Environmental Services

Engineering Services

Stormwater Report

Proposed Multifamily Residences
#778 Main Street
Leicester, MA

Revised: May 12, 2023

Prepared for:

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#778 Main Street, Leicester, MA
May 12, 2023

Project Description:

The project Applicant*, Charlton Road Realty, LLC.,* retained *CMG Engineering* to prepare this engineering analysis of pre- and post-development drainage runoff conditions for a proposed **Multifamily Residences Project.** The proposed site improvements are located on assessor's parcel 21A - 11 with a total area of 3.21 Acres, identified as #778 Main Street (Site).

The site is currently a single-family residence with a dwelling, paved parking area, and barn located along the Main Street frontage. The northern property boundary abuts Waite Pond and currently contains undeveloped woodlands. The property also contains approximately 50' of frontage along Waite Street located in the Eastern Portion of the Site. Municipal water and sewer service the existing property with connections located within the Main Street right-of-way.

The current site topography pitches towards the Main Street right-of-way along the front of the site as well as a majority of the site pitching towards the rear property line to Waite Pond. There are currently no existing stormwater BMPs implemented on the site. A portion of the rear of the property is located within the 100' jurisdictional wetland buffer and will require a Notice of Intent filing with the Leicester Conservation Commission. A 25' "No Disturb" Zone associated with the Waite Pond wetlands is also on-site and will not be affected by this proposal. Approximately 32,600 s.f. of the southern portion of the site, which abuts the Main Street right-of-way, lies within the Town of Leicester Water Resources Protection Overlay District.

The applicant is proposing to construct five (5) townhouse style duplexes and one (1) townhouse style triplex for a total of 13 units. The units will include a garage and a paved driveway which will accommodate two off-street parking spaces. Proposed site access will be proposed along the Main Street right-of-way. In accordance with the MassDEP Stormwater Handbook, an on-site stormwater management system is proposed as part of this project, and will utilize a combination of treatment and infiltration BMP's. In accordance with the Town of Leicester's Zoning Bylaws §7.1.04.2.a., the applicant is proposing less than 30% of impervious coverage within the limits of the Water Resources Protection Overlay District.

A copy of the "MA-DEP Checklist for Stormwater Report" is included as **Appendix A**.

Hydrologic Calculation Methodology:

Hydrology

Computer Model: HydroCAD 10.0 © 2015 Applied Microcomputer Systems, drainage modeling software;

Hydrologic Methodology: TR-55 Methodology is used for analysis of peak flow and drywell sizing.

Surface Runoff Conditions

Rainfall Intensity: NOAA Atlas 14 (Volume 10, Version 3) – Rainfall Data
2-Year Storm = 3.13 in.
10-Year Storm = 4.85 in
25-Year Storm = 5.95 in.
100-Year Storm = 7.59 in.

Watershed Areas: Watershed areas are calculated using AutoCAD software based on the subcatchment areas delineated on topographic mapping included as "Pre-Development Drainage" and "Post-Development Drainage". The areas shown, times of concentration and runoff coefficients are all consistent with the TR-55 drainage calculation method.

Flood Plain:

FEMA Flood Mapping: A portion of the site is located in the Special Flood Hazard Area – Zone "A" based on Flood Insurance Rate Map (FIRM) Town of Leicester, Worcester County Massachusetts (All Jurisdictions) Map Number 25027C0782E, Effective Date July 04, 2011 (see **Appendix B).**

At this time, a hydraulic analysis of Waite Pond has not been conducted to determine a base flood elevation. However, CMG conducted a survey on the Waite Pond spillway to obtain its elevation which was determined to be 819.5 +/-. Additionally, during the public hearing process with the Commission, the longtime tenant of the existing property at 778 Main Street noted that he has observed flooding in Waites Pond to approximately 25 feet beyond the limits of the normally observed high water lines. Onsite elevations associated with a 25-foot offset to the normal water line (assume this to be BVW), generally range from elevation 822 to 827. Considering the higher of these elevations, it would pose a flooding elevation of 7.5 feet over the spill way of Waite Pond (elev=819.5), which, to the knowledge of the Applicant and others solicited feedback, has never observed to such an elevation. As such an estimate of the 100-year flood elevation would be 827. As seen within the development plan set, elevation 827 is located within the limits of the FEMA mapped Zone A. All proposed work is to be located outside of the mapped Zone A, therefore, the mapped flood zone has been applied to this project to be conservative. All proposed work is located above the limits of this elevation, therefore there are no impacts to the flood plain and compensatory storage mitigation is not warranted.

Soils & Topography:

The Site soils are mapped as and appear to be consistent with Canton Fine Sandy Loam (420B) with 3 ~ 8% slopes classified as Hydrologic Soil Group "B" and modelled as such in the hydrology calculations. However, based upon on-site observatory testing, subsurface soils are classified as "Loamy Sands" per classification by a Massachusetts Licensed Soil Evaluator. Loamy sands correlate to an "A" type soil classification within the Rawls Rate soil permeability table.

A copy of the *National Resources Conservation Service* (NRCS) Soils Map, listed area soil types are included as **Appendix C.**

On-Site Soil Testing:

May 12, 2022 Soil Testing – Avizinis Environmental Services, Inc. (Edward J. Avizinis, LSE)

On May 13, 2022 Avizinis Environmental Services, Inc. completed eight (8) on-site soil test pits within the proposed project area. The purpose of these test pits was to verify the ESHGW and soil conditions within the proposed stormwater management areas.

Depth to Groundwater:
Estimated seasonal high groundwater (ESHGW) elevations based on soil mottling are as follows:

TH - 1	**TH - 2**	**TH - 3**	**TH – 4**
ESHGW = 50”	**ESHGW=73”**	**ESHGW = 77”**	**ESHGW = 79”**
TH-5	**TH-6**	**TH-7**	**TH-8**
ESHGW = 90”	**ESHGW = 90”**	**ESHGW = 76”**	**ESHGW = 80”**

TH – 5 did not contain mottling as the excavator encountered shallow refusal.

Soil Conditions:
Test pit TH – 1 was excavated in close proximity to one of the proposed roof drain infiltration systems to approximately 8 ft. below ground surface (b.g.s.). Soil testing results yielded native loamy sands with an ESHGW located approximately 4.1 ft. b.g.s.

Test pit TH - 2 was excavated in close proximity to the second roof drain infiltration system to approximately 8 ft. b.g.s. Soil testing results yielded loamy sands with an ESHGW located approximately 6’ b.g.s.

Test pit TH – 3 was excavated within the proposed access driveway to approximately 8’ below grade. Soil testing yielded loamy sands with an ESHGW located approximately 6.4’ b.g.s.

Test pit TH – 4 was excavated within the limits of one of the three proposed infiltration basins to approximately 6.5’ b.g.s. Soil testing yielded ESHGW located approximately 6.5’ b.g.s.

Test pit TH – 5 was excavated within the front parking area to approximately 8’ b.g.s. Soil testing yielded native loamy sands with an ESHGW located approximately 7.5’ b.g.s.

Test pit TH – 6 was excavated within the front parking area to approximately 8’ b.g.s. Soil testing yielded native loamy sands with an ESHGW located approximately 7.5’ b.g.s.

Test pit TH – 7 was excavated within the front parking area to approximately 8’ b.g.s. Soil testing yielded native loamy sands with an ESHGW located approximately 6.3’ b.g.s.

Test pit TH – 8 was excavated within the front parking area to approximately 8’ b.g.s. Soil testing yielded native loamy sands with an ESHGW located approximately 6.6’ b.g.s.

Copies of Site Soil Investigation Data are also included in **Appendix C**.

Additional soil testing took place on January 17, 2023 by James Bernardino, P.E. of CMG. The additional five (5) test pits were consistent with the soil testing conducted previously by Avizinis Environmental Services, Inc., indicating the presence of native loamy sands. Groundwater depth was observed as follows:

2023-01	**2023-02**	**2023-03**	**2023-04**	**2023-05**
ESHGW = 42”	**ESHGW = 74”**	**ESHGW = 62”**	**ESHGW = 88”**	**ESHGW = 80”**

CMG’s soil logs are included in **Appendix C**.

Soil Permeability (k):
Based upon on-site classification by a State of Massachusetts Licensed Soil Evaluator Edward Avizinis, site subsurface soils within the development area are classified as a “loamy sand”. Loamy sands correlate to a “A” type soil classification within the Rawls Rate soil permeability table; therefore, the drainage design permeability has been identified as follows:

Design permeability (k) values of Type "A" Soils:

***k* = 2.41 in / hr** (Rawls Rate: Type "A" Soils) Loamy Sand

Existing Conditions:

The existing site currently consists of one business zoned property located at #778 Main Street with an area of 3.21 Acres. The parcel consists of a single-family residential home along Main Street and undeveloped woodlands along the rear portion of the property, which abuts Waite Pond. The site topography appears to split in two directions with a small portion of the front of the site pitching towards Main Street and the large majority of the site pitching towards Waite Pond in the rear of the Site. There are two (2) stormwater outfall locations for the site:

Outfall 1S – Main Street Stormwater runoff associated with the existing single-family dwelling, paved driveway, and half of the existing barn roof area drain via overland flow to the Main Street right-of-way as well as a combination of grass and woods totaling approximately 32,400 s.f. No existing stormwater BMPs are present on-site to treat and convey existing stormwater flows. Stormwater runoff entering the Main Street right-of-way is captured and conveyed through the existing Mass DOT owned drainage system.

Outfall 2S – Waite Pond The remaining 127,635 +/- s.f. of the undeveloped woodlands and rear lawn area discharge via overland flow to Waite Pond, which abuts the rear portion of the site. As previously stated, the site does not currently employ stormwater management structures to treat and convey existing stormwater flows. The limits of the Waite Pond resource area were delineated by Goddard Consulting on December 27, 2021.

Proposed Conditions:

The project Applicant is proposing to construct five (5) townhouse style duplexes and one (1) townhouse style triplex with a total combined 13 dwelling units. A paved site access driveway will be located along the Main Street right-of-way which will lead to the unit's driveways. Stormwater runoff from impervious roof areas and impervious paved parking areas and walkways will be captured and conveyed to treatment and infiltration structures throughout the site. CMG is proposing the following Stormwater Management System for the Site in order to meet the MA-DEP Stormwater Management Standards for a new development project.

Outfall 1S – Main Street Subcatchment 1A consists of approximately 6,500 s.f. of landscaped area located along the right-of-way on Main Street. Approximately 100 s.f. of the proposed paved access driveway is also located in this subcatchment. This area will discharge directly into the Main Street right-of-way, which is consistent with pre-development flow patterns. The runoff will eventually be captured via the Main Street drainage system.

Subcatchment 1B contains approximately 13,600 s.f. of landscape area and paved site access driveway along the site's Main Street frontage. Please note, this subcatchment is located almost entirely within the Town of Leicester Water Resource Protection Overlay District. A drop inlet water quality unit located within the limits of the paved access driveway will capture runoff from the driveway and front landscape area. In accordance with §7.1.04.2.a of the Leicester Zoning Bylaws, provisions associated with trapping oil, gas, and other contaminants before recharge into the ground will be required. The proposed water quality unit is designed to meet the intent of this bylaw and is sized to handle the proposed water quality volume. The water quality unit will then discharge to an underground infiltration system which will consist of Cultec 330 XLHD chambers. The underground system will utilize a Cultec Separator row to provide additional TSS removal and protect the longevity of the infiltration system. The system will retain up to a 10-year storm and discharge runoff to the eastern property line via an overflow pipe during larger storm

events. Please note, the proposed peak discharge rate to the eastern property line will be reduced in comparison to pre-development conditions in accordance with the MassDEP Stormwater Handbook.

Outfall 2S – Waite Pond Subcatchment 2A consists of the rear portion of the site which abuts Waite Pond. A large portion of this subcatchment falls under the Leicester Conservation Commission 100' jurisdictional buffer associated with Waite Pond. The majority of the rear portion of the site will remain undisturbed in order to limit impacts directly adjacent to the Waite Pond resource area. Grading to accommodate the proposed duplexes is located in the southern portion of the subcatchment. Due to the existing steep slope located along the rear portion of the site, the proposed duplexes will utilize a walk-out basement to better accommodate the steep rear slope of the site. As a result, the roof leaders for the rear half of the buildings will outlet roof runoff to the rear slope which will eventually discharge to Waite Pond via overland flow.

Subcatchment 2B consists of the remaining roof areas, paved driveways, and landscape areas associated with the proposed townhouse dwellings. The paved portions of the subcatchment will be collected via catch basins and be conveyed to a water quality unit. The water quality unit is designed to treat the required water quality volume and also provide storage in the case of a potential release of pollutants. The water quality units will then discharge runoff to a stormwater infiltration basin. The basin will retain smaller rain events and discharge larger rain events through an outlet control structure. The outlet control structure will convey overflows to the rear of the property where it will eventually enter Waite Pond. Roof drains will be conveyed to the same subsurface drainage system and be conveyed to the previously mentioned stormwater basin.

Water Resources Protection Overlay District (Leicester Zoning Bylaws §7.1)

As previously stated, approximately 32,600 s.f. of the front portion of the site is located within the Water Resources Protection Overlay District. The Town of Leicester Zoning Bylaws allow a maximum 30% of impervious area be located within the limits of the overlay and require measures be taken to ensure increases in stormwater runoff be artificially recharged. To meet the regulations, the applicant is proposing 28% of the overlay district be impervious coverage associated with the paved driveway and a portion of the triplex's roof area. The impervious areas will be collected via a proposed drop inlet water quality unit located within the limits of the proposed paved entrance driveway. To meet the intent of the bylaw, a water quality unit is proposed to collect and prevent any oil, gas or other contaminants from infiltrating into the aquifer.

The proposed underground infiltration system located within the limits of the overlay district will promote artificial recharge to the groundwater exceeding the pre-development condition. A summary of the pre-development and post-development recharge volumes within the limits of the Water Resources Protection Overlay District is included as Table 3.

Proposed Stormwater Management System:

Proposed Multifamily Residence:

- Deep sump hooded catch basins collect runoff for site's impervious and landscaped areas
- Water quality units are proposed to treat paved surfaces, including areas associated with the Town of Leicester Water Resources Protection Overlay District. The water quality units will provide protection from oil, gas or other contaminants potentially infiltrating into the aquifer.

- Underground infiltration systems will be utilized to meet the required recharge volume and water quality volume. Infiltration system will be outfitted with Cultec Separator Rows to achieve pre-treatment requirements prior to infiltration.
- A stormwater infiltration basin is proposed to also meet the required recharge volume and water quality volume.
- Site Long-term Operation and Maintenance plan is provided for the Site.

MA-DEP Stormwater Management Standards:

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

Proposed Full Compliance:

- **Combination of on-site stormwater BMPs including deep sump catch basins with hoods, an underground infiltration system, and stormwater infiltration basin provide treatment for on-site stormwater prior to discharge to Outfall 1S & 2S.**

STANDARD 2: (Peak rate control and flood prevention):
Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.

Proposed Full Compliance:

- **There is no proposed increase to Site peak runoff rates at both discharge points.**

STANDARD 3: (Recharge to Groundwater):
Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development conditions based on soil type. This Standard is met when the storm water management system is design to infiltrate the required recharge volume as determined in accordance with the Massachusetts Storm water Handbook.

Proposed Full Compliance:

- **The site will be utilizing an underground infiltration system and stormwater infiltration basin to meet the required recharge volume.**
- **Site specific BMPs are utilized to treat stormwater runoff prior to discharging to infiltration practices.**

STANDARD 4: (TSS Removal):
Stormwater management systems must be designed to remove 80% of the average annual post construction load of Total Suspended Solids (TSS).

Proposed Full Compliance:

- **Prior to Outfall 1S, stormwater runoff will be captured via a drop inlet water quality unit (80% TSS Removal) and then conveyed to infiltration chambers (80% TSS Removal), resulting in excess of 80% TSS Removal Annual Load.**

- **Prior to Outfall 2S, stormwater will be routed through a water quality unit (80% TSS Removal) which discharges to a stormwater infiltration basin (80% TSS Removal), resulting in excess of 80% TSS Removal Annual Load.**

STANDARD 5: (Higher Potential Pollutant Loads (LUHPPL)):

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Storm water Handbook to eliminate or reduce the discharge of storm water runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, or storm water runoff, the proponent shall use the specific storm water BMP's determined by the Department to be suitable for such use as provided in the Massachusetts Storm water Handbook.

Proposed Full Compliance:

- **Not Applicable – Site is not considered a LUHPPL**

STANDARD 6: (Critical Areas)

Storm water discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and storm water discharges near or any other critical area require the use of the specific storm water best management practices determined by the Department to be suitable for managing discharges to such area as provided in the Massachusetts Storm water Handbook.

Proposed Full Compliance:

- **A portion of the site falls within the Town of Leicester Water Resources Protection Overlay District. As a result, site specific BMP's are proposed to promote infiltration measures and capture potential contaminants within the stormwater runoff within the overlay district.**

STANDARD 7: (Redevelopment)

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

Proposed Full Compliance:

- **A majority of the Site is considered new development and will meet all applicable Stormwater Management Standards.**

STANDARD 8: (Erosion, Sediment Control):

A plan to control construction related impacts including erosion sedimentation and other pollution prevention sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) must be implemented.

Proposed Full Compliance:

- **The "Erosion and Sedimentation Control Plan" and "Erosion and Sediment Control Details" are incorporated into the Plan Set.**
- **Project will disturb > 1 Acre, therefore an EPA–NPDES Stormwater General Permit is required prior to construction and will be accompanied with a comprehensive SWPP Plan.**

STANDARD 9: (Operation and Maintenance):
A long-term operation and maintenance plan must be developed and implemented to ensure that storm water management systems function as designed.

Proposed Full Compliance:

- **Long Term Operation and Maintenance Plan is included in Stormwater Management Report, Appendix H.**

STANDARD 10: (Illicit Discharges):
All illicit discharges to the stormwater management system are prohibited.

Proposed Full Compliance:

- **A signed "illicit discharge compliance statement" will be provided as part of the final "Storm water Management System Long-Term Operation & Maintenance Plan".**

A copy of the "MA-DEP Checklist for Stormwater Report" is included as **Appendix A**.

Table No. 1 provides a summary of off-site Pre- and Post-Development peak runoff flow rates and volumes**.**

Table No. 2 provides a summary of the subcatchment drainage area calculations.

Appendix D & E includes the complete Pre-Development and Post-Development *HydroCAD* drainage calculation reports and **Figures D-1 and D-2 "Pre- "and "Post-Development Drainage Areas" plans**.

Appendix F provides additional stormwater calculations.

Appendix G provides a Verification Statement associated with the performance of the Cultec Separator Row

Appendix H provides a "Long Term Stormwater Operation & Maintenance Plan"

The complete Site Plans for the **"Proposed Multifamily Residences - #778 Main Street, Leicester, MA" prepared by CMG Engineering, revised date 5/12/2023** (or latest version) provide details of the complete storm water management system design**.** Please note these plans are subject to review and approval by three (3) separate Town Boards including: the Leicester Conservation Commission, Zoning Board of Appeals, & Planning Board.

TABLE 1

PRE- VS. POST-DEVELOPMENT STORMWATER RUNOFF SUMMARY

TABLE NO. 1

5/5/2023

STORMWATER RUNOFF PEAK FLOW SUMMARY
PROPOSED MULTIFAMILY RESIDENCES
#778 MAIN ST
LEICESTER, MA

Pre-Existing Site Development (Fig D1) Conditions					
		2-Year	10-Year	25-Year	100-Year
1S - MAIN STREET	*Peak Flow (cfs)*	*0.38*	*1.28*	*1.97*	*3.10*
2S - WAITE POND	*Peak Flow (cfs)*	*0.45*	*2.91*	*5.04*	*8.66*

Proposed - Site Development (Fig D2) Conditions					
1S - MAIN STREET	*Peak Flow (cfs)*	*0.05*	*0.22*	*0.35*	*0.91*
2S - WAITE POND	*Peak Flow (cfs)*	*0.31*	*2.32*	*4.92*	*8.52*

TABLE 2

SUBCATCHMENT DRAINAGE AREA CALCULATIONS

TABLE NO. 2
DRAINAGE AREA CALCULATIONS
PROPOSED MULTIFAMILY RESIDENCES
#778 MAIN STREET
LEICESTER, MA

PRE-DEVELOPMENT DRAINAGE AREAS (s.f.)

On-Site	Soil Type B						Watershed
Area	Impervious	Perv. Pav.	Grass/Ldscp	Woods			Total
1	5,992		11,740	14,700			32,432
2	4,027		24,805	98,803			127,635
							Total
	10,019	0	36,545	113,503			**160,067 s.f.**
				Total Site Area=	160,067	s.f.	**3.67** Ac
Total Impervious=	**10,019 s.f.**				3.67	Ac	
Total Open Space =	**150,048 s.f.**						

POST-DEVELOPMENT DRAINAGE AREAS (s.f.)

On-Site	Soil Type B						Watershed
Area	Impervious	Perv. Pav.	Grass/Ldscp	Woods			Total
1A	114		6,521				6,635
1B	3,018		10,617				13,635
2A	3,900		16,932	46,130			66,962
2B	29,292		43,543				72,835
							0
							0
							0
							Total
	36,324	0	77,613	46,130			***160,067 s.f.***
				Total Site Area=	160,067	s.f.	**3.67** Ac
Total Impervious=	**36,324 s.f.**				3.67	Ac	
Total Open Space =	**123,743 s.f.**						

Note:

[1] All Drainage Areas are calculated using CAD Software based on Pre- & Post Development Drainage Plans prepared by CMG date 10/24/22

TABLE 3

WATER RESOURCES PROTECTION OVERLAY DISTRICT
COMPARISON TABLE

Pre-Development Conditions (Within WRPOD):

Storm Event	**2-Year** 3.13”	**10-Year** 4.85”	**25-Year** 5.95”	**100-Year** 7.59”
Rainfall Volume (Depth x Area) Area = 32,600 s.f.	8,503 c.f.	13,175 c.f.	16,164 c.f.	20,619 c.f.
Runoff Volume*	1,888 c.f.	4,818 c.f.	7,016 c.f.	8,178 c.f.
Recharge Volume (Rainfall Volume – Runoff Volume)	6,615 c.f.	8,357c.f.	9,148 c.f.	12,441 c.f.

Post-Development Conditions (Within (WRPOD):

Storm Event	**2-Year** 3.13”	**10-Year** 4.85”	**25-Year** 5.95”	**100-Year** 7.59”
Rainfall Volume (Depth x Area) Area = 32,600 s.f.	8,503 c.f.	13,175 c.f.	16,164 c.f.	20,619 c.f.
Runoff Volume*	2,275 c.f.	5,450 c.f.	7,775 c.f.	11,492 c.f.
Recharge Volume (Surface) (Rainfall Volume – Runoff Volume)	6,228 c.f.	7,725 c.f.	8,389 c.f.	9,127 c.f.
Infiltration Chamber Recharge Volume (Pond 1P)	842 c.f.	2,101 c.f.	2,915 c.f.	3,470 c.f.
Recharge Volume (Recharge Volume (Surface) + Infil. Volume)	7,070 c.f.	9,826 c.f.	11,304 c.f.	12,597 c.f.

* Runoff volumes are based on HydroCAD modelling of Pre-Development & Post-Development Areas within the limits of the Water Resources Protection Overlay District. Please see attached HydroCAD reports detailing the modelling within the WRPOD.

Subcat Reach Pond Link

Routing Diagram for TABLE 3-WRPOD MODEL_REV3
Prepared by {enter your company name here}, Printed 5/11/2023

Summary for Subcatchment 1: Pre-Development

Runoff = 0.52 cfs @ 12.10 hrs, Volume= 1,888 cf, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
5,927	98	Paved parking, HSG B
26,673	61	>75% Grass cover, Good, HSG B
32,600	68	Weighted Average
26,673		81.82% Pervious Area
5,927		18.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 2: Post-Development

Runoff = 0.66 cfs @ 12.10 hrs, Volume= 2,275 cf, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
6,836	98	Paved parking, HSG B
23,508	61	>75% Grass cover, Good, HSG B
2,296	98	Roofs, HSG B
32,640	71	Weighted Average
23,508		72.02% Pervious Area
9,132		27.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 1: Pre-Development

Runoff = 1.51 cfs @ 12.09 hrs, Volume= 4,818 cf, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
5,927	98	Paved parking, HSG B
26,673	61	>75% Grass cover, Good, HSG B
32,600	68	Weighted Average
26,673		81.82% Pervious Area
5,927		18.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 2: Post-Development

Runoff = 1.73 cfs @ 12.09 hrs, Volume= 5,450 cf, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
6,836	98	Paved parking, HSG B
23,508	61	>75% Grass cover, Good, HSG B
2,296	98	Roofs, HSG B
32,640	71	Weighted Average
23,508		72.02% Pervious Area
9,132		27.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 1: Pre-Development

Runoff = 2.24 cfs @ 12.09 hrs, Volume= 7,016 cf, Depth= 2.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
5,927	98	Paved parking, HSG B
26,673	61	>75% Grass cover, Good, HSG B
32,600	68	Weighted Average
26,673		81.82% Pervious Area
5,927		18.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 2: Post-Development

Runoff = 2.50 cfs @ 12.09 hrs, Volume= 7,775 cf, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
6,836	98	Paved parking, HSG B
23,508	61	>75% Grass cover, Good, HSG B
2,296	98	Roofs, HSG B
32,640	71	Weighted Average
23,508		72.02% Pervious Area
9,132		27.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 1: Pre-Development

Runoff = 3.41 cfs @ 12.09 hrs, Volume= 10,577 cf, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
5,927	98	Paved parking, HSG B
26,673	61	>75% Grass cover, Good, HSG B
32,600	68	Weighted Average
26,673		81.82% Pervious Area
5,927		18.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 2: Post-Development

Runoff = 3.71 cfs @ 12.09 hrs, Volume= 11,492 cf, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
6,836	98	Paved parking, HSG B
23,508	61	>75% Grass cover, Good, HSG B
2,296	98	Roofs, HSG B
32,640	71	Weighted Average
23,508		72.02% Pervious Area
9,132		27.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Appendix A

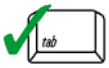
MA-DEP Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

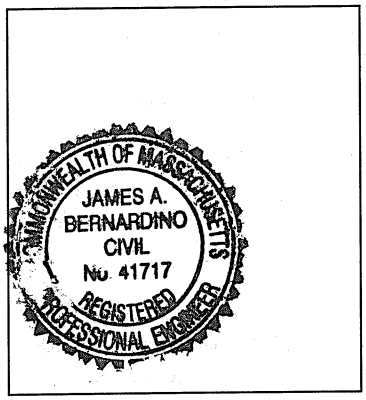
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): Porous Pavement

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☒ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

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

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

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

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Appendix B

USGS FIGURE
FEMA Flood Plain Mapping

TOWN LOCATION - LEICESTER, MA

FIGURE 1: SITE LOCATION

778 MAIN STREET
LEICESTER, MA 01524
CMG ID 2021-226

SCALE 1" = 1,000'

1000 FT 0 1000 FT

ENVIRONMENTAL SERVICES
CMG EST. 2002
ENGINEERING SERVICES
67 HALL ROAD. STURBRIDGE MA 01566

National Flood Hazard Layer FIRMette

FEMA

71°54'W 42°14'58"N

71°53'23"W 42°14'31"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

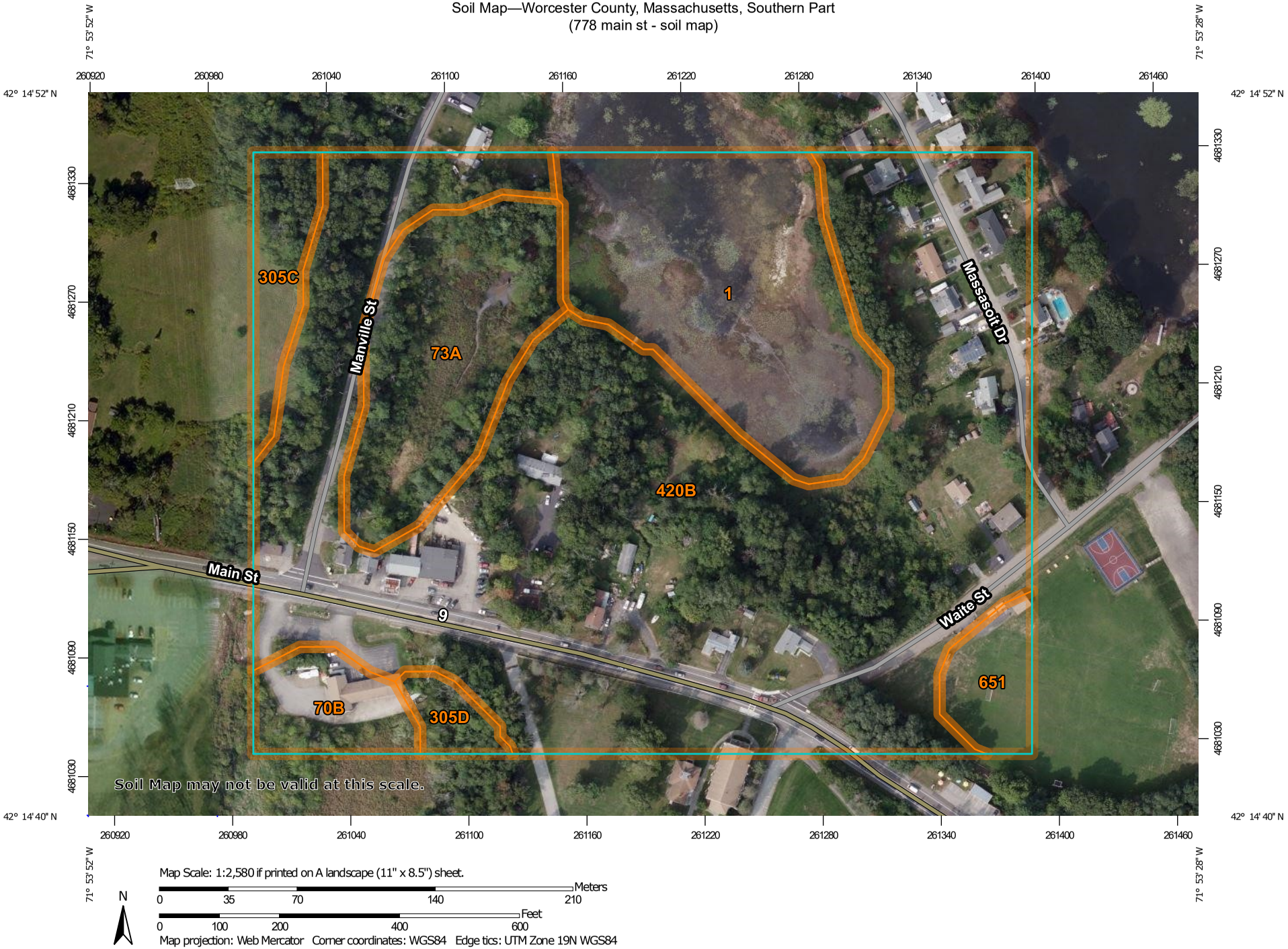
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/3/2021 at 11:48 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix C

NCRS Soil Mapping
&
On-Site Soil Testing Logs

Soil Map—Worcester County, Massachusetts, Southern Part
(778 main st - soil map)



Map Scale: 1:2,580 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 35 70 140 210

Feet
0 100 200 400 600

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 14, Sep 3, 2021

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

Date(s) aerial images were photographed: Apr 8, 2011—Oct 1, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	4.6	15.5%
70B	Ridgebury fine sandy loam, 3 to 8 percent slopes	0.9	3.1%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	3.1	10.4%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	0.9	2.9%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	0.4	1.3%
420B	Canton fine sandy loam, 3 to 8 percent slopes	19.2	64.2%
651	Udorthents, smoothed	0.7	2.4%
Totals for Area of Interest		**29.9**	**100.0%**

Worcester County, Massachusetts, Southern Part

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w81b
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Canton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Hills, moraines, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s

Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Scituate
Percent of map unit: 10 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Montauk
Percent of map unit: 5 percent
Landform: Moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Charlton
Percent of map unit: 4 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Swansea
Percent of map unit: 1 percent
Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 14, Sep 3, 2021

AVIZINIS
ENVIRONMENTAL
SERVICES INC

SOIL EVALUATION REPORT

SITE LOCATION:

A.P. 21A, Lot A11

778 Main Street

Leicester, Massachusetts

PREPARED FOR:

James Bernardino, PE

CMG

jbernardino@cmgenv.com

PREPARED (May 24, 2022) BY:

Edward J. Avizinis, CPSS, PWS | President

INTRODUCTION

Avizinis Environmental Services, Inc., (AES), has completed the requested soil evaluations for stormwater mitigation system design purposes at the above referenced address, 778 Main Street in Leicester, Massachusetts. These evaluations were performed in accordance with the Massachusetts Stormwater Handbook, Volume 3, Chapter 1 by a Title 5 certified soil evaluator, Edward J. Avizinis (SE#14250). Eight soil evaluations were performed on this property. Site work was performed and completed on May 12, 2022.

SOIL DATA

The following table outlines the soil data collected onsite. Test hole numbers correspond to the numbering sequence as depicted on the accompanying map. Test holes have been GPS located with a Spectra SP20 submetric GPS/GNSS. This data is not survey quality but generally sufficient for use in showing test hole locations. A copy of this data shall also be forwarded to your office in conjunction with this report.

TH1

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
0 – 7	Ap	10YR 3/2	-	FSL	1 M GR	ablation
7 – 15	Bw1	10YR 5/6	-	SL	1 M SBK	ablation
15 - 28	Bw2	10YR 6/4	-	GR SL	1 M SBK	ablation
28 – 96	C	2.5Y 5/3	@50 F, 4, D	ST LS	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH1	96	-	80	50

TH2

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
-13 – 0	^A/^C	-	-	-	-	HTM
0 – 5	Apb	10YR 3/2	-	FSL	1 M GR	ablation
5 – 14	Bwb	10YR 5/4	-	GR FSL	1 M SBK	ablation
14 - 96	C	2.5Y 5/3	@60 F, 4, D	COB LS	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH2	96	-	dry	60

TH3

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
-12 – 0	^A	-	-	-	-	HTM
0 – 4	Ab	10YR 3/2	-	SL	1 M GR	ablation
4 – 27	Bw1	7.5YR 5/6	-	BO SL	1 M SBK	ablation
27 - 49	Bw2	10YR 6/4	-	BO SL	1 M SBK	ablation
49 - 96	C	2.5Y 5/3	@67 F, 3, D	BO SL	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH3	96	-	dry	67

TH4

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
-25 – -7	^C	-	-	-	-	HTM/turf
-7 – -3	^Ab	10YR 3/2	-	SL	1 M GR	HTM
-3 – 0	^Bwb	7.5YR 4/6	-	GR SL	1 M SBK	HTM
0 - 11	Apb	10YR 3/2	-	FSL	1 M GR	ablation
11 - 19	Bwb	10YR 4/4	-	ST SL	1 M SBK	ablation
19 - 72	C	2.5Y 5/3	@54 F, 3, D	BO LS	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH4	72	-	dry	54

TH5

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
-18 – 0	^C	-	-	-	-	HTM/turf
0 – 12	Apb	10YR 3/2	-	FSL	1 M GR	ablation
12 – 26	Bwb	10YR 5/6	-	BO SL	1 M SBK	ablation
26 - 96	C	2.5Y 5/3	@72 F, 3, D	ST LS	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH5	96	-	dry	72

TH6

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
-18 – 0	^C	-	-	-	-	HTM/turf
0 – 11	Apb	10YR 3/2	-	FSL	1 M GR	ablation
11 – 21	Bwb	7.5YR 4/6	-	ST SL	1 M SBK	ablation
21 - 96	C	2.5Y 5/3	-	ST LS	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH6	96	-	dry	Inconclusive; likely around 72

TH7

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
-24 – 0	^C	-	-	-	-	HTM
0 – 20	Bwb	10YR 4/4	-	COB SL	1 M SBK	ablation
20 – 96	C	2.5Y 5/3	@52 F, 3, D	BO LS	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH7	96	-	dry	52

TH8

Depth	Horizon	Color	Redoximorphic Features	Texture	Structure/Grade	Parent Material
-28 – -18	^A	-	-	-	-	HTM
-18 – 0	^C	-	-	-	-	HTM
0 – 44	C1	10YR 4/3	-	COB LS	0 SG	ablation
44 - 96	C2	2.5Y 5/3	@72	COB LS	0 SG	ablation

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH8	96	-	dry	Inconclusive; likely approx. 52

Notes: CMG NOTE:
Estimated Seasonal High Groundwater Table (SHWT) noted below are taken from depth below natural grade. To achieve a depth coorelated to existing grade, one must add (HTM) depth to SHWT noted below.

SUMMARY TABLE

Test Hole	Total Depth	Depth to Ledge	Depth to Seep	SHWT
TH1	96	-	80	50
TH2	96	-	dry	60
TH3	96	-	dry	67
TH4	72	-	dry	54
TH5	96	-	dry	72
TH6	96	-	dry	Inconclusive; likely around 72
TH7	96	-	dry	52
TH8	96	-	dry	Inconclusive; likely approx. 52

CLOSING

Thank you for giving AES the opportunity to assist you with preliminary planning of this project. AES has completed the onsite soil evaluations for this property. Please review the preceding data tables that describe the explored soils. In addition, the attached map depicts the test hole locations. AES staff has used a Spectra SP20 submetric GPS unit to locate the soil evaluations which are numbered consistent with the numbering of the data tables. This does not constitute a survey but is useful in preliminary planning and is generally sufficient for soil evaluation purposes. Please do not hesitate to let me know if you have any questions and best of luck moving forward.

SITE MAPS

1. 2021 AERIAL PHOTOGRAPH
2. USDA – NRCS SOIL SURVEY MAP
3. USGS TOPOGRAPHIC MAP
4. SOIL EVALUATION LOCATION MAP

AVIZINIS
ENVIRONMENTAL
SERVICES INC

2021 AERIAL MAP
A.P. 21A, Lot A11 | 778 Main Street
Leicester, Massachusetts

LEGEND

Property Line

70 35 0 70 140 210
Feet

General Notes:
1. This map should not be interpreted as a survey quality graphic. It is designed for preliminary planning purposes only. AES recommends consultation with a Professional Land Surveyor for accurate site feature locations.
2. Property lines as depicted on this map have been approximated from plat maps available from the town assessor's online database.
3. 2021 Aerial photograph base map acquired from the Massachusetts OLIVER database.

Map created by: Patrick J. Loveland, GIS Specialist 04/29/2022

OneDrive/Desktop/AES/JOBS/22/22-109

AVIZINIS
ENVIRONMENTAL
SERVICES INC

USDA - NRCS SOIL SURVEY MAP
MASSACHUSETTS STATE SOIL SURVEY
A.P. 21A, Lot A11 | 778 Main Street
Leicester, Massachusetts

LEGEND

1- Water
70B - Ridgebury fine sandy loam, 0 to 6 percent slopes; Ridgebury fine sandy loam, 3 to 8 percent slopes; Ridgebury gravelly fine sandy loam, 0 to 5 percent slopes
73A - Whitman fine sandy loam, 0 to 5 percent slopes, extremely stony; Whitman sandy loam, 0 to 3 percent slopes, extremely stony; Whitman very stony mucky fine sandy loam, 0 to 3 percent slopes, extremely stony
305D - Paxton fine sandy loam, 15 to 35 percent slopes
420B - Canton very fine sandy loam, 3 to 8 percent slopes

100 50 0 100 200 300
Feet

General Notes:
1. This map should not be interpreted as a survey quality graphic. It is designed for preliminary planning purposes only. AES recommends consultation with a Professional Land Surveyor for accurate site feature locations.
2. Property lines as depicted on this map have been approximated from plat maps available from the town assessor's online database.
3. 2021 Aerial photograph base map acquired from the Massachusetts OLIVER database.

Map created by: Patrick J. Loveland, GIS Specialist 04/29/2022

OneDrive/Desktop/AES/JOBS/22/22-109

AVIZINIS
ENVIRONMENTAL
SERVICES INC

USGS TOPOGRAPHIC MAP
A.P. 21A, Lot A11 | 778 Main Street
Leicester, Massachusetts

LEGEND

Property Line

400 200 0 400 800 1,200
Feet

General Notes:
1. This map should not be interpreted as a survey quality graphic. It is designed for preliminary planning purposes only. AES recommends consultation with a Professional Land Surveyor for accurate site feature locations.
2. Property lines as depicted on this map have been approximated from plat maps available from the town assessor's online database.
3. 2021 Aerial photograph base map acquired from the Massachusetts OLIVER database.

Map created by: Patrick J. Loveland, GIS Specialist 04/29/2022

OneDrive/Desktop/AES/JOBS/22/22-109

AVIZINIS
ENVIRONMENTAL
SERVICES INC

2022 SOIL EVALUATION MAP
A.P. 21A, Lot A11 | 778 Main Street
Leicester, Massachusetts

LEGEND

Property Line

Soil Evaluation Location

70 35 0 70 140
Feet

General Notes:
1. This map should not be interpreted as a survey quality graphic. It is designed for preliminary planning purposes only. AES recommends consultation with a Professional Land Surveyor for an accurate site plan.
2. Property lines as depicted on this map have been approximated from plat maps available from the town assessor's online database.
3. 2021 Aerial photograph base map acquired from the Massachusetts OLIVER database.
4. Site features located with a Juniper Geode Submetric GNSS receiver with SWmaps data collection software. Non-delineated wetland edges have not been field verified and are depicted for graphic purposes only.

Delineation performed by:
Edward J. Avizinis, CPSS, PWS 05/12/2022

Map created by:
Patrick J. Loveland, GIS Specialist 05/24/2022

OneDrive/Desktop/AES/JOBS/22/22-109

SOIL TEST PIT LOGS
778 Main Street
Leicester, MA 01524

Conducted By: James Bernardino, P.E.
Date: January 17, 2023

2023-01
Elev.= 840.5 +/-

0” ~ 12”	Loam
12” ~ 18”	B – Sandy Loam
18” ~ 38”	C1 – Sandy Loam
38” ~ 80”	C2 – Sandy Loam

Mottling Observed @ 42”
Water Seeping @ 80”
ESHGW @ 42”, Elev. = 837.0

2023-02
Elev.= 843.5 +/-

0” ~ 8”	Fill
8” ~ 12”	A – Loam
12” ~ 30”	B – Sandy Loam
30” ~ 92”	C – Sandy Loam

Mottling Observed @ 74”
No Observed GW Weeping
ESHGW @ 74”, Elev. = 837.3

2023-03
Elev.= 836.7 +/-

0” ~ 10”	Fill
10” ~ 18”	A – Loam
18” ~ 40”	B – Sandy Loam
40” ~ 96”	C – Sandy Loam

Mottling Observed @ 62”
No Observed GW Weeping
ESHGW @ 62”, Elev. = 831.5

67 Hall Road
Sturbridge, MA 01566
Phone (774) 241-0901
Fax (774) 241-0906

2023-04

Elev.= 845.0 +/-

0” ~ 24”	Fill
24” ~ 30”	A – Loam
30” ~ 36”	B – Sandy Loam
36” ~ 108”	C – Sandy Loam

Mottling Observed @ 88”
No Observed GW Weeping
ESHGW @ 88”, Elev. = 837.6

2023-05

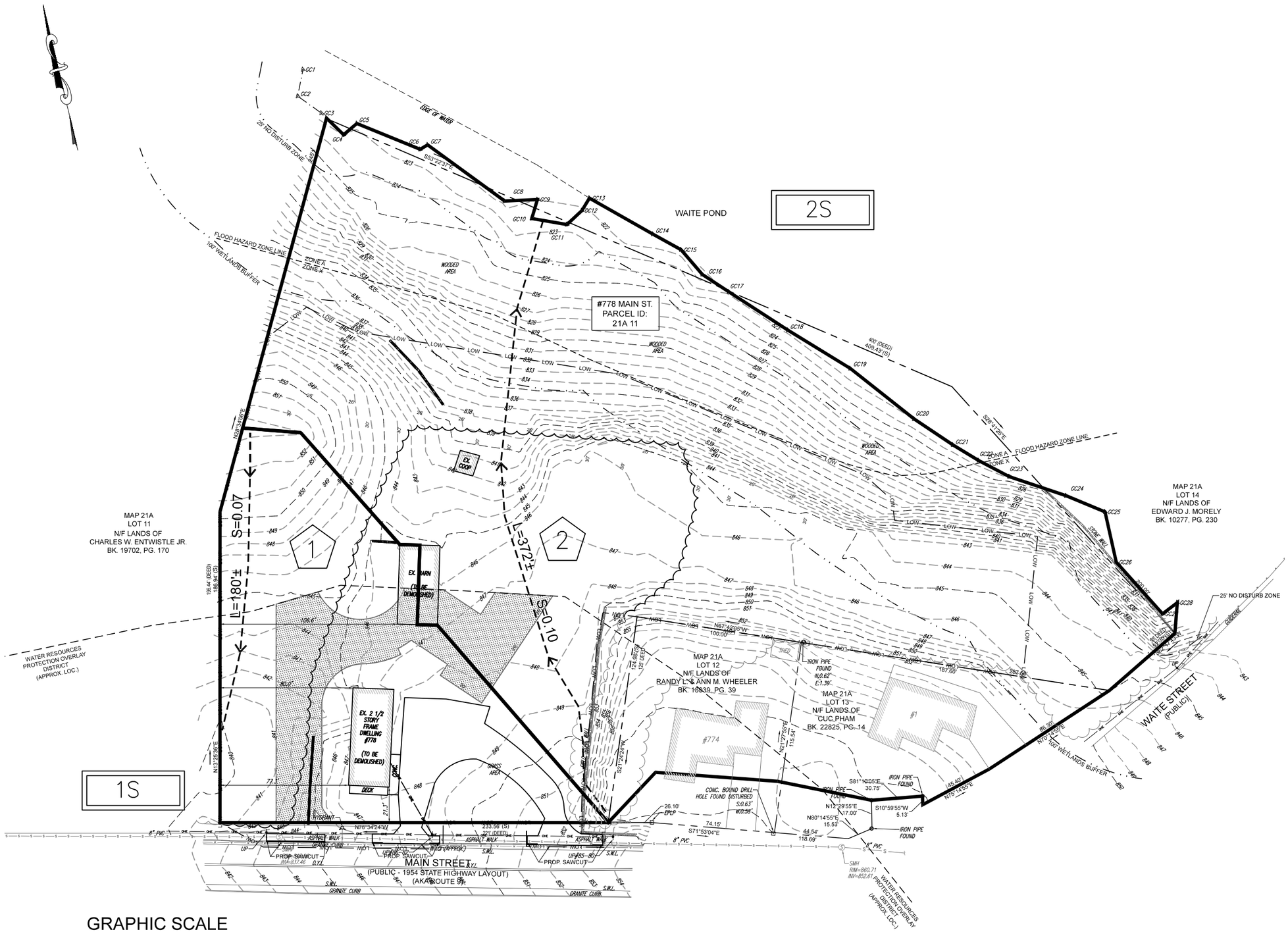
Elev.= 845.0 +/-

0” ~ 60”	Fill
60” ~ 70”	A – Loam
70” ~ 80”	B – Sandy Loam
80” ~ 98”	C – Sandy Loam

Mottling Observed @ 80”
No Observed GW Weeping
ESHGW @ 80”, Elev. = 838.3

Appendix D

Pre-Development Drainage Calculations



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 ft.

REVISIONS			
NO.	DATE	DESCRIPTION	BY CKD
1.	12/6/2022	ZONING BOARD OF APPEALS SUBMISSION	RL JAB
2.	1/13/2023	REVISIONS PER PEER REVIEW COMMENTS	RL JAB
3.	5/01/2023	PROPOSED TOWNHOUSE LAYOUT	MM JAB

PROFESSIONAL SEAL

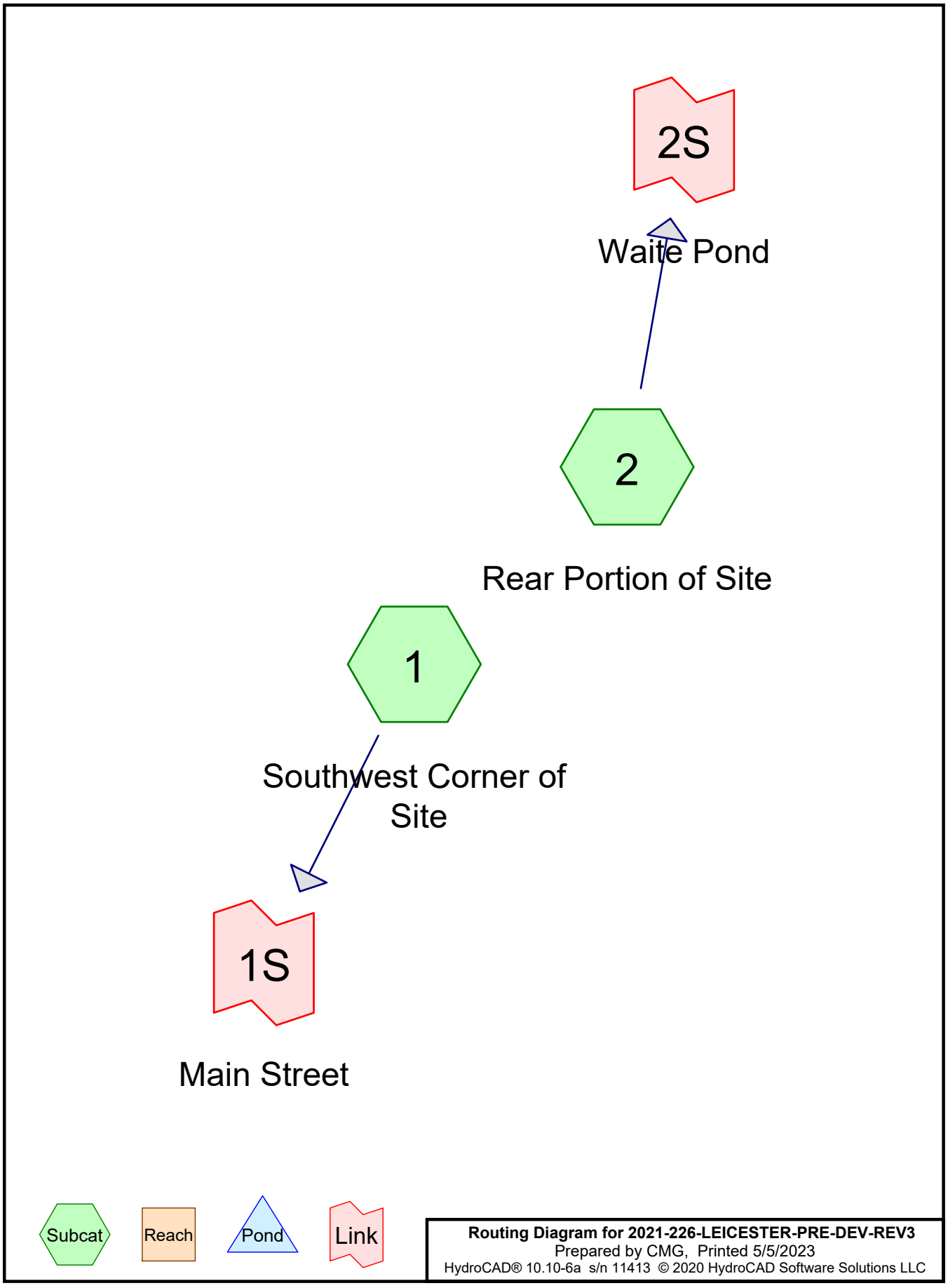
PROJECT:
PROPOSED MULTIFAMILY RESIDENCE
#778 MAIN STREET
LEICESTER, MA 01524

PREPARED FOR:
CHARLTON ROAD REALTY, LLC.
25 WATERVILLE LANE
SHREWSBURY, MA 01545

ENGINEERING SERVICES
ENVIRONMENTAL SERVICES
67 Hall Road
Sturbridge, MA 01566
Phone: 774-241-0901
fax: 774-241-0906

CMG EST. 2002

ISSUE DATE: 10/24/2022
DRAWN BY: RL CHECKED BY: JAB
SCALE: 1" = 40'
PROJECT NO.: 2021-225
SHEET NAME:
PRE-DEVELOPMENT
DRAINAGE MAP
SHEET NO.:
D - 1.0



Routing Diagram for 2021-226-LEICESTER-PRE-DEV-REV3
Prepared by CMG, Printed 5/5/2023
HydroCAD® 10.10-6a s/n 11413 © 2020 HydroCAD Software Solutions LLC

Summary for Subcatchment 1: Southwest Corner of Site

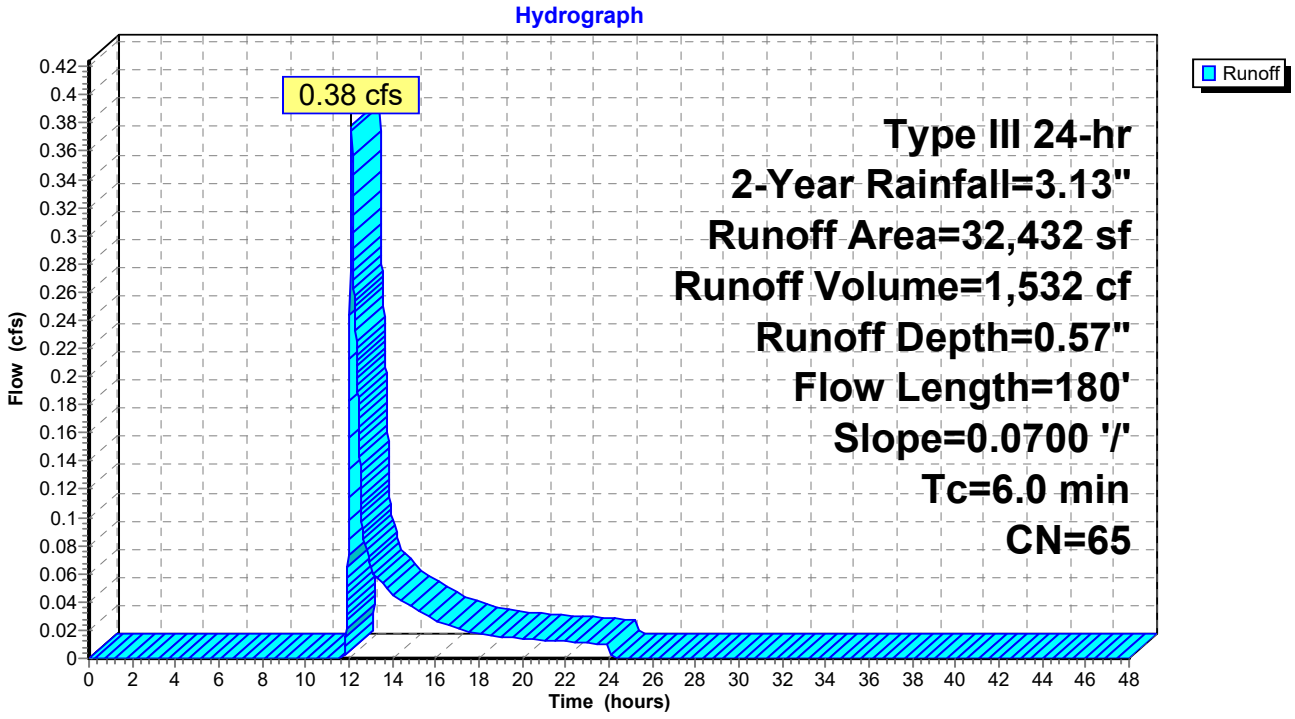
Runoff = 0.38 cfs @ 12.11 hrs, Volume= 1,532 cf, Depth= 0.57"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
5,992	98	Paved parking, HSG B
11,740	61	>75% Grass cover, Good, HSG B
14,700	55	Woods, Good, HSG B
32,432	65	Weighted Average
26,440		81.52% Pervious Area
5,992		18.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	180	0.0700	0.65		**Lag/CN Method,**
4.6	180	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1: Southwest Corner of Site



Summary for Subcatchment 2: Rear Portion of Site

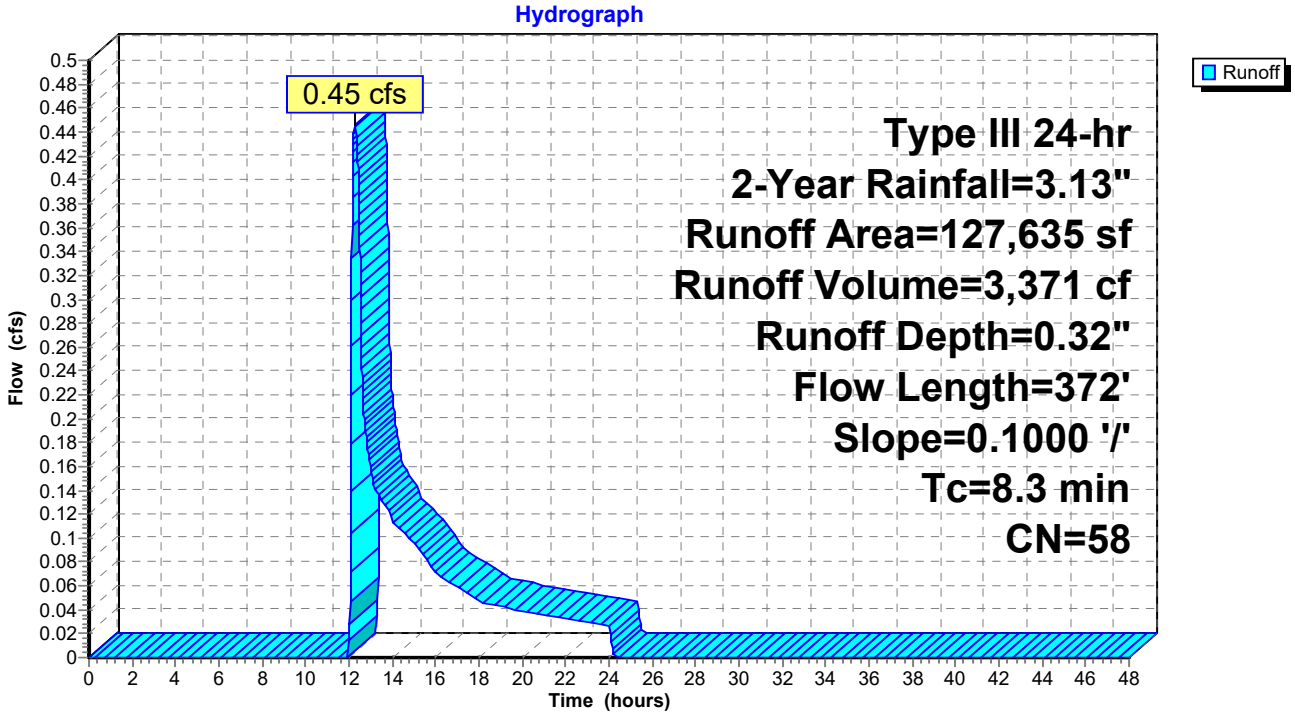
Runoff = 0.45 cfs @ 12.29 hrs, Volume= 3,371 cf, Depth= 0.32"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
4,027	98	Paved parking, HSG B
24,805	61	>75% Grass cover, Good, HSG B
98,803	55	Woods, Good, HSG B
127,635	58	Weighted Average
123,608		96.84% Pervious Area
4,027		3.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	372	0.1000	0.75		**Lag/CN Method,**

Subcatchment 2: Rear Portion of Site

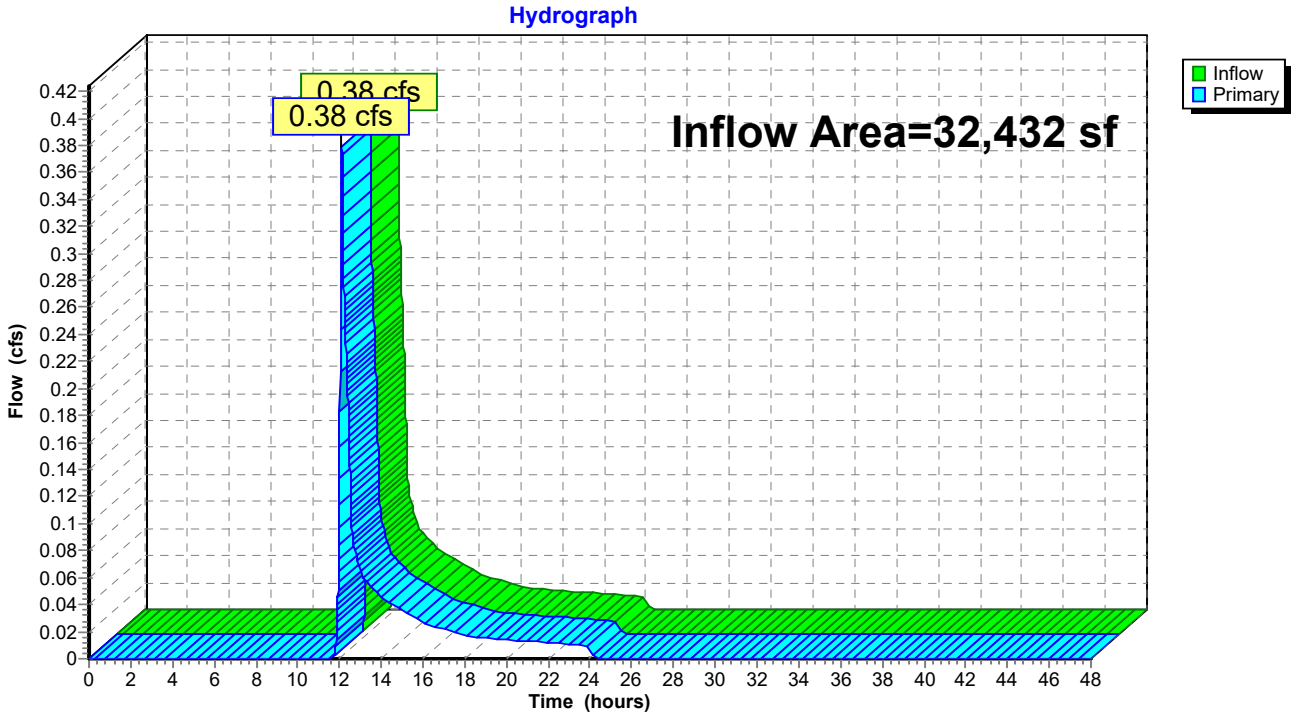


Summary for Link 1S: Main Street

Inflow Area = 32,432 sf, 18.48% Impervious, Inflow Depth = 0.57" for 2-Year event
Inflow = 0.38 cfs @ 12.11 hrs, Volume= 1,532 cf
Primary = 0.38 cfs @ 12.11 hrs, Volume= 1,532 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

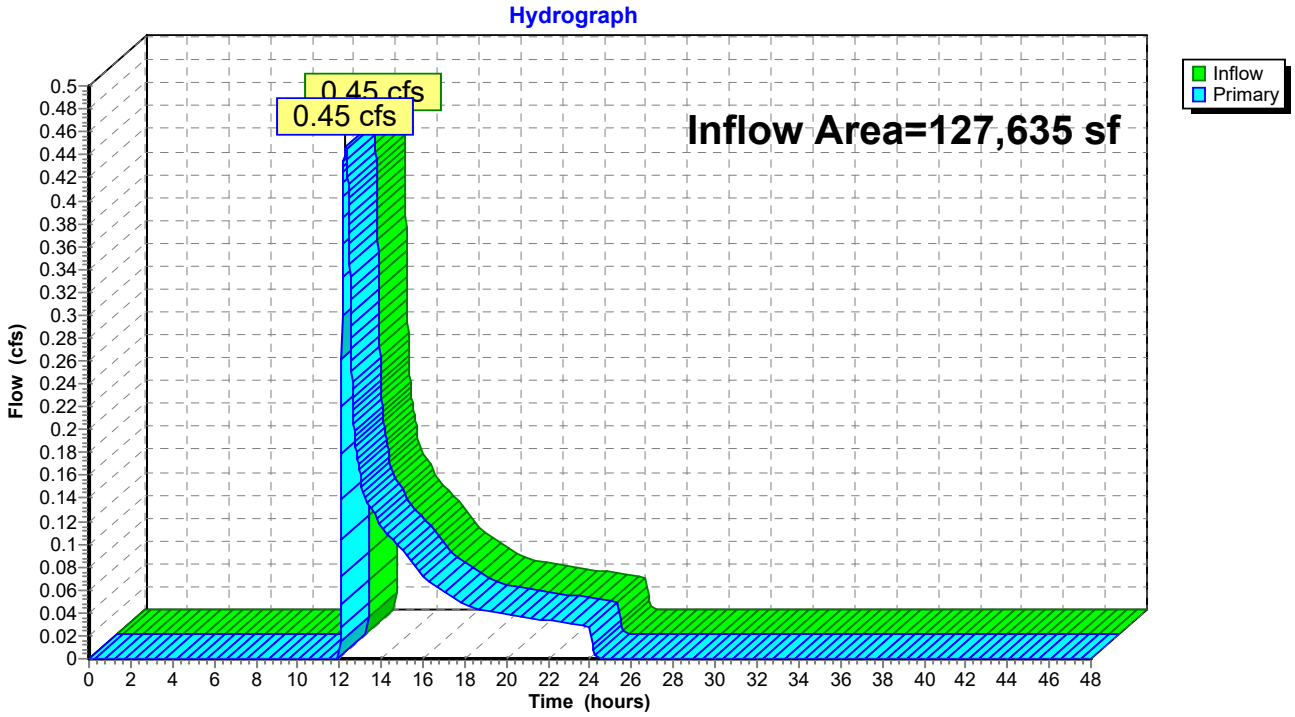


Summary for Link 2S: Waite Pond

Inflow Area = 127,635 sf, 3.16% Impervious, Inflow Depth = 0.32" for 2-Year event
Inflow = 0.45 cfs @ 12.29 hrs, Volume= 3,371 cf
Primary = 0.45 cfs @ 12.29 hrs, Volume= 3,371 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Summary for Subcatchment 1: Southwest Corner of Site

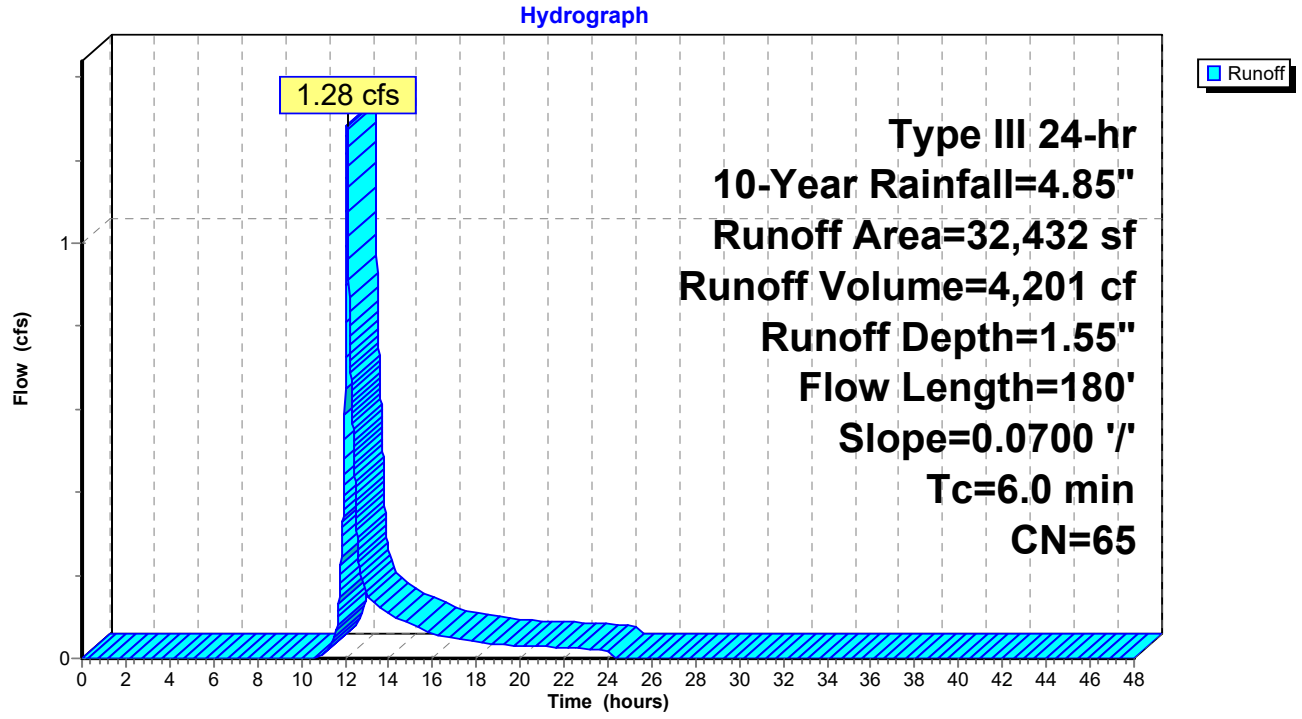
Runoff = 1.28 cfs @ 12.10 hrs, Volume= 4,201 cf, Depth= 1.55"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
5,992	98	Paved parking, HSG B
11,740	61	>75% Grass cover, Good, HSG B
14,700	55	Woods, Good, HSG B
32,432	65	Weighted Average
26,440		81.52% Pervious Area
5,992		18.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	180	0.0700	0.65		**Lag/CN Method,**
4.6	180	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1: Southwest Corner of Site



Summary for Subcatchment 2: Rear Portion of Site

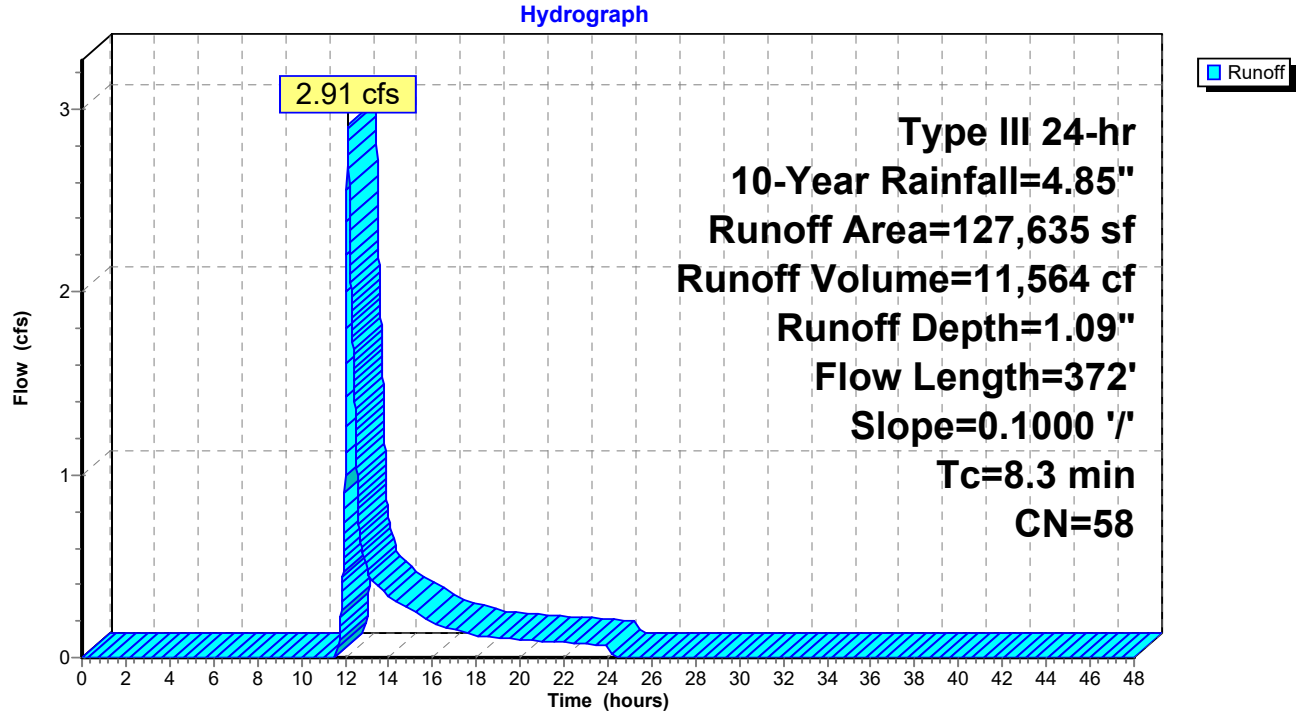
Runoff = 2.91 cfs @ 12.13 hrs, Volume= 11,564 cf, Depth= 1.09"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
4,027	98	Paved parking, HSG B
24,805	61	>75% Grass cover, Good, HSG B
98,803	55	Woods, Good, HSG B
127,635	58	Weighted Average
123,608		96.84% Pervious Area
4,027		3.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	372	0.1000	0.75		**Lag/CN Method,**

Subcatchment 2: Rear Portion of Site

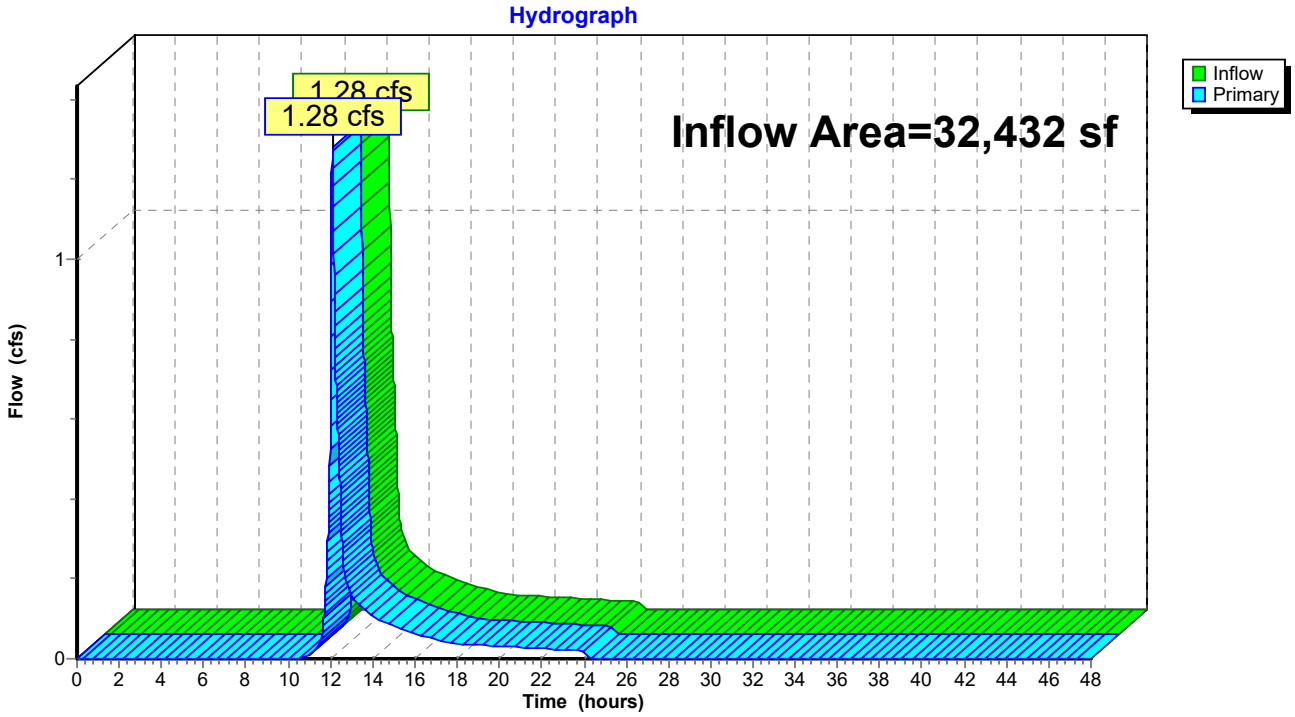


Summary for Link 1S: Main Street

Inflow Area = 32,432 sf, 18.48% Impervious, Inflow Depth = 1.55" for 10-Year event
Inflow = 1.28 cfs @ 12.10 hrs, Volume= 4,201 cf
Primary = 1.28 cfs @ 12.10 hrs, Volume= 4,201 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

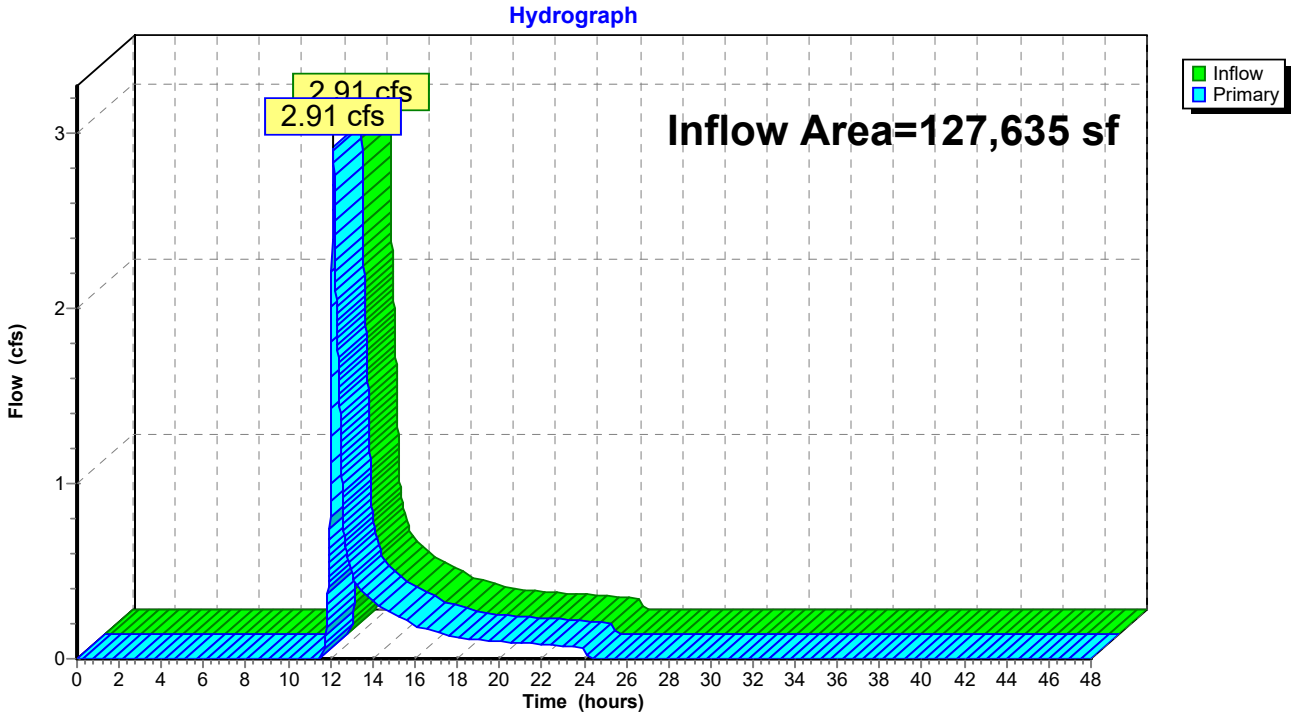


Summary for Link 2S: Waite Pond

Inflow Area = 127,635 sf, 3.16% Impervious, Inflow Depth = 1.09" for 10-Year event
Inflow = 2.91 cfs @ 12.13 hrs, Volume= 11,564 cf
Primary = 2.91 cfs @ 12.13 hrs, Volume= 11,564 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Summary for Subcatchment 1: Southwest Corner of Site

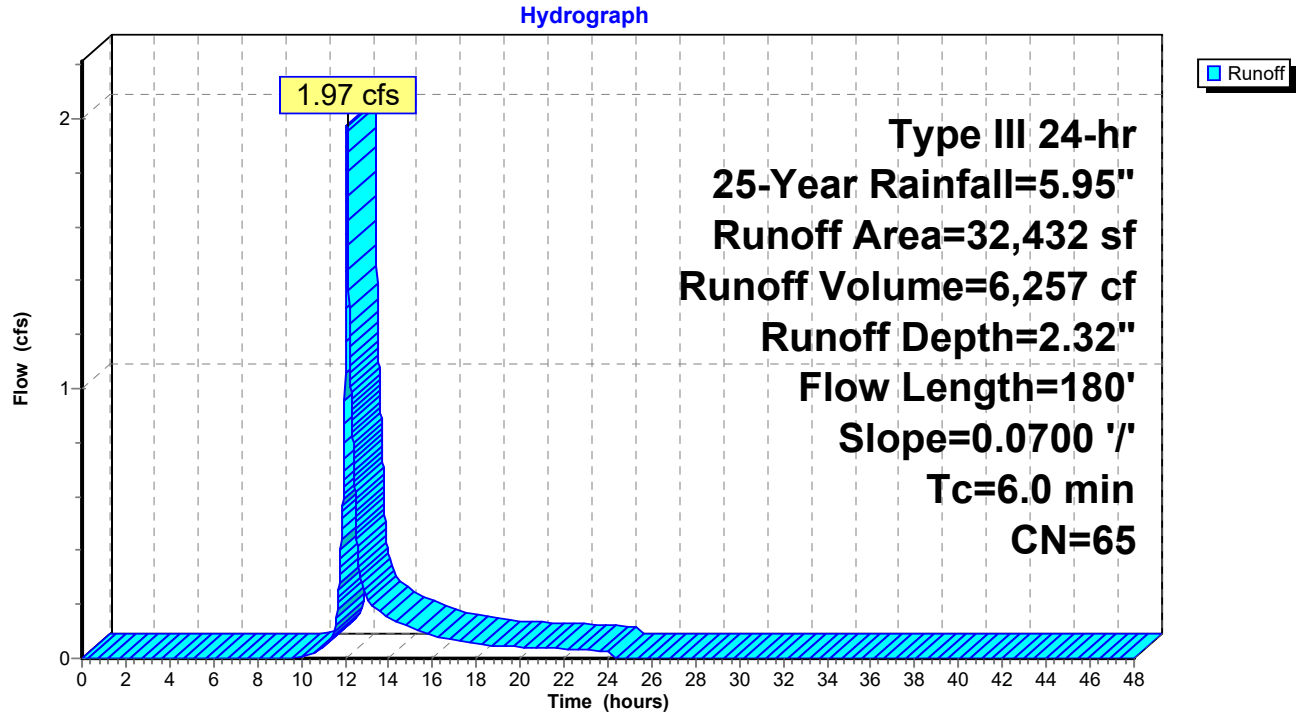
Runoff = 1.97 cfs @ 12.09 hrs, Volume= 6,257 cf, Depth= 2.32"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
5,992	98	Paved parking, HSG B
11,740	61	>75% Grass cover, Good, HSG B
14,700	55	Woods, Good, HSG B
32,432	65	Weighted Average
26,440		81.52% Pervious Area
5,992		18.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	180	0.0700	0.65		**Lag/CN Method,**
4.6	180	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1: Southwest Corner of Site



Summary for Subcatchment 2: Rear Portion of Site

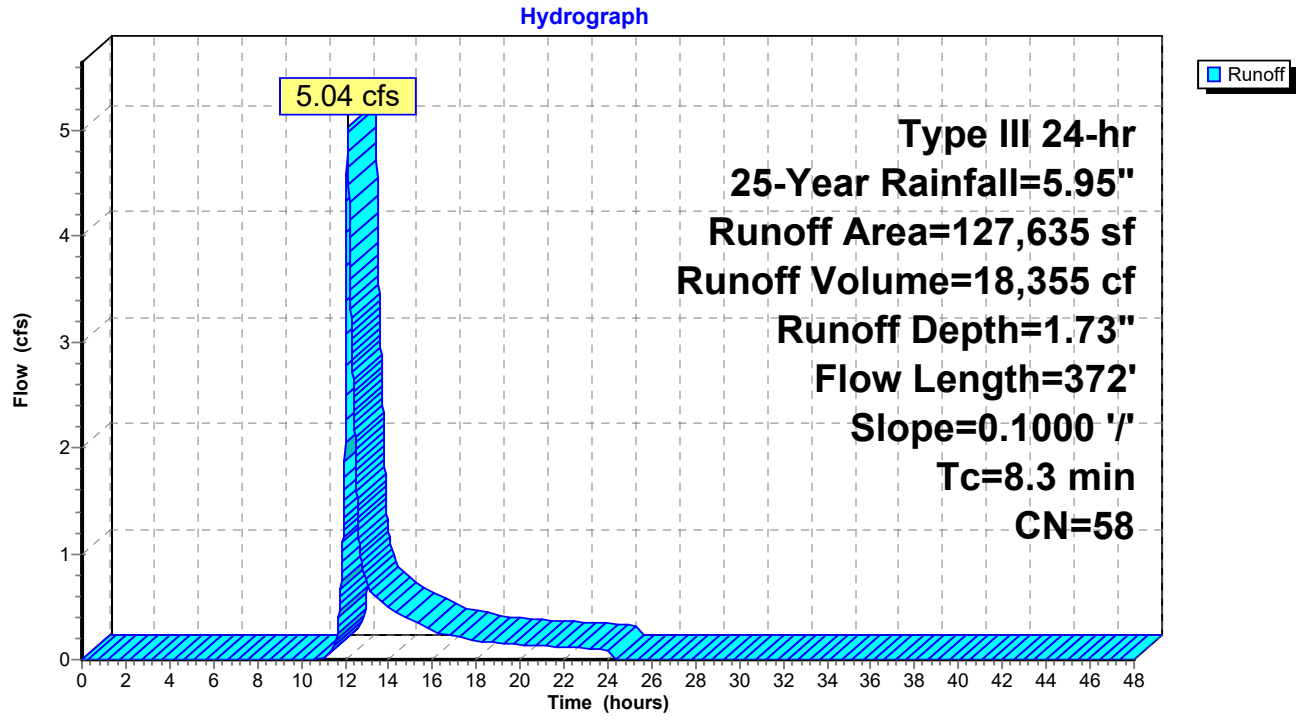
Runoff = 5.04 cfs @ 12.13 hrs, Volume= 18,355 cf, Depth= 1.73"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
4,027	98	Paved parking, HSG B
24,805	61	>75% Grass cover, Good, HSG B
98,803	55	Woods, Good, HSG B
127,635	58	Weighted Average
123,608		96.84% Pervious Area
4,027		3.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	372	0.1000	0.75		**Lag/CN Method,**

Subcatchment 2: Rear Portion of Site

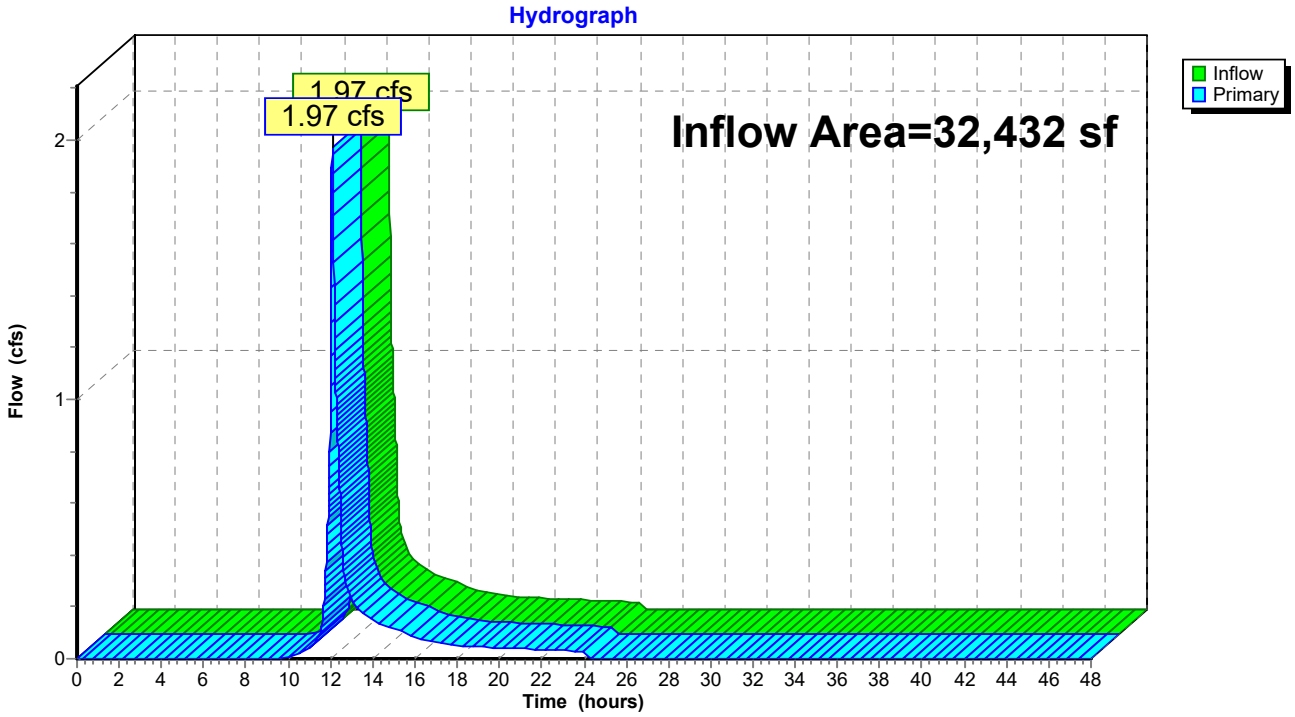


Summary for Link 1S: Main Street

Inflow Area = 32,432 sf, 18.48% Impervious, Inflow Depth = 2.32" for 25-Year event
Inflow = 1.97 cfs @ 12.09 hrs, Volume= 6,257 cf
Primary = 1.97 cfs @ 12.09 hrs, Volume= 6,257 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

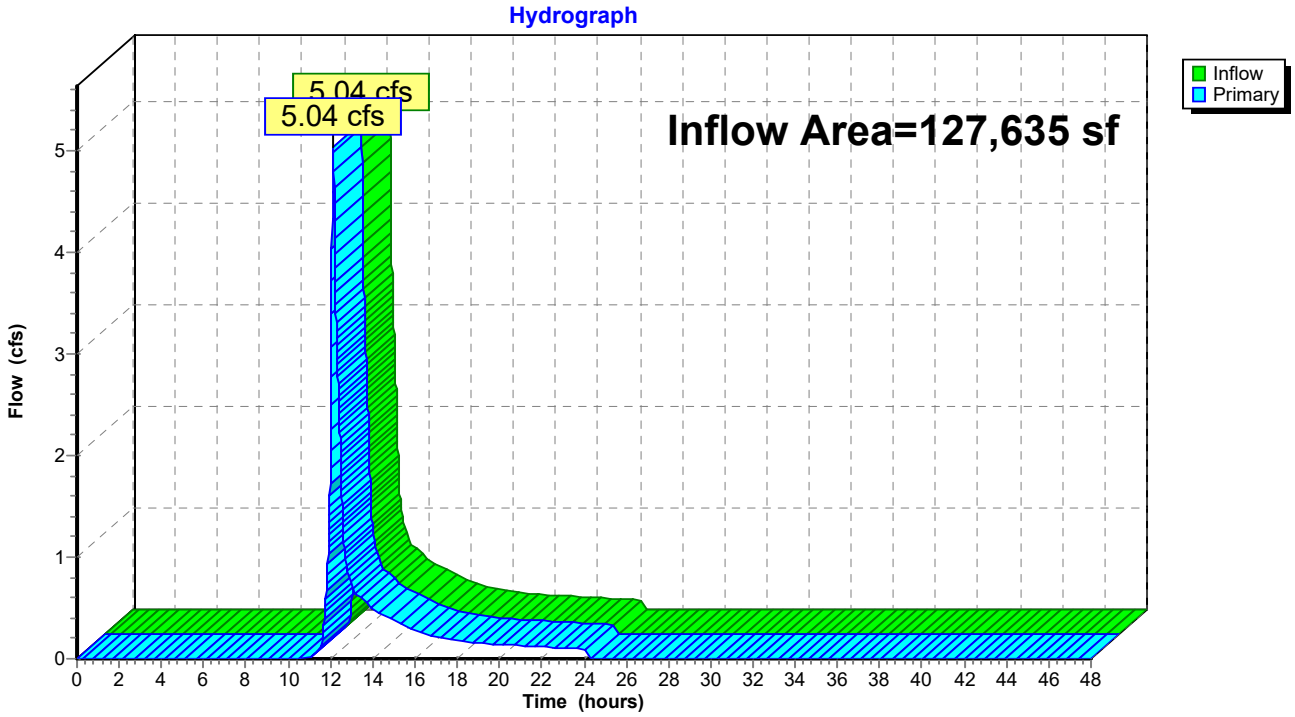


Summary for Link 2S: Waite Pond

Inflow Area = 127,635 sf, 3.16% Impervious, Inflow Depth = 1.73" for 25-Year event
Inflow = 5.04 cfs @ 12.13 hrs, Volume= 18,355 cf
Primary = 5.04 cfs @ 12.13 hrs, Volume= 18,355 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Summary for Subcatchment 1: Southwest Corner of Site

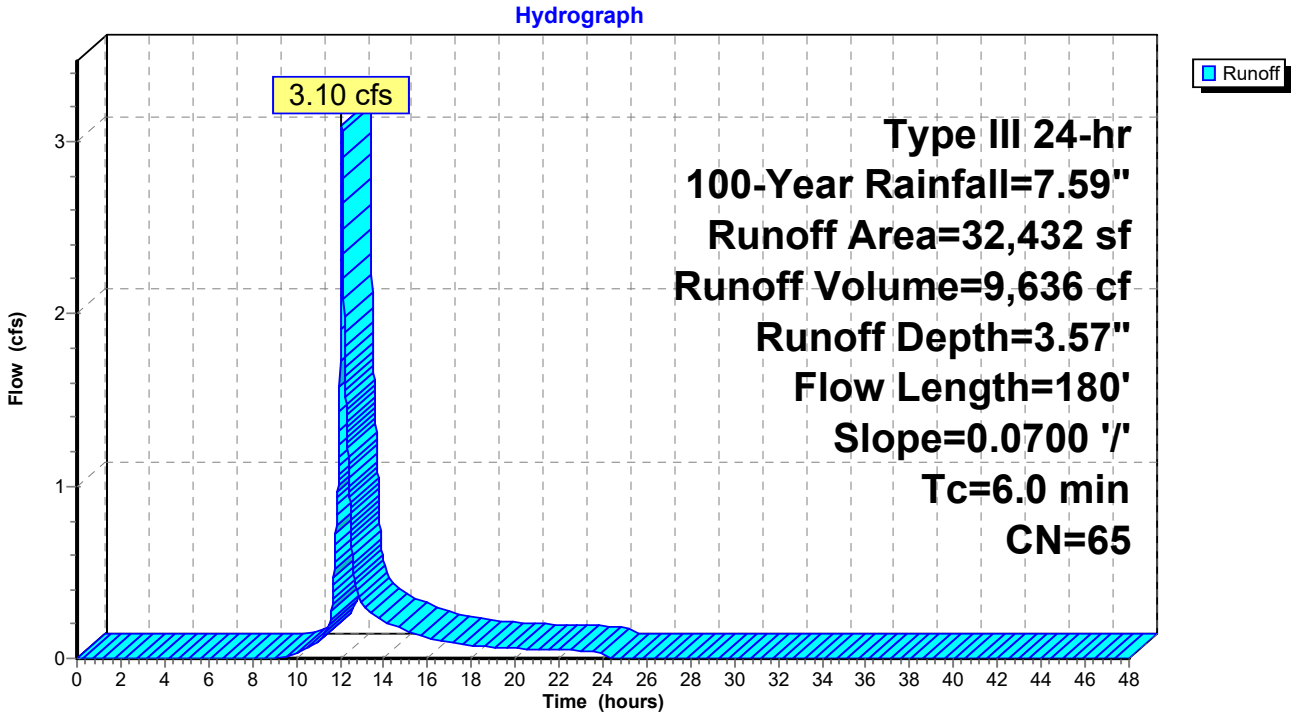
Runoff = 3.10 cfs @ 12.09 hrs, Volume= 9,636 cf, Depth= 3.57"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
5,992	98	Paved parking, HSG B
11,740	61	>75% Grass cover, Good, HSG B
14,700	55	Woods, Good, HSG B
32,432	65	Weighted Average
26,440		81.52% Pervious Area
5,992		18.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	180	0.0700	0.65		**Lag/CN Method,**
4.6	180	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1: Southwest Corner of Site



Summary for Subcatchment 2: Rear Portion of Site

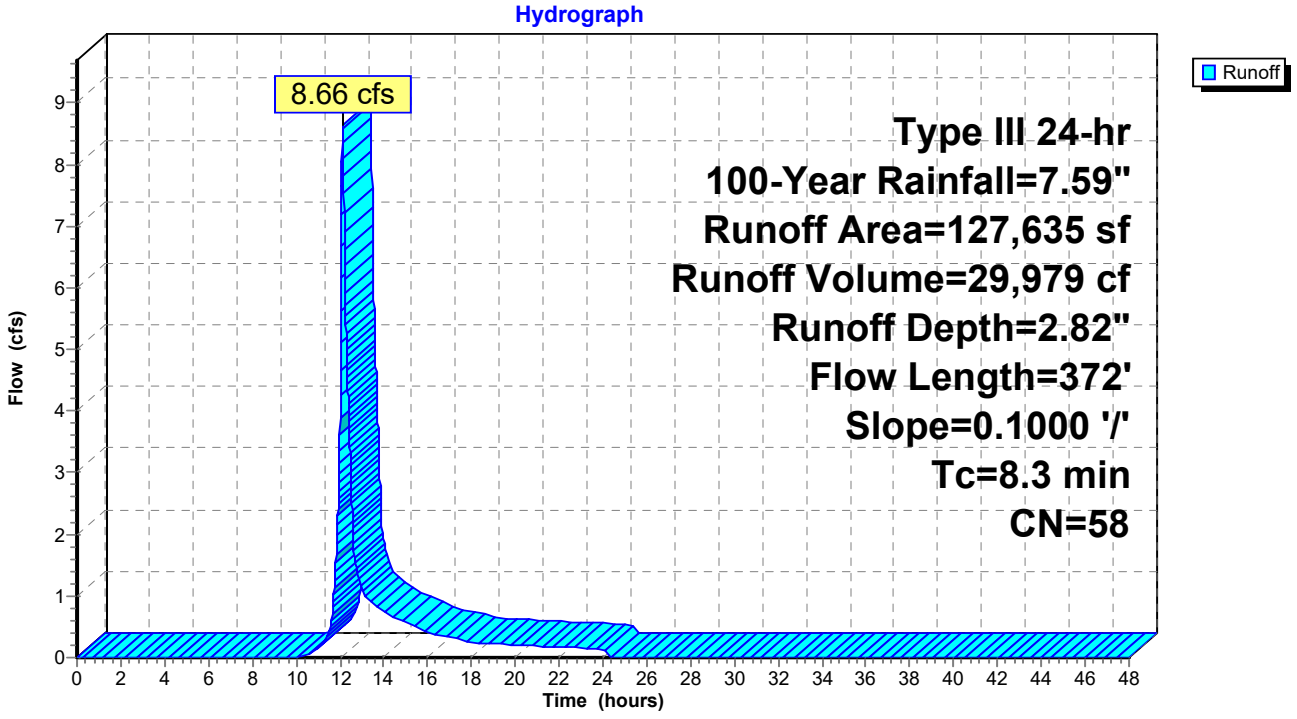
Runoff = 8.66 cfs @ 12.12 hrs, Volume= 29,979 cf, Depth= 2.82"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
4,027	98	Paved parking, HSG B
24,805	61	>75% Grass cover, Good, HSG B
98,803	55	Woods, Good, HSG B
127,635	58	Weighted Average
123,608		96.84% Pervious Area
4,027		3.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	372	0.1000	0.75		**Lag/CN Method,**

Subcatchment 2: Rear Portion of Site

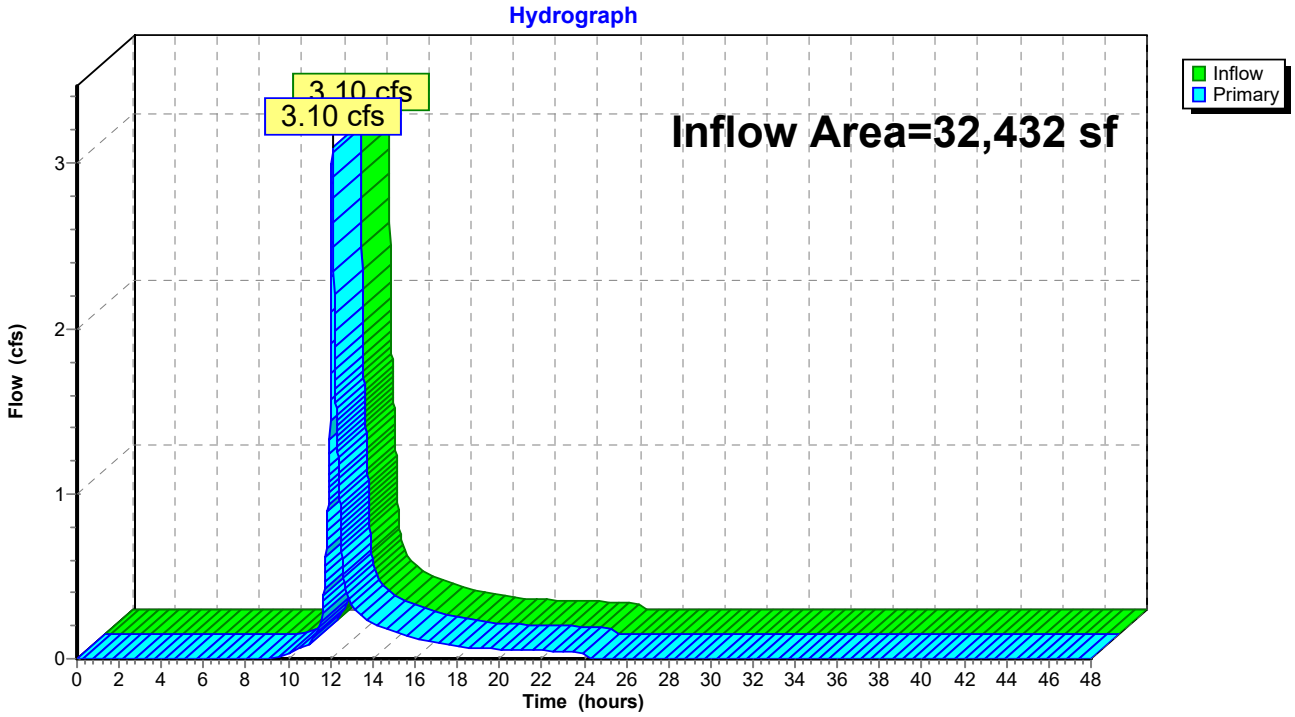


Summary for Link 1S: Main Street

Inflow Area = 32,432 sf, 18.48% Impervious, Inflow Depth = 3.57" for 100-Year event
Inflow = 3.10 cfs @ 12.09 hrs, Volume= 9,636 cf
Primary = 3.10 cfs @ 12.09 hrs, Volume= 9,636 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

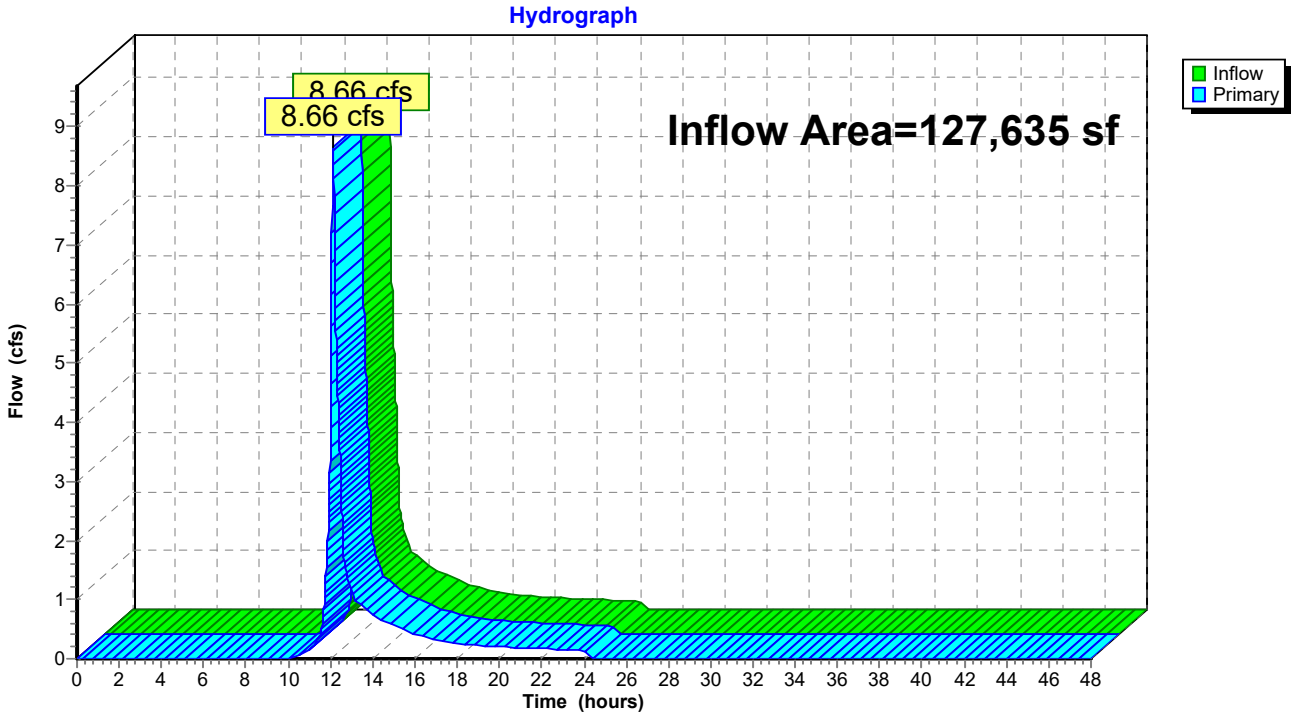


Summary for Link 2S: Waite Pond

Inflow Area = 127,635 sf, 3.16% Impervious, Inflow Depth = 2.82" for 100-Year event
Inflow = 8.66 cfs @ 12.12 hrs, Volume= 29,979 cf
Primary = 8.66 cfs @ 12.12 hrs, Volume= 29,979 cf, Atten= 0%, Lag= 0.0 min

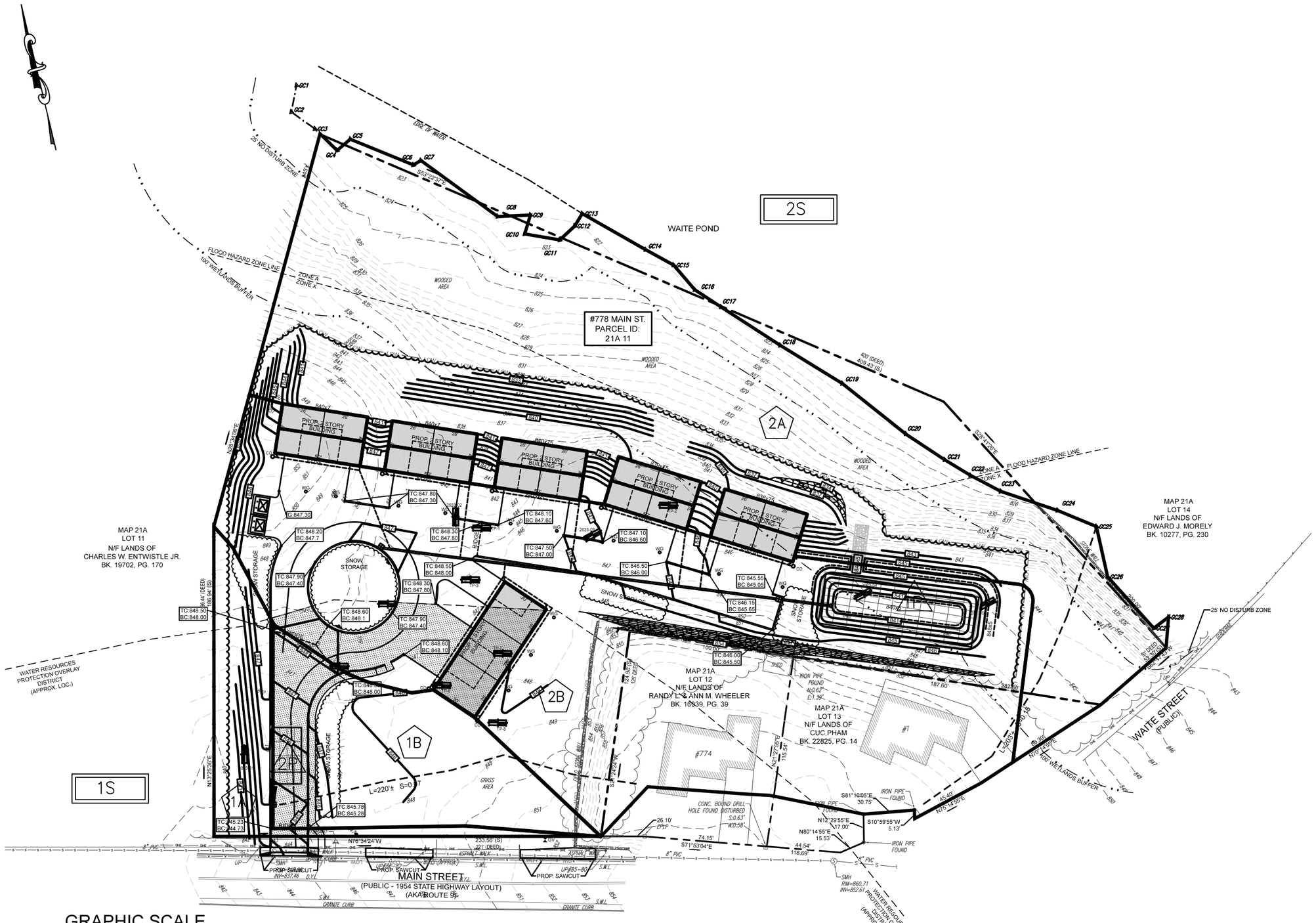
Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Appendix E

Post-Development Drainage Calculations



REVISIONS

NO.	DATE	DESCRIPTION	BY	CKD
1.	12/6/2022	ZONING BOARD OF APPEALS SUBMISSION	RL	JAB
2.	1/13/2023	REVISIONS PER PEER REVIEW COMMENTS	RL	JAB
3.	5/01/2023	PROPOSED TOWNHOUSE LAYOUT	MM	JAB

PROFESSIONAL SEAL

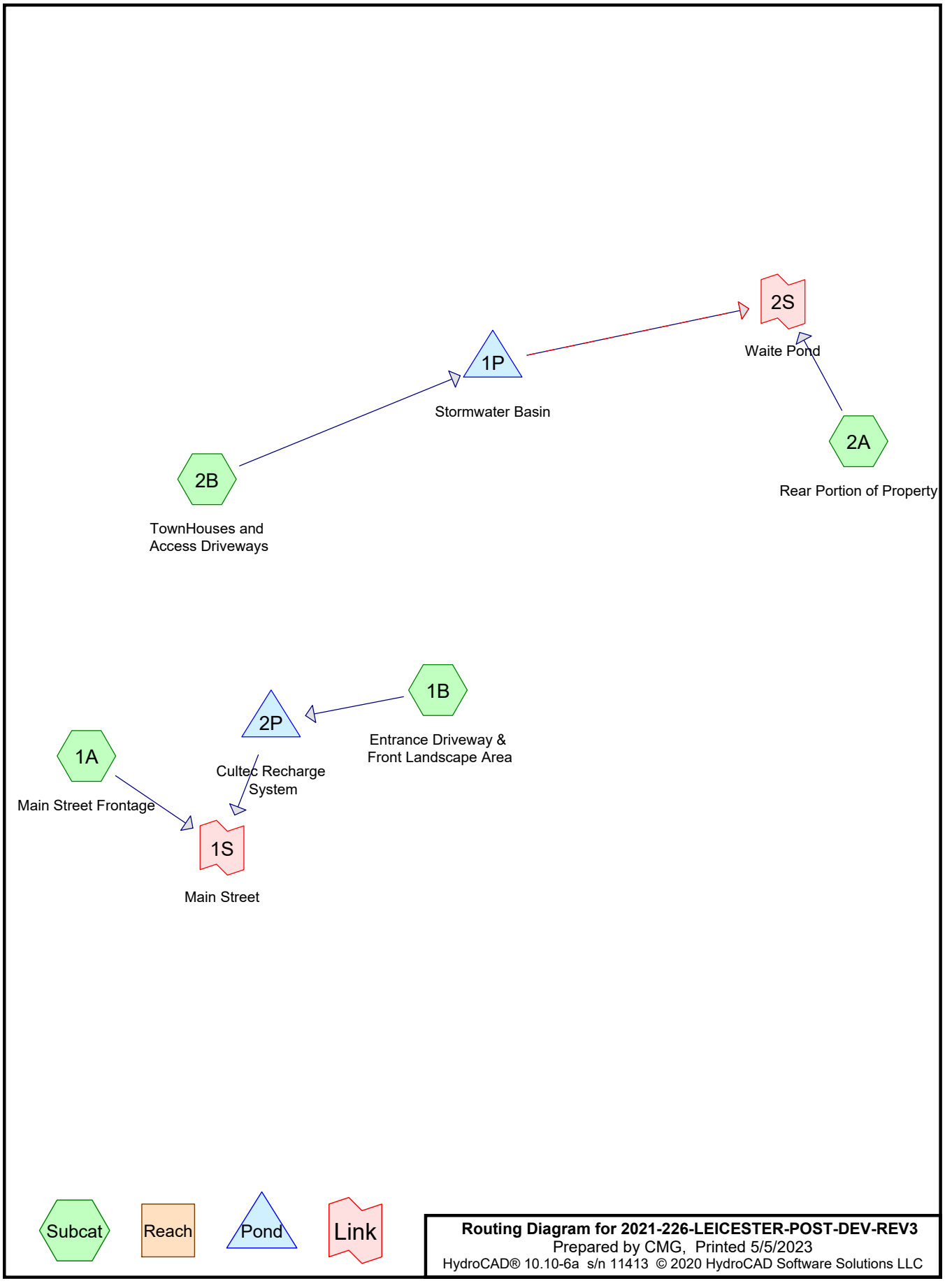
PROJECT:
PROPOSED MULTIFAMILY RESIDENCE
#778 MAIN STREET
LEICESTER, MA 01524

PREPARED FOR:
CHARLTON ROAD REALTY, LLC.
25 WATERVILLE LANE
SHREWSBURY, MA 01545

ENGINEERING SERVICES
ENVIRONMENTAL SERVICES
67 Hall Road
Sturbridge, MA 01566
Phone: 774-241-0901
fax: 774-241-0906

CMG EST. 2002

ISSUE DATE: 10/24/2022
DRAWN BY: RL | CHECKED BY: JAB
SCALE: 1" = 40'
PROJECT NO.: 2021-225
SHEET NAME:
POST-DEVELOPMENT DRAINAGE MAP
SHEET NO.:
D - 2.0



Routing Diagram for 2021-226-LEICESTER-POST-DEV-REV3
Prepared by CMG, Printed 5/5/2023

Summary for Subcatchment 1A: Main Street Frontage

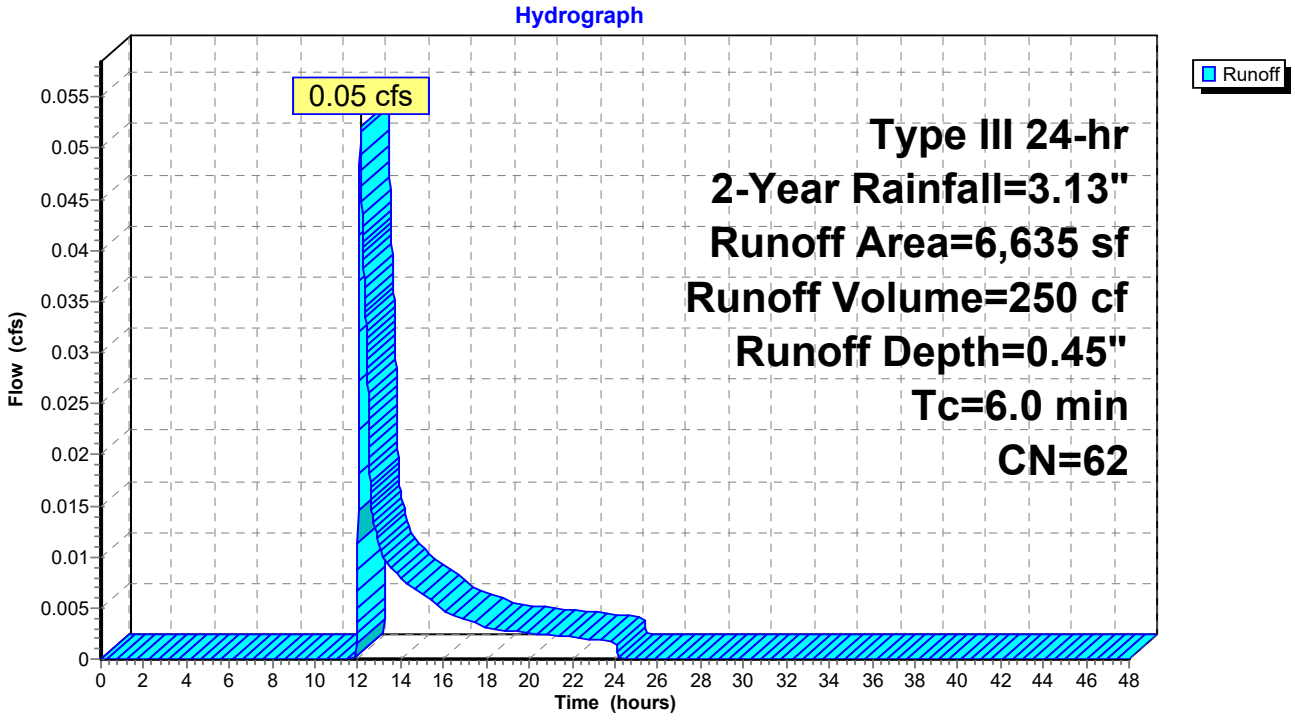
Runoff = 0.05 cfs @ 12.12 hrs, Volume= 250 cf, Depth= 0.45"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
114	98	Paved parking, HSG B
6,521	61	>75% Grass cover, Good, HSG B
6,635	62	Weighted Average
6,521		98.28% Pervious Area
114		1.72% Impervious Area

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

Subcatchment 1A: Main Street Frontage



Summary for Subcatchment 1B: Entrance Driveway & Front Landscape Area

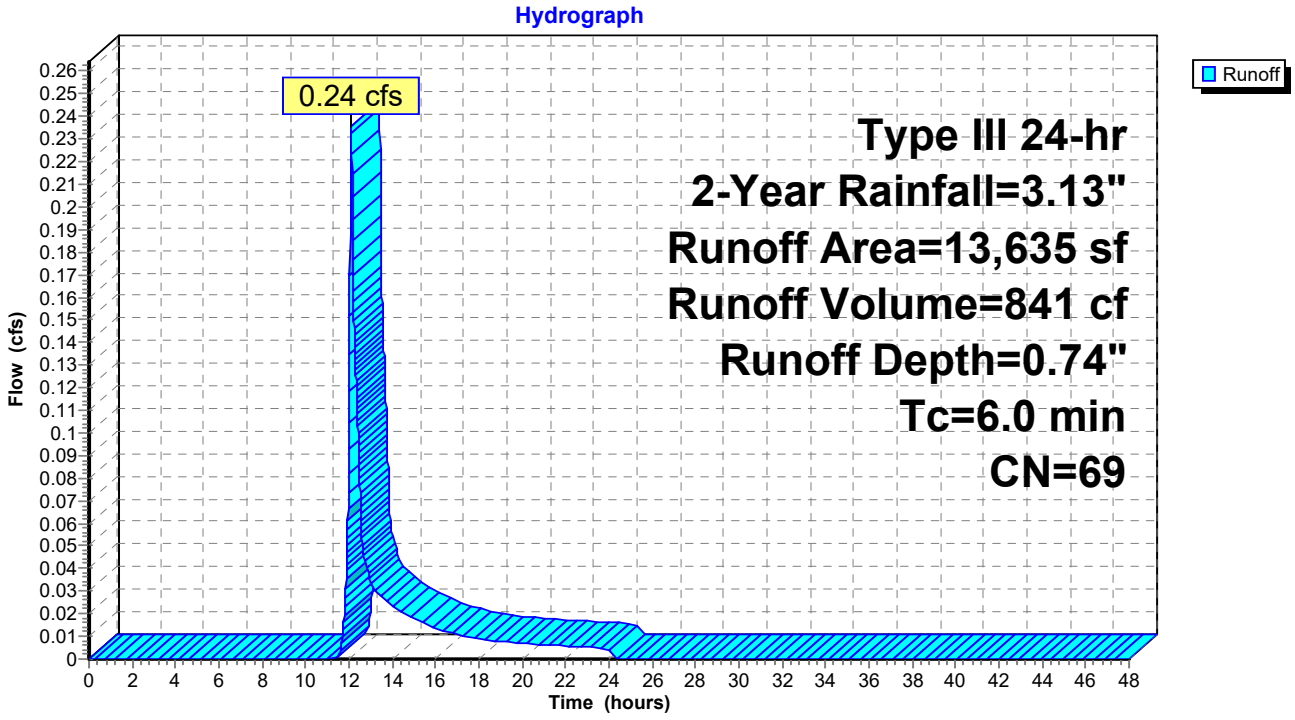
Runoff = 0.24 cfs @ 12.10 hrs, Volume= 841 cf, Depth= 0.74"
Routed to Pond 2P : Cultec Recharge System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
3,018	98	Paved parking, HSG B
10,617	61	>75% Grass cover, Good, HSG B
13,635	69	Weighted Average
10,617		77.87% Pervious Area
3,018		22.13% Impervious Area

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

Subcatchment 1B: Entrance Driveway & Front Landscape Area



Summary for Subcatchment 2A: Rear Portion of Property

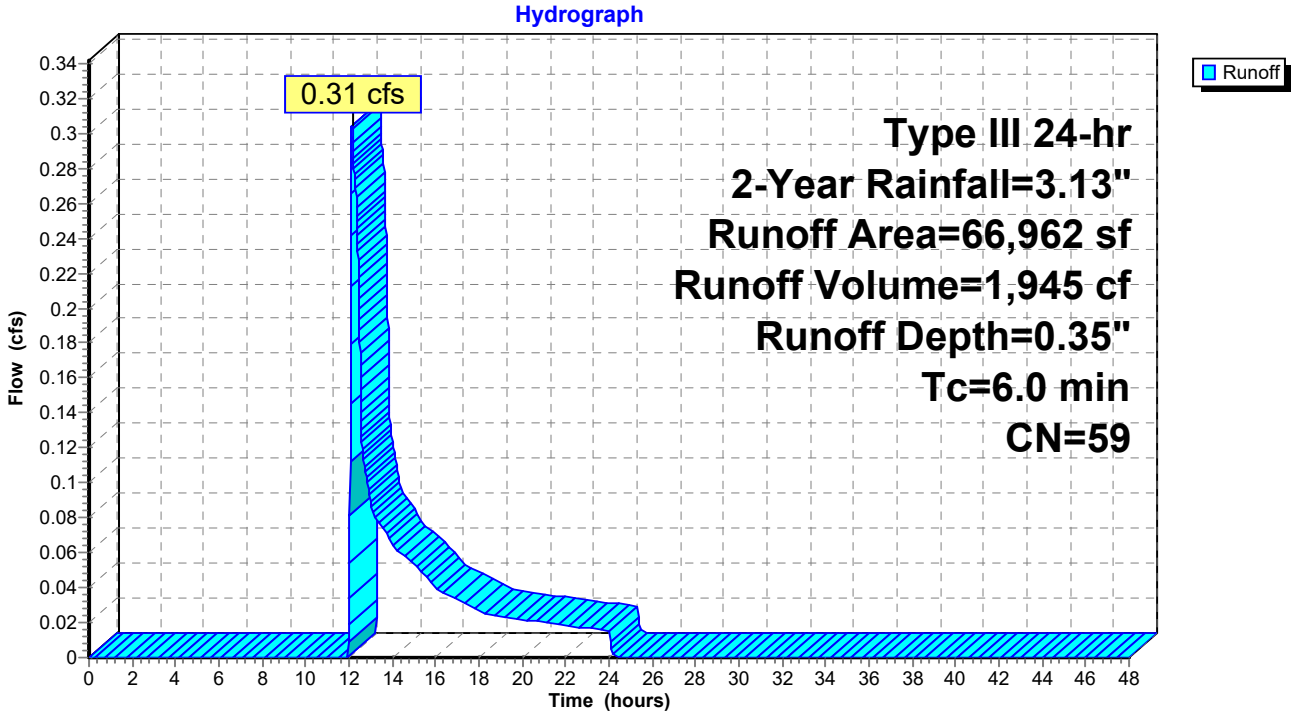
Runoff = 0.31 cfs @ 12.14 hrs, Volume= 1,945 cf, Depth= 0.35"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
3,900	98	Roofs, HSG B
16,932	61	>75% Grass cover, Good, HSG B
46,130	55	Woods, Good, HSG B
66,962	59	Weighted Average
63,062		94.18% Pervious Area
3,900		5.82% Impervious Area

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

Subcatchment 2A: Rear Portion of Property



Summary for Subcatchment 2B: TownHouses and Access Driveways

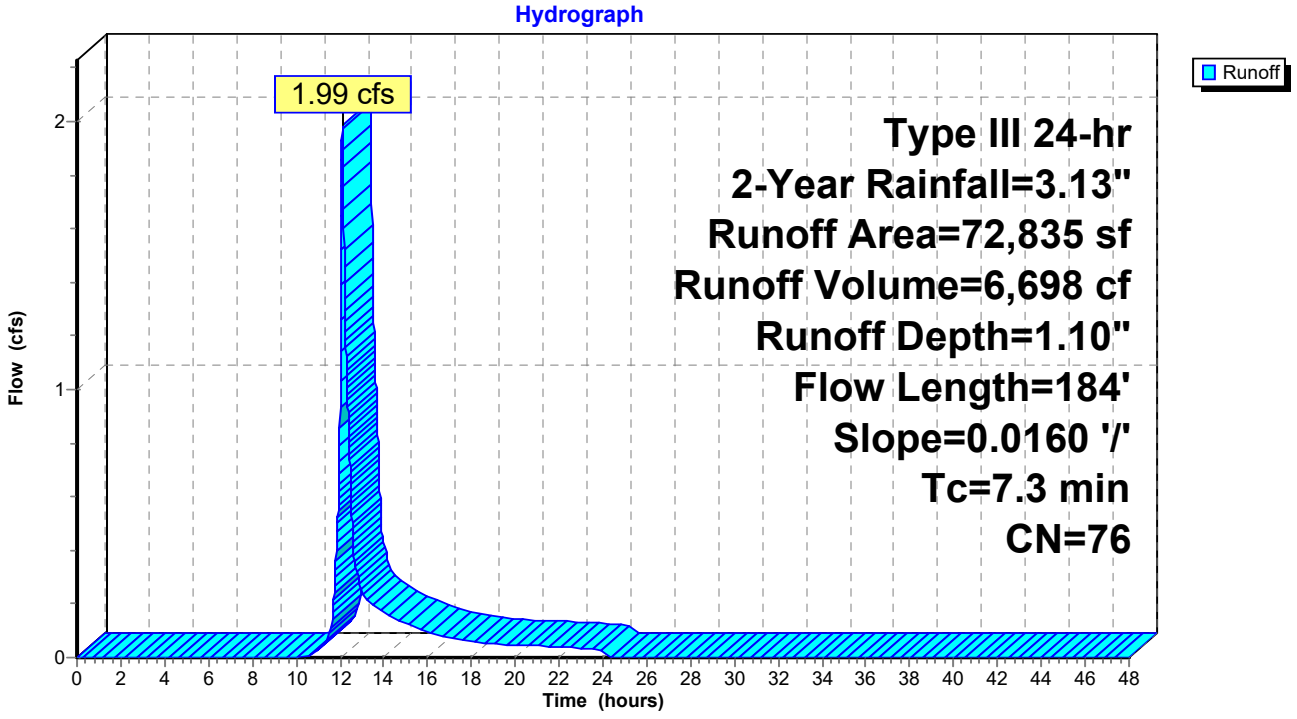
Runoff = 1.99 cfs @ 12.11 hrs, Volume= 6,698 cf, Depth= 1.10"
Routed to Pond 1P : Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

Area (sf)	CN	Description
9,869	98	Roofs, HSG B
19,423	98	Paved parking, HSG B
43,543	61	>75% Grass cover, Good, HSG B
72,835	76	Weighted Average
43,543		59.78% Pervious Area
29,292		40.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	184	0.0160	0.42		**Lag/CN Method,**

Subcatchment 2B: TownHouses and Access Driveways



Summary for Pond 1P: Stormwater Basin

Inflow Area = 72,835 sf, 40.22% Impervious, Inflow Depth = 1.10" for 2-Year event
Inflow = 1.99 cfs @ 12.11 hrs, Volume= 6,698 cf
Outflow = 0.12 cfs @ 15.11 hrs, Volume= 6,699 cf, Atten= 94%, Lag= 180.0 min
Discarded = 0.12 cfs @ 15.11 hrs, Volume= 6,699 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 2S : Waite Pond
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 2S : Waite Pond

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 842.67' @ 15.11 hrs Surf.Area= 2,235 sf Storage= 3,348 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 330.0 min (1,188.1 - 858.1)

Volume	Invert	Avail.Storage	Storage Description
#1	840.50'	12,504 cf	**Stormwater Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
840.50	910	171.0	0	0	910
841.00	1,186	183.0	522	522	1,259
842.00	1,792	207.0	1,479	2,001	2,029
843.00	2,470	231.0	2,122	4,123	2,894
844.00	3,191	249.0	2,823	6,946	3,622
845.00	3,970	263.0	3,573	10,519	4,248
845.50	3,970	263.0	1,985	12,504	4,379

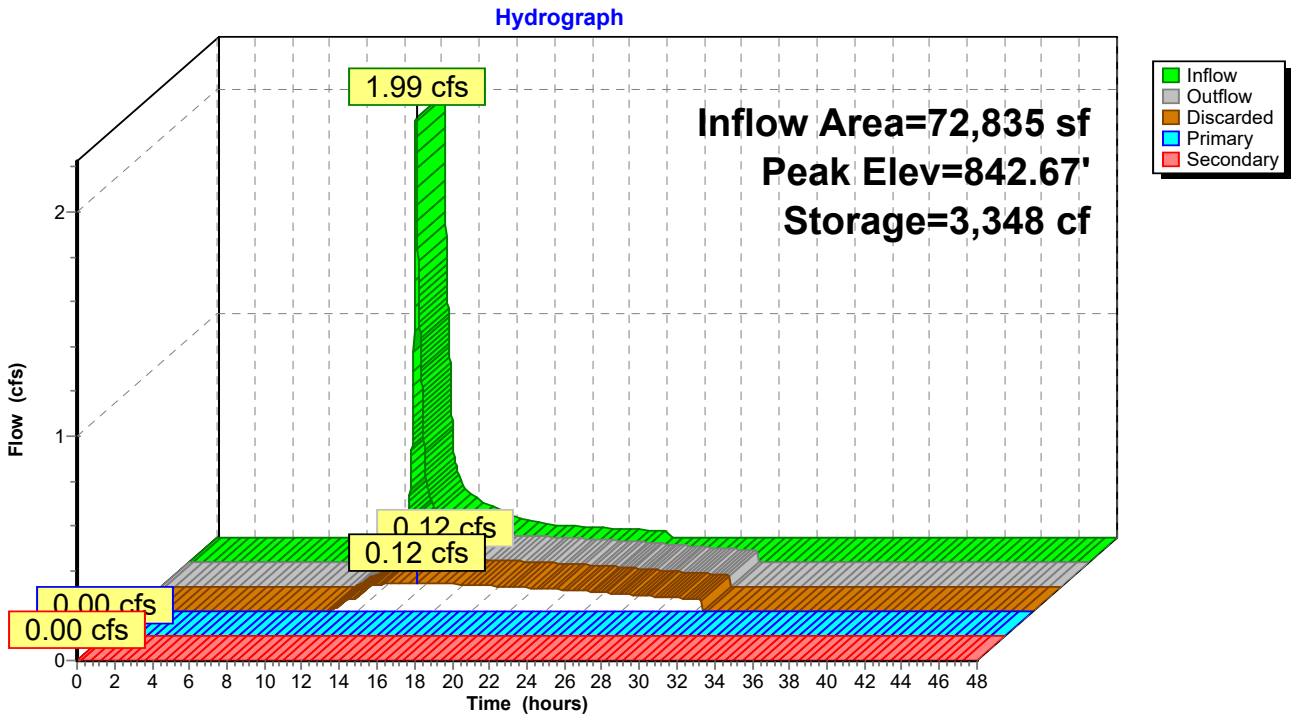
Device	Routing	Invert	Outlet Devices
#1	Discarded	840.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 238.40'
#2	Secondary	844.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 4	843.25'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	838.65'	**12.0" Round Culvert** L= 33.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 838.65' / 836.00' S= 0.0803 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.12 cfs @ 15.11 hrs HW=842.67' (Free Discharge)
↑**1=Exfiltration** (Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=840.50' TW=0.00' (Dynamic Tailwater)
↑**4=Culvert** (Passes 0.00 cfs of 3.88 cfs potential flow)
↑**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=840.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Stormwater Basin



Summary for Pond 2P: Cultec Recharge System

Inflow Area = 13,635 sf, 22.13% Impervious, Inflow Depth = 0.74" for 2-Year event
Inflow = 0.24 cfs @ 12.10 hrs, Volume= 841 cf
Outflow = 0.05 cfs @ 12.60 hrs, Volume= 842 cf, Atten= 79%, Lag= 30.1 min
Discarded = 0.05 cfs @ 12.60 hrs, Volume= 842 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 1S : Main Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 839.60' @ 12.60 hrs Surf.Area= 696 sf Storage= 196 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 26.8 min (908.0 - 881.1)

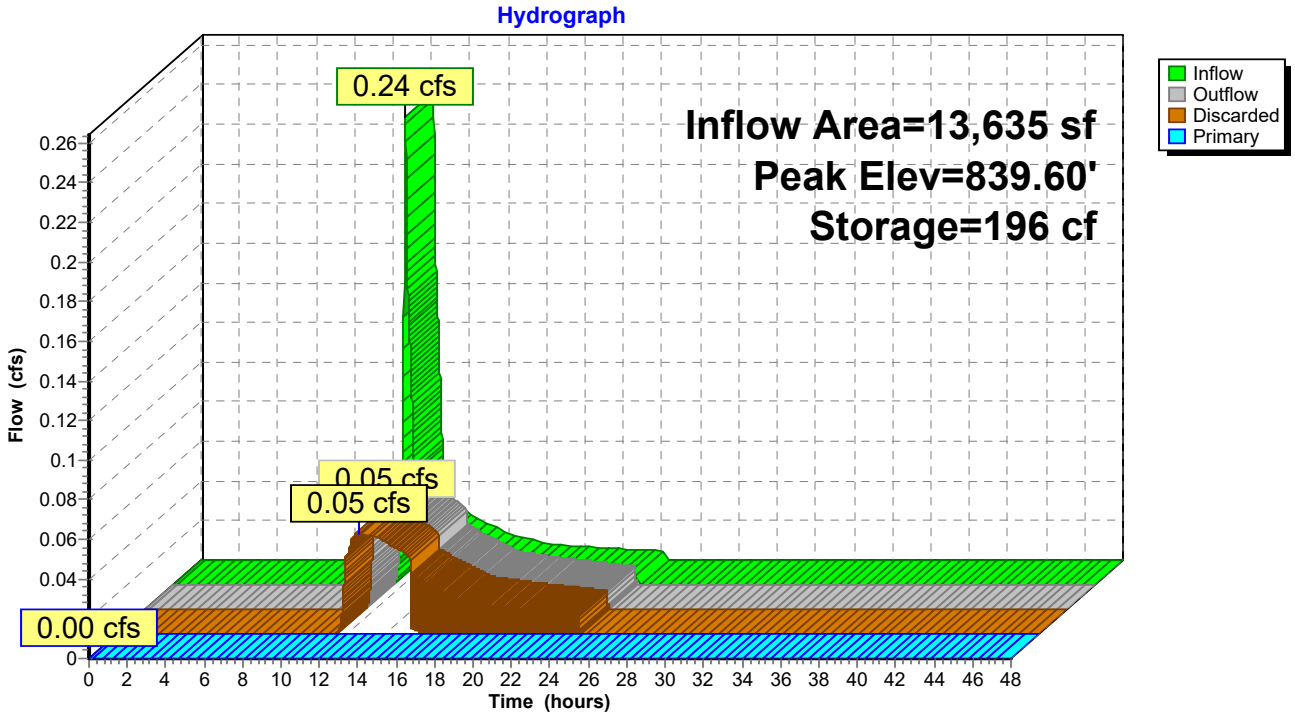
Volume	Invert	Avail.Storage	Storage Description
#1	839.00'	633 cf	**19.32'W x 36.00'L x 3.54'H Crushed Stone Surround** 2,462 cf Overall - 879 cf Embedded = 1,583 cf x 40.0% Voids
#2	839.50'	879 cf	**Cultec R-330XLHD** x 16 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		1,512 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	839.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 837.00'
#2	Primary	841.37'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 841.37' / 840.00' S= 0.0457 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.05 cfs @ 12.60 hrs HW=839.60' (Free Discharge)
↑**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=839.00' TW=0.00' (Dynamic Tailwater)
↑**2=Culvert** (Controls 0.00 cfs)

Pond 2P: Cultec Recharge System

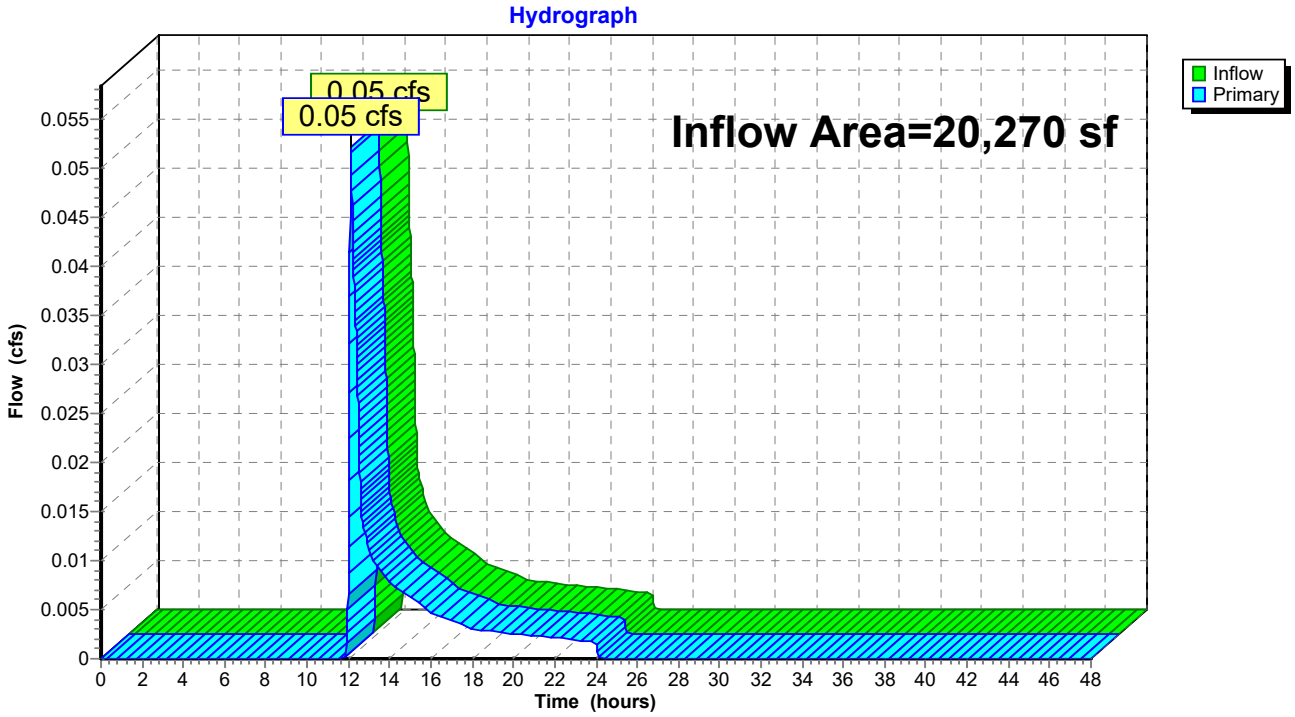


Summary for Link 1S: Main Street

Inflow Area = 20,270 sf, 15.45% Impervious, Inflow Depth = 0.15" for 2-Year event
Inflow = 0.05 cfs @ 12.12 hrs, Volume= 250 cf
Primary = 0.05 cfs @ 12.12 hrs, Volume= 250 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

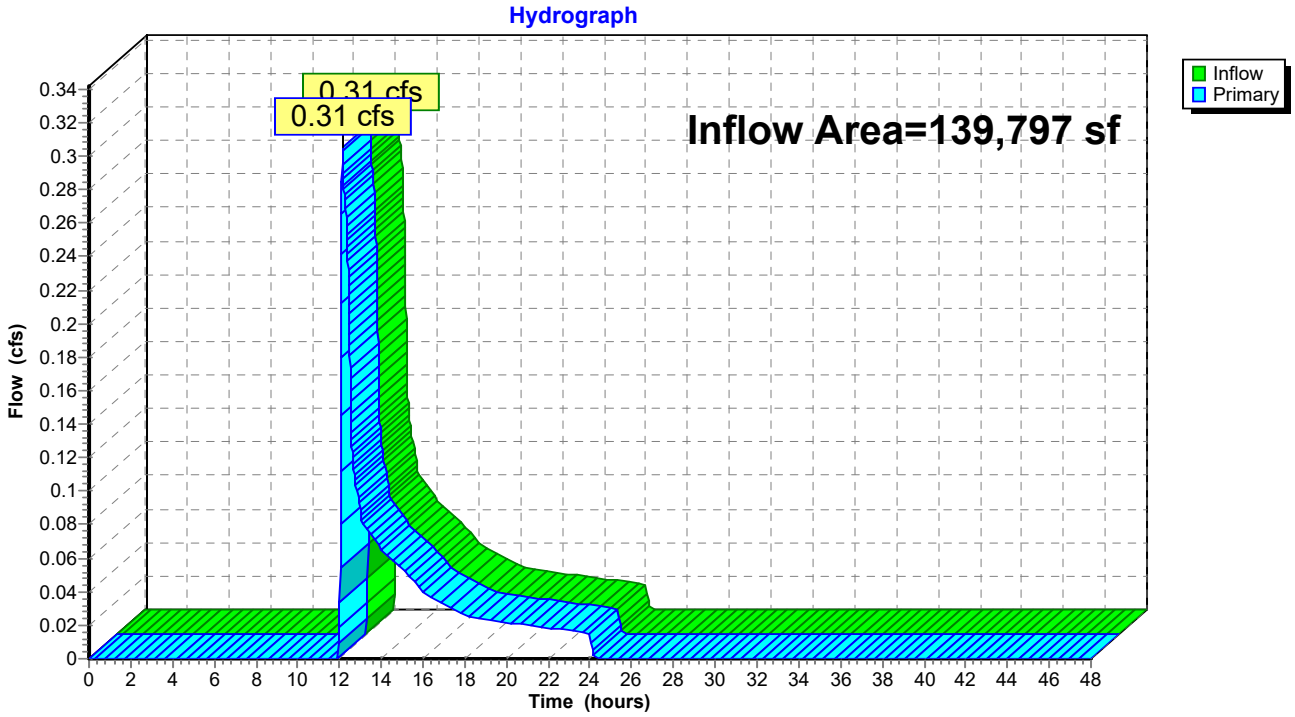


Summary for Link 2S: Waite Pond

Inflow Area = 139,797 sf, 23.74% Impervious, Inflow Depth = 0.17" for 2-Year event
Inflow = 0.31 cfs @ 12.14 hrs, Volume= 1,945 cf
Primary = 0.31 cfs @ 12.14 hrs, Volume= 1,945 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Summary for Subcatchment 1A: Main Street Frontage

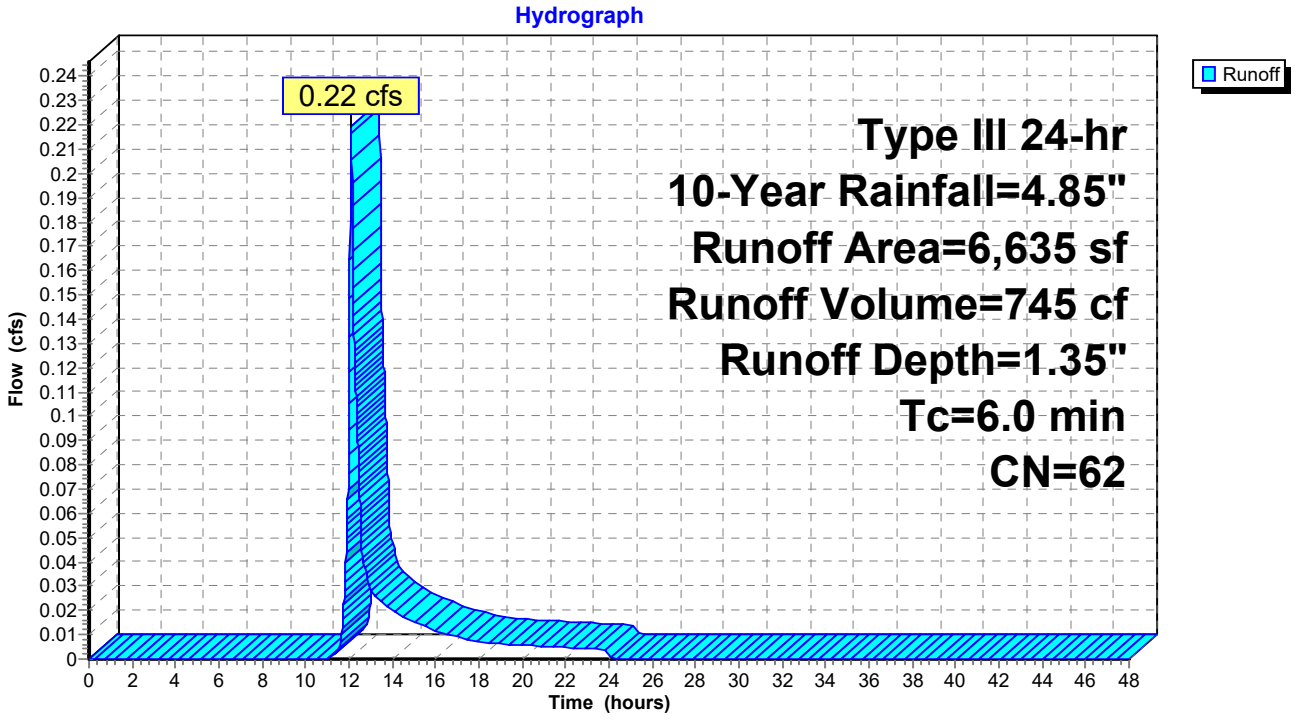
Runoff = 0.22 cfs @ 12.10 hrs, Volume= 745 cf, Depth= 1.35"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
114	98	Paved parking, HSG B
6,521	61	>75% Grass cover, Good, HSG B
6,635	62	Weighted Average
6,521		98.28% Pervious Area
114		1.72% Impervious Area

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

Subcatchment 1A: Main Street Frontage



Summary for Subcatchment 1B: Entrance Driveway & Front Landscape Area

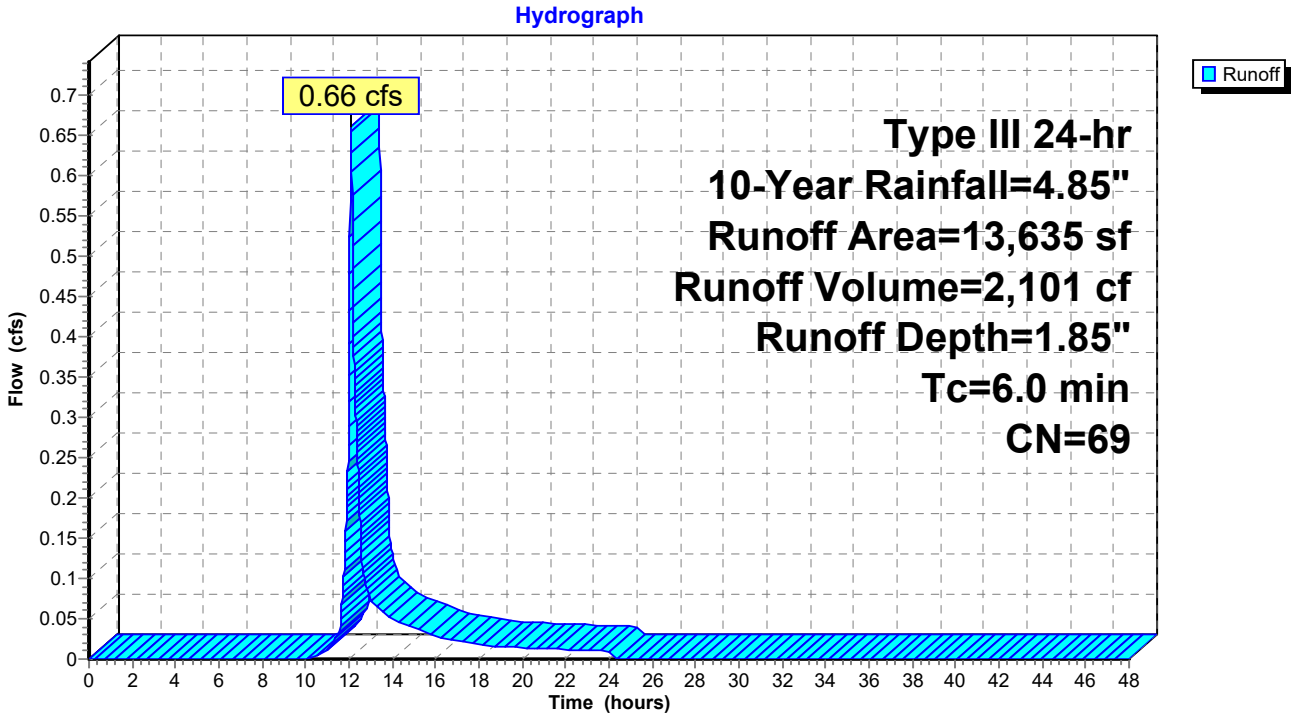
Runoff = 0.66 cfs @ 12.09 hrs, Volume= 2,101 cf, Depth= 1.85"
Routed to Pond 2P : Cultec Recharge System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
3,018	98	Paved parking, HSG B
10,617	61	>75% Grass cover, Good, HSG B
13,635	69	Weighted Average
10,617		77.87% Pervious Area
3,018		22.13% Impervious Area

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

Subcatchment 1B: Entrance Driveway & Front Landscape Area



Summary for Subcatchment 2A: Rear Portion of Property

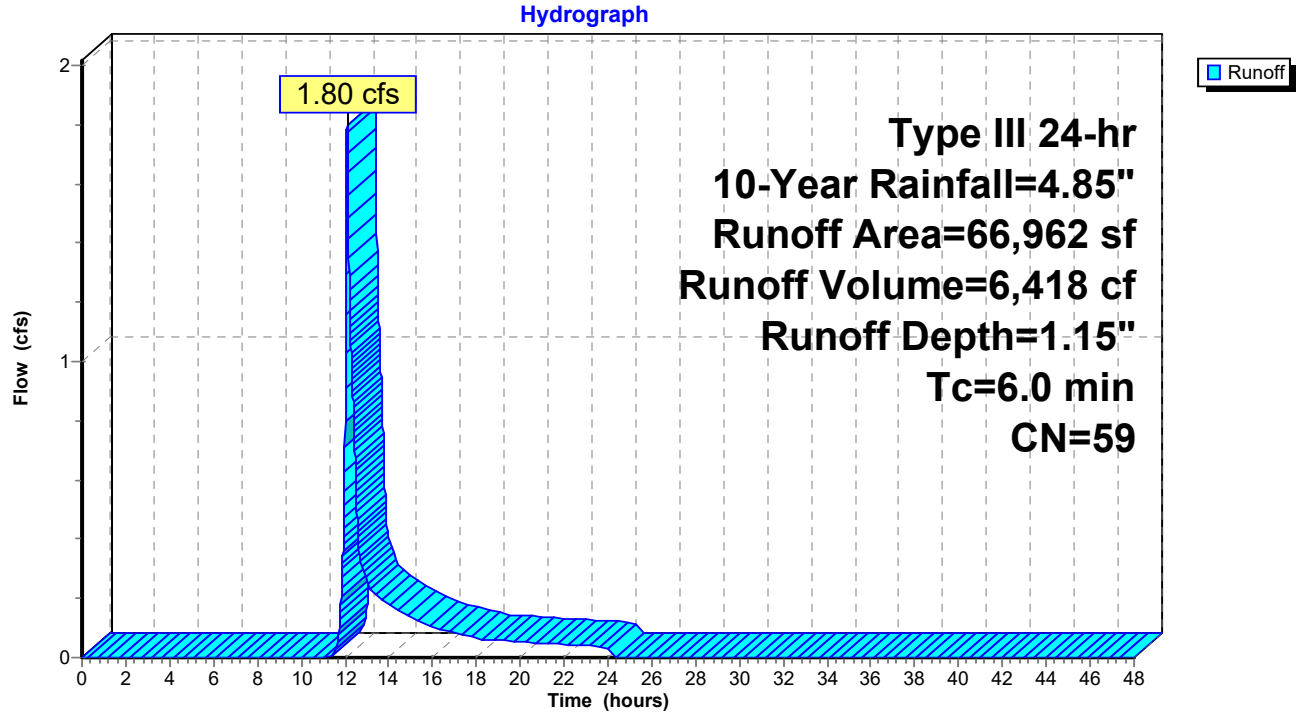
Runoff = 1.80 cfs @ 12.10 hrs, Volume= 6,418 cf, Depth= 1.15"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
3,900	98	Roofs, HSG B
16,932	61	>75% Grass cover, Good, HSG B
46,130	55	Woods, Good, HSG B
66,962	59	Weighted Average
63,062		94.18% Pervious Area
3,900		5.82% Impervious Area

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

Subcatchment 2A: Rear Portion of Property



Summary for Subcatchment 2B: TownHouses and Access Driveways

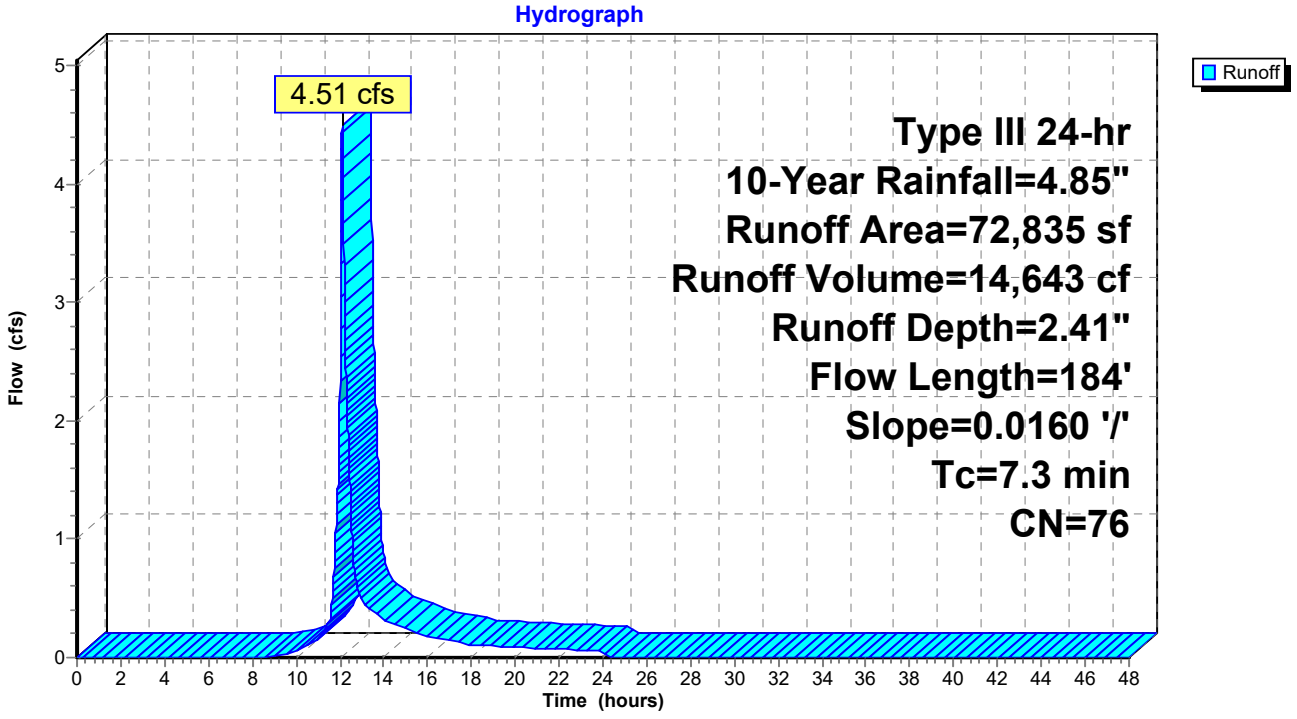
Runoff = 4.51 cfs @ 12.11 hrs, Volume= 14,643 cf, Depth= 2.41"
Routed to Pond 1P : Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.85"

Area (sf)	CN	Description
9,869	98	Roofs, HSG B
19,423	98	Paved parking, HSG B
43,543	61	>75% Grass cover, Good, HSG B
72,835	76	Weighted Average
43,543		59.78% Pervious Area
29,292		40.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	184	0.0160	0.42		**Lag/CN Method,**

Subcatchment 2B: TownHouses and Access Driveways



Summary for Pond 1P: Stormwater Basin

Inflow Area = 72,835 sf, 40.22% Impervious, Inflow Depth = 2.41" for 10-Year event
Inflow = 4.51 cfs @ 12.11 hrs, Volume= 14,643 cf
Outflow = 1.67 cfs @ 12.42 hrs, Volume= 14,643 cf, Atten= 63%, Lag= 18.5 min
Discarded = 0.16 cfs @ 12.42 hrs, Volume= 10,224 cf
Primary = 1.51 cfs @ 12.42 hrs, Volume= 4,419 cf
Routed to Link 2S : Waite Pond
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 2S : Waite Pond

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 843.53' @ 12.42 hrs Surf.Area= 2,839 sf Storage= 5,524 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 290.9 min (1,125.8 - 835.0)

Volume	Invert	Avail.Storage	Storage Description
#1	840.50'	12,504 cf	**Stormwater Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
840.50	910	171.0	0	0	910
841.00	1,186	183.0	522	522	1,259
842.00	1,792	207.0	1,479	2,001	2,029
843.00	2,470	231.0	2,122	4,123	2,894
844.00	3,191	249.0	2,823	6,946	3,622
845.00	3,970	263.0	3,573	10,519	4,248
845.50	3,970	263.0	1,985	12,504	4,379

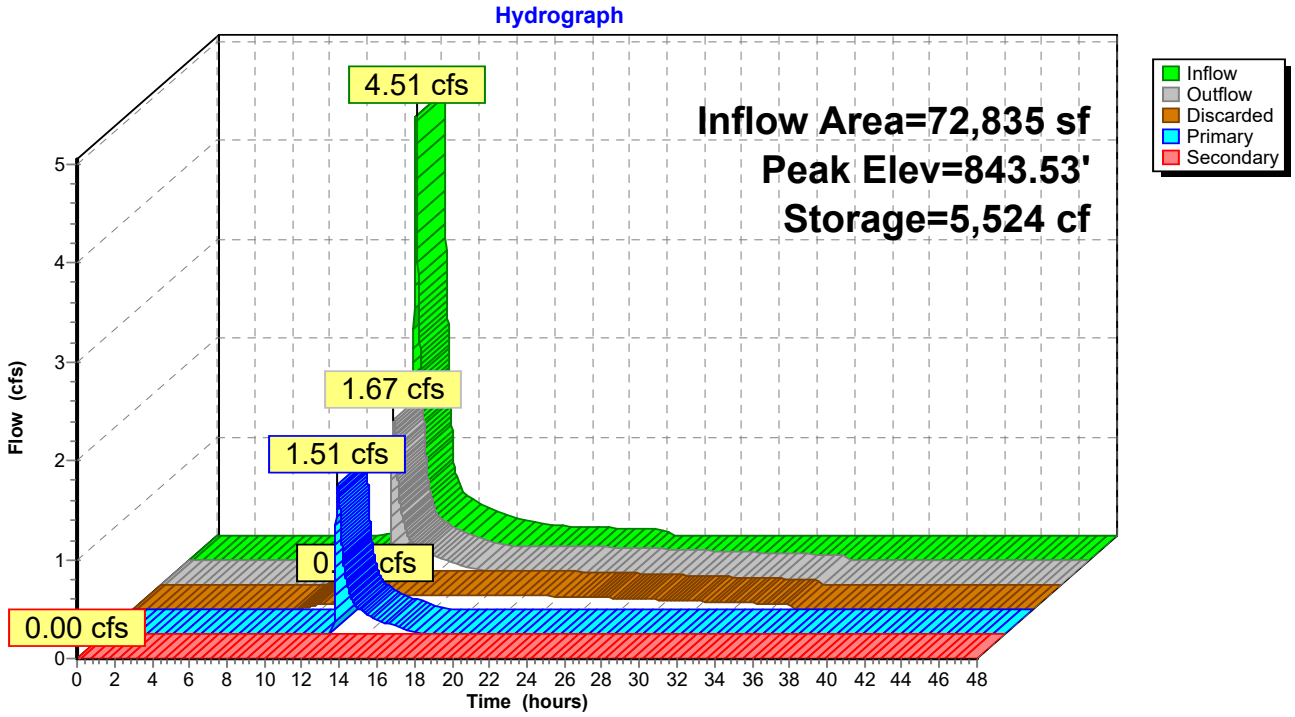
Device	Routing	Invert	Outlet Devices
#1	Discarded	840.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 238.40'
#2	Secondary	844.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 4	843.25'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	838.65'	**12.0" Round Culvert** L= 33.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 838.65' / 836.00' S= 0.0803 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.16 cfs @ 12.42 hrs HW=843.53' (Free Discharge)
↑**1=Exfiltration** (Controls 0.16 cfs)

Primary OutFlow Max=1.51 cfs @ 12.42 hrs HW=843.53' TW=0.00' (Dynamic Tailwater)
↑**4=Culvert** (Passes 1.51 cfs of 6.98 cfs potential flow)
↑**3=Orifice/Grate** (Weir Controls 1.51 cfs @ 1.72 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=840.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Stormwater Basin



Summary for Pond 2P: Cultec Recharge System

Inflow Area = 13,635 sf, 22.13% Impervious, Inflow Depth = 1.85" for 10-Year event
Inflow = 0.66 cfs @ 12.09 hrs, Volume= 2,101 cf
Outflow = 0.07 cfs @ 13.06 hrs, Volume= 2,101 cf, Atten= 89%, Lag= 57.9 min
Discarded = 0.07 cfs @ 13.06 hrs, Volume= 2,101 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 1S : Main Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 840.69' @ 13.06 hrs Surf.Area= 696 sf Storage= 787 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 112.3 min (964.3 - 851.9)

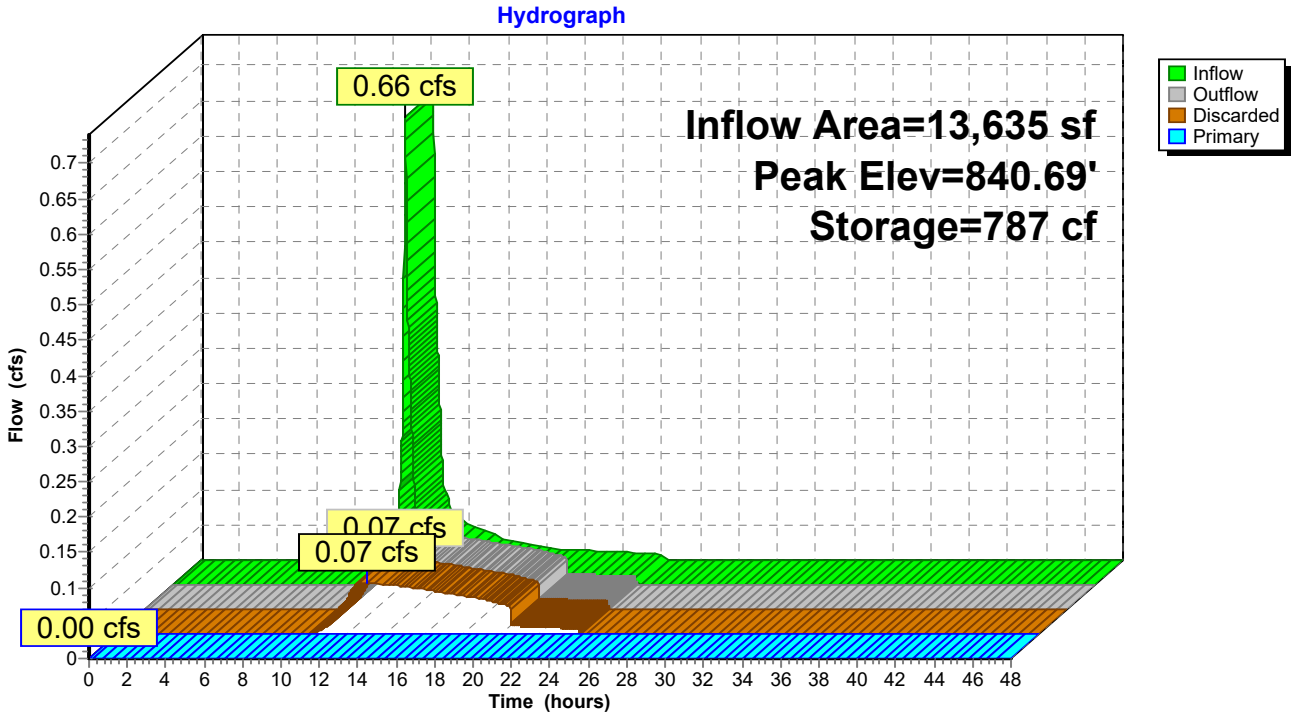
Volume	Invert	Avail.Storage	Storage Description
#1	839.00'	633 cf	**19.32'W x 36.00'L x 3.54'H Crushed Stone Surround** 2,462 cf Overall - 879 cf Embedded = 1,583 cf x 40.0% Voids
#2	839.50'	879 cf	**Cultec R-330XLHD** x 16 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		1,512 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	839.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 837.00'
#2	Primary	841.37'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 841.37' / 840.00' S= 0.0457 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 13.06 hrs HW=840.69' (Free Discharge)
↑**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=839.00' TW=0.00' (Dynamic Tailwater)
↑**2=Culvert** (Controls 0.00 cfs)

Pond 2P: Cultec Recharge System

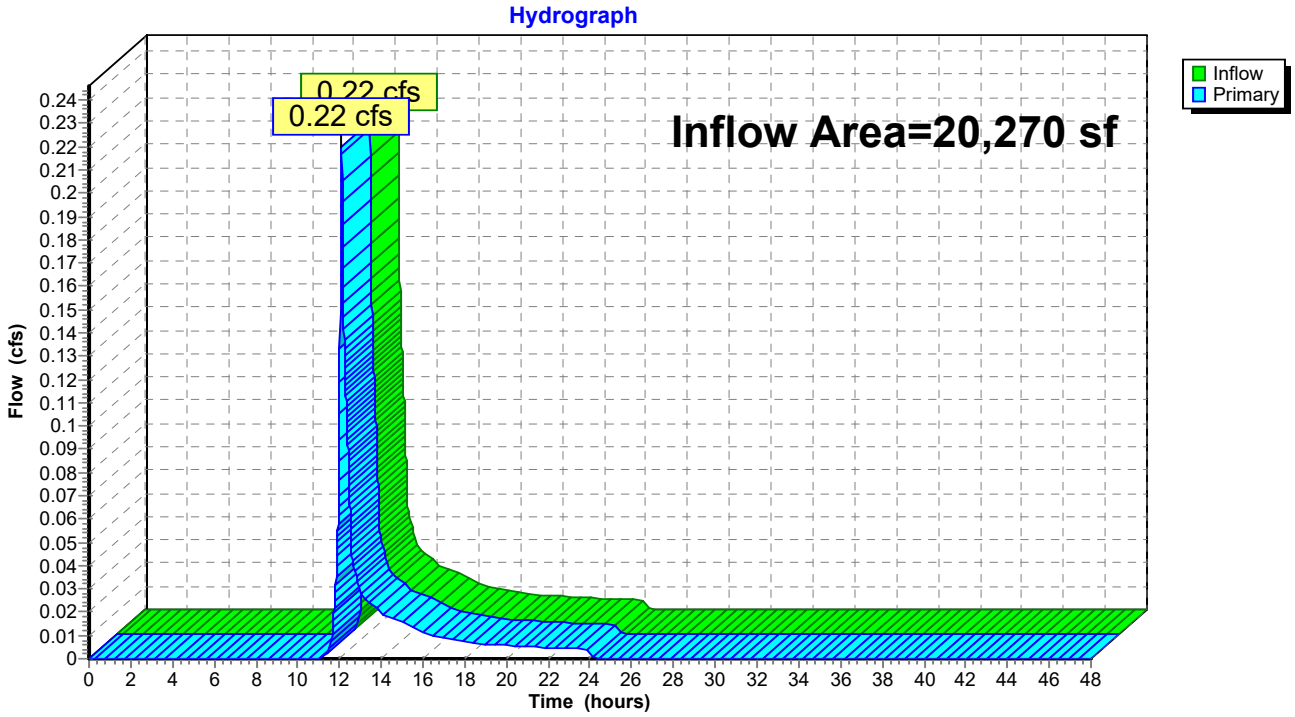


Summary for Link 1S: Main Street

Inflow Area = 20,270 sf, 15.45% Impervious, Inflow Depth = 0.44" for 10-Year event
Inflow = 0.22 cfs @ 12.10 hrs, Volume= 745 cf
Primary = 0.22 cfs @ 12.10 hrs, Volume= 745 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

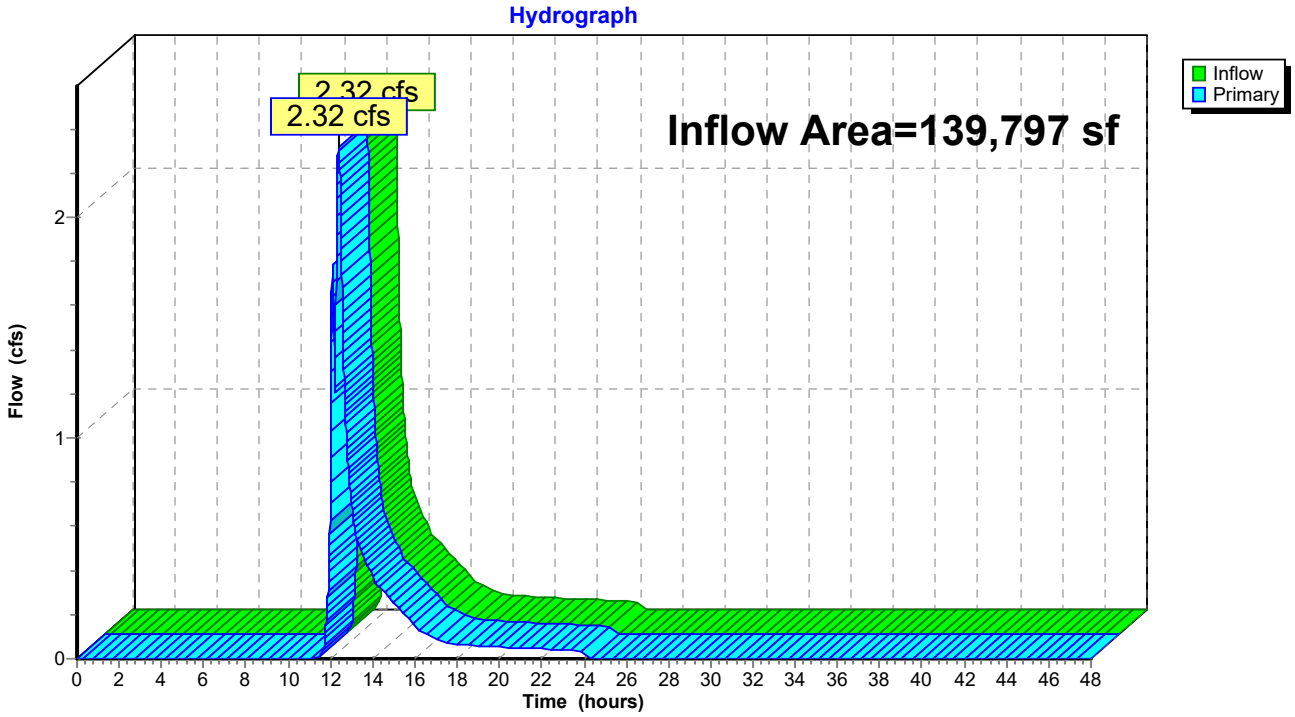


Summary for Link 2S: Waite Pond

Inflow Area = 139,797 sf, 23.74% Impervious, Inflow Depth = 0.93" for 10-Year event
Inflow = 2.32 cfs @ 12.38 hrs, Volume= 10,837 cf
Primary = 2.32 cfs @ 12.38 hrs, Volume= 10,837 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Summary for Subcatchment 1A: Main Street Frontage

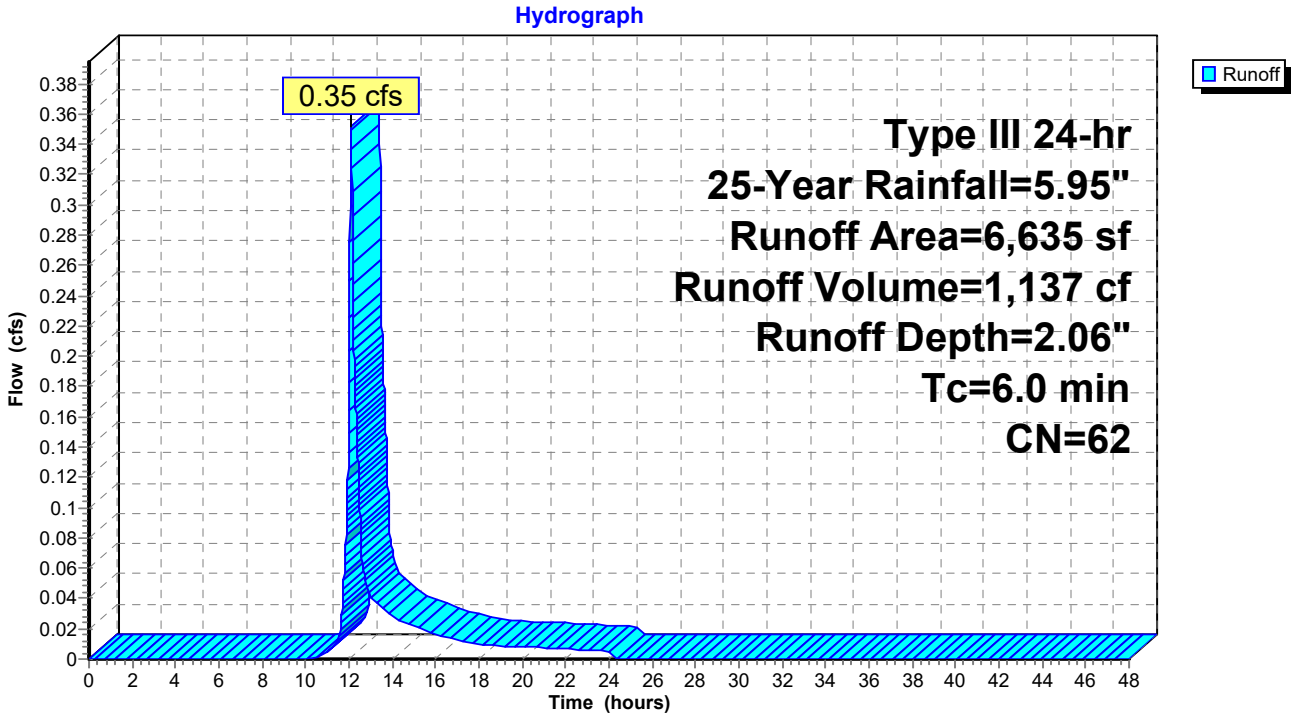
Runoff = 0.35 cfs @ 12.09 hrs, Volume= 1,137 cf, Depth= 2.06"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
114	98	Paved parking, HSG B
6,521	61	>75% Grass cover, Good, HSG B
6,635	62	Weighted Average
6,521		98.28% Pervious Area
114		1.72% Impervious Area

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

Subcatchment 1A: Main Street Frontage



Summary for Subcatchment 1B: Entrance Driveway & Front Landscape Area

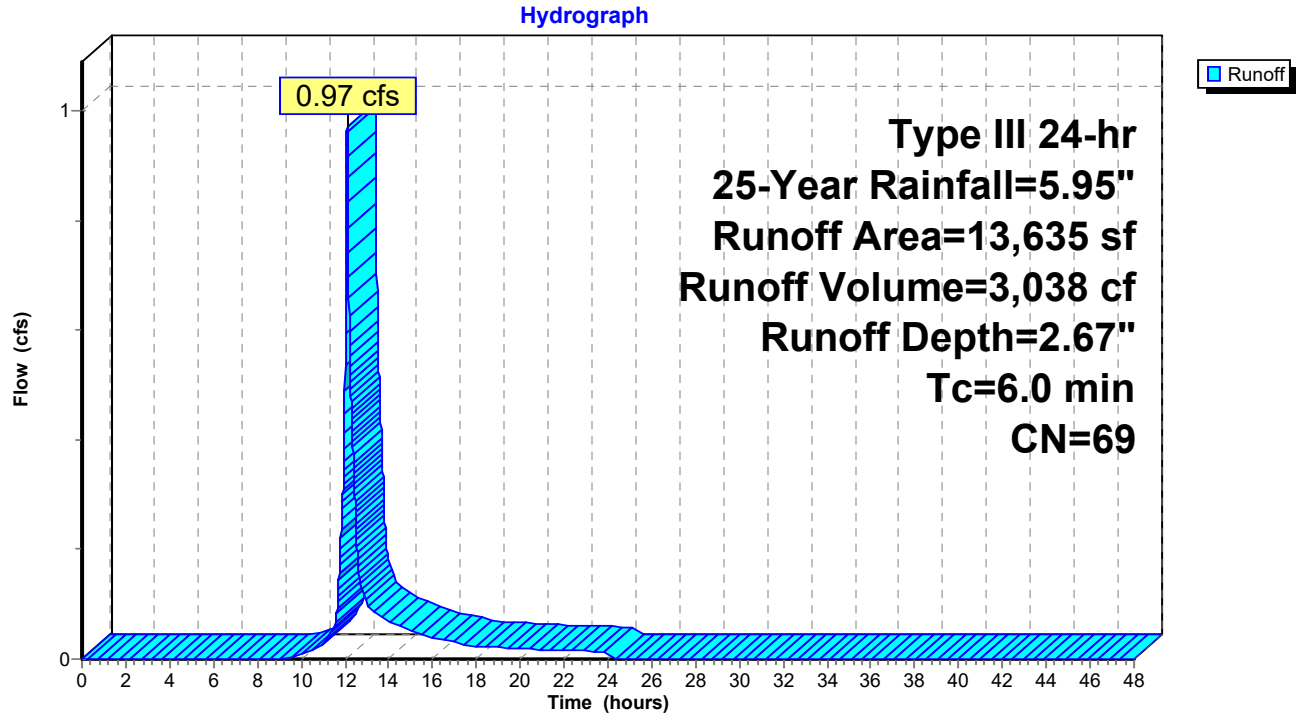
Runoff = 0.97 cfs @ 12.09 hrs, Volume= 3,038 cf, Depth= 2.67"
Routed to Pond 2P : Cultec Recharge System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
3,018	98	Paved parking, HSG B
10,617	61	>75% Grass cover, Good, HSG B
13,635	69	Weighted Average
10,617		77.87% Pervious Area
3,018		22.13% Impervious Area

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

Subcatchment 1B: Entrance Driveway & Front Landscape Area



Summary for Subcatchment 2A: Rear Portion of Property

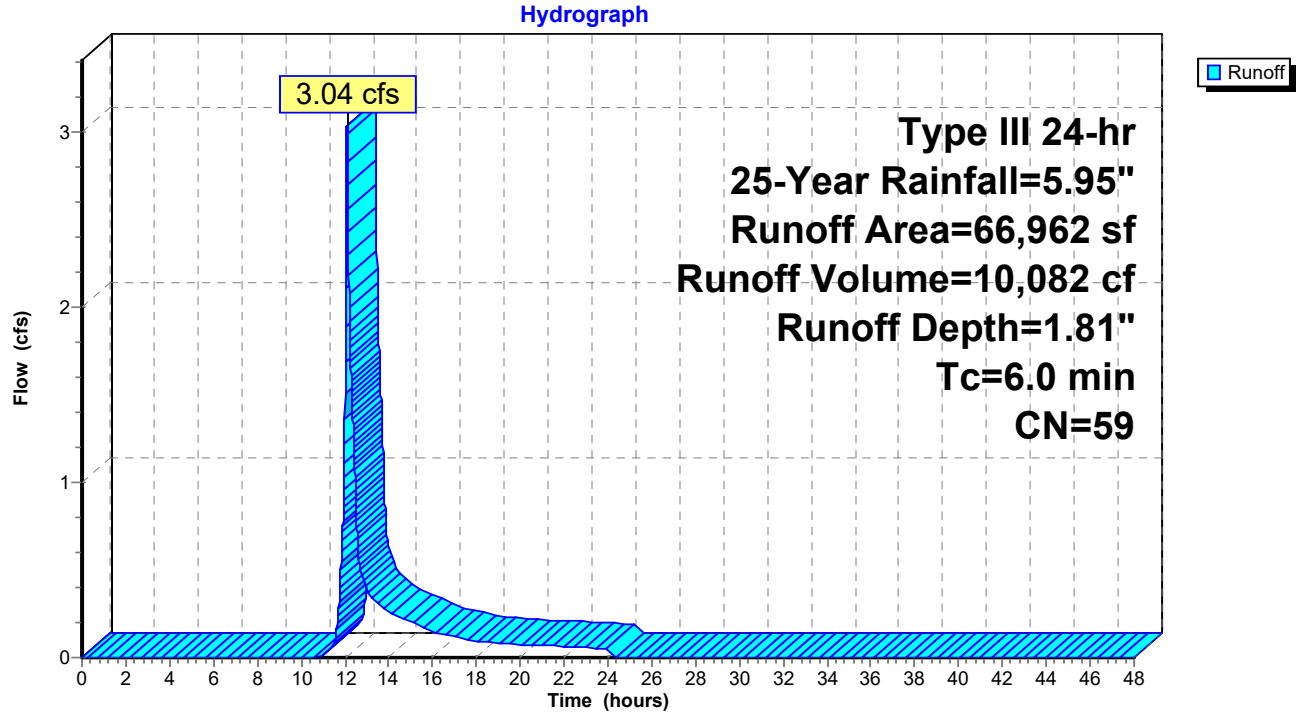
Runoff = 3.04 cfs @ 12.10 hrs, Volume= 10,082 cf, Depth= 1.81"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
3,900	98	Roofs, HSG B
16,932	61	>75% Grass cover, Good, HSG B
46,130	55	Woods, Good, HSG B
66,962	59	Weighted Average
63,062		94.18% Pervious Area
3,900		5.82% Impervious Area

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

Subcatchment 2A: Rear Portion of Property



Summary for Subcatchment 2B: TownHouses and Access Driveways

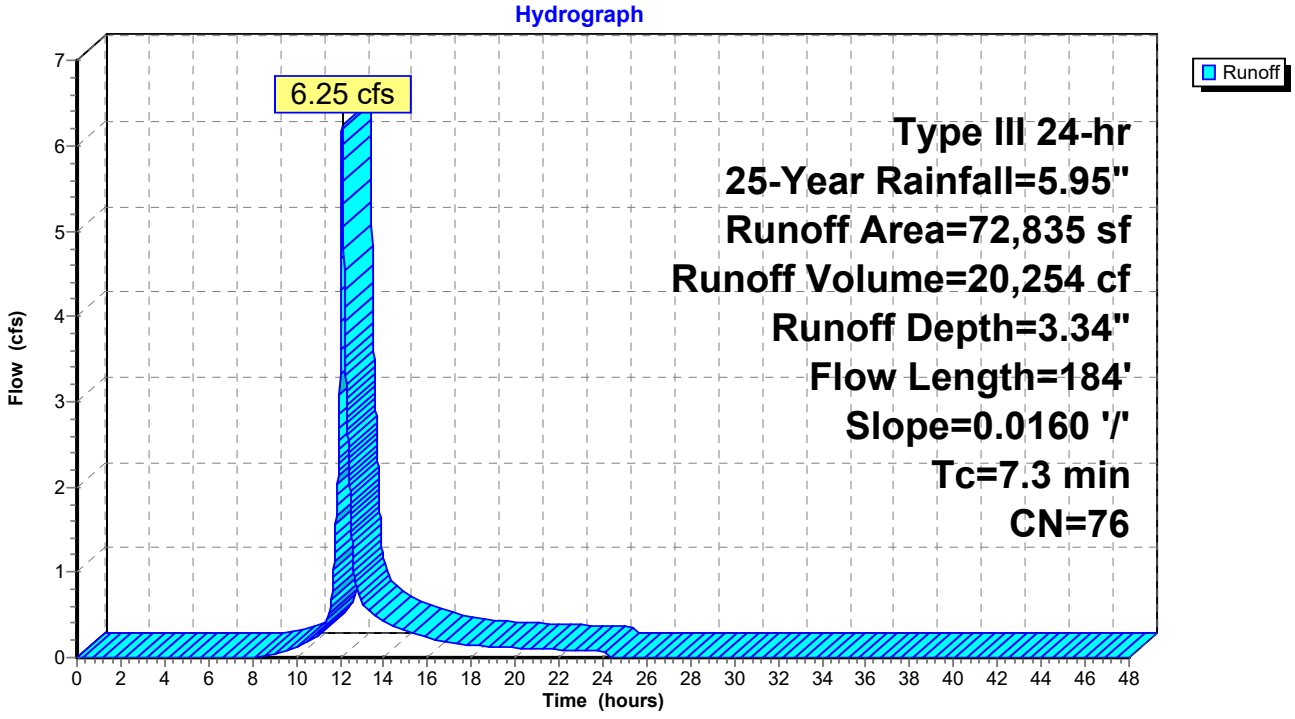
Runoff = 6.25 cfs @ 12.11 hrs, Volume= 20,254 cf, Depth= 3.34"
Routed to Pond 1P : Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.95"

Area (sf)	CN	Description
9,869	98	Roofs, HSG B
19,423	98	Paved parking, HSG B
43,543	61	>75% Grass cover, Good, HSG B
72,835	76	Weighted Average
43,543		59.78% Pervious Area
29,292		40.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	184	0.0160	0.42		**Lag/CN Method,**

Subcatchment 2B: TownHouses and Access Driveways



Summary for Pond 1P: Stormwater Basin

Inflow Area = 72,835 sf, 40.22% Impervious, Inflow Depth = 3.34" for 25-Year event
Inflow = 6.25 cfs @ 12.11 hrs, Volume= 20,254 cf
Outflow = 3.07 cfs @ 12.30 hrs, Volume= 20,255 cf, Atten= 51%, Lag= 11.5 min
Discarded = 0.17 cfs @ 12.30 hrs, Volume= 11,113 cf
Primary = 2.89 cfs @ 12.30 hrs, Volume= 9,142 cf
Routed to Link 2S : Waite Pond
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link 2S : Waite Pond

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 843.84' @ 12.30 hrs Surf.Area= 3,066 sf Storage= 6,432 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 233.3 min (1,058.9 - 825.6)

Volume	Invert	Avail.Storage	Storage Description
#1	840.50'	12,504 cf	**Stormwater Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
840.50	910	171.0	0	0	910
841.00	1,186	183.0	522	522	1,259
842.00	1,792	207.0	1,479	2,001	2,029
843.00	2,470	231.0	2,122	4,123	2,894
844.00	3,191	249.0	2,823	6,946	3,622
845.00	3,970	263.0	3,573	10,519	4,248
845.50	3,970	263.0	1,985	12,504	4,379

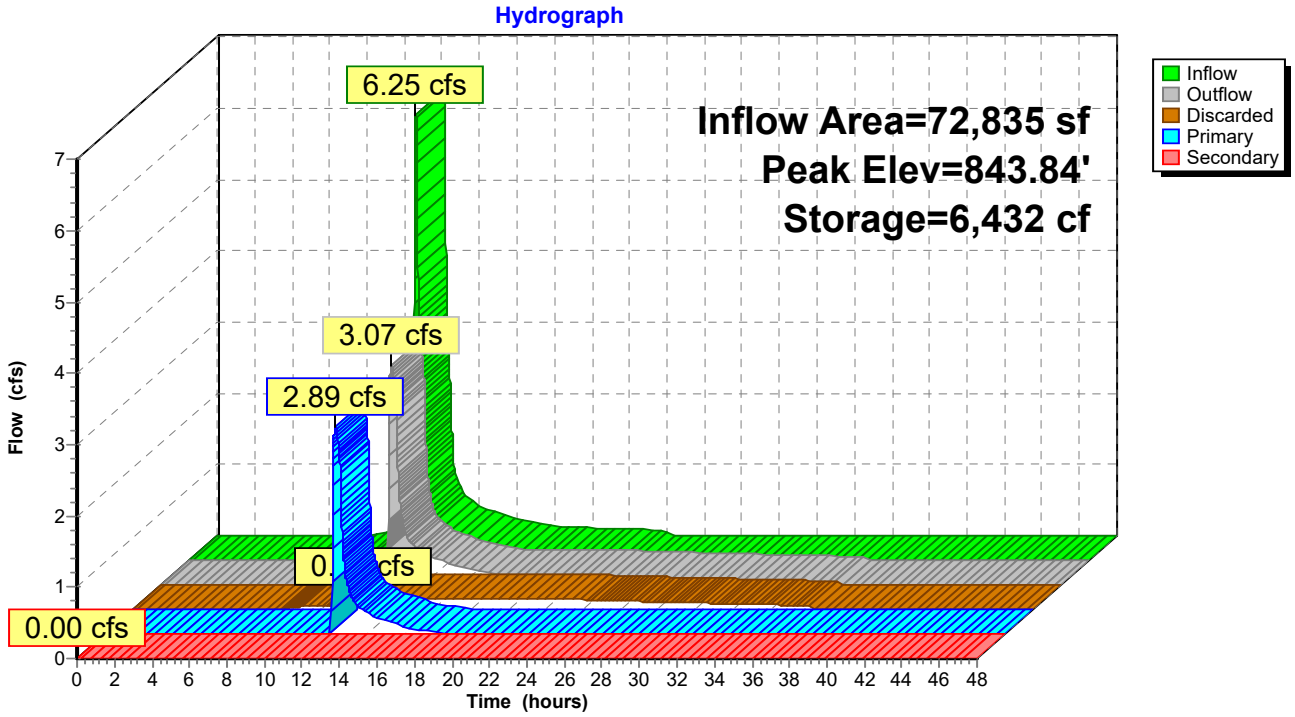
Device	Routing	Invert	Outlet Devices
#1	Discarded	840.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 238.40'
#2	Secondary	844.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 4	843.25'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	838.65'	**12.0" Round Culvert** L= 33.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 838.65' / 836.00' S= 0.0803 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.17 cfs @ 12.30 hrs HW=843.84' (Free Discharge)
↑**1=Exfiltration** (Controls 0.17 cfs)

Primary OutFlow Max=2.89 cfs @ 12.30 hrs HW=843.84' TW=0.00' (Dynamic Tailwater)
↑**4=Culvert** (Passes 2.89 cfs of 7.22 cfs potential flow)
↑**3=Orifice/Grate** (Orifice Controls 2.89 cfs @ 3.68 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=840.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Stormwater Basin



Summary for Pond 2P: Cultec Recharge System

Inflow Area = 13,635 sf, 22.13% Impervious, Inflow Depth = 2.67" for 25-Year event
Inflow = 0.97 cfs @ 12.09 hrs, Volume= 3,038 cf
Outflow = 0.14 cfs @ 12.67 hrs, Volume= 3,038 cf, Atten= 85%, Lag= 35.0 min
Discarded = 0.09 cfs @ 12.67 hrs, Volume= 2,915 cf
Primary = 0.05 cfs @ 12.67 hrs, Volume= 123 cf
Routed to Link 1S : Main Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 841.51' @ 12.67 hrs Surf.Area= 696 sf Storage= 1,186 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 143.3 min (984.3 - 841.0)

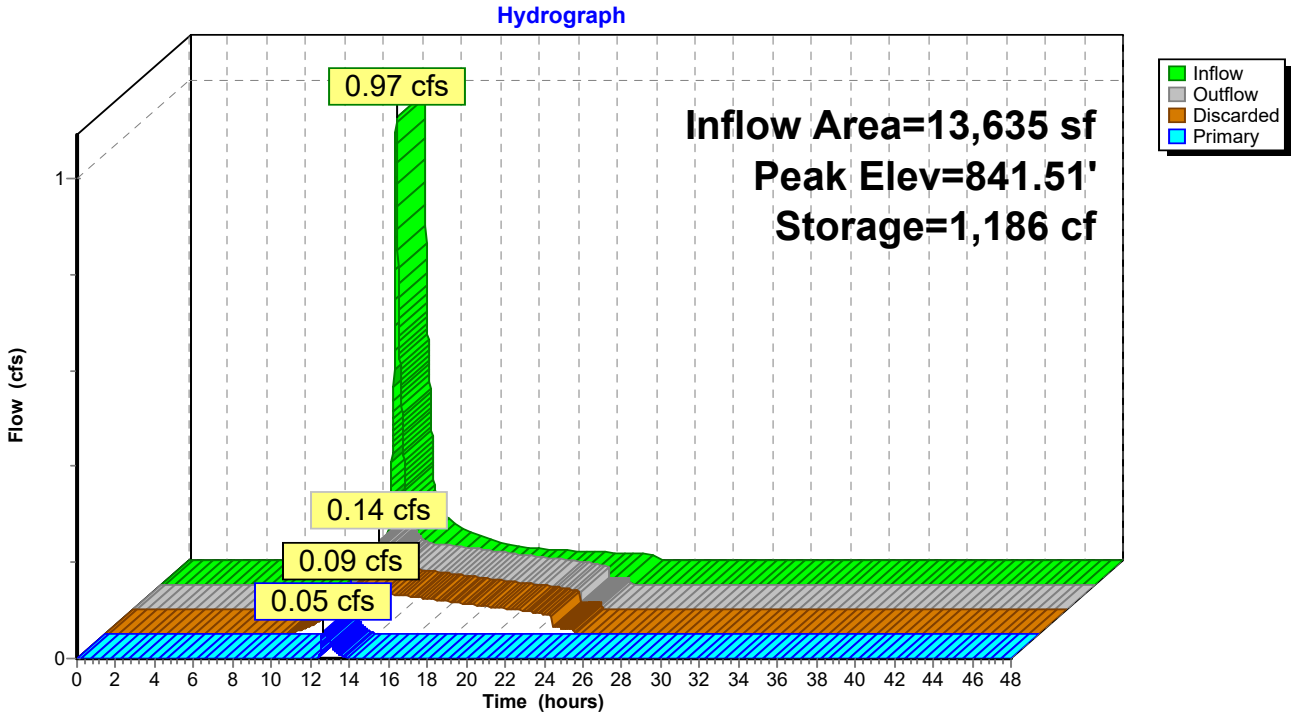
Volume	Invert	Avail.Storage	Storage Description
#1	839.00'	633 cf	**19.32'W x 36.00'L x 3.54'H Crushed Stone Surround** 2,462 cf Overall - 879 cf Embedded = 1,583 cf x 40.0% Voids
#2	839.50'	879 cf	**Cultec R-330XLHD** x 16 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		1,512 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	839.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 837.00'
#2	Primary	841.37'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 841.37' / 840.00' S= 0.0457 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.09 cfs @ 12.67 hrs HW=841.51' (Free Discharge)
↑**1=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=0.05 cfs @ 12.67 hrs HW=841.51' TW=0.00' (Dynamic Tailwater)
↑**2=Culvert** (Inlet Controls 0.05 cfs @ 1.01 fps)

Pond 2P: Cultec Recharge System

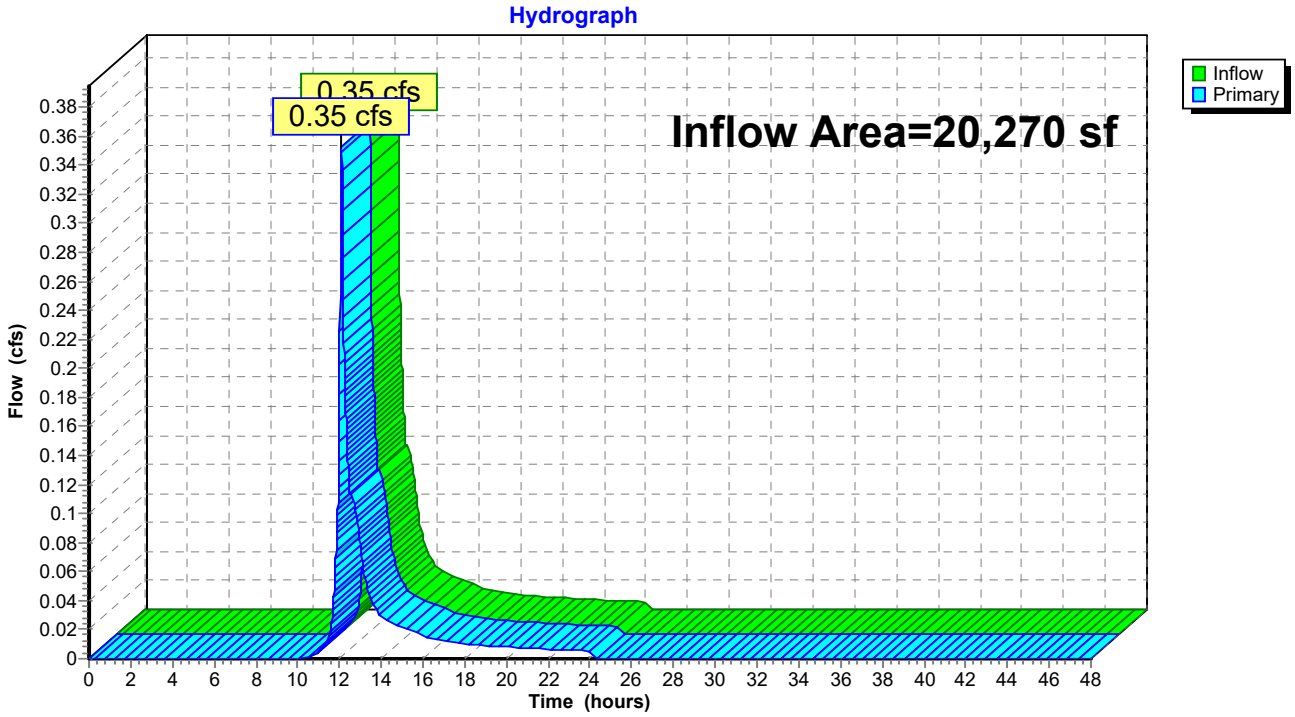


Summary for Link 1S: Main Street

Inflow Area = 20,270 sf, 15.45% Impervious, Inflow Depth = 0.75" for 25-Year event
Inflow = 0.35 cfs @ 12.09 hrs, Volume= 1,260 cf
Primary = 0.35 cfs @ 12.09 hrs, Volume= 1,260 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

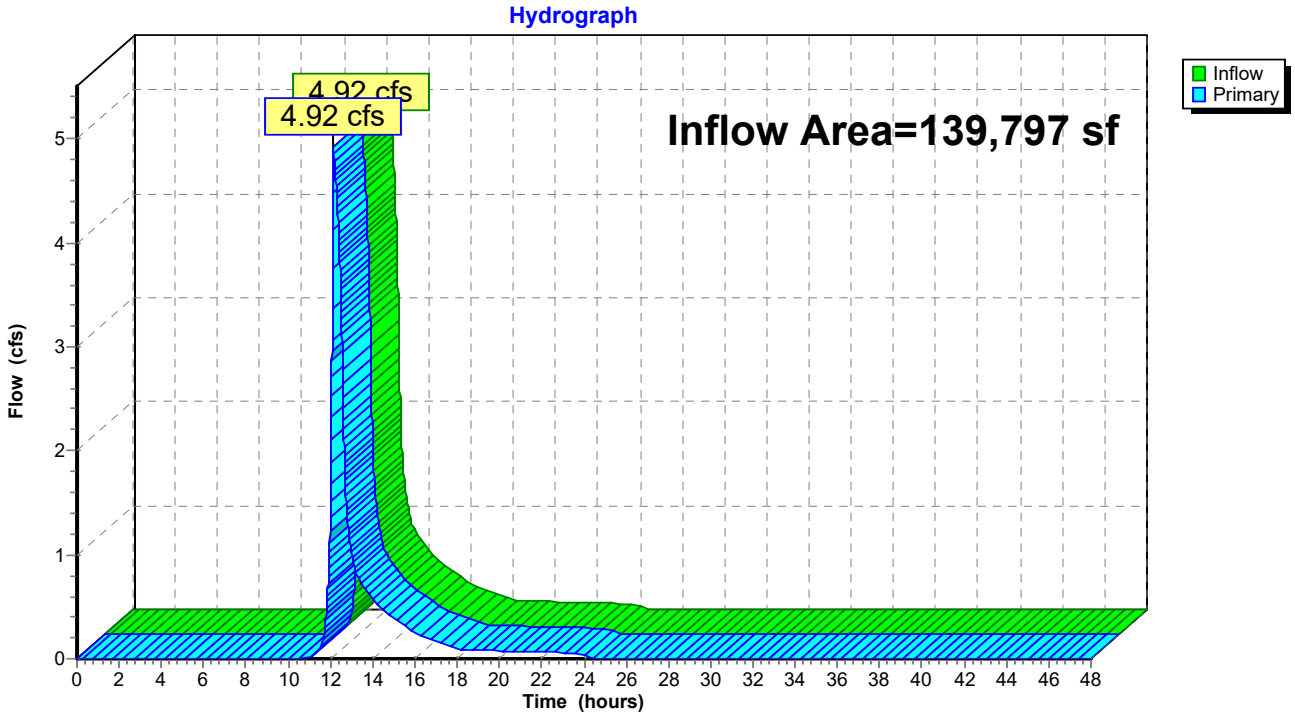


Summary for Link 2S: Waite Pond

Inflow Area = 139,797 sf, 23.74% Impervious, Inflow Depth = 1.65" for 25-Year event
Inflow = 4.92 cfs @ 12.15 hrs, Volume= 19,224 cf
Primary = 4.92 cfs @ 12.15 hrs, Volume= 19,224 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Summary for Subcatchment 1A: Main Street Frontage

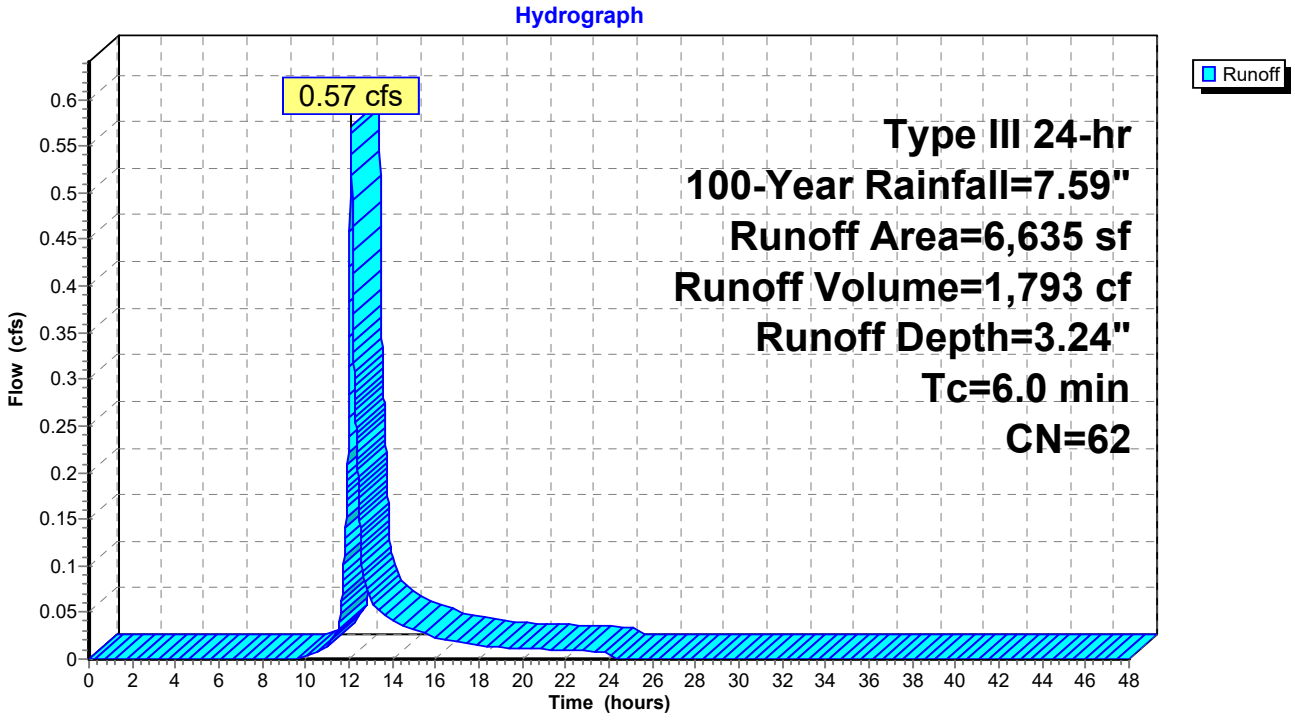
Runoff = 0.57 cfs @ 12.09 hrs, Volume= 1,793 cf, Depth= 3.24"
Routed to Link 1S : Main Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
114	98	Paved parking, HSG B
6,521	61	>75% Grass cover, Good, HSG B
6,635	62	Weighted Average
6,521		98.28% Pervious Area
114		1.72% Impervious Area

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

Subcatchment 1A: Main Street Frontage



Summary for Subcatchment 1B: Entrance Driveway & Front Landscape Area

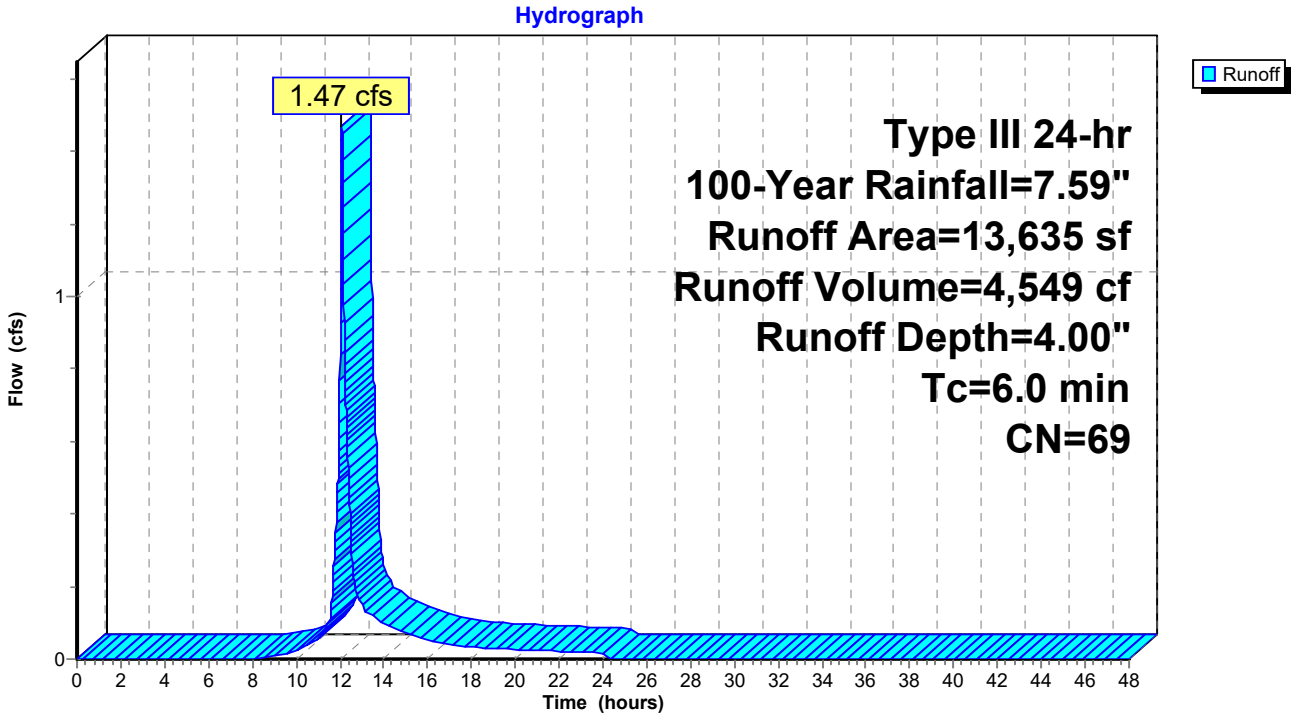
Runoff = 1.47 cfs @ 12.09 hrs, Volume= 4,549 cf, Depth= 4.00"
Routed to Pond 2P : Cultec Recharge System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
3,018	98	Paved parking, HSG B
10,617	61	>75% Grass cover, Good, HSG B
13,635	69	Weighted Average
10,617		77.87% Pervious Area
3,018		22.13% Impervious Area

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

Subcatchment 1B: Entrance Driveway & Front Landscape Area



Summary for Subcatchment 2A: Rear Portion of Property

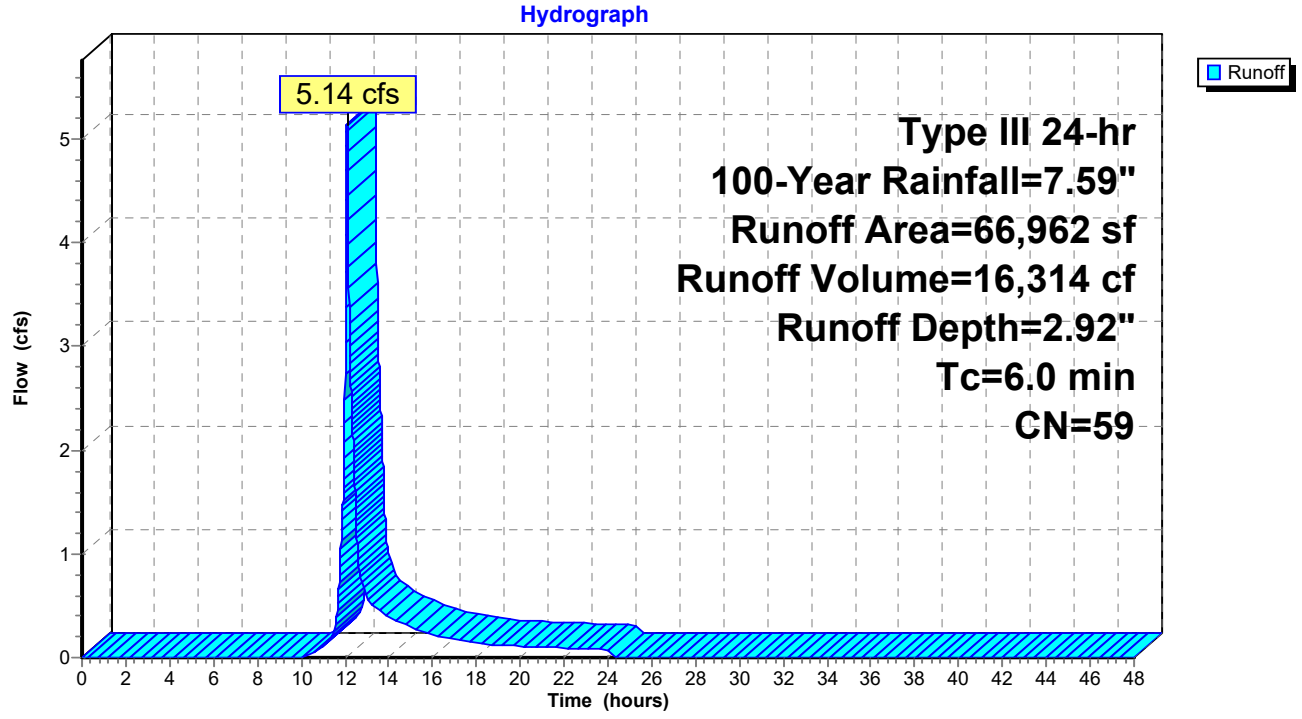
Runoff = 5.14 cfs @ 12.09 hrs, Volume= 16,314 cf, Depth= 2.92"
Routed to Link 2S : Waite Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
3,900	98	Roofs, HSG B
16,932	61	>75% Grass cover, Good, HSG B
46,130	55	Woods, Good, HSG B
66,962	59	Weighted Average
63,062		94.18% Pervious Area
3,900		5.82% Impervious Area

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

Subcatchment 2A: Rear Portion of Property



Summary for Subcatchment 2B: TownHouses and Access Driveways

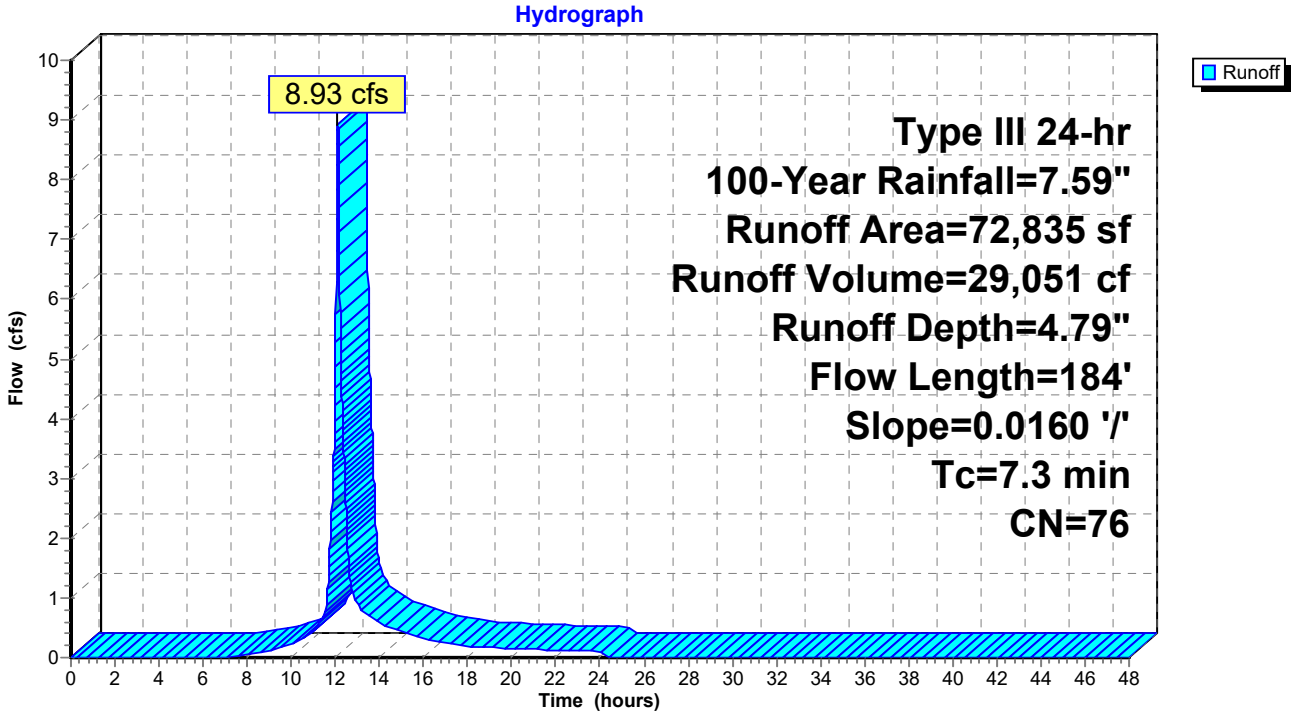
Runoff = 8.93 cfs @ 12.10 hrs, Volume= 29,051 cf, Depth= 4.79"
Routed to Pond 1P : Stormwater Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.59"

Area (sf)	CN	Description
9,869	98	Roofs, HSG B
19,423	98	Paved parking, HSG B
43,543	61	>75% Grass cover, Good, HSG B
72,835	76	Weighted Average
43,543		59.78% Pervious Area
29,292		40.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	184	0.0160	0.42		**Lag/CN Method,**

Subcatchment 2B: TownHouses and Access Driveways



Summary for Pond 1P: Stormwater Basin

Inflow Area = 72,835 sf, 40.22% Impervious, Inflow Depth = 4.79" for 100-Year event
Inflow = 8.93 cfs @ 12.10 hrs, Volume= 29,051 cf
Outflow = 4.44 cfs @ 12.28 hrs, Volume= 29,051 cf, Atten= 50%, Lag= 10.7 min
Discarded = 0.20 cfs @ 12.28 hrs, Volume= 12,178 cf
Primary = 4.24 cfs @ 12.28 hrs, Volume= 16,872 cf
Routed to Link 2S : Waite Pond
Secondary = 0.01 cfs @ 12.28 hrs, Volume= 1 cf
Routed to Link 2S : Waite Pond

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 844.50' @ 12.28 hrs Surf.Area= 3,574 sf Storage= 8,652 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 183.4 min (998.7 - 815.3)

Volume	Invert	Avail.Storage	Storage Description
#1	840.50'	12,504 cf	**Stormwater Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
840.50	910	171.0	0	0	910
841.00	1,186	183.0	522	522	1,259
842.00	1,792	207.0	1,479	2,001	2,029
843.00	2,470	231.0	2,122	4,123	2,894
844.00	3,191	249.0	2,823	6,946	3,622
845.00	3,970	263.0	3,573	10,519	4,248
845.50	3,970	263.0	1,985	12,504	4,379

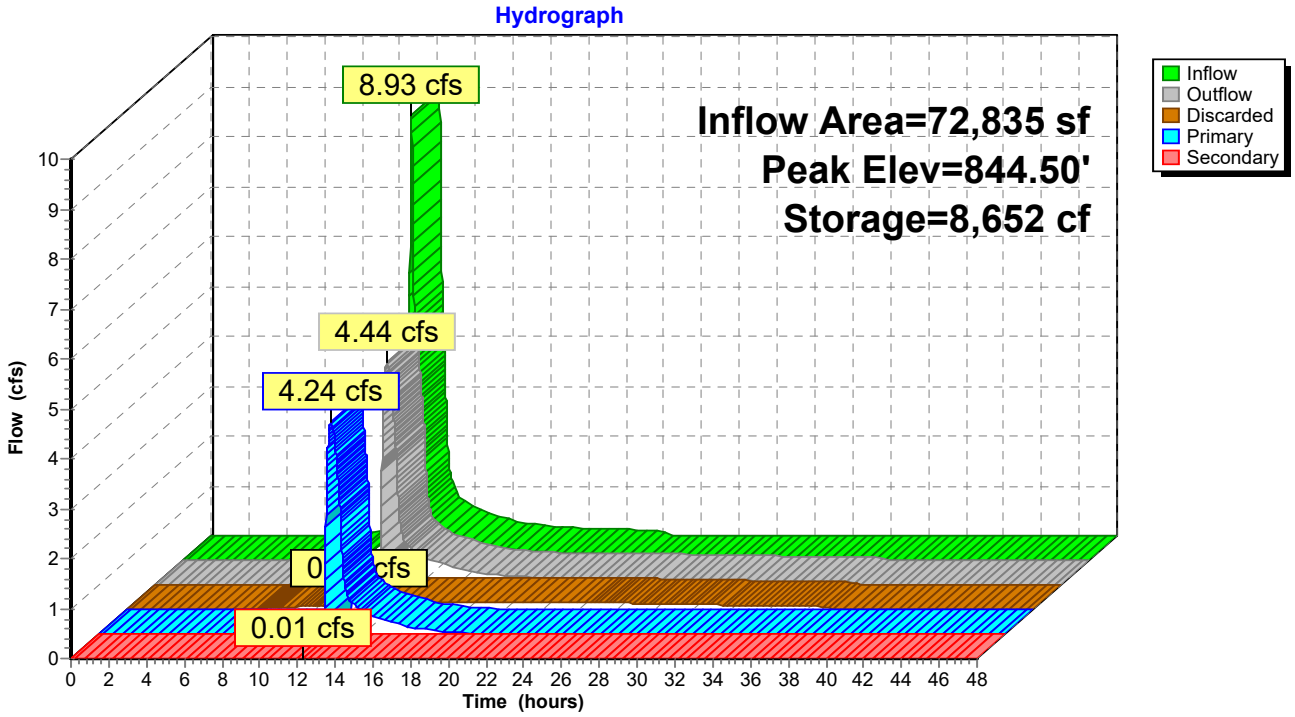
Device	Routing	Invert	Outlet Devices
#1	Discarded	840.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 238.40'
#2	Secondary	844.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Device 4	843.25'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	838.65'	**12.0" Round Culvert** L= 33.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 838.65' / 836.00' S= 0.0803 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Discarded OutFlow Max=0.20 cfs @ 12.28 hrs HW=844.50' (Free Discharge)
↑**1=Exfiltration** (Controls 0.20 cfs)

Primary OutFlow Max=4.24 cfs @ 12.28 hrs HW=844.50' TW=0.00' (Dynamic Tailwater)
↑**4=Culvert** (Passes 4.24 cfs of 7.72 cfs potential flow)
↑**3=Orifice/Grate** (Orifice Controls 4.24 cfs @ 5.39 fps)

Secondary OutFlow Max=0.01 cfs @ 12.28 hrs HW=844.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.17 fps)

Pond 1P: Stormwater Basin



Summary for Pond 2P: Cultec Recharge System

Inflow Area = 13,635 sf, 22.13% Impervious, Inflow Depth = 4.00" for 100-Year event
Inflow = 1.47 cfs @ 12.09 hrs, Volume= 4,549 cf
Outflow = 0.71 cfs @ 12.27 hrs, Volume= 4,549 cf, Atten= 52%, Lag= 10.5 min
Discarded = 0.10 cfs @ 12.27 hrs, Volume= 3,470 cf
Primary = 0.61 cfs @ 12.27 hrs, Volume= 1,079 cf
Routed to Link 1S : Main Street

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 841.92' @ 12.27 hrs Surf.Area= 696 sf Storage= 1,339 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 120.2 min (949.5 - 829.3)

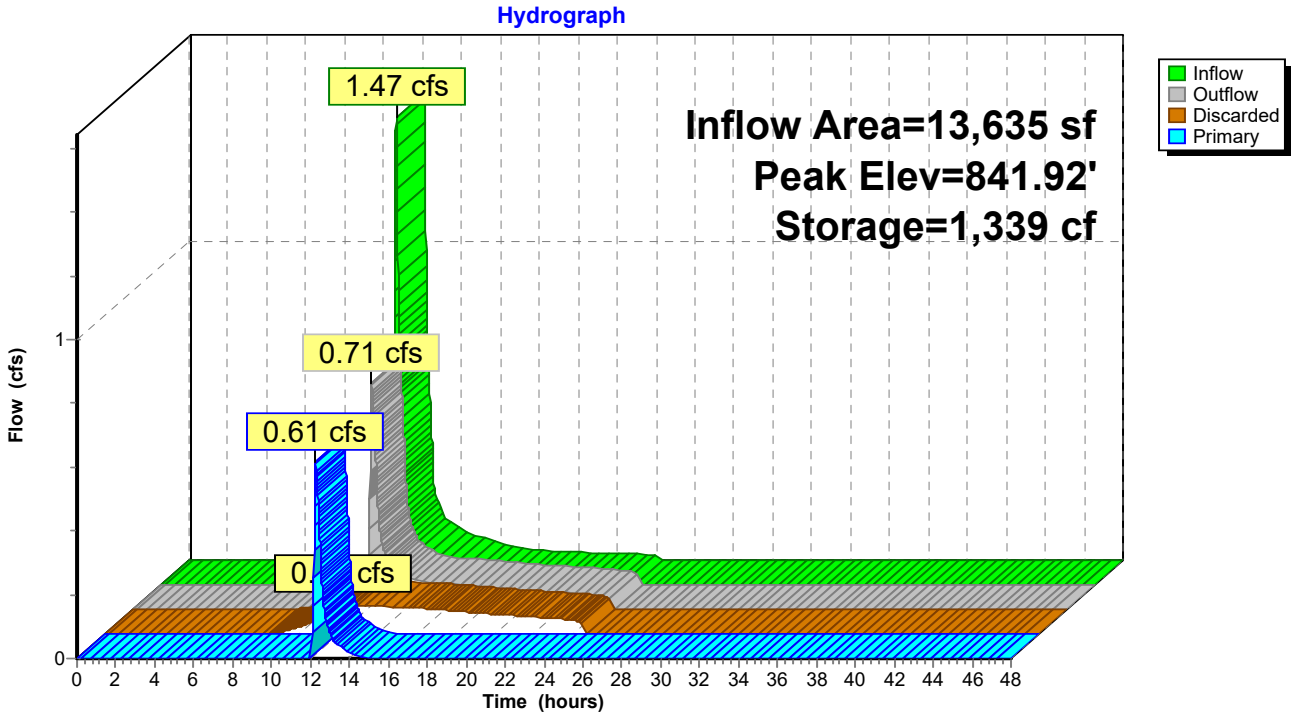
Volume	Invert	Avail.Storage	Storage Description
#1	839.00'	633 cf	**19.32'W x 36.00'L x 3.54'H Crushed Stone Surround** 2,462 cf Overall - 879 cf Embedded = 1,583 cf x 40.0% Voids
#2	839.50'	879 cf	**Cultec R-330XLHD** x 16 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
		1,512 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	839.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 837.00'
#2	Primary	841.37'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 841.37' / 840.00' S= 0.0457 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.10 cfs @ 12.27 hrs HW=841.92' (Free Discharge)
↑**1=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=0.61 cfs @ 12.27 hrs HW=841.92' TW=0.00' (Dynamic Tailwater)
↑**2=Culvert** (Inlet Controls 0.61 cfs @ 1.99 fps)

Pond 2P: Cultec Recharge System

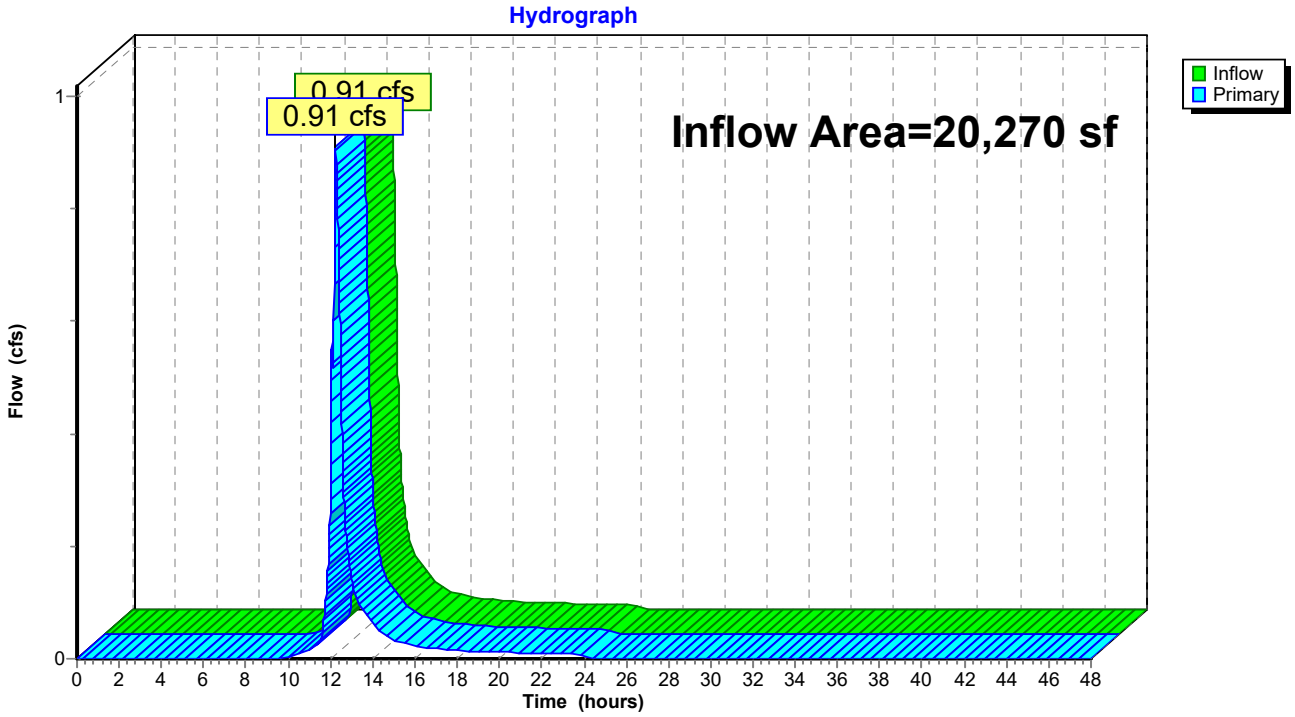


Summary for Link 1S: Main Street

Inflow Area = 20,270 sf, 15.45% Impervious, Inflow Depth = 1.70" for 100-Year event
Inflow = 0.91 cfs @ 12.25 hrs, Volume= 2,872 cf
Primary = 0.91 cfs @ 12.25 hrs, Volume= 2,872 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1S: Main Street

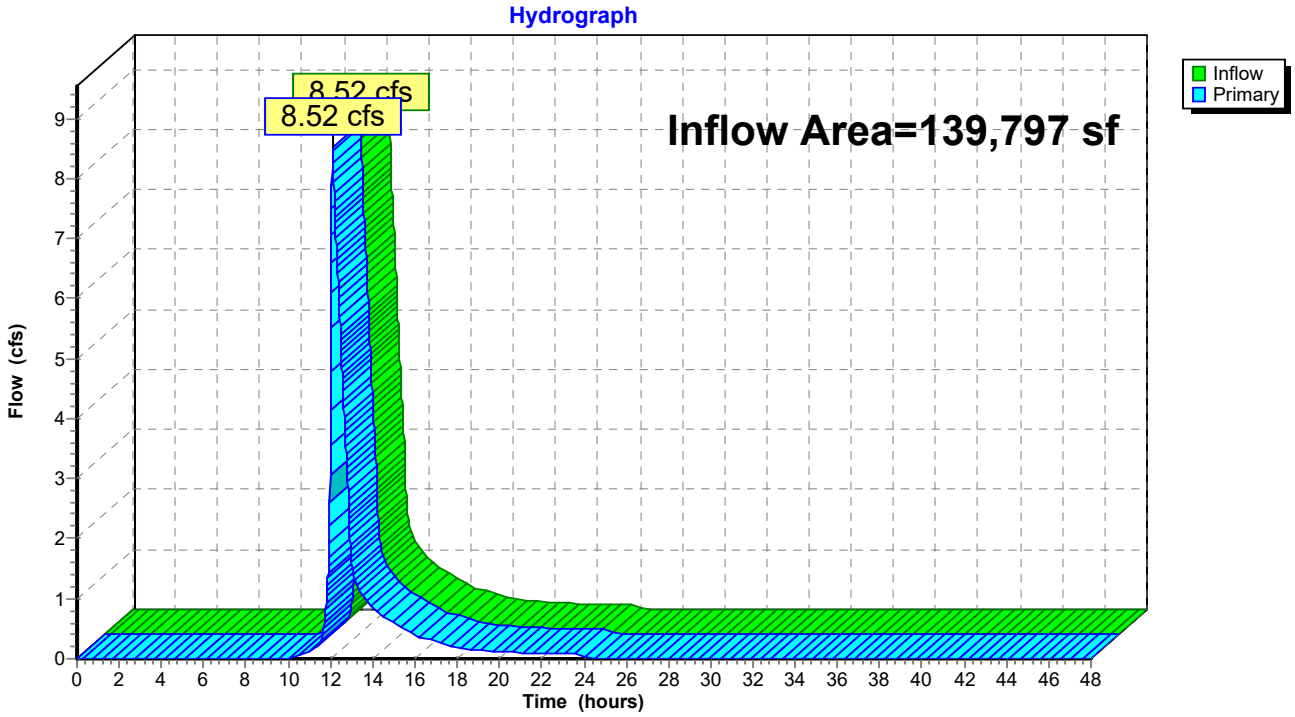


Summary for Link 2S: Waite Pond

Inflow Area = 139,797 sf, 23.74% Impervious, Inflow Depth = 2.85" for 100-Year event
Inflow = 8.52 cfs @ 12.11 hrs, Volume= 33,186 cf
Primary = 8.52 cfs @ 12.11 hrs, Volume= 33,186 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2S: Waite Pond



Appendix F

Additional Stormwater Design
Drainage Calculations

TABLE NO. 4
STORMWATER MANAGEMENT CALCULATIONS
PROPOSED MULTIFAMILY RESIDENCES
#778 MAIN ST
LEICESTER, MA

STANDARD 3 - RECHARGE
REQUIRED RECHARGE VOLUME
RECHARGE VOLUME (Rv)

Existing Impervious Area =	10,019	s.f.
Proposed Impervious Area =	**36,324**	**s.f.**

Impervious Area (s.f.)	**Rv (cf)**	**Soil Type - Type B = 0.35 inches**
Impervious Area s.f. x (0.35") x (1'/12")	**1,059**	c.f.

Proposed Underground Infiltration Chambers (Pond 1P)

Storage Volume =	1,137	c.f.	(Elev. 841.37 = 12" Diam. Outlet Pipe)

Proposed Stormwater Infiltration Chambers (Pond 2P)

Storage Volume =	4,763	c.f.	(Elev. 843.25 = 12" Diam. Outlet Pipe)

STANDARD 4 - WATER QUALITY

Impervious Area (s.f.)	**WQv (cf)**	**Rapid Infiltration Rate = 1" Runoff**
Impervious Area s.f. x (1") x (1'/12")	**3,027**	**c.f.**
Proposed Storage =	**5,900**	**c.f.**

SUBCATCHMENT 1B - Access Driveway (IWPA)

TSS Removal Calculation		**TSS Removal**	**TSS Remaining**	
1. Hydroworks Water Quality Unit	80%	0.80	**0.20**	
2. Cultec Separator Row	25%	0.25	**0.15**	
3. Underground Infiltration Chambers	80%	0.80	**0.03**	
		TSS Removal Efficiency =		**0.97 > 80%**

SUBCATCHMENT 2B - Paved Driveway

TSS Removal Calculation		**TSS Removal**	**TSS Remaining**	
1. Hydroworks Water Quality Unit	80%	0.80	**0.20**	
2. Cultec Separator Row	25%	0.25	**0.15**	
3. Underground Infiltration Chambers	80%	0.80	**0.03**	
		TSS Removal Efficiency =		**0.97 > 80%**

Proposed Underground Infiltration Chambers (Pond 1P)

Drawdown (Td) = Rv / k A	**8.15**	**hours**	< 72 Hours OK
Recharge Volume (Rv) =	1,137	c.f.	
Permeability (k) =	2.41	in/hr	
Bottom Area (A) =	695	s.f.	

TABLE NO. 4
STORMWATER MANAGEMENT CALCULATIONS
PROPOSED MULTIFAMILY RESIDENCES
#778 MAIN ST
LEICESTER, MA

Proposed Underground Infiltration Chambers (Pond 2P)

Drawdown (Td) = Rv / k A	**26.06**	**hours**	< 72 Hours OK
Recharge Volume (Rv) =	4,763	c.f.	
Permeability (k) =	2.41	in/hr	
Bottom Area (A) =	910	s.f.	

5/5/2023

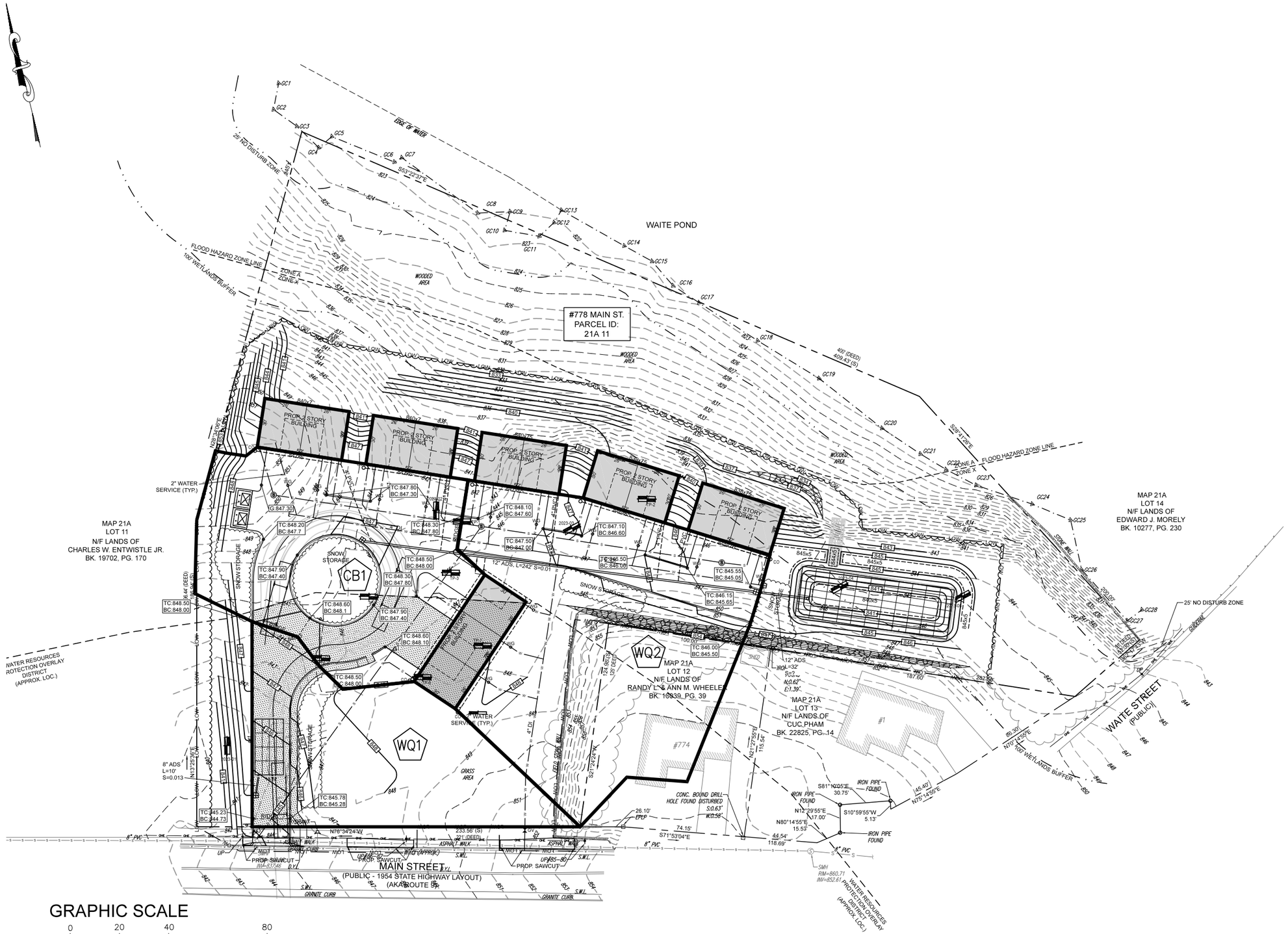
RATIONAL METHOD PIPE DESIGN WORKSHEET
PROPOSED MULTIFAMILY RESIDENCES
LEICESTER, MA

LOCATION	PIPE SEGMENT		INCREMENTAL AREA						FLOW TIME (min.)			25-Yr	25-Yr	DESIGN CONDITIONS					Design (25-Yr)		Inverts		Remarks
	From	To	DESIGNATION	A (Acres)	Total A	C	C*A	Sum (C*A)	To Inlet	In Chan.	Tot.	I (in/hr)	Q (cfs)	Pipe Diam (in.)	Length (ft)	Slope (%)	Q-full (cfs)	V-Full (fps)	Depth Peak (in.)	V-Peak (fps)	Up	Down	
CB-1 to BASIN (POND 1P)																							
	CB-1	WQU-2		0.43		0.62	**0.26**		6		6	6.3	1.65	12	242	0.010	**3.87**	4.93	5.1	2.11	843.34	840.92	CB-1 Rim =846.70
	WQU-2	BASIN		0.82	1.25	0.53	**0.43**	**0.70**	6		6	6.3	4.39	15	32	0.010	**7.01**	5.72	9.4	3.58	840.82	840.50	WQ-2 Rim =845.00
WQ-1 to CHAMBERS (POND 2P)																							
	WQU-1	CHAMBERS		0.33		0.37	**0.12**		6		6	6.3	0.79	8	10	0.200	**5.87**	16.82	1.1	2.25	841.50	839.50	WQU-1 Rim =844.50

Notes:

1) Runoff Coefficient C-Values used; Impervious(Pavement) C=0.90 Grass/OpenSpace C=0.20, Residential Suburban C=.25~.40, Mannings "n" HDPE n=0.012, RCP n=0.013
2) Rainfall Intensity I (in/hr) values taken from Figure 10-4 Intensity-Duration-Frequency Curve for Boston, Massachusetts, Mass Highway Design Manual.
3) Five (5) minute minimum flow time used for minimum time of concentration (Tc) to CB inlet to system
4) Massachusetts Cascade Grate Inlet Capacity = 1.26 cfs @ 100% efficiency, Standard Grate = 0.95 cfs est.
5) Blue Highlight denotes calculated peak flow (cfs) to CB Inlet

Drainage Structure	Contributing Area Impervious	Grass/Lawn	Total s.f.	Ac.	Runoff Coefficient C
CB-1	11,027	7,550	18,577	0.426	0.62
WQ-2	16,770	19,142	35,912	0.824	0.53
WQ-1	3,613	10,930	14,543	0.334	0.37



REVISIONS

NO.	DATE	DESCRIPTION	BY	CKD
1.	12/6/2022	ZONING BOARD OF APPEALS SUBMISSION	RL	JAB
2.	1/13/2023	REVISIONS PER PEER REVIEW COMMENTS	RL	JAB
3.	5/01/2023	PROPOSED TOWNHOUSE LAYOUT	MM	JAB

PROFESSIONAL SEAL

PROJECT:
PROPOSED MULTIFAMILY RESIDENCE
#778 MAIN STREET
LEICESTER, MA 01524

PREPARED FOR:
CHARLTON ROAD REALTY, LLC.
25 WATERVILLE LANE
SHREWSBURY, MA 01545

ENGINEERING SERVICES
ENVIRONMENTAL SERVICES
67 Hall Road
Sturbridge, MA 01566
Phone: 774-241-0901
fax: 774-241-0906

CMG EST. 2002

ISSUE DATE: 10/24/2022
DRAWN BY: RL | CHECKED BY: JAB
SCALE: 1" = 40'
PROJECT NO.: 2021-225
SHEET NAME:
RATIONAL METHOD
DRAINAGE MAP
SHEET NO.:
D - 3.0

Groundwater Mounding Analysis - Hantush Method

Project: Proposed Multifamily Residence **Project #:** 2021-226

Performed By: RL **Description:** Pond 1P

Checked By: JAB **Calculated Mound Height:** 0.3 **feet**

Input Parameters (input only shaded areas)**:**

Recharge Period	t =	0.35	days	Time to equilibrium (Dewater in 8.5 hrs)
Width of Field	W =	19.3	feet	
Length of Field	L =	36	feet	
Hydraulic Conductivity	K =	4.82	ft/day	**2.41 in / hr - Rawls Rate Loamy Sand**
Specific Yield	V =	0.25	ft^3/ft^3	Loamy Sand = 0.25 See Specific Yield Tab
Saturated Thickness	D =	21.5	feet	**ESHGW @ 42", Assumed bed rock depth 25'**
Daily Flow	Q =	1,877	gpd	**251 c.f. = Required Recharge Volume**

Calculated Parameters:

1/2 width	a =	9.65	feet
1/2 length	b =	18	feet
Recharge Rate	j =	0.36	ft/day

$$\gamma = \frac{KD}{V} = \quad 414.5 \quad ft^2/day$$

Dimensionless width $$\alpha = \frac{a}{\sqrt{4\gamma t}} = \quad 0.4006$$

Dimensionless length $$\beta = \frac{b}{\sqrt{4\gamma t}} = \quad 0.7472$$

Solution:

From Table 1of Hantush (1967), attached:

Function S*(a , b) = 0.5622

Water Table + Mound $$h_m = \sqrt{h_i^2 + \left[\frac{2j}{K}\lambda t \cdot S^*(\alpha,\beta)\right]}$$

h_m = 21.8 feet

Mound Height =	**h_m - D =**	**0.3**	**feet**

Reference: Hantush, M.S. 1967. "Growth and Decay of Groundwater Mounds in Response to Uniform Percolation."
Water Resources Research, 3, pp. 227-234.

Groundwater Mounding Analysis - Hantush Method

Project: Proposed Multifamily Residence **Project #:** 2021-226

Performed By: RL **Description:** Pond 2P

Checked By: JAB **Calculated Mound Height:** 1.0 **feet**

Input Parameters (input only shaded areas)**:**

Recharge Period	t =	1.05	days	Time to equilibrium (Dewater in 26.06 hrs)
Width of Field	W =	15	feet	
Length of Field	L =	80	feet	
Hydraulic Conductivity	K =	4.82	ft/day	**2.41 in / hr - Rawls Rate Loamy Sand**
Specific Yield	V =	0.25	ft^3/ft^3	Loamy Sand = 0.25 See Specific Yield Tab
Saturated Thickness	D =	18.33	feet	**ESHGW @ 80", Assumed bed rock depth 25'**
Daily Flow	Q =	6,390	gpd	**854 c.f. = Required Recharge Volume**

Calculated Parameters:

1/2 width	a =	7.5	feet
1/2 length	b =	40	feet
Recharge Rate	j =	0.71	ft/day

$$\gamma = \frac{KD}{V} = \quad 353.4 \quad ft^2/day$$

Dimensionless width $$\alpha = \frac{a}{\sqrt{4\gamma t}} = \quad 0.1947$$

Dimensionless length $$\beta = \frac{b}{\sqrt{4\gamma t}} = \quad 1.0382$$

Solution:

From Table 1of Hantush (1967), attached:

Function S*(a , b) = 0.3555

Water Table + Mound $$h_m = \sqrt{h_i^2 + \left[\frac{2j}{K}\lambda t \cdot S^*(\alpha,\beta)\right]}$$

h_m = 19.4 feet

Mound Height =	**h_m - D =**	**1.0**	**feet**

Reference: Hantush, M.S. 1967. "Growth and Decay of Groundwater Mounds in Response to Uniform Percolation."
Water Resources Research, 3, pp. 227-234.

RIP RAP SIZING CALCULATIONS
PROPOSED MULTIFAMILY RESIDENCES
#778 MAIN STREET
LEICESTER, MA

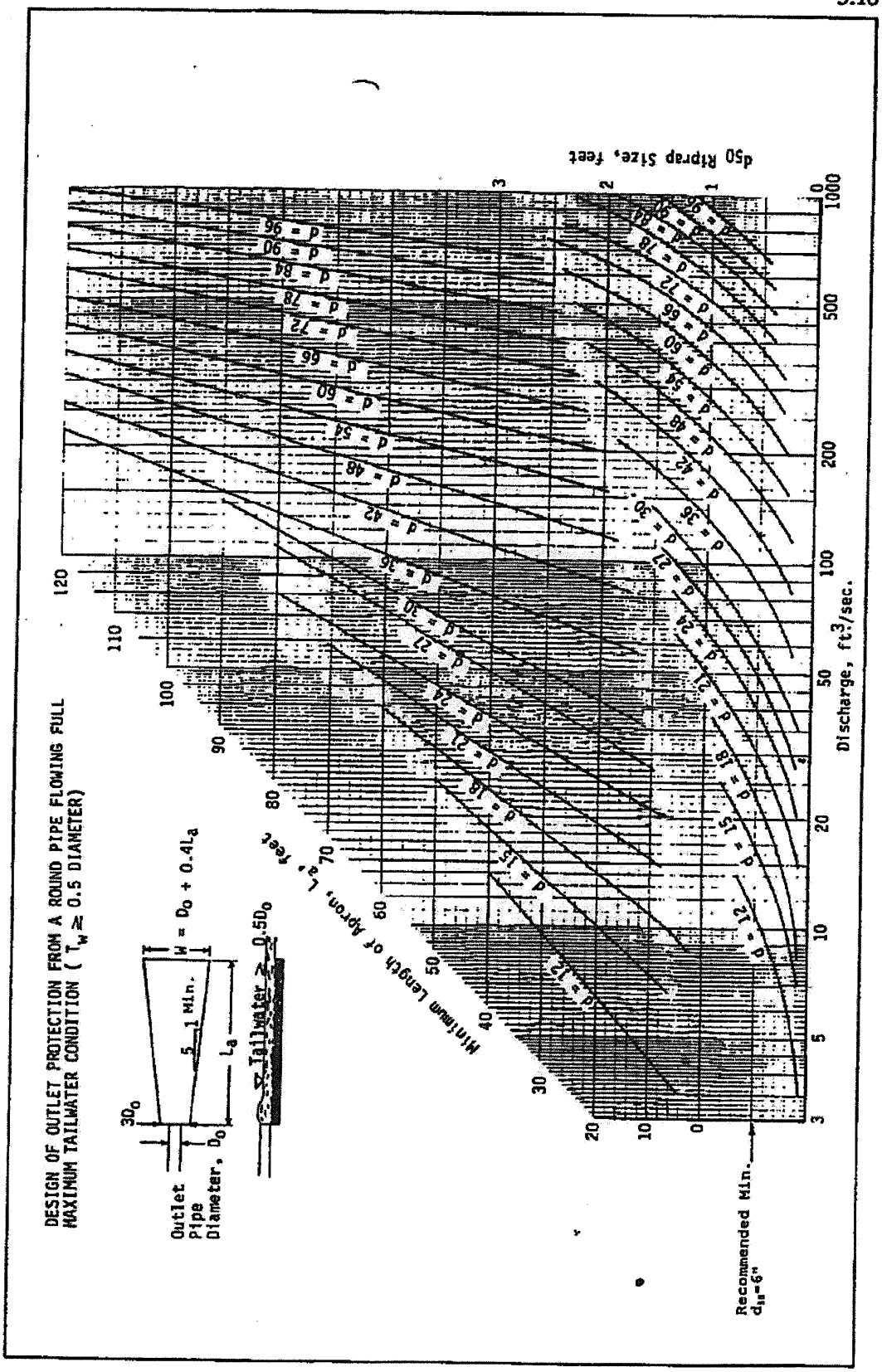
STANDARD 1 - DRAINAGE OUTFALL RIPRAP APRON SIZING

INFILTRATION CHAMBERS OUTLET PIPE	Flow Rate (cfs)	Min. Stone Diam. (in)*	Apron Length (ft)*	Apron Width (Upstream)*	Apron Width (Downstream)*
INFILTRATION CHAMBERS OUTLET PIPE***	0.61	6	5	3	6
WATER QUALITY UNIT 2 TO BASIN**	8.93	6	15	4	7
BASIN OUTLET PIPE***	4.24	6	8	2	9

*Minimum Stone Diameter, Riprap Apron Length, and Riprap Apron Width were determined by USDA-NRCS Outlet Protection Spec 3.18, dated 1992. See attached nomographs from applicable sections.

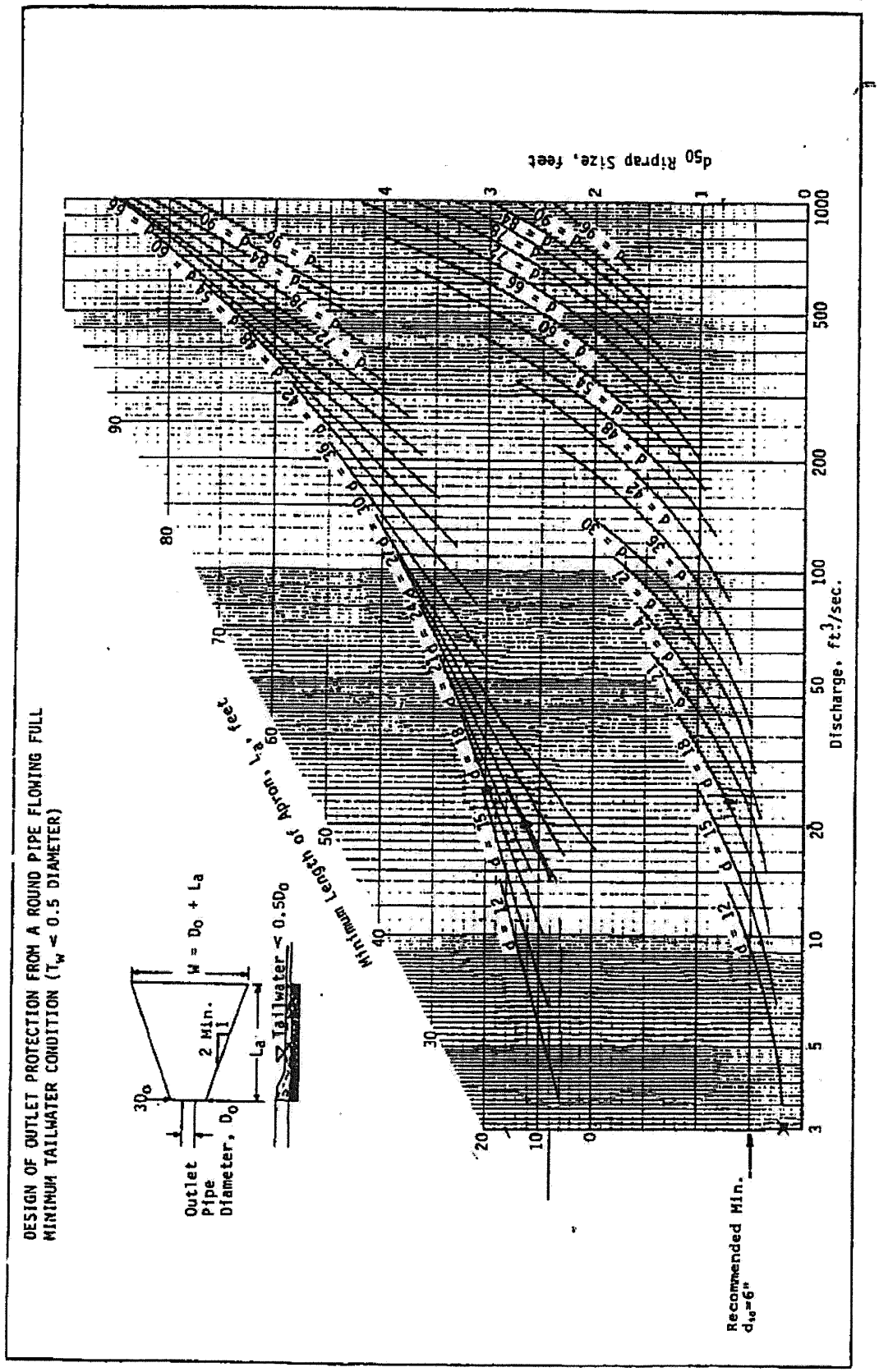
**All outlets designed for 100-year storm flow conditions. Outlets assumed to be below water during design storm flows, therefore, maximum tailwater design calculations were used.

***Outlets assumed to be discharging to grassy slope with no tailwater during design storm flows, therefore, minimum tailwater design calculations were used.



Source: USDA-SCS

Plate 3.18-4



Source: USDA-SCS

Plate 3.18-3

Technical Design Submission

778 Main Street
Leicester, MA

Revised
5/9/2023

Hydroworks, LLC

Hydroworks Technical Submission for 778 Main Street

Hydroworks is pleased to make a submission regarding the stormwater treatment structure for 778 Main Street in Leicester, MA. We propose the use of a HD 3 and a HD 4 hydrodynamic separator for this project. Sizing calculations were based on an annual TSS removal objective of 80% for the NJDEP particle size distribution and treatment of the water quality flow rate.

Hydroworks HydroDome Operation

HydroDome is unique since it provides benefits for both water quality and water quantity or flow control. HydroDome comes complete and simply slides into the outlet pipe from a drainage structure and is secured to the wall with two anchor bolts. (Figure 1).

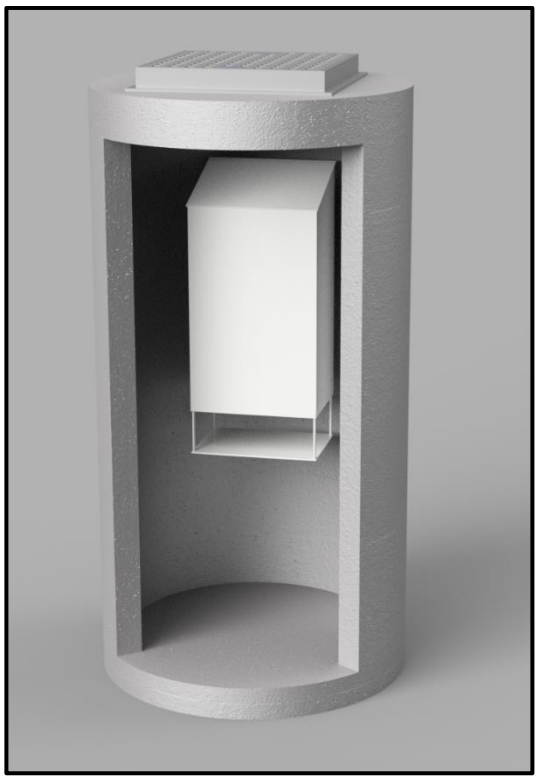


Figure 1. Hydroworks HydroDome

HydroDome consists of two main components:

1. A siphon with flow control
2. A flow weir (main flow path)

At the heart of HydroDome is a siphon that regulates the water level in the structure and the flow rate leaving the structure. (Figure 2)

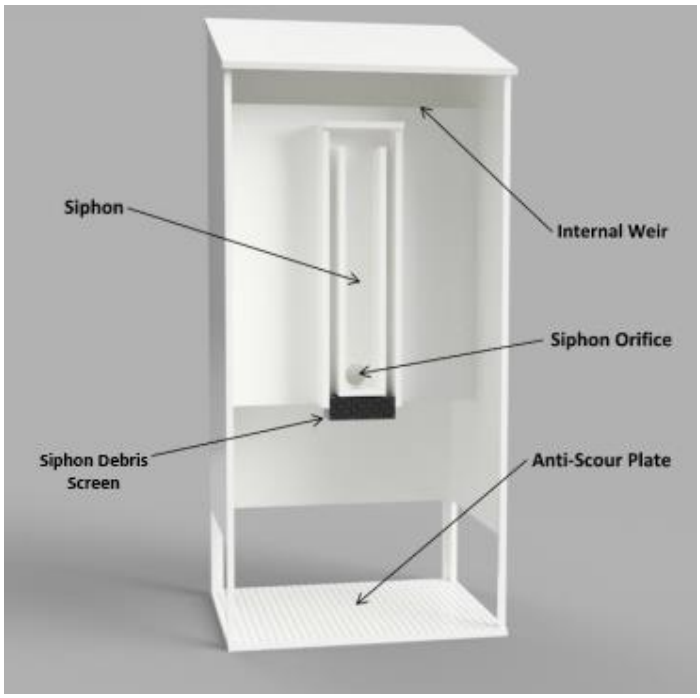


Figure 2 HydroDome Components

The siphon raises the water level to a pre-determined level without allowing water to exit the structure. The raised water level provides greater time for initial TSS removal, reduces inlet velocities by increasing the area of flow in the upstream pipe, and provides a greater volume or buffer of water to prevent scour of previously settled solids.

Water flows into the device through horizontal openings at the bottom of the HydroDome. Water then must travel upwards through a siphon. A debris screen is located at the entrance to the siphon to provide secondary protection for the siphon (primary protection provided by the body of the HydroDome itself). Once the water level reaches a pre-determined height the siphon begins to engage and water flows out of the structure downstream. The siphon flow is controlled by an orifice whose size can be changed to provide the desired flow control. The water level continues to rise since the siphon flow is regulated by a small orifice.

A weir above the siphon provides the main flow path through the separator and prevents the system from surcharging. A scour protection plate minimizes scour by preventing upward velocities/flow from the structure floor during periods of peak flow.

HydroDome combines the function of separator, hood, and flow control with active storage to provide a multi-purpose stormwater management solution in one structure.

HydroDome can be used as an inlet structure or as a regular drainage structure without any modification.

Construction Materials

The internal components of the HydroDome are made from HDPE. The shell of the structure is pre-cast concrete. Pre-cast concrete is readily accepted by all municipalities since it has the following advantages:

- long service life
- ease of installation (less dependent on backfill (contractor proficiency) for structural integrity)
- concrete structures are designed for both anti-buoyancy and traffic loading without any field requirements (such as structural loading slabs in traffic areas and anti-buoyancy slabs to prevent groundwater uplift).
- low maintenance requirements

Hydroworks HD Separator Dimensions and Capacities

The HD separator is manufactured in a variety of sizes from 4 ft inside diameter to 12 ft inside diameter as shown in Table 1.

Table 1. Hydroworks HD Separator Dimensions*

Model	Structure Inside Diam. (ft)	Structure Depth (ft)*	Sediment/ Sinking Trash Volume (ft^3)	Oil/Floating Trash Volume (gal)	Permanent Pool (Wet) Volume (gal)
HD 3	3	4	11	31	210
HD 4	4	4	25	70	420
HD 5	5	5.5	47	134	805
HD 6	6	6.5	80	230	1375
HD 7	7	7.5	125	360	2155
HD 8	8	8.5	188	560	3195
HD 10	10	10.5	367	1125	6165
HD 12	12	12.5	631	1975	10575

*Dimensions vary with project requirements

The volumes provided in Table 1 for oil and sediment are to full capacity and not indicative of recommended depths/volumes for maintenance.

Headloss

Any water quality system implemented in a storm drain network will create headloss in the system. In general, depending on the configuration of the by-pass, systems designed to treat high flows or all of the flow will have a higher headloss impact on the storm drain network than systems that by-pass high flows.

The headloss created by the HD separator was measured in an independent laboratory (Alden Research Laboratory) for a full-scale HD 3 (Figures 3).

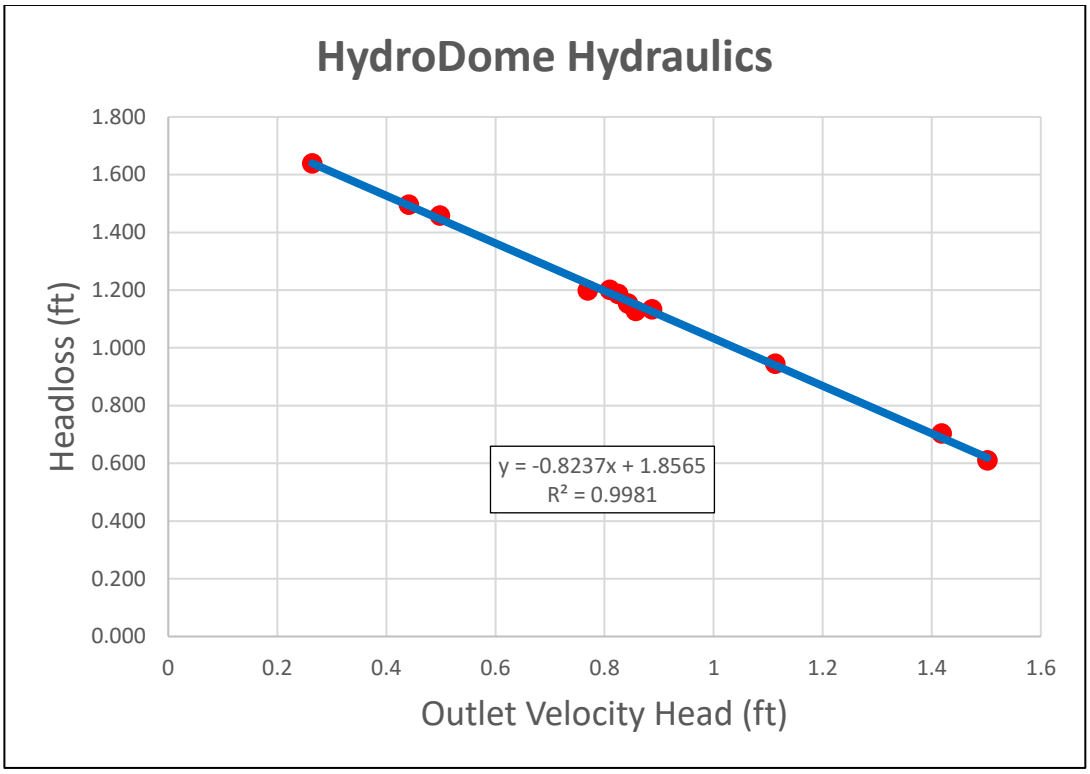


Figure 3. HydroDome Headloss

Headloss in the HydroDome decreases with velocity head due to the siphon creating an initial large headloss and the high weir reducing the headloss with increasing flow. The water level inside the HydroDome must exceed the level of the siphon for water to flow out of the structure. This creates an initially high headloss and a discontinuity between the upstream and downstream flow depths.

The sizing program calculates upstream flow head based on either the provided downstream flow rate or full pipe flow assuming the flow is not surcharged in the outlet pipe. Please contact Hydroworks to determine headloss in designs where tailwater creates a surcharge condition to ensure the headloss created by the HydroDome is acceptable for these site-specific applications.

Site Drainage

The water quality flow and peak conveyance flow were calculated based on areas and imperviousness provided by CMG Environmental and the pipe sizes and slopes provided on the grading and drainage plan. These flows are provided in Table 2

Table 2. 778 Main Street Water Quality Separator Parameters

Location	Area (ac)	Impervious (%)	WQF (cfs)*	Peak Conveyance (cfs)**	Recommended Unit
WQU 1	0.334	25	0.10	1.49	HD 3
WQU 2	1.672	40.3	0.81	3.84	HD 4

*Based on 1" of runoff and 6 min time of concentration
** Based on full pipe flow (un-surcharged)

The HydroDome HD 4 water quality treatment rate based on NJDEP ratings is 1.51 cfs and the HD 3 is rated for a water quality flow rate of 0.85 cfs. Therefore, the HD 3 and HD 4 are the appropriate sizes of separators for this project for water quality treatment.

A review of the hydraulics and rim elevations upstream indicate that the HydroDome will safely convey the peak conveyance flow based on the pipe sizes and slopes give for non-surcharged conditions.

TSS Removal Calculations for the Specified System

Hydroworks sizes separators based on continuous analysis of rainfall, runoff, and TSS settling in the HydroDome based on laboratory testing.

These calculations require a user input particle size distribution. We have used the NJDEP particle size distribution for this project.

Table 3. 778 Main Street TSS Particle Size Distribution	
Particle Size (um)	% by Mass
1	5
4	5
6	5
8	5
18	15
45	10
70	5
90	10
125	15
200	15
400	5
850	5

TSS removal calculations in the sizing program are based on the HydroDome being a completely mixed reactor vessel. The removal calculations solve a first order differential equation for the concentration of solids in the tank at any time. The first order differential equation is for continuity of mass.

$C'V = QC_i - QC_t - r_cV$

C' = the change in concentration of solids in the tank with time
Q = flow rate through the tank
C_i = solids concentration in the influent to the tank
C_t = solids concentration in the tank
V = tank volume
r_c = reduction in solids in the tank (TSS Removal)

Continuous simulation requires historical rainfall data. Forty-five years of rainfall data (1957-2001) from Worcester, MA, were used to analyze the 778 Main Street project.

Laboratory testing (Alden, 2020) results for TSS removal for the HydroDome using the NJDEP TSS distribution is provided in Figure 4. Figure 5 shows the NJDEP TSS particle size distribution tested with the HD 3.

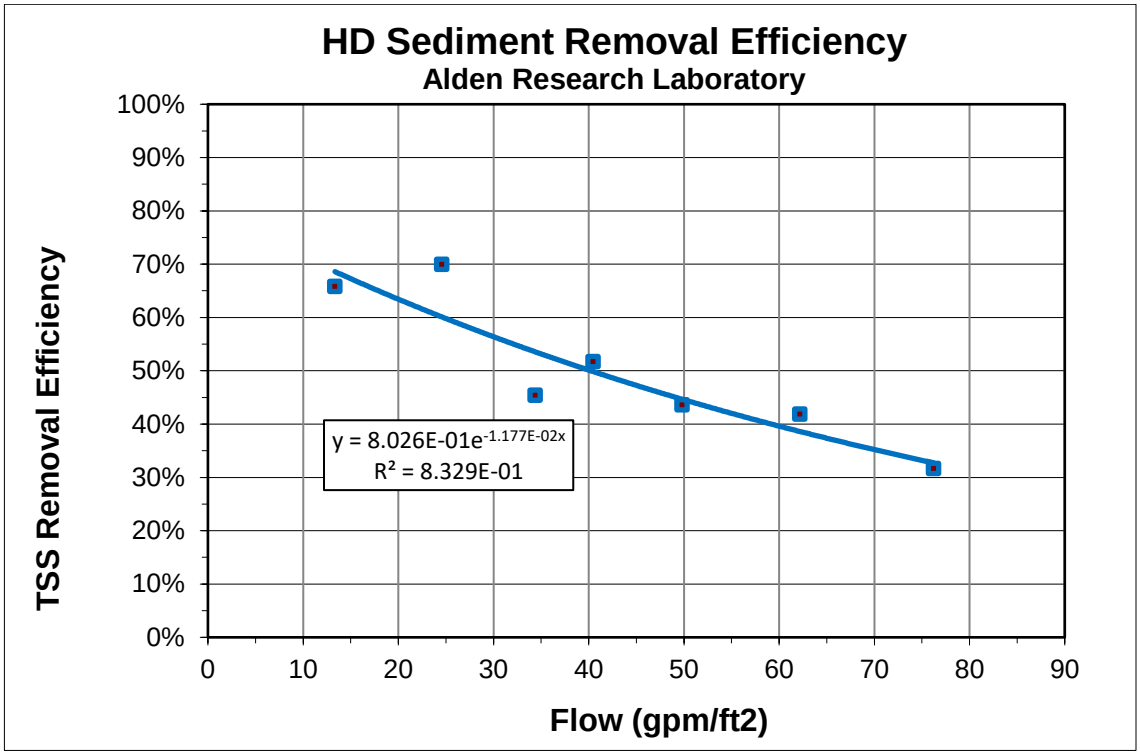


Figure 4. HydroDome TSS Removal Results (Alden, 2020)

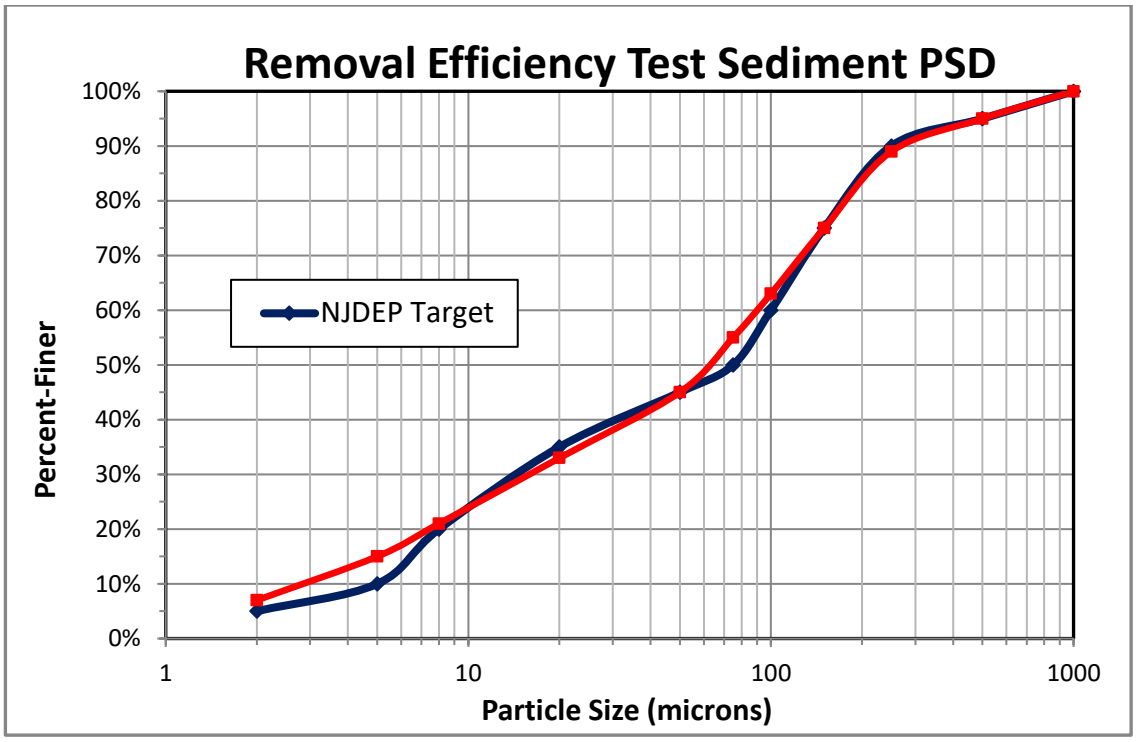


Figure 5. NJDEP TSS Particle Size Distribution (Alden, 2020)

Hydroworks uses the Peclet Number to calculate TSS removal based on the independent laboratory testing. The Peclet number has been used as a dimensionless scaling number for sediment deposition in lakes (Dhamotharan, et. Al. 1981). Others have suggested its use for scaling of TSS removal results for hydrodynamic separators (Dhanak, 2008, Gulliver, Guo and Wu, 2008, ASCE, EWRI, NJDEP).

The Peclet number is the ratio of convection (convective settling) to diffusion (turbulence keeping particles in suspension). The Peclet number (Equation 1) varies with the size of separator, particle size of TSS, and flow rate.

$$Pe = Vs\ h\ d\ /Q \qquad \text{Equation 1}$$

Where Pe = Peclet number
Vs = settling velocity
h = characteristic dimension
d = characteristic dimension
Q = flow rate

The Peclet number equates to surface area scaling if d and h are assumed to the length and width or diameter of a separator. A particle will be removed in the separator if the Peclet number is equal to, or greater than, the Peclet number calculated for removal of that particle based on the independent laboratory results. Based on the NJDEP PSD in Figure 5, the TSS removal in Figure 4, and the dimensions of the tested HD 3, critical Peclet Numbers can be calculated for each particle size in Figure 5 (critical Peclet number is the Peclet Number above which the particle is removed). A critical Peclet Number curve was then developed and input to the model (Figure 6).

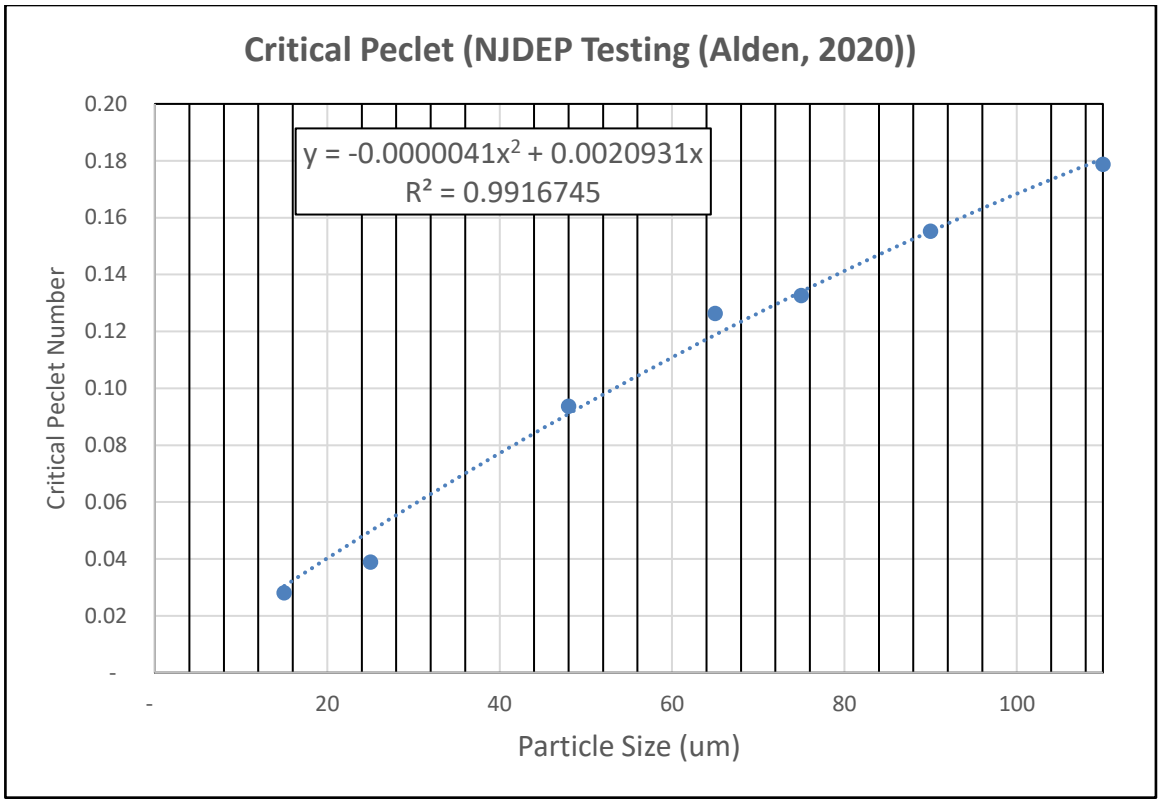


Figure 6. Critical Peclet Number Curve

At each timestep the Peclet Number is calculated for every flow and every HydroDome separator for each particle size in the design particle size distribution. The calculated Peclet Number is then compared to the Critical Peclet Number to determine if the particle is removed at that timestep or not (removed if the calculated Peclet Number is greater than the Critical Peclet Number and not removed if less than the Critical Peclet Number). These calculations are done for the entire rainfall record and all particle sizes in the distribution to determine an overall TSS removal percentage.

Hydroworks added a Peclet routine to the USEPA SWMM model to determine TSS removal based on the Peclet number calibrated to the independent laboratory testing completed by Alden Research Laboratory (regression equation in Figure 6). A comparison of the Alden test data to that predicted by the Peclet routine is given in Figure 7.

The use of the Peclet Number allows Hydroworks to size the HydroDome based on any particle size and design storm or local hydrology

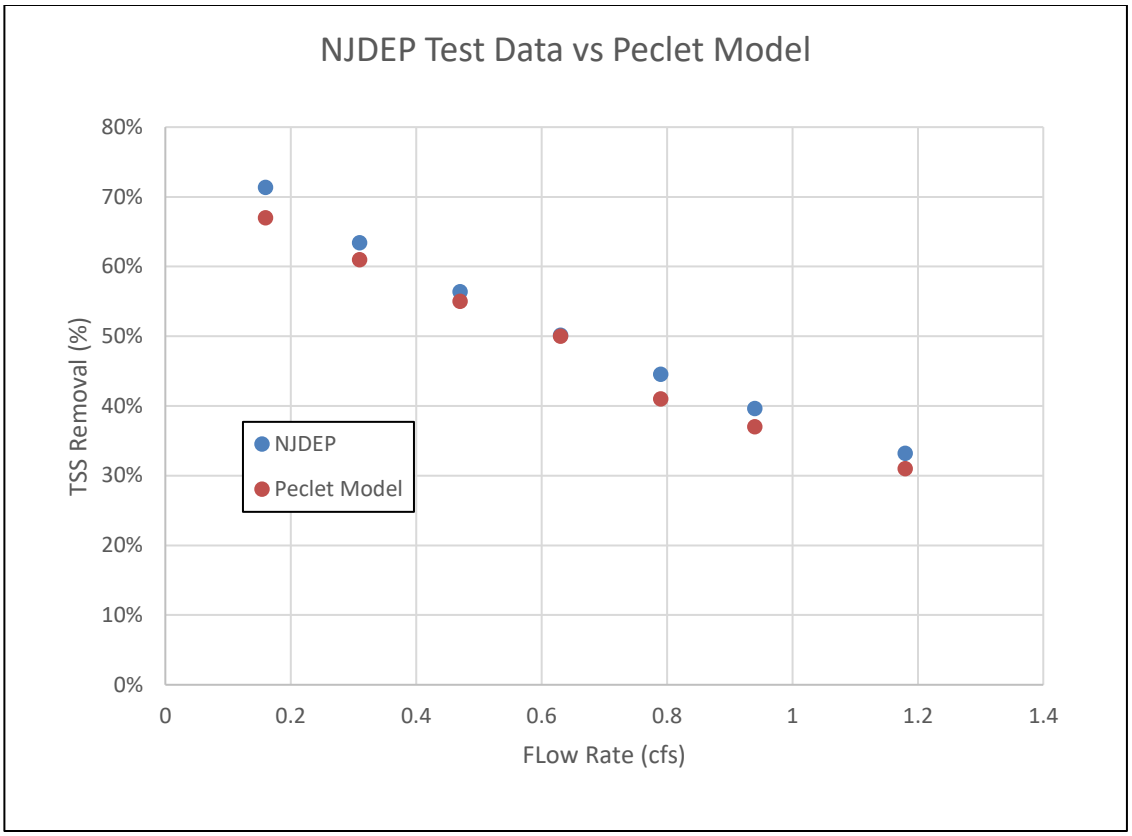


Figure 7. Comparison of NJDEP Removal Data with Peclet Model

Sizing Recommendations

TSS Removal

The annual TSS removal results are given in Figures 8 and 9. The sizing indicates the HD 3 is appropriately sized for WQU 1 and the HD 4 is appropriately sized for WQU 2 to provide 80% TSS removal.

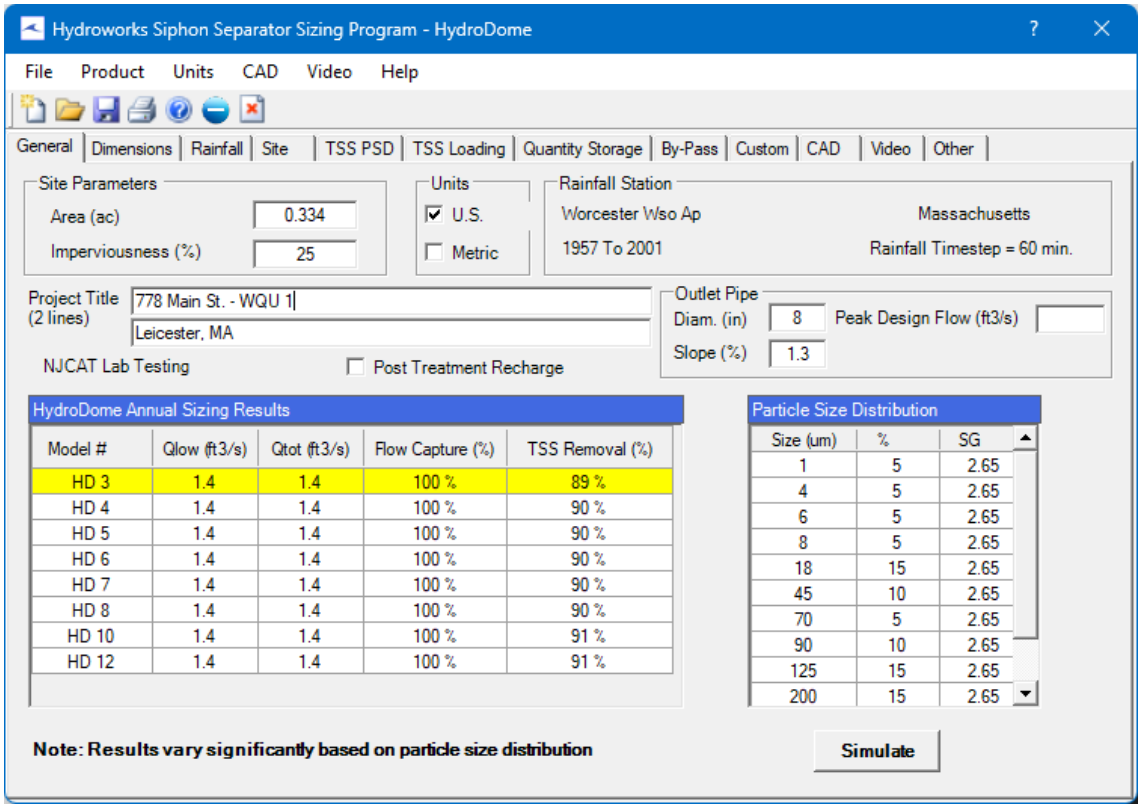


Figure 8. 778 Main Street Separator Sizing Results – WQU 1

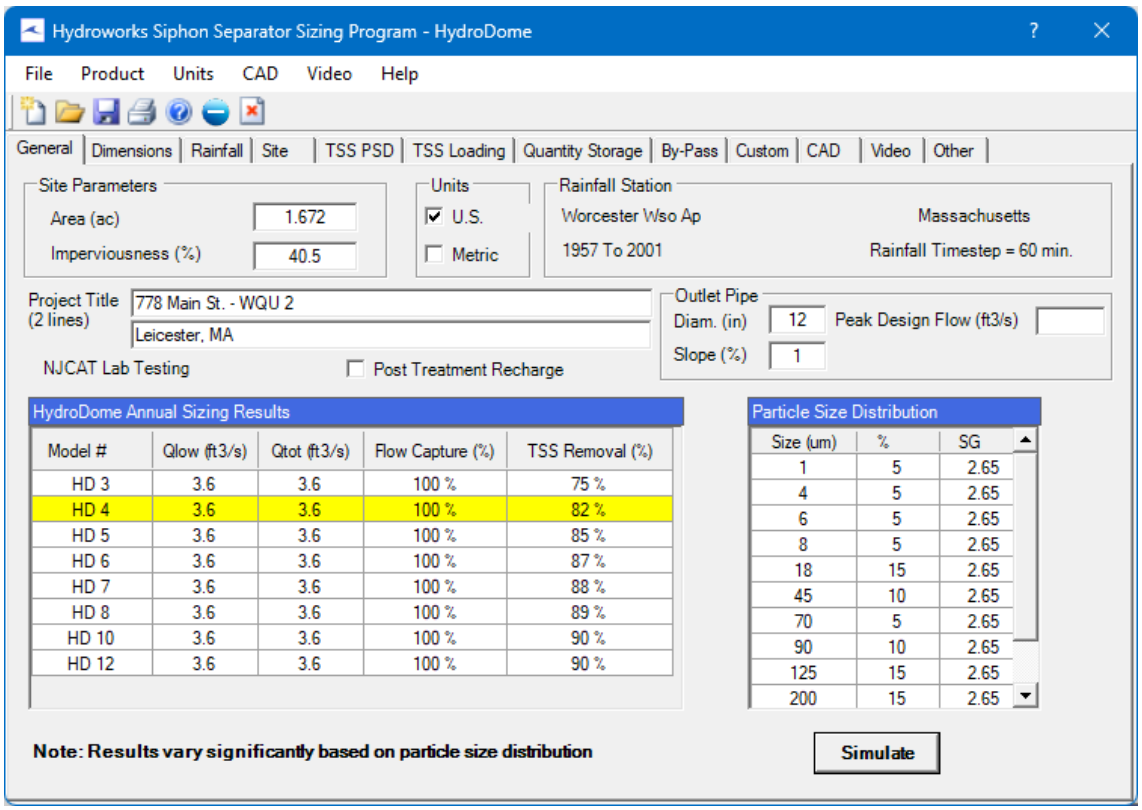


Figure 9. 778 Main Street Separator Sizing Results – WQU 2

Local Production

Hydroworks units are made locally by STI in Massachusetts, United Concrete in Connecticut and Concrete Systems Inc. in New Hampshire. Many of the Hydroworks internal components are made in Massachusetts. Therefore, the use of HydroDome supports the local New England economy.

Summary

We propose the use of a HydroDome HD 3 separator for WQU 1 and a HD 4 separator for WQU 2 at the 778 Main Street project in Leicester, MA. The proposed HydroDome separators will provide 80% annual TSS removal for the NJDEP TSS particle size distribution and treat the site water quality flow rate.

APPENDIX 1

HydroDome Approvals

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
PHILIP D. MURPHY
Governor
SHEILA Y. OLIVER
Lt. Governor
DIVISION OF WATERSHED PROTECTION AND RESTORATION
BUREAU OF NJPDES STORMWATER PERMITTING & WATER QUALITY MANAGEMENT
P.O. Box 420 Mail Code 401-02B
Trenton, New Jersey 08625-0420
609-633-7021 / Fax: 609-777-0432
www.njstormwater.org
SHAWN M. LATOURETTE
Commissioner

June 30, 2021

Graham Bryant
President
Hydroworks, LLC
257 Cox Street
Roselle, NJ 07203

Re: MTD Lab Certification
HydroDome (HD) Stormwater Separator by Hydroworks, LLC
On-line Installation

TSS Removal Rate 50%

Dear Mr. Bryant:

The Stormwater Management rules under N.J.A.C. 7:8-5.2(f) and 5.2(j) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Hydroworks, LLC has requested an MTD Laboratory Certification for the HydroDome Stormwater Separator (HydroDome).

The project falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report dated May 2021 with the Verification Appendix for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the HydroDome by Hydroworks, LLC at a TSS removal rate of 50% when designed, operated and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.

2. The HydroDome shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in in item 6 below.

3. This HydroDome cannot be used in series with another MTD or a media filter (such as a sand filter), to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 11.3 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual which can be found on-line at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the HydroDome, which is attached to this document. However, it is recommended to review the maintenance manual at www.hydroworks.com\hdmaintenance.pdf for any changes to the maintenance requirements.

6. Sizing Requirements:

   The example below demonstrates the sizing procedure for the HydroDome:

   Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a HydroDome. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

   Maximum Treatment Flow Rate (MTFR) Evaluation:

   The site runoff (Q) was based on the following:
   time of concentration = 10 minutes
   i=3.2 in/hr (page 21, Fig. 5-10 of Chapter 5 of the NJ Stormwater BMP Manual)
   c=0.99 (curve number for impervious)
   Q=ciA=0.99x3.2x0.25=0.79 cfs

   Given the site runoff is 0.79 cfs and based on Table 1 below, the HydroDome Model HD 3 with a MTFR of 0.85 cfs would be the smallest model approved that could be used for this site that could remove 50% of the TSS from the impervious area without exceeding the MTFR.

   The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the Verification Appendix under Table A-1 and Table A-2.

Table 1 HydroDome Models

HydroDome Model	Manhole Diameter (ft)	Maximum Treatment Flowrate, MTFR (cfs)
HD 3	3	0.85
HD 4	4	1.51
HD 5	5	2.36
HD 6	6	3.40
HD 7	7	4.63
HD 8	8	6.03
HD 10	10	9.44
HD 12	12	13.60

Be advised a detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Lisa Schaefer of my office at lisa.schaefer@dep.nj.gov.

Sincerely,

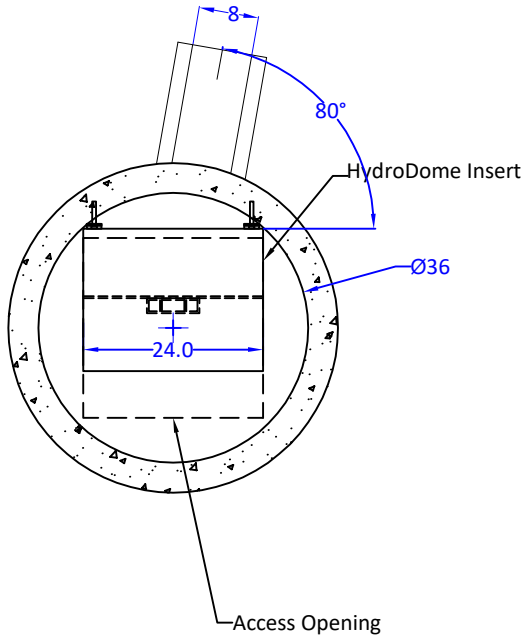
Gabriel Mahon, Chief
Bureau of NJPDES Stormwater Permitting & Water Quality Management
Division of Watershed Protection and Restoration
New Jersey Department of Environmental Protection

Attachment: Maintenance Plan

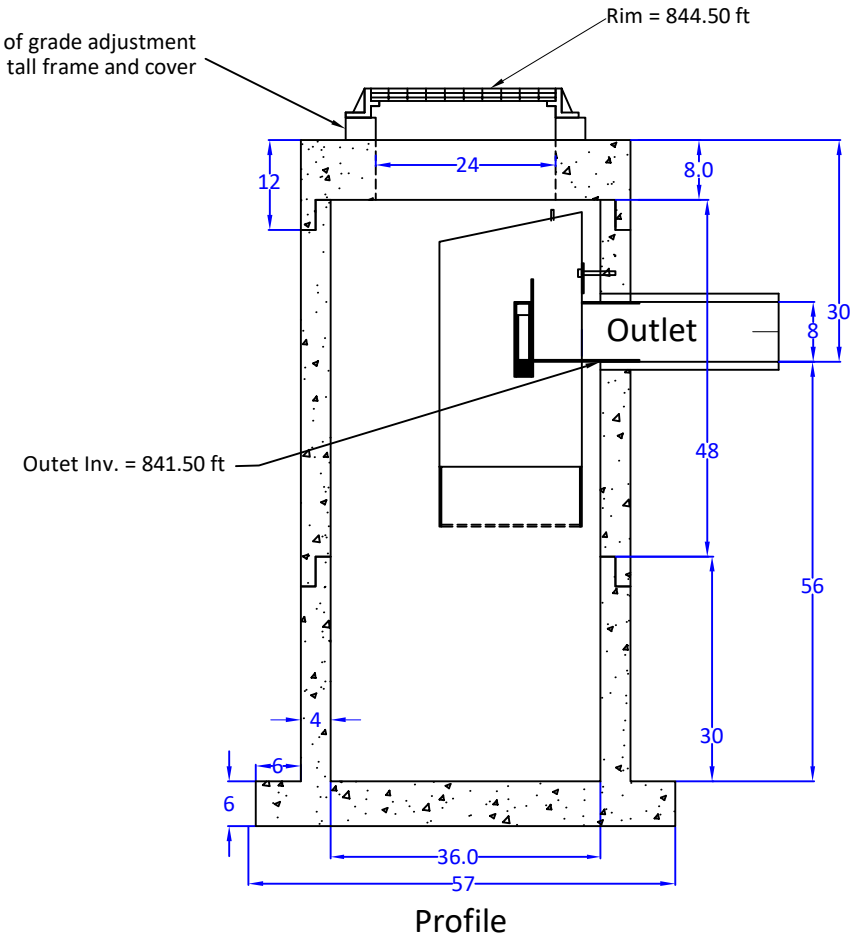
cc: Richard Magee, NJCAT

APPENDIX 2

CAD Drawings



Plan



Profile

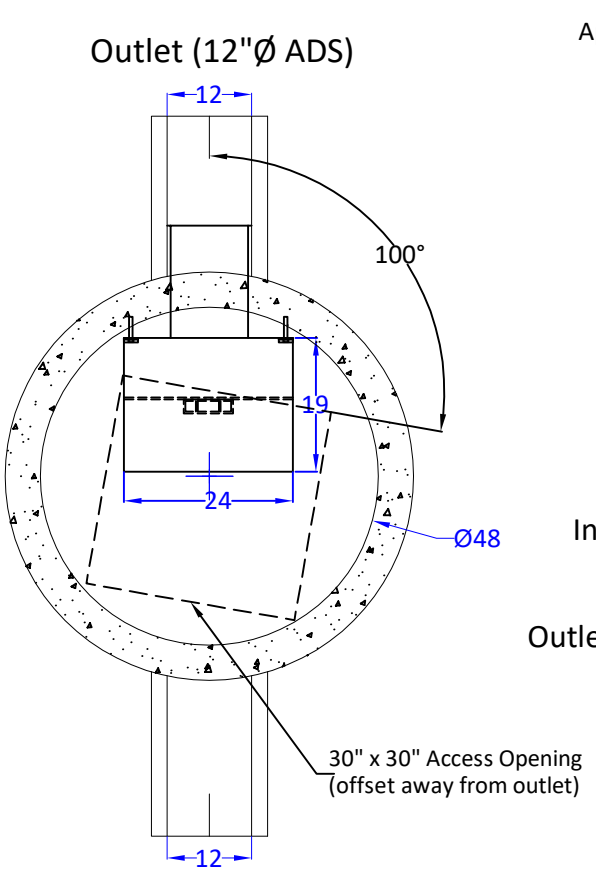
HD 3 Storage Vol = 245 gal

HydroDome
US Patent # 10,801,196
www.hydroworks.com
888-290-7900

Hydroworks HydroDome HD 3i (36"Ø)
PROJECT: 778 Main St. - WQU 1
LOCATION: Leicester, MA
REVISION DATE: 5/10/2023

Hydroworks

SELLING AGENT RESPONSIBLE FOR PROVIDING CONTRACTOR WITH PAGE 1



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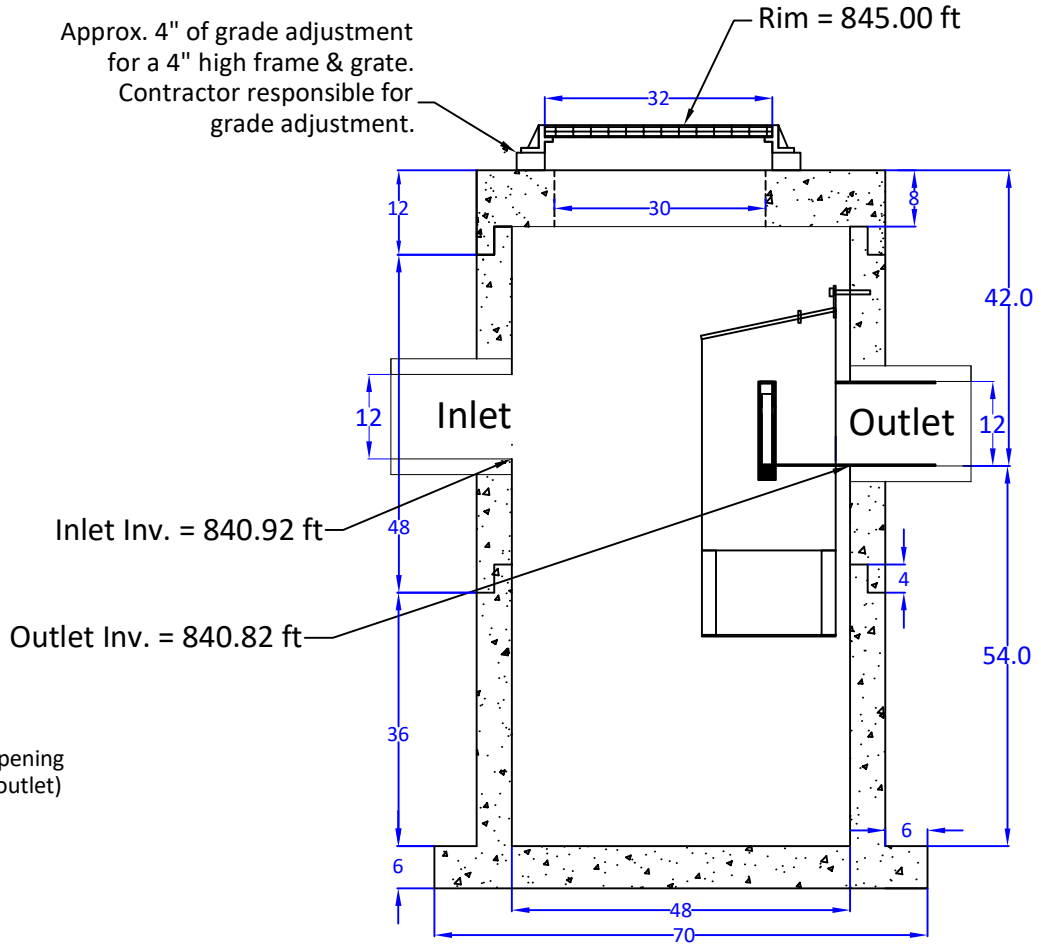


Profile

Any alternate equal must have independent testing to both the 2013 NJDEP separator protocol and the 2013 ETV Canada separator protocol

HydroDome by
Hydroworks, LLC
U.S. Patent #10,801,196
www.hydroworks.com
888-290-7900

Hydroworks HD4i (48"Ø)

PROJECT: 778 Main St. - WQU 2

LOCATION: Leicester, MA

REVISION DATE: 05/10/2023

Hydroworks

APPENDIX 3

HydroDome Sizing Output

Hydroworks Sizing Summary

778 Main St. - WQU 1

Leicester, MA

05-09-2023

Recommended Size: HydroDome HD 3i

A HydroDome HD 3i is recommended to provide 80 % annual TSS removal based on a drainage area of 0.334 (ac) with an imperviousness of 25 % and Worcester Wso Ap, Massachusetts rainfall for the NJDEP particle size distribution.

The recommended HydroDome HD 3i treats 100 % of the annual runoff and provides 89 % annual TSS removal for the Worcester Wso Ap rainfall records and NJDEP particle size distribution.

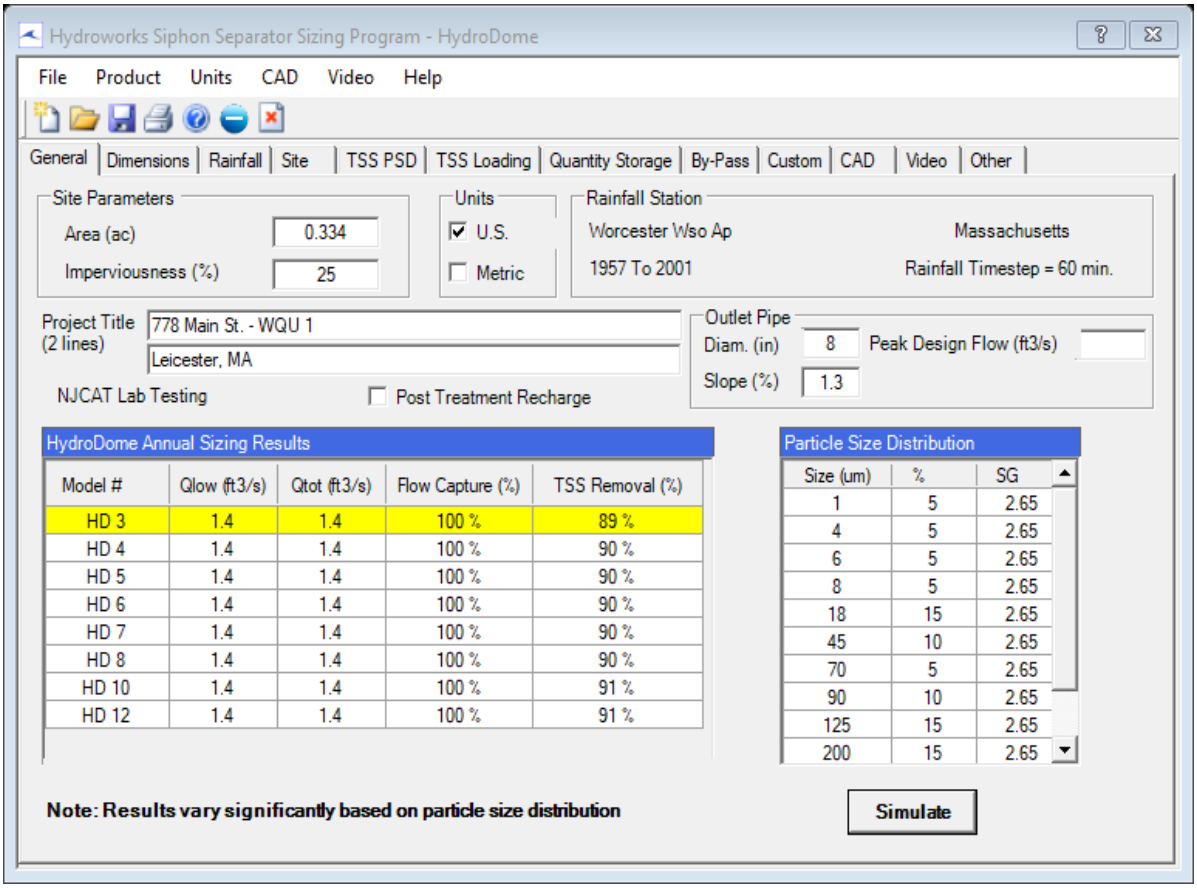
The HydroDome has a siphon which creates a discontinuity in headloss. Since a peak flow was not specified, headloss was calculated using the full pipe flow of 1.38 (ft3/s) for the given 8 (in) pipe diameter at 1.3% slope. The headloss was calculated to be 10 (in) above the crown of the 8 (in) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

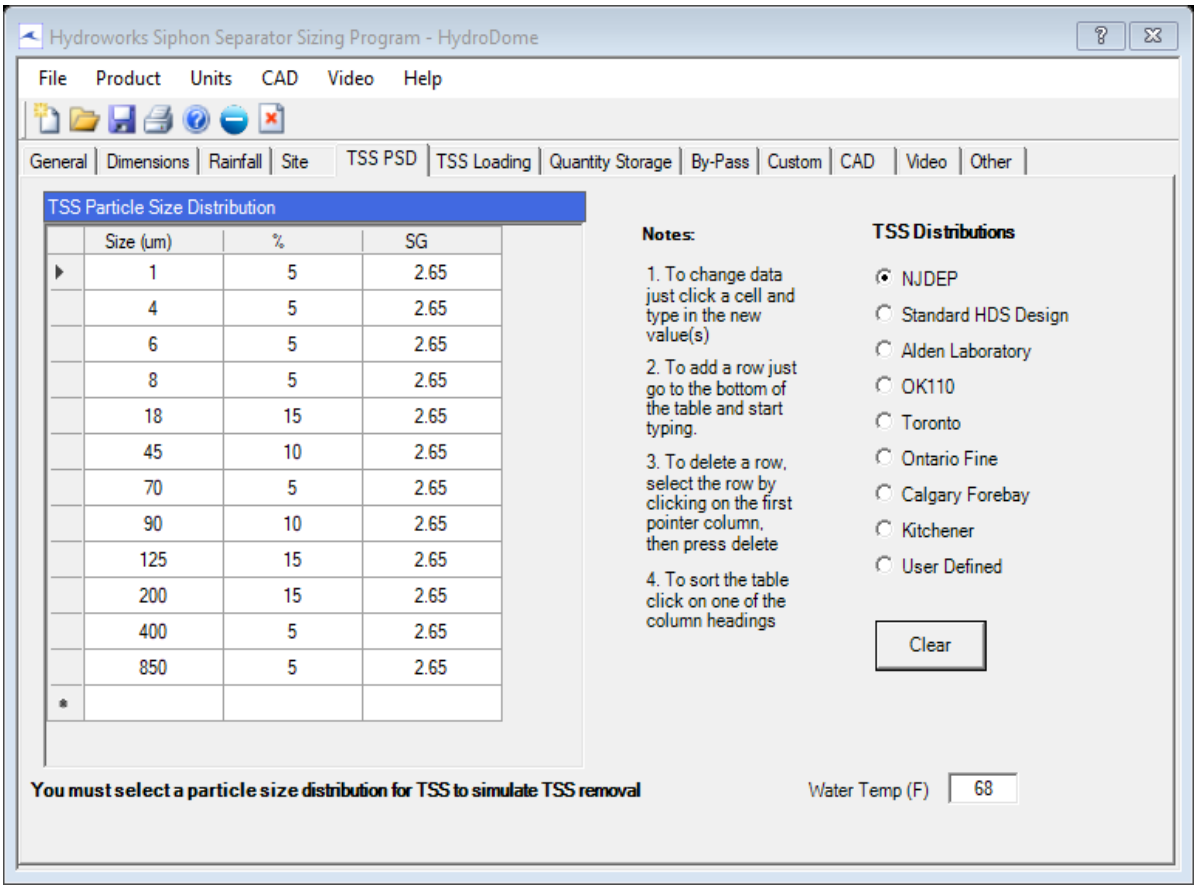
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroDome .

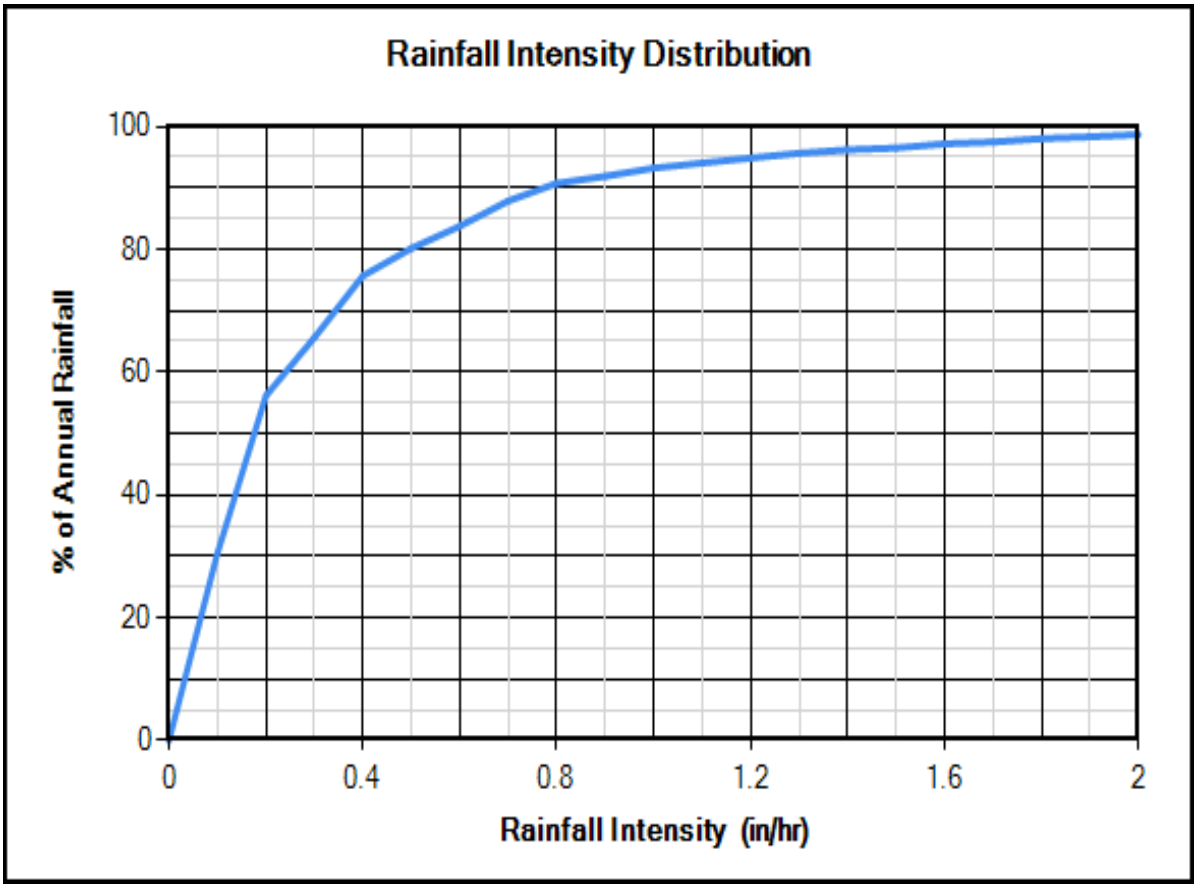
TSS Removal Sizing Summary



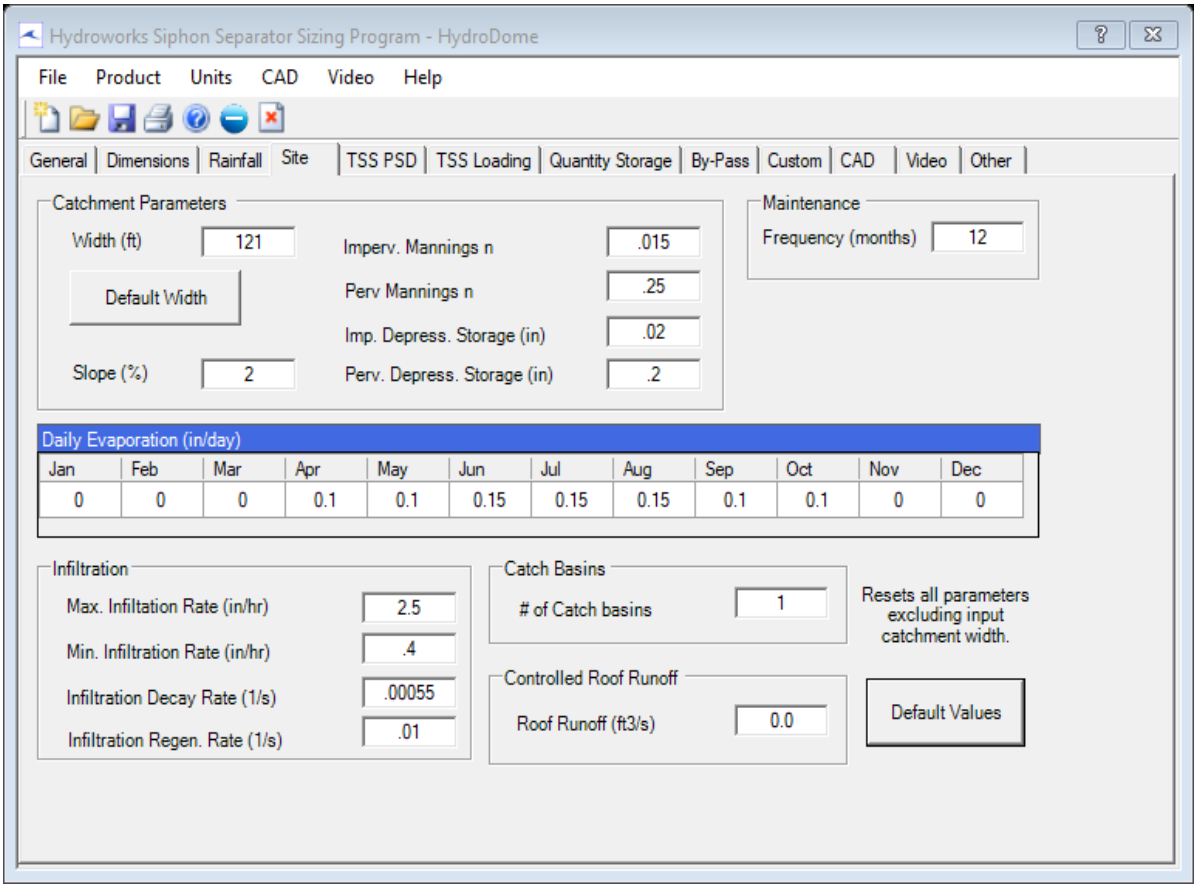
TSS Particle Size Distribution



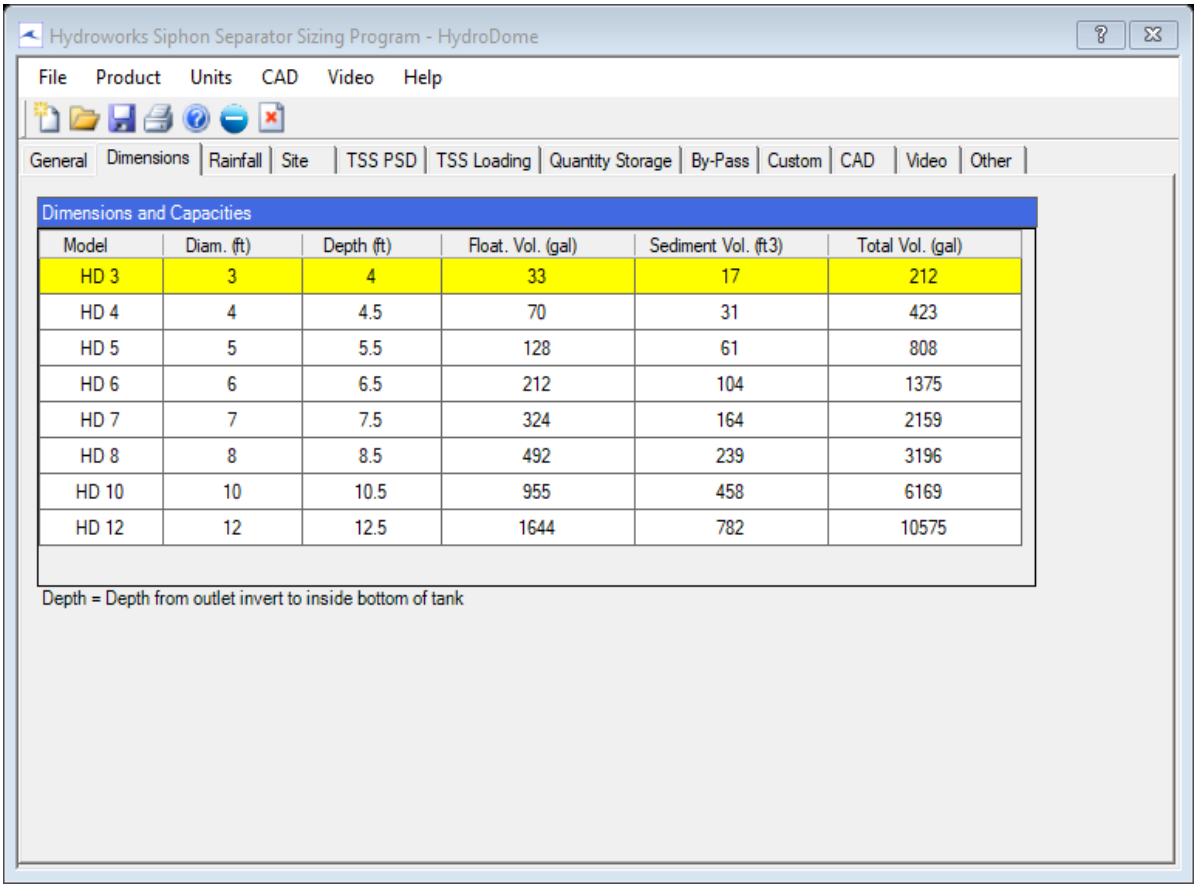
Rainfall Station - Worcester Wso Ap, Massachusetts(1957 To 2001)



Site Physical Characteristics



Dimensions And Capacities

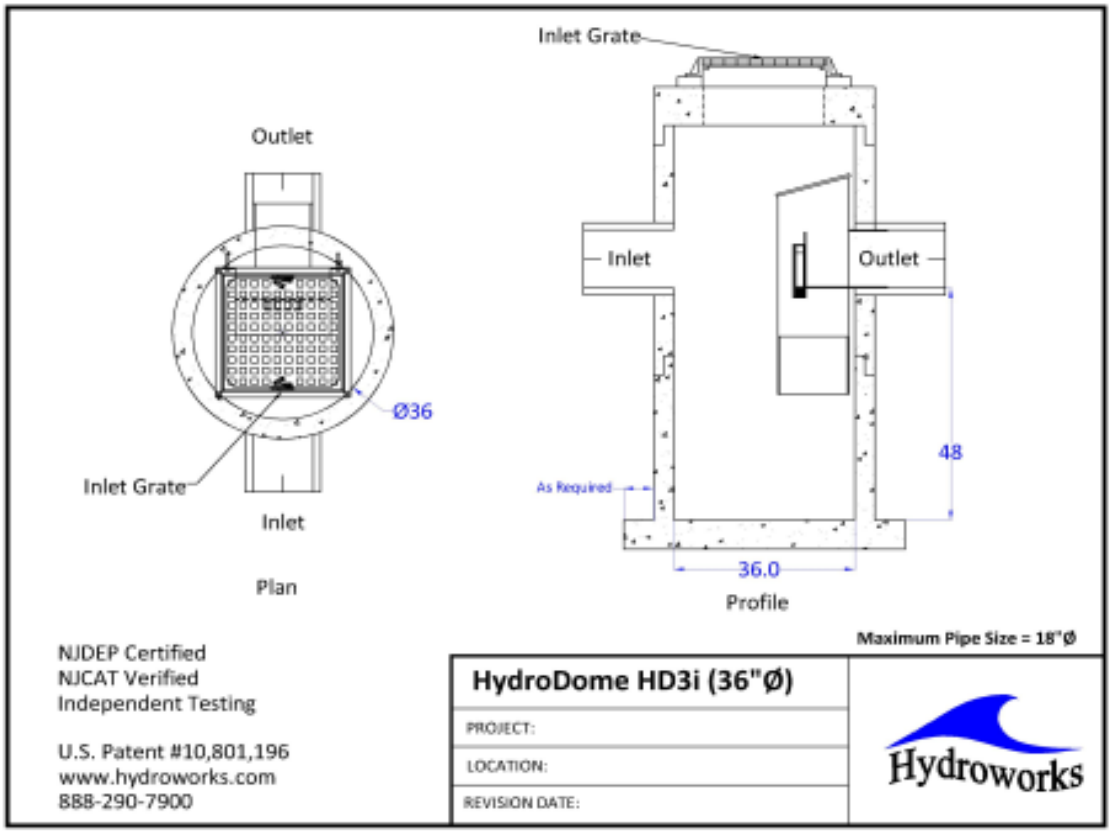


Dimensions and Capacities

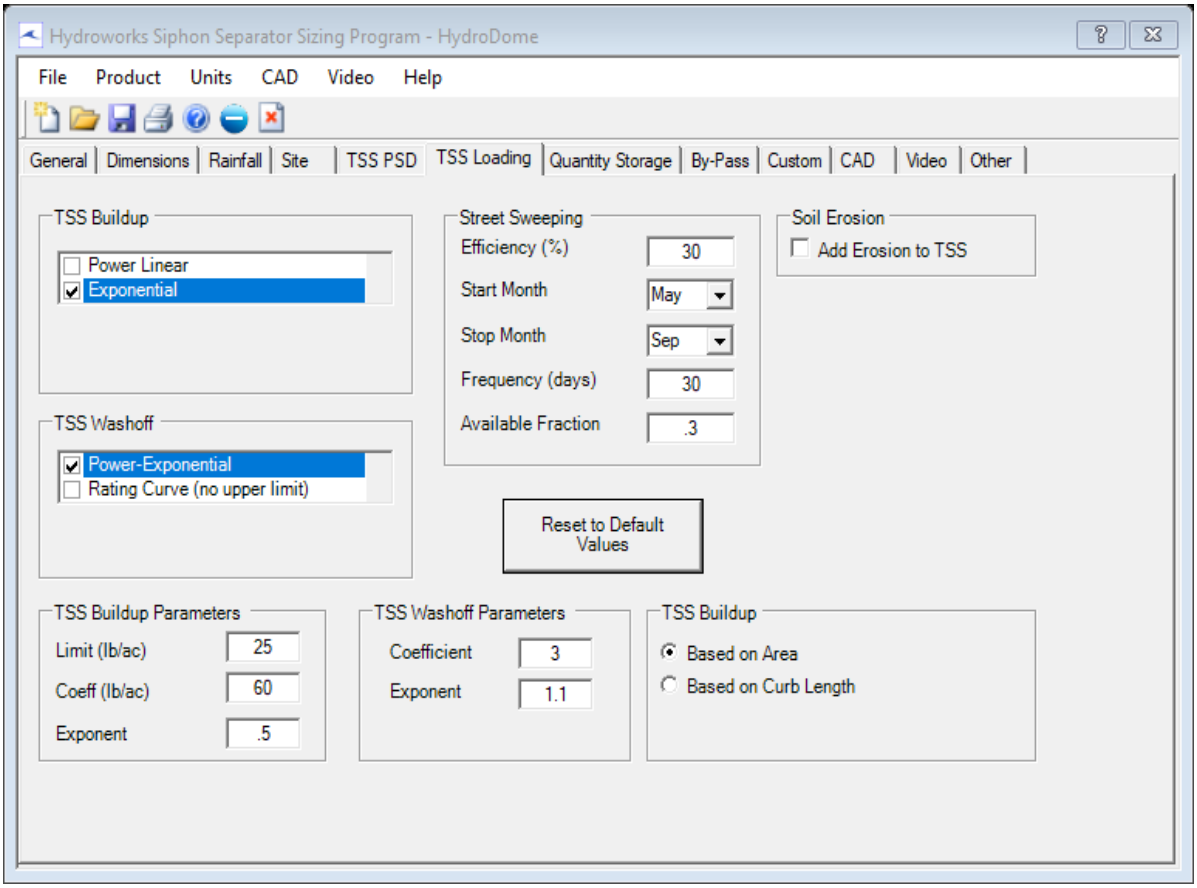
Model	Diam. (ft)	Depth (ft)	Float. Vol. (gal)	Sediment Vol. (ft3)	Total Vol. (gal)
HD 3	3	4	33	17	212
HD 4	4	4.5	70	31	423
HD 5	5	5.5	128	61	808
HD 6	6	6.5	212	104	1375
HD 7	7	7.5	324	164	2159
HD 8	8	8.5	492	239	3196
HD 10	10	10.5	955	458	6169
HD 12	12	12.5	1644	782	10575

Depth = Depth from outlet invert to inside bottom of tank

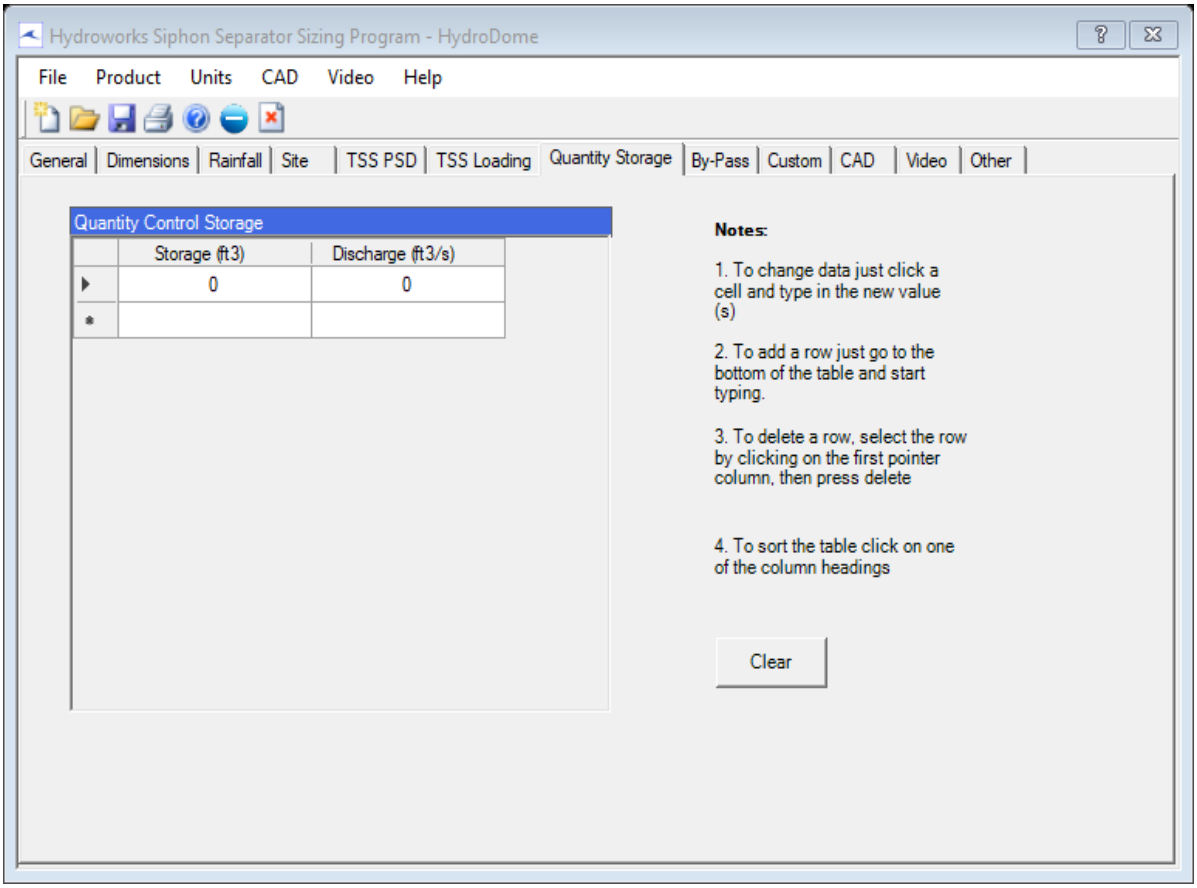
Generic HD 3i CAD Drawing



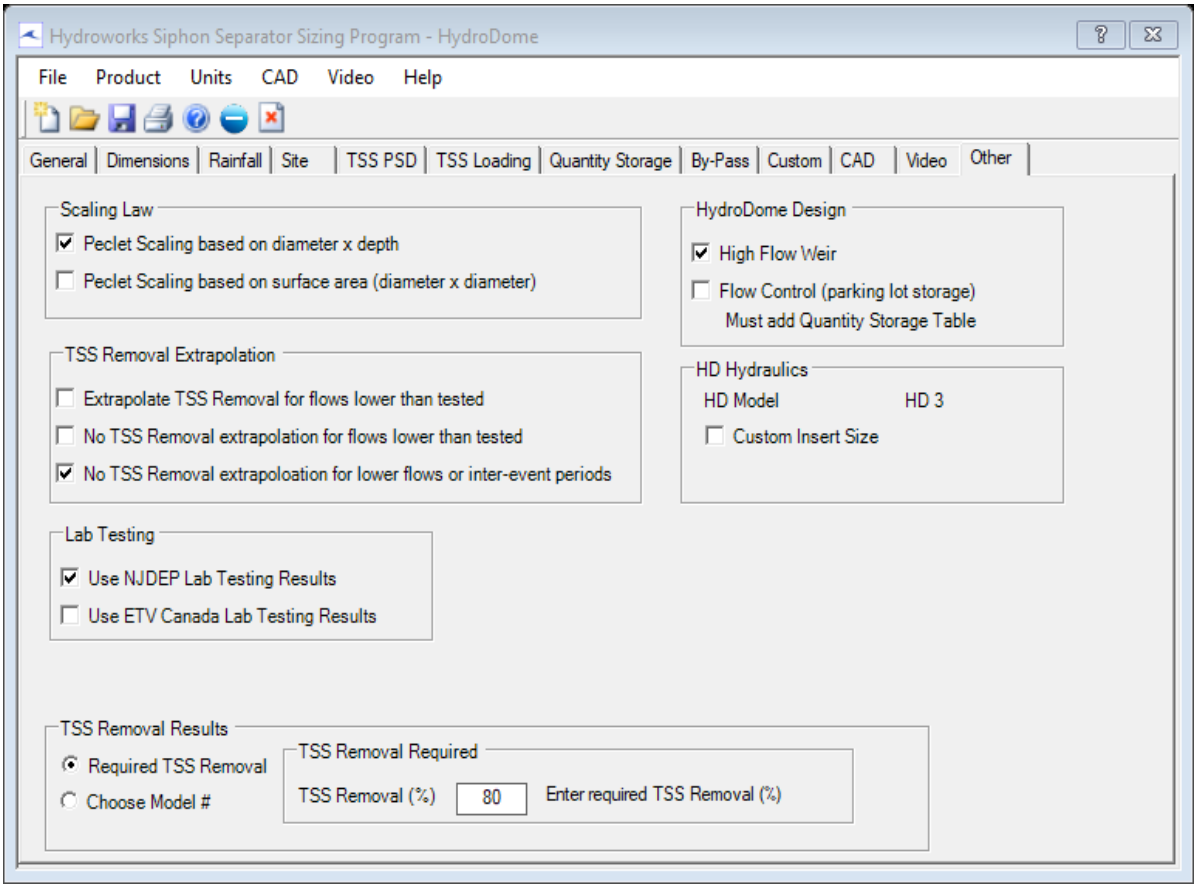
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.8
Copyright Hydroworks, LLC, 2023
1-800-290-7900
www.hydroworks.com

Hydroworks Sizing Summary

778 Main St. - WQU 2
Leicester, MA

05-09-2023

Recommended Size: HydroDome HD 4i

A HydroDome HD 4i is recommended to provide 80 % annual TSS removal based on a drainage area of 1.672 (ac) with an imperviousness of 40.5 % and Worcester Wso Ap, Massachusetts rainfall for the NJDEP particle size distribution.

The recommended HydroDome HD 4i treats 100 % of the annual runoff and provides 82 % annual TSS removal for the Worcester Wso Ap rainfall records and NJDEP particle size distribution.

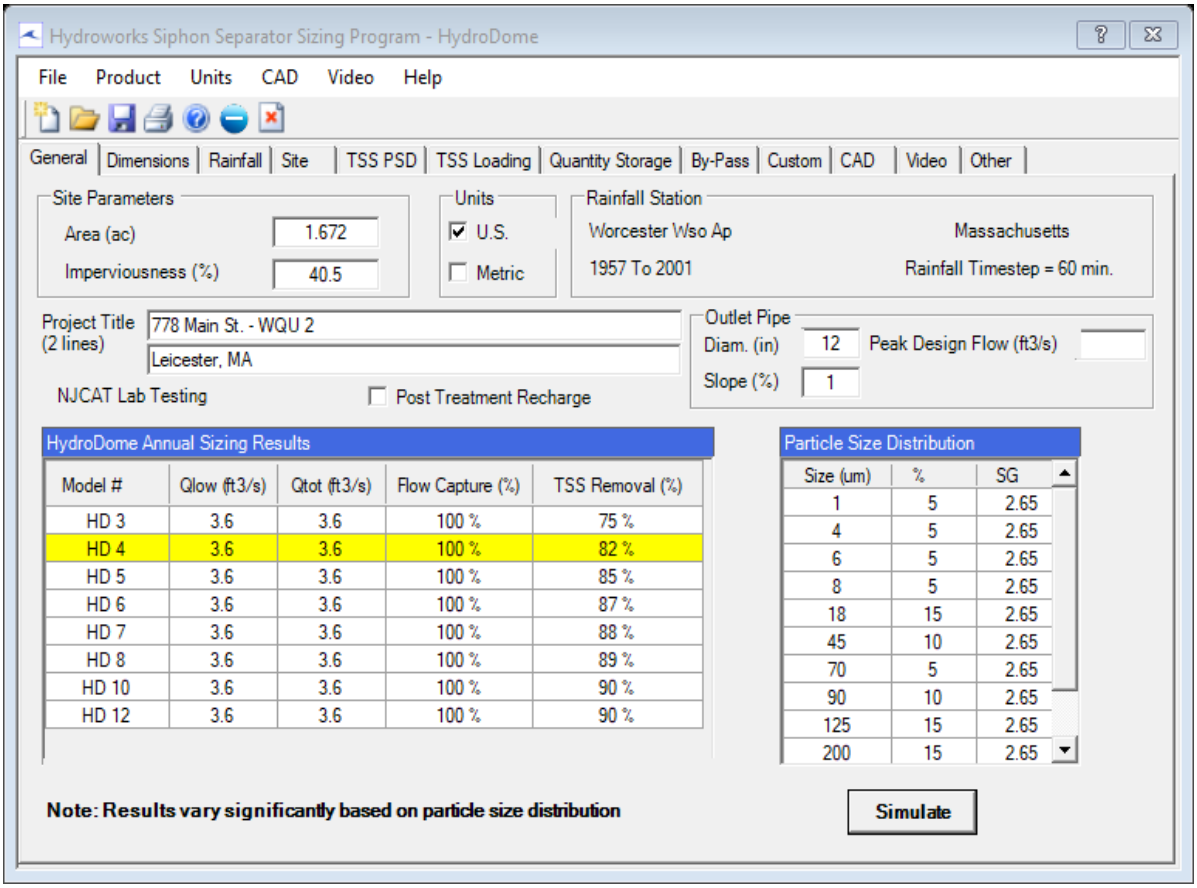
The HydroDome has a siphon which creates a discontinuity in headloss. Since a peak flow was not specified, headloss was calculated using the full pipe flow of 3.56 (ft3/s) for the given 12 (in) pipe diameter at 1% slope. The headloss was calculated to be 12 (in) above the crown of the 12 (in) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

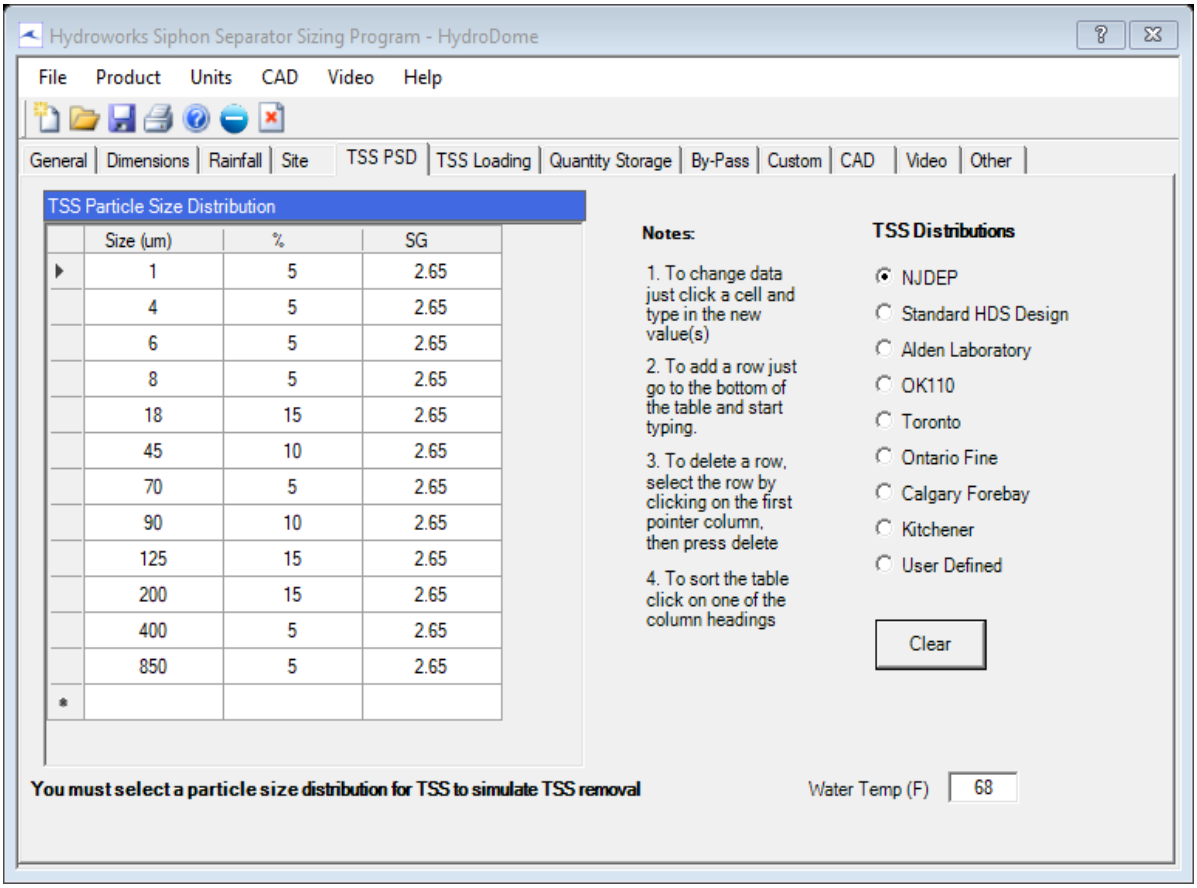
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroDome .

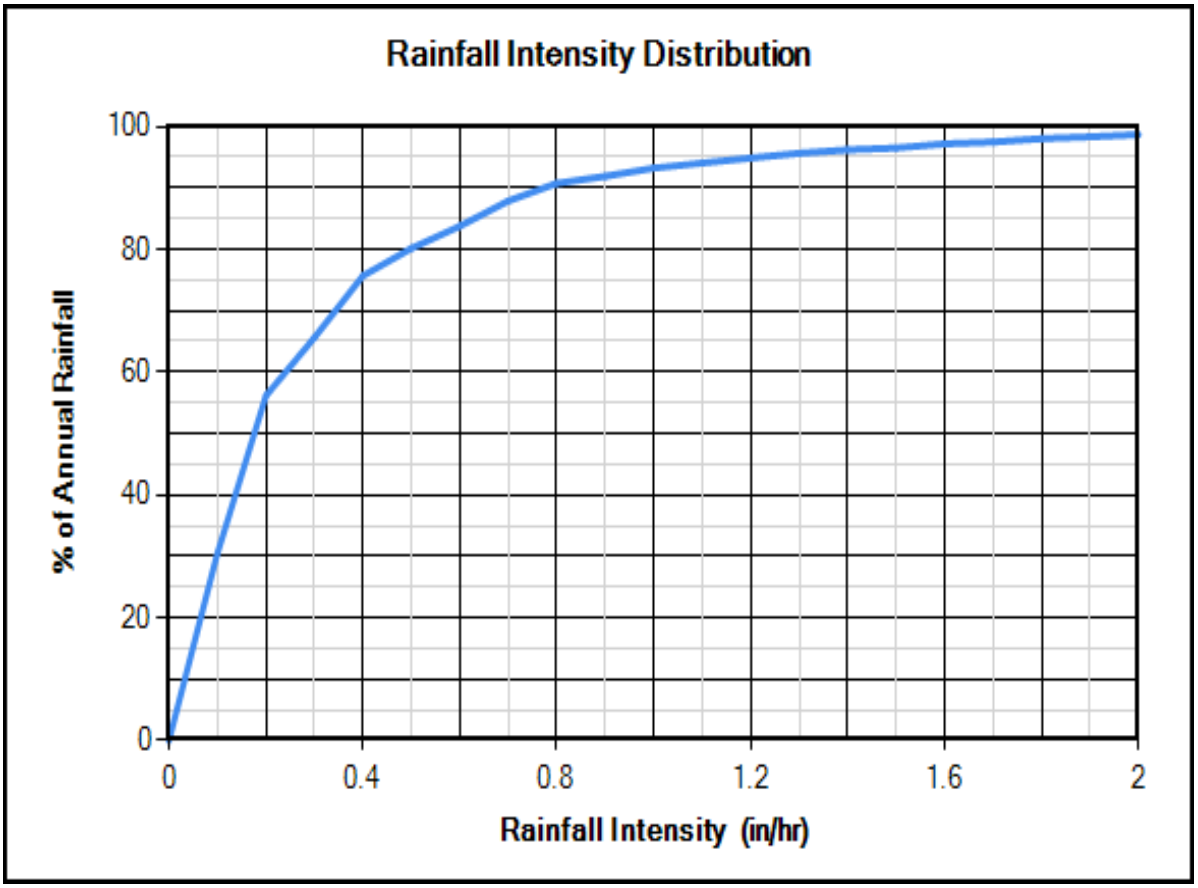
TSS Removal Sizing Summary



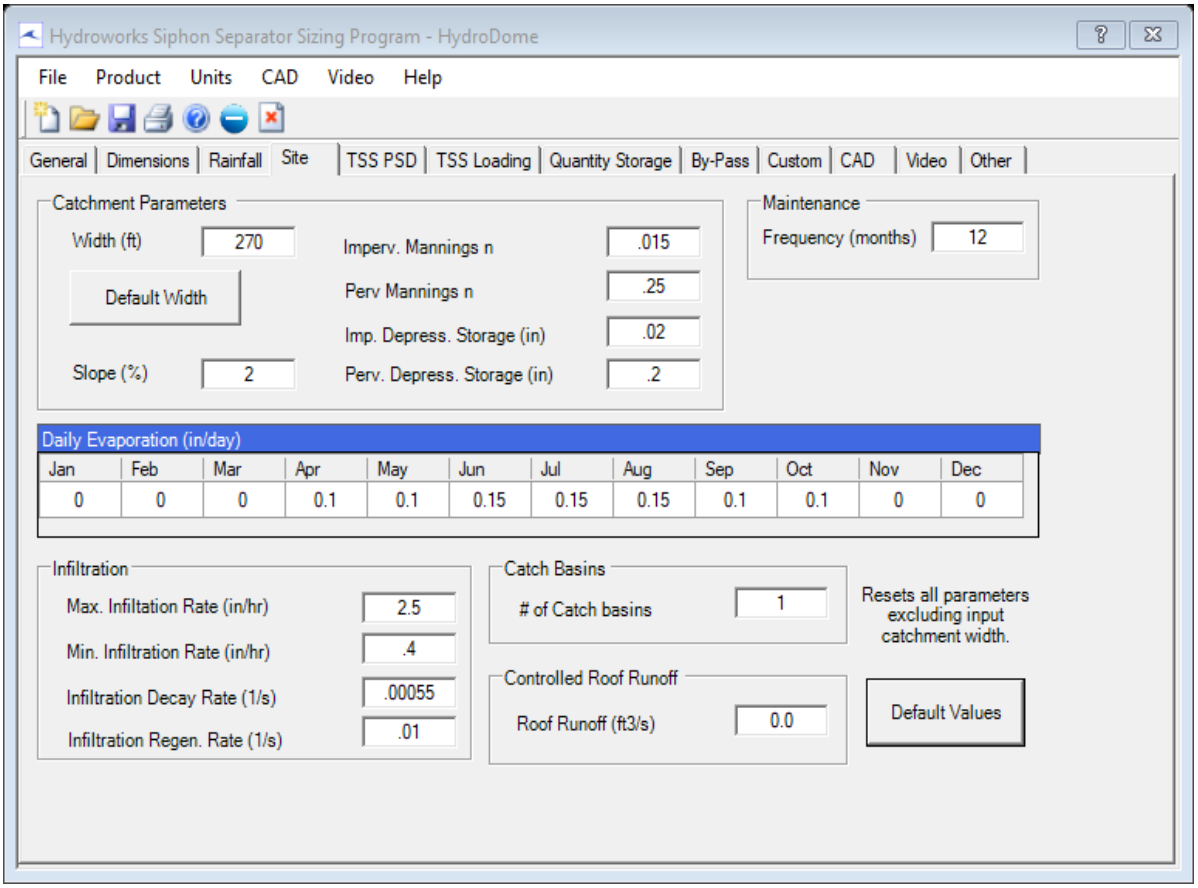
TSS Particle Size Distribution



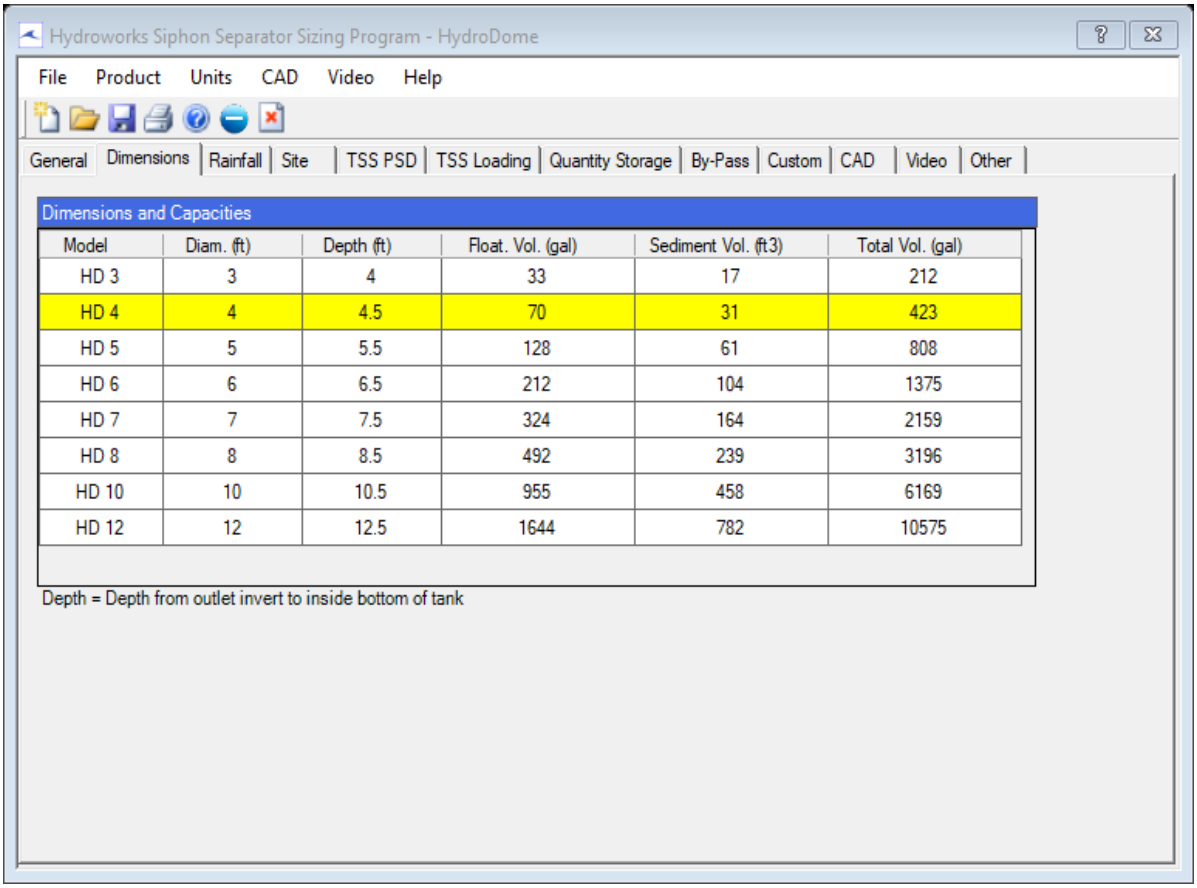
Rainfall Station - Worcester Wso Ap, Massachusetts(1957 To 2001)



Site Physical Characteristics



Dimensions And Capacities

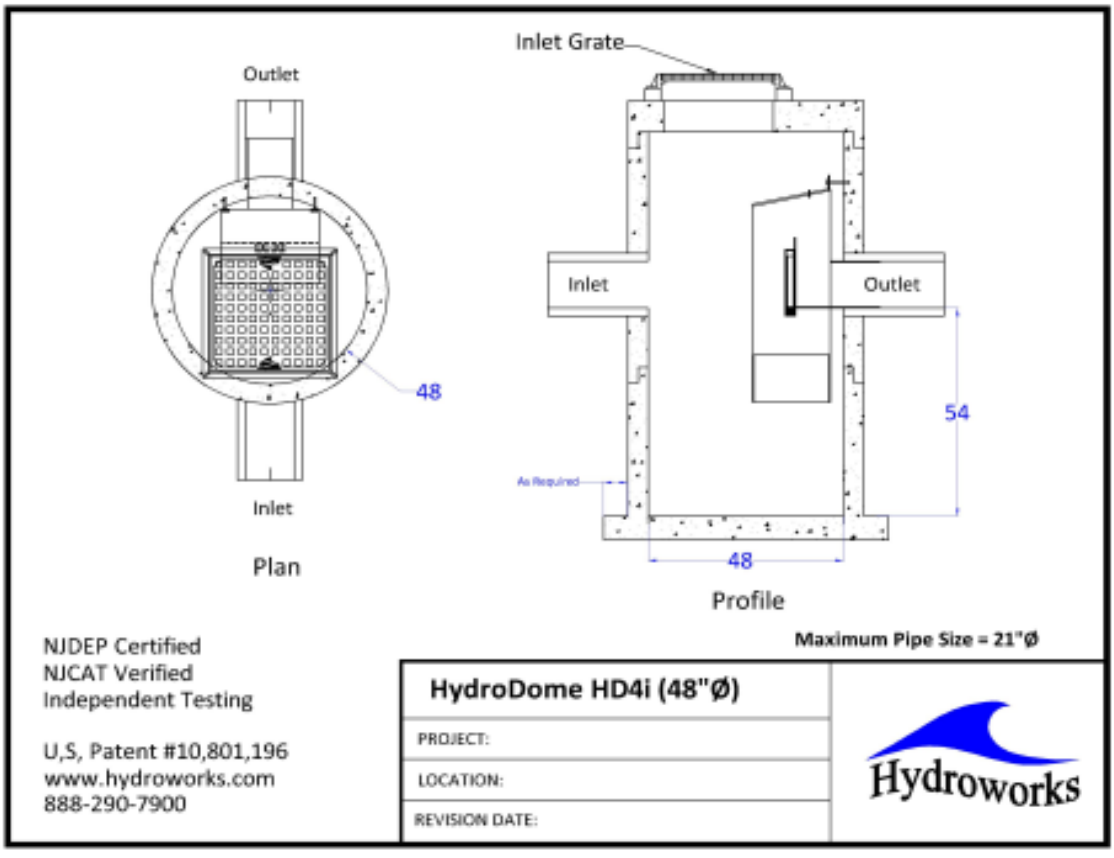


Dimensions and Capacities

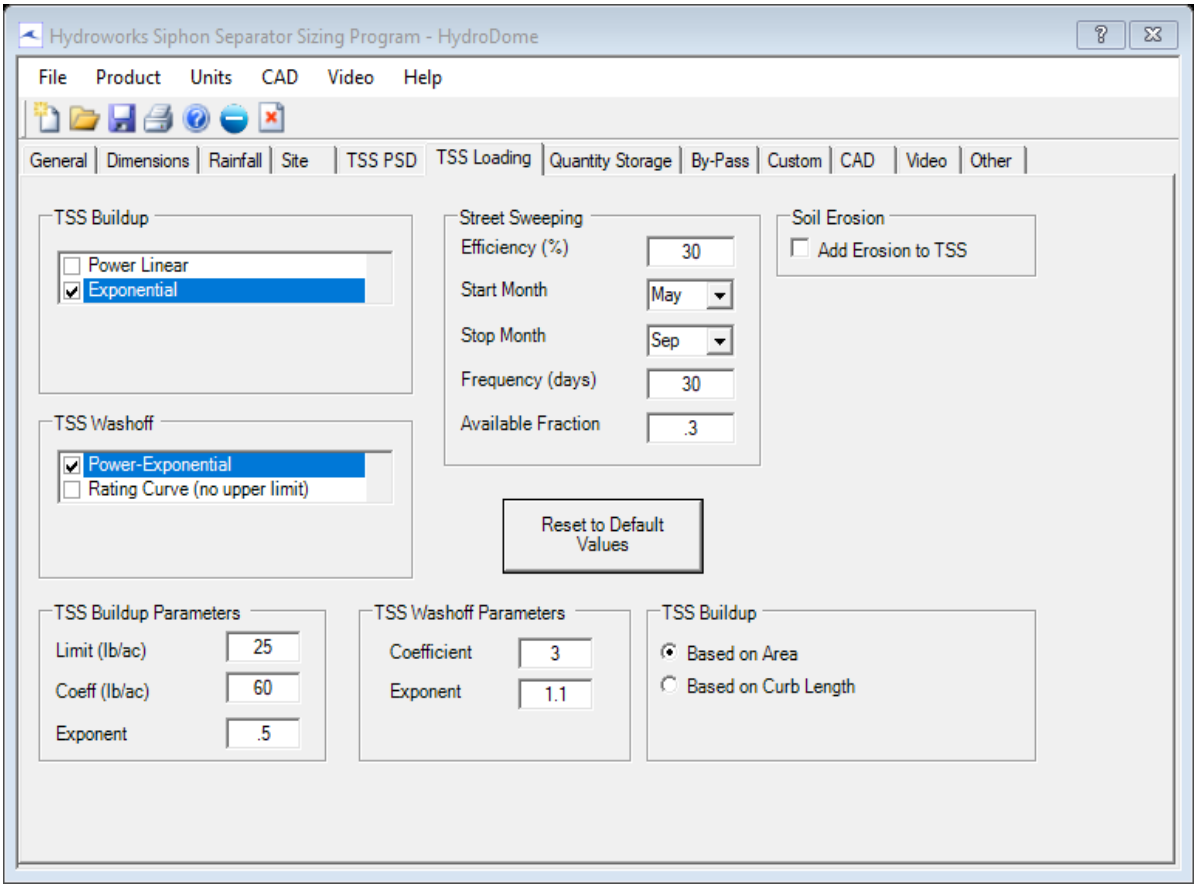
Model	Diam. (ft)	Depth (ft)	Float. Vol. (gal)	Sediment Vol. (ft3)	Total Vol. (gal)
HD 3	3	4	33	17	212
HD 4	4	4.5	70	31	423
HD 5	5	5.5	128	61	808
HD 6	6	6.5	212	104	1375
HD 7	7	7.5	324	164	2159
HD 8	8	8.5	492	239	3196
HD 10	10	10.5	955	458	6169
HD 12	12	12.5	1644	782	10575

Depth = Depth from outlet invert to inside bottom of tank

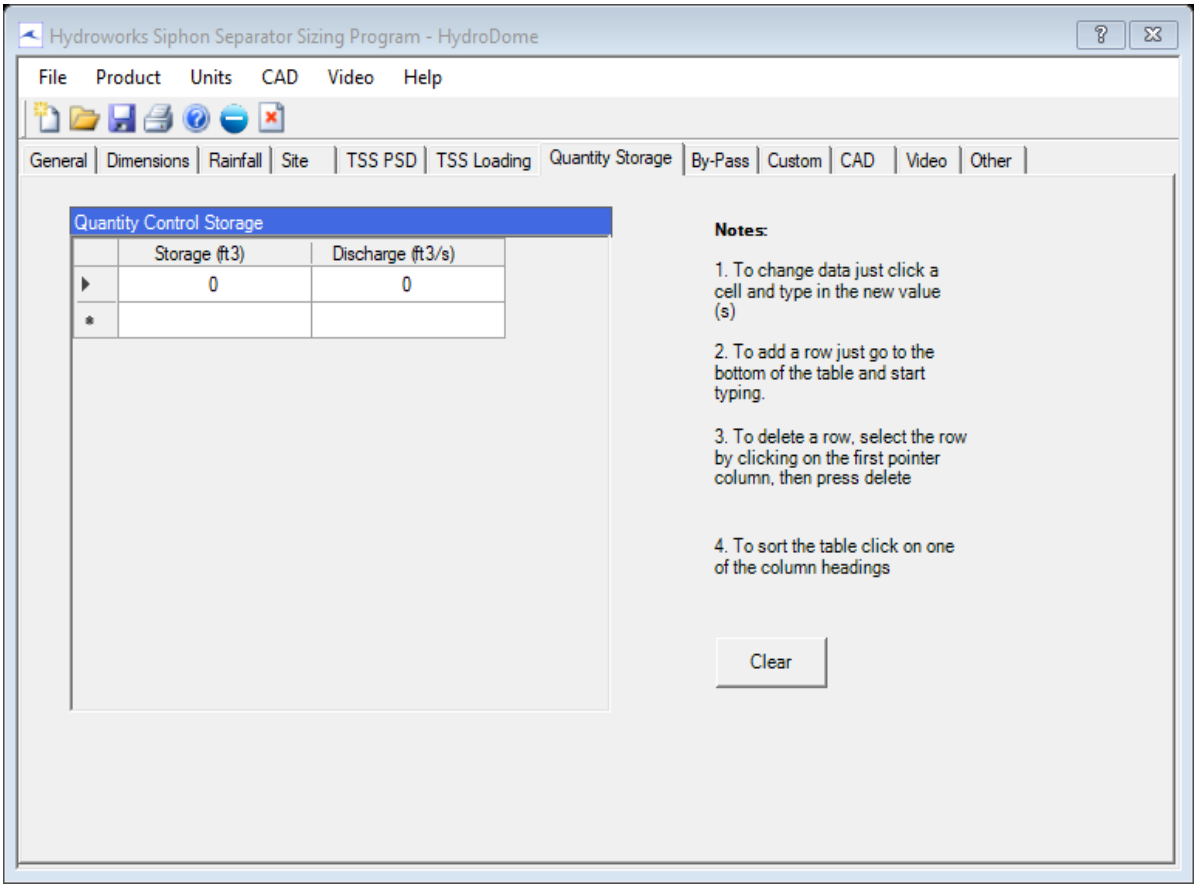
Generic HD 4i CAD Drawing



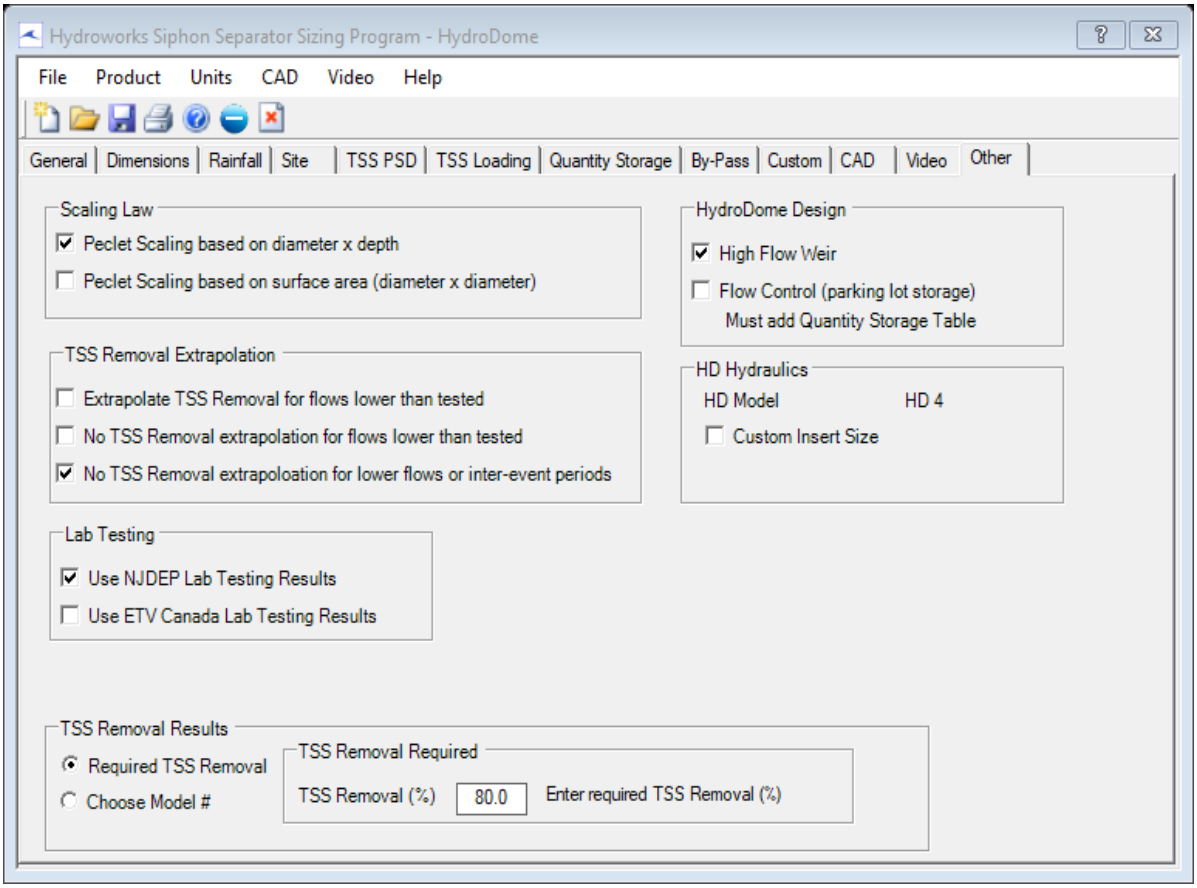
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.8
Copyright Hydroworks, LLC, 2023
1-800-290-7900
www.hydroworks.com

Appendix G

Cultec Separator Row
Performance Verification Statement

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Cultec Separator Row™ Filtration System

Developed by Cultec, Inc.
Brookfield, Connecticut, USA

In accordance with

ISO 14034:2016

Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 15, 2018
Vancouver, BC, Canada

GLOBE PERFORMANCE SOLUTIONS

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

Cultec Recharger and Contactor chambers are used for infiltration, detention and/or retention of stormwater underground. The system is comprised of thermoplastic arch-shaped chambers surrounded by clear crushed stone. Water enters the system through a Separator row and then flows through the stone and into a Chamber row prior to exiting. The Cultec stormwater system is sized based on the volume of stormwater which is stored in the voids created by the chamber and the voids in the clear stone surround, with a void ratio of 40%. The entire system is wrapped in a non-woven geotextile and/or impermeable geomembrane. In order to minimize fine particles and silts from blinding the voids in the clear stone surround, a single chamber row is wrapped in non-woven geotextile and placed on a woven geotextile. This row is connected to the inlet pipe of the Cultec system providing a filtration function as the surface stormwater run-off passes through the geotextile wrapped inlet row. Sediment is trapped within the Cultec Separator Row™ and may be removed through back flushing of this row. A typical system installation is illustrated in Figure 1 and Figure 2 below.

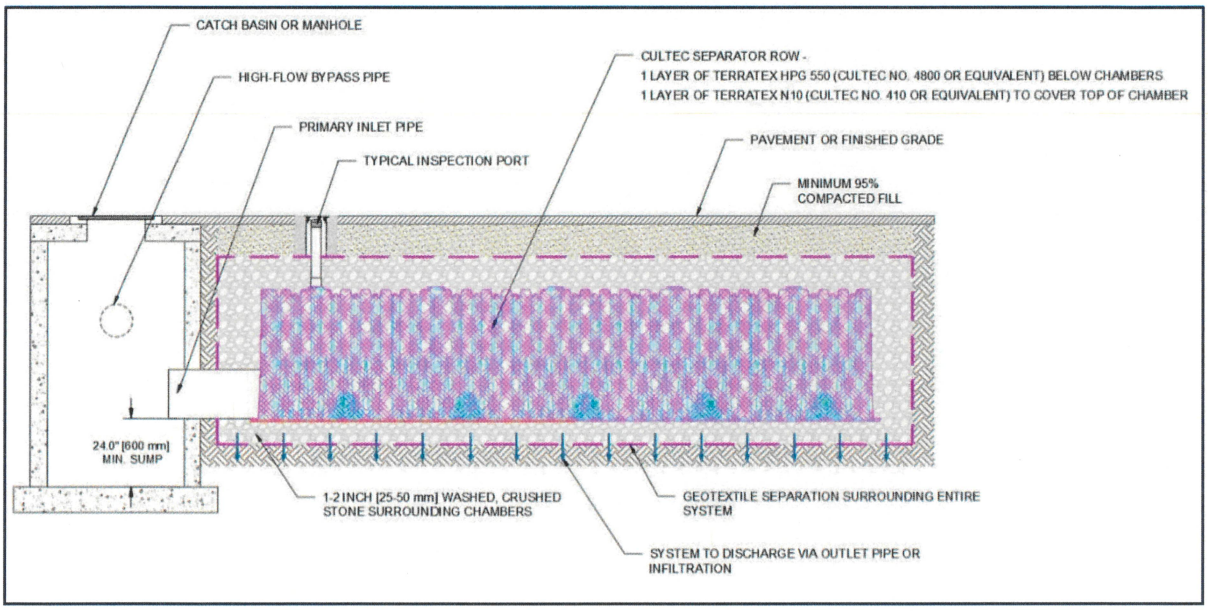


Figure 1: Cultec Separator Row™ Filtration System – Cross-Sectional View

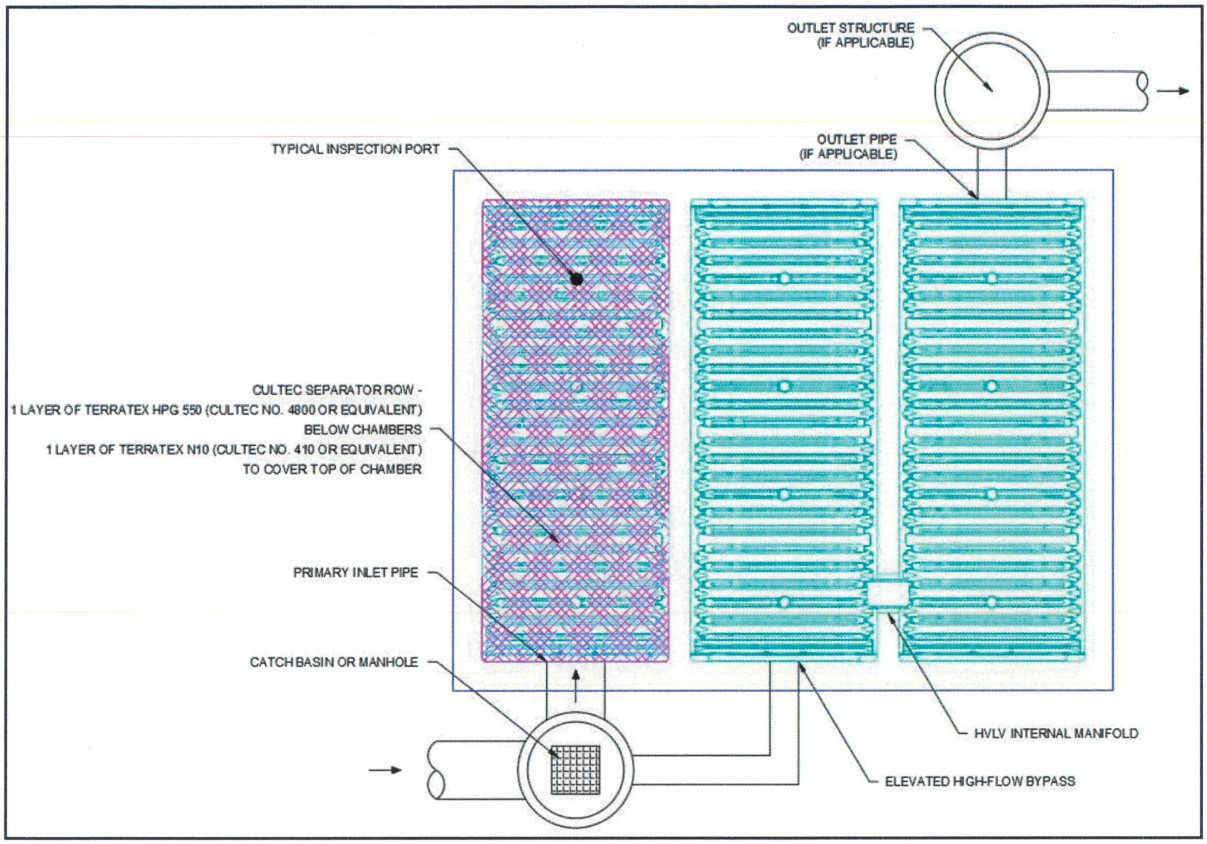


Figure 2: Cultec Separator Row™ Filtration System – Plan View

Performance conditions

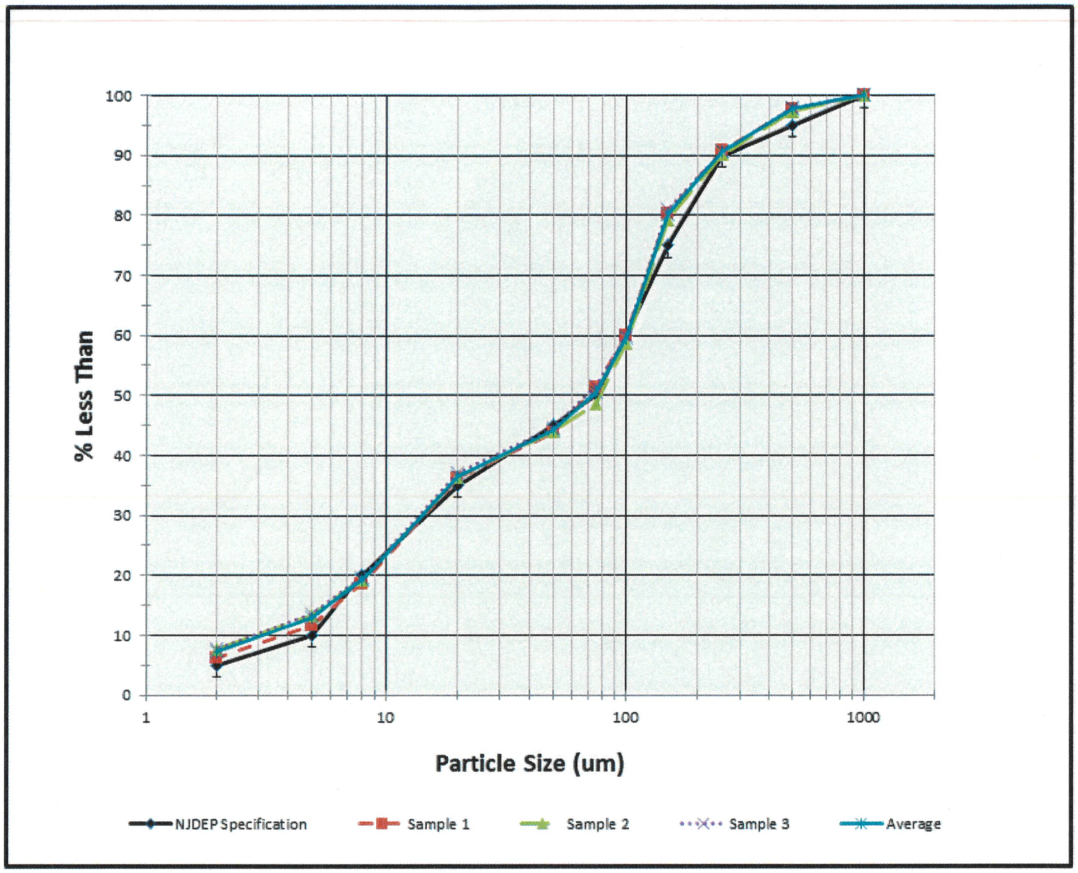
The data and results published in this Verification Statement were obtained from the testing program conducted on the Cultec Separator Row™ in accordance with a technology specific test plan (TSTP) developed and approved by the client and test lab (Good Harbour Laboratories, Mississauga, Ontario), and reviewed by Verification Expert and Verifying Organization, in compliance with ISO/IEC 14034. A copy of the testing procedures contained in the TSTP may be accessed at the following website: https://www.goodharbourlabs.com.

Performance claims

When installed with Terratex HPG 550 and Terratex N10 geotextiles, and tested with silica sediment having a particle size distribution conforming to the *Canadian Environmental Technology Verification Program Procedure for Laboratory Testing of Oil-Grit Separators*, the Cultec Recharger® 150XLHD Separator Row™ will remove at least the following fractions of suspended sediment at the corresponding flow rates: 80% at 24 gpm, 77% at 49 gpm, 73% at 73 gpm, 70% at 97 gpm, and 65% at 121 gpm. These performance claims are verified statistically at a 95% level of confidence.

Performance results

TEST SEDIMENT PARTICLE SIZE DISTRIBUTION IN RELATION TO SPECIFIED PSD



SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 24 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	39.6	38.7	39.2	39.8	39.1	39.5	41.7	41.9	41.1	42.4	43.2	41.6	40.8	41.1	41.6
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	37.6	36.7	37.2	37.8	37.1	37.5	39.7	39.9	39.1	40.4	41.2	39.6	38.8	39.1	39.6
Average Adjusted Effluent Concentration					38.8 mg/L			Removal Efficiency					80.2%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 48 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	47.1	47.0	47.1	46.8	47.3	47.3	49.0	50.1	49.5	50.4	49.1	50.2	52.2	49.7	51.8
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	45.1	45.0	45.1	44.8	45.3	45.3	47.0	48.1	47.5	48.4	47.1	48.2	50.2	47.7	49.8
Average Adjusted Effluent Concentration					47.0 mg/L			Removal Efficiency					76.9%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 73 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	54.3	55.2	53.3	53.8	55.8	55.8	55.3	54.5	53.5	56.2	56.4	56.5	58.4	56.8	57.7
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	52.3	53.2	51.3	51.8	53.8	53.8	53.3	52.5	51.5	54.2	54.4	54.5	56.4	54.8	55.7
Average Adjusted Effluent Concentration					53.6 mg/L			Removal Efficiency					73.3%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 97 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	58.4	59.4	59.0	61.2	61.6	61.1	58.9	60.4	59.9	63.9	63.3	62.5	61.9	61.0	61.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	56.4	57.4	57.0	59.2	59.6	59.1	56.9	58.4	57.9	61.9	61.3	60.5	59.9	59.0	59.0
Average Adjusted Effluent Concentration					58.9 mg/L			Removal Efficiency					70.0 %		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 121 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	72.0	72.8	71.7	72.1	70.1	72.1	69.3	72.3	77.2	71.0	70.7	72.7	71.1	70.4	73.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	70.0	70.8	69.7	70.1	68.1	70.1	67.3	70.3	75.2*	69.0	68.7	70.7	69.1	68.4	71.0
Average Adjusted Effluent Concentration					69.9 mg/L			Removal Efficiency					65.3%		

*Note: This data point was considered to be a significant outlier and was therefore omitted as part of the overall statistical calculations to verify performance at a 95% level of confidence.

Verification

This verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Cultec, Inc. to support the performance claim included the final test report prepared by Good Harbour Laboratories of Mississauga, Ontario and dated November 9, 2017. The test report is based on testing completed in compliance with the requirements of ISO/IEC 17025.

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Cultec Separator Row™ Filtration System please contact:

Cultec, Inc.
878 Federal Road
Brookfield, CT
06804 USA
Tel: 203.775.4416 / Toll Free: 1.800.4.CULTEC
custservice@cultec.com
www.cultec.com

For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
www.globeperformance.com

Appendix H

Stormwater Management System
Long-Term Operation & Maintenance (O&M) Plan

STORM WATER MANAGEMENT SYSTEM
LONG-TERM OPERATION & MAINTENANCE PLAN

May 12, 2023

Proposed Multifamily Residences
#778 Main Street
Leicester, MA

Prepared For:
Charlton Road Realty, LLC.
25 Waterville Lane
Shrewsbury, MA 01545

Prepared By:
CMG Environmental, Inc.
67 Hall Road
Sturbridge, MA 01566
Phone: (774) 241-0901

CMG ID 2021-226

TABLE OF CONTENTS

TABLES

ATTACHMENTS

Long Term Operation & Maintenance Plan
Site Stormwater Management System
#778 Main Street
Proposed Multifamily Residences
LEICESTER, MA

Operation and Maintenance (O&M) Plan

The purpose of this Storm Water Management System Operation and Maintenance Plan is to prevent erosion, sedimentation, pollution or other deterioration of the storm water management system and resource areas located on and adjacent to the site property located at **#778 Main Street in Leicester, MA** (the "Site"). The storm water management system shall be maintained properly to assure its continued performance.

Responsible Party:
Charlton Road Realty, LLC.
25 Waterville Lane
Shrewsbury, MA 01545
p. (413) 593-1900

Storm water Management System Owner: **(same as above)**

Site subject to Wetlands Protection Act: **YES**

The "Responsible Party" Shall:

- Prepare and submit an **"Operation and Maintenance (O & M) Compliance Statement" (see Attachment #1)** upon completion of site construction activities.
- Implement the routine and non-routine operation, maintenance, and inspection tasks in accordance with the procedures specified in this document to ensure that all storm water management systems function as designed;
- Maintain a log of all operation and maintenance (O & M) activities for the last five (5) years, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and disposal location);
- Make this log available to **Town of Leicester** official representatives upon request;
- Agree to notify in writing all "future property owners" of the presence of the storm water management system and the requirement for proper operation and maintenance.

"Charlton Road Realty, LLC." maintains a contract with the following companies:

Landscaping & Pavement Maintenance: _____

Snow Removal & Plowing: _____

Storm Water System Maintenance: _____

Table No. 1
#778 Main Street, Leicester, MA
Proposed Multifamily Residence

STORMWATER SYSTEM INSPECTION AND MAINTENANCE SCHEDULE		
Best Management Practice (BMP)	**Inspection Frequency**	**Maintenance Frequency**
STRUCTURAL BMPs		
DEEP-SUMP HOODED CATCH BASIN	Four (4) Times/ Year At end of foliage & snow removal seasons	Remove Sediment if Sediment Depth Reaches 50% of Sump as Min 2 Times per Year (End of Foliage & Snow Removal Season)
HYDROWORKS WATER QUALITY UNIT	Four (4) Times / Year	Per Manufacturer's Recommendations (See Attached Hydroworks Operation and Maintenance Manual)
CULTEC SEPARATOR ROW	Bi – Annual (Early Spring & Late Fall)	Refer to Manufacturer's Recommendations
UNDERGROUND INFILTRATION CHAMBERS	Bi-Annual (Early Spring & Late Fall)	Refer to Manufacturer's Recommendations
STORMWATER INFILTRATION BASIN	Bi-annual (Early Spring & Late Fall)	Remove Sediment or Debris that may clog the system as needed
OUTLET PIPES Rip-Rap Apron	Four (4) Times / Year	Remove Sediment Four (4) Times / Year (Including End of Foliage & Snow Removal Seasons)
NON-STRUCTURAL STORMWATER CONTROLS		
Landscaping	Four (4) Times / Year	Seasonally As Needed
Roadway / Driveway Sweeping	One (1) Time /Year	Seasonally As Needed
Snow Removal	Seasonally As Needed	In Accordance with M.G.L. Title XIV. Public Ways and Works; Chapter 85

STRUCTURAL STORMWATER BMP MAINTENANCE:

Deep Sump Catch Basin(s):

- Inspect catch basin(s) at least four (4) times per year, including the end of the foliage and snow removal seasons.
- Inspection shall occur by probing the structure with a rod to determine the depth of accumulated sediment.
- Sediments must be removed whenever the depth of sediment is greater than or equal to one half of the depth from the bottom of the invert of the lowest pipe in the basin. At a minimum, cleaning shall occur twice a year during the spring and fall.
- The structure will be cleaned of water and sand/debris with the use of a vacuum truck. Material removed from the structure will be disposed of legally off-site by the vendor.
- Unless there is evidence that they have been contaminated by a spill or other means, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste.

Hydroworks Water Quality Unit

- Per manufacturer's recommendations, see Attachment #2: Hydroworks Operation and Maintenance Manual

Cultec Separator Row

- Inspect Separator Rows bi-annually using the installed inspection ports.
- Utilizing the JetVac process, remove accumulated sediment or pollutants in the separator row. See the attached Cultec Operation and Maintenance Plan for more details regarding the JetVac process and monitoring procedure.

Underground Infiltration Chambers

- Inspect inlet at least twice a year and remove any debris that may clog the system.

Storm Water Infiltration Basins

- Inspect basin inlets twice per year for signs of accumulation of sediment or debris. Any debris or sediment that could potentially clog the system shall be removed as necessary.
- Inspection shall also involve visual observations of failure apparent in the area surrounding the basins perimeter and outlet structure.
- Sediment collection areas shall be inspected on a bi-annual basis and cleaned/maintained at least four once per year;
- Vegetation within the stormwater basin shall be kept between 3-6 inches in height;
- Following maintenance removal of accumulated sediment, any vegetation damaged within the basin area shall be repaired by re-seeding or re-sodding. When re-seeding, practices such as hydroseeding with a tackifier, blanket or similar practice should be incorporated to eliminate scour while the seeds germinate and develop roots.

Rip-rap Apron Outlets

- Inspect regularly, especially after large rainfall events;
- Note and repair any erosion & sediment buildup at the Rip-Rap outlet protection.

NON- STRUCTURAL STORM WATER MANAGEMENT CONTROLS:

Non-Structural Control Measures & Stormwater Treatment

Landscape & Pavement Maintenance:

- **No debris, refuse or other materials,** including but not limited to landscaping debris, leaves, shrubs and tree trimmings, logs, bricks, stone or trash shall be deposited within the vegetated wetland.
- The use of pesticides, herbicides, and fertilizers on the site shall be minimized to the extent practicable and shall be applied in accordance with manufacture recommendations by experienced and if applicable, licensed personnel.
- Pavement areas will be swept seasonally as necessary to remove accumulated winter sand and salt and fall leaves, and shall be swept as required to remove litter. Collected material will be properly disposed of off-site.

Trash Removal

- Inspect on-site area for litter and trash as needed. Any accumulated trash, litter, and discarded materials in this area will be removed and will be disposed of at a suitable location on a weekly basis.

HAZARDOUS WASTE / OIL SPILL RESPONSE PROCEDURE

Initial Notification. In the event of a spill of hazardous waste or oil the facility manager or supervisor will be notified immediately by telephone.

Assessment – Initial Containment. The supervisor or manager will assess the incident and initiate control measures. The supervisor will first contact the **Town of Leicester Fire Department** and then notify the **Town of Leicester Police Department**. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately.

Fire Department Telephone: 911 (Emergency); (508) 892-7022 (Non-Emergency)

Police Department Telephone: 911 (Emergency); 508-892-7010 (Non-Emergency)

Further Notification. Based on the assessment by the Fire Chief, additional notification to a clean up contractor may be made. The Massachusetts Department of Environmental Protection and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of clean up and notification required.

SNOW MANAGEMENT PLAN:

- No snow storage shall be located within or "deposited" within wetland resource areas on or off-site.

- No salt shall be used to treat unpaved areas during snow and ice conditions. The storage of all "de-icing" chemicals and treatment products is to be inside the building.

- If Site snow storage interferes with driveway maneuvers or sight distances (i.e. blocking of travel aisles, sight distance, or parking) the snow pile will be either removed or reduced legally in a legal manner by the snow plow vendor within 24-hours.
- Pavement areas will be swept seasonally as necessary to remove accumulated winter sand and salt and fall leaves, and shall be swept as required to remove litter. Collected material will be properly disposed of off-site.

INSPECTIONS / RECORDKEEPING:

Routine Inspections:
Routine inspections and maintenance to be conducted with the frequency described in this Operation and Maintenance Plan. All repairs and maintenance activities regarding the stormwater management system should be recorded and provided to the Leicester Planning Board upon request. An example inspection form is provided in **Attachment #3**.

Recordkeeping
Records of all drainage system inspections and maintenance shall be kept on file for a period of at least **three (3) years.**

PUBLIC SAFETY FEATURES:

- All cast iron storm water structure grates and covers shall be kept in good condition and kept closed at all times. Any damaged or broken structures will be replaced immediately upon discovery;

Attachment #1

Illicit Discharge Compliance Statement

Illicit Discharge Compliance Statement
Site Storm Water Management System
#778 Main Street
Proposed Multifamily Residences
LEICESTER, MA

Responsible Party:
Charlton Road Realty, LLC.
25 Waterville Lane
Shrewsbury, MA 01524
p. (774) 696-3288

Storm Water Management System Owner: (same as above)

Site subject to Wetlands Protection Act: YES

The above listed "responsible party" is responsible for implementation of this "Long-Term Operation and Maintenance Plan" and certifies that:

- The site has been inspected for erosion and appropriate steps have been taken to permanently stabilize any eroded areas;
- All aspects of storm water BMPs have been inspected for damage, wear and malfunction, and appropriate steps have been taken to repair or replace the system or portions of the system so that the storm water at the site may be managed in accordance with:
    - MA-DEP Stormwater Management Standards, revise date January 2, 2008;
- There is no record or knowledge of illicit discharges to the on-site stormwater management system;
- All "future property owners" must be notified of their continuing legal responsibility to operate and maintain the Site Stormwater Management System.
- The "Long-Term Operation and Maintenance Plan" for the storm water BMPs is being implemented.

Signature of Responsible Party:

_____ _____
Charlton Road Realty, LLC. Date

Attachment #2

Hydroworks Water Quality Unit
Operations & Maintenance Manual

Hydroworks® HydroDome

Operations & Maintenance Manual

Version 1.0

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please email a copy of the completed checklist to Hydroworks at support@hydroworks.com for our records.

Introduction

The HydroDome (Figure 1) is a state-of-the-art hydrodynamic separator. HydroDome can be used for water quality and quantity flow control if desired.

Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroDome is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroDome.

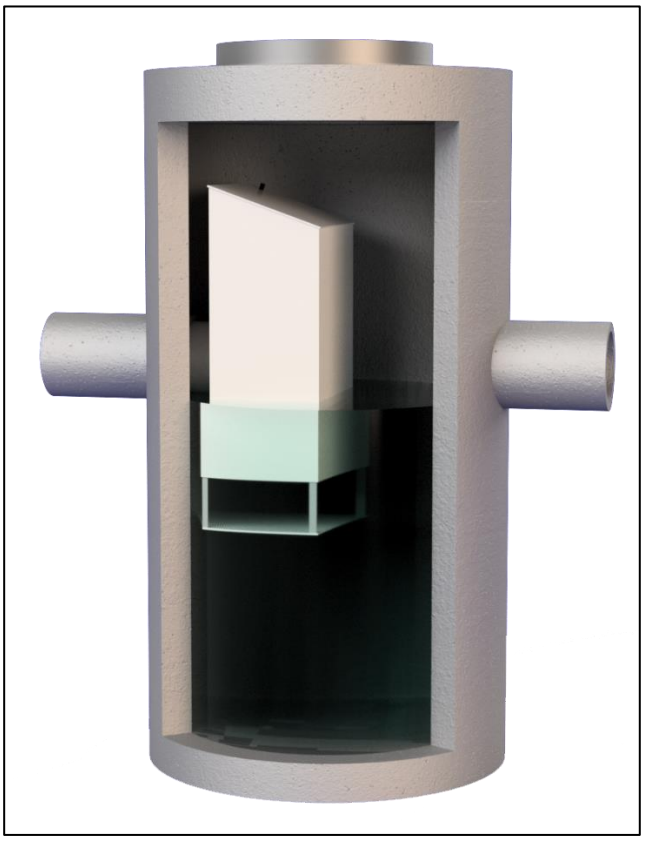


Figure 1. Hydroworks HydroDome

Hydroworks

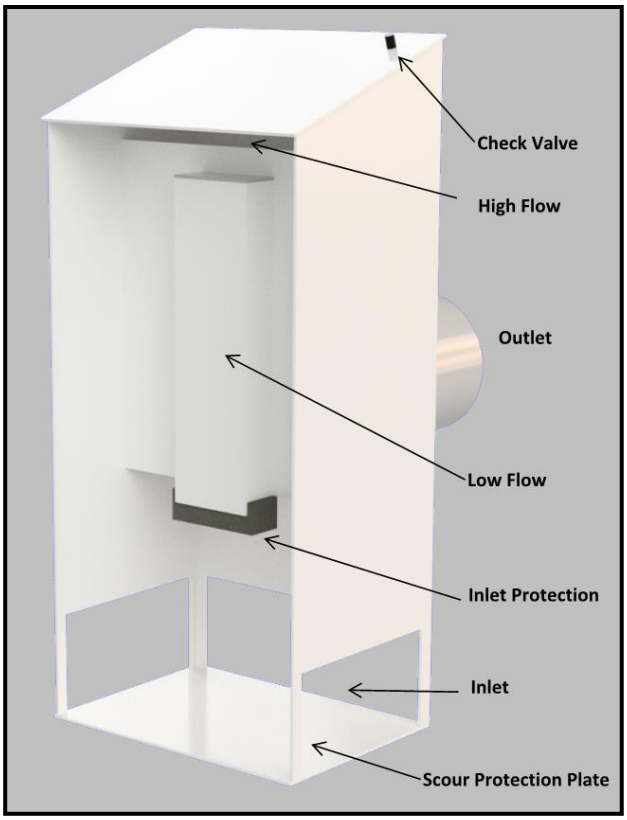


Figure 2 HydroDome Internal Components

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the cover/grate and looking down into the separator.

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. Several readings (2 or 3) should be made at different locations of the structure to ensure that an accurate TSS depth measurement is recorded.

Operation

The water level during periods without rain should be near the outlet invert of the structure. If the water level remains near the top of the HydroDome this may suggest that there is an obstruction downstream of the HydroDome or that the inlet protection at the HydroDome may need to be cleaned.

Frequency

Construction Period

The HydroDome separator should be inspected every four weeks and after every large storm (over 0.5" (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroDome separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized areas (storage piles, exposed soils), the HydroDome separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, elevated water level)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroDome unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroDome separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

The area around the HydroDome provides clear access to the bottom of the structure (Figure 3). This is the area where a vacuum hose would be lowered to clean the unit.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature.

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Maintenance of a Hydroworks HydroDome unit will typically take 1 to 2 hours depending on size of unit and using a vacuum truck. Cleaning may take longer for other cleaning methods (i.e. clamshell bucket).

Inlet protection (Figure 2) in the form of a coarse foam screen is located at the inlet to the siphon opening in the HydroDome to ensure the opening does not become clogged. Although it is not anticipated that the inlet protection will have to be replaced on a regular basis since the inlet protection is protected by the submerged entrance to the HydroDome and is backflushed by the siphon after each storm , the inlet protection should be checked each time the HydroDome is inspected or maintained. The inlet protection is removable and should be rinsed with water to ensure any debris caught on the protection is discarded. Unless damaged, the inlet protection can be reinstalled. A replacement piece can be bought through Hydroworks and/or retail stores. Hydroworks can provide information on the inlet protection and where it can be bought. A sign that the inlet protection needs cleaning/replacement would be a water level near the crown of the outlet pipe in the structure during periods with no flow (i.e. unit does not drain down to the pipe invert).

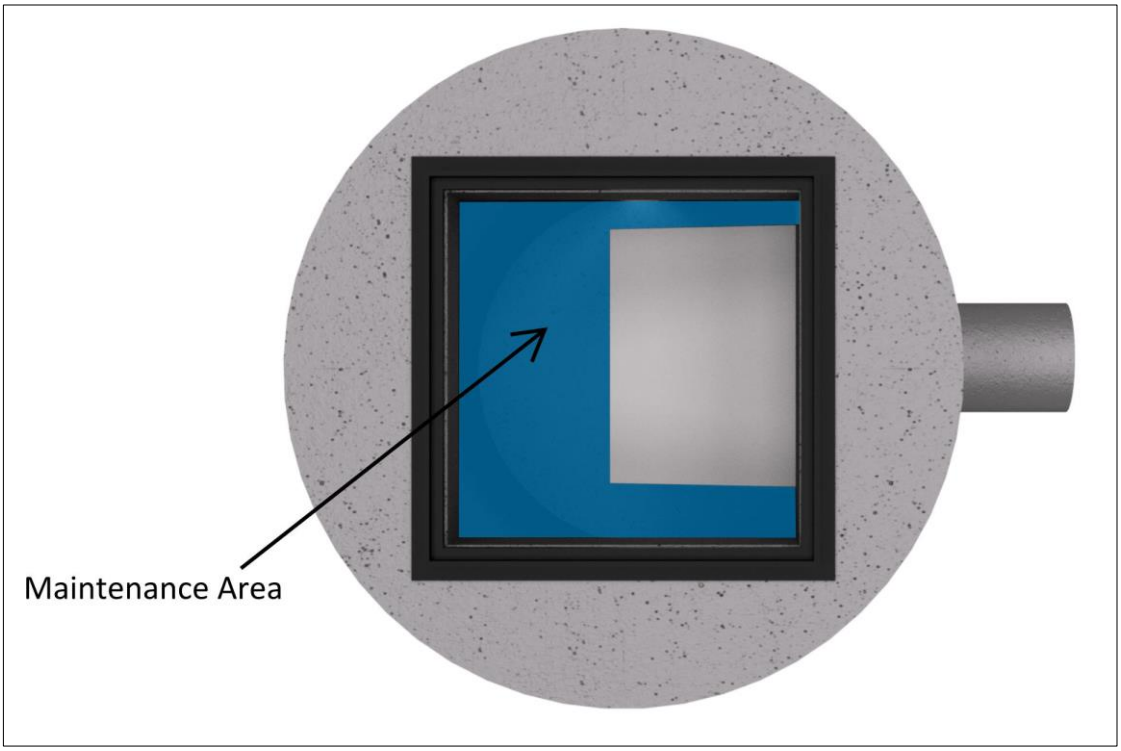


Figure 3. HydroDome Maintenance Access

Frequency

Construction Period

A HydroDome separator can fill with construction sediment quickly during the construction period. The HydroDome must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroDome separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. Please contact Hydroworks at 888-290-7900 to inquire whether your HydroDome was designed with extra sump depth to extend the frequency of maintenance.

The HydroDome separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 75% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroDome Models

Model	Diameter ft (mm)	Maintenance Sediment Depth in (mm)
HD 3	3 (900)	12 (300)
HD 4	4 (1200)	12 (300)
HD 5	5 (1500)	12 (300)
HD 6	6 (1800)	12 (300)
HD 7	7 (2100)	12 (300)
HD 8	8 (2400)	12 (300)
HD 10	10 (3000)	12 (300)
HD 12	12 (3600)	12 (300)

HYDRODOME INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroDome	**Yes**	**No**
Obstructions in the inlet	☐ *	☐
Damage to HydroDome (cracked, broken, loose pieces)	☐ **	☐
Improperly installed outlet pipe	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Raised water level (water level close to top of HydroDome)	☐ ***	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____“

Routine Measurements

Floating debris depth	**< 0.5” (13mm)**	☐	**>0.5” 13mm)**	☐ *
Floating debris coverage	**< 75% of surface area**	☐	**> 75% surface area**	☐ *
Sludge depth	**< 12” (300mm)**	☐	**> 12” (300mm)**	☐ *****

* Maintenance required
** Repairs required
*** Further investigation is required

Note: Inspections should not be made within 24 hours of a storm to allow the water to drain from the structure to assess a raised water level or water level seepage

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroDome

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroDome to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroDome are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroDome, or the cost of other goods or services related to the purchase and installation of the HydroDome. For this Limited Warranty to apply, the HydroDome must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

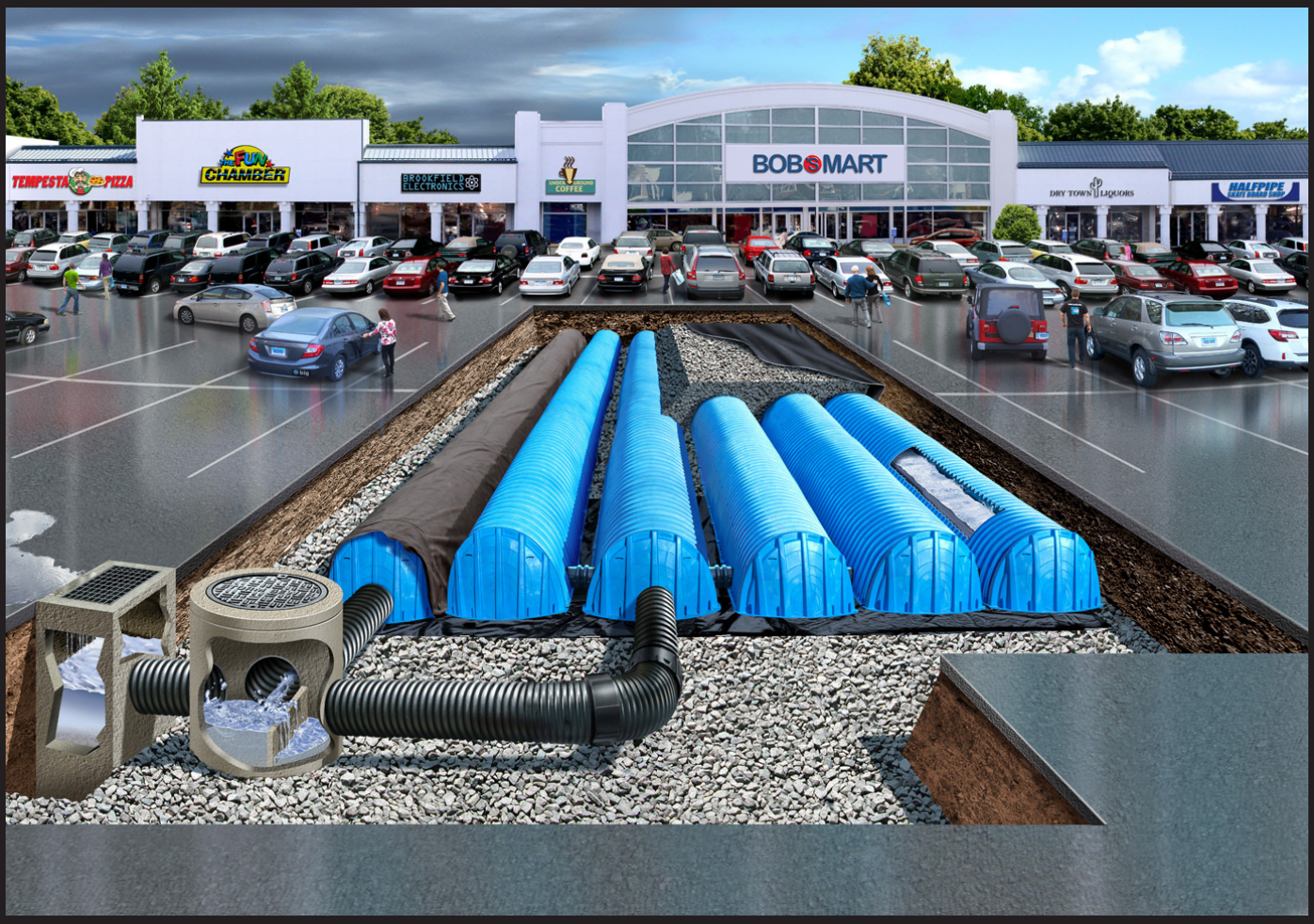
Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroDome arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroDome, whether the claim is based upon contract, tort, or other legal basis.

Attachment #3

Cultec Separator Row
Operations & Maintenance Manual

CULTEC SEPARATOR™ ROW

WATER QUALITY SYSTEM



OPERATION & MAINTENANCE GUIDE

FOR CULTEC STORMWATER MANAGEMENT SYSTEMS

GLOBE VERIFIED VÉRIFIÉ

STORMWATER MANAGEMENT SOLUTIONS

CULTEC®

Inspection and Maintenance

CULTEC recommends inspection of the Separator Row to be performed every six months for the first year of service. Future inspection frequency can be adjusted based upon previous inspection observations. However annual inspections are recommended. Inspection of the Separator Row can be achieved via an inspection port riser installed during construction. This inspection port riser will connect the top of the Separator Row chambers to finished grade with a removable lid. Alternatively the Separator Row may be inspected via the manhole(s) located at the end(s) of the Separator Row. However this method of inspection requires confined space entry. If entry into the manhole is required, all local and OSHA rules for confined space entries must be strictly followed.

To inspect:

- Remove the inspection port lid from the floor box frame.
- Remove the riser pipe cap.
- With a flashlight and stadia rod, measure the depth of sediment.
- Record results in a maintenance log.
- When depth of sediment exceeds 3” (76 mm), use the JetVac procedure described below.

The JetVac process utilizes a high pressure water nozzle controlled from the surface. The high pressure nozzle is introduced down the Separator Row via the access manhole(s). The high pressure water cleans all sediment and debris from the Separator Row as the nozzle is retrieved. Captured pollutants are flushed into the sumped access manhole for vacuuming. This process is repeated until the Separator Row is completely free of sediment and debris. A small diameter culvert cleaning nozzle is recommended for this procedure.

High pressure water nozzle

Cleaning Separator Row and pipes with high pressure water nozzle

SEPARATOR ROW: Separator Row prior to cleaning

ADJACENT ROW: When the Separator Row is working properly, the adjacent rows will not show signs of sediment.

Inspection and Maintenance Record

Date	Mode of Access	Frequency	Depth of Sediment	Actions	Expenses	Inspector	Notes
Ex.	Inspection Port	Semi-annually	2”	Measure sediment depth with stadia rod. Visually inspect	$100	DPG	Depth of Sediment was measured via Northeast Inspection Port Adjacent to MH-1. Sediment depth was found to be 2”. No further action required at this time.
Ex.	Access Manhole	Annually					

Attachment #4

Stormwater Management System
Quarterly Inspection Form

Inspection Form - Storm Water Management System
Proposed Multifamily Residences
#778 Main Street, Leicester, Massachusetts

QUARTERLY INSPECTION AND MAINTENANCE REPORT

Jan.-Mar. Apr.-Jun. July-Sep. Oct. – Dec.

Note: This Log should be copied prior to use. Note Additional Comments on back of Form.

Inspector's Name: _____ Date: _____ Time: _____ am/pm

Inspector's Qualifications: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____ inches

Item/Condition to be Checked	Maintenance Required		Corrective Action & Date
	No	Yes	
Catch Basins			Clean Unit Twice /Year or After Spill Event
Hydroworks Water Quality Units			
Cultec Separator Row			
Underground Infiltration Chambers			
Stormwater Infiltration Basin			
Rip-Rap Aprons			
SPILL KIT			
Parking Lot / Driveway Sweeping			*Sweep Seasonally – As Needed
Landscaping / Trash Removal			
Snow Removal (seasonal)			*All De-icing chemical storage to be inside building

Additional Comments: _____