STORMWATER MANAGEMENT REPORT

ETHAN CIRCLE SUBDIVISION

SOUTH HADLEY, MA

Applicant:
Ethan Bagg

Prepared by:

Shawn K. Kimberley, P.E.
S. K. Kimberley Engineering
309 Thompson Road
Colrain, MA 01340
&
Charles H. Dauchy
Environmental Consultant
24 Old Long Plain Rd.
Leverett, MA 01054

1/20/14
Revised: 8/25/14

STORMWATER MANAGEMENT REPORT
ETHAN CIRCLE SUBDIVISION
SOUTH HADLEY, MA

1/20/14, Rev. 8/25/14

CONTENTS:

		Pages
Summary of site conditions and proposed stormwater management system		2-4
Design Criteria and Methodology		4-5
Compliance with DEP Standards		5-8
Long Term Operation and Maintenance Plan	Appendix A	3 pgs
Construction Period Pollution Prevention & Erosion/Sedimentation Control Plan	Appendix B	9 pgs
Design Calculations and documentation:		
Water Quality Management & Recharge Calculations	Appendix C	1 pgs
- Treatment and Recharge volume calculations		
- Infiltration basin drain time calculations		
- Grit Chamber volume calculations		
- TSS removal calculations		
Worksheet for Tc and Area calculations	Appendix D	5 pgs
Watershed model and routing calculations - HydroCad Model	Appendix E	
Watershed Routing Diagram		1 pg
Summary for 2 Yr Storm		1-3
Summary for 10 Yr Storm		4-6
Detailed descriptions and parameters for 100 yr storm		7-21
Detention Basin hydrographs for 100 yr storm		22
Diversion calculations for recharge volume storm		23
Pipe outlet and grass swale velocity calculations		24-26
Soils Logs & Summary with groundwater elevations	Appendix F	5 pgs
Analysis of Low Impact Development Alternatives	Appendix G	2 pgs
Documentation regarding StormTech Chambers	Appendix H	12 pgs
Tributary Area Maps, Existing and Proposed		2 Sheets

STORMWATER MANAGEMENT REPORT
for
ETHAN CIRCLE SUBDIVISION
SOUTH HADLEY, MA

SUMMARY:

The project is a single family subdivision of 8 lots, including two existing homes, on a proposed cul-de-sac off of Hadley Street, between existing house # 57 and #61. The Stormwater Management System begins with deep-sump catch basins that collect runoff, to be piped to a diversion manhole (DMH2). There, flows are split, with all flows up to the volume required for groundwater recharge and water quality treatment going to an infiltration basin. Larger flows are also routed to an underground detention system using Stormtech chambers surrounded with stone, which then discharges to an open detention basin. Overflow from the infiltration basin in larger storms also is piped to the detention basin. The restricted discharge from the detention basin leads to a level spreader over 50 feet from the nearest wetland. Two small rain-gardens are also proposed to provide additional recharge and runoff control. The stormwater management system complies with DEP standards in preventing increases in peak runoff, providing for groundwater recharge, removing pollutants, controlling erosion and sediment during construction, and providing for long-term management. There will be no increase in peak rate of runoff to any of the abutting properties to the project.

EXISTING CONDITIONS:

Land Use and vegetative cover: Except for the two existing house lots fronting on Hadley Street, the area is currently forested. The forest vegetation is predominantly deciduous, with understory shrubs and vines, dispersed ground cover of ferns, seedlings, and herbaceous growth, and detrital litter and debris.

Soils: The soils on the site have been mapped by the USDA. Our field investigations confirm the general character of the mapped soils, but we have adjusted the mapped boundaries based on our soils investigations and detailed topographic mapping. Adjusted soil boundaries and map codes are shown on the accompanying tributary area maps. The soil series present are all formed on glacial outwash materials. The difference in hydrologic characteristics is due to both the soil texture and the depth to underlying silty soils and the water table. Windsor loamy sand (Wo) is excessively drained and rated as Hydrologic Soil Group (HSG) “A”, with little direct runoff except in major storms. Agawam fine sandy loam (Ag) soil is well drained and rated as HSG B, yeilding somewhat higher runoff rates. Amostown fine sandy loam (Am) is moderately well drained, with underlying silty material closer to the surface. It is rated as HSG C, with relatively high runoff rate. A small area of wetland in the southeast corner of the property is typically saturated and we have mapped that area as HSG D.

Hydrologic Setting: (See Tributary Area Maps - 2 pages) Drainage from the site flows in four different directions. The central and eastern portions of the site drain to a wetland along the easterly property line. A smaller area in the northwest drains to the northwest boundary. The front of the existing houses drains to Hadley Street, while a small area in the northeast drains to the abutting lots to the north. There is very little off-site area that drains onto or through the site.

PROPOSED CONDITIONS AND STORMWATER MANAGEMENT SYSTEM:

Low Impact Development:

The use of "Low Impact Development" practices is limited by both the Town's zoning and subdivision regulations, and by the topography and soils of the site. The Town of South Hadley Zoning Bylaw provides for a "Flexible Development" which can allow for flexibility from the normal zoning lot sizes and configurations, and from standard subdivision design standards. However, this provision is limited to sites of 5 acres or larger. The site in question is 3.624 acres, and therefore not eligible for "Flexible Development" under the town's zoning. A preliminary plan for the proposed subdivision was approved in 2007, prior to the LID requirement in the Mass. Stormwater Standards.

Although slopes and limited yard areas on the lots make use of on-lot rain-gardens or direction of runoff over "qualifying pervious areas" difficult, two rain-gardens are proposed where site conditions allow. Favorable soils and groundwater depth in the northeastern portion of the site allow an infiltration basin that provides groundwater recharge and water quality treatment in excess of Stormwater Management requirements. Otherwise, relatively high groundwater levels prevent effective use of drywells or other underground chambers for recharge of roof runoff. A grass swale is proposed along the rear of lots 4 & 5, but it is intended for runoff control and does not have adequate travel time for water quality treatment. A brief analysis if alternative LID measures is provided in Appendix F.

Of the total project area of 158,667 sq. ft., approximately 36,133 sq.ft., or 22.77% will be impervious. This is over the 15% limit for Environmentally Sensitive Development credit and does not qualify for the credit.

Stormwater Management System Summary:

Runoff from most of the lots and roofs, and all but 15 ft. of the roadway is captured in deep-sump catch basins and routed through a diversion manhole (DMH2) to separate infiltration and detention systems. At DMH2, flows are split, with all flows up to the volume required for groundwater recharge and water quality treatment going to an infiltration basin. Larger flows are also routed to an underground detention system using Stormtech chambers surrounded with stone, which then discharges to a surface detention basin. Overflow from the infiltration basin in larger storms also is piped to the detention basin. The restricted discharge from the detention basin leads to a level spreader over 50 feet from the nearest wetland.

Pretreatment for the infiltration basin is provided by a grit chamber which provides slightly greater volume than required for a forebay, and also provides control of floating materials by use of a pipe "T" at the outlet. The infiltration basin provides final water quality treatment by infiltration and also provides groundwater recharge meeting DEP requirements. The bottom of the basin (94.0) is over 4' above the estimated seasonal high water table (89.77).. Above the level required for recharge and treatment (94.5), flows are directed to the surface detention basin.

At DMH2, flows from larger storms are also directed to an underground detention system composed of StormTech 740 chambers in stone bedding and surround. Discharges from the underground system flow to the surface detention system and are controlled by a 5" diameter control orifice and 12" diameter high-level standpipe overflow for large storms. The outlet

structure is designed with the 5" control orifice at the bottom of a submerged pipe “T” which protects the orifice from clogging by floating debris. The orifice can easily be cleaned by rodding from the manhole access above. The discharge from the underground system is directed to a surface detention basin that also receives inflow from the separate infiltration basin when levels exceed the volume required for recharge or treatment. At the outlet of the detention basin, a 3" orifice in the bottom of a 12" standpipe provided further control of peak flows. A stone spreader assures that flows from the detention basin are dispersed and non-erosive.

Runoff to Hadley Street is reduced slightly by reduction of the tributary area that compensates for the added impervious surface of the new street entrance. Runoff to the north is calculated as zero (below the limit of estimates) because of the highly permeable soils and reduction in the tributary area. In the northwest, the tributary area is reduced and two rain-gardens provide additional runoff control, keeping proposed runoff rates to abutting properties below existing.

DESIGN CRITERIA

Infiltration Basin: Embankment slopes 4:1 interior and 3:1 exterior. Depth to estimated seasonal high groundwater over 4'. Max. Depth in 100 yr storm = 0.69'.

Detention Basin: No increase in peak discharge for 2 through 100 year storms. Embankment slopes 4:1 interior and 3:1 exterior. Maximum depth in 100 year storm < 3ft (2.69').

Grit Chamber: volume over 400 cf/acre of tributary impervious surfaces. Exceeds forebay treatment volume and provides control of floating materials.

Water quality treatment: over 80% TSS removal for over 0.5" of runoff from impervious surfaces, by deep-sump-catchbasins, forebay and infiltration of over 1223 cu. ft.

Groundwater Recharge: 1246 cu. ft. required. 1283cu. ft. is provided by the main infiltration basin to elev. 94.5, (elevation of the overflow weir) with an additional 498 cu. ft. provided by the two rain gardens although not counted. Infiltration calculations for recharge are based on the “Static” method. Drain time for the infiltration basin is less than 72 hours (estimated 6 hours).

Assumed infiltration rate: = 1in./hr, conservatively estimated, allowing for compaction of “loamy sand” surface to “sandy loam” due to the potential use of the basin as lawn and yard area. Drain time is also evaluated assuming 0.17 in/hr, the rate for “sandy clay loam”, (time 35.3hrs).

Capture area of the main infiltration basin includes 90% of all new impervious surfaces, far exceeding the DEP requirement of 65%

Pipe outlet stability: velocities of pipe flows to discharges are estimated for the 100 year storm, and all are less than 5 fps, generally considered the maximum for well developed sod cover. To assure no erosion at the outlets, either stone aprons or turf reinforcement mat are proposed to conservatively assure protection during establishment of vegetation. See Appendix E for calculations.

DESIGN METHODOLOGY:

For watershed modeling and design of the detention/infiltration basin, Natural Resource Conservation Service methods, based on TR-55 and TR-20, were followed using the "HydroCad" computer program (ver. 10.0 build 12), an adaptation of SCS TR-20 and TR-55 methods. The drainage basin characteristics of Curve Number (CN) and time of concentration (Tc) are described and calculated based on NRCS methodology. To facilitate calculations, a separate spreadsheet was used for Tc and area calculations, which was then input to the HydroCad model. Appendix E provides the principal calculations normally needed for review. Summaries are provided for the 2 and 10 year storms. Detail of parameters used for the model are provided in the section on the 100 year storm. All input parameters for the runoff estimate from the tributary areas are the same except for the rainfall.

The two year storm is modeled, assuming functioning of the infiltration basin. The 10 and 100 year storms are modeled as if there was effectively no storage or infiltration in the infiltration basin, and the diverted flows through the infiltration basin continue un-controlled to the detention basin. This is done to demonstrate that even if the detention basin did not infiltrate as designed, there would be no increase in peak discharges from the site for the larger storms.

The diversion to the grit chamber and infiltration basin was designed so that the storm (0.75") that would produce at least the required recharge volume from the tributary area would flow entirely to the infiltration basin and not to the detention chamber system. Larger storms would be increasingly diverted to the detention chamber system. See Appendix E for calculations.

The Hydrocad model was also used to calculated the flow velocities from the several pipe outlets to allow verification of stability at the outlets. In this case, separate pipe reaches were modeled, with the 100 year discharge being input as base flow in order for the model to calculate maximum flow velocity.

If additional information or the Hydrocad computer model are needed for review, please contact Charles H. Dauchy at 413-548-8005 or cdauchy@wildblue.net

COMPLIANCE WITH DEP STANDARDS:

The project design complies fully with MA DEP stormwater management standards, as summarized below.

1. *No new untreated discharge or erosion*: The new point source discharge from the project will receive over 80% TSS removal for water quality treatment in compliance with DEP guidelines. Erosion controls will be implemented during construction to prevent sediment discharge from the site (see Appendix C and plans). The flow rate from the detention basin to the upland swale leading to the wetland is lower than under current conditions, and the discharge is dispersed by a stone spreader, eliminating erosion hazard. Discharge velocity from the 12" outlet, with an upstream 3" orifice, is 4.74 ft./sec., or within the control capacity of a good sod cover. The stone stilling basin and spreader will further reduce the discharge velocities to well below any potentially erosive rates.

2. *Post-development peak discharge rates do not exceed pre-development*: Proposed peak flows from the site are reduced compared to existing flows as summarized below:

Rainfall return period:		2 yr	10 yr	100 yr
To southeast property line & wetland:				
Existing-	ESUM2	0.60 cfs	1.59 cfs	3.24 cfs
Proposed-	PSUM2	0.55 cfs	1.20 cfs	2.99 cfs
To northwest property line:				
Existing -	ESUM3	0.11 cfs	0.51 cfs	1.25 cfs
Proposed-	PSUM3	0.10 cfs	0.47 cfs	1.00 cfs
To northeast property line				
Existing	E3	0.0 cfs	0.0 cfs	0.0 cfs
Proposed	P3	0.0 cfs	0.0 cfs	0.0 cfs
To Hadley Street				
Existing	E4	0.20 cfs	0.46 cfs	0.87 cfs
Proposed	P4	0.12 cfs	0.31 cfs	0.60 cfs

Note: these flows are less than the limits of the model to compute. The tributary area is reduced under proposed conditions, with no impervious tributary area added.

See Appendix E for Hydrocad model calculations of peak flows and detention.

3. *Annual recharge of groundwater should approximate current conditions*: Runoff from the storm that would generate the required groundwater recharge volume is diverted at DMH2 to a grit chamber and then an infiltration basin, with over 4' depth to the estimated seasonal high water table. The recharge requirement is based on DEP's differential requirements for each hydrologic soil group and is tabulated in Appendix C, totaling 1127 cubic feet . Adjusted for the percentage of impervious area draining to the infiltration basin, IAW the DEP capture area adjustment, the total required recharge volume is 1246 cubic feet. The proposed infiltration basin provides 1283 cubic feet of volume below the outlet structure invert (6" depth at elev. 94.5). Therefore, the recharge volume requirement is exceeded. Drain time of the infiltration basin for the recharge volume is estimated as 6 hours at 1" per hour.

The two rain-gardens provide an additional 498 cubic feet of storage for infiltration, but are not considered in meeting the recharge volume requirement due to the limited depth to groundwater.

4. *80% Total Suspended Solids (TSS) removal*: All point source discharges from impervious surfaces are treated to remove over 80% of Total Suspended Solids (TSS). All impervious areas tributary to the discharge are routed through the stormwater management system. Runoff from the storm that would generate the required treatment volume (1223 cu. ft.) is diverted at DMH2 to a grit chamber and then infiltration basin. Treatment is provided by deep sump catch basins, a grit chamber, and infiltration. The required runoff volume to be treated

is 1223 cu. ft.,based on 0.5" of runoff over 29362 sq. ft. of impervious tributary area. The infiltration volume provided is 1283 cu. ft. (below the infiltration basin overflow weir crest). Calculated TSS removal will be 85.0% (See Appendix C).

5. *Higher potential pollutant loadings prohibit certain practices*: Not Applicable

6. *Discharges to critical areas treat 1" of runoff and prohibit certain practices*: Not Applicable

7. *Redevelopment sites must meet standards to maximum extent practicable and improve existing conditions*: Not Applicable

8. *Construction related Impacts including Erosion and Sediment Controls must be implemented*: See Appendix B.
A detailed erosion and sediment control procedure is spelled out for the project on the Erosion & Sediment Control detail sheet. This includes a perimeter sediment barrier, temporary use of a partially excavated detention basin as a sediment basin, rough grading of lots to provide depressions for sediment capture, and interim seeding of rough graded lots for stabilization until final construction is done on the lots. Until construction is completed and all tributary areas are stabilized, frequent inspection and maintenance of the erosion controls is required. Construction period maintenance will be the responsibility of the site work contractor. A construction period "Stormwater Pollution Prevention Plan" (SWPPP) will be prepared and submitted by the ultimate developer and site contractor before any site work begins.

9. *Long Term Operation and Maintenance Plan required*: See Appendix A.
After construction, a minimum of annual inspection and maintenance of all system components is recommended. It may be that the Town of South Hadley will be unwilling to take responsibility for maintenance of any stormwater facilities within the street Right-of-Way, as well as facilities outside of the ROW. This is yet to be finally determined. Maintenance of stormwater facilities outside of the public way will be the responsibility of the homeowners' association. In compliance with the Town of South Hadley Stormwater Bylaw, an operation, maintenance, and inspection agreement will be submitted for approval before any site work.

The only vegetation management required is annual mowing of the detention and infiltration basins and adjacent slopes to prevent development of large woody vegetation and maintain a good sod cover. Slopes to be mown are 3:1 or flatter, allowing safe mowing by tractor or riding mower. The infiltration basin is designed so that it can be maintained as lawn by the owner of Lot #5 if desired. The assumed infiltration rate makes allowance for compaction by regular mowing and foot traffic.

The stormwater management facilities should be inspected monthly during the first year of operation or until it is clear they are functioning properly. After that, inspections should generally be twice a year, with maintenance as required.

With proper construction and maintenance, clogging of the infiltration surface of the infiltration basin is not expected to be a problem. However, if ponding persists in the basin for over 72 hours, the basin should be de-watered (pump to the detention basin) and roto-tilled to restore the infiltration capacity, and re-seeded.

10. *Illicit discharges prohibited*: No illicit discharges are known to exist on the site, and the proposed project has no potential sources of illicit discharge. Sanitary sewerage will be pumped to the municipal sewer system as shown on the plans. An Illicit Discharge Compliance Statement will be submitted to the South Hadley Conservation Commission prior to any discharge from the proposed stormwater management system.

APPENDIX A

LONG TERM OPERATION & MAINTENANCE PLAN

ETHAN CIRCLE SUBDIVISION

SOUTH HADLEY, MA

LONG TERM OPERATION AND MAINTENANCE PLAN FOR STORMWATER MANAGEMENT SYSTEM **APPENDIX A**

ETHAN CIRCLE SUBDIVISION, SOUTH HADLEY, MA

OWNERS: For the street Right of Way - The Town of South Hadley (after/if acceptance)
If street is private way, the Homeowners Association
For the Infiltration and Detention Basins - Owners of lots 5 & 6, with easement to the Homeowners Association
For rain-gardens and grass swale on lots 4 & 5, with easement to the Homeowners Association.

RESPONSIBILITY: The Homeowners Association shall be responsible for effective operation and maintenance of stormwater management facilities and related parts of the site as required by the conditions of approval by the Town of South Hadley. The association may contract the required work to outside parties, but retains responsibility for effective maintenance. The responsible party shall maintain an operation and maintenance log for the last three years. Logs shall include inspections, repairs, replacement, and disposal. Records for disposal shall include type of material and disposal location.

PUBLIC SAFETY: The stormwater infiltration and detention basins are designed to avoid potential safety hazards. The side slopes within the stormwater basins are 4 horizontal to 1 vertical. This is flatter than the DEP standard of 3 horizontal to 1 vertical, which is flat enough for mowing by riding mower or tractor and does not present a hazard of "falling in". The maximum prolonged ponding depth in the infiltration basin is less than 6" for 6 hours. Maximum depth of the detention basin in a 100 year storm is 2.7 feet for a brief period. No fencing should be required.

MAINTENANCE TASKS and BUDGET - ROUTINE AND NON-ROUTINE:

SYSTEM COMPONENT	WHEN NEEDED	REQUIRED MAINTENANCE	ESTIMATED COST - 2014 $
Infiltration Basin	After major storms for the 1st year, then 2x/year in spring and fall.	Inspect for signs of prolonged ponding, erosion of slopes or at inlet, clogging of outlet weir and pipe, complete vegetative cover, settlement of embankment.	$20/inspection when combined with other inspections
	2 x per year or more often if desired.	-Mow basin, slopes, and fill embankment not shorter than 3". Remove debris.	$200/year
	If ponded over 72 hours after end of rainfall	Pump to detention basin to de-water. Rototill basin surface, re-seed, and mulch. Block pipe to Grit Chamber until vegetation established.	$1000/occurrence

	If needed - (when average grade in basin bottom is 4" or less below outlet weir	-Remove accumulated sediment to design grade. Rototill, reseed and mulch. -Avoid traffic on basin during wet conditions	$3000/occurrence
Detention Basin	After major storms for the 1st year, then 2x/year in spring and fall.	Inspect for erosion of slopes or at inlet, clogging of outlet orifice and pipe, complete vegetative cover, settlement of embankment. Repair as needed.	$30/inspection when combined with other inspections
	2 x per year or more often if desired..	Mow basin, slopes, and fill embankment not shorter than 3". Remove debris.	$200/yr
Stone Level Spreader	After major storms for the 1st year, then 2x/year in spring and fall	Check for displacement of stone or signs of erosive flows downslope. Repair or adjust as needed.	$20/inspection when combined with other inspections
Grit Chamber & Catch Basins	Spring and Fall	Inspect. Clean-out when sediment ½ depth of sump.	500/yr avg. cost

LAWN AND LANDSCAPE MAINTENANCE: Use of fertilizers, herbicides, and pesticides will be at the discretion of individual lot owners and should be accordance with manufacturer's recommendations and regulatory requirements. All lawn or landscaped areas are over 50 feet from the wetlands.

SNOW PLOWING AND DISPOSAL: Snow plowing of the street will be done by the Town of South Hadley or by contractor for the Homeowners Association. Snow will normally be plowed to the treebelt. Meltwater from snow in the street or on driveways will be routed through the stormwater management system.

PLAN OF STORMWATER MANAGEMENT SYSTEM: See project plans.

SAMPLE DRAFT - OPERATION AND MAINTENANCE LOG FORM:

ETHAN CIRCLE, SOUTH HADLEY, MA

SYSTEM COMPONENT	WHEN NEEDED	REQUIRED MAINTENANCE	COMMENTS, DATE DONE, BY WHOM
Infiltration Basin	If ponded over 72 hours after end of rainfall	Pump to detention basin to de-water. Rototill basin surface, re-seed, and mulch. Block pipe to Grit Chamber until vegetation established.	
	If needed - (when average grade in basin bottom is 4" or less below outlet weir.	-Remove accumulated sediment to design grade. Rototill, reseed and mulch. -Avoid traffic on basin during wet conditions	
Detention Basin	After major storms for the 1st year, then 2x/year in spring and fall.	Inspect for erosion of slopes or at inlet, clogging of outlet orifice and pipe, complete vegetative cover, settlement of embankment. Repair as needed	.
Detention and Infiltration Basins	2 x per year or more often if desired..	-Mow basin, slopes, and fill embankment not shorter than 3". Remove debris.	
Stone Level Spreader	After major storms for the 1st year, then 2x/year in spring and fall	Check for displacement of stone or signs of erosive flows downslope. Repair or adjust as needed.	
Grit Chamber & Catch Basins	Spring and Fall	Inspect. Clean-out when sediment ½ depth of sump.	

APPENDIX B

CONSTRUCTION PERIOD
POLLUTION PREVENTION &
EROSION/SEDIMENTATION CONTROL PLAN

ETHAN CIRCLE, SOUTH HADLEY, MA

CONSTRUCTION PERIOD POLLUTION PREVENTION & EROSION/SEDIMENTATION CONTROL PLAN
ETHAN CIRCLE SUBDIVISION SOUTH HADLEY, MA.

CONTENTS:

1. INTRODUCTION

2. PROJECT OPERATOR AND RESPONSIBILITIES

3. DESCRIPTION OF SITE AND ACTIVITIES

4. STORMWATER MANAGEMENT CONTROLS

5. INSPECTION AND MAINTENANCE PROCEDURES

6. RECOMMENDED MAINTENANCE - CONSTRUCTION PHASE
   and
   INSPECTION AND MAINTENANCE REPORT FORM - BLANK

CONSTRUCTION PERIOD
POLLUTION PREVENTION & EROSION & SEDIMENTATION CONTROL PLAN
ETHAN CIRCLE SUBDIVISION, SOUTH HADLEY, MA.

1. INTRODUCTION:
This document and the referenced plans and reports are intended to provide guidance to the responsible party on site for protection of water quality in adjacent receiving water during construction of the project, and to be integrated with required Storm Water Pollution Prevention Plan (SWPPP) in compliance with the NPDES General Permit for Storm Water Discharge from Construction Sites, issued by US EPA. A full SWPPP will be filed with the South Hadley Conservation Commission before construction begins.

2. PROJECT OPERATOR AND RESPONSIBILITIES:

2.1 OPERATOR: The responsible "operator" for this project is that party that has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications. The operator for this project shall be designated on the USEPA eNOI "Notice of Intent", to be submitted to the USEPA. Land disturbance on the site may begin 14 days after acknowledgment of receipt on the EPA wet site, http://www.epa.gov/npdes/stormwater/cgpnoisearch.

The Operator for the road way and utility construction, stormwater management construction and rough grading on lots will be determined prior to construction, and designated in the SWPPP.

Owner/operators of individual lots, not under control of the "operator" for the overall subdivision construction, are responsible for Submittal of their own "Notice of Intent", for preparation and execution of their own SWPPP for any work not covered by the final SWPPP, and for compliance with relevant portions of the SWPPP.

2.2 OPERATOR'S RESPONSIBILITIES:
The Operator shall install, maintain, and replace as necessary all measures for erosion control, sediment control, wetland protection, and water quality protection, throughout the site as is outlined in this document and shown on the drawings and in accordance with local, state, and federal wetlands and environmental regulations and permits. The Operator shall execute all work in such a manner as to prevent alteration or degradation of wetlands or buffer zones beyond designated work limit lines, including taking temporary or emergency measures as necessary.

The Operator shall assume all responsibility for compliance with the following permits and related regulations:

1. Orders of Conditions issued under the Mass. Wetlands Protection Act, including referenced Notice of Intent for the project.
2. Water Quality Certification requirements of the Mass. DEP. under Section 401 of the Clean Water Act. (Not expected to be applicable)
3. U.S. Army Corps of Engineers Programmatic General Permit under Section 404 of the Clean Water Act. (Not expected to be applicable)
4. NPDES General Permit for Storm Water Discharge from Construction Sites, issued by US EPA.

3. <u>DESCRIPTION OF SITE AND ACTIVITIES</u>:

3.1 PROJECT DESCRIPTION: The Ethan Circle Subdivision is an 8 lot single family residential subdivision (including 2 existing homes) located on approximately 3.624 acres. The undeveloped land consists predominantly of soils derived from glacial outwash, with a forest cover. Slopes on the site range from gentle to moderate. The site includes a small area of wetland which will not be disturbed.

The work includes the construction of approximately 380 linear feet of roadway, private sanitary pressure sewer, public water supply, a stormwater management system, other utilities, and the construction of 6 new single family homes and related site work on the lots. A 50 ft wide naturally vegetated buffer is maintained between all land disturbance and any wetlands or waters.

3.2 AREAS:

Total site area:	3.624± Acres
Total Land Disturbance:	2.685± Acres.
Total Impervious Area:	0.822± Acres

3.4 PLANS and DOCUMENTS: (to be available on-site during construction):

Plans will include Topography and Grading with Plan/Profile sheet, and Construction Details and Erosion/Sediment Control Details and specifications. Documents will include the "Notice of Intent" (under Mass. Wetlands Protection Act), with exhibits (including Stormwater Management Plan), and any "Order of Conditions" (Mass. Wetlands Protection Act).

3.5 POTENTIAL SOURCES OF STORMWATER POLLUTION DURING CONSTRUCTION

1. Exposed soils during site work and grading - temporarily susceptible to erosion and source of sediment until re-stabilized by construction or permanent vegetation.
2. Construction vehicle and equipment fueling and maintenance
3. Sanitary waste from construction crews
4. Concrete truck wash-water
5. Building site waste and trash
6. Sediment tracked onto pavement by vehicles
7. Fertilizer for lawn establishment
8. Paints, glues, cleaning solvents, and other construction related chemicals

4.0 STORMWATER MANAGEMENT CONTROLS:

4.1 PHASING OF WORK AREAS:

Due to the small size of the site (3.6 AC) and extent of grading required, the potential for phasing of disturbance within this subdivision phase is limited. Therefore the work will be in two basic phases as follows:

- Stormwater basin, roadway, drainage, and utilities, and rough grading on lots where related to road construction, with seeding on lots for interim vegetative cover and permanent seeding of treebelt, grass swale, infiltration basin, and detention basin.
- House construction on individual lots with finish grading and permanent vegetative cover.

4.2 GENERAL SEQUENCE OF WORK:

1. Stakeout and review of clearing limits and perimeter sediment barrier locations.
2. Clearing of work areas without stripping or grubbing. Installation of perimeter sediment barriers along perimeter work limit.
3. Construction of detention basin, installation of outlet and stone spreader with temporary skimmer and filter sock at spreader, permanent seeding of cut slopes and embankment, and temporary seeding of basin bottom.
4. Grubbing and stripping of ROW and grubbing of lots as needed, including loaming and temporary seeding of disturbed areas on lots.
5. Rough grading of roadway, installation of chamber system, & grading/seeding of slope to Detention Basin, with stone swale.
6. Construction and seeding of infiltration basin and swale on lots 4 & 5.
7. Construction of roadway, drainage, sewer, water, and utilities, with temporary erosion controls and maintenance of erosion control measures, as site conditions require.
8. Permanent seeding and stabilization of ROW. Outlet from DMH2 to Grit Chamber shall be blocked

until ROW and adjacent slopes are stabilized.

9. Removal of accumulated sediment from detention basin and permanent seeding of basin bottom after initial temporary and permanent seedings on the site are sufficiently established to prevent erosion. Detention basin outlet skimmer shall remain in place until vegetation is established on detention basin bottom.
10. Site development of individual lots may begin during road construction, with erosion/sediment controls for each lot.

4.3 EROSION AND SEDIMENT CONTROL MEASURES:

Preconstruction notifications and meetings: No land disturbance associated with this project shall occur until 14 days after receipt of USEPA eNOI has been confirmed by the USEPA. No work shall be performed within 100 feet of any wetland area until any notification and pre-construction meeting requirements of the Order of Conditions under the Mass. Wetlands Protection Act have been completed. These requirements shall be the responsibility of the Operator to arrange, attend, and document.

Perimeter Sediment Barrier and Work Limit: Before installation of the sediment barriers, the location shall be staked in the field for review and approval by the engineer or their representative. To facilitate sediment barrier installation, woody vegetation may then be removed and any required trench may be cut by machine, provided other ground cover is left intact.

No excavation, grading, filling, or removal of vegetative ground cover shall be performed within 100 feet of any wetland or stream until perimeter sediment barriers have been installed as shown on plans and have been inspected by the engineer or their representative.

Perimeter sediment barriers located adjacent to wetland areas shall serve as the limit of work for this project. No construction, equipment traffic, stockpiles, removal of vegetation, or other alteration shall be permitted on the wetland side of the sediment barrier/work limit without the approval of the engineer or their representative and the municipal Conservation Commission,

Silt fence: The bottom of the fence shall be trenched into the ground a minimum of 4" and back-filled with compacted soil. Where trenching is not feasible, silt fence skirt shall be covered with compacted soil or washed stone. The top of the fabric shall be stretched as tightly as is practical, with intermediate stakes added to correct excessive sags. Stakes shall be driven at least 12" into the ground. Splices between sections shall be made by rolling end stakes together one complete turn and driving into the ground together.

Straw bales: Bales may be used as temporary and moveable control measures, temporary check dams, or as reinforcement for silt fence in areas of concentrated runoff or high fills. Bales shall be tightly butted and staked 12" into the ground, with joints stuffed with straw.

Filter Sock (“Filtrexx” or equivalent): In areas of expected sheet flow, filter sock may be placed directly on the ground without trenching or stakes. In areas of expected concentrated flow, filter sock shall be staked as required to prevent movement or floatation, and mulch or washed stone shall be placed along the up-slope face to filter underflow. Area for filter sock installation may be machine or hand prepared

to provide best bonding of sock with soil.

Stone Construction Entrance: A "Stone construction entrance" or "tracking mat" shall be installed and maintained at any points where construction traffic from an unpaved construction road or site access enters onto the paved public way or a paved portion of the project roadway.

Stockpiles: There shall be a sediment barrier between any soil stockpile any wetland, waterway, swale, gutter, or drain inlet. The base of the stockpile shall be kept at least 10 feet from the barrier. Temporary piles of trench spoil may be closer to the sediment barrier but shall not rest against the barrier. Soil expected to remain stockpiled for over 30 days shall be shaped to stable slopes and seeded or mulched for temporary cover. No stockpile shall be placed within a swale, drainage-way, or other path of concentrated surface runoff.

Temporary runoff controls: As site grading progresses, temporary erosion control measures shall be installed, maintained, and removed as necessary to control erosive accumulations of runoff or sediment discharge until final grade and cover are established. Temporary control measures may include sediment barriers, check dams, diversions, sediment basins, open-top culverts, and stone-lined swales.

Stocking additional materials: A stock of additional erosion control materials shall be maintained available on the site for emergency repairs and temporary measures. Stock shall be replenished when decreased to 50% of the numbers below. Stock shall include:

Straw-bales -	15 (Covered to be kept dry)
Oak stakes -	30
Silt fence -	100 linear feet.
Washed stone -	2 cubic yards, 3/4" to 1 ½" diameter
Filter fabric -	25± linear feet of 12 ft. Wide roll, or equivalent.

Trench protection: Open trenches shall be protected from accumulation of surface water or groundwater that could result in erosion of the trench and discharge of sediment. Where feasible, spoil shall be stockpiled on the up-slope side of the trench to prevent entrance of surface runoff. Backfill shall be crowned to allow for settlement and to avoid concentration of runoff on top of the trench.

Storm drain protection: The storm drain system shall be put into operation as soon as possible in order to control runoff within a non-erodible system. The storm drain system shall be protected against inflow of sediment. Open storm drain structures shall be protected by sediment barriers, filtrex filter socks, stone filter berms, or filter fabric inserts ("tea-bags", "silt-sacks" or equivalents). These measures shall be maintained until the tributary area is stabilized by pavement and vegetative cover. If CB grates are set above the base course of pavement, temporary asphalt berms or other measures may be required to direct runoff into the CB's.

Roadside slopes: Cut and fill slopes for roadway construction shall be finish graded, loamed, seeded, and mulched as soon as possible during road construction. This stabilization shall not await finish grading of roadway, tree-belts, or lots. Where necessary, temporary runoff controls will be provided to permit establishment of permanent vegetative cover.

Erosion control netting, mulch mats or Turf Reinforcement Mats shall be used on steep slopes or in swales if required to protect seeding until establishment. Materials shall be installed per manufacturers' recommendations and anchored by burial of edges, staples, or stakes, as applicable.

Site Stabilization - Temporary: Where a portion of the site will not be subject to construction activity for over 14 days, measures shall be taken to provide temporary stabilization of that inactive portion of the site, within 14 days of the cessation of construction activity. Stabilization measures may include seeding for temporary cover, mulching, or other measures to protect exposed soil from erosion and prevent sediment movement.

Site Stabilization - Permanent: Within 14 days of completion of loaming and finish grading on any portion of the site, that area shall be seeded or planted for permanent cover in accordance with USDA NRCS guidelines or equivalent, season permitting.

Roadway Sweeping: The entrance to the site and affected portions of the public roadway or paved project roadway shall be swept as needed to control sediment runoff into storm drains or waterways and to control blowing dust.

Dust Control: Until the roadway is paved, the contractor shall take measures as necessary to control blowing dust, such as wetting the road surface, calcium chloride, or other soil stabilization compounds.

4.4 WORK ON INDIVIDUAL LOTS:

Site work on individual lots shall be controlled so as to prevent sediment discharge to the roadway, wetlands, or abutting lots. Typical measures may include:

- Sediment barrier along down-slope edge of graded areas.
- Stone construction entrance on driveway cut.
- Check dams across swales carrying concentrated runoff.
- Temporary diversions to carry runoff around open construction site.
- Stone-lined swales to carry concentrated runoff.
- Immediate temporary re-vegetation of slopes, prior to finish grading of yard and lawn.
- Curtain drainage or stone blanket to control seepage from cut slopes.
- Temporary piping of down-spout discharges across graded areas until lawn establishment.
- Water-bars or open-topped culverts on unpaved driveways to divert runoff to vegetated areas.

4.5 CONSTRUCTION PHASE HOUSE-KEEPING MEASURES:

- All vehicles on site will be monitored for leaks and receive regular preventive maintenance.
- Petroleum products will be stored in tightly sealed containers which are clearly labeled.
- Asphalt substances will be applied according to manufacturer's recommendations.
- Sanitary waste will be collected from portable units a minimum of weekly to avoid overfilling.
- A covered dumpster or appropriate trash container will be used for all waste materials.
- Concrete trucks will not be allowed to wash out chutes within 100 feet of any waterway or wetland. Discharge of surplus concrete or drum wash is not permitted on site.

- Vehicle maintenance and fueling will not be allowed within 100 feet of any waterway or wetland.
- Fertilizer for lawn establishment and stabilization seeding will be applied in accordance with manufacturers instructions and will be incorporated into the soil or as part of a hydro seeding mulch or "Terraseeding" mix.
- Paints, Glues, cleaning solvents, and other construction related chemicals will be used in accordance with manufacturer's instructions. Residue and empty containers will be disposed of in closed containers for appropriate final off-site disposal. Hazardous materials shall be stored in lockable secondary containment boxes.

4.6 POST-CONSTRUCTION STORMWATER MANAGEMENT:

See accompanying "Stormwater Management Report" for stormwater management design calculations, TSS removal calculations, Groundwater Recharge calculations, and post-construction maintenance program. See Appendix B for Operation and Maintenance procedures.

5.0 INSPECTION AND MAINTENANCE PROCEDURES:

All cleared and/or graded areas of the site that have not been permanently stabilized shall be inspected by the Operator or their designated representative at least once every 7 days during construction, or at least once every 14 days and within 24 hours after any storm event of 0.25 inches or more. The inspections are intended to verify that erosion and sediment control measures are properly functioning, to identify any repairs or maintenance needed, and to identify actual or potential sources of sediment discharge and recommend corrective action. Inspections may be monthly if the ground is covered with snow and/or ice or is temporarily stabilized. Measures shall be kept in functioning condition until tributary areas are stabilized. Sediment will be removed from sediment barriers, check dams, swales, and sediment basins when it reaches 6" depth or half the depth of the structure, whichever is less. The inspector shall complete and sign an inspection report, including date, conditions noted, and corrective actions taken. Corrective actions or maintenance or maintenance on existing controls must be performed on the same day or next day after discovery that corrective action is required.

Inspections shall be performed by qualified personnel, knowledgeable in construction practices for erosion and sediment control. Inspectors shall be designated by the Operator or Site Contractor. Completed inspection reports will be maintained on-site until stabilization of the project area. All records will then be kept by the Operator for a minimum of 3 years.

STORMWATER MANAGEMENT - CONSTRUCTION PHASE MAINTENANCE

SYSTEM COMPONENT	RECOMMENDED MAINTENANCE BY SITE CONTRACTOR
SEDIMENT BARRIERS Silt Fence, Straw Bale, or Filtrex Sock	-Add stakes or re-staple sagging silt fence -Replace decomposed bales or deteriorated fabric -Remove sediments when 6" deep against the barrier -Any sediment remaining after barrier is no longer required should be removed or dressed to conform to existing grade, prepared and seeded. - Remove barrier as soon as tributary area is permanently stabilized.
Storm Drain Inlet Protection	- inspect to assure runoff is not by-passing inlet and creating erosion downstream. - Inspect for integrity - Remove sediment as needed or when at ½ design depth - Remove protection as soon as tributary area is permanently stabilized.
Catch Basins	-Check monthly until tributary area is stabilized and clean when sediment is half the depth of the sump.
Mulching	-Check rill erosion and apply additional mulch if needed -Inspect nets or mats for dislocation or failure -Repair washouts and reinstall nets or mats -Inspect until grass is established
Detention Basin as Sediment basin	-Remove sediment when it is 6" deep in bottom of basin. -Check skimmer to be sure it is floating freely. -Check for erosion of embankment, outlet blockage or other operational problems
Stone Construction Entrance (Tracking Mat)	- Check for clogging of stone surface and sediment accumulation - Remove clogged surface and renew, or wash to sediment trap.
Straw bale/silt fence sediment traps	-Remove sediment as needed when depth is 6" -Replace rotten and destroyed bales or deteriorated fence
Stone/fabric sediment filter	-Inspect for excessive clogging and prolonged ponding behind filter. -Remove sediment as needed when depth is 6" -Replace fabric and stone cover
Check Dams (stone, hay-bales, filtrex)	- Inspect for underflow or bypass. Low point should be approx center, 6" below ends. - Reshape or reinforce. Add stone upstream to control underflow
Water-bars	- Reshape as necessary to assure continued operation. - Inspect outlet for erosion and provide stone protection if needed
Open-Top Culverts	-Clean as necessary to assure continued operation -Inspect outlet for erosion and provide stone protection if needed

INSPECTION AND MAINTENANCE REPORT FORM

To be completed every 7 days or every 14 days and within 24 hours of a rainfall of 0.25" or more, or more frequently if weather conditions or site activities require. A copy of this report shall be kept on site with the SWPPP.

Inspector:_____ Title: _____ Date:_____

Qualifications:_____

Date of last storm: _____ Amount of last storm (inches): _____

Weather during inspection: _____

Location: _____

Items inspected: ___ Sediment barrier ___ Drain inlet protection ___ Mulch ___ Vegetative cover

____ Tracking mat ___ Detention/sediment basin ___ Check dams Other_____

Findings: ____ No sediment discharge (project is in compliance with SWPPP)

____ No action required ____ Maintenance required ____ Additional measures needed

____ Sediment discharge (describe)_____

_____

Signature of Inspector: _____

Corrective action/maintenance required:_____

_____

_____

_____

by whom:_____ by date:_____ Completed(initials) : _____ Date: _____

Sketch (if needed)

APPENDIX C

WATER QUALITY MANAGEMENT & RECHARGE CALCULATIONS

ETHAN CIRCLE SUBDIVISION
SOUTH HADLEY, MA

APPENDIX C

RECHARGE AND WATER QUALITY TREATMENT CALCULATIONS **ETHAN CIRCLE SUBDIVISION**

REVISED 8/13/14

VOLUME FOR GROUNDWATER RECHARGE:

HYDROLOGIC SOIL GROUP					A	B	C	D		
DEPTH TO INFILTRATE (INCHES)					0.60	0.35	0.25	0.1		
AREA:	NEW IMPERVIOUS (SQ.FT.)								TOTAL	
	ROOF	DRIVE	ROAD	WALK						
Wo	5942	2800	1877	804	11423					
Ag	5048	3450	5007	688		14193				
Am		800	6036				6836			
	10990	7050	12920	1492						
TOTAL IMPERV AREA BY HSG:					11423	14193	6836	0	32452	SQ.FT.
% OF TOTAL IMPERVIOUS:					35.2%	43.7%	21.1%	0.0%		
TOTAL RECHARGE REQUIRED (UNADJUSTED):					571	414	142	0	1127	CUBIC FEET

IMPERV AREA DRAINING TO RECHARGE BASIN: 29362 SQ.FT. = 90.48% OF TOTAL = % CAPTURE AREA

RECHARGE VOLUME ADJUSTMENT FACTOR: 1.105238

TOTAL ADJUSTED RECHARGE VOLUME REQUIRED: **1246 CUBIC FEET**

PROVIDED AT ELEV 94.5 **1283 CU FT.**

DRAIN TIME CALCULATION MAIN INFILTRATION BASIN

2341	SF INFILTRATION AREA			2341	SF INFILTRATION AREA		
0.5	FT DEPTH	AT ELEV	94.5	0.5	FT DEPTH	AT ELEV	94.5
1	IN PER HOUR EXFILTRATION RATE			0.17	IN PER HOUR EXFILTRATION RATE		
0.083333	FT PER HOUR EXFILTRATION RATE			0.014167	FT PER HOUR EXFILTRATION RATE		
6	**HOURS DRAIN TIME**			**35.3**	**HOURS DRAIN TIME**		

DRAIN TIME CALCULATION RAIN GARDENS

420	SF INFILTRATION AREA		420	SF INFILTRATION AREA	
0.5	FT DEPTH	AT ELEV	0.5	FT DEPTH	AT ELEV
1	IN PER HOUR EXFILTRATION RATE		0.17	IN PER HOUR EXFILTRATION RATE	
0.083333	FT PER HOUR EXFILTRATION RATE		0.014167	FT PER HOUR EXFILTRATION RATE	
6	**HOURS DRAIN TIME**		**35.3**	**HOURS DRAIN TIME**	

VOLUME FOR TREATMENT

32452	SQ.FT.	TOTAL NEW IMPERVIOUS
3090	SQ. FT.	LESS NEW IMPERVIOUS NOT DRAINING TO STORMWATER DISCHARGE (rear roofs, lots 2,3,&6)
29362	SQ. FT.	NEW IMPERVIOUS AREA FOR TREATMENT
0.5	INCH TREATMENT VOLUME	
1223	**CU FT.**	**REQUIRED**

1283 CU FT. **PROVIDED AT ELEV 94.5**

GRIT CHAMBER VOLUME

IMPERVIOUS AREA FOR TREATMENT: 29362 SQ.FT.= 0.67 ACRES

TREATMENT VOLUME REQUIRED: 400 CF/AC x 0.67 AC = 270 CU. FT. REQUIRED

VOLUME CALCULATIONS:	WIDTH	LENGTH	DEPTH	VOLUME	
	4.5	10.7	5.6	270	CU.FT. MINIMUM PROVIDED

TSS REMOVAL CALCULATIONS

A	B	C	D	E	
BMP	TSS REMOVAL RATE	STARTING LOAD	REMOVED A x C	REMAINING LOAD (C-D)	COMBINED REMOVAL
DEEP SUMP CB'S	25.00%	100.00%	0.250	75.0%	25.00%
INFILTRATION BASIN	80.00%	75.00%	0.600	15.0%	**85.00%**

WITH PRETREATMENT BY GRIT CHAMBER, EQUIVALENT TO OR GREATER THAN FOREBAY.

APPENDIX D

WORKSHEET FOR Tc & AREA CALCULATIONS

ETHAN CIRCLE SUBDIVISION

SOUTH HADLEY, MA

APPENDIX D

TIME OF CONCENTRATION AND DRAINAGE AREA WORKSHEET **ETHAN CIRCLE, SO. HADLEY, MA**

12/24/13
REVISED 08/13/14

AREA ID: E1A TO NORTHWESTERN PL, HSGA

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
109.1	106	100	3.10%	0.4	WOODS	3.1	18.3

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
106	104	50	4.00%	0.1	0.1	WOODS NO DEFINED SWALE	3	0.6	1.4
104	102	80	2.50%	0.08	0.15	LAWN, SLIGHT SWALE	5	0.8	1.7

TOTAL TIME OF CONCENTRATION: E1A **MINUTES 21.4**

WOODS	HSGA	12903

AREA ID: E1B TO NORTHWESTERN PL, HSGB

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
108.1	104	80	5.12%	0.4	WOODS	3.1	12.5

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
104	102.5	65	2.31%	0.1	0.15	WOODS, SLIGHT SWALE	4	0.6	1.8
102.5	102	55	0.91%	0.08	0.15	LAWN, SLIGHT SWALE	5	0.5	1.8

TOTAL TIME OF CONCENTRATION: E1B **MINUTES 16.1**

ROOFS UNCON	HSGB	603
DRIVE UNCON	HSGB	478
LAWN	HSGB	14026
WOODS	HSGB	16429
TOTAL AREA:		31536

AREA ID: E2A CENTRAL AREA, HSGA TO SOUTHEASTERN PL

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
109.1	101	100	8.10%	0.4	WOODS	3.1	12.5

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
101	96	60	8.33%	0.1	0.15	WOODS, SLIGHT SWALE	4	1.2	0.8

TOTAL TIME OF CONCENTRATION: MINUTES 13.3

WOODS	HSGA	24255

AREA ID: E2B CENTRAL AREA, HSGB TO SOUTHEASTERN PL

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
108.1	107	75	1.47%	0.4	WOODS	3.1	19.6

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
107	104	115	2.61%	0.1	0.15	LAWN & WOODS, SLIGHT SWALE	4	0.6	3.2
104	96	80	10.00%	0.1	0.15	WOODS, SLIGHT SWALE	4	1.3	1.0

TOTAL TIME OF CONCENTRATION: MINUTES 23.8

ROOFS UNCON	HSGB	2000
LAWN	HSGB	13290
WOODS	HSGB	16481
	TOT. B	31771

AREA ID: E2C CENTRAL AREA, HSGC TO SOUTHEASTERN PL

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
103.5	94.5	100	9.00%	0.4	WOODS	3.1	12.0

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
94.5	88	90	7.22%	0.1	0.1	WOODS NO DEFINED SWALE	3	0.8	1.9

TOTAL TIME OF CONCENTRATION: **MINUTES** **13.9**

WOODS	HSGC	25334
TOTAL AREA E2'S		81360

WOODED SWALE SOUTHEAST TO PL

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"
96	88	175	4.57%	0.1

AREA ID: E3 TO NORTHEASTERN PL

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
108	101	75	9.33%	0.4	WOODS	3.1	9.4

TOTAL TIME OF CONCENTRATION: **E3** **MINUTES** **9.4**

WOODS	HSGA	12089

AREA ID: E4 TO HADLEY STREET

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
108.1	105.5	75	3.47%	0.24	LAWN	3.1	9.2

TOTAL TIME OF CONCENTRATION: **E4** **MINUTES** **9.2**

DRIVES CON	HSGB	1427
ROOFS UNCON	HSGB	1173
LAWN	HSGB	10171
TOTAL AREA:		12771

AREA ID: E5

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
103	93	66	15.15%	0.4	WOODS	3.1	7.0

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
93	90	80	3.75%	0.1	0.1	WOODS NO DEFINED SWALE	3	0.6	2.2

TOTAL TIME OF CONCENTRATION: **E5** **MINUTES** **9.2**

WOODS	HSGC	7274
WOODS	HSGD	6234
TOTAL AREA:		13508

AREA ID: P1A TO RAINGARDEN #2 HSGA

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
107.8	105.5	100	2.30%	0.24	LAWN	3.1	**13.7**

GRASS	HSGA	8171	
ROOFS-UNCON	HSGA	990	Lot 3,rear roof.
TOTAL AREA:	HSGA	9161	

SLIGHT SWALE IN LAWN FROM RG2 TO RG1

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"
105	102	30	10.00%	0.08

AREA ID: P1B TO NORTHWESTERN PL HSGB

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
106	102	115	3.48%	0.24	LAWN	3.1	**13.0**

ROOFS-UNCON	HSGB	1653	Lot 1 part, & lot 2 rear
GRASS	HSGB	17610	
TOTAL AREA:	HSGB	19263	

-

AREA ID: P2A TO CB1&2 - DMH1

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
107.3	104.5	40	7.00%	0.24	LAWN	3.1	4.2

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
104.5	102.7	120	1.50%	0.012	0.2	GUTTER	42	5.1	0.4

TOTAL TIME OF CONCENTRATION: ----------

P2A **MINUTES** **4.6**

ROOFS CON	HSGB	1796	Lot 1 part, Lot 2 front, Lot 7 part
ROOFS CON	HSGA	990	Lot 3, front
DRIVES CON	HSGB	2400	Lots 1,2,7
DRIVES CON	HSGA	900	Lot 3
ROAD	HSGB	5007	
ROAD	HSGA	360	
ROAD	HSGC	510	
WALK	HSGB	688	
WALK	HSGA	280	
LAWN	HSGA	3715	
LAWN	HSGB	9018	
TOTAL AREA:		25664	

AREA ID: P2B TO CB3

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
108.1	107	70	1.57%	0.24	LAWN	3.1	12.0

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
107	101.5	140	3.93%	0.1	0.15	SLIGHT SWALE IN LAWN	4	0.8	2.9
101.5	100.26	94	1.32%	0.012	0.2	GUTTER	42	4.8	0.3

TOTAL TIME OF CONCENTRATION: ----------

P2B **MINUTES** **15.3**

ROOFS CON	HSGA	1490	Lot 4 front, lot 5 part of front
ROOFS CON	HSGB	1365	Lots 6,7, part of fronts
ROOFS UNCON	HSGB	1811	Lots 7 & 8, rear roofs.
DRIVES CON	HSBA	1900	Lots 4,5
DRIVES CON	HSGC	800	Lot 6
DRIVES UNCON	HSGA	300	Lot 4, part
ROAD	HSGC	5526	
ROAD	HSGA	1517	
WALK	HSGA	524	
LAWN	HSGA	6418	

LAWN	HSGB	21392
LAWN	HSGC	1765
TOTAL AREA:		44808

AREA ID: P2C OVERLAND TO DETENTION BASIN

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
101.5	94	55	13.64%	0.24	LAWN	3.1	4.2

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
NA	NA	NA	NA	0.12	0.15	SLIGHT SWALE IN LAWN	4	0.0	NA

TOTAL TIME OF CONCENTRATION: P2C MINUTES 4.2

ROOFS CON	HSGA	560
DTN BSN	HSGC	1675
GRASS	HSGA	1750
GRASS	HSGB	7189
TOTAL AREA:		11174

AREA ID: P2D DIRECT TO SOUTHEASTERN PL

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
99	92	100	7.00%	0.4	WOODS	3.1	13.2

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
92	89	35	8.57%	0.1	0.1	WOODS NO DEFINED SWALE	3	0.9	0.7
89	88	20	5.00%	0.1	0.15	WOODLAND SWALE	4	0.9	0.4

TOTAL TIME OF CONCENTRATION: P2D MINUTES 14.2

GRASS	HSGA	1409
WOODS	HSGA	1200
WOODS	HSGC	5715
GRASS	HSGC	2835
TOTAL AREA:		11159

AREA ID: P2E OVERLAND TO INFILTRATION BASIN

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
107.5	107	47	1.06%	0.24	LAWN	3.1	10.2

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
107	94	154	8.44%	0.04	0.2	GRASS SWALE	13	3.8	0.7

TOTAL TIME OF CONCENTRATION: P2E MINUTES 10.9

ROOFS CON	HSGA	1000	LOT 5 REAR
ROOFS UNCON	HSGA	1050	LOT 4 REAR
INFILTR. BASIN	HSGA	1918	
GRASS	HSGA	9441	
TOTAL AREA:		13409	

AREA ID: P3 TO NORTHEASTERN PL

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
95	94	10	10.00%	0.24	LAWN	3.1	1.2

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
NA	NA	MA	NA						

TOTAL TIME OF CONCENTRATION: P3 MINUTES 1.2

GRASS, MEADOW	HSGA	1390

AREA ID: P4 TO HADLEY STREET

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
108.1	105.5	75	3.47%	0.24	LAWN	3.1	9.2

TOTAL TIME OF CONCENTRATION: P4 MINUTES 9.2

DRIVES CON	HSGB	607
ROOFS UNCON	HSGB	890
LAWN	HSGB	7674
TOTAL AREA:		9171

AREA ID: P5

SHEET FLOW: (TR55, REV. 6/86, EQ.3-3)

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"		24 HR. PRECIP. (INCHES)	TIME(MIN)
108.5	108	60	0.83%	0.24	LAWN	3.1	13.7

SHALLOW CONCENTRATED FLOW

ELEV.	TO ELEV.	DIST.(FT)	SLOPE	"n"	HYD. RAD.	DESCRIPTION	Kv	VEL(FPS)	TIME(MIN)
108	101	50	14.00%	0.08	0.15	LAWN, SLIGHT SWALE	5	1.9	0.4
101	93	60	13.33%	0.1	0.1	WOODS NO DEFINED SWALE	3	1.1	0.9
93	90	80	3.75%	0.1	0.1	WOODS NO DEFINED SWALE	3	0.6	2.2

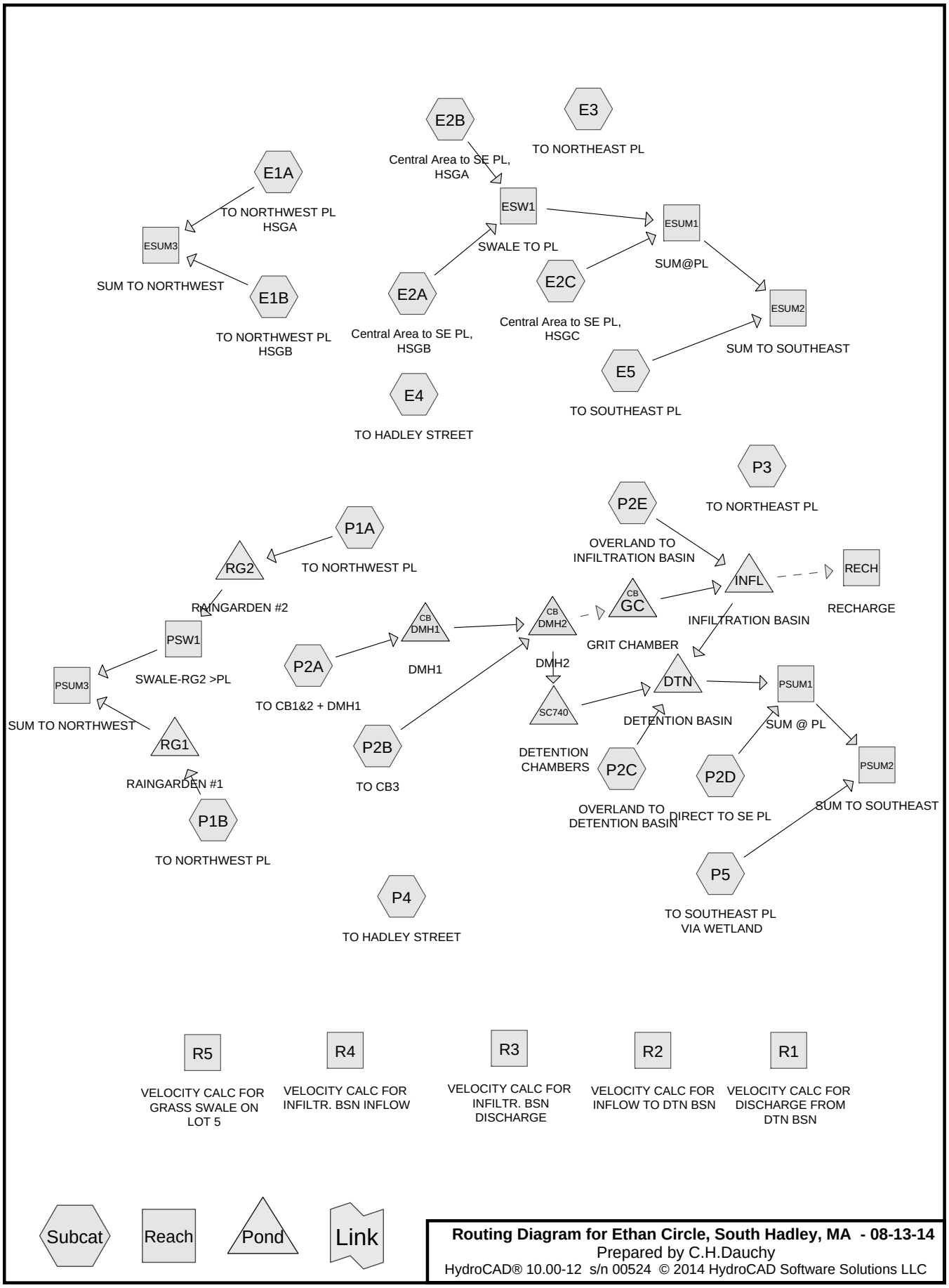
TOTAL TIME OF CONCENTRATION: P5 MINUTES 17.3

WOODS	HSGC	6521
LAWN	HSGC	964
LAWN	HSGB	4109
ROOFS UNCON		1050
WOODS	HSGD	6234
TOTAL AREA:		18878

APPENDIX E

WATERSHED MODEL AND ROUTING CALCULATIONS

ETHAN CIRCLE SUBDIVISION
SOUTH HADLEY, MA



Routing Diagram for Ethan Circle, South Hadley, MA - 08-13-14
Prepared by C.H.Dauchy
HydroCAD® 10.00-12 s/n 00524 © 2014 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1A: TO NORTHWEST PL Runoff Area=12,903 sf 0.00% Impervious Runoff Depth=0.00"
Tc=21.4 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment E1B: TO NORTHWEST PL Runoff Area=31,536 sf 3.43% Impervious Runoff Depth=0.36"
Tc=16.1 min CN=58/98 Runoff=0.11 cfs 944 cf

Subcatchment E2A: Central Area to SE PL, Runoff Area=31,771 sf 6.30% Impervious Runoff Depth=0.43"
Tc=23.8 min CN=58/98 Runoff=0.13 cfs 1,141 cf

Subcatchment E2B: Central Area to SE PL, Runoff Area=24,255 sf 0.00% Impervious Runoff Depth=0.00"
Tc=13.3 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment E2C: Central Area to SE PL, Runoff Area=25,334 sf 0.00% Impervious Runoff Depth=0.71"
Tc=13.9 min CN=70/0 Runoff=0.33 cfs 1,508 cf

Subcatchment E3: TO NORTHEAST PL Runoff Area=12,089 sf 0.00% Impervious Runoff Depth=0.00"
Tc=9.4 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment E4: TO HADLEY STREET Runoff Area=12,771 sf 20.36% Impervious Runoff Depth=0.85"
Tc=9.2 min CN=61/98 Runoff=0.20 cfs 909 cf

Subcatchment E5: TO SOUTHEAST PL Runoff Area=13,508 sf 0.00% Impervious Runoff Depth=0.86"
Tc=9.2 min CN=73/0 Runoff=0.26 cfs 965 cf

Subcatchment P1A: TO NORTHWEST PL Runoff Area=9,161 sf 10.81% Impervious Runoff Depth=0.30"
Tc=18.1 min CN=39/98 Runoff=0.05 cfs 228 cf

Subcatchment P1B: TO NORTHWEST PL Runoff Area=19,263 sf 8.58% Impervious Runoff Depth=0.57"
Tc=13.0 min CN=61/98 Runoff=0.16 cfs 917 cf

Subcatchment P2A: TO CB1&2 + DMH1 Runoff Area=25,664 sf 50.39% Impervious Runoff Depth=1.49"
Tc=4.6 min CN=55/98 Runoff=0.91 cfs 3,190 cf

Subcatchment P2B: TO CB3 Runoff Area=44,808 sf 34.00% Impervious Runoff Depth=1.10"
Tc=15.3 min CN=57/98 Runoff=0.79 cfs 4,121 cf

Subcatchment P2C: OVERLAND TO Runoff Area=11,174 sf 5.01% Impervious Runoff Depth=0.43"
Tc=4.2 min CN=59/98 Runoff=0.07 cfs 397 cf

Subcatchment P2D: DIRECT TO SE PL Runoff Area=11,159 sf 0.00% Impervious Runoff Depth=0.43"
Tc=14.2 min CN=63/0 Runoff=0.06 cfs 402 cf

Subcatchment P2E: OVERLAND TO Runoff Area=13,409 sf 15.29% Impervious Runoff Depth=0.43"
Tc=10.9 min CN=43/98 Runoff=0.12 cfs 481 cf

Subcatchment P3: TO NORTHEAST PL Runoff Area=1,390 sf 0.00% Impervious Runoff Depth=0.00"
Tc=1.2 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment P4: TO HADLEY STREET Runoff Area=9,171 sf 16.32% Impervious Runoff Depth=0.76"
Tc=9.2 min CN=61/98 Runoff=0.12 cfs 579 cf

Subcatchment P5: TO SOUTHEAST PL VIA Runoff Area=18,878 sf 5.56% Impervious Runoff Depth=0.87"
Tc=17.3 min CN=71/98 Runoff=0.28 cfs 1,372 cf

Reach ESUM1: SUM@PL Inflow=0.39 cfs 2,649 cf
Outflow=0.39 cfs 2,649 cf

Reach ESUM2: SUM TO SOUTHEAST Inflow=0.60 cfs 3,614 cf
Outflow=0.60 cfs 3,614 cf

Reach ESUM3: SUM TO NORTHWEST Inflow=0.11 cfs 944 cf
Outflow=0.11 cfs 944 cf

Reach ESW1: SWALE TO PL Avg. Flow Depth=0.06' Max Vel=0.39 fps Inflow=0.13 cfs 1,141 cf
n=0.100 L=175.0' S=0.0457 '/' Capacity=48.40 cfs Outflow=0.13 cfs 1,141 cf

Reach PSUM1: SUM @ PL Inflow=0.30 cfs 3,960 cf
Outflow=0.30 cfs 3,960 cf

Reach PSUM2: SUM TO SOUTHEAST Inflow=0.55 cfs 5,332 cf
Outflow=0.55 cfs 5,332 cf

Reach PSUM3: SUM TO NORTHWEST Inflow=0.10 cfs 303 cf
Outflow=0.10 cfs 303 cf

Reach PSW1: SWALE-RG2 >PL Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.080 L=30.0' S=0.0967 '/' Capacity=13.85 cfs Outflow=0.00 cfs 0 cf

Reach RECH: RECHARGE Inflow=0.07 cfs 4,630 cf
Outflow=0.07 cfs 4,630 cf

Pond DMH1: DMH1 Peak Elev=98.65' Inflow=0.91 cfs 3,190 cf
12.0" Round Culvert n=0.012 L=90.3' S=0.0239 '/' Outflow=0.91 cfs 3,190 cf

Pond DMH2: DMH2 Peak Elev=96.25' Inflow=1.43 cfs 7,310 cf
Primary=0.86 cfs 1,258 cf Secondary=0.57 cfs 6,052 cf Outflow=1.43 cfs 7,310 cf

Pond DTN: DETENTION BASIN Peak Elev=92.55' Storage=1,455 cf Inflow=0.95 cfs 3,557 cf
Outflow=0.27 cfs 3,557 cf

Pond GC: GRIT CHAMBER Peak Elev=95.95' Inflow=0.57 cfs 6,052 cf
Outflow=0.57 cfs 6,052 cf

Pond INFL: INFILTRATION BASIN Peak Elev=94.59' Storage=1,539 cf Inflow=0.68 cfs 6,534 cf
Primary=0.45 cfs 1,904 cf Secondary=0.07 cfs 4,630 cf Outflow=0.52 cfs 6,534 cf

Pond RG1: RAINGARDEN #1 Peak Elev=102.12' Storage=263 cf Inflow=0.16 cfs 917 cf
Discarded=0.01 cfs 613 cf Primary=0.10 cfs 303 cf Outflow=0.11 cfs 916 cf

Pond RG2: RAINGARDEN #2 Peak Elev=104.78' Storage=132 cf Inflow=0.05 cfs 228 cf
Discarded=0.00 cfs 227 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 227 cf

Pond SC740: DETENTION CHAMBERS Peak Elev=93.98' Storage=553 cf Inflow=0.86 cfs 1,258 cf
Outflow=0.45 cfs 1,256 cf

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1A: TO NORTHWEST PL Runoff Area=12,903 sf 0.00% Impervious Runoff Depth=0.00"
Tc=21.4 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment E1B: TO NORTHWEST PL Runoff Area=31,536 sf 3.43% Impervious Runoff Depth=1.02"
Tc=16.1 min CN=58/98 Runoff=0.51 cfs 2,680 cf

Subcatchment E2A: Central Area to SE PL, Runoff Area=31,771 sf 6.30% Impervious Runoff Depth=1.12"
Tc=23.8 min CN=58/98 Runoff=0.49 cfs 2,955 cf

Subcatchment E2B: Central Area to SE PL, Runoff Area=24,255 sf 0.00% Impervious Runoff Depth=0.00"
Tc=13.3 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment E2C: Central Area to SE PL, Runoff Area=25,334 sf 0.00% Impervious Runoff Depth=1.67"
Tc=13.9 min CN=70/0 Runoff=0.86 cfs 3,534 cf

Subcatchment E3: TO NORTHEAST PL Runoff Area=12,089 sf 0.00% Impervious Runoff Depth=0.00"
Tc=9.4 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment E4: TO HADLEY STREET Runoff Area=12,771 sf 20.36% Impervious Runoff Depth=1.73"
Tc=9.2 min CN=61/98 Runoff=0.46 cfs 1,839 cf

Subcatchment E5: TO SOUTHEAST PL Runoff Area=13,508 sf 0.00% Impervious Runoff Depth=1.90"
Tc=9.2 min CN=73/0 Runoff=0.61 cfs 2,134 cf

Subcatchment P1A: TO NORTHWEST PL Runoff Area=9,161 sf 10.81% Impervious Runoff Depth=0.56"
Tc=18.1 min CN=39/98 Runoff=0.07 cfs 427 cf

Subcatchment P1B: TO NORTHWEST PL Runoff Area=19,263 sf 8.58% Impervious Runoff Depth=1.35"
Tc=13.0 min CN=61/98 Runoff=0.48 cfs 2,171 cf

Subcatchment P2A: TO CB1&2 + DMH1 Runoff Area=25,664 sf 50.39% Impervious Runoff Depth=2.52"
Tc=4.6 min CN=55/98 Runoff=1.55 cfs 5,383 cf

Subcatchment P2B: TO CB3 Runoff Area=44,808 sf 34.00% Impervious Runoff Depth=2.01"
Tc=15.3 min CN=57/98 Runoff=1.54 cfs 7,506 cf

Subcatchment P2C: OVERLAND TO Runoff Area=11,174 sf 5.01% Impervious Runoff Depth=1.13"
Tc=4.2 min CN=59/98 Runoff=0.30 cfs 1,050 cf

Subcatchment P2D: DIRECT TO SE PL Runoff Area=11,159 sf 0.00% Impervious Runoff Depth=1.20"
Tc=14.2 min CN=63/0 Runoff=0.25 cfs 1,118 cf

Subcatchment P2E: OVERLAND TO Runoff Area=13,409 sf 15.29% Impervious Runoff Depth=0.84"
Tc=10.9 min CN=43/98 Runoff=0.18 cfs 943 cf

Subcatchment P3: TO NORTHEAST PL Runoff Area=1,390 sf 0.00% Impervious Runoff Depth=0.00"
Tc=1.2 min CN=30/0 Runoff=0.00 cfs 0 cf

Subcatchment P4: TO HADLEY STREET Runoff Area=9,171 sf 16.32% Impervious Runoff Depth=1.60"
Tc=9.2 min CN=61/98 Runoff=0.31 cfs 1,222 cf

Subcatchment P5: TO SOUTHEAST PL VIA Runoff Area=18,878 sf 5.56% Impervious Runoff Depth=1.89"
Tc=17.3 min CN=71/98 Runoff=0.66 cfs 2,968 cf

Reach ESUM1: SUM@PL Inflow=1.11 cfs 6,489 cf
Outflow=1.11 cfs 6,489 cf

Reach ESUM2: SUM TO SOUTHEAST Inflow=1.59 cfs 8,623 cf
Outflow=1.59 cfs 8,623 cf

Reach ESUM3: SUM TO NORTHWEST Inflow=0.51 cfs 2,680 cf
Outflow=0.51 cfs 2,680 cf

Reach ESW1: SWALE TO PL Avg. Flow Depth=0.12' Max Vel=0.58 fps Inflow=0.49 cfs 2,955 cf
n=0.100 L=175.0' S=0.0457 '/' Capacity=48.40 cfs Outflow=0.47 cfs 2,955 cf

Reach PSUM1: SUM @ PL Inflow=0.60 cfs 15,941 cf
Outflow=0.60 cfs 15,941 cf

Reach PSUM2: SUM TO SOUTHEAST Inflow=1.20 cfs 18,909 cf
Outflow=1.20 cfs 18,909 cf

Reach PSUM3: SUM TO NORTHWEST Inflow=0.47 cfs 1,484 cf
Outflow=0.47 cfs 1,484 cf

Reach PSW1: SWALE-RG2 >PL Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.080 L=30.0' S=0.0967 '/' Capacity=13.85 cfs Outflow=0.00 cfs 0 cf

Reach RECH: RECHARGE Inflow=0.00 cfs 56 cf
Outflow=0.00 cfs 56 cf

Pond DMH1: DMH1 Peak Elev=98.83' Inflow=1.55 cfs 5,383 cf
12.0" Round Culvert n=0.012 L=90.3' S=0.0239 '/' Outflow=1.55 cfs 5,383 cf

Pond DMH2: DMH2 Peak Elev=96.34' Inflow=2.52 cfs 12,889 cf
Primary=1.78 cfs 3,240 cf Secondary=0.74 cfs 9,649 cf Outflow=2.52 cfs 12,889 cf

Pond DTN: DETENTION BASIN Peak Elev=93.77' Storage=4,931 cf Inflow=1.73 cfs 14,823 cf
Outflow=0.56 cfs 14,823 cf

Pond GC: GRIT CHAMBER Peak Elev=96.03' Inflow=0.74 cfs 9,649 cf
Outflow=0.74 cfs 9,649 cf

Pond INFL: INFILTRATION BASIN Peak Elev=94.64' Storage=0 cf Inflow=0.91 cfs 10,591 cf
Primary=0.91 cfs 10,536 cf Secondary=0.00 cfs 56 cf Outflow=0.91 cfs 10,591 cf

Pond RG1: RAINGARDEN #1 Peak Elev=102.17' Storage=290 cf Inflow=0.48 cfs 2,171 cf
Discarded=0.01 cfs 686 cf Primary=0.47 cfs 1,484 cf Outflow=0.48 cfs 2,170 cf

Pond RG2: RAINGARDEN #2 Peak Elev=104.93' Storage=210 cf Inflow=0.07 cfs 427 cf
Discarded=0.01 cfs 425 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 425 cf

Pond SC740: DETENTION CHAMBERS Peak Elev=94.84' Storage=1,569 cf Inflow=1.78 cfs 3,240 cf
Outflow=0.76 cfs 3,238 cf

Summary for Subcatchment E1A: TO NORTHWEST PL HSGA

Runoff = 0.00 cfs @ 15.24 hrs, Volume= 129 cf, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
12,903	30	Woods, Good, HSG A
12,903		100.00% Pervious Area

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

Summary for Subcatchment E1B: TO NORTHWEST PL HSGB

Runoff = 1.25 cfs @ 12.24 hrs, Volume= 5,659 cf, Depth= 2.15"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
16,429	55	Woods, Good, HSG B
14,026	61	>75% Grass cover, Good, HSG B
603	98	Unconnected roofs, HSG B
478	98	Unconnected pavement, HSG B
31,536	59	Weighted Average
30,455		96.57% Pervious Area
1,081		3.43% Impervious Area

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

Summary for Subcatchment E2A: Central Area to SE PL, HSGB

Runoff = 1.13 cfs @ 12.35 hrs, Volume= 6,016 cf, Depth= 2.27"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
2,000	98	Unconnected roofs, HSG B
13,290	61	>75% Grass cover, Good, HSG B
16,481	55	Woods, Good, HSG B
31,771	60	Weighted Average
29,771		93.70% Pervious Area
2,000		6.30% Impervious Area

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

Summary for Subcatchment E2B: Central Area to SE PL, HSGA

Runoff = 0.01 cfs @ 15.12 hrs, Volume= 242 cf, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
24,255	30	Woods, Good, HSG A
24,255		100.00% Pervious Area

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

Summary for Subcatchment E2C: Central Area to SE PL, HSGC

Runoff = 1.65 cfs @ 12.19 hrs, Volume= 6,599 cf, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
25,334	70	Woods, Good, HSG C
25,334		100.00% Pervious Area

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

Summary for Subcatchment E3: TO NORTHEAST PL

Runoff = 0.00 cfs @ 15.07 hrs, Volume= 121 cf, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
12,089	30	Woods, Good, HSG A
12,089		100.00% Pervious Area

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

Summary for Subcatchment E4: TO HADLEY STREET

Runoff = 0.87 cfs @ 12.13 hrs, Volume= 3,266 cf, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

	Area (sf)	CN	Description
	10,171	61	>75% Grass cover, Good, HSG B
*	1,427	98	Driveway, HSG B
	1,173	98	Unconnected roofs, HSG B
	12,771	69	Weighted Average
	10,171		79.64% Pervious Area
	2,600		20.36% Impervious Area

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

Summary for Subcatchment E5: TO SOUTHEAST PL

Runoff = 1.12 cfs @ 12.13 hrs, Volume= 3,854 cf, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

	Area (sf)	CN	Description
	7,274	70	Woods, Good, HSG C
*	6,234	77	Woods, Good, HSG D (WETLAND)
	13,508	73	Weighted Average
	13,508		100.00% Pervious Area

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

Summary for Subcatchment P1A: TO NORTHWEST PL

Runoff = 0.12 cfs @ 12.29 hrs, Volume= 894 cf, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
8,171	39	>75% Grass cover, Good, HSG A
990	98	Unconnected roofs, HSG A
9,161	45	Weighted Average
8,171		89.19% Pervious Area
990		10.81% Impervious Area

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

Summary for Subcatchment P1B: TO NORTHWEST PL

Runoff = 1.02 cfs @ 12.18 hrs, Volume= 4,191 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
17,610	61	>75% Grass cover, Good, HSG B
603	98	Unconnected roofs, HSG B
1,050	98	Unconnected roofs, HSG B
19,263	64	Weighted Average
17,610		91.42% Pervious Area
1,653		8.58% Impervious Area

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

Summary for Subcatchment P2A: TO CB1&2 + DMH1

Runoff = 2.52 cfs @ 12.07 hrs, Volume= 8,499 cf, Depth= 3.97"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

	Area (sf)	CN	Description
	1,796	98	Roofs, HSG B
	990	98	Roofs, HSG A
*	2,400	98	Driveways, HSG B
*	900	98	Driveways, HSG A
	5,007	98	Paved roads w/curbs & sewers, HSG B
	360	98	Paved roads w/curbs & sewers, HSG A
	510	98	Paved roads w/curbs & sewers, HSG C
*	688	98	Walk, HSG B
*	280	98	Walk, HSG A
	3,715	39	>75% Grass cover, Good, HSG A
	9,018	61	>75% Grass cover, Good, HSG B
	25,664	76	Weighted Average
	12,733		49.61% Pervious Area
	12,931		50.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6					**Direct Entry, See Separate Calculations**

Summary for Subcatchment P2B: TO CB3

Runoff = 2.71 cfs @ 12.21 hrs, Volume= 12,563 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

	Area (sf)	CN	Description
	1,490	98	Roofs, HSG A
	1,365	98	Roofs, HSG B
	1,811	98	Unconnected roofs, HSG B
*	1,900	98	Driveways, HSG A
*	800	98	Driveways, HSG C
	300	98	Unconnected pavement, HSG A
	5,526	98	Paved roads w/curbs & sewers, HSG C
	1,517	98	Paved roads w/curbs & sewers, HSG A
*	524	98	Walk, HSG A
	6,647	39	>75% Grass cover, Good, HSG A
	21,163	61	>75% Grass cover, Good, HSG B
	1,765	74	>75% Grass cover, Good, HSG C
	44,808	71	Weighted Average
	29,575		66.00% Pervious Area
	15,233		34.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.3					**Direct Entry, See Separate calculations**

Summary for Subcatchment P2C: OVERLAND TO DETENTION BASIN

Runoff = 0.69 cfs @ 12.07 hrs, Volume= 2,144 cf, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

	Area (sf)	CN	Description
	560	98	Roofs, HSG A
*	1,675	74	Dtn Bsn Btm, HSGC
	7,189	61	>75% Grass cover, Good, HSG B
	1,750	39	>75% Grass cover, Good, HSG A
	11,174	61	Weighted Average
	10,614		94.99% Pervious Area
	560		5.01% Impervious Area

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

Summary for Subcatchment P2D: DIRECT TO SE PL

Runoff = 0.55 cfs @ 12.20 hrs, Volume= 2,288 cf, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
1,409	39	>75% Grass cover, Good, HSG A
1,200	30	Woods, Good, HSG A
5,715	70	Woods, Good, HSG C
2,835	74	>75% Grass cover, Good, HSG C
11,159	63	Weighted Average
11,159		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2					**Direct Entry, See separate calculations**

Summary for Subcatchment P2E: OVERLAND TO INFILTRATION BASIN

Runoff = 0.36 cfs @ 12.17 hrs, Volume= 1,835 cf, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

	Area (sf)	CN	Description
	1,000	98	Roofs, HSG A
	1,050	98	Unconnected pavement, HSG A
*	1,918	61	Infiltration basin bottom
	9,441	39	>75% Grass cover, Good, HSG A
	13,409	51	Weighted Average
	11,359		84.71% Pervious Area
	2,050		15.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9					**Direct Entry, 11.1**

Summary for Subcatchment P3: TO NORTHEAST PL

Runoff = 0.00 cfs @ 14.92 hrs, Volume= 14 cf, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
1,390	30	Meadow, non-grazed, HSG A
1,390		100.00% Pervious Area

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

Summary for Subcatchment P4: TO HADLEY STREET

Runoff = 0.60 cfs @ 12.13 hrs, Volume= 2,225 cf, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

	Area (sf)	CN	Description
	7,674	61	>75% Grass cover, Good, HSG B
	890	98	Unconnected roofs, HSG B
*	607	98	Driveways, HSG B
	9,171	67	Weighted Average
	7,674		83.68% Pervious Area
	1,497		16.32% Impervious Area

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

Summary for Subcatchment P5: TO SOUTHEAST PL VIA WETLAND

Runoff = 1.21 cfs @ 12.24 hrs, Volume= 5,329 cf, Depth= 3.39"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR STORM Rainfall=6.40"

Area (sf)	CN	Description
6,521	70	Woods, Good, HSG C
964	74	>75% Grass cover, Good, HSG C
4,109	61	>75% Grass cover, Good, HSG B
1,050	98	Unconnected roofs, HSG B
6,234	77	Woods, Good, HSG D
18,878	72	Weighted Average
17,828		94.44% Pervious Area
1,050		5.56% Impervious Area

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

Summary for Reach ESUM1: SUM@PL

Inflow Area = 81,360 sf, 2.46% Impervious, Inflow Depth = 1.90" for 100YR STORM event
Inflow = 2.37 cfs @ 12.25 hrs, Volume= 12,857 cf
Outflow = 2.37 cfs @ 12.25 hrs, Volume= 12,857 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Summary for Reach ESUM2: SUM TO SOUTHEAST

Inflow Area = 94,868 sf, 2.11% Impervious, Inflow Depth = 2.11" for 100YR STORM event
Inflow = 3.24 cfs @ 12.19 hrs, Volume= 16,711 cf
Outflow = 3.24 cfs @ 12.19 hrs, Volume= 16,711 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Summary for Reach ESUM3: SUM TO NORTHWEST

Inflow Area = 44,439 sf, 2.43% Impervious, Inflow Depth = 1.56" for 100YR STORM event
Inflow = 1.25 cfs @ 12.24 hrs, Volume= 5,788 cf
Outflow = 1.25 cfs @ 12.24 hrs, Volume= 5,788 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

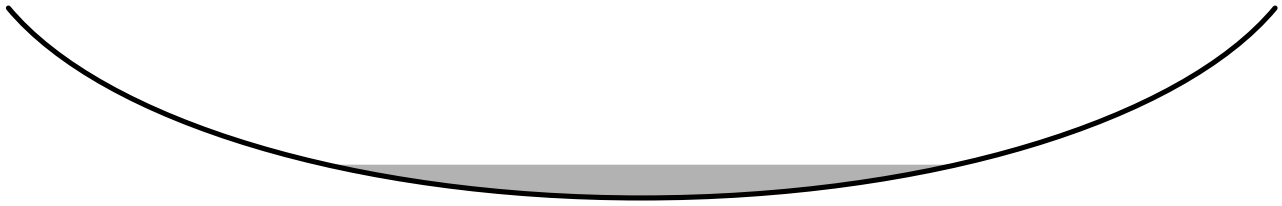
Summary for Reach ESW1: SWALE TO PL

Inflow Area = 56,026 sf, 3.57% Impervious, Inflow Depth = 1.34" for 100YR STORM event
Inflow = 1.13 cfs @ 12.35 hrs, Volume= 6,258 cf
Outflow = 1.10 cfs @ 12.40 hrs, Volume= 6,258 cf, Atten= 2%, Lag= 3.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.76 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.25 fps, Avg. Travel Time= 11.9 min

Peak Storage= 255 cf @ 12.40 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 1.00' Flow Area= 20.0 sf, Capacity= 48.40 cfs

30.00' x 1.00' deep Parabolic Channel, n= 0.100
Length= 175.0' Slope= 0.0457 '/'
Inlet Invert= 96.00', Outlet Invert= 88.00'



‡

Summary for Reach PSUM1: SUM @ PL

Inflow Area = 106,214 sf, 28.97% Impervious, Inflow Depth = 3.08" for 100YR STORM event
Inflow = 2.31 cfs @ 12.54 hrs, Volume= 27,271 cf
Outflow = 2.31 cfs @ 12.54 hrs, Volume= 27,271 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Summary for Reach PSUM2: SUM TO SOUTHEAST

Inflow Area = 125,092 sf, 25.44% Impervious, Inflow Depth = 3.13" for 100YR STORM event
Inflow = 2.99 cfs @ 12.51 hrs, Volume= 32,600 cf
Outflow = 2.99 cfs @ 12.51 hrs, Volume= 32,600 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Summary for Reach PSUM3: SUM TO NORTHWEST

Inflow Area = 28,424 sf, 9.30% Impervious, Inflow Depth = 1.58" for 100YR STORM event
Inflow = 1.00 cfs @ 12.20 hrs, Volume= 3,741 cf
Outflow = 1.00 cfs @ 12.20 hrs, Volume= 3,741 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

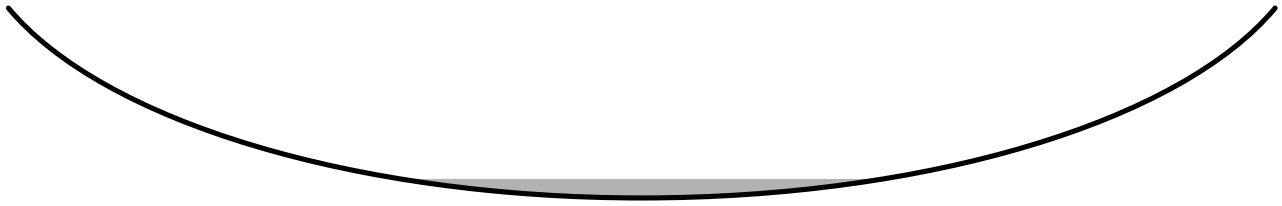
Summary for Reach PSW1: SWALE-RG2 >PL

Inflow Area = 9,161 sf, 10.81% Impervious, Inflow Depth = 0.36" for 100YR STORM event
Inflow = 0.09 cfs @ 12.49 hrs, Volume= 275 cf
Outflow = 0.09 cfs @ 12.50 hrs, Volume= 275 cf, Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 0.59 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 1.8 min

Peak Storage= 5 cf @ 12.50 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.50' Flow Area= 5.0 sf, Capacity= 13.85 cfs

15.00' x 0.50' deep Parabolic Channel, n= 0.080
Length= 30.0' Slope= 0.0967 '/'
Inlet Invert= 104.90', Outlet Invert= 102.00'



‡

Summary for Reach RECH: RECHARGE

Inflow	=	0.00 cfs @	12.28 hrs,	Volume=	57 cf
Outflow	=	0.00 cfs @	12.28 hrs,	Volume=	57 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Summary for Pond DMH1: DMH1

Inflow Area =		25,664 sf, 50.39% Impervious, Inflow Depth = 3.97" for 100YR STORM event			
Inflow	=	2.52 cfs @	12.07 hrs,	Volume=	8,499 cf
Outflow	=	2.52 cfs @	12.07 hrs,	Volume=	8,499 cf, Atten= 0%, Lag= 0.0 min
Primary	=	2.52 cfs @	12.07 hrs,	Volume=	8,499 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 99.10' @ 12.07 hrs
Flood Elev= 102.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	98.16'	**12.0" Round Culvert** L= 90.3' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 98.16' / 96.00' S= 0.0239 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=2.52 cfs @ 12.07 hrs HW=99.10' TW=96.45' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 2.52 cfs @ 3.30 fps)

Summary for Pond DMH2: DMH2

Inflow Area =		70,472 sf, 39.96% Impervious, Inflow Depth = 3.59" for 100YR STORM event			
Inflow	=	4.27 cfs @	12.10 hrs,	Volume=	21,063 cf
Outflow	=	4.27 cfs @	12.10 hrs,	Volume=	21,063 cf, Atten= 0%, Lag= 0.0 min
Primary	=	3.34 cfs @	12.10 hrs,	Volume=	6,849 cf
Secondary	=	1.14 cfs @	12.29 hrs,	Volume=	14,213 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 96.67' @ 12.30 hrs
Flood Elev= 100.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	94.10'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 94.10' / 94.00' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	96.10'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	95.75'	**8.0" Round Culvert** L= 6.0' Ke= 0.500 Inlet / Outlet Invert= 95.75' / 95.65' S= 0.0167 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=3.34 cfs @ 12.10 hrs HW=96.46' TW=94.87' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.34 cfs of 4.77 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 3.34 cfs @ 1.96 fps)

Secondary OutFlow Max=1.02 cfs @ 12.29 hrs HW=96.66' TW=96.29' (Dynamic Tailwater)
└─**3=Culvert** (Inlet Controls 1.02 cfs @ 2.91 fps)

Summary for Pond DTN: DETENTION BASIN

Inflow Area = 95,055 sf, 32.37% Impervious, Inflow Depth = 3.15" for 100YR STORM event
Inflow = 3.47 cfs @ 12.33 hrs, Volume= 24,983 cf
Outflow = 2.06 cfs @ 12.55 hrs, Volume= 24,983 cf, Atten= 41%, Lag= 13.2 min
Primary = 2.06 cfs @ 12.55 hrs, Volume= 24,983 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 94.00' @ 12.55 hrs Surf.Area= 3,809 sf Storage= 5,768 cf
Flood Elev= 94.10' Surf.Area= 3,928 sf Storage= 6,168 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 96.6 min (904.2 - 807.5)

Volume	Invert	Avail.Storage	Storage Description
#1	91.30'	10,192 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
91.30	0	0.0	0	0	0
92.00	1,675	233.0	391	391	4,321
93.00	2,682	265.0	2,159	2,550	5,613
94.00	3,813	295.0	3,231	5,781	6,979
95.00	5,039	321.0	4,412	10,192	8,290

Device	Routing	Invert	Outlet Devices
#1	Primary	91.20'	**12.0" Round Culvert** L= 25.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 91.20' / 91.00' S= 0.0080 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	91.20'	**3.0" Horiz. Orifice/Grate** C= 0.600
#3	Device 1	93.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.06 cfs @ 12.55 hrs HW=94.00' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.06 cfs of 5.73 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.40 cfs @ 8.05 fps)
  └─**3=Orifice/Grate** (Weir Controls 1.66 cfs @ 1.78 fps)

Summary for Pond GC: GRIT CHAMBER

Inflow	=	1.14 cfs @	12.29 hrs,	Volume=	14,213 cf
Outflow	=	1.14 cfs @	12.29 hrs,	Volume=	14,213 cf, Atten= 0%, Lag= 0.0 min
Primary	=	1.14 cfs @	12.29 hrs,	Volume=	14,213 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 96.29' @ 12.29 hrs
Flood Elev= 96.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	95.50'	**8.0" Round Culvert** L= 105.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 95.50' / 94.00' S= 0.0143 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Device 1	95.50'	**8.0" Horiz. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.14 cfs @ 12.29 hrs HW=96.29' TW=94.69' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.14 cfs @ 3.27 fps)
└─**2=Orifice/Grate** (Passes 1.14 cfs of 1.50 cfs potential flow)

Summary for Pond INFL: INFILTRATION BASIN

Inflow Area =		13,409 sf, 15.29% Impervious, Inflow Depth = 14.36" for 100YR STORM event			
Inflow	=	1.42 cfs @	12.28 hrs,	Volume=	16,048 cf
Outflow	=	1.42 cfs @	12.28 hrs,	Volume=	16,048 cf, Atten= 0%, Lag= 0.0 min
Primary	=	1.42 cfs @	12.28 hrs,	Volume=	15,991 cf
Secondary	=	0.00 cfs @	12.28 hrs,	Volume=	57 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 94.69' @ 12.28 hrs Surf.Area= 2,991 sf Storage= 0 cf
Flood Elev= 95.00' Surf.Area= 3,316 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (813.3 - 813.3)

Volume	Invert	Avail.Storage	Storage Description
#1	94.00'	0 cf	**Custom Stage Data (Irregular)**Listed below (Recalc) 2,809 cf Overall x 0.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
94.00	2,341	194.0	0	0	2,341
94.50	2,796	224.0	1,283	1,283	3,344
95.00	3,316	263.0	1,526	2,809	4,861

Device	Routing	Invert	Outlet Devices
#1	Secondary	94.00'	**0.010 in/hr Exfiltration over Horizontal area** Phase-In= 0.02'
#2	Primary	93.20'	**10.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 93.20' / 93.00' S= 0.0111 '/' Cc= 0.900

			n= 0.012, Flow Area= 0.55 sf
#3	Device 2	94.50'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=1.42 cfs @ 12.28 hrs HW=94.69' TW=93.53' (Dynamic Tailwater)
└─**2=Culvert** (Passes 1.42 cfs of 2.72 cfs potential flow)
└─**3=Broad-Crested Rectangular Weir** (Weir Controls 1.42 cfs @ 1.23 fps)

Secondary OutFlow Max=0.00 cfs @ 12.28 hrs HW=94.69' TW=0.00' (Dynamic Tailwater)
└─**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Summary for Pond RG1: RAINGARDEN #1

Inflow Area =	19,263 sf,	8.58% Impervious,	Inflow Depth =	2.61"	for 100YR STORM event
Inflow =	1.02 cfs @	12.18 hrs, Volume=	4,191 cf		
Outflow =	1.01 cfs @	12.20 hrs, Volume=	4,190 cf,	Atten= 1%,	Lag= 0.9 min
Discarded =	0.01 cfs @	12.20 hrs, Volume=	725 cf		
Primary =	1.00 cfs @	12.20 hrs, Volume=	3,466 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 102.22' @ 12.20 hrs Surf.Area= 613 sf Storage= 317 cf

Plug-Flow detention time= 79.8 min calculated for 4,190 cf (100% of inflow)
Center-of-Mass det. time= 79.7 min (919.8 - 840.1)

Volume	Invert	Avail.Storage	Storage Description
#1	101.60'	577 cf	**6.00'W x 70.00'L x 1.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.60'	**2.400 in/hr Exfiltration over Horizontal area above 101.60'**
			Conductivity to Groundwater Elevation = 1.70'
			Excluded Horizontal area = 420 sf Phase-In= 0.01'
#2	Primary	102.10'	**10.0' long x 2.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50
			Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.01 cfs @ 12.20 hrs HW=102.22' (Free Discharge)
└─**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=1.00 cfs @ 12.20 hrs HW=102.22' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 1.00 cfs @ 0.86 fps)

Summary for Pond RG2: RAINGARDEN #2

Inflow Area =	9,161 sf,	10.81% Impervious,	Inflow Depth =	1.17"	for 100YR STORM event
Inflow =	0.12 cfs @	12.29 hrs, Volume=	894 cf		
Outflow =	0.10 cfs @	12.49 hrs, Volume=	892 cf,	Atten= 19%,	Lag= 12.0 min
Discarded =	0.01 cfs @	12.49 hrs, Volume=	617 cf		
Primary =	0.09 cfs @	12.49 hrs, Volume=	275 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 105.02' @ 12.49 hrs Surf.Area= 584 sf Storage= 262 cf

Plug-Flow detention time= 315.8 min calculated for 892 cf (100% of inflow)
Center-of-Mass det. time= 314.9 min (1,157.5 - 842.6)

Volume	Invert	Avail.Storage	Storage Description
#1	104.50'	577 cf	**6.00'W x 70.00'L x 1.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	104.50'	**2.400 in/hr Exfiltration over Horizontal area above 104.50'** Conductivity to Groundwater Elevation = 2.00' Excluded Horizontal area = 420 sf Phase-In= 0.02'
#2	Primary	105.00'	**10.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.01 cfs @ 12.49 hrs HW=105.02' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.09 cfs @ 12.49 hrs HW=105.02' TW=104.95' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.09 cfs @ 0.39 fps)

Summary for Pond SC740: DETENTION CHAMBERS

Inflow Area = 70,472 sf, 39.96% Impervious, Inflow Depth = 1.17" for 100YR STORM event
Inflow = 3.34 cfs @ 12.10 hrs, Volume= 6,849 cf
Outflow = 1.85 cfs @ 12.35 hrs, Volume= 6,847 cf, Atten= 45%, Lag= 14.8 min
Primary = 1.85 cfs @ 12.35 hrs, Volume= 6,847 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 96.38' @ 12.35 hrs Surf.Area= 2,144 sf Storage= 3,029 cf

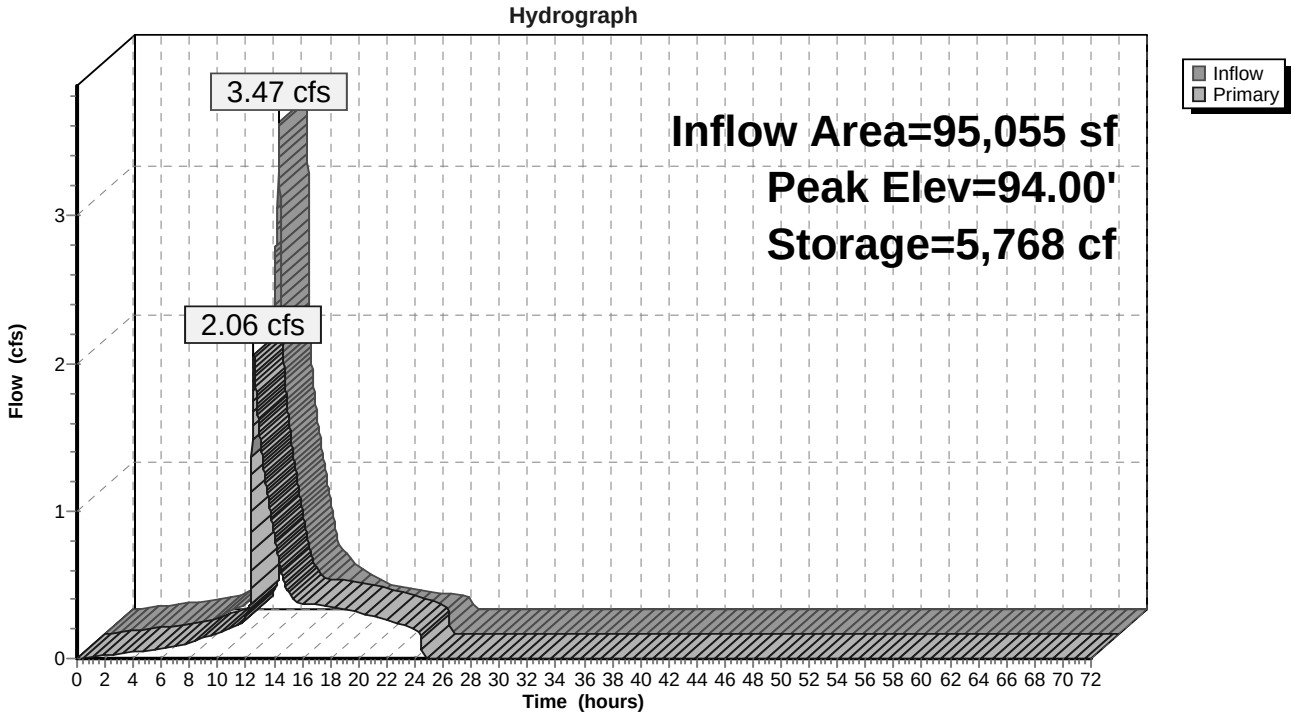
Plug-Flow detention time= 44.6 min calculated for 6,846 cf (100% of inflow)
Center-of-Mass det. time= 44.9 min (782.3 - 737.4)

Volume	Invert	Avail.Storage	Storage Description
#1	93.50'	1,602 cf	**28.00'W x 26.00'L x 3.00'H Prismatoid Z=1.0** x 2 5,412 cf Overall - 1,406 cf Embedded = 4,006 cf x 40.0% Voids
#2	93.50'	1,406 cf	**ADS_StormTech SC-740** x 30 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 Row Length Adjustment= +0.44' x 6.45 sf x 10 rows
#3	93.50'	124 cf	**18.0" Round Pipe Storage** L= 70.0'
		3,132 cf	Total Available Storage

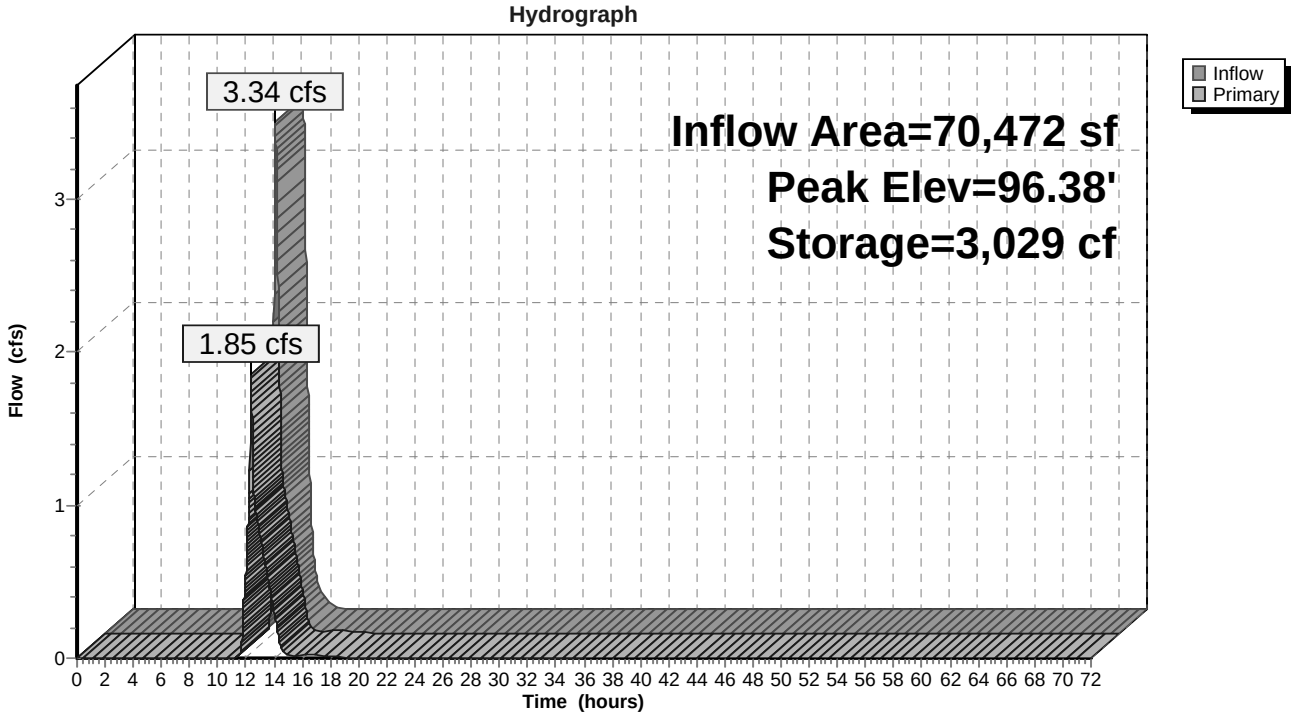
Device	Routing	Invert	Outlet Devices
#1	Primary	93.50'	**12.0" Round Culvert** L= 53.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 93.50' / 93.00' S= 0.0094 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	93.50'	**5.0" Horiz. Orifice/Grate** C= 0.600
#3	Device 1	96.20'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.85 cfs @ 12.35 hrs HW=96.38' TW=93.73' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.85 cfs of 5.69 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.07 cfs @ 7.83 fps)
  └─**3=Orifice/Grate** (Weir Controls 0.78 cfs @ 1.39 fps)

Pond DTN: DETENTION BASIN



Pond SC740: DETENTION CHAMBERS



Summary for Pond DMH2: DMH2

Inflow Area =	70,472 sf,	39.96% Impervious,	Inflow Depth =	0.22"	for WQ/RECHARGE STORM event
Inflow =	0.31 cfs @	12.09 hrs,	Volume=	1,293 cf	
Outflow =	0.31 cfs @	12.09 hrs,	Volume=	1,293 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	
Secondary =	0.31 cfs @	12.09 hrs,	Volume=	1,293 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 96.09' @ 12.09 hrs
Flood Elev= 100.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	94.10'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 94.10' / 94.00' S= 0.0250 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	96.10'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	95.75'	**8.0" Round Culvert** L= 6.0' Ke= 0.500 Inlet / Outlet Invert= 95.75' / 95.65' S= 0.0167 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=94.16' TW=93.50' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.00 cfs of 0.02 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.31 cfs @ 12.09 hrs HW=96.09' TW=95.81' (Dynamic Tailwater)
└─**3=Culvert** (Barrel Controls 0.31 cfs @ 2.53 fps)

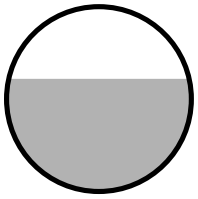
Summary for Reach R1: VELOCITY CALC FOR DISCHARGE FROM DTN BSN

Inflow	=	2.06 cfs @	0.00 hrs, Volume=	534,026 cf,	Incl. 2.06 cfs Base Flow
Outflow	=	2.37 cfs @	0.01 hrs, Volume=	534,015 cf,	Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.74 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.59 fps, Avg. Travel Time= 0.1 min

Peak Storage= 13 cf @ 0.01 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.45 cfs

12.0" Round Pipe
n= 0.012
Length= 25.0' Slope= 0.0080 '/'
Inlet Invert= 91.20', Outlet Invert= 91.00'



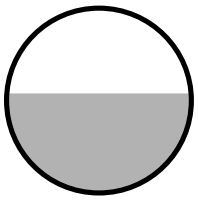
Summary for Reach R2: VELOCITY CALC FOR INFLOW TO DTN BSN

Inflow	=	1.85 cfs @	0.00 hrs, Volume=	479,587 cf,	Incl. 1.85 cfs Base Flow
Outflow	=	2.12 cfs @	0.01 hrs, Volume=	479,566 cf,	Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.92 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.76 fps, Avg. Travel Time= 0.2 min

Peak Storage= 23 cf @ 0.01 hrs
Average Depth at Peak Storage= 0.54'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.75 cfs

12.0" Round Pipe
n= 0.012
Length= 53.0' Slope= 0.0094 '/'
Inlet Invert= 93.50', Outlet Invert= 93.00'



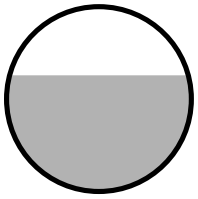
Summary for Reach R3: VELOCITY CALC FOR INFILTR. BSN DISCHARGE

Inflow	=	1.42 cfs @	0.00 hrs, Volume=	368,115 cf,	Incl. 1.42 cfs Base Flow
Outflow	=	1.63 cfs @	0.01 hrs, Volume=	368,108 cf,	Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.52 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.38 fps, Avg. Travel Time= 0.1 min

Peak Storage= 8 cf @ 0.01 hrs
Average Depth at Peak Storage= 0.52'
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.26 cfs

10.0" Round Pipe
n= 0.012
Length= 22.0' Slope= 0.0091 '/'
Inlet Invert= 93.20', Outlet Invert= 93.00'



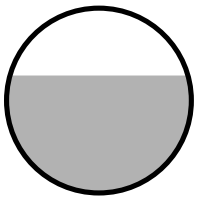
Summary for Reach R4: VELOCITY CALC FOR INFILTR. BSN INFLOW

Inflow	=	1.14 cfs @	0.00 hrs, Volume=	295,529 cf,	Incl. 1.14 cfs Base Flow
Outflow	=	1.14 cfs @	0.01 hrs, Volume=	295,505 cf,	Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 4.89 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 4.89 fps, Avg. Travel Time= 0.4 min

Peak Storage= 25 cf @ 0.01 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.56 cfs

8.0" Round Pipe
n= 0.012
Length= 105.0' Slope= 0.0143 '/'
Inlet Invert= 95.50', Outlet Invert= 94.00'



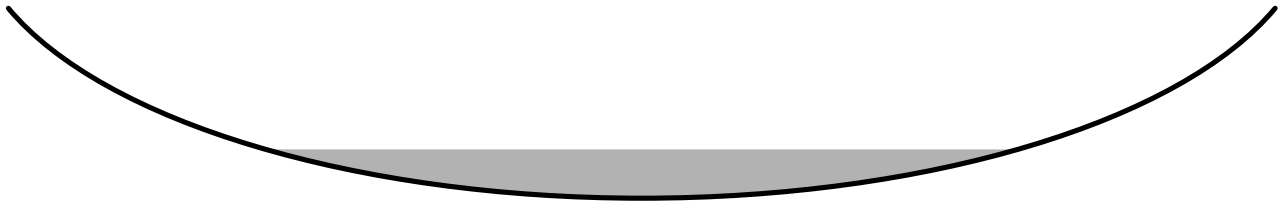
Summary for Reach R5: VELOCITY CALC FOR GRASS SWALE ON LOT 5

Inflow	=	0.36 cfs @	0.00 hrs, Volume=	93,325 cf,	Incl. 0.36 cfs Base Flow
Outflow	=	0.36 cfs @	0.51 hrs, Volume=	93,298 cf,	Atten= 0%, Lag= 30.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.08 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 2.08 fps, Avg. Travel Time= 1.2 min

Peak Storage= 27 cf @ 0.51 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 0.50' Flow Area= 1.3 sf, Capacity= 6.74 cfs

4.00' x 0.50' deep Parabolic Channel, n= 0.040
Length= 154.0' Slope= 0.0844 '/'
Inlet Invert= 107.00', Outlet Invert= 94.00'



‡

APPENDIX F

SOILS LOGS & SUMMARY

ETHAN CIRCLE SUBDIVISION
SOUTH HADLEY, MA

FORM 11: Soil Evaluation Form NO:_____

Commonwealth of Massachusetts
Town of SOUTH HADLEY

Soil Suitability Assessment: On-Site Sewage Disposal

Performed By: SHAWN KIMBERLEY Date: 11/9/12
Witnessed By: _____

Location Address of: RT 47
Lot #:
Owner's Name: ETHAN BAGG
Address of:

New Construction ☐ Repair ☐ Telephone:

Number of bedrooms:

Office Review

Published Soil Survey Available? No ☐ Yes ☒
Year Published _____ Publication Scale _____ Soil Map Unit _____
Drainage Class _____ Soil Limitations _____

Surficial Geologic Report Available? No ☐ Yes ☐
Year Published _____ Publication Scale _____
Geologic Material (map unit) _____
Landform _____

Flood Insurance Rate Map:
Above 500 year flood boundary? No ☐ Yes ☒
Within 500 year flood boundary? No ☒ Yes ☐
Within 100 year flood boundary? No ☒ Yes ☐

Wetland Area:
National Wetland Inventory Map (map unit) _____
Wetlands Conservancy Program Map (map unit) _____

Current Water Resource Conditions (USGS): month _____
Range: Above Normal ☐ Normal ☒ Below Normal ☐

Other Reference Reviewed:

Determination: Seasonal High Water Table

Methods Used:

☐ Depth observed standing in observation hole _____ inches
☐ Depth weeping from side of observation hole _____ inches
☐ Depth to soil mottles _____ inches
☐ Ground water adjustment _____ feet

Index Well No. _____ Reading Date _____ Index Well Level _____
Adjustment factor _____ Adjusted ground water _____

Depth of Naturally Occurring Pervious Material

Does at least four feet of naturally occurring pervious materials exist in all areas observed throughout the area proposed for this soil absorption system? yes

If not, what is the depth of naturally occurring pervious material?
_____

Certification

I certify that on 6/97 *(date) I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience described in 310 CMR 15.017.*

Signature _____

Date _____

On-Site Review

Deep Hole Number 2012-01 Date: 11/19/12 Time 1:30
Weather CLEAR
Land Use WOODLAND Slope (%) 4%
Surface Stone FEW
Vegetation:
MIXED

Landform:

Position on Landscape (sketch on back) _____
Distances from:

Open Water Body 50+ feet
Drainageway _____ feet
Possible Wet Areas 50+ feet
Property Line 50 feet
Drinking Water Well _____ feet
Other _____

DEEP OBSERVATION HOLE LOG

depth from surface (inches)	soil horizon	soil texture (USDA)	soil color (Munsel)	soil mottling	other (structure, stones, boulders) consistency, % gravel
0-13	A	LOAMY SAND	10YR 4/4	-	CRUMB
13-20	B	LOAMY SAND	10YR 5/6	-	SI.GR.
20-64	C1	FINE SAND	2.5Y 5/4	7.5YR 4/6 @ 54"	SI.GR.
64-72	C2	VERY FINE SAND	5Y 4/2	SAME	FIRM
-					
-					
-					
-					
-					

Parent Material (geologic) _____
Depth to Bedrock >72
Depth to Groundwater:

Standing Water in the Hole NONE
Weeping from Pit Face NONE
Estimated Seasonal High Water 54"

Comments:

On-Site Review

Deep Hole Number 02 Date: _____ Time _____
Weather _____
Land Use _____ Slope (%) _____
Surface Stone _____
Vegetation:

Landform:

Position on Landscape (sketch on back) _____
Distances from:

Open Water Body _____ feet
Drainageway _____ feet
Possible Wet Areas _____ feet
Property Line _____ feet
Drinking Water Well _____ feet
Other _____

DEEP OBSERVATION HOLE LOG

depth from surface (inches)	soil horizon	soil texture (USDA)	soil color (Munsel)	soil mottling	other (structure, stones, boulders) consistency, % gravel
0-12	A	LOAMY SAND	10YR 4/4	-	CRUMB
12-24	B	LOAMY SAND	10YR 5/6	-	SI.GR.
24-60	C1	FINE SAND	2.5Y 5/4	7.5YR 4/6 @ 48"	SI.GR.
60-70	C2	VERY FINE SAND	5Y 4/2	SAME	FIRM
-					
-					
-					
-					
-					

Parent Material (geologic) _____
Depth to Bedrock >70"
Depth to Groundwater:

Standing Water in the Hole NONE
Weeping from Pit Face NONE
Estimated Seasonal High Water 48"

Comments:

On-Site Review

Deep Hole Number 2012-03 Date: 11/9/12 Time 2:00
Weather _____
Land Use _____ Slope (%) _____
Surface Stone _____
Vegetation:
_____
_____
Landform:
_____
_____
Position on Landscape (sketch on back) _____
Distances from:

Open Water Body _____ feet
Drainageway _____ feet
Possible Wet Areas _____ feet
Property Line _____ feet
Drinking Water Well _____ feet
Other _____

DEEP OBSERVATION HOLE LOG

depth from surface (inches)	soil horizon	soil texture (USDA)	soil color (Munsel)	soil mottling	other (structure, stones, boulders) consistency, % gravel
0-15	A	LOAMY SAND	10YR 3/4	-	CRUMB
15-20	B	LOAMY SAND	10YR 4/4	-	SI.GR.
20-36	C1	FINE SAND	2.5Y 5/4	-	SI.GR.
36-43	Ab	LOAMY SAND	10YR 3/2	7.5YR 4/6	MS,FR
43-63	C2	SANDY LOAM	5Y 4/2	SAME	FIRM
63-68	C3	FINE SANDY LOAM	5Y 4/2	SAME	FIRM
-					
-					
-					

Parent Material (geologic) _____
Depth to Bedrock >68"
Depth to Groundwater:

Standing Water in the Hole NONE
Weeping from Pit Face NONE
Estimated Seasonal High Water 36"

Comments:

On-Site Review

Deep Hole Number -04 Date: 11/9/12 Time 2:30
Weather _____
Land Use _____ Slope (%) _____
Surface Stone _____
Vegetation:
_____
_____
Landform:
_____
_____
Position on Landscape (sketch on back) _____
Distances from:

Open Water Body _____ feet
Drainageway _____ feet
Possible Wet Areas _____ feet
Property Line _____ feet
Drinking Water Well _____ feet
Other _____

DEEP OBSERVATION HOLE LOG

depth from surface (inches)	soil horizon	soil texture (USDA)	soil color (Munsel)	soil mottling	other (structure, stones, boulders) consistency, % gravel
0-8	A	SANDY LOAM	10YR 3/4	-	CRUMB
8-16	B	SANDY LOAM	10YR 4/4	7.5YR 4/6 @ 15"	FIRM
16-42	C	SILT LOAM	5Y 4/3	SAME	COMPACT
-					
-					
-					
-					
-					
-					

Parent Material (geologic) _____
Depth to Bedrock >42"
Depth to Groundwater:

Standing Water in the Hole NONE
Weeping from Pit Face NONE
Estimated Seasonal High Water 15"

Comments:

LOG OF SOIL INVESTIGATION

ETHAN CIRCLE SUBDIVISION - STORMWATER INFILTRATION BASIN

INVESTIGATION DATE: 8/24/2014 BY: C. H. DAUCHY

AH #5

DEPTH FROM SURFACE (INCHES)	MATRIX COLOR	REDOX COLOR	REDOX %	SOIL TEXTURE (USDA)	OTHER	REMARKS
0-3	10YR 3/2			LOAMY SAND	CRUMB	
3-12	10YR 3/3			FINE SAND	SI.GR.	
12-18	10YR 5/4			FINE SAND	SI.GR.	
18-26	10YR 4/4			LOAMY SAND	SI.GR.	
26-60	10YR 5/4			FINE SAND	SI.GR.	
60-74	10YR 5/4	7.5YR 4/6	5%	FINE SAND	SI.GR.	ESHWT = 60"
74-79	10YR 4/3			VERY FINE SANDY LOAM	FIRM	
79-84	10YR 4/4	7.5YR 4/6	5%	FINE SAND	SI.GR.	

AH #6

DEPTH FROM SURFACE (INCHES)	MATRIX COLOR	REDOX COLOR	REDOX %	SOIL TEXTURE (USDA)	OTHER	REMARKS
0/13	10YR 3/3			LOAMY SAND	CRUMB	
13-28	10YR 4/5			FINE SAND	SI.GR.	
28-53	10YR 5/4			FINE SAND	SI.GR.	
53-60	10YR 5/4	7.5YR 4/6	5%	FINE SAND	SI.GR.	ESHWT = 53"
60-62	10YR 5/4	7.5YR 4/6	20%	FINE SAND	SI.GR.	
62-74	10YR 5/4	7.5YR 4/6	20%	FINE SAND	SI.GR.	STRATIFIED
	10YR 4/3			LOAMY SAND	FIRM	
74-80	10YR 5/4	7.5YR 4/6	20%	FINE SAND	SI.GR.	STRATIFIED
	10YR 4/3			VERY FINE SANDY LOAM	FIRM	
80-84	10YR 4/3			SILT LOAM	FIRM	

ESTIMATED GROUNDWATER ELEVATIONS
ETHAN CIRCLE SUBDIVISION, SOUTH HADLEY, MA

HOLE ID	DOMINANT TEXTURES	GROUND ELEV.	DEPTH TO ESHWT	ESHWT ELEV.
2012-01	LS, FS	94.27	4.5	89.77
2012-2	LS, FS	94.1	4	90.1
2012-3	LS, FS	92.87	3	89.87
2012-4	SL, SIL	91.76	1.25	90.51
AH1	LS	102.45	2.5	99.95
AH2	LS, FS	106.5	3.5	103
AH3	FS	108.76	6	102.76
AH4	SL, SIL	106.4	3	103.4

HAND AUGER HOLES A1-4 WERE DONE 11/9/12 BY C. H. DAUCHY TO DETERMINE FEASIBILITY OF RAIN GARDENS.

AH5	LS,FS	94.58	5	89.58
AH6	LS,FS	94.07	4.42	89.65

HA HOLES A5-A6, 8/24/14 BY C.H.DAUCHY

APPENDIX G

ANALYSIS OF
LOW IMPACT DEVELOPMENT ALTERNATIVES

ETHAN CIRCLE SUBDIVISION
SOUTH HADLEY, MA

APPENDIX G

Analysis of Low Impact Development Alternatives for Stormwater Management Ethan Circle Subdivision, South Hadley, MA

The list of LID alternatives considered below (*shown in italics*) reflects Feb. 2010 guidance from DEP to Conservation Commissions. Considerations are shown without italics.

a. Removal of all proposed work and/or impervious surfaces from the Department's jurisdiction:
Due to the configuration of this small site, such an alternative would make the project economically unfeasible.

b. Division of the upper portion of the subject catchments into smaller subcatchments, where resultant stormwater discharges should be completely infiltrated and/or retained;
The small size of the site means that the subcatchments are small to start with and that there are few "upper" portions of the subcatchments. Due to the relatively high groundwater levels and topographic constraints, retention and infiltration on most of the lots is not feasible.

c. Maintaining existing drainage patterns and not mixing country drainage with untreated stormwater; The overall drainage patterns from the site are maintained, except that the tributary are to the northwest and northeast is somewhat reduced to avoid exacerbating existing neighborhood drainage complaints.

d. Treatment of remaining stormwater at or proximate to its source within these subcatchments;
Topography, small lot size, and groundwater elevations prevent significant treatment and/or infiltration of stormwater within the tributary subcatchments. Two raingardens are proposed for control of runoff peak flows and volumes, but do not qualify for treatment or recharge due to the limited depth to water table. A grass swale is also proposed to direct flow away from abutters, but has insufficient travel time to qualify as providing treatment.

e .Installation of "qualifying pervious areas" (See Handbook, Volume 3, Chapter 1, p. 42) to accept stormwater discharge from roads and driveways within each subcatchment;
On this site, only the rear of two lots, draining away from the regulated point source discharge might be considered for "qualifying pervious areas". However the additional requirements in terms of length and width of flow path could not reasonably be met, enforced, and inspected on these small individual lots. This practice is more applicable to larger lots, or to a condominium.

f .Installation of dry wells for acceptance of roof drainage;
Dry wells, or even shallower infiltration trenches or chambers, are not practicable on this site due to the relatively high groundwater level on most of the site. There is also the practical impediment of enforcement, supervision of installation, and maintenance of an underground infiltration structure on an individual lot.

g. Disconnection of roof drainage;
The design proposes disconnection of roof drainage where feasible, in that no drain is to be directly connected to the storm drain system. All rear roofs are expected to drain to the rear lawns, where they will flow over vegetated areas. Except for Lots 1(already developed), 2, and

3, the rear yard runoff is directed over vegetated areas, but ultimately to the stormwater management system. Front roofs will drain to the front lawns, but due to the small lot areas, the flow paths to the street are so short that they are considered connected impervious for purposes of conservative runoff calculations.

h Installation of discrete structural Best Management Practices at relatively high elevations in each subcatchment. For instance, canting access road surfaces into grassed channels, water quality swales, vegetated filter strips, bioretention areas, sand and organic filters, drainage swales, level spreaders, etc. which terminate outside of the Department's jurisdiction;
As discussed above, small lots, topographic constraints, and the matter of individual lot ownership and maintenance responsibility limit the practicality of such techniques in this situation. Drainage swales and rain gardens are used where feasible, but cannot meet DEP standards for treatment or recharge.

i.If a redesign based upon the above requirements still results in a "point source" of "stormwater discharge" into the Department's jurisdiction, then further assessment of the following should be included in the written analysis:
•Reduction in impervious surfaces;
The proposed road is as narrow as is permitted under the town subdivision regulations. The proposed houses and driveways are typical in size to others in the general neighborhood. The Planning Board has agreed to a sidewalk on only one side of the street.

•Reduction in the number of proposed lots, proposed housing units, and/or allied appurtenances;
The concept of 5 new lots instead of 6 was considered and rejected due to economic considerations.

•Road width and length reductions;
The road is as narrow as permitted by town subdivision regulations. Reduction in road length would result in loss of a lot due to inadequate frontage.

•Clustering of impervious surfaces;
The total project area is too small to qualify for "Flexible Development" under the town's zoning, which might otherwise allow clustering of impervious surfaces.

•Addition of planted materials and landscaped areas;
All lots will be vegetated, except for normal features such as houses, driveways, walks, patios.

•Re-grading of landscaped areas away from jurisdictional Resource Areas and their Buffer Zones;
Due to neighborhood concerns about runoff to abutting properties, re-grading to divert runoff away from the buffer zone is not feasible.

•Preservation of vegetated areas within the Buffer Zone, and immediately proximate to jurisdictional resource areas;
A 50' wide undisturbed upland buffer will be preserved between developed areas and the wetlands.

APPENDIX H

DOCUMENTATION REGARDING
STORMTECH CHAMBERS

ETHAN CIRCLE SUBDIVISION
SOUTH HADLEY, MA

StormTech SC-740 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

StormTech®
Detention • Retention • Recharge
Subsurface Stormwater Management℠

StormTech SC-740 Chamber
(not to scale)

Nominal Chamber Specifications

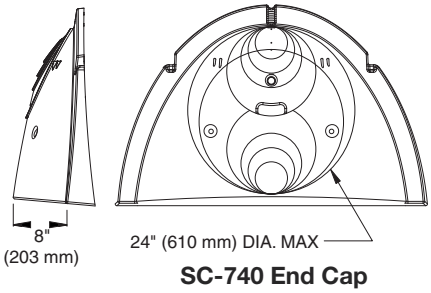
Size (L x W x H)
85.4" x 51.0" x 30.0"
(2170 x 1295 x 762 mm)

Chamber Storage
45.9 ft³ (1.30 m³)

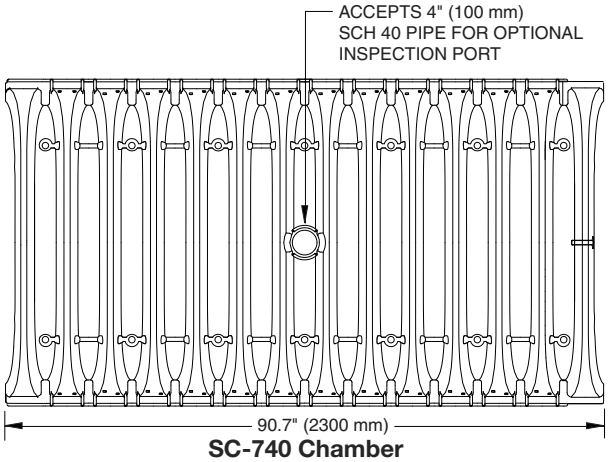
Minimum Installed Storage*
74.9 ft³ (2.12 m³)

Weight
74.0 lbs (33.6 kg)

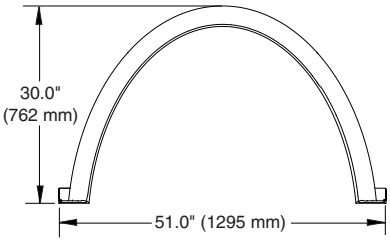
Shipping
30 chambers/pallet
60 end caps/pallet
12 pallets/truck

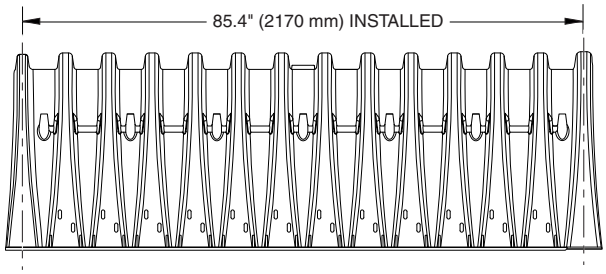


SC-740 End Cap

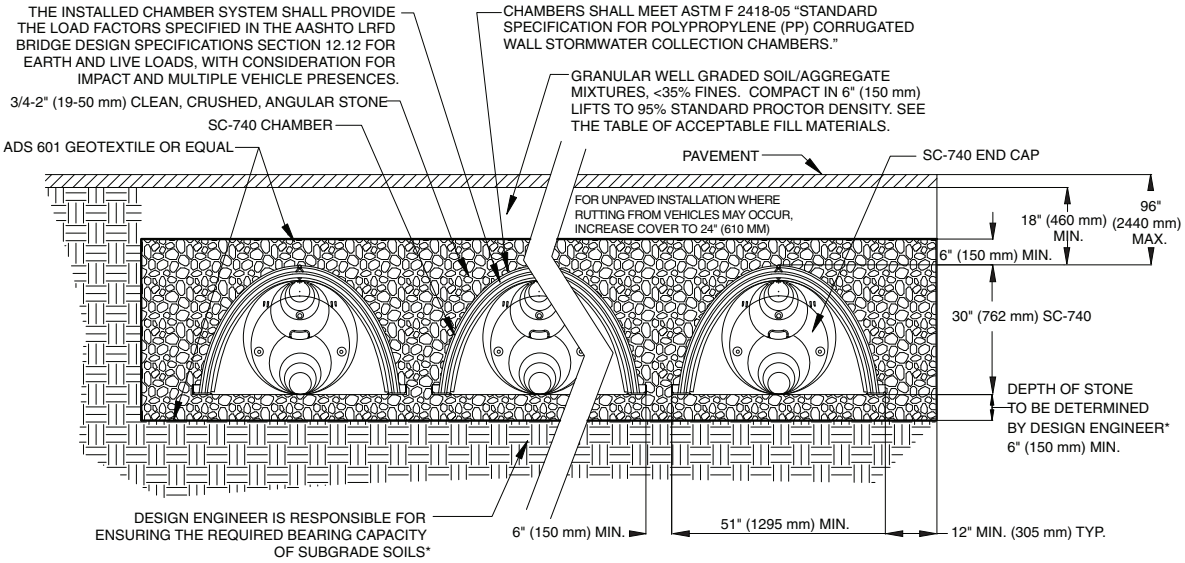


SC-740 Chamber





Typical Cross Section Detail
(not to scale)



THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

MADE IN THE U.S.A.

SC-740 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
42 (1067)	45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (948)	45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	41.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	0	6.76 (0.191)
5 (127)	0	5.63 (0.160)
4 (102)	Stone Foundation 0	4.51 (0.125)
3 (76)	0	3.38 (0.095)
2 (51)	0	2.25 (0.064)
1 (25)	0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber

	Bare Chamber Storage	Chamber and Stone Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (150)	12 (305)	18 (460)
StormTech SC-740	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Storage volumes are in cubic feet per chamber. Assumes 40% porosity for the stone plus the chamber volume.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (CUBIC YARDS)	**6"**	**12"**	**18"**
StormTech SC-740	3.8 (2.8 yd³)	4.6 (3.3 yd³)	5.5 (3.9 yd³)
METRIC KILOGRAMS (METER³)	**150 mm**	**305 mm**	**460 mm**
StormTech SC-740	3450 (2.1 m³)	4170 (2.5 m³)	4490 (3.0 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber

	Stone Foundation Depth		
	6" (150 mm)	**12" (305 mm)**	**18" (460 mm)**
StormTech SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Volumes are in cubic yards (cubic meters) per chamber. Assumes 6" (150 mm) of separation between chamber rows and 18" (460 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

STANDARD LIMITED WARRANTY OF STORMTECH LLC ("STORMTECH"): PRODUCTS

(A) This Limited Warranty applies solely to the StormTech chambers and endplates manufactured by StormTech and sold to the original purchaser (the "Purchaser"). The chambers and endplates are collectively referred to as the "Products."

(B) The structural integrity of the Products, when installed strictly in accordance with StormTech's written installation instructions at the time of installation, are warranted to the Purchaser against defective materials and workmanship for one (1) year from the date of purchase. Should a defect appear in the Limited Warranty period, the Purchaser shall provide StormTech with written notice of the alleged defect at StormTech's corporate headquarters within ten (10) days of the discovery of the defect. The notice shall describe the alleged defect in reasonable detail. StormTech agrees to supply replacements for those Products determined by StormTech to be defective and covered by this Limited Warranty. The supply of replacement products is the sole remedy of the Purchaser for breaches of this Limited Warranty. StormTech's liability specifically excludes the cost of removal and/or installation of the Products.

(C) **THIS LIMITED WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANT-ABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

(D) This Limited Warranty only applies to the Products when the Products are installed in a single layer. **UNDER NO CIRCUMSTANCES, SHALL THE PRODUCTS BE INSTALLED IN A MULTI-LAYER CONFIGURATION.**

(E) No representative of StormTech has the authority to change this Limited Warranty in any manner or to extend this Limited Warranty. This Limited Warranty does not apply to any person other than to the Purchaser.

(F) Under no circumstances shall StormTech be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Products, or the cost of other goods or services related to the purchase and installation of the Products. For this Limited Warranty to apply, the Products must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and StormTech's written installation instructions.

(G) **THE LIMITED WARRANTY DOES NOT EXTEND TO INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES. STORMTECH SHALL NOT BE LIABLE FOR PENALTIES OR LIQUIDATED DAMAGES, INCLUDING LOSS OF PRODUCTION AND PROFITS; LABOR AND MATERIALS; OVERHEAD COSTS; OR OTHER LOSS OR EXPENSE INCURRED BY THE PURCHASER OR ANY THIRD PARTY. SPECIFICALLY EXCLUDED FROM LIMITED WARRANTY COVERAGE ARE DAMAGE TO THE PRODUCTS ARISING FROM ORDINARY WEAR AND TEAR; ALTERATION, ACCIDENT, MISUSE, ABUSE OR NEGLECT; THE PRODUCTS BEING SUBJECTED TO VEHICLE TRAFFIC OR OTHER CONDITIONS WHICH ARE NOT PERMITTED BY STORMTECH'S WRITTEN SPECIFICATIONS OR INSTALLATION INSTRUCTIONS; FAILURE TO MAINTAIN THE MINIMUM GROUND COVERS SET FORTH IN THE INSTALLATION INSTRUCTIONS; THE PLACEMENT OF IMPROPER MATERIALS INTO THE PRODUCTS; FAILURE OF THE PRODUCTS DUE TO IMPROPER SITING OR IMPROPER SIZING; OR ANY OTHER EVENT NOT CAUSED BY STORMTECH. THIS LIMITED WARRANTY REPRESENTS STORMTECH'S SOLE LIABILITY TO THE PURCHASER FOR CLAIMS RELATED TO THE PRODUCTS, WHETHER THE CLAIM IS BASED UPON CONTRACT, TORT, OR OTHER LEGAL THEORY.**

20 Beaver Road, Suite 104 | Wethersfield | Connecticut | 06109
860.529.8188 | 888.892.2694 | fax 866.328.8401 | fax 860-529-8040 | www.stormtech.com

Printed in U.S.A. © Copyright. All rights reserved. StormTech LLC, 2007

Printed on recycled paper

S16-090508

StormTech®
Detention • Retention • Water Quality
A division of ADS

SC-310/SC-740/DC-780

StormTech Construction Guide

REQUIRED MATERIALS AND EQUIPMENT LIST

- Acceptable fill materials per **Table 1**
- Woven and non-woven geotextiles
- StormTech solid end caps and pre-cored end caps
- StormTech chambers
- StormTech manifolds and fittings

IMPORTANT NOTES:

A. This installation guide provides the minimum requirements for proper installation of chambers. Non-adherence to this guide may result in damage to chambers during installation. Replacement of damaged chambers during or after backfilling is costly and very time consuming. It is recommended that all installers are familiar with this guide, and that the contractor inspects the chambers for distortion, damage and joint integrity as work progresses.

B. Use of a dozer to push embedment stone between the rows of chambers may cause damage to chambers and is not an acceptable backfill method. Any chambers damaged by using the "dump and push" method are not covered under the StormTech standard warranty.

C. Care should be taken in the handling of chambers and end caps. Avoid dropping, prying or excessive force on chambers during removal from pallet and initial placement.

Requirements for System Installation

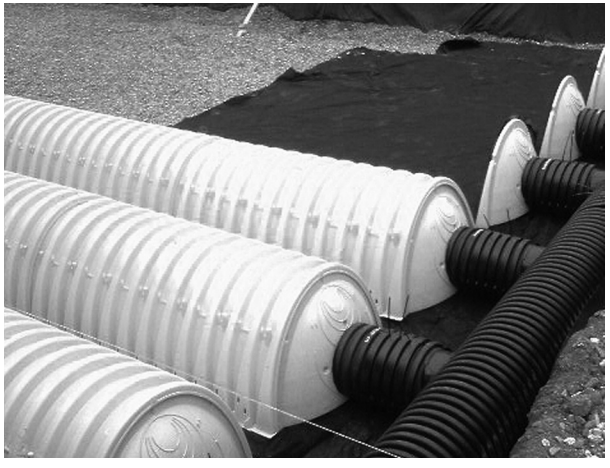
Excavate bed and prepare subgrade per engineer's plans.

Place non-woven geotextile over prepared soils and up excavation walls.

Place clean, crushed, angular stone foundation 6" (150 mm) min. Install underdrains if required. Compact to achieve a flat surface.

Manifold, Scour Fabric and Chamber Assembly

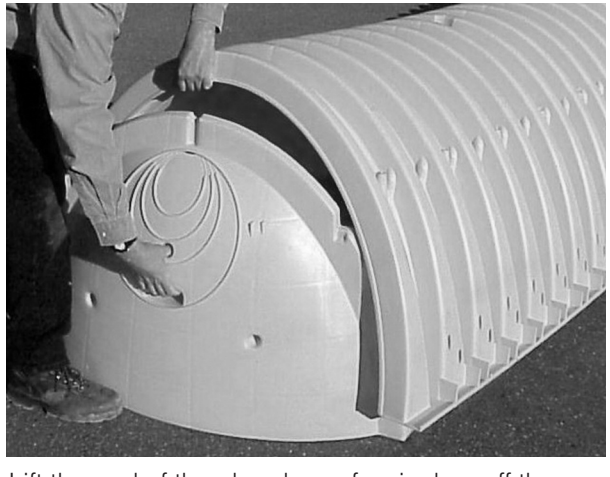
Install manifolds and lay out woven scour geotextile at inlet rows [min. 12.5 ft (3.8 m)] at each inlet end cap. Place a continuous piece (no seams, double layer) along entire length of Isolator® Row(s).



Align the first chamber and end cap of each row with inlet pipes. Contractor may choose to postpone stone placement around end chambers and leave ends of rows open for easy inspection of chambers during the backfill process.

Construct the chamber bed by overlapping the chambers lengthwise in rows. Attach chambers by overlapping the end corrugation of one chamber on to the end corrugation of the last chamber in the row. Be sure that the chamber placement does not exceed the reach of the construction equipment used to place the stone.

Attaching the End Caps



Lift the end of the chamber a few inches off the ground. With the curved face of the end cap facing outward, place the end cap into the chamber's end corrugation.

Prefabricated End Caps

24" (600 mm) inlets are the maximum size that can fit into a SC-740/DC-780 end cap and must be prefabricated with a 24" (600 mm) pipe stub. SC-310 chambers with a 12" (300 mm) inlet pipe must use a prefabricated end cap with a 12" (300 mm) pipe stub.

Isolator Row

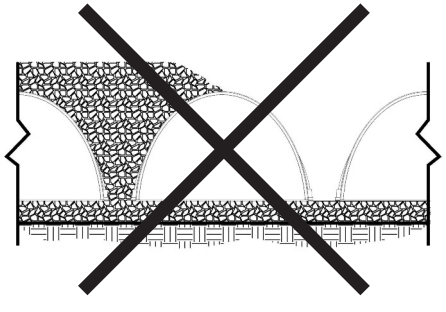
Drape a strip of ADS non-woven geotextile over the row of chambers (not required over DC-780). This is the same type of non-woven geotextile used as a separation layer around the angular stone of the StormTech system.

Initial Anchoring of Chambers – Embedment Stone

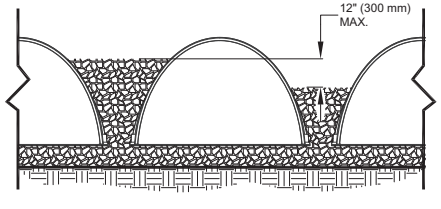
Initial embedment shall be spotted along the centerline of the chamber evenly anchoring the lower portion of the chamber. This is best accomplished with a stone conveyor or excavator reaching along the row.

No equipment shall be operated on the bed at this stage of the installation. Excavators must be located off the bed. Dump trucks shall not dump stone directly on to the bed. Dozers or loaders are not allowed on the bed at this time.

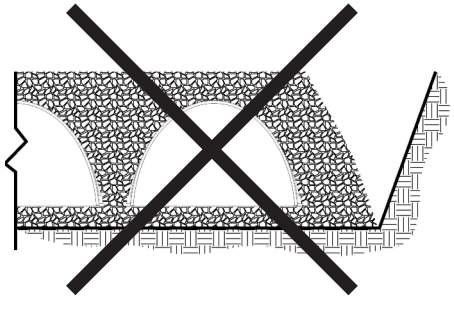
Backfill of Chambers – Embedment Stone



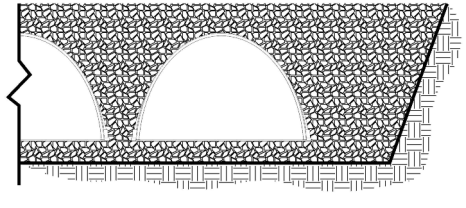
UNEVEN BACKFILL



EVEN BACKFILL



PERIMETER NOT BACKFILLED

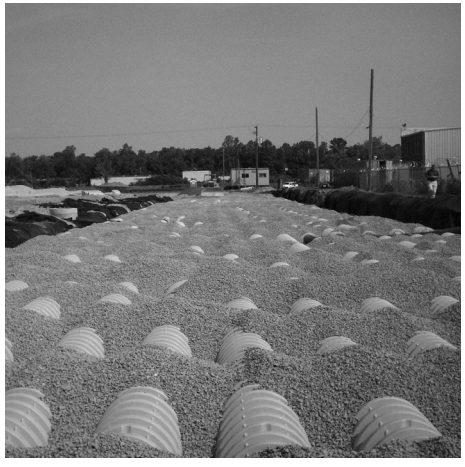


PERIMETER FULLY BACKFILLED

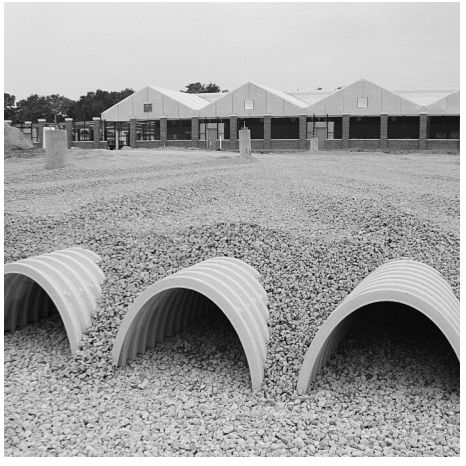
Backfill chambers evenly. Stone column height should never differ by more than 12” (300 mm) between adjacent chamber rows or between chamber rows and perimeter.

Perimeter stone must be brought up evenly with chamber rows. Perimeter must be fully backfilled, with stone extended horizontally to the excavation wall.

Backfill of Chambers – Embedment Stone and Cover Stone

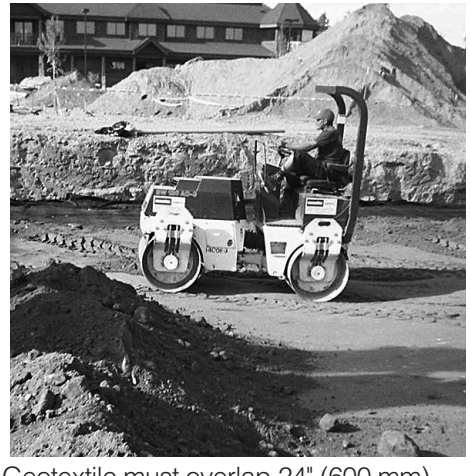


Continue evenly backfilling between rows and around perimeter until embedment stone reaches tops of chambers. Perimeter stone must extend horizontally to the excavation wall for both straight or sloped sidewalls. **Only after chambers have been backfilled to top of chamber and with a minimum 6" (150 mm) of cover stone on top of chambers can small dozers be used over the chambers for backfilling remaining cover stone.**



Small dozers and skid loaders may be used to finish grading stone backfill in accordance with ground pressure limits in Table 2. They must push material parallel to rows only. Never push perpendicular to rows. StormTech recommends that the contractor inspect chambers before placing final backfill. Any chambers damaged by construction shall be removed & replaced.

Final Backfill of Chambers – Fill Material



Install non-woven geotextile over stone. Geotextile must overlap 24" (600 mm) min. where edges meet. Compact each lift of backfill as specified in the site design engineer's drawings. Roller travel parallel with rows.

StormTech Isolator Row Detail

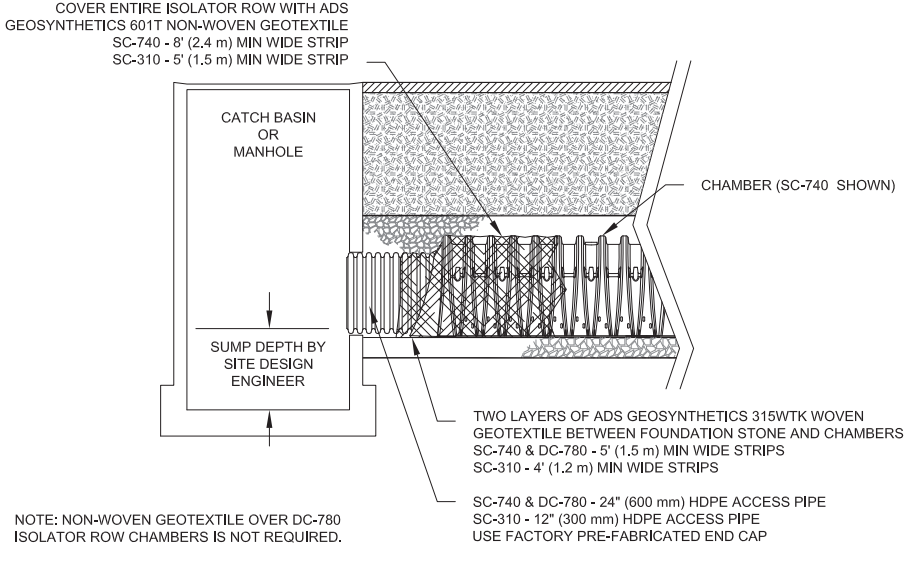


Table 1 – Acceptable Fill Materials

Material Location	Description	AASHTO M43 Designation[1]	Compaction/Density Requirement
Ⓓ **Final Fill:** Fill Material for layer 'D' starts from the top of the 'C' layer to the bottom of flexible pavement or unpaved finished grade above. Note that the pavement subbase may be part of the 'D' layer.	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	N/A	Prepare per site design engineer's plans. Paved installations may have stringent material and preparation requirements.
Ⓒ **Initial Fill:** Fill Material for layer 'C' starts from the top of the embedment stone ('B' layer) to 18" (450 mm) above the top of the chamber. Note that pavement subbase may be part of the 'C' layer.	Granular well-graded soil/aggregate mixtures, <35% fines or processed aggregate. Most pavement subbase materials can be used in lieu of this layer.	AASHTO M45 A-1, A-2-4, A-3 or AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	Begin compaction after min. 12" (300 mm) of material over the chambers is reached. Compact additional layers in 6" (150 mm) max. lifts to a min. 95% Proctor density for well-graded material and 95% relative density for processed aggregate materials. Roller gross vehicle weight not to exceed 12,000 lbs (53 kN). Dynamic force not to exceed 20,000 lbs (89 kN)
Ⓑ **Embedment Stone:** Embedment Stone surrounding chambers from the foundation stone to the 'C' layer above.	Clean, crushed, angular stone nominal size distribution 3/4 - 2" (20 mm - 50 mm)	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	No compaction required.
Ⓐ **Foundation Stone:** Foundation Stone below the chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone, nominal size distribution 3/4 - 2" (20 mm - 50 mm)	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	Place and compact in 6" (150 mm) lifts using two full coverages with a vibratory compactor.[2, 3]

PLEASE NOTE:

1. ***The listed AASHTO designations are for gradations only. The stone must also be clean, crushed, angular. For example, a specification for #4 stone would state: "clean, crushed, angular no. 4 (AASHTO M43) stone".***
2. ***StormTech compaction requirements are met for 'A' location materials when placed and compacted in 6" (150 mm) (max) lifts using two full coverages with a vibratory compactor.***
3. ***Where infiltration surfaces may be comprised by compaction, for standard installations and standard design load conditions, a flat surface may be achieved by raking or dragging without compaction equipment. For special load designs, contact StormTech for compaction requirements.***

Figure 1 – Inspection Port Detail

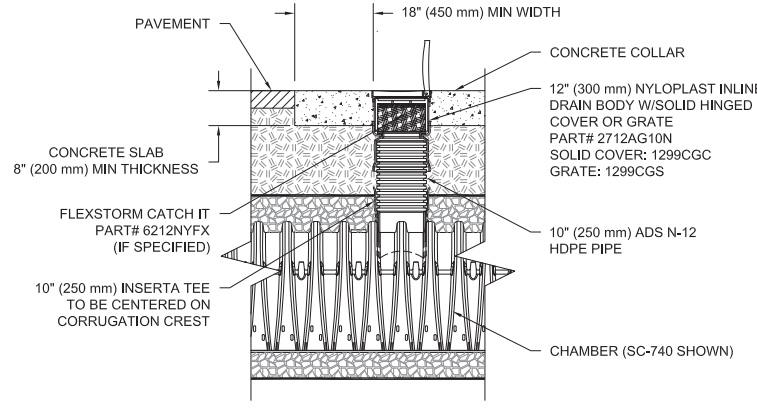
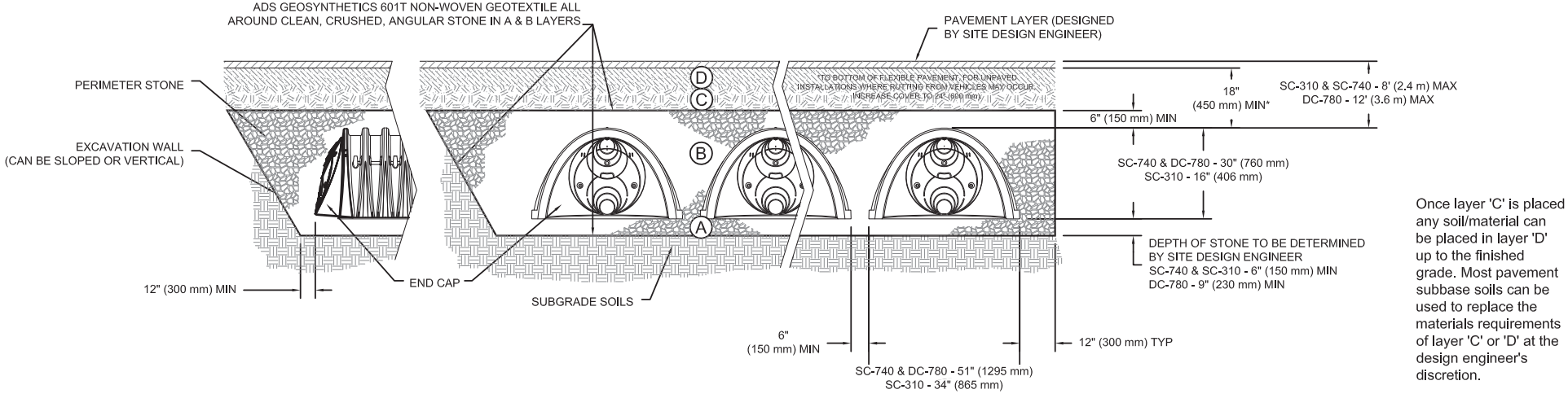


Figure 2 – Fill Material Locations



Once layer 'C' is placed any soil/material can be placed in layer 'D' up to the finished grade. Most pavement subbase soils can be used to replace the materials requirements of layer 'C' or 'D' at the design engineer's discretion.

NOTES:

1. *36" (900 mm) of stabilized cover materials over the chambers is required for full dump truck travel and dumping.*
2. *During paving operations, dump truck axle loads on 18" (450 mm) of cover may be necessary. Precautions should be taken to avoid rutting of the road base layer, to ensure that compaction requirements have been met, and that a minimum of 18" (450 mm) of cover exists over the chambers. Contact StormTech for additional guidance on allowable axle loads during paving.*
3. *Ground pressure for track dozers is the vehicle operating weight divided by total ground contact area for both tracks. Excavators will exert higher ground pressures based on loaded bucket weight and boom extension.*
4. *Mini-excavators (< 8,000lbs/3,628 kg) can be used with at least 12" (300 mm) of stone over the chambers and are limited by the maximum ground pressures in Table 2 based on a full bucket at maximum boom extension.*
5. *Storage of materials such as construction materials, equipment, spoils, etc. should not be located over the StormTech system. The use of equipment over the StormTech system not covered in Table 2 (ex. soil mixing equipment, cranes, etc) is limited. Please contact StormTech for more information.*
6. *Allowable track loads based on vehicle travel only. Excavators shall not operate on chamber beds until the total backfill reaches 3 feet (900 mm) over the entire bed.*

ADS "Terms and Conditions of Sale" are available on the ADS website, www.ads-pipe.com.
Advanced Drainage Systems, the ADS logo, and the green stripe are registered trademarks of Advanced Drainage Systems.
StormTech® and the Isolator® Row are registered trademarks of StormTech, Inc
#090113 09/13

©2013 Advanced Drainage Systems, Inc.

Table 2 – Maximum Allowable Construction Vehicle Loads[5]

Material Location	Fill Depth over Chambers in. [mm]	Maximum Allowable Wheel Loads		Maximum Allowable Track Loads[6]		Maximum Allowable Roller Loads
		Max Axle Load for Trucks lbs [kN]	Max Wheel Load for Loaders lbs [kN]	Track Width in. [mm]	Max Ground Pressure psf [kPa]	Max Drum Weight or Dynamic Force lbs [kN]
(D) Final Fill Material	36" [900] Compacted	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	3420 [164] 2350 [113] 1850 [89] 1510 [72] 1310 [63]	38,000 [169]
(C) Initial Fill Material	24" [600] Compacted	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2480 [119] 1770 [85] 1430 [68] 1210 [58] 1070 [51]	20,000 [89]
	24" [600] Loose/Dumped	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2245 [107] 1625 [78] 1325 [63] 1135 [54] 1010 [48]	20,000 [89] Roller gross vehicle weight not to exceed 12,000 lbs. [53 kN]
	18" [450]	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2010 [96] 1480 [71] 1220 [58] 1060 [51] 950 [45]	20,000 [89] Roller gross vehicle weight not to exceed 12,000 lbs. [53 kN]
(B) Embedment Stone	12" [300]	16,000 [71]	NOT ALLOWED	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	1540 [74] 1190 [57] 1010 [48] 910 [43] 840 [40]	20,000 [89] Roller gross vehicle weight not to exceed 12,000 lbs. [53 kN]
	6" [150]	8,000 [35]	NOT ALLOWED	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	1070 [51] 900 [43] 800 [38] 760 [36] 720 [34]	NOT ALLOWED

Table 3 – Placement Methods and Descriptions

Material Location	Placement Methods/ Restrictions	Wheel Load Restrictions	Track Load Restrictions	Roller Load Restrictions
		See Table 2 for Maximum Construction Loads		
(D) Final Fill Material	A variety of placement methods may be used. All construction loads must not exceed the maximum limits in Table 2.	36" (900 mm) minimum cover required for dump trucks to dump over chambers.	Dozers to push parallel to rows until 36" (900mm) compaced cover is reached.[4]	Roller travel parallel to rows only until 36" (900 mm) compacted cover is reached.
(C) Initial Fill Material	Excavator positioned off bed recommended. Small excavator allowed over chambers. Small dozer allowed.	Asphalt can be dumped into paver when compacted pavement subbase reaches 18" (450 mm) above top of chambers.	Small LGP track dozers & skid loaders allowed to grade cover stone with at least 6" (150 mm) stone under tracks at all times. Equipment must push parallel to rows at all times.	Use dynamic force of roller only after compacted fill depth reaches 12" (300 mm) over chambers. Roller travel parallel to chamber rows only.
(B) Embedment Stone	No equipment allowed on bare chambers. Use excavator or stone conveyor positioned off bed or on foundation stone to evenly fill around all chambers to at least the top of chambers.	No wheel loads allowed. Material must be placed outside the limits of the chamber bed.	No tracked equipment is allowed on chambers until a min. 6" (150 mm) cover stone is in place.	No rollers allowed.
(A) Foundation Stone	No StormTech restrictions. Contractor responsible for any conditions or requirements by others relative to subgrade bearing capacity, dewatering or protection of subgrade.			

StormTech
Subsurface Stormwater Management™

Home
About Us
Products
Resources
- Overview
- Site Calculator
- Manuals & Tech Sheets
- Accept. Fill Materials
- Accept. Geotextiles
- **AASHTO / ASTM**
- Industry Links

Case Studies
FAQ
Contact Us

StormTech
A Division of ADS, Inc.
70 Inwood Road
Suite 3
Rocky Hill, CT 06067

(P) 888-892-2694
(F) 866-328-8401

Canada Français
1-888-367-7473

StormTech
A Division of
ADS Europe B.V.
+31 (0)10-299-6410

StormTech International

info@stormtech.com

AASHTO/ASTM Standards

StormTech chambers are designed in accordance with Section 12.12 of the American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications. This document establishes requirements for design of profile wall thermoplastic structures for both live loads and permanent earth loads. Proper use of the AASHTO design method requires that load multipliers for impact and multiple presences are applied to the AASHTO design truck (HS20) live load. Additional factors are applied to the load and earth loads to provide the full safety factors for both live and earth loads.

When installed in accordance with the minimum requirements specified in the StormTech installation instructions, StormTech chambers meet or exceed the AASHTO requirements for both live load and earth load design. StormTech chambers are also designed in accordance with ASTM F2787 “Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers”. This standard practice relates the AASHTO design methodology for thermoplastic pipe and applies it to buried stormwater chambers.

Note that proper design for permanent earth loads, although often ignored by producers of other buried plastic structures, governs safe product design and is the basis for the service life of the system. StormTech's cutting edge materials research program and extensive product testing has established StormTech as the leader on thermoplastic chamber design for safe, long service life installations.

StormTech chambers are produced to the requirements of the American Society of Testing Materials (ASTM) F2418 “Standard Specification for Polypropylene (PP) Corrugated Stormwater Collection Chambers” and ASTM F2922 “Standard Specification for Polyethylene (PE) Corrugated Stormwater Collection Chambers”. ASTM standards play an important role in establishing strict product requirements that engineers and owners can rely upon for a high quality product on every project.

StormTech's commitment to these two standards ensures consistent high quality products, safe structural design, and a service life in the 100-year range.

StormTech... We Make Land Work for You

Copyright© 2012 StormTech, A Division of ADS, Inc., 70 Inwood Road, Suite 3, Rocky Hill, Connecticut 06067

Tech Sheet

StormTech®
Detention • Retention • Water Quality
A division of ADS

ASTM & AASHTO Standards for Buried Thermoplastic Structures

Tech Sheet # 6
November 2012

Design Requirements for Thermoplastic Structures:

1. **The structural design must evaluate short term live loads, intermediate term loads and long term soil loads.**
2. **The materials used in production must provide necessary short, intermediate and long term properties.**
3. **The structural design must be completed by experts in the field of soil-structure interaction.**
4. **The product must be designed and manufactured to meet meaningful standards.**
5. **The structural design of the subsurface stormwater system must be up to the standards that a professional engineer expects.**

General:
This summarizes key components of structural design and national standards for subsurface thermoplastic structures. Although the focus of this guidance is on chamber systems, the principles apply to the wider category of buried products of various structural shapes and material properties.

Structural Design of a Subsurface Thermoplastic System:
The objective of *structural* design is to ensure a proper safety factor over the intended ***service life*** of the buried system. Typically the intended service life of a subsurface storm drainage system ranges from 20 to 100 years. Since the polypropylene and polyethylene, thermoplastic materials now used for subsurface structures are very stable in the stormwater environment; the limiting criterion for service life is generally long-term structural stability.

The primary benefit of subsurface systems is to facilitate additional paved surfaces for the purpose of parking or traffic flow. For such applications, where public safety is of paramount importance, "structural survival", i.e. lack of failure, is not sufficient. For a design to be safe, structural ***safety factors*** must be demonstrated for the entire service life of the project to account for uncertainties in loading, installation, and material performance. AASHTO design procedures mandate load factors of 1.75 for live loads to account for impact effects and the presence of multiple or overweight loads and 1.95 for earth loads on buried culverts.

There are two components to ensuring long term performance of any structural product: 1) the product must be designed, tested and manufactured to meet meaningful ***product standards*** and 2) the system must be designed to meet meaningful ***design standards***. ASTM and AASHTO, the most respected, dependable standards available, have developed standards for buried structures.

Short Term Properties, Intermediate Term Properties, Long Term Properties, Strain and Deflection:
Buried thermoplastic products must be designed for three conditions: 1) short duration live loads under shallow cover, 2) minimum 1-week sustained loads and 3) permanent earth loads. ***Load duration*** is a key criterion for the design of thermoplastic structures since the "apparent strength" and stiffness decrease with increasing load duration. For live load design, the thermoplastic product must be able to withstand the dynamic load from moving vehicles. *Live load design is based on short duration loads and short term material properties.* Intermediate load design requires the thermoplastic product to withstand 1-week sustained loads from parked oversized loads. *Intermediate load design is based on 1-week duration loads and 1-week material properties.*

1 AASHTO is the American Association of State Highway and Transportation Officials
2 ASTM / ASTM International is the American Society of Testing Materials

Earth (dead) loads are permanent in duration and magnitude. For dead load design, the thermoplastic product must be able to withstand the continuous dead load and remain stable after 75 years or more under sustained load. For thermoplastic systems using structural aggregate (stone) support, the performance of the structure is a function of the ability of the thermoplastic structure to a shed significant portion of the load to the surrounding stone (arching). *Earth load design is based on permanent loads and long term material properties.* The material properties that govern long-term design are tensile creep rupture and creep modulus.

Strain limits are the maximum strains that can occur before the structure fails. Long, slender shapes are inherently unstable and fail at lower loads by buckling. Wide, flat shapes may also buckle under continuous load. Design for long-term service life must be based on long duration loads, long term creep modulus and strain limits. ***Without proper soil support, thermoplastic structures may reach a strain limit and fail.***

Deflection is generally not a failure limit or a service limit for soil supported chamber systems. When deflection is not limited by soil support, excessive deflection of thermoplastic structures has been found to cause pavement distress. ***Without proper soil support, deflection is a service limit for thermoplastic structures.***

Specifying industry standards, not just products, establishes objective, meaningful performance criteria and a defensible basis of design.

AASHTO Standards:
The AASHTO LRFD Bridge Design Specification is the primary source of design standards for soil-structure interaction under traffic loads. Section 3 of this specification provides for calculation of loads and Section 12.12 provides for structural design of buried thermoplastic structures.
The AASHTO standard:

- **Assures design safety factors for live loads and long-term loads**
- **Provides the design method for soil-structure interaction**
- **Assures a long-term service life by designing for creep and strain limits**
- **Provides consulting engineers with a defensible basis of design**

ASTM Standards:
ASTM is an internationally recognized source for a variety of standards including; testing methods, standard practices and product specifications. ASTM has developed two product standards for Stormwater chambers, designations ASTM F2418 (polypropylene chambers) and ASTM F2922 (polyethylene chambers).
The ASTM F 2418 and F2922 Standards:

- **Assure consistent product quality in a non-proprietary specification**
- **Establish physical and mechanical requirements for the finished product**
- **Establish long and short-term material properties for design**
- **Require AASHTO safety factors and full scale validation testing**

ASTM has developed a design standard for Stormwater chambers, designation: ASTM F 2787, entitled "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers".
The ASTM F 2787 Standard:

- **Applies the AASHTO Section 12.12 thermoplastic pipe design criteria and applies it directly to chambers**
- **Includes an additional design load for a minimum 1-week sustained vehicle load to account for parked vehicles**
- **Provides design criteria that can be applied to different thermoplastic resins.**

Product Design:

Stone support is a key component of the soil-structure interaction system. Stone columns between thermoplastic components provide the load paths from the load above to the foundation below. For stone-structure designs, the stone reduces the load that the thermoplastic components must carry and limits the deflection and strain of the thermoplastic components. Designs of subsurface thermoplastic structures that purport to require no structural stone or are not designed in accordance with AASHTO requirements may result in excessive deflections or complete failure.

StormTech chambers are designed and rigorously tested in accordance with national standards to provide the most reliable subsurface system available.

ADS "Terms and Conditions of Sale" are available on the ADS website, www.ads-pipe.com
StormTech is a registered trademark of StormTech, Inc.

©2012 Advanced Drainage Systems, Inc. ST TS6 11/12

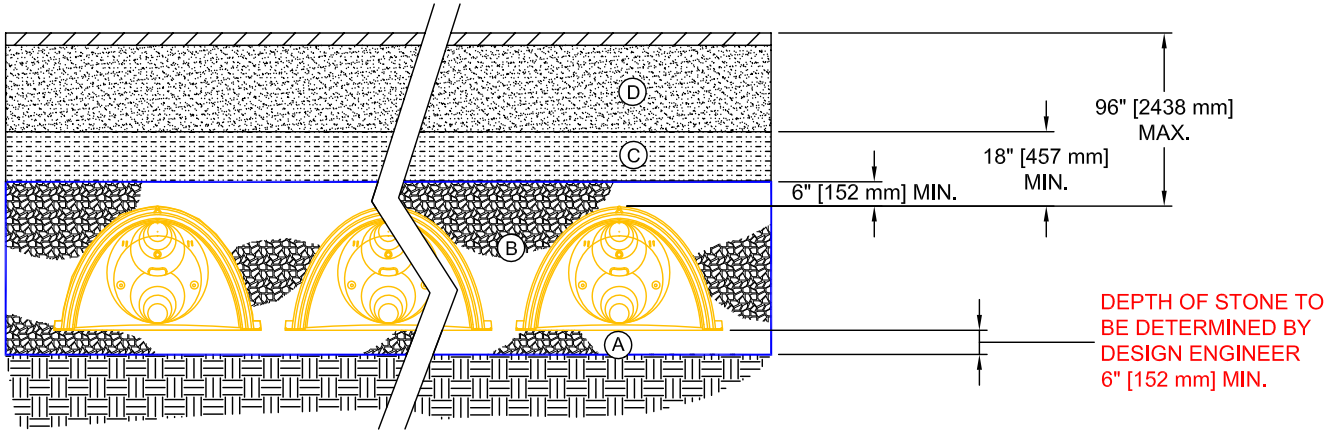
ACCEPTABLE FILL MATERIALS: STORMTECH SC-740 AND SC-310 CHAMBER SYSTEMS

MATERIAL LOCATION	DESCRIPTION	AASHTO M43 DESIGNATION(1)	COMPACTION/DENSITY REQUIREMENT
(D) FILL MATERIAL FOR LAYER D STARTS FROM THE TOP OF THE C LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISH GRADE ABOVE. NOTE THAT PAVEMENT SUB-BASE MAY BE PART OF THIS LAYER.	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
(C) FILL MATERIAL FOR LAYER C STARTS FROM THE TOP OF THE EMBEDMENT STONE (B LAYER) TO 18" [457 mm] ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUB-BASE MAY BE A PART OF THIS LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, < 35% FINES. MOST PAVEMENT SUB-BASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTION AFTER 12" [305 mm] OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" [152 mm] LIFTS TO A MIN. 95% STANDARD PROCTOR DENSITY (2). ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs [53 kN]. DYNAMIC FORCE NOT TO EXCEED 20,000 lbs [89 kN].
(B) EMBEDMENT STONE SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE (A LAYER) TO THE C LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4 - 2 INCH [19 - 51 mm]	3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
(A) FOUNDATION STONE BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4 - 2 INCH [19 - 51 mm]	3, 35, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A 95% STANDARD PROCTOR DENSITY(2).

PLEASE NOTE:

1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".

2. AS AN ALTERNATE TO PROCTOR TESTING AND FIELD DENSITY MEASUREMENTS ON OPEN GRADED STONE, STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" [229 mm] (MAX) LIFTS USING TWO FULL COVERAGES WITH AN APPROPRIATE COMPACTOR.



ADVANCED DRAINAGE SYSTEMS, INC.

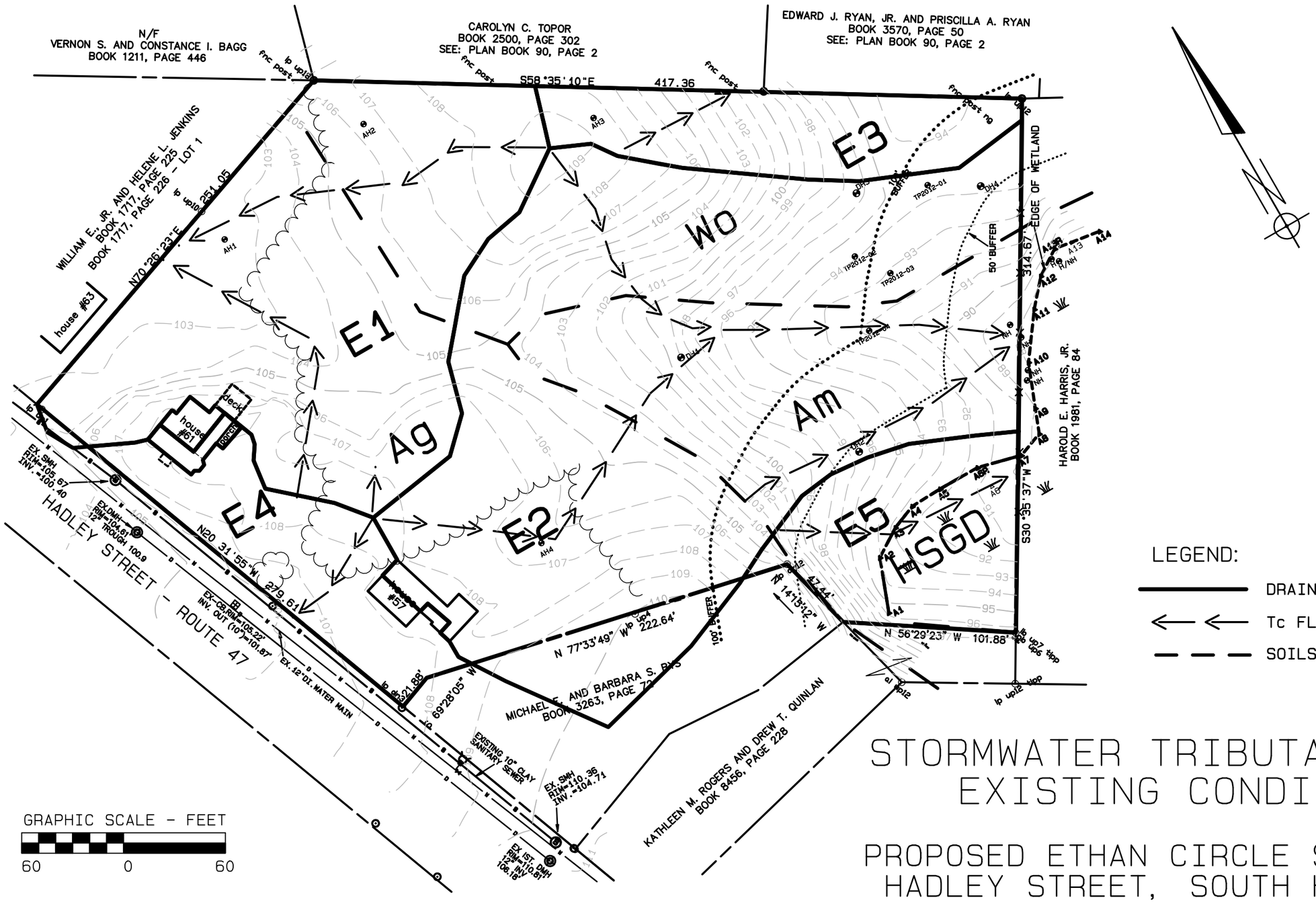
THE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

U.S. GREEN BUILDING COUNCIL MEMBER

StormTech
Detention•Retention•Recharge
Subsurface Stormwater Management
70 INWOOD ROAD, SUITE 3 | ROCKY HILL, CT 06067
PHONE: 888-892-2694 | FAX: 866-328-8401
WWW.STORMTECH.COM

STORMTECH ACCEPTABLE FILL

SCALE:	NTS
DATE:	3/30/10
DRAWN BY:	KLJ
CHECKED:	



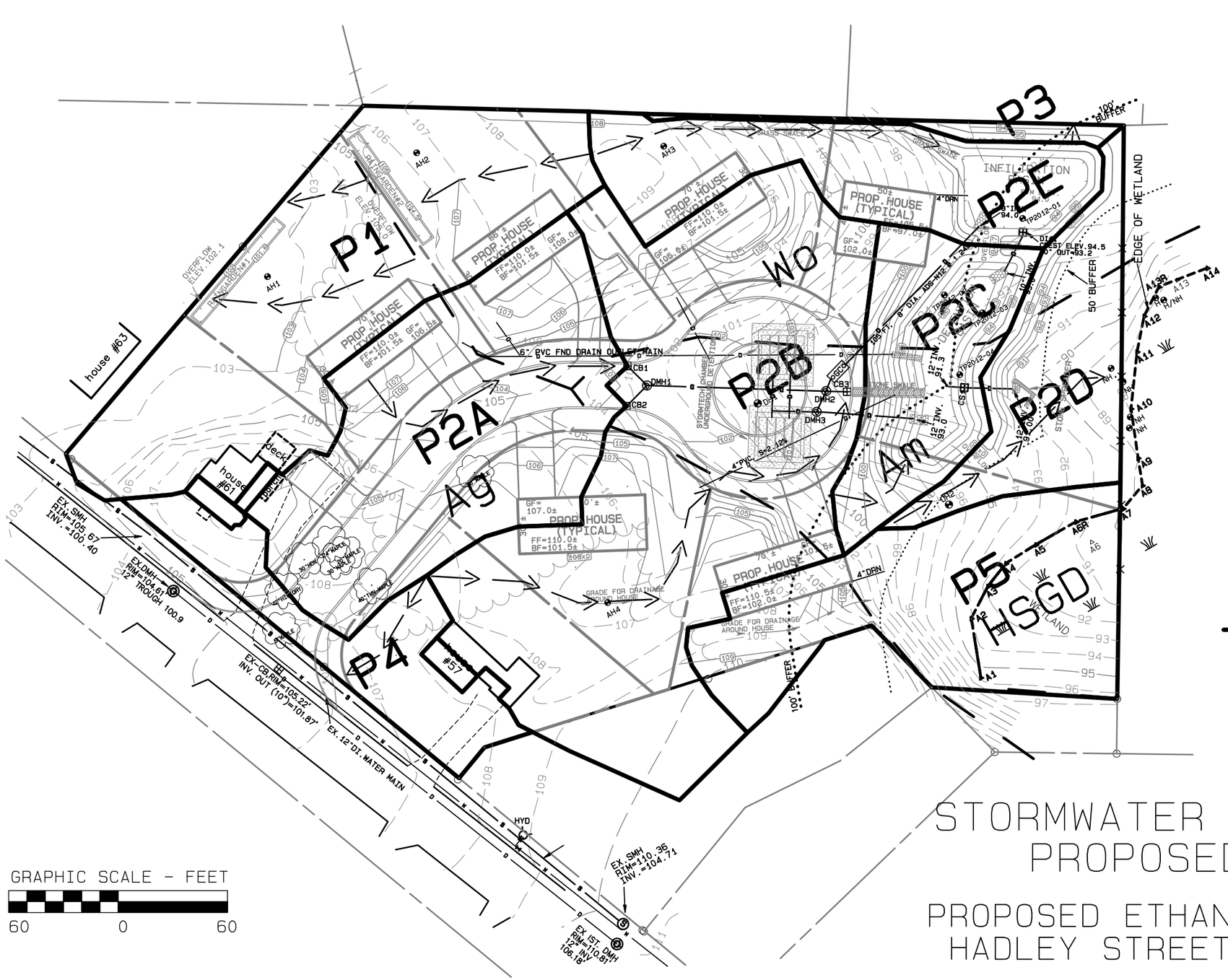
LEGEND:

- DRAINAGE DIVIDE
- Tc FLOW PATH
- SOILS BOUNDARY (APPROX)

STORMWATER TRIBUTARY AREAS EXISTING CONDITIONS

PROPOSED ETHAN CIRCLE SUBDIVISION
HADLEY STREET, SOUTH HADLEY, MA

12/24/13



LEGEND:

- DRAINAGE DIVIDE
- Tc FLOW PATH
- SOILS BOUNDARY (APPROX)

STORMWATER TRIBUTARY AREAS PROPOSED CONDITIONS

PROPOSED ETHAN CIRCLE SUBDIVISION HADLEY STREET, SOUTH HADLEY, MA

12/24/13, REV.8/13/14