PROJECT NARRATIVE AND STORMWATER MANAGEMENT REPORT

for

THE INSTITUTION FOR SAVINGS
93 STATE STREET
NEWBURYPORT, MASSACHUSETTS

Prepared for:

The Institution for Savings
93 State Street
Newburyport, Massachusetts 01950

Prepared by:

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January 8, 2020

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PROJECT NARRATIVE &
STORMWATER MANAGEMENT STANDARDS

Project Narrative:

The project site is located at 93 State Street at the corner of Prospect Street in Newburyport, Massachusetts on a parcel totaling approximately 0.85 acres. The site has been home to the Institution for Savings since 1820 with the original building being constructed in 1872 and an additional building constructed in 1980. The site topography is predominantly flat with a slight pitch towards Prospect Street to allow for positive drainage in the parking areas. The existing site features consist of two connected parking areas, a central stone island, landscaped areas, brick walkways, as well as the iconic clock tower monument with associated seating areas.

The applicant is proposing the construction of an approximate 8,880 square foot, two story addition connecting to the 1980 building with ground level parking beneath. To minimize the increase in impervious area, the proposed addition is being located over the existing employee parking lot at the eastern portion of the site. As part of this improvement, the applicant is also proposing to redirect the majority of surface and roof runoff to a Cultec 280HD subsurface storage facility for mitigation of peak flows. Existing parking area drains in the employee parking lot beneath the addition will be upgraded and redirected through an oil and grease separator before connecting into the existing sewer line in Prospect Street.

The proposed project results in a net increase in total impervious area by roughly 2,200 square feet. However, the proposed drainage system utilizes a series of vortchnic units and catch basins to pretreat surface runoff before directing flow into the subsurface storage facility that will provide a reduction of peak discharge rates. The subsurface storage facility is a sealed detention basin system and has been designed to provide a fifteen percent reduction to the existing 100-year storm event peak discharge rate. Infiltration was considered as a potential BMP but given the densely developed urban environment and proximity to residential houses was deemed disadvantageous by the city's engineer. Additional areas of the site that are to be disturbed will be restored with a mixture of shrubs and perennial plantings to match the existing plant pallet and character of the site.

Stormwater Management Standards

The following are the ten (10) DEP Stormwater Standards as outlined in the Wetlands Regulations:

Standard 1: No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

There are no new stormwater discharges to waters of the Commonwealth with the completion of this project. Stormwater will continue to be discharged into the existing conventional drainage system within Prospect Street. Runoff from paved surfaces will be treated through catch basins and vortechnic units prior to discharge from the property.

Standard 2: Peak Rate Attenuation - Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

The stormwater analysis utilizes compiled data from the Northeast Regional Climate Center in conjunction with US Natural Resource Conservation Service (NRCS) and Cornell University to calculate peak runoff rates. Full detail of peak rate attenuation along with supplemental

stormwater calculation utilizing HydroCAD as well as existing and post development watershed plans can be found in this report.

The table below illustrates the predicted existing and post development stormwater peak rates of flow, in cubic feet per second (CFS) for the 2, 10, and 100-year storm events as required by the Newburyport Stormwater Management Standards (4/28/2014)

Peak Discharge Rates (cfs)	2-Year 24-Hour Storm Event	10-Year 24-Hour Storm Event	100-Year 24-Hour Storm Event
Existing	1.3	2.7	6.4
Proposed	1.3	2.6	5.4
Change	-0.0	-0.10	-1.0

Standard 3: Recharge - Loss of annual recharge to groundwater shall be eliminated or minimized…at a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume in accordance with the Mass Stormwater Handbook.

This project results in an overall increase in impervious area but after discussions with the City Engineer the preferred method of managing runoff in the urban environment is attenuation rather than infiltration. Loss of annual recharge to groundwater has been minimized to the maximum extent practical.

Standard 4: Water Quality – Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The standard is met with pollution prevention plans, stormwater BMP's sized to capture required water quality volume, and pretreatment measures.

Treatment measures are provided to the maximum extent practical for this project. Stormwater runoff from paved surfaces is directed through catch basins and vortechnic units for treatment prior to discharge into the existing drain line in Prospect Street. The proposed drainage treatment train has been sized to capture surface runoff and provide the required 80% of the average annual post-construction load of Total Suspended Solids (TSS) as specified in the Massachusetts Stormwater Handbook.

The Stormwater Management Handbook assigns TSS removal percentages to each treatment BMP. Catch basins are assigned a rate of 25%. Vortecnic units are assigned 80% removal provided they are sized in accordance with the DEP notice for proprietary structure sizing. Proprietary sizing calculations for each unit are in the Appendix of this report.

Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs) – Source control and pollution prevention shall be implemented in accordance with the Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

Stormwater Standard 5 is not applicable to this project. The proposed project will not be subject the site to higher potential pollutant loads as defined in the Massachusetts Department of Environmental protection Wetlands and Water Quality Regulations.

LUHPPLs are identified in 310 CMR 22.20B(2) and C(2)(a)-(k) and (m) and CMR 22.21(2)(a)(1)-(8) and (b)(1)-(6), areas within a site that are the location of activities that are subject to an individual National Pollutant Discharge Elimination System (NPDES) permit or the NPDES Multi-sector General Permit; auto fueling facilities, exterior fleet storage areas, exterior vehicle service and equipment cleaning areas; marinas and boatyards; parking lots with high-intensity-use; confined disposal facilities and disposal sites.

Standard 6: Critical Areas – Stormwater discharges to critical areas require the use of specific source control and pollution prevention measures and specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas.

Stormwater Standard 6 is not applicable to this project given that proposed stormwater is not being discharged to a critical area. Critical areas being Outstanding Resource Waters and Special Resource Waters as designated in 314 CMR 4.0, recharge areas for public water supplies as defined in 310 CMR 22.02, bathing beaches as defined in 105 CMR 445.000, cold-water fisheries and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

Standard 7: Redevelopments – A redevelopment project is required to meet Standards 1-6 only to the maximum extent practicable. Remaining standards shall be met as well as the project shall improve the existing conditions.

This project does not qualify as a redevelopment project. Within the Stormwater Management Handbook (volume 1, chapter 1, page 20), the definition of a redevelopment project includes, "development, rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in imperious area".

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan shall be implemented.

The permit site plans which accompany this report provide details for all the proposed construction erosion and sediment control devices. Refer to Appendix for the Construction Period Pollution Prevention Plan And Erosion And Sediment Control Plan. Notes regarding the sequence for erosion control activities during construction are also provided on the Permit Site Plan.

Standard 9: A long term Operation and Maintenance Plan shall be implemented.

The stormwater management system consists of a series of catch basins, vortechnic units, and a Cultec 280HD subsurface storage facility. The accompanying written plan includes information regarding the maintenance of the proposed BMPs. Refer to Appendix for the Long-Term Operation and Maintenance Plan. The site owner, The Institution for Savings, is the party responsible for maintenance.

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

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

There are no known illicit discharges anticipated through the completion of this project. During construction and post construction procedures are provided to dissipate the potential for illicit discharges to the drainage system. Post construction preventions of illicit discharges are described in the Inspection and Maintenance Measures under the Good Housekeeping Practices section of the report (Appendix).

APPENDIX

PROPRIETARY STRUCTURE SIZING BASED ON DEP NOTICE – OCTOBER 15, 2013

Per Notice: Treatment requirement based on ½" rule [WQV] see following Vortex page for design flow rates.

PVCB#1

Impervious area directed to structure = 9,150± s.f.

Water Quality Flow:

WQF = (qu)(A)(WQV)

qu→unit peak discharge in cfs/mi^2/watershed inches
(qu based on Figure 3 & 4 Ia/P tables with a t_c value of 0.1 hrs.)
A→impervious surface drainage area (in. sq. mi*)
*conversation factor: 0.0015625 mi^2/acre

qu = 752 cfs/mi^2/in.
A = 9,150 s.f./43,560 s.f./acre = 0.21 acres
(0.21 acres)(0.0015625 mi^2/acre) = 0.00032 mi^2
WQF = (752 cfs/mi^2/in.)(0.00032 mi^2)(0.5 in.)
WQF = 0.12 cfs

Design flow rate for Stormceptor 450*i* = 0.40 cfs

PVCB#2

Impervious area directed to structure = 1,245± s.f.

Water Quality Flow:

WQF = (qu)(A)(WQV)

qu→unit peak discharge in cfs/mi^2/watershed inches
(qu based on Figure 3 & 4 Ia/P tables with a t_c value of 0.1 hrs.)
A→impervious surface drainage area (in. sq. mi*)
*conversation factor: 0.0015625 mi^2/acre

qu = 752 cfs/mi^2/in.
A = 1,245 s.f./43,560 s.f./acre = 0.03 acres
(0.03 acres)(0.0015625 mi^2/acre) = 0.00005 mi^2
WQF = (752 cfs/mi^2/in.)(0.00005 mi^2)(0.5 in.)
WQF = 0.02 cfs

Design flow rate for Stormceptor 450*i* = 0.40 cfs

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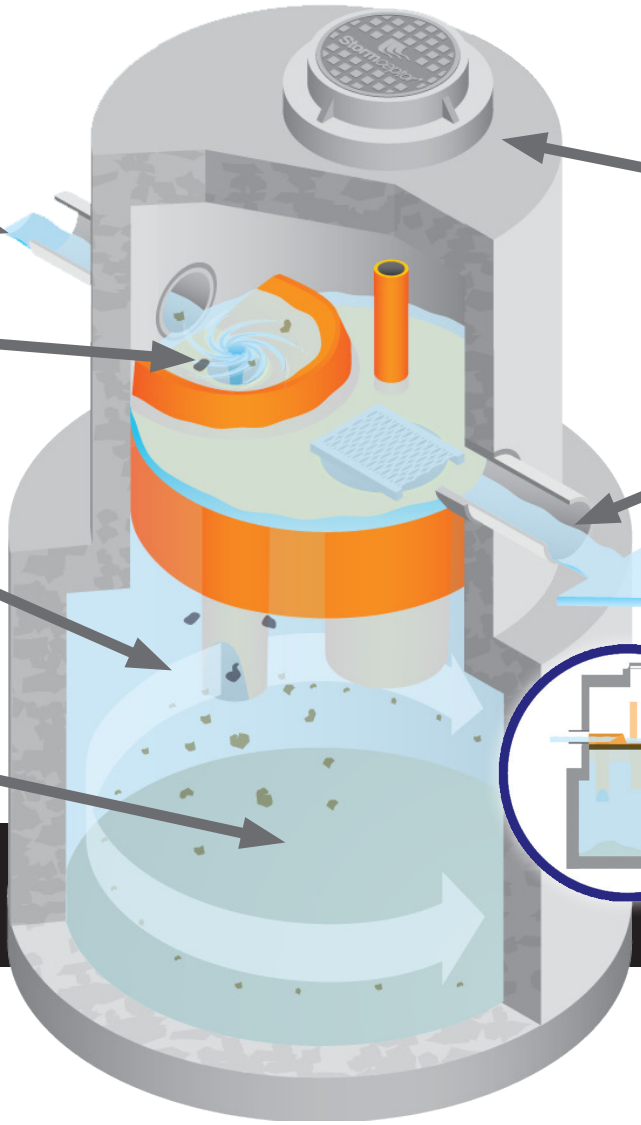

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Stormceptor® STC

Stormceptor® is an underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention. With thousands of systems operating worldwide, Stormceptor delivers protection every day in every storm.

With patented technology, optimal treatment occurs by allowing free oil to rise and sediment to settle. The Stormceptor design prohibits scour and release of previously captured pollutants, ensuring superior treatment and protection during even the most extreme storm events.

Stormceptor is very easy to design and provides flexibility under varying site constraints such as tight right-of-ways, zero lot lines and retrofit projects. Design flexibility allows for a cost-effective approach to stormwater treatment. Stormceptor has proven performance backed by the longest record of lab and field verification in the industry.

Tested Performance

- Fine particle capture
- Prevents scour or release
- 95%+ Oil removal

Massachusetts – Water Quality (Q) Flow Rate

Stormceptor STC Model	Inside Diameter	Typical Depth Below Inlet Pipe Invert [1]	Water Quality Flow Rate Q [2]	Peak Conveyance Flow Rate [3]	Hydrocarbon Capacity [4]	Maximum Sediment Capacity [4]
	(ft)	(in)	(cfs)	(cfs)	(Gallons)	(ft^3)
STC 450i	4	68	0.40	5.5	86	46
STC 900	6	63	0.89	22	251	89
STC 2400	8	104	1.58	22	840	205
STC 4800	10	140	2.47	22	909	543
STC 7200	12	148	3.56	22	1,059	839
STC 11000	2 x 10	142	4.94	48	2,792	1,086
STC 16000	2 x 12	148	7.12	48	3,055	1,677

[1] Depth Below Pipe Inlet Invert to the Bottom of Base Slab, and Maximum Sediment Capacity can vary to accommodate specific site designs and pollutant loads. Depths can vary to accommodate special designs or site conditions. Contact your local representative for assistance.
[2] Water Quality Flow Rate (Q) is based on 80% annual average TSS removal of the OK110 particle size distribution.
[3] Peak Conveyance Flow Rate is based upon ideal velocity of 3 feet per second and outlet pipe diameters of 18-inch, 36-inch, and 54-inch diameters.
[4] Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

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11-22-13-R13-802 MDEP

Stormceptor®
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CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN AND EROSION SEDIMENTATION CONTROL PLAN

located at

INSTITUTION FOR SAVINGS
93 STATE STREET
NEWBURYPORT, MASSACHUSETTS

Applicant:

Institution for Savings
93 State Street
Newburyport, Massachusetts 01950

Prepared by:

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500 Cummings Center, Suite 5950
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January 8, 2020

Project Name: Institution for Savings
93 State Street
Newburyport, Massachusetts 01950

Owner Name: Institution for Savings
93 State Street
Newburyport, Massachusetts 01950

Party Responsible for Maintenance: Institution for Savings
93 State Street
Newburyport, Massachusetts 01950

Project Description:

The project site is located at 93 State Street at the corner of Prospect Street in Newburyport, Massachusetts. The site has been home to the Institution for Savings since 1820 with the original building being constructed in 1872 and an additional building constructed in 1980. The site topography is predominantly flat with minor grading to allow for positive drainage in the parking areas. The existing ground cover consists of two connected parking areas, a central gravel island, landscaped areas, brick walkways, as well as the iconic clock tower monument with associated seating areas.

The client is proposing to add an 8,880 square foot, two story addition with ground level parking beneath, connecting to the 1980 building. Additional associated utility work will also be done as part of this project to upgrade the current site drainage systems.

The proposed drainage system utilizes a series of vortchnic units and catch basins to pretreat surface runoff before entering into the Cultec 280HD subsurface storage facility. The subsurface storage facility is designed as a sealed detention basin and sized to provide a reduction of peak stormwater flow. Additional areas of the site that are to be disturbed will be restored with a mixture of shrubs and perennial plantings to match the existing plant pallet and character of the site.

Erosion and Sedimentation Control Measures During Construction Activities

Erosion Control Sock

Compost Erosion Control Socks are proposed to be installed, as shown on the site plan, around all proposed improvement areas. The barriers are burlap fabric socks filled with compost blends and shall be installed prior to the commencement of any work on-site and in accordance with the design plans. An additional supply of socks shall be on-site to replace and/or repair socks that have been disturbed. The lines of socks shall be inspected and maintained on a weekly basis during construction. Deposited sediments shall be removed when the level of deposition reaches approximately one-half the height of the sock.

Storm Drain Inlet Protection

Temporary storm inlet protection filters will be placed around all catch basin units. The purpose of the filter is to prevent the inflow of sediments into the closed drainage system. The filters shall remain in place until a permanent vegetative cover is established and the transport of sediment is no longer visibly apparent. The filter shall be inspected and maintained on a weekly basis and after every storm of 0.25 inches or more of rainfall/precipitation.

Surface Stabilization

The surface of all disturbed areas shall be stabilized during and after construction. Temporary measures shall be taken during construction to prevent erosion and siltation. No construction sediment shall be allowed to enter any infiltration systems or the pocket wetland. All disturbed slopes will be stabilized with a permanent vegetative cover. Some or all of the following measures will be utilized on this project as conditions may warrant.

a. Temporary Seeding
b. Temporary Mulching
c. Permanent Seeding
d. Placement of Sod
e. Hydroseeding
f. Placement of Hay
g. Placement of Jute Netting

Street Sweeping

Any sediment tracked onto public right-of-ways or parking areas shall be swept at the end of each working day.

Subsurface Detention

The performance of the subsurface detention facilities shall be checked weekly and after every major storm event during construction. No construction period runoff should be directed into the subsurface detention facilities. Excavation for the facility shall be performed from the edge of the facility location to avoid compaction of the parent material. Prior to the installation of the top surface, implement erosion and sediment controls around the perimeter of the open system to prevent sheet flow or windblown sediment from entering the system.

Catch Basins and Stormwater Water Quality Units (Stormceptor 450*i*)

The performance of the catch basins and water quality units shall be checked weekly and after every major storm event during construction. Prevent construction period runoff from being discharged into the units until construction is complete and soil is stabilized.

Interim Erosion Control

Additional erosion control measures shall be implemented as conditions warrant during construction or as directed by the owner or owner's representative.

Construction Entrance

Install the construction entrance as shown on the detail sheet. The entrance should be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic topdressing with additional stone. Inspect entrance/exit pad and sediment disposal area weekly and after heavy rains or heavy use. Remove mud and sediment tracked or washed onto public roads immediately. Mud and soil particles will eventually clog the voids in the gravel and the effectiveness of the gravel pad will not be satisfactory. When this occurs, the pad should be top dressed with new stone. Complete replacement of the pad may be necessary when the pad becomes completely clogged. Reshape pad as needed for drainage and runoff control. Repair any broken road pavement immediately.

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STORMWATER MANAGEMENT
CONSTRUCTION PHASE

INSPECTION SCHEDULE AND EVALUATION CHECKLIST

PROJECT LOCATION: 93 State Street, Newburyport, Massachusetts

Inspection Date	Inspector	Area Inspected	Best Management Practice (yes/no)	Required Inspection Frequency if BMP	Comments	Recommendation	Follow-up Inspection Required (yes/no)
		Erosion Control Sock	No	Weekly and After Major Storm Events			
		Storm Drain Inlet Protection	No	Weekly and After Major Storm Events			
		Construction Entrance	No	Weekly and After Major Storm Events			
		Catch Basin and Vortex	Yes	Weekly and After Major Storm Events			
		Subsurface Detention	Yes	Weekly and After Major Storm Events			

(1) Refer to the Massachusetts Stormwater Handbook, Volume Two: Stormwater Technical Handbook (February 2008) for recommendations regarding frequency for inspection and maintenance of specific BMP's.

(2) Inspections to be conducted by a qualified professional such as an environmental scientist or civil engineer.

Limited or no use of sodium chloride salts, fertilizers or pesticides recommended.
Other notes: (Include deviations from: Con. Comm. Order of Conditions, PB Approval, Construction Sequence and Approved Plan)
Stormwater Control Manager: _____

LONG TERM OPERATION AND MAINTENANCE PLAN

located at

INSTITUTION FOR SAVINGS
93 STATE STREET
NEWBURYPORT, MASSACHUSETTS

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The proposed drainage system utilizes a series of vortchnic units and catch basins to pretreat surface runoff before entering into the Cultec 280HD subsurface storage facility. The subsurface storage facility is designed as a sealed detention basin and sized to provide a reduction of peak stormwater flow. Additional areas of the site that are to be disturbed will be restored with a mixture of shrubs and perennial plantings to match the existing plant pallet and character of the site.

Inspection and Maintenance Measures After Construction

Erosion Control

Eroded sediments can adversely affect the performance of the stormwater management system. Eroding or barren areas should be immediately re-vegetated.

Subsurface Detention Facilities

The facilities should be inspected after the first several rainfall events or first few months after construction, after all major storms (2-year), and on regular bi-annual scheduled dates. Open provided inspection ports and visually inspect for sediment and or ponded water. Ponded water inside the system after several days often indicates that the bottom of the system is clogged. A stadia rod may be used to measure the depth of sediment if any in the row. If the depth of sediment is in excess of 3" then the row should be cleaned with high pressure water through a culvert cleaning nozzle. Refer to maintenance guide from manufacturer for additional detail.

Debris and Litter Removal

Trash may collect in the BMP's, potentially causing clogging of the facilities. All debris and litter shall be removed when necessary, and after each storm event.

Catch Basins

The catch basins shall be inspected two (2) times per year, and if necessary, any maintenance shall be performed so that it functions as designed. The catch basins shall be cleaned once per year or when sediment in the bottom of the sump reaches 24 inches below the bottom of the outlet. Inlet and outlet pipes should be checked for clogging. Catch basin grates shall be kept free of snow and ice in the winter months and kept free of leaves, sand and debris during warmer months. At a minimum, inspection of the catch basin shall be performed during the last week of April and the first week of October each year.

Water Quality Vortex Treatment Unit (Stormceptor 450*i*)

Inspection and maintenance of the stormceptor unit shall follow documentation guidance as prepared by the manufacturer. At minimum, inspections should be performed twice per year once in the spring after snowmelt and once in late fall. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. Visual inspections should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. Additionally, the visual inspection shall include quantifying the accumulation of trash and sediment in the system. The 450*i* system should be cleaned when the level of sediment in the isolated sump storage chamber has reached 8" of capacity. Cleaning of the system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. The system should be completely drained down and the sump fully evacuated of sediment. Oils and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from other pollutants.

Disposal of all material removed from the 450*i* system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from deep sump catch basins.

<u>Good Housekeeping Practices</u> (in accordance with Standard 10 of the Stormwater Management Handbook to prevent illicit discharges)

Provisions for storing paints, cleaners, automotive waste and other potentially hazardous household waste products inside or under cover

- All materials on site will be stored inside in a neat, orderly, manner in their appropriate containers with the original manufacturer's label.
- Only store enough material necessary. Whenever possible, all of a product shall be used up before disposing of container
- Manufacturer, local, and State recommendations for proper use and disposal shall be followed.

Vehicle washing controls

- A commercial car wash shall be used when possible. Car washes treat and/or recycle water.
- Cars shall be washed on gravel, grass, or other permeable surfaces to allow filtration to occur.
- Use biodegradable soaps.
- A water hose with a nozzle that automatically turns off when left unattended.

Requirements for routine inspection and maintenance of stormwater BMPs

- See Inspection and Maintenance Measures after Construction.

Spill prevention and response plans

- Spill Control Practices shall be in conformance with the guidelines set forth in the National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan (SWPPP)

Provisions for maintenance of lawns, gardens, and other landscaped areas

- Grass shall not be cut shorter than 2 to 3 inches.
- Use low volume water approaches such as drip-type or sprinkler systems. Water plants only when needed to enhance root growth and avoid runoff problems.
- The use of mulch shall be utilized where possible. Mulch helps retain water and prevents erosion.

Requirements for storage and use of fertilizers, herbicides and pesticides

- Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. Storage will be in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.
- Do not fertilize before a rainstorm.
- Consider using organic fertilizers. They release nutrients more slowly.
- Pesticides shall be applied on lawns and gardens only when necessary and applied only in the minimum amounts recommended by the manufacturer.

Pet waste management

- Scoop up and seal pet wastes in a plastic bag. Dispose of properly, in the garbage.

Provisions for operation and management of septic systems

- Not Applicable

Provisions for solid waste management

- All solid waste shall be disposed of or recycled in accordance with local city regulations.

Roadway and Parking Lot sweeping schedule

- Pavement sweeping shall be conducted at a frequency of not less than once per year
- Removal of any accumulated sand, grit, and debris from driveway after the snow melts shall be completed shortly after snow melts for the season.

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

- Not Applicable

Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan

- To be determined by the owner.

List of Emergency contacts for implementing Long-Term Pollution Prevention Plan

To be determined by the owner.

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STORMWATER MANAGEMENT
POST-CONSTRUCTION PHASE

INSPECTION SCHEDULE AND EVALUATION CHECKLIST

PROJECT LOCATION: 93 State Street, Newburyport, Massachusetts

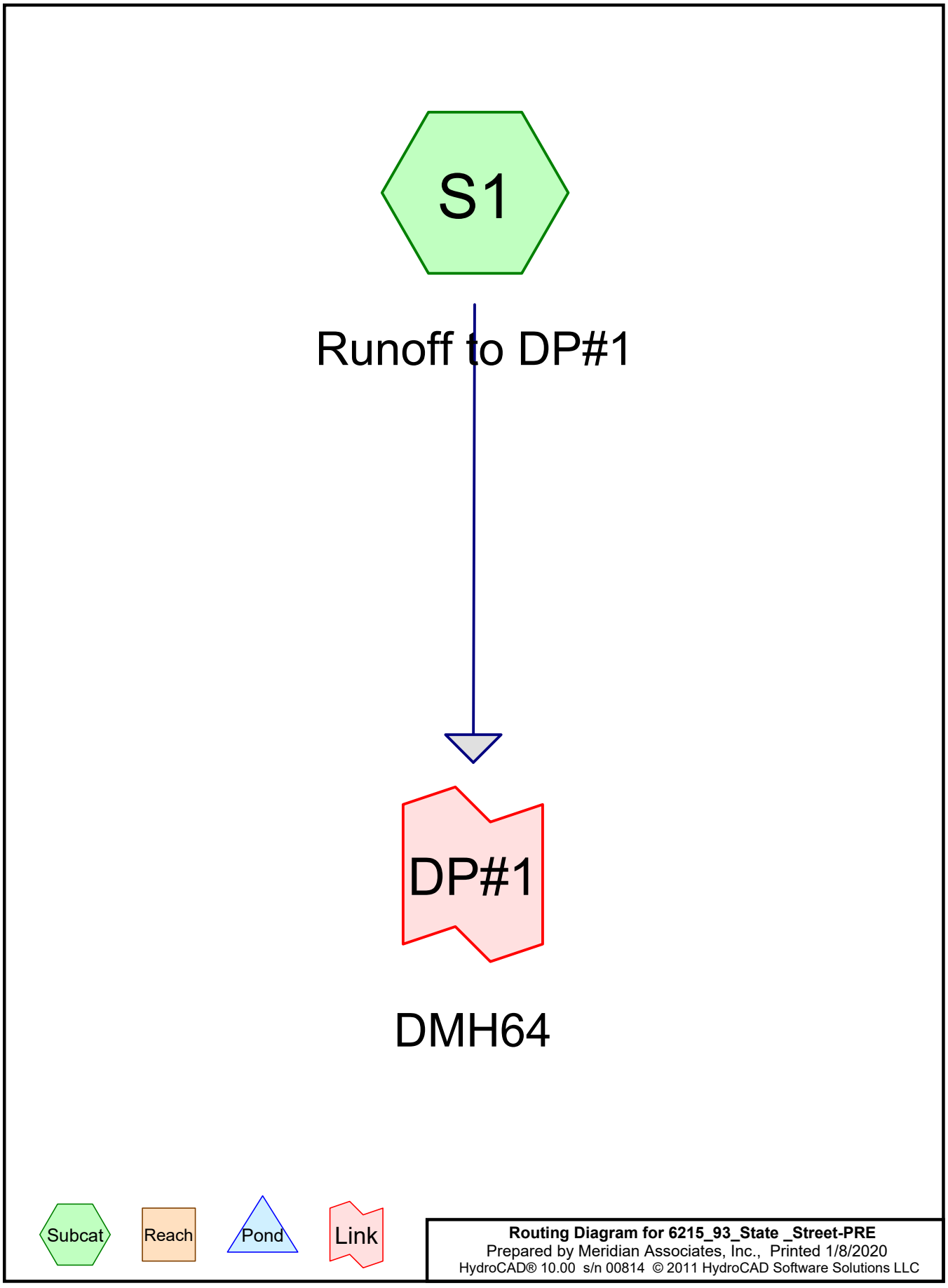
Inspection Date	Inspector	Area Inspected	Best Management Practice (yes/no)	Required Inspection Frequency if BMP	Comments	Recommendation	Follow-up Inspection Required (yes/no)
		Catch Basin	Yes	2 Times per year (clean as necessary)			
		Vortex Units	Yes	2 Times per year			
		Subsurface Detention Facility	Yes	2 Times per year			

(1) Refer to the Massachusetts Stormwater Handbook, Volume Two: Stormwater Technical Handbook (February 2008) for recommendations regarding frequency for inspection and maintenance of specific BMP's.

(2) Inspections to be conducted by a qualified professional such as an environmental scientist or civil engineer.

Limited or no use of sodium chloride salts, fertilizers or pesticides recommended.
Other notes: (Include deviations from: Con. Comm. Order of Conditions, PB Approval, Construction Sequence and Approved Plan)

Stormwater Control Manager: _____



Routing Diagram for 6215_93_State _Street-PRE
Prepared by Meridian Associates, Inc., Printed 1/8/2020

Summary for Subcatchment S1: Runoff to DP#1

Runoff = 1.27 cfs @ 12.09 hrs, Volume= 3,989 cf, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

	Area (sf)	CN	Description
*	15,000	98	Existing Asphalt Parking Areas
*	6,750	98	Existing Roof Area
*	2,425	98	Existing Brick & Misc. Concrete
	12,825	39	>75% Grass cover, Good, HSG A
	37,000	78	Weighted Average
	12,825		34.66% Pervious Area
	24,175		65.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	16	0.0700	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.5	36	0.0300	1.32		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.4	49	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.7					**Direct Entry, Minimum Tc**
6.0	101	Total			

Summary for Link DP#1: DMH64

Inflow Area = 37,000 sf, 65.34% Impervious, Inflow Depth > 1.29" for 2-yr event
Inflow = 1.27 cfs @ 12.09 hrs, Volume= 3,989 cf
Primary = 1.27 cfs @ 12.09 hrs, Volume= 3,989 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Subcatchment S1: Runoff to DP#1

Runoff = 2.67 cfs @ 12.09 hrs, Volume= 8,247 cf, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

	Area (sf)	CN	Description
*	15,000	98	Existing Asphalt Parking Areas
*	6,750	98	Existing Roof Area
*	2,425	98	Existing Brick & Misc. Concrete
	12,825	39	>75% Grass cover, Good, HSG A
	37,000	78	Weighted Average
	12,825		34.66% Pervious Area
	24,175		65.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	16	0.0700	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.5	36	0.0300	1.32		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.4	49	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.7					**Direct Entry, Minimum Tc**
6.0	101	Total			

Summary for Link DP#1: DMH64

Inflow Area = 37,000 sf, 65.34% Impervious, Inflow Depth > 2.67" for 10-yr event
Inflow = 2.67 cfs @ 12.09 hrs, Volume= 8,247 cf
Primary = 2.67 cfs @ 12.09 hrs, Volume= 8,247 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Subcatchment S1: Runoff to DP#1

Runoff = 6.37 cfs @ 12.09 hrs, Volume= 20,023 cf, Depth> 6.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

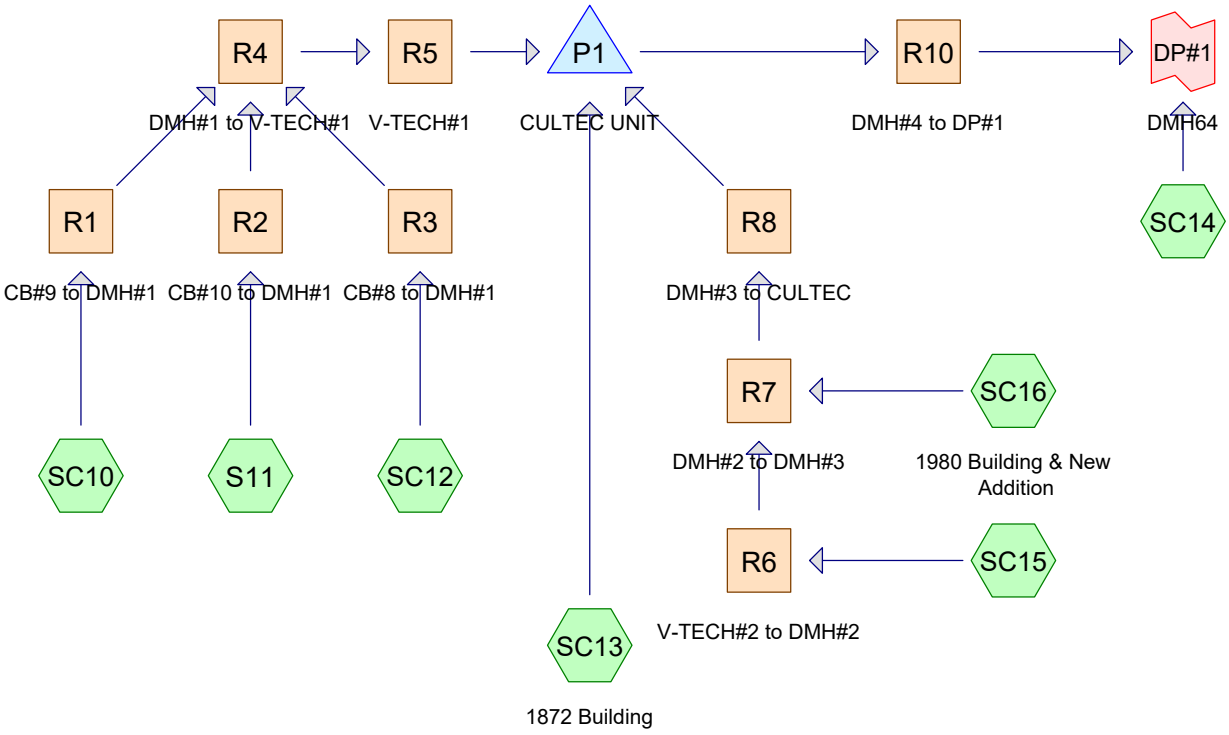
	Area (sf)	CN	Description
*	15,000	98	Existing Asphalt Parking Areas
*	6,750	98	Existing Roof Area
*	2,425	98	Existing Brick & Misc. Concrete
	12,825	39	>75% Grass cover, Good, HSG A
	37,000	78	Weighted Average
	12,825		34.66% Pervious Area
	24,175		65.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	16	0.0700	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.5	36	0.0300	1.32		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.4	49	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.7					**Direct Entry, Minimum Tc**
6.0	101	Total			

Summary for Link DP#1: DMH64

Inflow Area = 37,000 sf, 65.34% Impervious, Inflow Depth > 6.49" for 100-yr event
Inflow = 6.37 cfs @ 12.09 hrs, Volume= 20,023 cf
Primary = 6.37 cfs @ 12.09 hrs, Volume= 20,023 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Subcat Reach Pond Link

Routing Diagram for 6215_93_State_Street-POST
Prepared by Meridian Associates, Inc., Printed 1/8/2020

Summary for Subcatchment S11:

Runoff = 0.14 cfs @ 12.09 hrs, Volume= 455 cf, Depth> 1.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

Area (sf)	CN	Description
2,855	98	Paved parking, HSG A
1,575	39	>75% Grass cover, Good, HSG A
4,430	77	Weighted Average
1,575		35.55% Pervious Area
2,855		64.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	17	0.0500	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.4	34	0.0300	1.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.2	39	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.8					**Direct Entry, Minimum Tc**
6.0	90	Total			

Summary for Subcatchment SC10:

Runoff = 0.12 cfs @ 12.10 hrs, Volume= 436 cf, Depth> 0.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

Area (sf)	CN	Description
3,560	98	Paved parking, HSG A
3,900	39	>75% Grass cover, Good, HSG A
7,460	67	Weighted Average
3,900		52.28% Pervious Area
3,560		47.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	36	0.0300	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.2	17	0.0300	1.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	55	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.8					**Direct Entry, Minimum Tc**
6.0	108	Total			

Summary for Subcatchment SC12:

Runoff = 0.13 cfs @ 12.09 hrs, Volume= 423 cf, Depth> 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

Area (sf)	CN	Description
2,735	98	Paved parking, HSG A
1,595	39	>75% Grass cover, Good, HSG A
4,330	76	Weighted Average
1,595		36.84% Pervious Area
2,735		63.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	25	0.0500	0.45		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.3	25	0.0300	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	72	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.5					**Direct Entry, Minimum Tc**
6.0	122	Total			

Summary for Subcatchment SC13: 1872 Building

Runoff = 0.26 cfs @ 12.08 hrs, Volume= 911 cf, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

Area (sf)	CN	Description
3,650	98	Roofs, HSG A
3,650		100.00% Impervious Area

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

Summary for Subcatchment SC14:

Runoff = 0.03 cfs @ 12.10 hrs, Volume= 96 cf, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

	Area (sf)	CN	Description
*	725	98	Existing Asphalt Parking Areas
	640	39	>75% Grass cover, Good, HSG A
	1,365	70	Weighted Average
	640		46.89% Pervious Area
	725		53.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	23	0.0300	0.36		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.2	16	0.0300	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
4.7					**Direct Entry, Minimum Tc**
6.0	39	Total			

Summary for Subcatchment SC15:

Runoff = 0.05 cfs @ 12.10 hrs, Volume= 175 cf, Depth> 0.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

	Area (sf)	CN	Description
*	1,245	98	Existing Asphalt Parking Areas
	975	39	>75% Grass cover, Good, HSG A
	2,220	72	Weighted Average
	975		43.92% Pervious Area
	1,245		56.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	17	0.0300	0.34		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.1	9	0.0300	1.00		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
5.1					**Direct Entry, Minimum Tc**
6.0	26	Total			

Summary for Subcatchment SC16: 1980 Building & New Addition

Runoff = 0.82 cfs @ 12.09 hrs, Volume= 2,578 cf, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.23"

Area (sf)	CN	Description
715	98	Paved parking, HSG A
11,285	98	Roofs, HSG A
1,545	39	>75% Grass cover, Good, HSG A
13,545	91	Weighted Average
1,545		11.41% Pervious Area
12,000		88.59% Impervious Area

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

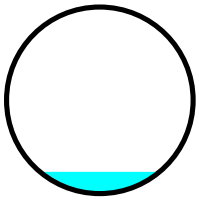
Summary for Reach R1: CB#9 to DMH#1

Inflow Area = 7,460 sf, 47.72% Impervious, Inflow Depth > 0.70" for 2-yr event
Inflow = 0.12 cfs @ 12.10 hrs, Volume= 436 cf
Outflow = 0.12 cfs @ 12.11 hrs, Volume= 436 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.32 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.98 fps, Avg. Travel Time= 0.8 min

Peak Storage= 2 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.11 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 45.0' Slope= 0.0133 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



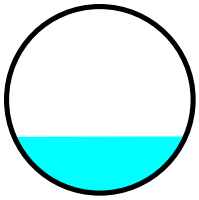
Summary for Reach R10: DMH#4 to DP#1

Inflow Area = 35,635 sf, 73.09% Impervious, Inflow Depth > 1.60" for 2-yr event
Inflow = 1.31 cfs @ 12.14 hrs, Volume= 4,752 cf
Outflow = 1.31 cfs @ 12.14 hrs, Volume= 4,751 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.16 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.63 fps, Avg. Travel Time= 0.4 min

Peak Storage= 12 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 6.54 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 39.0' Slope= 0.0103 '/'
Inlet Invert= 94.40', Outlet Invert= 94.00'



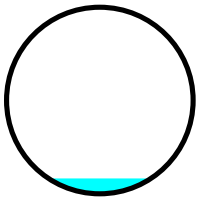
Summary for Reach R2: CB#10 to DMH#1

Inflow Area = 4,430 sf, 64.45% Impervious, Inflow Depth > 1.23" for 2-yr event
Inflow = 0.14 cfs @ 12.09 hrs, Volume= 455 cf
Outflow = 0.14 cfs @ 12.09 hrs, Volume= 455 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.70 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 0.1 min

Peak Storage= 0 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.08'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 10.43 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.0857 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



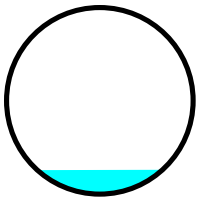
Summary for Reach R3: CB#8 to DMH#1

Inflow Area = 4,330 sf, 63.16% Impervious, Inflow Depth > 1.17" for 2-yr event
Inflow = 0.13 cfs @ 12.09 hrs, Volume= 423 cf
Outflow = 0.13 cfs @ 12.10 hrs, Volume= 422 cf, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.19 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.84 fps, Avg. Travel Time= 1.2 min

Peak Storage= 3 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.62 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 58.0' Slope= 0.0103 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



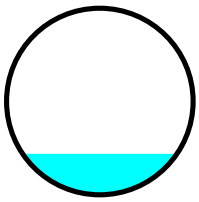
Summary for Reach R4: DMH#1 to V-TECH#1

Inflow Area = 16,220 sf, 56.41% Impervious, Inflow Depth > 0.97" for 2-yr event
Inflow = 0.39 cfs @ 12.10 hrs, Volume= 1,313 cf
Outflow = 0.39 cfs @ 12.10 hrs, Volume= 1,313 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.10 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 0.1 min

Peak Storage= 1 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.76 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 9.0' Slope= 0.0111 '/'
Inlet Invert= 95.90', Outlet Invert= 95.80'



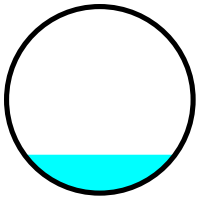
Summary for Reach R5: V-TECH#1

Inflow Area = 16,220 sf, 56.41% Impervious, Inflow Depth > 0.97" for 2-yr event
Inflow = 0.39 cfs @ 12.10 hrs, Volume= 1,313 cf
Outflow = 0.39 cfs @ 12.10 hrs, Volume= 1,313 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.39 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 0.1 min

Peak Storage= 1 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.26 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.0143 '/'
Inlet Invert= 95.70', Outlet Invert= 95.60'



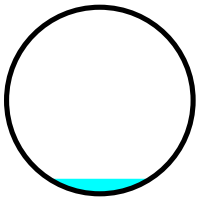
Summary for Reach R6: V-TECH#2 to DMH#2

Inflow Area = 2,220 sf, 56.08% Impervious, Inflow Depth > 0.95" for 2-yr event
Inflow = 0.05 cfs @ 12.10 hrs, Volume= 175 cf
Outflow = 0.05 cfs @ 12.10 hrs, Volume= 175 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.77 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 0.2 min

Peak Storage= 0 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.08'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.98 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 8.0' Slope= 0.0125 '/'
Inlet Invert= 96.90', Outlet Invert= 96.80'



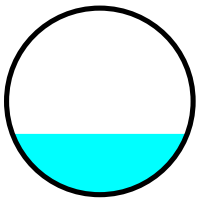
Summary for Reach R7: DMH#2 to DMH#3

Inflow Area = 15,765 sf, 84.02% Impervious, Inflow Depth > 2.10" for 2-yr event
Inflow = 0.87 cfs @ 12.09 hrs, Volume= 2,753 cf
Outflow = 0.87 cfs @ 12.09 hrs, Volume= 2,753 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.93 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 0.4 min

Peak Storage= 8 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.81 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 35.0' Slope= 0.0114 '/'
Inlet Invert= 96.70', Outlet Invert= 96.30'



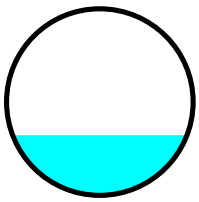
Summary for Reach R8: DMH#3 to CULTEC

Inflow Area = 15,765 sf, 84.02% Impervious, Inflow Depth > 2.10" for 2-yr event
Inflow = 0.87 cfs @ 12.09 hrs, Volume= 2,753 cf
Outflow = 0.87 cfs @ 12.09 hrs, Volume= 2,753 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.97 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 0.6 min

Peak Storage= 11 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.86 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 51.0' Slope= 0.0118 '/'
Inlet Invert= 96.20', Outlet Invert= 95.60'



Summary for Pond P1: CULTEC UNIT

Inflow Area = 35,635 sf, 73.09% Impervious, Inflow Depth > 1.68" for 2-yr event
Inflow = 1.52 cfs @ 12.09 hrs, Volume= 4,977 cf
Outflow = 1.31 cfs @ 12.14 hrs, Volume= 4,752 cf, Atten= 14%, Lag= 2.9 min
Primary = 1.31 cfs @ 12.14 hrs, Volume= 4,752 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 95.53' @ 12.14 hrs Surf.Area= 863 sf Storage= 632 cf

Plug-Flow detention time= 48.8 min calculated for 4,750 cf (95% of inflow)
Center-of-Mass det. time= 23.6 min (835.8 - 812.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	94.40'	689 cf	**19.17'W x 45.00'L x 3.21'H Field A** 2,767 cf Overall - 1,044 cf Embedded = 1,723 cf x 40.0% Voids
#2A	94.90'	1,044 cf	**Cultec R-280** x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 4 rows
		1,733 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	94.90'	**12.0" Round Culvert - R9** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 94.90' / 94.52' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.30 cfs @ 12.14 hrs HW=95.53' TW=94.78' (Dynamic Tailwater)
↑—**1=Culvert - R9** (Barrel Controls 1.30 cfs @ 3.55 fps)

Summary for Link DP#1: DMH64

Inflow Area = 37,000 sf, 72.35% Impervious, Inflow Depth > 1.57" for 2-yr event
Inflow = 1.33 cfs @ 12.14 hrs, Volume= 4,847 cf
Primary = 1.33 cfs @ 12.14 hrs, Volume= 4,847 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Subcatchment S11:

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 955 cf, Depth> 2.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

Area (sf)	CN	Description
2,855	98	Paved parking, HSG A
1,575	39	>75% Grass cover, Good, HSG A
4,430	77	Weighted Average
1,575		35.55% Pervious Area
2,855		64.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	17	0.0500	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.4	34	0.0300	1.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.2	39	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.8					**Direct Entry, Minimum Tc**
6.0	90	Total			

Summary for Subcatchment SC10:

Runoff = 0.34 cfs @ 12.09 hrs, Volume= 1,102 cf, Depth> 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

Area (sf)	CN	Description
3,560	98	Paved parking, HSG A
3,900	39	>75% Grass cover, Good, HSG A
7,460	67	Weighted Average
3,900		52.28% Pervious Area
3,560		47.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	36	0.0300	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.2	17	0.0300	1.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	55	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.8					**Direct Entry, Minimum Tc**
6.0	108	Total			

Summary for Subcatchment SC12:

Runoff = 0.29 cfs @ 12.09 hrs, Volume= 902 cf, Depth> 2.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

Area (sf)	CN	Description
2,735	98	Paved parking, HSG A
1,595	39	>75% Grass cover, Good, HSG A
4,330	76	Weighted Average
1,595		36.84% Pervious Area
2,735		63.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	25	0.0500	0.45		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.3	25	0.0300	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	72	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.5					**Direct Entry, Minimum Tc**
6.0	122	Total			

Summary for Subcatchment SC13: 1872 Building

Runoff = 0.41 cfs @ 12.08 hrs, Volume= 1,436 cf, Depth> 4.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

Area (sf)	CN	Description
3,650	98	Roofs, HSG A
3,650		100.00% Impervious Area

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

Summary for Subcatchment SC14:

Runoff = 0.07 cfs @ 12.09 hrs, Volume= 228 cf, Depth> 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

	Area (sf)	CN	Description
*	725	98	Existing Asphalt Parking Areas
	640	39	>75% Grass cover, Good, HSG A
	1,365	70	Weighted Average
	640		46.89% Pervious Area
	725		53.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	23	0.0300	0.36		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.2	16	0.0300	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
4.7					**Direct Entry, Minimum Tc**
6.0	39	Total			

Summary for Subcatchment SC15:

Runoff = 0.13 cfs @ 12.09 hrs, Volume= 400 cf, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

	Area (sf)	CN	Description
*	1,245	98	Existing Asphalt Parking Areas
	975	39	>75% Grass cover, Good, HSG A
	2,220	72	Weighted Average
	975		43.92% Pervious Area
	1,245		56.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	17	0.0300	0.34		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.1	9	0.0300	1.00		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
5.1					**Direct Entry, Minimum Tc**
6.0	26	Total			

Summary for Subcatchment SC16: 1980 Building & New Addition

Runoff = 1.38 cfs @ 12.08 hrs, Volume= 4,447 cf, Depth> 3.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.96"

Area (sf)	CN	Description
715	98	Paved parking, HSG A
11,285	98	Roofs, HSG A
1,545	39	>75% Grass cover, Good, HSG A
13,545	91	Weighted Average
1,545		11.41% Pervious Area
12,000		88.59% Impervious Area

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

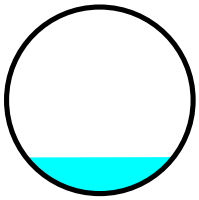
Summary for Reach R1: CB#9 to DMH#1

Inflow Area = 7,460 sf, 47.72% Impervious, Inflow Depth > 1.77" for 10-yr event
Inflow = 0.34 cfs @ 12.09 hrs, Volume= 1,102 cf
Outflow = 0.34 cfs @ 12.10 hrs, Volume= 1,102 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.22 fps, Avg. Travel Time= 0.6 min

Peak Storage= 5 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.11 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 45.0' Slope= 0.0133 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



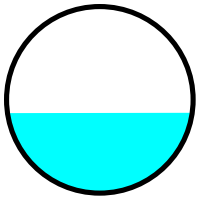
Summary for Reach R10: DMH#4 to DP#1

Inflow Area = 35,635 sf, 73.09% Impervious, Inflow Depth > 3.03" for 10-yr event
Inflow = 2.51 cfs @ 12.13 hrs, Volume= 9,000 cf
Outflow = 2.51 cfs @ 12.14 hrs, Volume= 8,999 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.98 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 0.3 min

Peak Storage= 20 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.54'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 6.54 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 39.0' Slope= 0.0103 '/'
Inlet Invert= 94.40', Outlet Invert= 94.00'



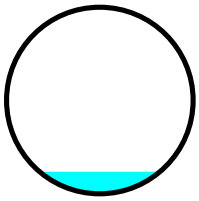
Summary for Reach R2: CB#10 to DMH#1

Inflow Area = 4,430 sf, 64.45% Impervious, Inflow Depth > 2.59" for 10-yr event
Inflow = 0.31 cfs @ 12.09 hrs, Volume= 955 cf
Outflow = 0.31 cfs @ 12.09 hrs, Volume= 955 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.92 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.14 fps, Avg. Travel Time= 0.1 min

Peak Storage= 0 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 10.43 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.0857 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



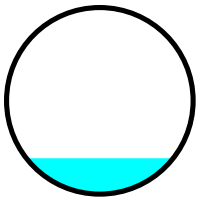
Summary for Reach R3: CB#8 to DMH#1

Inflow Area = 4,330 sf, 63.16% Impervious, Inflow Depth > 2.50" for 10-yr event
Inflow = 0.29 cfs @ 12.09 hrs, Volume= 902 cf
Outflow = 0.29 cfs @ 12.09 hrs, Volume= 902 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.77 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.00 fps, Avg. Travel Time= 1.0 min

Peak Storage= 6 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.62 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 58.0' Slope= 0.0103 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



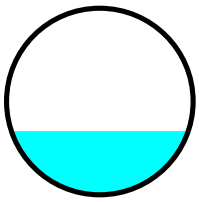
Summary for Reach R4: DMH#1 to V-TECH#1

Inflow Area = 16,220 sf, 56.41% Impervious, Inflow Depth > 2.19" for 10-yr event
Inflow = 0.94 cfs @ 12.09 hrs, Volume= 2,958 cf
Outflow = 0.94 cfs @ 12.09 hrs, Volume= 2,958 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.98 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.44 fps, Avg. Travel Time= 0.1 min

Peak Storage= 2 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.76 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 9.0' Slope= 0.0111 '/'
Inlet Invert= 95.90', Outlet Invert= 95.80'



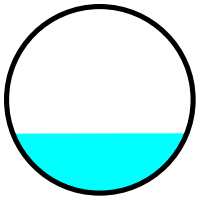
Summary for Reach R5: V-TECH#1

Inflow Area = 16,220 sf, 56.41% Impervious, Inflow Depth > 2.19" for 10-yr event
Inflow = 0.94 cfs @ 12.09 hrs, Volume= 2,958 cf
Outflow = 0.94 cfs @ 12.09 hrs, Volume= 2,958 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.35 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.57 fps, Avg. Travel Time= 0.1 min

Peak Storage= 2 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.26 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.0143 '/'
Inlet Invert= 95.70', Outlet Invert= 95.60'



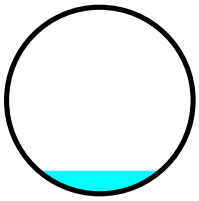
Summary for Reach R6: V-TECH#2 to DMH#2

Inflow Area = 2,220 sf, 56.08% Impervious, Inflow Depth > 2.16" for 10-yr event
Inflow = 0.13 cfs @ 12.09 hrs, Volume= 400 cf
Outflow = 0.13 cfs @ 12.09 hrs, Volume= 400 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.32 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.86 fps, Avg. Travel Time= 0.2 min

Peak Storage= 0 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.98 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 8.0' Slope= 0.0125 '/'
Inlet Invert= 96.90', Outlet Invert= 96.80'



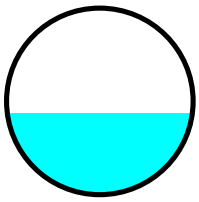
Summary for Reach R7: DMH#2 to DMH#3

Inflow Area = 15,765 sf, 84.02% Impervious, Inflow Depth > 3.69" for 10-yr event
Inflow = 1.50 cfs @ 12.09 hrs, Volume= 4,847 cf
Outflow = 1.50 cfs @ 12.09 hrs, Volume= 4,847 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.56 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.53 fps, Avg. Travel Time= 0.4 min

Peak Storage= 12 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.81 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 35.0' Slope= 0.0114 '/'
Inlet Invert= 96.70', Outlet Invert= 96.30'



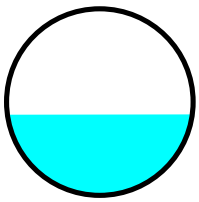
Summary for Reach R8: DMH#3 to CULTEC

Inflow Area = 15,765 sf, 84.02% Impervious, Inflow Depth > 3.69" for 10-yr event
Inflow = 1.50 cfs @ 12.09 hrs, Volume= 4,847 cf
Outflow = 1.50 cfs @ 12.09 hrs, Volume= 4,846 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.61 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.54 fps, Avg. Travel Time= 0.6 min

Peak Storage= 17 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.86 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 51.0' Slope= 0.0118 '/'
Inlet Invert= 96.20', Outlet Invert= 95.60'



Summary for Pond P1: CULTEC UNIT

Inflow Area = 35,635 sf, 73.09% Impervious, Inflow Depth > 3.11" for 10-yr event
Inflow = 2.85 cfs @ 12.09 hrs, Volume= 9,240 cf
Outflow = 2.51 cfs @ 12.13 hrs, Volume= 9,000 cf, Atten= 12%, Lag= 2.6 min
Primary = 2.51 cfs @ 12.13 hrs, Volume= 9,000 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 95.88' @ 12.13 hrs Surf.Area= 863 sf Storage= 870 cf

Plug-Flow detention time= 32.6 min calculated for 9,000 cf (97% of inflow)
Center-of-Mass det. time= 17.2 min (817.5 - 800.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	94.40'	689 cf	**19.17'W x 45.00'L x 3.21'H Field A** 2,767 cf Overall - 1,044 cf Embedded = 1,723 cf x 40.0% Voids
#2A	94.90'	1,044 cf	**Cultec R-280** x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 4 rows
		1,733 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	94.90'	**12.0" Round Culvert - R9** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 94.90' / 94.52' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.51 cfs @ 12.13 hrs HW=95.88' TW=94.94' (Dynamic Tailwater)
↑—**1=Culvert - R9** (Barrel Controls 2.51 cfs @ 4.06 fps)

Summary for Link DP#1: DMH64

Inflow Area = 37,000 sf, 72.35% Impervious, Inflow Depth > 2.99" for 10-yr event
Inflow = 2.57 cfs @ 12.13 hrs, Volume= 9,227 cf
Primary = 2.57 cfs @ 12.13 hrs, Volume= 9,227 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Subcatchment S11:

Runoff = 0.75 cfs @ 12.09 hrs, Volume= 2,351 cf, Depth> 6.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

Area (sf)	CN	Description
2,855	98	Paved parking, HSG A
1,575	39	>75% Grass cover, Good, HSG A
4,430	77	Weighted Average
1,575		35.55% Pervious Area
2,855		64.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	17	0.0500	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.4	34	0.0300	1.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.2	39	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.8					**Direct Entry, Minimum Tc**
6.0	90	Total			

Summary for Subcatchment SC10:

Runoff = 1.03 cfs @ 12.09 hrs, Volume= 3,184 cf, Depth> 5.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

Area (sf)	CN	Description
3,560	98	Paved parking, HSG A
3,900	39	>75% Grass cover, Good, HSG A
7,460	67	Weighted Average
3,900		52.28% Pervious Area
3,560		47.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	36	0.0300	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.23"
0.2	17	0.0300	1.14		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	55	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.8					**Direct Entry, Minimum Tc**
6.0	108	Total			

Summary for Subcatchment SC12:

Runoff = 0.72 cfs @ 12.09 hrs, Volume= 2,254 cf, Depth> 6.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

Area (sf)	CN	Description
2,735	98	Paved parking, HSG A
1,595	39	>75% Grass cover, Good, HSG A
4,330	76	Weighted Average
1,595		36.84% Pervious Area
2,735		63.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	25	0.0500	0.45		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.3	25	0.0300	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	72	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.5					**Direct Entry, Minimum Tc**
6.0	122	Total			

Summary for Subcatchment SC13: 1872 Building

Runoff = 0.76 cfs @ 12.08 hrs, Volume= 2,720 cf, Depth> 8.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

Area (sf)	CN	Description
3,650	98	Roofs, HSG A
3,650		100.00% Impervious Area

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

Summary for Subcatchment SC14:

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 625 cf, Depth> 5.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

	Area (sf)	CN	Description
*	725	98	Existing Asphalt Parking Areas
	640	39	>75% Grass cover, Good, HSG A
	1,365	70	Weighted Average
	640		46.89% Pervious Area
	725		53.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	23	0.0300	0.36		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.2	16	0.0300	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
4.7					**Direct Entry, Minimum Tc**
6.0	39	Total			

Summary for Subcatchment SC15:

Runoff = 0.34 cfs @ 12.09 hrs, Volume= 1,063 cf, Depth> 5.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

	Area (sf)	CN	Description
*	1,245	98	Existing Asphalt Parking Areas
	975	39	>75% Grass cover, Good, HSG A
	2,220	72	Weighted Average
	975		43.92% Pervious Area
	1,245		56.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	17	0.0300	0.34		**Sheet Flow,** Fallow n= 0.050 P2= 3.23"
0.1	9	0.0300	1.00		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
5.1					**Direct Entry, Minimum Tc**
6.0	26	Total			

Summary for Subcatchment SC16: 1980 Building & New Addition

Runoff = 2.72 cfs @ 12.08 hrs, Volume= 9,136 cf, Depth> 8.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=9.19"

Area (sf)	CN	Description
715	98	Paved parking, HSG A
11,285	98	Roofs, HSG A
1,545	39	>75% Grass cover, Good, HSG A
13,545	91	Weighted Average
1,545		11.41% Pervious Area
12,000		88.59% Impervious Area

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

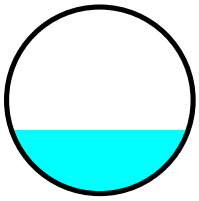
Summary for Reach R1: CB#9 to DMH#1

Inflow Area = 7,460 sf, 47.72% Impervious, Inflow Depth > 5.12" for 100-yr event
Inflow = 1.03 cfs @ 12.09 hrs, Volume= 3,184 cf
Outflow = 1.03 cfs @ 12.09 hrs, Volume= 3,183 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.36 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.55 fps, Avg. Travel Time= 0.5 min

Peak Storage= 11 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.11 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 45.0' Slope= 0.0133 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



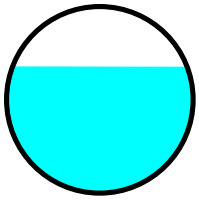
Summary for Reach R10: DMH#4 to DP#1

Inflow Area = 35,635 sf, 73.09% Impervious, Inflow Depth > 6.88" for 100-yr event
Inflow = 5.25 cfs @ 12.14 hrs, Volume= 20,439 cf
Outflow = 5.25 cfs @ 12.14 hrs, Volume= 20,438 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.93 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.27 fps, Avg. Travel Time= 0.3 min

Peak Storage= 35 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 6.54 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 39.0' Slope= 0.0103 '/'
Inlet Invert= 94.40', Outlet Invert= 94.00'



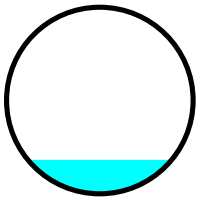
Summary for Reach R2: CB#10 to DMH#1

Inflow Area = 4,430 sf, 64.45% Impervious, Inflow Depth > 6.37" for 100-yr event
Inflow = 0.75 cfs @ 12.09 hrs, Volume= 2,351 cf
Outflow = 0.75 cfs @ 12.09 hrs, Volume= 2,351 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.71 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.60 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 10.43 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.0857 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



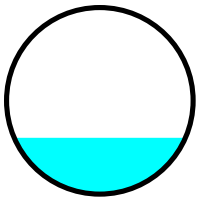
Summary for Reach R3: CB#8 to DMH#1

Inflow Area = 4,330 sf, 63.16% Impervious, Inflow Depth > 6.25" for 100-yr event
Inflow = 0.72 cfs @ 12.09 hrs, Volume= 2,254 cf
Outflow = 0.72 cfs @ 12.09 hrs, Volume= 2,253 cf, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.60 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.22 fps, Avg. Travel Time= 0.8 min

Peak Storage= 12 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.62 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 58.0' Slope= 0.0103 '/'
Inlet Invert= 96.60', Outlet Invert= 96.00'



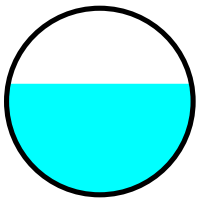
Summary for Reach R4: DMH#1 to V-TECH#1

Inflow Area = 16,220 sf, 56.41% Impervious, Inflow Depth > 5.76" for 100-yr event
Inflow = 2.50 cfs @ 12.09 hrs, Volume= 7,788 cf
Outflow = 2.50 cfs @ 12.09 hrs, Volume= 7,788 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.12 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 0.1 min

Peak Storage= 4 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.76 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 9.0' Slope= 0.0111 '/'
Inlet Invert= 95.90', Outlet Invert= 95.80'



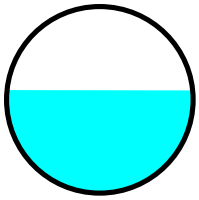
Summary for Reach R5: V-TECH#1

Inflow Area = 16,220 sf, 56.41% Impervious, Inflow Depth > 5.76" for 100-yr event
Inflow = 2.50 cfs @ 12.09 hrs, Volume= 7,788 cf
Outflow = 2.50 cfs @ 12.09 hrs, Volume= 7,787 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.64 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.95 fps, Avg. Travel Time= 0.1 min

Peak Storage= 3 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.26 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 7.0' Slope= 0.0143 '/'
Inlet Invert= 95.70', Outlet Invert= 95.60'



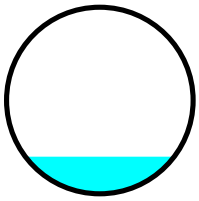
Summary for Reach R6: V-TECH#2 to DMH#2

Inflow Area = 2,220 sf, 56.08% Impervious, Inflow Depth > 5.75" for 100-yr event
Inflow = 0.34 cfs @ 12.09 hrs, Volume= 1,063 cf
Outflow = 0.34 cfs @ 12.09 hrs, Volume= 1,063 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.10 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.07 fps, Avg. Travel Time= 0.1 min

Peak Storage= 1 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.98 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 8.0' Slope= 0.0125 '/'
Inlet Invert= 96.90', Outlet Invert= 96.80'



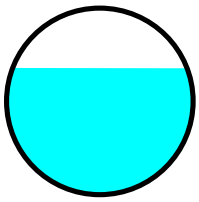
Summary for Reach R7: DMH#2 to DMH#3

Inflow Area = 15,765 sf, 84.02% Impervious, Inflow Depth > 7.76" for 100-yr event
Inflow = 3.06 cfs @ 12.08 hrs, Volume= 10,200 cf
Outflow = 3.06 cfs @ 12.09 hrs, Volume= 10,199 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.39 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.87 fps, Avg. Travel Time= 0.3 min

Peak Storage= 20 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.81 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 35.0' Slope= 0.0114 '/'
Inlet Invert= 96.70', Outlet Invert= 96.30'



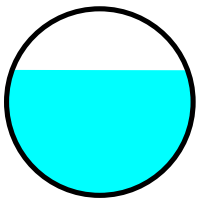
Summary for Reach R8: DMH#3 to CULTEC

Inflow Area = 15,765 sf, 84.02% Impervious, Inflow Depth > 7.76" for 100-yr event
Inflow = 3.06 cfs @ 12.09 hrs, Volume= 10,199 cf
Outflow = 3.06 cfs @ 12.09 hrs, Volume= 10,198 cf, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.45 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 0.5 min

Peak Storage= 29 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.86 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 51.0' Slope= 0.0118 '/'
Inlet Invert= 96.20', Outlet Invert= 95.60'



Summary for Pond P1: CULTEC UNIT

Inflow Area = 35,635 sf, 73.09% Impervious, Inflow Depth > 6.97" for 100-yr event
Inflow = 6.31 cfs @ 12.09 hrs, Volume= 20,705 cf
Outflow = 5.25 cfs @ 12.14 hrs, Volume= 20,439 cf, Atten= 17%, Lag= 3.2 min
Primary = 5.25 cfs @ 12.14 hrs, Volume= 20,439 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 97.39' @ 12.14 hrs Surf.Area= 863 sf Storage= 1,658 cf

Plug-Flow detention time= 19.6 min calculated for 20,431 cf (99% of inflow)
Center-of-Mass det. time= 11.6 min (795.4 - 783.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	94.40'	689 cf	**19.17'W x 45.00'L x 3.21'H Field A** 2,767 cf Overall - 1,044 cf Embedded = 1,723 cf x 40.0% Voids
#2A	94.90'	1,044 cf	**Cultec R-280** x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 4 rows
		1,733 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	94.90'	**12.0" Round Culvert - R9** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 94.90' / 94.52' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=5.25 cfs @ 12.14 hrs HW=97.39' TW=95.25' (Dynamic Tailwater)
↑—**1=Culvert - R9** (Barrel Controls 5.25 cfs @ 6.68 fps)

Summary for Link DP#1: DMH64

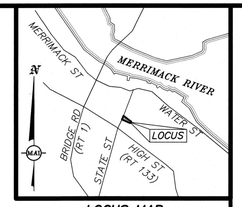
Inflow Area = 37,000 sf, 72.35% Impervious, Inflow Depth > 6.83" for 100-yr event
Inflow = 5.42 cfs @ 12.14 hrs, Volume= 21,063 cf
Primary = 5.42 cfs @ 12.14 hrs, Volume= 21,063 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

TEMPORARY BENCHMARK CHART:

T.B.M.#	DESCRIPTION	ELEVATION
1	X-CUT RIGHT FRONT CAP BOLT HYDRANT, 2.8' A.G.	102.30
2	TOP OF GRANITE POST, 3.5' A.G.	107.26

(SEE NOTE 6)



LOCUS MAP:
(NOT TO SCALE)

LEGEND

- SUBCATCHMENT LIMIT
- SC#2 — SUBCATCHMENT LABEL
- STUDY POINT #1 (DESIGN POINT)
- OVERLAND FLOW DIRECTION
- 602 — SOIL TYPE
- SOIL TYPE DELINEATION LINE
- HSG — HYDROLOGIC SOIL GROUP
- HYDROLOGIC FLOW PATH

NOTES:

1. LOCATIONS AND TYPES OF SOIL DESIGNATIONS WITHIN THE LOCUS PROPERTY SUBCATCHMENT LIMITS HAVE BEEN DELINEATED BY USDA NATURAL RESOURCES CONSERVATION SERVICE (NRCS).
2. BASED ON NRCS, THE SOIL TYPES ARE ASSOCIATED WITH THE FOLLOWING HYDROLOGIC SOIL GROUPS (HSG):
   254A – MERRIMAC FINE SANDY LOAM (0–3% SLOPE) – HSG A
   254B – MERRIMAC FINE SANDY LOAM (3–8% SLOPE) – HSG A

GRAPHIC SCALE
SCALE: 1"= 20'
10 0 10 20 40 80

REVISIONS

BY	DESCRIPTION	DATE

COMMONWEALTH OF MASSACHUSETTS
WEAR III
CIVIL
No.37611
REGISTERED
PROFESSIONAL ENGINEER
1/8/20

93 STATE STREET
EXISTING CONDITION WATERSHED
NEWBURYPORT, MASSACHUSETTS
LOCATED IN
(ESSEX COUNTY)
PREPARED FOR
INSTITUTION FOR SAVINGS

MERIDIAN ASSOCIATES
500 CUMMINGS CENTER, SUITE 5950
BEVERLY, MASSACHUSETTS 01915
TELEPHONE: (978) 299-0447
69 MILK STREET, SUITE 302
WESTBOROUGH, MASSACHUSETTS 01581
TELEPHONE: (508) 871-7030
WWW.MERIDIANASSOC.COM

DESIGNED BY:
CHECKED BY:

DATE:
JANUARY 8, 2020

SCALE:
1"=20'

SHEET No.
1 OF 2

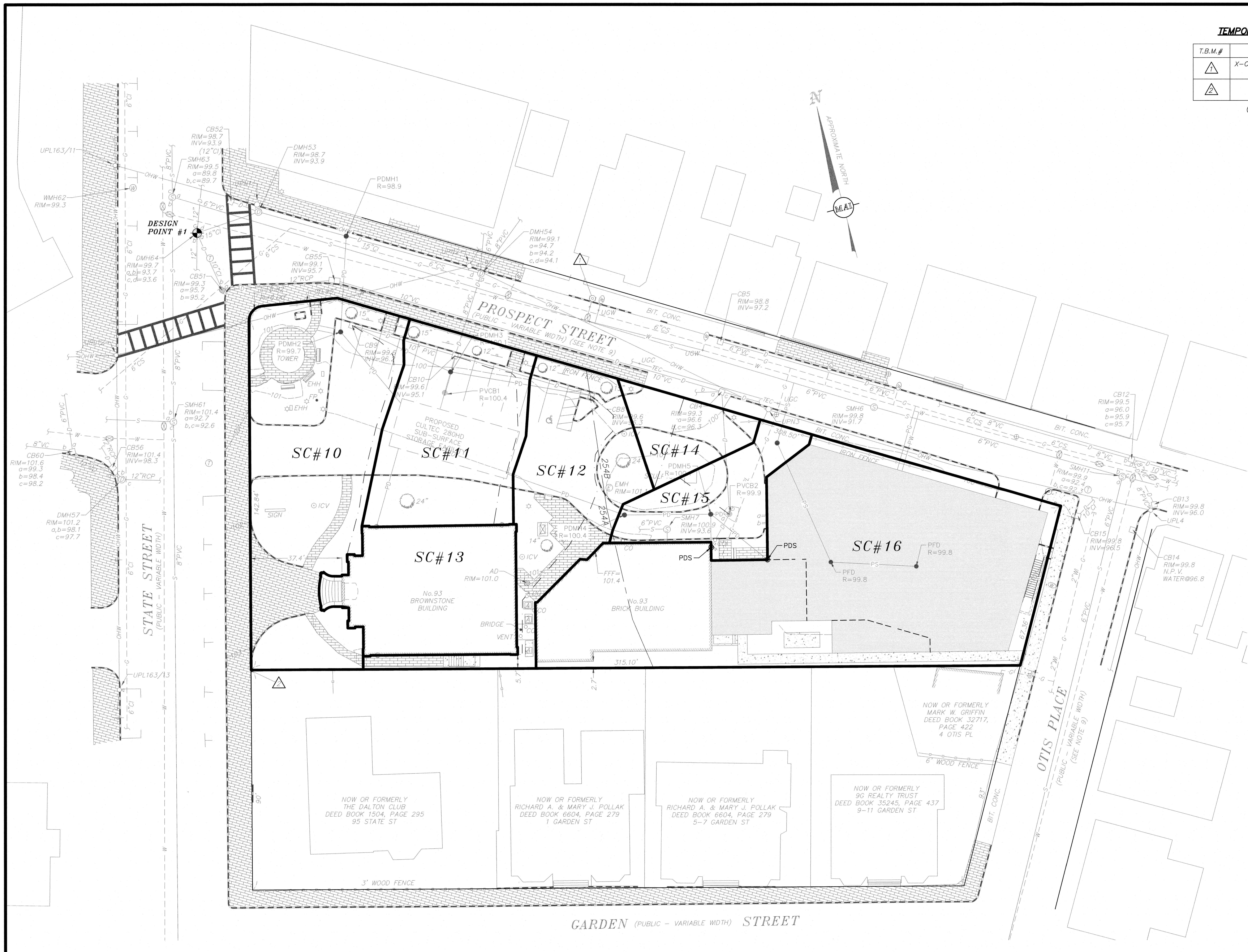
PROJECT No.
6215

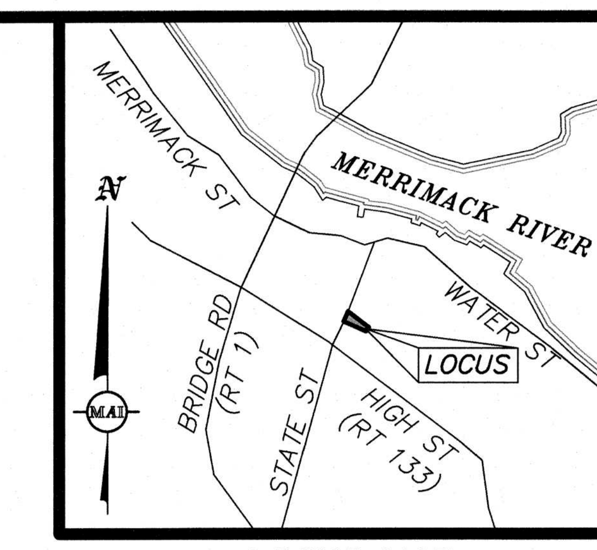
(XREF: 6215_REC)
DWG. No. 6215_PRE.DWG

TEMPORARY BENCHMARK CHART:

T.B.M.#	DESCRIPTION	ELEVATION
1	X-CUT RIGHT FRONT CAP BOLT HYDRANT, 2.8' A.G.	102.30
2	TOP OF GRANITE POST	107.26

(SEE NOTE 6 SHEET 2)





LOCUS MAP:
(NOT TO SCALE)

LEGEND

(line)	SUBCATCHMENT LIMIT
SC#2	SUBCATCHMENT LABEL
(symbol)	STUDY POINT #1 (DESIGN POINT)
602	SOIL TYPE
(dashed line)	SOIL TYPE DELINEATION LINE
HSG	HYDROLOGIC SOIL GROUP
(dash-dot line)	HYDROLOGIC FLOW PATH

NOTES:

1. LOCATIONS AND TYPES OF SOIL DESIGNATIONS WITHIN THE LOCUS PROPERTY SUBCATCHMENT LIMITS HAVE BEEN DELINEATED BY USDA NATURAL RESOURCES CONSERVATION SERVICE (NRCS).
2. BASED ON NRCS, THE SOIL TYPES ARE ASSOCIATED WITH THE FOLLOWING HYDROLOGIC SOIL GROUPS (HSG):
   254A - MERRIMAC FINE SANDY LOAM (0-3% SLOPE) - HSG A
   254B - MERRIMAC FINE SANDY LOAM (3-8% SLOPE) - HSG A

GRAPHIC SCALE
SCALE: 1"= 20'
10 0 10 20 40 80

FOR PERMITTING ONLY
NOT FOR CONSTRUCTION

(XREF: 6215_REC/SITE)
DWG. No. 6215_POST.DWG

REVISIONS

DATE	DESCRIPTION	BY

93 STATE STREET
POST CONSTRUCTION WATERSHED
LOCATED IN
NEWBURYPORT, MASSACHUSETTS
(ESSEX COUNTY)
PREPARED FOR
INSTITUTION FOR SAVINGS

MERIDIAN ASSOCIATES
500 CUMMINGS CENTER, SUITE 5950
BEVERLY, MASSACHUSETTS 01915
TELEPHONE: (978) 299-0447
69 MILK STREET, SUITE 302
WESTBOROUGH, MASSACHUSETTS 01581
TELEPHONE: (508) 871-7030
WWW.MERIDIANASSOC.COM

DESIGNED BY:
CHECKED BY:

DATE: JANUARY 8, 2020
SCALE: 1"=20'
SHEET No. 2 OF 2
PROJECT No. 6215