CIVIL DESIGN GROUP, LLC
ENGINEERING. LAND USE. PLANNING. PERMITTING.

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May 19, 2020

Sudbury Planning Board
278 Old Sudbury Road
Sudbury, Massachusetts 01776

Re: ***Cold Brook Crossing***
Stormwater Management Peer Review
Response to Comments

Dear Board Members:

Civil Design Group, LLC (CDG) is in receipt of The Horsley Witten Group's (HW's) review letter, dated April 17, 2020, for the above-referenced project. Our responses are provided below in **bold** following each of HW's comments, and supporting plans and documents are enclosed herein:

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

   a. The existing site discharges stormwater via overland flow to four separate points of analysis (POA):
      (1) The wetland resource area located in the Town of Concord,
      (2) the abutting property to the west,
      (3) North Road, and
      (4) the cell tower road.

   Under proposed conditions the Applicant has provided stormwater practices to collect, manage, treat and recharge the stormwater within the developed areas of the site. The watershed areas and flow rates that continue to discharge towards the POAs have been reduced under proposed conditions. It does not appear that the proposed stormwater management will cause erosion in the adjacent wetlands.

   The Applicant complies with Standard 1.

   No response required.

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

   The Applicant has designed the proposed stormwater system to manage the 100-year stormwater runoff utilizing various stormwater practices including permeable pavement, an infiltration basin, and subsurface infiltration chambers. HW has the following comments regarding the proposed stormwater design:

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a. There appears to be some inconsistency between the proposed HydroCAD analysis, and the areas illustrated on the Post-Development Watersheds, Figure 4. HW was not able to confirm the watershed areas provided for some of the watershed areas and recommends that the Applicant revisit the watershed plan and HydroCAD model to confirm that the areas modeled are accurate. HW recommends that the Applicant confirm the following areas:

- Subcatchment PR-3B
- Subcatchment PR-3D
- Subcatchment PR-3G
- Subcatchment PR-3I

CDG has calculated the watershed areas in AutoCAD and made minor adjustments to the watershed areas listed above. Updated HydroCad modeling output for these watersheds is included in Attachment 1.

Furthermore, HW recommends that the Applicant confirm that the following subsurface infiltration systems have been sized to manage the applicable watershed area.

- Pond-SIS-10
- Pond-SIS-7
- Pond-SIS-4
- Pond-SIS-3

Based on the watershed adjustments noted above, CDG has made minor revisions to SIS-3 and SIS-7. No revisions were necessary for SIS-4 and SIS-10. Updated HydroCad modeling output for these watersheds is included in Attachment 1. Updated versions of the details entitled "Subsurface Infiltration System (SIS) Dimensions" and "Subsurface Infiltration System (SIS) Detail" are included in Attachment 2. These updated details will be incorporated into the plan set at the completion of the peer review.

b. The Applicant has used an exfiltration rate of 8.27 inches per hour (iph) for the infiltration basin and all 10 subsurface infiltration systems. The site has been mapped primarily as hydrologic soil group (HSG) A, in accordance with the Natural Resources Conservation Service (NRCS) soil maps. The test pits included in the Stormwater Management Report were completed in the area of the leaching field. The majority of the 13 test pit logs provided indicate that the subsoil or C horizon is sand, however a few indicate that the C horizon is loamy sand. HW recommends that the Applicant conduct soil test pits in the location of each of the infiltration practices proposed to verify the exfiltration for each individual system. Furthermore, HW recommends that the Applicant utilize the infiltration rate for sandy loam at 2.41 iph were applicable.

Twenty-two additional test pits were conducted on April 28, 2020 to further evaluate soils and seasonal high groundwater conditions in the vicinity of the infiltration basin and subsurface

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infiltration systems. Test pit logs and a location plan are included as Attachment 3. Below is an analysis of the data collected and associated plan modifications:

- **Basin 1:**
  Test pits TP-INFL-1A, TP-INFL-1B, and TP-INFL-1C were evaluated in relation to this BMP. Soil texture within the C horizon of these test pits ranged from sand to coarse sand. Since the bottom of this BMP is proposed to be at elevation 129, well within the C horizon, the infiltration rate of 8.27 inches/hour used in our hydrology modeling is appropriate for this BMP.

  With regard to seasonal high groundwater, test pits TP-INFL-1A and TP-INFL-1B were terminated at elevation 124 and TP-INFL-1C was terminated at elevation 125 with no redoximorphic features observed. As such, seasonal high groundwater is at least 5 feet beneath the proposed bottom of this BMP. No design modifications were necessary for this BMP based on the additional test pit data.

- **SIS-1:**
  SIS-1 is located at the far northwestern corner of the property where the existing grades are at their highest point on the site and as such, the proposed elevation of the bottom of this BMP could not be reached by the excavator. GeoHydroCycle, Inc. performed a boring (B-1) in this area in conjunction with the project leach field design and found the soil texture to consist of sand at the depth corresponding to the bottom of this BMP (boring log for B-1 included in Attachment 3). CDG performed a test pit, TP-SIS-1A, at this location to compare soil textures to those logged for Boring B-1. We found the C horizon to consist predominantly of sand but for a distinctive narrow band of loamy sand encountered at a depth of 7'-8' that does not appear to have been encountered in Boring B-1. Below this band of loamy sand the soil transitioned back to coarse sand down to the test pit termination elevation of 181. Since the test pit could not be extended as far down as the elevation of SIS-1, it remains a possibility that the soil texture could transition to something other than sand or coarse sand beyond the depth of the test pit. Due to this uncertainty, a note has been added to the "Subsurface Infiltration System (SIS) Detail" (Attachment 2) that during construction, three confirmatory test pits shall be conducted by CDG within the footprint of SIS-1, which shall extend to a depth corresponding to 4 feet beneath the proposed system bottom. If soil having an infiltration rate less than that of sand (8.27 inches/hour) is encountered in this zone, SIS-1 shall be over excavated by a depth of 4 feet and backfilled to the bottom of the system with 8.27 inch/hour material, which is abundantly available on site.

  With regard to seasonal high groundwater, the hydrogeological modeling predicts the seasonal high groundwater mound at the leach field to be at elevation 126.3 dropping radially outward from the leach field. At elevation 163, the bottom of this BMP will be well above the predicted seasonal high groundwater.

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- **SIS-2:**
  Test pits TP-SIS-2A and TP-SIS-2B were evaluated in relation to this BMP. The soil texture within the C horizon of these test pits was consistently sand. Since the bottom of this BMP is proposed to be at elevation 141.5, within the C horizon, the infiltration rate of 8.27 inches/hour used in our hydrology modeling is appropriate for this BMP.

  With regard to seasonal high groundwater, test pits TP-SIS-2A and TP-SIS-2B were terminated at elevations 135 and 138, respectively, with no redoximorphic features observed. As such, seasonal high groundwater is at least 6.5 feet beneath the proposed bottom of this BMP. While no design modifications appear to be necessary for this BMP based on the additional test pit data, CDG acknowledges that these test pits were performed slightly outside the footprint of SIS-2 due to the site terrain constraints. To be conservative, a note has been added to the "Subsurface Infiltration System (SIS) Detail" (Attachment 2) that during construction, three confirmatory test pits shall be conducted by CDG within the footprint of SIS-2, which shall extend to a depth corresponding to 4 feet beneath the proposed system bottom. If soil having an infiltration rate less than that of sand (8.27 inches/hour) is encountered in this zone, SIS-2 shall be over excavated by a depth of 4 feet and backfilled to the bottom of the system with 8.27 inch/hour material, which is abundantly available on site.

- **SIS-3:**
  Test pits TP-SIS-3/4A, TP-SIS-3/4B, and TP-SIS-3/4C were evaluated in relation to this BMP. The soil texture within the C horizon of TP-SIS-3/4A and TP-SIS-3/4B transitioned from sand to loamy sand at elevations 134 and 137.5, respectively. The soil texture within the C horizon of TP-SIS-3/4C ranged from sand to coarse sand down to the termination elevation of 136.5. The bottom of this BMP is proposed to be at elevation 140.5, which would place the zone of loamy sand encountered in TP-SIS-3/4B within 4' of the bottom of the system. Therefore, a note has been added to the "Subsurface Infiltration System (SIS) Detail" (Attachment 2) that this BMP shall be over excavated by a depth of 4 feet and backfilled to the bottom of the system with 8.27 inch/hour material, which is abundantly available on site.

  With regard to seasonal high groundwater, test pits TP-SIS-3/4A, TP-SIS-3/4B, and TP-SIS-3/4C were terminated at elevations 132.5, 133.5, and 136.5, respectively, with no redoximorphic features observed. As such, seasonal high groundwater is at least 4 feet beneath the proposed bottom of this BMP.

- **SIS-4:**
  Test pits TP-SIS-3/4A, TP-SIS-3/4B, and TP-SIS-3/4C were evaluated in relation to this BMP. The soil texture within the C horizon of TP-SIS-3/4A and TP-SIS-3/4B transitioned from sand to loamy sand at elevations 134 and 137.5, respectively. The soil texture within the C horizon of TP-SIS-3/4C ranged from sand to coarse sand down to the termination elevation of 136.5. The bottom of this BMP is proposed to be at elevation 145, which would more than 4' above the zone of loamy sand.

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With regard to seasonal high groundwater, test pits TP-SIS-3/4A, TP-SIS-3/4B, and TP-SIS-3/4C were terminated at elevations 132.5, 133.5, and 136.5, respectively, with no redoximorphic features observed. As such, seasonal high groundwater is at least 12.5 feet beneath the proposed bottom of this BMP. No design modifications were necessary for this BMP based on the additional test pit data.

- **SIS-5:**
  Test pits TP-SIS-5A and TP-SIS-5B were evaluated in relation to this BMP. Soil texture within the C horizon of these test pits was consistently sand. Since the bottom of this BMP is proposed to be at elevation 137, within the C horizon, the infiltration rate of 8.27 inches/hour used in our hydrology modeling is appropriate for this BMP.

  With regard to seasonal high groundwater, test pits TP-SIS-5A and TP-SIS-5B were terminated at elevations 131 and 128, respectively, with no redoximorphic features observed. As such, seasonal high groundwater is at least 9 feet beneath the proposed bottom of this BMP. No design modifications were necessary for this BMP based on the additional test pit data.

- **SIS-6:**
  Test pits TP-SIS-6A and TP-SIS-6B were evaluated in relation to this BMP. Soil texture within the C horizon of these test pits was consistently sand. Since the bottom of this BMP is proposed to be at elevation 132, within the C horizon, the infiltration rate of 8.27 inches/hour used in our hydrology modeling is appropriate for this BMP.

  With regard to seasonal high groundwater, test pits TP-SIS-6A and TP-SIS-6B were terminated at elevations 125 and 123.5, respectively, with no redoximorphic features observed. As such, seasonal high groundwater is at least 8.5 feet beneath the proposed bottom of this BMP. No design modifications were necessary for this BMP based on the additional test pit data.

- **SIS-7:**
  Test pits TP-SIS-7A, TP-SIS-7B, and TP-SIS-7C were evaluated in relation to this BMP. The soil texture within the C horizon of these three test pits transitioned from sand to loamy sand at elevations 127.5, 124.5, and 130, respectively. The bottom of this BMP is proposed to be at elevation 131.5, which would place the zone of loamy sand within 4' of the bottom of the system. Therefore, a note has been added to the "Subsurface Infiltration System (SIS) Detail" (Attachment 2) that this BMP shall be over excavated by a depth of 4 feet and backfilled to the bottom of the system with 8.27 inch/hour material, which is abundantly available on site.

  With regard to seasonal high groundwater, test pit TP-SIS-7A was terminated at elevation 121.5 with no redoximorphic features observed. TP-SIS-7B and TP-SIS-7C were terminated at elevations 120.5 and 121, respectively, with redoximorphic features observed

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at elevations 122.5 and 122.25, respectively. As such, seasonal high groundwater is 9 feet beneath the proposed bottom of this BMP.

- **SIS-8:**
  Test pits TP-SIS-8A and TP-SIS-8B were evaluated in relation to this BMP. The soil texture within the C horizon of these test pits transitioned from sand to loamy sand at elevations 125 and 119, respectively. The bottom of this BMP is proposed to be at elevation 127, which would place the zone of loamy sand within 4' of the bottom of the system. Therefore, a note has been added to the "Subsurface Infiltration System (SIS) Detail" (Attachment 2) that this BMP shall be over excavated by a depth of 4 feet and backfilled to the bottom of the system with 8.27 inch/hour material, which is abundantly available on site.

  With regard to seasonal high groundwater, test pits TP-SIS-8A and TP-SIS-8B were both terminated at elevation 118 with redoximorphic features observed at elevations 121.5 and 120, respectively. As such, seasonal high groundwater is 5.5 feet beneath the proposed bottom of this BMP.

- **SIS-9:**
  Test pits TP-SIS-9A and TP-SIS-9B were evaluated in relation to this BMP. The soil texture within the C horizon of TP-SIS-9A transitioned from sand to loamy sand at elevation 121. Soil texture within the C horizon of TP-SIS-9B was consistently sand. The bottom of this BMP is proposed to be at elevation 126, which would place the zone of loamy sand more than 4' beneath the bottom of the system thereby confirming the infiltration rate of 8.27 inches/hour used in our hydrology modeling.

  With regard to seasonal high groundwater, TP-SIS-9A was terminated at elevation 118 with redoximorphic features observed at elevation 121. TP-SIS-9B was terminated at elevation 119.5 with no redoximorphic features observed. As such, seasonal high groundwater is 5 feet beneath the proposed bottom of this BMP. No design modifications were necessary for this BMP based on the additional test pit data.

- **SIS-10:**
  Test pits TP-SIS-10A and TP-SIS-10B were evaluated in relation to this BMP. Soil texture within the C horizon of these test pits ranged from coarse sand to sand. Since the bottom of this BMP is proposed to be at elevation 127, within the C horizon, the infiltration rate of 8.27 inches/hour used in our hydrology modeling is appropriate for this BMP.

  With regard to seasonal high groundwater, test pits TP-SIS-10A and TP-SIS-10B were terminated at elevations 120.5 and 121.5, respectively, with no redoximorphic features observed. As such, seasonal high groundwater is at least 6.5 feet beneath the proposed bottom of this BMP. No design modifications were necessary for this BMP based on the additional test pit data.

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c. In Attachment I, the Applicant has provided an Hydrogeologic Evaluation for Quarry North Road, prepared by GeoHydroCycle, Inc., dated July 30, 2019. In this evaluation, six monitoring wells were drilled and evaluated. A groundwater mounding analysis was done and the estimated seasonal high groundwater (ESHGW) was determined to be between elevations 122.04 and 123.57. The wells are in the area of the leaching field and near the Town Boundary line. HW agrees that the ESHGW on the northern portion of the site is at approximately elevation 123, however no testing has occurred on the southern portion of the site near several proposed stormwater infiltration systems. HW recommends that the Applicant confirm the ESHGW elevation beneath all proposed infiltration systems.

Refer to response to comment 2b herein.

d. The Applicant provided a HydroCAD analysis that included a Weighted Q runoff method. This is in lieu of the standard weighted composite curve number method. The Weighted Q method tends to improve runoff accuracy but is not common. HW has no objection to this method.

No response required.

e. SIS-6 includes a riser that allows the stormwater to overtop the system into a grass depression directly above it. The depression will contain stormwater during the larger storm events. HW recommends that the Applicant provide an additional detail clarifying how the riser is connected to the subsurface system.

A new detail entitled "SIS-6 Section A-A" has been created to clarify how the riser system will connect to the SIS and is included in Attachment 2. This detail will be incorporated into the plan set at the completion of the peer review.

f. The Applicant has utilized a curve number for brush assuming "fair" conditions for existing and proposed conditions. Standard engineering practice is to utilize a "good" surface for existing conditions. HW recommends that the Applicant adjust the curve number for brush or provide a justification for the use of "fair".

We understand this comment as it relates to standard practice, but in light of existing site conditions, the selection of "fair" is a conservative measure.

Runoff curve numbers are published by the U.S. Department of Agriculture in Technical Release 55 (TR-55) entitled *Urban Hydrology for Small Watersheds.* Table 2-2c of TR-55 contains a footnote that the "fair" condition is to be used for brush when the ground cover is 50%-75% (relevant section of the table is shown below). In our opinion, this is an accurate classification and perhaps overestimate of the actual ground cover within the site, as shown in the photograph below taken on April 28, 2020.

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Cover description — Cover type	Hydrologic condition
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor Fair Good
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor Fair Good
Woods—grass combination (orchard or tree farm). [5]	Poor Fair Good
Woods. [6]	Poor Fair Good
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

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g. The Applicant provided a Subsurface Infiltration System (SIS) detail on Sheet 29 of the Site plans. The SIS detail does not indicate the width of stone to be placed around the system. HW recommends that the Applicant add the width of stone required to the detail.

The width of stone around the edges of the SIS systems is proposed to be 12". The referenced detail (Attachment 2) has been updated to include this dimension. This updated detail will be incorporated into the plan set at the completion of the peer review.

3. *Standard 3 requires that the annual recharge from post-development shall approximate annual recharge from pre-development conditions.*

a. In accordance with the MSH Volume 2, Chapter 2, Page 97 a minimum of two test pits or borings should be conducted for each infiltration system. HW recommends that additional test pits be conducted within the footprint of each infiltration practice.

Refer to response to comment 2b herein.

b. The bottom of subsurface infiltration system #9 (SIS-9) is set at elevation 126. Assuming that the ESHGW is at elevation 123 for the entire property, SIS-9 does not have the required 4 feet of separation between the bottom of the system and the ESHGW. HW recommends that the Applicant confirm the ESHGW beneath SIS-9 and if necessary, provide a mounding analysis in accordance with the MSH Volume 3, Chapter 1, page 28.

Refer to response to comment 2b herein.

c. The Applicant has proposed 11 infiltration practices with the intention that it will retain up to and including the 100-year storm event for the entire development.

As designed the Applicant complies with Standard 3.

No response required.

4. *Standard 4 requires that the stormwater system be designed to remove 80% Total Suspended Solids (TSS) and to treat 1.0-inch of volume from the impervious area for water quality.*

a. The Applicant has proposed a stormwater management system that consists of deep sump catch basins and proprietary water quality units prior to discharging to an infiltration system. The treatment train will provide the required 44% TSS removal prior to discharging to an infiltration system and provide the 80% TSS removal overall.

No response required.

b. The Applicant has proposed porous pavement within the drive aisle and parking area associated with Building #1 and Building #2 of the SGOD development. The permeable pavement will collect

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sediment and infiltrate the stormwater providing the required 80% TSS removal. HW agrees that porous pavement is an acceptable surface material in this area, however routine maintenance will be critical for continuous stormwater management.

As designed the Applicant complies with Standard 4.

No response required. However, as a supplemental response, the Applicant notes that the Board Chair raised the question at the hearing on April 29, 2020 as to whether the Stormwater Handbook, indicates that permeable pavement is "not suitable" for use in Zone II. MassDEP has clarified to the Board Chair and Applicant in writing that the Stormwater Handbook Vol. 2 page 118 reference to permeable pavement being "not suitable" for Zone II is an error, and that permeable pavement is suitable for Zone II (but not Zone I). DEP has also clarified that permeable pavement, with appropriate maintenance, attenuates hydrocarbons, zincs, and TSS at levels comparable to infiltration basins, infiltration trenches and subsurface infiltrators, which, unlike permeable pavement, are limited in the amount of volume that can be treated for removal of these materials. The use of permeable pavement would therefore appear to be more protective of groundwater (or at a minimum provide equivalent protection) versus more conventional methods of infiltration that are limited in the volumes that they can treat.

At the hearing on April 29, 2020, the Board Chair also questioned the practicality of prohibiting winter sanding on the porous pavement areas but allowing it on the standard asphalt pavement areas as this approach introduces the possibility of inadvertently placing sand on the porous pavement. To address this concern, the Operation & Maintenance Plan (Attachment 6) has been updated to prohibit sanding of all pavement areas within the project. With this restriction in place, all paved areas (porous and standard asphalt pavement) will be deiced in the same manner eliminating the need to differentiate between the two types of pavement.

5. *Standard 5 is related to projects with a Land Use of Higher Potential Pollutant Loads (LUHPPL).*

   a. The proposed development is not considered a LUHPPL, therefore Standard 5 is not applicable. No further comment is needed.

      No response required.

6. *Standard 6 is related to projects with stormwater discharging into a critical area, a Zone II or an Interim Wellhead Protection Area of a public water supply.*

   a. A portion of the project site is located within a Zone I Wellhead Protection area. There are no offsite discharges allowed in this area. Based on the current grading and drainage plan submitted, there are no discharges from the site to this area.

      No response required.

   b. The project site is also located within a Zone II Interim Wellhead Protection Area. The Applicant

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has proposed site improvements that treat the one inch Water Quality Volume and has proposed stormwater practices such as deep sump catch basins, water quality units, and subsurface infiltration chambers, which are all appropriate BMPs for a Zone II Interim Wellhead Protection Area per the MSH.

No response required.

Additionally, the Applicant has identified proposed source controls and pollution prevention measures in the submission. These proposed measures appear to achieve the 44% TSS pretreatment requirement and the 1" water quality requirement as provided in Table CA3 Standard 6, page 19.

No response required.

The Applicant appears to be in compliance with Standard 6.

No response required.

7. *Standard 7 is related to projects considered Redevelopment.*

   a. The proposed project is considered a new development and is required to fully meet the Massachusetts Stormwater Standards. Standard 7 is not applicable. No further comment is needed.

   No response required.

8. *Standard 8 requires a plan to control construction related impacts including erosion, sedimentation or other pollutant sources.*

   The Applicant has provided an Erosion Control Plan on Sheet 5 of the plan set and erosion control details on Sheet 26.

   a. HW recommends that, if applicable, the Applicant provide inlet protection on every catch basin within 100 feet of the construction entrance. Furthermore, HW recommends that inlet protection is provided on each proposed catch basin when the grate is installed.

      The "Silt Sack Detail" (Attachment 4) has been updated to require inlet protection on every catch basin within 100' of the construction entrance and on proposed catch basins upon installation. This updated detail will be incorporated into the plan set at the completion of the peer review.

   b. The site plans reviewed by HW did not include extensive erosion control locations. HW recommends that the Applicant provide full erosion control plans with typical construction practices including the location of stockpiles for review and approval by the Town of Sudbury.

      Noted, the project will require the preparation of detailed erosion control plans in connection with the Stormwater Pollution Prevention Plan (SWPPP) required to obtain coverage under

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EPA's National Pollutant Discharge Elimination System (NPDES) Construction General Permit. The applicant has no objection to providing a copy of these plans to the Town of Sudbury as a condition of approval.

c. HW recommends that the Applicant extend the length of the construction entrance to at least 75 feet.

The "Typical Stabilized Construction Entrance Detail" and "Site Preparation & Erosion Control Plan" (Attachment 5) have been updated to show a 75' long stone tracking pad as requested. These updates will be incorporated into the plan set at the completion of the peer review.

d. HW recommends that the Applicant provide additional notes regarding the avoidance of heavy equipment over the infiltration chambers areas.

A note has been added to the "Subsurface Infiltration System (SIS) Detail" (Attachment 2) requiring the limits of the SIS systems to be delineated and the use of heavy equipment to be avoided in those areas. This updated detail will be incorporated into the plan set at the completion of the peer review.

e. The Applicant has noted that a Stormwater Pollution Prevention Plan (SWPPP) has not been completed but will be prior to construction activities commencing on the project. HW recommends that the Applicant provide the SWPPP to the Town of Sudbury a minimum of 14 days prior to land disturbance for review.

Noted, the applicant has no objection to this approach.

9. *Standard 9 requires a Long Term Operation and Maintenance (O & M) Plan to be provided.*

a. The Applicant has included a Long Term Operation and Maintenance (O&M) Plan in the submission including checklists for maintenance. HW recommends that the Applicant confirm who the responsible party will be prior to acceptance by the Town.

The property owner will be responsible for the ongoing maintenance of the stormwater system until such time as the Town accepts the roads, if that were to occur.

b. HW recommends that the Applicant provide a simple stormwater practice location map as part of the Long Term O&M Plan.

As requested, a *BMP Plan* has been added to the O&M plan to show the locations of the various BMPs referenced in the O&M plan. A copy of the updated O&M plan including the *BMP Plan* is included as Attachment 6.

10. *Standard 10 requires an Illicit Discharge Compliance Statement be provided.*

a. The Applicant has provided an Illicit Discharge Compliance Statement in the O&M Plan. HW

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recommends that an Illicit Discharge Compliance Statement signed by the owner be submitted to the Sudbury Conservation Commission prior to any land disturbance.

A signed version of the illicit discharge is included as Attachment 7.

We trust the responses provided above and the enclosed plans and documents sufficiently address the comments expressed by HW. Please feel free to contact our office should you have any questions or required further clarification.

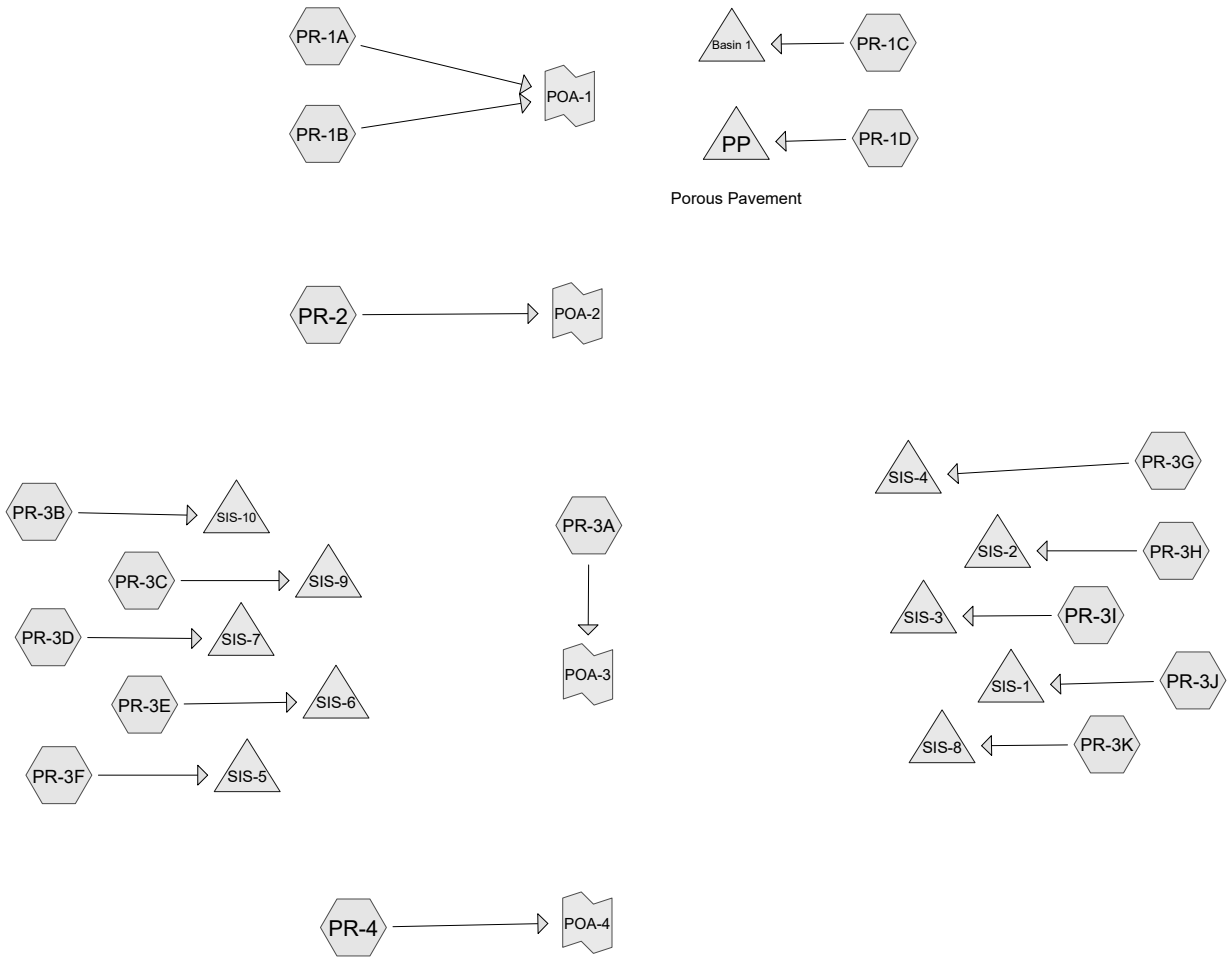
Respectfully Submitted,
CIVIL DESIGN GROUP, LLC

Matthew A. Leidner, P.E.
Principal

Enclosures

Attachment 1

- Updated HydroCad Modeling



Subcat Reach Pond Link

Routing Diagram for Sudbury Post-Development

Prepared by {enter your company name here}, Printed 5/12/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
12.400	39	>75% Grass cover, Good, HSG A (PR-1C, PR-1D, PR-3A, PR-3B, PR-3C, PR-3D, PR-3E, PR-3F, PR-3G, PR-3H, PR-3I, PR-3J, PR-3K)
5.450	35	Brush, Fair, HSG A (PR-1C, PR-3A)
5.220	98	Paved parking, HSG A (PR-1B, PR-1C, PR-3B, PR-3C, PR-3E, PR-3G, PR-3I)
1.220	98	Porous Pavement, HSG A (PR-1D)
5.230	98	Roofs, HSG A (PR-1C, PR-3B, PR-3C, PR-3D, PR-3E, PR-3F, PR-3G, PR-3H, PR-3I, PR-3J, PR-3K)
0.180	98	Water Surface, HSG A (PR-1C)
6.230	77	Wetland (PR-2)
8.180	30	Woods, Good, HSG A (PR-1A, PR-1B, PR-1C, PR-2, PR-3J, PR-4)
44.110	**58**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
37.880	HSG A	PR-1A, PR-1B, PR-1C, PR-1D, PR-2, PR-3A, PR-3B, PR-3C, PR-3D, PR-3E, PR-3F, PR-3G, PR-3H, PR-3I, PR-3J, PR-3K, PR-4
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
6.230	Other	PR-2
44.110		**TOTAL AREA**

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

Subcatchment PR-1A: Runoff Area=0.500 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=557' Tc=11.7 min CN=30 Runoff=0.00 cfs 0.000 af

Subcatchment PR-1B: Runoff Area=0.270 ac 14.81% Impervious Runoff Depth>0.12"
Flow Length=188' Tc=6.1 min CN=WQ Runoff=0.03 cfs 0.003 af

Subcatchment PR-1C: Runoff Area=6.360 ac 29.40% Impervious Runoff Depth>0.23"
Tc=6.0 min CN=WQ Runoff=1.63 cfs 0.123 af

Subcatchment PR-1D: Runoff Area=1.650 ac 73.94% Impervious Runoff Depth>0.29"
Tc=790.0 min CN=WQ Runoff=0.07 cfs 0.040 af

Subcatchment PR-2: Runoff Area=12.150 ac 0.00% Impervious Runoff Depth>0.02"
Flow Length=2,069' Tc=304.8 min CN=WQ Runoff=0.03 cfs 0.019 af

Subcatchment PR-3A: Runoff Area=6.410 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,024' Tc=14.9 min CN=WQ Runoff=0.00 cfs 0.000 af

Subcatchment PR-3B: Runoff Area=1.060 ac 67.92% Impervious Runoff Depth>0.54"
Tc=6.0 min CN=WQ Runoff=0.63 cfs 0.047 af

Subcatchment PR-3C: Runoff Area=2.300 ac 77.39% Impervious Runoff Depth>0.61"
Tc=6.0 min CN=WQ Runoff=1.55 cfs 0.117 af

Subcatchment PR-3D: Runoff Area=1.210 ac 40.50% Impervious Runoff Depth>0.32"
Tc=6.0 min CN=WQ Runoff=0.43 cfs 0.032 af

Subcatchment PR-3E: Runoff Area=1.330 ac 62.41% Impervious Runoff Depth>0.49"
Tc=6.0 min CN=WQ Runoff=0.72 cfs 0.055 af

Subcatchment PR-3F: Runoff Area=0.590 ac 47.46% Impervious Runoff Depth>0.38"
Tc=6.0 min CN=WQ Runoff=0.24 cfs 0.018 af

Subcatchment PR-3G: Runoff Area=0.920 ac 75.00% Impervious Runoff Depth>0.59"
Tc=6.0 min CN=WQ Runoff=0.60 cfs 0.045 af

Subcatchment PR-3H: Runoff Area=1.380 ac 39.13% Impervious Runoff Depth>0.31"
Tc=6.0 min CN=WQ Runoff=0.47 cfs 0.036 af

Subcatchment PR-3I: Runoff Area=5.790 ac 50.95% Impervious Runoff Depth>0.40"
Tc=6.0 min CN=WQ Runoff=2.56 cfs 0.194 af

Subcatchment PR-3J: Runoff Area=1.930 ac 15.54% Impervious Runoff Depth>0.12"
Tc=6.0 min CN=WQ Runoff=0.26 cfs 0.020 af

Subcatchment PR-3K: Runoff Area=0.220 ac 63.64% Impervious Runoff Depth>0.50"
Tc=6.0 min CN=WQ Runoff=0.12 cfs 0.009 af

Subcatchment PR-4: Runoff Area=0.040 ac 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=30 Runoff=0.00 cfs 0.000 af

Pond Basin 1: Peak Elev=129.55' Storage=1,136 cf Inflow=1.63 cfs 0.123 af
Outflow=0.51 cfs 0.123 af

Pond PP: Porous Pavement Peak Elev=0.03' Storage=0.040 af Inflow=0.07 cfs 0.040 af
Outflow=0.00 cfs 0.000 af

Pond SIS-1: Peak Elev=163.02' Storage=20 cf Inflow=0.26 cfs 0.020 af
Outflow=0.25 cfs 0.020 af

Pond SIS-10: Peak Elev=127.20' Storage=130 cf Inflow=0.63 cfs 0.047 af
Outflow=0.41 cfs 0.047 af

Pond SIS-2: Peak Elev=141.65' Storage=78 cf Inflow=0.47 cfs 0.036 af
Outflow=0.34 cfs 0.036 af

Pond SIS-3: Peak Elev=140.69' Storage=631 cf Inflow=2.56 cfs 0.194 af
Outflow=1.58 cfs 0.194 af

Pond SIS-4: Peak Elev=145.12' Storage=113 cf Inflow=0.60 cfs 0.045 af
Outflow=0.44 cfs 0.045 af

Pond SIS-5: Peak Elev=137.18' Storage=46 cf Inflow=0.24 cfs 0.018 af
Outflow=0.17 cfs 0.018 af

Pond SIS-6: Peak Elev=132.54' Storage=278 cf Inflow=0.72 cfs 0.055 af
Outflow=0.33 cfs 0.055 af

Pond SIS-7: Peak Elev=131.67' Storage=78 cf Inflow=0.43 cfs 0.032 af
Outflow=0.29 cfs 0.032 af

Pond SIS-8: Peak Elev=127.05' Storage=11 cf Inflow=0.12 cfs 0.009 af
Outflow=0.12 cfs 0.009 af

Pond SIS-9: Peak Elev=126.26' Storage=376 cf Inflow=1.55 cfs 0.117 af
Outflow=0.91 cfs 0.117 af

Link POA-1: Inflow=0.03 cfs 0.003 af
Primary=0.03 cfs 0.003 af

Link POA-2: Inflow=0.03 cfs 0.019 af
Primary=0.03 cfs 0.019 af

Link POA-3: Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link POA-4: Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 44.110 ac Runoff Volume = 0.759 af Average Runoff Depth = 0.21"
73.14% Pervious = 32.260 ac 26.86% Impervious = 11.850 ac

Summary for Subcatchment PR-3B:

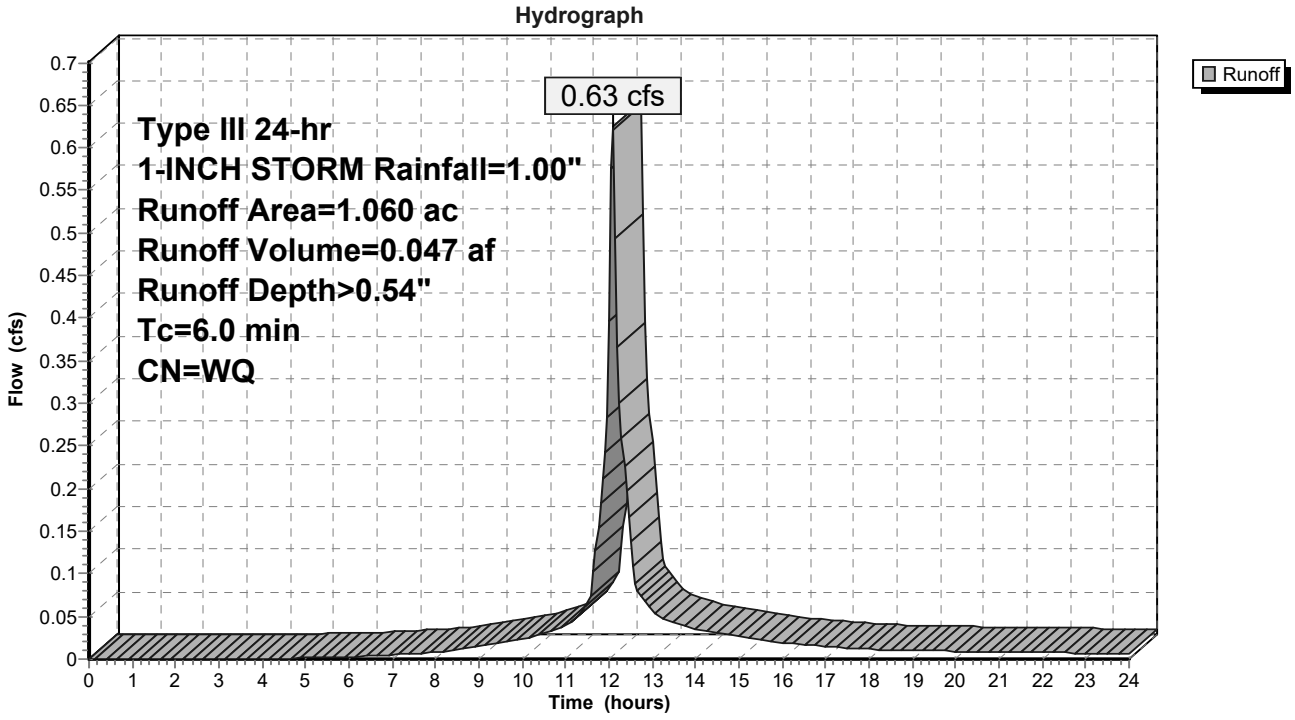
Runoff = 0.63 cfs @ 12.09 hrs, Volume= 0.047 af, Depth> 0.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-INCH STORM Rainfall=1.00"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.410	98	Roofs, HSG A
0.340	39	>75% Grass cover, Good, HSG A
1.060		Weighted Average
0.340		32.08% Pervious Area
0.720		67.92% Impervious Area

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

Subcatchment PR-3B:



Summary for Subcatchment PR-3D:

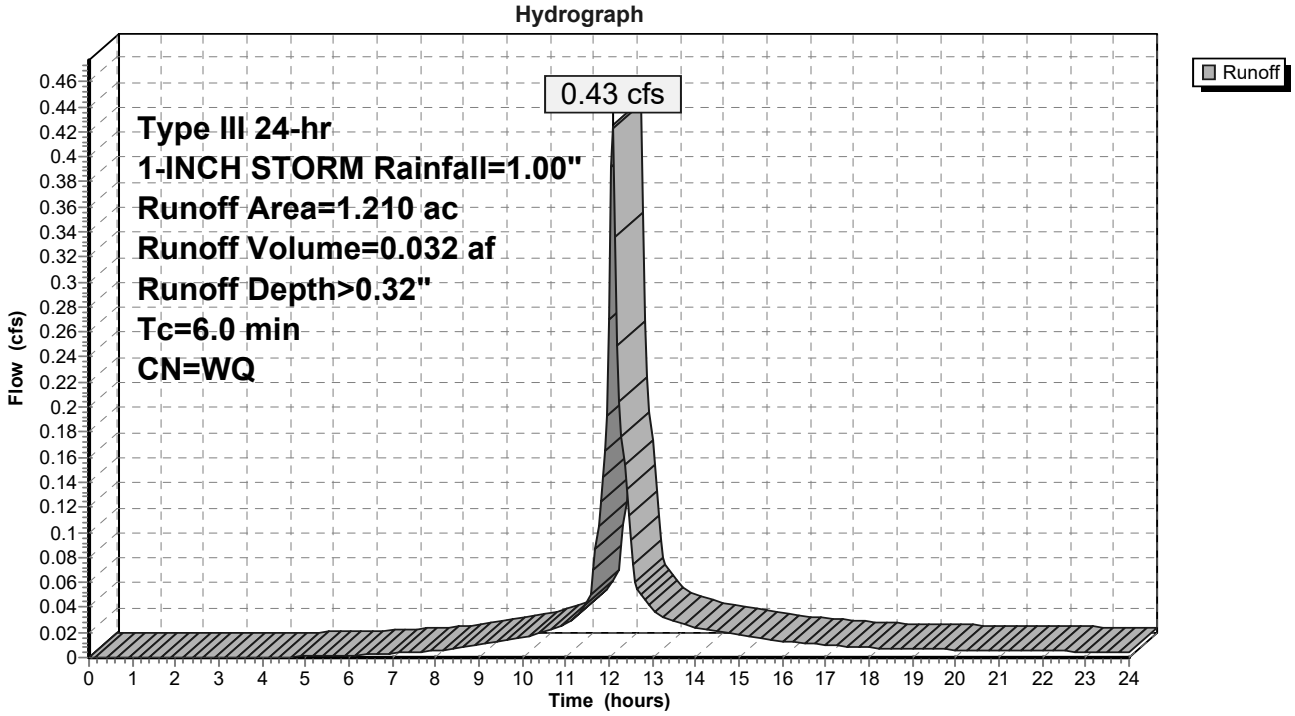
Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.032 af, Depth> 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-INCH STORM Rainfall=1.00"

Area (ac)	CN	Description
0.490	98	Roofs, HSG A
0.720	39	>75% Grass cover, Good, HSG A
1.210		Weighted Average
0.720		59.50% Pervious Area
0.490		40.50% Impervious Area

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

Subcatchment PR-3D:



Summary for Subcatchment PR-3G:

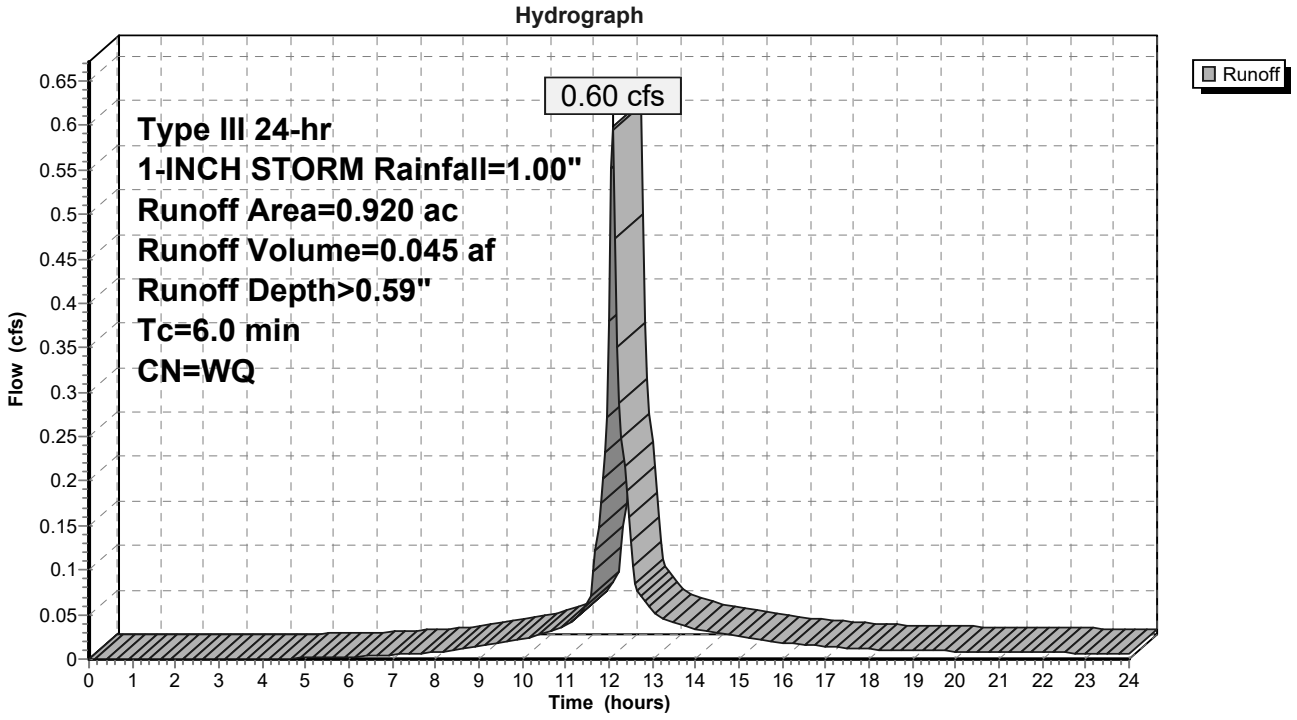
Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.045 af, Depth> 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-INCH STORM Rainfall=1.00"

Area (ac)	CN	Description
0.530	98	Paved parking, HSG A
0.160	98	Roofs, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.920		Weighted Average
0.230		25.00% Pervious Area
0.690		75.00% Impervious Area

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

Subcatchment PR-3G:



Summary for Subcatchment PR-3I:

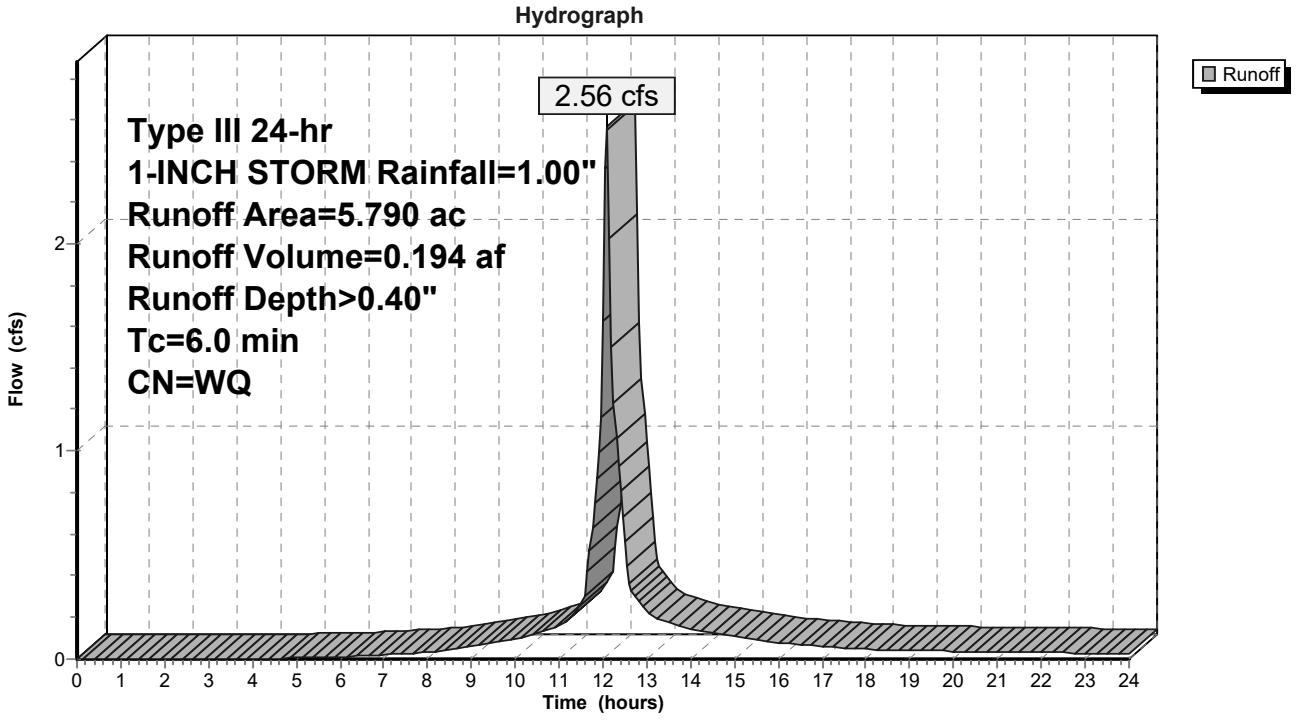
Runoff = 2.56 cfs @ 12.09 hrs, Volume= 0.194 af, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-INCH STORM Rainfall=1.00"

Area (ac)	CN	Description
1.770	98	Paved parking, HSG A
1.180	98	Roofs, HSG A
2.840	39	>75% Grass cover, Good, HSG A
5.790		Weighted Average
2.840		49.05% Pervious Area
2.950		50.95% Impervious Area

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

Subcatchment PR-3I:



Summary for Pond SIS-10:

Inflow Area = 1.060 ac, 67.92% Impervious, Inflow Depth > 0.54" for 1-INCH STORM event
Inflow = 0.63 cfs @ 12.09 hrs, Volume= 0.047 af
Outflow = 0.41 cfs @ 12.05 hrs, Volume= 0.047 af, Atten= 35%, Lag= 0.0 min
Discarded = 0.41 cfs @ 12.05 hrs, Volume= 0.047 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 127.20' @ 12.19 hrs Surf.Area= 2,116 sf Storage= 130 cf

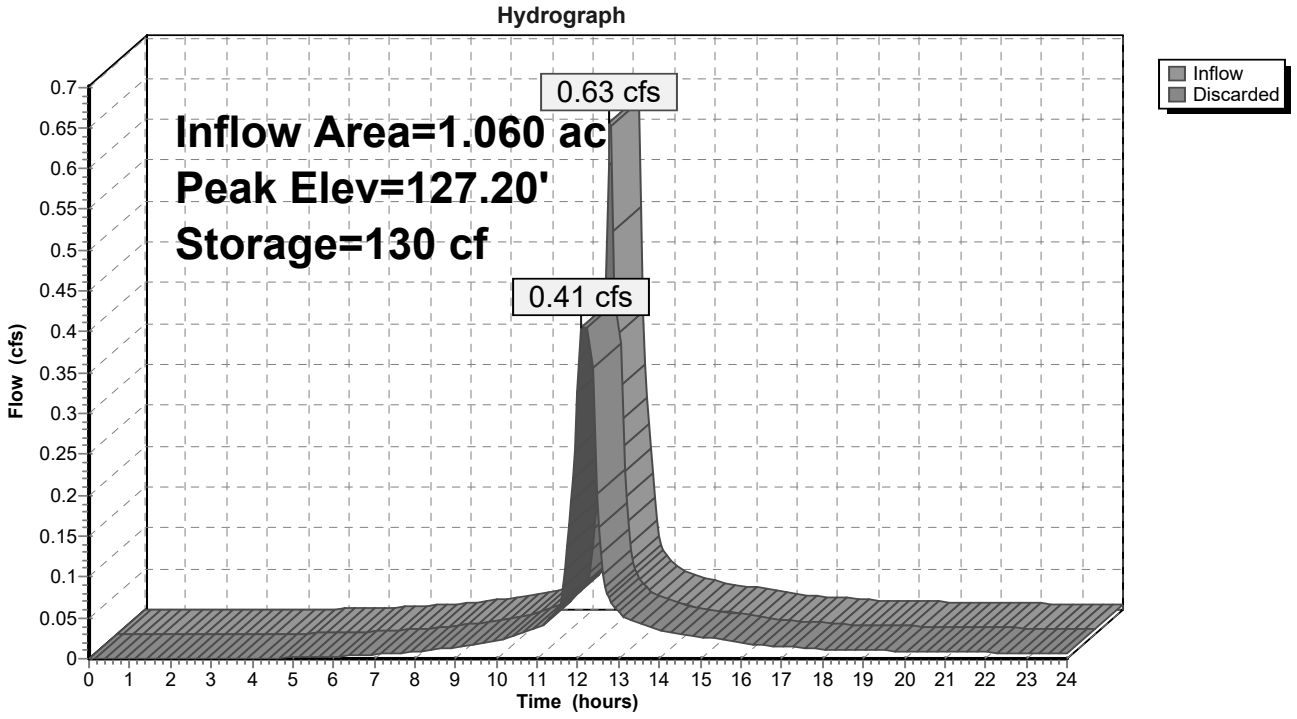
Plug-Flow detention time= 2.6 min calculated for 0.047 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (789.7 - 787.4)

Volume	Invert	Avail.Storage	Storage Description
#1	127.00'	2,788 cf	**46.00'W x 46.00'L x 8.00'H Prismatoid** 16,928 cf Overall - 7,634 cf Embedded = 9,294 cf x 30.0% Voids
#2	128.00'	7,634 cf	**72.0" Round Pipe Storage** Inside #1 L= 270.0'
		10,422 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	127.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.41 cfs @ 12.05 hrs HW=127.10' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.41 cfs)

Pond SIS-10:



Summary for Pond SIS-3:

Inflow Area = 5.790 ac, 50.95% Impervious, Inflow Depth > 0.40" for 1-INCH STORM event
Inflow = 2.56 cfs @ 12.09 hrs, Volume= 0.194 af
Outflow = 1.58 cfs @ 12.05 hrs, Volume= 0.194 af, Atten= 38%, Lag= 0.0 min
Discarded = 1.58 cfs @ 12.05 hrs, Volume= 0.194 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 140.69' @ 12.20 hrs Surf.Area= 8,256 sf Storage= 631 cf

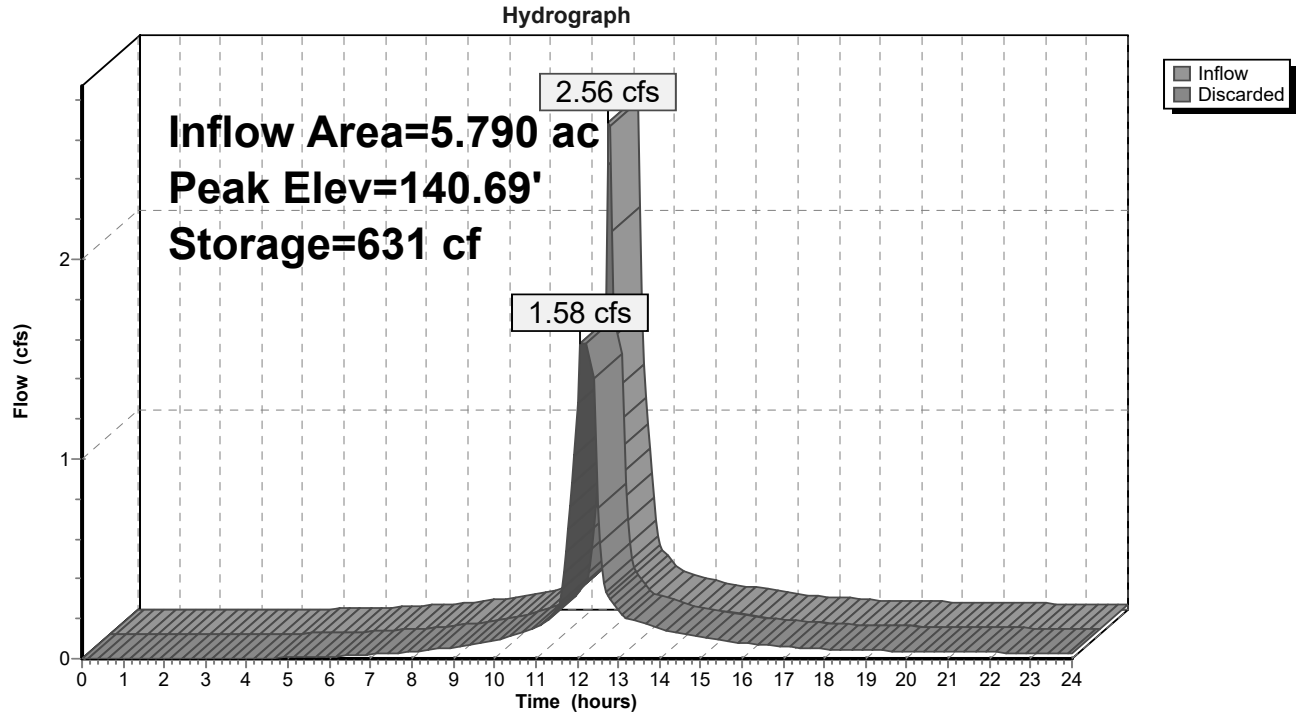
Plug-Flow detention time= 3.4 min calculated for 0.194 af (100% of inflow)
Center-of-Mass det. time= 3.1 min (790.5 - 787.4)

Volume	Invert	Avail.Storage	Storage Description
#1	140.50'	14,612 cf	**64.00'W x 129.00'L x 8.00'H Prismatoid** 66,048 cf Overall - 29,518 cf Embedded = 36,530 cf x 40.0% Voids
#2	141.50'	29,518 cf	**72.0" Round Pipe Storage** Inside #1 L= 1,044.0'
		44,130 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	140.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=1.58 cfs @ 12.05 hrs HW=140.60' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.58 cfs)

Pond SIS-3:



Summary for Pond SIS-4:

Inflow Area = 0.920 ac, 75.00% Impervious, Inflow Depth > 0.59" for 1-INCH STORM event
Inflow = 0.60 cfs @ 12.09 hrs, Volume= 0.045 af
Outflow = 0.44 cfs @ 12.10 hrs, Volume= 0.045 af, Atten= 26%, Lag= 0.7 min
Discarded = 0.44 cfs @ 12.10 hrs, Volume= 0.045 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 145.12' @ 12.16 hrs Surf.Area= 2,304 sf Storage= 113 cf

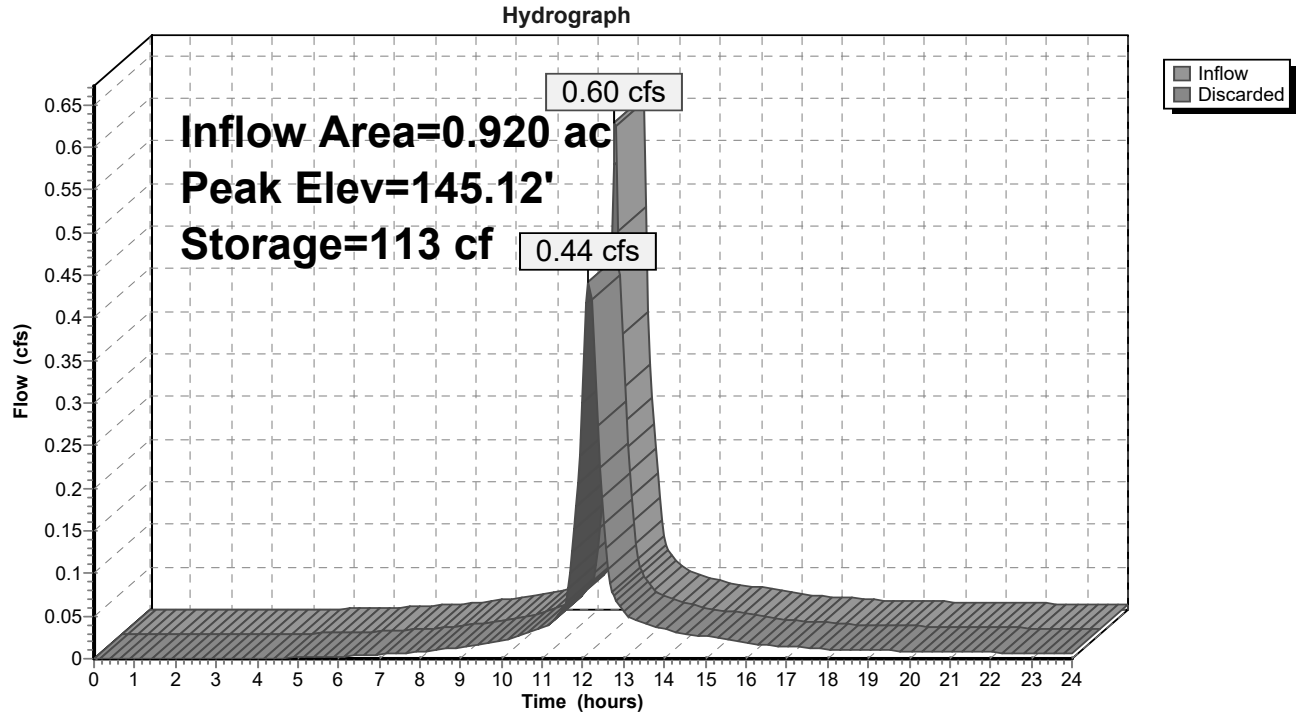
Plug-Flow detention time= 2.9 min calculated for 0.045 af (100% of inflow)
Center-of-Mass det. time= 2.6 min (790.0 - 787.4)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	4,116 cf	**16.00'W x 144.00'L x 8.00'H Prismatoid** 18,432 cf Overall - 8,143 cf Embedded = 10,289 cf x 40.0% Voids
#2	146.00'	8,143 cf	**72.0" Round Pipe Storage** Inside #1 L= 288.0'
		12,259 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.44 cfs @ 12.10 hrs HW=145.10' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.44 cfs)

Pond SIS-4:



Summary for Pond SIS-7:

Inflow Area = 1.210 ac, 40.50% Impervious, Inflow Depth > 0.32" for 1-INCH STORM event
Inflow = 0.43 cfs @ 12.09 hrs, Volume= 0.032 af
Outflow = 0.29 cfs @ 12.05 hrs, Volume= 0.032 af, Atten= 31%, Lag= 0.0 min
Discarded = 0.29 cfs @ 12.05 hrs, Volume= 0.032 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 131.67' @ 12.17 hrs Surf.Area= 1,536 sf Storage= 78 cf

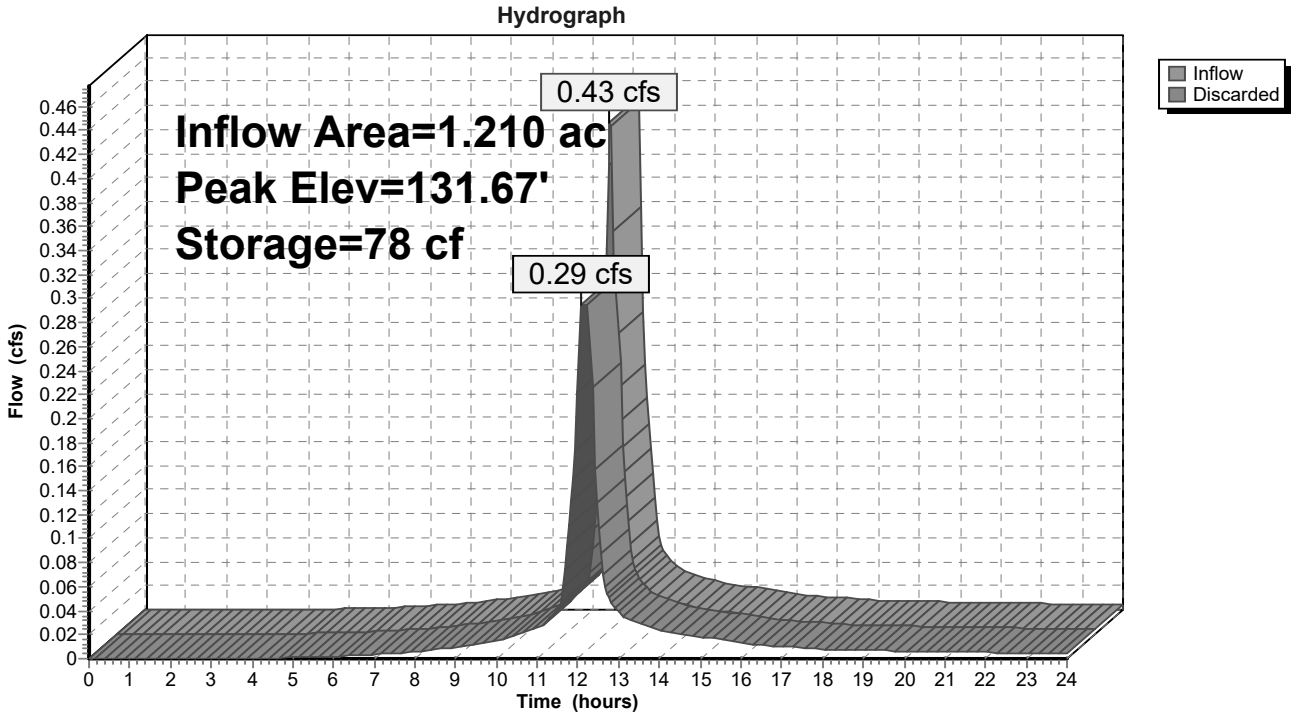
Plug-Flow detention time= 2.4 min calculated for 0.032 af (100% of inflow)
Center-of-Mass det. time= 2.2 min (789.6 - 787.4)

Volume	Invert	Avail.Storage	Storage Description
#1	131.50'	2,075 cf	**8.00'W x 192.00'L x 8.00'H Prismatoid** 12,288 cf Overall - 5,372 cf Embedded = 6,916 cf x 30.0% Voids
#2	132.50'	5,372 cf	**72.0" Round Pipe Storage** Inside #1 L= 190.0'
		7,447 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.29 cfs @ 12.05 hrs HW=131.59' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.29 cfs)

Pond SIS-7:

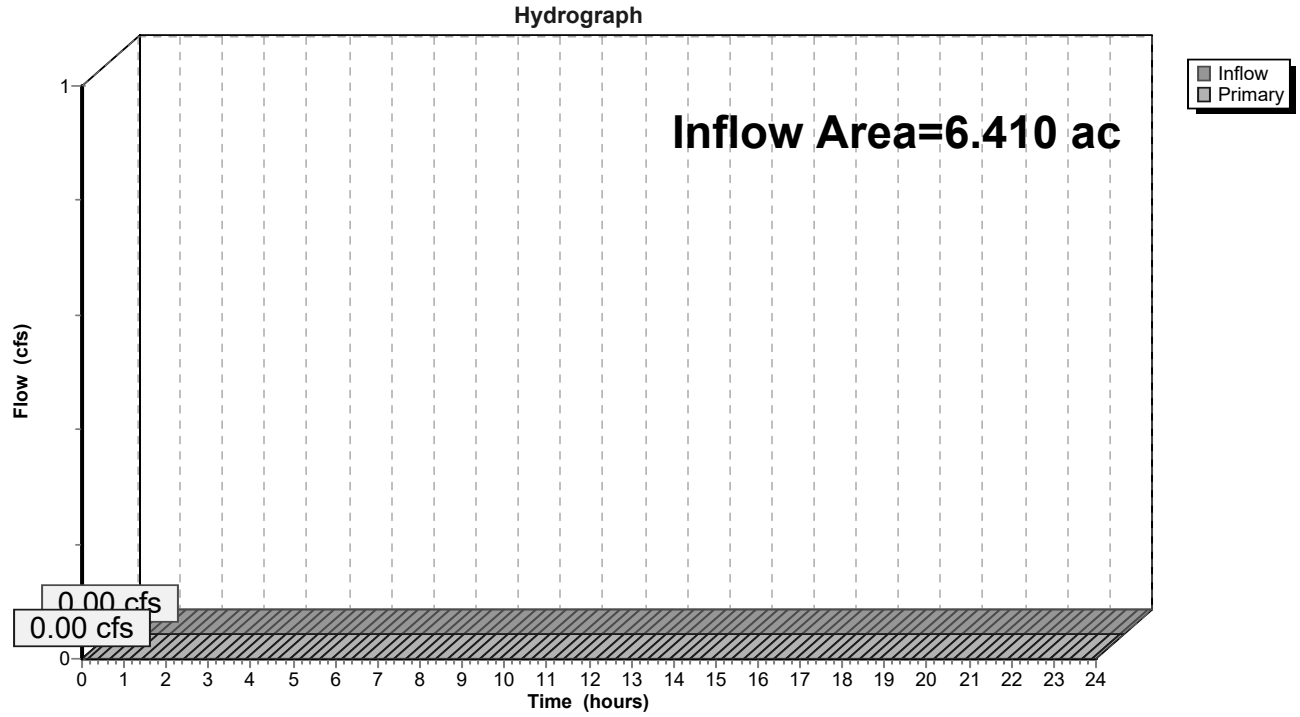


Summary for Link POA-3:

Inflow Area = 6.410 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1-INCH STORM event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-3:



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

Subcatchment PR-3B: Runoff Area=1.060 ac 67.92% Impervious Runoff Depth>2.01"
Tc=6.0 min CN=WQ Runoff=2.18 cfs 0.178 af

Subcatchment PR-3D: Runoff Area=1.210 ac 40.50% Impervious Runoff Depth>1.20"
Tc=6.0 min CN=WQ Runoff=1.49 cfs 0.121 af

Subcatchment PR-3G: Runoff Area=0.920 ac 75.00% Impervious Runoff Depth>2.22"
Tc=6.0 min CN=WQ Runoff=2.09 cfs 0.171 af

Subcatchment PR-3I: Runoff Area=5.790 ac 50.95% Impervious Runoff Depth>1.51"
Tc=6.0 min CN=WQ Runoff=8.95 cfs 0.729 af

Pond SIS-10: Peak Elev=129.05' Storage=1,930 cf Inflow=2.18 cfs 0.178 af
Outflow=0.41 cfs 0.178 af

Pond SIS-3: Peak Elev=142.44' Storage=8,209 cf Inflow=8.95 cfs 0.729 af
Outflow=1.58 cfs 0.729 af

Pond SIS-4: Peak Elev=146.59' Storage=1,713 cf Inflow=2.09 cfs 0.171 af
Outflow=0.44 cfs 0.170 af

Pond SIS-7: Peak Elev=133.43' Storage=1,260 cf Inflow=1.49 cfs 0.121 af
Outflow=0.29 cfs 0.121 af

Link POA-3: Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 8.980 ac Runoff Volume = 1.199 af Average Runoff Depth = 1.60"
45.99% Pervious = 4.130 ac 54.01% Impervious = 4.850 ac

Summary for Subcatchment PR-3B:

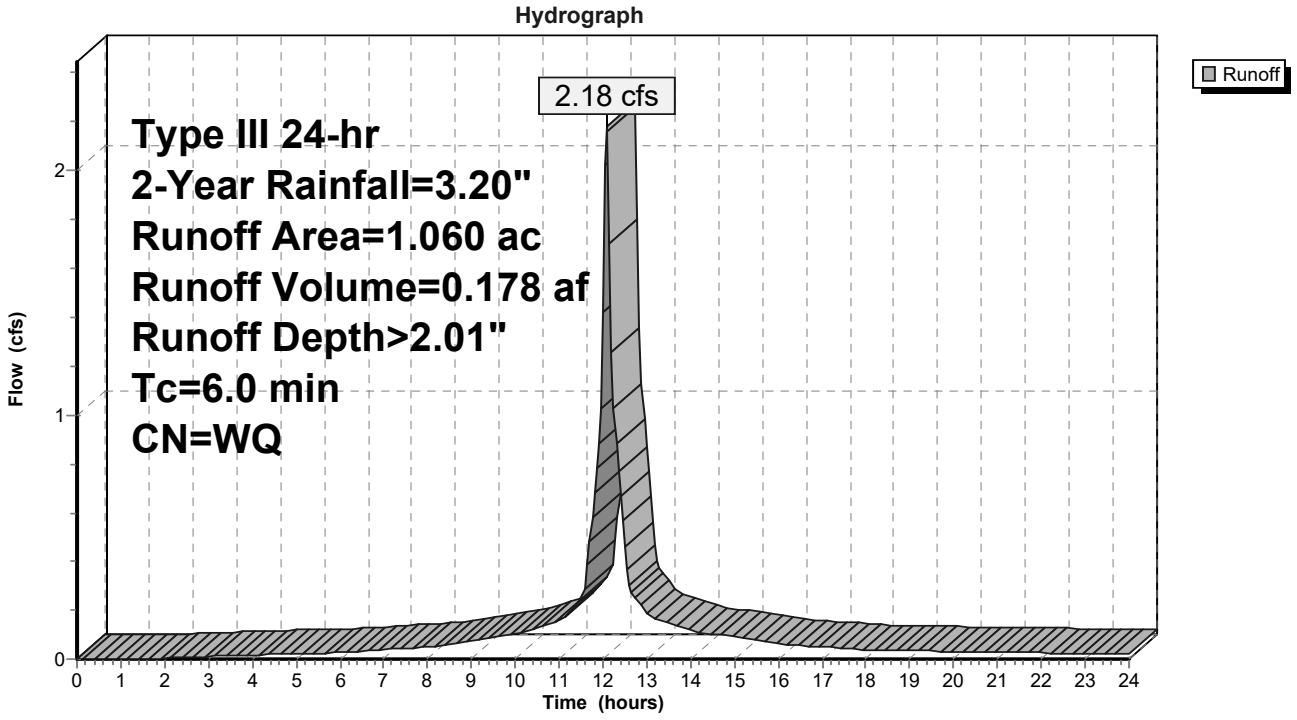
Runoff = 2.18 cfs @ 12.09 hrs, Volume= 0.178 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.410	98	Roofs, HSG A
0.340	39	>75% Grass cover, Good, HSG A
1.060		Weighted Average
0.340		32.08% Pervious Area
0.720		67.92% Impervious Area

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

Subcatchment PR-3B:



Summary for Subcatchment PR-3D:

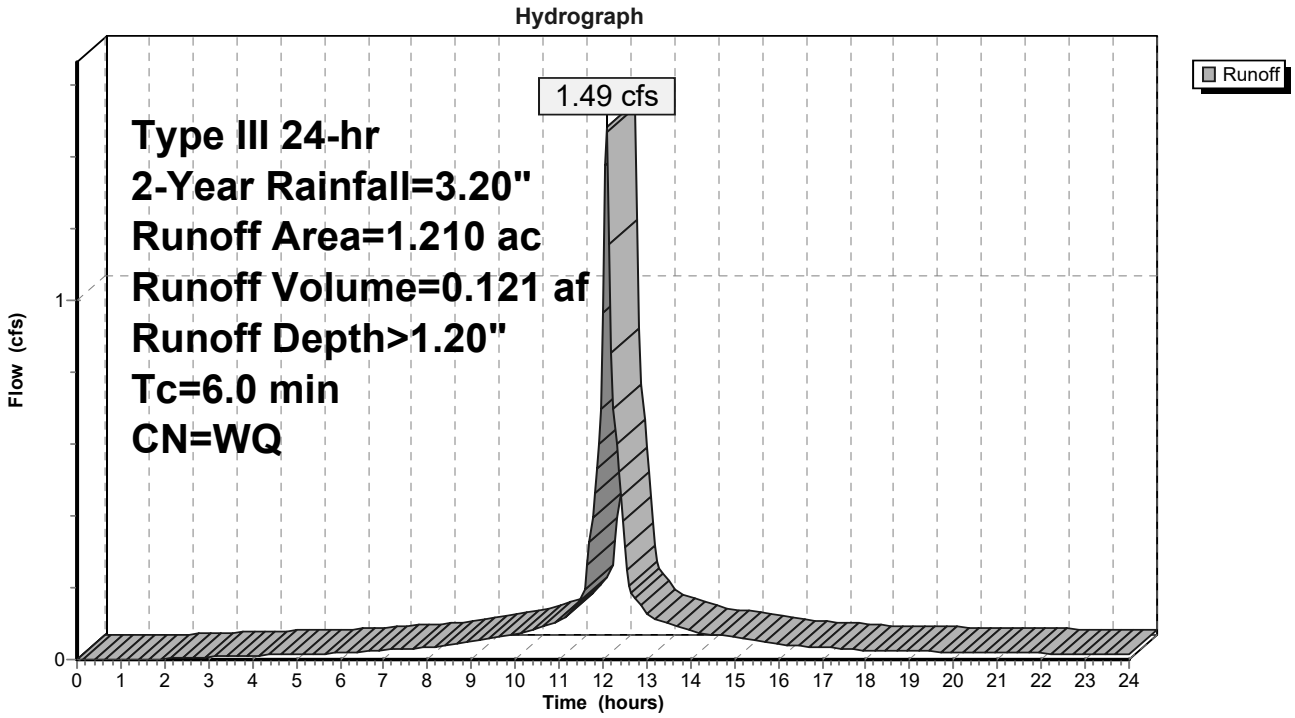
Runoff = 1.49 cfs @ 12.09 hrs, Volume= 0.121 af, Depth> 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.490	98	Roofs, HSG A
0.720	39	>75% Grass cover, Good, HSG A
1.210		Weighted Average
0.720		59.50% Pervious Area
0.490		40.50% Impervious Area

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

Subcatchment PR-3D:



Summary for Subcatchment PR-3G:

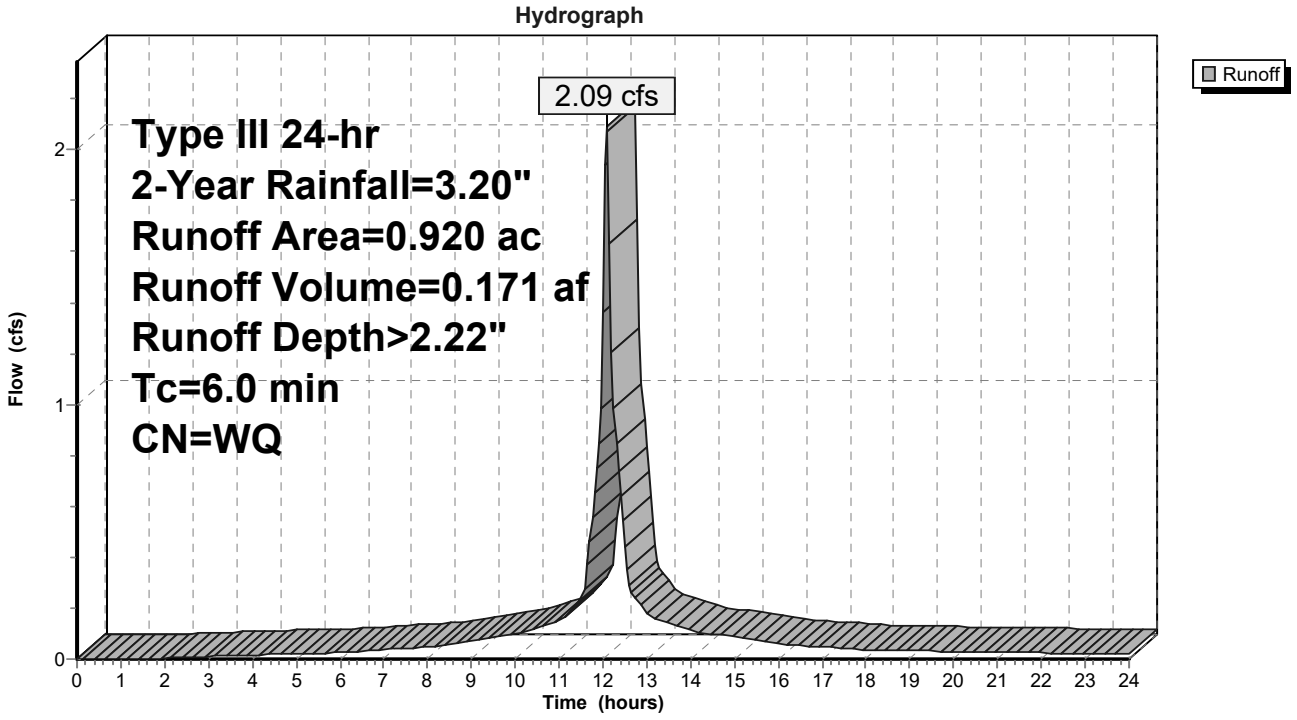
Runoff = 2.09 cfs @ 12.09 hrs, Volume= 0.171 af, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.530	98	Paved parking, HSG A
0.160	98	Roofs, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.920		Weighted Average
0.230		25.00% Pervious Area
0.690		75.00% Impervious Area

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

Subcatchment PR-3G:



Summary for Subcatchment PR-3I:

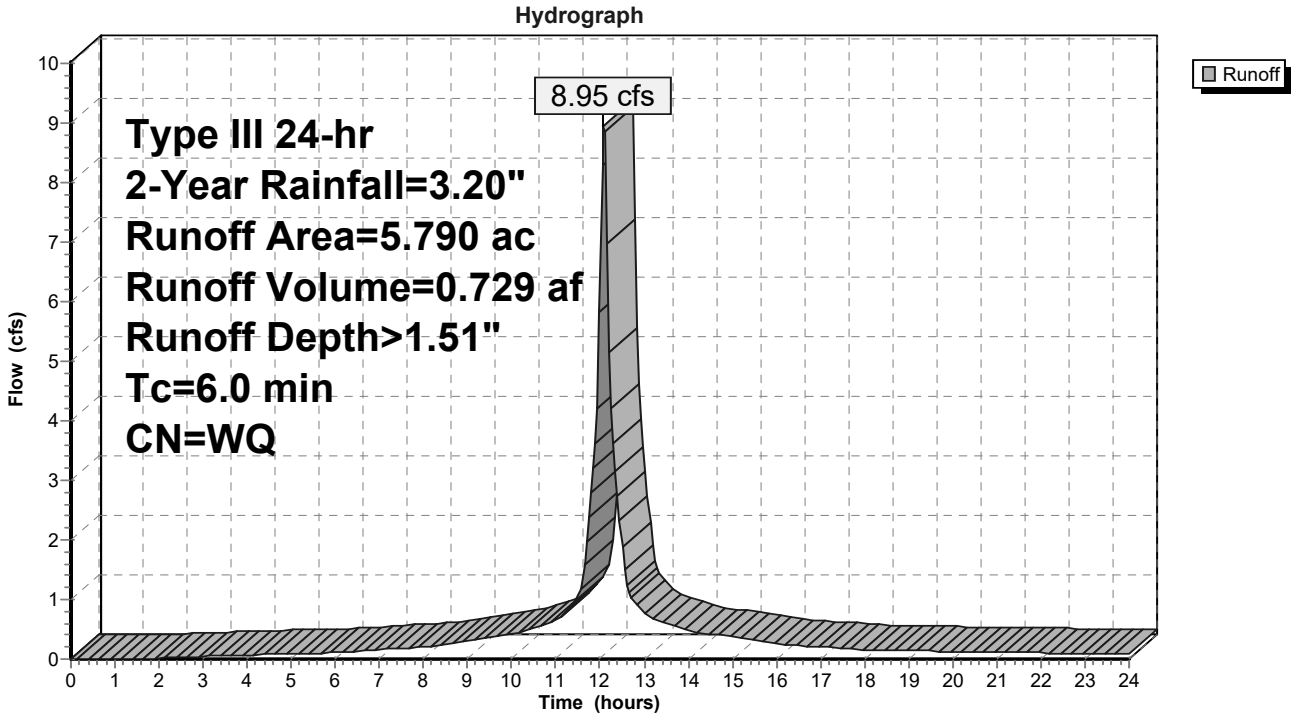
Runoff = 8.95 cfs @ 12.09 hrs, Volume= 0.729 af, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
1.770	98	Paved parking, HSG A
1.180	98	Roofs, HSG A
2.840	39	>75% Grass cover, Good, HSG A
5.790		Weighted Average
2.840		49.05% Pervious Area
2.950		50.95% Impervious Area

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

Subcatchment PR-3I:



Summary for Pond SIS-10:

Inflow Area = 1.060 ac, 67.92% Impervious, Inflow Depth > 2.01" for 2-Year event
Inflow = 2.18 cfs @ 12.09 hrs, Volume= 0.178 af
Outflow = 0.41 cfs @ 11.70 hrs, Volume= 0.178 af, Atten= 81%, Lag= 0.0 min
Discarded = 0.41 cfs @ 11.70 hrs, Volume= 0.178 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 129.05' @ 12.53 hrs Surf.Area= 2,116 sf Storage= 1,930 cf

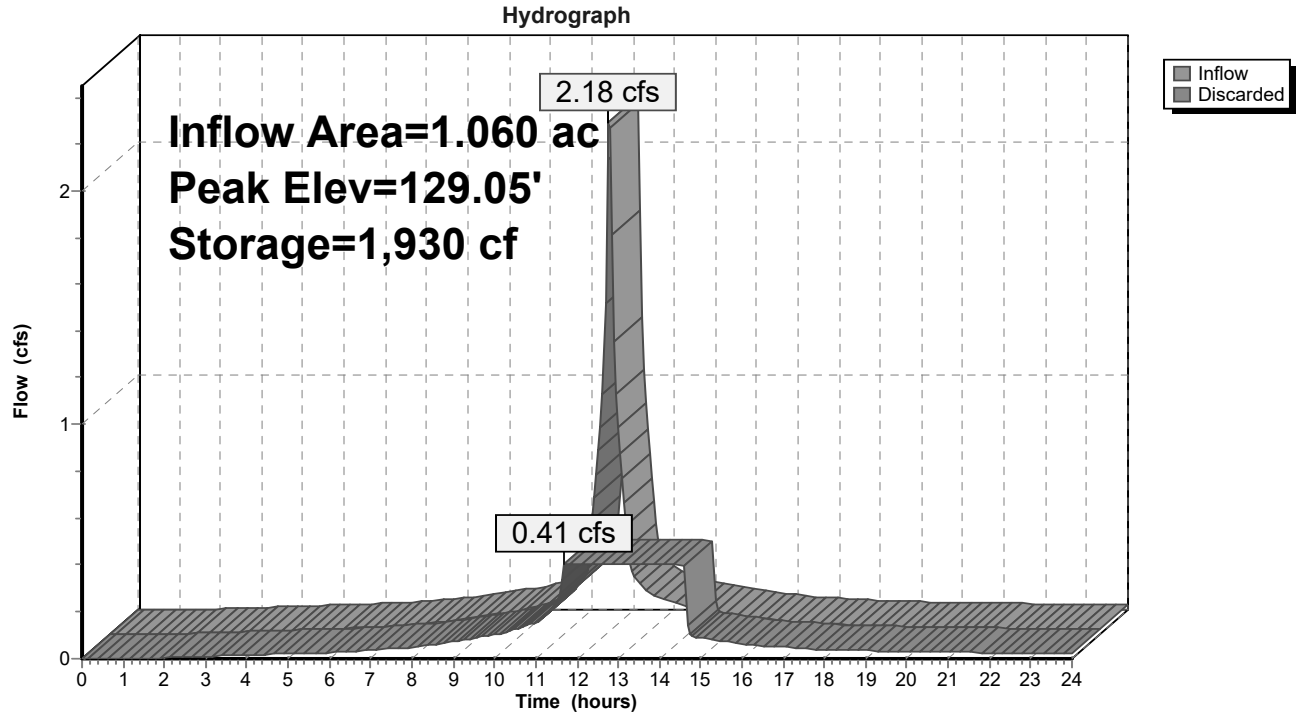
Plug-Flow detention time= 25.7 min calculated for 0.178 af (100% of inflow)
Center-of-Mass det. time= 25.5 min (781.5 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	127.00'	2,788 cf	**46.00'W x 46.00'L x 8.00'H Prismatoid** 16,928 cf Overall - 7,634 cf Embedded = 9,294 cf x 30.0% Voids
#2	128.00'	7,634 cf	**72.0" Round Pipe Storage** Inside #1 L= 270.0'
		10,422 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	127.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.41 cfs @ 11.70 hrs HW=127.08' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.41 cfs)

Pond SIS-10:



Summary for Pond SIS-3:

Inflow Area = 5.790 ac, 50.95% Impervious, Inflow Depth > 1.51" for 2-Year event
Inflow = 8.95 cfs @ 12.09 hrs, Volume= 0.729 af
Outflow = 1.58 cfs @ 11.70 hrs, Volume= 0.729 af, Atten= 82%, Lag= 0.0 min
Discarded = 1.58 cfs @ 11.70 hrs, Volume= 0.729 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 142.44' @ 12.54 hrs Surf.Area= 8,256 sf Storage= 8,209 cf

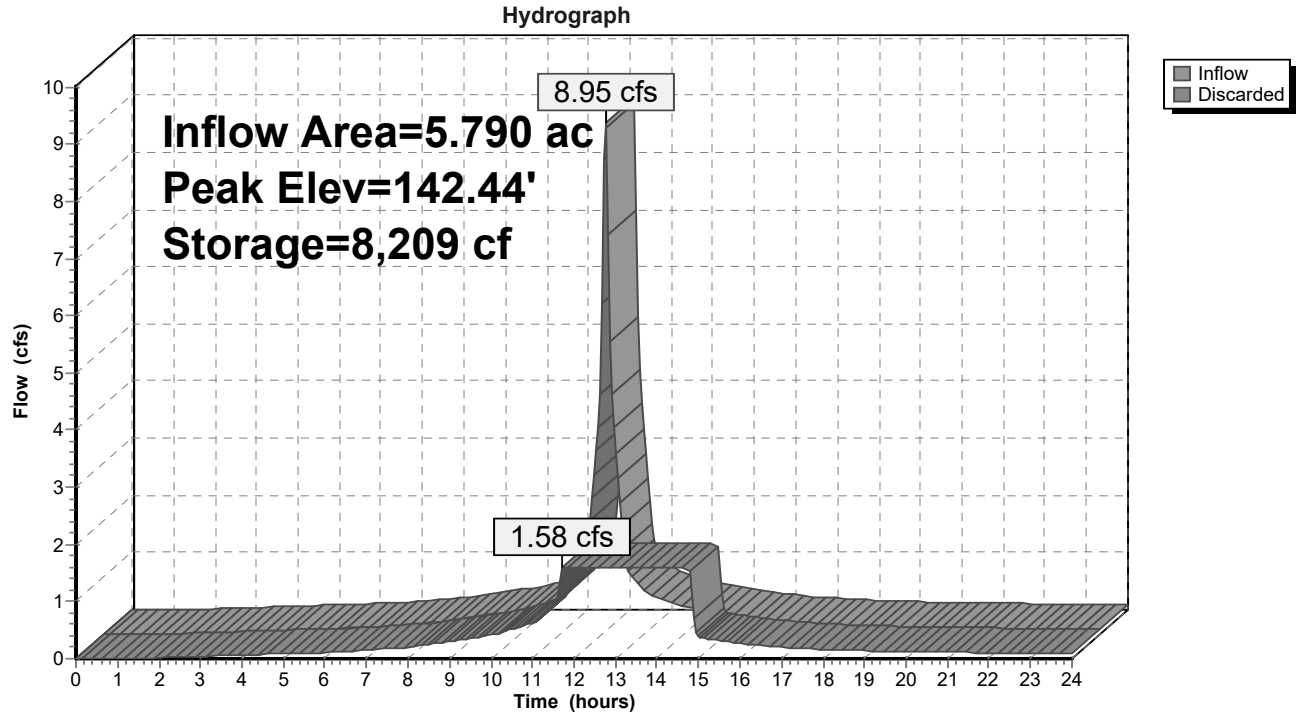
Plug-Flow detention time= 28.9 min calculated for 0.727 af (100% of inflow)
Center-of-Mass det. time= 28.6 min (784.6 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	140.50'	14,612 cf	**64.00'W x 129.00'L x 8.00'H Prismatoid** 66,048 cf Overall - 29,518 cf Embedded = 36,530 cf x 40.0% Voids
#2	141.50'	29,518 cf	**72.0" Round Pipe Storage** Inside #1 L= 1,044.0'
		44,130 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	140.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=1.58 cfs @ 11.70 hrs HW=140.59' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.58 cfs)

Pond SIS-3:



Summary for Pond SIS-4:

Inflow Area = 0.920 ac, 75.00% Impervious, Inflow Depth > 2.22" for 2-Year event
Inflow = 2.09 cfs @ 12.09 hrs, Volume= 0.171 af
Outflow = 0.44 cfs @ 11.75 hrs, Volume= 0.170 af, Atten= 79%, Lag= 0.0 min
Discarded = 0.44 cfs @ 11.75 hrs, Volume= 0.170 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 146.59' @ 12.50 hrs Surf.Area= 2,304 sf Storage= 1,713 cf

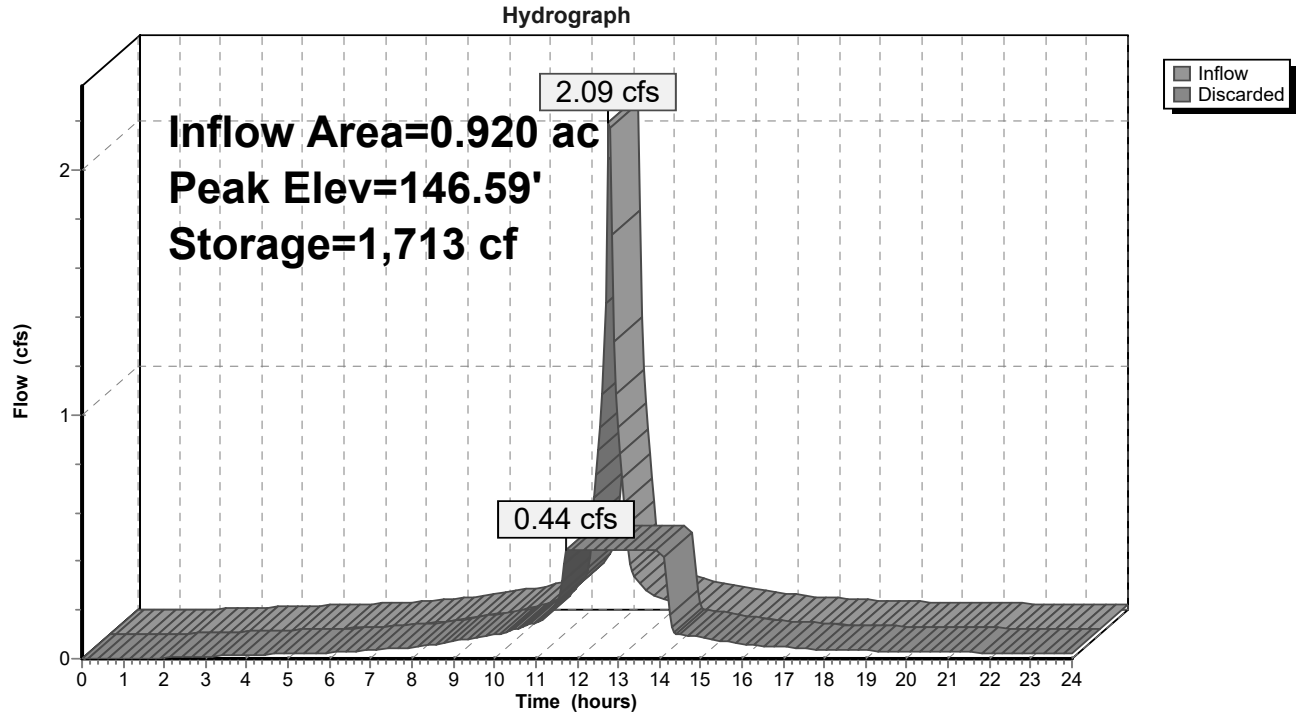
Plug-Flow detention time= 20.6 min calculated for 0.170 af (100% of inflow)
Center-of-Mass det. time= 20.3 min (776.3 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	4,116 cf	**16.00'W x 144.00'L x 8.00'H Prismatoid** 18,432 cf Overall - 8,143 cf Embedded = 10,289 cf x 40.0% Voids
#2	146.00'	8,143 cf	**72.0" Round Pipe Storage** Inside #1 L= 288.0'
		12,259 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.44 cfs @ 11.75 hrs HW=145.09' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.44 cfs)

Pond SIS-4:



Summary for Pond SIS-7:

Inflow Area = 1.210 ac, 40.50% Impervious, Inflow Depth > 1.20" for 2-Year event
Inflow = 1.49 cfs @ 12.09 hrs, Volume= 0.121 af
Outflow = 0.29 cfs @ 11.75 hrs, Volume= 0.121 af, Atten= 80%, Lag= 0.0 min
Discarded = 0.29 cfs @ 11.75 hrs, Volume= 0.121 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 133.43' @ 12.52 hrs Surf.Area= 1,536 sf Storage= 1,260 cf

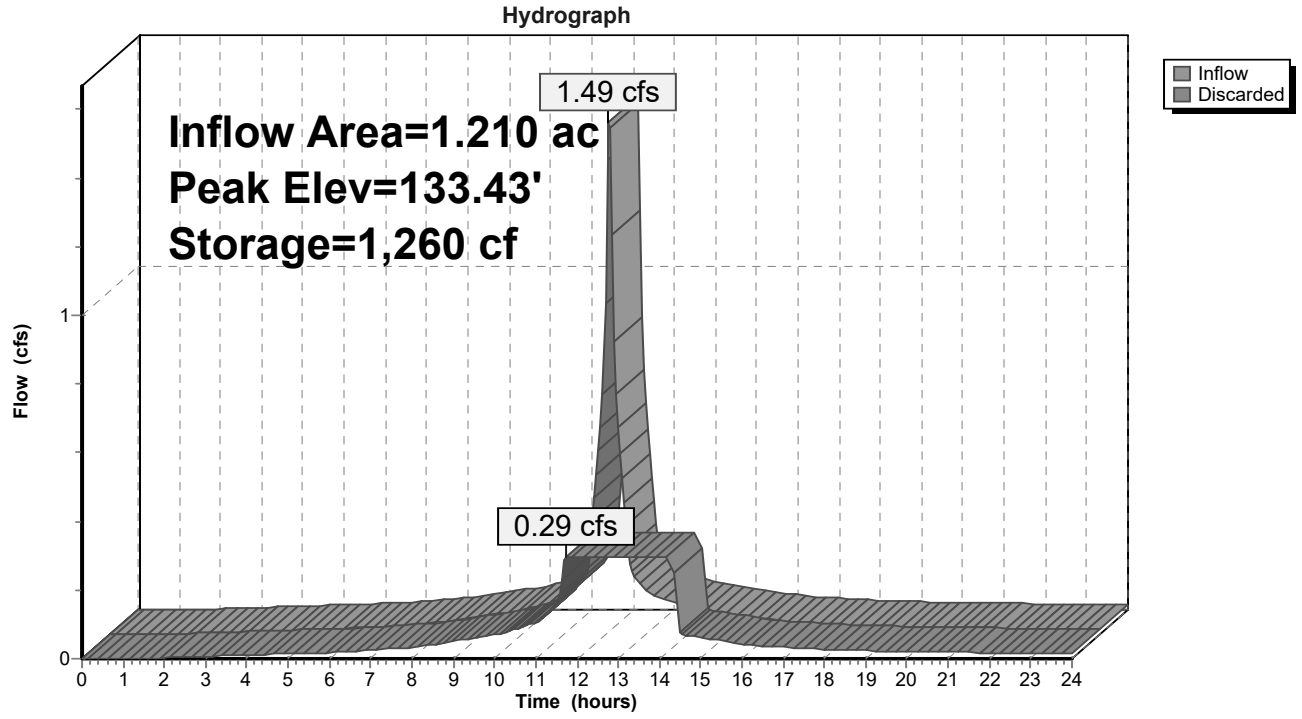
Plug-Flow detention time= 22.6 min calculated for 0.121 af (100% of inflow)
Center-of-Mass det. time= 22.4 min (778.5 - 756.1)

Volume	Invert	Avail.Storage	Storage Description
#1	131.50'	2,075 cf	**8.00'W x 192.00'L x 8.00'H Prismatoid** 12,288 cf Overall - 5,372 cf Embedded = 6,916 cf x 30.0% Voids
#2	132.50'	5,372 cf	**72.0" Round Pipe Storage** Inside #1 L= 190.0'
		7,447 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.29 cfs @ 11.75 hrs HW=131.61' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.29 cfs)

Pond SIS-7:

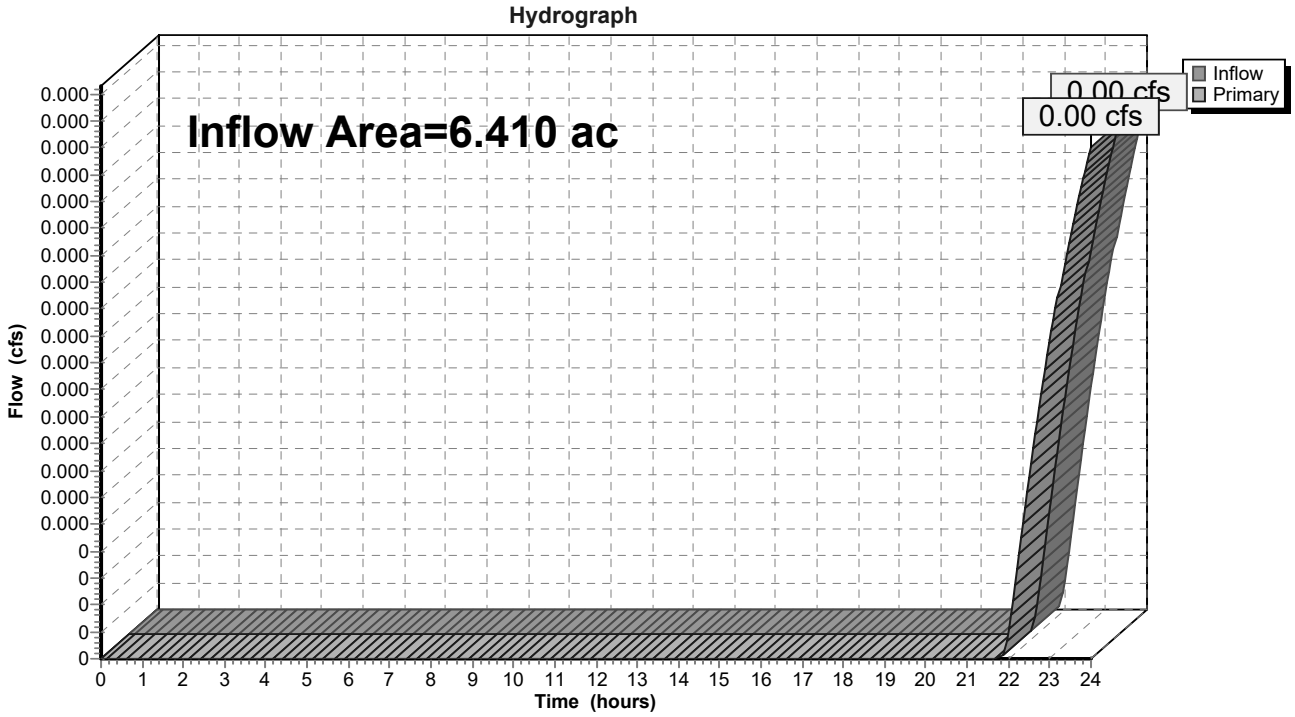


Summary for Link POA-3:

Inflow Area = 6.410 ac, 0.00% Impervious, Inflow Depth > 0.00" for 2-Year event
Inflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-3:



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

Subcatchment PR-3B: Runoff Area=1.060 ac 67.92% Impervious Runoff Depth>3.15"
Tc=6.0 min CN=WQ Runoff=3.30 cfs 0.278 af

Subcatchment PR-3D: Runoff Area=1.210 ac 40.50% Impervious Runoff Depth>1.94"
Tc=6.0 min CN=WQ Runoff=2.25 cfs 0.196 af

Subcatchment PR-3G: Runoff Area=0.920 ac 75.00% Impervious Runoff Depth>3.46"
Tc=6.0 min CN=WQ Runoff=3.16 cfs 0.265 af

Subcatchment PR-3I: Runoff Area=5.790 ac 50.95% Impervious Runoff Depth>2.40"
Tc=6.0 min CN=WQ Runoff=13.52 cfs 1.159 af

Pond SIS-10: Peak Elev=130.09' Storage=3,623 cf Inflow=3.30 cfs 0.278 af
Outflow=0.41 cfs 0.278 af

Pond SIS-3: Peak Elev=143.53' Storage=15,256 cf Inflow=13.52 cfs 1.159 af
Outflow=1.58 cfs 1.159 af

Pond SIS-4: Peak Elev=147.52' Storage=3,292 cf Inflow=3.16 cfs 0.265 af
Outflow=0.44 cfs 0.265 af

Pond SIS-7: Peak Elev=134.44' Storage=2,403 cf Inflow=2.25 cfs 0.196 af
Outflow=0.29 cfs 0.196 af

Link POA-3: Inflow=0.07 cfs 0.045 af
Primary=0.07 cfs 0.045 af

Total Runoff Area = 8.980 ac Runoff Volume = 1.899 af Average Runoff Depth = 2.54"
45.99% Pervious = 4.130 ac 54.01% Impervious = 4.850 ac

Summary for Subcatchment PR-3B:

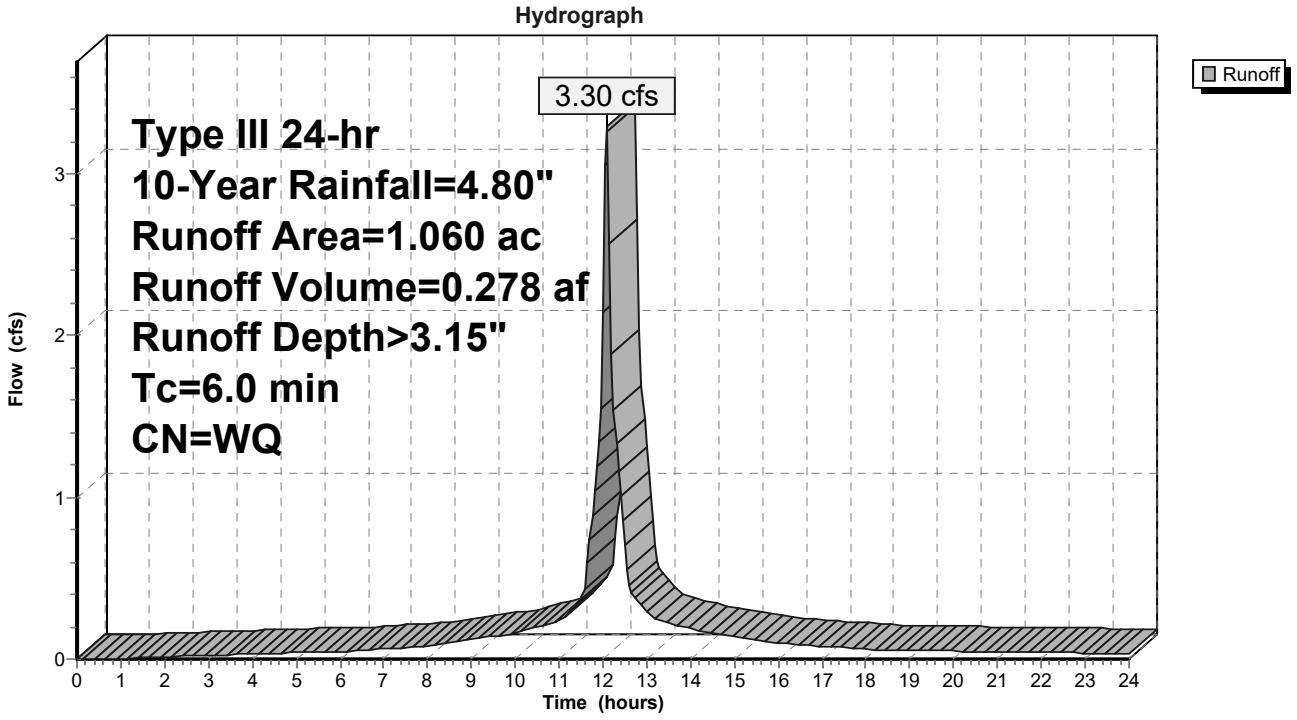
Runoff = 3.30 cfs @ 12.09 hrs, Volume= 0.278 af, Depth> 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.410	98	Roofs, HSG A
0.340	39	>75% Grass cover, Good, HSG A
1.060		Weighted Average
0.340		32.08% Pervious Area
0.720		67.92% Impervious Area

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

Subcatchment PR-3B:



Summary for Subcatchment PR-3D:

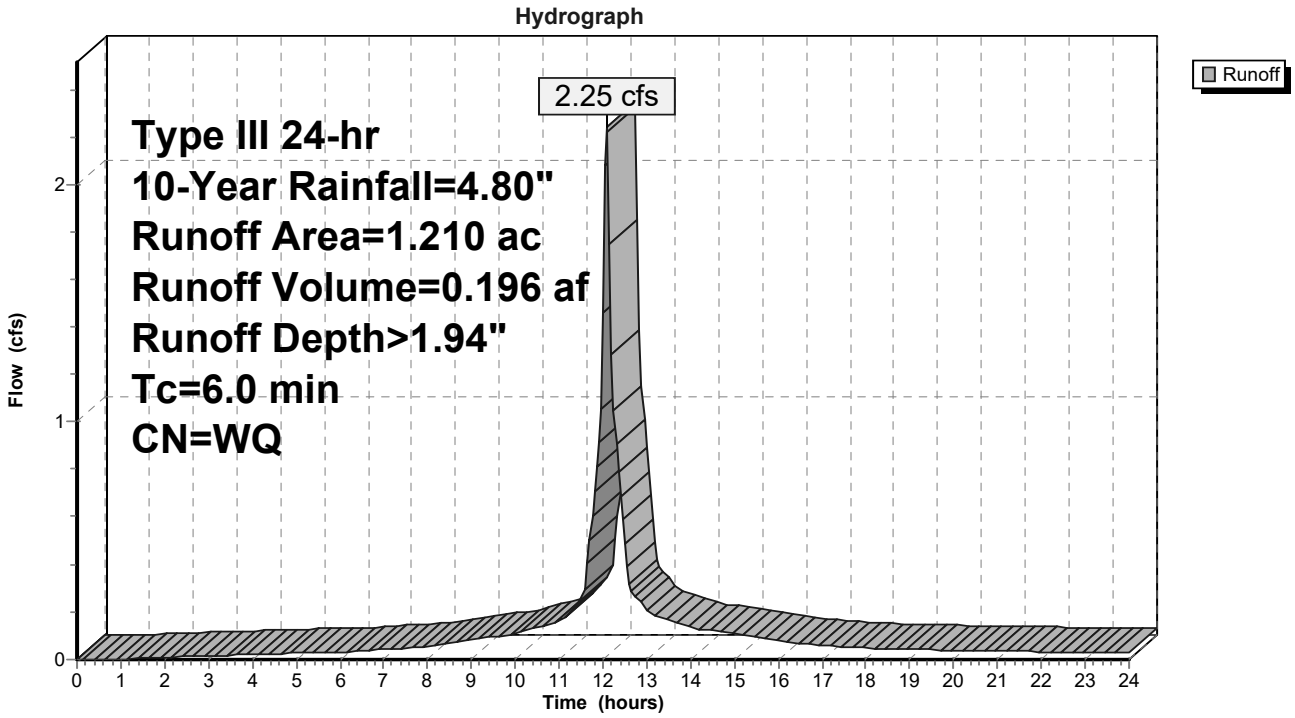
Runoff = 2.25 cfs @ 12.09 hrs, Volume= 0.196 af, Depth> 1.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
0.490	98	Roofs, HSG A
0.720	39	>75% Grass cover, Good, HSG A
1.210		Weighted Average
0.720		59.50% Pervious Area
0.490		40.50% Impervious Area

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

Subcatchment PR-3D:



Summary for Subcatchment PR-3G:

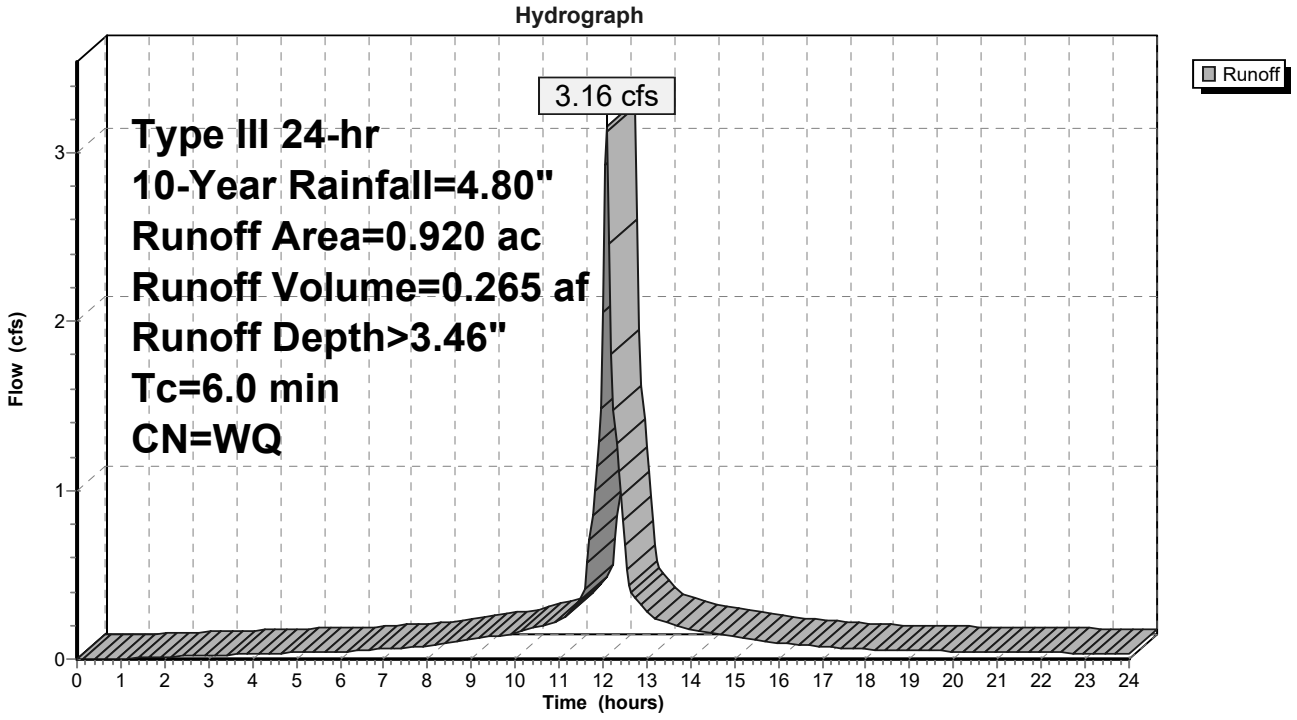
Runoff = 3.16 cfs @ 12.09 hrs, Volume= 0.265 af, Depth> 3.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
0.530	98	Paved parking, HSG A
0.160	98	Roofs, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.920		Weighted Average
0.230		25.00% Pervious Area
0.690		75.00% Impervious Area

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

Subcatchment PR-3G:



Summary for Subcatchment PR-3I:

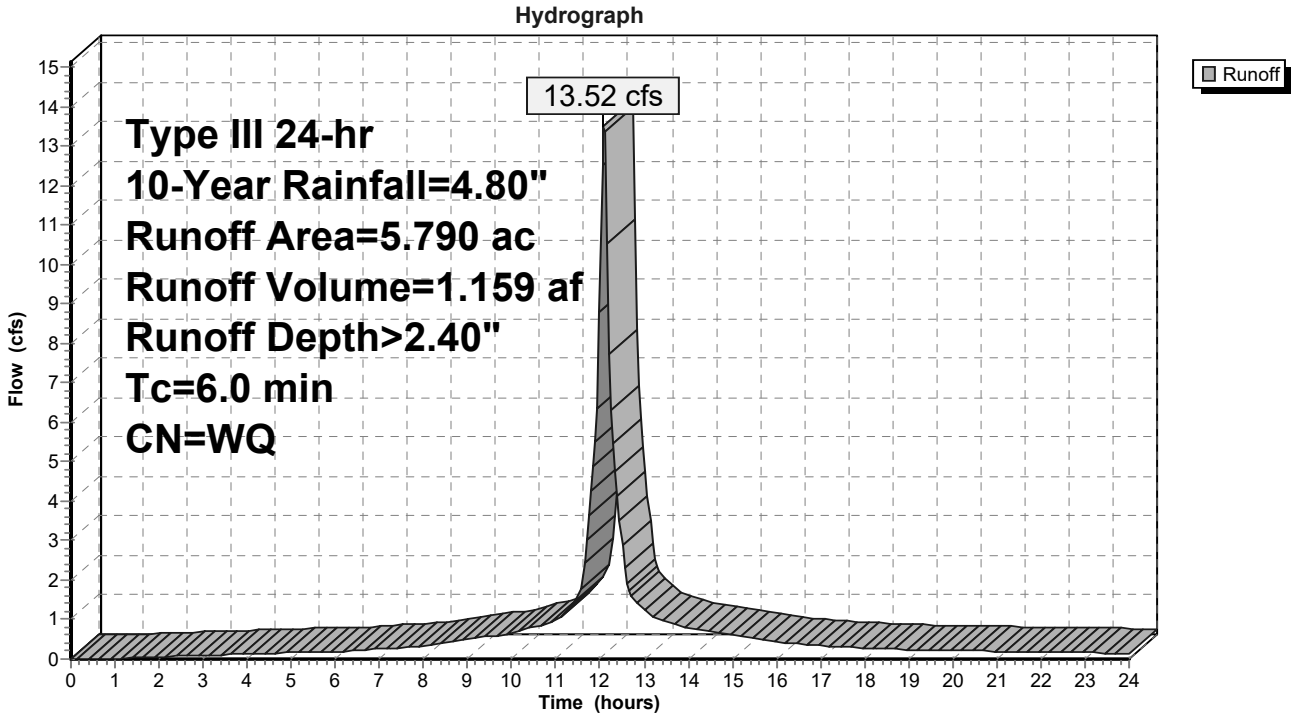
Runoff = 13.52 cfs @ 12.09 hrs, Volume= 1.159 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
1.770	98	Paved parking, HSG A
1.180	98	Roofs, HSG A
2.840	39	>75% Grass cover, Good, HSG A
5.790		Weighted Average
2.840		49.05% Pervious Area
2.950		50.95% Impervious Area

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

Subcatchment PR-3I:



Summary for Pond SIS-10:

Inflow Area = 1.060 ac, 67.92% Impervious, Inflow Depth > 3.15" for 10-Year event
Inflow = 3.30 cfs @ 12.09 hrs, Volume= 0.278 af
Outflow = 0.41 cfs @ 11.60 hrs, Volume= 0.278 af, Atten= 88%, Lag= 0.0 min
Discarded = 0.41 cfs @ 11.60 hrs, Volume= 0.278 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 130.09' @ 12.67 hrs Surf.Area= 2,116 sf Storage= 3,623 cf

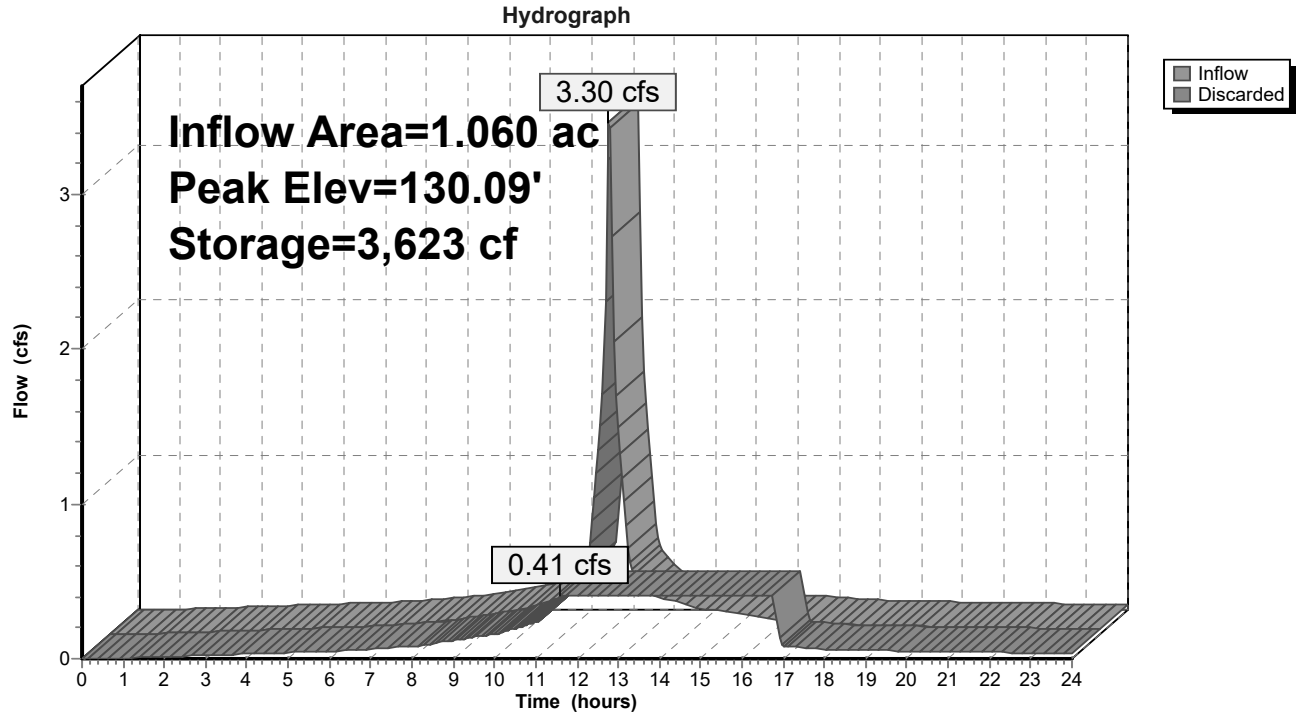
Plug-Flow detention time= 55.5 min calculated for 0.278 af (100% of inflow)
Center-of-Mass det. time= 55.2 min (808.0 - 752.8)

Volume	Invert	Avail.Storage	Storage Description
#1	127.00'	2,788 cf	**46.00'W x 46.00'L x 8.00'H Prismatoid** 16,928 cf Overall - 7,634 cf Embedded = 9,294 cf x 30.0% Voids
#2	128.00'	7,634 cf	**72.0" Round Pipe Storage** Inside #1 L= 270.0'
		10,422 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	127.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.41 cfs @ 11.60 hrs HW=127.09' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.41 cfs)

Pond SIS-10:



Summary for Pond SIS-3:

Inflow Area = 5.790 ac, 50.95% Impervious, Inflow Depth > 2.40" for 10-Year event
Inflow = 13.52 cfs @ 12.09 hrs, Volume= 1.159 af
Outflow = 1.58 cfs @ 11.60 hrs, Volume= 1.159 af, Atten= 88%, Lag= 0.0 min
Discarded = 1.58 cfs @ 11.60 hrs, Volume= 1.159 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 143.53' @ 12.73 hrs Surf.Area= 8,256 sf Storage= 15,256 cf

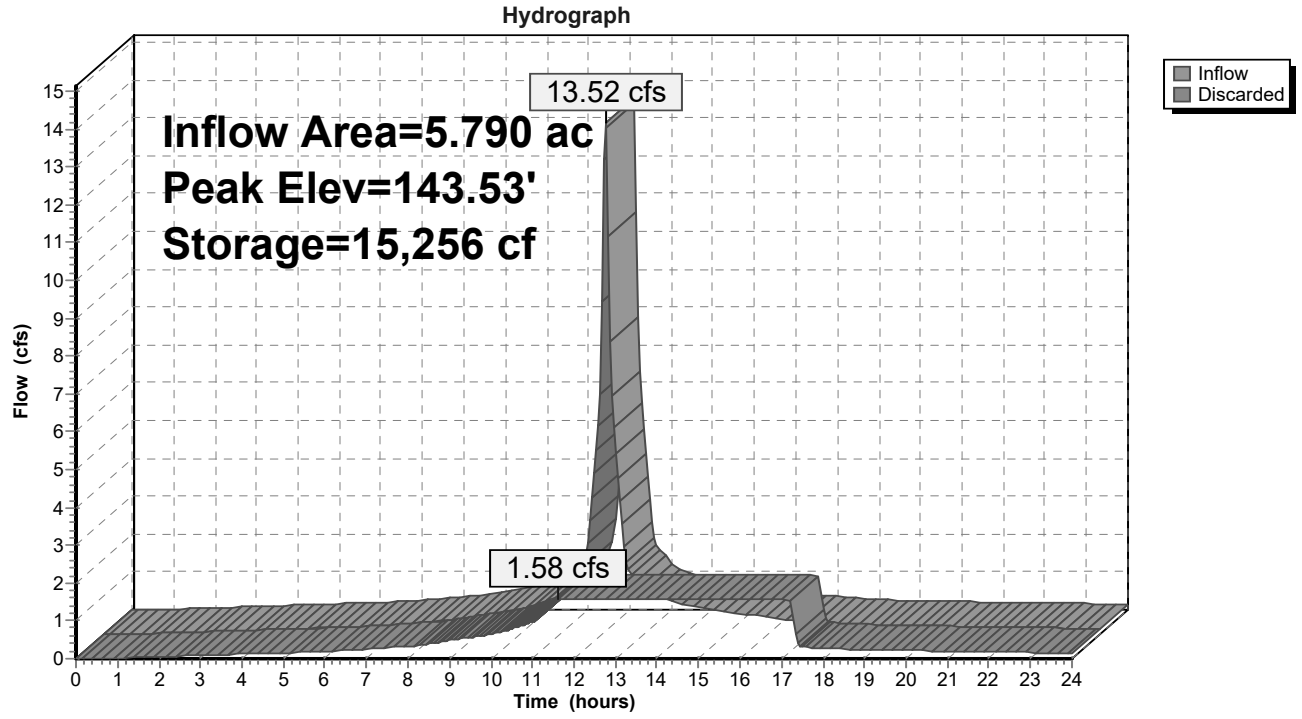
Plug-Flow detention time= 61.9 min calculated for 1.156 af (100% of inflow)
Center-of-Mass det. time= 61.5 min (818.8 - 757.3)

Volume	Invert	Avail.Storage	Storage Description
#1	140.50'	14,612 cf	**64.00'W x 129.00'L x 8.00'H Prismatoid** 66,048 cf Overall - 29,518 cf Embedded = 36,530 cf x 40.0% Voids
#2	141.50'	29,518 cf	**72.0" Round Pipe Storage** Inside #1 L= 1,044.0'
		44,130 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	140.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=1.58 cfs @ 11.60 hrs HW=140.59' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.58 cfs)

Pond SIS-3:



Summary for Pond SIS-4:

Inflow Area = 0.920 ac, 75.00% Impervious, Inflow Depth > 3.46" for 10-Year event
Inflow = 3.16 cfs @ 12.09 hrs, Volume= 0.265 af
Outflow = 0.44 cfs @ 11.65 hrs, Volume= 0.265 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.44 cfs @ 11.65 hrs, Volume= 0.265 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 147.52' @ 12.61 hrs Surf.Area= 2,304 sf Storage= 3,292 cf

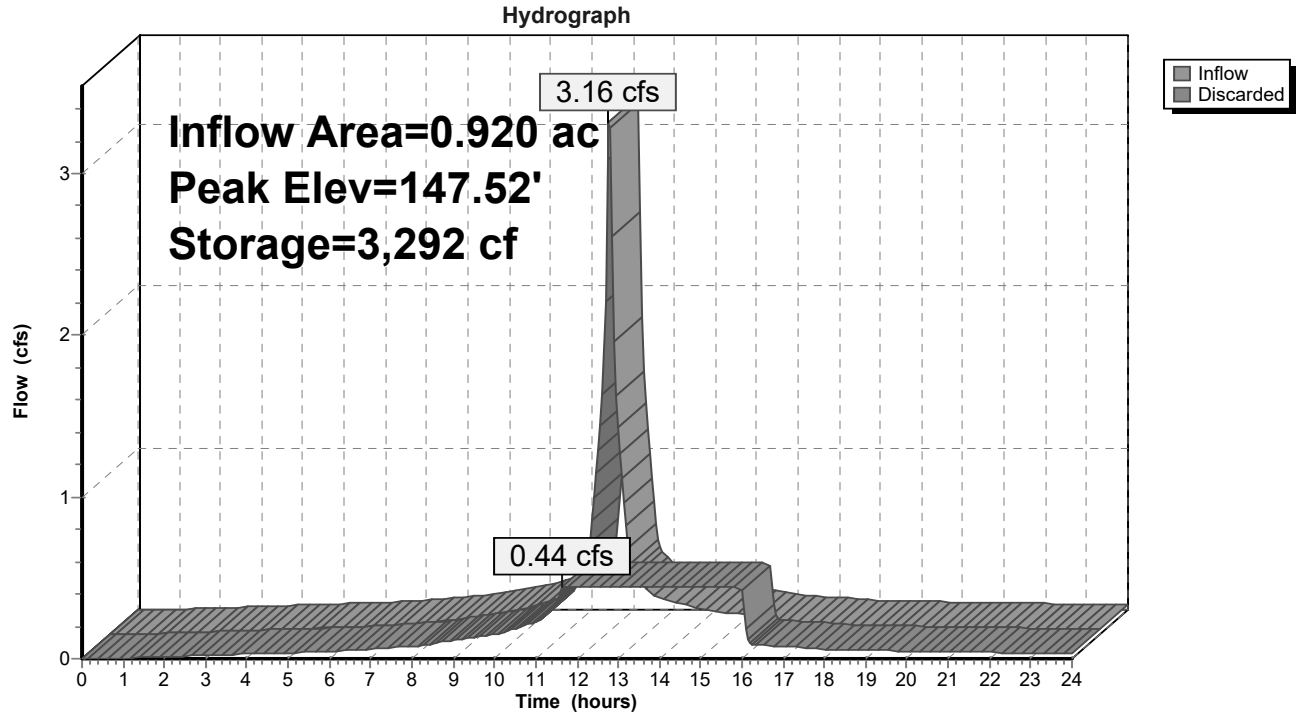
Plug-Flow detention time= 44.4 min calculated for 0.265 af (100% of inflow)
Center-of-Mass det. time= 44.1 min (795.5 - 751.5)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	4,116 cf	**16.00'W x 144.00'L x 8.00'H Prismatoid** 18,432 cf Overall - 8,143 cf Embedded = 10,289 cf x 40.0% Voids
#2	146.00'	8,143 cf	**72.0" Round Pipe Storage** Inside #1 L= 288.0'
		12,259 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.44 cfs @ 11.65 hrs HW=145.09' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.44 cfs)

Pond SIS-4:



Summary for Pond SIS-7:

Inflow Area = 1.210 ac, 40.50% Impervious, Inflow Depth > 1.94" for 10-Year event
Inflow = 2.25 cfs @ 12.09 hrs, Volume= 0.196 af
Outflow = 0.29 cfs @ 11.65 hrs, Volume= 0.196 af, Atten= 87%, Lag= 0.0 min
Discarded = 0.29 cfs @ 11.65 hrs, Volume= 0.196 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 134.44' @ 12.65 hrs Surf.Area= 1,536 sf Storage= 2,403 cf

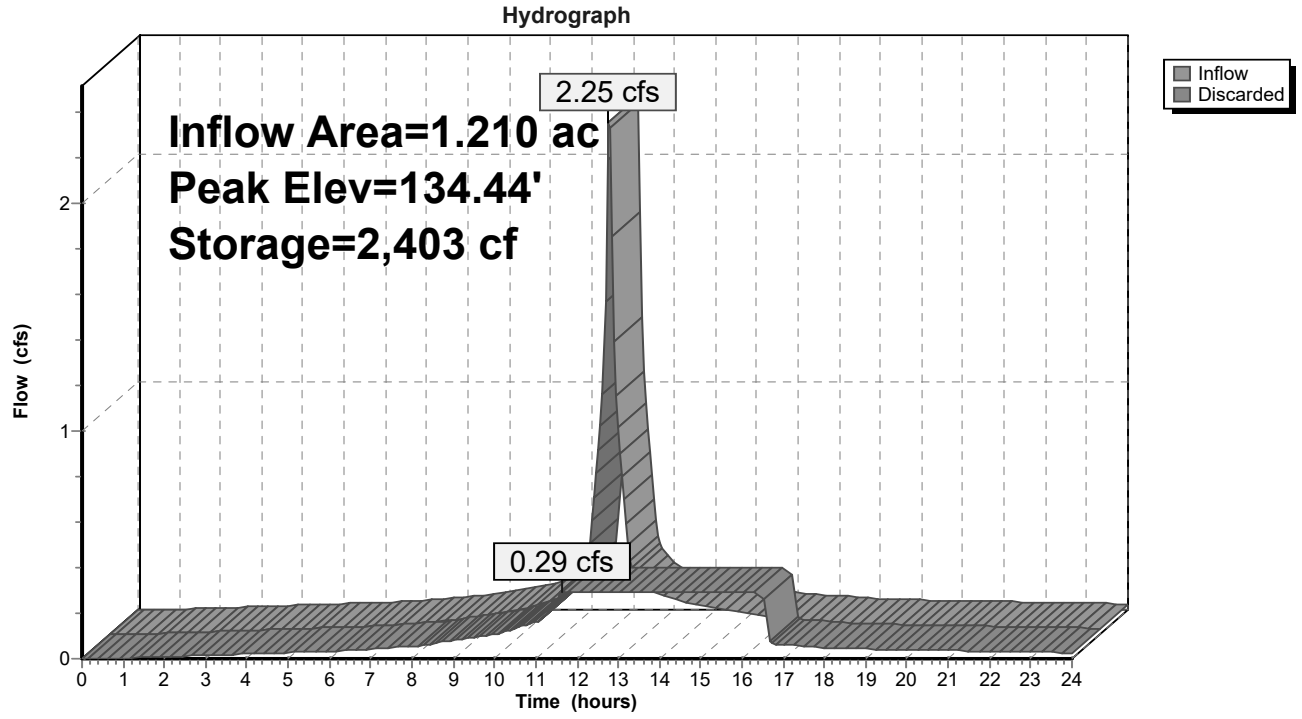
Plug-Flow detention time= 49.8 min calculated for 0.196 af (100% of inflow)
Center-of-Mass det. time= 49.6 min (811.5 - 761.9)

Volume	Invert	Avail.Storage	Storage Description
#1	131.50'	2,075 cf	**8.00'W x 192.00'L x 8.00'H Prismatoid** 12,288 cf Overall - 5,372 cf Embedded = 6,916 cf x 30.0% Voids
#2	132.50'	5,372 cf	**72.0" Round Pipe Storage** Inside #1 L= 190.0'
		7,447 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.29 cfs @ 11.65 hrs HW=131.61' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.29 cfs)

Pond SIS-7:

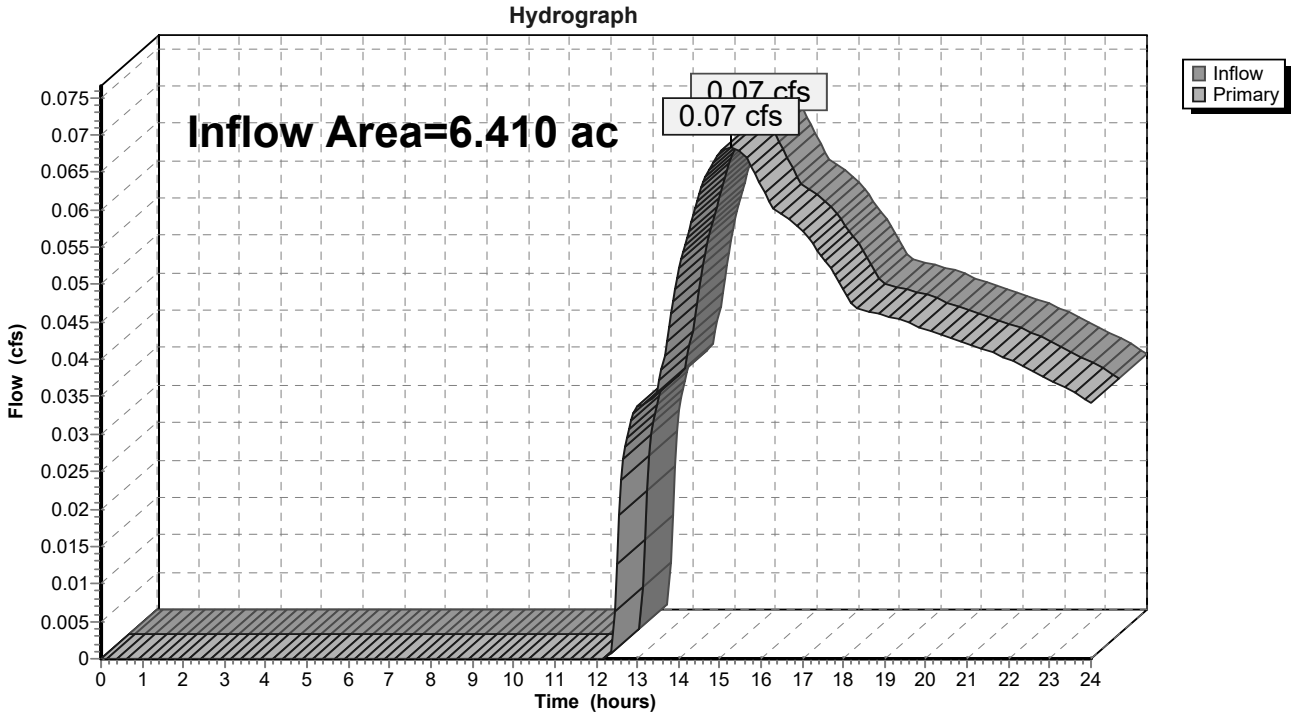


Summary for Link POA-3:

Inflow Area = 6.410 ac, 0.00% Impervious, Inflow Depth > 0.08" for 10-Year event
Inflow = 0.07 cfs @ 15.27 hrs, Volume= 0.045 af
Primary = 0.07 cfs @ 15.27 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-3:



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

Subcatchment PR-3B: Runoff Area=1.060 ac 67.92% Impervious Runoff Depth>4.05"
Tc=6.0 min CN=WQ Runoff=4.14 cfs 0.358 af

Subcatchment PR-3D: Runoff Area=1.210 ac 40.50% Impervious Runoff Depth>2.60"
Tc=6.0 min CN=WQ Runoff=2.83 cfs 0.262 af

Subcatchment PR-3G: Runoff Area=0.920 ac 75.00% Impervious Runoff Depth>4.43"
Tc=6.0 min CN=WQ Runoff=3.97 cfs 0.340 af

Subcatchment PR-3I: Runoff Area=5.790 ac 50.95% Impervious Runoff Depth>3.15"
Tc=6.0 min CN=WQ Runoff=17.02 cfs 1.521 af

Pond SIS-10: Peak Elev=130.95' Storage=5,121 cf Inflow=4.14 cfs 0.358 af
Outflow=0.41 cfs 0.358 af

Pond SIS-3: Peak Elev=144.50' Storage=22,063 cf Inflow=17.02 cfs 1.521 af
Outflow=1.58 cfs 1.520 af

Pond SIS-4: Peak Elev=148.22' Storage=4,620 cf Inflow=3.97 cfs 0.340 af
Outflow=0.44 cfs 0.339 af

Pond SIS-7: Peak Elev=135.37' Storage=3,561 cf Inflow=2.83 cfs 0.262 af
Outflow=0.29 cfs 0.262 af

Link POA-3: Inflow=0.44 cfs 0.159 af
Primary=0.44 cfs 0.159 af

Total Runoff Area = 8.980 ac Runoff Volume = 2.480 af Average Runoff Depth = 3.31"
45.99% Pervious = 4.130 ac 54.01% Impervious = 4.850 ac

Summary for Subcatchment PR-3B:

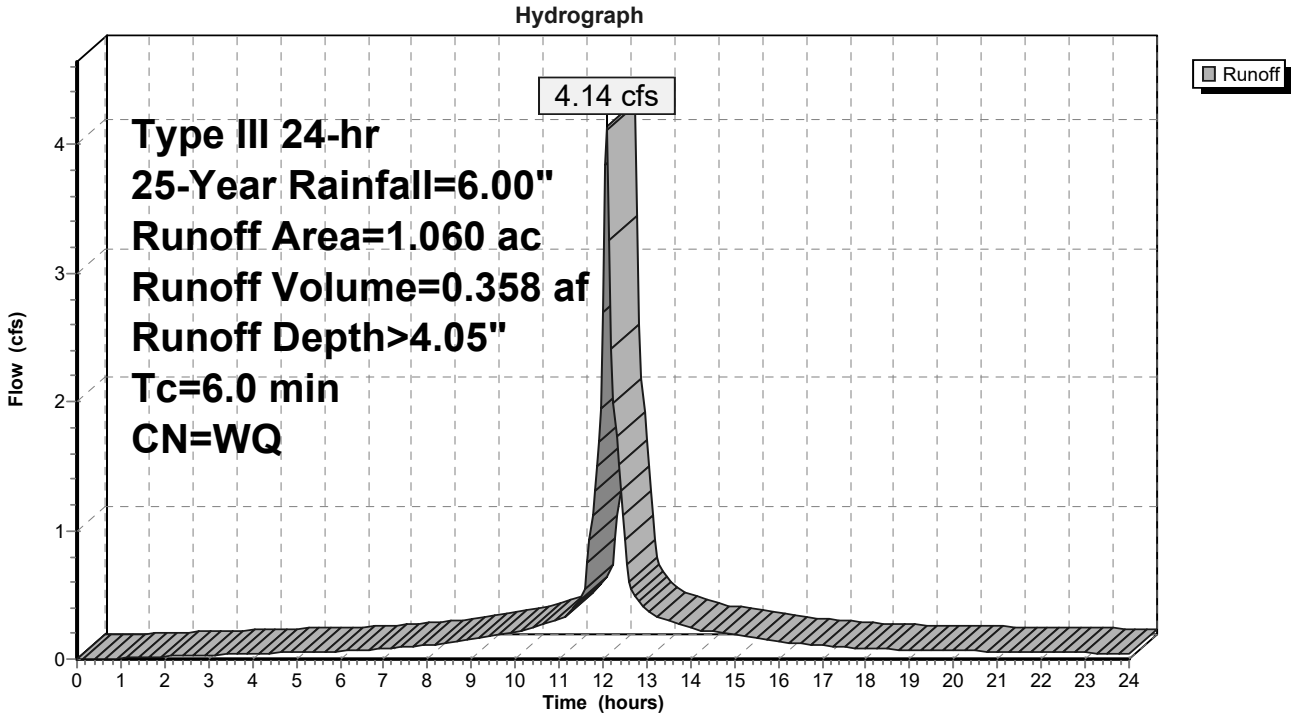
Runoff = 4.14 cfs @ 12.09 hrs, Volume= 0.358 af, Depth> 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.410	98	Roofs, HSG A
0.340	39	>75% Grass cover, Good, HSG A
1.060		Weighted Average
0.340		32.08% Pervious Area
0.720		67.92% Impervious Area

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

Subcatchment PR-3B:



Summary for Subcatchment PR-3D:

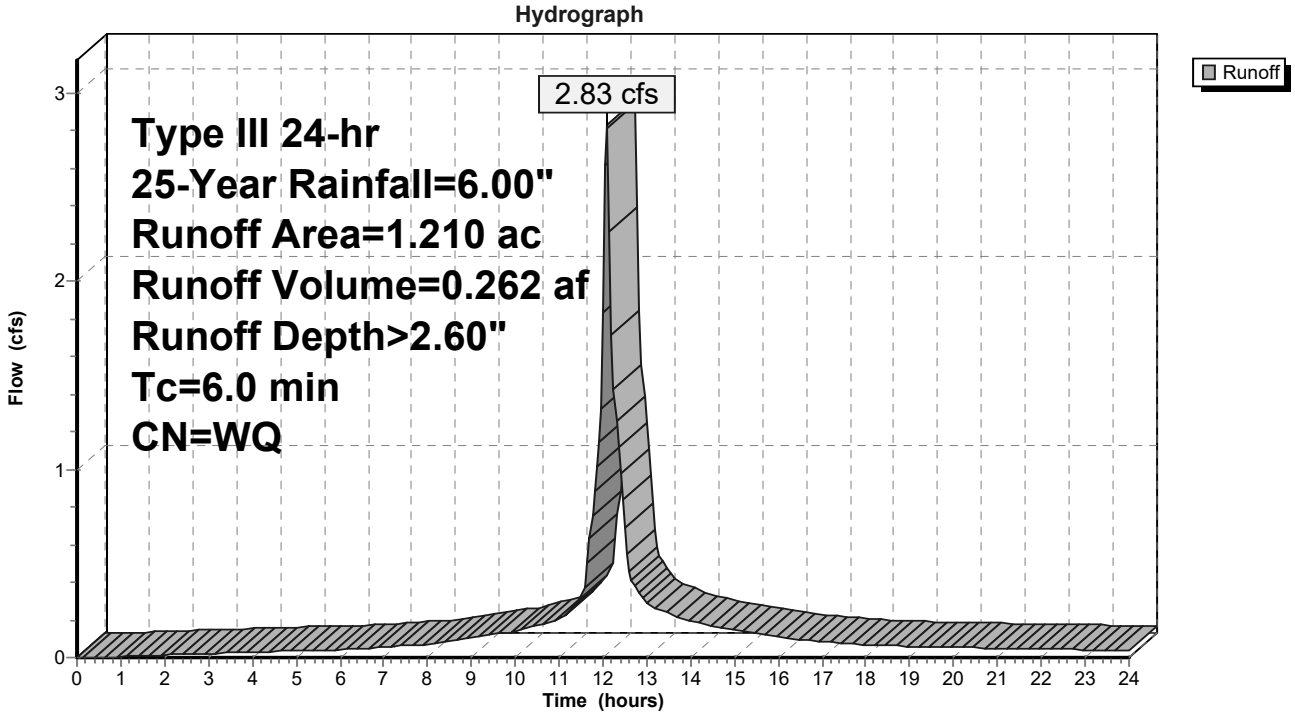
Runoff = 2.83 cfs @ 12.09 hrs, Volume= 0.262 af, Depth> 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (ac)	CN	Description
0.490	98	Roofs, HSG A
0.720	39	>75% Grass cover, Good, HSG A
1.210		Weighted Average
0.720		59.50% Pervious Area
0.490		40.50% Impervious Area

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

Subcatchment PR-3D:



Summary for Subcatchment PR-3G:

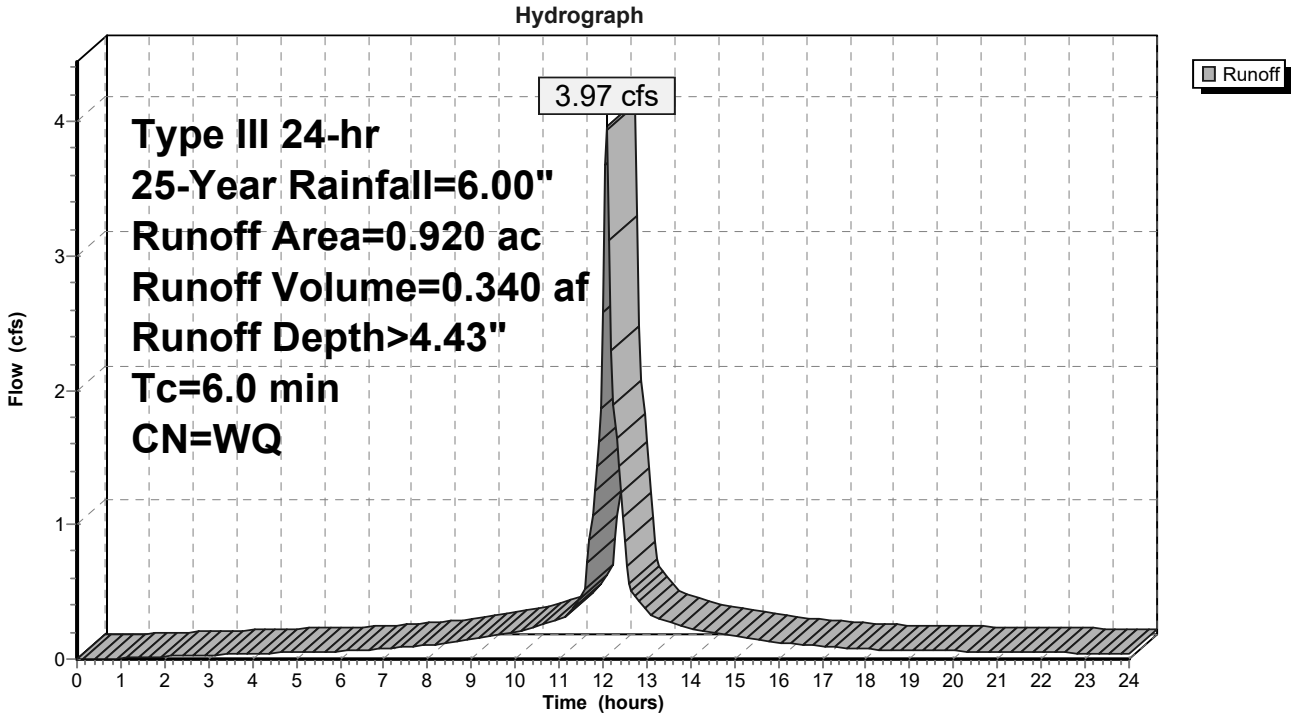
Runoff = 3.97 cfs @ 12.09 hrs, Volume= 0.340 af, Depth> 4.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (ac)	CN	Description
0.530	98	Paved parking, HSG A
0.160	98	Roofs, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.920		Weighted Average
0.230		25.00% Pervious Area
0.690		75.00% Impervious Area

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

Subcatchment PR-3G:



Summary for Subcatchment PR-3I:

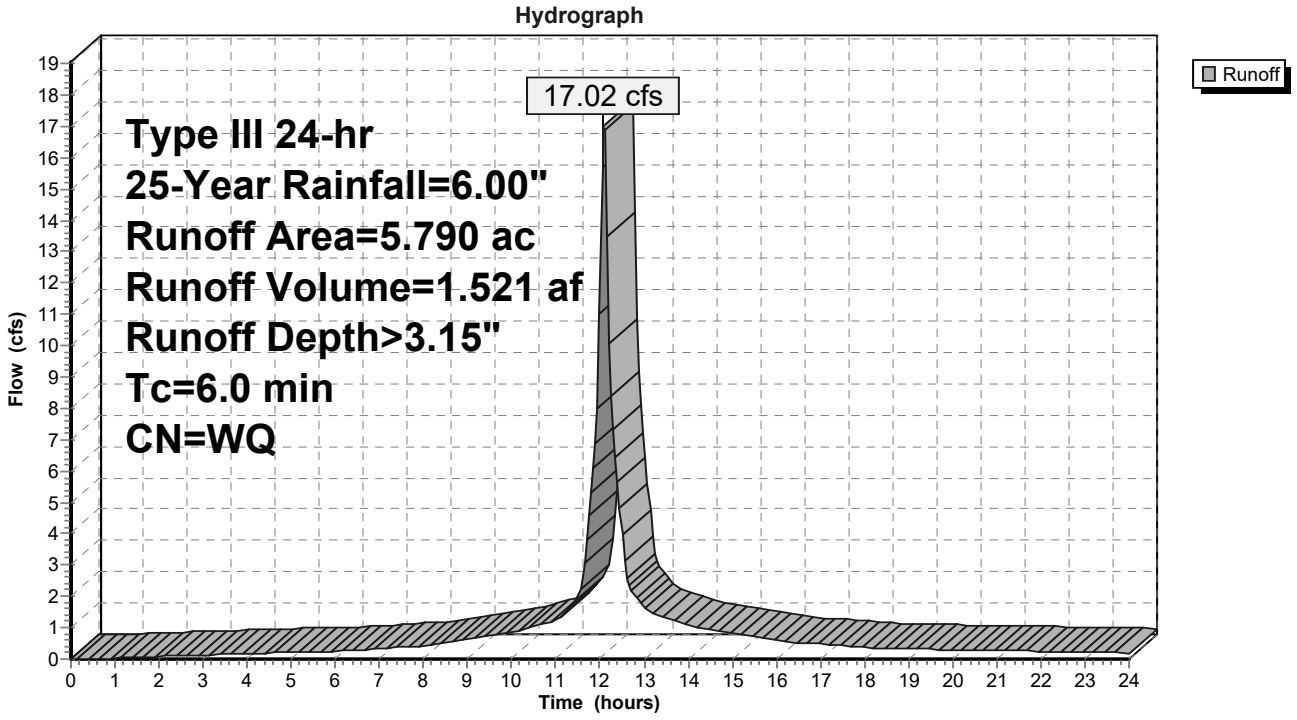
Runoff = 17.02 cfs @ 12.09 hrs, Volume= 1.521 af, Depth> 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (ac)	CN	Description
1.770	98	Paved parking, HSG A
1.180	98	Roofs, HSG A
2.840	39	>75% Grass cover, Good, HSG A
5.790		Weighted Average
2.840		49.05% Pervious Area
2.950		50.95% Impervious Area

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

Subcatchment PR-3I:



Summary for Pond SIS-10:

Inflow Area = 1.060 ac, 67.92% Impervious, Inflow Depth > 4.05" for 25-Year event
Inflow = 4.14 cfs @ 12.09 hrs, Volume= 0.358 af
Outflow = 0.41 cfs @ 11.40 hrs, Volume= 0.358 af, Atten= 90%, Lag= 0.0 min
Discarded = 0.41 cfs @ 11.40 hrs, Volume= 0.358 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 130.95' @ 12.94 hrs Surf.Area= 2,116 sf Storage= 5,121 cf

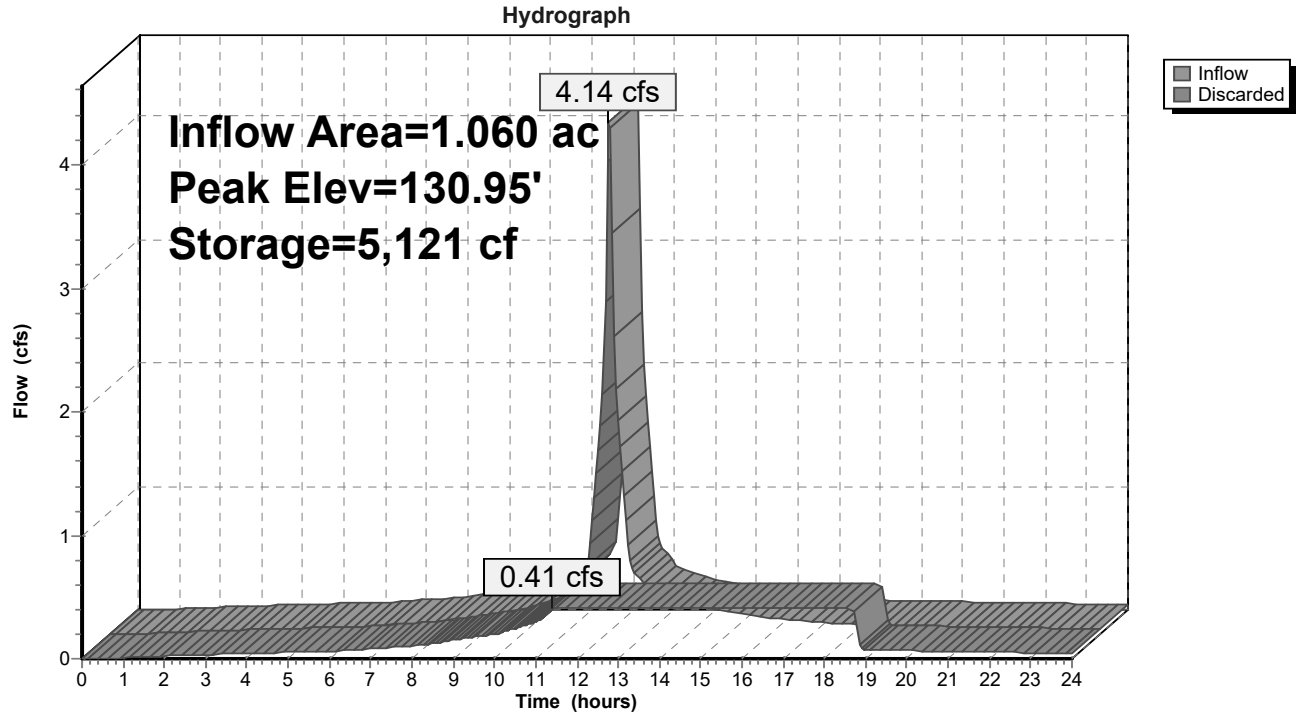
Plug-Flow detention time= 86.0 min calculated for 0.358 af (100% of inflow)
Center-of-Mass det. time= 85.8 min (838.0 - 752.2)

Volume	Invert	Avail.Storage	Storage Description
#1	127.00'	2,788 cf	**46.00'W x 46.00'L x 8.00'H Prismatoid** 16,928 cf Overall - 7,634 cf Embedded = 9,294 cf x 30.0% Voids
#2	128.00'	7,634 cf	**72.0" Round Pipe Storage** Inside #1 L= 270.0'
		10,422 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	127.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.41 cfs @ 11.40 hrs HW=127.09' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.41 cfs)

Pond SIS-10:



Summary for Pond SIS-3:

Inflow Area = 5.790 ac, 50.95% Impervious, Inflow Depth > 3.15" for 25-Year event
Inflow = 17.02 cfs @ 12.09 hrs, Volume= 1.521 af
Outflow = 1.58 cfs @ 11.35 hrs, Volume= 1.520 af, Atten= 91%, Lag= 0.0 min
Discarded = 1.58 cfs @ 11.35 hrs, Volume= 1.520 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 144.50' @ 13.05 hrs Surf.Area= 8,256 sf Storage= 22,063 cf

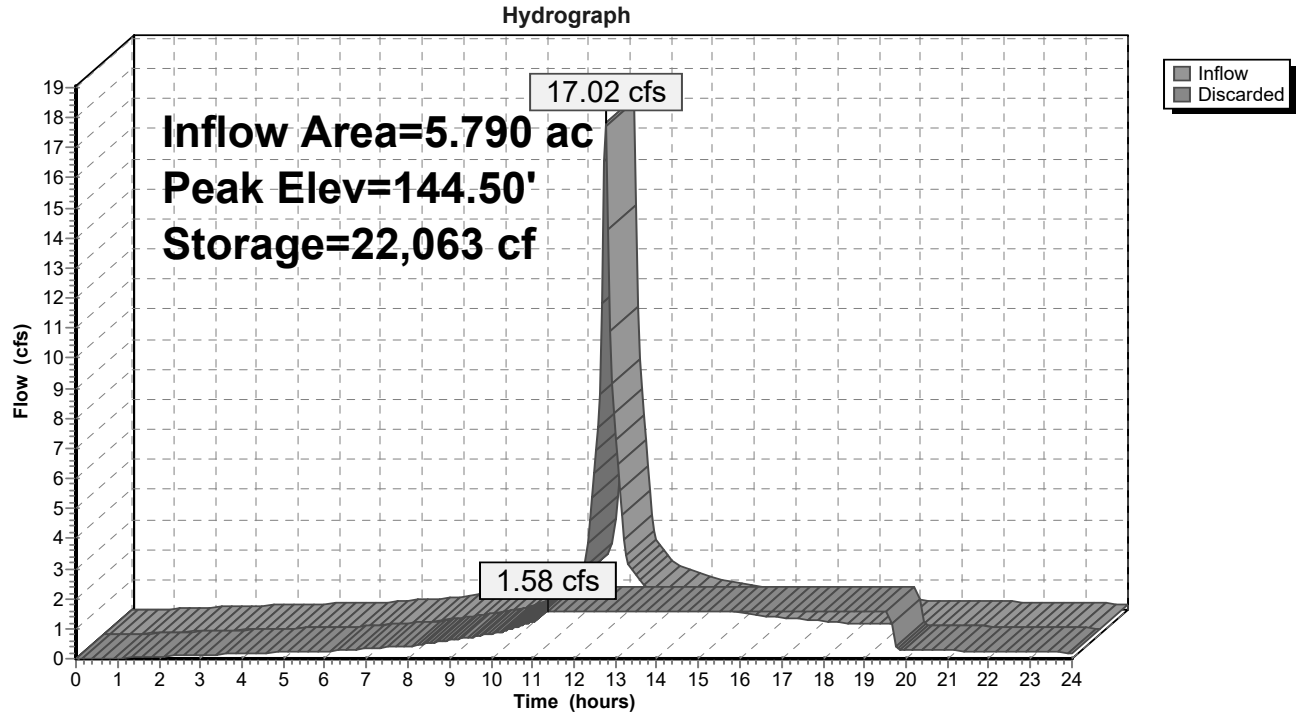
Plug-Flow detention time= 99.9 min calculated for 1.517 af (100% of inflow)
Center-of-Mass det. time= 99.3 min (858.8 - 759.5)

Volume	Invert	Avail.Storage	Storage Description
#1	140.50'	14,612 cf	**64.00'W x 129.00'L x 8.00'H Prismatoid** 66,048 cf Overall - 29,518 cf Embedded = 36,530 cf x 40.0% Voids
#2	141.50'	29,518 cf	**72.0" Round Pipe Storage** Inside #1 L= 1,044.0'
		44,130 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	140.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=1.58 cfs @ 11.35 hrs HW=140.58' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.58 cfs)

Pond SIS-3:



Summary for Pond SIS-4:

Inflow Area = 0.920 ac, 75.00% Impervious, Inflow Depth > 4.43" for 25-Year event
Inflow = 3.97 cfs @ 12.09 hrs, Volume= 0.340 af
Outflow = 0.44 cfs @ 11.55 hrs, Volume= 0.339 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.44 cfs @ 11.55 hrs, Volume= 0.339 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 148.22' @ 12.79 hrs Surf.Area= 2,304 sf Storage= 4,620 cf

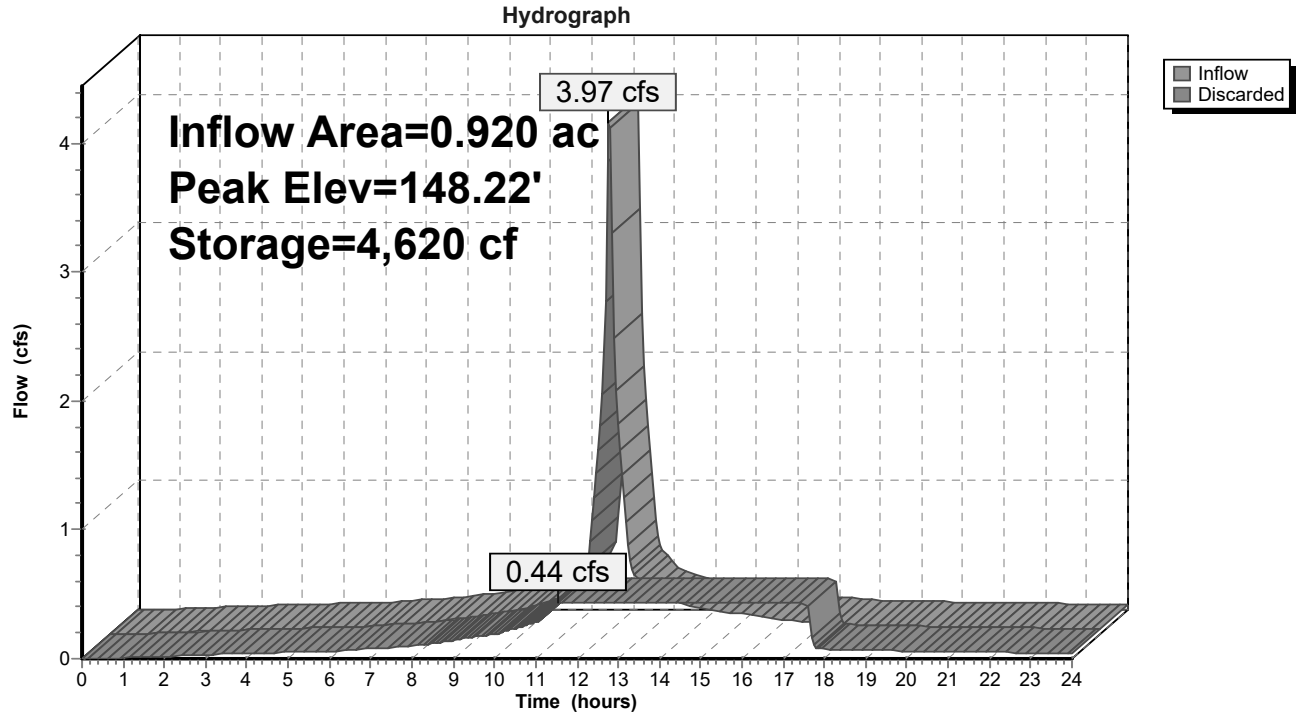
Plug-Flow detention time= 68.0 min calculated for 0.339 af (100% of inflow)
Center-of-Mass det. time= 67.6 min (817.7 - 750.1)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	4,116 cf	**16.00'W x 144.00'L x 8.00'H Prismatoid** 18,432 cf Overall - 8,143 cf Embedded = 10,289 cf x 40.0% Voids
#2	146.00'	8,143 cf	**72.0" Round Pipe Storage** Inside #1 L= 288.0'
		12,259 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.44 cfs @ 11.55 hrs HW=145.09' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.44 cfs)

Pond SIS-4:



Summary for Pond SIS-7:

Inflow Area = 1.210 ac, 40.50% Impervious, Inflow Depth > 2.60" for 25-Year event
Inflow = 2.83 cfs @ 12.09 hrs, Volume= 0.262 af
Outflow = 0.29 cfs @ 11.45 hrs, Volume= 0.262 af, Atten= 90%, Lag= 0.0 min
Discarded = 0.29 cfs @ 11.45 hrs, Volume= 0.262 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 135.37' @ 13.00 hrs Surf.Area= 1,536 sf Storage= 3,561 cf

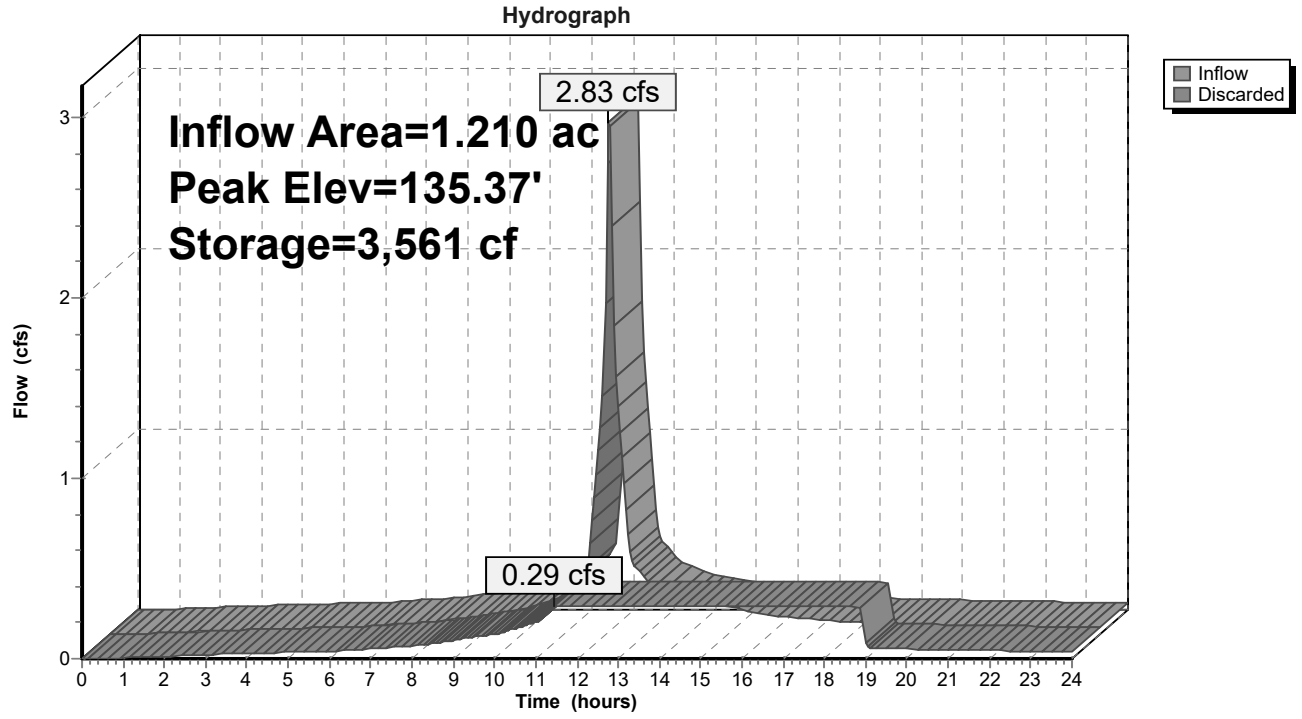
Plug-Flow detention time= 84.6 min calculated for 0.262 af (100% of inflow)
Center-of-Mass det. time= 84.3 min (850.8 - 766.5)

Volume	Invert	Avail.Storage	Storage Description
#1	131.50'	2,075 cf	**8.00'W x 192.00'L x 8.00'H Prismatoid** 12,288 cf Overall - 5,372 cf Embedded = 6,916 cf x 30.0% Voids
#2	132.50'	5,372 cf	**72.0" Round Pipe Storage** Inside #1 L= 190.0'
		7,447 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.29 cfs @ 11.45 hrs HW=131.58' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.29 cfs)

Pond SIS-7:

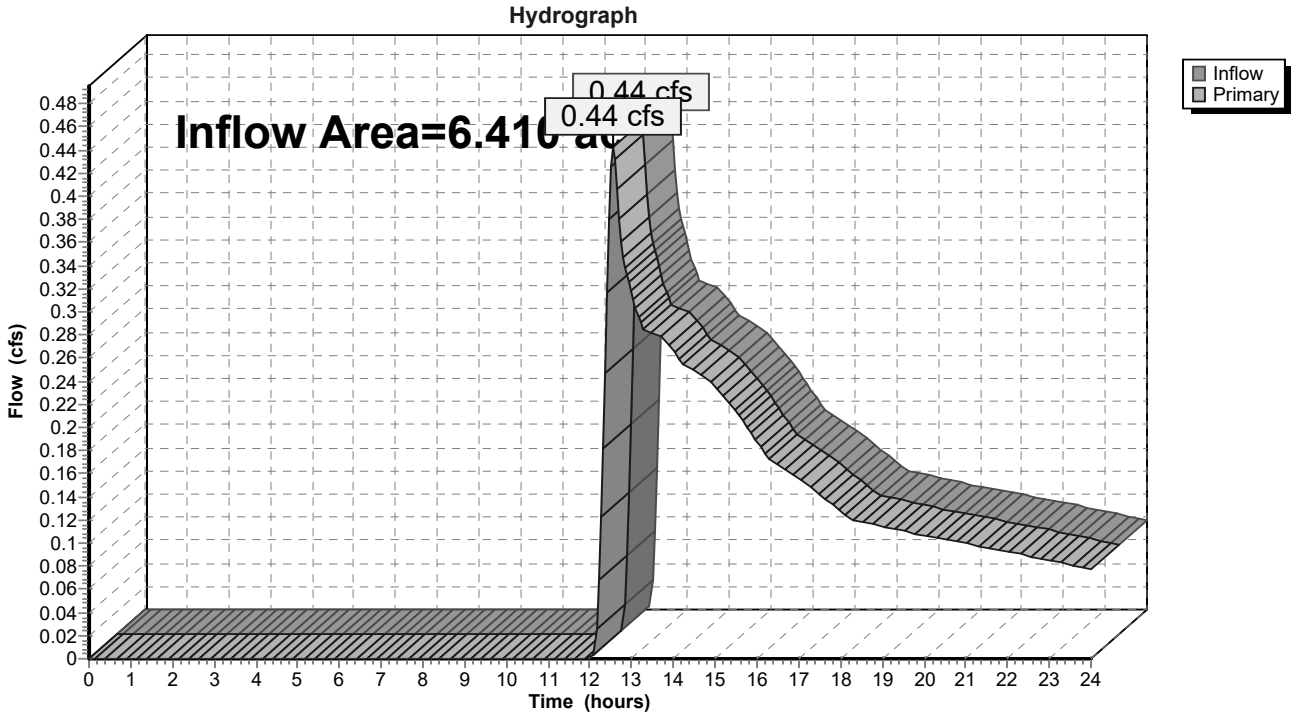


Summary for Link POA-3:

Inflow Area = 6.410 ac, 0.00% Impervious, Inflow Depth > 0.30" for 25-Year event
Inflow = 0.44 cfs @ 12.56 hrs, Volume= 0.159 af
Primary = 0.44 cfs @ 12.56 hrs, Volume= 0.159 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-3:



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

Subcatchment PR-3B: Runoff Area=1.060 ac 67.92% Impervious Runoff Depth>6.13"
Tc=6.0 min CN=WQ Runoff=6.32 cfs 0.541 af

Subcatchment PR-3D: Runoff Area=1.210 ac 40.50% Impervious Runoff Depth>4.23"
Tc=6.0 min CN=WQ Runoff=4.85 cfs 0.426 af

Subcatchment PR-3G: Runoff Area=0.920 ac 75.00% Impervious Runoff Depth>6.62"
Tc=6.0 min CN=WQ Runoff=5.95 cfs 0.508 af

Subcatchment PR-3I: Runoff Area=5.790 ac 50.95% Impervious Runoff Depth>4.95"
Tc=6.0 min CN=WQ Runoff=27.51 cfs 2.389 af

Pond SIS-10: Peak Elev=133.49' Storage=9,240 cf Inflow=6.32 cfs 0.541 af
Outflow=0.41 cfs 0.541 af

Pond SIS-3: Peak Elev=148.10' Storage=42,816 cf Inflow=27.51 cfs 2.389 af
Outflow=1.58 cfs 2.151 af

Pond SIS-4: Peak Elev=150.04' Storage=8,142 cf Inflow=5.95 cfs 0.508 af
Outflow=0.44 cfs 0.507 af

Pond SIS-7: Peak Elev=139.45' Storage=7,422 cf Inflow=4.85 cfs 0.426 af
Outflow=0.29 cfs 0.392 af

Link POA-3: Inflow=3.83 cfs 0.594 af
Primary=3.83 cfs 0.594 af

Total Runoff Area = 8.980 ac Runoff Volume = 3.864 af Average Runoff Depth = 5.16"
45.99% Pervious = 4.130 ac 54.01% Impervious = 4.850 ac

Summary for Subcatchment PR-3B:

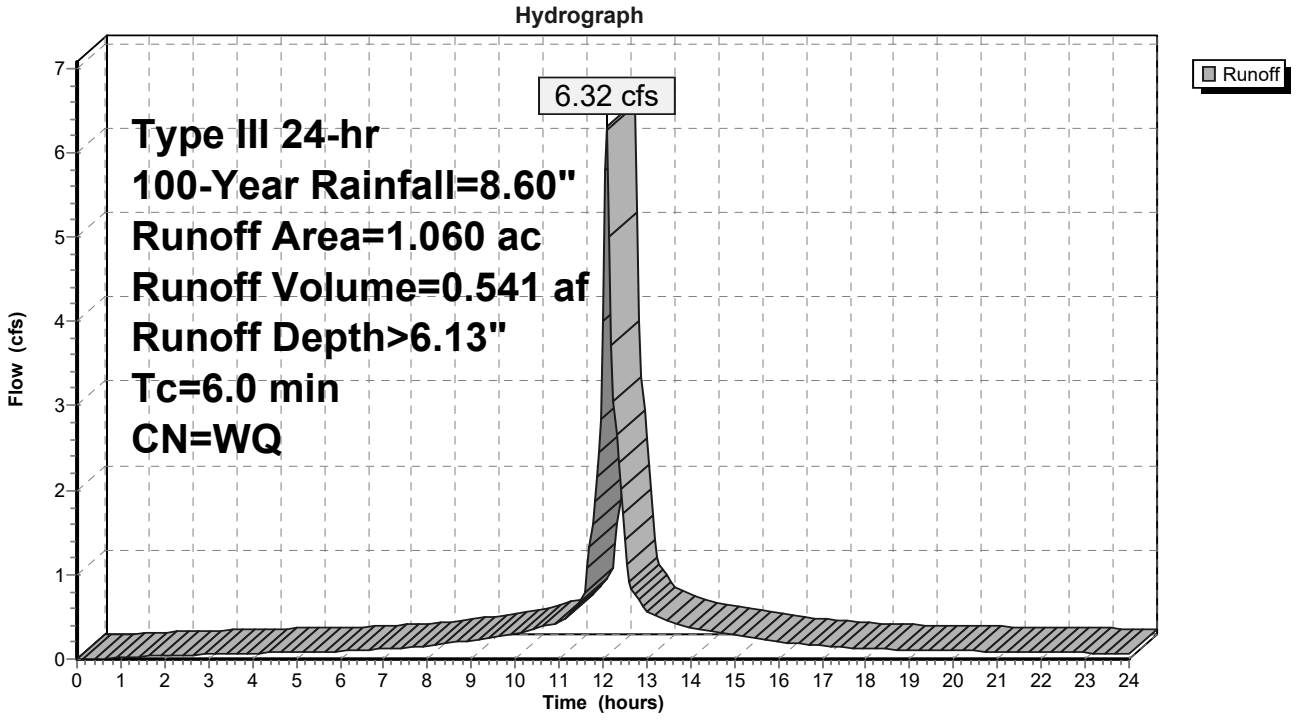
Runoff = 6.32 cfs @ 12.09 hrs, Volume= 0.541 af, Depth> 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.410	98	Roofs, HSG A
0.340	39	>75% Grass cover, Good, HSG A
1.060		Weighted Average
0.340		32.08% Pervious Area
0.720		67.92% Impervious Area

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

Subcatchment PR-3B:



Summary for Subcatchment PR-3D:

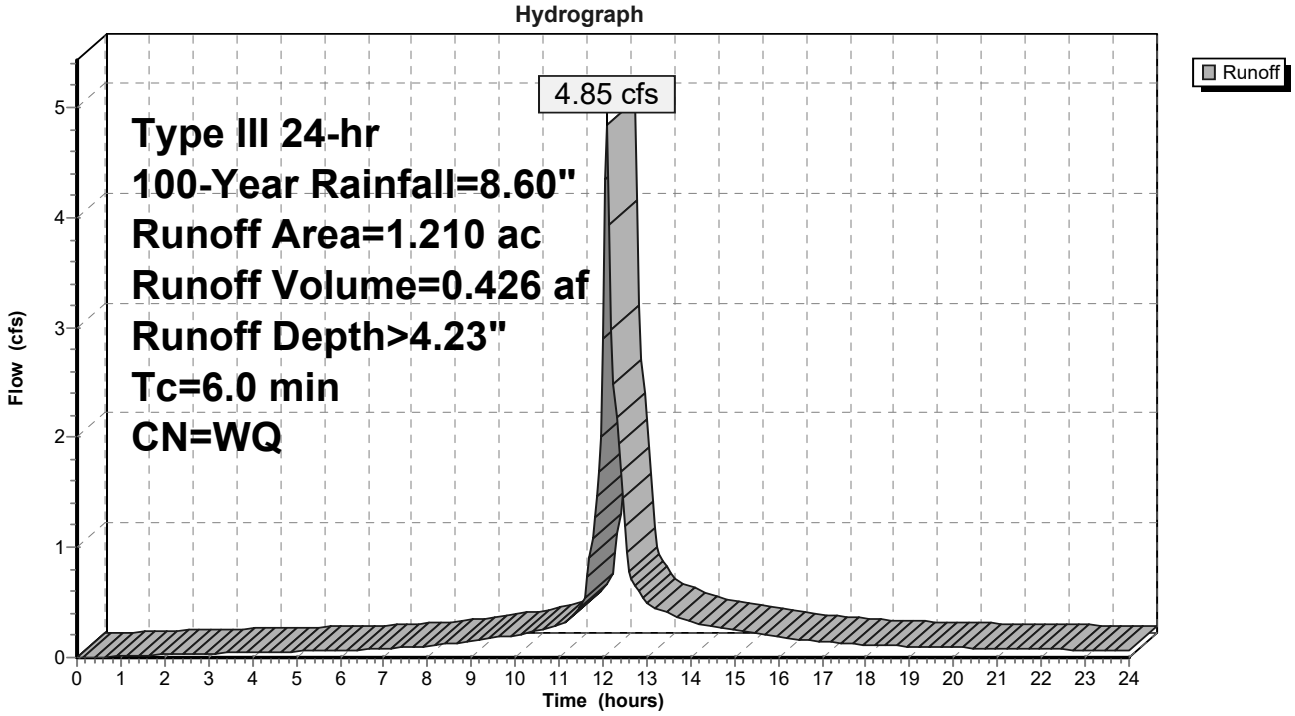
Runoff = 4.85 cfs @ 12.09 hrs, Volume= 0.426 af, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.490	98	Roofs, HSG A
0.720	39	>75% Grass cover, Good, HSG A
1.210		Weighted Average
0.720		59.50% Pervious Area
0.490		40.50% Impervious Area

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

Subcatchment PR-3D:



Summary for Subcatchment PR-3G:

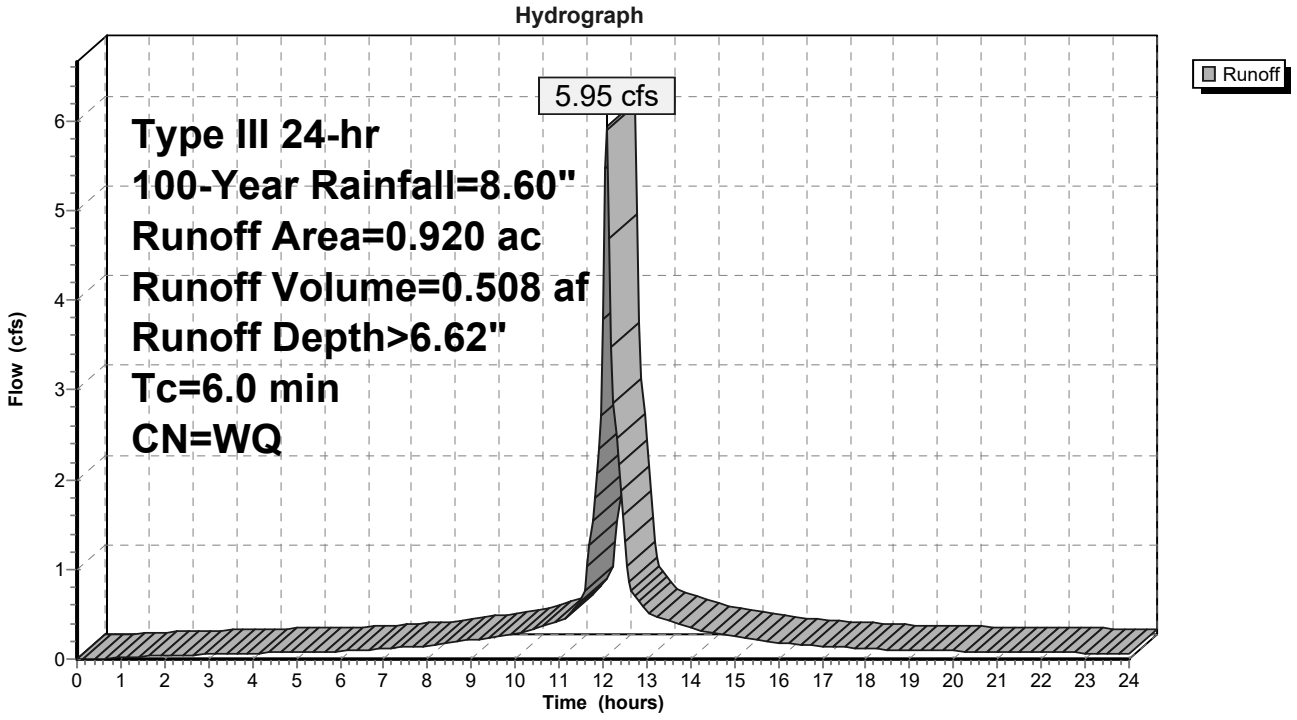
Runoff = 5.95 cfs @ 12.09 hrs, Volume= 0.508 af, Depth> 6.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.530	98	Paved parking, HSG A
0.160	98	Roofs, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.920		Weighted Average
0.230		25.00% Pervious Area
0.690		75.00% Impervious Area

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

Subcatchment PR-3G:



Summary for Subcatchment PR-3I:

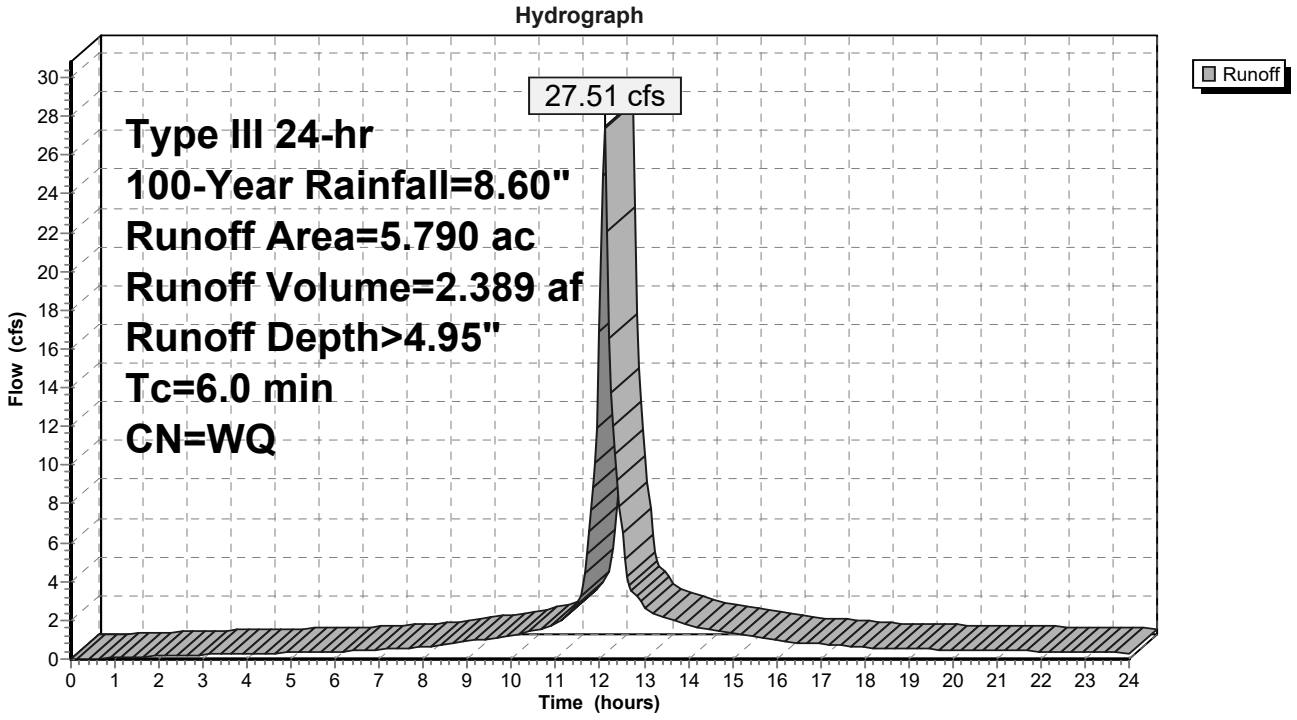
Runoff = 27.51 cfs @ 12.09 hrs, Volume= 2.389 af, Depth> 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
1.770	98	Paved parking, HSG A
1.180	98	Roofs, HSG A
2.840	39	>75% Grass cover, Good, HSG A
5.790		Weighted Average
2.840		49.05% Pervious Area
2.950		50.95% Impervious Area

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

Subcatchment PR-3I:



Summary for Pond SIS-10:

Inflow Area = 1.060 ac, 67.92% Impervious, Inflow Depth > 6.13" for 100-Year event
Inflow = 6.32 cfs @ 12.09 hrs, Volume= 0.541 af
Outflow = 0.41 cfs @ 10.85 hrs, Volume= 0.541 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.41 cfs @ 10.85 hrs, Volume= 0.541 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 133.49' @ 13.81 hrs Surf.Area= 2,116 sf Storage= 9,240 cf

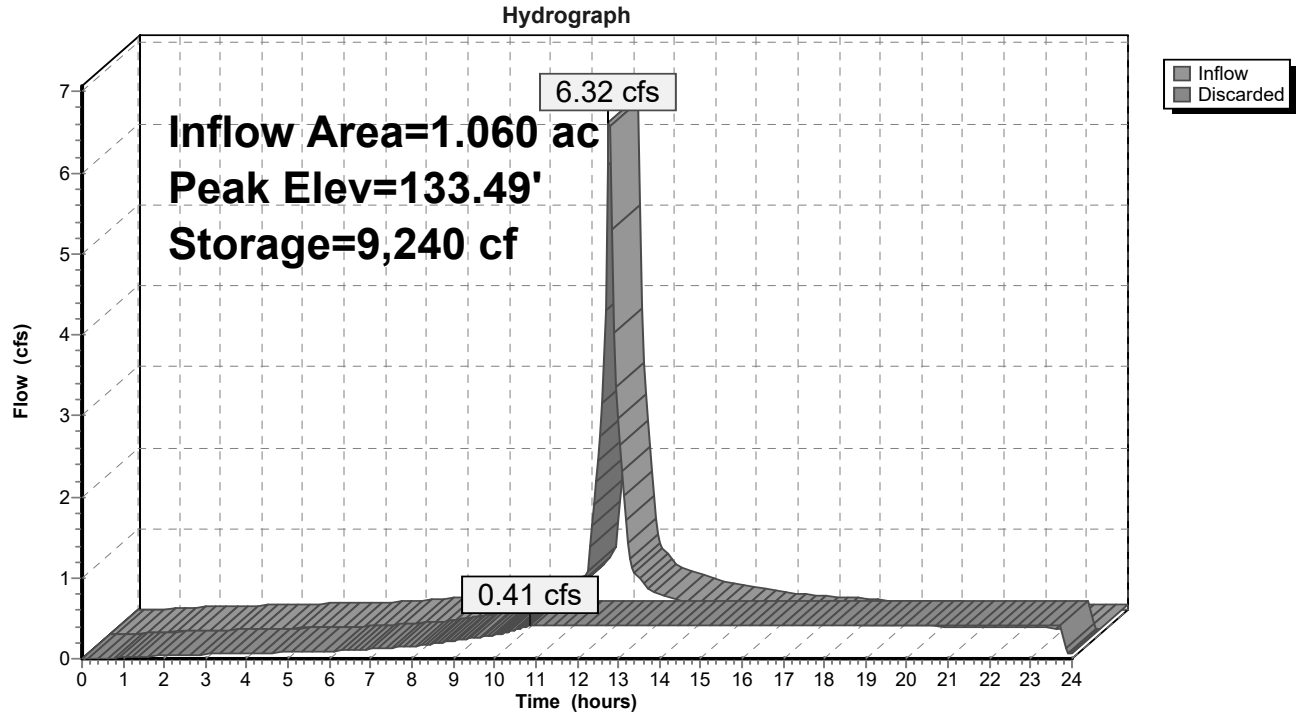
Plug-Flow detention time= 178.7 min calculated for 0.540 af (100% of inflow)
Center-of-Mass det. time= 178.1 min (930.1 - 752.0)

Volume	Invert	Avail.Storage	Storage Description
#1	127.00'	2,788 cf	**46.00'W x 46.00'L x 8.00'H Prismatoid** 16,928 cf Overall - 7,634 cf Embedded = 9,294 cf x 30.0% Voids
#2	128.00'	7,634 cf	**72.0" Round Pipe Storage** Inside #1 L= 270.0'
		10,422 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	127.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.41 cfs @ 10.85 hrs HW=127.08' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.41 cfs)

Pond SIS-10:



Summary for Pond SIS-3:

Inflow Area = 5.790 ac, 50.95% Impervious, Inflow Depth > 4.95" for 100-Year event
Inflow = 27.51 cfs @ 12.09 hrs, Volume= 2.389 af
Outflow = 1.58 cfs @ 10.70 hrs, Volume= 2.151 af, Atten= 94%, Lag= 0.0 min
Discarded = 1.58 cfs @ 10.70 hrs, Volume= 2.151 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 148.10' @ 14.37 hrs Surf.Area= 8,256 sf Storage= 42,816 cf

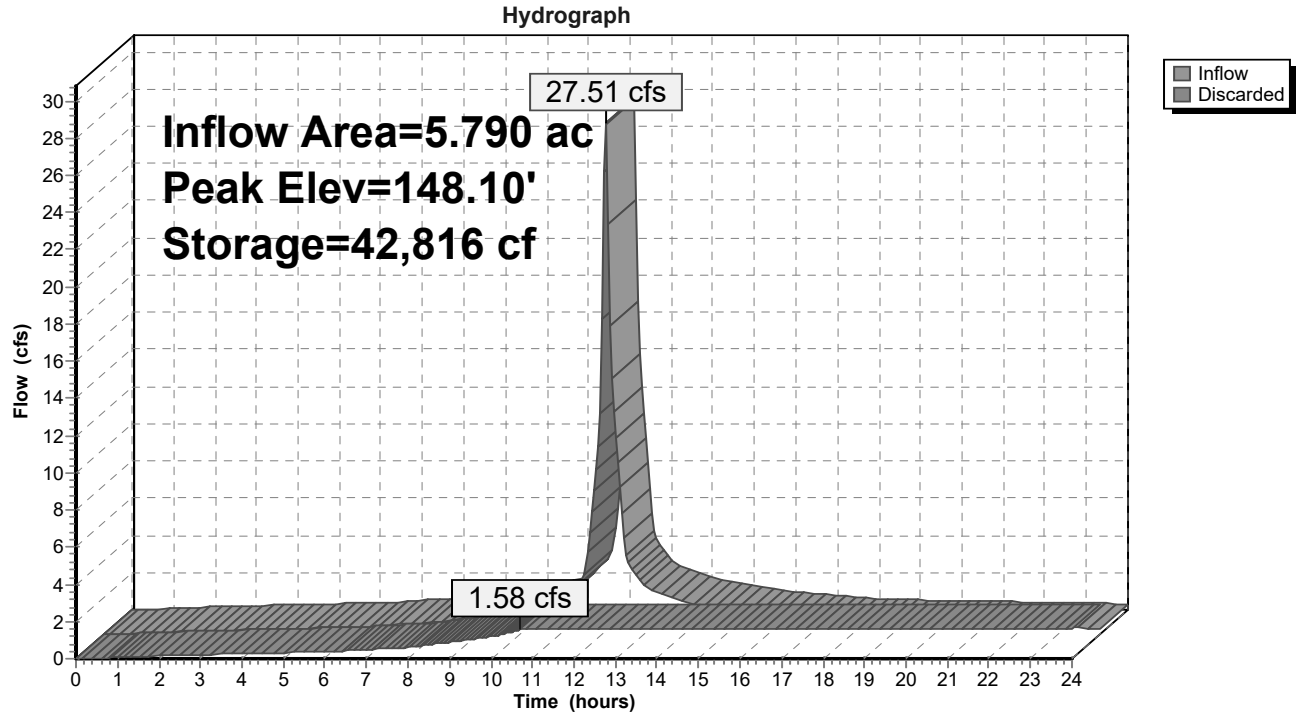
Plug-Flow detention time= 219.4 min calculated for 2.147 af (90% of inflow)
Center-of-Mass det. time= 168.2 min (931.0 - 762.7)

Volume	Invert	Avail.Storage	Storage Description
#1	140.50'	14,612 cf	**64.00'W x 129.00'L x 8.00'H Prismatoid** 66,048 cf Overall - 29,518 cf Embedded = 36,530 cf x 40.0% Voids
#2	141.50'	29,518 cf	**72.0" Round Pipe Storage** Inside #1 L= 1,044.0'
		44,130 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	140.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=1.58 cfs @ 10.70 hrs HW=140.58' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.58 cfs)

Pond SIS-3:



Summary for Pond SIS-4:

Inflow Area = 0.920 ac, 75.00% Impervious, Inflow Depth > 6.62" for 100-Year event
Inflow = 5.95 cfs @ 12.09 hrs, Volume= 0.508 af
Outflow = 0.44 cfs @ 11.15 hrs, Volume= 0.507 af, Atten= 93%, Lag= 0.0 min
Discarded = 0.44 cfs @ 11.15 hrs, Volume= 0.507 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 150.04' @ 13.37 hrs Surf.Area= 2,304 sf Storage= 8,142 cf

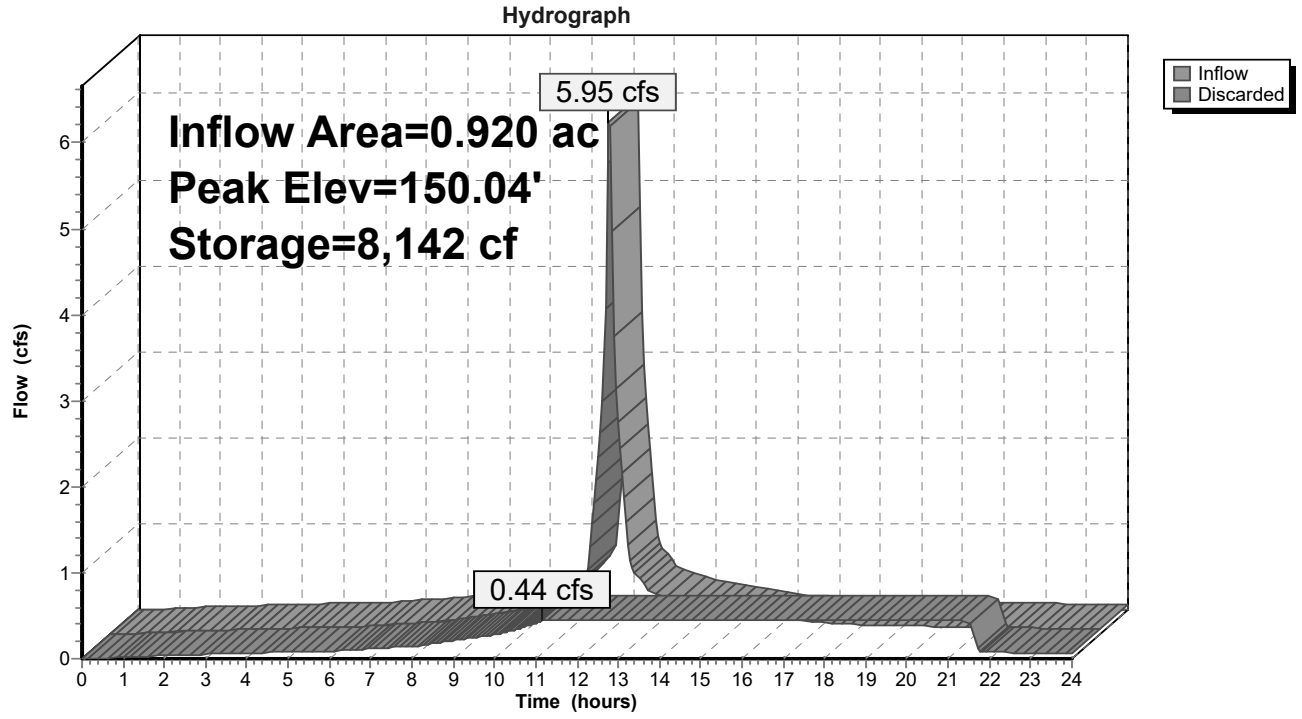
Plug-Flow detention time= 137.3 min calculated for 0.507 af (100% of inflow)
Center-of-Mass det. time= 137.0 min (885.6 - 748.6)

Volume	Invert	Avail.Storage	Storage Description
#1	145.00'	4,116 cf	**16.00'W x 144.00'L x 8.00'H Prismatoid** 18,432 cf Overall - 8,143 cf Embedded = 10,289 cf x 40.0% Voids
#2	146.00'	8,143 cf	**72.0" Round Pipe Storage** Inside #1 L= 288.0'
		12,259 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.44 cfs @ 11.15 hrs HW=145.08' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.44 cfs)

Pond SIS-4:



Summary for Pond SIS-7:

Inflow Area = 1.210 ac, 40.50% Impervious, Inflow Depth > 4.23" for 100-Year event
Inflow = 4.85 cfs @ 12.09 hrs, Volume= 0.426 af
Outflow = 0.29 cfs @ 11.00 hrs, Volume= 0.392 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.29 cfs @ 11.00 hrs, Volume= 0.392 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 139.45' @ 14.43 hrs Surf.Area= 1,536 sf Storage= 7,422 cf

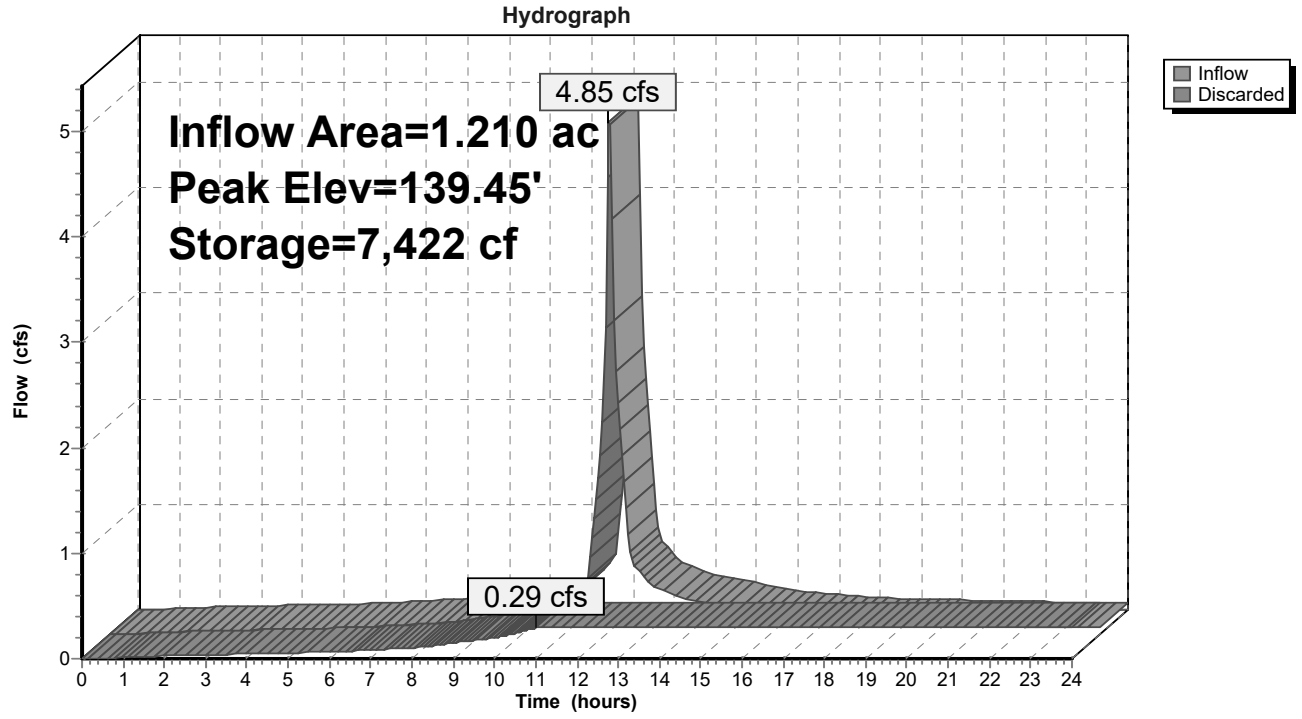
Plug-Flow detention time= 212.0 min calculated for 0.391 af (92% of inflow)
Center-of-Mass det. time= 168.4 min (940.7 - 772.4)

Volume	Invert	Avail.Storage	Storage Description
#1	131.50'	2,075 cf	**8.00'W x 192.00'L x 8.00'H Prismatoid** 12,288 cf Overall - 5,372 cf Embedded = 6,916 cf x 30.0% Voids
#2	132.50'	5,372 cf	**72.0" Round Pipe Storage** Inside #1 L= 190.0'
		7,447 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.50'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.29 cfs @ 11.00 hrs HW=131.58' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.29 cfs)

Pond SIS-7:

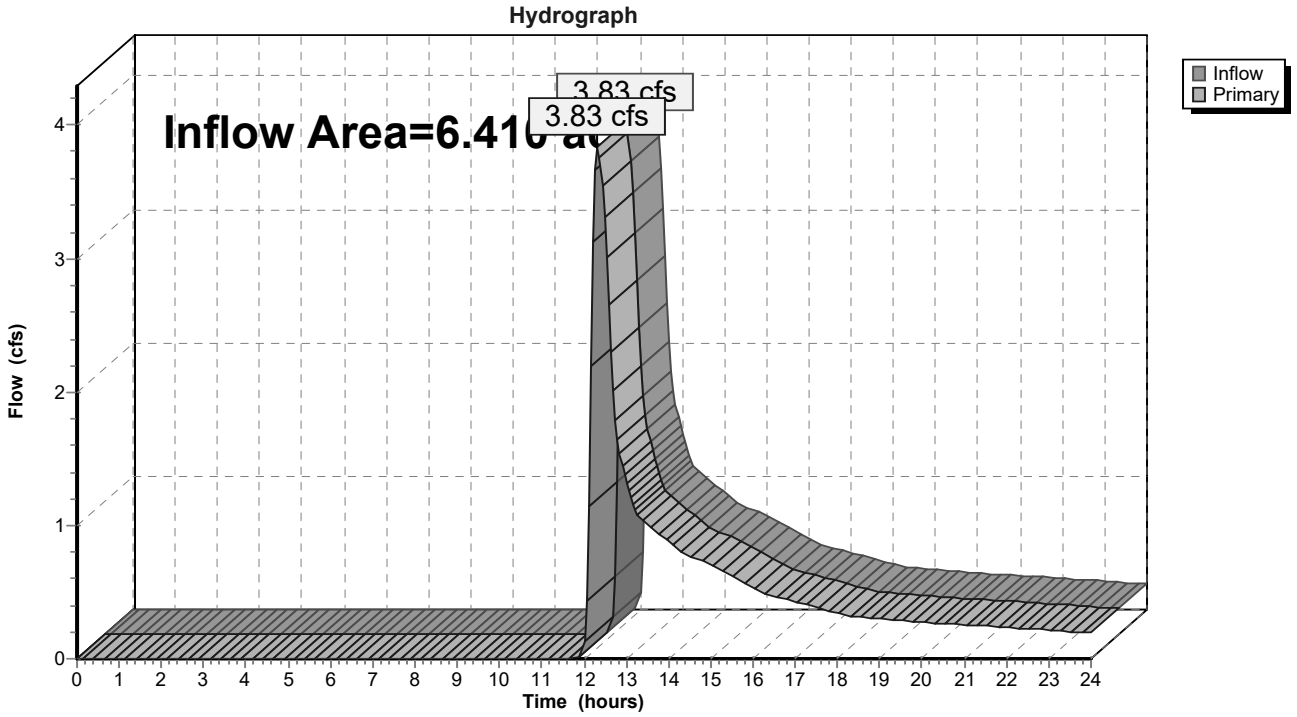


Summary for Link POA-3:

Inflow Area = 6.410 ac, 0.00% Impervious, Inflow Depth > 1.11" for 100-Year event
Inflow = 3.83 cfs @ 12.32 hrs, Volume= 0.594 af
Primary = 3.83 cfs @ 12.32 hrs, Volume= 0.594 af, Atten= 0%, Lag= 0.0 min

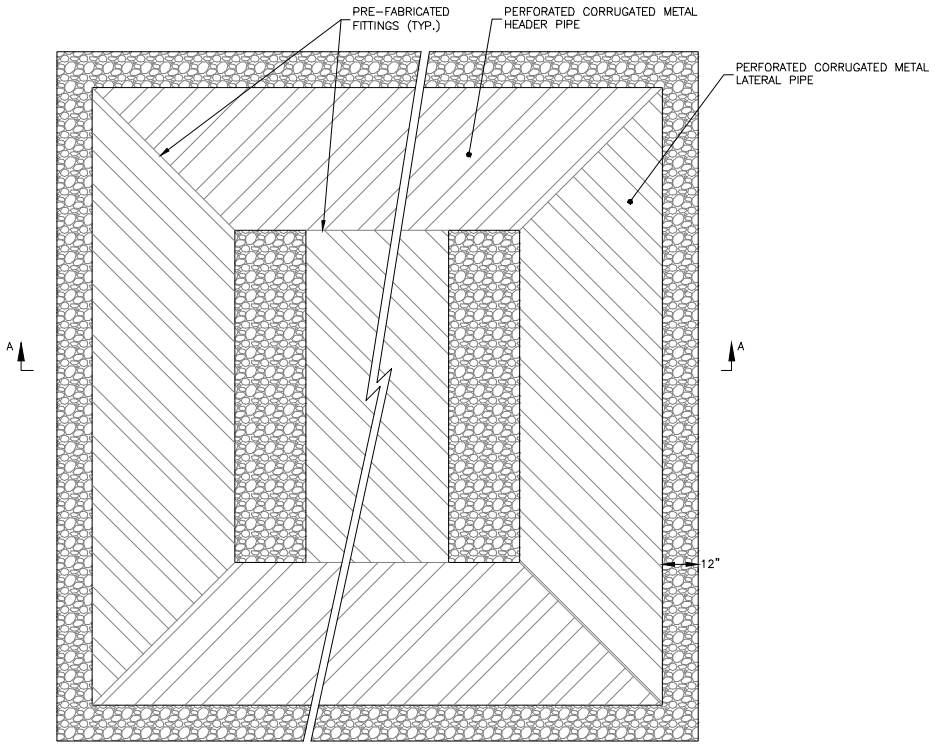
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

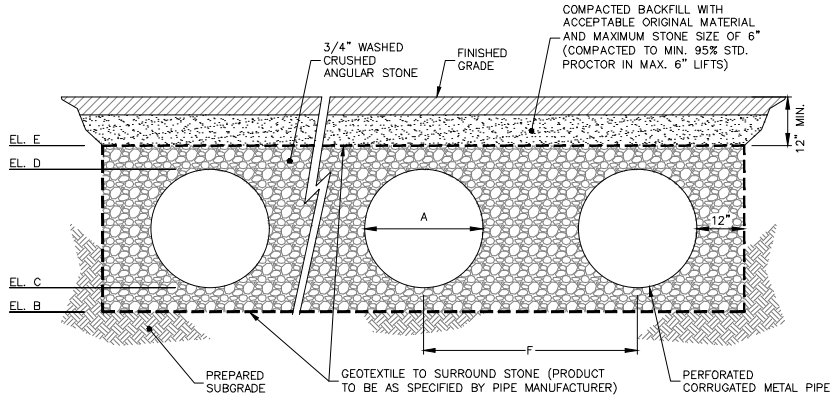
Link POA-3:



Attachment 2

- Updated SIS Details





ESTIMATED SEASONAL HIGH WATER TABLE (REFER TO HYDROGEOLOGOY STUDY & TEST PIT LOGS)

SECTION A-A

NOT TO SCALE

TABLE OF DIMENSIONS/ELEVATIONS							
SYSTEM*	PIPE DIAMETER (A)	NUMBER OF LATERAL PIPES	BOTTOM OF STONE (B)	BOT. INSIDE OF PIPE (C)	TOP INSIDE OF PIPE (D)	TOP OF STONE (E)	ON-CENTER SPACING (F)
SIS-1	36"	1	163.00	164.00	167.00	168.00	NA
SIS-2	72"	1	141.50	142.50	148.50	149.50	NA
SIS-3	72"	8	140.50	141.50	147.50	148.50	96"
SIS-4	72"	2	145.00	146.00	152.00	153.00	96"
SIS-5	72"	2	137.00	138.00	144.00	145.00	96"
SIS-6	72"	4	132.00	133.00	139.00	140.00	96"
SIS-7	72"	1	131.50	132.50	138.50	139.50	NA
SIS-8	48"	1	127.00	128.00	132.00	133.00	NA
SIS-9	72"	7	126.00	127.00	133.00	134.00	96"
SIS-10	72"	3	127.00	128.00	134.00	135.00	96"

* SEE NOTE 10 FOR BMP-SPECIFIC NOTES

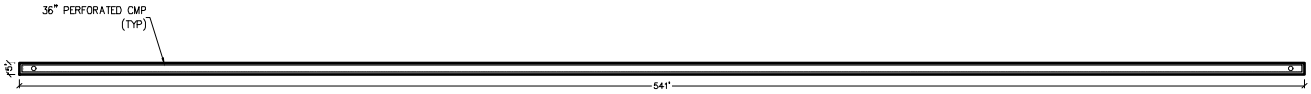
SIEVE	% PASSING
#4	100
#50	10-100
#100	0-20
#200	0-5

NOTES:

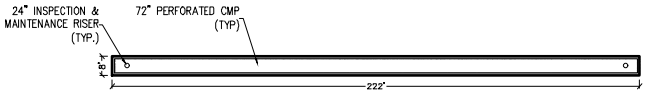
1. THE SUBSURFACE INFILTRATION SYSTEMS SHALL BE CONSTRUCTED OF ALUMINIZED TYPE II CORRUGATED METAL PIPE (CMP) AS SUPPLIED BY CONTECH ENGINEERED SOLUTIONS OR APPROVED EQUAL. ALL PIPING WITHIN THE LIMITS OF THE STONE BED SHALL BE PERFORATED, AND ALL PIPING OUTSIDE LIMITS OF THE STONE BED SHALL BE SOLID WALL.
2. ALUMINIZED TYPE II MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M274 OR ASTM A929. CMP SHALL BE MANUFACTURED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M36 OR ASTM A760.
3. THE CMP SYSTEM SHALL BE DESIGNED FOR A MINIMUM HS-20/HS-25 FINAL LIVE LOADING CONDITIONS. THE CMP SYSTEM SHALL MEET HS-20/HS-25 LOADING REQUIREMENTS WITH A MINIMUM OF 12-INCHES OF COVER TO BOTTOM OF FLEXIBLE PAVEMENT FOR PIPE SPANS LESS THAN OR EQUAL TO 96 INCHES AND 18 INCHES OF COVER TO BOTTOM OF FLEXIBLE PAVEMENT FOR PIPE SPANS GREATER THAN 96 INCHES.
4. THE CMP SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
5. FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE; CONSULT MANUFACTURER'S RECOMMENDATIONS.
6. PIPING THROUGHOUT SYSTEM SHALL BE SET LEVEL AT THE INVERT INDICATED IN THE DETAIL.
7. BACKFILL MATERIAL SHALL BE PLACED IN 8 INCH LOOSE LIFTS AND COMPACTED TO 90% AASHTO T99 STANDARD PROCTOR DENSITY.
8. WITHIN THE FOOTPRINT OF THE SUBSURFACE INFILTRATION SYSTEMS, EXISTING TOPSOIL AND SUBSOIL SHALL BE REMOVED TO EXPOSE THE EXISTING SUBGRADE. THE AREA SHALL THEN BE BUILT UP TO PROPOSED SUBGRADE WITH MATERIAL MEETING THE FOLLOWING SPECIFICATION, UNLESS OTHERWISE APPROVED BY THE ENGINEER.
9. FOLLOWING THE PRELIMINARY ROUGH GRADING OF THE SITE OR PORTIONS THEREOF, THE LIMITS OF THE SUBSURFACE INFILTRATION SYSTEMS IN THOSE AREAS SHALL BE FIELD DELINEATED BY THE CONTRACTOR. THE USE OF HEAVY EQUIPMENT IN THOSE AREAS SHALL BE AVOIDED TO THE EXTEND PRACTICABLE TO HELP PREVENT COMPACTION OF THE UNDERLYING SOILS.
10. BMP-SPECIFIC NOTES:
    - 10.1. SIS-1: UPON ESTABLISHMENT OF ROUGH GRADE IN THE VICINITY OF SIS-1, THE CONTRACTOR SHALL SCHEDULE AND PERFORM THREE TEST PITS WITH THE DESIGN ENGINEER WITHIN THE FOOTPRINT OF THE SYSTEM. THE TEST PITS SHALL EXTEND TO A DEPTH CORRESPONDING TO ELEVATION 159 (I.E. 4 FEET BELOW THE PROPOSED BOTTOM OF THE SYSTEM). IF ANY SOIL HAVING AN INFILTRATION RATE LESS THAN THAT OF SAND (8.27 INCHES/HOUR) IS ENCOUNTERED IN THIS ZONE, SIS-1 SHALL BE OVER EXCAVATED BY A DEPTH OF 4 FEET AND BACKFILLED WITH SAND UP TO THE BOTTOM OF THE SYSTEM. THE SAND SOURCE SHALL BE APPROVED BY THE DESIGN ENGINEER.
    - 10.2. SIS-2: UPON ESTABLISHMENT OF ROUGH GRADE IN THE VICINITY OF SIS-2, THE CONTRACTOR SHALL SCHEDULE AND PERFORM THREE TEST PITS WITH THE DESIGN ENGINEER WITHIN THE FOOTPRINT OF THE SYSTEM. THE TEST PITS SHALL EXTEND TO A DEPTH CORRESPONDING TO ELEVATION 137.5 (I.E. 4 FEET BELOW THE PROPOSED BOTTOM OF THE SYSTEM). IF ANY SOIL HAVING AN INFILTRATION RATE LESS THAN THAT OF SAND (8.27 INCHES/HOUR) IS ENCOUNTERED IN THIS ZONE, SIS-2 SHALL BE OVER EXCAVATED BY A DEPTH OF 4 FEET AND BACKFILLED WITH SAND UP TO THE BOTTOM OF THE SYSTEM. THE SAND SOURCE SHALL BE APPROVED BY THE DESIGN ENGINEER.
    - 10.3. SIS-3 SHALL BE OVER EXCAVATED BY A DEPTH OF 4 FEET AND BACKFILLED WITH SAND UP TO THE BOTTOM OF THE SYSTEM. THE SAND SOURCE SHALL BE APPROVED BY THE DESIGN ENGINEER.
    - 10.4. SIS-7 SHALL BE OVER EXCAVATED BY A DEPTH OF 4 FEET AND BACKFILLED WITH SAND UP TO THE BOTTOM OF THE SYSTEM. THE SAND SOURCE SHALL BE APPROVED BY THE DESIGN ENGINEER.
    - 10.5. SIS-8 SHALL BE OVER EXCAVATED BY A DEPTH OF 4 FEET AND BACKFILLED WITH SAND UP TO THE BOTTOM OF THE SYSTEM. THE SAND SOURCE SHALL BE APPROVED BY THE DESIGN ENGINEER.

SUBSURFACE INFILTRATION SYSTEM (SIS) DETAIL

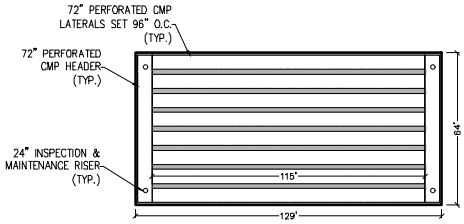
NOT TO SCALE



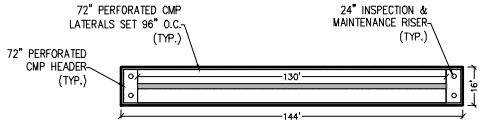
SIS-1



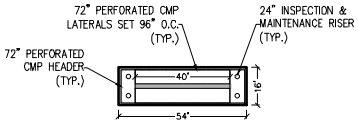
SIS-2



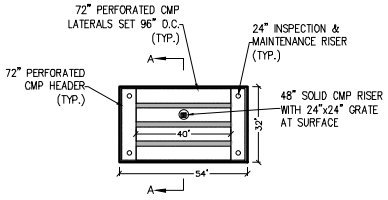
SIS-3



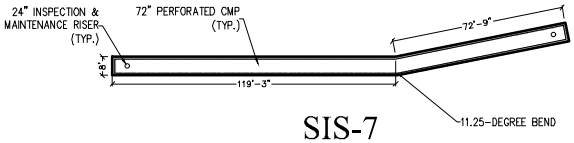
SIS-4



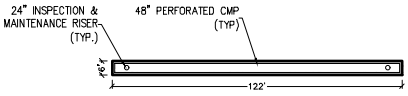
SIS-5



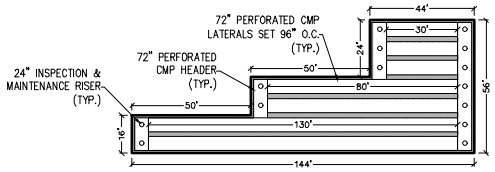
SIS-6



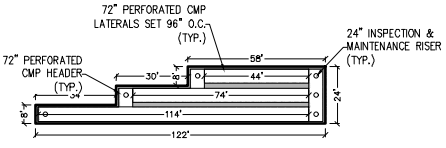
SIS-7



SIS-8



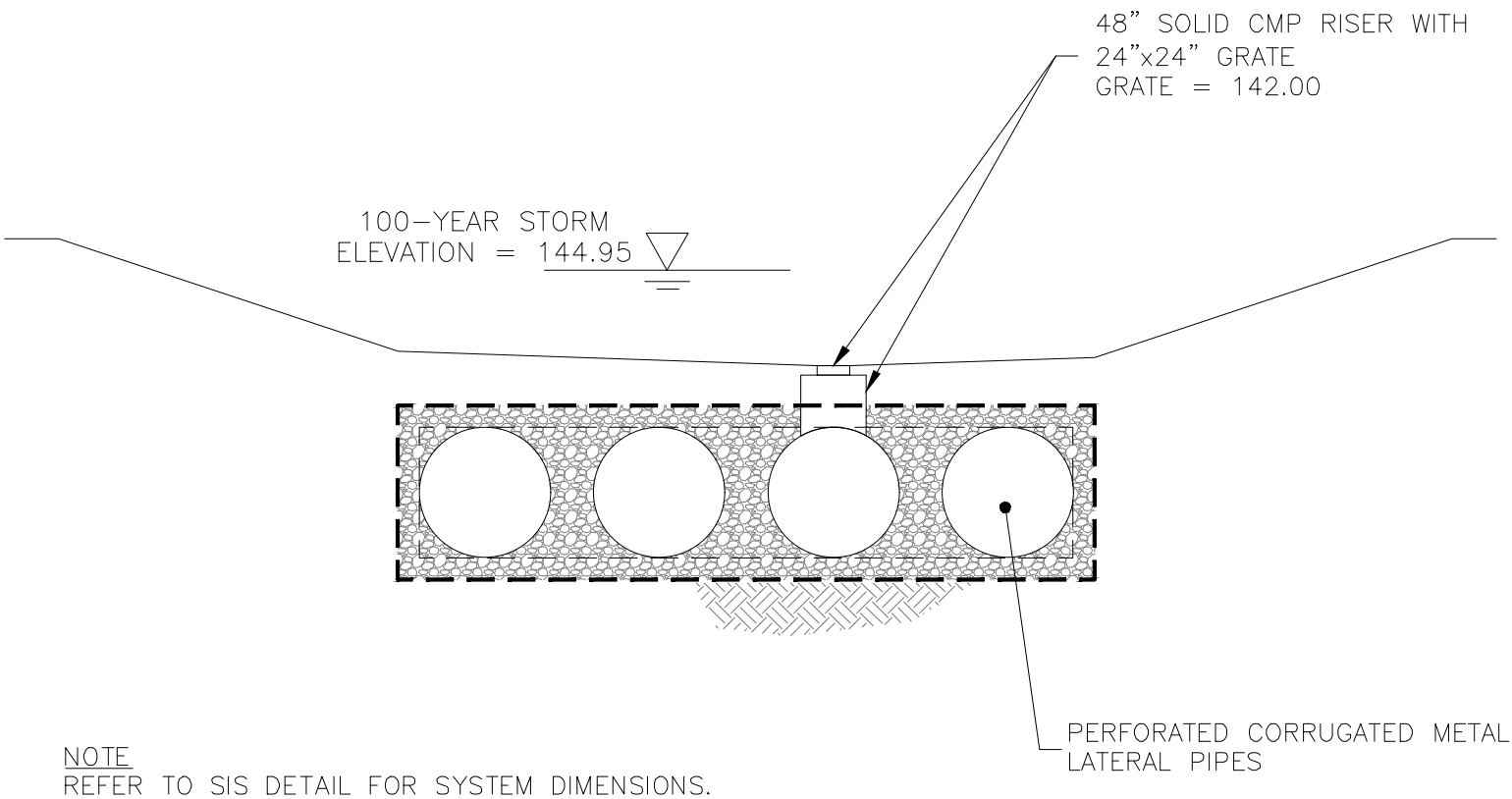
SIS-9



SIS-10

SUBSURFACE INFILTRATION SYSTEM (SIS) DIMENSIONS

NOT TO SCALE



NOTE
REFER TO SIS DETAIL FOR SYSTEM DIMENSIONS.

SIS-6 SECTION A-A

NOT TO SCALE

Attachment 3

- Test Pit Logs
- Test Pit Location Plan
- Boring B-1 Log

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-INFL-1A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: SF home (e.g., woodland, agricultural field, vacant lot, etc.) | Woods (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 20 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-6	Ap	X	X	X	X	X	X	X	X	X	X
6-24	B	S	10YR 5/6	X	X	X	0	0	GRANULAR	LOOSE	X
24-144	C	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-INFL-1B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: SF home (e.g., woodland, agricultural field, vacant lot, etc.) | Woods (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 20 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-24	HTM	X	X	X	X	X	X	X	X	X	X
24-30	Ab	X	X	X	X	X	X	X	X	X	X
30-54	B	S	10YR 5/6	X	X	X	10	0	GRANULAR	LOOSE	X
54-144	C	S	10YR 5/4	X	X	X	10	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-INFL-1C (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: SF home (e.g., woodland, agricultural field, vacant lot, etc.) | Woods (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 20 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	X	X	X	X	X	X	X	X	X	X
12-36	B	S	10YR 5/6	X	X	X	0	0	GRANULAR	LOOSE	X
36-144	C1	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-1A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Woods (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-6	A	X	X	X	X	X	X	X	X	X	X
6-24	B	S	10YR 5/6	X	X	X	0	0	GRANULAR	LOOSE	X
24-48	C1	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X
48-84	C2	S	10YR 5/4	X	X	X	25	5	GRANULAR	LOOSE	X
84-96	C3	LS	10YR 6/3	X	X	X	0	5	BLOCKY	FRIABLE	X
96-108	C4	S	10YR 5/4	X	X	X	25	5	GRANULAR	LOOSE	X
108-120	C5	COS	10YR 5/3	X	X	X	10	5	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-2A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-36	HTM	X	X	X	X	X	X	X	X	X	X
36-144	C	S	10YR 5/4	X	X	X	5	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-2B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-36	HTM	X	X	X	X	X	X	X	X	X	X
36-72	C1	COS	10YR 5/4	X	X	X	5	0	GRANULAR	LOOSE	X
72-144	C2	S	10YR 5/3	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-3/4A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-4	HTM	X	X	X	X	X	X	X	X	X	X
4-96	C1	S	10YR 5/4	X	X	X	5	0	GRANULAR	LOOSE	X
96-108	C2	LS	10YR 5/3	X	X	X	0	0	BLOCKY	FRIABLE	X
108-114	C3	LS	10YR 5/4	X	X	X	25	0	BLOCKY	FRIABLE	X

Additional Notes:
Ledge encountered at 114".

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-3/4B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-4	HTM	X	X	X	X	X	X	X	X	X	X
4-48	C1	COS	10YR 5/4	X	X	X	5	0	GRANULAR	LOOSE	X
48-66	C2	LS	10YR 5/3	X	X	X	0	0	BLOCKY	FRIABLE	X
66-96	C3	LS	10YR 5/4	X	X	X	25	50	BLOCKY	FRIABLE	DENSE

Additional Notes:
Ledge encountered at 96".

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-3/4C (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-48	C1	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X
48-66	C2	COS	10YR 5/4	X	X	X	25	10	GRANULAR	LOOSE	X

Additional Notes:
Ledge encountered at 66".

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-5A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-108	C	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-5B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-4	HTM	X	X	X	X	X	X	X	X	X	X
4-144	C	S	10YR 5/4	X	X	X	5	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-6A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-144	C	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-6B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-144	C	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-7A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-72	C1	S	10YR 6/3	X	X	X	0	0	GRANULAR	LOOSE	X
72-84	C2	LS	10YR 6/2	X	X	X	10	0	BLOCKY	FRIABLE	X
84-144	C3	S	10YR 6/3	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-7B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-32	HTM	X	X	X	X	X	X	X	X	X	X
32-96	C1	S	10YR 6/3	X	X	X	0	0	GRANULAR	LOOSE	X
96-108	C2	LS	10YR 6/2	X	X	X	0	0	BLOCKY	FRIABLE	X
108-144	C3	S	10YR 6/3	120	7.5YR 5/8	20	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-7C (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-36	C1	COS	10YR 6/3	X	X	X	0	0	GRANULAR	LOOSE	X
36-60	C2	LS	10YR 6/2	X	X	X	0	0	BLOCKY	FRIABLE	X
60-144	C3	S	10YR 6/3	129	7.5YR 5/8	20	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-8A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-42	HTM	X	X	X	X	X	X	X	X	X	X
42-60	C1	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X
60-72	C2	LS	10YR 5/3	X	X	X	0	0	BLOCKY	FRIABLE	X
72-144	C3	S	10YR 5/4	102	7.5YR 5/8	20	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-8B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-132	C1	S	10YR 5/4	120	7.5YR 5/8	10	5	0	GRANULAR	LOOSE	X
132-144	C2	LS	10YR 5/2	X	X	X	0	0	BLOCKY	FRIABLE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-9A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-96	C1	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X
96-108	C2	LS	10YR 5/3	96	7.5YR 5/8	5	0	0	BLOCKY	FRIABLE	X
108-132	C3	S	10YR 5/4	X	X	X	0	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-9B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Brushy (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-6	A	X	X	X	X	X	X	X	X	X	X
6-24	B	S	10YR 5/4	X	X	X	10	0	GRANULAR	LOOSE	X
24-108	C	COS	10YR 5/4	X	X	X	50	10	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-10A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-36	C1	COS	10YR 5/4	X	X	X	25	0	GRANULAR	LOOSE	X
36-132	C2	S	10YR 5/4	X	X	X	5	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-10B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

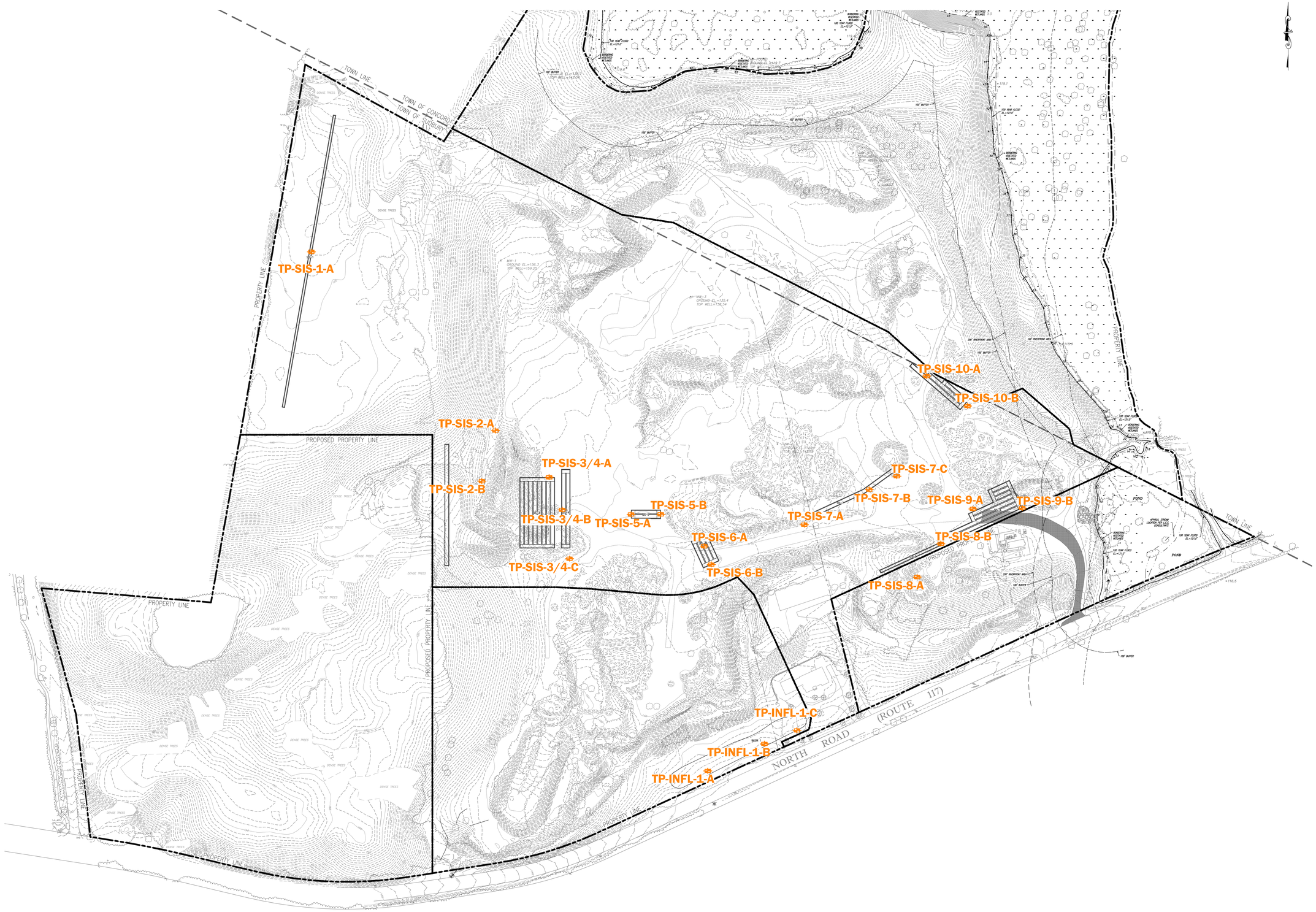
Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-132	C	COS	10YR 5/4	X	X	X	20	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.



NOT FOR CONSTRUCTION

CDG PROJECT #: 19044 & 19045

REVISIONS:

REV	DATE	COMMENT
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

PLANNING BOARD:

SEAL:

MATTHEW A. LEIDNER, P.E.

PREPARED BY:

CIVIL DESIGN GROUP, LLC

21 HIGH STREET, SUITE 207
NORTH ANDOVER, MA 01845
www.cdgengineering.com
p: 978-794-5400 f: 978-965-3971

PREPARED FOR:

QUARRY NORTH ROAD LLC

2134 SEVILLA WAY
NAPLES, FL 34109

PROJECT:

COLD BROOK CROSSING

NORTH ROAD
SUDBURY, MASSACHUSETTS

SCALE:

100 0 50 100 200

GRAPHIC SCALE IN FEET

SHEET:

TEST PIT LOCATIONS

1

DATE: 05/15/2020

GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Location No. **B-1**	Sheet 1 of 2
Drilling Location: 379 Concord Road (Rte 117) Sudbury, MA	Begun: 4/16/19		
	Finished: 4/16/19		
Drill Rig: Track Mounted HSA	Inspector: Carolyn Matthews		
Drill Hole Diameter: 8-inch	Driller: DRILEX - Jamie and Matt	Groundwater Depth @ Completion	
Sampler Type: Split Spoon	Weather: Clear/windy.	Date/Time	Depth / Measure Pt.
Sampler Length: 24-inch	Temperature: 40s	4/16/2019	~42 / Grade

Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description/ Detector Readings	Strat. Descrip	Materials Installed
5	S-1	5-7	14"		3,2,2,4	**S-1** Yellow-brown, v loose, f SAND, t- Silt.		
10	S-2	10-12	15"		2,3,2,3	**S-2** Yellow-brown, loose, f SAND, t- Silt.		
15	S-3	15-17	15"		2,3,5,5	**S-3** Yellow-brown, loose, f SAND, t- Silt.	OUTWASH SANDS	
20	S-4	20-22	17"		4,6,6,4	**S-4** Yellow-brown, med dense, f SAND, t- Silt.		
25	S-5	25-27	14"		2,2,2,2	**S-5** Yellow-brown, v loose, f SAND, t- Silt.		
30	S-6	30-32	18"		4,5,6,5	**S-6** Yellow-brown, med dense, f SAND, t- Silt.		
35								

MINOR COMPONENTS

and	35 to 50%
some	20 to 35%
little	10 to 20%
trace	1 to 10%

RELATIVE DENSITY

0-4	very loose
4-10	loose
10-30	medium
30-50	dense
>50	very dense

OVERALL PLASTICITY

Slight	Clayey SILT	1/4"
Low	SILT & CLAY	1/8"
Medium	CLAY & SILT	1/16"
High	Silty CLAY	1/32"
Very High	CLAY	1/64"

GeoHydroCycle, Inc.

321 Walnut Street #450, Newton, MA 02460 (617)527-8074

Environmental Drilling Log

Project: Quarry North Road	Project No. GHC #19004	Boring No. **B-1**	Sheet 2 of 2

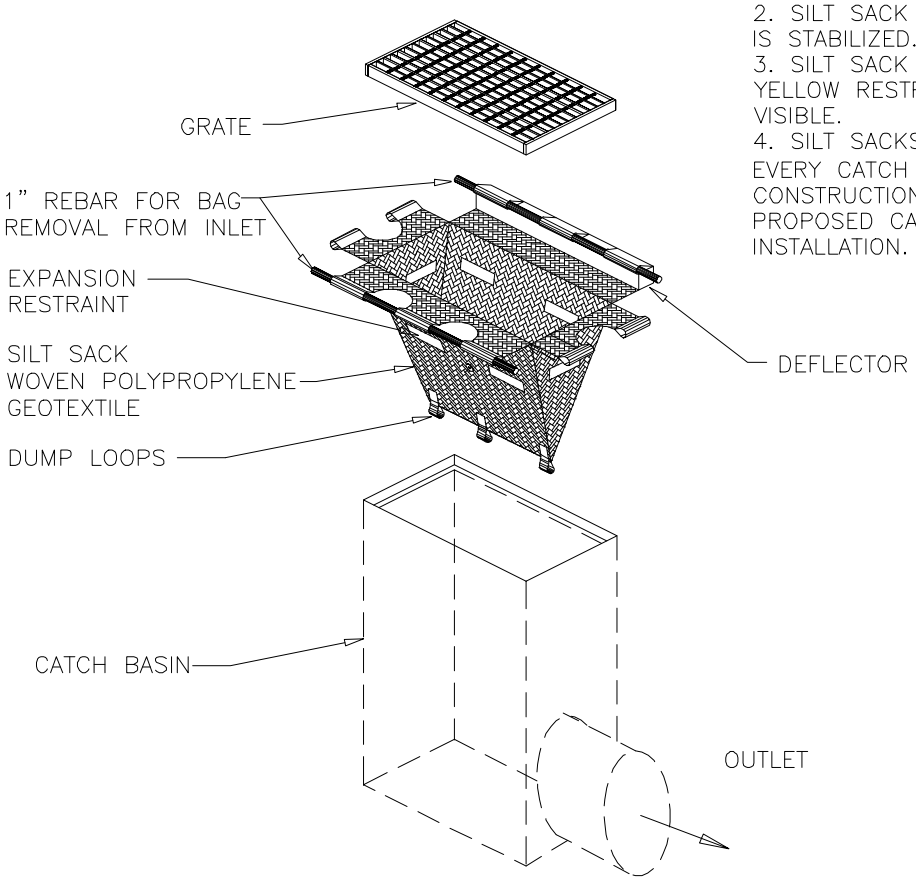
Depth	Sample No.	Sample Depth	Sample Recov.	Rock RQD	Soil Blows per 6"	Sample Description	Stratigraphic Description	Materials Installed
	S-7	35-37	14"		7,3,12,12	**S-7** Top 5" - Yellow-brown, v loose, f SAND, t- Silt.		
						Bot 9" - Brown, med dense, f-m SAND, lit Cobbles.		
							OUTWASH SANDS	
40								
	S-8	40-42	14"		4,13,28,60 for 2"	**S-8** Top 8" - Brown, dense, f-m SAND, lit Gravel, t Silt.		
						Bot 6" - Red-brn, dense, f-m SAND, t+ Silt. Wet.		
						Refusal @ 42' - Bedrock/Groundwater		
45								
50								
55								
60								
65								
70								
75								
80								

Remarks:

Attachment 4

- Updated Silt Sack Detail

NOTES:
1. SILTSACK MANUFACTURED BY SI GEOSOLUTION (800–621–0444); INSTALL AND REMOVE PER MANUFACTURER'S RECOMMENDATIONS.
2. SILT SACK TO BE REMOVED WHEN SITE IS STABILIZED.
3. SILT SACK SHALL BE EMPTIED WHEN YELLOW RESTRAINT CORD IS NO LONGER VISIBLE.
4. SILT SACKS SHALL BE INSTALLED ON EVERY CATCH BASIN WITHIN 100' OF THE CONSTRUCTION ENTRANCE AND ON EACH PROPOSED CATCH BASIN UPON INSTALLATION.

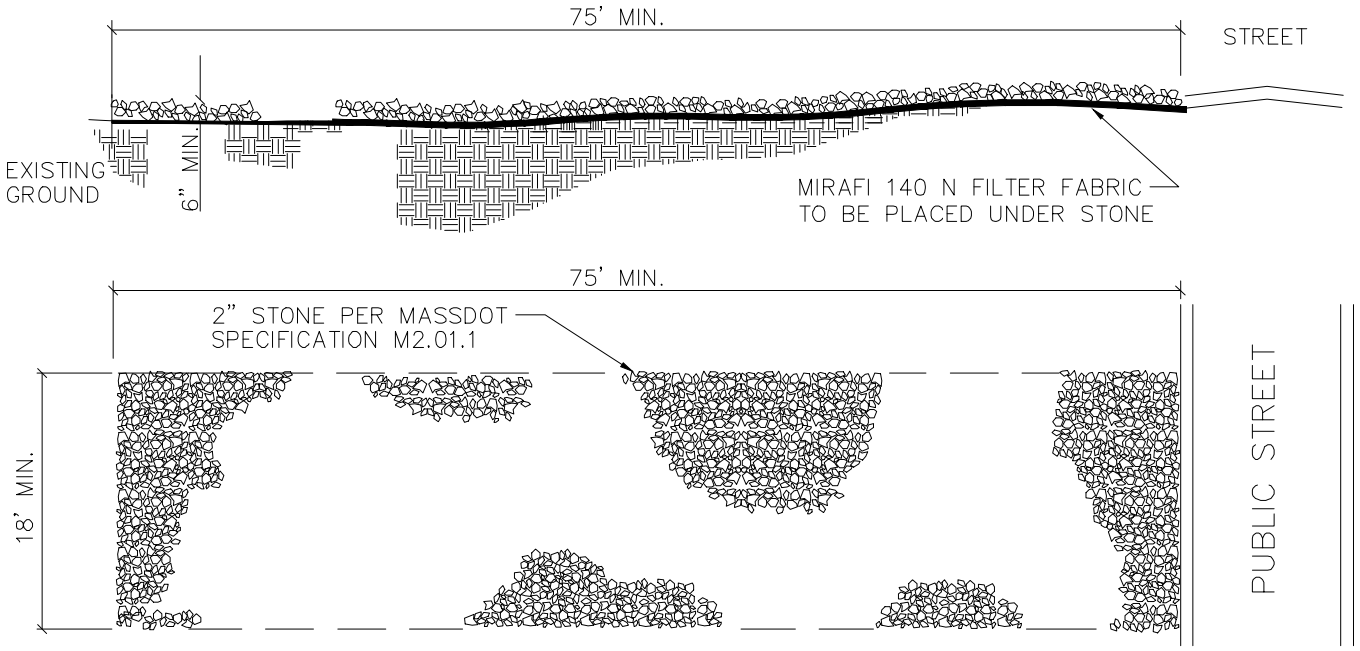


TYPICAL SILT SACK DETAIL

NOT TO SCALE

Attachment 5

- Updated Stabilized Construction Entrance Detail

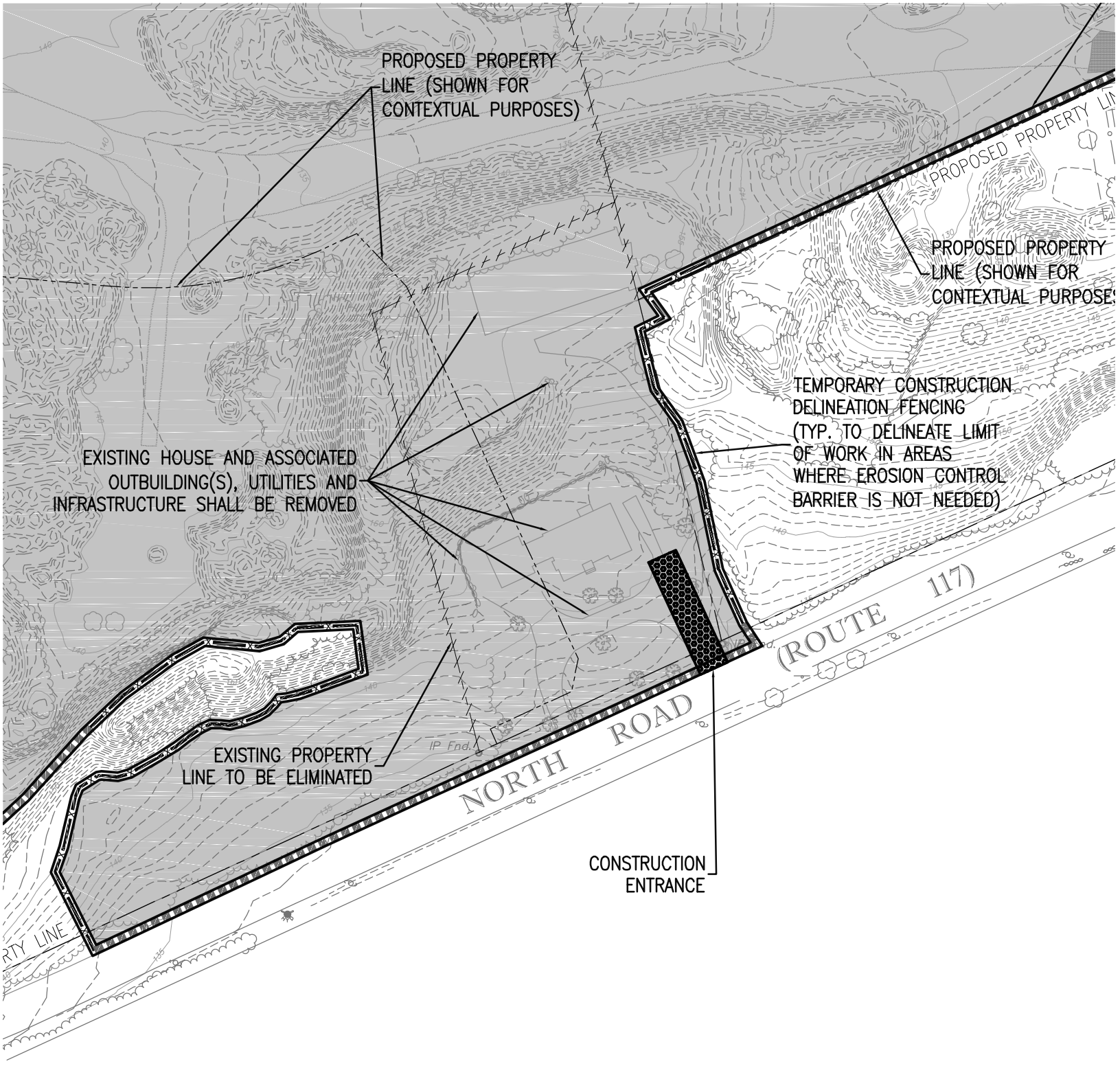


NOTES:

1. A STABILIZED CONSTRUCTION ENTRANCE COMPRISED OF 2"–3" CRUSHED STONE SHALL BE LOCATED WHERE CONSTRUCTION RELATED VEHICLES WILL ACCESS THE CONSTRUCTION SITE ONTO A PUBLIC STREET.
2. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC STREETS OR ADJACENT LAND. ADDITIONAL STONE SHALL BE ADDED AS CONDITIONS WARRANT.
3. ANY SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC STREETS SHALL BE REMOVED IMMEDIATELY.
4. WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTERING A PUBLIC STREET, IF APPLICABLE. WHEEL WASHING SHALL BE DONE IN AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS TO A DESIGNATED SEDIMENT TRAP.

TYPICAL STABILIZED CONSTRUCTION ENTRANCE DETAIL

NOT TO SCALE


PROPOSED PROPERTY LINE (SHOWN FOR CONTEXTUAL PURPOSES)
PROPOSED PROPERTY LIN
PROPOSED PROPERTY LINE (SHOWN FOR CONTEXTUAL PURPOSES
TEMPORARY CONSTRUCTION DELINEATION FENCING (TYP. TO DELINEATE LIMIT OF WORK IN AREAS WHERE EROSION CONTROL BARRIER IS NOT NEEDED)
EXISTING HOUSE AND ASSOCIATED OUTBUILDING(S), UTILITIES AND INFRASTRUCTURE SHALL BE REMOVED
EXISTING PROPERTY LINE TO BE ELIMINATED
CONSTRUCTION ENTRANCE
NORTH ROAD
(ROUTE 117)
IP Fnd.
RTY LINE

Attachment 6

- Updated Operation & Maintenance Plan

OPERATION AND MAINTENANCE PLAN

&

LONG-TERM POLLUTION PREVENTION PLAN

FOR

THE APARTMENTS AT COLD BROOK CROSSING

SMART GROWTH OVERLAY DISTRICT (SGOD) PROJECT

&

COLD BROOK CROSSING

NORTH ROAD RESIDENTIAL OVERLAY DISTRICT (NRROD) PROJECT

NORTH ROAD
SUDBURY, MASSACHUSETTS

PREPARED FOR:

QUARRY NORTH ROAD, LLC
2134 SEVILLA WAY
NAPLES, FL 34109

PREPARED BY:

CIVIL DESIGN GROUP, LLC
21 HIGH STREET, SUITE 207
NORTH ANDOVER, MA 01845

DATE: MARCH 11, 2020
REVISED: MAY 15, 2020

1.0 OPERATION AND MAINTENANCE PLAN

1.1 INTRODUCTION

In accordance with the standards set forth by the Massachusetts Department of Environmental Protection (MADEP) Stormwater Management Policy, Civil Design Group, LLC has prepared the following Operation and Maintenance (O&M) Plan for *The Apartments at Cold Brook Crossing* and *Cold Brook Crossing*.

CONTACT INFORMATION

PROJECT	LANDOWNER & STORMWATER MANAGEMENT SYSTEM OWNER
THE APARTMENTS AT COLD BROOK CROSSING (SGOD RENTAL PROJECT)	Owner: The Apartments at Cold Brook Crossing
	Contact: TBD (interim contact Quarry North Road, LLC)
	Phone: TBD (interim phone 239-571-5500 – Chris Claussen)
COLD BROOK CROSSING (NRROD HOME OWNERSHIP PROJECT)	Owner: Cold Brook Crossing Unit Owner's Association
	Contact: TBD (interim contact Quarry North Road, LLC)
	Phone: TBD (interim phone 239-571-5500 – Chris Claussen)

The owner of each property shall be responsible for the long-term operation and maintenance of the stormwater management system components on their property and shall be responsible for record keeping of inspections, maintenance and repairs of the stormwater management system components on their property. Any time that the ownership changes, the new property owner shall assume all responsibilities for their property as outlined in this O&M plan. The owner of each property shall hire a qualified professional to conduct scheduled inspections and maintain records in accordance with the inspection schedule outline enclosed within this document.

Design Engineer: Civil Design Group, LLC
Address: 21 High Street, Suite 207, North Andover, MA 01845
Office Phone: 978-794-5400
Contact: Matthew Leidner, P.E.

The components of the stormwater management system shall be inspected, monitored and maintained in accordance with the following to ensure that the on-site stormwater management/ best management practice facilities for the project function as intended. Routine inspection and proper maintenance of these individual components is essential to providing the long-term enhancement of both the quality and quantity of the runoff from the site.

The proposed stormwater management best management practices (BMPs) have been designed to collect and convey runoff from developed areas in accordance with the Massachusetts DEP's Stormwater Management Handbook. Using the rational method to determine peak runoff flows, the onsite drainage structures and pipes

are designed for the 25-year storm event. The system consists of deep sump hooded catch basins, trench drains, manholes, water quality units, an infiltration basin, subsurface infiltration systems, and porous pavement.

Street Sweeping

Sweeping of site drives and parking lots constructed of standard impervious asphalt pavement shall be performed twice a year, once in the spring and once in the fall, to reduce the amount of sediment and debris entering the catch basins. More frequent street sweeping is required for porous pavement areas as outlined in further detail below under the "Porous Pavement" section.

Deep Sump Hooded Catch Basins and Deep Sump Hooded Manholes

Stormwater runoff from proposed standard impervious asphalt pavement is directed via curbing and site grading to catch basins with deep sumps and hooded outlets and trench drains. Since trench drains do not contain hoods and sumps, they will be routed through manholes with deep sumps and hooded outlets. These structures are designed to trap and remove sediment and larger particles from the stormwater and improve the performance of subsequent BMP's. The sumps are a minimum of 4' in depth and a routine inspection and cleaning schedule shall be followed to ensure optimal effectiveness.

Inspection Frequency:	Quarterly
Inspection Tools:	Manhole hook; survey rod; sludge judge
Items to Inspect:	Measure sediment in sump using survey rod; visually check for floating debris or trash; visually check for oil and if more than a sheen is present, use sludge judge to measure thickness of layer; visually ensure that hood is in place; visually ensure that grate is in good condition; visually ensure that outlet pipe is unobstructed
Maintenance Threshold(s):	Annually or ≥24" sediment in sump (whichever comes first); discernible layer of oil/hydrocarbons on surface; floating trash
Maintenance Equipment:	Vactor or clamshell for sediment removal; vactor and/or oil sorbent pads for oil/hydrocarbon removal; net for floating debris or trash removal

Trench Drains

Stormwater runoff garage entrances will be directed to trench drains. As noted above, the trench drains will be routed through manholes with deep sumps and hooded outlets to provide treatment. Routine inspection and cleaning of the trench drains will help ensure optimal effectiveness of the downstream manholes.

Inspection Frequency:	Quarterly
Inspection Tools:	Manhole hook; survey rod or ruler
Items to Inspect:	Measure sediment in the trench drain using survey rod or ruler; visually check for debris or trash; visually check for oil; visually ensure that grate is in good condition; visually ensure that outlet pipe is unobstructed
Maintenance Threshold(s):	Annually or if outlet pipe begins to get blocked or appears to be at risk of getting blocked by trash or debris (whichever comes first)
Maintenance Equipment:	Hand shovel to clean

Water Quality Units

Proprietary water quality units are designed to remove heavy particles, floating debris and hydrocarbons from stormwater. Stormwater enters the system where floatables and oils are separated prior to the

clarified stormwater runoff discharging to an outlet pipe. The project design proposes to use the following Contech Engineered Solutions models: Cascade CS-4, Cascade CS-6, and CDS1515-3.

Inspection Frequency:	Quarterly
Inspection Tools:	Manhole hook; survey rod; sludge judge
Items to Inspect:	Measure sediment in sump using survey rod; use sludge judge to measure thickness of oil layer through oil port; visually ensure that insert and weir are in good condition; visually ensure that cover is in good condition
Maintenance Threshold(s):	≥8" sediment and/or a discernible layer of oil/hydrocarbons or as otherwise recommended by the manufacturer
Maintenance Equipment:	Vactor

Infiltration Basin

Basin 1 is designed to treat, detain, and infiltrate stormwater. The side slopes and floor of the basin are vegetated with stone on the lowest portions of the floor to enhance infiltration.

Inspection Frequency:	Quarterly
Inspection Tools:	Ruler or survey rod to measure sediment
Items to Inspect:	Measure any accumulated sediment using a ruler or survey rod; visually inspect for erosion on the side slopes
Maintenance Threshold(s):	≥4" sediment; mow side slopes at least twice annually and remove clippings to avoid clogging of downstream structures; remove weeds, sediment, and other debris from stone routinely throughout the year and replace stone as needed to maintain a clean & neat appearance of the basin floor; repair any noted issues as required
Maintenance Equipment:	Skid steer or similar small machine for removing sediment; shovels for hand removal of sediment in tight areas such as around the outlet control structures; mower/trimmer for mowing (mow at least twice per year and remove clippings)

Subsurface Infiltration Systems (SISs)

Subsurface infiltration systems are designed to infiltrate runoff from the site. These systems are comprised of pipe and stone. The systems are equipped with inspection/cleanout ports to facilitate inspection for standing water and sediment accumulation. There are ten (10) subsurface infiltration systems in total.

Inspection Frequency:	Quarterly
Inspection Tools:	Ruler or survey rod to measure sediment
Items to Inspect:	Measure any accumulated sediment using a ruler or survey rod; inspect for standing water if more than 72 hours have elapsed since the previous rain event.
Maintenance Threshold(s):	≥1" sediment
Maintenance Equipment:	Water jet and vactor

Riprap Apron

Basin 1 includes a riprap apron at the inlet pipe, which is intended to dissipate energy and spread out flow as it enters the basin.

Inspection Frequency:	Quarterly

Inspection Tools:	None (all visual)
Items to Inspect:	Visually ensure that flared end section is intact; visually ensure that riprap stones are intact; visually inspect that pipe is unobstructed
Maintenance Threshold(s):	Trim vegetation around pipe annually to maintain accessibility and visibility for inspection purposes, remove sediment if present, replace any displaced stones
Maintenance Equipment:	Mower/trimmer for trimming vegetation, hand methods or equipment as required for sediment removal and stone replacement

Porous Pavement

Porous pavement is a paved surface with a higher than normal percentage of air voids to allow water to infiltrate directly into the soil and receive water quality treatment. It is used for sidewalks throughout the *Apartments at Cold Brook Crossing* and *Cold Brook Crossing* and for parking lots and drive aisles within the *Apartments at Cold Brook Crossing*. It is also used for the driveway and parking spaces associated with the Waste Water Treatment Facility. Since the pavement itself acts as pretreatment to the stone reservoir below, frequent cleaning and maintenance of the pavement surface is critical to prevent clogging.

Inspection Frequency:	Quarterly
Inspection Tools:	None (all visual)
Items to Inspect:	Inspect the surface for deterioration or spalling; perform at least one of the inspections during a rain event to confirm that the water infiltrates into the pavement surface
Maintenance Threshold(s):	Jet wash porous pavement surfaces twice per year, increasing the frequency if needed to ensure proper functioning of the pavement; clean the surface using vacuum sweeping machines monthly
Maintenance Equipment:	Jet washer, vacuum sweeper
Other Considerations:	No sanding shall be conducted on the porous surface (sanding shall be prohibited on all paved surfaces in the community – refer to the Long-Term Pollution Prevention Plan contained herein for further detail); salt and deicing chemicals shall be used at the minimum acceptable rate to ensure safety; keep adjacent landscaped areas well maintained to prevent soil from being transported onto the pavement; never reseal or repave with impermeable materials

1.2 ILLICIT DISCHARGE STATEMENT

Illicit discharges to the stormwater management system are discharges not entirely comprised of stormwater. Discharges to the stormwater management system from the following activities or facilities are permissible: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

There are no known illicit discharges currently at the site nor are any illicit discharges proposed as part of the project. The stormwater management system is not intended to convey any illicit discharges and or pollutants and as such, control measures that are identified within this report shall be strictly adhered to in order to minimize the risk of contamination. Any unknown existing illicit discharges that are discovered as part of the development of the subject site shall be eliminated in accordance with local, state and federal regulations.

2.0 LONG-TERM POLLUTION PREVENTION PLAN (LTPPP)

The Massachusetts DEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation & Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

Solid Waste Storage:
There are no proposed exterior (un-covered) solid waste storage areas. Trash and recycling shall be stored either indoors or in closed containers. The unit owners association and apartment management company shall contract with a waste hauling company to service the development on a routine basis.

Street Sweeping
Sweeping of site drives and parking lots constructed of standard impervious asphalt pavement shall be performed twice a year, once in the spring and once in the fall, to reduce the amount of sediment and debris entering the catch basins. More frequent street sweeping is required for porous pavement areas as outlined in Section 1.1. Swept materials shall be disposed of in accordance with applicable local and state requirements.

Deicing and Salt Storage
Deicing methods shall be used in conjunction with snow removal to maintain safe pedestrian and vehicular access. The unit owner's association and apartment management company will be responsible for maintaining roads, driveways, sidewalks and pedestrian access onsite.

This development requires special consideration to deicing due to the use of porous pavement and because the site is located in an environmentally sensitive Zone II area. To the extent practicable, snow shall be piled in areas where the snowmelt will receive maximum treatment through the proposed BMPs. In order to avoid the potential for inadvertently placing sand on porous pavement areas, sanding shall be prohibited on all paved surface within the *Cold Brook Crossing* and the *Apartments at Cold Brook Crossing* communities. This restriction applies to all pavement, including porous pavement and standard asphalt pavement, throughout both communities. Industry standard deicing products shall be used on paved surfaces unless specifically restricted by the municipality and shall be used at the minimum acceptable rate to ensure pedestrian and vehicular safety. Deicing products shall be stored off-site or in a covered location.

Snow Disposal
This development requires special attention to snow removal because the site is located in an environmentally sensitive Zone II area. To the extent practicable, snow shall be piled in areas where the snowmelt will receive maximum treatment through the proposed BMPs. Snow meltwater can filter into the soil, leaving behind sand and debris, which can be removed in the springtime, or run onto surfaces that undergo treatment through the proposed BMPs. Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. In no case shall snow be disposed of or stored in wetlands, streams or other water bodies. If necessary to remove snow from the site, the snow shall be disposed of at an off-site location in accordance with applicable local, state and federal regulations. No snow may be brought into the Zone II from areas outside the Zone II.

Miscellaneous Hazardous Materials
Sources of potential spill hazards within residential developments include items such as vehicle fluids, pesticides, paints, and liquid cleaning products. The majority of the spill hazards would likely occur within buildings and would not enter the stormwater drainage system. Exterior spill hazards, while minimal, have the potential to enter the stormwater drainage system and shall be addressed as follows:

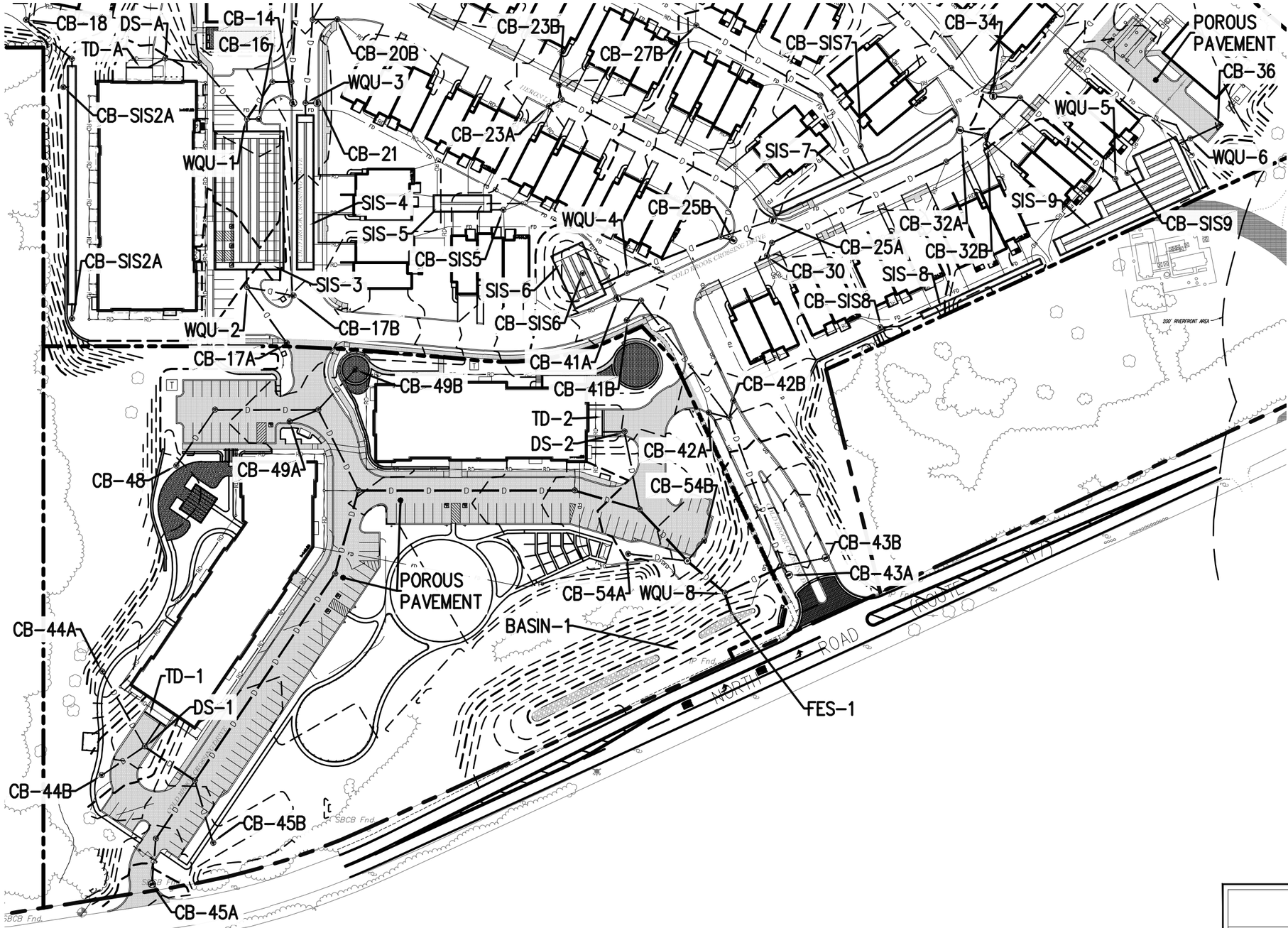
- Spills of branded products such as pesticides and paints shall be remediated using the manufacturers' recommended spill cleanup protocol.
- Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
- Any hazardous spills shall be cleaned up immediately after discovery.
- Should a spill occur, this pollution prevention plan should be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures should be included in the updated pollution prevention plan.

Lawn, Garden, and Landscape Management:

Lawn areas shall be maintained and mowed regularly throughout the growing season. Any bare areas of lawn shall be reseeded and plants shall be pruned on an as-needed basis. Trash and debris shall be removed from landscaped and planted areas as-needed. Fertilizers, herbicides and pesticides shall be used within the amounts recommended by the manufacturer. These products shall be stored in containers indoors. Pet waste shall be disposed of properly.

FIGURES 1A, 1B, AND 1C

BMP PLAN



100 0 50 100 200

GRAPHIC SCALE IN FEET

LEGEND

CATCH BASIN	CB
DOUBLE CATCH BASIN	DCB
DRAIN MANHOLE	DMH
OUTLET CONTROL STRUCTURE	OCS
WATER QUALITY UNIT	WQU
TRENCH DRAIN	TD
FLARED END SECTION	FES

REVISIONS:

REV	DATE	COMMENT
1		
2		
3		

DESIGNED BY: MAL
CHECK BY: PRH

PREPARED FOR:

QUARRY NORTH ROAD, LLC.

2134 SEVILLA WAY
NAPLES, FL 34109

PROJECT:

COLD BROOK CROSSING

NORTH ROAD RESIDENTIAL OVERLAY DISTRICT (NRROD) & SMART GROWTH OVERLAY DISTRICT (SGOD)
NORTH ROAD
SUDBURY, MASSACHUSETTS

PREPARED BY:

CIVIL DESIGN GROUP, LLC

21 HIGH STREET, SUITE 207
NORTH ANDOVER, MA 01845
www.cdgengineering.com
p: 978-794-5400 f: 978-914-6161

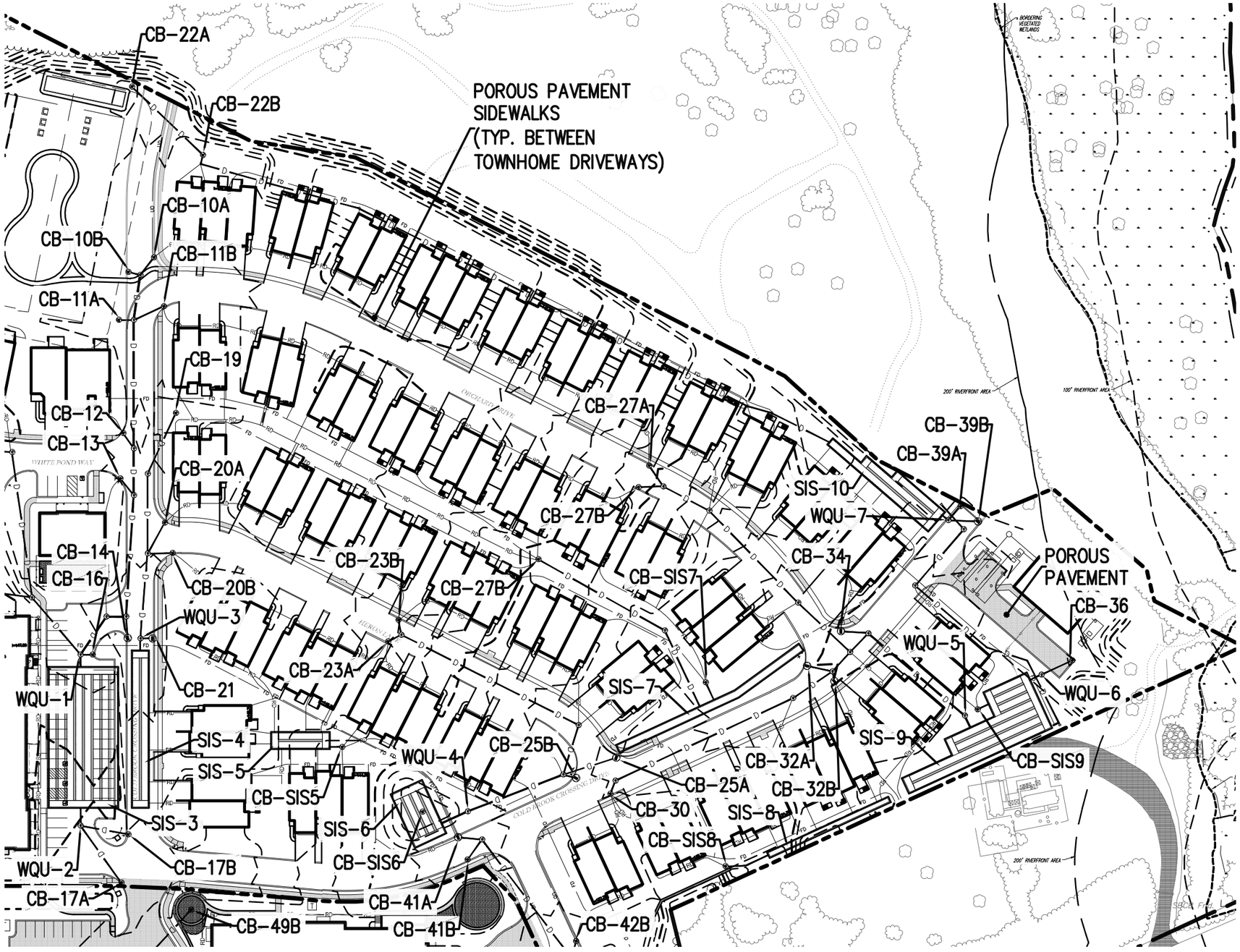
SHEET:

BMP PLAN

FIGURE 1A

CDG PROJECT #: 19044

DATE: 05/15/2020



100 0 50 100 200

GRAPHIC SCALE IN FEET

LEGEND

CATCH BASIN	CB
DOUBLE CATCH BASIN	DCB
DRAIN MANHOLE	DMH
OUTLET CONTROL STRUCTURE	OCS
WATER QUALITY UNIT	WQU
TRENCH DRAIN	TD
FLARED END SECTION	FES

REVISIONS:		
REV	DATE	COMMENT
1		
2		
3		

DESIGNED BY: MAL
CHECK BY: PRH

PREPARED FOR:

QUARRY NORTH ROAD, LLC.

2134 SEVILLA WAY
NAPLES, FL 34109

PROJECT:

COLD BROOK CROSSING

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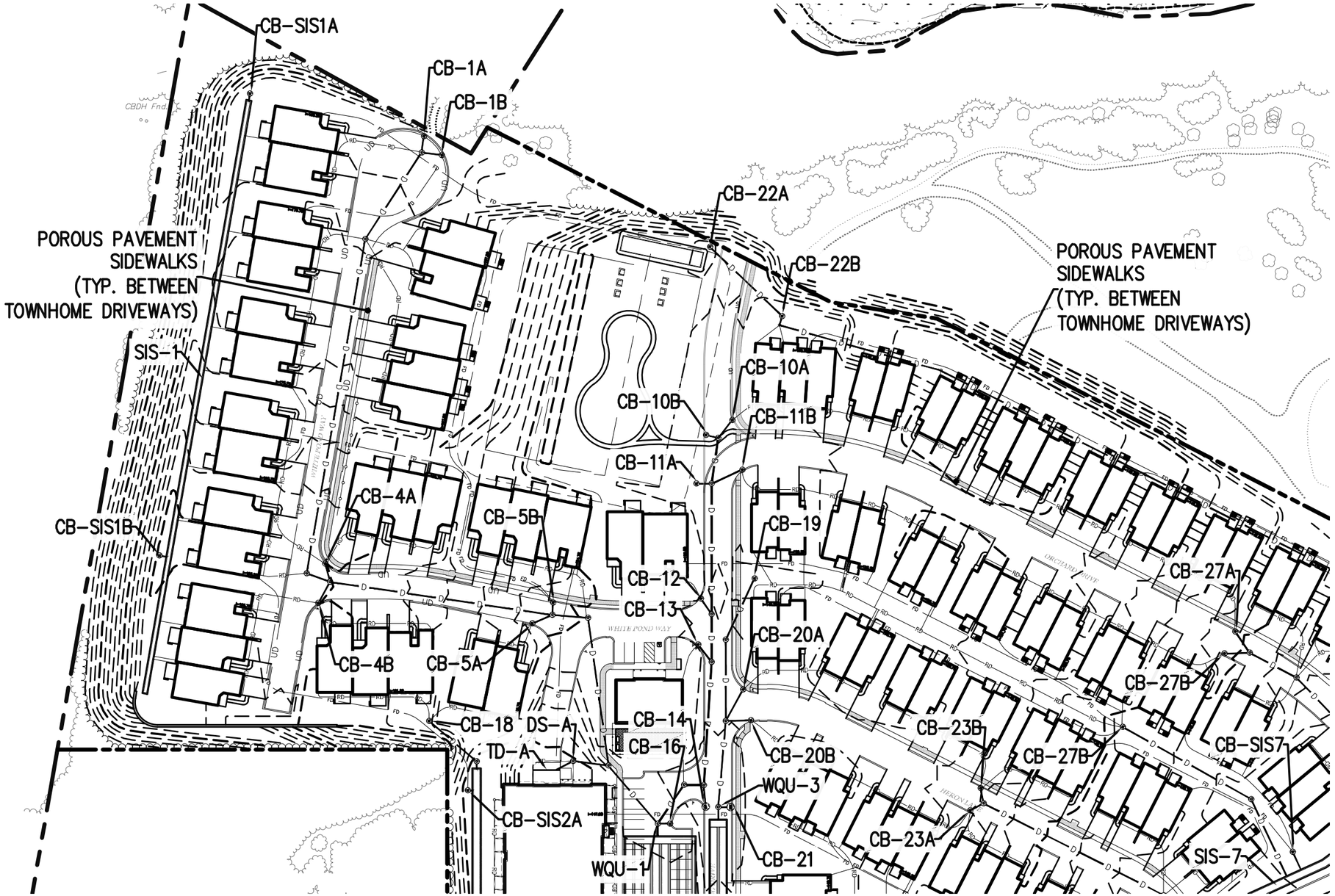
SHEET:

BMP PLAN

FIGURE 1B

CDG PROJECT #: 19044

DATE: 05/15/2020



100 0 50 100 200

GRAPHIC SCALE IN FEET

LEGEND

CATCH BASIN	CB
DOUBLE CATCH BASIN	DCB
DRAIN MANHOLE	DMH
OUTLET CONTROL STRUCTURE	OCS
WATER QUALITY UNIT	WQU
TRENCH DRAIN	TD
FLARED END SECTION	FES

REVISIONS:		
REV	DATE	COMMENT
1		
2		
3		

DESIGNED BY: MAL
CHECK BY: PRH

PREPARED FOR:

QUARRY NORTH ROAD, LLC.

2134 SEVILLA WAY
NAPLES, FL 34109

PROJECT:

COLD BROOK CROSSING

NORTH ROAD RESIDENTIAL OVERLAY DISTRICT (NRROD) & SMART GROWTH OVERLAY DISTRICT (SGOD)
NORTH ROAD
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SHEET:

BMP PLAN

FIGURE 1C

CDG PROJECT #: 19044

DATE: 05/15/2020

APPENDIX-A

EXAMPLE
OPERATION AND MAINTENANCE
REPORT FORMS

CIVIL DESIGN GROUP, LLC

ENGINEERING. LAND USE. PLANNING. PERMITTING.

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North Andover, MA 01845
Tel 978.794.5400
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QUARTERLY STORMWATER INSPECTION REPORT (1/3)

Site:	Cold Brook Crossing	**Date:**	
Address:	North Road, Sudbury, Massachusetts	**Time:**	
Inspector:		**Weather:**	

CATCH BASINS

Unit #	Sediment (inches)	Oil (inches)	Hood/ Pipes	Grate	Last Cleaned	Attention Recommended

QUARTERLY STORMWATER INSPECTION REPORT (2/3)

Site:	Cold Brook Crossing	**Date:**	
Address:	North Road, Sudbury, Massachusetts	**Time:**	
Inspector:		**Weather:**	

WATER QUALITY UNITS

Unit #	Sediment (inches)	Oil (inches)	Trash	Cover	Last Cleaned	Attention Recommended

INFILTRATION BASIN

Unit #	Notes	Attention Recommended

SUBSURFACE INFILTRATION SYSTEMS

Unit #	Notes	Attention Recommended

QUARTERLY STORMWATER INSPECTION REPORT (3/3)

Site:	Cold Brook Crossing	**Date:**	
Address:	North Road, Sudbury, Massachusetts	**Time:**	
Inspector:		**Weather:**	

RIPRAP APRON

Unit #	Notes	Attention Recommended

POROUS PAVEMENT

Area	Notes	Attention Recommended

APPENDIX-B

CONTECH WATER QUALITY UNIT MAINTENANCE GUIDELINES

CONTECH®
ENGINEERED SOLUTIONS

Cascade Separator™ Inspection and Maintenance Guide

CASCADE
separator™

Maintenance

The Cascade Separator™ system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall). However, more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment wash-down areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

A visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet chamber, flumes or outlet channel. The inspection should also quantify the accumulation of hydrocarbons, trash and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided in this Inspection and Maintenance Guide.

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

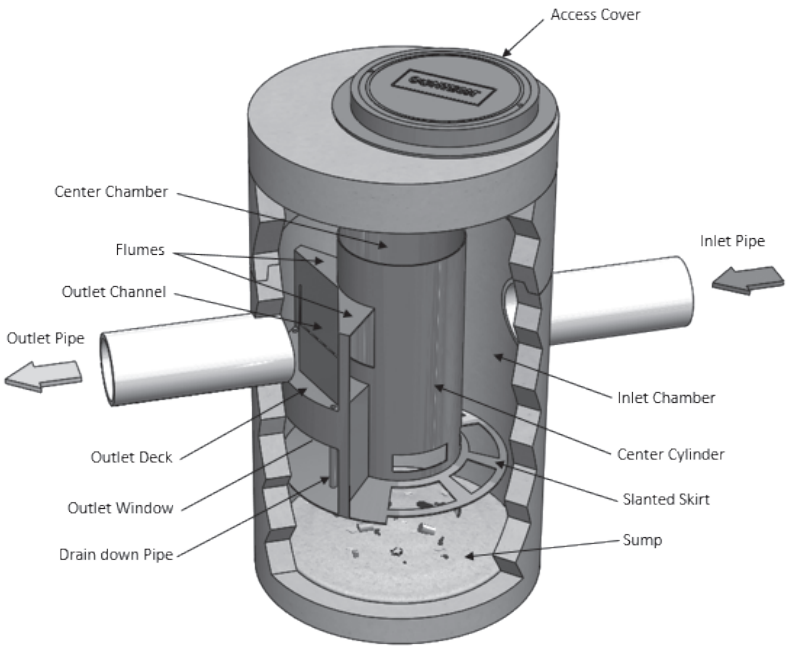
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. Then the system should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator™ Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CS-4	4	1.2	1.5	0.5	0.7	0.5
CS-5	5	1.3	1.5	0.5	1.1	0.8
CS-6	6	1.8	1.5	0.5	1.6	1.2
CS-8	8	2.4	1.5	0.5	2.8	2.1
CS-10	10	3.0	1.5	0.5	4.4	3.3
CS-12	12	3.6	1.5	0.5	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.

A Cascade Separator unit can be easily cleaned in less than 30 minutes.

A vacuum truck excavates pollutants from the systems.

Cascade Separator™ Inspection & Maintenance Log

Cascade Model:			Location:		
Date	Depth Below Invert to Top of Sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, and earth stabilization products. For information, visit www.ContechES.com or call 800.338.1122

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CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Attachment 7

- Signed Illicit Discharge Statement

ILLICIT DISCHARGE STATEMENT

FOR

COLD BROOK CROSSING

NORTH ROAD RESIDENTIAL OVERLAY DISTRICT (NRROD)
& SMART GROWTH OVERLAY DISTRICT (SGOD) PROJECT

NORTH ROAD
SUDBURY, MASSACHUSETTS

DATE: MARCH 11, 2020
REVISED: MAY 14, 2020

Illicit discharges to the stormwater management system are discharges not entirely comprised of stormwater. Discharges to the stormwater management system from the following activities or facilities are permissible: *firefighting, water line flushing, landscape irrigation, uncontaminated groundwater,* potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

There are no known illicit discharges currently at the site nor are any illicit discharges proposed as part of the project. The stormwater management system is *not* intended to convey any illicit discharges and/or pollutants and as such, control measures that are identified within this report shall be strictly adhered to in order to minimize the risk of contamination. Any unknown existing illicit discharges that are discovered as part of the development of the subject site shall be eliminated in accordance with local, state and federal regulations.

Manager Quarry North Road LLC
Signature

5/14/2020
Date