Kimley»Horn

STORMWATER REPORT

for

ADESA Holliston

194 Lowland Street, Holliston, MA

October 6, 2020

Prepared for:
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Project Information

Proposed Development

ADESA is proposing a parking area for vehicle staging on a 41.3 acre site in the Town of Holliston. The project will include asphalt paving for parking, landscaping, and stormwater management improvements. The project will be completed in one phase.

Location

The project site is located at 194 Lowland Street in Holliston, MA. The existing site is relatively flat and with areas of impacted topography given its prior use as a gravel pit and location for material stockpiles. The site is bordered by industrial properties to the north, wetlands and transmission line ROW to the east, Bogastow Brook to the south, and Lowland Street to the west.

Existing Conditions

The site was previously disturbed for commercial gravel pit operations and is currently a storage yard for aggregate and landscape materials with various material stockpiles. The property also includes two existing building structures with associated utility service lines. A large pond is located on the northern section of the property as well. Elevations across the site range from 153 to 170. The site topography has been heavily impacted in all areas due to its history as a commercial gravel pit.

Soils

The U.S. Natural Resources Conservation Service (NRCS) Soil Survey does not identify the Hydrologic Soil Group (HSG) at the project site; therefore, textural analyses of the soils present within the proposed limits of construction were conducted in the surface soil horizons to determine the HSG's. The USDA textural classification were predominantly loamy sand to sand, which are in HSG A or sandy loam, which are in HSG B. Further information can be found in the Soil Evaluation Technical Memo prepared by Tetra Tech within Appendix G

Stormwater Management

Design Criteria

Stormwater management systems have been designed in accordance with the Regulations and the Stormwater Management Policy promulgated by the Massachusetts Department of Environmental Protection (Mass. DEP) and the United States Environmental Protection Agency.

Outfalls

Runoff from the site will generally discharge to two separate outfalls, maintaining existing drainage boundaries to the maximum extent practicable. Approximately 1.71 acres of drainage area will be directed to outfall #1 at the northern portion of the site. Approximately 2.11 acres of drainage area will be directed to outfall #2 at the southern portion of the site. The remaining 1.175 acres of drainage area consists of grassed areas along the perimeter of the parcel and a portion of each driveway which will drain away from the proposed development. All of this drainage eventually ends up at the same ultimate outfall points at outfalls #1 and 2 on the subject site. The two outfalls are defined below.

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Northern Outfall (POI#1)

Currently, a portion of the site's runoff sheet flows towards the existing pond at the north end of the property. The proposed storm system has been designed so that the post-development drainage area is as close as possible to the pre-development area draining to the existing pond today. An underground detention facility with an outlet control structure is proposed at the northern part of the site. Stormwater will discharge from the underground detention facility into an area adjacent to the pond and from there it will sheet flow into the existing pond.

Southern Outfall (POI#2)

Currently, a portion of the site's runoff sheet flows towards Bogastow Brook at the south end of the property. The proposed storm system has been designed so that the post-development drainage area is as close as possible to the pre-development area draining to the Brook today. An underground detention facility with an outlet control system is proposed at the southern part of the site. Stormwater will discharge from the underground detention facility into an area adjacent to Bogastow Brook and from there it will sheet flow into Bogastow Brook.

STORMWATER CHECKLIST – REVIEW OF MASSDEP STANDARDS

Standard #1 – No New Untreated Discharges

No new untreated discharges are proposed with the project.

Standard #2 – Peak Rate Attenuation

Outfall #1

On-site quantity control has been provided by the inclusion of an underground detention basin in the parking lot. The underground detention area is proposed to address the stormwater quality requirements for the site and it will also provide quantity control by infiltrating and storing stormwater runoff during rainfall events.

Outfall #2

On-site quantity control has been provided by the inclusion of an underground detention basin in the parking lot. This underground detention basin is proposed to address the stormwater quality requirements for the site, and it will also provide quantity control by infiltrating and storing stormwater runoff during rainfall events.

A peak rate summary table for each outfall is provided in Appendix B.

Standard #3 – Recharge

The proposed project is located in an area with soils classified as HSG A and B as shown in the Soil Evaluation Technical Memo prepared by Tetra Tech dated 9/17/2020. See Appendix G for a copy of the soil evaluation memo.

Underground Detention Facility #1 and #2 will be sized using the "Static" method to utilize the most conservative approach for groundwater recharge volume.

A 72-hour drawdown analysis has been calculated for both BMPs. Each BMP dewaters well under 72 hours.

A mounding analysis for each underground detention system has also been completed.

All calculations for Standard #3 compliance are provided in Appendix D

Standard #4 – Water Quality

Stormwater quality for the project will be separated by the site's two outfall locations. All drainage that reaches outfall #1 and #2 will be treated in the proposed underground detention facilities.

There will be three treatment areas for all drainage reaching outfall #1 and #2. Before stormwater discharges from either outfall, it will be conveyed through deep sump catch basins, then through a

Barracuda Water Quality Inlet, and finally by an underground infiltration system consisting of a StormTech ADS Chamber design.

TSS water quality compliance worksheets are provided in Appendix D.

Standard #5 – Land Uses with Higher Potential Pollutant Loads (LUHPPL's)

Due to the proposed use of the site, it has been determined to be a Land Use with Higher Potential Pollutant Loads (LUHPPLs). Due to this, the one-inch rule has been applied when calculating Required Volume Recharge. Furthermore, pretreatment requirement 44% TSS removal has been achieved before discharging to infiltration structures.

Standard #6 – Critical Areas

The proposed project area discharges within a Zone II, Interim Wellhead Protection Area. A source control pollution prevention plan utilizing on-site drainage infrastructure has been identified in a long-term pollution prevention plan that has been submitted with the project.

Standard #7 – Redevelopments and Other Projects Subject to the Standards Only to the Maximum Extent Practicable

While the project is located on an existing property that has previously been disturbed for commercial operations, this project will be considered new development due to the amount of new disturbance and additional impervious area on site.

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

A detailed Erosion and Sediment Control Plan, with associated Details, has been provided with the Site Plan construction documents.

Standard #9 – Operation and Maintenance Plan

A stand-alone O&M Plan has been prepared for all stormwater facilities on site, including underground detention areas, and is provided as a stand-alone document with this submittal package.

Standard #10 – Illicit Discharges

An Illicit Discharge Statement is attached and can be found in **Appendix F**

Appendix

Appendix A: Checklist for Stormwater Report

Appendix B: Existing Conditions Analysis

Appendix C: Proposed Conditions Analysis

Appendix D: Best Management Practices

Appendix E: Pipe Sizing Calculations

Appendix F: Illicit Discharge Statement

Appendix G: Reference Documents

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.

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[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

10-6-20

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): Underground detention system in development footprint

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
Existing Conditions Analysis

STORMWATER PEAK RATE SUMMARY

PROJECT: ***ADESA Holliston***
194 Lowland Street
Town of Holliston, MA

DATE: ***10/6/2020***
BY: ***TGK***
CHECKED BY: ***BJB***
REVISION: ***1***

Point of Interest #1 - Stormwater Peak Rate Summary

Hydrograph	2	10	25	100
Pre-Development Flow (cfs)	1.21	5.82	9.49	15.88
Allowable Total Post Development Flow (cfs)*	**1.21**	**5.82**	**9.49**	**15.88**
	2 Yr Pre *	**10 Yr Pre***	**25 Yr Pre***	**100 Yr Pre***
Provided Post Development Flow (cfs)	**1.07**	**5.41**	**9.36**	**15.87**
Difference (cfs)	**-0.14**	**-0.41**	**-0.13**	**-0.01**

*Post development peak rates to be less than or equal to the provided design storm

STORMWATER PEAK RATE SUMMARY

PROJECT: ***ADESA Holliston***
194 Lowland Street
Town of Holliston, MA

DATE: ***10/6/2020***
BY: ***TGK***
CHECKED BY: ***BJB***
REVISION: ***1***

Point of Interest #2 - Stormwater Peak Rate Summary

Hydrograph	2	10	25	100
Pre-Development Flow (cfs)	1.29	6.33	10.47	17.77
Allowable Total Post Development Flow (cfs)*	**1.29**	**6.33**	**10.47**	**17.77**
	2 Yr Pre *	**10 Yr Pre***	**25 Yr Pre***	**100 Yr Pre***
Provided Post Development Flow (cfs)	**1.25**	**6.22**	**9.73**	**16.96**
Difference (cfs)	**-0.04**	**-0.11**	**-0.74**	**-0.81**

*Post development peak rates to be less than or equal to the provided design storm

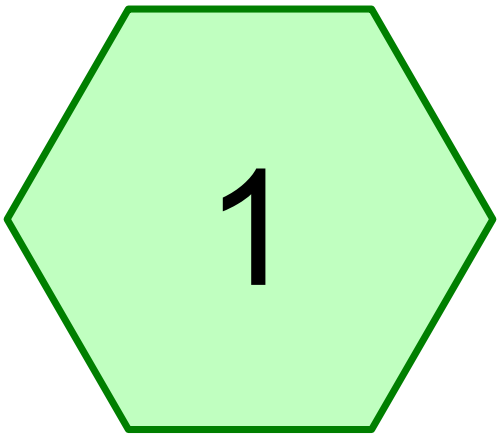
COMPUTATION SHEET: SCS RUNOFF COEFFICIENT (CN)

PROJECT: ***ADESA Holliston***
Lowland Street - Town of Holliston
Massachusetts

DATE: ***4/13/2020***
BY: ***TGK***
CHECKED BY: ***-***
REVISION: ***1***

ACTUAL PRE-DEVELOPMENT DRAINAGE AREAS

Cover Type Description	Soil HSG	CN	1 DA to Pre-Dev POI#1 (Acres)	2 DA to Pre-Dev POI#2 (Acres)	(Acres)	(Acres)
Meadow	A	30				
Wooded	A	30				
Meadow	B	58	3.037	4.769		
Wooded	B	55	1.676	1.844		
Meadow	D	78				
Wooded	D	77				
Impervious	ALL	98	0.271	0.165		
		Total Area (Ac)	4.984	6.779		
		SCS Runoff Coefficient (CN)	59	58		
		Time of Concentration (Tc)	12.4	18.6	6.0	6.0



DA to Pre-Dev POI#1

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-1
Prepared by Kimley-Horn and Associates, Printed 10/7/2020

Summary for Subcatchment 1: DA to Pre-Dev POI#1

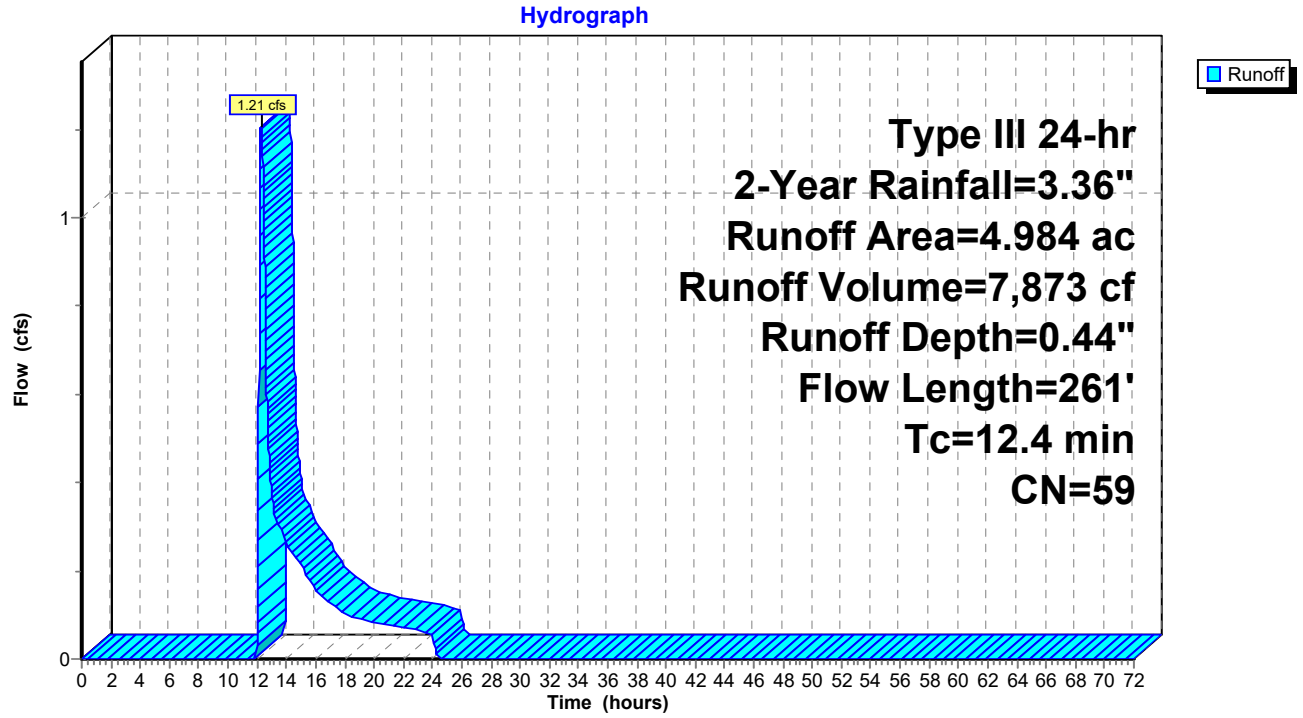
Runoff = 1.21 cfs @ 12.25 hrs, Volume= 7,873 cf, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
3.037	58	Meadow, non-grazed, HSG B
1.676	55	Woods, Good, HSG B
0.271	98	Paved parking, HSG A
4.984	59	Weighted Average
4.713		94.56% Pervious Area
0.271		5.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0204	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	23	0.0417	3.29		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
2.7	109	0.0183	0.68		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
12.4	261	Total			

Subcatchment 1: DA to Pre-Dev POI#1



Summary for Subcatchment 1: DA to Pre-Dev POI#1

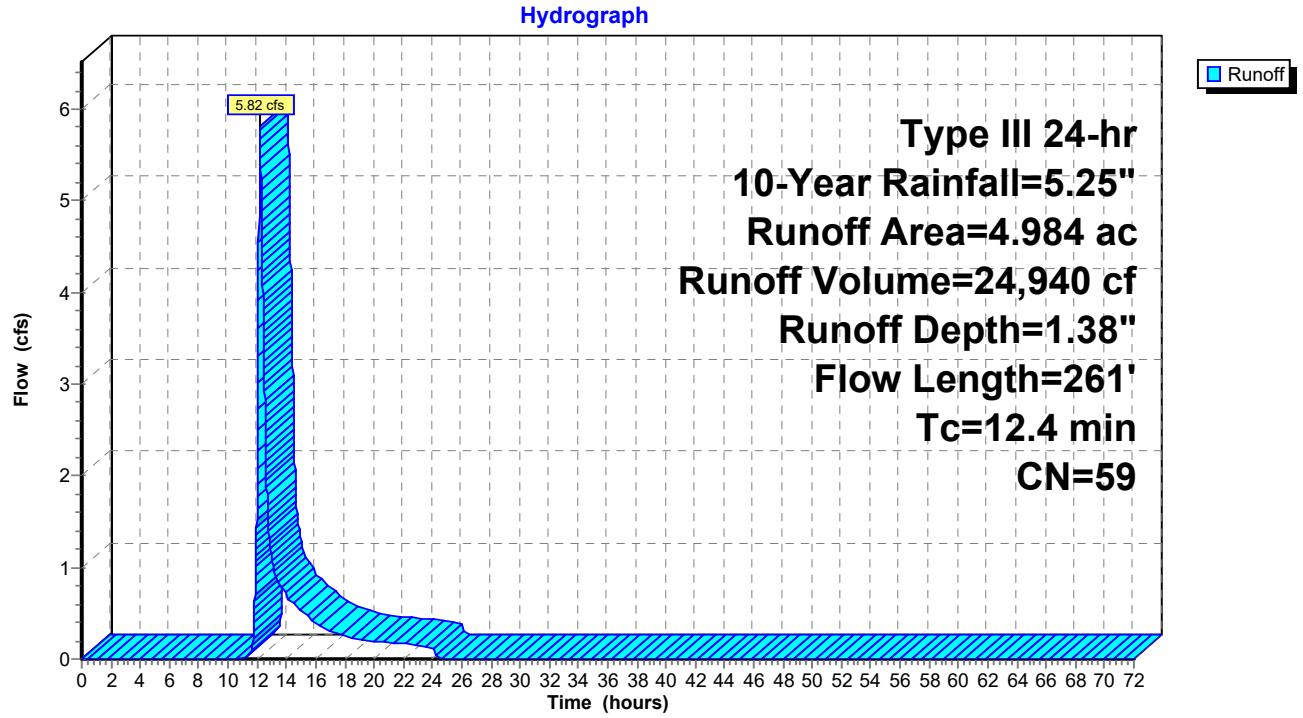
Runoff = 5.82 cfs @ 12.19 hrs, Volume= 24,940 cf, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
3.037	58	Meadow, non-grazed, HSG B
1.676	55	Woods, Good, HSG B
0.271	98	Paved parking, HSG A
4.984	59	Weighted Average
4.713		94.56% Pervious Area
0.271		5.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0204	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	23	0.0417	3.29		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
2.7	109	0.0183	0.68		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
12.4	261	Total			

Subcatchment 1: DA to Pre-Dev POI#1



Summary for Subcatchment 1: DA to Pre-Dev POI#1

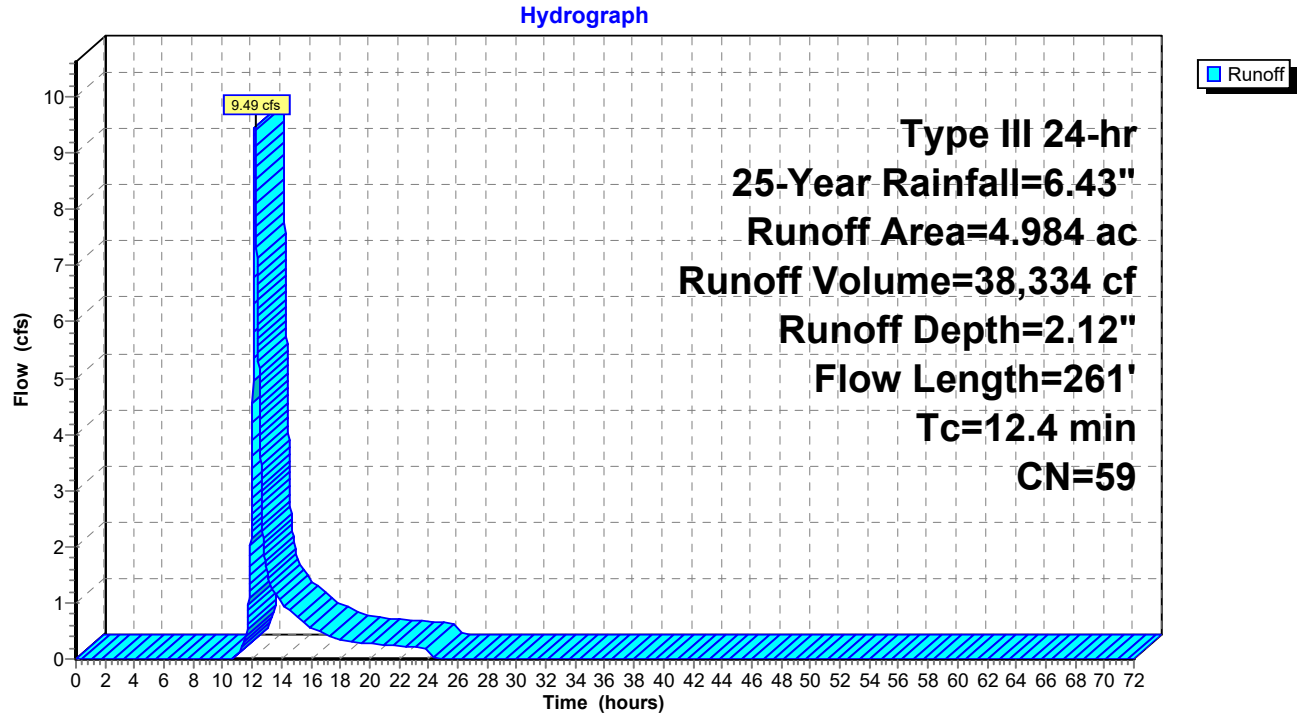
Runoff = 9.49 cfs @ 12.18 hrs, Volume= 38,334 cf, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (ac)	CN	Description
3.037	58	Meadow, non-grazed, HSG B
1.676	55	Woods, Good, HSG B
0.271	98	Paved parking, HSG A
4.984	59	Weighted Average
4.713		94.56% Pervious Area
0.271		5.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0204	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	23	0.0417	3.29		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
2.7	109	0.0183	0.68		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
12.4	261	Total			

Subcatchment 1: DA to Pre-Dev POI#1



Summary for Subcatchment 1: DA to Pre-Dev POI#1

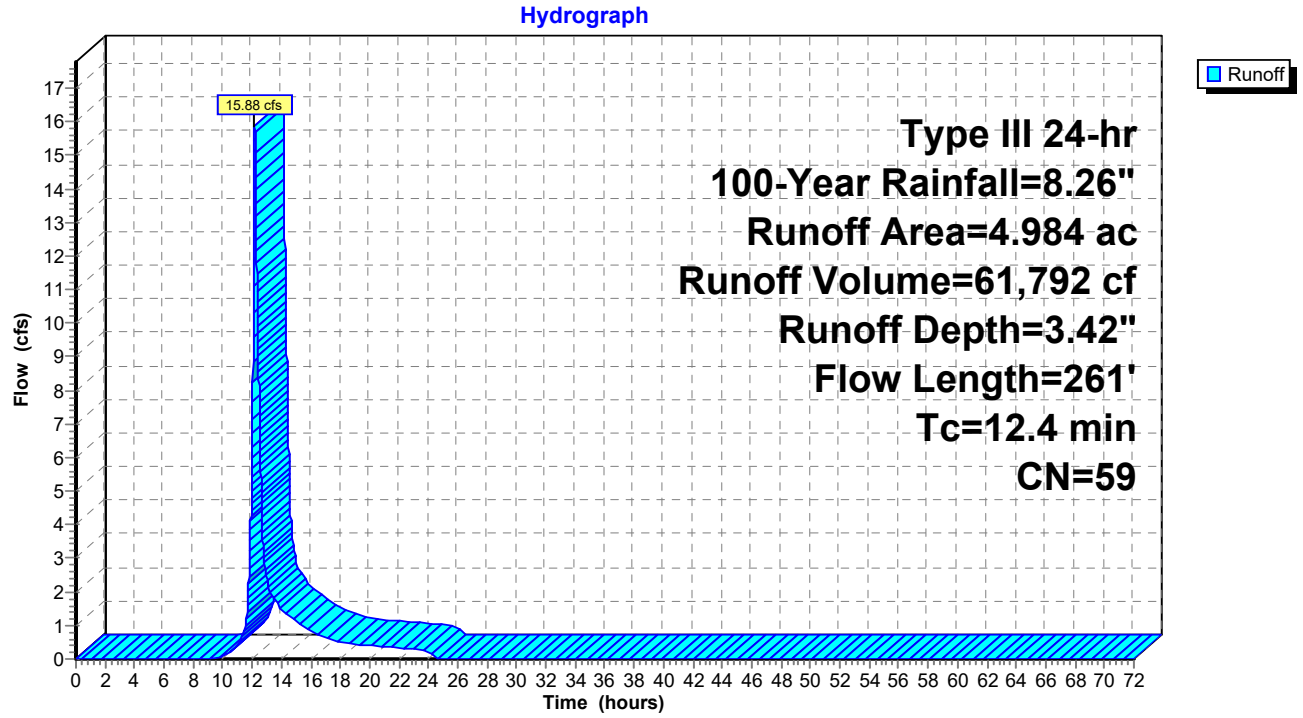
Runoff = 15.88 cfs @ 12.18 hrs, Volume= 61,792 cf, Depth= 3.42"

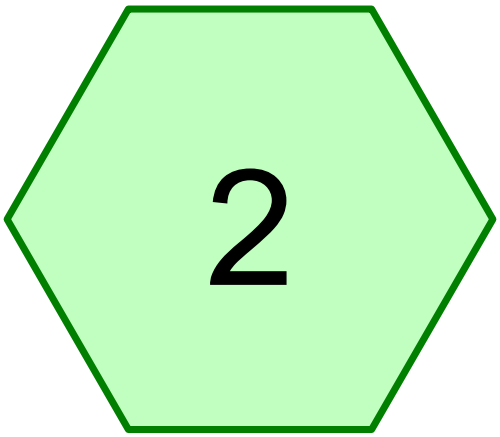
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
3.037	58	Meadow, non-grazed, HSG B
1.676	55	Woods, Good, HSG B
0.271	98	Paved parking, HSG A
4.984	59	Weighted Average
4.713		94.56% Pervious Area
0.271		5.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0204	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	23	0.0417	3.29		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
2.7	109	0.0183	0.68		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
12.4	261	Total			

Subcatchment 1: DA to Pre-Dev POI#1





DA to Pre-Dev POI#2

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-1
Prepared by Kimley-Horn and Associates, Printed 10/7/2020

Summary for Subcatchment 2: DA to Pre-Dev POI#2

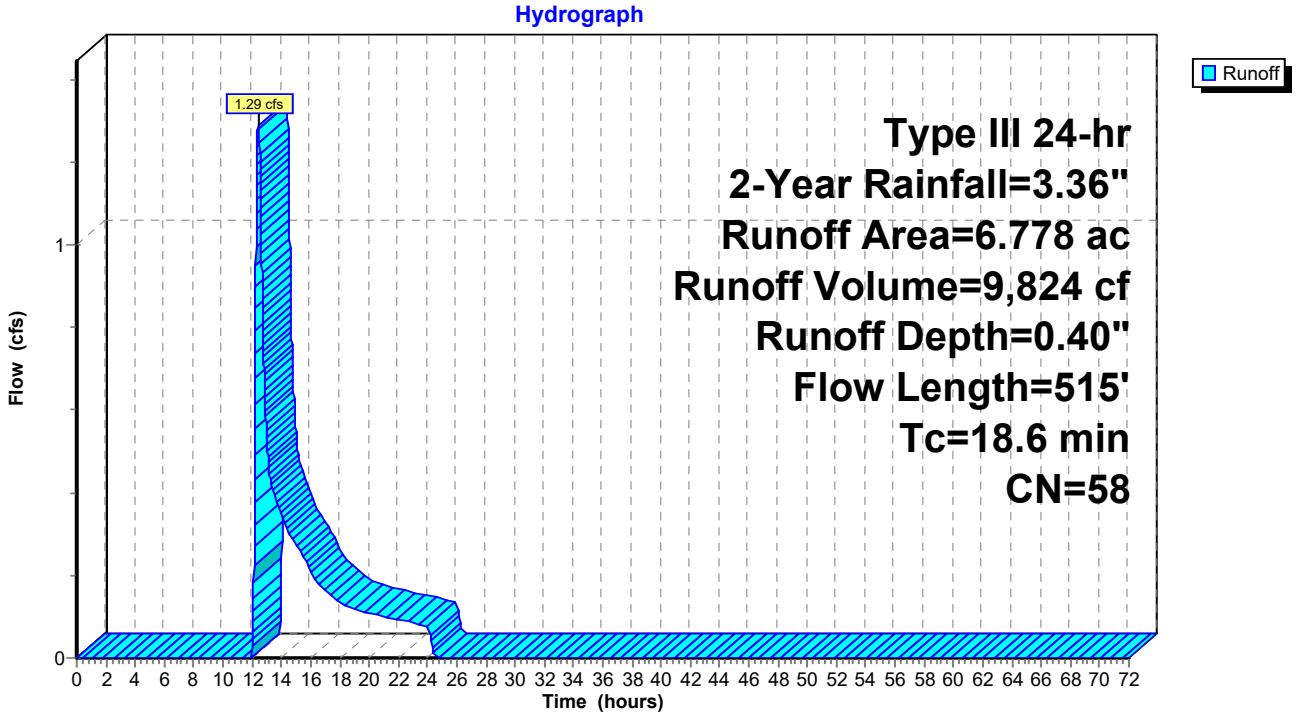
Runoff = 1.29 cfs @ 12.42 hrs, Volume= 9,824 cf, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
4.769	58	Meadow, non-grazed, HSG B
1.844	55	Woods, Good, HSG B
0.165	98	Paved parking, HSG B
6.778	58	Weighted Average
6.613		97.57% Pervious Area
0.165		2.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	100	0.0132	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
1.2	203	0.0294	2.76		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.1	212	0.0133	0.58		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
18.6	515	Total			

Subcatchment 2: DA to Pre-Dev POI#2



Summary for Subcatchment 2: DA to Pre-Dev POI#2

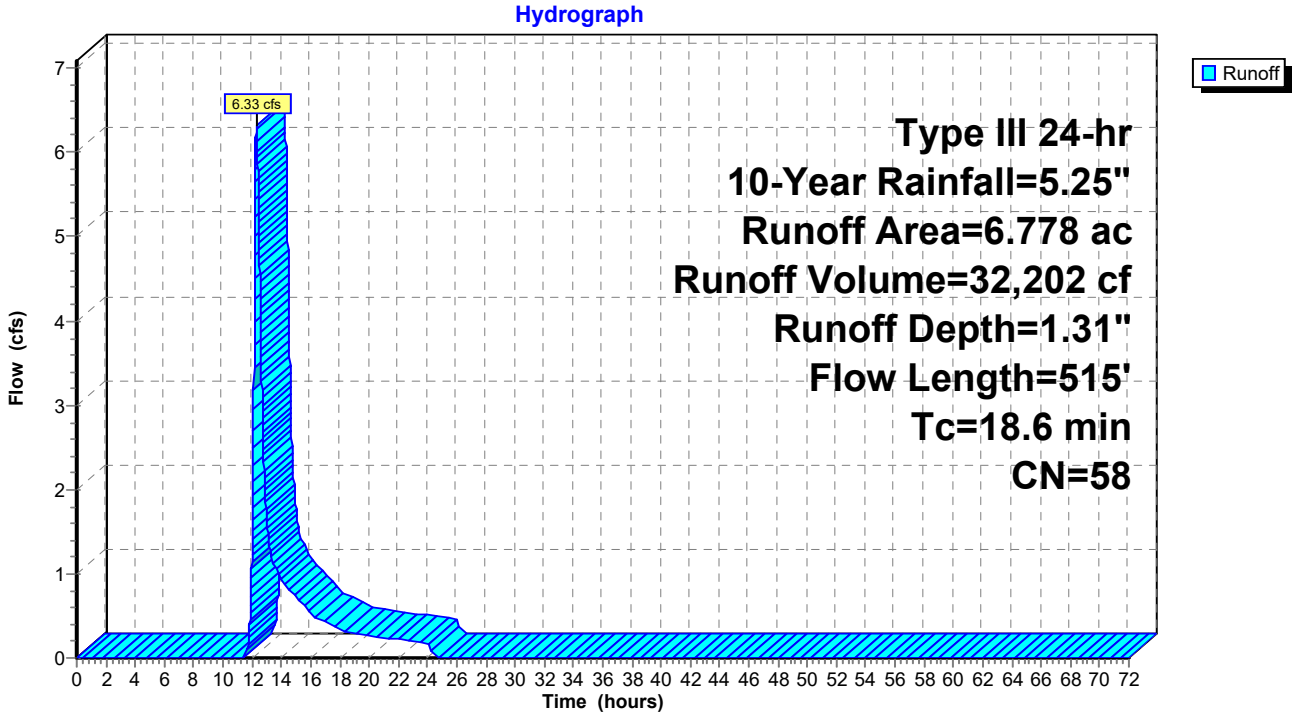
Runoff = 6.33 cfs @ 12.30 hrs, Volume= 32,202 cf, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
4.769	58	Meadow, non-grazed, HSG B
1.844	55	Woods, Good, HSG B
0.165	98	Paved parking, HSG B
6.778	58	Weighted Average
6.613		97.57% Pervious Area
0.165		2.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	100	0.0132	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
1.2	203	0.0294	2.76		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.1	212	0.0133	0.58		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
18.6	515	Total			

Subcatchment 2: DA to Pre-Dev POI#2



Summary for Subcatchment 2: DA to Pre-Dev POI#2

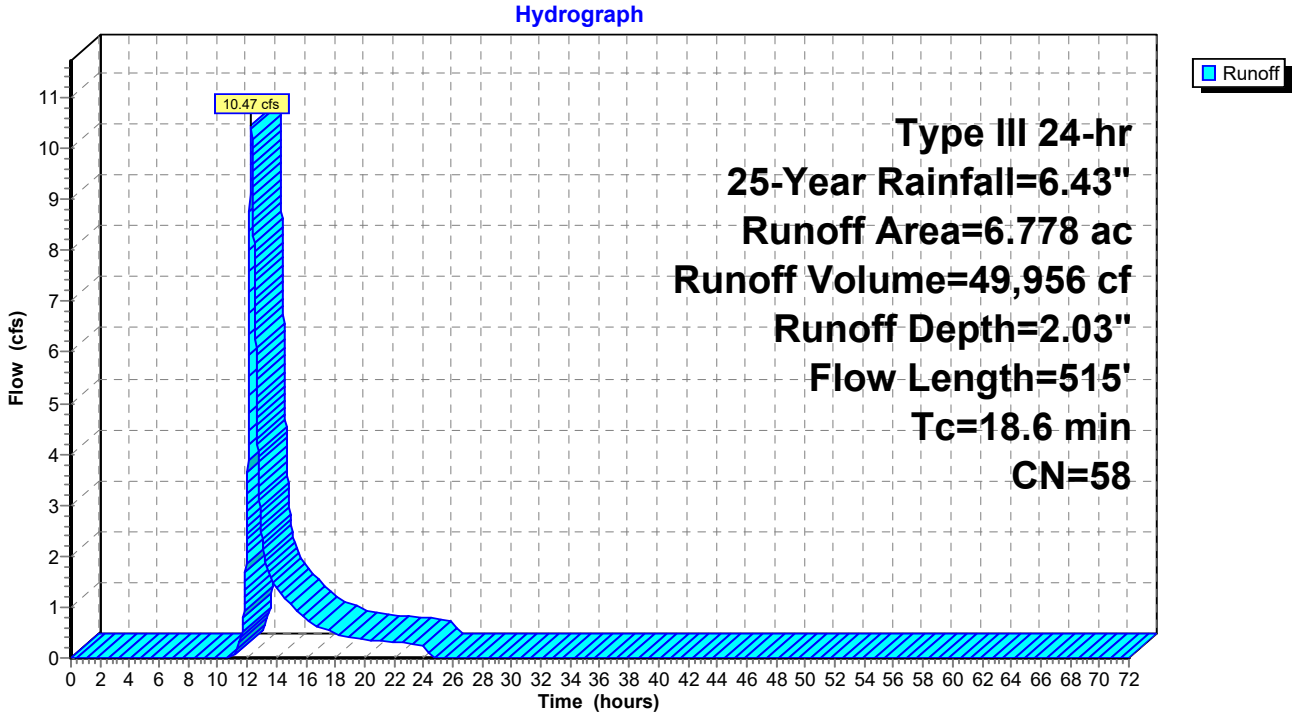
Runoff = 10.47 cfs @ 12.28 hrs, Volume= 49,956 cf, Depth= 2.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (ac)	CN	Description
4.769	58	Meadow, non-grazed, HSG B
1.844	55	Woods, Good, HSG B
0.165	98	Paved parking, HSG B
6.778	58	Weighted Average
6.613		97.57% Pervious Area
0.165		2.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	100	0.0132	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
1.2	203	0.0294	2.76		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.1	212	0.0133	0.58		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
18.6	515	Total			

Subcatchment 2: DA to Pre-Dev POI#2



Summary for Subcatchment 2: DA to Pre-Dev POI#2

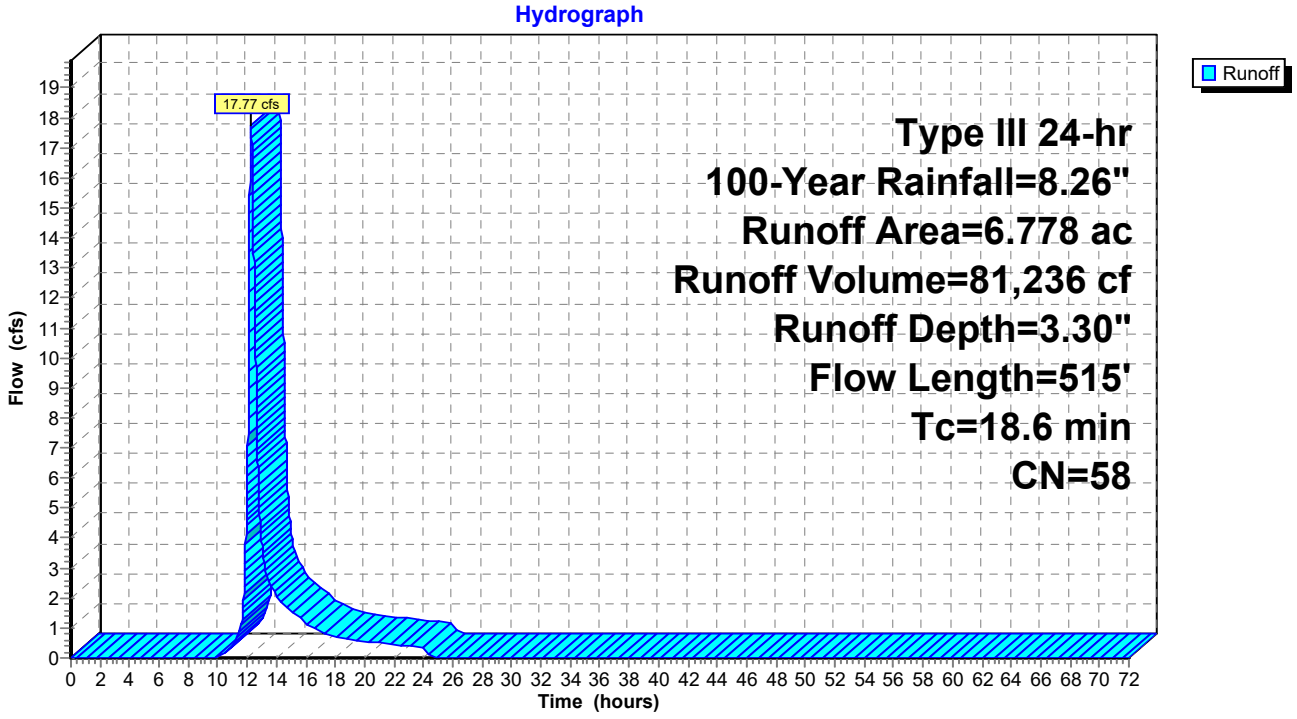
Runoff = 17.77 cfs @ 12.26 hrs, Volume= 81,236 cf, Depth= 3.30"

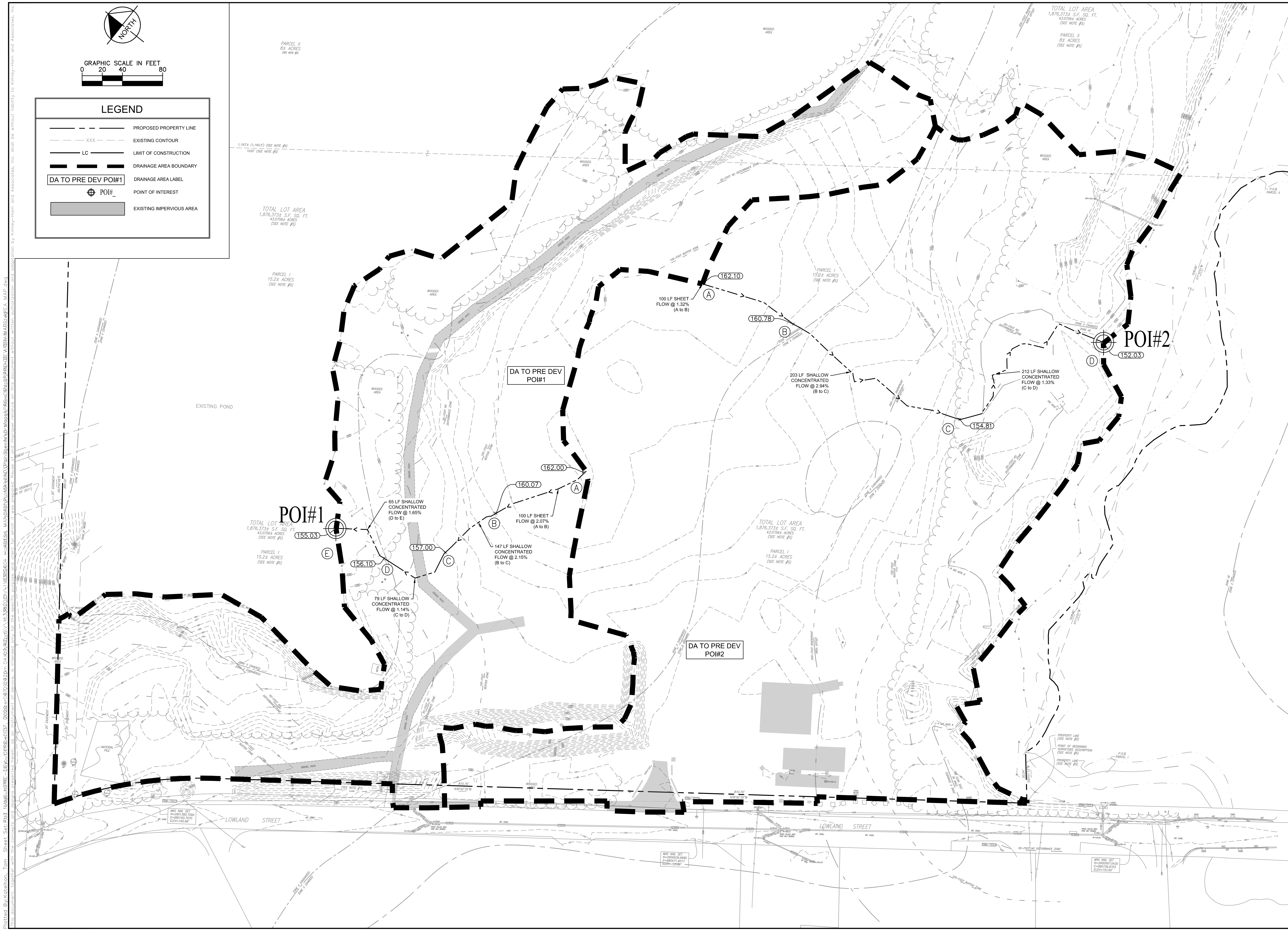
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
4.769	58	Meadow, non-grazed, HSG B
1.844	55	Woods, Good, HSG B
0.165	98	Paved parking, HSG B
6.778	58	Weighted Average
6.613		97.57% Pervious Area
0.165		2.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	100	0.0132	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
1.2	203	0.0294	2.76		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.1	212	0.0133	0.58		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
18.6	515	Total			

Subcatchment 2: DA to Pre-Dev POI#2





No.	REVISIONS	DATE	BY
1	PER CMG 7/24/20 SWM PEER REVIEW	9/25/20	TGK

Kimley»Horn

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PHONE: 804-673-3882
WWW.KIMLEY-HORN.COM

LICENSED PROFESSIONAL

COMMONWEALTH OF MASSACHUSETTS — BRIAN BREWER — CIVIL — No. 46948 — REGISTERED PROFESSIONAL ENGINEER

KHA PROJECT	113382001
DATE	04/28/2020
SCALE	AS SHOWN
DESIGNED BY	TGK
DRAWN BY	TGK
CHECKED BY	BJB

PREDEVELOPMENT DRAINAGE AREA MAP

ADESA HOLLISTON

PREPARED FOR
ADESA, INC.

TOWN OF HOLLISTON MA

SHEET NUMBER
DA-1

APPENDIX C
Proposed Conditions Analysis

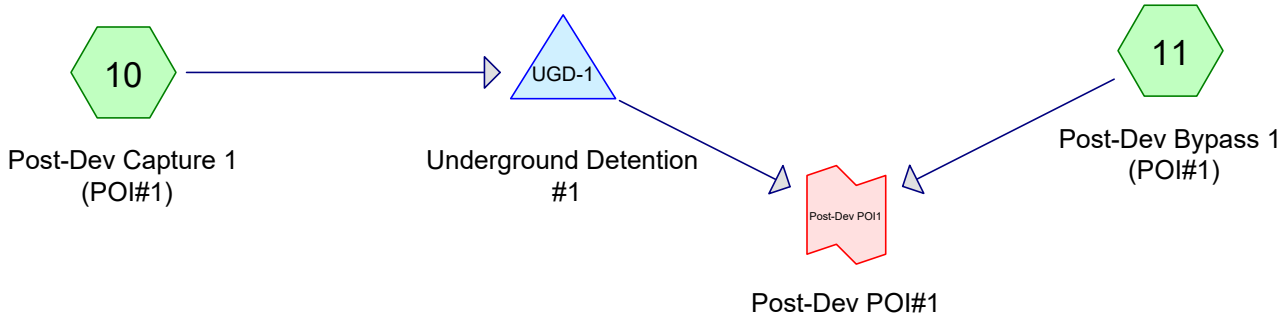
COMPUTATION SHEET: SCS RUNOFF COEFFICIENT (CN)

PROJECT: ***ADESA Holliston***
Lowland Street - Town of Holliston
Massachusetts

DATE: ***4/13/2020***
BY: ***TGK***
CHECKED BY: ***-***
REVISION: ***1***

POST-DEVELOPMENT DRAINAGE AREAS

Cover Type Description	Soil HSG	CN	10 Post Dev Capture 1 (POI#1) (Acres)	11 Post Dev Bypass 1 (POI#1) (Acres)	12 Post Dev Capture 2 (POI#2) (Acres)	13 Post Dev Bypass 2 (POI#2) (Acres)
Meadow	A	30				
Wooded	A	30				
Lawn	A	39				
Meadow	B	58		1.857		1.237
Wooded	B	55		1.657		1.703
Lawn	B	61	0.042	0.268	0.045	0.733
Meadow	D	78				
Wooded	D	77				
Lawn	D	80				
Impervious	ALL	98	1.714	0.219	2.112	0.174
		Total Area	1.756	4.001	2.158	3.847
		SCS Runoff Coefficient (CN)	97	59	97	59
		Time of Concentration (Tc)	6.0	8.8	6.0	12.5



Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-1
Prepared by Kimley-Horn and Associates, Printed 10/7/2020

Summary for Subcatchment 10: Post-Dev Capture 1 (POI#1)

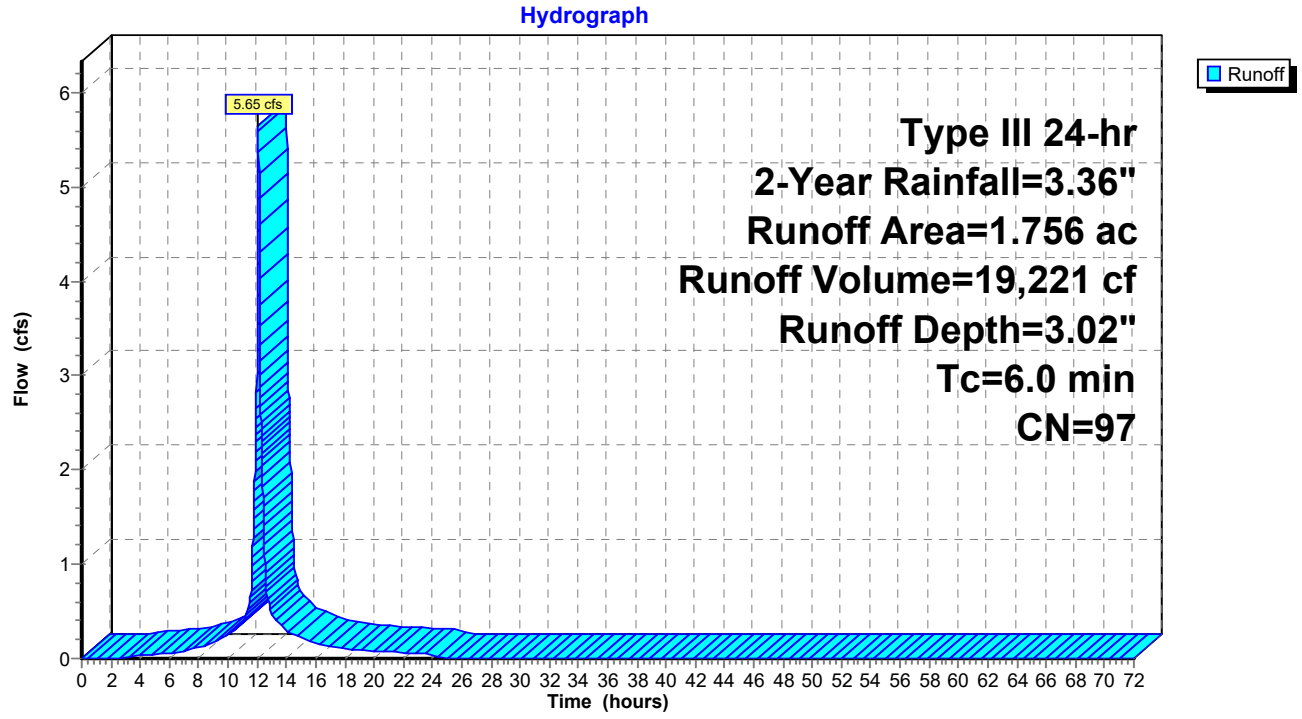
Runoff = 5.65 cfs @ 12.08 hrs, Volume= 19,221 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
1.714	98	Paved parking, HSG A
1.756	97	Weighted Average
0.042		2.39% Pervious Area
1.714		97.61% Impervious Area

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

Subcatchment 10: Post-Dev Capture 1 (POI#1)



Summary for Subcatchment 11: Post-Dev Bypass 1 (POI#1)

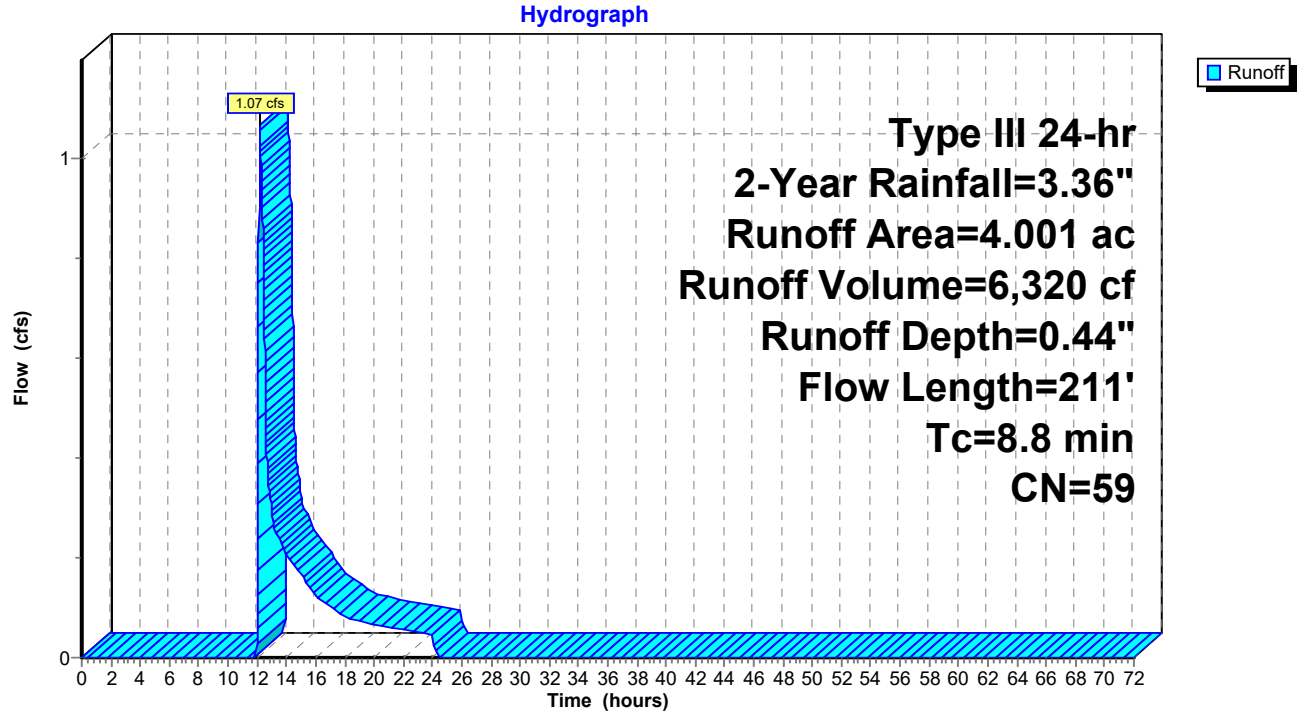
Runoff = 1.07 cfs @ 12.17 hrs, Volume= 6,320 cf, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
1.857	58	Meadow, non-grazed, HSG B
1.657	55	Woods, Good, HSG B
0.268	61	>75% Grass cover, Good, HSG B
0.219	98	Paved parking, HSG B
4.001	59	Weighted Average
3.782		94.53% Pervious Area
0.219		5.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	73	0.0170	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.8	109	0.0183	2.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.8	211	Total			

Subcatchment 11: Post-Dev Bypass 1 (POI#1)



Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 76,491 sf, 97.61% Impervious, Inflow Depth = 3.02" for 2-Year event
Inflow = 5.65 cfs @ 12.08 hrs, Volume= 19,221 cf
Outflow = 0.50 cfs @ 12.95 hrs, Volume= 19,221 cf, Atten= 91%, Lag= 52.3 min
Discarded = 0.50 cfs @ 12.95 hrs, Volume= 19,206 cf
Primary = 0.01 cfs @ 12.95 hrs, Volume= 15 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 156.74' @ 12.95 hrs Surf.Area= 8,907 sf Storage= 7,015 cf

Plug-Flow detention time= 103.9 min calculated for 19,218 cf (100% of inflow)
Center-of-Mass det. time= 103.9 min (868.7 - 764.8)

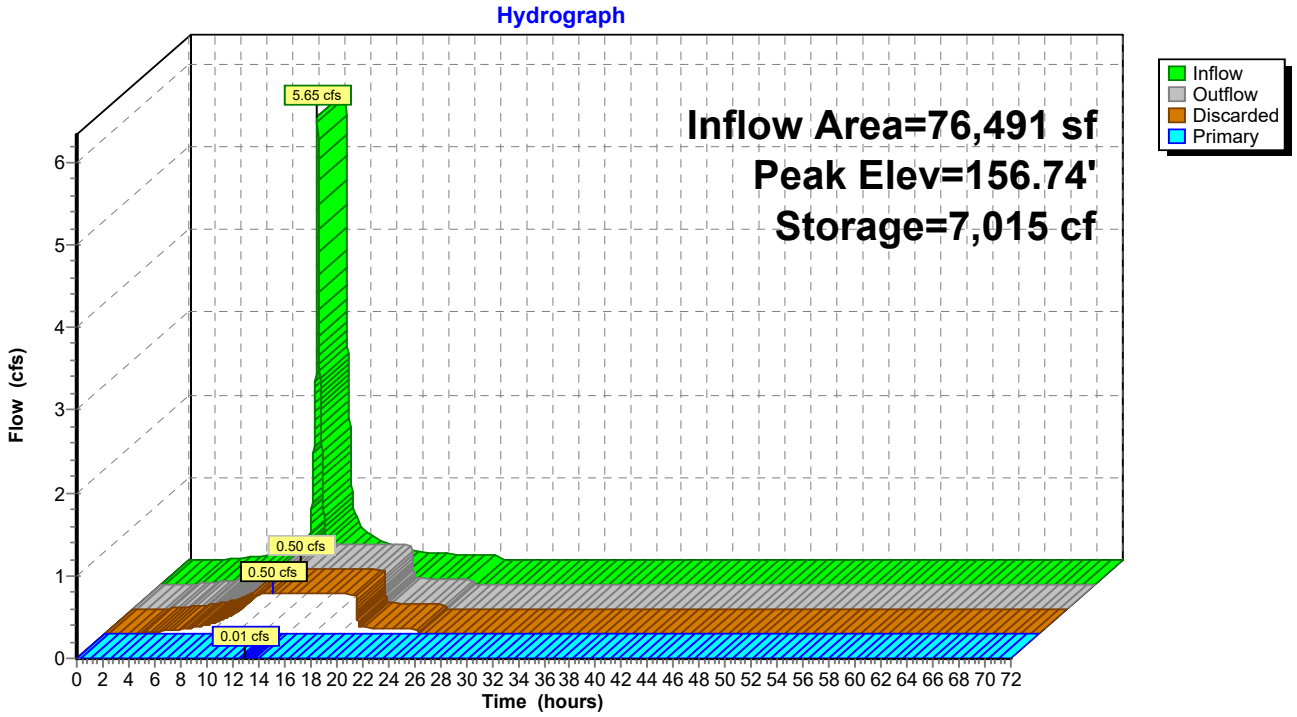
Volume	Invert	Avail.Storage	Storage Description
#1	155.50'	8,344 cf	**72.75'W x 115.92'L x 3.50'H Prismatoid Z=1.0** 31,885 cf Overall - 11,026 cf Embedded = 20,859 cf x 40.0% Voids
#2	156.00'	11,026 cf	**ADS_StormTech SC-740 +Cap** x 240 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		19,369 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**18.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 154.00' S= 0.0062 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	156.70'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.50 159.00 159.00 Width (feet) 4.00 4.00 0.00
#4	Discarded	155.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.50 cfs @ 12.95 hrs HW=156.74' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.50 cfs)

Primary OutFlow Max=0.01 cfs @ 12.95 hrs HW=156.74' (Free Discharge)
└**1=Culvert** (Passes 0.01 cfs of 2.30 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.68 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond UGD-1: Underground Detention #1

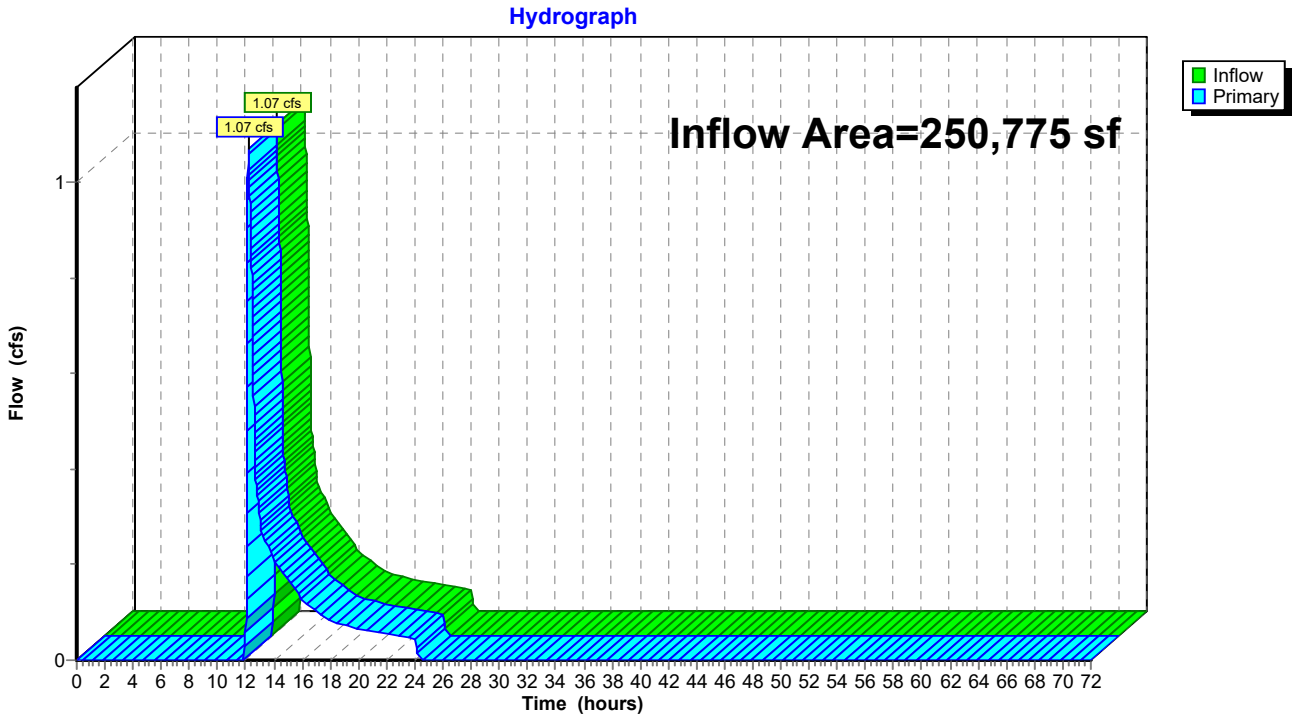


Summary for Link Post-Dev POI1: Post-Dev POI#1

Inflow Area = 250,775 sf, 33.58% Impervious, Inflow Depth = 0.30" for 2-Year event
Inflow = 1.07 cfs @ 12.17 hrs, Volume= 6,336 cf
Primary = 1.07 cfs @ 12.17 hrs, Volume= 6,336 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI1: Post-Dev POI#1



Summary for Subcatchment 10: Post-Dev Capture 1 (POI#1)

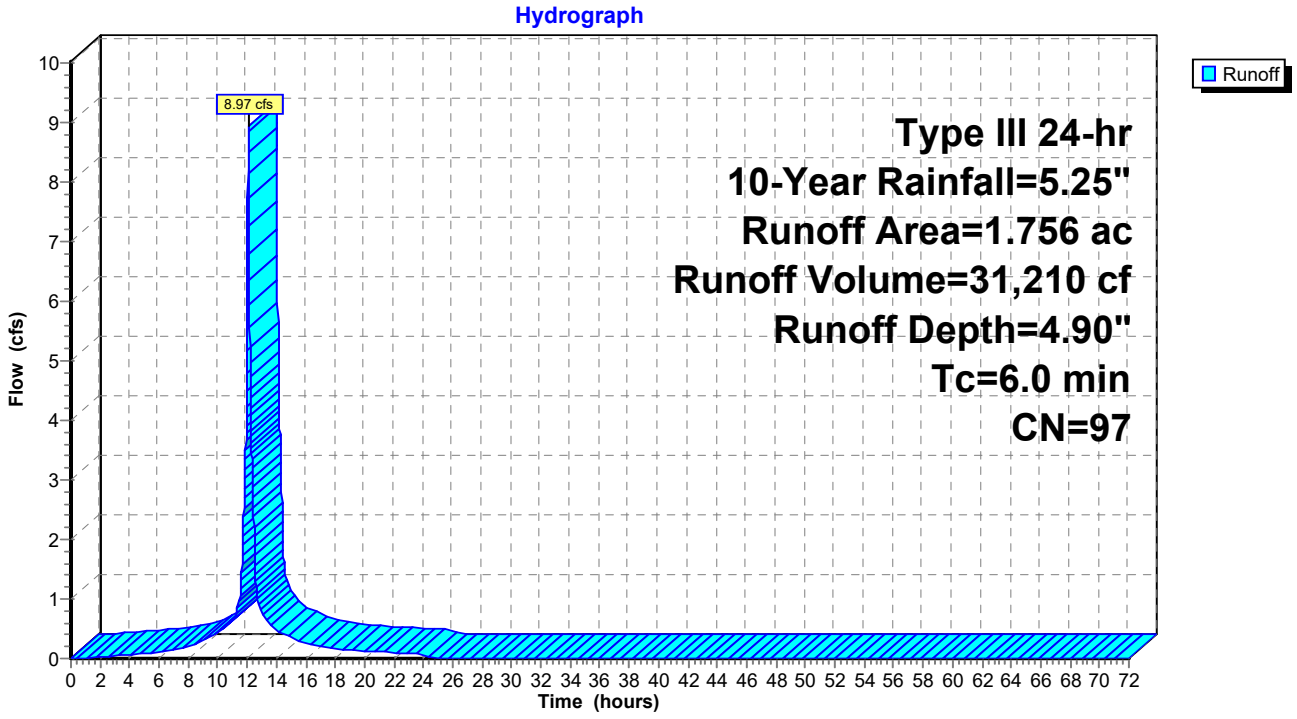
Runoff = 8.97 cfs @ 12.08 hrs, Volume= 31,210 cf, Depth= 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
1.714	98	Paved parking, HSG A
1.756	97	Weighted Average
0.042		2.39% Pervious Area
1.714		97.61% Impervious Area

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

Subcatchment 10: Post-Dev Capture 1 (POI#1)



Summary for Subcatchment 11: Post-Dev Bypass 1 (POI#1)

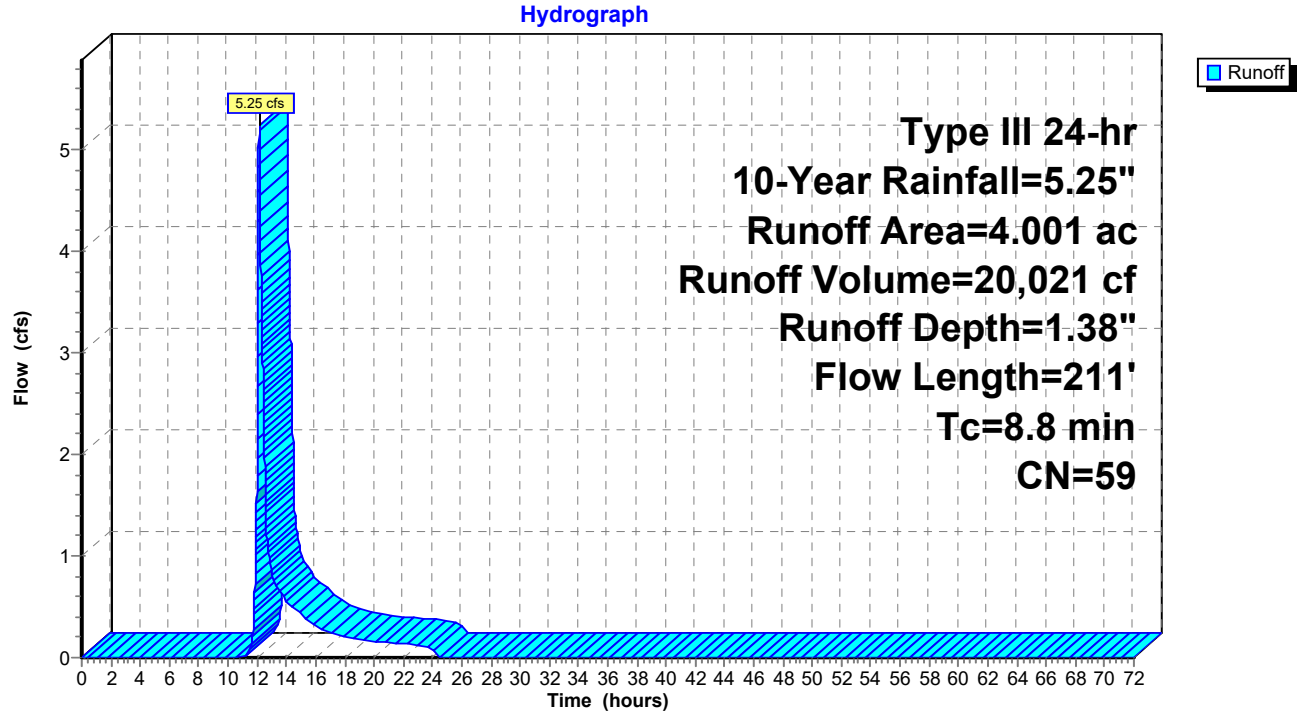
Runoff = 5.25 cfs @ 12.14 hrs, Volume= 20,021 cf, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
1.857	58	Meadow, non-grazed, HSG B
1.657	55	Woods, Good, HSG B
0.268	61	>75% Grass cover, Good, HSG B
0.219	98	Paved parking, HSG B
4.001	59	Weighted Average
3.782		94.53% Pervious Area
0.219		5.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	73	0.0170	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.8	109	0.0183	2.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.8	211	Total			

Subcatchment 11: Post-Dev Bypass 1 (POI#1)



Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 76,491 sf, 97.61% Impervious, Inflow Depth = 4.90" for 10-Year event
Inflow = 8.97 cfs @ 12.08 hrs, Volume= 31,210 cf
Outflow = 1.50 cfs @ 12.54 hrs, Volume= 31,210 cf, Atten= 83%, Lag= 27.6 min
Discarded = 0.51 cfs @ 12.54 hrs, Volume= 25,769 cf
Primary = 0.99 cfs @ 12.54 hrs, Volume= 5,441 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 157.38' @ 12.54 hrs Surf.Area= 9,157 sf Storage= 11,358 cf

Plug-Flow detention time= 114.0 min calculated for 31,206 cf (100% of inflow)
Center-of-Mass det. time= 114.0 min (868.7 - 754.8)

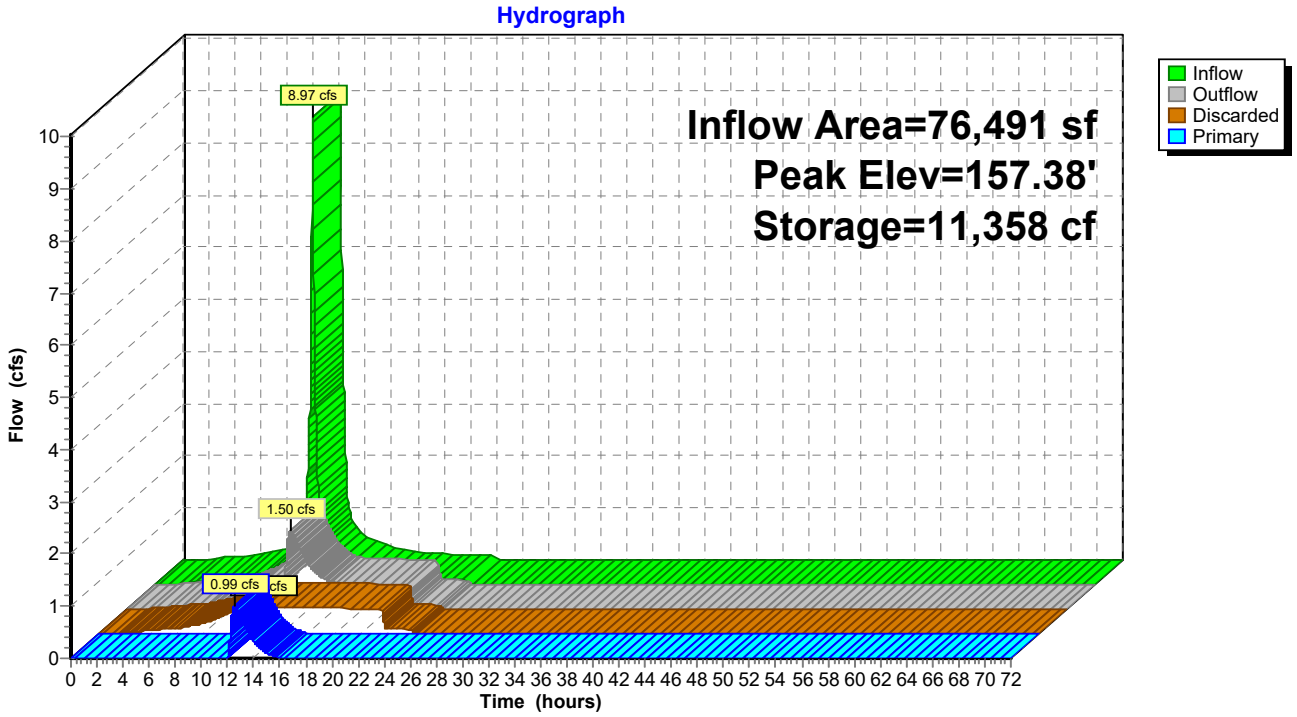
Volume	Invert	Avail.Storage	Storage Description
#1	155.50'	8,344 cf	**72.75'W x 115.92'L x 3.50'H Prismatoid Z=1.0** 31,885 cf Overall - 11,026 cf Embedded = 20,859 cf x 40.0% Voids
#2	156.00'	11,026 cf	**ADS_StormTech SC-740 +Cap** x 240 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		19,369 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**18.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 154.00' S= 0.0062 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	156.70'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.50 159.00 159.00 Width (feet) 4.00 4.00 0.00
#4	Discarded	155.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.51 cfs @ 12.54 hrs HW=157.38' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.51 cfs)

Primary OutFlow Max=0.99 cfs @ 12.54 hrs HW=157.38' (Free Discharge)
└**1=Culvert** (Passes 0.99 cfs of 6.39 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.99 cfs @ 2.84 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond UGD-1: Underground Detention #1

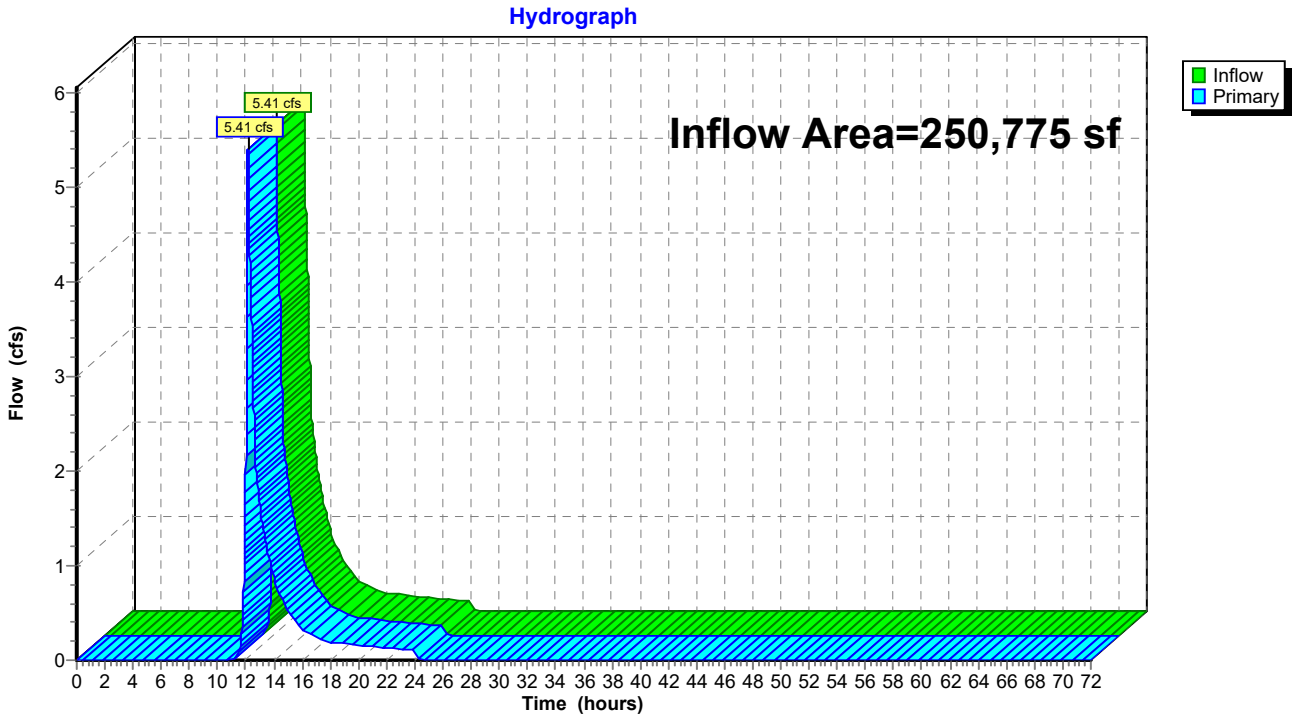


Summary for Link Post-Dev POI1: Post-Dev POI#1

Inflow Area = 250,775 sf, 33.58% Impervious, Inflow Depth = 1.22" for 10-Year event
Inflow = 5.41 cfs @ 12.15 hrs, Volume= 25,462 cf
Primary = 5.41 cfs @ 12.15 hrs, Volume= 25,462 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI1: Post-Dev POI#1



Summary for Subcatchment 10: Post-Dev Capture 1 (POI#1)

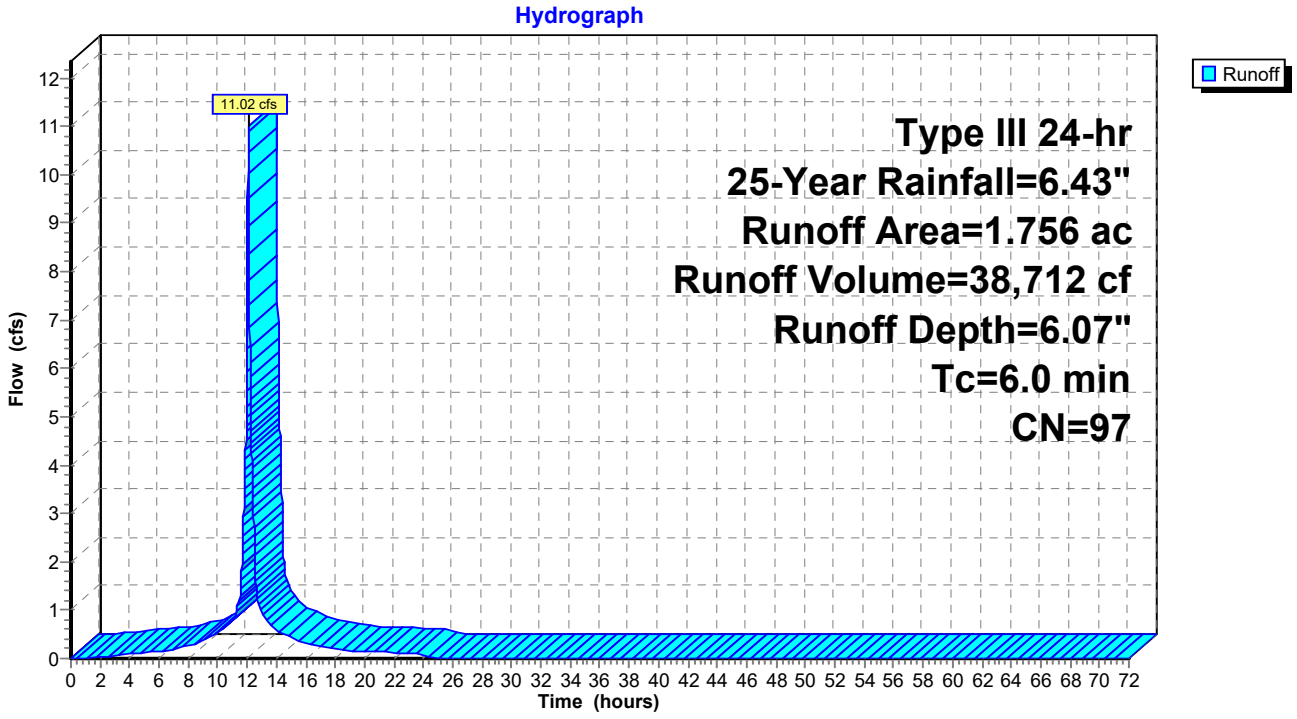
Runoff = 11.02 cfs @ 12.08 hrs, Volume= 38,712 cf, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
1.714	98	Paved parking, HSG A
1.756	97	Weighted Average
0.042		2.39% Pervious Area
1.714		97.61% Impervious Area

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

Subcatchment 10: Post-Dev Capture 1 (POI#1)



Summary for Subcatchment 11: Post-Dev Bypass 1 (POI#1)

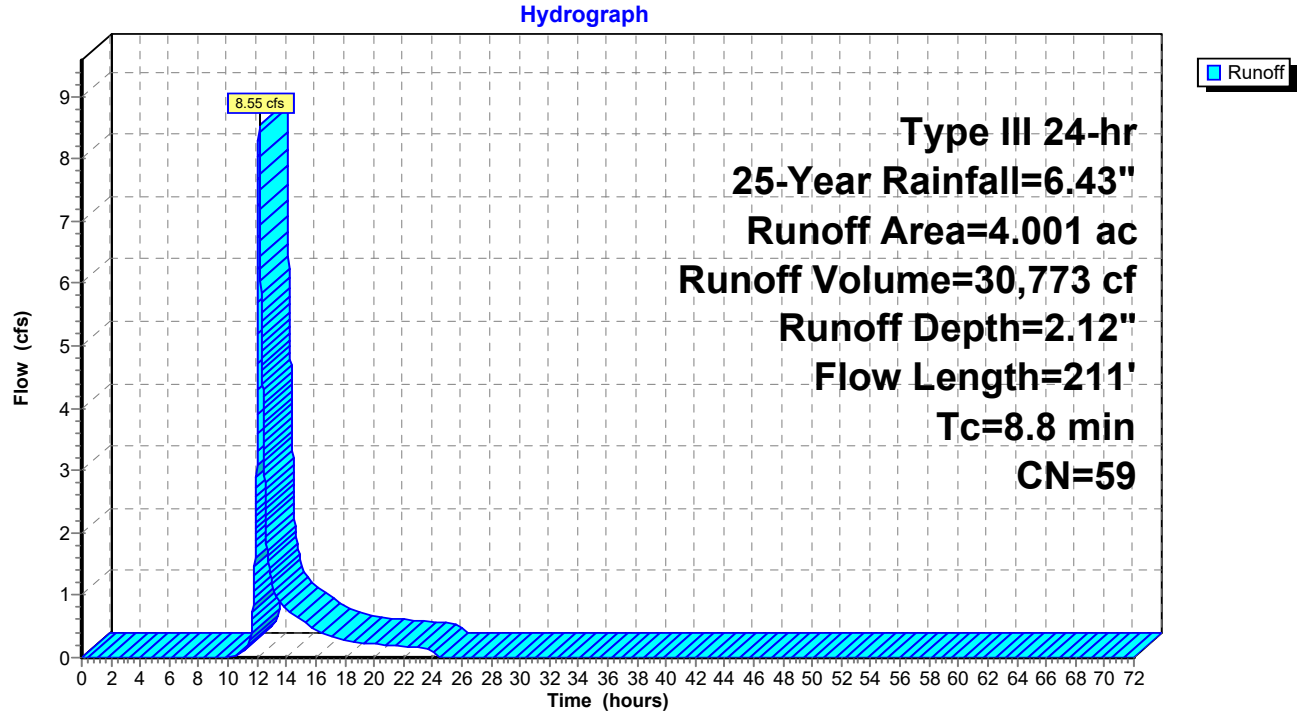
Runoff = 8.55 cfs @ 12.13 hrs, Volume= 30,773 cf, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (ac)	CN	Description
1.857	58	Meadow, non-grazed, HSG B
1.657	55	Woods, Good, HSG B
0.268	61	>75% Grass cover, Good, HSG B
0.219	98	Paved parking, HSG B
4.001	59	Weighted Average
3.782		94.53% Pervious Area
0.219		5.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	73	0.0170	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.8	109	0.0183	2.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.8	211	Total			

Subcatchment 11: Post-Dev Bypass 1 (POI#1)



Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 76,491 sf, 97.61% Impervious, Inflow Depth = 6.07" for 25-Year event
Inflow = 11.02 cfs @ 12.08 hrs, Volume= 38,712 cf
Outflow = 2.03 cfs @ 12.52 hrs, Volume= 38,712 cf, Atten= 82%, Lag= 26.5 min
Discarded = 0.52 cfs @ 12.52 hrs, Volume= 28,575 cf
Primary = 1.51 cfs @ 12.52 hrs, Volume= 10,137 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 157.84' @ 12.52 hrs Surf.Area= 9,338 sf Storage= 14,208 cf

Plug-Flow detention time= 112.0 min calculated for 38,712 cf (100% of inflow)
Center-of-Mass det. time= 112.0 min (862.8 - 750.9)

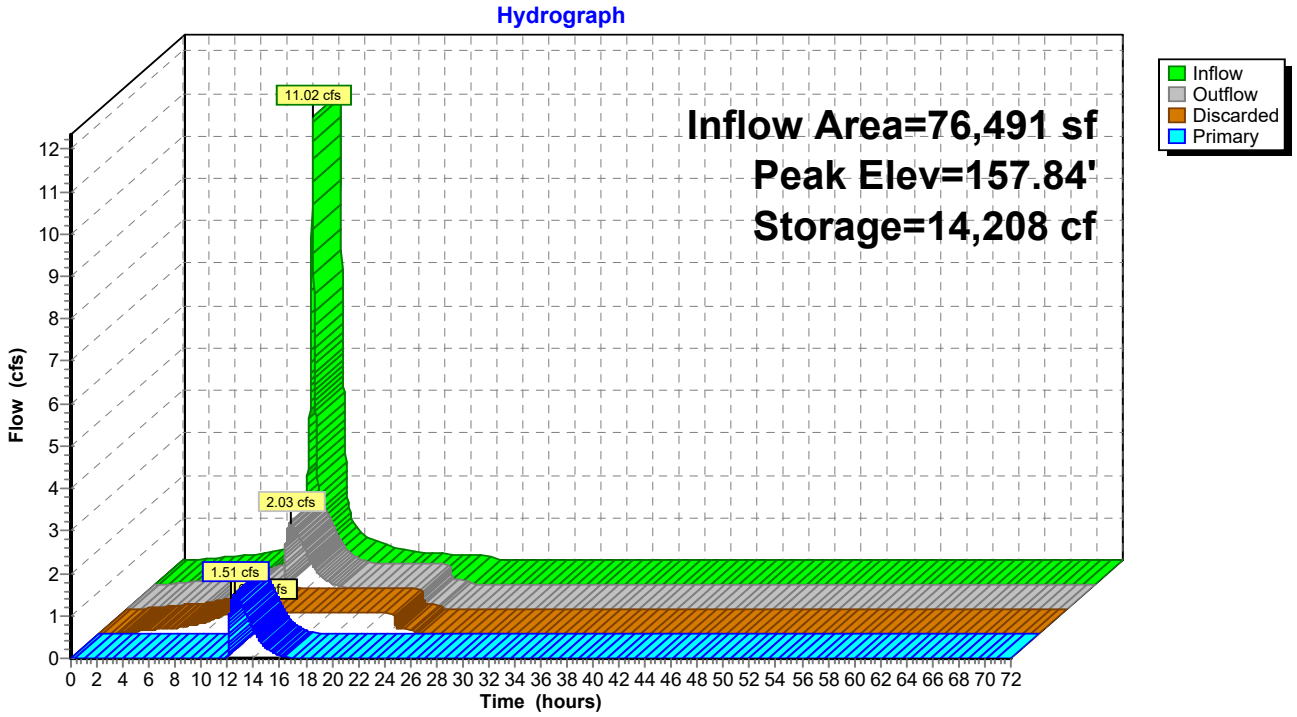
Volume	Invert	Avail.Storage	Storage Description
#1	155.50'	8,344 cf	**72.75'W x 115.92'L x 3.50'H Prismatoid Z=1.0** 31,885 cf Overall - 11,026 cf Embedded = 20,859 cf x 40.0% Voids
#2	156.00'	11,026 cf	**ADS_StormTech SC-740 +Cap** x 240 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		19,369 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**18.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 154.00' S= 0.0062 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	156.70'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.50 159.00 159.00 Width (feet) 4.00 4.00 0.00
#4	Discarded	155.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.52 cfs @ 12.52 hrs HW=157.84' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=1.51 cfs @ 12.52 hrs HW=157.84' (Free Discharge)
└**1=Culvert** (Passes 1.51 cfs of 8.54 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.51 cfs @ 4.33 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond UGD-1: Underground Detention #1

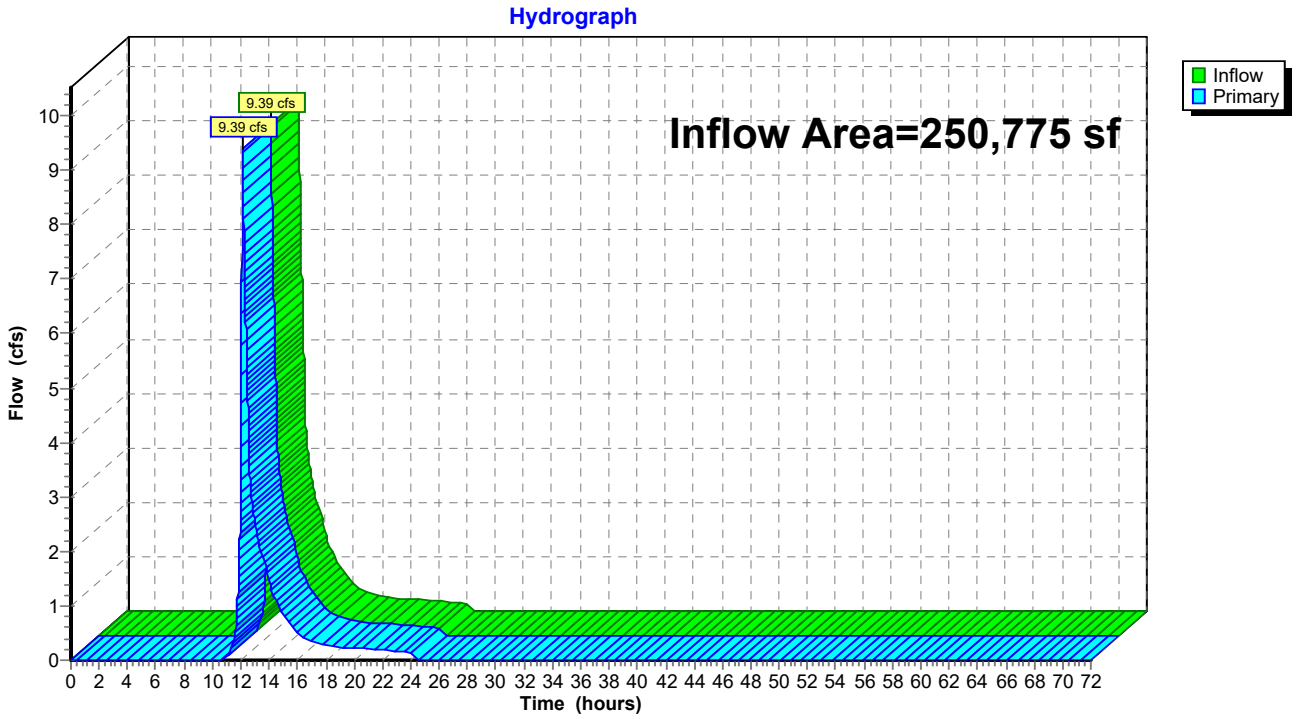


Summary for Link Post-Dev POI1: Post-Dev POI#1

Inflow Area = 250,775 sf, 33.58% Impervious, Inflow Depth = 1.96" for 25-Year event
Inflow = 9.39 cfs @ 12.14 hrs, Volume= 40,910 cf
Primary = 9.39 cfs @ 12.14 hrs, Volume= 40,910 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI1: Post-Dev POI#1



Summary for Subcatchment 10: Post-Dev Capture 1 (POI#1)

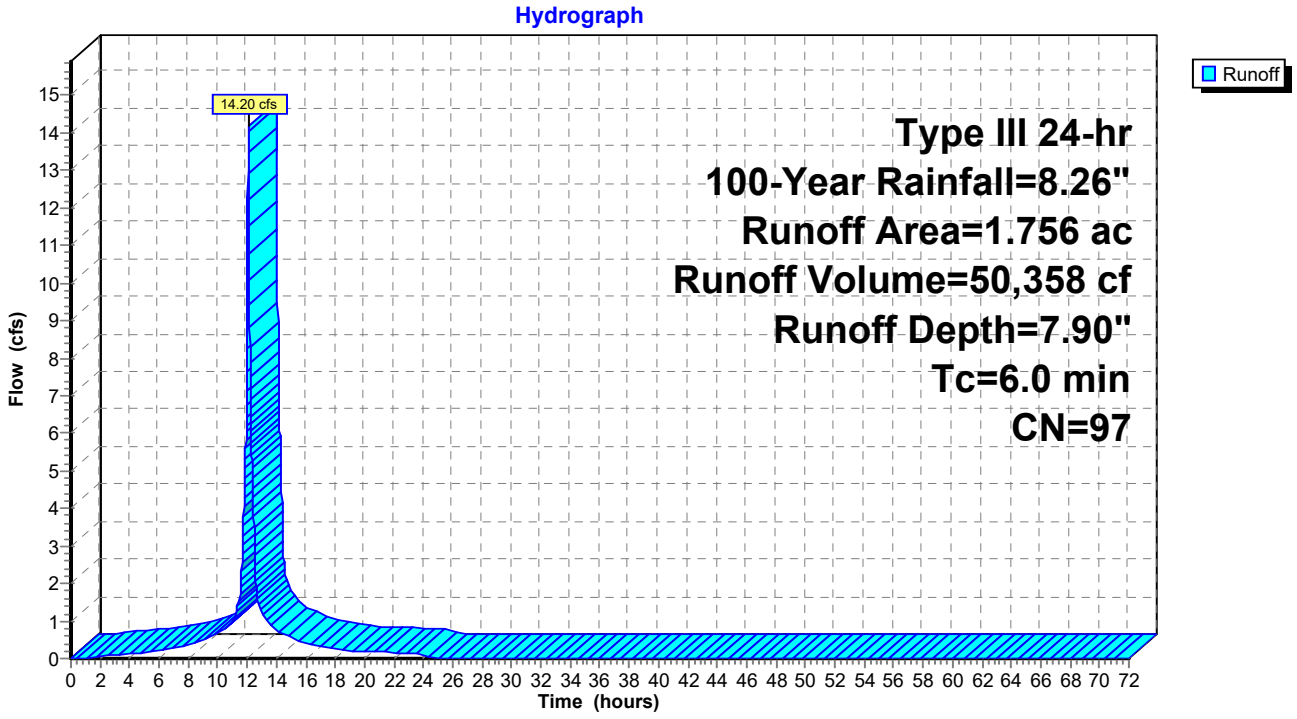
Runoff = 14.20 cfs @ 12.08 hrs, Volume= 50,358 cf, Depth= 7.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
1.714	98	Paved parking, HSG A
1.756	97	Weighted Average
0.042		2.39% Pervious Area
1.714		97.61% Impervious Area

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

Subcatchment 10: Post-Dev Capture 1 (POI#1)



Summary for Subcatchment 11: Post-Dev Bypass 1 (POI#1)

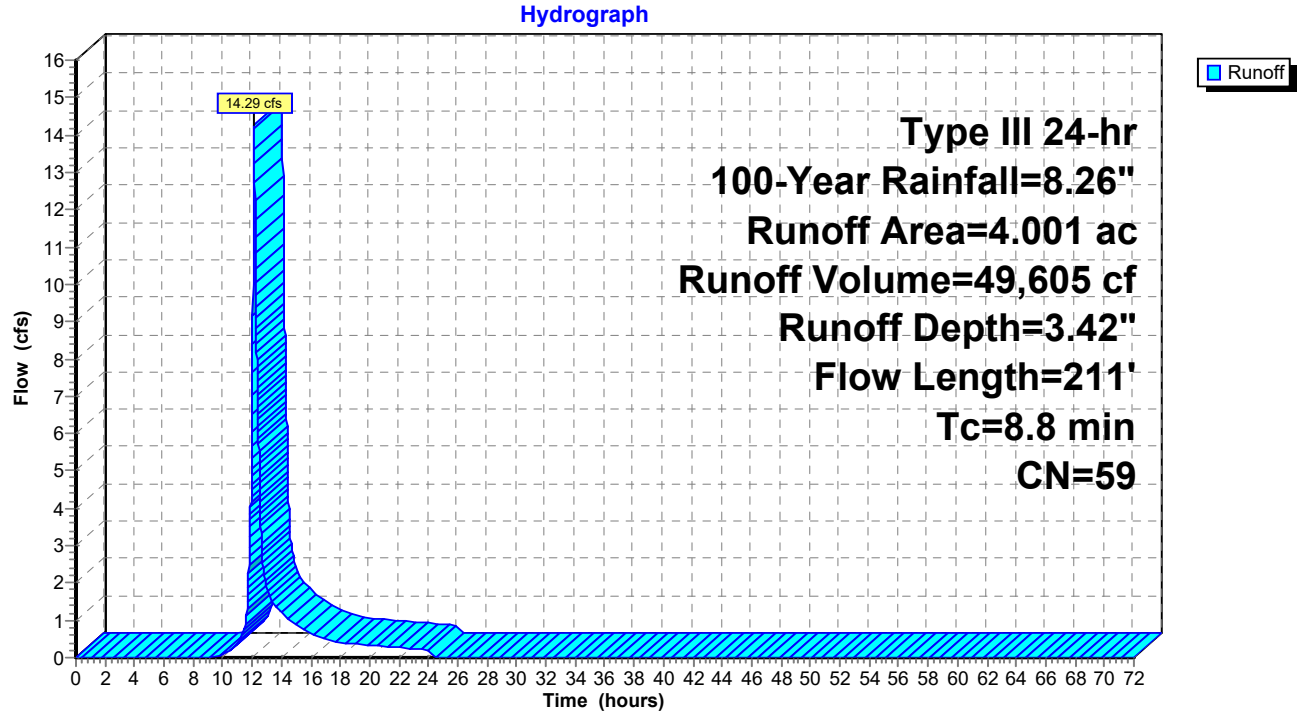
Runoff = 14.29 cfs @ 12.13 hrs, Volume= 49,605 cf, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
1.857	58	Meadow, non-grazed, HSG B
1.657	55	Woods, Good, HSG B
0.268	61	>75% Grass cover, Good, HSG B
0.219	98	Paved parking, HSG B
4.001	59	Weighted Average
3.782		94.53% Pervious Area
0.219		5.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	73	0.0170	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.1	29	0.1034	5.18		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.8	109	0.0183	2.18		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.8	211	Total			

Subcatchment 11: Post-Dev Bypass 1 (POI#1)



Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 76,491 sf, 97.61% Impervious, Inflow Depth = 7.90" for 100-Year event
Inflow = 14.20 cfs @ 12.08 hrs, Volume= 50,358 cf
Outflow = 4.11 cfs @ 12.41 hrs, Volume= 50,358 cf, Atten= 71%, Lag= 19.5 min
Discarded = 0.54 cfs @ 12.41 hrs, Volume= 32,146 cf
Primary = 3.57 cfs @ 12.41 hrs, Volume= 18,211 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 158.72' @ 12.41 hrs Surf.Area= 9,691 sf Storage= 18,291 cf

Plug-Flow detention time= 110.0 min calculated for 50,351 cf (100% of inflow)
Center-of-Mass det. time= 110.0 min (856.6 - 746.6)

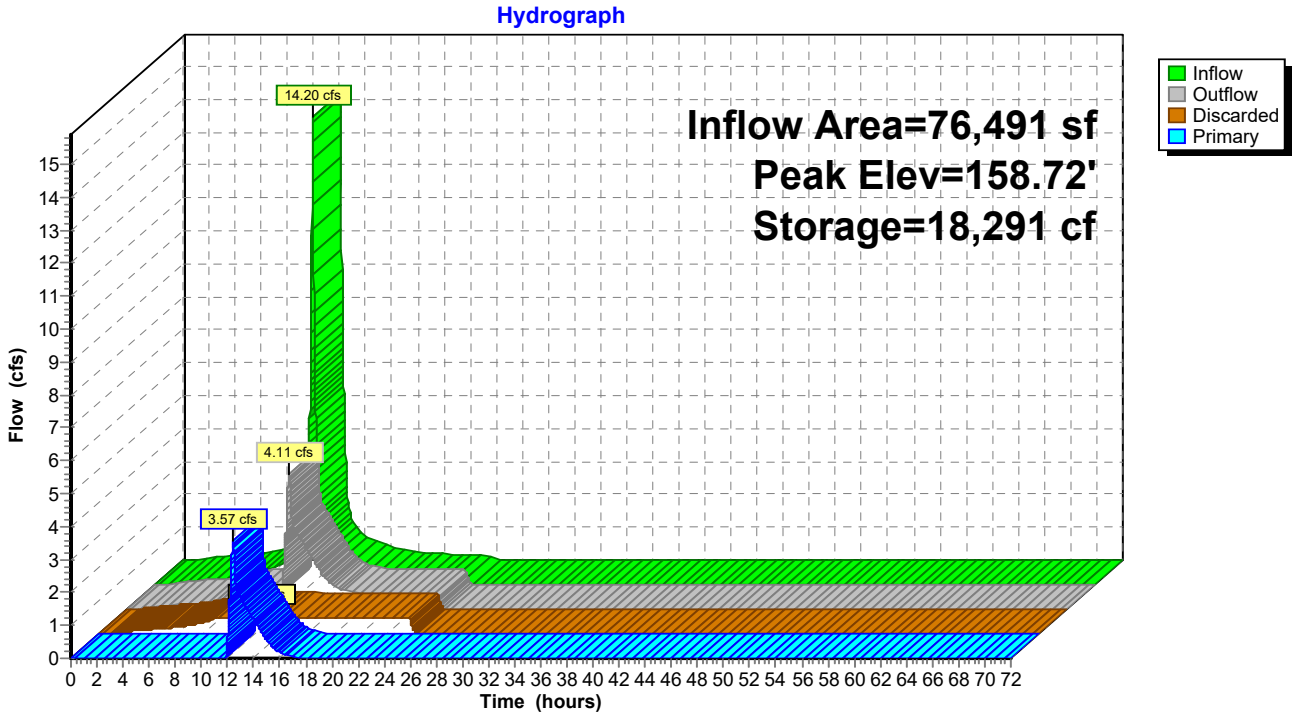
Volume	Invert	Avail.Storage	Storage Description
#1	155.50'	8,344 cf	**72.75'W x 115.92'L x 3.50'H Prismatoid Z=1.0** 31,885 cf Overall - 11,026 cf Embedded = 20,859 cf x 40.0% Voids
#2	156.00'	11,026 cf	**ADS_StormTech SC-740 +Cap** x 240 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		19,369 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**18.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 154.00' S= 0.0062 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	156.70'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.50'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.50 159.00 159.00 Width (feet) 4.00 4.00 0.00
#4	Discarded	155.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.54 cfs @ 12.41 hrs HW=158.72' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.54 cfs)

Primary OutFlow Max=3.57 cfs @ 12.41 hrs HW=158.72' (Free Discharge)
└**1=Culvert** (Passes 3.57 cfs of 9.33 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 2.19 cfs @ 6.26 fps)
  └**3=Custom Weir/Orifice** (Weir Controls 1.38 cfs @ 1.55 fps)

Pond UGD-1: Underground Detention #1

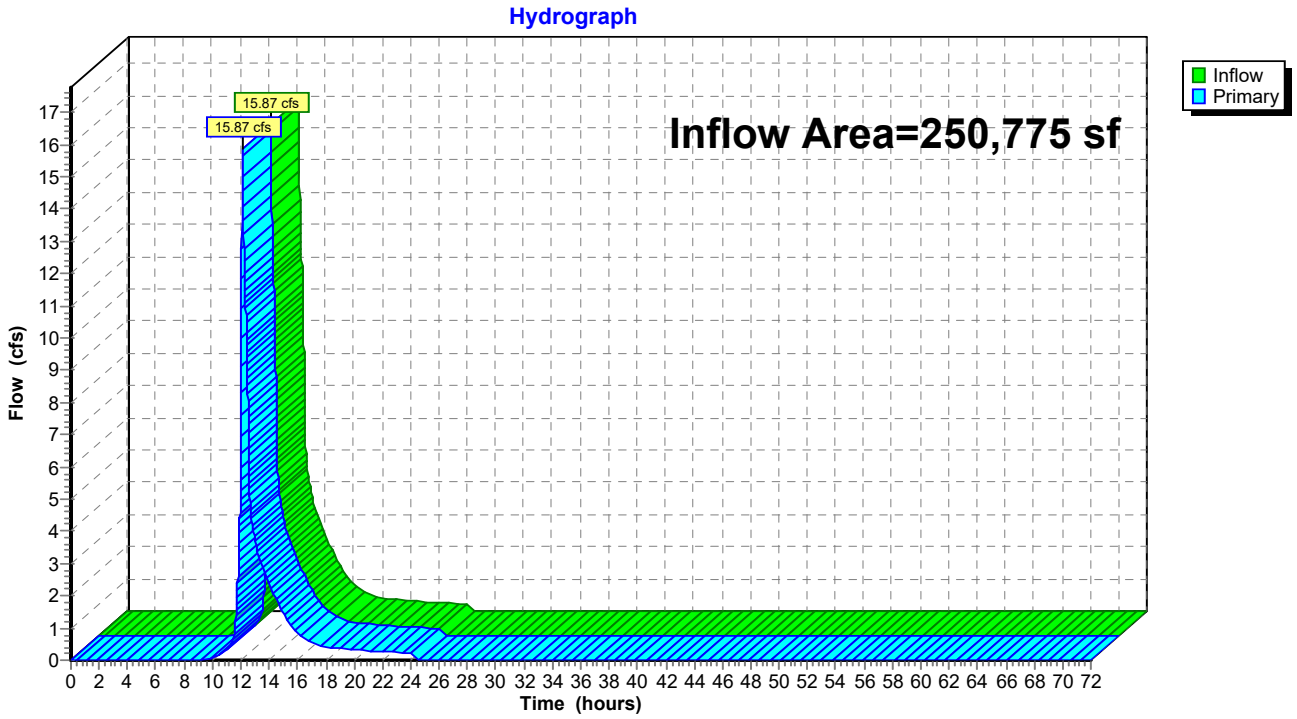


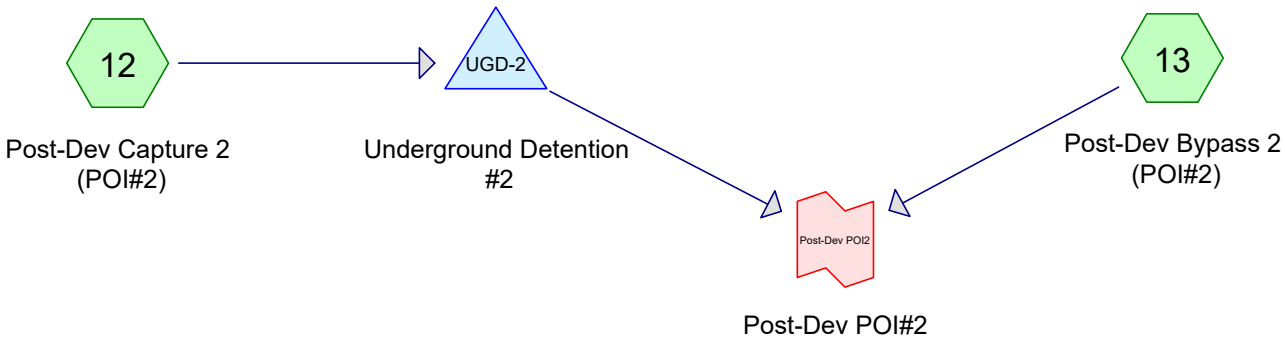
Summary for Link Post-Dev POI1: Post-Dev POI#1

Inflow Area = 250,775 sf, 33.58% Impervious, Inflow Depth = 3.25" for 100-Year event
Inflow = 15.87 cfs @ 12.13 hrs, Volume= 67,816 cf
Primary = 15.87 cfs @ 12.13 hrs, Volume= 67,816 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI1: Post-Dev POI#1





Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-1
Prepared by Kimley-Horn and Associates, Printed 10/7/2020

Summary for Subcatchment 12: Post-Dev Capture 2 (POI#2)

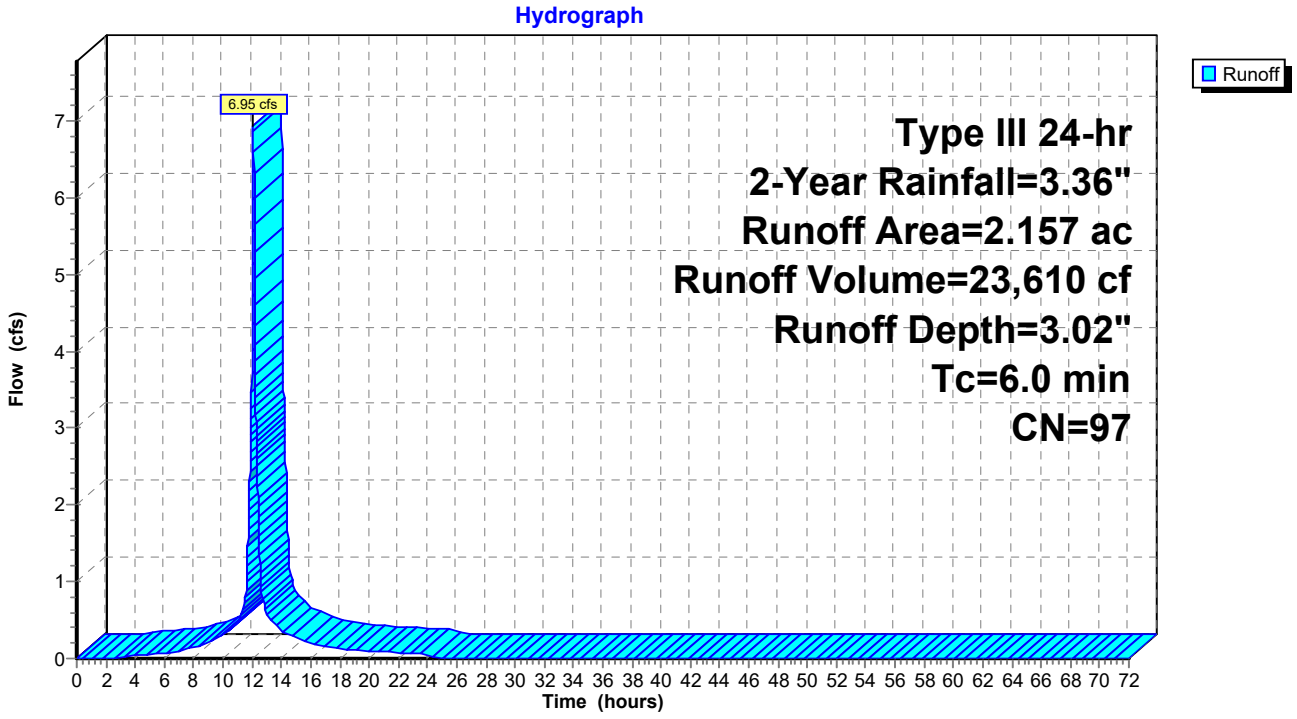
Runoff = 6.95 cfs @ 12.08 hrs, Volume= 23,610 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
0.045	61	>75% Grass cover, Good, HSG B
2.112	98	Paved parking, HSG B
2.157	97	Weighted Average
0.045		2.09% Pervious Area
2.112		97.91% Impervious Area

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

Subcatchment 12: Post-Dev Capture 2 (POI#2)



Summary for Subcatchment 13: Post-Dev Bypass 2 (POI#2)

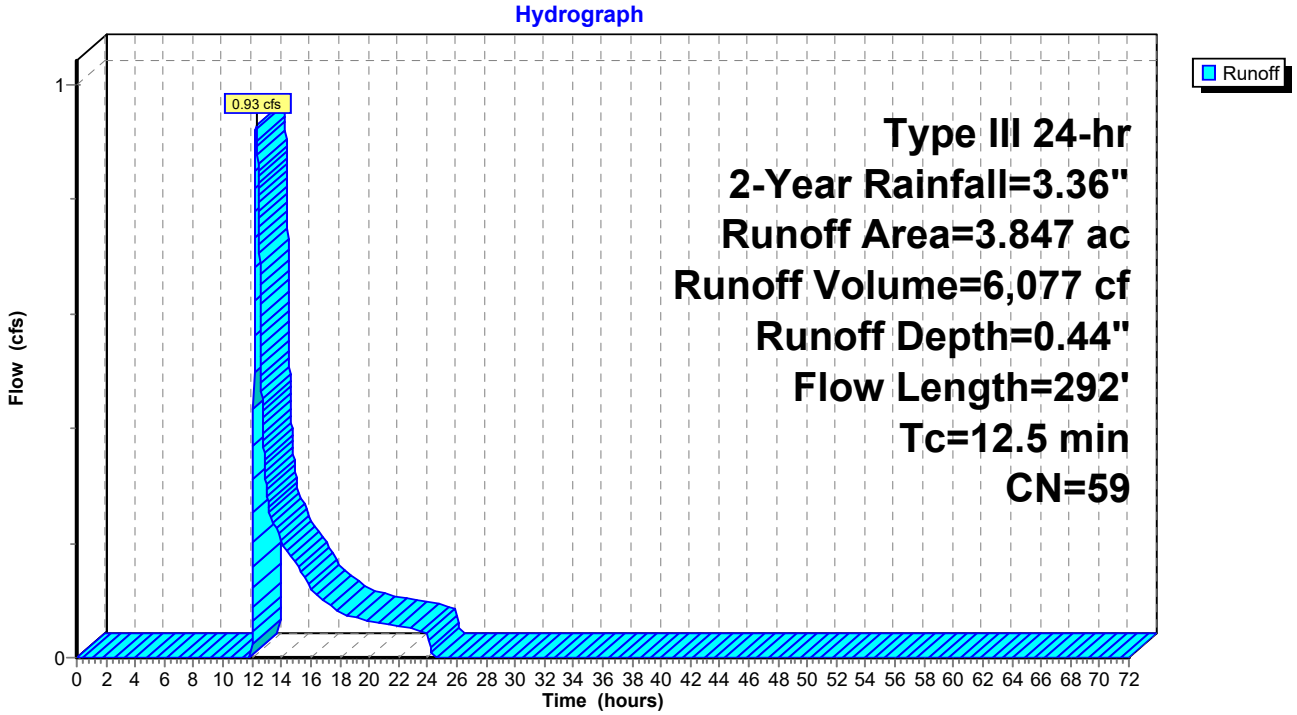
Runoff = 0.93 cfs @ 12.26 hrs, Volume= 6,077 cf, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
1.237	58	Meadow, non-grazed, HSG B
1.703	55	Woods, Good, HSG B
0.733	61	>75% Grass cover, Good, HSG B
0.174	98	Paved parking, HSG B
3.847	59	Weighted Average
3.673		95.48% Pervious Area
0.174		4.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	80	0.0363	0.21		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
6.2	212	0.0130	0.57		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.5	292	Total			

Subcatchment 13: Post-Dev Bypass 2 (POI#2)



Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 93,959 sf, 97.91% Impervious, Inflow Depth = 3.02" for 2-Year event
Inflow = 6.95 cfs @ 12.08 hrs, Volume= 23,610 cf
Outflow = 0.58 cfs @ 13.01 hrs, Volume= 12,520 cf, Atten= 92%, Lag= 55.5 min
Primary = 0.58 cfs @ 13.01 hrs, Volume= 12,520 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 156.86' @ 13.01 hrs Surf.Area= 14,773 sf Storage= 15,564 cf

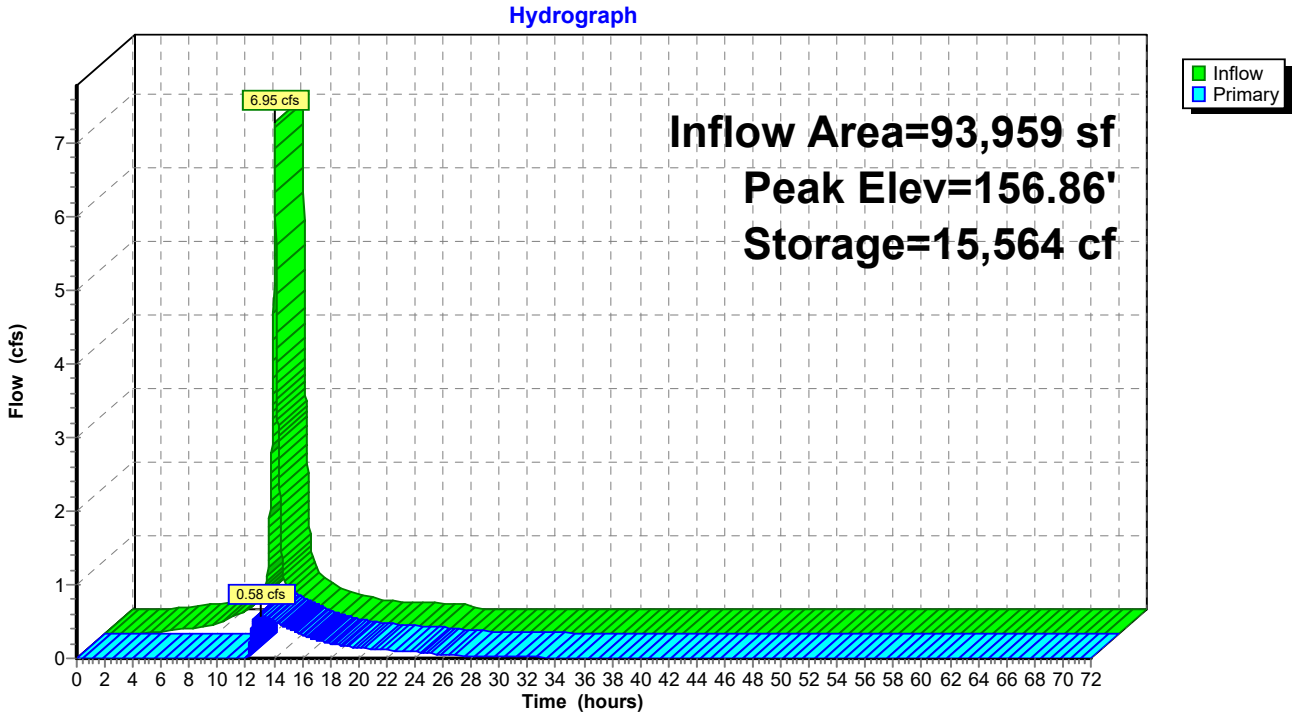
Plug-Flow detention time= 447.3 min calculated for 12,520 cf (53% of inflow)
Center-of-Mass det. time= 331.3 min (1,096.2 - 764.8)

Volume	Invert	Avail.Storage	Storage Description
#1	155.25'	13,653 cf	**49.00'W x 279.68'L x 3.50'H Prismatoid Z=1.0** 52,049 cf Overall - 17,917 cf Embedded = 34,132 cf x 40.0% Voids
#2	155.75'	17,917 cf	**ADS_StormTech SC-740 +Cap** x 390 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		31,569 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**15.0" Round Culvert** L= 187.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 155.00' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	156.45'	**10.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.25 158.75 158.75 Width (feet) 3.00 3.00 0.00

Primary OutFlow Max=0.58 cfs @ 13.01 hrs HW=156.86' (Free Discharge)
↑**1=Culvert** (Passes 0.58 cfs of 2.36 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 0.58 cfs @ 2.18 fps)
3=Custom Weir/Orifice (Controls 0.00 cfs)

Pond UGD-2: Underground Detention #2

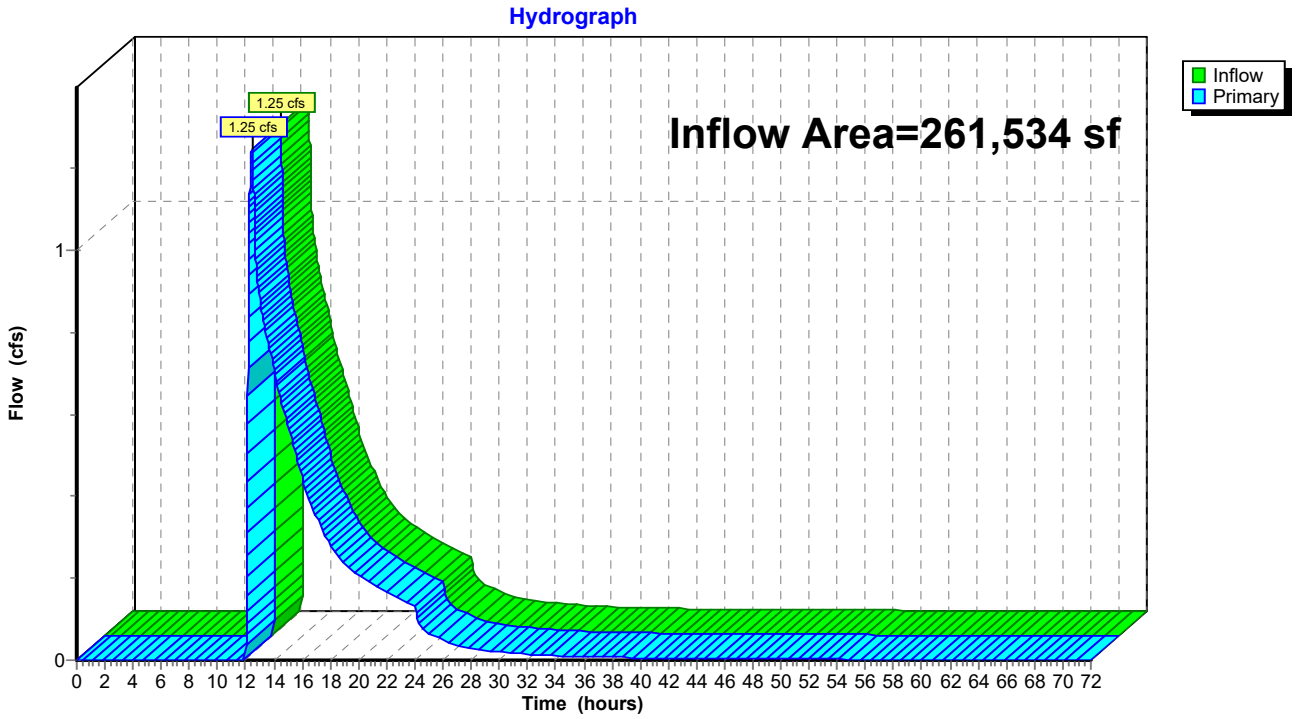


Summary for Link Post-Dev POI2: Post-Dev POI#2

Inflow Area = 261,534 sf, 38.07% Impervious, Inflow Depth > 0.85" for 2-Year event
Inflow = 1.25 cfs @ 12.43 hrs, Volume= 18,597 cf
Primary = 1.25 cfs @ 12.43 hrs, Volume= 18,597 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI2: Post-Dev POI#2



Summary for Subcatchment 12: Post-Dev Capture 2 (POI#2)

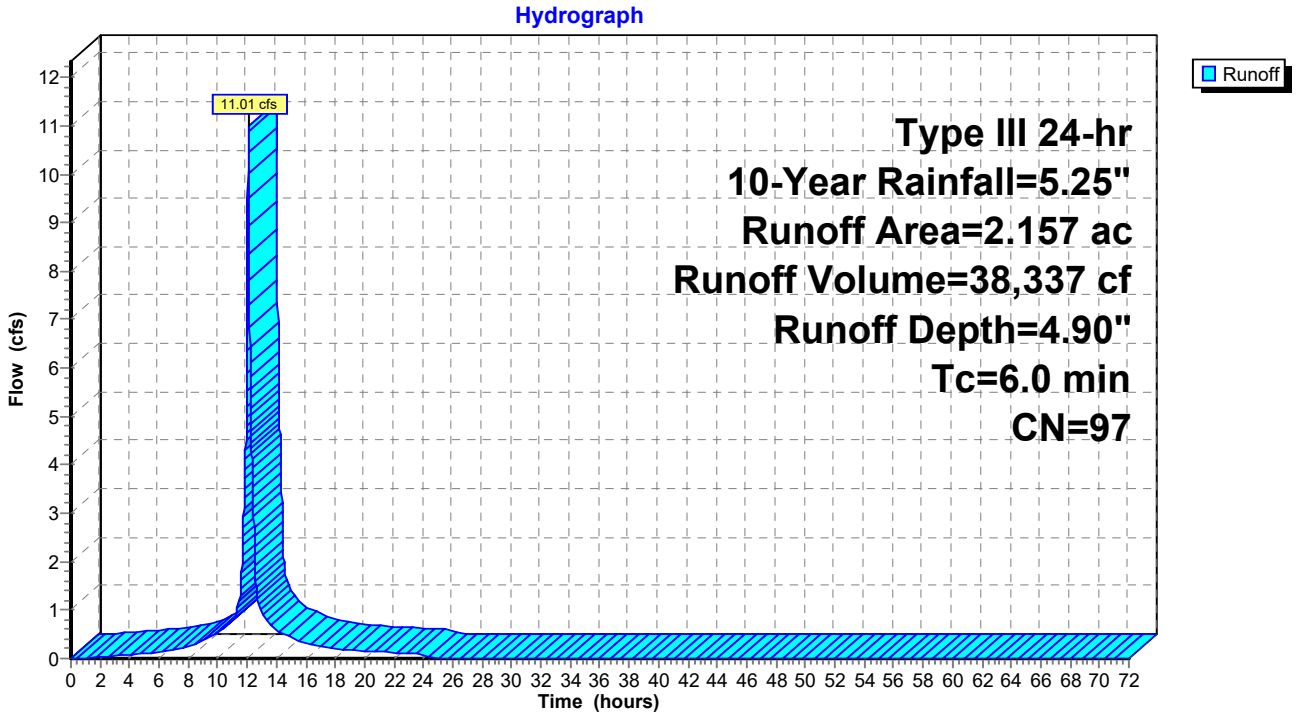
Runoff = 11.01 cfs @ 12.08 hrs, Volume= 38,337 cf, Depth= 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
0.045	61	>75% Grass cover, Good, HSG B
2.112	98	Paved parking, HSG B
2.157	97	Weighted Average
0.045		2.09% Pervious Area
2.112		97.91% Impervious Area

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

Subcatchment 12: Post-Dev Capture 2 (POI#2)



Summary for Subcatchment 13: Post-Dev Bypass 2 (POI#2)

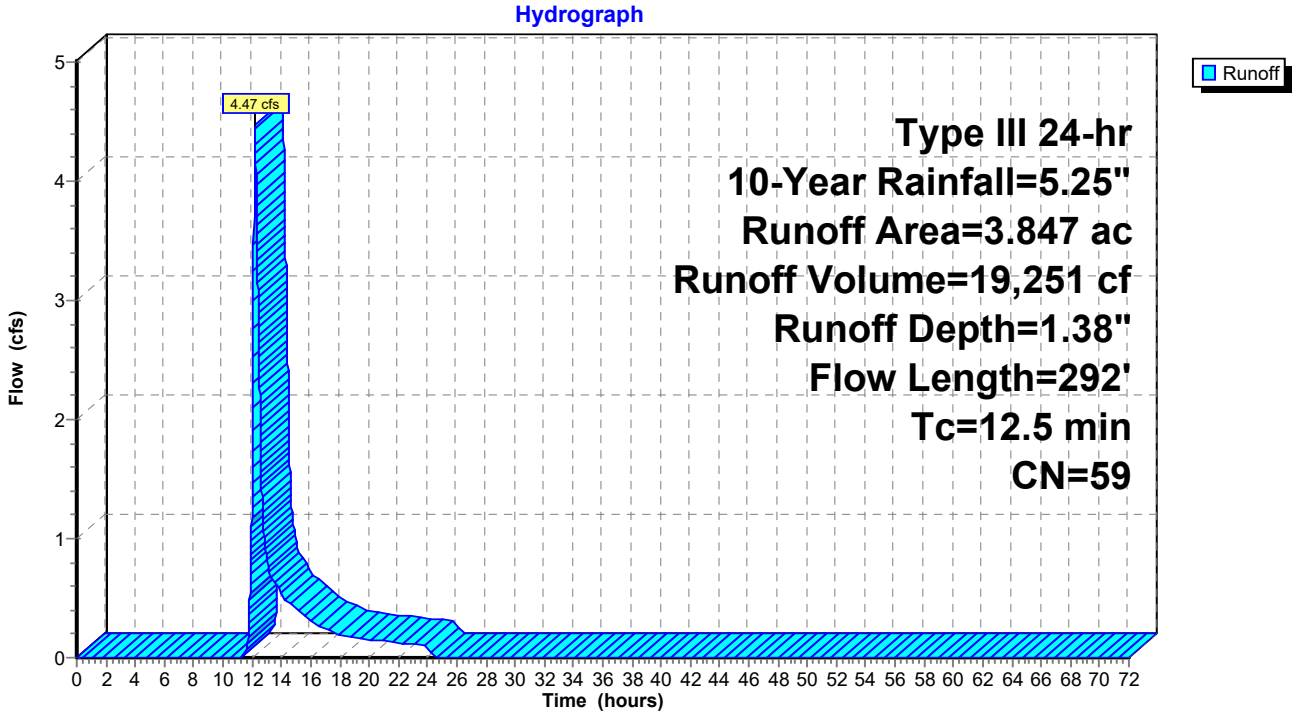
Runoff = 4.47 cfs @ 12.19 hrs, Volume= 19,251 cf, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
1.237	58	Meadow, non-grazed, HSG B
1.703	55	Woods, Good, HSG B
0.733	61	>75% Grass cover, Good, HSG B
0.174	98	Paved parking, HSG B
3.847	59	Weighted Average
3.673		95.48% Pervious Area
0.174		4.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	80	0.0363	0.21		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
6.2	212	0.0130	0.57		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.5	292	Total			

Subcatchment 13: Post-Dev Bypass 2 (POI#2)



Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 93,959 sf, 97.91% Impervious, Inflow Depth = 4.90" for 10-Year event
Inflow = 11.01 cfs @ 12.08 hrs, Volume= 38,337 cf
Outflow = 2.12 cfs @ 12.52 hrs, Volume= 27,243 cf, Atten= 81%, Lag= 26.0 min
Primary = 2.12 cfs @ 12.52 hrs, Volume= 27,243 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 157.52' @ 12.52 hrs Surf.Area= 15,215 sf Storage= 22,422 cf

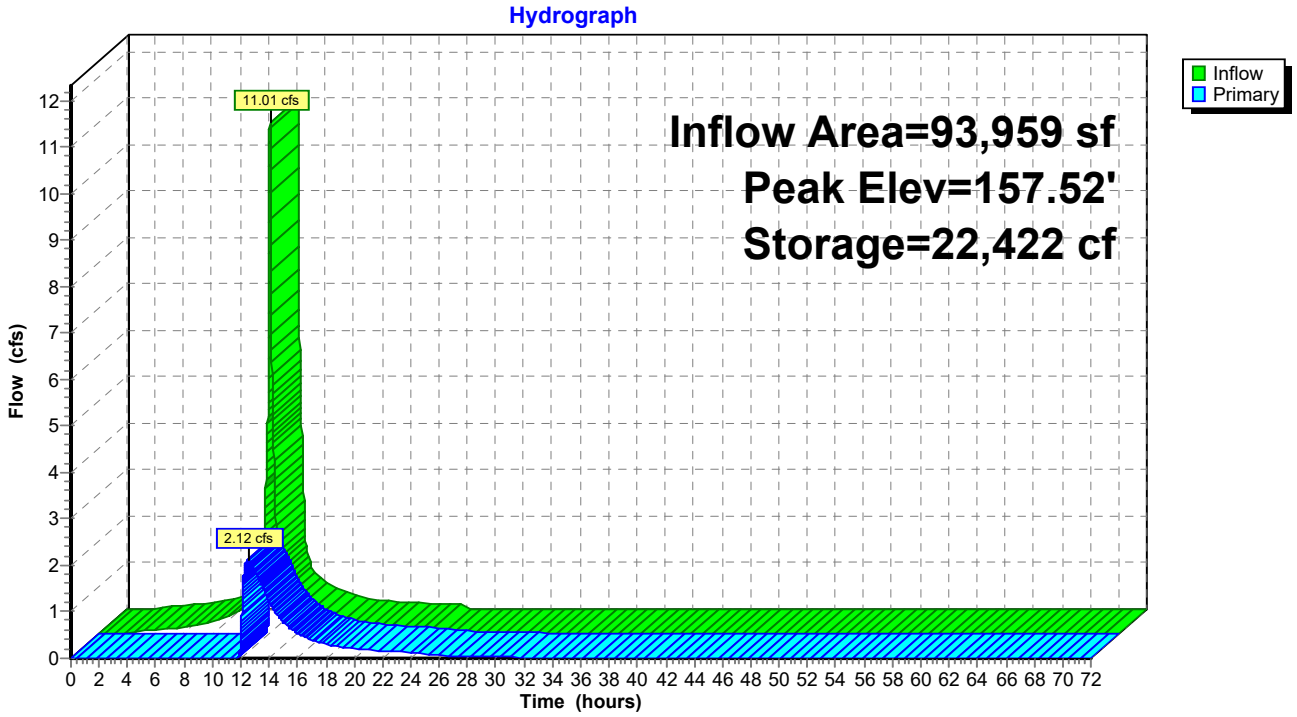
Plug-Flow detention time= 316.6 min calculated for 27,243 cf (71% of inflow)
Center-of-Mass det. time= 224.1 min (978.8 - 754.8)

Volume	Invert	Avail.Storage	Storage Description
#1	155.25'	13,653 cf	**49.00'W x 279.68'L x 3.50'H Prismatoid Z=1.0** 52,049 cf Overall - 17,917 cf Embedded = 34,132 cf x 40.0% Voids
#2	155.75'	17,917 cf	**ADS_StormTech SC-740 +Cap** x 390 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		31,569 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**15.0" Round Culvert** L= 187.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 155.00' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	156.45'	**10.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.25 158.75 158.75 Width (feet) 3.00 3.00 0.00

Primary OutFlow Max=2.12 cfs @ 12.52 hrs HW=157.52' (Free Discharge)
└**1=Culvert** (Passes 2.12 cfs of 4.95 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 2.12 cfs @ 3.88 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond UGD-2: Underground Detention #2

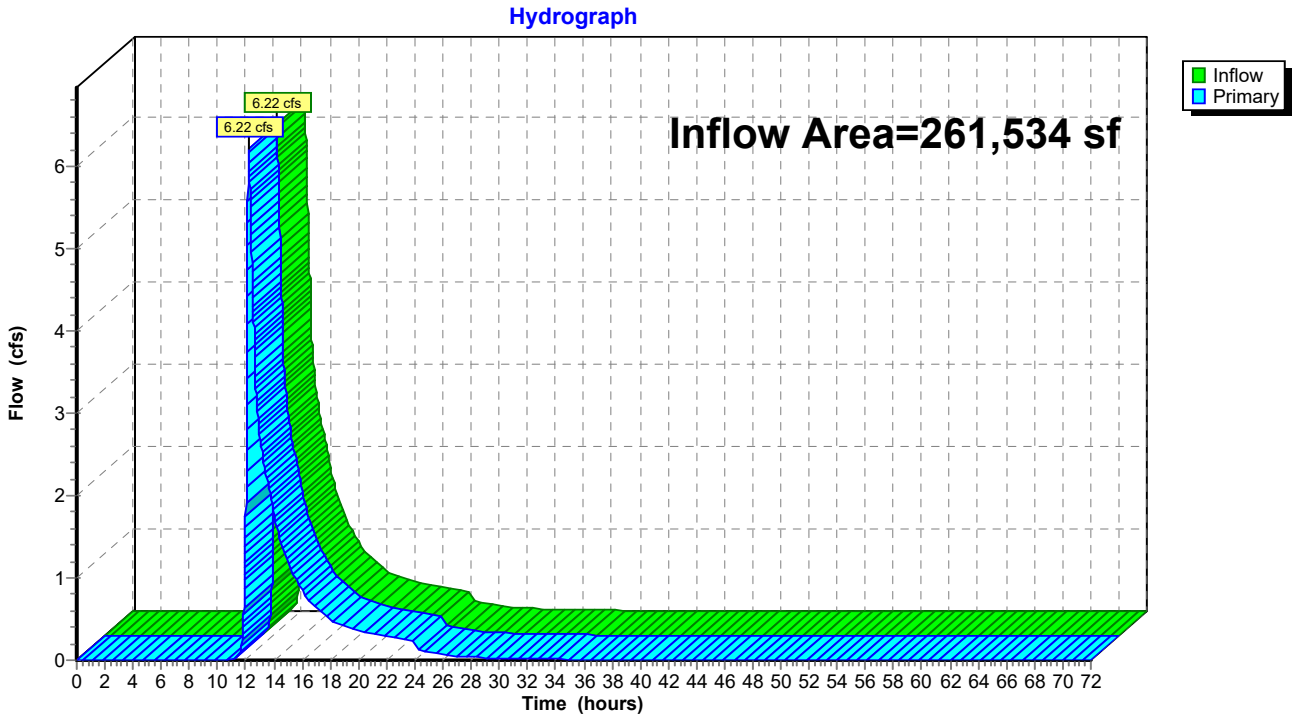


Summary for Link Post-Dev POI2: Post-Dev POI#2

Inflow Area = 261,534 sf, 38.07% Impervious, Inflow Depth > 2.13" for 10-Year event
Inflow = 6.22 cfs @ 12.20 hrs, Volume= 46,494 cf
Primary = 6.22 cfs @ 12.20 hrs, Volume= 46,494 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI2: Post-Dev POI#2



Summary for Subcatchment 12: Post-Dev Capture 2 (POI#2)

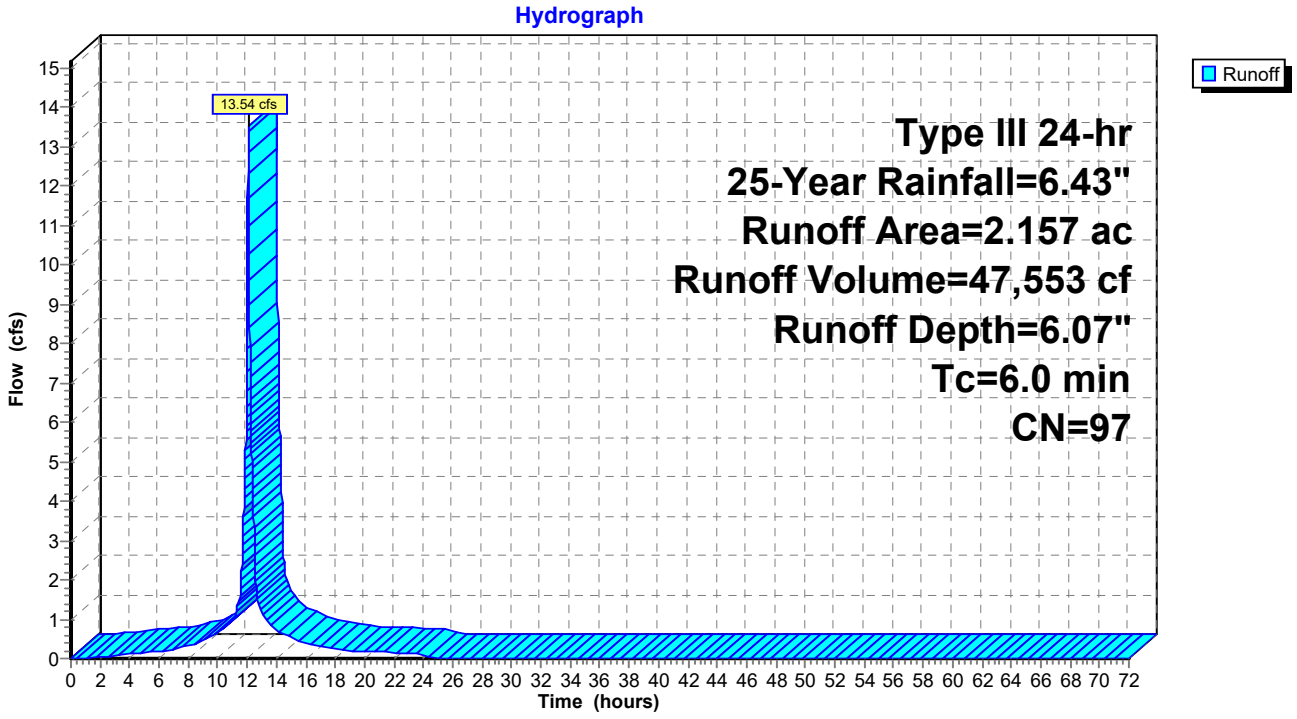
Runoff = 13.54 cfs @ 12.08 hrs, Volume= 47,553 cf, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (ac)	CN	Description
0.045	61	>75% Grass cover, Good, HSG B
2.112	98	Paved parking, HSG B
2.157	97	Weighted Average
0.045		2.09% Pervious Area
2.112		97.91% Impervious Area

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

Subcatchment 12: Post-Dev Capture 2 (POI#2)



Summary for Subcatchment 13: Post-Dev Bypass 2 (POI#2)

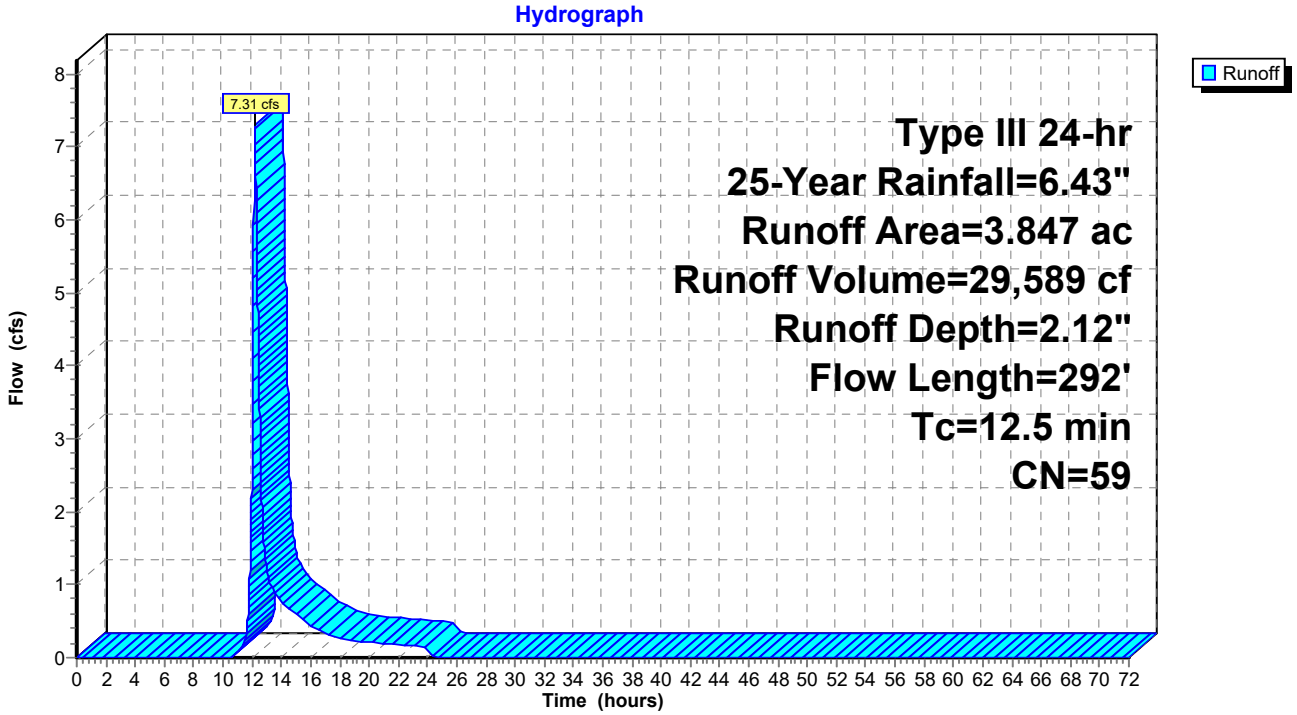
Runoff = 7.31 cfs @ 12.18 hrs, Volume= 29,589 cf, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.43"

Area (ac)	CN	Description
1.237	58	Meadow, non-grazed, HSG B
1.703	55	Woods, Good, HSG B
0.733	61	>75% Grass cover, Good, HSG B
0.174	98	Paved parking, HSG B
3.847	59	Weighted Average
3.673		95.48% Pervious Area
0.174		4.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	80	0.0363	0.21		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
6.2	212	0.0130	0.57		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.5	292	Total			

Subcatchment 13: Post-Dev Bypass 2 (POI#2)



Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 93,959 sf, 97.91% Impervious, Inflow Depth = 6.07" for 25-Year event
Inflow = 13.54 cfs @ 12.08 hrs, Volume= 47,553 cf
Outflow = 2.82 cfs @ 12.50 hrs, Volume= 36,456 cf, Atten= 79%, Lag= 24.9 min
Primary = 2.82 cfs @ 12.50 hrs, Volume= 36,456 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 158.02' @ 12.50 hrs Surf.Area= 15,554 sf Storage= 26,822 cf

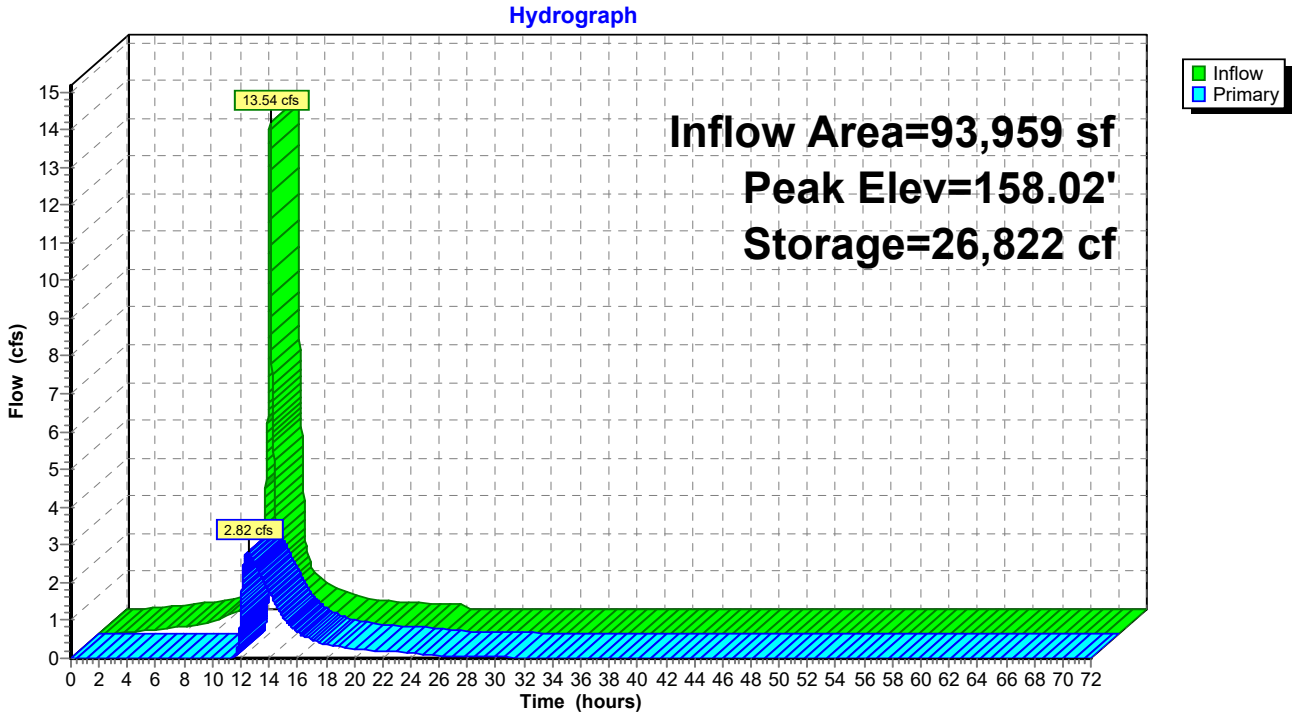
Plug-Flow detention time= 286.4 min calculated for 36,456 cf (77% of inflow)
Center-of-Mass det. time= 202.8 min (953.7 - 750.9)

Volume	Invert	Avail.Storage	Storage Description
#1	155.25'	13,653 cf	**49.00'W x 279.68'L x 3.50'H Prismatoid Z=1.0** 52,049 cf Overall - 17,917 cf Embedded = 34,132 cf x 40.0% Voids
#2	155.75'	17,917 cf	**ADS_StormTech SC-740 +Cap** x 390 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		31,569 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**15.0" Round Culvert** L= 187.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 155.00' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	156.45'	**10.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.25 158.75 158.75 Width (feet) 3.00 3.00 0.00

Primary OutFlow Max=2.82 cfs @ 12.50 hrs HW=158.02' (Free Discharge)
└**1=Culvert** (Passes 2.82 cfs of 5.41 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 2.82 cfs @ 5.16 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond UGD-2: Underground Detention #2

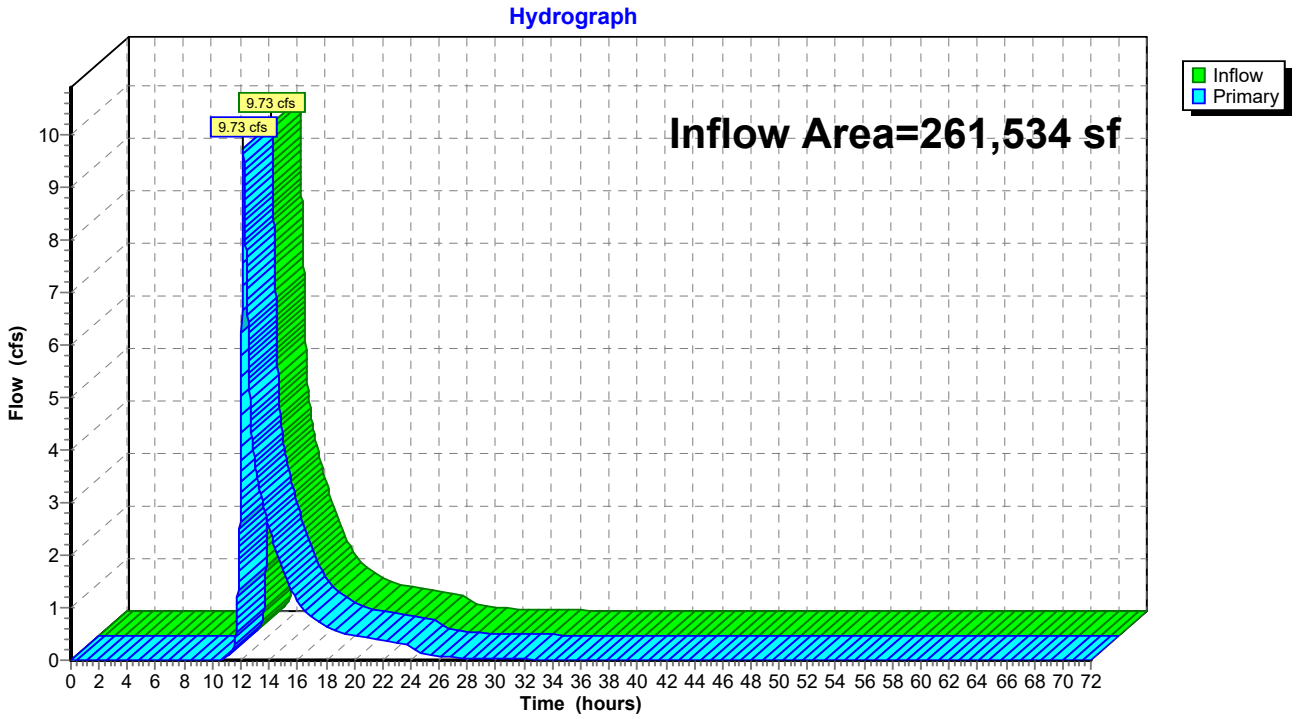


Summary for Link Post-Dev POI2: Post-Dev POI#2

Inflow Area = 261,534 sf, 38.07% Impervious, Inflow Depth > 3.03" for 25-Year event
Inflow = 9.73 cfs @ 12.19 hrs, Volume= 66,045 cf
Primary = 9.73 cfs @ 12.19 hrs, Volume= 66,045 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI2: Post-Dev POI#2



Summary for Subcatchment 12: Post-Dev Capture 2 (POI#2)

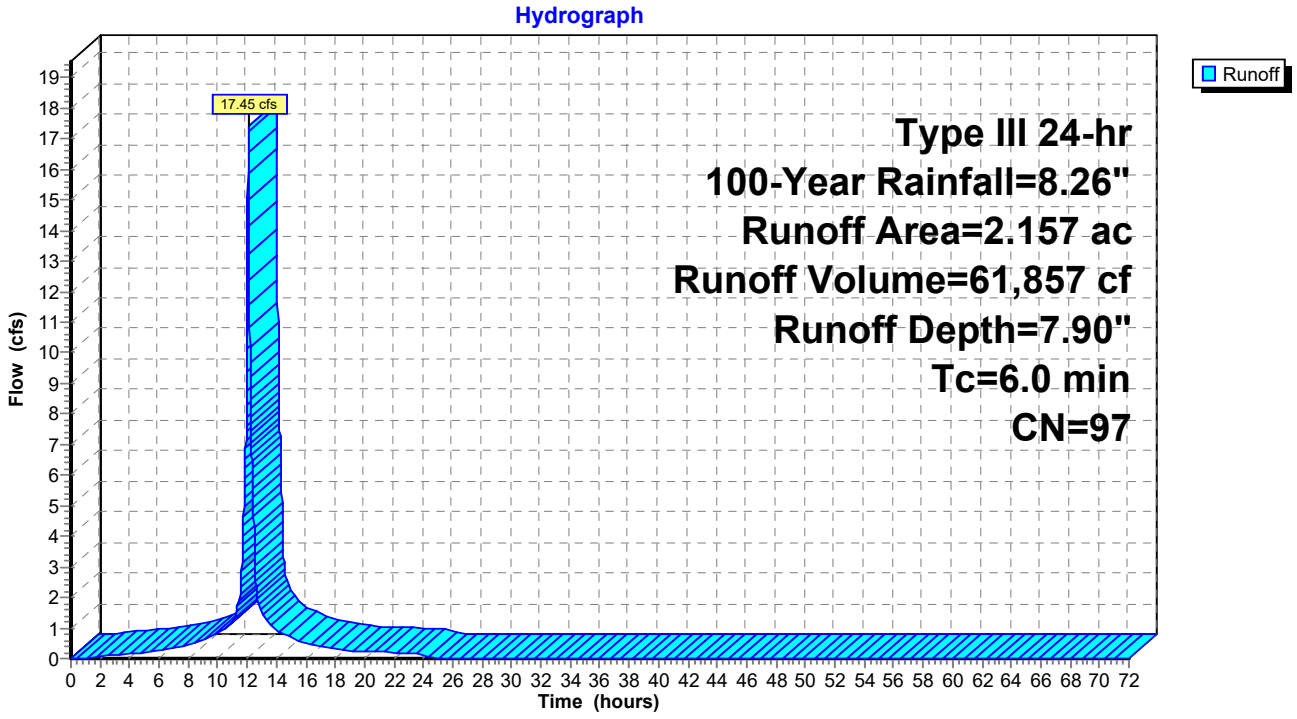
Runoff = 17.45 cfs @ 12.08 hrs, Volume= 61,857 cf, Depth= 7.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
0.045	61	>75% Grass cover, Good, HSG B
2.112	98	Paved parking, HSG B
2.157	97	Weighted Average
0.045		2.09% Pervious Area
2.112		97.91% Impervious Area

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

Subcatchment 12: Post-Dev Capture 2 (POI#2)



Summary for Subcatchment 13: Post-Dev Bypass 2 (POI#2)

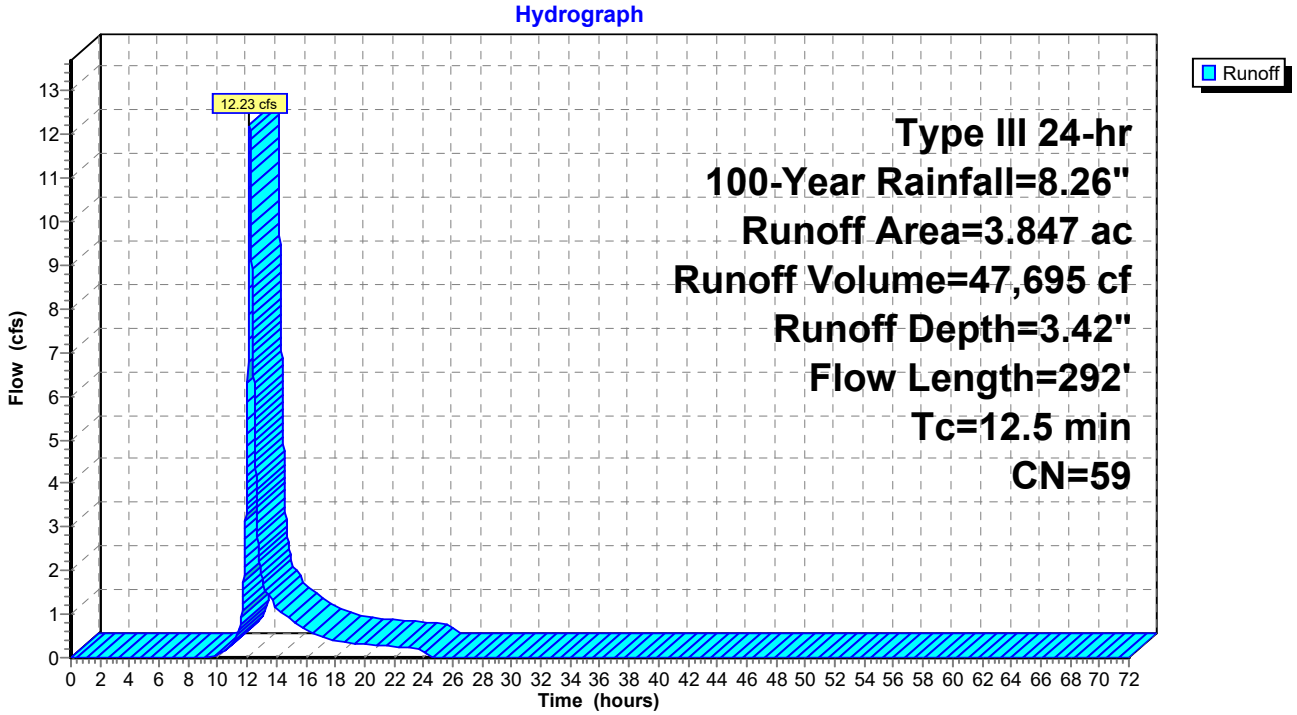
Runoff = 12.23 cfs @ 12.18 hrs, Volume= 47,695 cf, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
1.237	58	Meadow, non-grazed, HSG B
1.703	55	Woods, Good, HSG B
0.733	61	>75% Grass cover, Good, HSG B
0.174	98	Paved parking, HSG B
3.847	59	Weighted Average
3.673		95.48% Pervious Area
0.174		4.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	80	0.0363	0.21		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
6.2	212	0.0130	0.57		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.5	292	Total			

Subcatchment 13: Post-Dev Bypass 2 (POI#2)



Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 93,959 sf, 97.91% Impervious, Inflow Depth = 7.90" for 100-Year event
Inflow = 17.45 cfs @ 12.08 hrs, Volume= 61,857 cf
Outflow = 6.22 cfs @ 12.34 hrs, Volume= 50,759 cf, Atten= 64%, Lag= 15.2 min
Primary = 6.22 cfs @ 12.34 hrs, Volume= 50,759 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 158.67' @ 12.34 hrs Surf.Area= 16,000 sf Storage= 31,067 cf

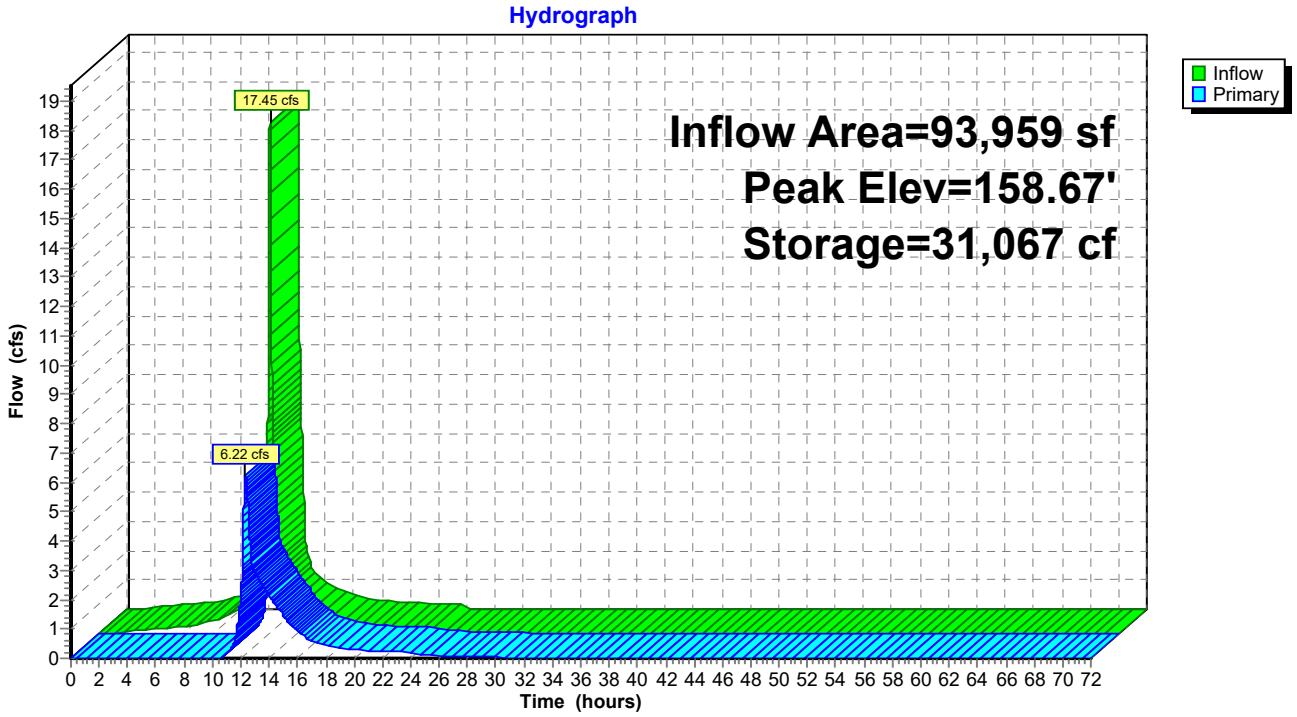
Plug-Flow detention time= 250.3 min calculated for 50,759 cf (82% of inflow)
Center-of-Mass det. time= 177.6 min (924.3 - 746.6)

Volume	Invert	Avail.Storage	Storage Description
#1	155.25'	13,653 cf	**49.00'W x 279.68'L x 3.50'H Prismatoid Z=1.0** 52,049 cf Overall - 17,917 cf Embedded = 34,132 cf x 40.0% Voids
#2	155.75'	17,917 cf	**ADS_StormTech SC-740 +Cap** x 390 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		31,569 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	156.00'	**15.0" Round Culvert** L= 187.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 156.00' / 155.00' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	156.45'	**10.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	158.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Elev. (feet) 158.25 158.75 158.75 Width (feet) 3.00 3.00 0.00

Primary OutFlow Max=6.22 cfs @ 12.34 hrs HW=158.67' (Free Discharge)
└**1=Culvert** (Passes 6.22 cfs of 6.33 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 3.53 cfs @ 6.47 fps)
  └**3=Custom Weir/Orifice** (Weir Controls 2.69 cfs @ 2.13 fps)

Pond UGD-2: Underground Detention #2

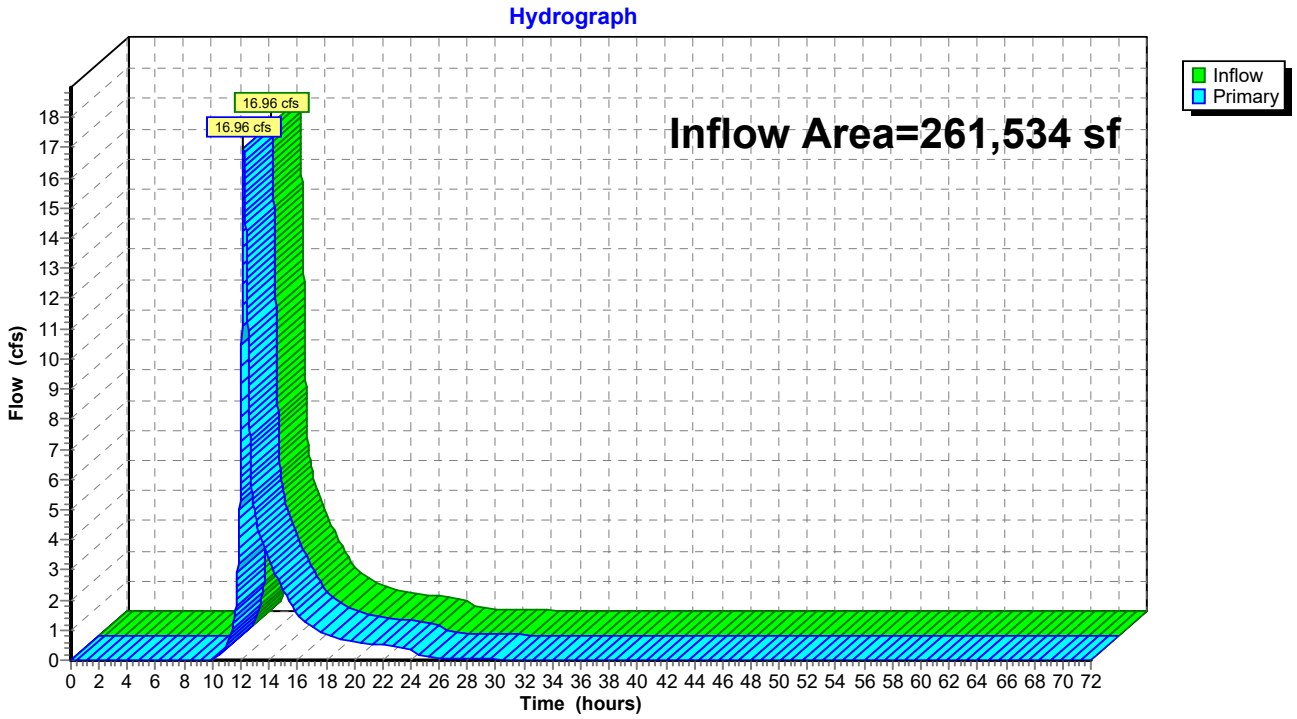


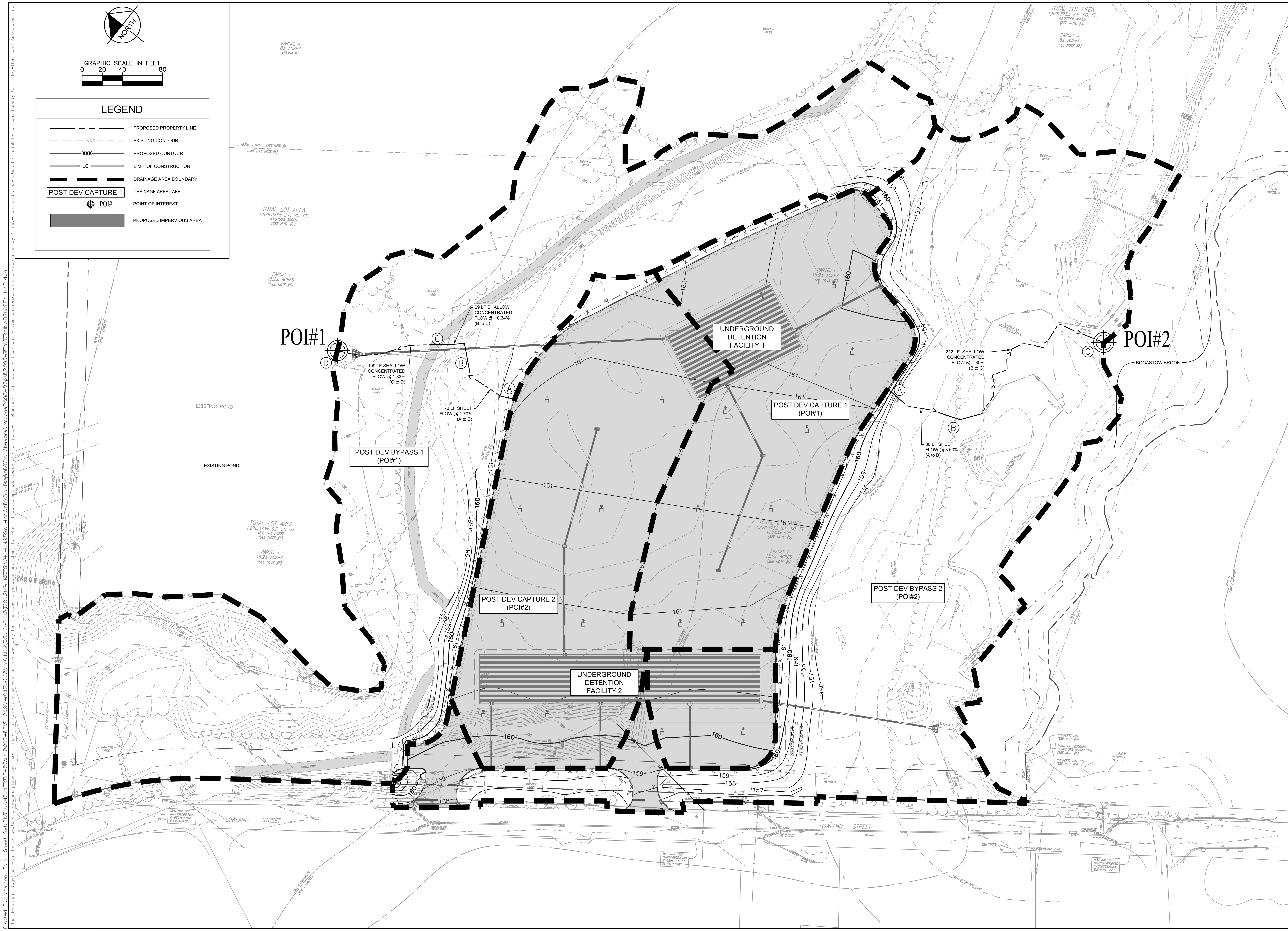
Summary for Link Post-Dev POI2: Post-Dev POI#2

Inflow Area = 261,534 sf, 38.07% Impervious, Inflow Depth = 4.52" for 100-Year event
Inflow = 16.96 cfs @ 12.21 hrs, Volume= 98,454 cf
Primary = 16.96 cfs @ 12.21 hrs, Volume= 98,454 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI2: Post-Dev POI#2




NORTH
GRAPHIC SCALE IN FEET
0 20 40 80
LEGEND
PROPOSED PROPERTY LINE
EXISTING CONTOUR
PROPOSED CONTOUR
LIMIT OF CONSTRUCTION
DRAINAGE AREA BOUNDARY
POST DEV CAPTURE 1
DRAINAGE AREA LABEL
POI#_
POINT OF INTEREST
PROPOSED IMPERVIOUS AREA
POI#1
POI#2
29 LF SHALLOW CONCENTRATED FLOW @ 10.34% (B to C)
109 LF SHALLOW CONCENTRATED FLOW @ 1.83% (C to D)
73 LF SHEET FLOW @ 1.70% (A to B)
212 LF SHALLOW CONCENTRATED FLOW @ 1.30% (B to C)
80 LF SHEET FLOW @ 3.63% (A to B)
BOGASTOW BROOK
UNDERGROUND DETENTION FACILITY 1
UNDERGROUND DETENTION FACILITY 2
POST DEV CAPTURE 1 (POI#1)
POST DEV CAPTURE 2 (POI#2)
POST DEV BYPASS 1 (POI#1)
POST DEV BYPASS 2 (POI#2)
EXISTING POND
EXISTING POND
TOTAL LOT AREA 1,876,373± S.F. SQ. FT. 43.0756± ACRES (SEE NOTE #5)
PARCEL I 15.2± ACRES (SEE NOTE #5)
PARCEL II 8± ACRES (SEE NOTE #5)
LOWLAND STREET
LOWLAND STREET

1 PER CMG 7/24/20 SWM PEER REVIEW 9/25/20 TGK

No.	REVISIONS	DATE	BY

Kimley»Horn

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1700 WILLOW LAWN DR, SUITE 200, RICHMOND, VA 23230
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WWW.KIMLEY-HORN.COM

LICENSED PROFESSIONAL

KHA PROJECT 113382001
DATE 04/27/2020
SCALE AS SHOWN
DESIGNED BY TGK
DRAWN BY TGK
CHECKED BY BJB

POST-DEVELOPMENT DRAINAGE AREA MAP

ADESA HOLLISTON

PREPARED FOR
ADESA, INC.

TOWN OF HOLLISTON MA

SHEET NUMBER
DA-2

APPENDIX D

Best Management Practices

Standard 3 - Required Dedicated Recharge Volume

The storage volume is the volume of the basin, chamber, or voids that must be constructed in order to hold the required recharge volume. The "static" method is used to determine the storage volume to make sure the most conservative measures are being used to size the stormwater facilities.

Required Dedicated Recharge Volume (*Rv) = F x impervious area where:*

Rv	= required recharge volume (cu.ft.)
F	= Target Depth Factor associated with each hydrologic soil group
Impervious Area	= pavement and rooftop area on site conveying to each stormwater management facility

Post Dev Capture 1

Required Dedicated Recharge Volume = 74,665 s.f.*0.60"/12 (Hydrologic Group A soils)

= **3,733 cu. ft.**

Provided Recharge Volume = **3,881 cu. ft.*** (Underground Detention Basin 1 at Elev. 156.30)

Post Dev Capture 2

Required Dedicated Recharge Volume = 99,593 s.f.*0.60"/12 (Hydrologic Group A/B soils)

= **4,980 cu. ft.**

Provided Recharge Volume = **5,136 cu. ft.*** (Underground Detention Basin 2 at Elev. 155.95)

*Provided Recharge Volume provided in stage-storage tables for each facility.

Standard 4 - Water Quality Detention Volumes

Required Water Quality Volume = 1.0” times the impervious area

Underground Detention Facility 1

Required = 1 in. x 1/12 x 74,665 s.f. = **6,222 cu. ft.**

Provided = 6,734 cu. ft.* @ Elevation 156.70

Underground Detention Facility 2

Required = 1 in. x 1/12 x 99,593 s.f. = **8,299 cu. ft.**

Provided = **10,955 cu. ft.*** @ Elevation 156.45

*Provided Recharge Volume provided in stage-storage tables for each facility.

Standard 3 - Drain Down Time

Draw down analysis is based on soil texture from the Soil Evaluation Technical Memo provided by Tetra Tech dated September 17, 2020.

Underground Detention Facility 1 is located in Hydrologic Group A soils. An infiltration rate of 2.41 in/hr is used.

Underground Detention Facility 2 is located in Hydrologic Group A/B soils. An infiltration rate of 1.02 in/hr is used.

Underground Detention Facility 1

Bottom Contact Area = 8,433 s.f.

Recharge Rate = 8,433 s.f. * 2.41 in/hr *1/12 = 1,693 cu.ft/hr

Drain Time for recharge volume = 6,734 cu.ft/ 1,693 cu.ft/hr = **3.98 hours**

Underground Detention Facility 2

Bottom Contact Area = 13,704 s.f.

Recharge Rate = 13,704 s.f. * 1.02 in/hr *1/12 = 1,165 cu.ft/hr

Drain Time for recharge volume = 10,955 cu.ft/ 1,165 cu.ft/hr = **9.40 hours**

Stage-Area-Storage for Pond UGD-1: Underground Detention #1

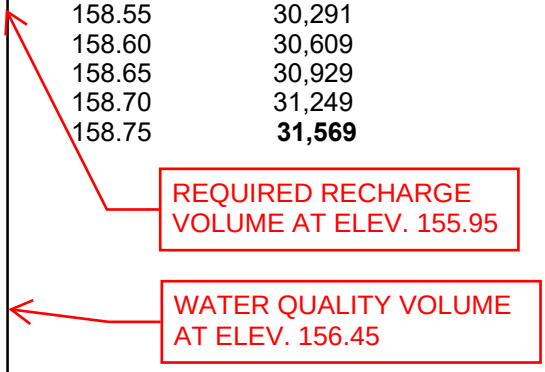
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
155.50	8,433	0
155.55	8,452	169
155.60	8,471	338
155.65	8,490	508
155.70	8,509	678
155.75	8,528	848
155.80	8,547	1,019
155.85	8,566	1,190
155.90	8,585	1,361
155.95	8,604	1,533
156.00	8,623	1,706
156.05	8,642	2,069
156.10	8,661	2,432
156.15	8,680	2,795
156.20	8,699	3,158
156.25	8,718	3,520
156.30	8,738	3,881
156.35	8,757	4,242
156.40	8,776	4,601
156.45	8,795	4,960
156.50	8,815	5,317
156.55	8,834	5,673
156.60	8,853	6,028
156.65	8,872	6,382
156.70	8,892	6,734
156.75	8,911	7,085
156.80	8,930	7,435
156.85	8,950	7,782
156.90	8,969	8,129
156.95	8,989	8,474
157.00	9,008	8,817
157.05	9,028	9,158
157.10	9,047	9,497
157.15	9,067	9,834
157.20	9,086	10,169
157.25	9,106	10,501
157.30	9,125	10,831
157.35	9,145	11,159
157.40	9,165	11,484
157.45	9,184	11,806
157.50	9,204	12,126
157.55	9,224	12,442
157.60	9,243	12,756
157.65	9,263	13,066
157.70	9,283	13,372
157.75	9,302	13,673
157.80	9,322	13,971
157.85	9,342	14,264
157.90	9,362	14,553
157.95	9,382	14,836
158.00	9,402	15,115
158.05	9,421	15,387
158.10	9,441	15,653
158.15	9,461	15,910
158.20	9,481	16,158
158.25	9,501	16,393
158.30	9,521	16,616
158.35	9,541	16,828
158.40	9,561	17,034
158.45	9,581	17,234
158.50	9,601	17,429
158.55	9,621	17,621
158.60	9,641	17,814
158.65	9,661	18,007
158.70	9,682	18,200
158.75	9,702	18,394
158.80	9,722	18,588
158.85	9,742	18,783
158.90	9,762	18,978
158.95	9,783	19,173
159.00	**9,803**	**19,369**

REQUIRED RECHARGE VOLUME AT ELEV. 156.30

WATER QUALITY VOLUME AT ELEV. 156.70

Stage-Area-Storage for Pond UGD-2: Underground Detention #2

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
155.25	0	157.85	25,490
155.30	274	157.90	25,911
155.35	549	157.95	26,315
155.40	825	158.00	26,699
155.45	1,102	158.05	27,064
155.50	1,379	158.10	27,411
155.55	1,656	158.15	27,747
155.60	1,935	158.20	28,074
155.65	2,214	158.25	28,393
155.70	2,493	158.30	28,707
155.75	2,774	158.35	29,023
155.80	3,365	158.40	29,339
155.85	3,956	158.45	29,655
155.90	4,546	158.50	29,973
155.95	5,136	158.55	30,291
156.00	5,725	158.60	30,609
156.05	6,313	158.65	30,929
156.10	6,899	158.70	31,249
156.15	7,484	158.75	**31,569**
156.20	8,067		
156.25	8,649		
156.30	9,229		
156.35	9,806		
156.40	10,382		
156.45	10,955		
156.50	11,527		
156.55	12,096		
156.60	12,662		
156.65	13,226		
156.70	13,787		
156.75	14,346		
156.80	14,902		
156.85	15,454		
156.90	16,003		
156.95	16,548		
157.00	17,090		
157.05	17,628		
157.10	18,162		
157.15	18,691		
157.20	19,217		
157.25	19,737		
157.30	20,254		
157.35	20,765		
157.40	21,270		
157.45	21,769		
157.50	22,261		
157.55	22,745		
157.60	23,224		
157.65	23,694		
157.70	24,158		
157.75	24,612		
157.80	25,057		



DETENTION BASIN #1
MOUNDING ANALYSIS

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
1.0200	*R*	**Recharge (infiltration) rate (feet/day)**
0.250	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
10.20	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
63.000	x	**1/2 length of basin (x direction, in feet)**
36.000	y	**1/2 width of basin (y direction, in feet)**
0.600	t	**duration of infiltration period (days)**
10.000	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

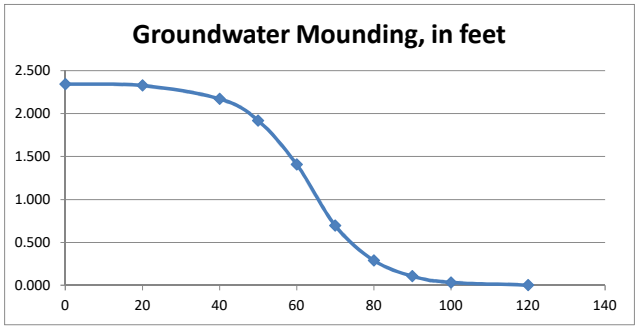
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

12.344	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
2.344	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
2.344	0
2.327	20
2.172	40
1.919	50
1.408	60
0.695	70
0.291	80
0.106	90
0.034	100
0.003	120

Re-Calculate Now



BOTTOM OF DETENTION BASIN STONE
EL = 155.50

ESHGW = 153.0

MOUNDING EL = 153.0+2.34 = 155.34

CLEARANCE = 0.16'

Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

DETENTION BASIN #2
MOUNDING ANALYSIS

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
1.0200	*R*	**Recharge (infiltration) rate (feet/day)**
0.250	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
10.20	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
145.000	x	**1/2 length of basin (x direction, in feet)**
24.000	y	**1/2 width of basin (y direction, in feet)**
0.590	t	**duration of infiltration period (days)**
10.000	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

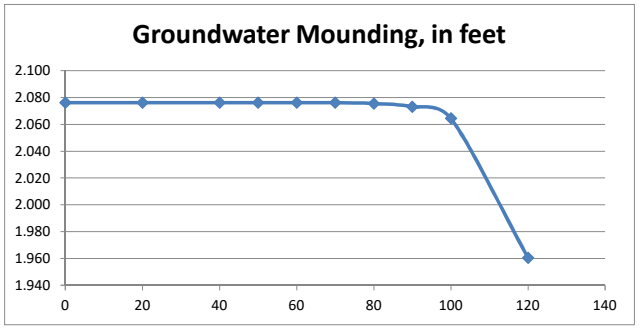
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

12.076	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
2.076	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
2.076	0
2.076	20
2.076	40
2.076	50
2.076	60
2.076	70
2.076	80
2.073	90
2.064	100
1.961	120

Re-Calculate Now



BOTTOM OF DETENTION BASIN STONE
EL = 155.25

ESHGW = 153.0

MOUNDING EL = 153.0+2.08 = 155.08

CLEARANCE = 0.17'

Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: 194 Lowland Street (Underground Detention Facility 1)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping - 5%	0.05	**1.00**	0.05	0.05
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Barracuda Separator	0.50	0.71	0.36	0.35
Subsurface Infiltration Structure	0.80	0.35	0.28	0.07

Total TSS Removal = 93%

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

Project: ADESA HOLLISTON

Prepared By: TGK

Date: 10/06/2020

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: 194 Lowland Street (Underground Detention Facility 2)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping - 5%	0.05	**1.00**	0.05	0.05
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Barracuda Separator	0.50	0.71	0.36	0.35
Subsurface Infiltration Structure	0.80	0.35	0.28	0.07

Total TSS Removal = 93%

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

Project: ADESA HOLLISTON

Prepared By: TGK

Date: 10/06/2020

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

TSS Calculations – Barracuda Water Quality Inlet

To achieve 44% TSS removal before stormwater conveys into the infiltration systems on site, additional pretreatment must be utilized. Barracuda Water Quality Inlets will be installed in each manhole that conveys to an underground detention facility to ensure pretreatment is acceptable.

Barracuda Specifications

Barracuda Model	Manhole Diameter (FT)	OK-110 (80% Removal) (CFS)	Pretretment for Infiltration (50% Removal of OK-110)
S3	3	0.61	1.2
S4	4	1.08	2.13
S6	6	2.43	4.8
S8	8	4.32	8.54

Manholes on site that will utilize Barracuda Water Quality Inlets

Manhole Structure Name	2-Yr Conveyance Flow (CFS)	Pretreatment Goal	Allowable Barracuda Model
A0	1.12	50%	S4
B0	1.17	50%	S4
C0	1.61	50%	S4
D0	6.38	50%	S6
E0	4.53	50%	S4
F0	3.78	50%	S4
J1	0.24	80%	S4
K1	0.1	80%	S4

The Barracuda Models chosen for manholes A0 – F0 above will successfully remove 44% TSS before discharge to infiltration facilities.

Manholes J1 and K1 will not be conveying to an infiltration BMP, so 80% TSS removal is required to achieve the necessary standards before discharging. The appropriate Barracuda Models were chosen above to achieve this removal rate.

BAYSAVER TECHNOLOGIES®

ADS®

Barracuda

The Barracuda is a market-changing stormwater quality technology. This high performance vortex hydrodynamic separator is designed to remove total suspended solids in order to protect our precious receiving waters. The Barracuda is also an outstanding value that offers multiple pipe configurations, and quick installation.

Variable inlet/outlet angle configurations

FEATURES:

- Single manhole design
- No elevation loss between the inlet and outlet
- Variable inlet/outlet angle configurations (not just 180 degree orientation)
- Internal bypass for inline installation (where applicable)
- Revolutionary, patent pending “teeth” mitigate turbulence in the sump area to prevent resuspension of captured contaminants
- Available with grated drop inlet configuration
- Available with trash and/or oil capture add-ons

BENEFITS:

- Internal components are in stock for quick delivery
- The S3, S4, S6, and S8 can be installed in a standard 36” (900 m), 48” (1200 mm), 72” (1800 mm), and 96” (2400 mm) precast manhole, respectively
- The S3 and S4 can be provided factory installed within a 36” (0.91 m) and 48” (1.22 m) ADS HP manhole and delivered to the jobsite
- The Barracuda “teeth” apparatus is fabricated and designed for quick and easy field assembly
- Designed for easy maintenance using a vacuum truck or similar equipment.
- Inspection and maintenance are performed from the surface with no confined space entry

ADS Service: ADS representatives are committed to providing you with the answers to all your questions, including specifications, installation and more.

BARRACUDA SPECIFICATION

MATERIALS AND DESIGN

- Concrete Structures: Designed for H-20 traffic loading and applicable soil loads or as otherwise determined by a Licensed Professional Engineer. The materials and structural design of the devices shall be per ASTM C857 and ASTM C858.
- The 36" and 48" HP Manhole Structures: Made from an impact modified copolymer polypropylene meeting the material requirements of ASTM F2764. The eccentric cone reducer shall be manufactured from polyethylene material meeting ASTM D3350 cell class 213320C. Gaskets shall be made of material meeting the requirements of ASTM F477.
- Separator internals shall be substantially constructed of stainless steel, polyethylene or other thermoplastic material approved by the manufacturer.

PERFORMANCE

- The stormwater treatment unit shall be an inline unit capable of conveying 100% of the design peak flow. If peak flow rates exceed maximum hydraulic rate, the unit shall be installed offline.

- The Barracuda unit shall be designed to remove at least 80% of the suspended solids on an annual aggregate removal basis. Said removal shall be based on full-scale third party testing using OK-110 media gradation or equivalent and 300 mg/L influent concentration. Said full scale testing shall have included sediment capture based on actual total mass collected by the stormwater treatment unit.

- OR -

The Barracuda unit shall be designed to remove at least 50% of TSS using a media mix with d_{50}=75 micron and 200 mg/L influent concentration.

- OR -

The Barracuda unit shall be designed to remove at least 50% of TSS per current NJDEP/NJCAT HDS protocol.

- The stormwater treatment unit internals shall consist of (1) separator cone assembly, and (1) sump assembly which includes (4) legs with "teeth".

Barracuda Model	Manhole Diameter	OK-110 (80% removal)	Pretreatment for infiltration[1]
S3	3 ft (0.91 m)	0.61 CFS	1.20 CFS
S4	4 ft (1.83 m)	1.08 CFS	2.13 CFS
S6	6 ft (1.83 m)	2.43 CFS	4.80 CFS
S8	8 ft (2.44 m)	4.32 CFS	8.54 CFS

* Peak bypass flows are dependent on final design.
[1] 50% removal of OK-110.

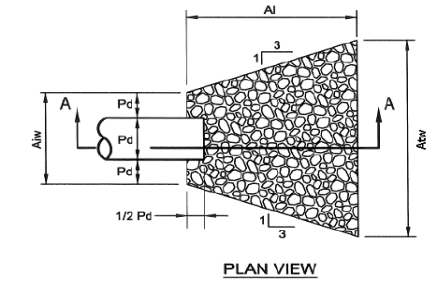
INSTALLATION

Installation of the stormwater treatment unit(s) shall be performed per manufacturer's installation instructions. Such instructions can be obtained by calling Advanced Drainage Systems at (800) 821-6710 or by logging on to www.ads-pipe.com or www.baysaver.com.

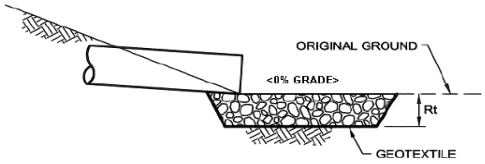
Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

Standard E&S Worksheet # 20
Riprap Apron Outlet Protection

Project Name:	ADESA Holliston		
Location:	Town of Holliston, Middlesex County, MA		
Prepared By	TGK	Date:	5/12/2020
Checked By:	-	Date:	-



PLAN VIEW



SECTION A - A

Riprap Apron No.	Outlet	Diameter Pd (in)	Tail Water Cond. (Max or Min)	Man. "n" for Pipe	Pipe Slope (Ft/Ft)	Q (CFS)	V* (FPS)	RIPRAP SIZE	Rt (in)	Al (ft)	Aiw (ft)	Atw (ft)
1	G0	15	Min	0.013	0.0051	1.83	1.04	R-3	9.00	6	3.75	9.75
2	H0	18	Min	0.013	0.0053	1.24	0.70	R-3	9.00	7	4.50	11.50

E&S WORKSHEET
COMPOST SOCK SEDIMENT TRAP DESIGN DATA

PROJECT NAME: ***ADESA Holliston***
LOCATION: ***Town of Holliston, Middlesex County, MA***
PREPARED BY: ***Town of Holliston, Middlesex County, MA*** DATE: ***5/7/2020***
CHECKED BY: ***TGK*** DATE:

TRAP NUMBER	***1***			
DRAINAGE AREA (5 ACRES MAX) (AC)	**1.85**			
REQUIRED CAPACITY (2000 CF/AC) (CF)	**3,699**			
CAPACITY PROVIDED AT ELEVATION h (CF)	**7,462**			
SOIL TYPES IN DRAINAGE AREA	**655**			
REQUIRED SURFACE AREA (5,300xAC)[1] (SQ.FT.)	**9,804**			
* AVERAGE BOTTOM LENGTH (FT)	**47.00**			
* AVERAGE BOTTOM WIDTH (FT)	**26.00**			
* AVERAGE TRAP LENGTH AT ELEVATION h (FT)	**123.00**			
* AVERAGE TRAP WIDTH AT ELEVATION h (FT)	**76.00**			
SURFACE AREA AT ELEVATION h (SF)	**7,549**			
BOTTOM ELEVATION	**155.00**			
CLEAN-OUT ELEVATION (@ 700 CF/AC)[2] (FT)	**156.00**			
1.5 CFS/AC. DISCHARGE ELEVATION (FT)	**157.00**			
TOP OF EMBANKMENT ELEVATION[3] (FT)	**157.00**			
EMBANKMENT HEIGHT (FT)	**2.00**			
CREST OF SPILLWAY ELEVATION[4] (FT)	**n/a**			
FLOW LENGTH AT ELEVATION h (FT)	**n/a**			
FLOW LENGTH / WIDTH RATIO AT ELEV. h[5] (2:1 MIN)	**n/a**			

1 If sandy clays, silty clays, silty clay loams, clay loams, or clay perdominate soil types.

2 Minimum 12" above bottom of trap.

3 Minimum 12" above elevation at which 1.5 cfs/acre discharge capacity is provided.

4 Minimum 24" above bottom of trap.

5 4:1 Flow Length:Width ratio required for HQ and EV watersheds

EMBANKMENT SPILLWAYS

OUTLET WIDTH (2x # ACRES MIN.)[1] (FT)	**n/a**			
SPILLWAY HEIGHT h (FT)	**n/a**			
OUTLET SIDE SLOPES (2H:1V MAX.)	**n/a**			
SPILLWAY OUTSIDE SLOPE Z1 (2 MIN.)	**n/a**			
SPILLWAY INSIDE SLOPE Z2 (2 MIN.)	**n/a**			

1 6 x # Acres Min. if not discharging directly to a waterway

RISER PIPE SPILLWAYS

D_r (RISER PERIMETER) (FT)	**n/a**			
D_b (BARREL DIAMETER, 6" MIN) (IN)	**n/a**			
SPILLWAY CAPACITY WITH 12" FREEBOARD (CFS)	**n/a**			
BARREL OUTLET ELEVATION (FT)	**n/a**			
MAX WATER SURFACE ELEVATION (@1.5 CFS/AC DISCHARGE) (FT)	**n/a**			

OUTLET BASIN

LENGTH (6Db) (FT)	**n/a**			
WIDTH (3 D_b) (FT)	**n/a**			
DEPTH (D_b) (FT)	**n/a**			
RIP-RAP PROTECTION (R-Size, R-3 min.)	**n/a**			

E&S WORKSHEET

Sediment Basin Storage Data

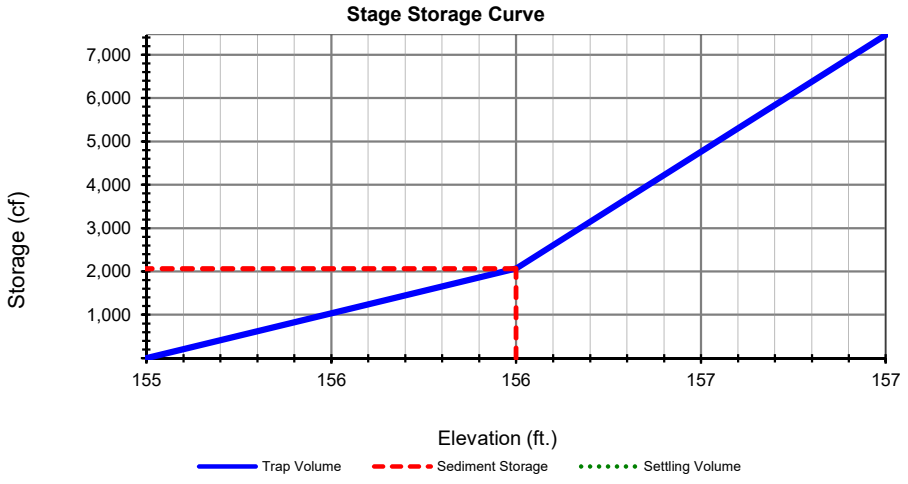
Project Name: ADESA Holliston

Location: Town of Holliston, Middlesex County, MA

Prepared By: Town of Holliston, Middlesex County, MA Date: 5/7/2020

Checked By: Date:

Water Surface Elevation (ft)	Area (s.f.)	Average Area (s.f.)	Difference in Elevation (ft)	Storage Volume (cuft)	
				Incremental	Total
155.00	885				
		2,065	1.00	2,065	
156.00	3,245				2,065
		5,397	1.00	5,397	
157.00	7,549				7,462



Cleanout Elevation		156.00	
	Required	Provided	
Depth to bottom	1.00	1.00	ft
Volume at elevation	1,295	2,065	cuft *(required = 700 cuft/acre)*

1.5 cfs/acre Elevation (ELEV. h)		157.00	
	Required	Provided	
Depth to cleanout	1.00	1.00	ft
Volume at elevation	3,699	7,462	cuft *(required = 1,300 cuft/acre)*

APPENDIX E

Pipe Sizing Calculations

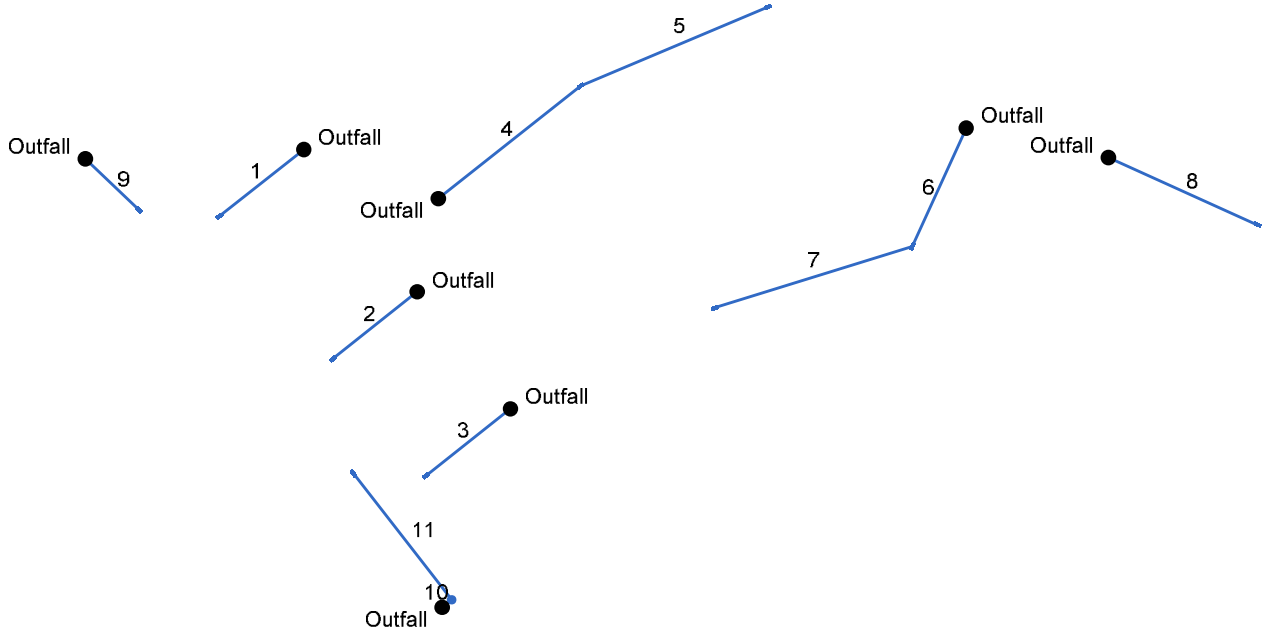
COMPUTATION SHEET : COMPOSITE RATIONAL RUNOFF COEFFICIENT (C)

PROJECT: ***ADESA Hollison***
194 Lowland Street
Town of Holliston, MA

DATE: ***10/6/2020***
BY: ***TGK***
CHECKED BY: ***BJB***
REVISION: ***1***

Inlet Drainage Area ID	Impervious (Acres) 0.90	Pervious (Acres) 0.35	Total Area (Acres)	Composite Runoff Coefficient	Time of Concentration (min)
A1	0.226		0.226	**0.90**	6.00
B1	0.235		0.235	**0.90**	6.00
C1	0.327		0.327	**0.90**	6.00
D1	0.589		0.589	**0.90**	6.00
D2	0.731	0.045	0.776	**0.87**	6.00
E1	0.488		0.488	**0.90**	6.00
E2	0.476		0.476	**0.90**	6.00
F1	0.754	0.042	0.796	**0.87**	6.00
J1	0.054		0.054	**0.90**	6.00
K2	0.020		0.020	**0.90**	6.00

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 113382001 - Rev-1.stm	Number of lines: 11	Date: 10/5/2020

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	64.000	141.542	Comb	0.00	0.23	0.90	6.0	155.88	0.50	156.20	15	Cir	0.013	1.00	159.00	A1-A0
2	End	64.000	141.542	Comb	0.00	0.24	0.90	6.0	155.88	0.50	156.20	15	Cir	0.013	1.00	159.00	B1-B0
3	End	64.000	141.542	Comb	0.00	0.33	0.90	6.0	155.88	0.50	156.20	15	Cir	0.013	1.00	159.04	C1-C0
4	End	108.000	-38.458	DrGrt	0.00	0.59	0.90	6.0	155.88	1.16	157.13	18	Cir	0.013	0.50	160.20	D1-D0
5	4	120.766	15.575	DrGrt	0.00	0.78	0.87	6.0	157.13	0.53	157.77	15	Cir	0.013	1.00	160.11	D2-D1
6	End	77.434	114.433	DrGrt	0.00	0.49	0.90	6.0	156.13	0.50	156.52	18	Cir	0.013	1.18	160.21	E1-E0
7	6	122.722	48.202	DrGrt	0.00	0.48	0.90	6.0	156.52	0.50	157.13	15	Cir	0.013	1.00	160.25	E2-E1
8	End	97.162	24.433	Comb	0.00	0.80	0.87	6.0	156.13	0.50	156.62	18	Cir	0.013	1.00	159.55	F1-F0
9	End	44.087	43.725	Grate	0.00	0.05	0.90	6.0	154.30	0.50	154.52	12	Cir	0.013	1.00	157.91	J1-J0
10	End	7.221	-38.783	MH	0.00	0.00	0.00	6.0	151.90	0.55	151.94	12	Cir	0.013	1.00	156.00	K1-K0
11	10	95.372	-89.070	Grate	0.00	0.02	0.90	6.0	151.94	0.49	152.41	12	Cir	0.013	1.00	157.42	K2-K1

Project File: 113382001 - Rev-1.stm | Number of lines: 11 | Date: 10/5/2020

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	A1-A0	1.44	15	Cir	64.000	155.88	156.20	0.500	157.34	157.37	0.02	157.39	End	Combination
2	B1-B0	1.50	15	Cir	64.000	155.88	156.20	0.500	157.34	157.37	0.02	157.40	End	Combination
3	C1-C0	2.07	15	Cir	64.000	155.88	156.20	0.500	157.34	157.40	0.05	157.45	End	Combination
4	D1-D0	8.25	18	Cir	108.000	155.88	157.13	1.157	157.34	158.24	n/a	158.24 j	End	DropGrate
5	D2-D1	4.72	15	Cir	120.766	157.13	157.77	0.530	158.24	158.81	0.29	159.10	4	DropGrate
6	E1-E0	5.89	18	Cir	77.434	156.13	156.52	0.504	157.48	157.66	0.30	157.97	End	DropGrate
7	E2-E1	3.01	15	Cir	122.722	156.52	157.13	0.497	157.97	158.21	0.11	158.32	6	DropGrate
8	F1-F0	4.84	18	Cir	97.162	156.13	156.62	0.504	157.48	157.64	0.22	157.86	End	Combination
9	J1-J0	0.31	12	Cir	44.087	154.30	154.52	0.499	154.53	154.77	0.07	154.83	End	Grate
10	K1-K0	0.09	12	Cir	7.221	151.90	151.94	0.554	152.03	152.06	0.04	152.11	End	Manhole
11	K2-K1	0.13	12	Cir	95.372	151.94	152.41	0.493	152.11	152.56	0.05	152.60	10	Grate

Project File: 113382001 - Rev-1.stm | Number of lines: 11 | Run Date: 10/5/2020

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	64.000	0.23	0.23	0.90	0.21	0.21	6.0	6.0	7.0	1.44	4.57	1.19	15	0.50	155.88	156.20	157.34	157.37	160.76	159.00	A1-A0
2	End	64.000	0.24	0.24	0.90	0.22	0.22	6.0	6.0	7.0	1.50	4.57	1.24	15	0.50	155.88	156.20	157.34	157.37	160.76	159.00	B1-B0
3	End	64.000	0.33	0.33	0.90	0.30	0.30	6.0	6.0	7.0	2.07	4.57	1.70	15	0.50	155.88	156.20	157.34	157.40	160.88	159.04	C1-C0
4	End	108.000	0.59	1.37	0.90	0.53	1.21	6.0	6.5	6.8	8.25	11.30	5.29	18	1.16	155.88	157.13	157.34	158.24	161.58	160.20	D1-D0
5	4	120.766	0.78	0.78	0.87	0.68	0.68	6.0	6.0	7.0	4.72	4.70	4.21	15	0.53	157.13	157.77	158.24	158.81	160.20	160.11	D2-D1
6	End	77.434	0.49	0.97	0.90	0.44	0.87	6.0	6.8	6.7	5.89	7.45	3.79	18	0.50	156.13	156.52	157.48	157.66	161.00	160.21	E1-E0
7	6	122.722	0.48	0.48	0.90	0.43	0.43	6.0	6.0	7.0	3.01	4.55	2.56	15	0.50	156.52	157.13	157.97	158.21	160.21	160.25	E2-E1
8	End	97.162	0.80	0.80	0.87	0.70	0.70	6.0	6.0	7.0	4.84	7.46	3.35	18	0.50	156.13	156.62	157.48	157.64	160.56	159.55	F1-F0
9	End	44.087	0.05	0.05	0.90	0.05	0.05	6.0	6.0	7.0	0.31	2.52	2.18	12	0.50	154.30	154.52	154.53	154.77	157.67	157.91	J1-J0
10	End	7.221	0.00	0.02	0.00	0.00	0.02	6.0	16.0	5.1	0.09	2.65	1.57	12	0.55	151.90	151.94	152.03	152.06	155.89	156.00	K1-K0
11	10	95.372	0.02	0.02	0.90	0.02	0.02	6.0	6.0	7.0	0.13	2.50	1.62	12	0.49	151.94	152.41	152.11	152.56	156.00	157.42	K2-K1

Project File: 113382001 - Rev-1.stm | Number of lines: 11 | Run Date: 10/5/2020

NOTES:Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Drainage Area ID	Impervious (Acres) 0.90	Pervious (Acres) 0.35	Total Area (Acres)	Composite Runoff Coefficient	Time of Concentration (min)
A1	0.226		0.226	**0.90**	6.00
B1	0.235		0.235	**0.90**	6.00
C1	0.327		0.327	**0.90**	6.00
D1	0.589		0.589	**0.90**	6.00
D2	0.731	0.045	0.776	**0.87**	6.00
E1	0.488		0.488	**0.90**	6.00
E2	0.476		0.476	**0.90**	6.00
F1	0.754	0.042	0.796	**0.87**	6.00
J1	0.054		0.054	**0.90**	6.00
K2	0.020		0.020	**0.90**	6.00

No.	REVISIONS	DATE	BY
1	PER CMG 7/24/20 SWM PEER REVIEW	9/25/20	TGK

Kimley»Horn

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1700 WILLOW LAWN DR, SUITE 200, RICHMOND, VA 23230
PHONE: 804-673-3882
WWW.KIMLEY-HORN.COM

LICENSED PROFESSIONAL

KHA PROJECT 113382001
DATE 04/27/2020
SCALE AS SHOWN
DESIGNED BY TGK
DRAWN BY TGK
CHECKED BY BJB

POST-DEVELOPMENT INLET AREA MAP

ADESA HOLLISTON
PREPARED FOR
ADESA, INC.
TOWN OF HOLLISTON MA

SHEET NUMBER
DA-3

APPENDIX F

Illicit Discharge Statement

Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

OWNER NAME: ADESA, Inc

ADDRESS: 11299 N. Illinois Street

Carmel, IN 46032

TEL. NUMBER: 317-617-2295

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.

10-06-20

Brian Brewer, P.E.
Kimley-Horn and Associates, Inc.

Date:

APPENDIX G

Reference Documents

NOAA Atlas 14, Volume 10, Version 3
Location name: Holliston, Massachusetts, USA*
Latitude: 42.2083°, Longitude: -71.4097°
Elevation: 156.12 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.328 (0.255-0.420)	0.397 (0.308-0.507)	0.508 (0.393-0.653)	0.600 (0.462-0.776)	0.727 (0.542-0.983)	0.823 (0.601-1.14)	0.923 (0.655-1.33)	1.03 (0.697-1.53)	1.20 (0.775-1.83)	1.33 (0.841-2.07)
10-min	0.465 (0.362-0.594)	0.562 (0.436-0.718)	0.720 (0.558-0.924)	0.850 (0.654-1.10)	1.03 (0.768-1.39)	1.17 (0.852-1.61)	1.31 (0.928-1.88)	1.47 (0.987-2.16)	1.70 (1.10-2.59)	1.88 (1.19-2.94)
15-min	0.547 (0.425-0.699)	0.661 (0.513-0.845)	0.847 (0.656-1.09)	1.00 (0.769-1.29)	1.21 (0.903-1.64)	1.37 (1.00-1.90)	1.54 (1.09-2.21)	1.73 (1.16-2.54)	1.99 (1.29-3.05)	2.21 (1.40-3.45)
30-min	0.750 (0.583-0.958)	0.906 (0.703-1.16)	1.16 (0.898-1.49)	1.37 (1.06-1.77)	1.66 (1.24-2.25)	1.88 (1.37-2.60)	2.11 (1.50-3.03)	2.37 (1.59-3.49)	2.73 (1.77-4.18)	3.03 (1.92-4.73)
60-min	0.953 (0.740-1.22)	1.15 (0.893-1.47)	1.48 (1.14-1.89)	1.74 (1.34-2.25)	2.11 (1.58-2.86)	2.39 (1.75-3.31)	2.68 (1.90-3.86)	3.01 (2.03-4.43)	3.48 (2.25-5.31)	3.86 (2.44-6.01)
2-hr	1.22 (0.954-1.55)	1.48 (1.16-1.88)	1.91 (1.48-2.43)	2.26 (1.75-2.90)	2.74 (2.06-3.70)	3.10 (2.29-4.29)	3.49 (2.51-5.04)	3.95 (2.67-5.79)	4.66 (3.02-7.07)	5.25 (3.33-8.14)
3-hr	1.41 (1.11-1.78)	1.71 (1.34-2.17)	2.21 (1.73-2.81)	2.62 (2.04-3.35)	3.19 (2.40-4.29)	3.61 (2.67-4.98)	4.06 (2.94-5.86)	4.62 (3.12-6.74)	5.48 (3.57-8.29)	6.22 (3.96-9.61)
6-hr	1.81 (1.43-2.27)	2.20 (1.73-2.77)	2.84 (2.23-3.58)	3.37 (2.63-4.28)	4.10 (3.12-5.49)	4.64 (3.46-6.38)	5.23 (3.81-7.52)	5.97 (4.05-8.65)	7.11 (4.64-10.7)	8.11 (5.17-12.4)
12-hr	2.29 (1.82-2.85)	2.79 (2.21-3.48)	3.61 (2.85-4.52)	4.29 (3.37-5.41)	5.22 (3.98-6.94)	5.91 (4.43-8.06)	6.66 (4.87-9.51)	7.59 (5.17-10.9)	9.03 (5.92-13.5)	10.3 (6.58-15.7)
24-hr	2.73 (2.18-3.38)	3.36 (2.68-4.17)	4.39 (3.49-5.47)	5.25 (4.15-6.58)	6.43 (4.94-8.51)	7.30 (5.50-9.91)	8.26 (6.07-11.7)	9.45 (6.46-13.5)	11.3 (7.43-16.8)	12.9 (8.30-19.6)
2-day	3.06 (2.46-3.77)	3.84 (3.08-4.73)	5.10 (4.08-6.31)	6.15 (4.89-7.65)	7.59 (5.87-10.0)	8.65 (6.57-11.7)	9.82 (7.29-14.0)	11.3 (7.77-16.1)	13.7 (9.05-20.3)	15.9 (10.2-23.9)
3-day	3.33 (2.69-4.08)	4.16 (3.35-5.11)	5.52 (4.43-6.80)	6.64 (5.30-8.23)	8.19 (6.35-10.8)	9.32 (7.10-12.6)	10.6 (7.88-15.0)	12.2 (8.39-17.3)	14.8 (9.78-21.8)	17.1 (11.0-25.7)
4-day	3.58 (2.90-4.38)	4.44 (3.59-5.44)	5.85 (4.71-7.18)	7.01 (5.61-8.66)	8.61 (6.69-11.3)	9.78 (7.46-13.1)	11.1 (8.26-15.6)	12.8 (8.79-18.0)	15.4 (10.2-22.6)	17.8 (11.5-26.6)
7-day	4.31 (3.50-5.24)	5.21 (4.23-6.34)	6.69 (5.41-8.17)	7.92 (6.36-9.73)	9.60 (7.49-12.5)	10.8 (8.29-14.4)	12.2 (9.10-17.0)	13.9 (9.62-19.6)	16.6 (11.0-24.2)	19.0 (12.3-28.2)
10-day	5.00 (4.08-6.06)	5.93 (4.83-7.20)	7.46 (6.05-9.08)	8.72 (7.04-10.7)	10.5 (8.17-13.5)	11.8 (8.99-15.5)	13.1 (9.78-18.2)	14.9 (10.3-20.8)	17.5 (11.6-25.4)	19.7 (12.8-29.3)
20-day	7.05 (5.79-8.48)	8.05 (6.60-9.70)	9.68 (7.91-11.7)	11.0 (8.96-13.4)	12.9 (10.1-16.4)	14.3 (10.9-18.6)	15.8 (11.7-21.3)	17.4 (12.2-24.2)	19.8 (13.2-28.5)	21.7 (14.1-32.0)
30-day	8.74 (7.20-10.5)	9.78 (8.05-11.7)	11.5 (9.42-13.8)	12.9 (10.5-15.6)	14.9 (11.7-18.7)	16.4 (12.5-21.1)	17.9 (13.2-23.8)	19.5 (13.6-26.9)	21.6 (14.5-30.9)	23.2 (15.1-34.1)
45-day	10.8 (8.95-12.9)	11.9 (9.84-14.2)	13.7 (11.3-16.4)	15.2 (12.4-18.3)	17.2 (13.5-21.6)	18.8 (14.4-24.0)	20.4 (15.0-26.8)	21.9 (15.4-30.0)	23.7 (16.0-33.9)	25.1 (16.4-36.7)
60-day	12.6 (10.4-15.0)	13.7 (11.3-16.3)	15.5 (12.8-18.6)	17.1 (14.0-20.5)	19.2 (15.1-23.9)	20.8 (16.0-26.4)	22.4 (16.4-29.3)	23.8 (16.8-32.6)	25.5 (17.2-36.2)	26.6 (17.4-38.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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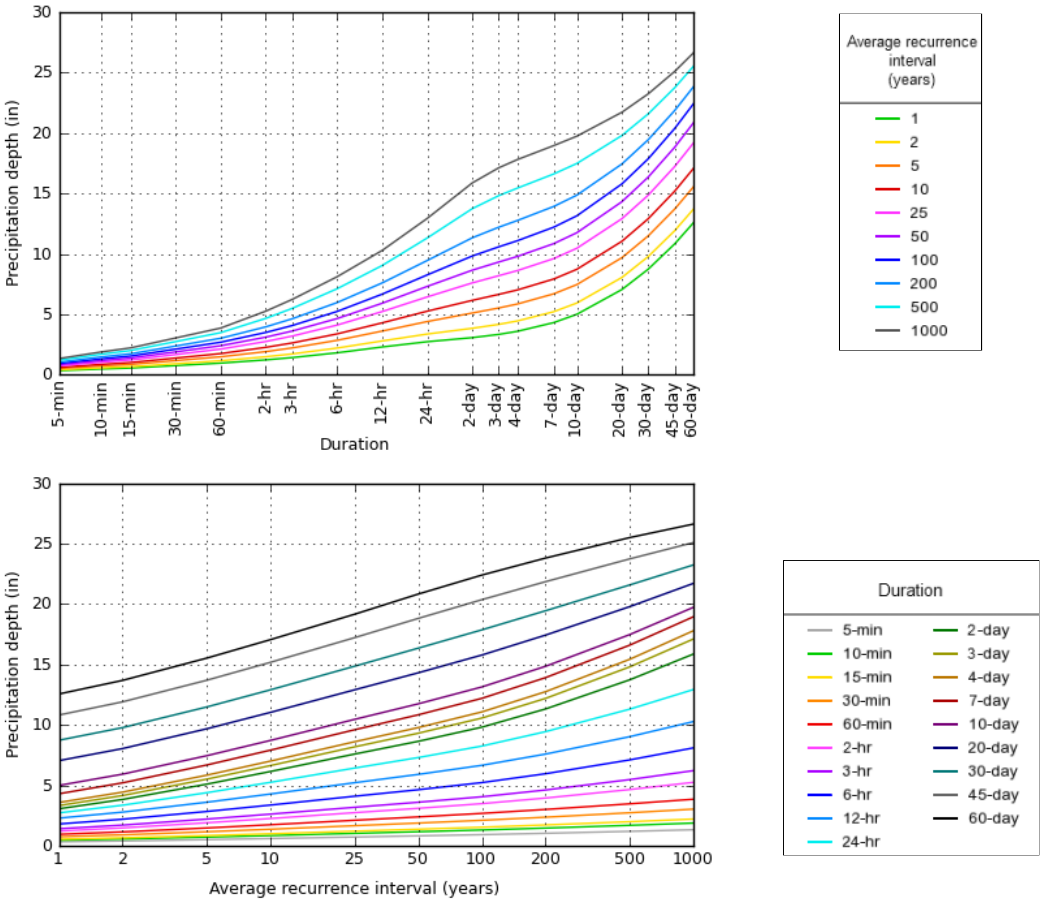
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 42.2083°, Longitude: -71.4097°



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Tue Apr 28 20:56:37 2020

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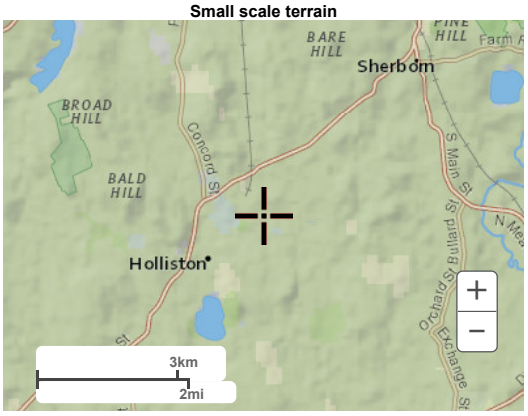
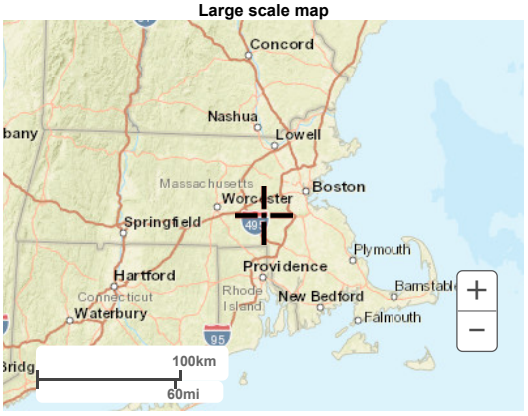
Maps & aerials

Small scale terrain

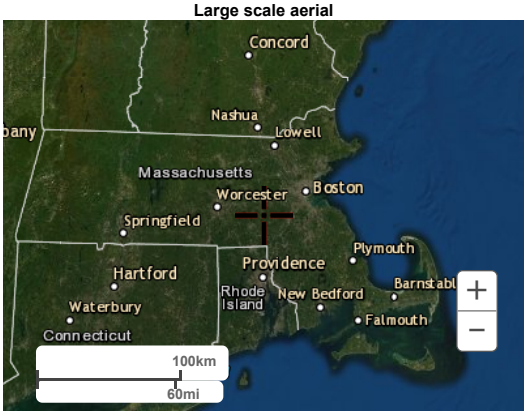


Large scale terrain

Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

NOAA Atlas 14, Volume 10, Version 3
Location name: Holliston, Massachusetts, USA*
Latitude: 42.2083°, Longitude: -71.4097°
Elevation: 156.12 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**3.94** (3.06-5.04)	**4.76** (3.70-6.08)	**6.10** (4.72-7.84)	**7.20** (5.54-9.31)	**8.72** (6.50-11.8)	**9.88** (7.21-13.7)	**11.1** (7.86-15.9)	**12.4** (8.36-18.3)	**14.4** (9.30-21.9)	**15.9** (10.1-24.9)
10-min	**2.79** (2.17-3.56)	**3.37** (2.62-4.31)	**4.32** (3.35-5.54)	**5.10** (3.92-6.59)	**6.18** (4.61-8.36)	**7.00** (5.11-9.68)	**7.85** (5.57-11.3)	**8.80** (5.92-13.0)	**10.2** (6.59-15.5)	**11.3** (7.15-17.6)
15-min	**2.19** (1.70-2.80)	**2.64** (2.05-3.38)	**3.39** (2.62-4.35)	**4.00** (3.08-5.17)	**4.85** (3.61-6.56)	**5.49** (4.01-7.59)	**6.16** (4.37-8.84)	**6.90** (4.64-10.2)	**7.98** (5.17-12.2)	**8.85** (5.60-13.8)
30-min	**1.50** (1.17-1.92)	**1.81** (1.41-2.32)	**2.32** (1.80-2.98)	**2.74** (2.11-3.54)	**3.33** (2.48-4.50)	**3.76** (2.75-5.20)	**4.22** (3.00-6.07)	**4.74** (3.19-6.97)	**5.47** (3.54-8.35)	**6.07** (3.84-9.47)
60-min	**0.953** (0.740-1.22)	**1.15** (0.893-1.47)	**1.48** (1.14-1.89)	**1.74** (1.34-2.25)	**2.11** (1.58-2.86)	**2.39** (1.75-3.31)	**2.68** (1.90-3.86)	**3.01** (2.03-4.43)	**3.48** (2.25-5.31)	**3.86** (2.44-6.01)
2-hr	**0.610** (0.477-0.774)	**0.740** (0.578-0.940)	**0.952** (0.741-1.21)	**1.13** (0.874-1.45)	**1.37** (1.03-1.85)	**1.55** (1.14-2.14)	**1.75** (1.25-2.52)	**1.98** (1.33-2.90)	**2.33** (1.51-3.54)	**2.63** (1.67-4.07)
3-hr	**0.470** (0.368-0.594)	**0.570** (0.447-0.722)	**0.736** (0.574-0.934)	**0.873** (0.678-1.12)	**1.06** (0.801-1.43)	**1.20** (0.889-1.66)	**1.35** (0.978-1.95)	**1.54** (1.04-2.25)	**1.83** (1.19-2.76)	**2.07** (1.32-3.20)
6-hr	**0.302** (0.238-0.379)	**0.367** (0.290-0.462)	**0.474** (0.373-0.599)	**0.563** (0.440-0.715)	**0.685** (0.520-0.917)	**0.775** (0.578-1.07)	**0.874** (0.636-1.26)	**0.996** (0.676-1.45)	**1.19** (0.775-1.79)	**1.35** (0.863-2.08)
12-hr	**0.190** (0.151-0.237)	**0.231** (0.184-0.289)	**0.299** (0.237-0.375)	**0.356** (0.280-0.449)	**0.433** (0.331-0.576)	**0.491** (0.367-0.669)	**0.553** (0.404-0.789)	**0.630** (0.429-0.908)	**0.750** (0.491-1.12)	**0.853** (0.546-1.30)
24-hr	**0.114** (0.091-0.141)	**0.140** (0.112-0.174)	**0.183** (0.146-0.228)	**0.219** (0.173-0.274)	**0.268** (0.206-0.355)	**0.304** (0.229-0.413)	**0.344** (0.253-0.489)	**0.394** (0.269-0.564)	**0.471** (0.310-0.700)	**0.539** (0.346-0.816)
2-day	**0.064** (0.051-0.079)	**0.080** (0.064-0.098)	**0.106** (0.085-0.131)	**0.128** (0.102-0.159)	**0.158** (0.122-0.208)	**0.180** (0.137-0.244)	**0.205** (0.152-0.291)	**0.236** (0.162-0.336)	**0.286** (0.189-0.422)	**0.331** (0.213-0.497)
3-day	**0.046** (0.037-0.057)	**0.058** (0.047-0.071)	**0.077** (0.062-0.094)	**0.092** (0.074-0.114)	**0.114** (0.088-0.149)	**0.129** (0.099-0.175)	**0.147** (0.109-0.208)	**0.169** (0.116-0.240)	**0.206** (0.136-0.302)	**0.238** (0.153-0.356)
4-day	**0.037** (0.030-0.046)	**0.046** (0.037-0.057)	**0.061** (0.049-0.075)	**0.073** (0.058-0.090)	**0.090** (0.070-0.117)	**0.102** (0.078-0.137)	**0.115** (0.086-0.163)	**0.133** (0.092-0.188)	**0.161** (0.106-0.236)	**0.185** (0.120-0.277)
7-day	**0.026** (0.021-0.031)	**0.031** (0.025-0.038)	**0.040** (0.032-0.049)	**0.047** (0.038-0.058)	**0.057** (0.045-0.074)	**0.065** (0.049-0.086)	**0.073** (0.054-0.101)	**0.083** (0.057-0.116)	**0.099** (0.066-0.144)	**0.113** (0.073-0.168)
10-day	**0.021** (0.017-0.025)	**0.025** (0.020-0.030)	**0.031** (0.025-0.038)	**0.036** (0.029-0.045)	**0.044** (0.034-0.056)	**0.049** (0.037-0.065)	**0.055** (0.041-0.076)	**0.062** (0.043-0.087)	**0.073** (0.048-0.106)	**0.082** (0.053-0.122)
20-day	**0.015** (0.012-0.018)	**0.017** (0.014-0.020)	**0.020** (0.016-0.024)	**0.023** (0.019-0.028)	**0.027** (0.021-0.034)	**0.030** (0.023-0.039)	**0.033** (0.024-0.044)	**0.036** (0.025-0.050)	**0.041** (0.028-0.059)	**0.045** (0.029-0.067)
30-day	**0.012** (0.010-0.015)	**0.014** (0.011-0.016)	**0.016** (0.013-0.019)	**0.018** (0.015-0.022)	**0.021** (0.016-0.026)	**0.023** (0.017-0.029)	**0.025** (0.018-0.033)	**0.027** (0.019-0.037)	**0.030** (0.020-0.043)	**0.032** (0.021-0.047)
45-day	**0.010** (0.008-0.012)	**0.011** (0.009-0.013)	**0.013** (0.010-0.015)	**0.014** (0.011-0.017)	**0.016** (0.013-0.020)	**0.017** (0.013-0.022)	**0.019** (0.014-0.025)	**0.020** (0.014-0.028)	**0.022** (0.015-0.031)	**0.023** (0.015-0.034)
60-day	**0.009** (0.007-0.010)	**0.010** (0.008-0.011)	**0.011** (0.009-0.013)	**0.012** (0.010-0.014)	**0.013** (0.010-0.017)	**0.014** (0.011-0.018)	**0.016** (0.011-0.020)	**0.017** (0.012-0.023)	**0.018** (0.012-0.025)	**0.018** (0.012-0.027)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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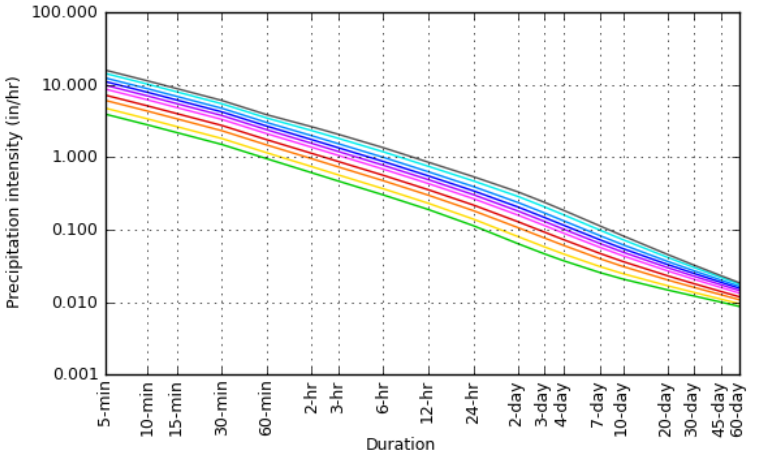
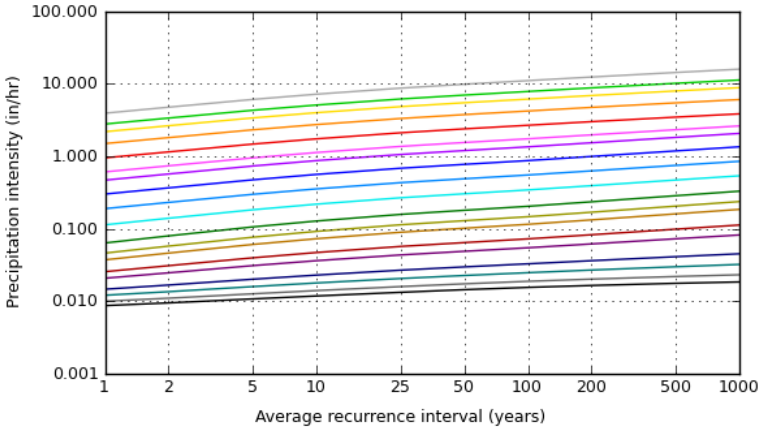
PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 42.2083°, Longitude: -71.4097°





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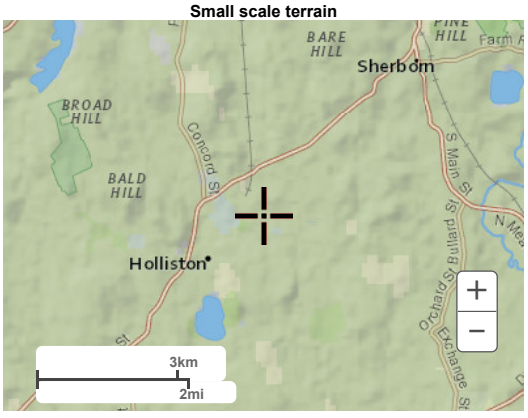
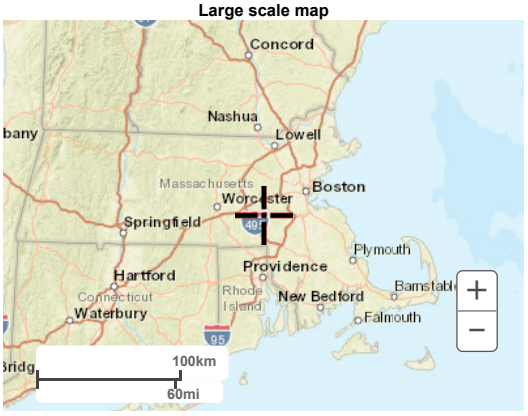
Maps & aerials

Small scale terrain

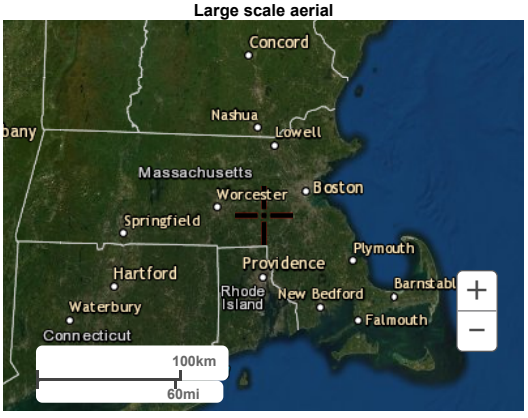


Large scale terrain

Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

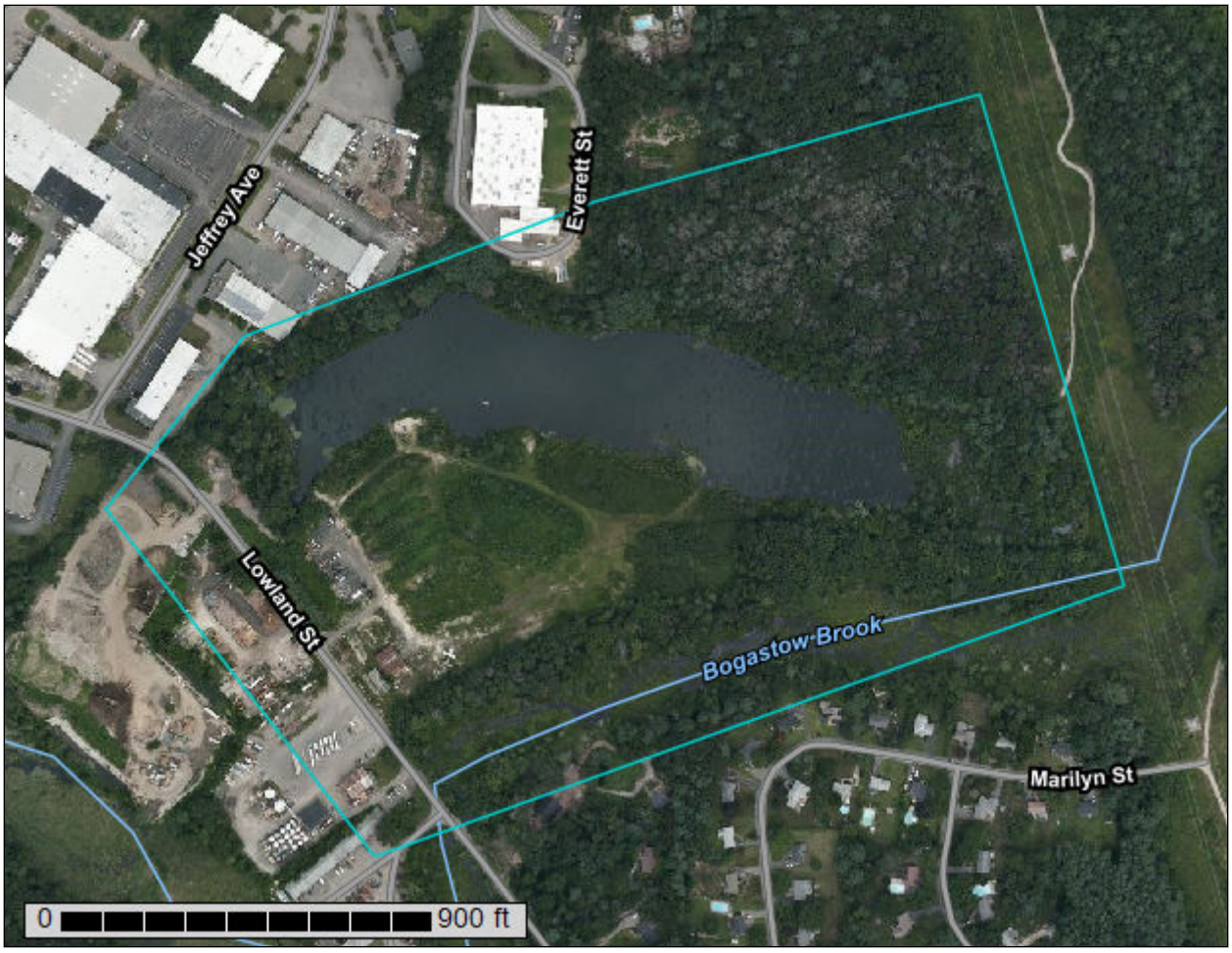
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

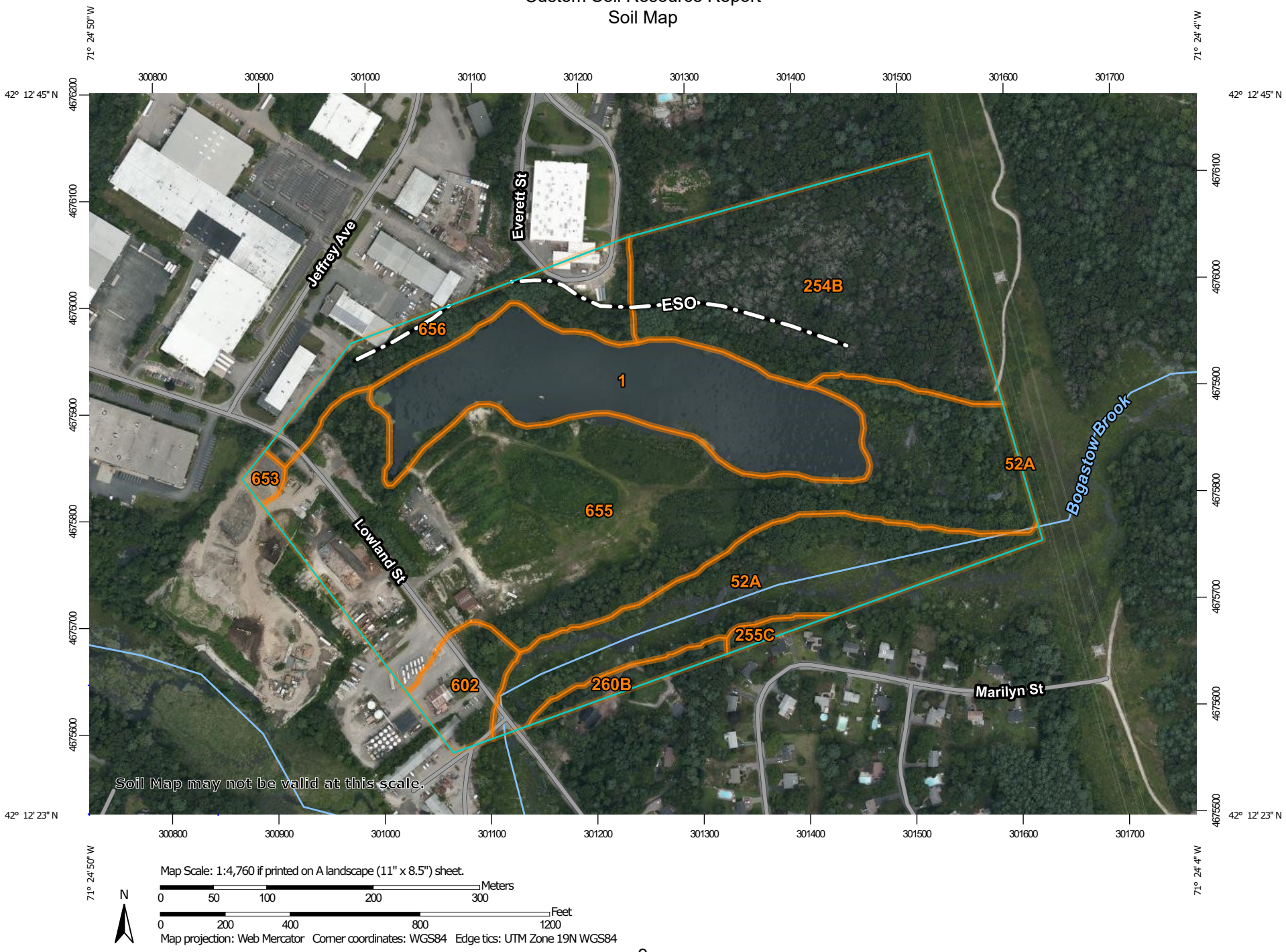
A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Middlesex County, Massachusetts



April 10, 2020

Custom Soil Resource Report
Soil Map



Map Scale: 1:4,760 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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: Middlesex County, Massachusetts
Survey Area Data: Version 19, Sep 12, 2019

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

Date(s) aerial images were photographed: Jul 28, 2019—Aug 15, 2019

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	9.7	15.4%
52A	Freetown muck, 0 to 1 percent slopes	7.9	12.6%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	13.2	20.9%
255C	Windsor loamy sand, 8 to 15 percent slopes	0.3	0.5%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	0.9	1.4%
602	Urban land	1.9	3.0%
653	Udorthents, sandy	0.3	0.5%
655	Udorthents, wet substratum	24.8	39.4%
656	Udorthents-Urban land complex	4.0	6.3%
Totals for Area of Interest		**62.9**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit

descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Middlesex County, Massachusetts

1—Water

Map Unit Setting

National map unit symbol: 996p
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 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: Not prime farmland

Map Unit Composition

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

Description of Freetown

Setting

Landform: Kettles, depressions, depressions, bogs, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
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: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Kettles, depressions, depressions, marshes, bogs, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 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

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

Description of Merrimac

Setting

Landform: Moraines, outwash plains, kames, eskers, outwash terraces
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Sudbury
Percent of map unit: 5 percent
Landform: Terraces, deltas, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley
Percent of map unit: 5 percent
Landform: Deltas, outwash plains, kames, eskers
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Windsor
Percent of map unit: 3 percent
Landform: Outwash plains, deltas, dunes, outwash terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Agawam
Percent of map unit: 2 percent
Landform: Moraines, outwash plains, kames, stream terraces, eskers, outwash terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

255C—Windsor loamy sand, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2svkq
Elevation: 0 to 1,260 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: Farmland of statewide importance

Map Unit Composition

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

Description of Windsor

Setting

Landform: — error in exists on —
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
Ap - 1 to 11 inches: loamy sand
Bw - 11 to 31 inches: loamy sand
C - 31 to 65 inches: sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 10 percent
Landform: Outwash plains, eskers, deltas, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, rise
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

260B—Sudbury fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9915
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Sudbury

Setting

Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 20 inches: fine sandy loam
H3 - 20 to 27 inches: loamy sand
H4 - 27 to 65 inches: stratified gravelly coarse sand to sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Plains, terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wareham

Percent of map unit: 4 percent
Landform: Depressions, terraces, deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Windsor

Percent of map unit: 2 percent
Landform: Flats, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent

602—Urban land

Map Unit Setting

National map unit symbol: 9950
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

Udorthents, wet substratum

Percent of map unit: 5 percent
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 5 percent
Hydric soil rating: No

653—Udorthents, sandy

Map Unit Setting

National map unit symbol: vr1k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udorthents, Sandy

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Udorthents, loamy

Percent of map unit: 5 percent
Hydric soil rating: No

Urban land

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Unnamed

Percent of map unit: 5 percent

655—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: vr1n
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udorthents, Wet Substratum

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Urban land

Percent of map unit: 8 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Freetown

Percent of map unit: 4 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

656—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

TETRA TECH

TECHNICAL MEMO

To:	Terri Bendes – ADESA, Inc.
Cc:	Laura Gretencord – ADESA, Inc. Brian Brewer, PE – Kimley-Horn Robert Farnes – Tetra Tech
From:	Matthew Moyen, PE
Date:	September 17, 2020
Subject:	Soil Evaluation Technical Memo Proposed ADESA Holliston Facility 194 Lowland Street, Holliston, MA

Tetra Tech has prepared this Technical Memo for ADESA, Inc (ADESA) to summarize the results of a Soil Evaluation completed in support of the proposed ADESA Holliston Facility located at 194 Lowland Street in Holliston, Massachusetts (the Site).

EXISTING CONDITIONS

The Site is comprised of various land covers including a roughly 10-acre pond along the northern boundary, a brook and adjacent wetlands along the southern boundary, and forested land on the eastern half of the subject parcel. At the time of our field work, the western half of the subject parcel was comprised of thick shrubs and grasses and a relatively small area of asphalt. Construction equipment, trailers and stockpiles were also present along the western boundary. Two large soil stockpiles were located near the Site's entrance along Lowland Street and about a dozen stockpiles of large stone were located to their north. The Site is depicted on Figure 1, Site Location Plan.

PROPOSED CONSTRUCTION

We understand that ADESA plans to develop the Site into a large parking lot for the storage of vehicles and that improvements will include the implementation two underground stormwater Best Management Practices (BMPs). Proposed limits of construction as well as the locations of proposed underground stormwater BMPs and test pits performed as part of this effort are shown on Figure 2, Test Pit Plan.

SOIL EVALUATION

The Soil Evaluation was performed in accordance with MassDEP Stormwater Handbook requirements to classify the Hydrologic Soil Groups soils on site, determine saturated hydraulic conductivity listed by the Rawls Rates table, and identify estimated seasonal high groundwater for design purposes.

Twelve exploratory (12) test pits, identified as TP-1 through TP-12, were field-located using a handheld GPS unit on August 15, 2020 and August 21, 2020 and are based on the locations provided by Kimley-Horn on July 31, 2020 and August 19, 2020. Test pits were performed at the Site by Northern Drill Service of Northborough, Massachusetts and observed by Tetra Tech on August 20, 2020 and August 21, 2020.

Tetra Tech personnel classified soils encountered in the test pits in general accordance with United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) methods and collected soils for laboratory testing. Depth to groundwater (if encountered), evidence of estimated seasonal high groundwater (where applicable), depth to bedrock (if encountered), and USDA soil texture classification for the stratums encountered are labelled and recorded on the Test Pit Logs. Laboratory test results were used for classification

purposes when applicable. For detailed descriptions of the subsurface conditions, refer to Appendix A, Test Pit Logs and Appendix B, Soil Laboratory Testing Results.

Soil Textural Analysis

The U.S. Natural Resources Conservation Service (NRCS) Soil Survey does not identify the Hydrologic Soil Group (HSG) at the project site, therefore, textural analyses of the soils present within the proposed limits of construction were conducted in the surface soil horizons to determine the HSGs for calculation of the required recharge volume. Soil textural analyses in the location and soil layer where recharge is proposed were also conducted to determine the saturated hydraulic conductivities listed by the Rawls Rates table.

Six (6) representative soil samples in the surface soil horizon and seven (7) soil samples in the location and soil layer where recharge is proposed were selected and submitted to GeoTesting Express of Acton, Massachusetts for laboratory analysis. Tests performed on the soil samples included grain size distribution sieve only analysis, sieve and hydrometer analysis, and USDA textural classification. The USDA textural classification for surface soil horizon and recharge elevation soil samples were predominantly LOAMY SAND to SAND, which are in HSG A or SANDY LOAM, which are in HSG B. Tables 1 and 2, below, summarize the USDA textural classification for surface soil horizon and recharge elevation soil samples, respectively.

Table 1 – Surface Soil Horizon Hydrologic Soil Group

Sample ID	USDA Textural Classification	Hydrologic Soil Group
TP-2 (1)	Sandy Loam	B
TP-3 (1)	Loamy Sand	A
TP-5 (1)	Loamy Sand	A
TP-6 (1)	Loamy Sand	A
TP-7 (1)	Loamy Sand	A
TP-8 (1)	Sandy Loam	B

Table 2 – Recharge Elevation Hydrologic Soil Group

Sample ID	USDA Textural Classification	Hydrologic Soil Group
TP-3 (2)	Sandy Loam	B
TP-4 (2)	Sand	A
TP-5 (2)	Loamy Sand	A
TP-8 (2)	Loamy Sand	A
TP-9 (2)	Sand	A
TP-10 (3)	Loamy Sand	A
TP-12 (2)	Loamy Sand	A

Saturated Hydraulic Conductivity

Four (4) test pits, identified as TP-3 through TP-5 and TP-12, were performed at the proposed western stormwater BMP location, adjacent to Lowland Street. USDA textural classifications resulting from laboratory analyses of the recharge elevation soil samples were LOAMY SAND to SAND, which are in HSG A, or SANDY LOAM, which are in HSG B. Using the Rawls Rate associated with the slowest of the HSGs to exist at the point where recharge is proposed (SANDY LOAM; HSG B) results in an infiltration rate of 1.02 inches per hour, which represents the saturated hydraulic conductivity for design of the western stormwater BMP location.

Three (3) test pits, identified as TP-8 through TP-10, were performed at the proposed eastern stormwater BMP location. USDA textural classifications resulting from laboratory analyses of the recharge elevation soil samples were LOAMY SAND to SAND, which are in HSG A. Using the Rawls Rate associated with the slowest of the HSGs to exist at the point where recharge is proposed (LOAMY SAND; HSG A) results in an infiltration rate of 2.41 inches per hour, which represents the saturated hydraulic conductivity for design of the eastern stormwater BMP location.

Estimated Seasonal High Groundwater

During our in-field evaluation of subsurface conditions, groundwater and evidence of estimated seasonal high groundwater was observed at all twelve (12) test pit locations. Groundwater was generally observed at the bottom of each test pit and resulted in termination of excavation. At the proposed western stormwater BMP location, adjacent to Lowland Street, estimated seasonal high groundwater was identified in TP-3 through TP-5 and TP-12 at depths roughly 4- to 5-feet below ground surface, corresponding to approximate plan elevation 152 to 153. At the proposed eastern stormwater BMP location estimated seasonal high groundwater was identified in TP-8 through TP-10 at depth roughly 9- to 10- feet below ground surface, corresponding to approximate plan elevation 152 to 153. Groundwater and estimated seasonal high groundwater depths observed are provided on each test pit log.

ATTACHMENTS

Figure 1 – Site Location Plan

Figure 2 – Test Pit Plan

Appendix A – Test Pit Logs

Appendix B – Soil Laboratory Results

P:\1298\143-1298-20004\DOCS\SOIL EVALUATION TECHNICAL MEMO.DOCX

Figures

Date: 9/17/2020
Path: P:\12981143-1298-20002\GIS\Existing Conditions Aerial.mxd

TETRA TECH
100 Nickerson Road
Marlborough, MA 01752
508.786.2200
www.tetratech.com

0 150 300
Feet

N

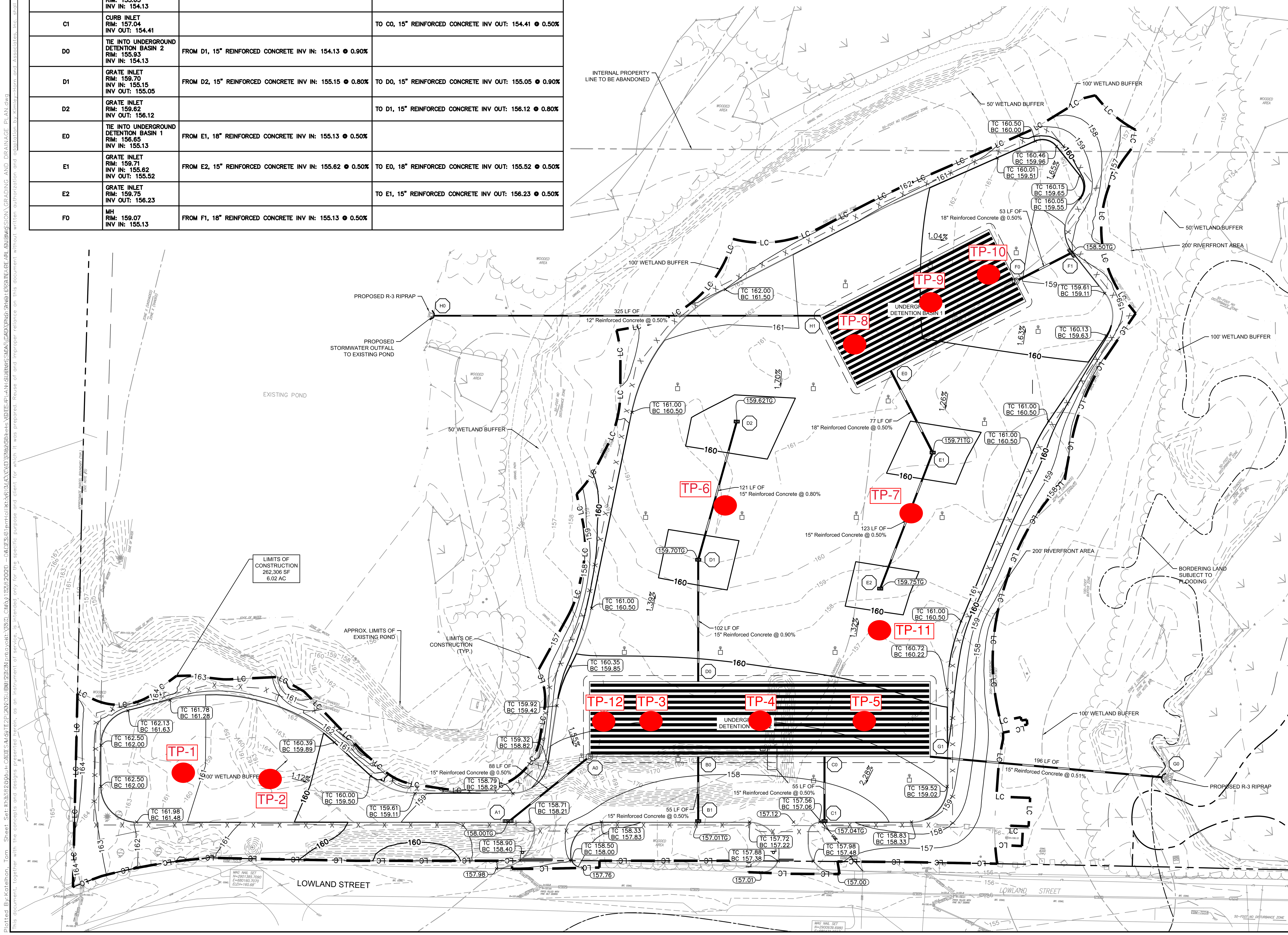
Base Map:
MassGIS Aerial

ADESA Holliston
194 Lowland Street
Holliston, Massachusetts

Figure 1
Site Location Plan

STRUCTURE TABLE			
STRUCTURE NAME:	DETAILS:	PIPES IN:	PIPES OUT
A0	MH RIM: 158.67 INV IN: 154.13	FROM A1, 15" REINFORCED CONCRETE INV IN: 154.13 @ 0.50%	
A1	DOUBLE CURB INLET RIM: 158.00 INV OUT: 154.57		TO A0, 15" REINFORCED CONCRETE INV OUT: 154.57 @ 0.50%
B0	TIE INTO UNDERGROUND DETENTION BASIN 2 RIM: 155.93 INV IN: 154.13	FROM B1, 15" REINFORCED CONCRETE INV IN: 154.13 @ 0.50%	
B1	CURB INLET RIM: 157.01 INV OUT: 154.41		TO B0, 15" REINFORCED CONCRETE INV OUT: 154.41 @ 0.50%
C0	TIE INTO UNDERGROUND DETENTION BASIN 2 RIM: 155.65 INV IN: 154.13	FROM C1, 15" REINFORCED CONCRETE INV IN: 154.13 @ 0.50%	
C1	CURB INLET RIM: 157.04 INV OUT: 154.41		TO C0, 15" REINFORCED CONCRETE INV OUT: 154.41 @ 0.50%
D0	TIE INTO UNDERGROUND DETENTION BASIN 2 RIM: 155.93 INV IN: 154.13	FROM D1, 15" REINFORCED CONCRETE INV IN: 154.13 @ 0.90%	
D1	GRATE INLET RIM: 159.70 INV IN: 155.15 INV OUT: 155.05	FROM D2, 15" REINFORCED CONCRETE INV IN: 155.15 @ 0.80%	TO D0, 15" REINFORCED CONCRETE INV OUT: 155.05 @ 0.90%
D2	GRATE INLET RIM: 159.62 INV OUT: 156.12		TO D1, 15" REINFORCED CONCRETE INV OUT: 156.12 @ 0.80%
E0	TIE INTO UNDERGROUND DETENTION BASIN 1 RIM: 156.65 INV IN: 155.13	FROM E1, 18" REINFORCED CONCRETE INV IN: 155.13 @ 0.50%	
E1	GRATE INLET RIM: 159.71 INV IN: 155.62 INV OUT: 155.52	FROM E2, 15" REINFORCED CONCRETE INV IN: 155.62 @ 0.50%	TO E0, 18" REINFORCED CONCRETE INV OUT: 155.52 @ 0.50%
E2	GRATE INLET RIM: 159.75 INV OUT: 156.23		TO E1, 15" REINFORCED CONCRETE INV OUT: 156.23 @ 0.50%
F0	MH RIM: 159.07 INV IN: 155.13	FROM F1, 18" REINFORCED CONCRETE INV IN: 155.13 @ 0.50%	

STRUCTURE TABLE			
STRUCTURE NAME:	DETAILS:	PIPES IN:	PIPES OUT
F1	DOUBLE CURB INLET RIM: 158.50 INV OUT: 155.40		TO F0, 18" REINFORCED CONCRETE INV OUT: 155.40 @ 0.50%
G0	HEADWALL RIM: 154.67 INV IN: 153.00	FROM G1, 15" REINFORCED CONCRETE INV IN: 153.00 @ 0.51%	
G1	OCS OUTFALL RIM: 155.23 INV OUT: 154.00		TO G0, 15" REINFORCED CONCRETE INV OUT: 154.00 @ 0.51%
H0	HEADWALL RIM: 155.04 INV IN: 153.37	FROM H1, 12" REINFORCED CONCRETE INV IN: 153.37 @ 0.50%	
H1	OCS OUTFALL RIM: 156.23 INV OUT: 155.00		TO H0, 12" REINFORCED CONCRETE INV OUT: 155.00 @ 0.50%



GRAPHIC SCALE IN FEET
0 20 40 80

NORTH

LEGEND

	EXISTING PROPERTY LINE
	PROPOSED CURB
	EXISTING CONTOUR
XXX	PROPOSED CONTOUR
	PROPOSED STORMWATER CONVEYANCE PIPE
	PROPOSED INLET
D	PROPOSED MANHOLE
	PROPOSED ENDWALL
XXX.XX	PAVEMENT SPOT ELEVATION LABEL

PAVING, GRADING AND DRAINAGE NOTES

1. ALL PAVING, CONSTRUCTION, MATERIALS, AND WORKMANSHIP WITHIN STATE AND TOWN RIGHT-OF-WAY SHALL BE IN ACCORDANCE WITH LOCAL OR STATE SPECIFICATIONS AND STANDARDS (LATEST EDITION) OR MASS HIGHWAY SPECIFICATIONS AND STANDARDS (LATEST EDITION) IF NOT COVERED BY STATE OR TOWN REGULATIONS.
2. ALL UNPAVED AREAS IN EXISTING RIGHTS-OF-WAY DISTURBED BY CONSTRUCTION SHALL BE REGRADED AND SEEDED.
3. TRAFFIC CONTROL ON ALL RIGHTS-OF-WAY SHALL MEET THE REQUIREMENTS OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (U.S. DOT/FHA) AND THE REQUIREMENTS OF THE STATE AND ANY LOCAL AGENCY HAVING JURISDICTION. IN THE EVENT THAT THE CONTRACT DOCUMENTS AND THE JURISDICTIONAL AGENCY REQUIREMENTS ARE NOT IN AGREEMENT, THE MOST STRINGENT SHALL GOVERN.
4. THE CONTRACTOR SHALL GRADE THE SITE TO THE ELEVATIONS INDICATED AND SHALL REGRADE WASHOUTS WHERE THEY OCCUR AFTER EVERY RAINFALL UNTIL A GRASS STAND IS WELL ESTABLISHED OR ADEQUATE STABILIZATION OCCURS.
5. ALL OPEN AREAS WITHIN THE PROJECT SITE SHALL BE SEEDED UNLESS INDICATED OTHERWISE ON THE LANDSCAPE PLAN.
6. ALL AREAS INDICATED AS PAVEMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE TYPICAL PAVEMENT SECTIONS AS INDICATED ON THE DRAWINGS.
7. WHERE EXISTING PAVEMENT IS INDICATED TO BE REMOVED AND REPLACED, THE CONTRACTOR SHALL SAW CUT A MINIMUM 2" DEEP FOR A SMOOTH AND STRAIGHT JOINT AND REPLACE THE PAVEMENT WITH THE SAME TYPE AND DEPTH OF MATERIAL AS EXISTING OR AS INDICATED.
8. WHERE NEW PAVEMENT MEETS THE EXISTING PAVEMENT, THE CONTRACTOR SHALL SAW CUT THE EXISTING PAVEMENT A MINIMUM 2" DEEP FOR A SMOOTH AND STRAIGHT JOINT AND MATCH THE EXISTING PAVEMENT ELEVATION WITH THE PROPOSED PAVEMENT UNLESS OTHERWISE INDICATED.
9. THE CONTRACTOR SHALL INSTALL FILTER FABRIC OVER ALL DRAINAGE STRUCTURES FOR THE DURATION OF CONSTRUCTION AND UNTIL ACCEPTANCE OF THE PROJECT BY THE OWNER. ALL DRAINAGE STRUCTURES SHALL BE CLEANED OF DEBRIS AS REQUIRED DURING AND AT THE END OF CONSTRUCTION TO PROVIDE POSITIVE DRAINAGE FLOWS.
10. IF DEWATERING IS REQUIRED, THE CONTRACTOR SHALL OBTAIN ANY APPLICABLE REQUIRED PERMITS. THE CONTRACTOR IS TO COORDINATE WITH THE OWNER AND THE DESIGN ENGINEER PRIOR TO ANY EXCAVATION.
11. STRIP TOPSOIL AND ORGANIC MATTER FROM ALL AREAS OF THE SITE AS REQUIRED. IN SOME CASES TOPSOIL MAY BE STOCKPILED ON SITE FOR PLACEMENT WITHIN LANDSCAPED AREAS BUT ONLY AS DIRECTED BY THE OWNER.
12. FIELD DENSITY TESTS SHALL BE TAKEN AT INTERVALS IN ACCORDANCE WITH THE LOCAL JURISDICTIONAL AGENCY OR TO MASS HIGHWAY STANDARDS. IN THE EVENT THAT THE CONTRACT DOCUMENTS AND THE JURISDICTIONAL AGENCY REQUIREMENTS ARE NOT IN AGREEMENT, THE MOST STRINGENT SHALL GOVERN.
13. ALL SLOPES AND AREAS DISTURBED BY CONSTRUCTION SHALL BE GRADED AS PER PLANS. THE AREAS SHALL THEN BE SODDED OR SEEDED AS SPECIFIED IN THE PLANS, FERTILIZED, MULCHED, WATERED AND MAINTAINED UNTIL HARDY GRASS GROWTH IS ESTABLISHED IN ALL AREAS. ANY AREAS DISTURBED FOR ANY REASON PRIOR TO FINAL ACCEPTANCE OF THE JOB SHALL BE CORRECTED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER. ALL EARTHEN AREAS WILL BE SODDED OR SEEDED AND MULCHED AS SHOWN ON THE LANDSCAPING PLAN.
14. ALL CUT OR FILL SLOPES SHALL BE 3 (HORIZONTAL) :1 (VERTICAL) OR FLATTER UNLESS OTHERWISE SHOWN.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONTROL OF DUST AND DIRT RISING AND SCATTERING IN THE AIR DURING CONSTRUCTION AND SHALL PROVIDE WATER SPRINKLING OR OTHER SUITABLE METHODS OF CONTROL. THE CONTRACTOR SHALL COMPLY WITH ALL GOVERNING REGULATIONS PERTAINING TO ENVIRONMENTAL PROTECTION.
16. THE CONTRACTOR SHALL ENSURE THAT ISLAND PLANTING AREAS AND OTHER PLANTING AREAS ARE NOT COMPACTED AND DO NOT CONTAIN ROAD BASE MATERIALS. THE CONTRACTOR SHALL ALSO EXCAVATE AND REMOVE ALL UNDESIRABLE MATERIAL FROM ALL AREAS ON THE SITE TO BE PLANTED AND PROPERLY DISPOSED OF IN A LEGAL MANNER.
17. REFER TO SHEETS 19 OF 23 AND 20 OF 23 FOR STORMWATER MANAGEMENT DETAILS

Figure 2
Test Pit Plan

Kimley»Horn
© 2020 KIMLEY-HORN AND ASSOCIATES, INC.
1700 WILLOW LAWN DR, SUITE 200, RICHMOND, VA 23230
PHONE: 804-673-3882
WWW.KIMLEY-HORN.COM

LICENSED PROFESSIONAL
COMMONWEALTH OF MASSACHUSETTS BRIAN J. BREWER CIVIL No. 46948 05-12-20 REGISTERED PROFESSIONAL ENGINEER
DATE:

KHA PROJECT 113382001
DATE 05/12/2020
SCALE AS SHOWN
DESIGNED BY TGK
DRAWN BY BB
CHECKED BY BB

No. REVISIONS DATE BY

GRADING AND DRAINAGE PLAN

ADESA HOLLISTON
PREPARED FOR
ADESA, INC.
TOWN OF HOLLISTON MA

Appendix A

Test Pit Logs

TEST PIT NUMBER TP-01

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-21-2020
START TIME 11:30 AM
GROUND ELEVATION ± 160
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 80s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0				
			Loamy Sand	Light Yellowish Brown, LOAMY SAND, HSG A. Moist soil consistency, Friable. (Topsoil)
5.0				5.0
		▽ Evidence of ESHG Observed at 72"	Loamy Sand	Dark Yellowish Brown, GRAVELLY LOAMY SAND, HSG A. 20% Cobbles and Stones, 35% Gravel by Volume. Moist soil consistency, Loose. Redoximorphic red staining pockets observed at approximately 6.0' below ground surface. (Subsoil)
		▼		9.0
10.0		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 9.0' below ground surface
15.0				

TEST PIT NUMBER TP-02

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-21-2020
START TIME 12:10 PM
GROUND ELEVATION ± 161
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 80s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0			Sandy Loam	Brown, SANDY LOAM, HSG B. Moist soil consistency, Friable. (Topsoil)
0.5	TP-2 (1)		Sandy Loam	Pale Brown, SANDY LOAM, HSG A. Moist soil consistency, Loose. (Subsoil) [Laboratory Results: 52% Sand, 46% Silt, 2% Clay; USDA Classification = SANDY LOAM]
2.5				
5.0		▽▼ Weeping observed at 90"	Gravelly Sand	Dark Brown, GRAVELLY SAND, HSG A. 15% Cobbles and Stones, 25% Gravel by Volume. Moist soil consistency, Loose. (Substratum)
8.0				
10.0		Standing groundwater observed at bottom of test pit; Sides caving in once standing water was present		Test pit terminated at approximately 8.0' below ground surface
15.0				

TEST PIT NUMBER TP-03

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-21-2020
START TIME 9:40 AM
GROUND ELEVATION ± 158
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 80s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)		SUBSURFACE DESCRIPTION
0.0			Loamy Sand	0.9	Yellowish Brown, LOAMY SAND, HSG A. 10% Gravel by Volume. Moist soil consistency, Friable. (Topsoil)
	TP-3 (1)		Loamy Sand	2.0	Yellowish Brown, LOAMY SAND, HSG A. 10% Cobbles and Stones, 15% Gravel by Volume. Moist soil consistency, Friable. (Subsoil) [Laboratory Results: 83% Sand, 17% Silt, 0% Clay; USDA Classification = LOAMY SAND]
5.0	TP-3 (2)	▽ Weeping observed at 58"	Sandy Loam	8.0	Yellowish Brown, GRAVELLY SANDY LOAM, HSG B. 15% Cobbles and Stones, 25% Gravel by Volume. Moist soil consistency, Loose. (Substratum) [Laboratory Results: 60% Sand, 37% Silt, 3% Clay; USDA Classification = SANDY LOAM]
10.0		▼ Standing groundwater observed at bottom of test pit; Sides caving in once standing water was present			Test pit terminated at approximately 8.0' below ground surface
15.0					

TEST PIT NUMBER TP-04

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-20-2020
START TIME 2:00 PM
GROUND ELEVATION ± 158
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 70s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0			Loamy Sand	Brown, GRAVELLY LOAMY SAND, HSG A. 20% Cobbles and Stones, 25% Gravel by Volume. Moist soil consistency, Loose. (Topsoil)
0.7			Loamy Sand	Yellowish Brown, LOAMY SAND, HSG A. 10% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Subsoil)
1.8	TP-4 (2)	▽ Weeping observed at 60"	Sand	Pale Brown, SAND, HSG A. 15% Cobbles and Stones, 20% Gravel by Volume. Large stones present. Moist soil consistency, Loose. (Substratum) [Laboratory Results: 86% Sand, 14% Silt, 0% Clay; USDA Classification = SAND]
5.0				
9.3		▼ Standing groundwater observed at bottom of test pit; Sides caving in once standing water was present		Test pit terminated at approximately 9.3' below ground surface
10.0				
15.0				

TEST PIT NUMBER TP-05

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-21-2020
START TIME 9:50 AM
GROUND ELEVATION ± 157
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 80s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0	TP-5 (1)		Loamy Sand	Dark Yellowish Brown, LOAMY SAND, HSG A. 15% Cobbles and Stones, 20% Gravel by Volume. Moist soil consistency, Friable. (Topsoil) [Laboratory Results: 75% Sand, 23% Silt, 2% Clay; USDA Classification = LOAMY SAND]
4.0				
5.0	TP-5 (2)	▽ Weeping observed at 60"	Laomy Sand	Dark Grayish Brown, LOAMY SAND, HSG A. 20% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Subsoil) [Laboratory Results: 78% Sand, 20% Silt, 2% Clay; USDA Classification = LOAMY SAND]
9.0		▼		
10.0		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 9.0' below ground surface
15.0				

TEST PIT NUMBER TP-06

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-20-2020 **START TIME** 1:15 PM
GROUND ELEVATION ± 162
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton **CHECKED BY** Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 70s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0			Sandy Loam	Brown, SANDY LOAM, HSG B. 5% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Topsoil)
				3.3
5.0	TP-6 (1)		Loamy Sand	Yellowish Brown, LOAMY SAND, HSG A. 10% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Subsoil) [Laboratory Results: 80% Sand, 18% Silt, 2% Clay; USDA Classification = LOAMY SAND]
				6.2
10.0		▽ ▼ Weeping observed at 114"	Sand	Dark Yellowish Brown, FINE SAND, HSG A. Moist soil consistency, Friable. (Substratum)
				10.0
15.0		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 10.0' below ground surface

TEST PIT NUMBER TP-07

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-20-2020
START TIME 8:05 AM
GROUND ELEVATION ± 159
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 70s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0			Loamy Sand	Brown, LOAMY SAND, HSG A. 10% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Topsoil)
				2.4
	TP-7 (1)		Loamy Sand	Dark Yellowish Brown, LOAMY SAND, HSG A. 5% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Loose. (Subsoil) [Laboratory Results: 84% Sand, 11% Silt, 5% Clay; USDA Classification = LOAMY SAND]
5.0				5.0
		▽ Evidence of ESHG Observed at 72" Weeping observed at 84"	Sand	Yellowish Brown, FINE SAND, HSG A. Moist soil consistency, Friable. Redoximorphic red staining pockets observed at approximately 6.0' below ground surface. (Substratum)
		▼		9.8
10.0		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 9.8' below ground surface
15.0				

TEST PIT NUMBER TP-08

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-20-2020
START TIME 9:30 AM
GROUND ELEVATION ± 162
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 70s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0			Loamy Sand	Brown, LOAMY SAND, HSG A. 5% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Topsoil)
1.0				
	TP-8 (1)		Sandy Loam	Dark Brown, SANDY LOAM, HSG B. 5% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Subsoil) [Laboratory Results: 64% Sand, 31% Silt, 5% Clay; USDA Classification = SANDY LOAM]
5.0				
6.0				
	TP-8 (2)	▽ Weeping observed at 108"	Loamy Sand	Light Yellowish Brown, LOAMY SAND, HSG A. 10% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Substratum) [Laboratory Results: 73% Sand, 26% Silt, 1% Clay; USDA Classification = LOAMY SAND]
10.0		▼		
12.0		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 12.0' below ground surface
15.0				

TEST PIT NUMBER TP-09

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-20-2020
START TIME 10:45 AM
GROUND ELEVATION ± 162
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 70s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0			Loamy Sand	Brown, LOAMY SAND, HSG A. 10% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Topsoil)
4.0			Sand	Pale Brown, SAND, HSG A. 5% Cobbles and Stones by Volume. Moist soil consistency, Friable. (Subsoil)
5.0	TP-9 (2)	▽ Weeping observed at 120" ▼	Sand	Dark Yellowish Brown, SAND, HSG A. 15% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Substratum) [Laboratory Results: 89% Sand, 10% Silt, 1% Clay; USDA Classification = SAND]
6.6				
10.0		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 11.2' below ground surface
11.2				
15.0				

TEST PIT NUMBER TP-10

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-20-2020
START TIME 12:00 PM
GROUND ELEVATION ± 161
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 70s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0				
5.0			Loamy Sand	Brown, LOAMY SAND, HSG A. 15% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Topsoil)
10.0	TP-10 (3)	▽ Weeping observed at 114"	Loamy Sand	Brownish Yellow, LOAMY SAND, HSG A. 5% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Subsoil) [Laboratory Results: 81% Sand, 18% Silt, 1% Clay; USDA Classification = LOAMY SAND]
12.0		▼	Sand	Light Yellowish Brown, FINE SAND, HSG A. Moist soil consistency, Friable. (Substratum)
15.0		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 12.0' below ground surface

TEST PIT NUMBER TP-11

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-21-2020
START TIME 9:00 AM
GROUND ELEVATION ± 157
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 80s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0			Loamy Sand	Brown, GRAVELLY LOAMY SAND, HSG A. 25% Cobbles and Stones, 35% Gravel by Volume. Moist soil consistency, Friable. (Topsoil)
				2.2
5.0		▽ Weeping observed at 78"	Sand	Yellowish Brown, SAND, HSG A. 5% Cobbles and Stones, 10% Gravel by Volume. Moist soil consistency, Friable. (Subsoil)
		▼		8.5
10.0		Standing groundwater observed at bottom of test pit; Sides caving in once standing water was present		Test pit terminated at approximately 8.5' below ground surface
15.0				

TEST PIT NUMBER TP-12

TETRA TECH

CLIENT ADESA
PROJECT NAME ADESA Holliston
PROJECT NUMBER 143-1298-20004
PROJECT LOCATION Lowland Street, Holliston, Massachusetts
DATE 8-21-2020
START TIME 10:35 PM
GROUND ELEVATION ± 157
EXCAVATION CONTRACTOR Northern Drill Service, Inc.
GROUNDWATER SYMBOLS:
EXCAVATION METHOD Excavator
▽ **ESTIMATED SEASONAL HIGH GROUNDWATER**
LOGGED BY Chris Stanton
CHECKED BY Matt Moyen, PE
▼ **GROUNDWATER**
WEATHER Partly cloudy; Temperature in the 80s

DEPTH (ft)	SAMPLE NUMBER	REMARKS	Soil Texture (USDA)	SUBSURFACE DESCRIPTION
0.0				0.5 Asphalt
	TP-12 (2)		Loamy Sand	Yellowish Brown, LOAMY SAND, HSG A. 10% Cobbles and Stones, 15% Gravel by Volume. Moist soil consistency, Friable. Redeximorphic red staining pockets observed at approximately 4.2' below ground surface. (Subsoil) [Laboratory Results: 77% Sand, 22% Silt, 1% Clay; USDA Classification = LOAMY SAND]
5.0		▽ Evidence of ESHG Observed at 50"		5.0
		Weeping observed at 84" ▼	Loamy Sand	Light Yellowish Brown, GRAVELLY LOAMY SAND, HSG A. 30% Cobbles and Stones, 50% Gravel by Volume. Moist soil consistency, Friable. (Substratum)
				8.0
		Standing groundwater observed at bottom of test pit		Test pit terminated at approximately 8.0' below ground surface
10.0				
15.0				

Appendix B

Soil Laboratory Testing Results

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-2	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576972		
Test Comment:	---				
Visual Description:	Moist, olive brown sandy silt				
Sample Comment:	---				

USDA Textural Classification

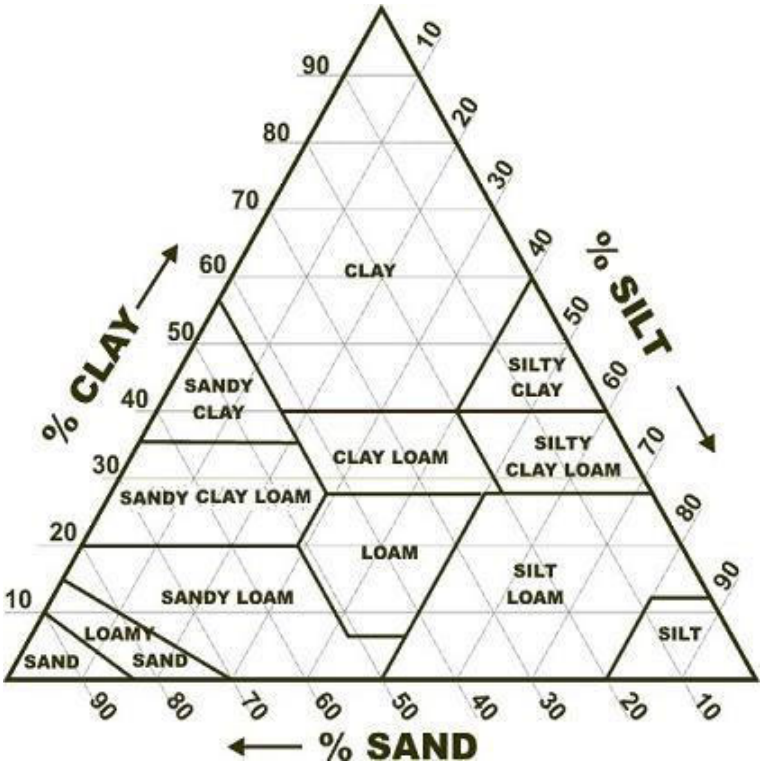
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(1)	TP-2	---	52	46	2	Sandy Loam

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter

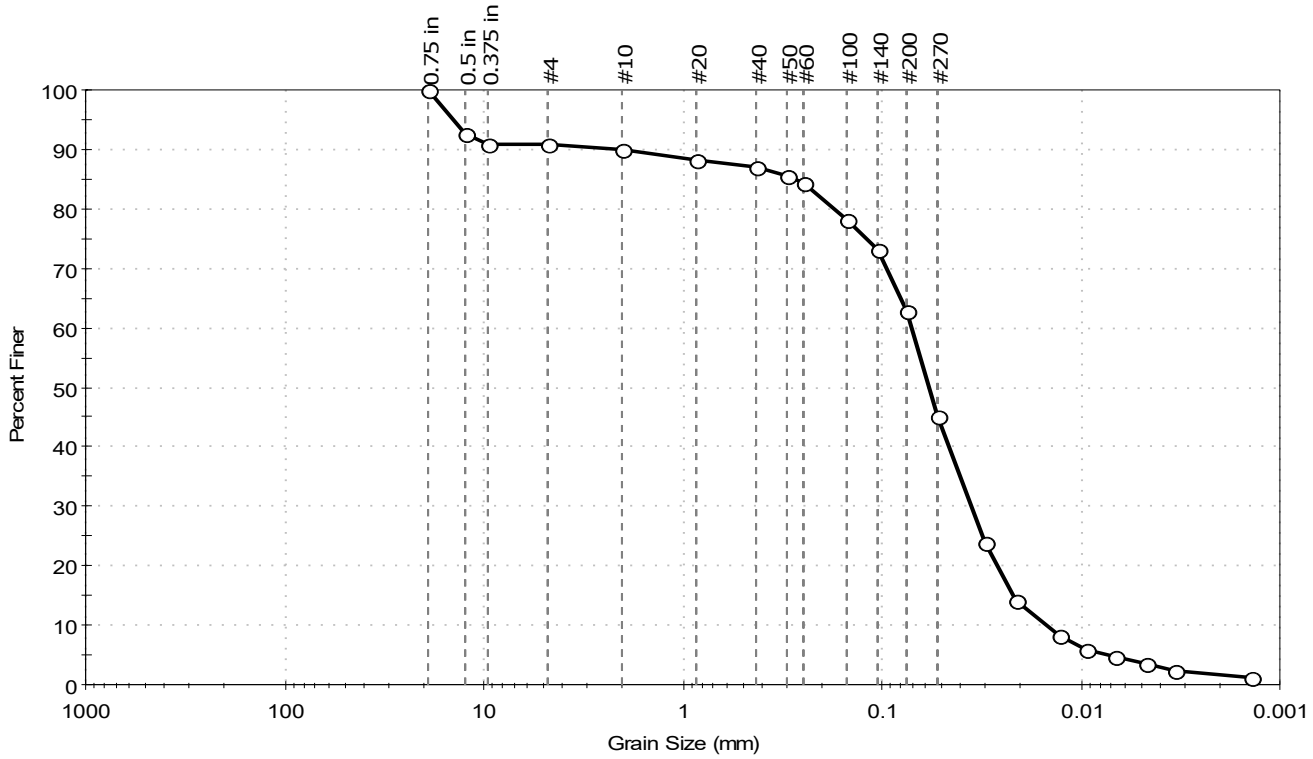


GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-2	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576952		

Test Comment: ---
Visual Description: Moist, olive brown sandy silt
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	9.2	28.0	62.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	93		
0.375 in	9.50	91		
#4	4.75	91		
#10	2.00	90		
#20	0.85	88		
#40	0.42	87		
#50	0.30	86		
#60	0.25	84		
#100	0.15	78		
#140	0.11	73		
#200	0.075	63		
#270	0.053	45		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0305	24		
---	0.0213	14		
---	0.0128	8		
---	0.0094	6		
---	0.0068	5		
---	0.0048	4		
---	0.0034	2		
---	0.0014	1		

Coefficients

D_{85} = 0.2777 mm
D_{30} = 0.0358 mm
D_{60} = 0.0710 mm
D_{15} = 0.0219 mm
D_{50} = 0.0584 mm
D_{10} = 0.0148 mm
C_u = 4.797
C_c = 1.220

Classification

ASTM N/A

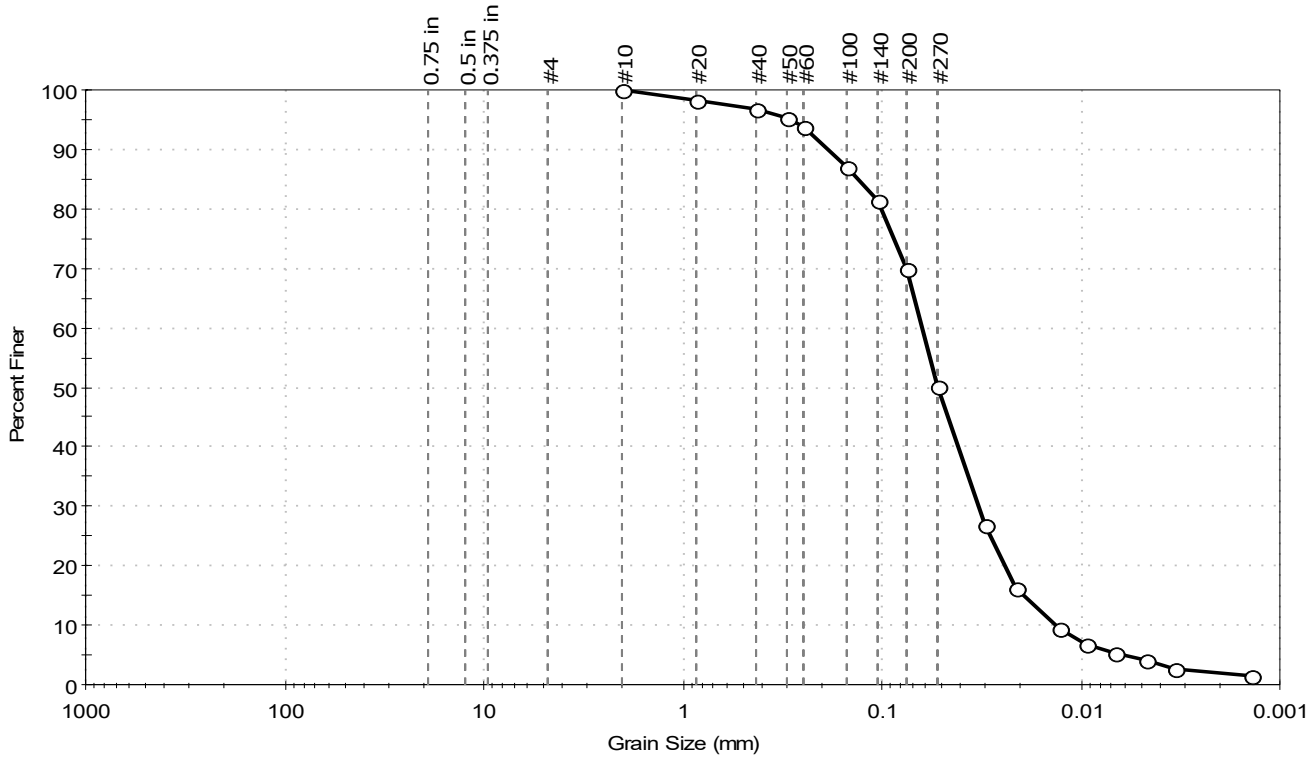
AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-2	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576952		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown sandy silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	30.2	69.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	98		
#40	0.42	97		
#50	0.30	95		
#60	0.25	94		
#100	0.15	87		
#140	0.11	82		
#200	0.075	70		
#270	0.053	50		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0305	27		
---	0.0213	16		
---	0.0128	9		
---	0.0094	7		
---	0.0068	5		
---	0.0048	4		
---	0.0034	3		
---	0.0014	1		

Coefficients

D_{85} = 0.1325 mm
D_{30} = 0.0328 mm
D_{60} = 0.0631 mm
D_{15} = 0.0196 mm
D_{50} = 0.0528 mm
D_{10} = 0.0134 mm
C_u = 4.709
C_c = 1.272

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-3	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576977		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

USDA Textural Classification

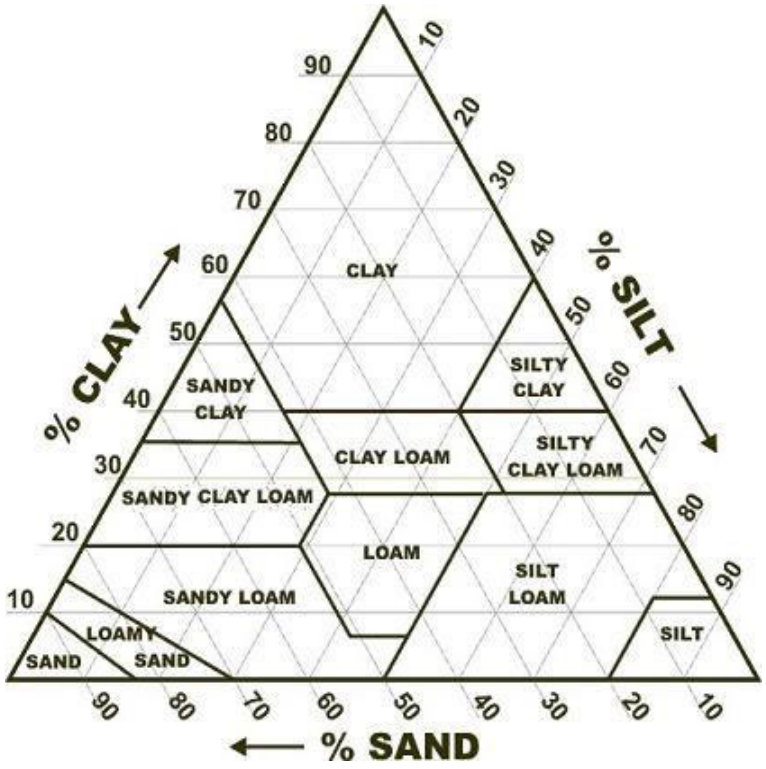
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(1)	TP-3	---	83	17	0	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter

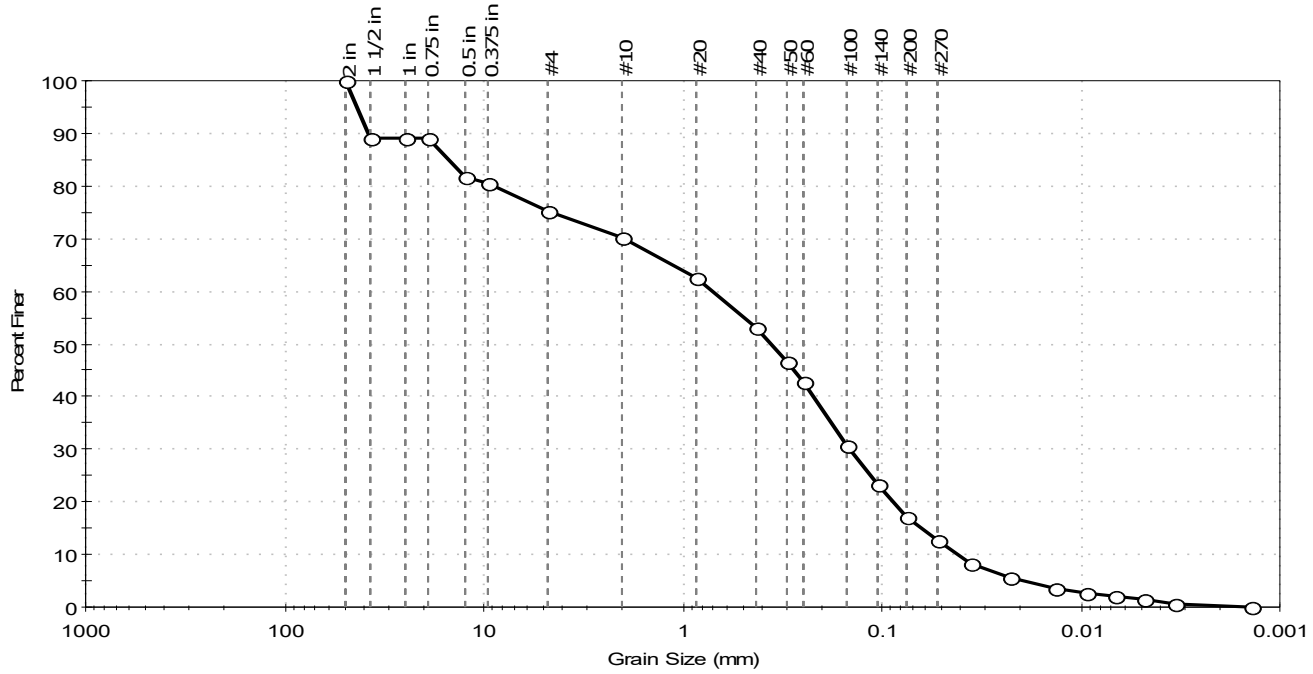


GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-3	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576957		

Test Comment: ---
Visual Description: Moist, olive brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	24.6	58.2	17.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
2 in	50.00	100		
1 1/2 in	37.50	89		
1 in	25.00	89		
0.75 in	19.00	89		
0.5 in	12.50	82		
0.375 in	9.50	80		
#4	4.75	75		
#10	2.00	70		
#20	0.85	63		
#40	0.42	53		
#50	0.30	47		
#60	0.25	43		
#100	0.15	31		
#140	0.11	23		
#200	0.075	17		
#270	0.053	13		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0354	8		
---	0.0229	6		
---	0.0135	3		
---	0.0095	3		
---	0.0068	2		
---	0.0048	1		
---	0.0034	1		
---	0.0014	0		

Coefficients

D_{85} = 15.1136 mm
D_{30} = 0.1455 mm
D_{60} = 0.7042 mm
D_{15} = 0.0638 mm
D_{50} = 0.3607 mm
D_{10} = 0.0415 mm
C_u = 16.969
C_c = 0.724

Classification

ASTM N/A

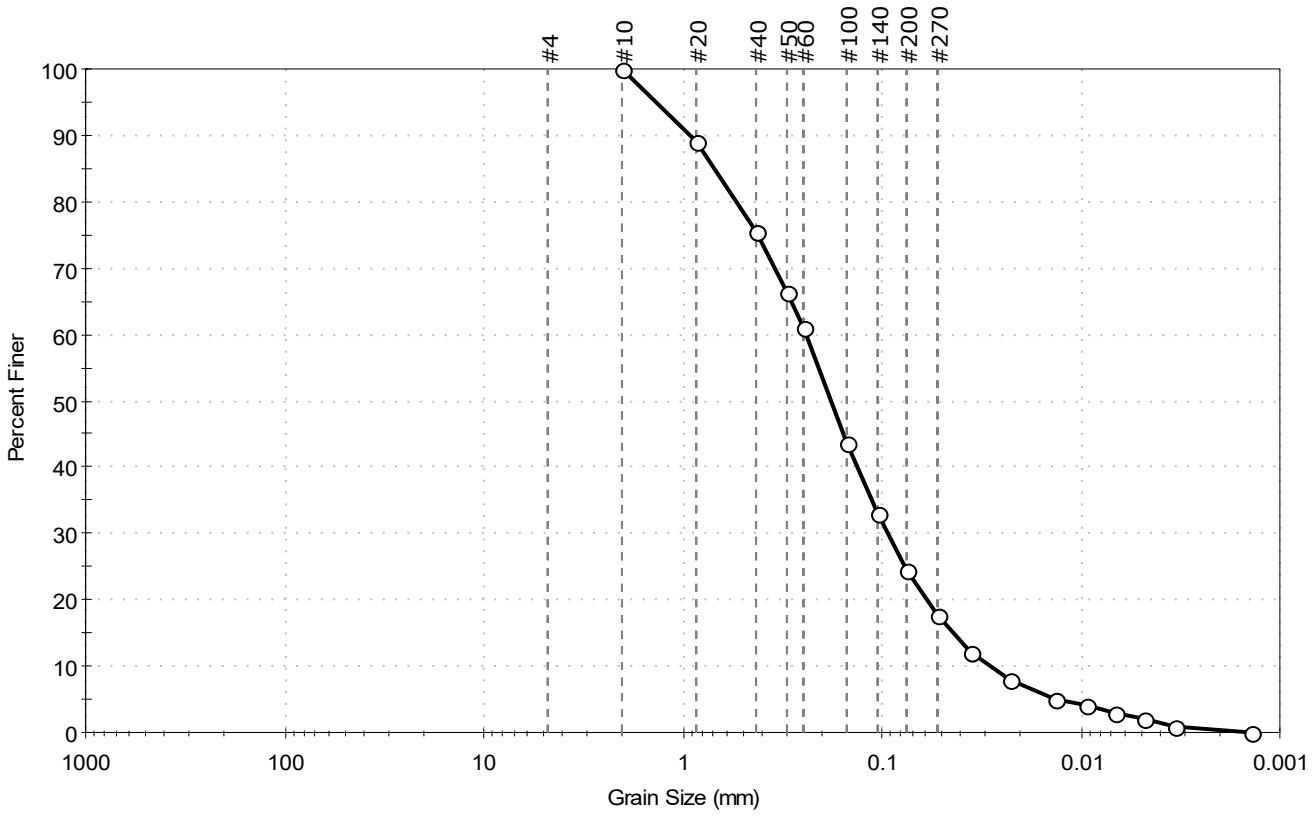
AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-3	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576957		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	75.6	24.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	89		
#40	0.42	75		
#50	0.30	66		
#60	0.25	61		
#100	0.15	44		
#140	0.11	33		
#200	0.075	24		
#270	0.053	18		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0354	12		
---	0.0229	8		
---	0.0135	5		
---	0.0095	4		
---	0.0068	3		
---	0.0048	2		
---	0.0034	1		
---	0.0014	0		

Coefficients

D_{85} = 0.6938 mm	D_{30} = 0.0938 mm
D_{60} = 0.2427 mm	D_{15} = 0.0434 mm
D_{50} = 0.1811 mm	D_{10} = 0.0281 mm
C_u = 8.637	C_c = 1.290

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-5	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576973		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

USDA Textural Classification

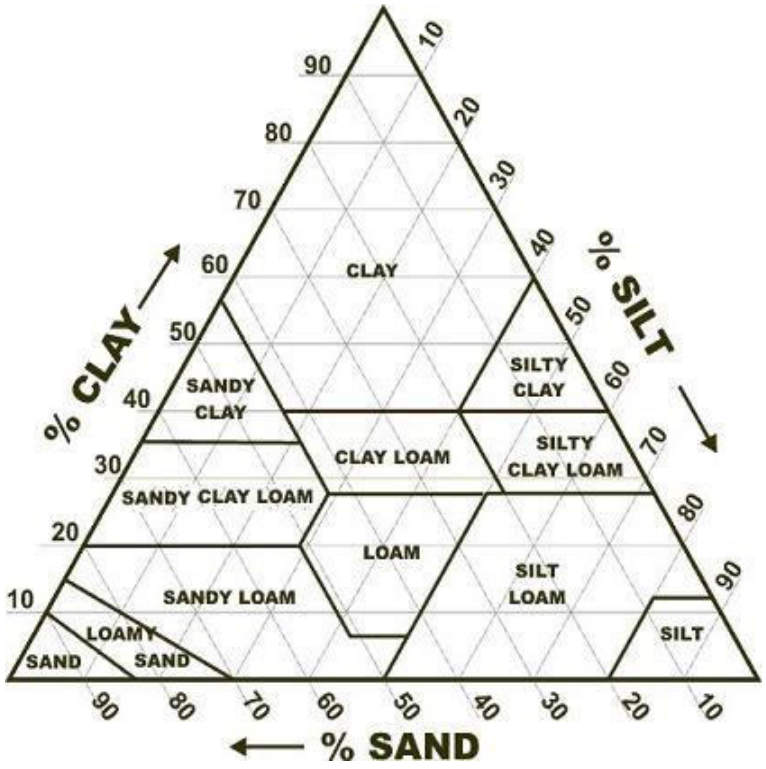
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(1)	TP-5	---	75	23	2	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

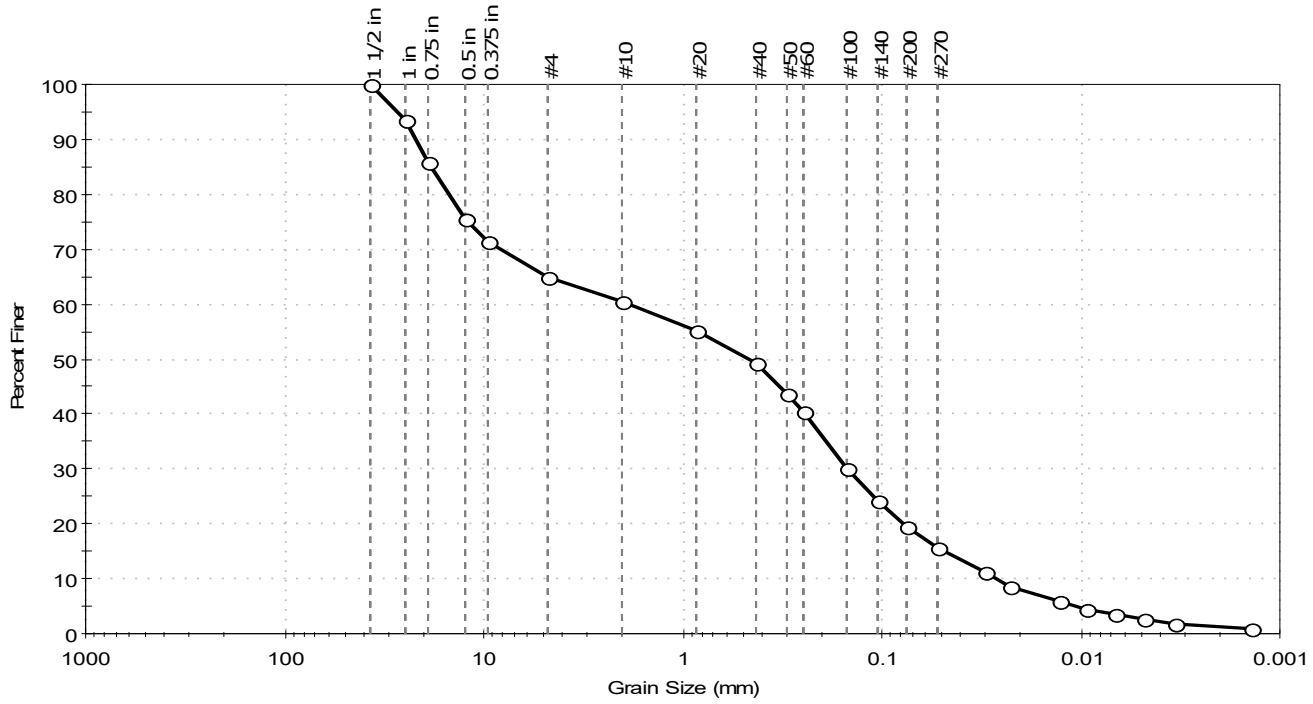
Clay: material passing 0.002 mm diameter



Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-5	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576953		

Test Comment: ---
Visual Description: Moist, olive brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	35.1	45.5	19.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 1/2 in	37.50	100		
1 in	25.00	94		
0.75 in	19.00	86		
0.5 in	12.50	75		
0.375 in	9.50	71		
#4	4.75	65		
#10	2.00	60		
#20	0.85	55		
#40	0.42	49		
#50	0.30	44		
#60	0.25	41		
#100	0.15	30		
#140	0.11	24		
#200	0.075	19		
#270	0.053	16		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0300	11		
---	0.0227	9		
---	0.0129	6		
---	0.0094	4		
---	0.0067	3		
---	0.0048	3		
---	0.0034	2		
---	0.0014	1		

Coefficients

D_{85} = 18.3180 mm D_{30} = 0.1489 mm
D_{60} = 1.8611 mm D_{15} = 0.0484 mm
D_{50} = 0.4622 mm D_{10} = 0.0264 mm
C_u = 70.496 C_c = 0.451

Classification

ASTM N/A

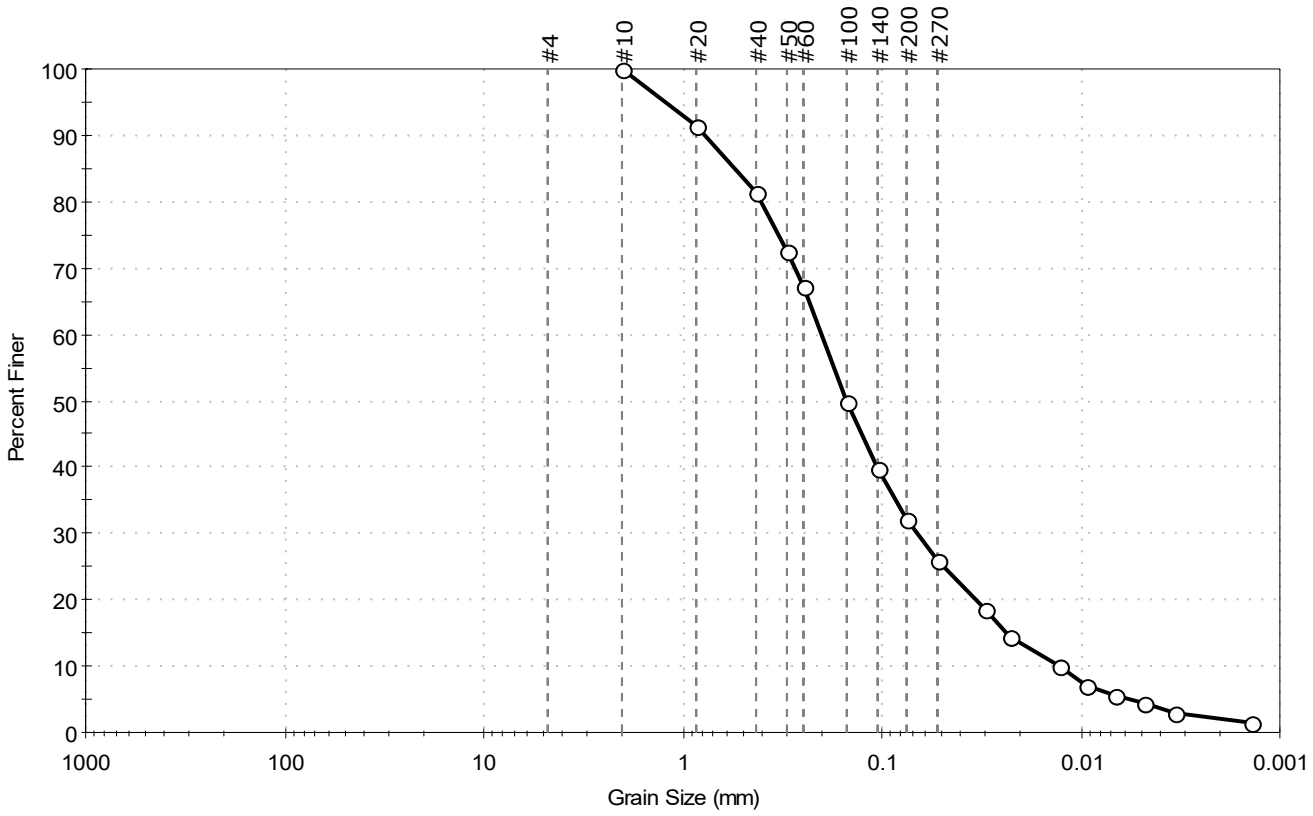
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-5	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576953		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	67.9	32.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	91		
#40	0.42	82		
#50	0.30	72		
#60	0.25	67		
#100	0.15	50		
#140	0.11	40		
#200	0.075	32		
#270	0.053	26		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0300	19		
---	0.0227	14		
---	0.0129	10		
---	0.0094	7		
---	0.0067	6		
---	0.0048	4		
---	0.0034	3		
---	0.0014	1		

Coefficients

D_{85} = 0.5412 mm	D_{30} = 0.0664 mm
D_{60} = 0.2025 mm	D_{15} = 0.0237 mm
D_{50} = 0.1506 mm	D_{10} = 0.0128 mm
C_u = 15.820	C_c = 1.701

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-6	Test Date:	09/15/20	Checked By:	n/a
Depth :	---	Test Id:	576966		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

USDA Textural Classification

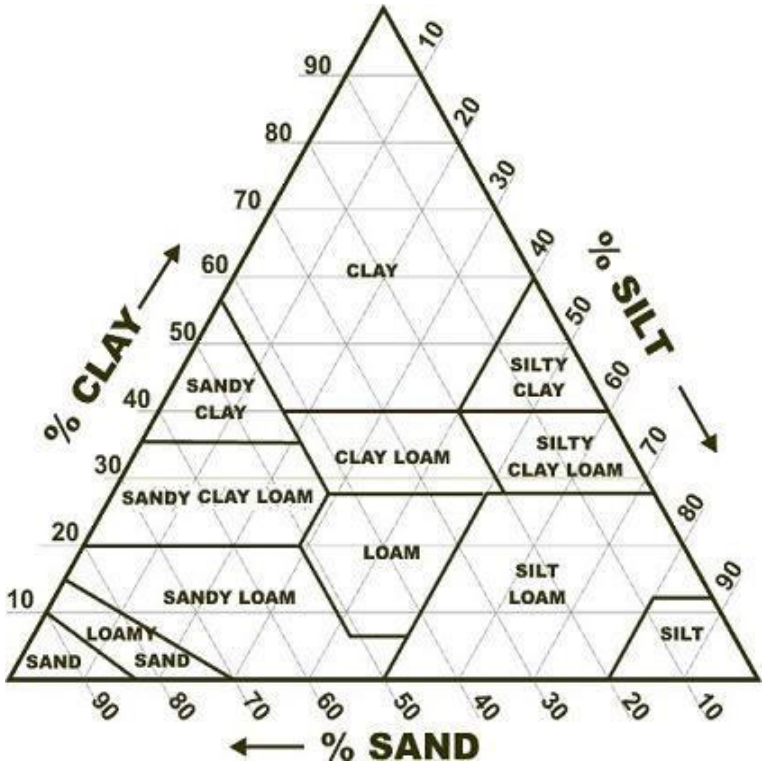
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(1)	TP-6	---	80	18	2	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter

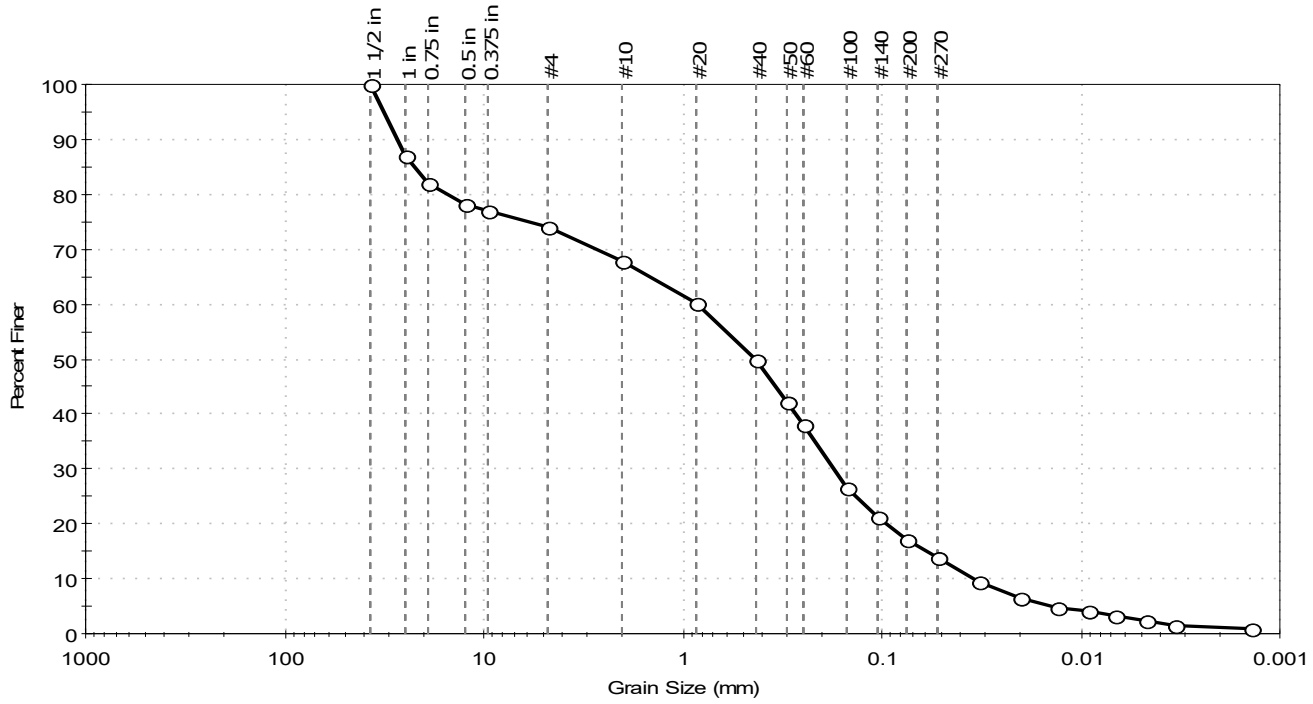


GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-6	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576946		

Test Comment: ---
Visual Description: Moist, olive brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	25.9	57.0	17.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 1/2 in	37.50	100		
1 in	25.00	87		
0.75 in	19.00	82		
0.5 in	12.50	78		
0.375 in	9.50	77		
#4	4.75	74		
#10	2.00	68		
#20	0.85	60		
#40	0.42	50		
#50	0.30	42		
#60	0.25	38		
#100	0.15	27		
#140	0.11	21		
#200	0.075	17		
#270	0.053	14		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0325	10		
---	0.0202	6		
---	0.0132	5		
---	0.0093	4		
---	0.0067	3		
---	0.0047	2		
---	0.0034	2		
---	0.0014	1		

Coefficients

D_{85} = 22.4513 mm
D_{30} = 0.1744 mm
D_{60} = 0.8435 mm
D_{15} = 0.0599 mm
D_{50} = 0.4306 mm
D_{10} = 0.0341 mm
C_u = 24.736
C_c = 1.057

Classification

ASTM N/A

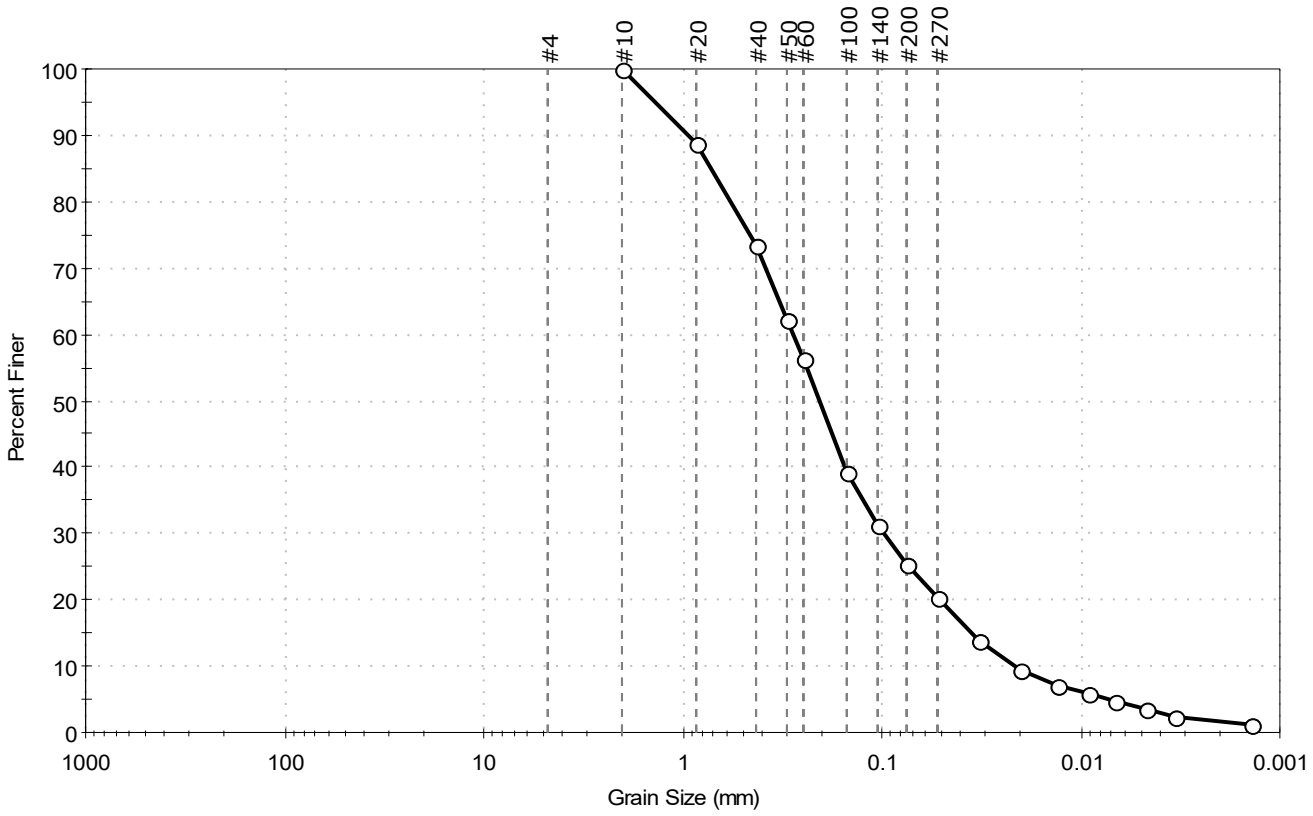
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-6	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576946		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	74.8	25.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	89		
#40	0.42	73		
#50	0.30	62		
#60	0.25	56		
#100	0.15	39		
#140	0.11	31		
#200	0.075	25		
#270	0.053	20		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0325	14		
---	0.0202	9		
---	0.0132	7		
---	0.0093	6		
---	0.0067	5		
---	0.0047	4		
---	0.0034	2		
---	0.0014	1		

Coefficients

D_{85} = 0.7193 mm	D_{30} = 0.0992 mm
D_{60} = 0.2796 mm	D_{15} = 0.0351 mm
D_{50} = 0.2071 mm	D_{10} = 0.0216 mm
C_u = 12.944	C_c = 1.629

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-7	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576963		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

USDA Textural Classification

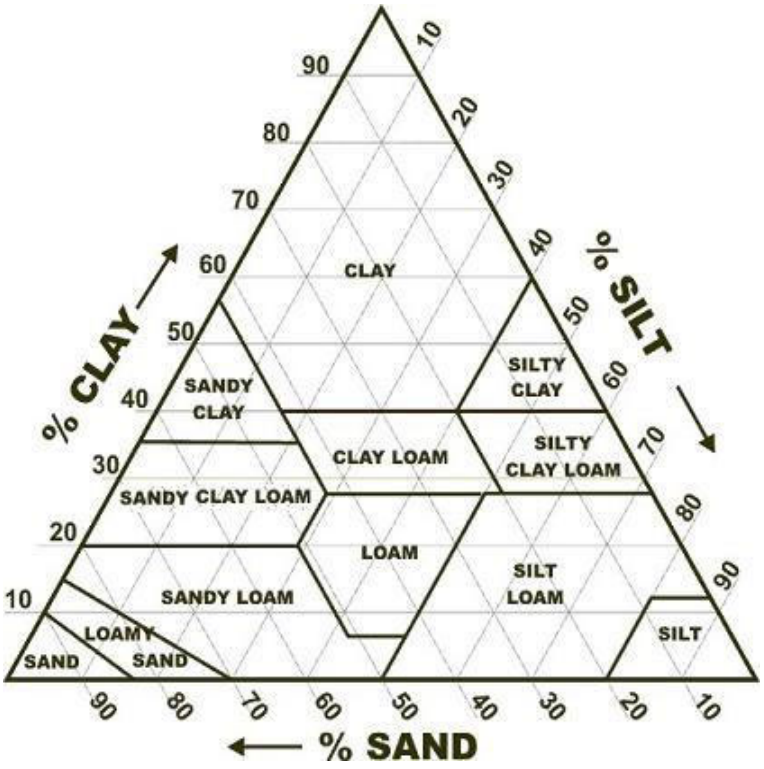
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(1)	TP-7	---	84	11	5	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

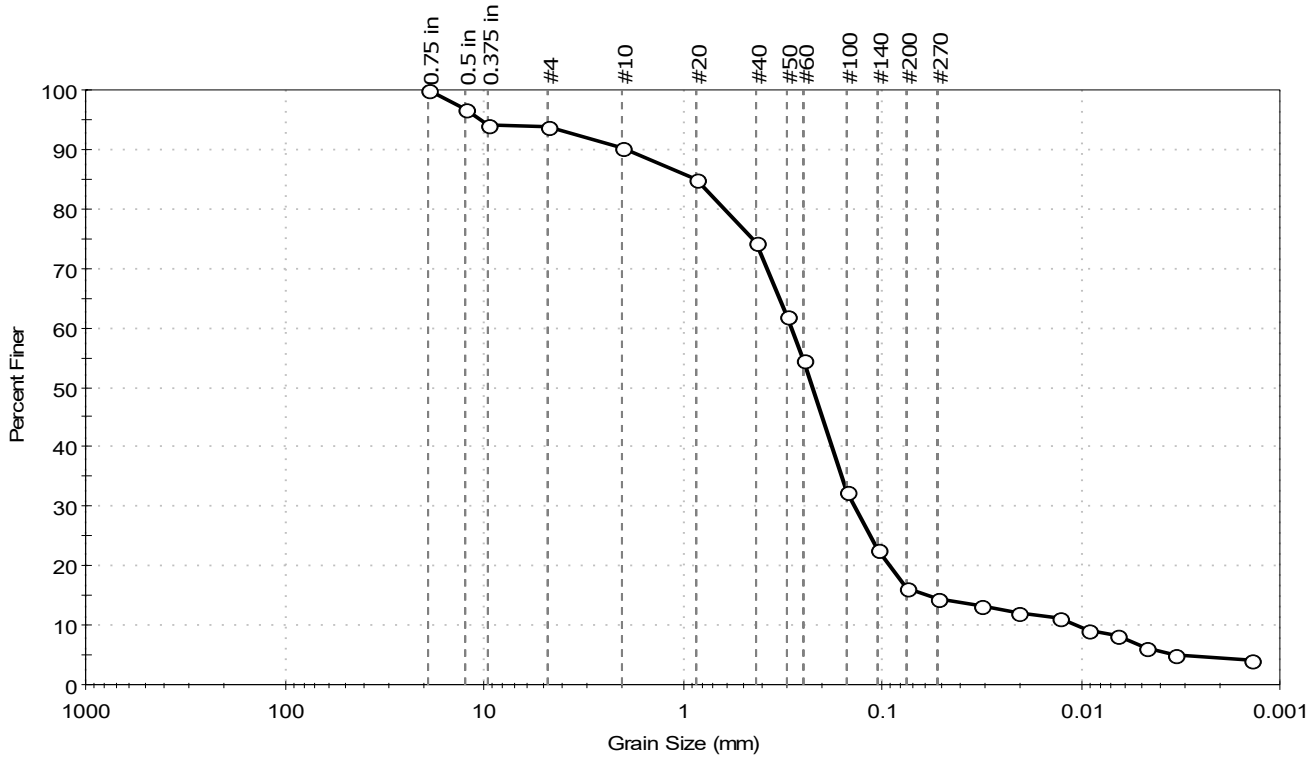
Clay: material passing 0.002 mm diameter



Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-7	Test Date:	09/10/20	Checked By:	bfs
Depth :	---	Test Id:	576943		

Test Comment: ---
Visual Description: Moist, olive brown silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	6.3	77.6	16.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	94		
#4	4.75	94		
#10	2.00	90		
#20	0.85	85		
#40	0.42	74		
#50	0.30	62		
#60	0.25	55		
#100	0.15	33		
#140	0.11	23		
#200	0.075	16		
#270	0.053	14		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0322	13		
---	0.0206	12		
---	0.0129	11		
---	0.0091	9		
---	0.0065	8		
---	0.0047	6		
---	0.0033	5		
---	0.0014	4		

Coefficients

D_{85} = 0.8655 mm D_{30} = 0.1370 mm
D_{60} = 0.2858 mm D_{15} = 0.0599 mm
D_{50} = 0.2251 mm D_{10} = 0.0106 mm
C_u = 26.962 C_c = 6.195

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

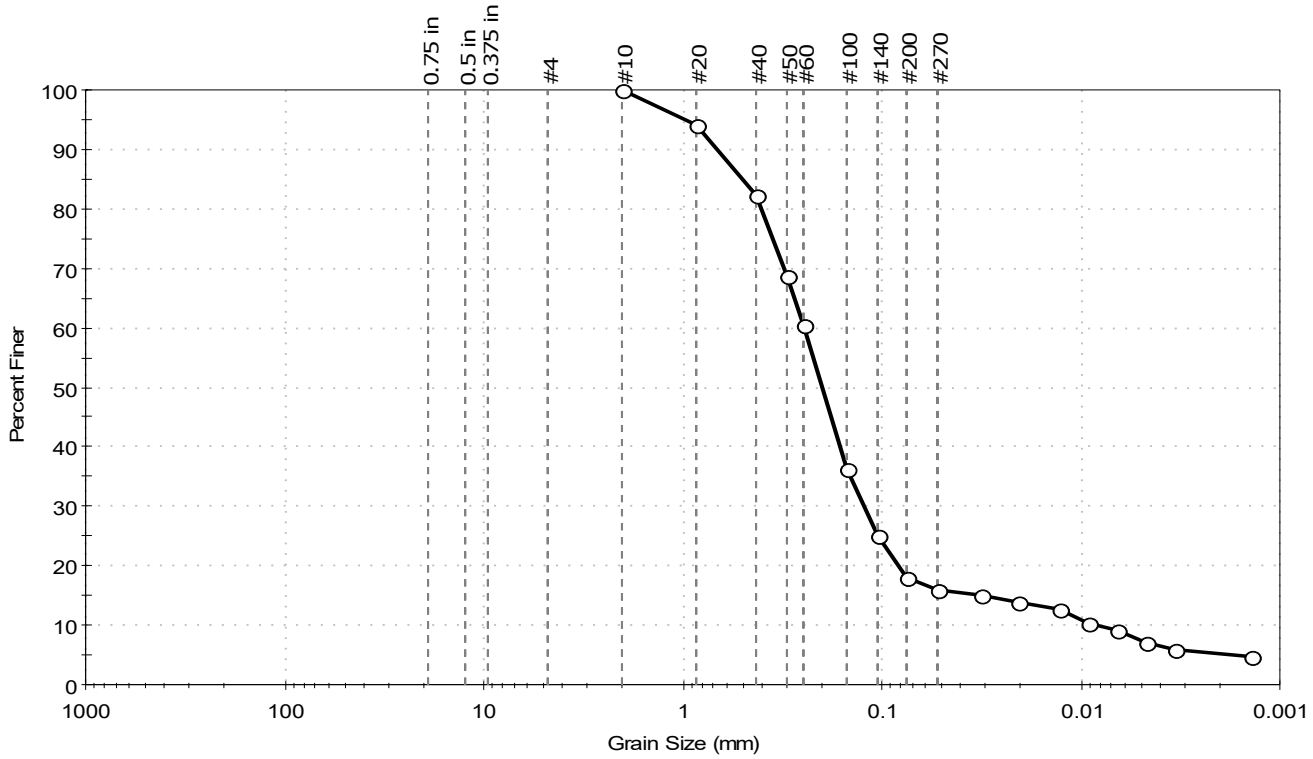
Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-7	Test Date:	09/10/20	Checked By:	bfs
Depth :	---	Test Id:	576943		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	82.1	17.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	94		
#40	0.42	82		
#50	0.30	69		
#60	0.25	60		
#100	0.15	36		
#140	0.11	25		
#200	0.075	18		
#270	0.053	16		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0322	15		
---	0.0206	14		
---	0.0129	13		
---	0.0091	10		
---	0.0065	9		
---	0.0047	7		
---	0.0033	6		
---	0.0014	5		

Coefficients

D_{85} =0.4967 mm	D_{30} =0.1235 mm
D_{60} =0.2476 mm	D_{15} =0.0310 mm
D_{50} =0.2007 mm	D_{10} =0.0080 mm
C_u =30.950	C_c =7.700

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	Tp-8	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576960		
Test Comment:	---				
Visual Description:	Moist, very dark brown silty gravel with sand				
Sample Comment:	---				

USDA Textural Classification

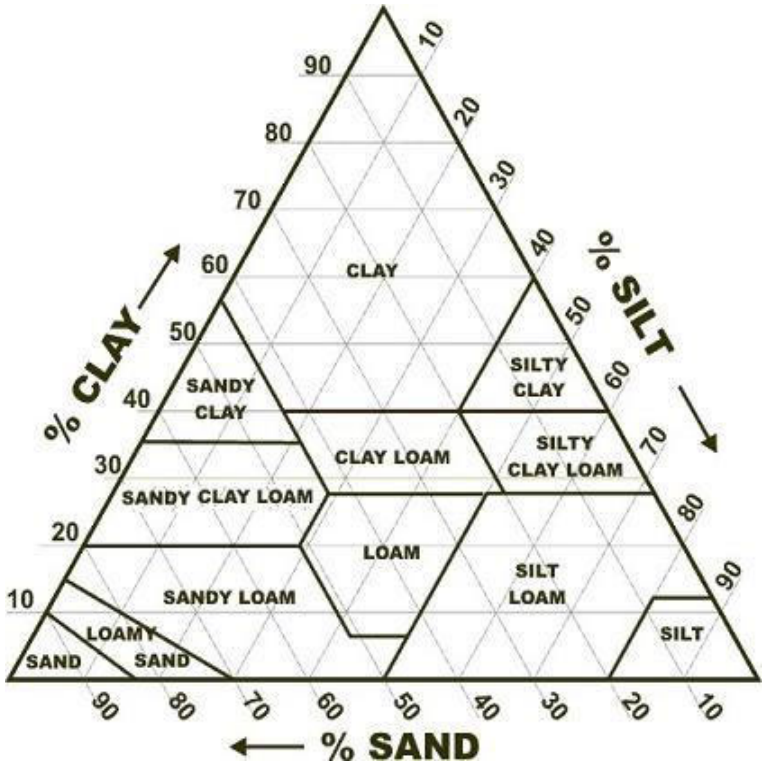
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(1)	Tp-8	---	64	31	5	Sandy Loam

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter

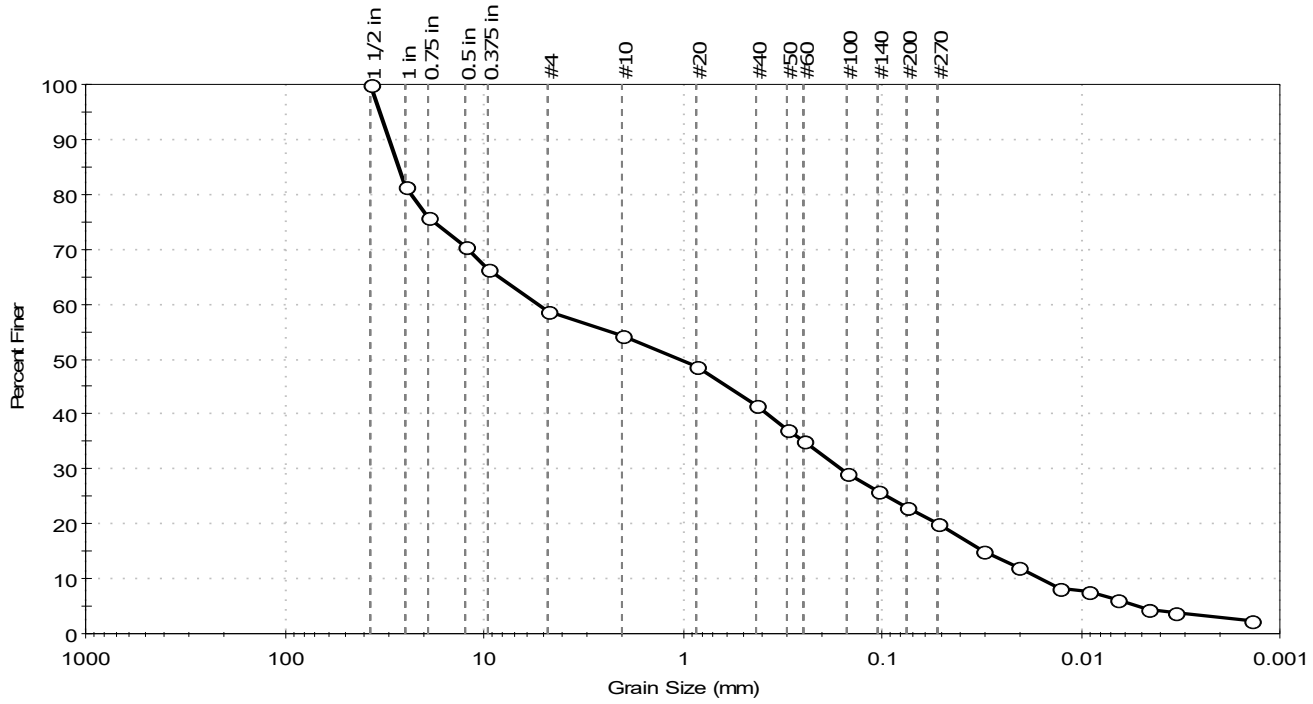


GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	Tp-8	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576940		

Test Comment: ---
Visual Description: Moist, very dark brown silty gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	41.3	35.6	23.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 1/2 in	37.50	100		
1 in	25.00	81		
0.75 in	19.00	76		
0.5 in	12.50	71		
0.375 in	9.50	67		
#4	4.75	59		
#10	2.00	54		
#20	0.85	49		
#40	0.42	42		
#50	0.30	37		
#60	0.25	35		
#100	0.15	29		
#140	0.11	26		
#200	0.075	23		
#270	0.053	20		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0309	15		
---	0.0206	12		
---	0.0128	8		
---	0.0091	8		
---	0.0066	6		
---	0.0047	5		
---	0.0033	4		
---	0.0014	2		

Coefficients

D_{85} = 27.0698 mm D_{30} = 0.1619 mm
D_{60} = 5.3162 mm D_{15} = 0.0301 mm
D_{50} = 1.0514 mm D_{10} = 0.0157 mm
C_u = 338.611 C_c = 0.314

Classification

ASTM N/A

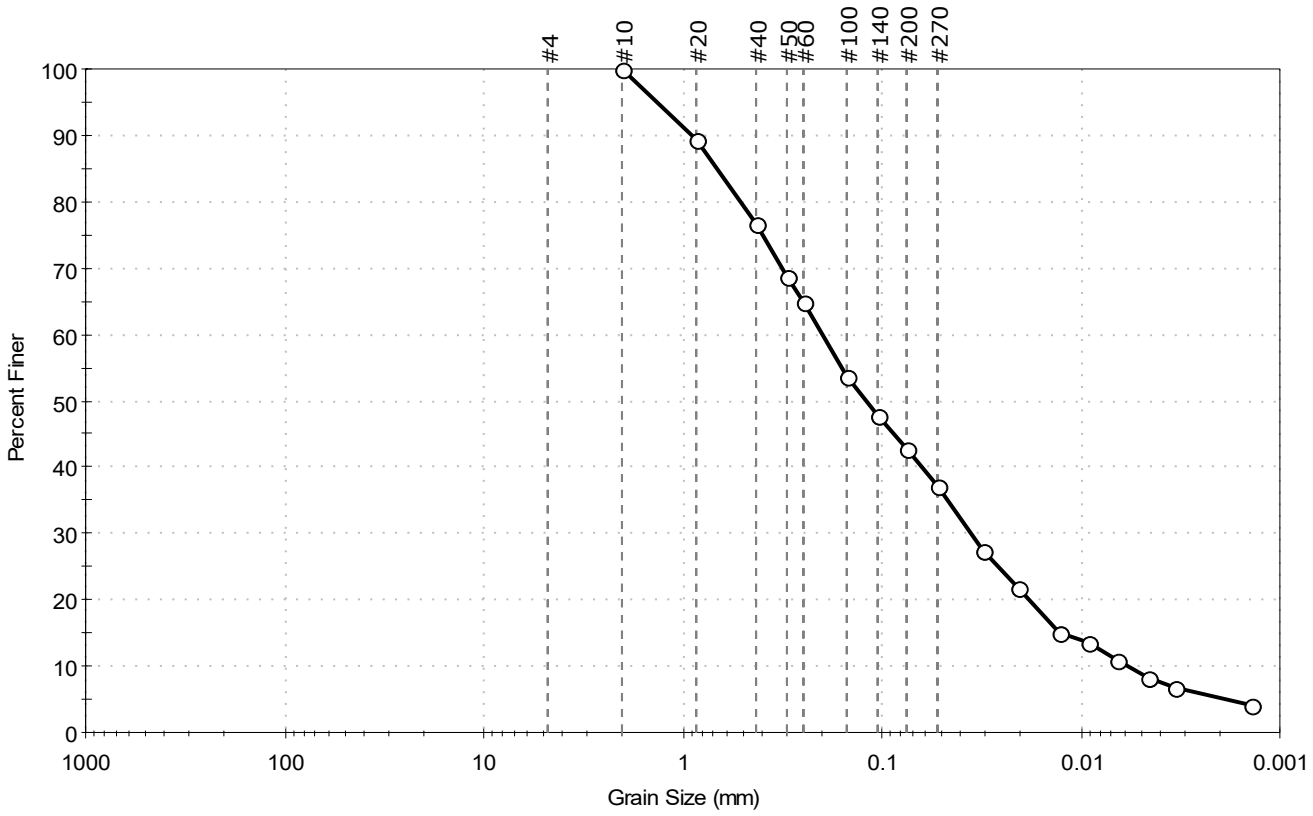
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(1)	Sample Type:	bag	Tested By:	ckg
Sample ID:	Tp-8	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576940		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, very dark brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	57.4	42.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	90		
#40	0.42	77		
#50	0.30	69		
#60	0.25	65		
#100	0.15	54		
#140	0.11	48		
#200	0.075	43		
#270	0.053	37		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0309	27		
---	0.0206	22		
---	0.0128	15		
---	0.0091	14		
---	0.0066	11		
---	0.0047	8		
---	0.0033	7		
---	0.0014	4		

Coefficients

D_{85} = 0.6646 mm	D_{30} = 0.0358 mm
D_{60} = 0.2009 mm	D_{15} = 0.0127 mm
D_{50} = 0.1215 mm	D_{10} = 0.0058 mm
C_u = 34.638	C_c = 1.100

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-3	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576974		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

USDA Textural Classification

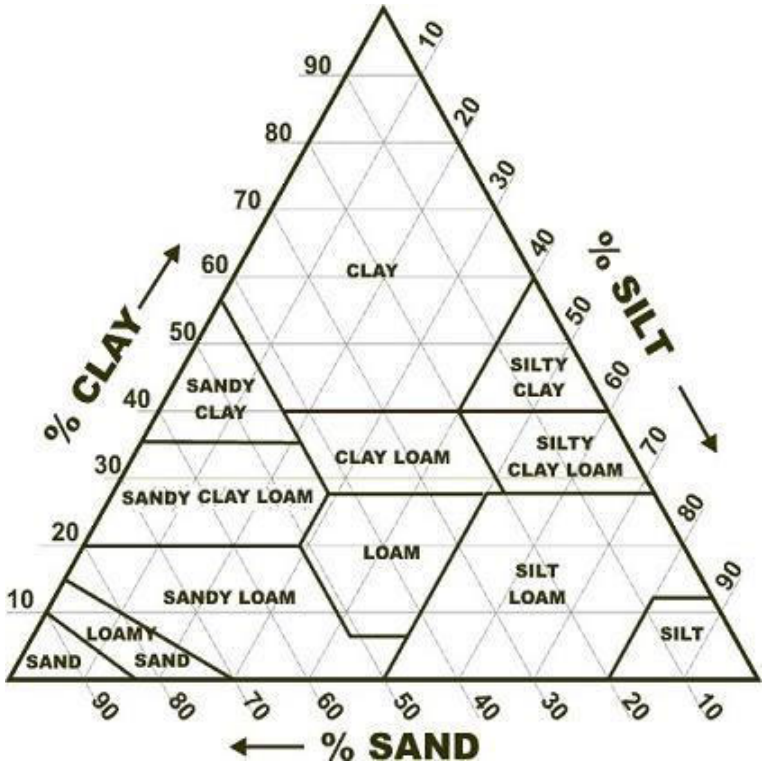
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(2)	TP-3	---	60	37	3	Sandy Loam

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

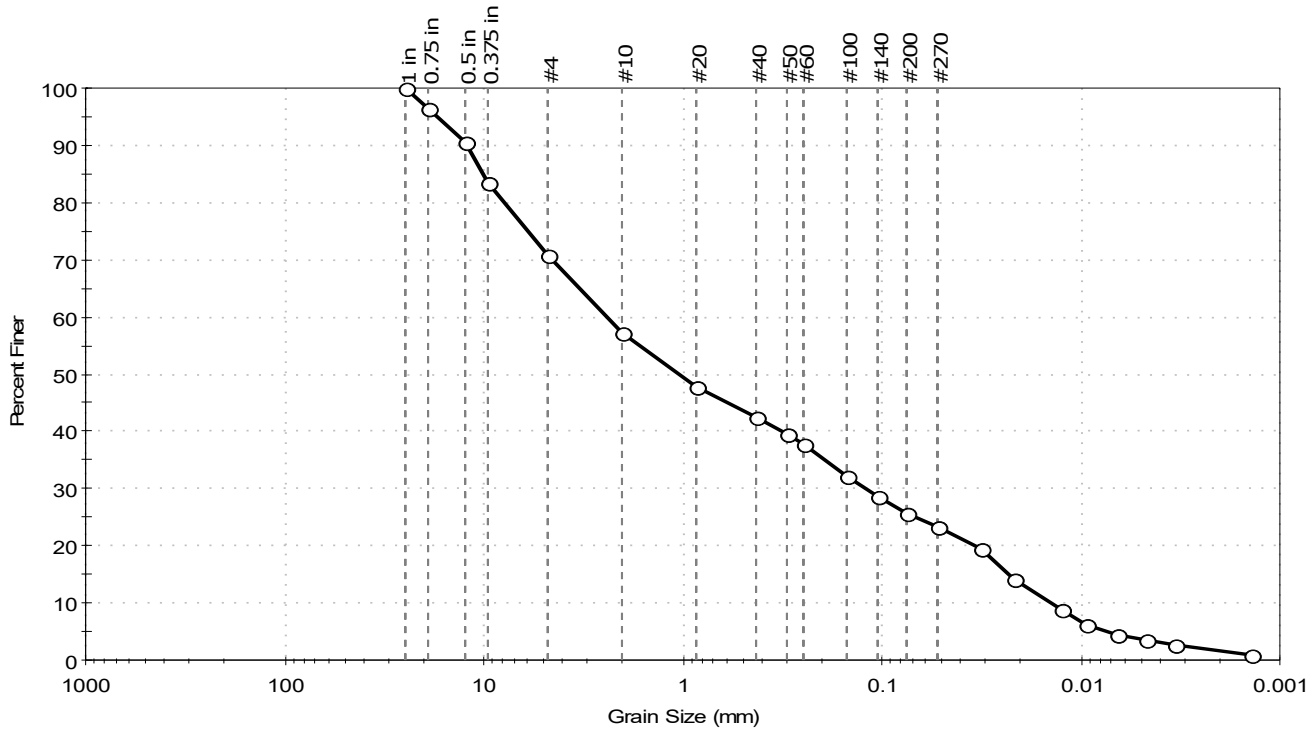
Clay: material passing 0.002 mm diameter



GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-3	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576954		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	29.1	45.2	25.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	96		
0.5 in	12.50	91		
0.375 in	9.50	83		
#4	4.75	71		
#10	2.00	57		
#20	0.85	48		
#40	0.42	43		
#50	0.30	39		
#60	0.25	38		
#100	0.15	32		
#140	0.11	29		
#200	0.075	26		
#270	0.053	23		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0318	19		
---	0.0216	14		
---	0.0127	9		
---	0.0094	6		
---	0.0067	4		
---	0.0048	4		
---	0.0034	3		
---	0.0014	1		

Coefficients

D_{85} = 10.0664 mm D_{30} = 0.1212 mm
D_{60} = 2.3931 mm D_{15} = 0.0229 mm
D_{50} = 1.0403 mm D_{10} = 0.0142 mm
C_u = 168.528 C_c = 0.432

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

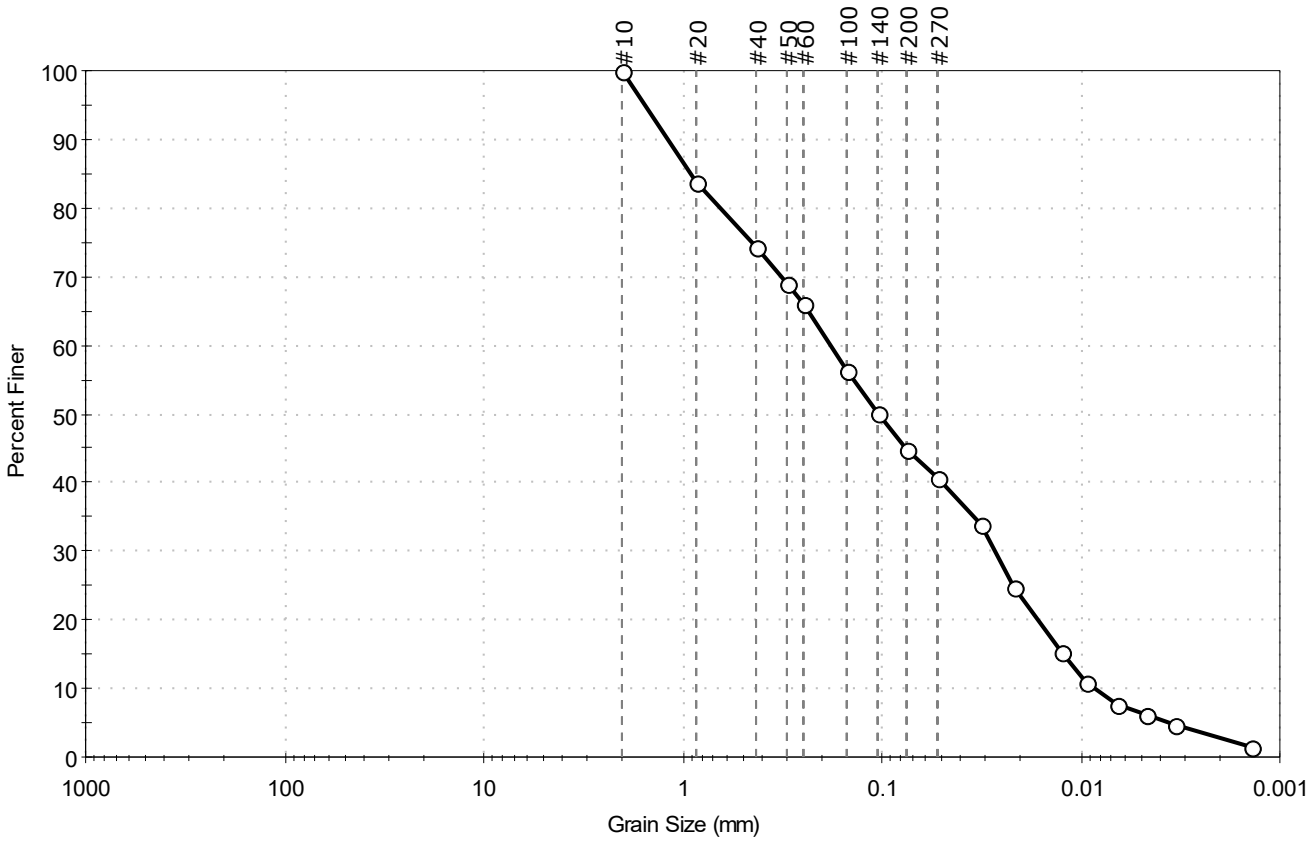
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-3	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576954		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	55.1	44.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	84		
#40	0.42	74		
#50	0.30	69		
#60	0.25	66		
#100	0.15	56		
#140	0.11	50		
#200	0.075	45		
#270	0.053	41		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0318	34		
---	0.0216	25		
---	0.0127	15		
---	0.0094	11		
---	0.0067	8		
---	0.0048	6		
---	0.0034	5		
---	0.0014	2		

Coefficients

D_{85} = 0.9128 mm	D_{30} = 0.0270 mm
D_{60} = 0.1810 mm	D_{15} = 0.0124 mm
D_{50} = 0.1057 mm	D_{10} = 0.0086 mm
C_u = 21.047	C_c = 0.468

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-4	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576967		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

USDA Textural Classification

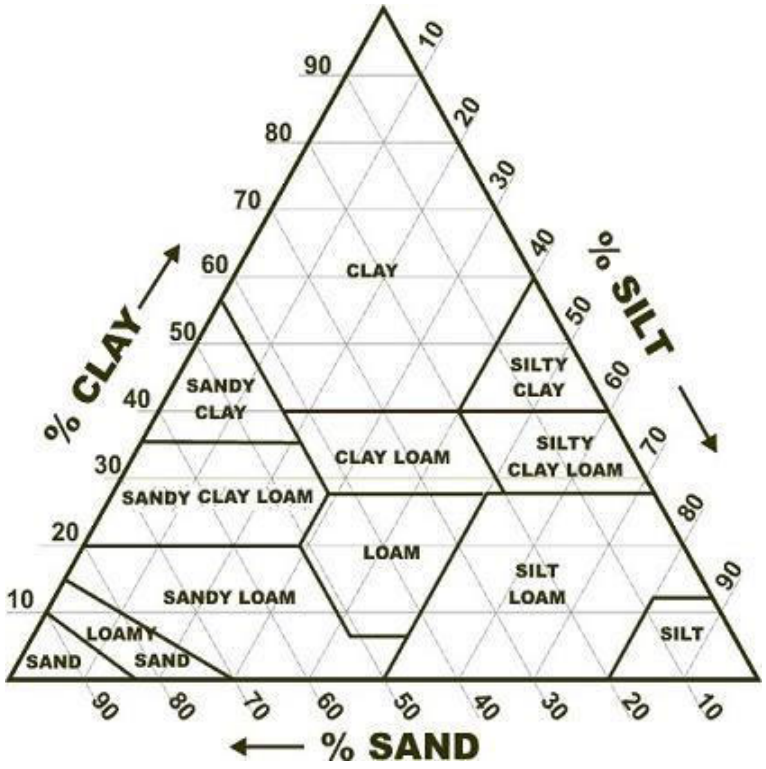
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(2)	TP-4	---	86	14	0	Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

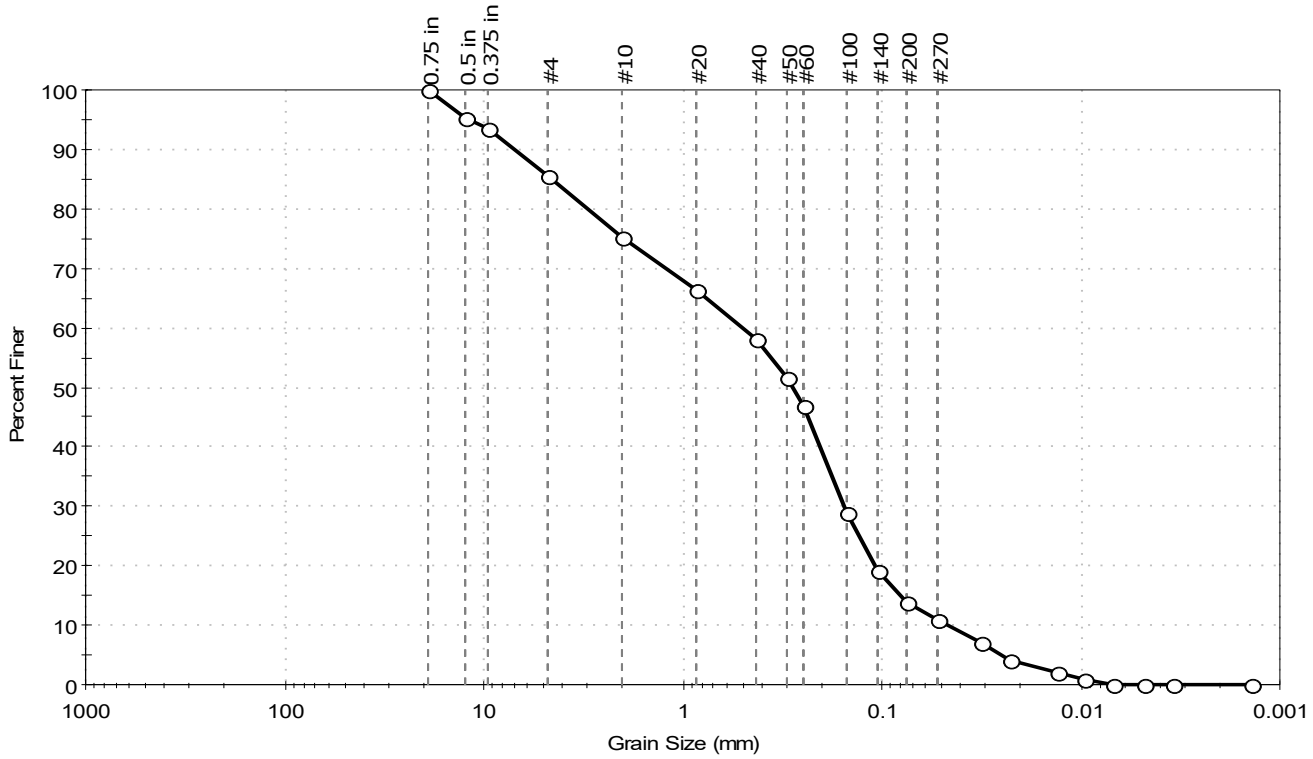
Clay: material passing 0.002 mm diameter



Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-4	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576947		

Test Comment: ---
Visual Description: Moist, olive brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	14.4	71.8	13.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	95		
0.375 in	9.50	94		
#4	4.75	86		
#10	2.00	75		
#20	0.85	66		
#40	0.42	58		
#50	0.30	51		
#60	0.25	47		
#100	0.15	29		
#140	0.11	19		
#200	0.075	14		
#270	0.053	11		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0317	7		
---	0.0227	4		
---	0.0130	2		
---	0.0097	1		
---	0.0068	0		
---	0.0049	0		
---	0.0034	0		
---	0.0014	0		

Coefficients

D_{85} = 4.5071 mm D_{30} = 0.1551 mm
D_{60} = 0.4966 mm D_{15} = 0.0808 mm
D_{50} = 0.2827 mm D_{10} = 0.0470 mm
C_u = 10.566 C_c = 1.031

Classification

ASTM N/A

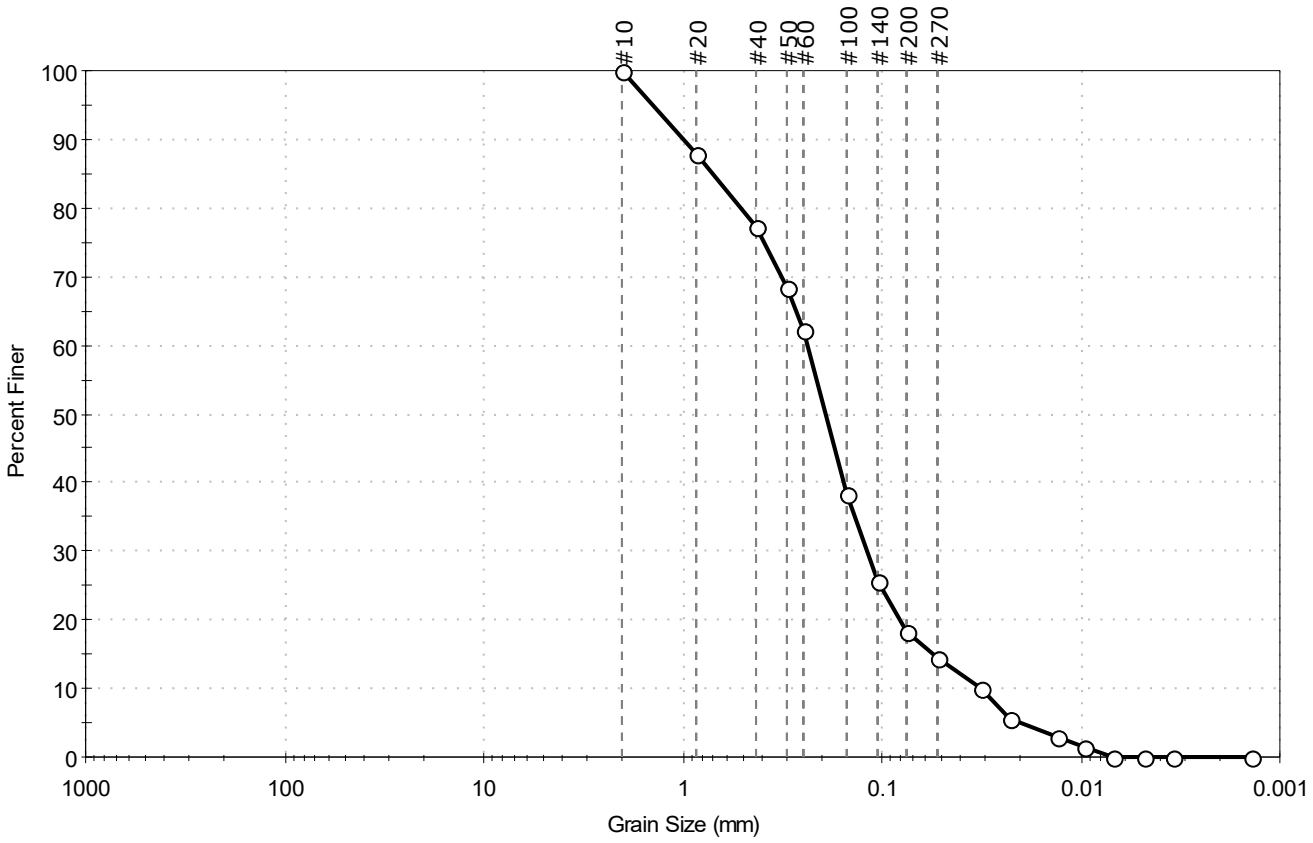
AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-4	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576947		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	81.6	18.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	88		
#40	0.42	77		
#50	0.30	68		
#60	0.25	62		
#100	0.15	38		
#140	0.11	26		
#200	0.075	18		
#270	0.053	14		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0317	10		
---	0.0227	6		
---	0.0130	3		
---	0.0097	1		
---	0.0068	0		
---	0.0049	0		
---	0.0034	0		
---	0.0014	0		

Coefficients

D_{85} =0.7000 mm	D_{30} =0.1197 mm
D_{60} =0.2378 mm	D_{15} =0.0558 mm
D_{50} =0.1923 mm	D_{10} =0.0316 mm
C_u =7.525	C_c =1.907

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-5	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576968		
Test Comment:	---				
Visual Description:	Moist, olive brown silty gravel with sand				
Sample Comment:	---				

USDA Textural Classification

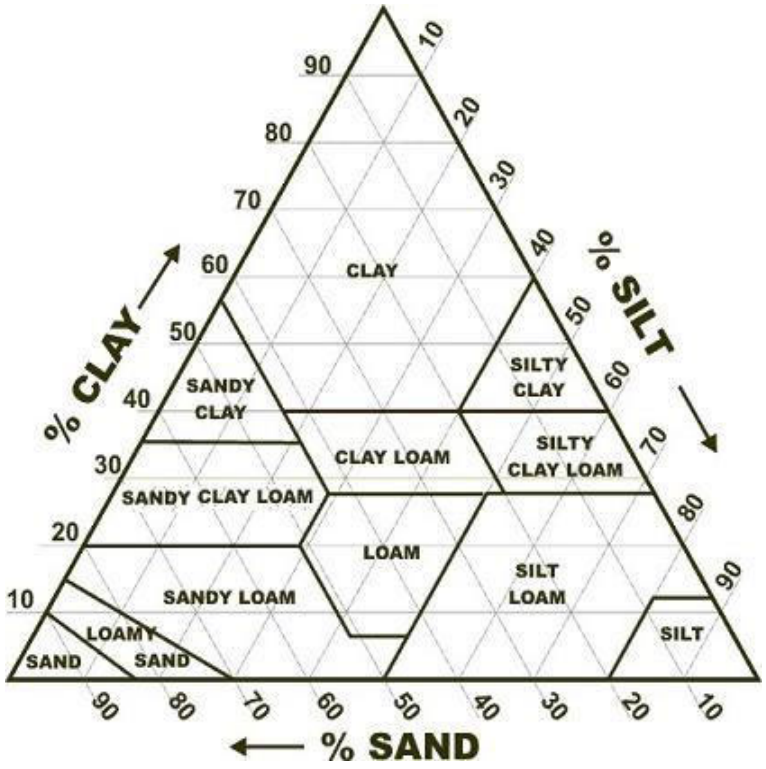
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(2)	TP-5	---	78	20	2	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

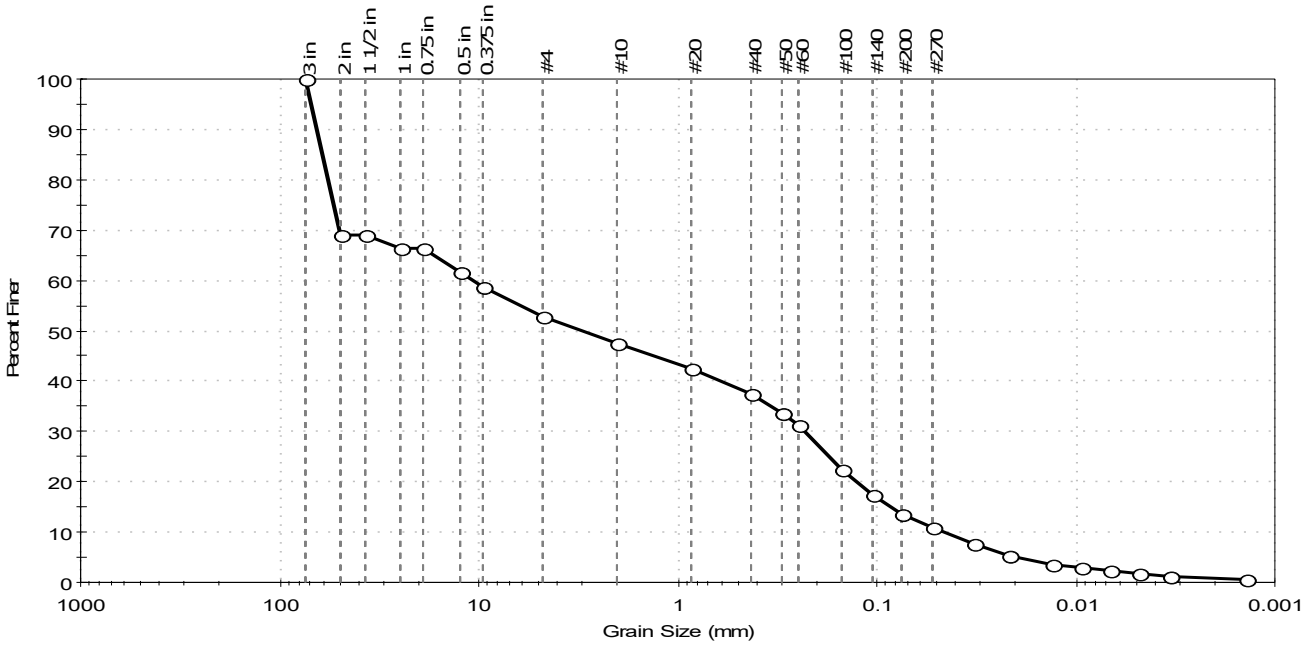
Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter



Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-5	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576948		
Test Comment:	---				
Visual Description:	Moist, olive brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	47.2	39.1	13.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3 in	75.00	100		
2 in	50.00	69		
1 1/2 in	37.50	69		
1 in	25.00	66		
0.75 in	19.00	66		
0.5 in	12.50	62		
0.375 in	9.50	59		
#4	4.75	53		
#10	2.00	48		
#20	0.85	42		
#40	0.42	37		
#50	0.30	34		
#60	0.25	31		
#100	0.15	22		
#140	0.11	17		
#200	0.075	14		
#270	0.053	11		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0329	8		
---	0.0219	5		
---	0.0133	4		
---	0.0094	3		
---	0.0067	2		
---	0.0048	2		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 61.6236 mm D_{30} = 0.2322 mm

D_{60} = 10.8075 mm D_{15} = 0.0849 mm

D_{50} = 2.9929 mm D_{10} = 0.0460 mm

C_u = 234.946 C_c = 0.108

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

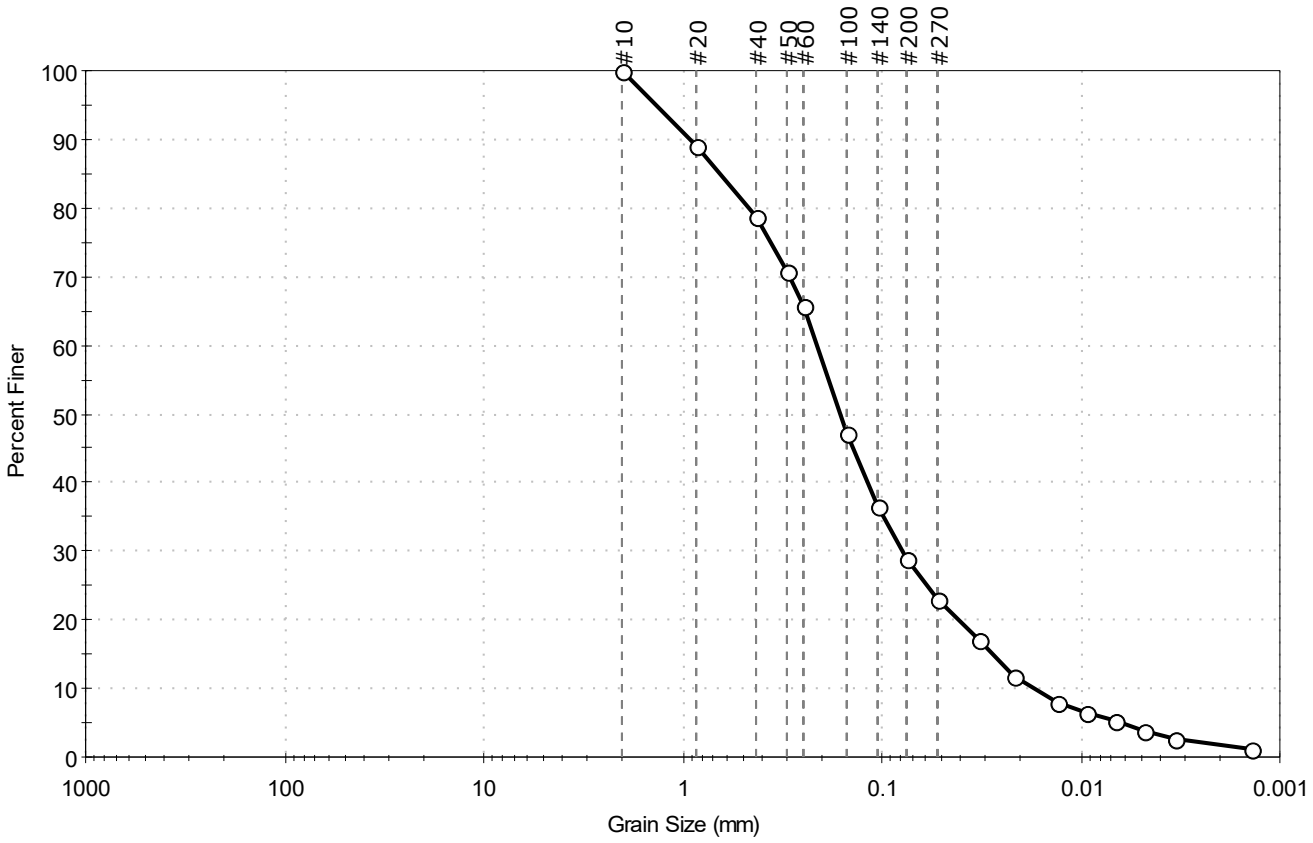
Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-5	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576948		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	71.2	28.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	89		
#40	0.42	79		
#50	0.30	71		
#60	0.25	66		
#100	0.15	47		
#140	0.11	37		
#200	0.075	29		
#270	0.053	23		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0329	17		
---	0.0219	12		
---	0.0133	8		
---	0.0094	7		
---	0.0067	5		
---	0.0048	4		
---	0.0034	3		
---	0.0014	1		

Coefficients

D_{85} =0.6468 mm	D_{30} =0.0792 mm
D_{60} =0.2131 mm	D_{15} =0.0280 mm
D_{50} =0.1618 mm	D_{10} =0.0173 mm
C_u =12.318	C_c =1.701

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-8	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576964		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

USDA Textural Classification

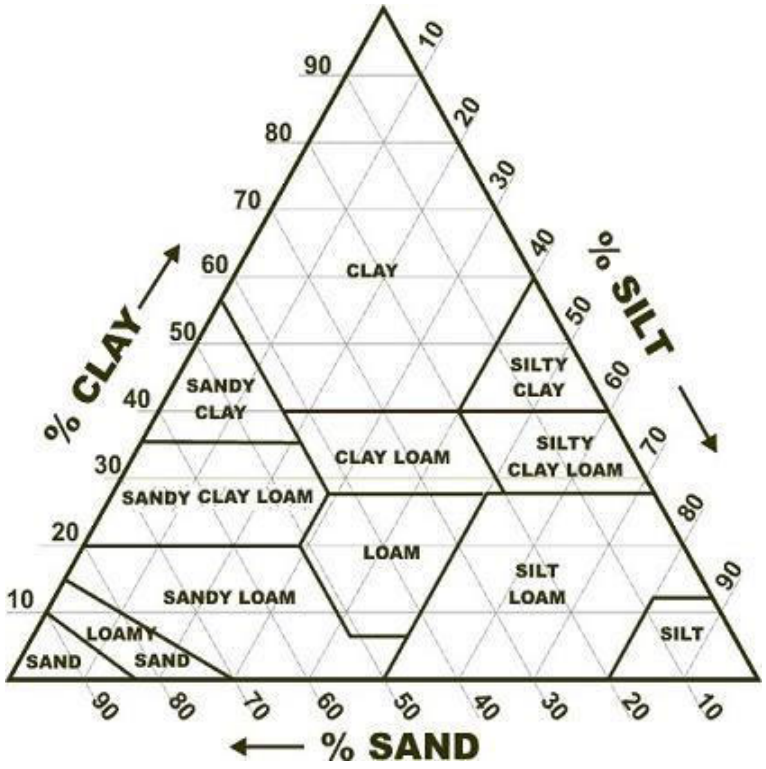
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(2)	TP-8	---	73	26	1	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

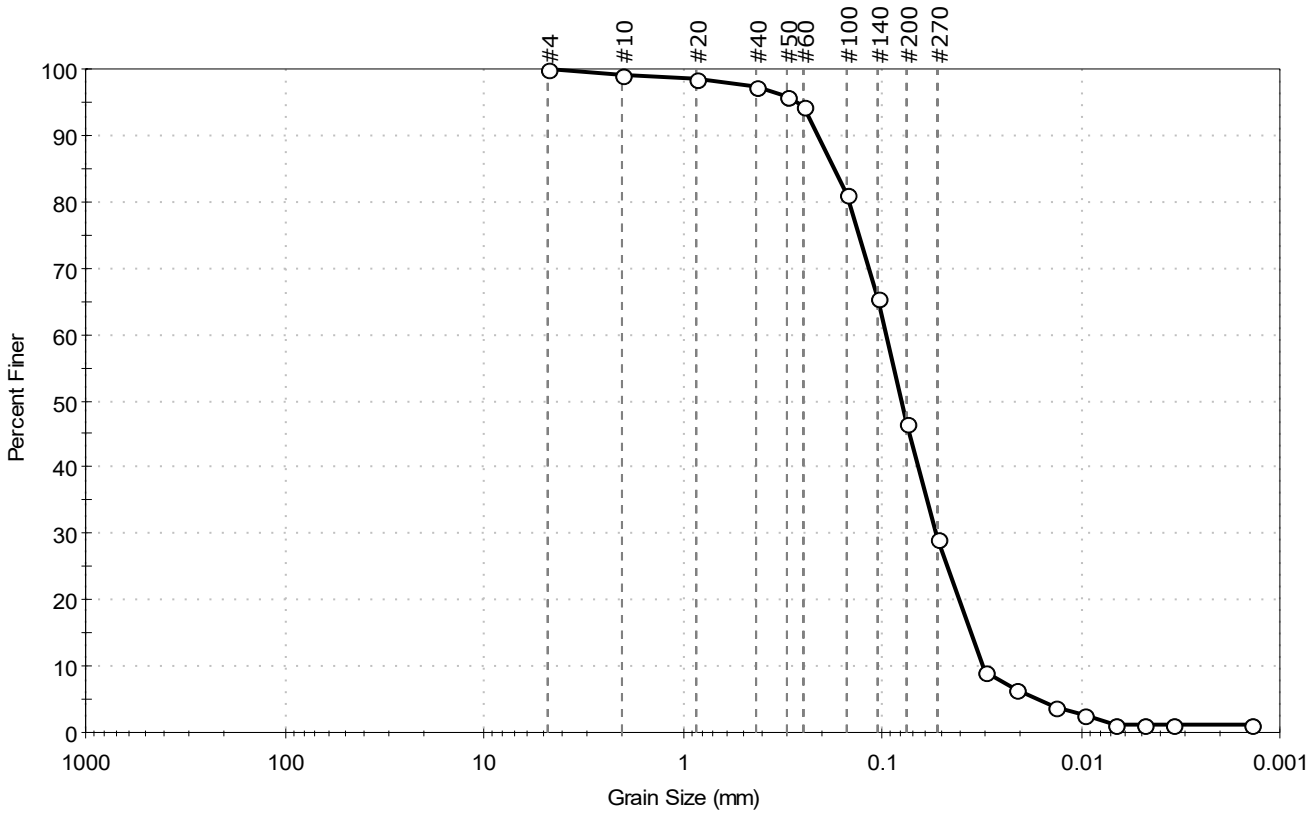
Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter



Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-8	Test Date:	09/10/20	Checked By:	bfs
Depth :	---	Test Id:	576944		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.1	53.2	46.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	99		
#40	0.42	97		
#50	0.30	96		
#60	0.25	94		
#100	0.15	81		
#140	0.11	66		
#200	0.075	47		
#270	0.053	29		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0302	9		
---	0.0213	7		
---	0.0134	4		
---	0.0097	3		
---	0.0068	1		
---	0.0049	1		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 0.1747 mm	D_{30} = 0.0539 mm
D_{60} = 0.0957 mm	D_{15} = 0.0356 mm
D_{50} = 0.0796 mm	D_{10} = 0.0309 mm
C_u = 3.097	C_c = 0.982

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

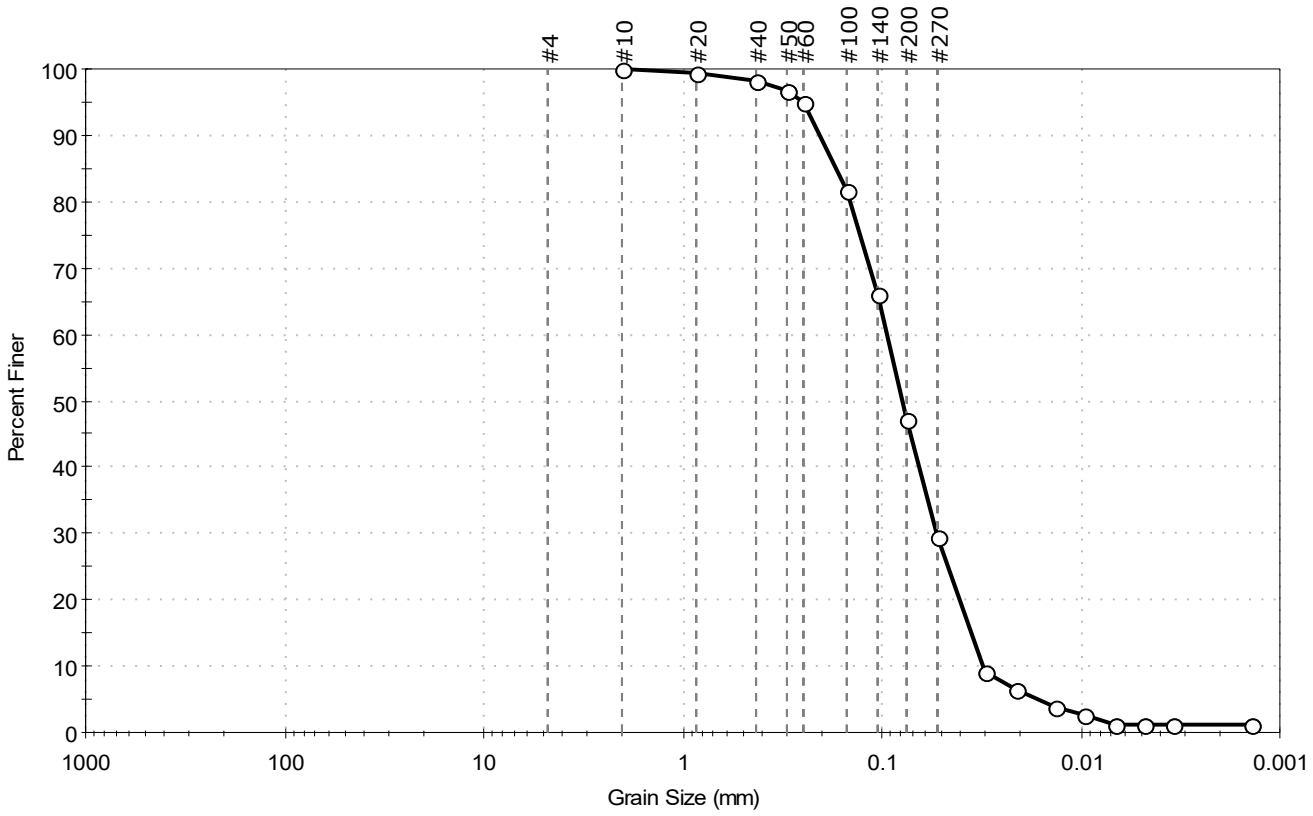
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-8	Test Date:	09/10/20	Checked By:	bfs
Depth :	---	Test Id:	576944		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	52.9	47.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	99		
#40	0.42	98		
#50	0.30	97		
#60	0.25	95		
#100	0.15	82		
#140	0.11	66		
#200	0.075	47		
#270	0.053	29		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0302	9		
---	0.0213	7		
---	0.0134	4		
---	0.0097	3		
---	0.0068	1		
---	0.0049	1		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 0.1702 mm	D_{30} = 0.0537 mm
D_{60} = 0.0948 mm	D_{15} = 0.0355 mm
D_{50} = 0.0790 mm	D_{10} = 0.0309 mm
C_u = 3.068	C_c = 0.984

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-9	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576962		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

USDA Textural Classification

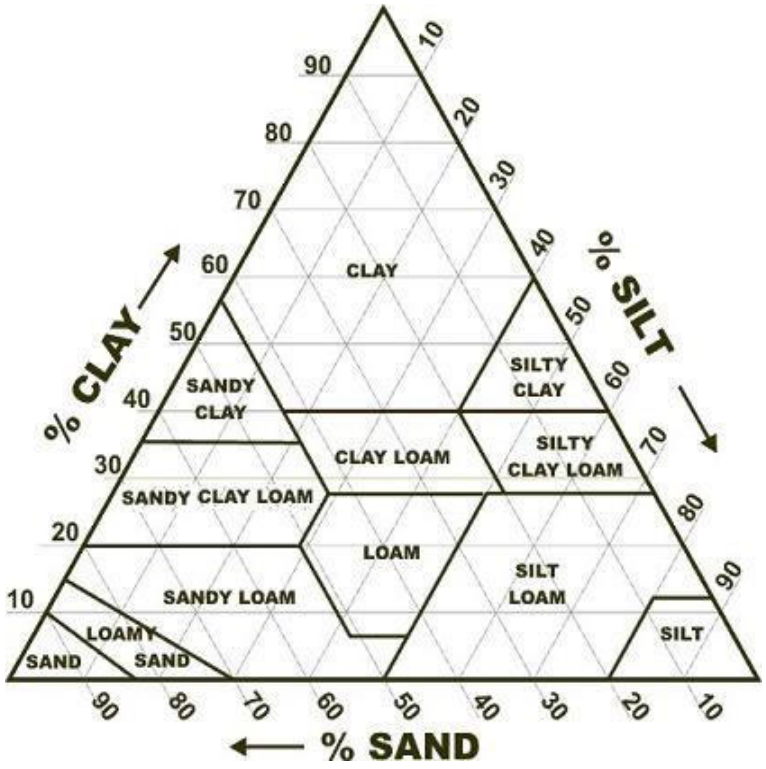
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(2)	TP-9	---	89	10	1	Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

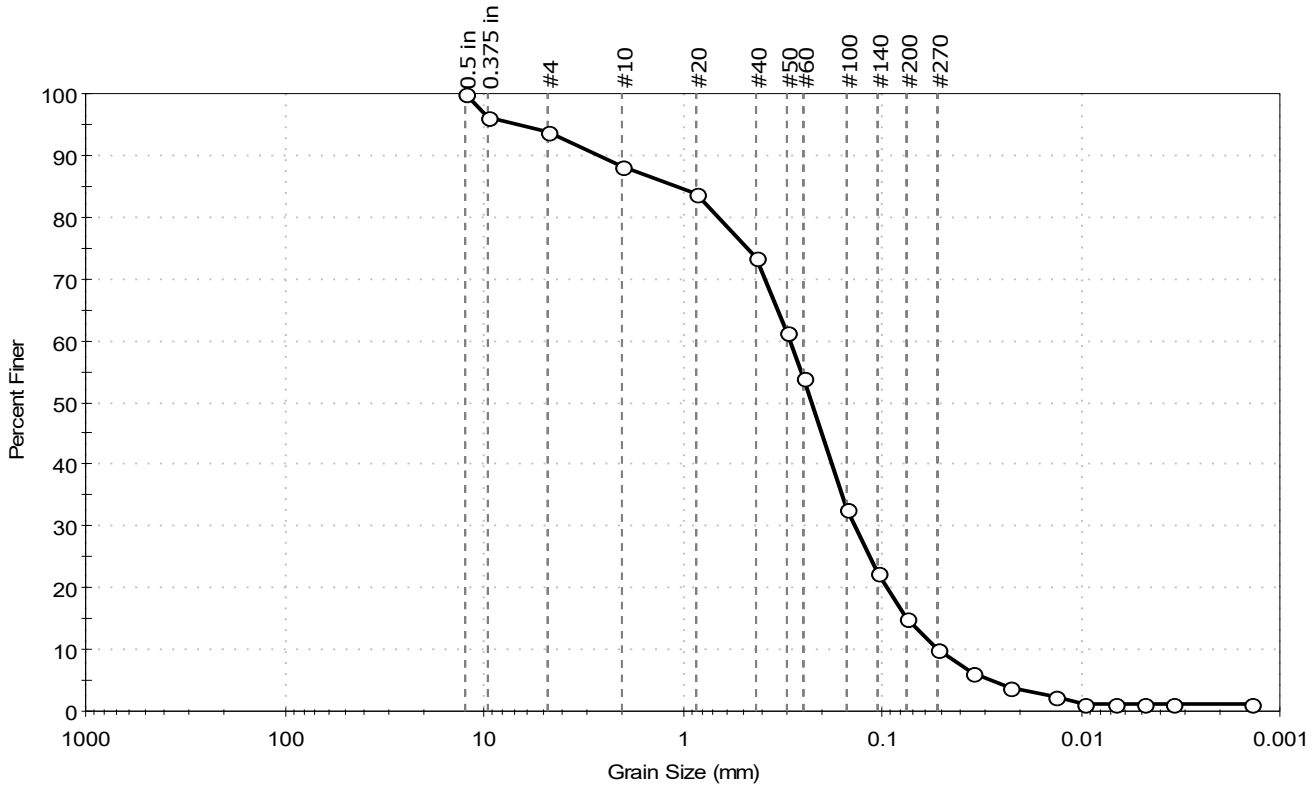
Clay: material passing 0.002 mm diameter



GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-9	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576942		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	6.2	78.8	15.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	96		
#4	4.75	94		
#10	2.00	88		
#20	0.85	84		
#40	0.42	73		
#50	0.30	61		
#60	0.25	54		
#100	0.15	33		
#140	0.11	22		
#200	0.075	15		
#270	0.053	10		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0350	6		
---	0.0228	4		
---	0.0135	2		
---	0.0097	1		
---	0.0068	1		
---	0.0049	1		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 1.0881 mm	D_{30} = 0.1364 mm
D_{60} = 0.2904 mm	D_{15} = 0.0749 mm
D_{50} = 0.2274 mm	D_{10} = 0.0532 mm
C_u = 5.459	C_c = 1.204

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

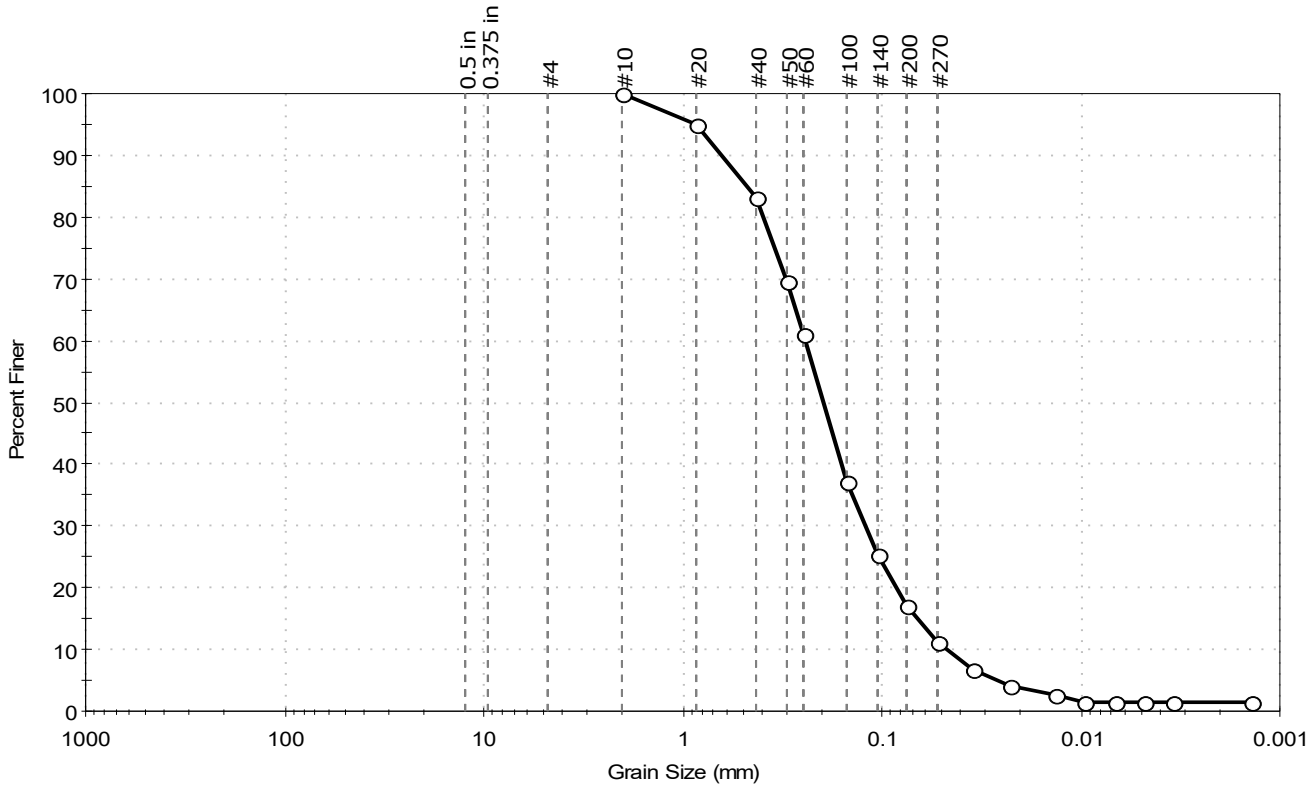
Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-9	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576942		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	83.0	17.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	95		
#40	0.42	83		
#50	0.30	70		
#60	0.25	61		
#100	0.15	37		
#140	0.11	25		
#200	0.075	17		
#270	0.053	11		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0350	7		
---	0.0228	4		
---	0.0135	3		
---	0.0097	1		
---	0.0068	1		
---	0.0049	1		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 0.4707 mm	D_{30} = 0.1212 mm
D_{60} = 0.2440 mm	D_{15} = 0.0664 mm
D_{50} = 0.1970 mm	D_{10} = 0.0470 mm
C_u = 5.191	C_c = 1.281

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-12	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576978		
Test Comment:	---				
Visual Description:	Moist, olive brown gravel with silt and sand				
Sample Comment:	---				

USDA Textural Classification

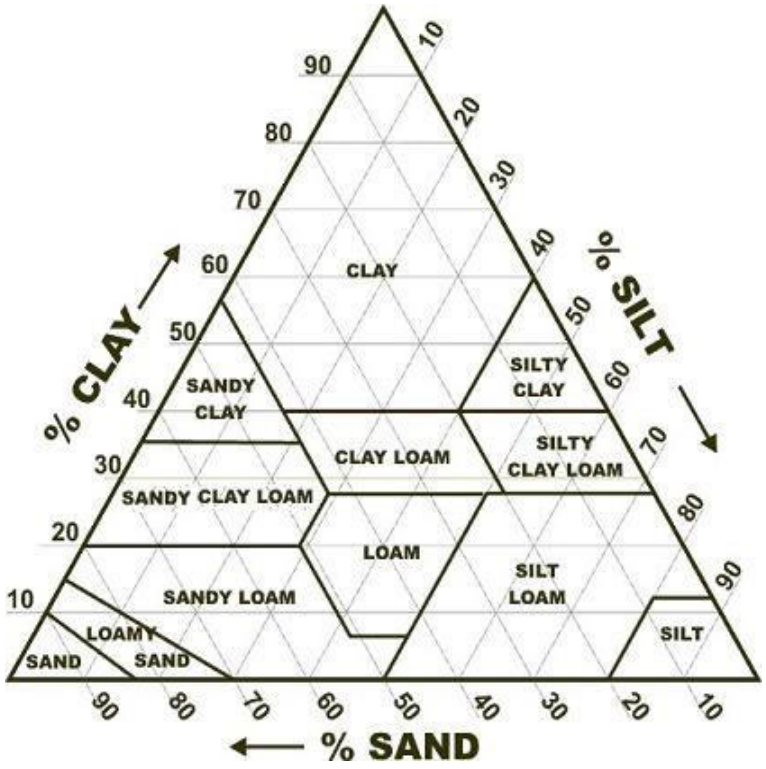
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(2)	TP-12	---	77	22	1	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter

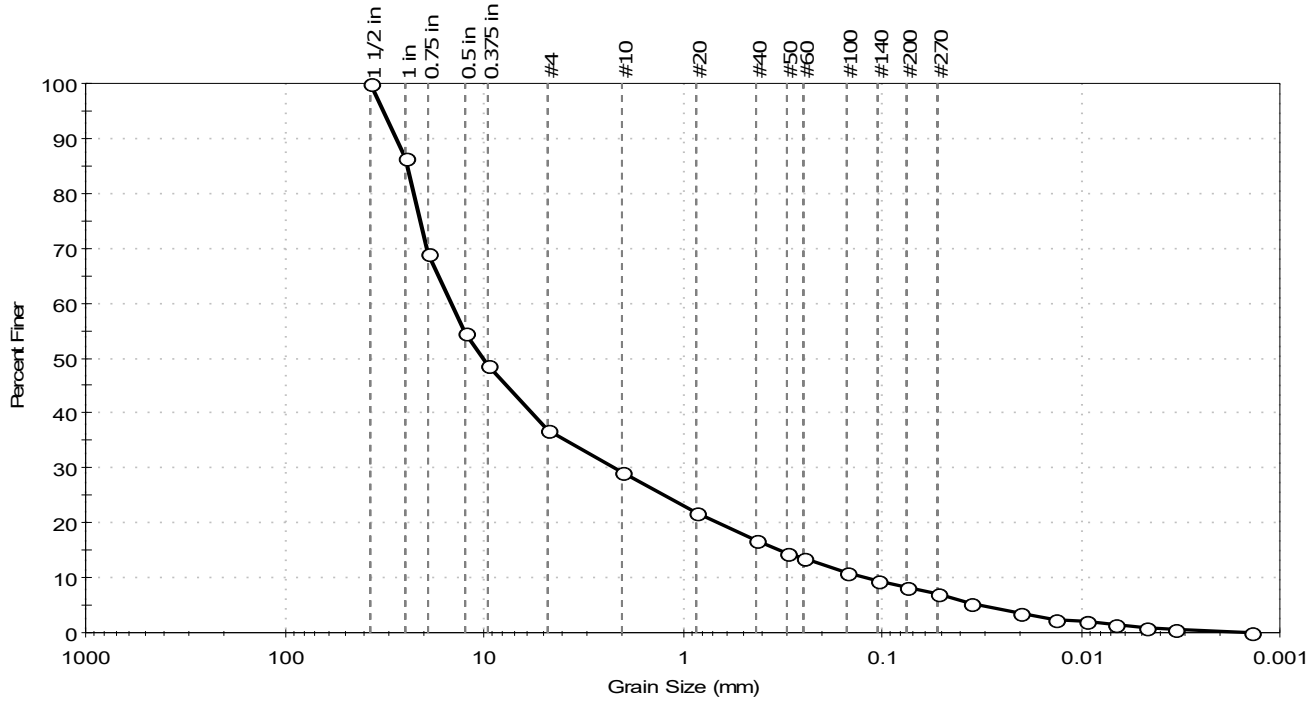


GeoTesting EXPRESS

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-12	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576958		

Test Comment: ---
Visual Description: Moist, olive brown gravel with silt and sand
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	63.1	28.7	8.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 1/2 in	37.50	100		
1 in	25.00	86		
0.75 in	19.00	69		
0.5 in	12.50	54		
0.375 in	9.50	49		
#4	4.75	37		
#10	2.00	29		
#20	0.85	22		
#40	0.42	17		
#50	0.30	15		
#60	0.25	14		
#100	0.15	11		
#140	0.11	9		
#200	0.075	8.2		
#270	0.053	7		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0359	5		
---	0.0204	3		
---	0.0134	2		
---	0.0094	2		
---	0.0067	1		
---	0.0048	1		
---	0.0034	0		
---	0.0014	0		

Coefficients

D_{85} = 24.4458 mm D_{30} = 2.1655 mm
D_{60} = 14.6716 mm D_{15} = 0.3229 mm
D_{50} = 10.0647 mm D_{10} = 0.1201 mm
C_u = 122.162 C_c = 2.661

Classification

ASTM N/A

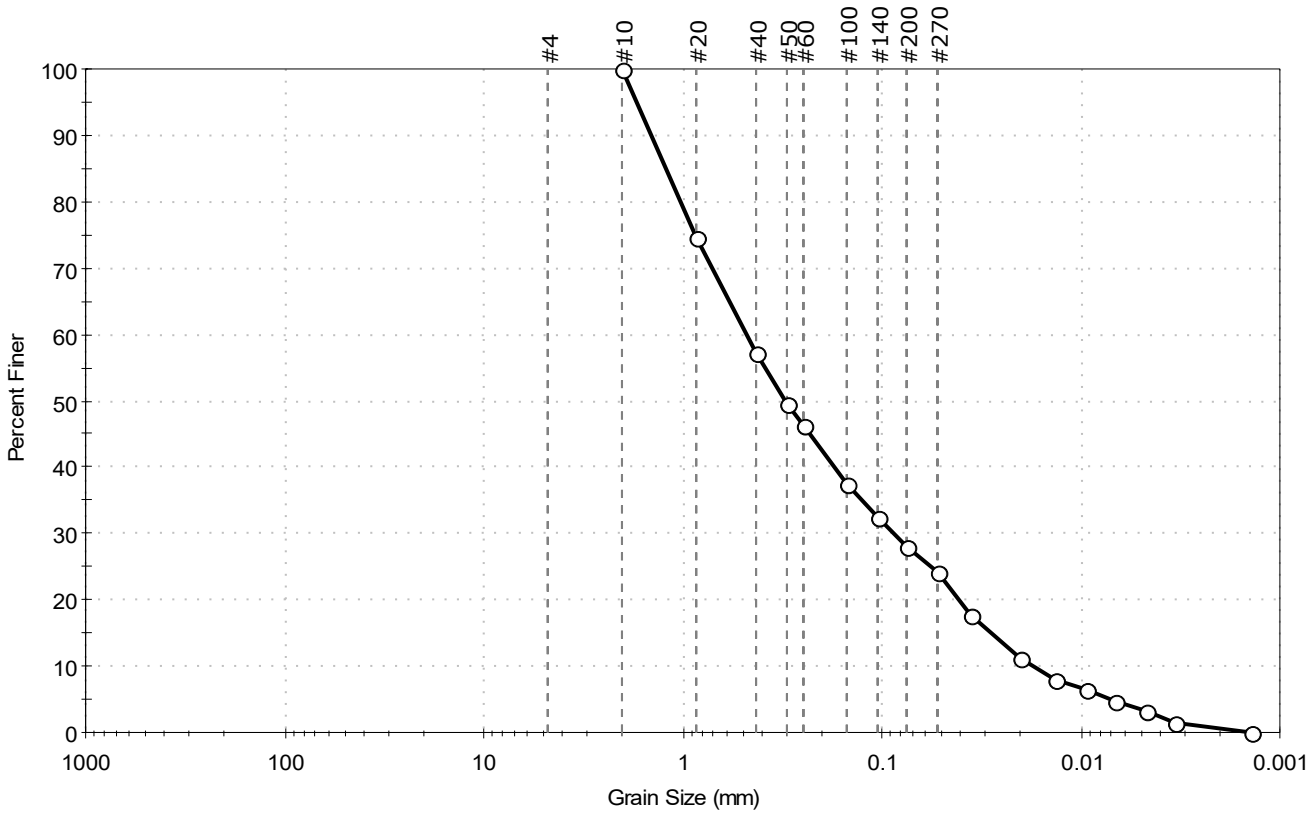
AASHTO Stone Fragments, Gravel and Sand (A-1-a (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(2)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-12	Test Date:	09/09/20	Checked By:	bfs
Depth :	---	Test Id:	576958		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown gravel with silt and sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	71.9	28.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	75		
#40	0.42	57		
#50	0.30	50		
#60	0.25	46		
#100	0.15	37		
#140	0.11	32		
#200	0.075	28		
#270	0.053	24		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0359	18		
---	0.0204	11		
---	0.0134	8		
---	0.0094	6		
---	0.0067	5		
---	0.0048	3		
---	0.0034	2		
---	0.0014	0		

Coefficients

D_{85} = 1.2073 mm D_{30} = 0.0877 mm

D_{60} = 0.4745 mm D_{15} = 0.0285 mm

D_{50} = 0.3058 mm D_{10} = 0.0174 mm

C_u = 27.270 C_c = 0.932

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(3)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-10	Test Date:	09/15/20	Checked By:	bfs
Depth :	---	Test Id:	576971		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

USDA Textural Classification

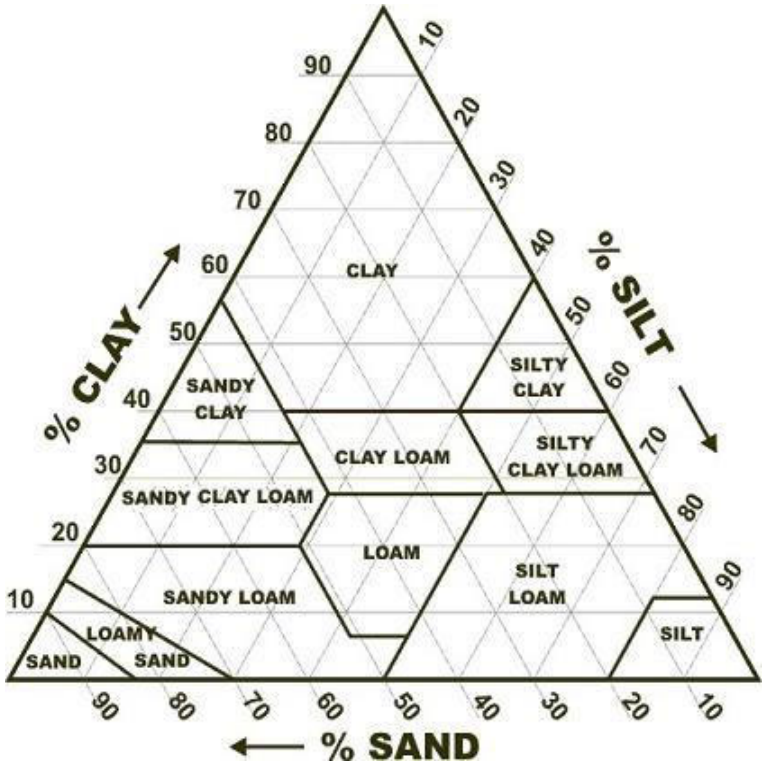
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
(3)	TP-10	---	81	18	1	Loamy Sand

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

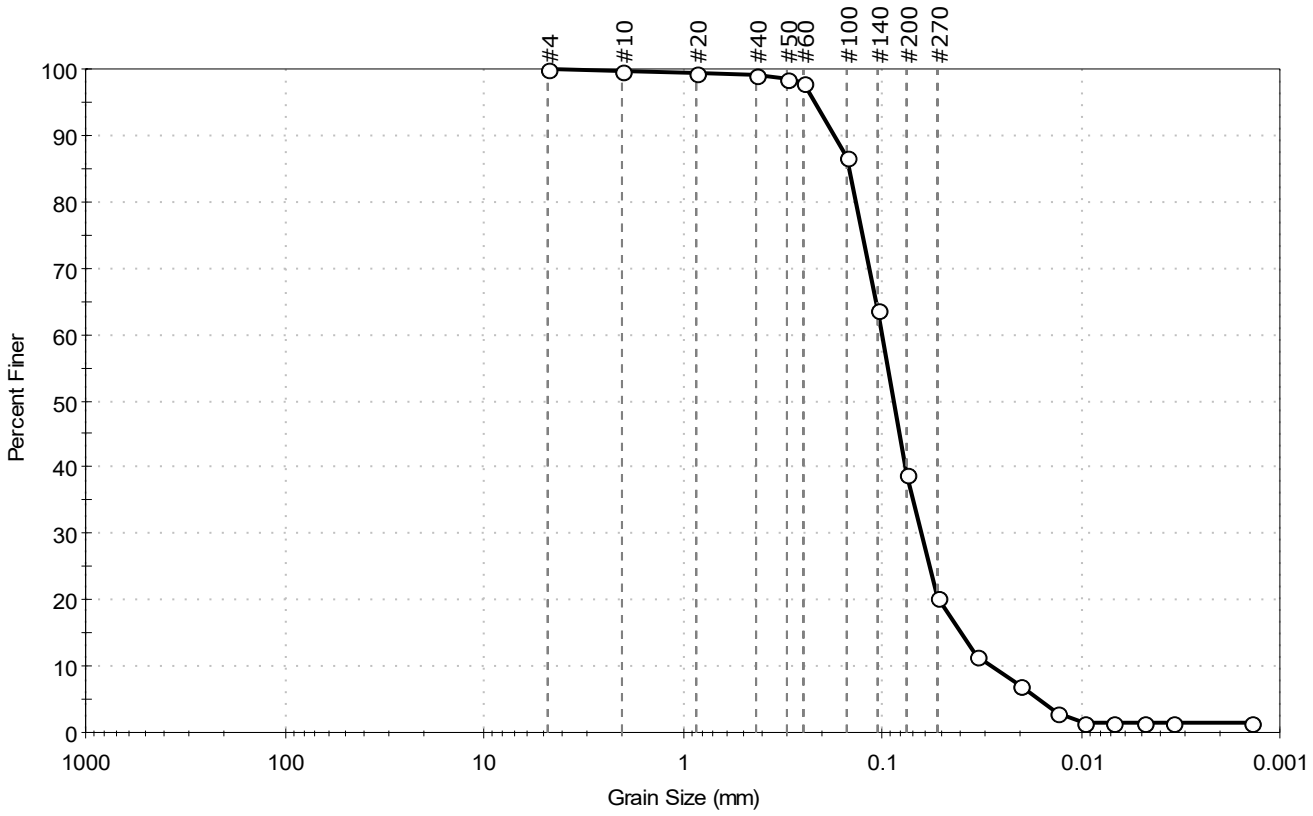
Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter



Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(3)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-10	Test Date:	09/10/20	Checked By:	bfs
Depth :	---	Test Id:	576951		
Test Comment:	---				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.1	60.9	39.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	99		
#50	0.30	99		
#60	0.25	98		
#100	0.15	87		
#140	0.11	64		
#200	0.075	39		
#270	0.053	20		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0335	11		
---	0.0204	7		
---	0.0133	3		
---	0.0098	1		
---	0.0068	1		
---	0.0048	1		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 0.1462 mm D_{30} = 0.0633 mm
D_{60} = 0.1005 mm D_{15} = 0.0401 mm
D_{50} = 0.0874 mm D_{10} = 0.0282 mm
C_u = 3.564 C_c = 1.414

Classification

ASTM N/A

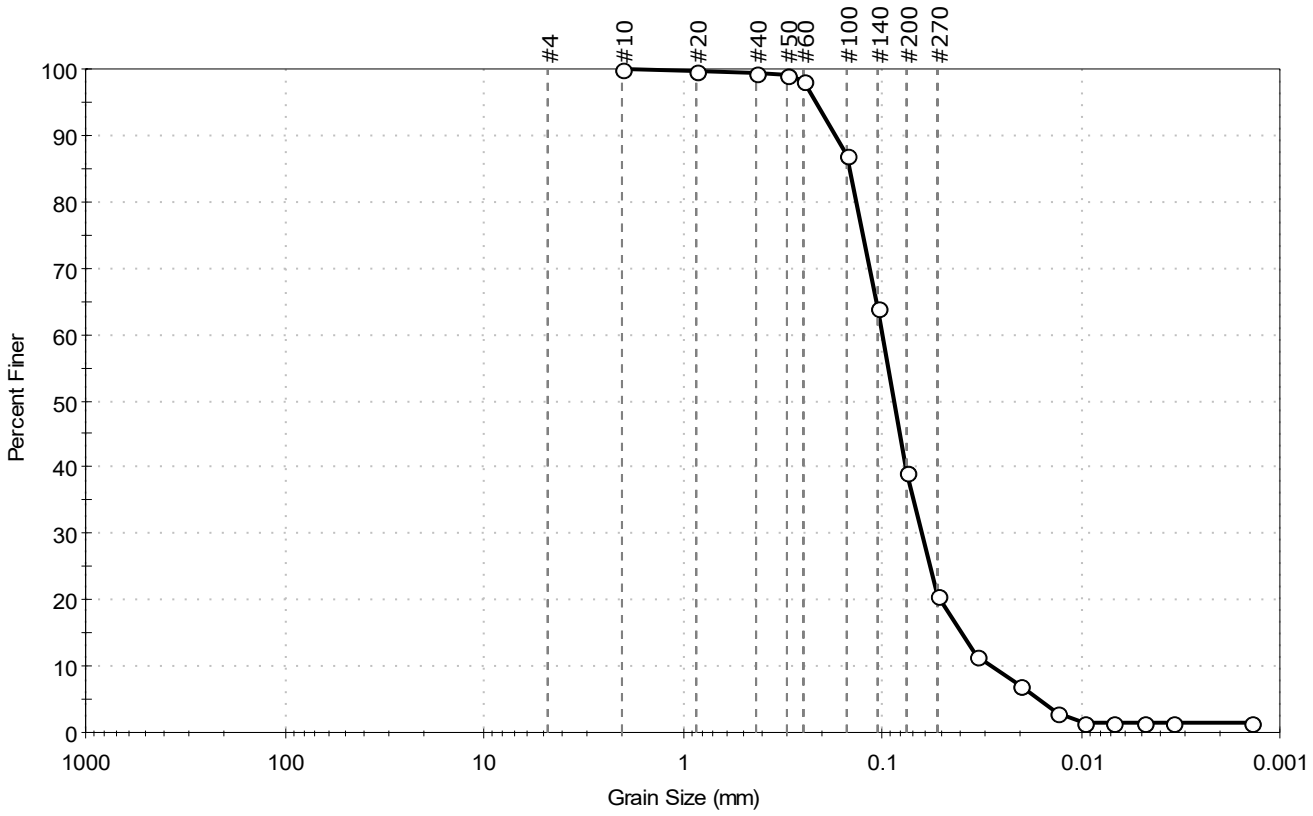
AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve

Client:	Tetra Tech				
Project:	Holliston Stormwater Test Pits				
Location:	---			Project No:	GTX-312288
Boring ID:	(3)	Sample Type:	bag	Tested By:	ckg
Sample ID:	TP-10	Test Date:	09/10/20	Checked By:	bfs
Depth :	---	Test Id:	576951		
Test Comment:	Only minus No. 10 sieve for USDA classification				
Visual Description:	Moist, olive brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	60.8	39.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#50	0.30	99		
#60	0.25	98		
#100	0.15	87		
#140	0.11	64		
#200	0.075	39		
#270	0.053	21		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0335	11		
---	0.0204	7		
---	0.0133	3		
---	0.0098	1		
---	0.0068	1		
---	0.0048	1		
---	0.0034	1		
---	0.0014	1		

Coefficients

D_{85} = 0.1454 mm D_{30} = 0.0632 mm
D_{60} = 0.1001 mm D_{15} = 0.0400 mm
D_{50} = 0.0871 mm D_{10} = 0.0282 mm
C_u = 3.550 C_c = 1.415

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #270 Sieve