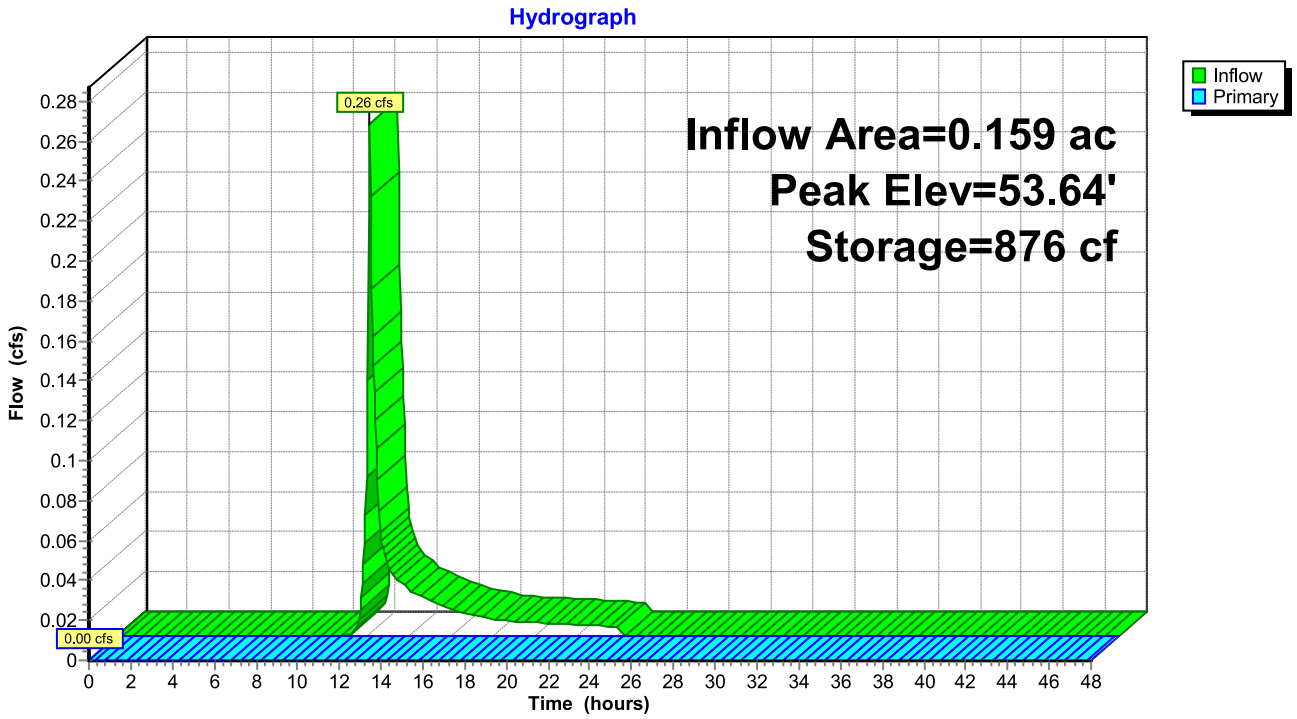
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 52.50' | 4,856 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 52.50 | 0 | 0 | 0 |
| 53.00 | 476 | 119 | 119 |
| 54.00 | 2,727 | 1,602 | 1,721 |
| 55.00 | 3,544 | 3,136 | 4,856 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 50.10' | **12.0" Round Culvert**<br>L= 33.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 50.10' / 49.90' S= 0.0061 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 54.60' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=52.50' (Free Discharge)
↑**1=Culvert** (Passes 0.00 cfs of 5.21 cfs potential flow)
↑**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond P: Pond


Hydrograph
Inflow
Primary
0.26 cfs
0.00 cfs
Inflow Area=0.159 ac
Peak Elev=53.64'
Storage=876 cf
Flow (cfs)
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1A:** Runoff Area=69,203 sf 78.59% Impervious Runoff Depth=4.85"
Tc=6.0 min CN=85 Runoff=8.62 cfs 0.642 af

**Subcatchment 1B:** Runoff Area=6,935 sf 36.14% Impervious Runoff Depth=2.31"
Tc=6.0 min CN=60 Runoff=0.41 cfs 0.031 af

**Subcatchment 2:** Runoff Area=54,170 sf 52.05% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=70 Runoff=4.67 cfs 0.339 af

**Reach DP-1:** Inflow=8.62 cfs 0.642 af
Outflow=8.62 cfs 0.642 af

**Reach DP-2:** Inflow=4.67 cfs 0.339 af
Outflow=4.67 cfs 0.339 af

**Pond P: Pond** Peak Elev=53.85' Storage=1,335 cf Inflow=0.41 cfs 0.031 af
Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 2.991 ac Runoff Volume = 1.012 af Average Runoff Depth = 4.06"**
**34.70% Pervious = 1.038 ac 65.30% Impervious = 1.953 ac**

## Summary for Subcatchment 1A:

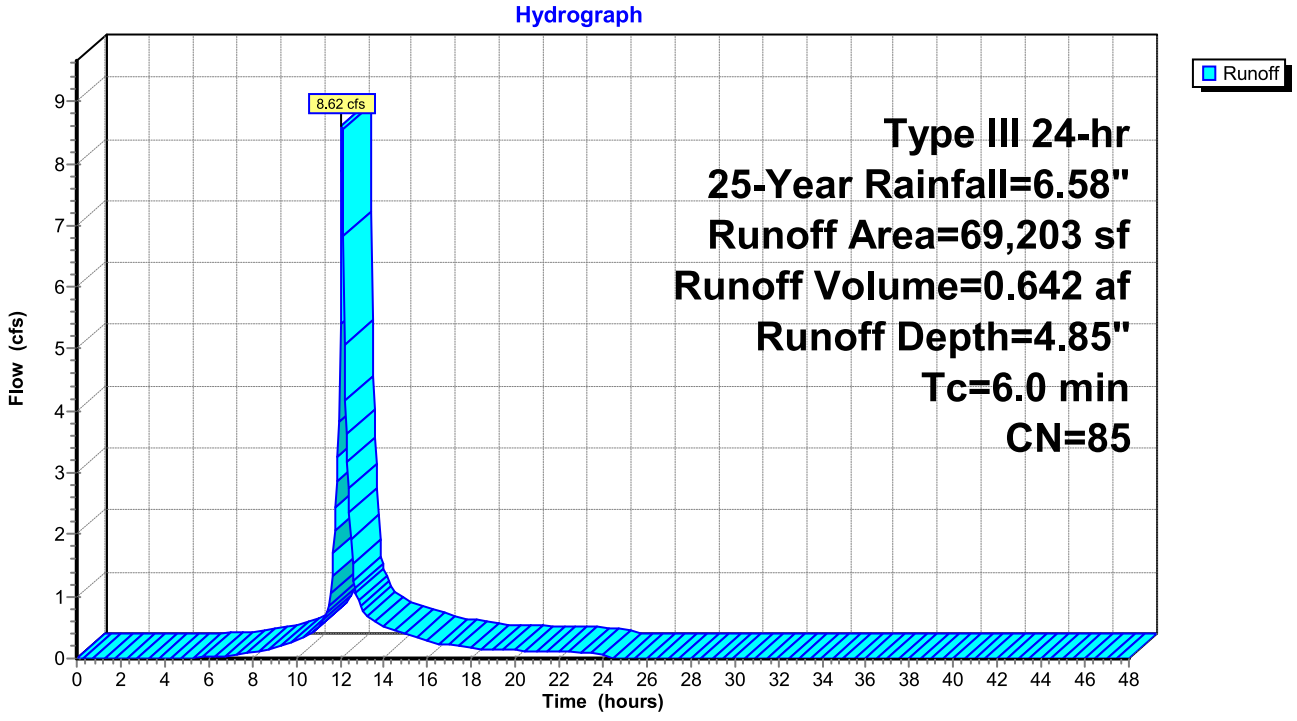
Runoff = 8.62 cfs @ 12.09 hrs, Volume= 0.642 af, Depth= 4.85"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.58"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 54,386 | 98 | Impervious |
| | 14,817 | 39 | Pervious Landscape & Grass |
| | 69,203 | 85 | Weighted Average |
| | 14,817 | | 21.41% Pervious Area |
| | 54,386 | | 78.59% Impervious Area |

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

## Subcatchment 1A:



## Summary for Subcatchment 1B:

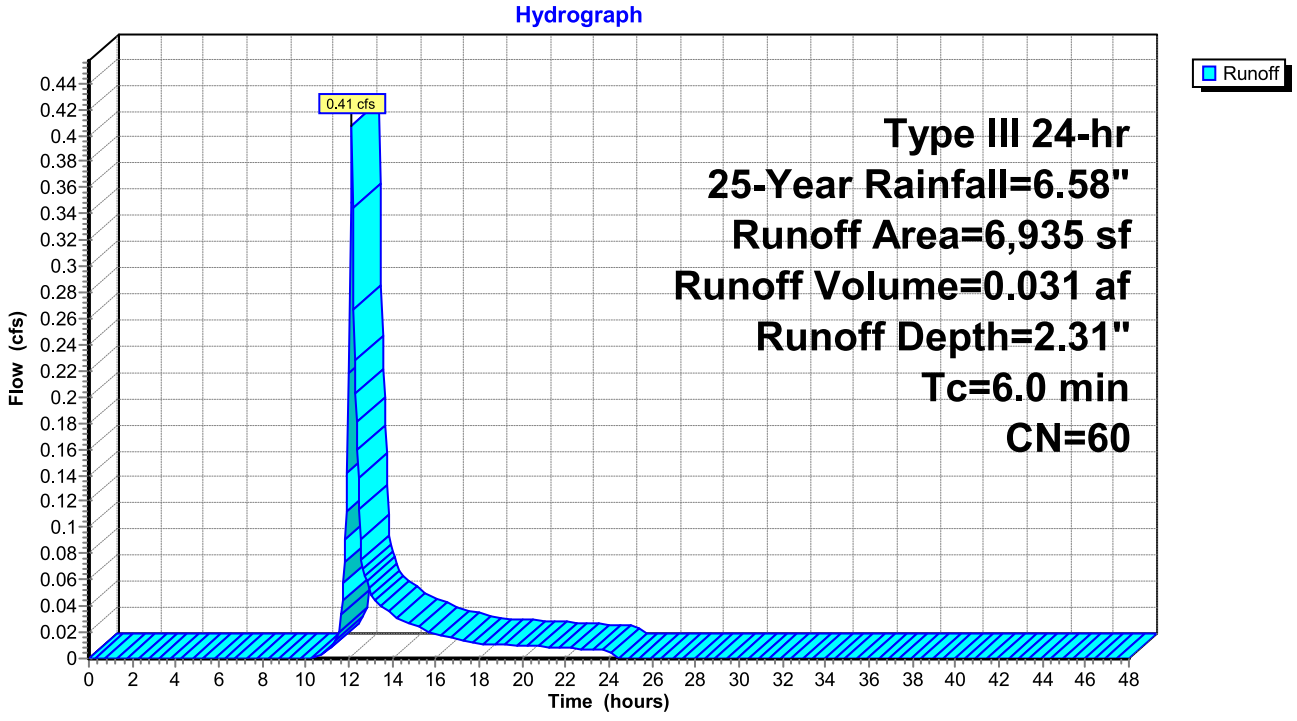
Runoff = 0.41 cfs @ 12.10 hrs, Volume= 0.031 af, Depth= 2.31"
Routed to Pond P : Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.58"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 4,429 | 39 | Pervious Landscape & Grass |
| * | 2,506 | 98 | Impervious |
| | 6,935 | 60 | Weighted Average |
| | 4,429 | | 63.86% Pervious Area |
| | 2,506 | | 36.14% Impervious Area |

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

## Subcatchment 1B:



## Summary for Subcatchment 2:

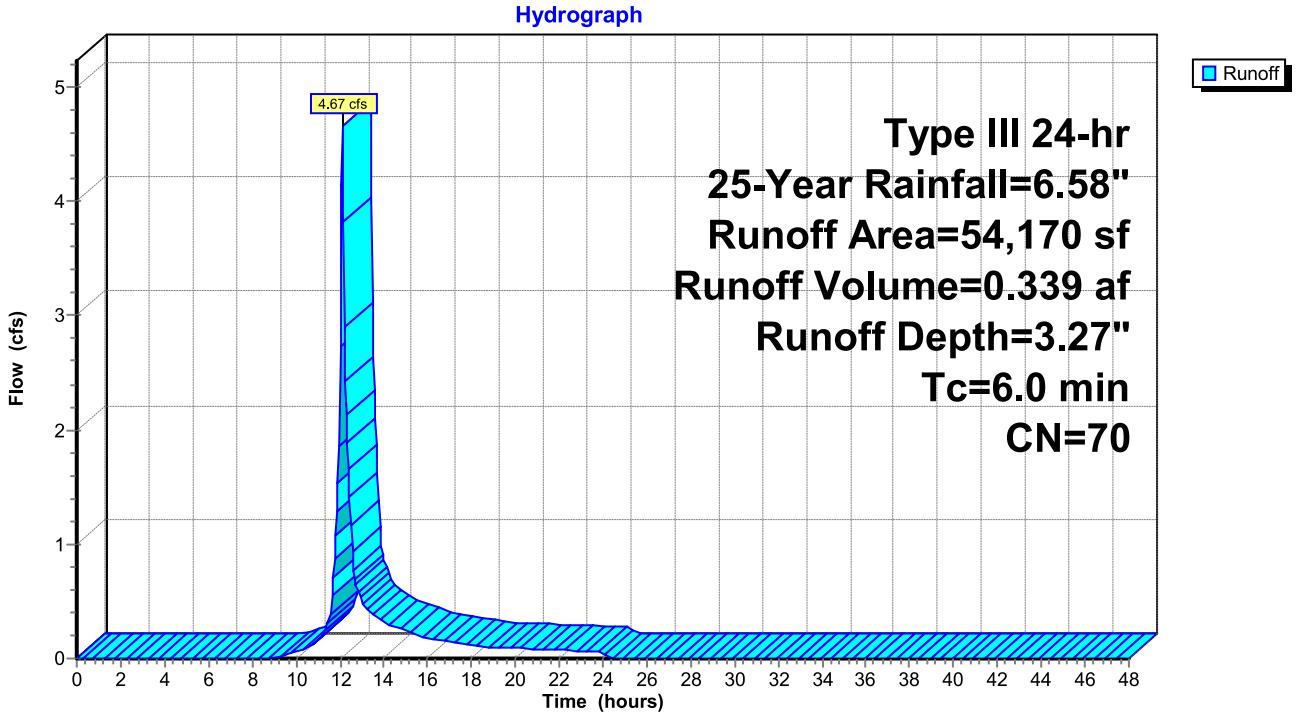
Runoff = 4.67 cfs @ 12.09 hrs, Volume= 0.339 af, Depth= 3.27"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.58"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,195 | 98 | Impervious |
| | 25,975 | 39 | Pervious Landscape & Grass |
| | 54,170 | 70 | Weighted Average |
| | 25,975 | | 47.95% Pervious Area |
| | 28,195 | | 52.05% Impervious Area |

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

## Subcatchment 2:

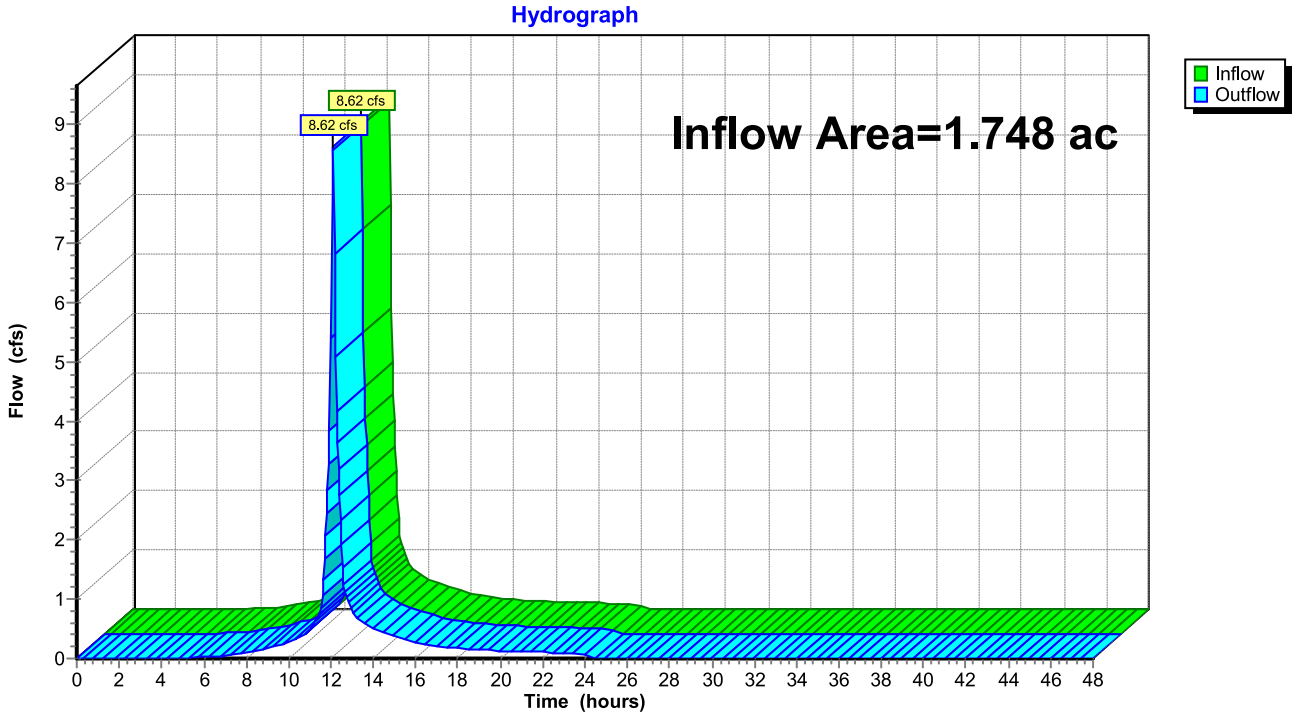


## Summary for Reach DP-1:

Inflow Area = 1.748 ac, 74.72% Impervious, Inflow Depth = 4.41" for 25-Year event
Inflow = 8.62 cfs @ 12.09 hrs, Volume= 0.642 af
Outflow = 8.62 cfs @ 12.09 hrs, Volume= 0.642 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

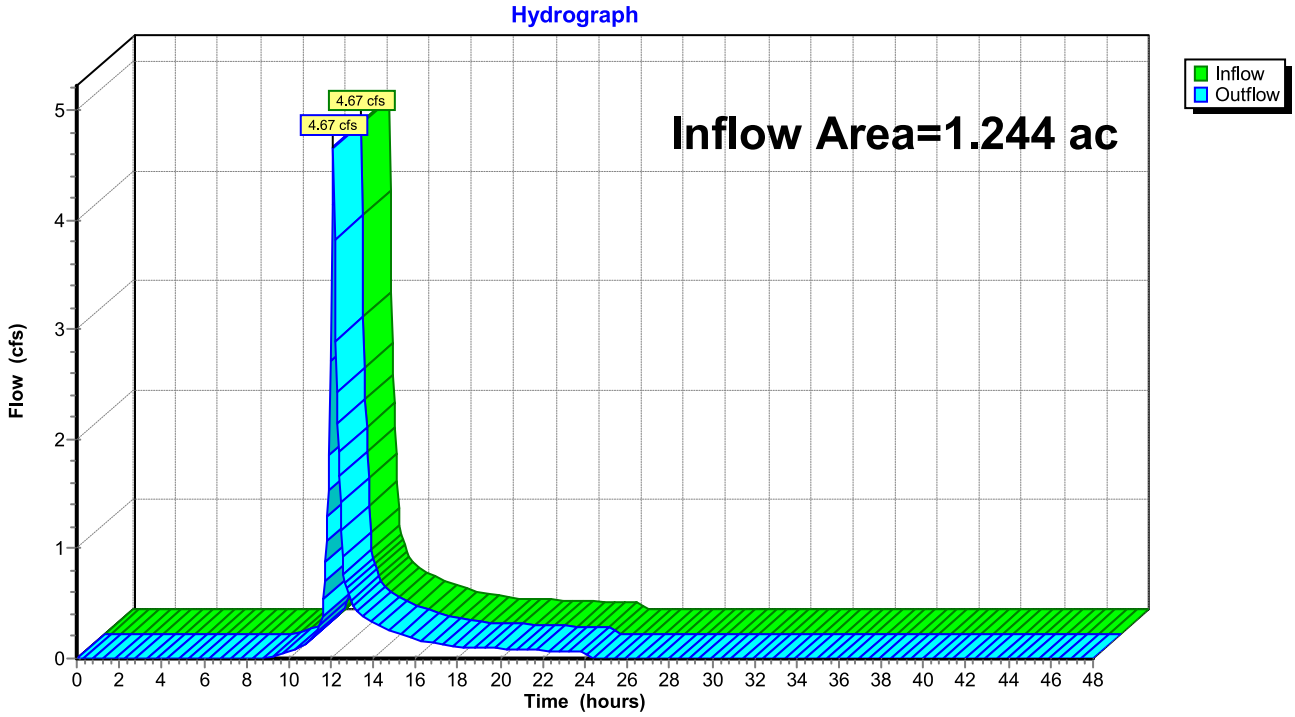


## Summary for Reach DP-2:

Inflow Area = 1.244 ac, 52.05% Impervious, Inflow Depth = 3.27" for 25-Year event
Inflow = 4.67 cfs @ 12.09 hrs, Volume= 0.339 af
Outflow = 4.67 cfs @ 12.09 hrs, Volume= 0.339 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:



## Summary for Pond P: Pond

Inflow Area = 0.159 ac, 36.14% Impervious, Inflow Depth = 2.31" for 25-Year event
Inflow = 0.41 cfs @ 12.10 hrs, Volume= 0.031 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 53.85' @ 24.40 hrs Surf.Area= 2,388 sf Storage= 1,335 cf

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

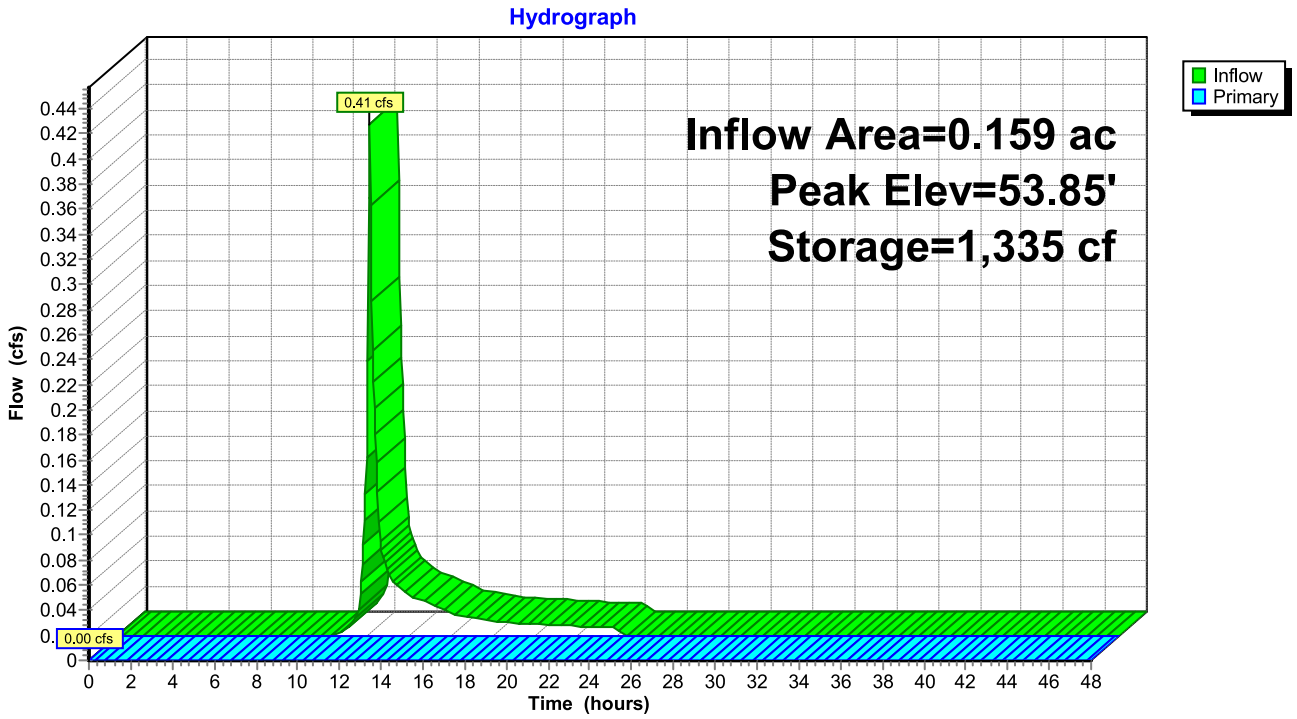
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 52.50' | 4,856 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 52.50 | 0 | 0 | 0 |
| 53.00 | 476 | 119 | 119 |
| 54.00 | 2,727 | 1,602 | 1,721 |
| 55.00 | 3,544 | 3,136 | 4,856 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 50.10' | **12.0" Round Culvert**<br>L= 33.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 50.10' / 49.90' S= 0.0061 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 54.60' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=52.50' (Free Discharge)
↑—**1=Culvert** (Passes 0.00 cfs of 5.21 cfs potential flow)
↑—**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond P: Pond


Hydrograph
Inflow
Primary
0.41 cfs
0.00 cfs
Inflow Area=0.159 ac
Peak Elev=53.85'
Storage=1,335 cf
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
0.44 0.42 0.4 0.38 0.36 0.34 0.32 0.3 0.28 0.26 0.24 0.22 0.2 0.18 0.16 0.14 0.12 0.1 0.08 0.06 0.04 0.

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1A:** Runoff Area=69,203 sf 78.59% Impervious Runoff Depth=6.68"
Tc=6.0 min CN=85 Runoff=11.68 cfs 0.884 af

**Subcatchment 1B:** Runoff Area=6,935 sf 36.14% Impervious Runoff Depth=3.70"
Tc=6.0 min CN=60 Runoff=0.67 cfs 0.049 af

**Subcatchment 2:** Runoff Area=54,170 sf 52.05% Impervious Runoff Depth=4.88"
Tc=6.0 min CN=70 Runoff=6.97 cfs 0.506 af

**Reach DP-1:** Inflow=11.68 cfs 0.884 af
Outflow=11.68 cfs 0.884 af

**Reach DP-2:** Inflow=6.97 cfs 0.506 af
Outflow=6.97 cfs 0.506 af

**Pond P: Pond** Peak Elev=54.15' Storage=2,137 cf Inflow=0.67 cfs 0.049 af
Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 2.991 ac Runoff Volume = 1.439 af Average Runoff Depth = 5.77"**
**34.70% Pervious = 1.038 ac 65.30% Impervious = 1.953 ac**

## Summary for Subcatchment 1A:

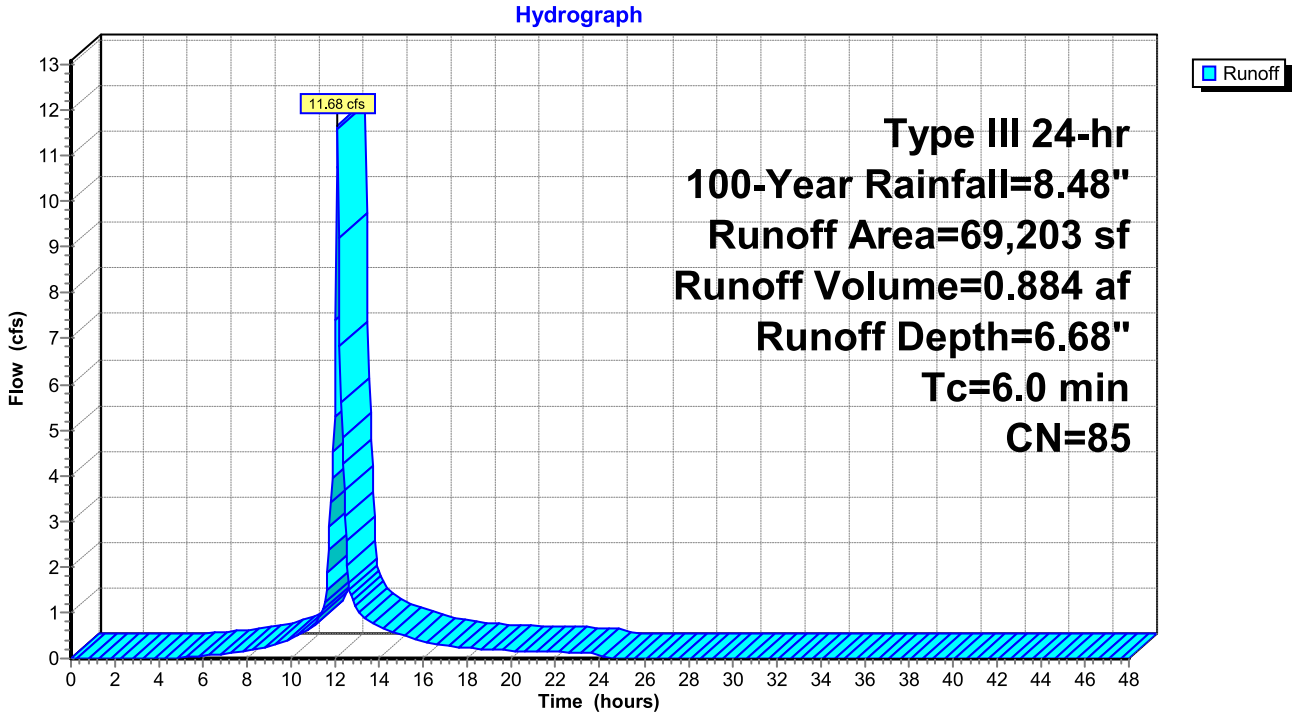
Runoff = 11.68 cfs @ 12.09 hrs, Volume= 0.884 af, Depth= 6.68"
Routed to Reach DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.48"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 54,386 | 98 | Impervious |
| | 14,817 | 39 | Pervious Landscape & Grass |
| | 69,203 | 85 | Weighted Average |
| | 14,817 | | 21.41% Pervious Area |
| | 54,386 | | 78.59% Impervious Area |

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

## Subcatchment 1A:



## Summary for Subcatchment 1B:

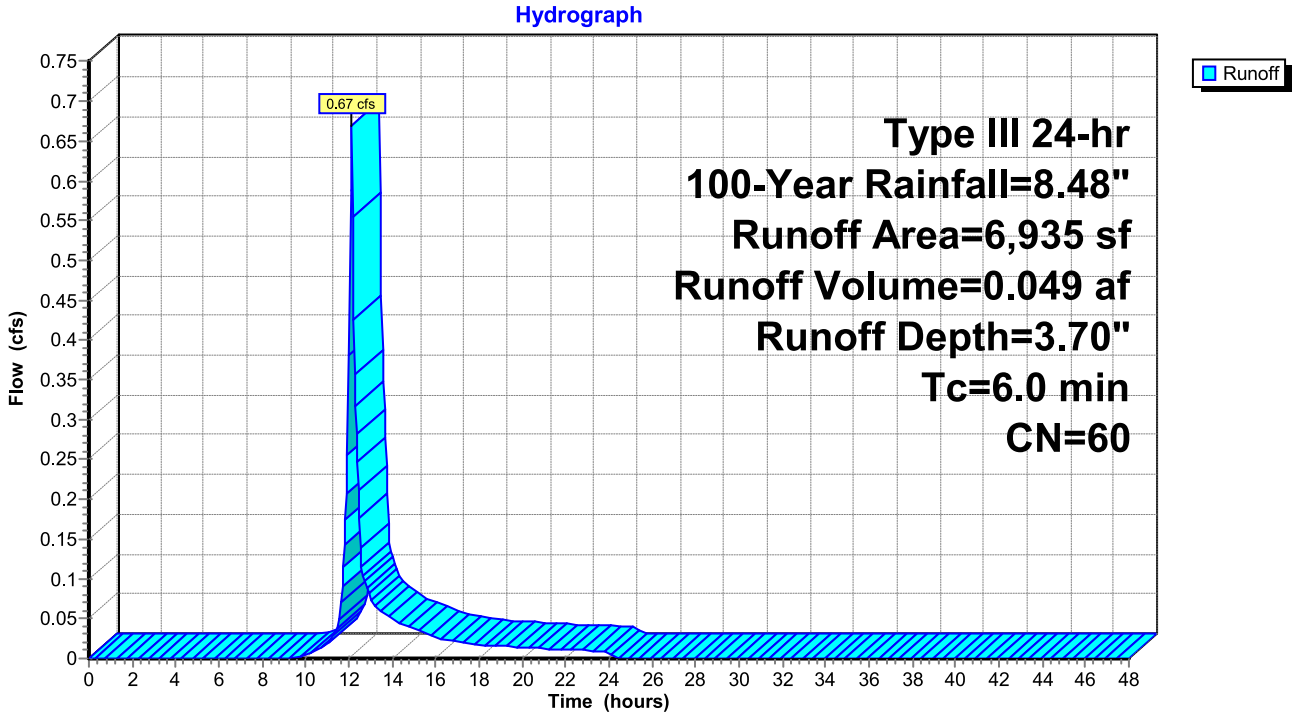
Runoff = 0.67 cfs @ 12.10 hrs, Volume= 0.049 af, Depth= 3.70"
Routed to Pond P : Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.48"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 4,429 | 39 | Pervious Landscape & Grass |
| * | 2,506 | 98 | Impervious |
| | 6,935 | 60 | Weighted Average |
| | 4,429 | | 63.86% Pervious Area |
| | 2,506 | | 36.14% Impervious Area |

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

## Subcatchment 1B:



## Summary for Subcatchment 2:

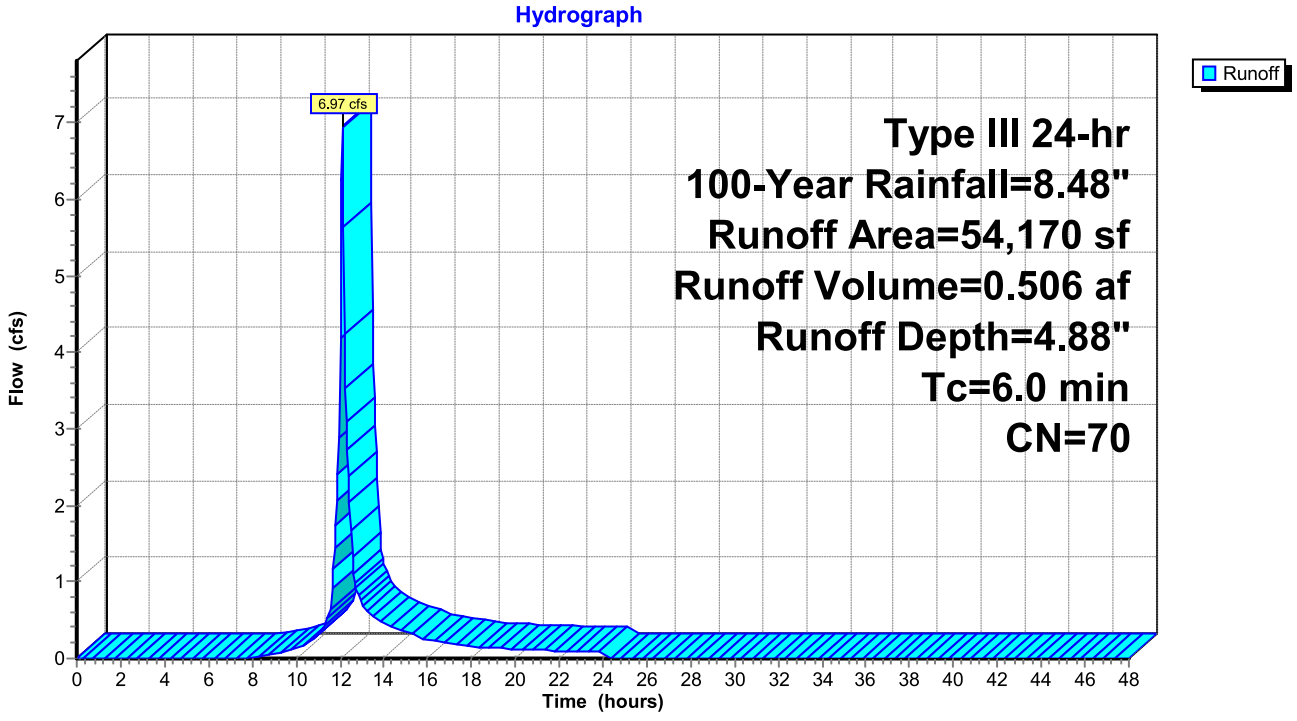
Runoff = 6.97 cfs @ 12.09 hrs, Volume= 0.506 af, Depth= 4.88"
Routed to Reach DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.48"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 28,195 | 98 | Impervious |
| | 25,975 | 39 | Pervious Landscape & Grass |
| | 54,170 | 70 | Weighted Average |
| | 25,975 | | 47.95% Pervious Area |
| | 28,195 | | 52.05% Impervious Area |

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

## Subcatchment 2:

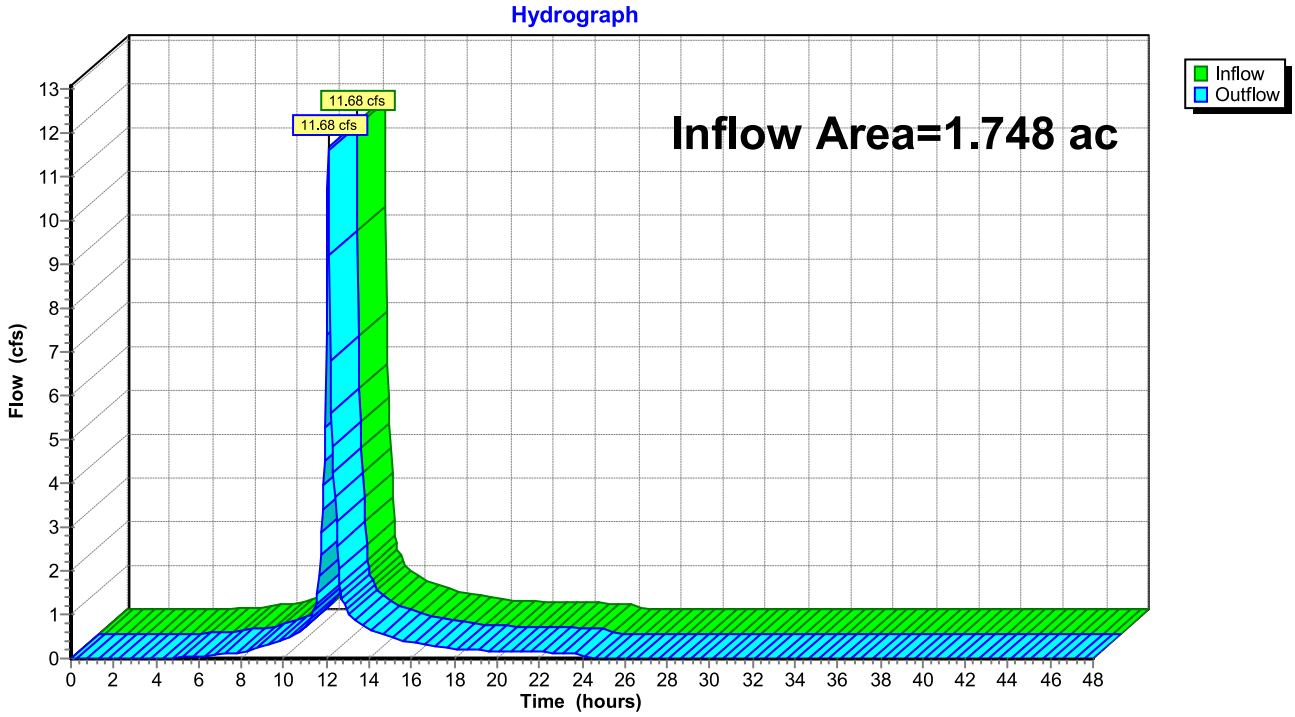


## Summary for Reach DP-1:

Inflow Area = 1.748 ac, 74.72% Impervious, Inflow Depth = 6.07" for 100-Year event
Inflow = 11.68 cfs @ 12.09 hrs, Volume= 0.884 af
Outflow = 11.68 cfs @ 12.09 hrs, Volume= 0.884 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-1:

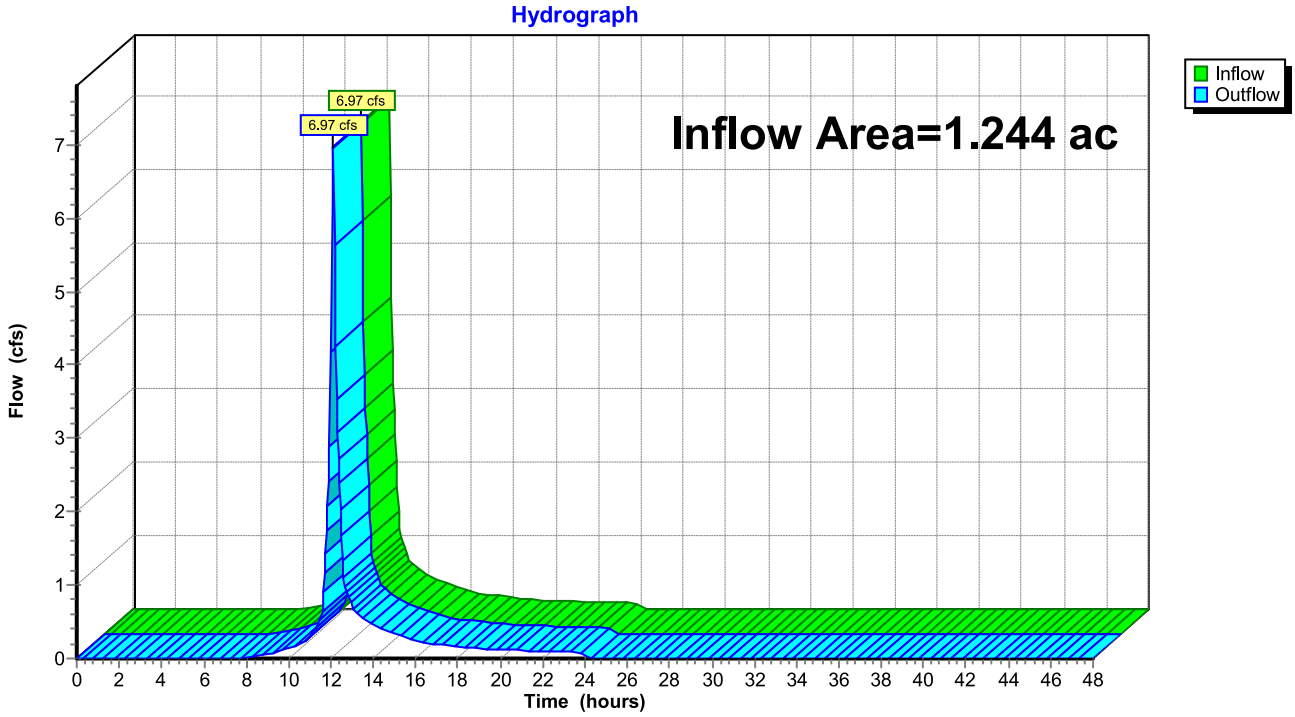


## Summary for Reach DP-2:

Inflow Area = 1.244 ac, 52.05% Impervious, Inflow Depth = 4.88" for 100-Year event
Inflow = 6.97 cfs @ 12.09 hrs, Volume= 0.506 af
Outflow = 6.97 cfs @ 12.09 hrs, Volume= 0.506 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

## Reach DP-2:



## Summary for Pond P: Pond

Inflow Area = 0.159 ac, 36.14% Impervious, Inflow Depth = 3.70" for 100-Year event
Inflow = 0.67 cfs @ 12.10 hrs, Volume= 0.049 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 :

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 54.15' @ 24.40 hrs Surf.Area= 2,849 sf Storage= 2,137 cf

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

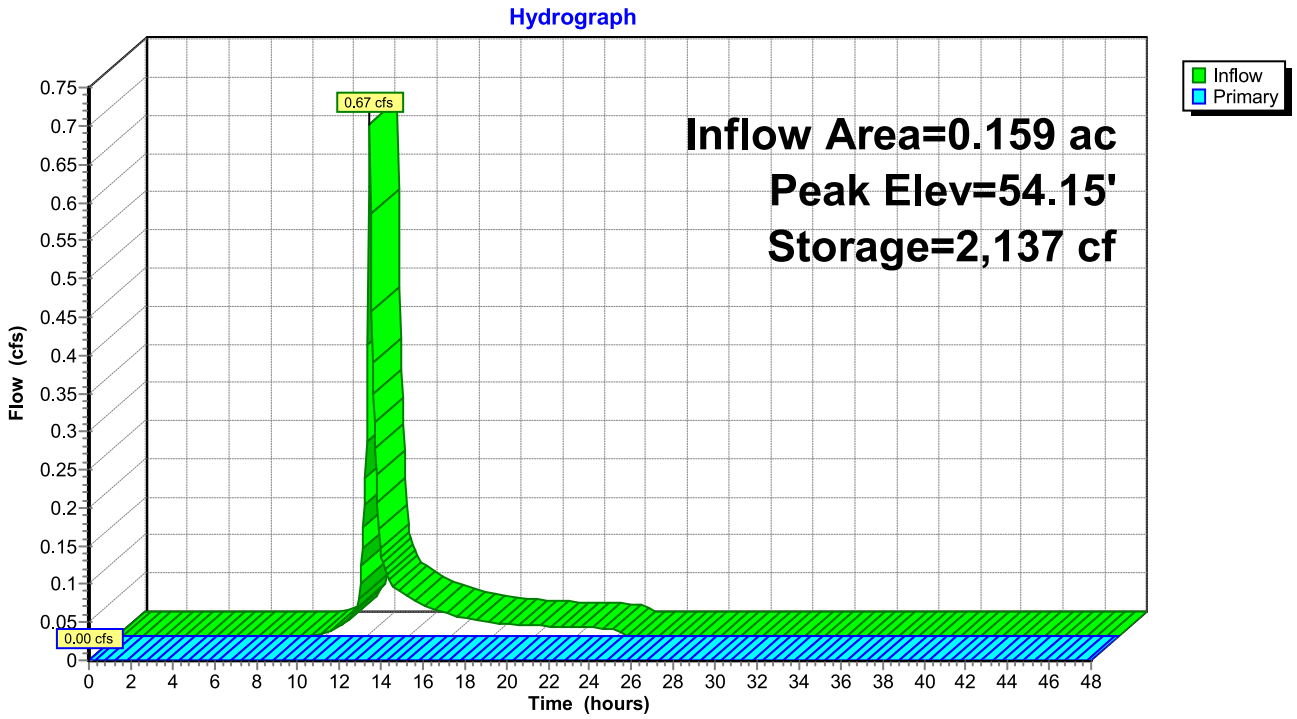
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 52.50' | 4,856 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 52.50 | 0 | 0 | 0 |
| 53.00 | 476 | 119 | 119 |
| 54.00 | 2,727 | 1,602 | 1,721 |
| 55.00 | 3,544 | 3,136 | 4,856 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 50.10' | **12.0" Round Culvert**<br>L= 33.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 50.10' / 49.90' S= 0.0061 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 54.60' | **12.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=52.50' (Free Discharge)
↑—**1=Culvert** (Passes 0.00 cfs of 5.21 cfs potential flow)
↑—**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond P: Pond


Hydrograph
Inflow
Primary
0.67 cfs
0.00 cfs
Inflow Area=0.159 ac
Peak Elev=54.15'
Storage=2,137 cf
Flow (cfs)
Time (hours)
0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5 0.55 0.6 0.65 0.7 0.75
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

# Amesbury - Starbucks

Design Assumptions

Project No. 81088
Project Starbucks
Location 37 Clark's Road
Amesbury, MA

10 Year Storm
5 Minute Duration
6.76 in/hr Intensity for Amesbury, MA IDF Curve

Pipe Coefficient "n" 0.013 HDPE/Conc.

SHEET 1 OF 1
COMPUTED BY JS DATE 6/25/2024
REVISED DATE
CHECKED BY DR DATE 6/25/2024

| DRAINAGE STRUCTURE | | TRIBUTRARY AREA | | RUNOFF COEFFICIENT | RUNOFF RATIONAL METHOD Q=Ca x C x i x A | | | | | | | PIPE | | | | | | | | FROM STRUCTURE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | TIME OF FLOW | | RAINFALL INTENSITY | DISCHARGE (Q) | | | | | | | | | | |
| FROM STRUCT. | TO STRUCT. | INCREM. (AC) | TOTAL | "C" | "Ca" | "Ca" X "C" X "A" | TC(MIN) | TF(MIN) | (IN/HR) | INCREM (CFS) | TOTAL (CFS) | LENGTH (FT) | DIA (IN) | SLOPE (FT/FT) | CAPACITY Q (CFS) | MEAN VELOCITY VF (FT/S) | AVAILABLE CAPACITY | FROM INVERT | TO INVERT | RIM |
| CB4 | DMH3 | 0.08 | | 0.79 | 1.1 | 0.07 | 5 | | 6.76 | 0.45 | | 58 | 12 | 0.005 | 2.57 | 3.27 | 2.12 | 50.40 | 50.10 | 54.00 |
| CB3 | DMH3 | 0.06 | | 0.83 | 1.1 | 0.05 | 5 | | 6.76 | 0.35 | | 3 | 12 | 0.033 | 6.52 | 8.30 | 6.17 | 50.20 | 50.10 | 54.30 |
| RD1 | DMH3 | 0.03 | | 0.90 | 1.1 | 0.03 | 5 | | 6.76 | 0.18 | | 18 | 12 | 0.011 | 3.76 | 4.79 | 3.58 | 50.30 | 50.10 | 55.50 |
| DMH3 | DMH2 | | 0.16 | | | | | | | | 0.98 | 27 | 12 | 0.007 | 3.07 | 3.91 | 2.10 | 50.10 | 49.90 | 54.30 |
| | | | | | | | | | | | | | | | | | | | | |
| CB2 | DMH2 | 0.01 | | 0.90 | 1.1 | 0.01 | 5 | | 6.76 | 0.07 | | 9 | 12 | 0.022 | 5.32 | 6.78 | 5.25 | 50.10 | 49.90 | 54.60 |
| INFIL. BASIN | DMH2 | 0.16 | | 0.54 | 1.1 | 0.10 | 5 | | 6.76 | 0.65 | | 33 | 12 | 0.006 | 2.78 | 3.54 | 2.12 | 50.10 | 49.90 | 54.60 |
| DMH2 | DMH1 | | 0.33 | | | | | | | | 1.70 | 55 | 12 | 0.005 | 2.64 | 3.36 | 0.93 | 49.90 | 49.60 | 54.80 |
| | | | | | | | | | | | | | | | | | | | | |
| CB1 | DMH1 | 0.07 | | 0.69 | 1.1 | 0.06 | 5 | | 6.76 | 0.37 | | 4 | 12 | 0.025 | 5.64 | 7.19 | 5.27 | 49.70 | 49.60 | 53.60 |
| DMH1 | DMH4 | | 0.41 | | | | | | | | 2.08 | 82 | 12 | 0.005 | 2.49 | 3.18 | 0.42 | 49.60 | 49.20 | 53.60 |
| | | | | | | | | | | | | | | | | | | | | |
| RD2 | DMH4 | 0.03 | | 0.90 | 1.1 | 0.03 | 5 | | 6.76 | 0.18 | | 23 | 12 | 0.017 | 4.71 | 6.00 | 4.52 | 49.60 | 49.20 | 55.50 |
| EX. CB-1 | EX. CB-2 | 0.66 | | 0.83 | 1.1 | 0.60 | 5 | | 6.76 | 4.09 | | 130 | 12 | 0.018 | 4.75 | 6.05 | 0.66 | 52.00 | 49.70 | 54.05 |
| EX. CB-2 | DMH4 | 0.28 | 0.95 | 0.79 | 1.1 | 0.25 | 5 | | 6.76 | 1.67 | 5.76 | 65 | 12 | 0.008 | 3.13 | 3.99 | -2.63 | 49.70 | 49.20 | 53.48 |
| | | | | | | | | | | | | | | | | | | | | |
| DMH4 | EX DMH1 | | 1.38 | | 1.1 | | | | | | 8.02 | 43 | 12 | 0.014 | 4.22 | 5.37 | -3.81 | 49.20 | 48.60 | 54.00 |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
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# APPENDIX D

# Long Term Pollution Prevention and Operation & Maintenance Plan

## Construction Period Management

# LONG-TERM STORMWATER POLLUTION PREVENTION AND OPERATION & MAINTENANCE PLAN TO COMPLY WITH STORMWATER STANDARDS 4, 6, & 9

## APPLICABILITY

This document identifies potential stormwater impacts resulting from the proposed Starbucks development project in Amesbury, MA, and provides a framework of Best Management Practices (BMP's) for managing stormwater runoff. It also outlines an inspection and maintenance program to ensure continued effectiveness of the proposed stormwater management system. The proposed stormwater system BMP's are shown on the project plans prepared by CHA Consulting, Inc. located at 141 Longwater Drive, Suite 104, Norwell, Massachusetts.

## PROJECT OVERVIEW:

The proposed redevelopment project is located at 37 Clark's Road in Amesbury, MA, on a 2.99-acre lot with an existing Friendly's restaurant and Fairfield Inn Hotel. The project includes demolition of the Friendly's restaurant and construction of a new Starbucks Drive-Thru restaurant with associated parking area and utilities in the northwest corner of the lot. The project design complies with Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards through the use of BMP's detailed within this report. The proposed stormwater system collects runoff from impervious surfaces on the lot, such as the roof of buildings, through the use of deep sump catch basins and an infiltrationn basin on-site.

Appended to this document is a sample maintenance form and a chart describing the anticipated frequency of tasks.

## OWNER AND RESPONSIBLE PARTY:

***Owner:***

Amesbury Lodging Ventures, LLC
11751 East Corning Road
Corning, NY 14830

***Day-to-day Operation and Maintenance:***

Fairfield Inn Hotel

## ON-GOING MAINTENANCE CONTRACT

The non-structural and structural approaches recommended below, 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 operate and maintain the system in perpetuity.

## LIVING DOCUMENT PROVISIONS

Due to the difficulty of identifying all sources of potential stormwater contamination and maintenance activities, this document should be updated as necessary to reflect new procedures, technologies or requirements.

## MAINTENANCE LOG

The Responsible Party will develop and maintain a log of inspections, maintenance, repairs, and disposal (e.g. location of disposal) during the life of the project. Records will be maintained for at least 3 years and be made available to MassDEP or the City of Amesbury in accordance with the provisions of the Massachusetts Stormwater Handbook (February 2008).

## MINIMIZING EXPOSURE

The Responsible Party shall minimize exposure of potential pollutant sources, preventing debris from collecting and entering drains or 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 waters or the stormwater management system.
- Securing any equipment or supplies so that they are not transported during storm events into receiving waters or the stormwater management system.

## BEST MANAGEMENT PRACTICES (BMP) MAINTENANCE

The proposed stormwater management system has been designed with appropriate BMP's aimed at reducing the pollutants discharge based upon the intended use of the proposed development. All BMP's require regular maintenance to function as intended. Some management measures have simple maintenance requirements; others are more involved. The Responsible Party must have all BMP's regularly inspected to ensure they are operating properly on an as-needed basis, including during runoff events exceeding 0.5 inches of rainfall.

The following non-structural and structural Best Management Practices are proposed to be incorporated into the stormwater management design to reduce source runoff and enhance stormwater runoff discharge quality. The Responsible Party will regularly inspect all BMP's 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.

## STRUCTURAL BEST MANAGEMENT PRACTICES:

Prior to final completion and full occupancy of the development, it is recommended that a representative of the Contractor, Manufacturer, and/or Engineer either designing or building the facility for the Owner properly instruct the Responsible Party as to the maintenance practices required to responsibly maintain the effectiveness of the drainage system. These practices and frequencies are recommended to maintain effectiveness in most conditions. Ultimately, 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 recommended by the manufacturer. The following maintenance of structural BMP's will be implemented:

*ROOF DRAIN GUTTERS AND DOWNSPOUTS*

Roof drain gutters and downspouts should be inspected and cleaned twice a year, once in the fall after leaf drop and in the spring after snow melt. Cleaning will take place at the completion of construction and in early spring after snow melt. Any obstructions, sediment, and debris that could potentially cause clogging shall be removed within the roof drain gutter and downspout system as necessary.

*DEEP SUMP CATCH BASINS AND MANHOLE STRUCTURES*

Catch basins shall be cleaned, in dry weather, when half of the sump capacity is filled or at a minimum quarterly or as required through periodic inspection. Cleaning will take place at the completion of construction and in early spring after sanding of roadways has ceased or as needed depending on the frequency of major storm events (greater than 1-inch of rainfall). All manholes shall be inspected at least once annually. Any obstructions, sediment, and debris that could potentially cause clogging shall be removed within the conveyance system as necessary. Inverts, grates, and hoods shall be checked and replaced as necessary to maintain hydraulic effectiveness.

**NON-STRUCTURAL BEST MANAGEMENT PRACTICES:**

*STREET/PARKING LOT SWEEPING*

This practice, considered by MassDEP to be a non-structural BMP, provides effective removal of Total Suspended Solids (TSS) in a comprehensive stormwater management program. A maintenance program of roadway/driveway sweeping with a High Efficiency Vacuum Sweeper or a Regenerative Air Sweeper to reduce sediment accumulation in the deep sump catch basins and infiltration basin shall be implemented based on the owner's discretion. Sweeping can be conducted on a quarterly basis (primarily during the spring and fall) to keep low impact BMP's operating effectively.

*GRADING*

The impervious areas of the site shall be graded as gently as possible, generally not more than 6% slopes, to reduce runoff velocities. Steep slopes will be permanently vegetated to dissipate energy and reduce potential erosion. No constructed vegetated slopes shall exceed 3H:1V without providing additional reinforcement. Steep slopes may require soil reinforcement and additional vegetation.

*SNOW STORAGE AND DEICING*

Snow storage will be located adjacent to parking area as indicated on the plans. In the event of a large snow event that exceeds snow storage on the site, snow will be removed and hauled off-site.

*WASTE MANAGEMENT:*

Solid waste will be contained within dumpsters. Waste deposition in these receptacles will be consistent with state and local permits. The covers and doors of the dumpsters will be kept closed to limit rainwater and wildlife intrusion.

**LONG-TERM OPERATION AND MAINTENANCE BUDGET:**

Consistent with Standard 9 of the MassDEP Stormwater Handbook the approximate cost of inspections and maintenance based on the above-mentioned activities and frequencies is as follows:

- Pavement Sweeping - $3,000 per year based on annual sweepings.
- Deep Sump Catch Basins and Manholes - inspection/cleaning - $1,000 per year/per catch basin (or manhole) based on quarterly inspections and sediment removal of both single and double grate deep sump catch basins.
- Infiltration Basin - inspection - $1,000 per year based on semi-annual inspections. Cleaning/debris removal - $1,000 per year for accumulated sediment and trash removal.

Additional costs may be incurred if it is determined during routine inspections of the BMP's that further corrective actions are necessary.

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Catch Basin | Quarterly | | ☑ | ☑ | ☑ | ☑ | ☑ | | | | | ☑ | |
| Manholes | Quarterly | | ☑ | ☑ | ☑ | ☑ | ☑ | | | | | ☑ | |
| Roof Drain Gutters and Downspouts | Semi-Annual | | ☑ | ☑ | ☑ | ☑ | ☑ | | | | | ☑ | |
| Infiltration Basin | Semi-Annual | ☑ | ☑ | ☑ | | ☑ | ☑ | ☑ | ☑ | | | ☑ | |

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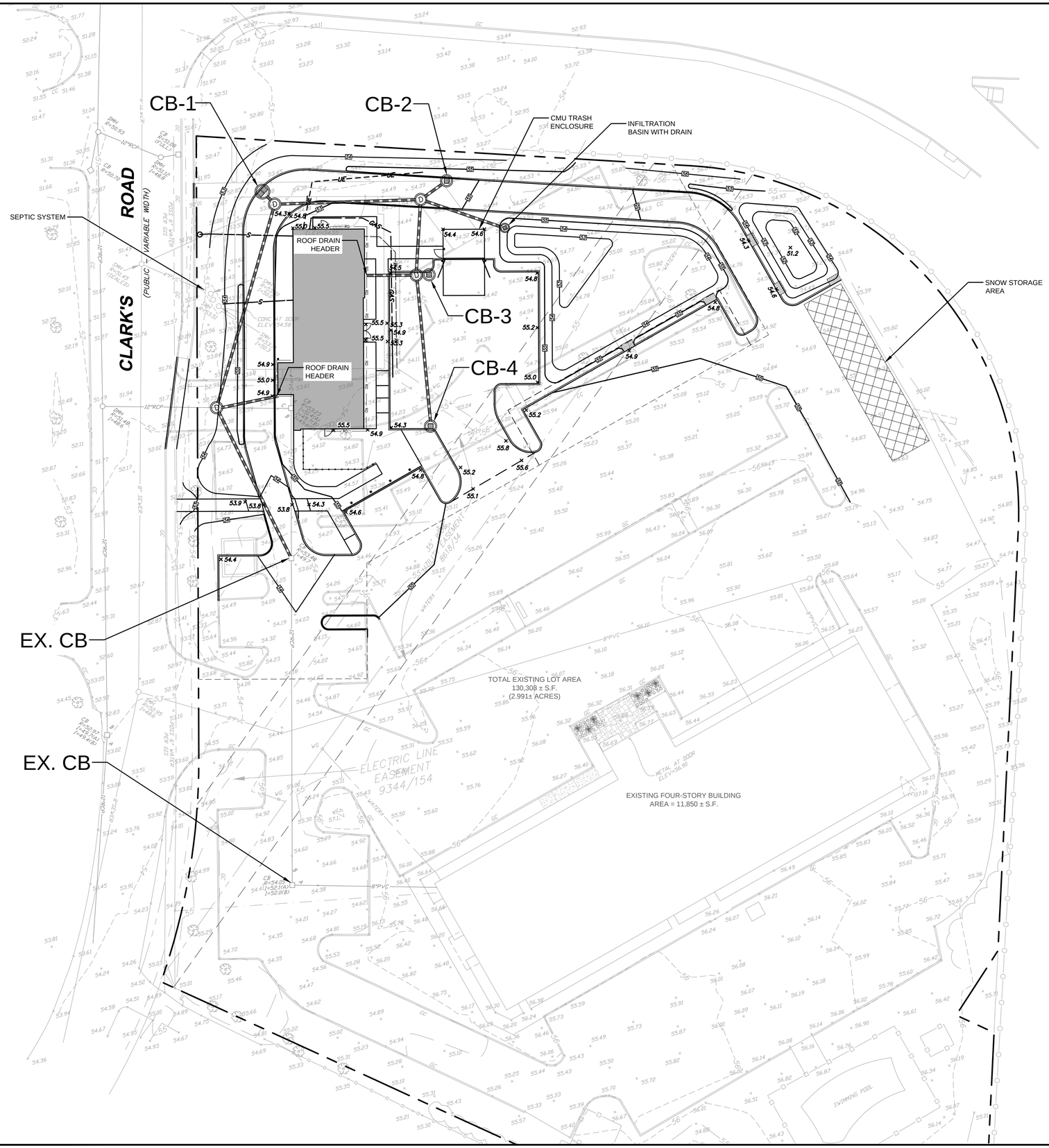
Instructions: Record all inspections and maintenance for all treatment BMPs on this form. Use additional log sheets and/or attach extended comments or documentation as necessary.

- 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.






CHA
141 Longwater Drive, Suite 104
Norwell, MA 02061-1620
781-982-5400 . www.chasolutions.com

0 20 40
Scale in feet

OWNER/ APPLICANT:

AMESBURY LODGING VENTURES LLC

11751 EAST CORNING ROAD
CORNING, NY 14830

COMMONWEALTH OF MASSACHUSETTS
DONALD A. ROSE
CIVIL
No. 49983
REGISTERED PROFESSIONAL ENGINEER
12/17/2024



PROPOSED STARBUCKS DRIVE-THRU

37 CLARK'S ROAD
AMESBURY, MA
01913

| No. | Submittal / Revision | App'd | By | Date |
|---|---|---|---|---|
| | | | | |
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OPERATION AND MAINTENANCE PLAN

| Designed By: | Drawn By: | Checked By: |
|---|---|---|
| DR | JAS | DR |
| Issue Date: | Project No: | Scale: |
| 06/27/2024 | 081088 | 1" = 20' |

Drawing No.:
O & M

File: W:\PROJECTS\ANY\K6\081088.000\09_DESIGN\DRAWINGS\01_SHEETS\081088_C-201 GRADING & DRAINAGE.DWG
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# CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN
# STORMWATER STANDARD 8

## INTRODUCTION:

This Construction Period Pollution Prevention Operation and Maintenance Plan has been created for the Starbucks located at 37 Clark's Road, Amesbury, MA. The goals of this CPOM (Construction Period O&M) are to detail the structural and non-structural practices selected to control erosion associated with surface stormwater discharges during construction and increase pollution attenuation after construction has been completed. Stormwater Best Management Practices (BMP's) have been incorporated into the design and will be implemented during construction to attenuate potential pollutants, dampen peak flow velocities, and prevent erosion. The format of this Plan follows the framework detailed as required by Standard 8 of the Stormwater Handbook.

## NARRATIVE:

The Applicant, Amesbury Lodging Ventures LLC, proposes to develop a new Starbucks Drive-Thru restaurant to replace the existing Friendly's restaurant on a portion of the property. The proposed redevelopment project is located within previously disturbed areas. The site consists of one parcel with two existing buildings, a Fairfield Inn Hotel and the Friendly's building and includes a parking, landscape, and other amenities. The proposed building has an approximate footprint of 2,374 square-feet and provides indoor and outdoor seating. The proposed project includes modified landscape areas, relocated parking spaces, and a shared access driveway.

The drainage system on the site is comprised of closed-conveyance pipe system which will collect and convey stormwater runoff from paved surfaces and roof area via deep sump catch basins and an on-site infiltration basin. The proposed systems will attenuate peak rates of runoff and meet state stormwater standards listed in the 2008 Massachusetts Stormwater Handbook. Refer to the site plans for additional information. The project will be serviced with utilities, including sewer and electric services.

## PARTY RESPONSIBLE FOR COMPLIANCE

***Owner:***

Amesbury Lodging Ventures, LLC
11751 East Corning Road
Corning, NY 14830

**Area of Control:** Amesbury Lodging Ventures, LLC has operational control over the construction plans and specifications for the project and has the ability to make modifications to the plans and specifications.

***Construction Manager or Site Supervisor:***

**TO BE DETERMINED**

**Area of Control:** A construction manager with adequate knowledge and experience on projects of similar size and scope shall be employed to oversee all site 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 (filter socks and silt fence, etc.), BMPs for collecting and treating runoff and groundwater during construction[1], 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 top of buried utilities or drain or chambers.

## GOOD HOUSEKEEPING PRACTICES DURING CONSTRUCTION

The Construction Manager 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. This 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 includes: material storage areas, vehicle and equipment maintenance areas, 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 removal of trash. 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.

## MINIMIZING EXPOSURE DURING CONSTRUCTION

The Responsible Party shall minimize exposure of potential pollutant sources, including debris from

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[1] 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 set 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.

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 that they are not transported during storm events into receiving waters or stormwater management system.

**BEST MANAGEMENT PRACTICES (BMP) MAINTENANCE**

The proposed stormwater management system has been designed with appropriate BMPs aimed at reducing the pollutants discharge based upon the intended use of the proposed development. All BMPs require regular maintenance to function as intended. Some management measures have simple maintenance requirements; others are more involved. The Construction Manager must have all BMPs regularly inspected weekly or after events exceeding 0.25 inches of rainfall to ensure the BMPs are operating properly.

The Construction Manager shall develop and maintain a log of inspections, maintenance, repairs, and disposal (including location of disposal) during the life of the project. Records will be maintained for at least 3 years and be made available to the Massachusetts Department of Environmental Protection or the City of Amedbury in accordance with the provisions of the Massachusetts Stormwater Handbook.

A description of the non-structural and structural approaches to be incorporated is indicated below. The following Best Management Practices are proposed to be incorporated into the stormwater management design to reduce source runoff and improve stormwater runoff discharge quality. 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.

**EROSION AND SEDIMENT CONTROLS:**

Erosion and sedimentation (ESC) measures will be installed as indicated on the site plans prior to the commencement of any construction activities and will be maintained throughout construction until the site is stabilized. ESC controls, in the form of 12-inch compost filter socks, temporary soil and stockpile areas, temporary sediment basins and drain inlet protection will be installed in accordance with project plans and details, as well as any other current State, and Local requirements. ESC measures will be incorporated into the project as needed by the contractor to control runoff and prevent impact to areas which are to remain undisturbed.

ESC measures will be maintained and/or replaced as inspection deems necessary and or as directed by the Engineer, Architect, or Environmental Inspector. Sediment accumulations along ESC measures to a depth of 6-inches or more shall be removed and re-distributed to an area in manner that does not contribute to additional sediment migration. Contractors who disturb ESC measures will be required to repair/replace them and should inform the engineer or environmental inspector of

deficiencies with ESC measures observed in the field.

Refer to the plans for locations of sediment controls.

*PERIMETER CONTROLS*

Perimeter sediment and stormwater controls consist of silt fence or compost filter socks which must be installed prior to commencement of earth disturbing activities at the site. Perimeter controls must be installed along the contour in the flattest area possible at a distance from the toe of slope; ends shall be placed up slope from the rest of the control. Perimeter controls must also be used around soil stockpiles as a sediment control measure.

Perimeter measures will be maintained and/or replaced as inspection deems necessary and or as directed by the Engineer, Architect, or Environmental Inspector. Sediment accumulations along the perimeter measures to a depth of 6-inches or more shall be removed and re-distributed to an area in manner that does not contribute to additional sediment migration. Contractors who disturb ESC measures will be required to repair/replace them and should inform the engineer or environmental inspector of deficiencies with ESC measures observed in the field.

*SEDIMENT TRACK OUT*

Construction vehicles are anticipated to utilize the designated access drives, and construction entrances will be established at various points of entry into the construction zone. Construction entrance locations may be relocated as needed during different phases of the construction. Property entrance/exit locations will be maintained in a condition that will prevent tracking or flowing of sediment onto public roadways. The construction entrances will be inspected daily by the Site Supervisor. Fines imposed for tracking sediment onto public roads will be paid by the culpable Contractor.

All materials spilled, tracked, or otherwise transported onto public road rights-of-way will be immediately removed. Remove the track-out by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal. It is prohibited from hosing or sweeping tracked-out sediment into any stormwater conveyance, storm drain inlet, or water of the U.S.

*STREET SWEEPING*

During the construction period, streets will be swept on an as-needed basis after all significant earth moving activities to remove pollutants and sediments that have accumulated.

STOCKPILED SEDIMENT OR SOIL

All inactive/temporary soil stockpiles will be protected with erosion controls and temporarily seeded, mulched, or covered with plastic if not reused within 14 days. Long-term stockpiles may be compacted and hydro-seeded/mulched prior to the onset of wet weather. Temporary soil stockpiles shall be located within the active construction work area and be surrounded by an approved siltation barrier.

Any exposed soils/disturbed areas where construction activity ceases for 14 or more calendar days will be temporarily stabilized with seed, mulch or a bonded-fiber mix or other approved erosion control material unless the area is covered with snow or unless work in the area is expected to resume within 21 days. This will be done on all slopes as well as exposed flat surfaces as deemed necessary. Straw material will be applied uniformly across disturbed areas to minimize erosion. Routine inspection and maintenance of stabilization practices will reduce soil erosion and minimize project runoff.

For any stockpiled or land clearing debris composed, in whole or in part, of sediment or soil, the following measures must be followed:

Locate the piles outside of any natural buffers established and physically separated from other stormwater controls implemented and as noted on the Plans;

- Protect from contact with stormwater (including run-on) using a temporary perimeter sediment barrier;
- Provide cover or appropriate temporary stabilization to avoid direct contact with precipitation or to minimize sediment discharge;
- Do not hose down or sweep soil or sediment accumulated on pavement or other impervious surfaces into any stormwater conveyance (unless connected to a sediment basin, sediment trap, or similarly effective control), storm drain inlet, or surface water; and
- Unless infeasible, contain and securely protect from wind.

*MINIMIZE DUST*

Dust control is important for controlling air quality on and off site during various phases of construction. Dust control will be provided on an as-needed basic during construction. Sprinkle irrigation using tanker trucks is effective to control dust from gravel/dirt haul roads and during earth-moving/grading phases of site preparation. On exposed soils where vehicular traffic is not expected and/or completed, vegetative cover and/or mulching can be used to stabilize soils. Stone graded out over exposed areas where vegetation cannot be established can be effective along high traffic areas. Dust shall be monitored regularly onsite and treated as necessary.

The following dust suppression methods may be used at the project:

- Watering/Irrigation: Sprinkling the ground surface with water until it is moist.
- Soil Stabilization: Vegetative cover, mulch, riprap or any method that covers the soil surface reduces the potential for soil particles to become airborne.
- Wind Breaks: Wind breaks are barriers (either natural or constructed) that reduce wind velocity across exposed soil surfaces and reduces the potential for soil particles become airborne. Wind breaks can be trees or shrubs left in place during site clearing or constructed barriers such as a wind fence.

If additional dust control measures are required, the situation will be assessed and addressed.

*TOPSOIL*

Where disturbance to native topsoil will occur at the site, unless infeasible, it must be preserved and reused. Existing and new vegetation will be maintained to the maximum extent practicable to prevent the contamination of storm water with sediment. Vegetated areas beginning to show signs of erosion or soil transport will be mulched or covered with jute netting or a comparable erosion control fabric to filter stormwater runoff prior to conveyance into the stormwater drainage system.

*SOIL COMPACTION*

In areas where final vegetative stabilization will occur or where infiltration practices (post development stormwater management system) will be installed either of the following measures must be followed by the Contractor:

- Restrict vehicle and equipment use and stockpile of materials in these locations to avoid soil compaction.
- Prior to seeding or planting areas of exposed soil that have been compacted, use techniques that condition the soils to support vegetative growth, if necessary.

*STORM DRAIN INLETS*

Catch basins and area drains associated with the existing and/or proposed stormwater management system located within the project limits and the adjacent Right-of-Ways may collect and convey sediment and sediment-laden stormwater runoff. Therefore, all catch basins and area drains, existing and proposed, within construction zones, will be protected with silt sacks during construction and until final site stabilization is complete.

*SEDIMENT BASINS*

The removal and disposal of collected water from construction areas is a potential source of sediment and can lead to erosion during construction activities. Temporary sedimentation basins shall be constructed according to the site plans and EPA regulations. The temporary sedimentation basins shall be monitored daily. Stormwater shall be directed towards the existing pipe conveyance system to help prevent overflow from leaving the construction work area.

Temporary sediment basins/traps are instrumental in controlling sediment-laden stormwater runoff during initial phases of construction involving earthmoving activities before permanent stormwater management systems are in place. Sediment basins and traps will be constructed in accordance with Environmental Protection Agency (EPA) guidelines. Sediment traps should have a minimum volume, based on 0.5-inch of storage for each acre of drainage area. Temporary sedimentation basins/traps shall be monitored daily. Stormwater shall be directed towards the existing conveyance system to help prevent overflow from leaving the construction work area.

*ROOF DRAIN GUTTERS AND DOWNSPOUTS*

Roof drain gutters and downspouts should be inspected once during construction and at the completion of construction. Cleaning will take place at the completion of construction and if

applicable, in early spring after snow melt. Any obstructions, sediment, and debris that could potentially cause clogging shall be removed within the roof drain gutter and downspout system as necessary.

*DEEP SUMP CATCH BASINS AND MANHOLE STRUCTURES*

Catch basins and catch basin filter sacks shall be cleaned, in dry weather, when half of the sump capacity is filled or as required through inspection per the Inspection and Maintenance schedule (see section below). Cleaning will take place at the completion of construction or as needed depending on the frequency of major storm events (greater than 1-inch of rainfall). All manholes shall be inspected per the inspection and maintenance schedule (see section below) during construction and cleaned upon the completion of construction. Any obstructions, sediment, and debris that could potentially cause clogging shall be removed within the conveyance system as necessary. Inverts, grates, and hoods shall be checked and replaced as to maintain hydraulic effectiveness.

**INSPECTION AND MAINTENANCE SCHEDULE**

At a minimum, the Contractor must conduct a site inspection at least once every 7 calendar days.
OR
Once every 14 calendar days and within 24 hours of the occurrence of a storm event of 0.5 inches or greater. To determine if a storm event of 0.5 inches or greater has occurred on the site, either keep a properly maintained rain gauge on the site or obtain the storm event information from a weather station that is representative of your location.

**VEGETATIVE PLANNING**

The Contractor must immediately initiate soil stabilization measures whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the site. Earth-disturbing activities have temporarily or permanently ceased when clearing, grading and excavating within any area of the site that will not include permanent structures, will not resume for a period of 14 or more calendar days, but will resume in the future.

Deadline to complete stabilization. As soon as practicable, but no later than 14 calendar days after the initiation of soil stabilization measures the following must be completed:

- For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized; and/or
- For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

Seed shall be sown from April 1 to June 15, or from August 15 to September 30 unless otherwise approved by the Engineer. Deciduous planting season is April 1 to May 20 and October 1 to November 15th unless otherwise approved by the Engineer. Evergreen planting season is April 1 to May 20 unless otherwise approved by the Engineer.

**CONSTRUCTION SEQUENCING:**

The following section provides construction details and highlights the construction sequence and timing of earthmoving activities. The overall project will be broken down into the following phases:

- Establish Erosion and Sediment Controls around the project site
- Demolition (ex. building, structures, driveways, septic systems)
- Site clearing and grading, drainage, utility, and roadway installation
- Building construction
- Final utility connections, and permanent stabilization

A. Pre-construction Meeting
An on-site meeting will be conducted by the Owner's Representative prior to the start of construction activity.

B. Installation of Erosion Controls
Erosion and sedimentation controls (i.e. silt fence, filter sock, and inlet protection) will be installed at the limits of work and within the existing catch basins, as applicable. Tree protection will be installed around trees specified to remain within the limit of work. Structures to remain shall also be visibly flagged/protected.

C. Installation of Construction Entrance
A construction entrance will be installed in the location as shown on the Erosion Control Plan in accordance with the construction detail provided in the plan set. Existing pavement will be removed within the limits of the proposed construction entrance to accommodate the crushed stone entrance.

D. Installation of Temporary Sediment Basins
Temporary sediment basins will be installed as shown on the plans with vertical 12" perforated pipe wrapped with filter fabric and screen on top for overflow. Side slopes of the temporary sediment basins shall be 3 foot horizontal to 1 foot vertical. Sediment to be removed when accumulation is within 6" of the outlet elevation.

E. Demolition
Any existing building, utilities services, and pavement within the project area will be demolished in accordance with the Construction Plans. Those utilities effected by construction activates shall be coordinated with the utility purveyors and Dig Safe procedures taken prior to implementation of agreed upon connections/ disconnections/ abandonment of services. Materials that are to be removed from the site will be transported to an appropriate facility or will be disposed of elsewhere according to Federal, State, and Local guidelines. Inactive stockpiles or areas of granular material or topsoil shall be temporarily secured to control sediment laden runoff.

F. Site Clearing and Rough Grading
The site will be cleared and rough graded in accordance with the proposed grading as shown on the plans. If suitable topsoil is found, it will be removed and stockpiled within the project limits. Areas which have been cleared (outside of the right-of-way) will be stabilized.

G. Installation of Drainage and Utilities
Utility relocations and modifications, including water, gas, and electric, are anticipated to

occur in conjunction with the drainage work. Temporary sediment basins will be constructed at this time on an as-needed basis to collect stormwater runoff during construction. Stockpiles will be established in designated areas as shown on project plans. All temporary/inactive stockpile areas will be encompassed by filter sock and silt fence or other approved erosion control devices to control sediment laden runoff as necessary and will be temporarily seeded, mulched or covered with plastic, as necessary.

H. Building Construction
This phase of construction will involve the installation of the building including the proposed foundation and vertical construction of the building. All building waste is to be properly disposed of in dumpsters. While this phase commences, other site construction activities will be taking place.

I. Fine Grading, Paving, Etc.
The fine grading and shaping will commence along with the installation of curbing to prepare for paving operations. Areas outside of the parking lot will be shaped and prepped for loam, seed, or other treatments. Paving operations will begin with the installation of both binder and finish course layers.

J. Permanent / Final Site Stabilization
The final phase of the project consists of landscaping and restoration and stabilization of all exposed surfaces. Final landscaping will be performed upon completion of earthwork and completion of all curbing and sidewalk construction. Disturbed areas will be landscaped, mulched or seeded in accordance with the landscape requirements. Permanent restoration and revegetation measures serve to control erosion and sedimentation by establishing a vegetative cover. In the event that weather conditions prevent final restoration, temporary erosion and sedimentation measures will be employed until the weather is suitable for final cleanup. A final inspection will ensure that the project site is cleared of all project debris and that erosion and sedimentation controls are functioning properly. Once the site has been stabilized, newly installed catch basins and the subsurface infiltration and detention systems will be inspected for sediment deposits and cleaned if necessary.

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Catch Basin | Quarterly | | ☑ | ☑ | ☑ | ☑ | ☑ | | | | | ☑ | |
| Manholes | Quarterly | | ☑ | ☑ | ☑ | ☑ | ☑ | | | | | ☑ | |
| Roof Drain Gutters and Downspouts | Semi-Annual | | ☑ | ☑ | ☑ | ☑ | ☑ | | | | | ☑ | |
| Infiltration Basin | Semi-Annual | ☑ | ☑ | ☑ | | ☑ | ☑ | ☑ | ☑ | | | ☑ | |

## CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

## CONSTRUCTION LOG FORM

**Amesbury, Massachusetts**

***RESPONSIBLE PARTY*** _____

| AREA OF PROJECT WITH CONSTRUCTION | DATE(S) OF MAJOR GRADING ACTVITY | DATE(S) WHEN CONSTRUCTION TEMPORARILY OR PERMANENTLY CEASED | DATE(S) WHEN STABILIZING MEASURES WERE INITIATED | DATE AND INITIAL |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

## INSPECTION AND MAINTENANCE REPORT

### Starbucks
### Amesbury, Massachusetts

| General Information | | | |
|---|---|---|---|
| **Project Name** | | | |
| **Location** | | | |
| **Date of Inspection** | | **Start/End Time** | |
| **Inspector's Name(s)** | | | |
| **Inspector's Title(s)** | | | |
| **Inspector's Contact Information** | | | |
| **Inspector's Qualifications** | | | |
| **Describe present phase of construction** | | | |
| **Type of Inspection:**<br>❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event | | | |
| **Weather Information** | | | |
| **Has there been a storm event since the last inspection?** ❑Yes ❑No<br>**If yes, provide:**<br>Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in): | | | |
| **Weather at time of this inspection?**<br>❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds<br>❑ Other: Temperature: | | | |
| **Have any discharges occurred since the last inspection?** ❑Yes ❑No<br>**If yes, describe:** | | | |
| **Are there any discharges at the time of inspection?** ❑Yes ❑No<br>**If yes, describe:** | | | |

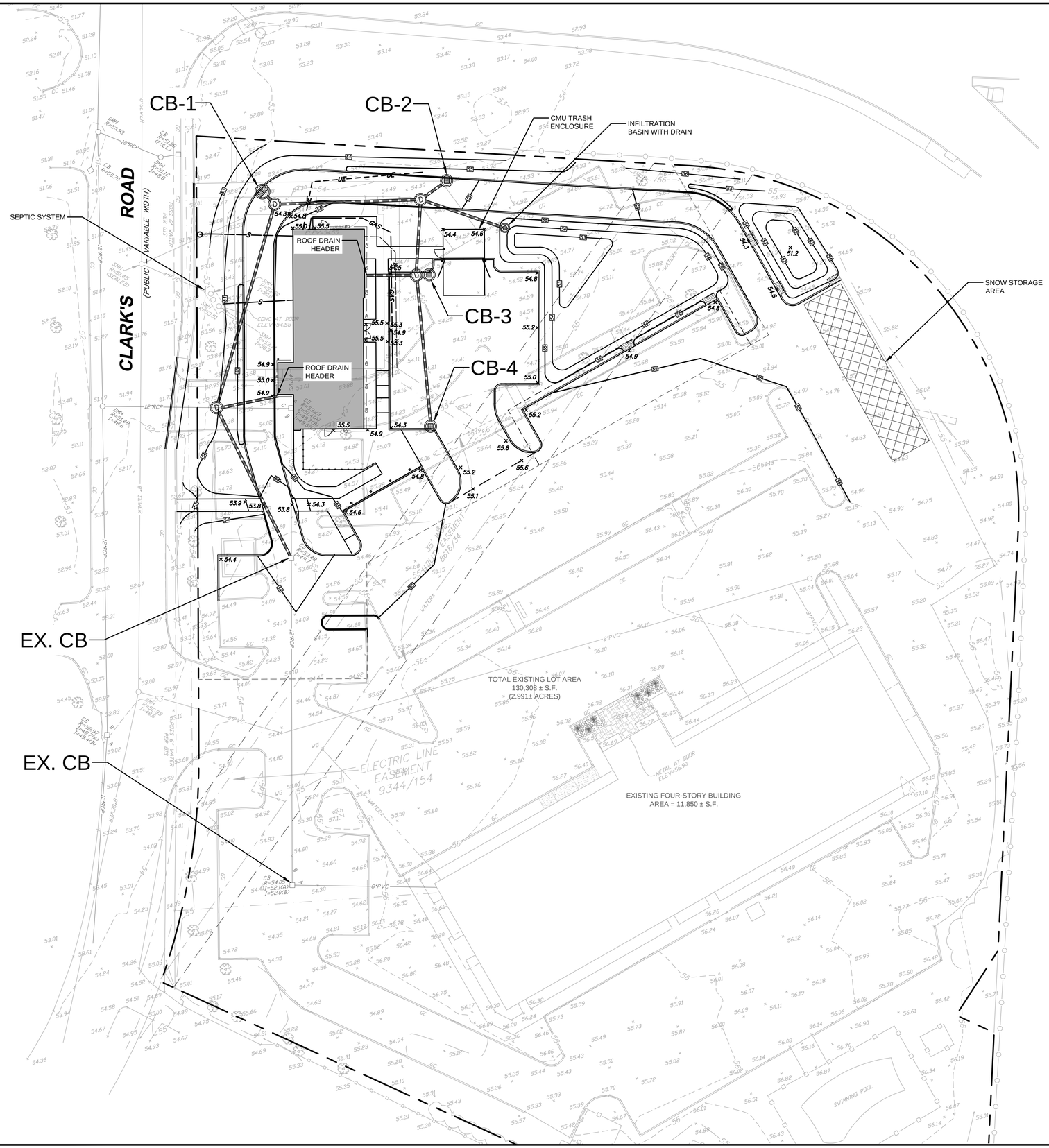
| | BMP | BMP Installed? | BMP Maintenance Required? | Corrective Action Needed and Notes |
|---|---|---|---|---|
| 1 | | ❑Yes ❑No | ❑Yes ❑No | |
| 2 | | ❑Yes ❑No | ❑Yes ❑No | |
| 3 | | ❑Yes ❑No | ❑Yes ❑No | |
| 4 | | ❑Yes ❑No | ❑Yes ❑No | |
| 5 | | ❑Yes ❑No | ❑Yes ❑No | |
| 6 | | ❑Yes ❑No | ❑Yes ❑No | |
| 7 | | ❑Yes ❑No | ❑Yes ❑No | |
| 8 | | ❑Yes ❑No | ❑Yes ❑No | |
| 9 | | ❑Yes ❑No | ❑Yes ❑No | |
| 10 | | ❑Yes ❑No | ❑Yes ❑No | |
| 11 | | ❑Yes ❑No | ❑Yes ❑No | |
| 12 | | ❑Yes ❑No | ❑Yes ❑No | |
| 13 | | ❑Yes ❑No | ❑Yes ❑No | |
| 14 | | ❑Yes ❑No | ❑Yes ❑No | |
| 15 | | ❑Yes ❑No | ❑Yes ❑No | |
| 16 | | ❑Yes ❑No | ❑Yes ❑No | |
| 17 | | ❑Yes ❑No | ❑Yes ❑No | |
| 18 | | ❑Yes ❑No | ❑Yes ❑No | |
| 19 | | ❑Yes ❑No | ❑Yes ❑No | |
| 20 | | ❑Yes ❑No | ❑Yes ❑No | |

| | BMP/activity | Implemented? | Maintenance Required? | Corrective Action Needed and Notes |
|---|---|---|---|---|
| 1 | Are all slopes and disturbed areas not actively being worked properly stabilized? | ❑Yes ❑No | ❑Yes ❑No | |
| 2 | Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs? | ❑Yes ❑No | ❑Yes ❑No | |
| 3 | Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained? | ❑Yes ❑No | ❑Yes ❑No | |
| 4 | Are discharge points and receiving waters free of any sediment deposits? | ❑Yes ❑No | ❑Yes ❑No | |
| 5 | Are storm drain inlets properly protected? | ❑Yes ❑No | ❑Yes ❑No | |
| 6 | Is the construction exit preventing sediment from being tracked into the street? | ❑Yes ❑No | ❑Yes ❑No | |
| 7 | Is trash/litter from work areas collected and placed in covered dumpsters? | ❑Yes ❑No | ❑Yes ❑No | |

| | BMP/activity | Implemented? | Maintenance Required? | Corrective Action Needed and Notes |
|---|---|---|---|---|
| 8 | Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained? | ❑Yes ❑No | ❑Yes ❑No | |
| 9 | Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material? | ❑Yes ❑No | ❑Yes ❑No | |
| 10 | Are materials that are potential stormwater contaminants stored inside or under cover? | ❑Yes ❑No | ❑Yes ❑No | |
| 11 | Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled? | ❑Yes ❑No | ❑Yes ❑No | |
| 12 | (Other) | ❑Yes ❑No | ❑Yes ❑No | |

**Non-Compliance**

| Describe any incidents of non-compliance not described above: |
|---|
| |






CHA
141 Longwater Drive, Suite 104
Norwell, MA 02061-1620
781-982-5400 . www.chasolutions.com

0 20 40
Scale in feet

OWNER/ APPLICANT:

AMESBURY LODGING VENTURES LLC

11751 EAST CORNING ROAD
CORNING, NY 14830

COMMONWEALTH OF MASSACHUSETTS
DONALD A. ROSE
CIVIL
No. 49983
REGISTERED PROFESSIONAL ENGINEER
12/17/2024



PROPOSED STARBUCKS DRIVE-THRU

37 CLARK'S ROAD
AMESBURY, MA
01913

| No. | Submittal / Revision | App'd | By | Date |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

OPERATION AND MAINTENANCE PLAN

| Designed By: | Drawn By: | Checked By: |
|---|---|---|
| DR | JAS | DR |
| Issue Date: | Project No: | Scale: |
| 06/27/2024 | 081088 | 1" = 20' |

Drawing No.:
O & M

File: W:\PROJECTS\ANY\K6\081088.000\09_DESIGN\DRAWINGS\01_SHEETS\081088_C-201 GRADING & DRAINAGE.DWG
Saved: 6/28/2024 8:31:58 AM Plotted: 6/28/2024 8:32:08 AM Current User: Sanchez, Jasmin Last Saved By: 7940

# APPENDIX E

## Stormwater Management Calculations

Water Quality
Total Suspended Solids Removal Calculations
Required Recharge Volume
Drawdown Time Calculations
Illicit Discharge Statement

## WATER QUALITY

The water quality volume has been calculated based on 1-inch of rainfall over the net new impervious area proposed on site. The calculation is shown below per Massachusetts standards. Note that the impervious areas are on-site and do not include off-site areas.

| | | |
|---|---|---|
| **Existing Impervious** | **= 89,000 sq. ft.** | **= 2.04 ac.** |
| **Proposed Impervious** | **= 85,087 sq. ft** | **= 1.95 ac** |
| **Net New Impervious On-Site** | **= -3,913 sq. ft.** | **= -0.090 ac.** |

WQV (Water Quality Volume) based on a 1-inch rainfall event.

**Required WQV = (1”/12”) ft. x (-3,913) sq. ft. = 0 cu. ft.**

The City of Amesbury Subdivision Rules and Regulations (2020) provides stormwater management design requirements in which the system must be designed to retain a minimum runoff volume equivalent to 0.8-inches of the total impervious surface area on the site post-construction. The project proposes to enhance water quality and maximize recharge volume to groundwater to the extent practicable.

Stormwater Management Calculations presented below are for required recharge volume and the volumetric capacity of each of the three depression areas.

**Required Volume = (0.8”/12”) ft. x (85,087) sq. ft. = 5,672 cu. ft.**

**Infiltration Basin Volume (below elevation 54.6) = 3,504 cu. ft.**

**Depression 1 Volume (below elevation 54.3) = 1,452 cu. ft.**

**Depression 2 Volume (below elevation 54.5) = 953 cu. ft.**

**Total Volume Provided = 5,909 cu. ft.**

**Refer to O&M Plan for location of the depressions and drainage structures (Appendix D).**

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: Catch Basin

**TSS Removal Calculation Worksheet**

| A<br>BMP[1] | B<br>TSS Removal Rate[1] | C<br>Starting TSS Load* | D<br>Amount Removed (B*C) | E<br>Remaining Load (C-D) |
|---|---|---|---|---|
| **Catch basin** | **0.25** | **1.00** | **0.25** | **0.75** |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Total TSS Removal =** **25%**

Project: **Amesbury Starbucks**

Prepared By: **DR**

Date: **5/20/2024**

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

INSTRUCTIONS:

*Non-automated: Mar. 4, 2008*

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

Location: Infiltration Basin

## TSS Removal Calculation Worksheet

| A<br>BMP[1] | B<br>TSS Removal Rate[1] | C<br>Starting TSS Load* | D<br>Amount Removed (B*C) | E<br>Remaining Load (C-D) |
|---|---|---|---|---|
| **Infiltration Basin with Stone Diaphragm** | **0.80** | **1.00** | **0.80** | **0.20** |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Total TSS Removal =** **80%**

Project: **Amesbury Starbucks**

Prepared By: **DR**

Date: **5/20/2024**

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

## RECHARGE

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 is a redevelopment and subject to the Recharge Standard to the extent practicable.

Soils on the site consist of hydrologic soil group (HSG) "A" based on the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), Soil Survey of Essex County. Soils within the property are classified as: Deerfield loamy fine sand (0 to 3 percent slopes). HSG "A" was utilized for the area,

The project has been designed to integrate a recharge BMP consisting of an infiltration basin to collect stormwater runoff from a portion of the parking lot. All other stormwater runoff is collected through the use of catch basins and a closed conveyance system.

The following equation can be used to determine the Required Recharge Volume.

*Rv = F x increase in impervious area* (Equation 1) Volume 3, Ch 1, page 15

*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 (does not include off-site impervious) and the calculated *Required Recharge Volume*.

| | | |
|---|---|---|
| Existing Impervious | = 89,000 sq. ft. | = 2.04 ac. |
| Proposed Impervious | = 85,087 sq. ft | = 1.95 ac |
| Net New Impervious On-Site | = -3,913 sq. ft. | = -0.090 ac. |

***There is less impervious area proposed than in the existing conditions, therefore, no recharge is required.***

*Impervious Areas Tributary to Systems*

Infiltration Basin = 6,935 sq. ft. = 0.159 ac.

*Storage volume in infiltration basin below invert out is 3,504 cubic ft.*

***Conclusion:***

*Hence, the storage available within the infiltration basin is greater than the Required Recharge Volume:*

***3,504 cu. ft. >> 0 cu. ft.***

The recharge volume provided by the proposed infiltration basin greatly exceeds the Required Recharge Volume for the site. The project's stormwater management system satisfies Standard 3 of the MassDEP Stormwater Regulations.

# DRAWDOWN TIME

Below are the drawdown time calculations for the recharge systems proposed on the site. The calculation uses an estimated hydraulic conductivity value "*K*." Soils on the site consist of soils from hydrologic soil groups (HSG) "A" based on the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), Soil Survey of Essex County. Soils within the property are classified as Deerfield loamy fine sand (0 to 3 percent slopes). Soil Data is located in Appendix F.

A reasonable value of a conservative hydraulic conductivity "K" of 0.5 inches per hour which corresponds to HSG "B" loam was selected for the basis of design.

The formula below is the recommended method of calculating drawdown times from the Massachusetts Stormwater Management Handbook

**DRAWDOWN TIME CALCULATION**

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

Where:
*Rv* = Storage Volume
*K* = Saturated Hydraulic Conductivity, Rawls Rate
*Bottom Area* = Bottom Area of Recharge Structure

See the following Drawdown Calculation table for infiltration rates, bottom area, and drawdown times.

**Drawdown Calculation**

| *Recharge BMP* | *Infiltration Rate (in/hr) k* | *Storage Volume (c.f.) Rv* | *Bottom Area (s.f.)* | *Draw Down Time (hrs.)* |
|---|---|---|---|---|
| *Infiltration Basin* | *0.5* | *3,504* | *2,727* | *30.8* |

**Conclusion:**

The calculations show that the drawdown times for the infiltration BMP is less than 72 hours, as required.

# 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 CHA, 141 Longwater Drive, Suite104, Norwell, Massachusetts 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: Donald Rose, P.E.
(please print)

Company: CHA Consulting, Inc.

# APPENDIX F

## Soil Data

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

# Custom Soil Resource Report for Essex County, Massachusetts, Northern Part


March 20, 2024

# Preface

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

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

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

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

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

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

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# Contents

# How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

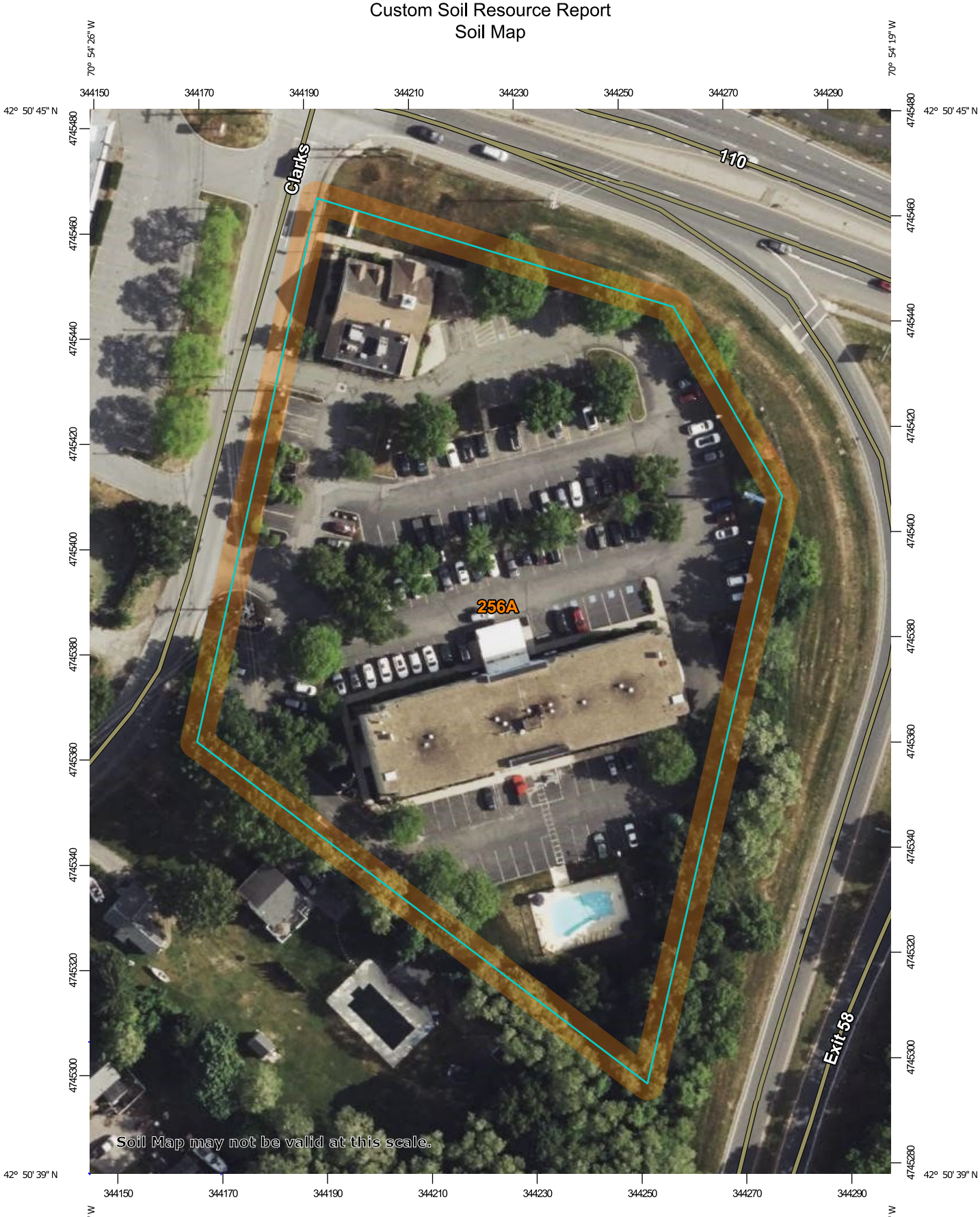
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

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

# Custom Soil Resource Report
## Soil Map




Map Scale: 1:985 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

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

**Water Features**
- Streams and Canals

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

**Background**
- Aerial Photography

## MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 19, Sep 10, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 256A | Deerfield loamy fine sand, 0 to 3 percent slopes | 2.9 | 100.0% |
| **Totals for Area of Interest** | | **2.9** | **100.0%** |

# Map Unit Descriptions

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

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

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

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

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

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

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

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

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

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

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

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

# Essex County, Massachusetts, Northern Part

## 256A—Deerfield loamy fine sand, 0 to 3 percent slopes

### Map Unit Setting

*National map unit symbol:* 2xfg8
*Elevation:* 0 to 1,100 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 145 to 240 days
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

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

### Description of Deerfield

#### Setting

*Landform:* Outwash terraces, outwash deltas, outwash plains, kame terraces
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Concave, convex, linear
*Across-slope shape:* Convex, linear, concave
*Parent material:* Sandy outwash derived from granite, gneiss, and/or quartzite

#### Typical profile

*Ap - 0 to 9 inches:* loamy fine sand
*Bw - 9 to 25 inches:* loamy fine sand
*BC - 25 to 33 inches:* fine sand
*Cg - 33 to 60 inches:* sand

#### Properties and qualities

*Slope:* 0 to 3 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Moderately well drained
*Runoff class:* Negligible
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to very high (1.42 to 99.90 in/hr)
*Depth to water table:* About 15 to 37 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Sodium adsorption ratio, maximum:* 11.0
*Available water supply, 0 to 60 inches:* Moderate (about 6.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* A
*Ecological site:* F144AY027MA - Moist Sandy Outwash
*Hydric soil rating:* No

### Minor Components

#### Windsor

*Percent of map unit:* 7 percent
*Landform:* Outwash terraces, kame terraces, outwash deltas, outwash plains
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Concave, convex, linear
*Across-slope shape:* Convex, linear, concave
*Hydric soil rating:* No

#### Wareham

*Percent of map unit:* 5 percent
*Landform:* Drainageways, depressions
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Hydric soil rating:* Yes

#### Sudbury

*Percent of map unit:* 2 percent
*Landform:* Outwash plains, kame terraces, outwash deltas, outwash terraces
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Concave, convex, linear
*Across-slope shape:* Convex, linear, concave
*Hydric soil rating:* No

#### Ninigret

*Percent of map unit:* 1 percent
*Landform:* Kame terraces, outwash plains, outwash terraces
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, concave
*Hydric soil rating:* No

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