Stormwater Management Plan
FOR
KEYSTONE, LLC.

MINOR LAND DEVELOPMENT

LOCATED AT

82 Main Street
South Kingstown, Rhode Island

SOUTH KINGSTOWN ASSESSOR'S
MAP 57-1, LOT 73

PREPARED FOR
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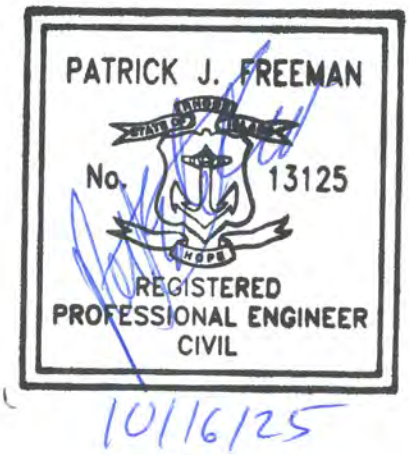


Table of Contents

INTRODUCTION

This report was prepared to document the proposed storm water collection and conveyance system for the proposed conditions at 82 Main Street in the Town of South Kingstown, Rhode Island.

The applicant is proposing to construct a mixed use building which will have a commercial component with 3 residential units on the upper floors. The proposed building would be accessed from a proposed paved driveway and parking area that enters from Hazard Avenue. The building will be serviced by available public utilities including municipal sewer and water supply

The purpose of this report is to document the storm water collection and treatment for this project. The proposed stormwater system consists of two catch basins, an underground infiltration system, and a crushed stone infiltration trench for water quality mitigation, conveyance and runoff rate & volume control.

CODE COMPLIANCE

The drainage analysis was performed by using the computer model "HydroCAD" which uses the Soil Conservation Service's "TR-55 & TR-20" methodology for determining peak runoff rates and total volumes. The drainage design was based on the "Rhode Island Stormwater Design and Installation Standards Manual, Effective November 2018" prepared by the RIDEM and CRMC.

The proposed drainage system was designed to:

1. Have no increase in peak runoff rates from the 1 -ycar, 10-year, and 100-year frequency storm events when compared to pre- project conditions and to pass the 100-year storm event without damage to property from flooding.
2. Maintain 100-year flood plain elevations so there are no impacts to any wetland's ability to protect life and/or property from flooding and or flood flows, and no adverse impacts to water levels on property not owned by the applicant.
3. Treat stormwater to meet the State's requirements for water quality.

EXISTING CONDITIONS

Topography: Refer to the attached maps which show the topography.

Drainage divides: From RIGIS data it was determined that the area to be developed is situated in the Saugatucket watershed. Runoff from the site flows onto Hazard Avenue and Main Street where it enters the municipal system.

Vegetation: The subject property is entirely grassed in the area of the proposed development.

Wetlands, Watercourses & Ponds: No freshwater wetlands have been identified onsite or on adjacent properties.

Soils: A soils map with accompanying soil evaluations used to determine the depth to the seasonal high ground water table are attached to the end of this report. There is one dominant soil type in the area to be developed for this project and its name and description as determined by The Soil Survey of Rhode

Island is as follows:

MU - Merrimac-Urban land complex.
This complex consists of well drained Merrimac soils and areas of Urban land. The complex is on terraces and outwash plains in densely populated areas of the State, mainly in the areas of Providence and Warwick. Areas are irregular in shape and mostly range from 10 to 400 acres. Slopes are mainly about 1 percent but range from 0 to 15 percent. The complex is about 40 percent Merrimac soils, 40 percent Urban land, and 20 percent other soils. The soils and urban land are so intermingled that it was not practical to map them separately. Typically the Merrimac soils have a surface layer of dark brown sandy loam 8 inches thick. The subsoil is yellowish brown and dark yellowish brown sandy loam 17 inches thick. The substratum is light yellowish brown gravelly sand to a depth of 60 inches or more. Urban land consists of areas covered by streets, parking lots, buildings, and other urban structures. Included with this complex in mapping are areas, up to 10 acres in size, of Udorthents, excessively drained Hinckley and Windsor soils, well drained Agawam and Enfield soils, and moderately well drained Sudbury and Ninigret soils. Also included are areas of darker colored soils. The permeability of the Merrimac soils is moderately rapid in the surface layer and upper part of the subsoil, moderately rapid to rapid in the lower part of the subsoil, and rapid in the substratum. The available water capacity is moderate. Runoff is slow to medium on the Merrimac soils. The soil is extremely acid through medium acid. This complex is mainly used for home sites, shopping centers, industrial parks, and other urban purposes. The home sites mostly range from 5,000 to 50,000 square feet. Onsite septic systems in this complex need careful design and installation to prevent pollution of ground water. Slopes of excavated areas are commonly unstable. Lawn grasses, shallow-rooted trees, and shrubs require watering in the summer. The use of straw bale sediment barriers and quickly establishing plant cover help to control erosion during construction. Areas of this complex require onsite investigation and evaluation for most uses. Capability subclass and wood land group not assigned.

FLOOD ZONES
The subject property is not situated in the 100-year flood zone as identified by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM Map Number's = 44009C0203 K, Effective Date = April 3, 2020

Potential drainage impacts: The following items have been identified as potential concerns when developing the project site; therefore, require pre & post analysis:
1. Treatment and mitigation of runoff as a result of the development of the site.

Subcatchment Areas Used in Analysis:

The subcatchment areas used in the pre/post project comparisons have the following characteristics:

Subcatchment Areas (Pre project) - have the following characteristics:

Watershed '1':	0.23 acres, CN=43	Tc= 18.4 min.
Totals/Composite:	0.23 acres	

Subcatchment Areas (Post project) - have the following characteristics:

Watershed '1':	0.08 acres, CN=57,	Tc = 17.8 min.
Watershed '2':	0.13 acres, CN=91,	Tc = 5.0 min.
Watershed '3':	0.02 acres, CN=45,	Tc = 8.8 min.
Totals/Composite:	0.23 acres	

Pre Project (Existing) Runoff: Peak stormwater runoff rates and total volume were analyzed for the 1, 10, and 100-year storm events (as required by the Rhode Island Stormwater Design and Installation Standards Manual, Effective November 2018). The points of analysis are identified on the attached maps. RIDEM's Washington County, Rhode Island 24-hour rainfall amounts for this area were used in the analysis. A summary of the pre-project peak runoff rates and total volumes are summarized below. Supporting calculations are provided in the Appendix.

Pre-Project Drainage Analysis Summary Summary of the Analysis Point		
Storm	**Peak Runoff Rate, CFS and Time of Peak**	**Total Runoff Volume, CF**
1-yr	0.00 @ 24.01 hrs	1
10-yr	0.02 @ 12.55 hrs	275
100-yr	0.28 @ 12.31 hrs	1,508

PROPOSED CONDITIONS

Site Alterations: The applicant is proposing to construct a mixed use building associated stormwater facilities. The proposed work activities are identified on the plans. The stormwater components designed into the drainage system to reduce peak flows, reduce runoff volume and to treat the water quality volume include the following:

1. Two Catch basins with 4' sumps which collect runoff from the proposed driveway and roof leader collector lines which discharge to two catch basins and an underground infiltration practice with an isolator row plus pretreatment system.
2. A proposed crushed stone trench which has been sized to capture and infiltrate the increase in runoff from the 10 year design storm.

Post-Project Runoff: Peak stormwater runoff rates were analyzed for the 1, 10, and 100-year storm events and routed through the proposed drainage system (as required by the Rhode Island Stormwater Design and Installation Standards Manual, Amended November 2018). RIDEM's Washington County, Rhode Island 24 hour rainfall amounts for this area were used in the analysis.

A summary of the results are summarized below. Supporting calculations are provided in the Appendix.

Post-Project Drainage Analysis Summary of the Analysis Point		
Storm	**Peak Runoff Rate, CFS and Time of Peak**	**Total Runoff Volume, CF**
1-yr	0.00 @ 12.54 hrs	53
10-yr	0.06* @ 12.30 hrs	295
100-yr	0.21 @ 12.26 hrs	942

*Post project runoff for the 10 year design storm for the watershed that could not be captured shows an increase in runoff rate/volume. The underground infiltration practice captures and infiltrates all runoff directed to it. The watershed that could not be captured is significantly smaller than the existing watershed with a smaller time of concentration, yet it still reports an increase in runoff. A crushed stone infiltration trench has been proposed to capture and infiltrate the calculated increase in runoff volume.

Summary/Conclusion:

Peak Runoff Rates: Post-project peak runoff rates approximate pre-project peak runoff rates.

Water Quality: Water quality BMPs have been incorporated into the design to meet the November 2018, stormwater standards.

Additional Discussion: Post-project peak runoff rates approximate pre-project rates for the 1, 10, and 100-year storm events for the point of analysis. An underground infiltration practice has been designed for the development is required to maintain pre-project peak runoff rates.

Post-project 100-year flood plain elevations are approximately equal to pre-project 100-year flood plain elevations since pre-project peak runoff rates approximate pre-project rates. The proposed project will not impact life and/or property from flooding and or flood flows, and no adverse impacts to water levels on property not owned by the applicant.

The proposed design does not create any restriction or significant modification of the path or velocities of flood flows for the 1, 10, or 100-year frequency, 24-hour, Type III storm events so as to cause harm to life, property, or other functions and values provided by freshwater wetlands since the flow paths will remain essentially the same and post-project peak runoff rates will approximate pre-project conditions.

The proposed design does not place any structure or obstruction within a floodway so as to cause harm to life, property, or other functions and values provided by freshwater wetlands.

DESIGN OF THE PROPOSED DRAINAGE SYSTEM:

The proposed drainage system consists of the following elements:

1. Two Catch basins with 4' sumps which collect runoff from the proposed driveway and roof leader collector lines which discharge to an underground infiltration practice with an isolator row plus pretreatment system.

2. A proposed crushed stone trench which has been sized to capture and infiltrate the increase in runoff from the 10 year design storm.

The drainage components were designed to meet the drainage regulations entitled "Rhode Island Stormwater Design and Installation Standards Manual, November 2018" prepared by the RIDEM and CRMC. This manual has a Low Impact Design (LID) planning and documentation process which is detailed below:

Step 1: Document Site Planning Process in Accordance with Standard 1.

The LID site planning and design process for subject project is documented below:

1. Protect as much undisturbed open space as possible to maintain pre-development hydrology and allow precipitation to naturally infiltrate into the ground:

   Due to the proposed use of the property and the limited space available, preservation of undisturbed open space is not feasible. Permeable areas have been maximized to the greatest extent feasible while meeting the projects goals.

2. Maximize the protection of natural drainage areas, streams, surface waters, wetlands, and other regulated areas:

   There are no natural drainage areas, streams, surface waters, and wetlands on site. Proper construction techniqucs in combination with soil and erosion control measures will protect downstream areas.

3. Minimize land disturbance, including clearing and grading, and avoid areas susceptible to erosion and sediment loss:

   Strict adherence to the projects limit of disturbance shall be kept in order to prevent unnecessary land clearing. The sites topography is gradual and is not particularly susceptible to erosion and sediment loss. Soil erosion control practices have been proposed to prevent sediment loss.

4. Minimize soil compaction and restore soils compacted as a result of construction activities or prior development:

   Stormwater Best Management Practice (BMP) areas have been specified to be delineated at the construction site so construction activities will not compact existing soils and all areas compacted by construction vehicles shall be restored by tilling the top 12 inches prior to final stabilization.

5. Provide low-maintenance, native vegetation that encourages retention and minimizes the use of lawns, fertilizers, and pesticides:

   The limit of disturbance has been minimized to the greatest extent possible. A conservation mix has been specified to revegetate all disturbed areas.

6. Minimize impervious surfaces:

The impervious surfaces have been minimized to the limits required for the project.

7. Minimize the decrease in the "time of concentration" from pre-construction to post-construction, where "time of concentration" means the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed:

Impervious surfaces have been captured to the greatest extent possible. The proposed time of concentration has been increased to the maximum extent possible by capturing and infiltrating the 100-year runoff volume for the proposed impervious surfaces that could be captured.

8. Infiltrate precipitation as close as possible to the point it reaches the ground using vegetated conveyance and treatment systems:

The proposed underground infiltration system will provide infiltration and is located as close as possible to the point of generation. The runoff from the proposed building and driveway will be directed to stormwater BMP's via roof leaders or catch basins as shown on the site plans.

9. Break up or disconnect the flow of runoff over impervious surfaces:

Impervious surfaces have been disconnected to the greatest extent possible.

10. Provide source controls to prevent or minimize the use or exposure of pollutants into stormwater runoff at the site in order to prevent or minimize the release of those pollutants into stormwater runoff:

The site owner should follow the recommendations in the Manual for other pollutant source controls such as:

1. Yard care shall be performed in accordance with the Manual's Lawn, Garden, and Landscape Management guidance.
2. Any paved driveways shall be maintained and sealed in accordance with Manual guidance so coal tar based sealants are not selected.
3. Trash and litter shall be kept out of stormwater BMP's and conveyance systems in accordance with the manual.
4. Road care, deicing and snow removal shall be performed in accordance with the manual.
5. All hazardous materials shall be stored in secondary containment areas and shielded against stormwater.
6. All BMP's shall be maintained in accordance with the procedures outlined on the design plans

Step 2: Determine Required Design Criteria (i.e., Re_V, WQ_V, CP_V, Q_J):

The project has been broken into two design areas. These are associated with;

1. **Watershed 1** – The runoff from this watershed is made up of all water that could not be captured

and flows to the Analysis Point.

2. **Watershed 2**– The runoff from this watershed is made up of all water that is captured by the proposed underground infiltration practice. The proposed underground infiltration practice has been designed to capture and infiltrate all runoff from the contributing areas for the 100-year storm. This practice has been designed to provide Water Quality treatment and mitigate the peak runoff rates and volumes for the project.
3. **Watershed 3**- The runoff from this watershed is made up of all the water that is captured by the crushed stone infiltration trench.

- Re_v = (1")(F)(I)/12: Recharge is required at the site based on land use and soils. Use an exfiltrating underground infiltration practice for impervious areas to meet this requirement.
- WQ_v (1")(I)/12: The WQv requirement will be managed by the underground infiltration practice.
- CP_v = 24-hour extended detention of post-development runoff from 1-year, 24-hour Type III storm: The Channel Protection volume is not required because the proposed impervious area is less than 1 acre.
- Q_p = Peak flow attenuation of the 10-year and 100-year, 24-hour Type III storm: The Q_p is required because the site does not drain to a 4th-order tributary or tidal water.
- Downstream = A downstream analysis is not required because the project's disturbed area does not meet the thresholds in Table 3-7 in terms of area of disturbance and impervious percentage (< 5 acres and < 75% impervious).

Table 1: Base Data for Fairview Estates– Residential Lot Development
Impervious Area: Proposed impervious areas, I = 5,583 sf (0.13 acres) (see summary below):
Site Soils Type: 100% "Hydro. A" Recharge Factor, F = 0.60. Average depth to groundwater ranging from 48" to 72" inches
Summary of Hydrologic Data
Rainfall Depths:
1-year, 24-hour, Type III = 2.80 inches 10-year, 24-hour, Type III = 4.90 inches 100-year, 24-hour, Type III = 8.50 inches

Step 3: Compute Required Storage Volumes:

The Recharge Volume (Re_v) is calculated using the equation from Section 3.3.2: For HSG A soils, F = 0.60 and I = 5,583 sf (0.13 ac):

- Rev = (1")(F)(I)/12 = (1")(0.60)(5,583 sf)/12 = 280 cf (.006 ac-ft)

The recharge volume for this project has been met with the sizing of the proposed underground infiltration practice and crushed stone trench. A total recharge volume of 982 cf has been provided.

The Water Quality Volume (WQ_v) is calculated using the equation from Section 3.3.3: For I = 5,583 sf (0.13 ac) the water quality treatment for the proposed facility is addressed in Minimum Standard 3 of

- $WQ_v = (1.0")(I)/12$

WQv = (1.0")(5,583 s.f.)/12 = 466 c.f. (0.011 ac-ft)

- Check WQ_v > minimum req'd 0.2" for disturbed area (7,512 sf (0.17 Acres)):
- WQ_v min = 0.2"(7,512 sf)/12 = 126 cf; < (466 cf), so use 466 cf

Check the capacity of the bypass weirs using the Water Quality Flow (WQf)

WQF calculations were performed using only the impervious areas in each watershed using a time of concentration of 6 minutes. Those calculations are shown in Appendix 4 and confirm the weirs have been sized properly.

The Channel Protection Volume (CP_v) is not required because the site's proposed impervious area is less than 1 acre. However, the Channel Protection Volume has been provided within the Underground Infiltration Practice. CPv was determined through the hydrology analysis for the 1 year storm. The runoff volume for the 1 year storm event for the proposed conditions is 53 cf. The required CPv volume is found using the following equation:

CPv =
UIP: 0.65 * Volume of Runoff = 0.65* 924 = 601 cf
CPv storage provided = 985 cf

The Overbank Flood Protection (Q_p) requirement states that the post-development peak discharge rates for the 10- and 100-year, 24 hour Type III storms be reduced to the predevelopment levels. The Proposed stormwater system was sized to provide adequate storage to attenuate the post development flow to approximate these levels.

Step 4: Size Water Quality Ponds to Meet (Re_v) and (WQ_v) Requirement:

Underground Infiltration Practice: (From W.S. 2)

Two 4' diameter Catch basins and an underground infiltration practice with an isolator row have been designed to treat the Rev and WQv for Watershed 2. The catch basins and infiltration practice are designed to intercept and treat a minimum of 25% of the WQv (0.25(466) = 116.5 cf). Two 4' diameter catch basins with a 4' sump provide 100.53 cf of pretreatment in addition to 58.8 cf provided by the isolator row provided 160 cf of pretreatment volume. The underground infiltration practice has been designed to treat the remaining 75% of the WQv (0.75(466 cf) = 350 cf). The underground infiltration practice has a capacity of 925 cf.

Step 5: Check the hydraulic capacity during the 100-year storms.

All components and conveyance systems were designed to convey the 100-year storm.

Step 6: Size the systems to provide CP_v

The CP_v is met within the water quality BMP's:

CPv = 0.65 * Volume of Runoff = 0.65* 924 = 601 cf
CPv storage provided = 985 cf

Step 7: Size dry extended detention basin to provide Q_p controls for 10- & 100-year storm):

A summary of the Pre-Project vs. Post-Project conditions were already provided. Post-Project runoff approximates Pre-project conditions.

EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES:

The following soil erosion and sediment control best management practices shall be implemented for pre- & post-construction activities:

1. install soil erosion and sediment control BMPs
2. establish temporary & permanent vegetative cover
3. install non-structural BMPs
4. install structural BMPs
5. BMP maintenance

1 Install Soil Erosion and Sediment Control BMPs

1.1 Install perimeter soil erosion and sediment control devices prior to construction. These include staked straw wattles and/or silt fence along the limit of disturbance to protect down gradient areas from soil erosion. The contractor shall not disturb any areas beyond the limit of disturbance indicated on the drawings.

1.2 Construct the `Construction Entrance' where vehicles will enter/exit the construction site. Crushed stone shall be placed in accordance with the detail on the drawings. All construction vehicles shall use this entrance(s).

1.3 Construct sediment barriers (straw wattle inlet protection) at all existing catch basin inlets and at other areas which receive concentrated stormwater runoff flows (if applicable).

1.4 All work to be performed in accordance with manufacturer's instructions.

1.5 The contractor shall have overall responsibility for plan implementation and for seeing that the appropriate workers are aware of the provisions of the plan. The contractor must repair and/or reseed any areas that do not develop within the period of one year and shall do so at no additional expense.

1.6 Reference the "Rhode Island Soil Erosion and Sedimentation Control Handbook" prepared by the USDA Soil Conservation Service 1989, revised 2014, as a guide.

2 Establish Temporary & Permanent Vegetative Cover

2.1 Slopes shall not be left unattended of exposed for excessive periods of time such as the inactive winter season.

2.2 All disturbed slopes either newly created or currently exposed shall be loamed and seeded or protected with erosion control blankets/straw. Temporary treatments for slope protection include erosion control blankets such as North American Erosion Control Blankets S150 or approved equal. Hay or straw applications shall be in the amounts 2 tons/acre. Incorporate into the work as warranted or as ordered by the RIDEM / Town / engineer.

2.3 Topsoil shall be a sandy loam texture free of subsoil material, stones, roots, lumps of soil, tree limbs, trash or construction debris. Topsoil shall conform to Rhode Island Department of Transportation's Standard Specification, M.20.

2.4 The seeding design mix shall be comprised of the following:

Type	LBS/Acre
Creeping Red Fescue	75
Kentucky Blue Grass	15
Colonial Bent Grass	5
Perennial Rye Grass	5

2.5 Seed shall generally be placed in early spring or late summer. The seed mix shall be inoculated within 24 hours and before mixing and planting, with appropriate inoculum for each variety.

2.6 All straw wattles or temporary protection shall remain in place until an acceptable stand of grass or approved ground cover is established.

2.7 All fill shall be thoroughly compacted upon placement in strict conformance with the Rhode Island Standard Specification for Road and Bridge Section 202 as amended.

2.8 Stockpiles of topsoil shall not be located near waterways. They shall have side slopes no greater than 2:1 and shall be temporarily seeded and/or stabilized. The down gradient areas shall be protected from soil erosion by installing a silt fence/straw wattles perimeter around the stockpile.

2.9 All areas distributed by construction shall be stabilized with loam and permanent seeding immediately following finish grading (and/or placing wood mulch over soil with a minimum thickness layer of 2 inches). Permanently seeded areas may require protection during establishment with straw. All seeded areas shall be checked regularly to see that a good stand is maintained. Areas shall be reseeded as necessary.

2.10 Maximum graded slope within the site is to be 3:1 unless otherwise shown on drawings.

3 Non-Structural BMPs

3.1 Construction traffic shall be limited to the access where the construction entrance is placed. The contractor shall maintain the construction entrance. All sediments spilled, dropped, washed, or tracked onto the public right of way must be removed, immediately by the contractor.

3.2 Topsoil shall be stripped from areas to be graded and stockpiled for later use. Stockpile

location shall be subject to approval by the project engineer. A sediment barrier such as straw wattles and/or silt fence should surround all topsoil stockpiles.

3.3 The contractor shall maintain erosion straw wattles and silt fence. Inspection shall be made within 24 hours after each storm event or every 7 days, whichever comes first, and repaired or replaced as warranted. The contractor shall clean the accumulated sediment if half of the original height of the wattles/ siltfence becomes filled in with sediment. A storm event shall be defined as 0.25 inches of rain within a 24-hour period.

4 Structural Measures

4.1 Runoff water quality is improved by constructing Forebays, Water Quality Ponds/practices. Location and details of these components are provided on the drawings. These drainage system components have been designed in accordance with the `Rhode Island Storm Water Design and Installation Standards Manual, November 2018.

4.2 All disturbed areas shall be permanently vegetated in accordance with the details/notes on the drawings. In general, vegetation shall be established by loaming and seeding. Bare or eroded areas shall be immediately repaired and reseeded by the contractor.

4.3 The contractor shall be responsible for maintaining the pipes, infiltration system and catch basins during construction until accepted by the Owner. The drainage system shall be maintained in accordance with the details/notes provided on the drawings.

5 Maintenance: Short Term / Long Term

5.1 All disturbed slopes either newly created or currently exposed shall be seeded, protected, and maintained by the contractor following final grading and construction. The contractor shall check regularly all seeded areas to see that a good stand is maintained. The contractor must repair or reseed any areas that do not develop within the period or one year and shall do so at no additional expense.

5.2 All straw wattles, temporary treatments (hay, straw, etc.) and temporary protection shall be maintained by the contractor throughout construction and shall remain in place until an acceptable stand of grass or approved ground cover is established.

5.3 The contractor shall maintain all topsoil stockpiles and sediment barriers throughout construction. Extreme care shall be taken to ensure that sediments do not spill over the sediment barrier. Straw wattles or silt fence shall be staked around the stockpiles

5.4 The contractor shall check the straw wattles or silt fence on a weekly basis and after each rain storm for undermining or deterioration. The contractor shall repair or replace the straw wattles as necessary. The contractor shall clean the accumulated sediment if half of the original height of the straw wattles become filled with the sediments.

5.5 The contractor shall maintain the construction entrance. All sediments spilled, dropped, washed, or tracked on the public right of way must be removed immediately by the contractor.

5.6 The contractor is responsible for maintenance and inspection of all drainage system

components until accepted by the Owner, including the 12-month warranty period which commences after substantial completion of the drainage system. Any accumulated sediments shall be removed and drainage pipes flushed by the contractor at the end of construction.

5.7 The drainage system shall be maintained in accordance with the details/notes provided on the drawings.

POLLUTION PREVENTION:

The following pollution prevention techniques shall be implemented for pre- & post-construction activities to minimize contamination of stormwater runoff:

1. Solid waste containment
2. Catch basin cleaning
3. Street sweeping
4. Snow removal management & salt storage
5. Hazardous chemical storage
6. Septic system maintenance
7. Vehicle storage
8. Vehicle fueling
9. Vehicle maintenance
10. Soil erosion

1. Solid waste containment - Provide waste containers for convenient disposal of solid waste for on-site individuals. Ensure all litter is routinely picked up and placed in waste containers so waste is not introduced into stormwater runoff.

2. Catch basin cleaning - Clean out catch basins to ensure they are free flowing and that all trash/sediment is removed from structure sump. Dispose off-site at an approved landfill facility in accordance with current regulations.

3. Street sweeping - Sweep all paved roadways annually which are subject to vehicular traffic. Dispose sweepings off-site at an approved landfill facility in accordance with current regulations.

4. Snow removal management & salt storage - Store road salt on impervious surfaces which are protected from precipitation and wind. All stormwater runoff should be directed away from any salt storage areas. Stockpile accumulated snow away from areas which receive concentrated stormwater runoff such as detention ponds, catch basins, drainage swales, roadway gutters, etc.... Stockpile snow on pervious areas such as gravel or grass.

5. Hazardous chemical use & storage - all hazardous chemicals shall be stored inside a building or shed. This will ensure stormwater runoff will not encounter the chemicals. Provide secondary containment of all hazardous chemicals stored outside. Use all chemicals in strict conformance with manufacturer's recommendations (i.e. do not apply too much, too often or in sensitive areas such as the detention pond, wetlands, near catch basins or channels, and other sensitive areas subject to stormwater runoff). Read label fully prior to use. Routinely inspect chemical storage areas for leaks and/or spills. Clean-up all leaks and/or spills immediately. All stormwater runoff

should be directed away from any hazardous chemical storage areas.

6. Septic system maintenance - if applicable, inspect septic system annually to ensure proper operation. Septic tanks will likely require a pump-out every 3 years to remove accumulated scum and sludge. Inspect pump and alarms to ensure system operation is functioning. Inspect leachfield area to ensure effluent is not surfacing (i.e. an indication of failure). Make repairs immediately in accordance with RIDEM OWTS regulations.

7. Vehicle storage - all vehicles shall be stored in good working order. Vehicles not in good working order shall be stored inside a building or removed off-site. Inspect vehicles monthly to ensure vehicles have no leaking fluids. Leaking fluids shall be cleaned-up immediately. Vehicles with leaking fluids are not considered in good working order and shall be repaired or removed off-site immediately.

8. Vehicle fueling - all vehicle fuelings shall be performed off-site.

9. Vehicle maintenance - all vehicle maintenance shall be performed offsite.

10. Vehicle cleaning - all construction vehicle washing/cleaning shall be performed at an approved location.

11. Soil erosion - place silt fence and/or straw wattles around the down gradient perimeter of stockpile areas to prevent soil erosion into stormwater runoff. Inspect straw wattles/silt fence every 7 days and/or after every precipitation event of 0.25 inches or greater. Repair damaged/eroded areas immediately. Re-vegetate disturbed area as soon as possible and always prior to the winter season. Water down exposed earth areas during dry periods to prevent dust from being generated.

Greater detail on pollution prevention techniques can be found at the US Environmental Protection Agency's NPDES Stormwater web site.

REFERENCES:

1. State of Rhode Island Stormwater Design and Installation Standards Manual, dated September 1, 1993, prepared by the RIDEM and CRMC.

2. Rhode Island Stormwater Quality Manual - Draft.

3. Rhode Island Stormwater Design and Installation Standards Manual - Draft

4. HydroCAD Stormwater Modeling System, Owner's Manual, Version 8, HydroCAD Software Solutions, LLC.

5. USDA `Soil Survey of Rhode Island', 1981.

6. Stormwater Management, MA Department of Environmental Protection & MA Office of Coastal Zone Management, Volumes I & II, March 1997.

7. US Environmental Protection Agency's NPDES Stormwater web site.

End of Report

Appendix 1
Supporting Drainage Calculations – Existing Conditions

Watershed 1

Subcat Reach Pond Link

Routing Diagram for 125222_EXISTING
Prepared by American Engineering, Inc., Printed 10/16/2025

Summary for Subcatchment 1S: Watershed 1

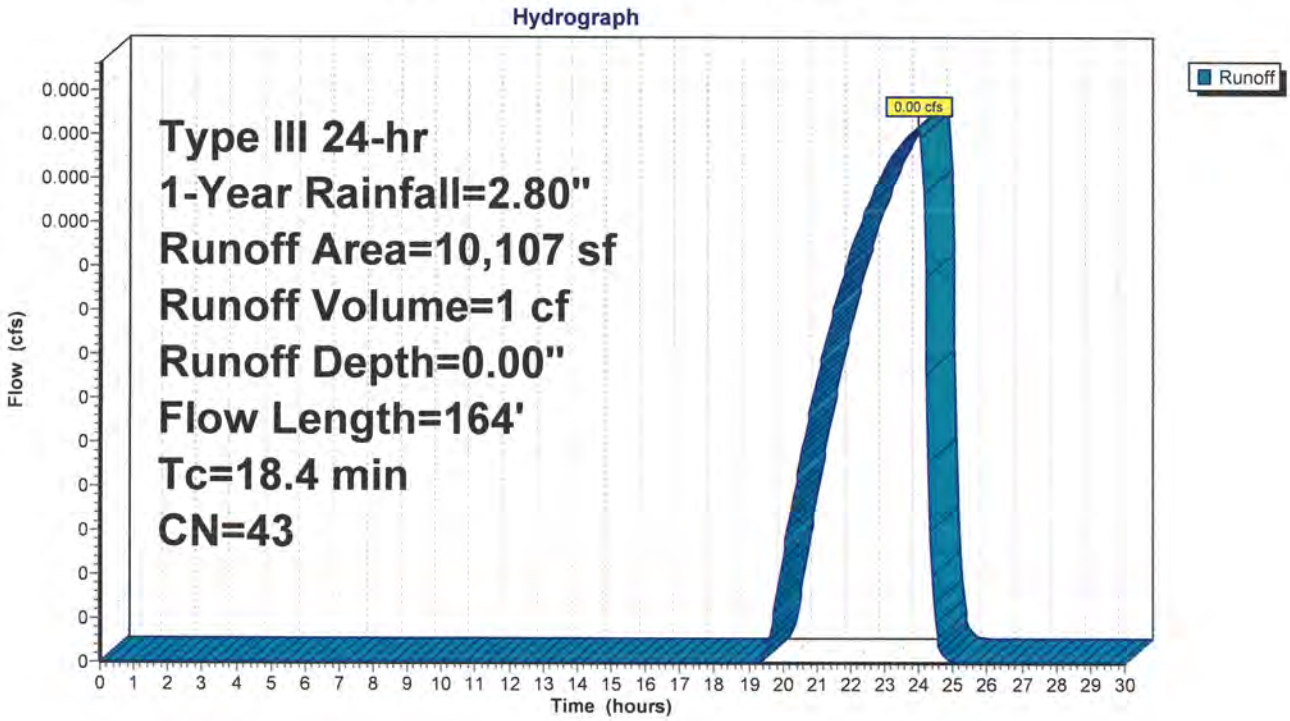
Runoff = 0.00 cfs @ 24.01 hrs, Volume= 1 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.80"

Area (sf)	CN	Description
9,406	39	>75% Grass cover, Good, HSG A
701	98	Paved parking, HSG A
10,107	43	Weighted Average
9,406		93.06% Pervious Area
701		6.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0150	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
2.3	24	0.1040	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
0.3	40	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
18.4	164	Total			

Subcatchment 1S: Watershed 1



Summary for Subcatchment 1S: Watershed 1

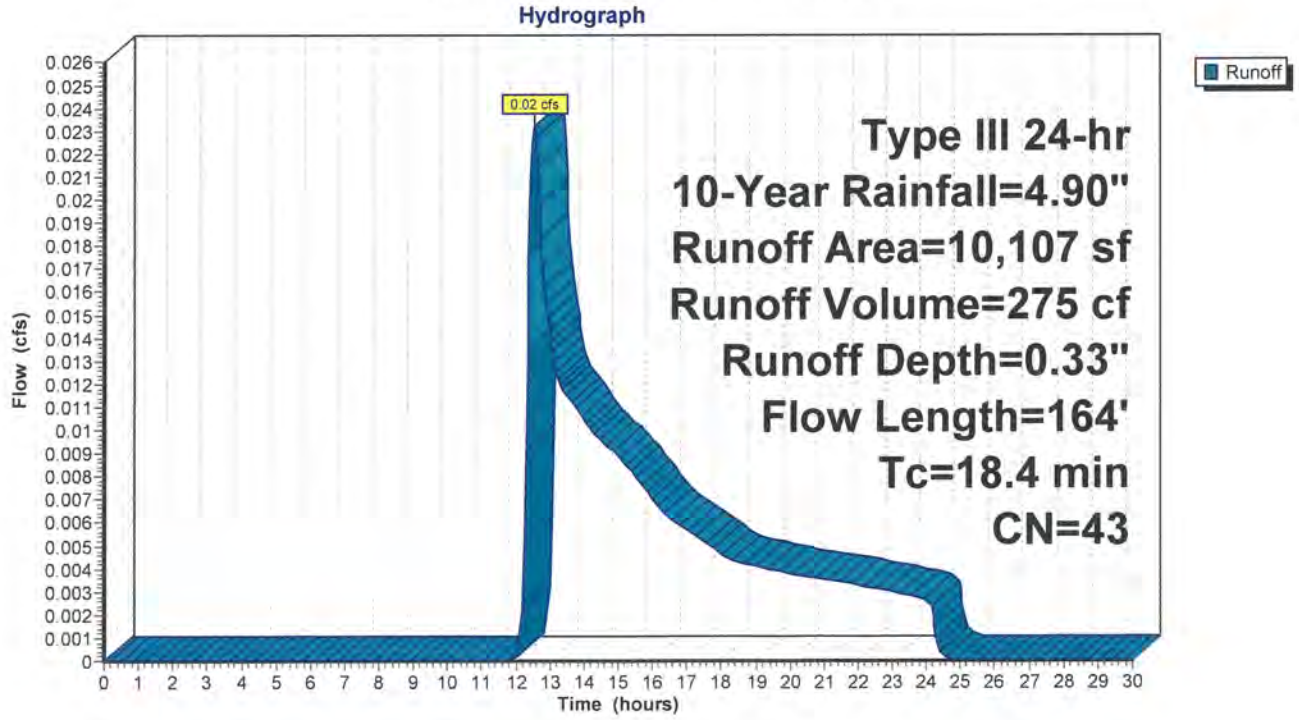
Runoff = 0.02 cfs @ 12.55 hrs, Volume= 275 cf, Depth= 0.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
9,406	39	>75% Grass cover, Good, HSG A
701	98	Paved parking, HSG A
10,107	43	Weighted Average
9,406		93.06% Pervious Area
701		6.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0150	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
2.3	24	0.1040	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
0.3	40	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
18.4	164	Total			

Subcatchment 1S: Watershed 1



Summary for Subcatchment 1S: Watershed 1

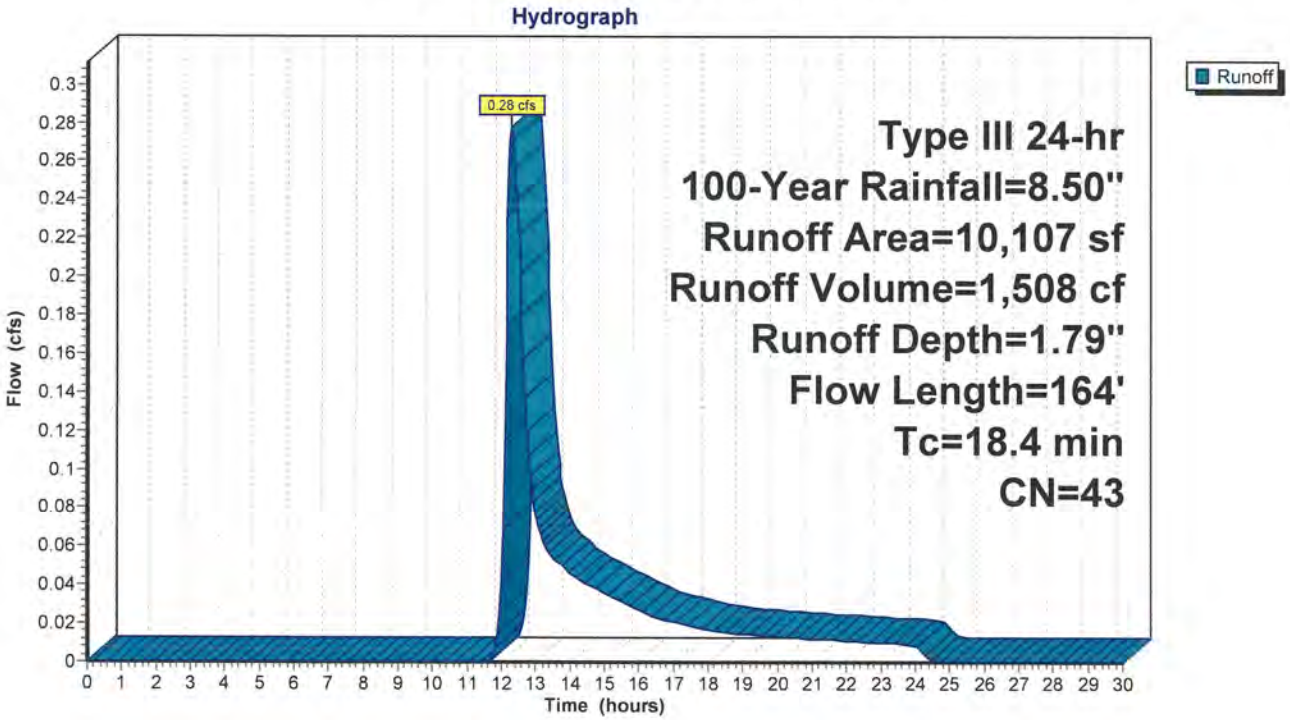
Runoff = 0.28 cfs @ 12.31 hrs, Volume= 1,508 cf, Depth= 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.50"

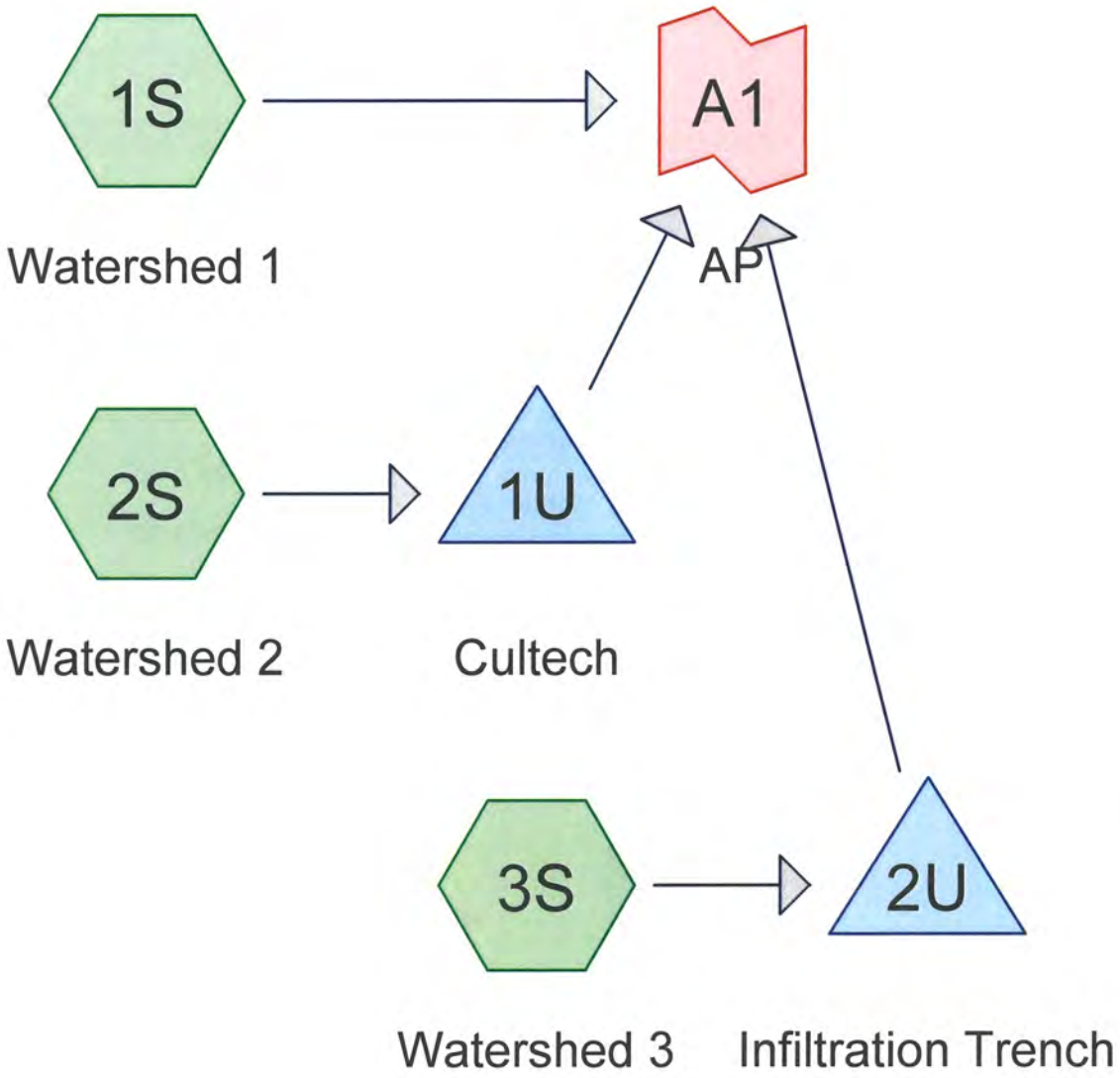
Area (sf)	CN	Description
9,406	39	>75% Grass cover, Good, HSG A
701	98	Paved parking, HSG A
10,107	43	Weighted Average
9,406		93.06% Pervious Area
701		6.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0150	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
2.3	24	0.1040	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
0.3	40	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
18.4	164	Total			

Subcatchment 1S: Watershed 1



Appendix 2
Supporting Drainage Calculations – Developed Conditions



Subcat Reach Pond Link

Routing Diagram for 125222_PROPOSED Rev-101625
Prepared by American Engineering, Inc., Printed 10/17/2025

Summary for Subcatchment 1S: Watershed 1

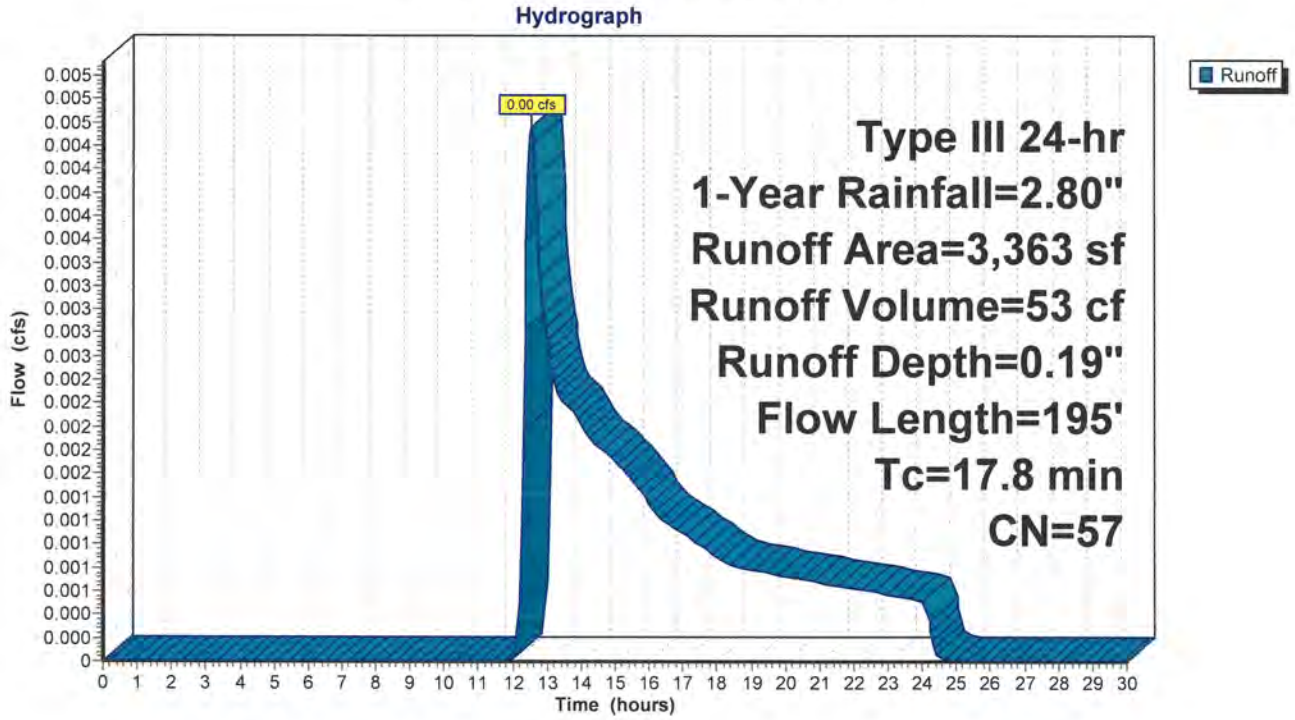
Runoff = 0.00 cfs @ 12.54 hrs, Volume= 53 cf, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.80"

	Area (sf)	CN	Description
	2,326	39	>75% Grass cover, Good, HSG A
*	642	98	Existing Paved parking, HSG A
*	395	98	Proposed Paved parking/walkway/conc pad, HSG A
	3,363	57	Weighted Average
	2,326	39	69.16% Pervious Area
	1,037	98	30.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0150	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
1.4	13	0.1154	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
0.6	82	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
17.8	195	Total			

Subcatchment 1S: Watershed 1



Summary for Subcatchment 2S: Watershed 2

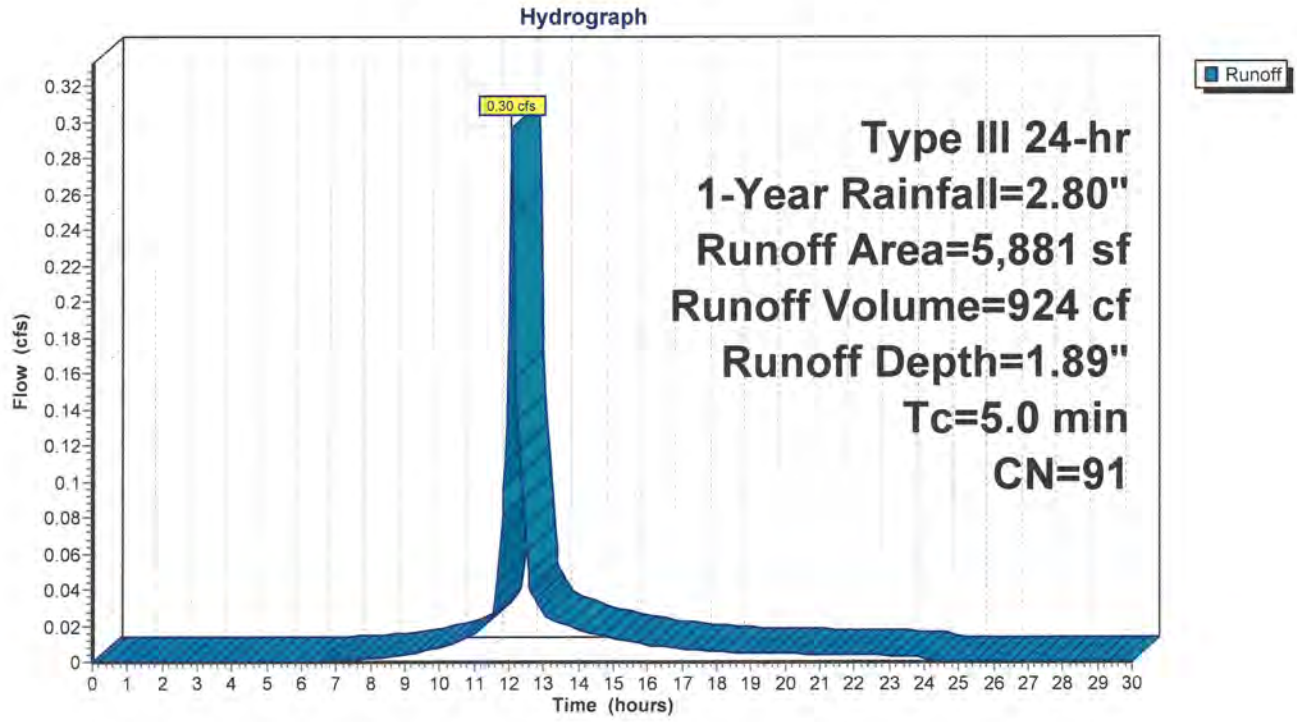
Runoff = 0.30 cfs @ 12.07 hrs, Volume= 924 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.80"

	Area (sf)	CN	Description
	722	39	>75% Grass cover, Good, HSG A
*	2,488	98	Proposed Paved parking/walkway/conc pad, HSG A
	2,671	98	Roofs, HSG A
	5,881	91	Weighted Average
	722	39	12.28% Pervious Area
	5,159	98	87.72% Impervious Area

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

Subcatchment 2S: Watershed 2



Summary for Subcatchment 3S: Watershed 3

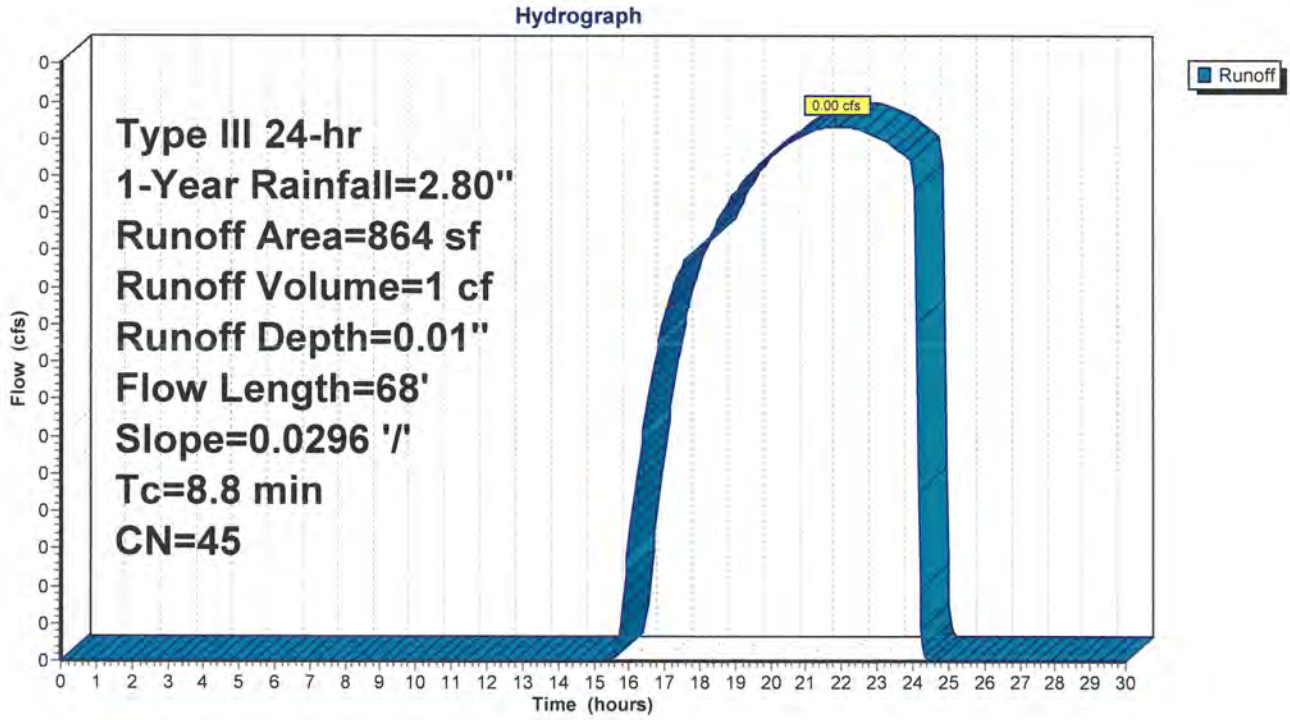
Runoff = 0.00 cfs @ 21.85 hrs, Volume= 1 cf, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.80"

Area (sf)	CN	Description
782	39	>75% Grass cover, Good, HSG A
52	98	Paved parking, HSG A
30	98	Paved parking, HSG A
864	45	Weighted Average
782	39	90.51% Pervious Area
82	98	9.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	68	0.0296	0.13		**Sheet Flow, 2/67.5** Grass: Dense n= 0.240 P2= 3.30"

Subcatchment 3S: Watershed 3



Summary for Pond 1U: Cultech

Inflow Area = 5,881 sf, 87.72% Impervious, Inflow Depth = 1.89" for 1-Year event
Inflow = 0.30 cfs @ 12.07 hrs, Volume= 924 cf
Outflow = 0.18 cfs @ 12.00 hrs, Volume= 924 cf, Atten= 39%, Lag= 0.0 min
Discarded = 0.18 cfs @ 12.00 hrs, Volume= 924 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 49.14' @ 12.18 hrs Surf.Area= 945 sf Storage= 68 cf

Plug-Flow detention time= 18.0 min calculated for 923 cf (100% of inflow)
Center-of-Mass det. time= 18.1 min (824.7 - 806.6)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	549 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,137 cf Overall - 472 cf Embedded = 1,665 cf x 33.0% Voids
#2	49.50'	472 cf	**ADS_StormTech SC-310 +Cap** x 32 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 32 Chambers in 8 Rows
#3	48.17'	128 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,149 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	917	0	0
51.33	917	2,137	2,137

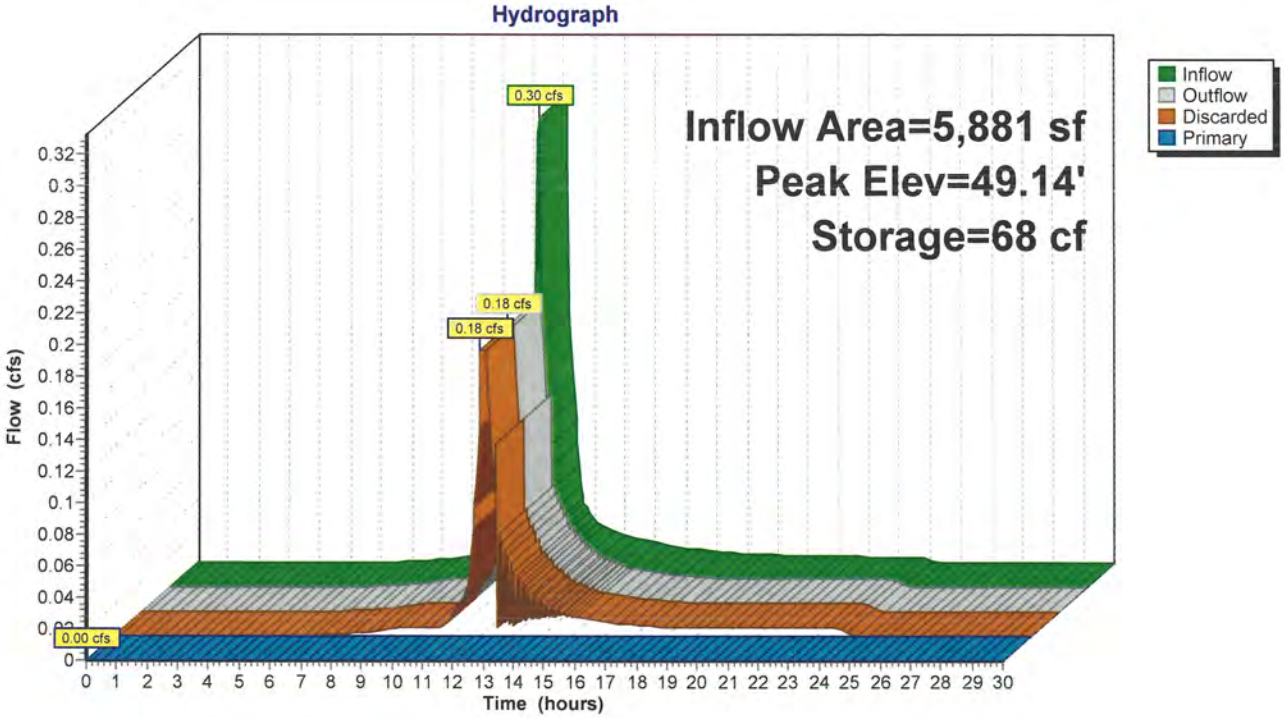
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.17	28	0	0
52.75	28	128	128

Device	Routing	Invert	Outlet Devices
#1	Primary	52.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.25 Width (feet) 2.00 10.00
#2	Discarded	48.17'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.18 cfs @ 12.00 hrs HW=49.01' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=48.17' TW=0.00' (Dynamic Tailwater)
↑—**1=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1U: Cultech



Summary for Pond 2U: Infiltration Trench

Inflow Area = 864 sf, 9.49% Impervious, Inflow Depth = 0.01" for 1-Year event
Inflow = 0.00 cfs @ 21.85 hrs, Volume= 1 cf
Outflow = 0.00 cfs @ 21.92 hrs, Volume= 1 cf, Atten= 0%, Lag= 4.0 min
Discarded = 0.00 cfs @ 21.92 hrs, Volume= 1 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 46.50' @ 21.92 hrs Surf.Area= 58 sf Storage= 0 cf

Plug-Flow detention time= 2.9 min calculated for 1 cf (100% of inflow)
Center-of-Mass det. time= 2.9 min (1,229.4 - 1,226.6)

Volume	Invert	Avail.Storage	Storage Description
#1	46.50'	57 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 174 cf Overall x 33.0% Voids

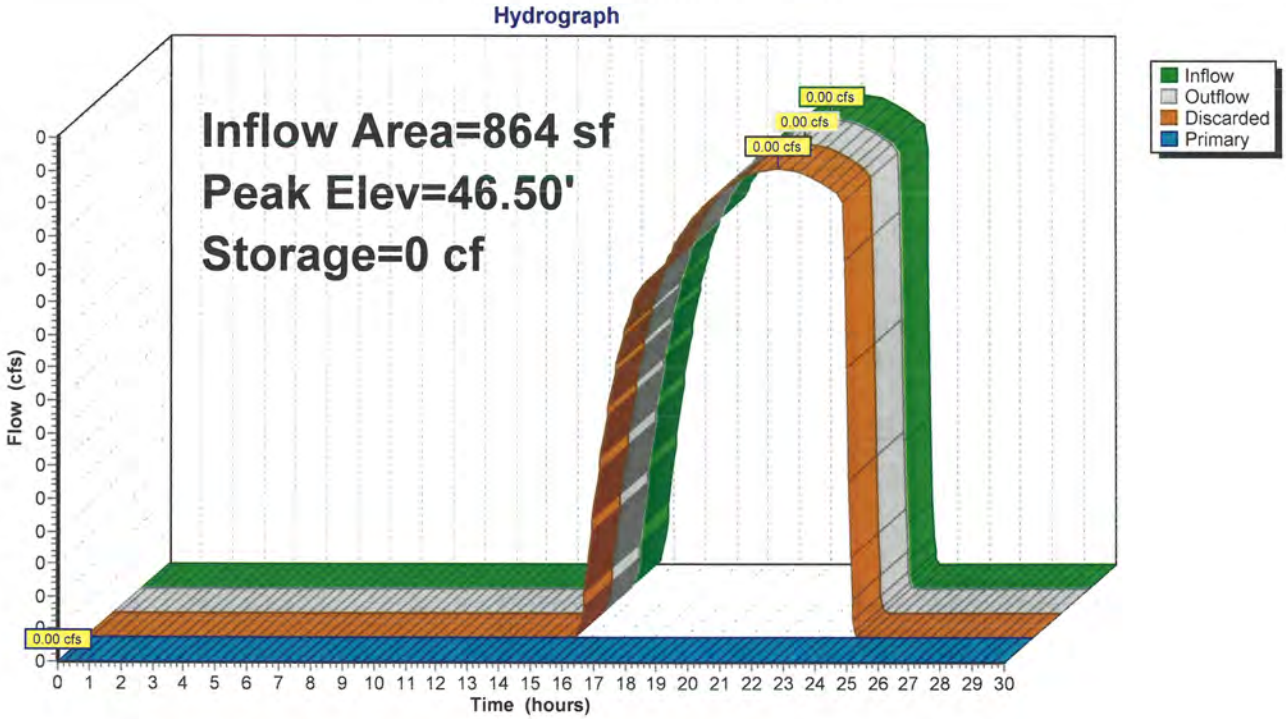
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.50	58	0	0
49.50	58	174	174

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Primary	49.50'	**49.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.00 cfs @ 21.92 hrs HW=46.50' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=46.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2U: Infiltration Trench

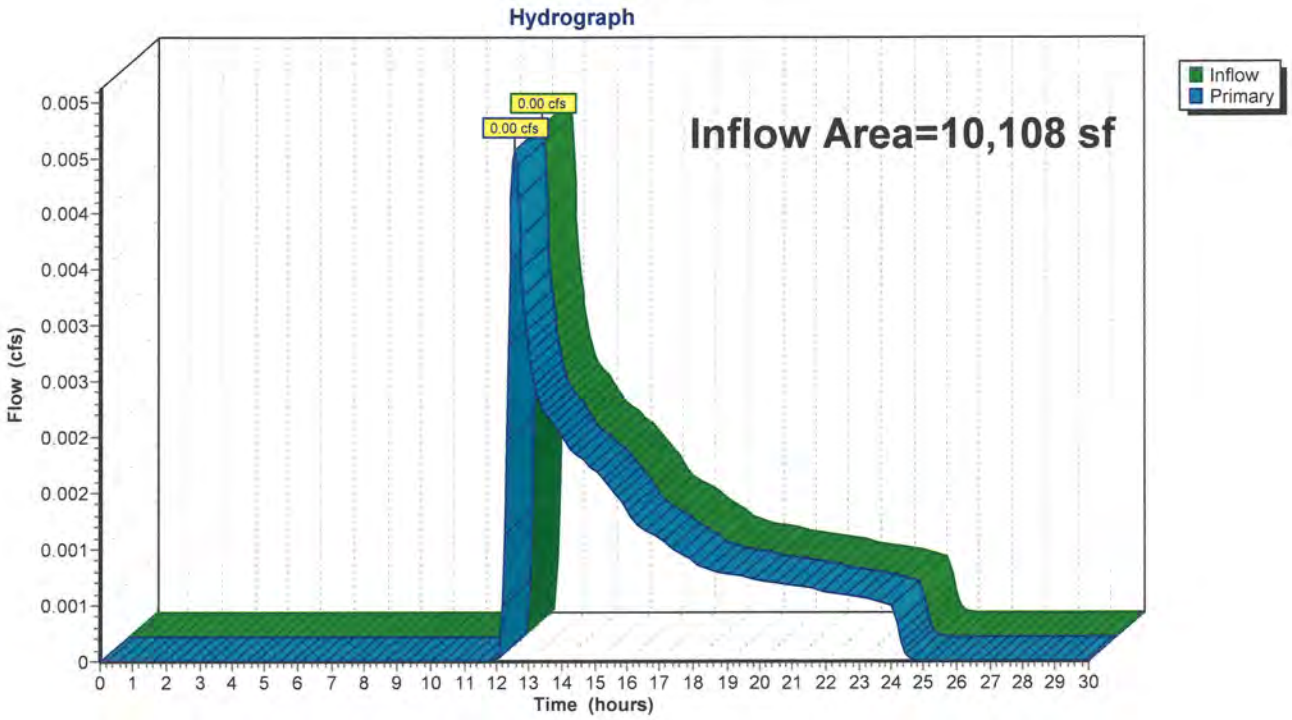


Summary for Link A1: AP

Inflow Area = 10,108 sf, 62.11% Impervious, Inflow Depth = 0.06" for 1-Year event
Inflow = 0.00 cfs @ 12.54 hrs, Volume= 53 cf
Primary = 0.00 cfs @ 12.54 hrs, Volume= 53 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link A1: AP



Summary for Subcatchment 1S: Watershed 1

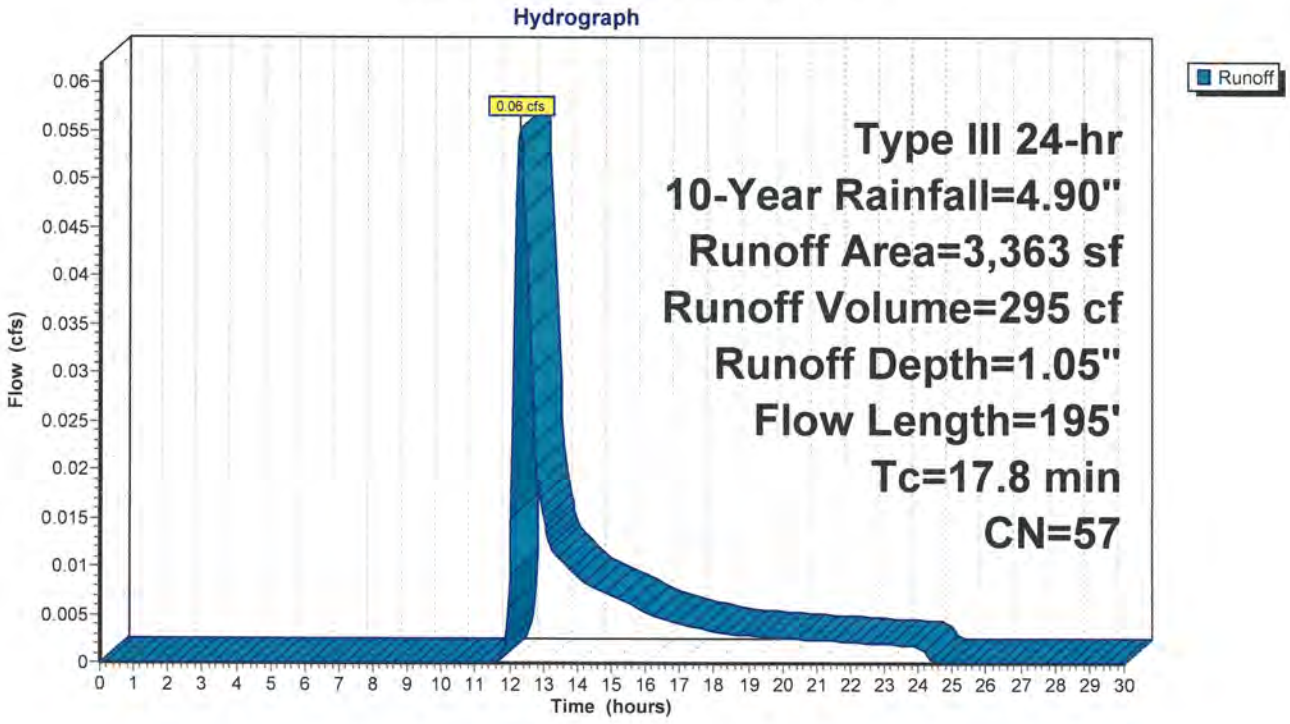
Runoff = 0.06 cfs @ 12.30 hrs, Volume= 295 cf, Depth= 1.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (sf)	CN	Description
	2,326	39	>75% Grass cover, Good, HSG A
*	642	98	Existing Paved parking, HSG A
*	395	98	Proposed Paved parking/walkway/conc pad, HSG A
	3,363	57	Weighted Average
	2,326	39	69.16% Pervious Area
	1,037	98	30.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0150	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
1.4	13	0.1154	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
0.6	82	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
17.8	195	Total			

Subcatchment 1S: Watershed 1



Summary for Subcatchment 2S: Watershed 2

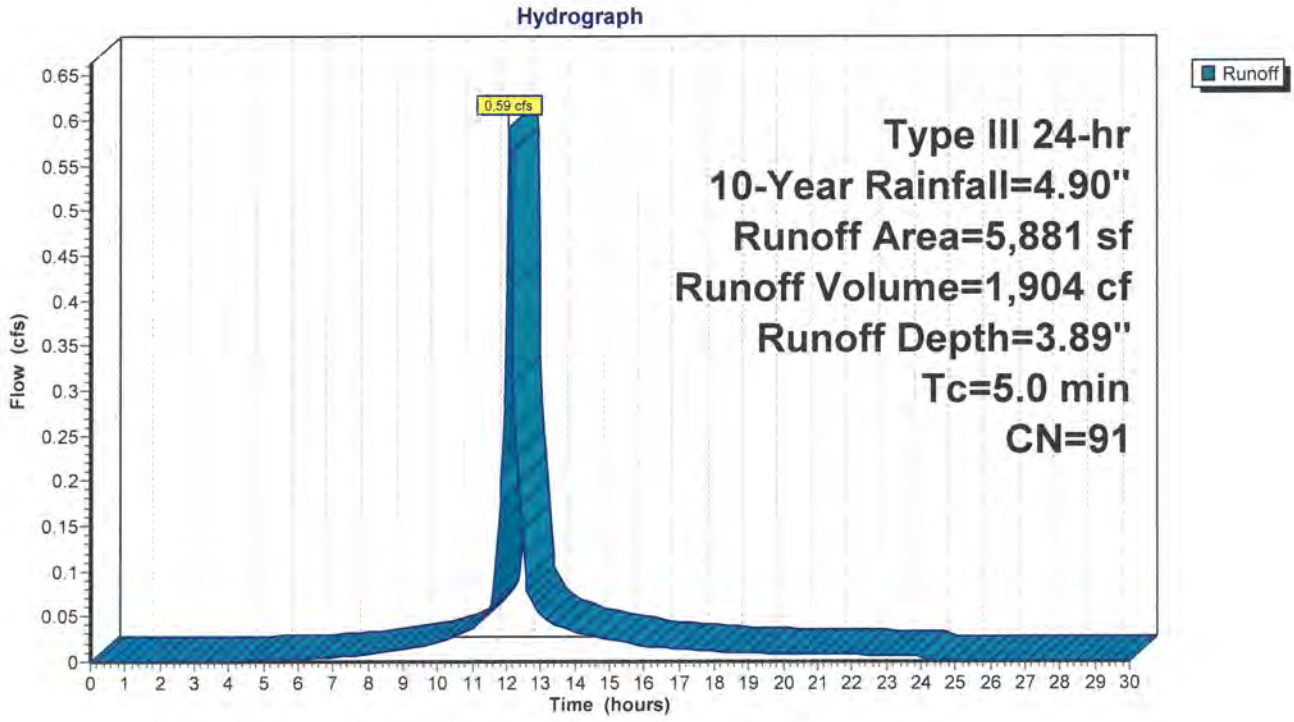
Runoff = 0.59 cfs @ 12.07 hrs, Volume= 1,904 cf, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (sf)	CN	Description
	722	39	>75% Grass cover, Good, HSG A
*	2,488	98	Proposed Paved parking/walkway/conc pad, HSG A
	2,671	98	Roofs, HSG A
	5,881	91	Weighted Average
	722	39	12.28% Pervious Area
	5,159	98	87.72% Impervious Area

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

Subcatchment 2S: Watershed 2



Summary for Subcatchment 3S: Watershed 3

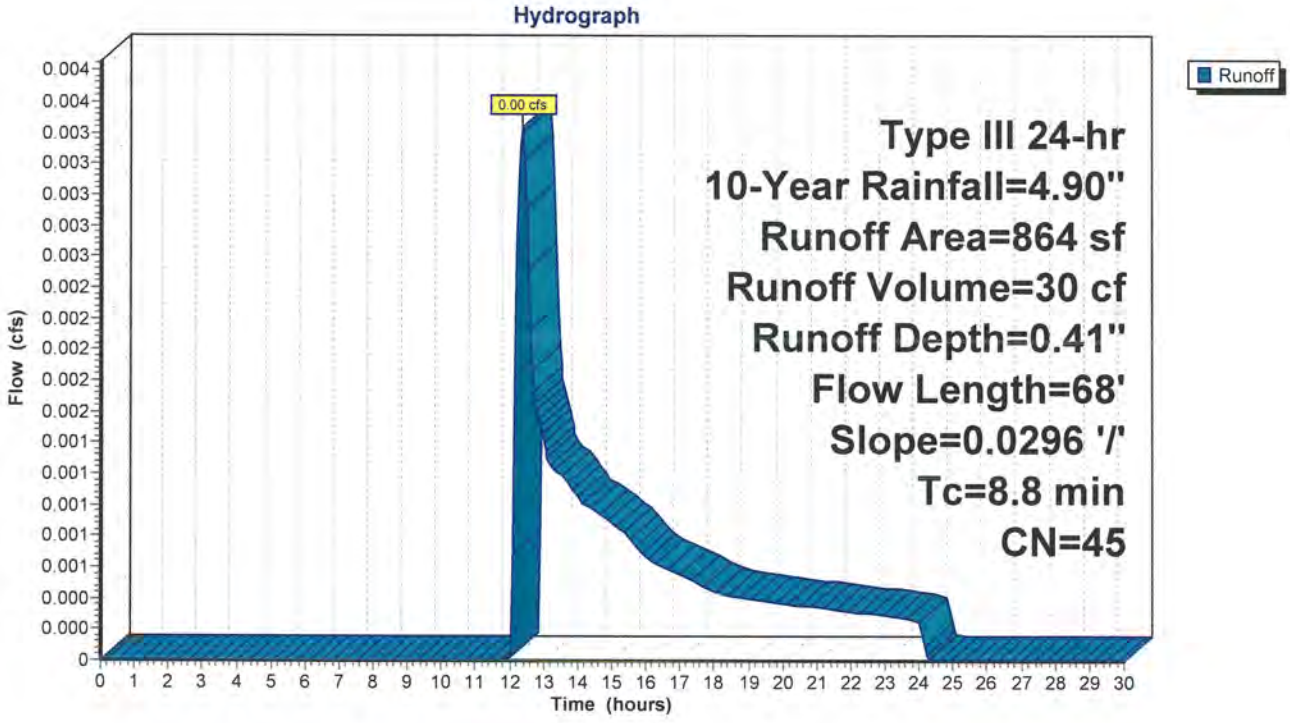
Runoff = 0.00 cfs @ 12.36 hrs, Volume= 30 cf, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
782	39	>75% Grass cover, Good, HSG A
52	98	Paved parking, HSG A
30	98	Paved parking, HSG A
864	45	Weighted Average
782	39	90.51% Pervious Area
82	98	9.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	68	0.0296	0.13		**Sheet Flow, 2/67.5** Grass: Dense n= 0.240 P2= 3.30"

Subcatchment 3S: Watershed 3



Summary for Pond 1U: Cultech

Inflow Area = 5,881 sf, 87.72% Impervious, Inflow Depth = 3.89" for 10-Year event
Inflow = 0.59 cfs @ 12.07 hrs, Volume= 1,904 cf
Outflow = 0.18 cfs @ 11.85 hrs, Volume= 1,904 cf, Atten= 69%, Lag= 0.0 min
Discarded = 0.18 cfs @ 11.85 hrs, Volume= 1,904 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 49.70' @ 12.38 hrs Surf.Area= 945 sf Storage= 325 cf

Plug-Flow detention time= 19.0 min calculated for 1,901 cf (100% of inflow)
Center-of-Mass det. time= 19.1 min (805.7 - 786.6)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	549 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,137 cf Overall - 472 cf Embedded = 1,665 cf x 33.0% Voids
#2	49.50'	472 cf	**ADS_StormTech SC-310 +Cap** x 32 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 32 Chambers in 8 Rows
#3	48.17'	128 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,149 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	917	0	0
51.33	917	2,137	2,137

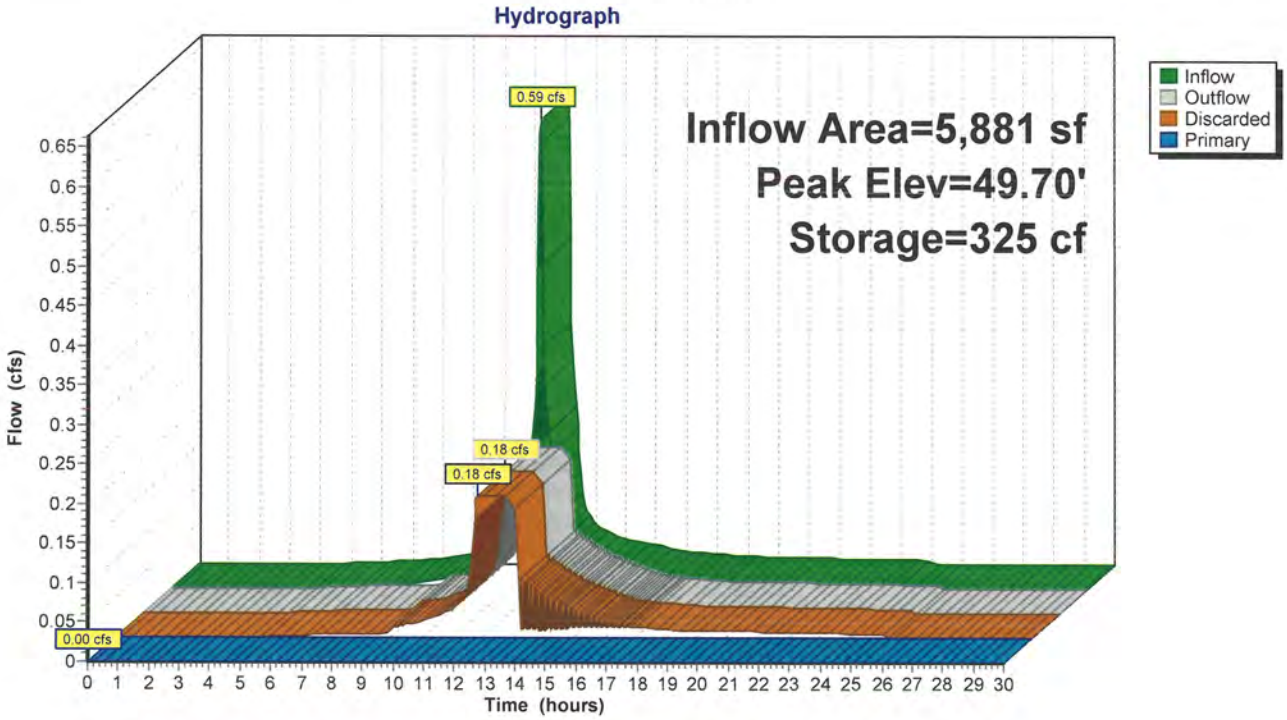
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.17	28	0	0
52.75	28	128	128

Device	Routing	Invert	Outlet Devices
#1	Primary	52.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.25 Width (feet) 2.00 10.00
#2	Discarded	48.17'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.18 cfs @ 11.85 hrs HW=49.01' (Free Discharge)
↑**2=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=48.17' TW=0.00' (Dynamic Tailwater)
↑**1=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1U: Cultech



Summary for Pond 2U: Infiltration Trench

Inflow Area = 864 sf, 9.49% Impervious, Inflow Depth = 0.41" for 10-Year event
Inflow = 0.00 cfs @ 12.36 hrs, Volume= 30 cf
Outflow = 0.00 cfs @ 12.41 hrs, Volume= 30 cf, Atten= 2%, Lag= 3.0 min
Discarded = 0.00 cfs @ 12.41 hrs, Volume= 30 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 46.53' @ 12.41 hrs Surf.Area= 58 sf Storage= 1 cf

Plug-Flow detention time= 2.9 min calculated for 30 cf (100% of inflow)
Center-of-Mass det. time= 2.9 min (955.8 - 952.9)

Volume	Invert	Avail.Storage	Storage Description
#1	46.50'	57 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 174 cf Overall x 33.0% Voids

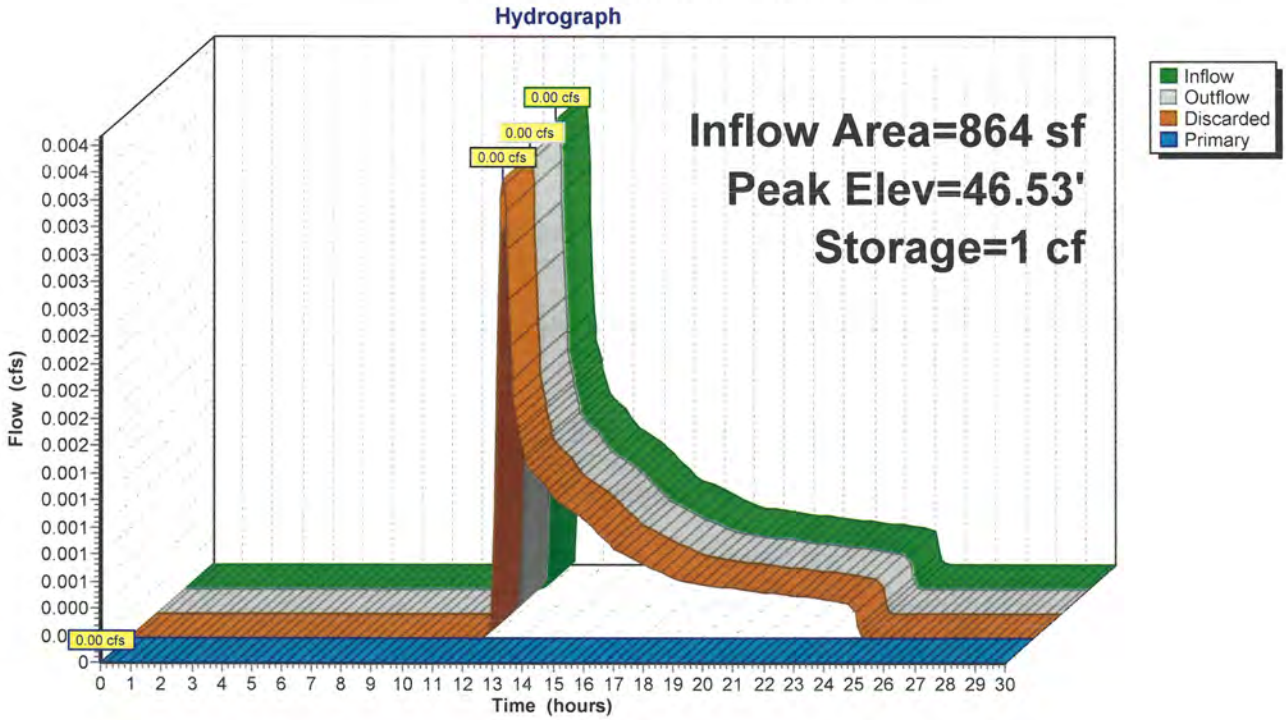
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.50	58	0	0
49.50	58	174	174

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Primary	49.50'	**49.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.00 cfs @ 12.41 hrs HW=46.53' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=46.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2U: Infiltration Trench

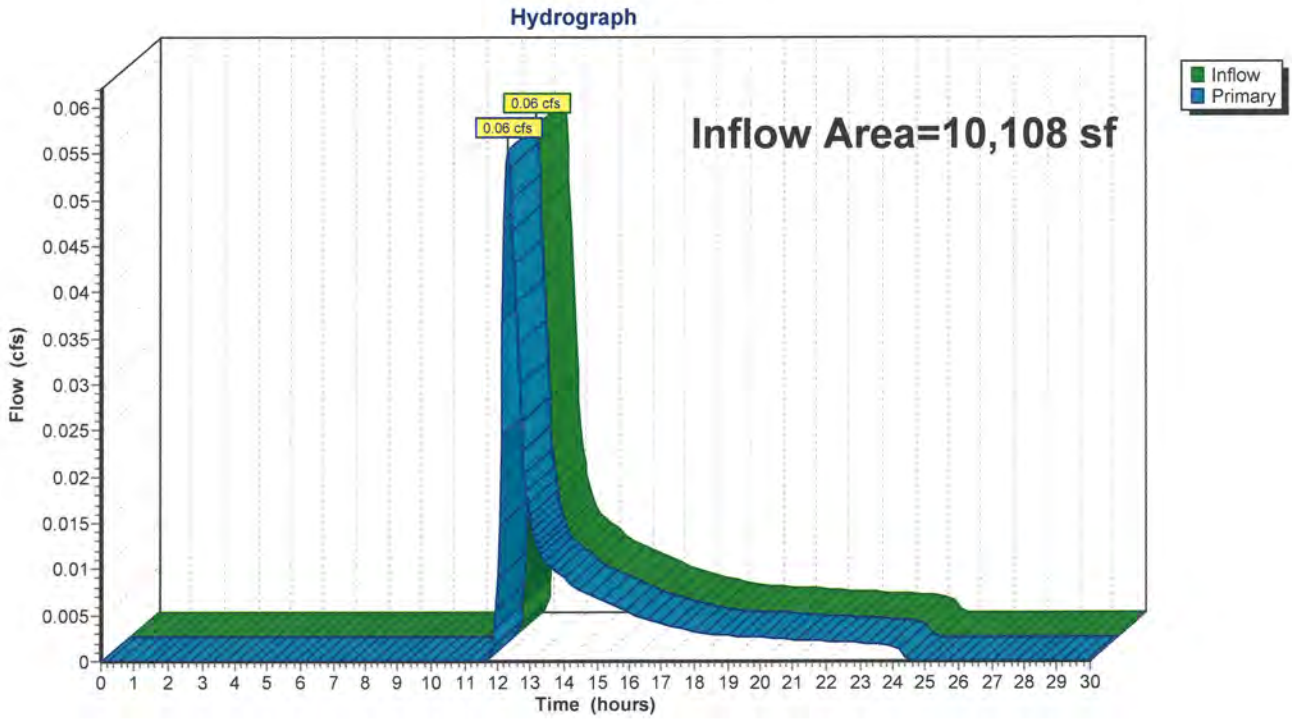


Summary for Link A1: AP

Inflow Area = 10,108 sf, 62.11% Impervious, Inflow Depth = 0.35" for 10-Year event
Inflow = 0.06 cfs @ 12.30 hrs, Volume= 295 cf
Primary = 0.06 cfs @ 12.30 hrs, Volume= 295 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link A1: AP



Summary for Subcatchment 1S: Watershed 1

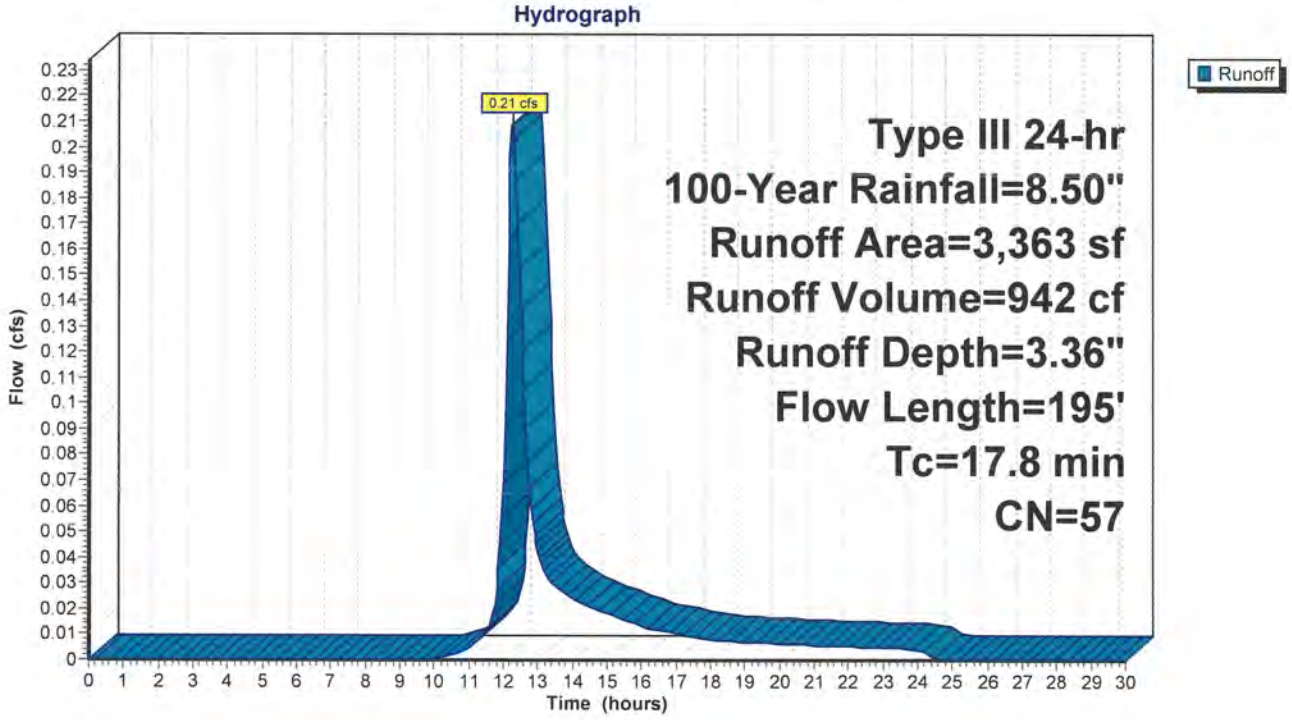
Runoff = 0.21 cfs @ 12.26 hrs, Volume= 942 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.50"

	Area (sf)	CN	Description
	2,326	39	>75% Grass cover, Good, HSG A
*	642	98	Existing Paved parking, HSG A
*	395	98	Proposed Paved parking/walkway/conc pad, HSG A
	3,363	57	Weighted Average
	2,326	39	69.16% Pervious Area
	1,037	98	30.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0150	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
1.4	13	0.1154	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
0.6	82	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
17.8	195	Total			

Subcatchment 1S: Watershed 1



Summary for Subcatchment 2S: Watershed 2

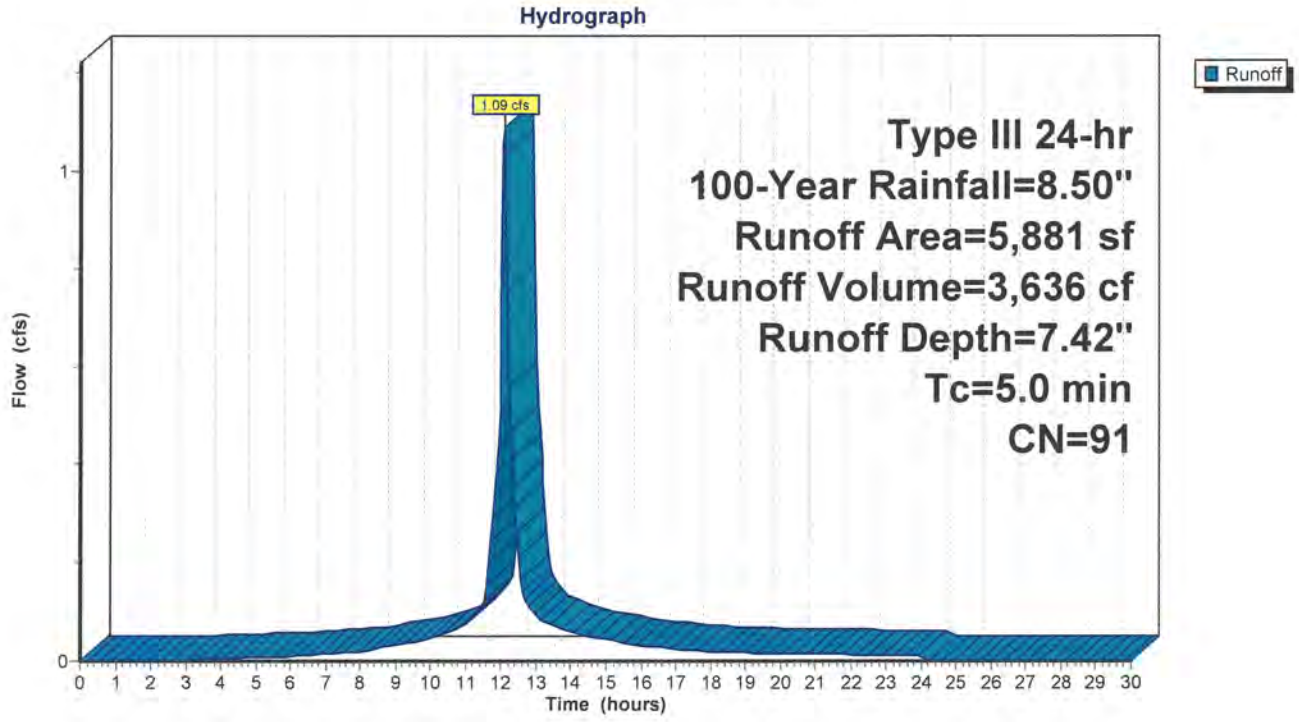
Runoff = 1.09 cfs @ 12.07 hrs, Volume= 3,636 cf, Depth= 7.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.50"

	Area (sf)	CN	Description
	722	39	>75% Grass cover, Good, HSG A
*	2,488	98	Proposed Paved parking/walkway/conc pad, HSG A
	2,671	98	Roofs, HSG A
	5,881	91	Weighted Average
	722	39	12.28% Pervious Area
	5,159	98	87.72% Impervious Area

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

Subcatchment 2S: Watershed 2



Summary for Subcatchment 3S: Watershed 3

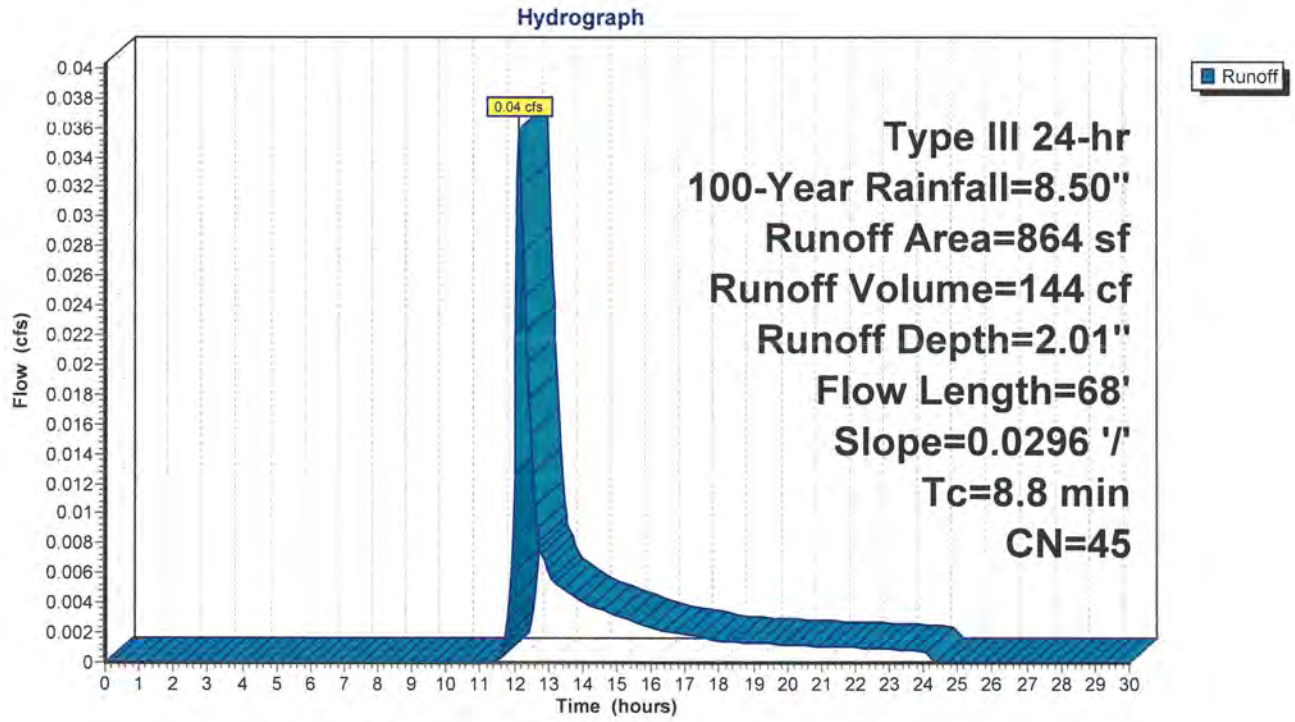
Runoff = 0.04 cfs @ 12.15 hrs, Volume= 144 cf, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.50"

Area (sf)	CN	Description
782	39	>75% Grass cover, Good, HSG A
52	98	Paved parking, HSG A
30	98	Paved parking, HSG A
864	45	Weighted Average
782	39	90.51% Pervious Area
82	98	9.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	68	0.0296	0.13		**Sheet Flow, 2/67.5** Grass: Dense n= 0.240 P2= 3.30"

Subcatchment 3S: Watershed 3



Summary for Pond 1U: Cultech

Inflow Area = 5,881 sf, 87.72% Impervious, Inflow Depth = 7.42" for 100-Year event
Inflow = 1.09 cfs @ 12.07 hrs, Volume= 3,636 cf
Outflow = 0.18 cfs @ 11.65 hrs, Volume= 3,636 cf, Atten= 83%, Lag= 0.0 min
Discarded = 0.18 cfs @ 11.65 hrs, Volume= 3,636 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 50.95' @ 12.54 hrs Surf.Area= 945 sf Storage= 986 cf

Plug-Flow detention time= 36.3 min calculated for 3,630 cf (100% of inflow)
Center-of-Mass det. time= 36.4 min (806.4 - 770.0)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	549 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,137 cf Overall - 472 cf Embedded = 1,665 cf x 33.0% Voids
#2	49.50'	472 cf	**ADS_StormTech SC-310 +Cap** x 32 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 32 Chambers in 8 Rows
#3	48.17'	128 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,149 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	917	0	0
51.33	917	2,137	2,137

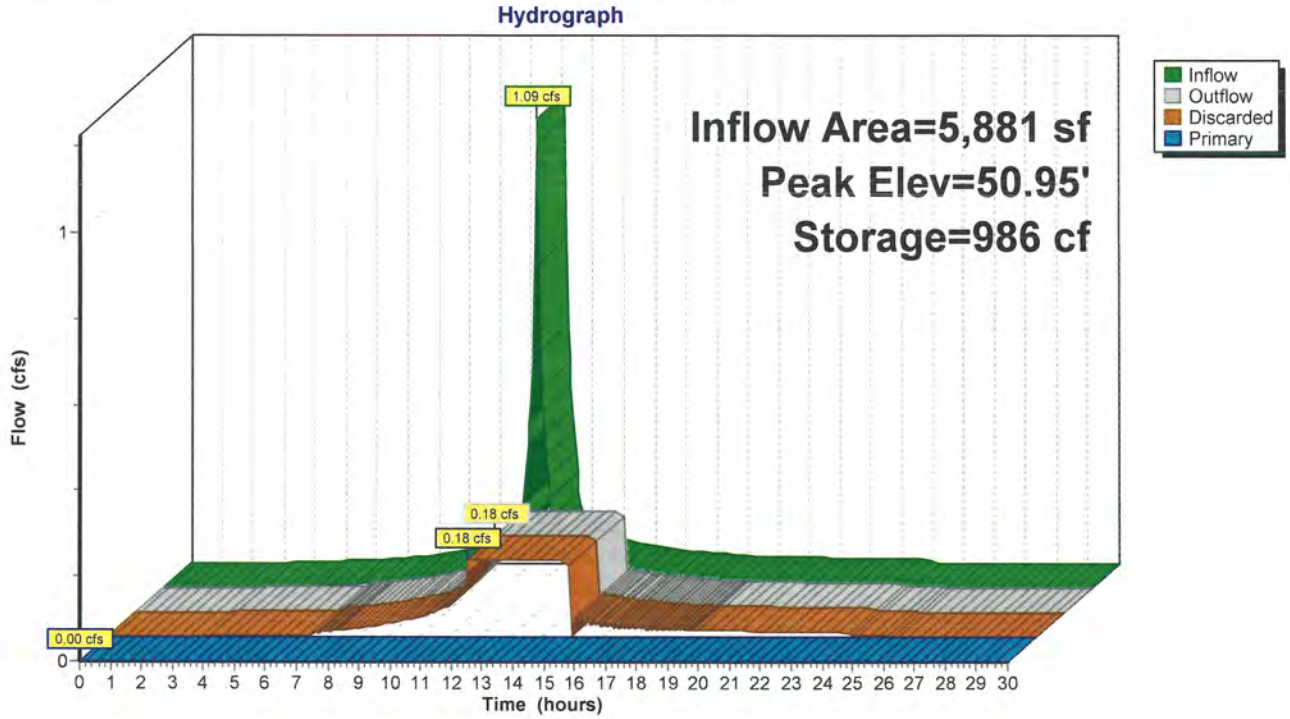
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.17	28	0	0
52.75	28	128	128

Device	Routing	Invert	Outlet Devices
#1	Primary	52.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.25 Width (feet) 2.00 10.00
#2	Discarded	48.17'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.18 cfs @ 11.65 hrs HW=49.00' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=48.17' TW=0.00' (Dynamic Tailwater)
↑—**1=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1U: Cultech



Summary for Pond 2U: Infiltration Trench

Inflow Area = 864 sf, 9.49% Impervious, Inflow Depth = 2.01" for 100-Year event
Inflow = 0.04 cfs @ 12.15 hrs, Volume= 144 cf
Outflow = 0.01 cfs @ 12.05 hrs, Volume= 144 cf, Atten= 69%, Lag= 0.0 min
Discarded = 0.01 cfs @ 12.05 hrs, Volume= 144 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 47.93' @ 12.59 hrs Surf.Area= 58 sf Storage= 27 cf

Plug-Flow detention time= 14.7 min calculated for 144 cf (100% of inflow)
Center-of-Mass det. time= 14.7 min (898.5 - 883.9)

Volume	Invert	Avail.Storage	Storage Description
#1	46.50'	57 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 174 cf Overall x 33.0% Voids

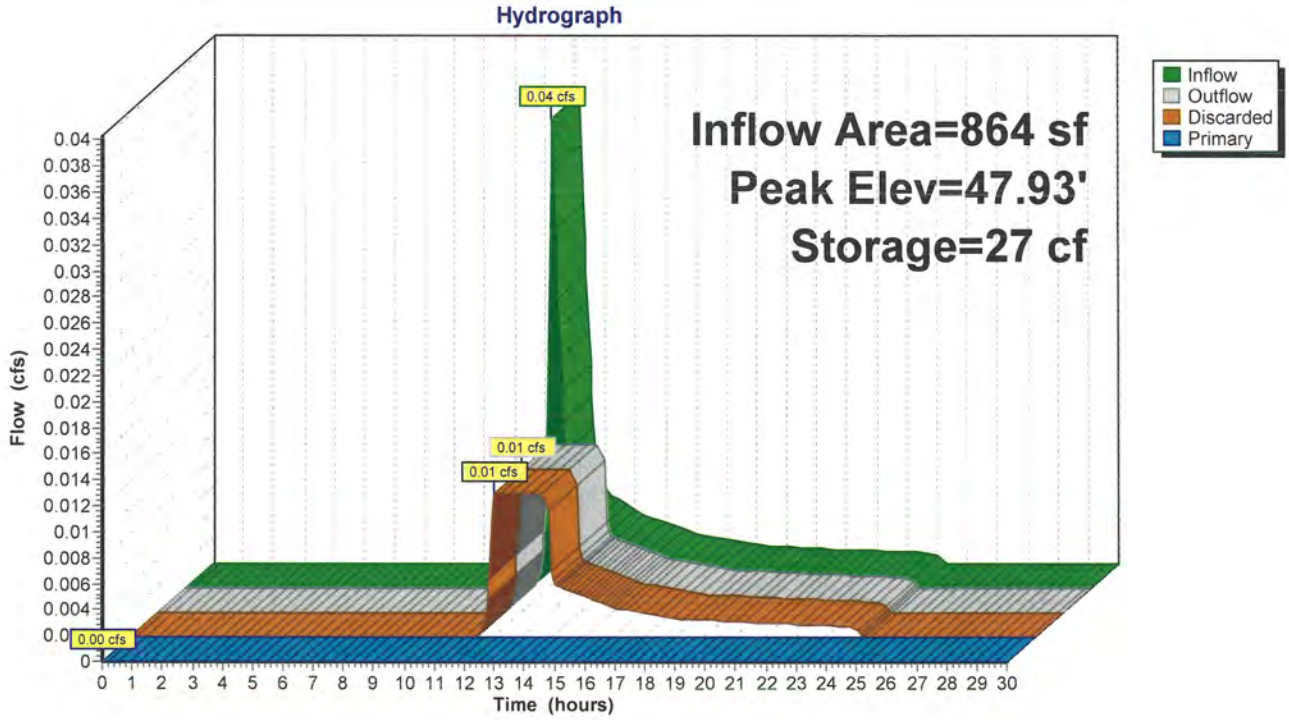
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.50	58	0	0
49.50	58	174	174

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Primary	49.50'	**49.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.01 cfs @ 12.05 hrs HW=46.65' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=46.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2U: Infiltration Trench

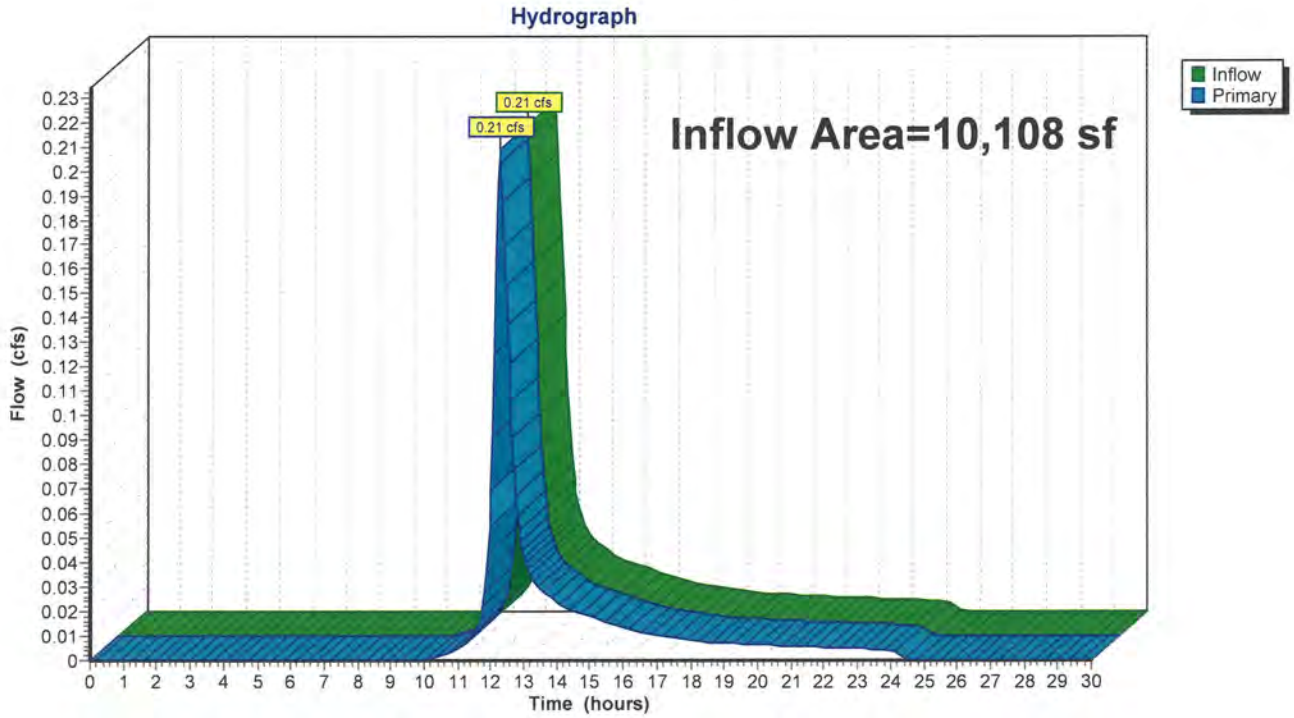


Summary for Link A1: AP

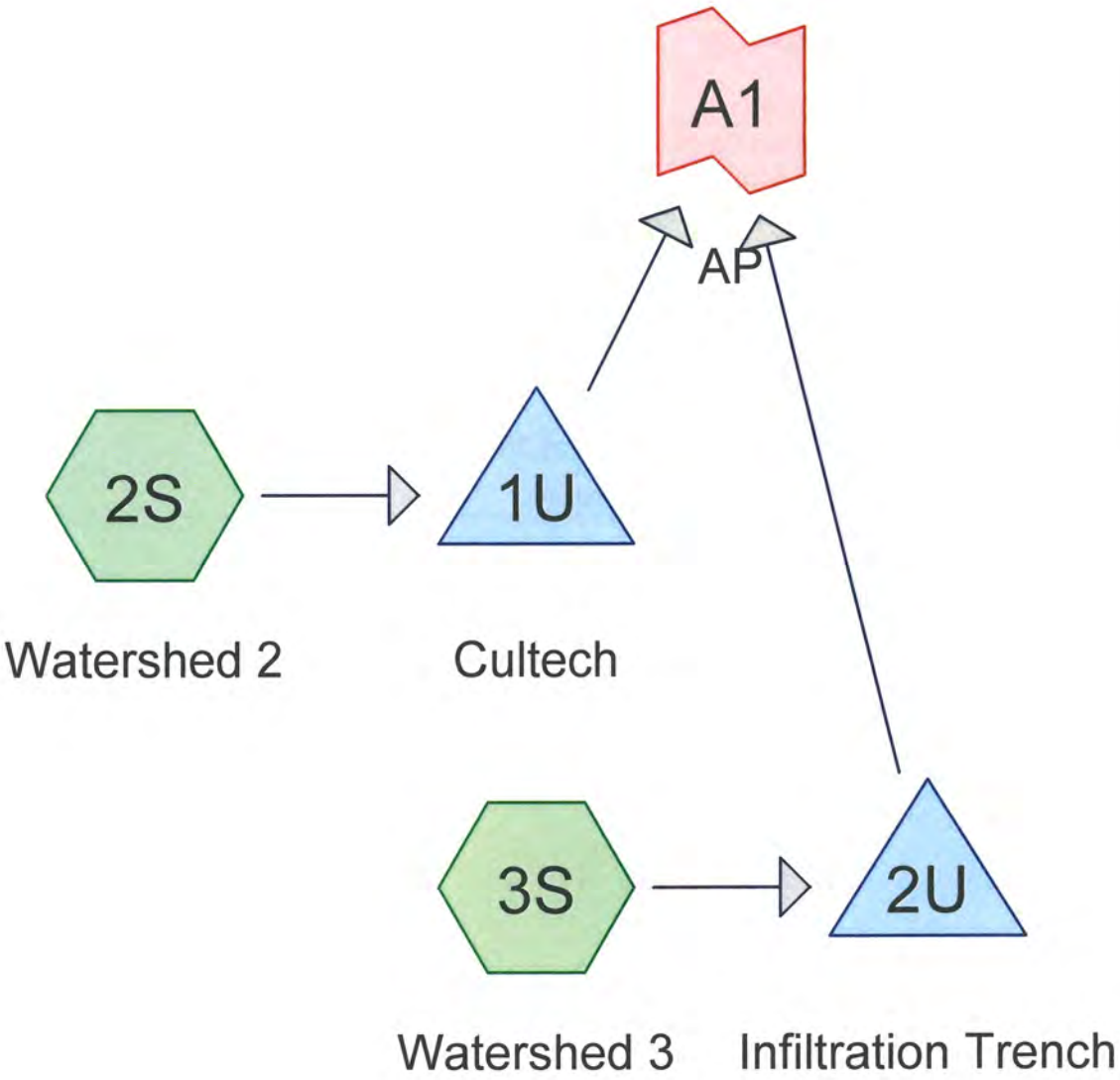
Inflow Area = 10,108 sf, 62.11% Impervious, Inflow Depth = 1.12" for 100-Year event
Inflow = 0.21 cfs @ 12.26 hrs, Volume= 942 cf
Primary = 0.21 cfs @ 12.26 hrs, Volume= 942 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link A1: AP



Appendix 3
Supporting Drainage Calculations – Water Quality Flow



Subcat Reach Pond Link

Routing Diagram for 125222_WQF Rev-101625
Prepared by American Engineering, Inc., Printed 10/17/2025
HydroCAD® 10.00-26 s/n 06264 © 2020 HydroCAD Software Solutions LLC

Summary for Subcatchment 2S: Watershed 2

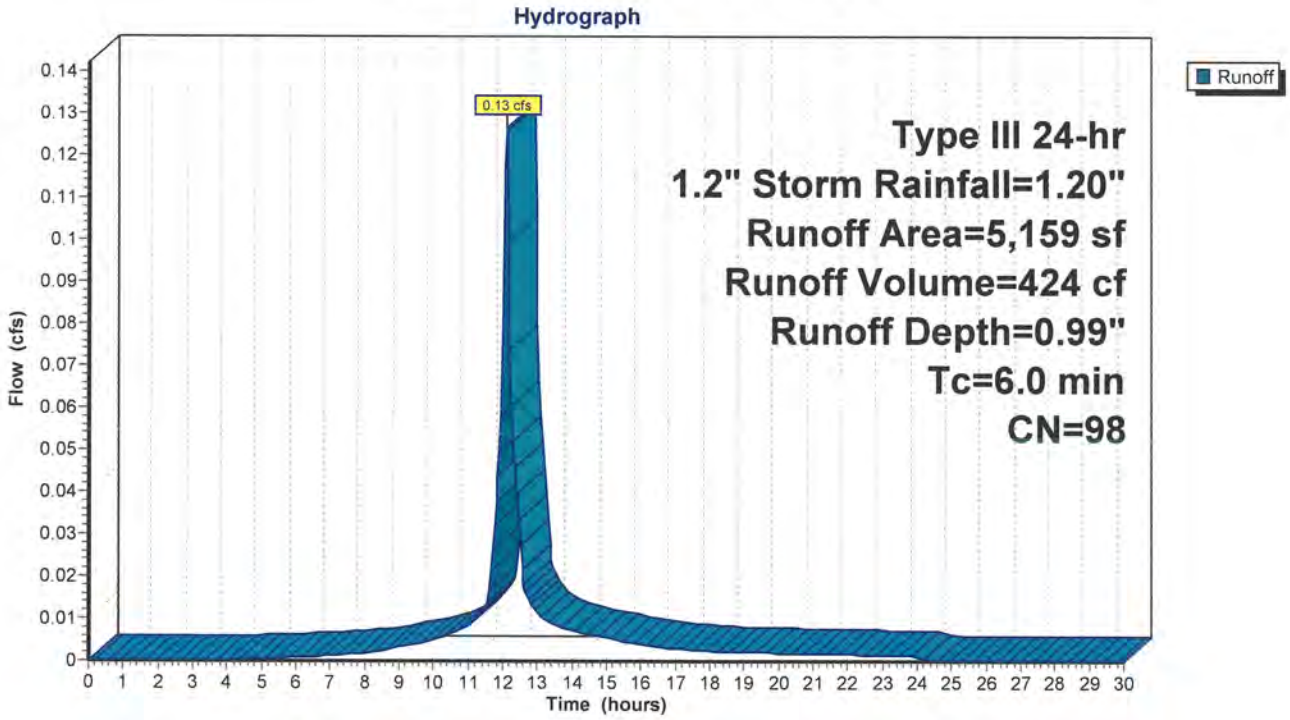
Runoff = 0.13 cfs @ 12.09 hrs, Volume= 424 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1.2" Storm Rainfall=1.20"

	Area (sf)	CN	Description
*	2,488	98	Proposed Paved parking/walkway/conc pad, HSG A
	2,671	98	Roofs, HSG A
	5,159	98	Weighted Average
	5,159	98	100.00% Impervious Area

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

Subcatchment 2S: Watershed 2



Summary for Subcatchment 3S: Watershed 3

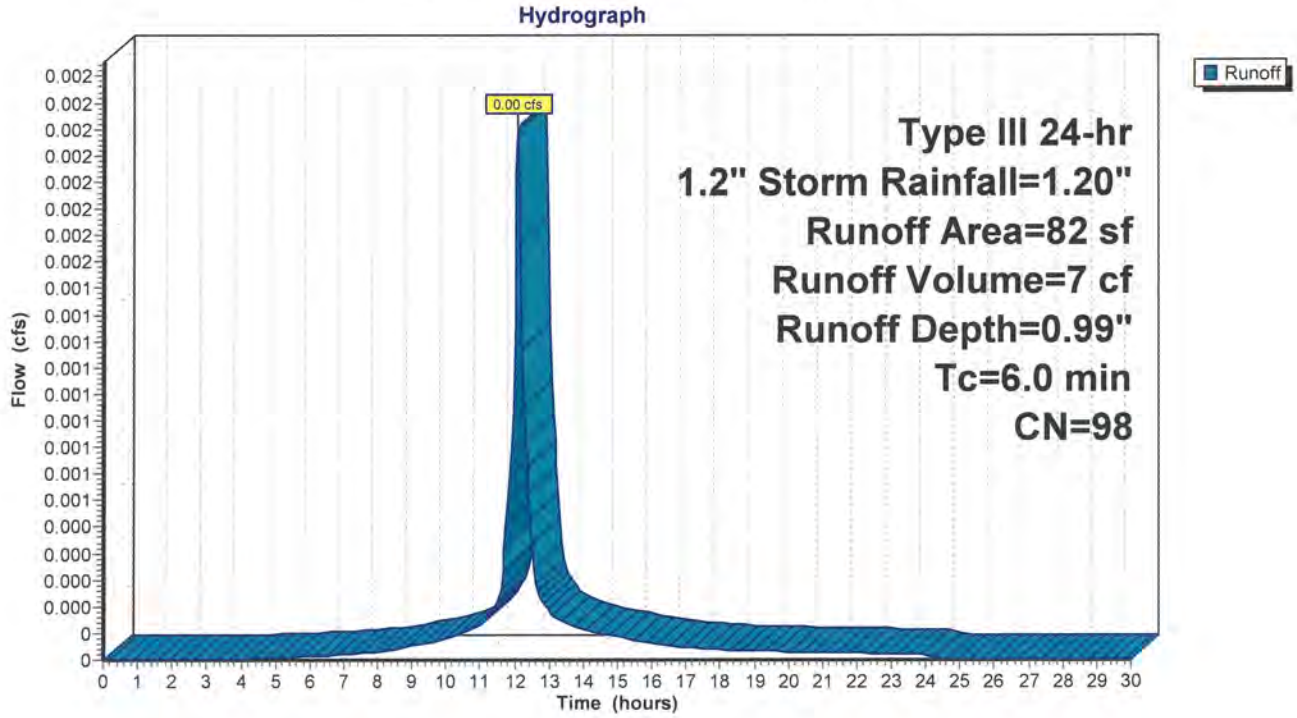
Runoff = 0.00 cfs @ 12.09 hrs, Volume= 7 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1.2" Storm Rainfall=1.20"

Area (sf)	CN	Description
52	98	Paved parking, HSG A
30	98	Paved parking, HSG A
82	98	Weighted Average
82	98	100.00% Impervious Area

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

Subcatchment 3S: Watershed 3



Summary for Pond 1U: Cultech

Inflow Area = 5,159 sf,100.00% Impervious, Inflow Depth = 0.99" for 1.2" Storm event
Inflow = 0.13 cfs @ 12.09 hrs, Volume= 424 cf
Outflow = 0.13 cfs @ 12.07 hrs, Volume= 424 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.13 cfs @ 12.07 hrs, Volume= 424 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 49.00' @ 12.05 hrs Surf.Area= 945 sf Storage= 23 cf

Plug-Flow detention time= 18.9 min calculated for 423 cf (100% of inflow)
Center-of-Mass det. time= 19.0 min (801.0 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	549 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,137 cf Overall - 472 cf Embedded = 1,665 cf x 33.0% Voids
#2	49.50'	472 cf	**ADS_StormTech SC-310 +Cap** x 32 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 32 Chambers in 8 Rows
#3	48.17'	128 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		1,149 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	917	0	0
51.33	917	2,137	2,137

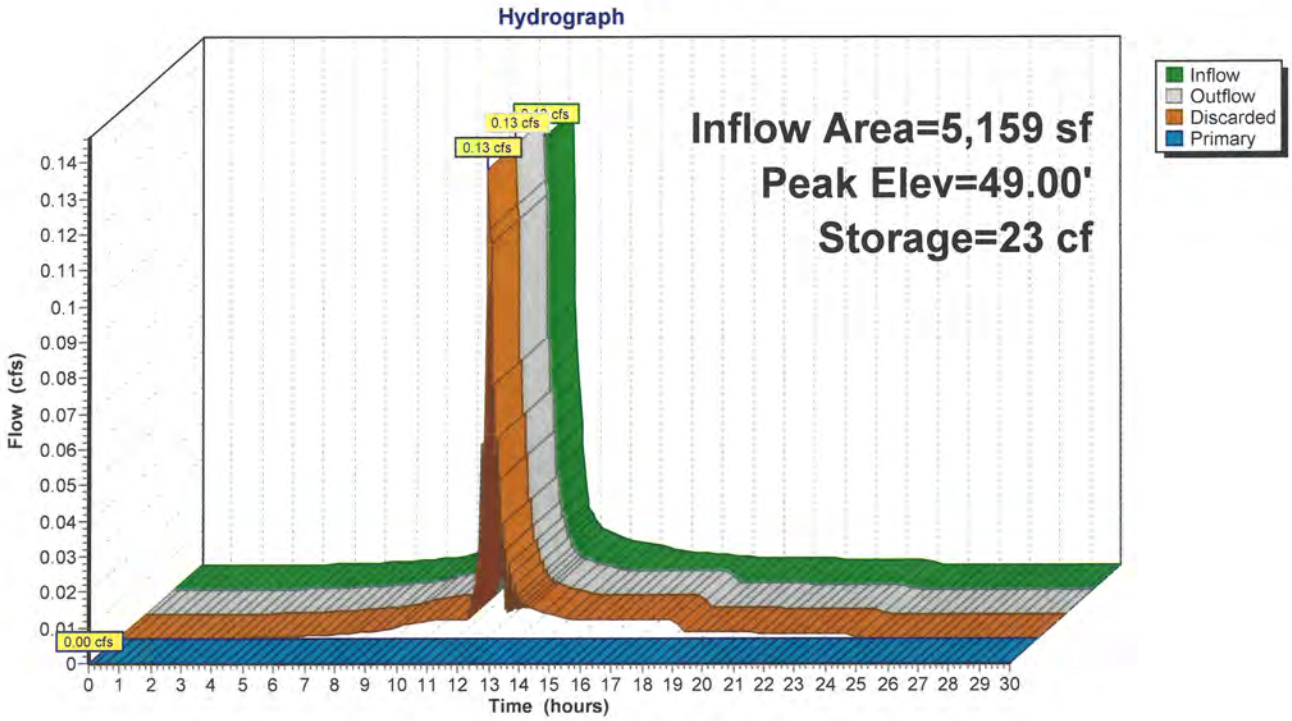
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.17	28	0	0
52.75	28	128	128

Device	Routing	Invert	Outlet Devices
#1	Primary	52.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.25 Width (feet) 2.00 10.00
#2	Discarded	48.17'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.18 cfs @ 12.07 hrs HW=49.00' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=48.17' TW=0.00' (Dynamic Tailwater)
↑—**1=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1U: Cultech



Summary for Pond 2U: Infiltration Trench

Inflow Area = 82 sf,100.00% Impervious, Inflow Depth = 0.99" for 1.2" Storm event
Inflow = 0.00 cfs @ 12.09 hrs, Volume= 7 cf
Outflow = 0.00 cfs @ 12.13 hrs, Volume= 7 cf, Atten= 10%, Lag= 2.4 min
Discarded = 0.00 cfs @ 12.13 hrs, Volume= 7 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 46.52' @ 12.13 hrs Surf.Area= 58 sf Storage= 0 cf

Plug-Flow detention time= 2.9 min calculated for 7 cf (100% of inflow)
Center-of-Mass det. time= 2.9 min (784.9 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	46.50'	57 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 174 cf Overall x 33.0% Voids

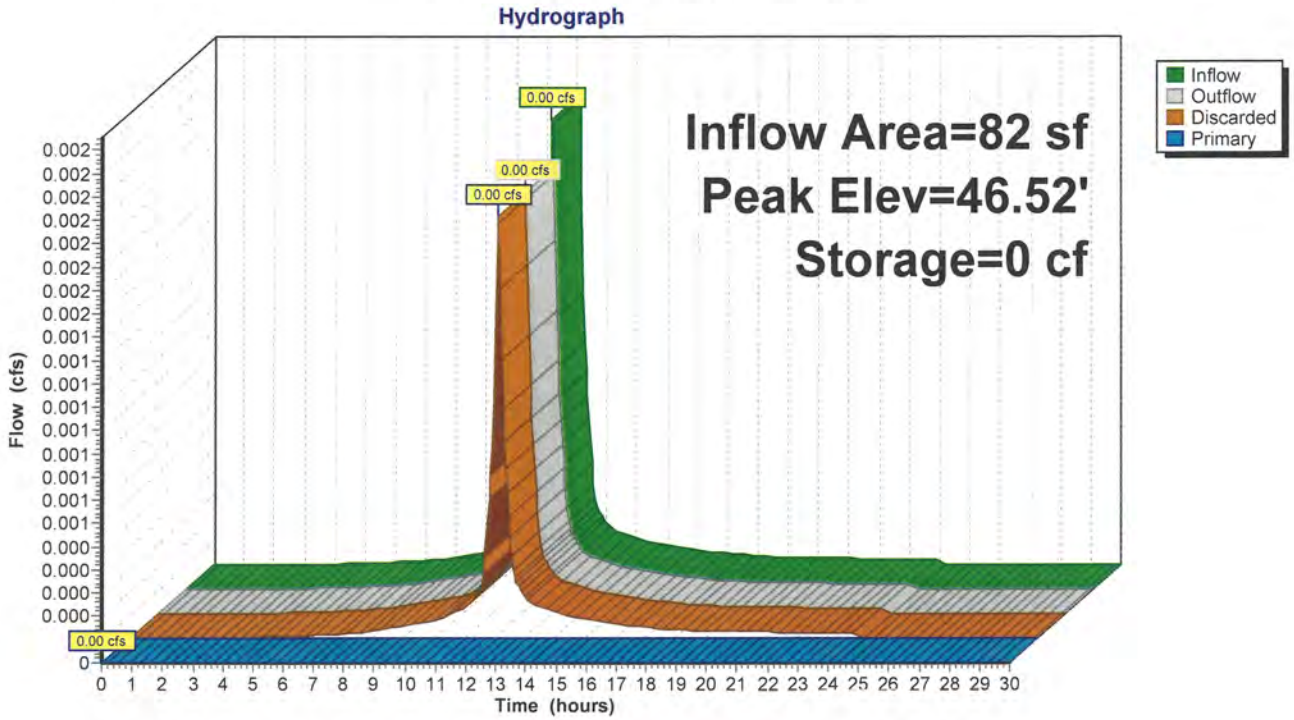
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.50	58	0	0
49.50	58	174	174

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Primary	49.50'	**49.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.00 cfs @ 12.13 hrs HW=46.52' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=46.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2U: Infiltration Trench

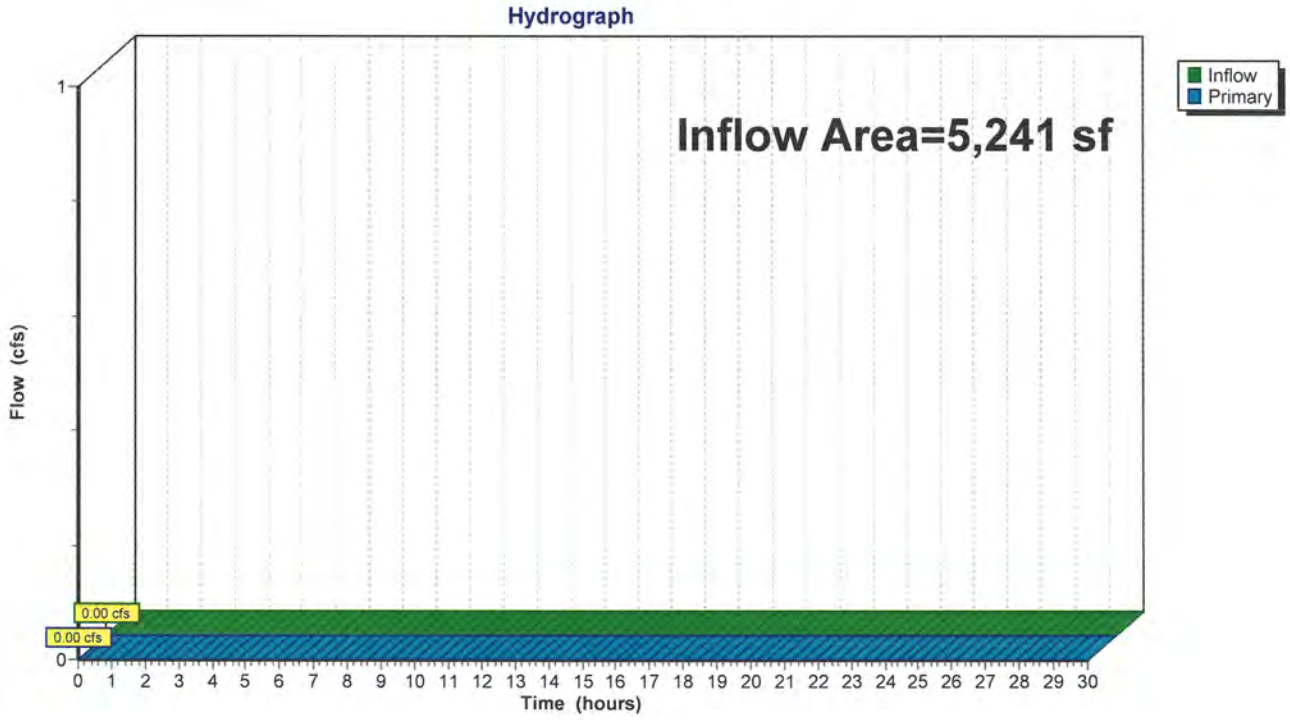


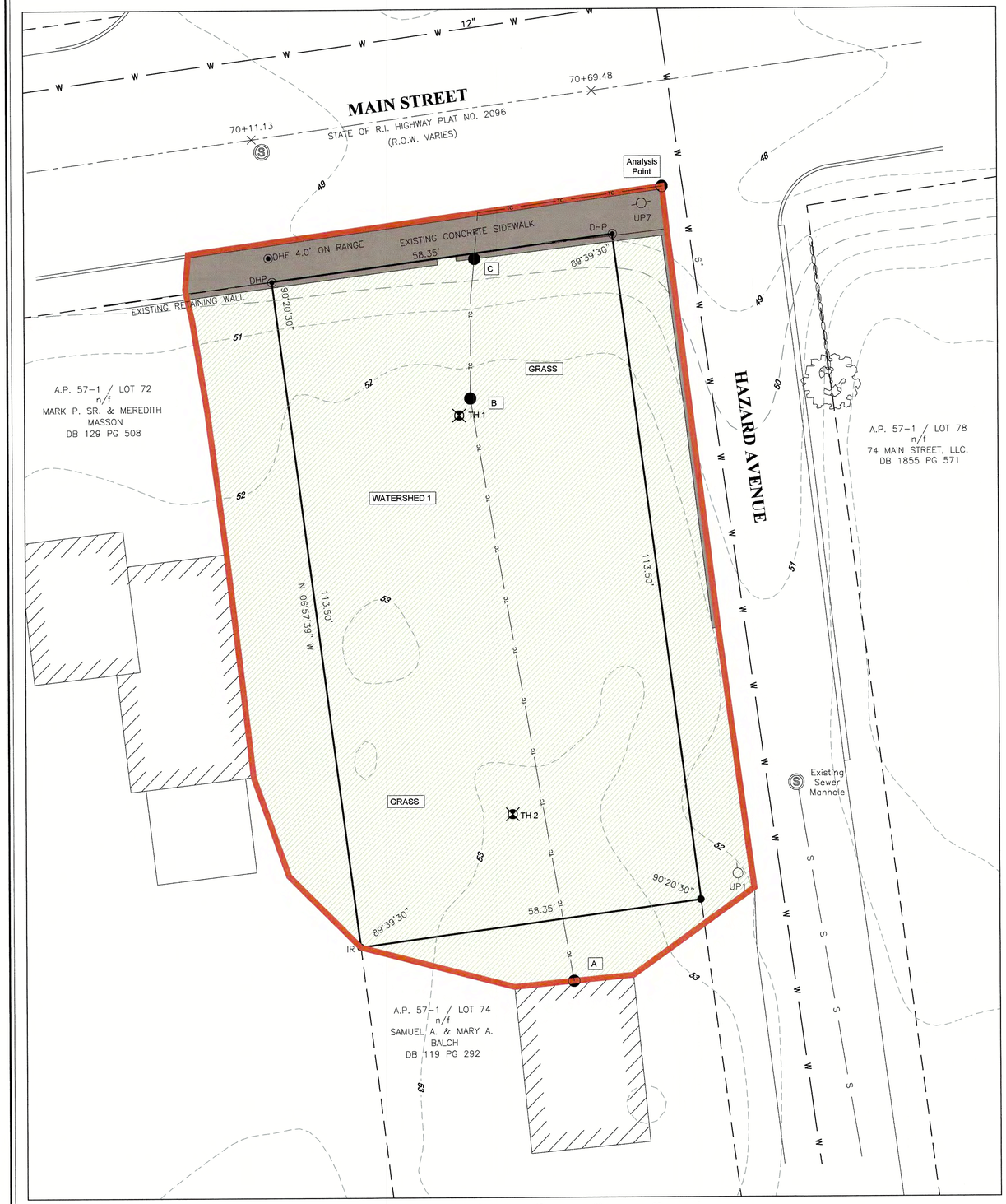
Summary for Link A1: AP

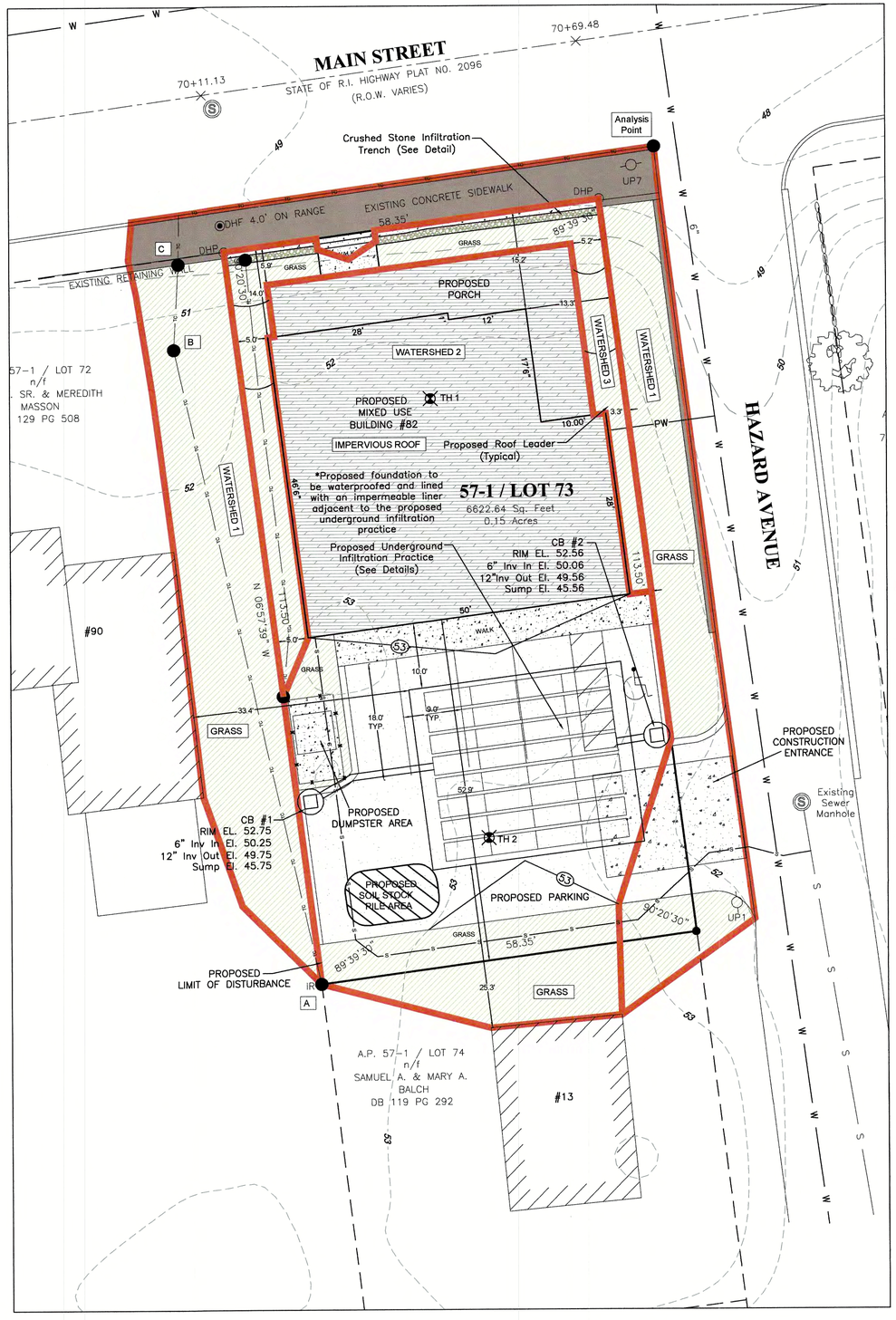
Inflow Area = 5,241 sf,100.00% Impervious, Inflow Depth = 0.00" for 1.2" Storm event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link A1: AP







WATERSHED MAPS
FOR
KEYSTONE, LLC.
LOCATED AT
A.P. 57-1, LOT 73
82 MAIN STREET
SOUTH KINGSTOWN, R.I.

Drawn By: MJC | Checked By: PJF | Date: 10/03/2025 | Scale: AS SHOWN

NO.	REVISION	BY	DATE
1.	Revision per town comments	ADM	10/15/25

REVISIONS

PATRICK J. FREEMAN
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REGISTERED PROFESSIONAL ENGINEER
CIVIL
10/16/2025

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Sheet 1 of 1 sheets

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