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Memorandum

100 Cambridge Street, Suite 1310 Boston, MA 02114 T: 617.824.9100 F: 617.824.9101

To: Tyler Rynne | East Point Energy, LLC

From: Hilary Holmes, P.E. | Langan

Date: 14 March 2025

Re: Stormwater Management Memorandum - 30% Design DPU Filing
Hillman Energy Center
73 & 75 Hillman Street, Tewksbury, MA 01876
Langan Project No.: 151043401

Summary

East Point Energy, LLC proposes to construct a Battery Energy Storage System (BESS) project to be located on two lots at 73 and 75 Hillman Street in Tewksbury, Massachusetts. The site is bound by Hillman Street to the south, high voltage power lines to the west, railroad tracks to the north, and Clinton Street to the east. The approximately 4.34-acre site is currently occupied by a residential house and two one-story slab-on-grade commercial masonry buildings. The exterior portions of the site are used for parking and material storage, including a Quonset hut and several trailers. Refer to Figure 1, Figure 2, and Figure 3 in Appendix A.

As part of this development, battery energy storage system modules consisting of lithium-ion batteries housed in above-ground storage cabinets and transformers on concrete slabs will be installed on the site with an ancillary electric substation located on the southern side of the parcel. The predevelopment site impervious area is 2.05 acres (47% of the site) and the post-development site impervious area is approximately 1.77 acres (41% of the site).

Existing Conditions

The site is in Zone X unshaded (areas outside of the 0.2% annual chance flood). The site within a Zone II Wellhead Protection Zone. There is an isolated wetland in the most northern part of the site and bordering vegetated wetlands to the west of the site. Hydrologically, the site is mostly in the Merrimack River watershed with the northern tip of the site in the Shawsheen River watershed. Runoff from the 4.34-acre site is split into three watersheds. The northeast portion of the site drains via overland flow to the isolated vegetated wetland in the north portion of the site. The western portion of the site drains via overland flow to the bordering vegetated wetlands to the west of the site. The southeast portion of the site, which includes the two commercial masonry buildings and some of the surrounding area drains to catch basins to the west, south, and east of the buildings. The catch basins are piped to the storm drain line at the intersection of Hillman and Clinton Street. See attached EX-WS in Appendix B for the existing watershed map.

According to the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, the site soil type is comprised of Windsor loamy sand and Deerfield loamy fine sand. See Figure 4: NRCS Soils Map in Appendix A. The Web Soil Survey has classified these soils as hydrologic soil group A. The applicant's soil evaluator conducted four test pits within the infiltration areas. The

soils on site were classified as loamy sand. Soil mottling indicating seasonal high groundwater elevation was observed in the test pits 4 to 5.5 feet from existing grade. Refer to Appendix D for the test pit logs and test pit location map.

Proposed Stormwater Management Design

In the proposed conditions, runoff from the 4.34-acre site is still split into three watersheds. The northeast portion of the site drains via overland flow to the isolated vegetated wetland. Most of 75 Hillman Street drains via overland flow to the bordering vegetated wetlands to the west of the site. The substation area and the northwest half of the BESS yard drains to two water quality units and then to underground infiltration system B-1A and B-1B, which discharges to a level spreader towards the western bordering vegetated wetlands. The remaining BESS yard is split into two watersheds each with water quality units which collect runoff and discharge to underground infiltration system C-1 and C-2. These systems have overflow structures which discharge to an existing drain line which connects to the town stormwater system in Hillman Street. A small strip of area to the south and east of the sound wall along Hillman and Clinton Street sheet flows into the street to catch basins that are part of the town stormwater system in Hillman Street. See attached PR-WS in Appendix C for the existing watershed map.

The project is designed to meet the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards and the most recent version of the town of Tewksbury Stormwater Management and Erosion Control Regulations. The stormwater management systems are designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. The site uses water quality units for pretreatment to provide at least 44% removal of average annual load of TSS before the stormwater is discharged into an underground infiltration system. The overall stormwater quality treatment achieved is equal to the removal of 80% of the average annual load of TSS from the total post-construction impervious surface area on the site as required by the Town of Tewksbury Stormwater Rules and Regulations.

Below are the features used in the proposed design:

1. Water quality units: hydrodynamic separators with inlet grates
2. Underground Infiltration Systems: precast concrete leaching chambers

Methodology and Calculations

The peak runoff discharges for the existing and proposed conditions were analyzed using Soil Conservation Service (SCS) methodology, which outlines procedures for calculating peak rates of runoff resulting from precipitation events, and procedures for developing runoff hydrographs. Values for area, curve number, and time of concentration were calculated for the existing and proposed conditions.

The storms analyzed include the following:

- A 2-year, 24-hour storm consisting of 3.18 inches of rainfall
- A 10-year, 24-hour storm consisting of 4.99 inches of rainfall

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- A 25-year, 24-hour storm consisting of 6.12 inches of rainfall
- A 50-year, 24-hour storm consisting of 6.96 inches of rainfall
- A 100-year, 24-hour storm consisting of 7.87 inches of rainfall

These events are based on the National Weather Service (NOAA) Precipitation Frequency Data Server (PFDS).

The peak flow rates were obtained using HydroCAD. The existing and proposed conditions peak flow rate comparison can be found in Table 1 below.

MassDEP Stormwater Performance Standards

A summary of MassDEP Stormwater Performance Standards as well as a method of ensuring compliance with each standard are summarized below:

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

   Response: There will be no new untreated stormwater conveyances to wetlands or waters of the Commonwealth.

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

   Response: The development of this site will result in a decrease of peak discharge rates from the existing condition, see Table 1 below for a summary. Existing and proposed stormwater discharge calculations are included in Appendix B and C of the memo.

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Table 1. Peak Flow Runoff Rate Comparison, Existing vs. Proposed Conditions

Design Point	Condition	2-year	10-year	25-year	50-year	100-year
A	Pre (cfs)	2.47	4.91	6.48	7.65	8.92
	Post (cfs)	0.85	2.41	3.54	4.41	5.39
	Delta	-1.62	-2.50	-2.94	-3.24	-3.53
	% Delta	-66%	-51%	-45%	-42%	-40%
B	Pre (cfs)	5.08	8.50	10.61	12.17	13.86
	Post (cfs)	4.44	8.42	10.13	10.94	12.47
	Delta	-0.64	-0.08	-0.48	-1.23	-1.39
	% Delta	-13%	-1%	-5%	-10%	-10%
C	Pre (cfs)	4.94	7.95	9.82	11.21	12.70
	Post (cfs)	4.03	6.51	8.09	9.34	11.12
	Delta	-0.91	-1.44	-1.73	-1.87	-1.58
	% Delta	-18%	-18%	-18%	-17%	-12%

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

   Response: This project proposes underground infiltration system to promote groundwater recharge. Required and provided recharge volume calculations are included in Appendix F. Refer to a summary below

   Required Recharge

   Total Required Recharge Volume for the Project = 3,646 cubic feet
   Total Provided Recharge Volume for the Project = 3,795 cubic feet
   9,704 cubic feet > 1,074 cubic feet

   Drawdown Time

   Infiltration structures must be able to drain fully within 72 hours. The underground infiltration system drawdown time for the systems is less than 72 hours. Refer to Appendix F for the drawdown time calculations.

   In addition to the 72 draw down time, there must be at least a two-foot separation between the bottom of the infiltration structure and the seasonal high groundwater table.

Test pits were conducted February 26, 2025 and observed by Langan's Soil Evaluator and a representative from the Town Engineer's Department. The bottom elevation of the underground infiltration system B-1A and B-1B is 117.8 feet and estimated seasonal high groundwater elevation was observed at elevation 115.8 feet in TP-3. The vertical separation is 2 feet. The bottom elevation of the underground infiltration system C-1 is 116.25 feet and estimated seasonal high groundwater elevation was observed at elevation 114.2 feet in TP-2. The vertical separation is 2.05 feet. The bottom elevation of the underground infiltration system C-2 is 117.33 feet and estimated seasonal high groundwater elevation was observed at elevation 115.33 feet in TP-1. The vertical separation is 2 feet.

Mounding analysis is required when the vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm. In such cases, the mounding analysis must demonstrate that the Required Recharge Volume is fully dewatered within 72 hours. The mounding analysis must also show that the groundwater mound that forms under the recharge system will not break out above the land. A mounding analysis for each underground infiltration system using the Hantush method can be found in Appendix H. The mounding height and does not break above the bottom elevation of the underground infiltration systems.

4. Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

- Suitable practices for source control and pollution prevention are identified in a long- term pollution prevention plan, and thereafter are implemented and maintained;
- Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
- Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

Response: Runoff generated from the proposed project will meet the water quality requirements of this standard using hydrodynamic separators to provide at least 44% TSS removal pretreatment prior to discharge to the infiltration systems and meet the overall 80% TSS removal requirement. Proposed treatment train features include water quality units and an underground infiltration system. TSS Removal worksheets can be found in Appendix E. A Long-Term Pollution Prevention Operation and Maintenance Plan can be found in Appendix G.

The hydrodynamic separators were sized to treat the equivalent Water Quality Flow for the 1 inch of rainfall over all new impervious surfaces to meet Water Quality Volume (WQV) requirement. See Appendix F for the water quality volume calculations.

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5. Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

   Response: The site is not considered a high pollutant load generator.

6. Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area, if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

   Response: The project is located within the Zone II Wellhead Protection Area of a public water supply. For discharges to the ground within a Zone II Wellhead Protection Area at least 44% of the total suspended solids must be removed prior to discharge to the infiltration structure. The proposed hydrodynamic separators provide at least 44% TSS removal pretreatment prior to discharge to the infiltration systems TSS Removal worksheets can be found in Appendix E. The required water quality volume equals 1.0 inch of runoff times the total impervious area of the post-development project site for a discharge within a Zone II Wellhead Protection Area. The hydrodynamic separators are sized to treat the Water Quality Flow equivalent of the 1.0 inch Water Quality Volume. See Appendix F for the water quality volume calculations.

7. Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all

other requirements of the Stormwater Management Standards and improve existing conditions.

Response: The site is considered a redevelopment project. The project will meet the requirements of the MassDEP Stormwater Standards.

8. Standard 8: A plan to control construction related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

   All redevelopment projects shall fully comply with Standard 8.

   Response: Soil erosion and sediment control plan has been developed for this project and can be found in the plan set. The plans have been designed in accordance with the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas.

9. Standard 9: A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

   Response: The owner shall maintain the stormwater management systems as outlined in the Massachusetts Stormwater Handbook and Stormwater Standards. A Long-Term Pollution Prevention Operation and Maintenance Plan is included in Appendix G.

10. Standard 10: All illicit discharges to the stormwater management system are prohibited.

    Response: The stormwater management system for this site does not include any illicit connections to the stormwater system. A signed illicit discharge compliance statement will be provided prior to the issuance of a building permit.

Conclusion

The proposed stormwater management system has been designed in accordance with the town of Tewksbury Stormwater Management and Erosion Control Regulations, Massachusetts Stormwater Management Handbook, and the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas. The system incorporates stormwater quality measures and maintains or decreases the existing rate of runoff for all storm events analyzed.

We believe based on the findings of this memo that the proposed stormwater system, as designed, will effectively manage quality and quantity of stormwater runoff for the proposed redevelopment.

Appendices

Appendix A – Figures
Appendix B – Existing Stormwater Discharge Calculations
Appendix C – Proposed Stormwater Discharge Calculations
Appendix D – Soil Test Pit Logs

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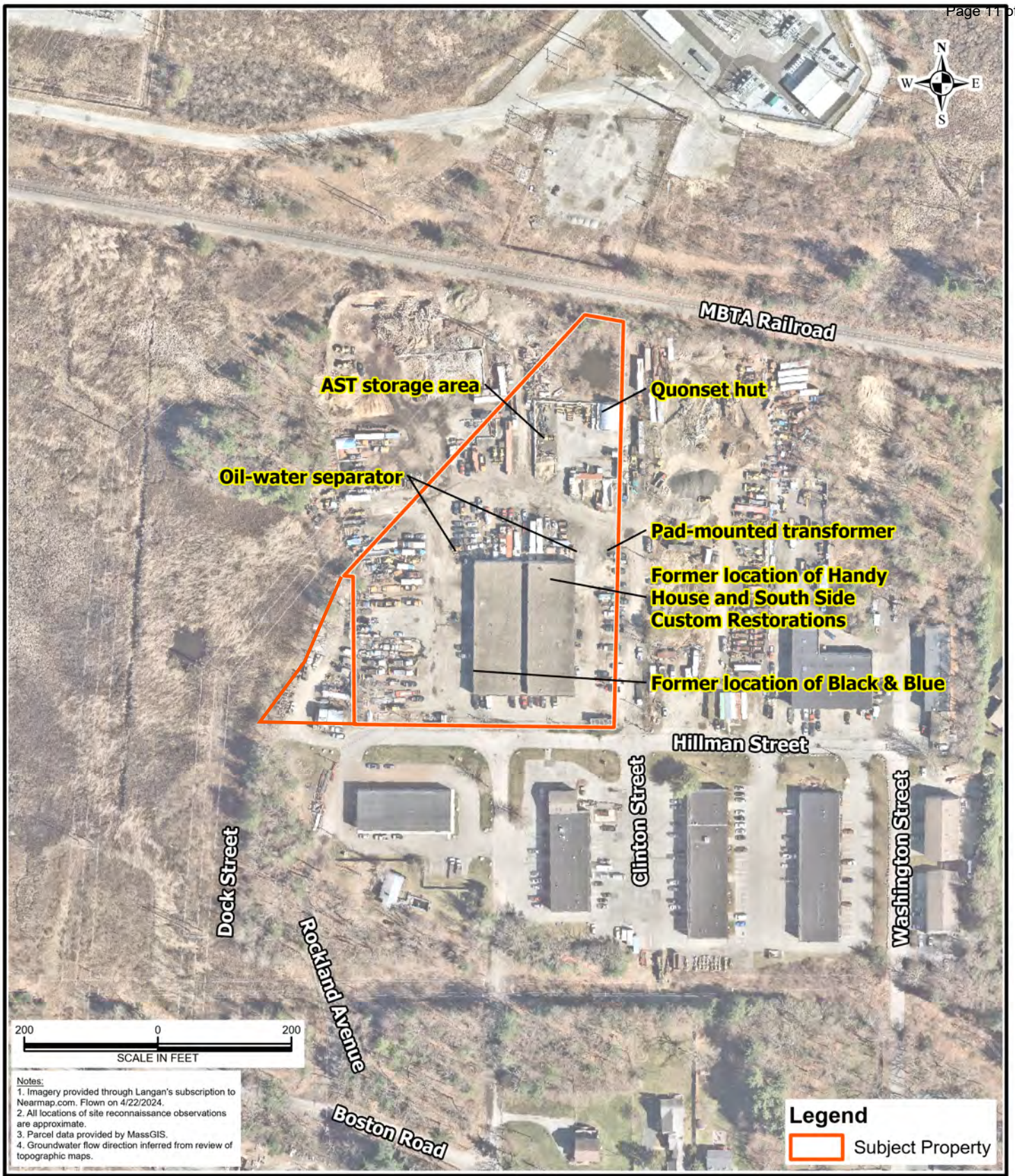
Appendix E – TSS Removal
Appendix F – Water Quality Volume Calculations
Appendix G – Long-Term Pollution Prevention Operation and Maintenance Plan
Appendix H – Groundwater Mounding Analysis

APPENDIX A

Figures

LANGAN Langan Engineering and Environmental Services, Inc. 100 Cambridge Street, Suite 1310 Boston, MA 02114 T: 617.824.9100 F: 617.824.9101 www.langan.com	Project **73 HILLMAN STREET** TEWKSBURY MIDDLESEX COUNTY MA	Figure Title **SUBJECT PROPERTY LOCATION MAP**	Project No. 151043401 Date 7/10/2024 Scale 1" = 2,000 feet Drawn By TO	Figure 1

Path: \\langan.com\data\BOS\data4\151043401\Project Data\ArcGIS\APRX\73 Hillman St - 151043401\73 Hillman St - 151043401.aprx



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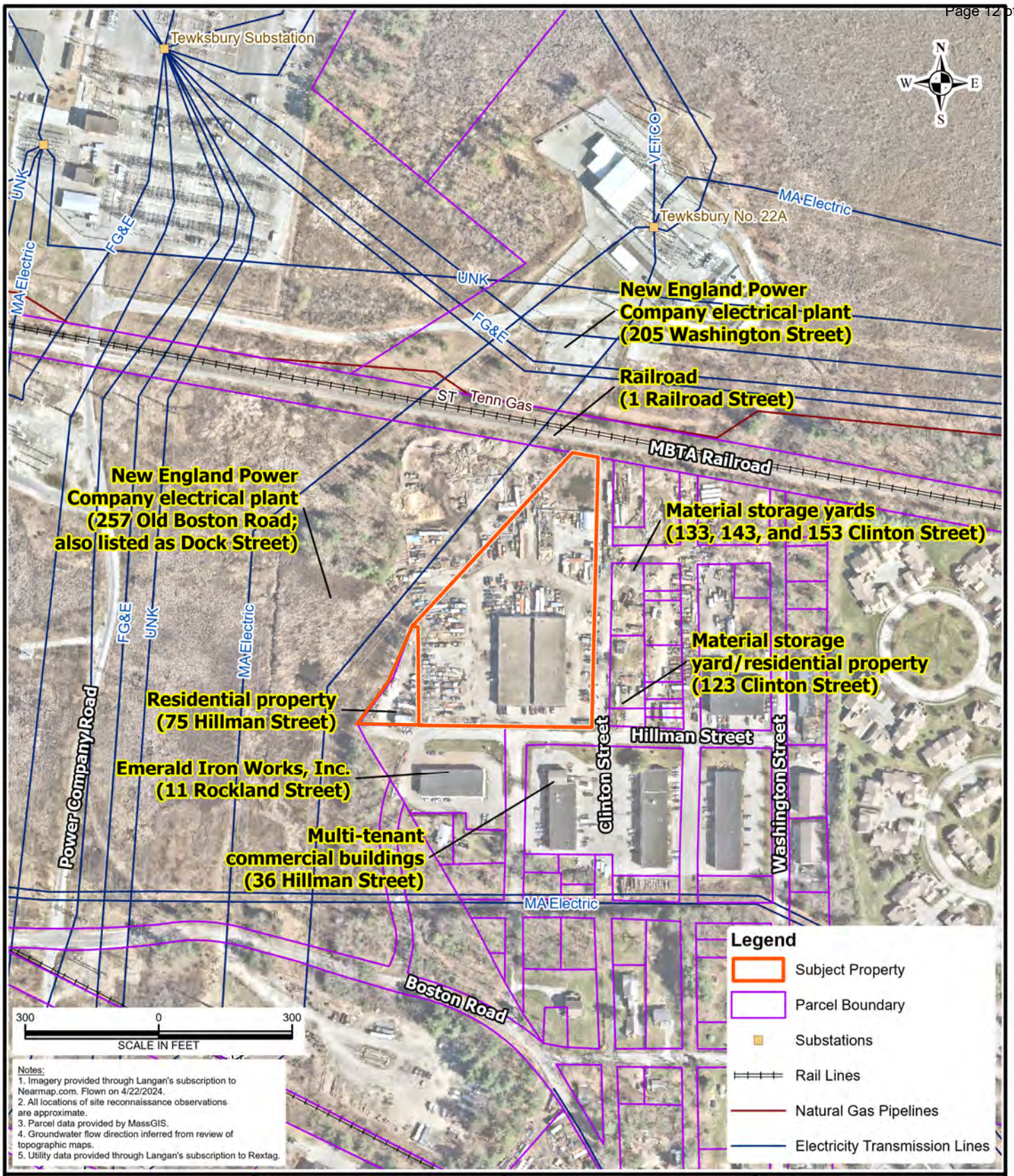
Project	73 HILLMAN STREET TEWKSBURY MIDDLESEX COUNTY MA
Figure Title	SUBJECT PROPERTY LAYOUT
Project No.	151043401
Date	7/24/2024
Scale	1" = 200 feet
Drawn By	TO
Figure	2

Path: \\langan.com\data\BOS\data4\151043401\Project Data\ArcGIS\APRX\73 Hillman St - 151043401\73 Hillman St - 151043401.aprx



Notes:
1. Imagery provided through Langan's subscription to Nearmap.com. Flown on 4/22/2024.
2. All locations of site reconnaissance observations are approximate.
3. Parcel data provided by MassGIS.
4. Groundwater flow direction inferred from review of topographic maps.
5. Utility data provided through Langan's subscription to Rextag.

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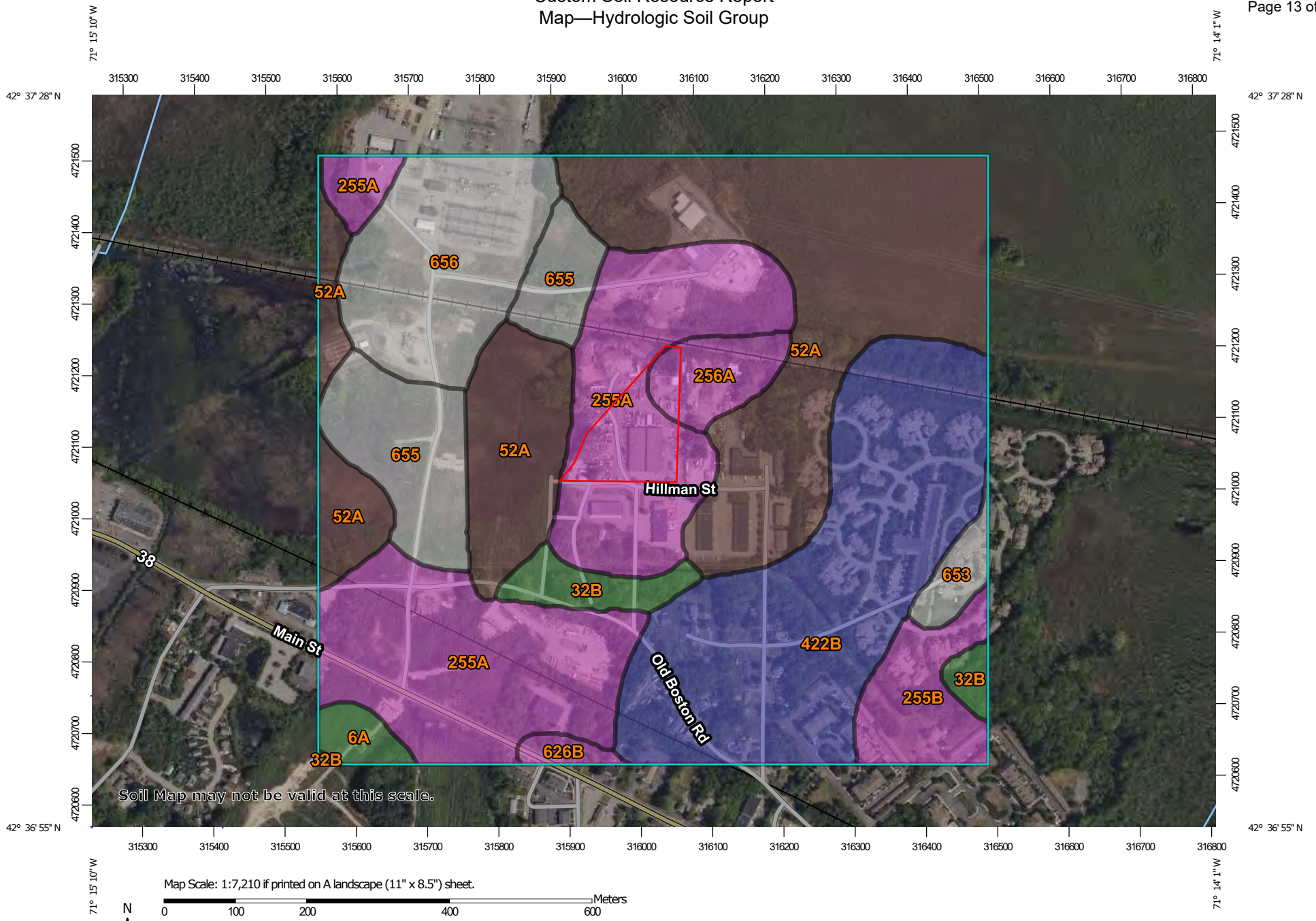
Project	73 HILLMAN STREET TEWKSBURY MIDDLESEX COUNTY MA
Figure Title	NEARBY PROPERTIES MAP
Project No.	151043401
Date	7/24/2024
Scale	1" = 300 feet
Drawn By	TO
Figure	3

Path: \\langan.com\data\BOS\data4\151043401\Project Data\ArcGIS\APRX\73 Hillman St - 151043401\73 Hillman St - 151043401.aprx

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:7,210 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 100 200 400 600

Feet
0 350 700 1400 2100

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

APPENDIX B

Existing Stormwater Discharge Calculations

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OAA Atlas 1 Volume 10, Version 3
Location name: Tewksbury, Massachusetts USA*
Latitude: 42.6202°, Longitude: -71.2433°
Elevation: 122 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tab lar

PD -based p int precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.31** (0.249-0.389)	**0.375** (0.297-0.465)	**0.475** (0.375-0.591)	**0.558** (0.438-0.697)	**0.673** (0.510-0.877)	**0.759** (0.562-1.01)	**0.849** (0.609-1.17)	**0.951** (0.644-1.34)	**1.10** (0.713-1.60)	**1.22** (0.771-1.80)
10-min	**0.445** (0.353-0.551)	**0.532** (0.421-0.659)	**0.674** (0.532-0.838)	**0.791** (0.621-0.989)	**0.953** (0.722-1.24)	**1.08** (0.797-1.43)	**1.20** (0.863-1.66)	**1.35** (0.912-1.90)	**1.56** (1.01-2.26)	**1.72** (1.09-2.56)
15-min	**0.523** (0.415-0.648)	**0.626** (0.495-0.775)	**0.793** (0.626-0.987)	**0.932** (0.730-1.16)	**1.12** (0.849-1.46)	**1.26** (0.936-1.68)	**1.42** (1.02-1.95)	**1.59** (1.07-2.23)	**1.83** (1.19-2.66)	**2.03** (1.28-3.01)
30-min	**0.718** (0.569-0.889)	**0.858** (0.680-1.06)	**1.09** (0.859-1.35)	**1.28** (1.00-1.60)	**1.54** (1.17-2.01)	**1.74** (1.29-2.32)	**1.95** (1.40-2.68)	**2.18** (1.48-3.07)	**2.52** (1.64-3.66)	**2.80** (1.77-4.15)
60-min	**0.912** (0.723-1.13)	**1.09** (0.864-1.35)	**1.38** (1.09-1.72)	**1.63** (1.28-2.03)	**1.96** (1.49-2.56)	**2.21** (1.64-2.95)	**2.48** (1.78-3.42)	**2.78** (1.88-3.91)	**3.2** (2.08-4.67)	**3.56** (2.26-5.28)
2-hr	**1.16** (0.930-1.43)	**1.41** (1.12-1.73)	**1.81** (1.44-2.23)	**2.14** (1.69-2.65)	**2.59** (1.98-3.37)	**2.93** (2.19-3.90)	**3.29** (2.40-4.56)	**3.73** (2.54-5.22)	**4.4** (2.87-6.37)	**4.99** (3.16-7.34)
3-hr	**1.34** (1.08-1.64)	**1.63** (1.31-2.00)	**2.10** (1.68-2.58)	**2.49** (1.98-3.08)	**3.03** (2.33-3.94)	**3.43** (2.58-4.55)	**3.86** (2.83-5.35)	**4.40** (2.99-6.13)	**5.2** (3.41-7.54)	**5.96** (3.79-8.74)
6-hr	**1.71** (1.39-2.08)	**2.09** (1.69-2.54)	**2.71** (2.18-3.31)	**3.22** (2.57-3.95)	**3.92** (3.04-5.06)	**4.44** (3.36-5.86)	**5.00** (3.69-6.90)	**5.72** (3.91-7.92)	**6.83** (4.47-9.78)	**7.81** (4.98-11.4)
12-hr	**2.16** (1.76-2.61)	**2.64** (2.15-3.19)	**3.43** (2.78-4.16)	**4.08** (3.29-4.98)	**4.98** (3.88-6.37)	**5.64** (4.30-7.39)	**6.36** (4.71-8.70)	**7.26** (4.98-9.98)	**8.65** (5.68-12.3)	**9.86** (6.31-14.3)
24-hr	**2.57** (2.11-3.08)	**3.18** (2.61-3.81)	**4.17** (3.41-5.02)	**4.99** (4.06-6.05)	**6.12** (4.81-7.80)	**6.96** (5.34-9.07)	**7.87** (5.87-10.7)	**9.02** (6.21-12.3)	**10.8** (7.12-15.3)	**12.4** (7.94-17.8)
2-day	**2.89** (2.40-3.45)	**3.64** (3.01-4.34)	**4.85** (4.00-5.81)	**5.86** (4.80-7.06)	**7.25** (5.74-9.20)	**8.27** (6.41-10.7)	**9.39** (7.08-12.8)	**10.8** (7.50-14.7)	**13.2** (8.70-18.5)	**15.2** (9.80-21.7)
3-day	**3.17** (2.64-3.76)	**3.97** (3.30-4.71)	**5.27** (4.37-6.28)	**6.35** (5.23-7.61)	**7.84** (6.24-9.91)	**8.93** (6.95-11.6)	**10.1** (7.67-13.7)	**11.7** (8.12-15.8)	**14.2** (9.42-19.9)	**16.4** (10.6-23.4)
4-day	**3.44** (2.88-4.07)	**4.26** (3.56-5.05)	**5.60** (4.66-6.66)	**6.72** (5.55-8.03)	**8.25** (6.58-10.4)	**9.37** (7.31-12.1)	**10.6** (8.05-14.4)	**12.2** (8.50-16.5)	**14.8** (9.84-20.7)	**17.1** (11.1-24.3)
7-day	**4.18** (3.52-4.92)	**5.03** (4.23-5.93)	**6.42** (5.38-7.59)	**7.58** (6.30-9.01)	**9.18** (7.36-11.5)	**10.3** (8.10-13.2)	**11.6** (8.84-15.6)	**13.3** (9.28-17.8)	**15.9** (10.6-22.1)	**18.3** (11.8-25.7)
10-day	**4.85** (4.10-5.69)	**5.73** (4.84-6.72)	**7.16** (6.02-8.44)	**8.36** (6.97-9.89)	**9.99** (8.03-12.4)	**11.2** (8.78-14.2)	**12.5** (9.50-16.6)	**14.2** (9.93-18.9)	**16.8** (11.2-23.1)	**19.0** (12.3-26.7)
20-day	**6.79** (5.79-7.90)	**7.75** (6.60-9.04)	**9.33** (7.91-10.9)	**10.6** (8.96-12.5)	**12.4** (10.0-15.2)	**13.8** (10.8-17.2)	**15.2** (11.5-19.7)	**16.8** (11.9-22.3)	**19.2** (12.9-26.2)	**2 .1** (13.7-29.4)
30-day	**8.41** (7.21-9.75)	**9.45** (8.08-11.0)	**11.1** (9.50-13.0)	**12.6** (10.6-14.7)	**14.5** (11.7-17.6)	**16.0** (12.6-19.8)	**17.5** (13.1-22.3)	**19.1** (13.5-25.1)	**21.2** (14.3-28.9)	**22.9** (14.9-31.8)
45-day	**10.5** (9.02-12.1)	**11.6** (9.97-13.4)	**13.4** (11.5-15.6)	**15.0** (12.7-17.4)	**17.1** (13.8-20.5)	**18.7** (14.7-22.9)	**20.3** (15.2-25.6)	**21.8** (15.5-28.6)	**23.8** (16.1-32.3)	**25.3** (16.5-35.0)
60-day	**12.2** (10.6-14.1)	**13.4** (11.6-15.5)	**15.4** (13.2-17.8)	**17.0** (14.5-19.7)	**19.2** (15.6-23.0)	**20.9** (16.5-25.6)	**22.6** (17.0-28.4)	**24.2** (17.3-31.5)	**26.** (17.7-35.2)	**27.4** (17.9-37.8)

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

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

Please refer to NOAA Atlas 14 document for more information.

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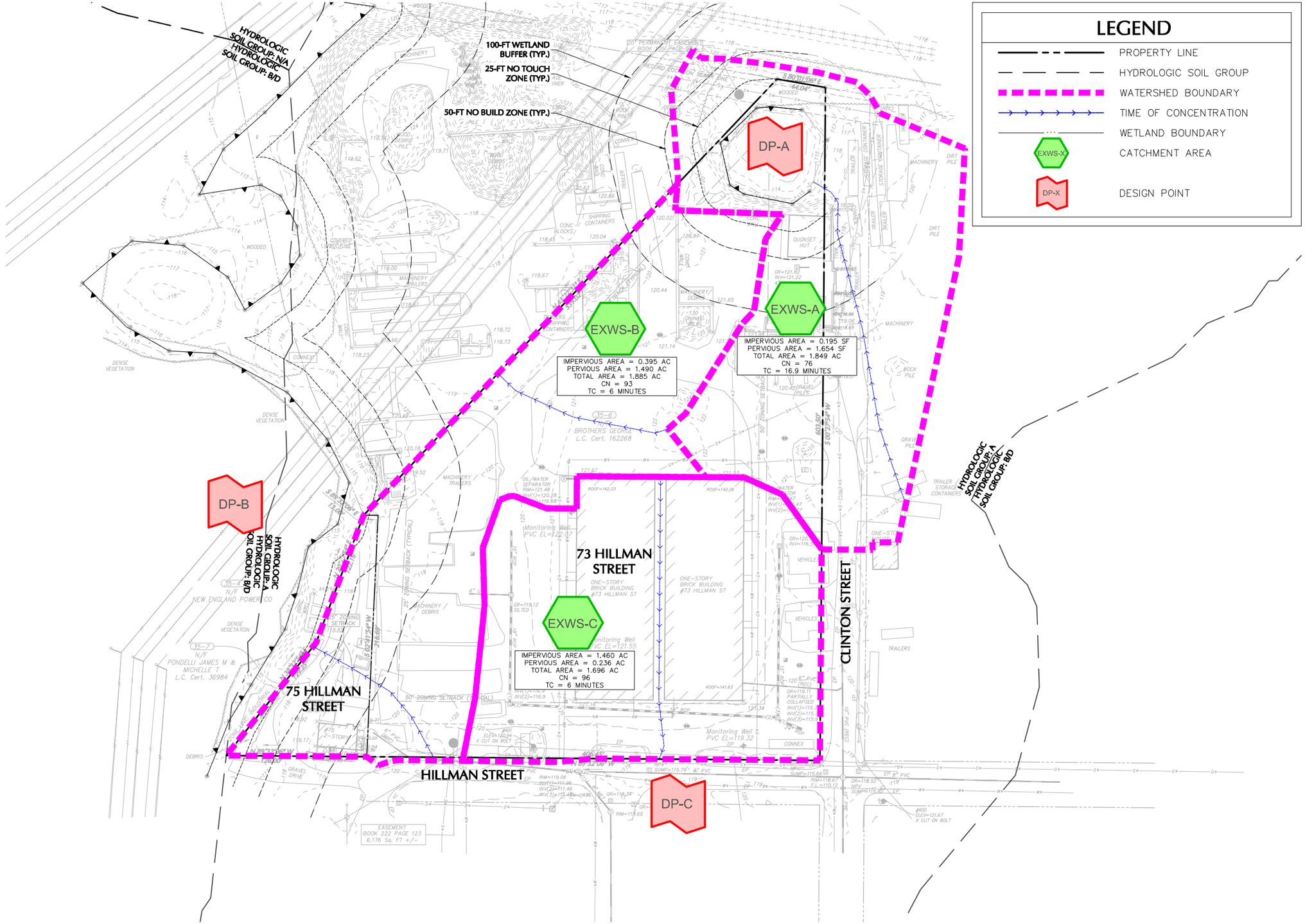
PF graphical



Date	Description	No.
Revisions		

LANGAN
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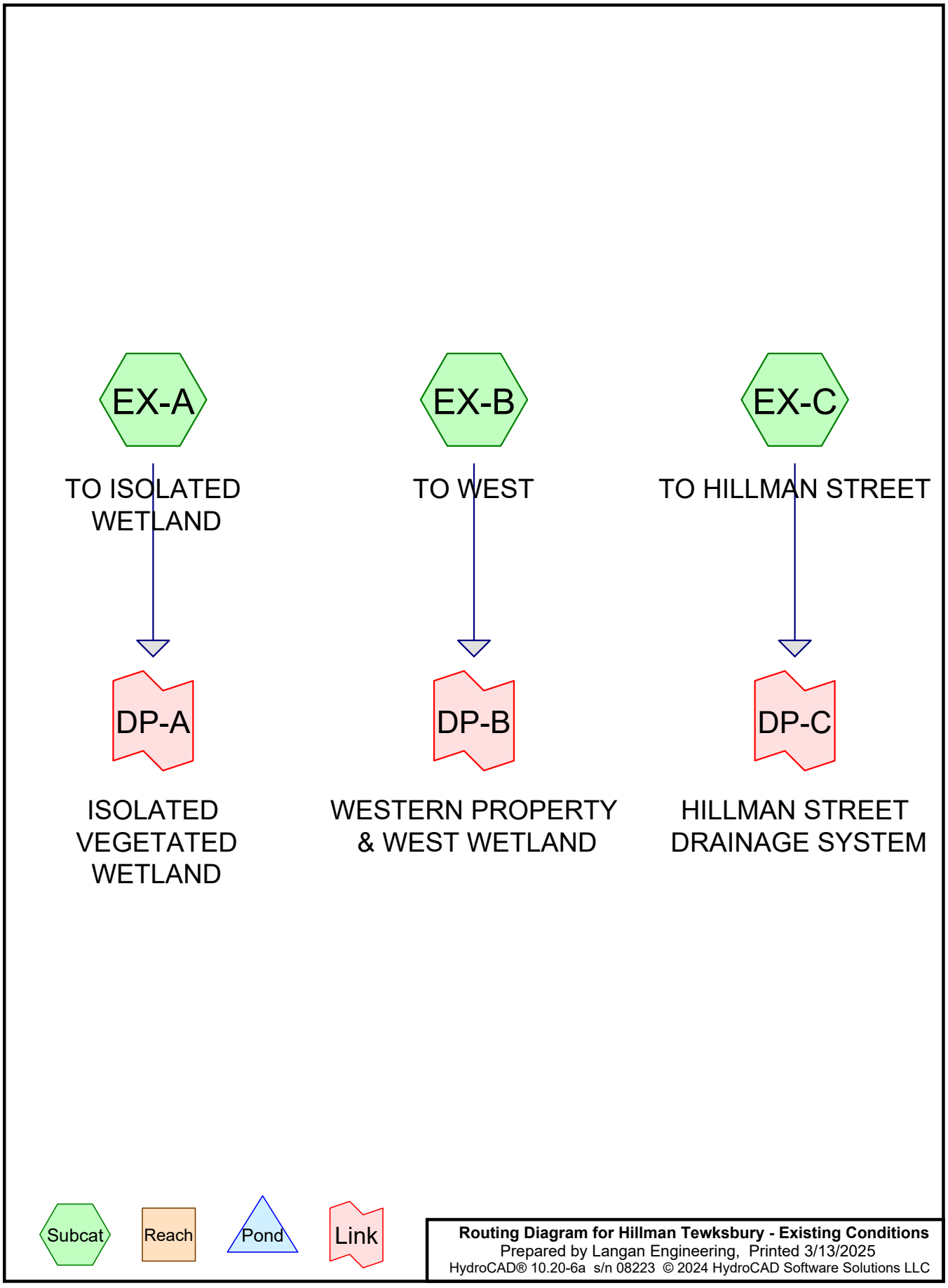
Project
HILLMAN ENERGY CENTER
BATTERY ENERGY STORAGE SYSTEM
TEWKSBURY
MIDDLESEX COUNTY MASSACHUSETTS

Drawing Title
EXISTING WATERSHED MAP

Project No.	Exhibit
151043401	EXWS
Date: 02/03/2025	
Drawn By: MPG	
Checked By: HH	

Project No. 151043401


EX-A
TO ISOLATED WETLAND
EX-B
TO WEST
EX-C
TO HILLMAN STREET
DP-A
DP-B
DP-C
ISOLATED VEGETATED WETLAND
WESTERN PROPERTY & WEST WETLAND
HILLMAN STREET DRAINAGE SYSTEM
Subcat
Reach
Pond
Link
Routing Diagram for Hillman Tewksbury - Existing Conditions
Prepared by Langan Engineering, Printed 3/13/2025
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Hillman Tewksbury - Existing Conditions

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.18	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.99	2
3	25-yr	Type III 24-hr		Default	24.00	1	6.12	2
4	50-yr	Type III 24-hr		Default	24.00	1	6.96	2
5	100-yr	Type III 24-hr		Default	24.00	1	7.87	2

Hillman Tewksbury - Existing Conditions

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.143	39	>75% Grass cover, Good, HSG A (EX-A, EX-B, EX-C)
2.849	96	Gravel surface, HSG A (EX-A, EX-B, EX-C)
2.050	98	Impervious surface, HSG A (EX-A, EX-B, EX-C)
0.315	30	Woods, Good, HSG A (EX-A)
0.073	32	Woods/grass comb., Good, HSG A (EX-B)
5.430	**91**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: TO ISOLATED Runoff Area=1.849 ac 10.55% Impervious Runoff Depth=1.59"
Flow Length=304' Tc=16.9 min CN=83 Runoff=2.47 cfs 0.245 af

Subcatchment EX-B: TO WEST Runoff Area=1.885 ac 20.95% Impervious Runoff Depth=2.43"
Flow Length=152' Tc=6.0 min CN=93 Runoff=5.08 cfs 0.381 af

Subcatchment EX-C: TO HILLMAN STREET Runoff Area=1.696 ac 86.08% Impervious Runoff Depth=2.73"
Flow Length=254' Tc=6.0 min CN=96 Runoff=4.94 cfs 0.386 af

Link DP-A: ISOLATED VEGETATED WETLAND Inflow=2.47 cfs 0.245 af
Primary=2.47 cfs 0.245 af

Link DP-B: WESTERN PROPERTY & WEST WETLAND Inflow=5.08 cfs 0.381 af
Primary=5.08 cfs 0.381 af

Link DP-C: HILLMAN STREET DRAINAGE SYSTEM Inflow=4.94 cfs 0.386 af
Primary=4.94 cfs 0.386 af

Total Runoff Area = 5.430 ac Runoff Volume = 1.012 af Average Runoff Depth = 2.24"
62.25% Pervious = 3.380 ac 37.75% Impervious = 2.050 ac

Summary for Subcatchment EX-A: TO ISOLATED WETLAND

Runoff = 2.47 cfs @ 12.24 hrs, Volume= 0.245 af, Depth= 1.59"
Routed to Link DP-A : ISOLATED VEGETATED WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	1.283	96	Gravel surface, HSG A
*	0.195	98	Impervious surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
	1.849	83	Weighted Average
	1.654		89.45% Pervious Area
	0.195		10.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment EX-B: TO WEST

Runoff = 5.08 cfs @ 12.09 hrs, Volume= 0.381 af, Depth= 2.43"
Routed to Link DP-B : WESTERN PROPERTY & WEST WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

	Area (ac)	CN	Description
	1.370	96	Gravel surface, HSG A
*	0.395	98	Impervious surface, HSG A
	0.047	39	>75% Grass cover, Good, HSG A
	0.073	32	Woods/grass comb., Good, HSG A
	1.885	93	Weighted Average
	1.490		79.05% Pervious Area
	0.395		20.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	36	0.0090	0.24		**Sheet Flow, SF-B** Fallow n= 0.050 P2= 3.18"
1.7	47	0.0090	0.47		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.3	30	0.0090	1.53		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
0.2	30	0.0200	2.28		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.2	9	0.0200	0.99		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
4.9	152	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment EX-C: TO HILLMAN STREET

Runoff = 4.94 cfs @ 12.09 hrs, Volume= 0.386 af, Depth= 2.73"
Routed to Link DP-C : HILLMAN STREET DRAINAGE SYSTEM

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

	Area (ac)	CN	Description
	0.040	39	>75% Grass cover, Good, HSG A
	0.196	96	Gravel surface, HSG A
*	1.460	98	Impervious surface, HSG A
	1.696	96	Weighted Average
	0.236		13.92% Pervious Area
	1.460		86.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.69		**Sheet Flow, SF-C** Smooth surfaces n= 0.011 P2= 3.18"
2.2	150	0.0050	1.14		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
0.2	54	0.0370	3.90		**Shallow Concentrated Flow, SCF-2** Paved Kv= 20.3 fps
3.6	254	Total, Increased to minimum Tc = 6.0 min			

Summary for Link DP-A: ISOLATED VEGETATED WETLAND

Inflow Area = 1.849 ac, 10.55% Impervious, Inflow Depth = 1.59" for 2-yr event
Inflow = 2.47 cfs @ 12.24 hrs, Volume= 0.245 af
Primary = 2.47 cfs @ 12.24 hrs, Volume= 0.245 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: WESTERN PROPERTY & WEST WETLAND

Inflow Area = 1.885 ac, 20.95% Impervious, Inflow Depth = 2.43" for 2-yr event
Inflow = 5.08 cfs @ 12.09 hrs, Volume= 0.381 af
Primary = 5.08 cfs @ 12.09 hrs, Volume= 0.381 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: HILLMAN STREET DRAINAGE SYSTEM

Inflow Area = 1.696 ac, 86.08% Impervious, Inflow Depth = 2.73" for 2-yr event
Inflow = 4.94 cfs @ 12.09 hrs, Volume= 0.386 af
Primary = 4.94 cfs @ 12.09 hrs, Volume= 0.386 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: TO ISOLATED Runoff Area=1.849 ac 10.55% Impervious Runoff Depth=3.17"
Flow Length=304' Tc=16.9 min CN=83 Runoff=4.91 cfs 0.488 af

Subcatchment EX-B: TO WEST Runoff Area=1.885 ac 20.95% Impervious Runoff Depth=4.19"
Flow Length=152' Tc=6.0 min CN=93 Runoff=8.50 cfs 0.658 af

Subcatchment EX-C: TO HILLMAN STREET Runoff Area=1.696 ac 86.08% Impervious Runoff Depth=4.52"
Flow Length=254' Tc=6.0 min CN=96 Runoff=7.95 cfs 0.639 af

Link DP-A: ISOLATED VEGETATED WETLAND Inflow=4.91 cfs 0.488 af
Primary=4.91 cfs 0.488 af

Link DP-B: WESTERN PROPERTY & WEST WETLAND Inflow=8.50 cfs 0.658 af
Primary=8.50 cfs 0.658 af

Link DP-C: HILLMAN STREET DRAINAGE SYSTEM Inflow=7.95 cfs 0.639 af
Primary=7.95 cfs 0.639 af

Total Runoff Area = 5.430 ac Runoff Volume = 1.785 af Average Runoff Depth = 3.94"
62.25% Pervious = 3.380 ac 37.75% Impervious = 2.050 ac

Summary for Subcatchment EX-A: TO ISOLATED WETLAND

Runoff = 4.91 cfs @ 12.23 hrs, Volume= 0.488 af, Depth= 3.17"
Routed to Link DP-A : ISOLATED VEGETATED WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	1.283	96	Gravel surface, HSG A
*	0.195	98	Impervious surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
	1.849	83	Weighted Average
	1.654		89.45% Pervious Area
	0.195		10.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment EX-B: TO WEST

Runoff = 8.50 cfs @ 12.09 hrs, Volume= 0.658 af, Depth= 4.19"
Routed to Link DP-B : WESTERN PROPERTY & WEST WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

	Area (ac)	CN	Description
	1.370	96	Gravel surface, HSG A
*	0.395	98	Impervious surface, HSG A
	0.047	39	>75% Grass cover, Good, HSG A
	0.073	32	Woods/grass comb., Good, HSG A
	1.885	93	Weighted Average
	1.490		79.05% Pervious Area
	0.395		20.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	36	0.0090	0.24		**Sheet Flow, SF-B** Fallow n= 0.050 P2= 3.18"
1.7	47	0.0090	0.47		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.3	30	0.0090	1.53		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
0.2	30	0.0200	2.28		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.2	9	0.0200	0.99		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
4.9	152	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment EX-C: TO HILLMAN STREET

Runoff = 7.95 cfs @ 12.09 hrs, Volume= 0.639 af, Depth= 4.52"
Routed to Link DP-C : HILLMAN STREET DRAINAGE SYSTEM

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

	Area (ac)	CN	Description
	0.040	39	>75% Grass cover, Good, HSG A
	0.196	96	Gravel surface, HSG A
*	1.460	98	Impervious surface, HSG A
	1.696	96	Weighted Average
	0.236		13.92% Pervious Area
	1.460		86.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.69		**Sheet Flow, SF-C** Smooth surfaces n= 0.011 P2= 3.18"
2.2	150	0.0050	1.14		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
0.2	54	0.0370	3.90		**Shallow Concentrated Flow, SCF-2** Paved Kv= 20.3 fps
3.6	254	Total, Increased to minimum Tc = 6.0 min			

Summary for Link DP-A: ISOLATED VEGETATED WETLAND

Inflow Area = 1.849 ac, 10.55% Impervious, Inflow Depth = 3.17" for 10-yr event
Inflow = 4.91 cfs @ 12.23 hrs, Volume= 0.488 af
Primary = 4.91 cfs @ 12.23 hrs, Volume= 0.488 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: WESTERN PROPERTY & WEST WETLAND

Inflow Area = 1.885 ac, 20.95% Impervious, Inflow Depth = 4.19" for 10-yr event
Inflow = 8.50 cfs @ 12.09 hrs, Volume= 0.658 af
Primary = 8.50 cfs @ 12.09 hrs, Volume= 0.658 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: HILLMAN STREET DRAINAGE SYSTEM

Inflow Area = 1.696 ac, 86.08% Impervious, Inflow Depth = 4.52" for 10-yr event
Inflow = 7.95 cfs @ 12.09 hrs, Volume= 0.639 af
Primary = 7.95 cfs @ 12.09 hrs, Volume= 0.639 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: TO ISOLATED Runoff Area=1.849 ac 10.55% Impervious Runoff Depth=4.20"
Flow Length=304' Tc=16.9 min CN=83 Runoff=6.48 cfs 0.648 af

Subcatchment EX-B: TO WEST Runoff Area=1.885 ac 20.95% Impervious Runoff Depth=5.30"
Flow Length=152' Tc=6.0 min CN=93 Runoff=10.61 cfs 0.833 af

Subcatchment EX-C: TO HILLMAN STREET Runoff Area=1.696 ac 86.08% Impervious Runoff Depth=5.65"
Flow Length=254' Tc=6.0 min CN=96 Runoff=9.82 cfs 0.798 af

Link DP-A: ISOLATED VEGETATED WETLAND Inflow=6.48 cfs 0.648 af
Primary=6.48 cfs 0.648 af

Link DP-B: WESTERN PROPERTY & WEST WETLAND Inflow=10.61 cfs 0.833 af
Primary=10.61 cfs 0.833 af

Link DP-C: HILLMAN STREET DRAINAGE SYSTEM Inflow=9.82 cfs 0.798 af
Primary=9.82 cfs 0.798 af

Total Runoff Area = 5.430 ac Runoff Volume = 2.278 af Average Runoff Depth = 5.04"
62.25% Pervious = 3.380 ac 37.75% Impervious = 2.050 ac

Summary for Subcatchment EX-A: TO ISOLATED WETLAND

Runoff = 6.48 cfs @ 12.23 hrs, Volume= 0.648 af, Depth= 4.20"
Routed to Link DP-A : ISOLATED VEGETATED WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	1.283	96	Gravel surface, HSG A
*	0.195	98	Impervious surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
	1.849	83	Weighted Average
	1.654		89.45% Pervious Area
	0.195		10.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment EX-B: TO WEST

Runoff = 10.61 cfs @ 12.09 hrs, Volume= 0.833 af, Depth= 5.30"
Routed to Link DP-B : WESTERN PROPERTY & WEST WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

	Area (ac)	CN	Description
	1.370	96	Gravel surface, HSG A
*	0.395	98	Impervious surface, HSG A
	0.047	39	>75% Grass cover, Good, HSG A
	0.073	32	Woods/grass comb., Good, HSG A
	1.885	93	Weighted Average
	1.490		79.05% Pervious Area
	0.395		20.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	36	0.0090	0.24		**Sheet Flow, SF-B** Fallow n= 0.050 P2= 3.18"
1.7	47	0.0090	0.47		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.3	30	0.0090	1.53		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
0.2	30	0.0200	2.28		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.2	9	0.0200	0.99		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
4.9	152	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment EX-C: TO HILLMAN STREET

Runoff = 9.82 cfs @ 12.09 hrs, Volume= 0.798 af, Depth= 5.65"
Routed to Link DP-C : HILLMAN STREET DRAINAGE SYSTEM

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

	Area (ac)	CN	Description
	0.040	39	>75% Grass cover, Good, HSG A
	0.196	96	Gravel surface, HSG A
*	1.460	98	Impervious surface, HSG A
	1.696	96	Weighted Average
	0.236		13.92% Pervious Area
	1.460		86.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.69		**Sheet Flow, SF-C** Smooth surfaces n= 0.011 P2= 3.18"
2.2	150	0.0050	1.14		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
0.2	54	0.0370	3.90		**Shallow Concentrated Flow, SCF-2** Paved Kv= 20.3 fps
3.6	254	Total, Increased to minimum Tc = 6.0 min			

Summary for Link DP-A: ISOLATED VEGETATED WETLAND

Inflow Area = 1.849 ac, 10.55% Impervious, Inflow Depth = 4.20" for 25-yr event
Inflow = 6.48 cfs @ 12.23 hrs, Volume= 0.648 af
Primary = 6.48 cfs @ 12.23 hrs, Volume= 0.648 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: WESTERN PROPERTY & WEST WETLAND

Inflow Area = 1.885 ac, 20.95% Impervious, Inflow Depth = 5.30" for 25-yr event
Inflow = 10.61 cfs @ 12.09 hrs, Volume= 0.833 af
Primary = 10.61 cfs @ 12.09 hrs, Volume= 0.833 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: HILLMAN STREET DRAINAGE SYSTEM

Inflow Area = 1.696 ac, 86.08% Impervious, Inflow Depth = 5.65" for 25-yr event
Inflow = 9.82 cfs @ 12.09 hrs, Volume= 0.798 af
Primary = 9.82 cfs @ 12.09 hrs, Volume= 0.798 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: TO ISOLATED Runoff Area=1.849 ac 10.55% Impervious Runoff Depth=4.99"
Flow Length=304' Tc=16.9 min CN=83 Runoff=7.65 cfs 0.769 af

Subcatchment EX-B: TO WEST Runoff Area=1.885 ac 20.95% Impervious Runoff Depth=6.13"
Flow Length=152' Tc=6.0 min CN=93 Runoff=12.17 cfs 0.963 af

Subcatchment EX-C: TO HILLMAN STREET Runoff Area=1.696 ac 86.08% Impervious Runoff Depth=6.48"
Flow Length=254' Tc=6.0 min CN=96 Runoff=11.21 cfs 0.916 af

Link DP-A: ISOLATED VEGETATED WETLAND Inflow=7.65 cfs 0.769 af
Primary=7.65 cfs 0.769 af

Link DP-B: WESTERN PROPERTY & WEST WETLAND Inflow=12.17 cfs 0.963 af
Primary=12.17 cfs 0.963 af

Link DP-C: HILLMAN STREET DRAINAGE SYSTEM Inflow=11.21 cfs 0.916 af
Primary=11.21 cfs 0.916 af

Total Runoff Area = 5.430 ac Runoff Volume = 2.648 af Average Runoff Depth = 5.85"
62.25% Pervious = 3.380 ac 37.75% Impervious = 2.050 ac

Summary for Subcatchment EX-A: TO ISOLATED WETLAND

Runoff = 7.65 cfs @ 12.23 hrs, Volume= 0.769 af, Depth= 4.99"
Routed to Link DP-A : ISOLATED VEGETATED WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	1.283	96	Gravel surface, HSG A
*	0.195	98	Impervious surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
	1.849	83	Weighted Average
	1.654		89.45% Pervious Area
	0.195		10.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment EX-B: TO WEST

Runoff = 12.17 cfs @ 12.09 hrs, Volume= 0.963 af, Depth= 6.13"
Routed to Link DP-B : WESTERN PROPERTY & WEST WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

	Area (ac)	CN	Description
	1.370	96	Gravel surface, HSG A
*	0.395	98	Impervious surface, HSG A
	0.047	39	>75% Grass cover, Good, HSG A
	0.073	32	Woods/grass comb., Good, HSG A
	1.885	93	Weighted Average
	1.490		79.05% Pervious Area
	0.395		20.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	36	0.0090	0.24		**Sheet Flow, SF-B** Fallow n= 0.050 P2= 3.18"
1.7	47	0.0090	0.47		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.3	30	0.0090	1.53		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
0.2	30	0.0200	2.28		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.2	9	0.0200	0.99		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
4.9	152	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment EX-C: TO HILLMAN STREET

Runoff = 11.21 cfs @ 12.09 hrs, Volume= 0.916 af, Depth= 6.48"
Routed to Link DP-C : HILLMAN STREET DRAINAGE SYSTEM

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

	Area (ac)	CN	Description
	0.040	39	>75% Grass cover, Good, HSG A
	0.196	96	Gravel surface, HSG A
*	1.460	98	Impervious surface, HSG A
	1.696	96	Weighted Average
	0.236		13.92% Pervious Area
	1.460		86.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.69		**Sheet Flow, SF-C** Smooth surfaces n= 0.011 P2= 3.18"
2.2	150	0.0050	1.14		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
0.2	54	0.0370	3.90		**Shallow Concentrated Flow, SCF-2** Paved Kv= 20.3 fps
3.6	254	Total, Increased to minimum Tc = 6.0 min			

Summary for Link DP-A: ISOLATED VEGETATED WETLAND

Inflow Area = 1.849 ac, 10.55% Impervious, Inflow Depth = 4.99" for 50-yr event
Inflow = 7.65 cfs @ 12.23 hrs, Volume= 0.769 af
Primary = 7.65 cfs @ 12.23 hrs, Volume= 0.769 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: WESTERN PROPERTY & WEST WETLAND

Inflow Area = 1.885 ac, 20.95% Impervious, Inflow Depth = 6.13" for 50-yr event
Inflow = 12.17 cfs @ 12.09 hrs, Volume= 0.963 af
Primary = 12.17 cfs @ 12.09 hrs, Volume= 0.963 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: HILLMAN STREET DRAINAGE SYSTEM

Inflow Area = 1.696 ac, 86.08% Impervious, Inflow Depth = 6.48" for 50-yr event
Inflow = 11.21 cfs @ 12.09 hrs, Volume= 0.916 af
Primary = 11.21 cfs @ 12.09 hrs, Volume= 0.916 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: TO ISOLATED Runoff Area=1.849 ac 10.55% Impervious Runoff Depth=5.85"
Flow Length=304' Tc=16.9 min CN=83 Runoff=8.92 cfs 0.902 af

Subcatchment EX-B: TO WEST Runoff Area=1.885 ac 20.95% Impervious Runoff Depth=7.03"
Flow Length=152' Tc=6.0 min CN=93 Runoff=13.86 cfs 1.105 af

Subcatchment EX-C: TO HILLMAN STREET Runoff Area=1.696 ac 86.08% Impervious Runoff Depth=7.39"
Flow Length=254' Tc=6.0 min CN=96 Runoff=12.70 cfs 1.045 af

Link DP-A: ISOLATED VEGETATED WETLAND Inflow=8.92 cfs 0.902 af
Primary=8.92 cfs 0.902 af

Link DP-B: WESTERN PROPERTY & WEST WETLAND Inflow=13.86 cfs 1.105 af
Primary=13.86 cfs 1.105 af

Link DP-C: HILLMAN STREET DRAINAGE SYSTEM Inflow=12.70 cfs 1.045 af
Primary=12.70 cfs 1.045 af

Total Runoff Area = 5.430 ac Runoff Volume = 3.051 af Average Runoff Depth = 6.74"
62.25% Pervious = 3.380 ac 37.75% Impervious = 2.050 ac

Summary for Subcatchment EX-A: TO ISOLATED WETLAND

Runoff = 8.92 cfs @ 12.23 hrs, Volume= 0.902 af, Depth= 5.85"
Routed to Link DP-A : ISOLATED VEGETATED WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	1.283	96	Gravel surface, HSG A
*	0.195	98	Impervious surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
	1.849	83	Weighted Average
	1.654		89.45% Pervious Area
	0.195		10.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment EX-B: TO WEST

Runoff = 13.86 cfs @ 12.09 hrs, Volume= 1.105 af, Depth= 7.03"
Routed to Link DP-B : WESTERN PROPERTY & WEST WETLAND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

	Area (ac)	CN	Description
	1.370	96	Gravel surface, HSG A
*	0.395	98	Impervious surface, HSG A
	0.047	39	>75% Grass cover, Good, HSG A
	0.073	32	Woods/grass comb., Good, HSG A
	1.885	93	Weighted Average
	1.490		79.05% Pervious Area
	0.395		20.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	36	0.0090	0.24		**Sheet Flow, SF-B** Fallow n= 0.050 P2= 3.18"
1.7	47	0.0090	0.47		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.3	30	0.0090	1.53		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
0.2	30	0.0200	2.28		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.2	9	0.0200	0.99		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
4.9	152	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment EX-C: TO HILLMAN STREET

Runoff = 12.70 cfs @ 12.09 hrs, Volume= 1.045 af, Depth= 7.39"
Routed to Link DP-C : HILLMAN STREET DRAINAGE SYSTEM

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

	Area (ac)	CN	Description
	0.040	39	>75% Grass cover, Good, HSG A
	0.196	96	Gravel surface, HSG A
*	1.460	98	Impervious surface, HSG A
	1.696	96	Weighted Average
	0.236		13.92% Pervious Area
	1.460		86.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.69		**Sheet Flow, SF-C** Smooth surfaces n= 0.011 P2= 3.18"
2.2	150	0.0050	1.14		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
0.2	54	0.0370	3.90		**Shallow Concentrated Flow, SCF-2** Paved Kv= 20.3 fps
3.6	254	Total, Increased to minimum Tc = 6.0 min			

Summary for Link DP-A: ISOLATED VEGETATED WETLAND

Inflow Area = 1.849 ac, 10.55% Impervious, Inflow Depth = 5.85" for 100-yr event
Inflow = 8.92 cfs @ 12.23 hrs, Volume= 0.902 af
Primary = 8.92 cfs @ 12.23 hrs, Volume= 0.902 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: WESTERN PROPERTY & WEST WETLAND

Inflow Area = 1.885 ac, 20.95% Impervious, Inflow Depth = 7.03" for 100-yr event
Inflow = 13.86 cfs @ 12.09 hrs, Volume= 1.105 af
Primary = 13.86 cfs @ 12.09 hrs, Volume= 1.105 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: HILLMAN STREET DRAINAGE SYSTEM

Inflow Area = 1.696 ac, 86.08% Impervious, Inflow Depth = 7.39" for 100-yr event
Inflow = 12.70 cfs @ 12.09 hrs, Volume= 1.045 af
Primary = 12.70 cfs @ 12.09 hrs, Volume= 1.045 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

APPENDIX C

Proposed Stormwater Discharge Calculations

LANGAN

NOAA Atlas 14, Volume 10, Version 3
Location name: Tewksbury, Massachusetts, USA*
Latitude: 42.6202°, Longitude: -71.2433°
Elevation: 122 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.314 (0.249-0.389)	0.375 (0.297-0.465)	0.475 (0.375-0.591)	0.558 (0.438-0.697)	0.673 (0.510-0.877)	0.759 (0.562-1.01)	0.849 (0.609-1.17)	0.951 (0.644-1.34)	1.10 (0.713-1.60)	1.22 (0.771-1.80)
10-min	0.445 (0.353-0.551)	0.532 (0.421-0.659)	0.674 (0.532-0.838)	0.791 (0.621-0.989)	0.953 (0.722-1.24)	1.08 (0.797-1.43)	1.20 (0.863-1.66)	1.35 (0.912-1.90)	1.56 (1.01-2.26)	1.72 (1.09-2.56)
15-min	0.523 (0.415-0.648)	0.626 (0.495-0.775)	0.793 (0.626-0.987)	0.932 (0.730-1.16)	1.12 (0.849-1.46)	1.26 (0.936-1.68)	1.42 (1.02-1.95)	1.59 (1.07-2.23)	1.83 (1.19-2.66)	2.03 (1.28-3.01)
30-min	0.718 (0.569-0.889)	0.858 (0.680-1.06)	1.09 (0.859-1.35)	1.28 (1.00-1.60)	1.54 (1.17-2.01)	1.74 (1.29-2.32)	1.95 (1.40-2.68)	2.18 (1.48-3.07)	2.52 (1.64-3.66)	2.80 (1.77-4.15)
60-min	0.912 (0.723-1.13)	1.09 (0.864-1.35)	1.38 (1.09-1.72)	1.63 (1.28-2.03)	1.96 (1.49-2.56)	2.21 (1.64-2.95)	2.48 (1.78-3.42)	2.78 (1.88-3.91)	3.21 (2.08-4.67)	3.56 (2.26-5.28)
2-hr	1.16 (0.930-1.43)	1.41 (1.12-1.73)	1.81 (1.44-2.23)	2.14 (1.69-2.65)	2.59 (1.98-3.37)	2.93 (2.19-3.90)	3.29 (2.40-4.56)	3.73 (2.54-5.22)	4.41 (2.87-6.37)	4.99 (3.16-7.34)
3-hr	1.34 (1.08-1.64)	1.63 (1.31-2.00)	2.10 (1.68-2.58)	2.49 (1.98-3.08)	3.03 (2.33-3.94)	3.43 (2.58-4.55)	3.86 (2.83-5.35)	4.40 (2.99-6.13)	5.24 (3.41-7.54)	5.96 (3.79-8.74)
6-hr	1.71 (1.39-2.08)	2.09 (1.69-2.54)	2.71 (2.18-3.31)	3.22 (2.57-3.95)	3.92 (3.04-5.06)	4.44 (3.36-5.86)	5.00 (3.69-6.90)	5.72 (3.91-7.92)	6.83 (4.47-9.78)	7.81 (4.98-11.4)
12-hr	2.16 (1.76-2.61)	2.64 (2.15-3.19)	3.43 (2.78-4.16)	4.08 (3.29-4.98)	4.98 (3.88-6.37)	5.64 (4.30-7.39)	6.36 (4.71-8.70)	7.26 (4.98-9.98)	8.65 (5.68-12.3)	9.86 (6.31-14.3)
24-hr	2.57 (2.11-3.08)	3.18 (2.61-3.81)	4.17 (3.41-5.02)	4.99 (4.06-6.05)	6.12 (4.81-7.80)	6.96 (5.34-9.07)	7.87 (5.87-10.7)	9.02 (6.21-12.3)	10.8 (7.12-15.3)	12.4 (7.94-17.8)
2-day	2.89 (2.40-3.45)	3.64 (3.01-4.34)	4.85 (4.00-5.81)	5.86 (4.80-7.06)	7.25 (5.74-9.20)	8.27 (6.41-10.7)	9.39 (7.08-12.8)	10.8 (7.50-14.7)	13.2 (8.70-18.5)	15.2 (9.80-21.7)
3-day	3.17 (2.64-3.76)	3.97 (3.30-4.71)	5.27 (4.37-6.28)	6.35 (5.23-7.61)	7.84 (6.24-9.91)	8.93 (6.95-11.6)	10.1 (7.67-13.7)	11.7 (8.12-15.8)	14.2 (9.42-19.9)	16.4 (10.6-23.4)
4-day	3.44 (2.88-4.07)	4.26 (3.56-5.05)	5.60 (4.66-6.66)	6.72 (5.55-8.03)	8.25 (6.58-10.4)	9.37 (7.31-12.1)	10.6 (8.05-14.4)	12.2 (8.50-16.5)	14.8 (9.84-20.7)	17.1 (11.1-24.3)
7-day	4.18 (3.52-4.92)	5.03 (4.23-5.93)	6.42 (5.38-7.59)	7.58 (6.30-9.01)	9.18 (7.36-11.5)	10.3 (8.10-13.2)	11.6 (8.84-15.6)	13.3 (9.28-17.8)	15.9 (10.6-22.1)	18.3 (11.8-25.7)
10-day	4.85 (4.10-5.69)	5.73 (4.84-6.72)	7.16 (6.02-8.44)	8.36 (6.97-9.89)	9.99 (8.03-12.4)	11.2 (8.78-14.2)	12.5 (9.50-16.6)	14.2 (9.93-18.9)	16.8 (11.2-23.1)	19.0 (12.3-26.7)
20-day	6.79 (5.79-7.90)	7.75 (6.60-9.04)	9.33 (7.91-10.9)	10.6 (8.96-12.5)	12.4 (10.0-15.2)	13.8 (10.8-17.2)	15.2 (11.5-19.7)	16.8 (11.9-22.3)	19.2 (12.9-26.2)	21.1 (13.7-29.4)
30-day	8.41 (7.21-9.75)	9.45 (8.08-11.0)	11.1 (9.50-13.0)	12.6 (10.6-14.7)	14.5 (11.7-17.6)	16.0 (12.6-19.8)	17.5 (13.1-22.3)	19.1 (13.5-25.1)	21.2 (14.3-28.9)	22.9 (14.9-31.8)
45-day	10.5 (9.02-12.1)	11.6 (9.97-13.4)	13.4 (11.5-15.6)	15.0 (12.7-17.4)	17.1 (13.8-20.5)	18.7 (14.7-22.9)	20.3 (15.2-25.6)	21.8 (15.5-28.6)	23.8 (16.1-32.3)	25.3 (16.5-35.0)
60-day	12.2 (10.6-14.1)	13.4 (11.6-15.5)	15.4 (13.2-17.8)	17.0 (14.5-19.7)	19.2 (15.6-23.0)	20.9 (16.5-25.6)	22.6 (17.0-28.4)	24.2 (17.3-31.5)	26.1 (17.7-35.2)	27.4 (17.9-37.8)

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

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

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

LEGEND

- PROPERTY LINE
- HYDROLOGIC SOIL GROUP
- WATERSHED BOUNDARY
- TIME OF CONCENTRATION
- WETLAND BOUNDARY
- EXWS-X — CATCHMENT AREA
- DP-X — DESIGN POINT

100-FT WETLAND BUFFER (TYP.)
25-FT NO TOUCH ZONE (TYP.)
50-FT NO BUILD ZONE (TYP.)
WETLAND LIMITS (TYP.)
PROPERTY LINE (TYP)

DP-A

PR-A
IMPERVIOUS AREA = 0.139 AC
PERVIOUS AREA = 1.372 AC
TOTAL AREA = 1.511 AC
CN = 69
TC = 16.9 MINUTES

PR-B1
IMPERVIOUS AREA = 0.040 AC.
PERVIOUS AREA = 0.520 AC.
TOTAL AREA = 0.560 AC.
CN = 96
TC = 6 MINUTES

PR-B2
IMPERVIOUS AREA = 0.669 AC.
PERVIOUS AREA = 0.451 AC.
TOTAL AREA = 1.120 AC.
CN = 97
TC = 6 MINUTES

PR-B3
IMPERVIOUS AREA = 0 AC
PERVIOUS AREA = 0.464 AC
TOTAL AREA = 0.464 AC
CN = 30
TC = 9.6 MINUTES

PR-C1
IMPERVIOUS AREA = 0.335 AC.
PERVIOUS AREA = 0.235 AC.
TOTAL AREA = 0.570 AC.
CN = 97
TC = 6 MINUTES

PR-C2
IMPERVIOUS AREA = 0.535 AC.
PERVIOUS AREA = 0.335 AC.
TOTAL AREA = 0.870 AC.
CN = 97
TC = 6 MINUTES

PR-C3
IMPERVIOUS AREA = 0.059 AC
PERVIOUS AREA = 0.276 AC
TOTAL AREA = 0.335 AC
CN = 40
TC = 7.9 MINUTES

DP-B
DP-C

TIME OF CONCENTRATION LINE (TYP)
WATERSHED DELINEATION (TYP)

HYDROLOGIC SOIL GROUP: A
HYDROLOGIC SOIL GROUP: B/D

73 HILLMAN STREET
75 HILLMAN STREET
HILLMAN STREET
CLINTON STREET

SEWER EASEMENT
BOOK 20628 PAGE 78
6,176 Sq. FT +/-

SCALE IN FEET: 40 0 20 40

Date	Description	No.

Revisions

Signature Date

LANGAN
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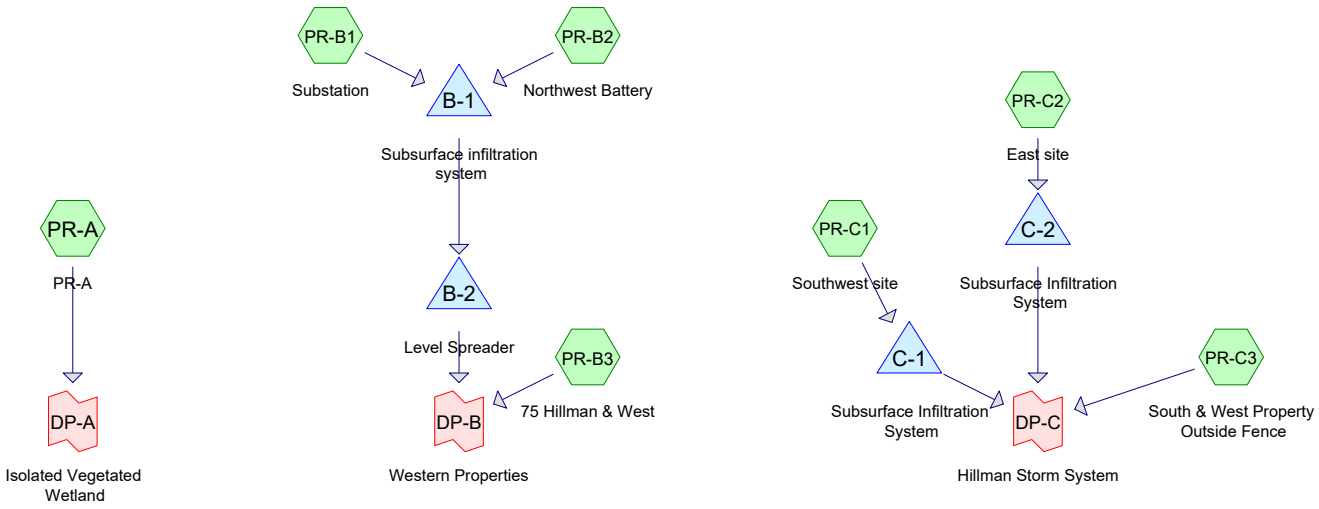
Project
HILLMAN ENERGY CENTER BATTERY ENERGY STORAGE SYSTEM
TEWKSBURY
MIDDLESEX COUNTY MASSACHUSETTS

Drawing Title
PROPOSED WATERSHED MAP

Project No.	Exhibit
151043401	PRWS
Date: 03/26/2025	
Drawn By: MPG	
Checked By: HH	

Project No. 151043401



Subcat Reach Pond Link

Routing Diagram for Hillman Tewksbury - Proposed Conditions
Prepared by Langan Engineering, Printed 3/13/2025
HydroCAD® 10.20-6a s/n 08223 © 2024 HydroCAD Software Solutions LLC

Hillman Tewksbury - Proposed Conditions

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.18	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.99	2
3	25-yr	Type III 24-hr		Default	24.00	1	6.12	2
4	50-yr	Type III 24-hr		Default	24.00	1	6.96	2
5	100-yr	Type III 24-hr		Default	24.00	1	7.87	2

Hillman Tewksbury - Proposed Conditions

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.071	39	>75% Grass cover, Good, HSG A (PR-A, PR-B3)
2.274	96	Gravel surface, HSG A (PR-A, PR-B1, PR-B2, PR-C1, PR-C2)
0.186	98	Impervious Surface, HSG A (PR-A, PR-C3)
1.005	30	Meadow, non-grazed, HSG A (PR-A, PR-B3, PR-C3)
1.539	98	Paved parking, HSG A (PR-B2, PR-C1, PR-C2)
0.040	98	Paved surface, HSG A (PR-B1)
0.315	30	Woods, Good, HSG A (PR-A)
5.430	**80**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-A: PR-A Runoff Area=1.511 ac 9.20% Impervious Runoff Depth=0.77"
Flow Length=304' Tc=16.9 min CN=69 Runoff=0.85 cfs 0.097 af

Subcatchment PR-B1: Substation Runoff Area=0.560 ac 7.14% Impervious Runoff Depth=2.73"
Flow Length=273' Tc=6.0 min CN=96 Runoff=1.63 cfs 0.127 af

Subcatchment PR-B2: Northwest Battery Runoff Area=1.120 ac 59.73% Impervious Runoff Depth=2.84"
Flow Length=338' Slope=0.0170 '/' Tc=6.0 min CN=97 Runoff=3.32 cfs 0.265 af

Subcatchment PR-B3: 75 Hillman & West Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=117' Tc=9.6 min CN=30 Runoff=0.00 cfs 0.000 af

Subcatchment PR-C1: Southwest site Runoff Area=0.570 ac 58.77% Impervious Runoff Depth=2.84"
Flow Length=154' Slope=0.0250 '/' Tc=6.0 min CN=97 Runoff=1.69 cfs 0.135 af

Subcatchment PR-C2: East site Runoff Area=0.870 ac 61.49% Impervious Runoff Depth=2.84"
Flow Length=236' Tc=6.0 min CN=97 Runoff=2.58 cfs 0.206 af

Subcatchment PR-C3: South & West Runoff Area=0.335 ac 14.03% Impervious Runoff Depth=0.00"
Flow Length=35' Slope=0.0110 '/' Tc=7.9 min CN=40 Runoff=0.00 cfs 0.000 af

Pond B-1: Subsurface infiltration system Peak Elev=118.87' Storage=2,742 cf Inflow=4.95 cfs 0.392 af
Outflow=4.44 cfs 0.354 af

Pond B-2: Level Spreader Peak Elev=117.65' Storage=114 cf Inflow=4.44 cfs 0.354 af
Outflow=4.44 cfs 0.352 af

Pond C-1: Subsurface Infiltration System Peak Elev=117.97' Storage=1,086 cf Inflow=1.69 cfs 0.135 af
Outflow=1.67 cfs 0.113 af

Pond C-2: Subsurface Infiltration System Peak Elev=118.28' Storage=1,684 cf Inflow=2.58 cfs 0.206 af
Outflow=2.37 cfs 0.178 af

Link DP-A: Isolated Vegetated Wetland Inflow=0.85 cfs 0.097 af
Primary=0.85 cfs 0.097 af

Link DP-B: Western Properties Inflow=4.44 cfs 0.352 af
Primary=4.44 cfs 0.352 af

Link DP-C: Hillman Storm System Inflow=4.03 cfs 0.291 af
Primary=4.03 cfs 0.291 af

Total Runoff Area = 5.430 ac Runoff Volume = 0.829 af Average Runoff Depth = 1.83"
67.50% Pervious = 3.665 ac 32.50% Impervious = 1.765 ac

Summary for Subcatchment PR-A: PR-A

Runoff = 0.85 cfs @ 12.27 hrs, Volume= 0.097 af, Depth= 0.77"
Routed to Link DP-A : Isolated Vegetated Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	0.733	96	Gravel surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
*	0.139	98	Impervious Surface, HSG A
	0.268	30	Meadow, non-grazed, HSG A
	1.511	69	Weighted Average
	1.372		90.80% Pervious Area
	0.139		9.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment PR-B1: Substation

Runoff = 1.63 cfs @ 12.09 hrs, Volume= 0.127 af, Depth= 2.73"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

	Area (ac)	CN	Description
	0.520	96	Gravel surface, HSG A
*	0.040	98	Paved surface, HSG A
	0.560	96	Weighted Average
	0.520		92.86% Pervious Area
	0.040		7.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.19		**Sheet Flow, Crushed Stone** Smooth surfaces n= 0.011 P2= 3.18"
0.8	107	0.0200	2.28		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
1.2	116	0.0100	1.61		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
2.7	273	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B2: Northwest Battery

Runoff = 3.32 cfs @ 12.09 hrs, Volume= 0.265 af, Depth= 2.84"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.669	98	Paved parking, HSG A
0.451	96	Gravel surface, HSG A
1.120	97	Weighted Average
0.451		40.27% Pervious Area
0.669		59.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0170	1.12		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
2.2	272	0.0170	2.10		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.1	16	0.0170	2.65		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
3.0	338	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B3: 75 Hillman & West

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link DP-B : Western Properties

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.015	39	>75% Grass cover, Good, HSG A
0.449	30	Meadow, non-grazed, HSG A
0.464	30	Weighted Average
0.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0170	0.09		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.18"
0.2	10	0.0170	0.91		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
0.3	27	0.0370	1.35		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.3	30	0.0500	1.57		**Shallow Concentrated Flow, SCF-3** Short Grass Pasture Kv= 7.0 fps
9.6	117	Total			

Summary for Subcatchment PR-C1: Southwest site

Runoff = 1.69 cfs @ 12.09 hrs, Volume= 0.135 af, Depth= 2.84"
Routed to Pond C-1 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.235	96	Gravel surface, HSG A
0.335	98	Paved parking, HSG A
0.570	97	Weighted Average
0.235		41.23% Pervious Area
0.335		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.7	104	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
1.3	154	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C2: East site

Runoff = 2.58 cfs @ 12.09 hrs, Volume= 0.206 af, Depth= 2.84"
Routed to Pond C-2 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

Area (ac)	CN	Description
0.335	96	Gravel surface, HSG A
0.535	98	Paved parking, HSG A
0.870	97	Weighted Average
0.335		38.51% Pervious Area
0.535		61.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.3	41	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	145	0.0200	2.87		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
1.7	236	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C3: South & West Property Outside Fence

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link DP-C : Hillman Storm System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.18"

	Area (ac)	CN	Description
	0.288	30	Meadow, non-grazed, HSG A
*	0.047	98	Impervious Surface, HSG A
	0.335	40	Weighted Average
	0.288		85.97% Pervious Area
	0.047		14.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	35	0.0110	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.18"

Summary for Pond B-1: Subsurface infiltration system

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 2.80" for 2-yr event
Inflow = 4.95 cfs @ 12.09 hrs, Volume= 0.392 af
Outflow = 4.44 cfs @ 12.13 hrs, Volume= 0.354 af, Atten= 10%, Lag= 2.5 min
Primary = 4.44 cfs @ 12.13 hrs, Volume= 0.354 af
Routed to Pond B-2 : Level Spreader

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.87' @ 12.13 hrs Surf.Area= 3,520 sf Storage= 2,742 cf

Plug-Flow detention time= 89.2 min calculated for 0.354 af (90% of inflow)
Center-of-Mass det. time= 41.7 min (810.5 - 768.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.80'	316 cf	**20.00'W x 92.00'L x 1.67'H Field A** 3,073 cf Overall - 2,284 cf Embedded = 789 cf x 40.0% Voids
#2A	117.80'	1,333 cf	**Shea Leaching Chamber 4x8x1.7**x 44 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 44 Chambers in 4 Rows
#3B	117.80'	292 cf	**20.00'W x 84.00'L x 1.67'H Field B** 2,806 cf Overall - 2,076 cf Embedded = 729 cf x 40.0% Voids
#4B	117.80'	1,211 cf	**Shea Leaching Chamber 4x8x1.7**x 40 Inside #3 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 40 Chambers in 4 Rows
		3,151 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	117.00'	**15.0" Round Culvert X 2.00** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 117.00' / 115.80' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	118.45'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.35 cfs @ 12.13 hrs HW=118.87' (Free Discharge)
↑**1=Culvert** (Passes 4.35 cfs of 13.18 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.35 cfs @ 2.11 fps)

Pond B-1: Subsurface infiltration system - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

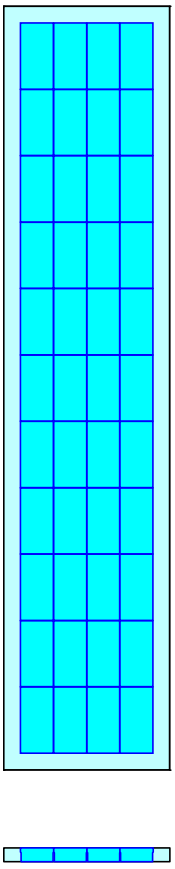
11 Chambers/Row x 8.00' Long = 88.00' Row Length +24.0" End Stone x 2 = 92.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

44 Chambers x 30.3 cf = 1,332.5 cf Chamber Storage
44 Chambers x 51.9 cf = 2,284.0 cf Displacement

3,072.8 cf Field - 2,284.0 cf Chambers = 788.8 cf Stone x 40.0% Voids = 315.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,648.0 cf = 0.038 af
Overall Storage Efficiency = 53.6%
Overall System Size = 92.00' x 20.00' x 1.67'

44 Chambers
113.8 cy Field
29.2 cy Stone



Pond B-1: Subsurface infiltration system - Chamber Wizard Field B

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

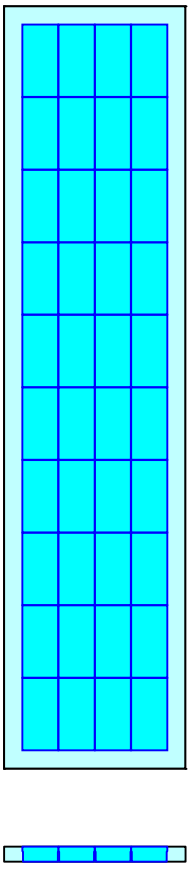
10 Chambers/Row x 8.00' Long = 80.00' Row Length +24.0" End Stone x 2 = 84.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

40 Chambers x 30.3 cf = 1,211.4 cf Chamber Storage
40 Chambers x 51.9 cf = 2,076.4 cf Displacement

2,805.6 cf Field - 2,076.4 cf Chambers = 729.2 cf Stone x 40.0% Voids = 291.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,503.0 cf = 0.035 af
Overall Storage Efficiency = 53.6%
Overall System Size = 84.00' x 20.00' x 1.67'

40 Chambers
103.9 cy Field
27.0 cy Stone



Summary for Pond B-2: Level Spreader

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 2.53" for 2-yr event
Inflow = 4.44 cfs @ 12.13 hrs, Volume= 0.354 af
Outflow = 4.44 cfs @ 12.13 hrs, Volume= 0.352 af, Atten= 0%, Lag= 0.1 min
Primary = 4.44 cfs @ 12.13 hrs, Volume= 0.352 af
Routed to Link DP-B : Western Properties

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 117.65' @ 12.13 hrs Surf.Area= 180 sf Storage= 114 cf

Plug-Flow detention time= 6.4 min calculated for 0.352 af (99% of inflow)
Center-of-Mass det. time= 1.5 min (812.1 - 810.5)

Volume	Invert	Avail.Storage	Storage Description
#1	115.30'	65 cf	**3.00'W x 30.00'L x 2.20'H Prismatoid** 198 cf Overall - 34 cf Embedded = 164 cf x 40.0% Voids
#2	117.50'	90 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#3	115.80'	34 cf	**15.0" Round Pipe Storage** Inside #1 L= 28.0'
		190 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
117.50	90	0	0
118.50	90	90	90

Device	Routing	Invert	Outlet Devices
#1	Primary	117.50'	**30.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=4.33 cfs @ 12.13 hrs HW=117.65' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 4.33 cfs @ 0.95 fps)

Summary for Pond C-1: Subsurface Infiltration System

Inflow Area = 0.570 ac, 58.77% Impervious, Inflow Depth = 2.84" for 2-yr event
Inflow = 1.69 cfs @ 12.09 hrs, Volume= 0.135 af
Outflow = 1.67 cfs @ 12.10 hrs, Volume= 0.113 af, Atten= 1%, Lag= 1.0 min
Primary = 1.67 cfs @ 12.10 hrs, Volume= 0.113 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 117.97' @ 12.10 hrs Surf.Area= 888 sf Storage= 1,086 cf

Plug-Flow detention time= 117.9 min calculated for 0.113 af (84% of inflow)
Center-of-Mass det. time= 51.2 min (817.4 - 766.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	116.25'	350 cf	**12.00'W x 74.00'L x 2.67'H Field A** 2,371 cf Overall - 1,495 cf Embedded = 876 cf x 40.0% Voids
#2A	116.25'	1,000 cf	**Shea Leaching Chamber 8x14x2.7**x 5 Inside #1 Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf
		1,350 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**18.0" Round Culvert** L= 150.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 116.25' / 115.30' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	117.75'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.65 cfs @ 12.10 hrs HW=117.97' (Free Discharge)
↑**1=Culvert** (Passes 1.65 cfs of 8.00 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.65 cfs @ 1.53 fps)

Pond C-1: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 8x14x2.7 (Shea Galley)
Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf
Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf

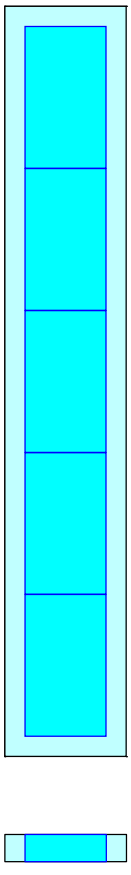
5 Chambers/Row x 14.00' Long = 70.00' Row Length +24.0" End Stone x 2 = 74.00' Base Length
1 Rows x 96.0" Wide + 24.0" Side Stone x 2 = 12.00' Base Width
32.0" Chamber Height = 2.67' Field Height

5 Chambers x 200.0 cf = 1,000.0 cf Chamber Storage
5 Chambers x 299.0 cf = 1,495.2 cf Displacement

2,371.0 cf Field - 1,495.2 cf Chambers = 875.8 cf Stone x 40.0% Voids = 350.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,350.3 cf = 0.031 af
Overall Storage Efficiency = 57.0%
Overall System Size = 74.00' x 12.00' x 2.67'

5 Chambers
87.8 cy Field
32.4 cy Stone



Summary for Pond C-2: Subsurface Infiltration System

Inflow Area = 0.870 ac, 61.49% Impervious, Inflow Depth = 2.84" for 2-yr event
Inflow = 2.58 cfs @ 12.09 hrs, Volume= 0.206 af
Outflow = 2.37 cfs @ 12.12 hrs, Volume= 0.178 af, Atten= 8%, Lag= 2.1 min
Primary = 2.37 cfs @ 12.12 hrs, Volume= 0.178 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.28' @ 12.12 hrs Surf.Area= 2,496 sf Storage= 1,684 cf

Plug-Flow detention time= 109.0 min calculated for 0.178 af (87% of inflow)
Center-of-Mass det. time= 49.6 min (815.8 - 766.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.33'	484 cf	**16.00'W x 156.00'L x 1.67'H Field A** 4,168 cf Overall - 2,959 cf Embedded = 1,209 cf x 40.0% Voids
#2A	117.33'	1,726 cf	**Shea Leaching Chamber 4x8x1.7** x 57 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 57 Chambers in 3 Rows
		2,210 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.75'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 115.75' / 115.30' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	118.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.31 cfs @ 12.12 hrs HW=118.27' (Free Discharge)
↑**1=Culvert** (Passes 2.31 cfs of 11.33 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.31 cfs @ 1.71 fps)

Pond C-2: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

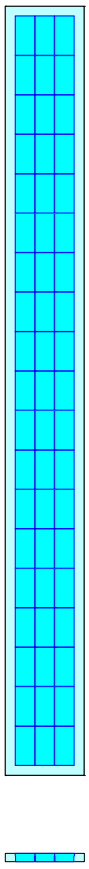
19 Chambers/Row x 8.00' Long = 152.00' Row Length +24.0" End Stone x 2 = 156.00' Base Length
3 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 16.00' Base Width
20.0" Chamber Height = 1.67' Field Height

57 Chambers x 30.3 cf = 1,726.2 cf Chamber Storage
57 Chambers x 51.9 cf = 2,958.9 cf Displacement

4,168.3 cf Field - 2,958.9 cf Chambers = 1,209.4 cf Stone x 40.0% Voids = 483.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,210.0 cf = 0.051 af
Overall Storage Efficiency = 53.0%
Overall System Size = 156.00' x 16.00' x 1.67'

57 Chambers
154.4 cy Field
44.8 cy Stone



Summary for Link DP-A: Isolated Vegetated Wetland

Inflow Area = 1.511 ac, 9.20% Impervious, Inflow Depth = 0.77" for 2-yr event
Inflow = 0.85 cfs @ 12.27 hrs, Volume= 0.097 af
Primary = 0.85 cfs @ 12.27 hrs, Volume= 0.097 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: Western Properties

Inflow Area = 2.144 ac, 33.07% Impervious, Inflow Depth = 1.97" for 2-yr event
Inflow = 4.44 cfs @ 12.13 hrs, Volume= 0.352 af
Primary = 4.44 cfs @ 12.13 hrs, Volume= 0.352 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: Hillman Storm System

Inflow Area = 1.775 ac, 51.66% Impervious, Inflow Depth = 1.97" for 2-yr event
Inflow = 4.03 cfs @ 12.11 hrs, Volume= 0.291 af
Primary = 4.03 cfs @ 12.11 hrs, Volume= 0.291 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-A: PR-A Runoff Area=1.511 ac 9.20% Impervious Runoff Depth=1.95"
Flow Length=304' Tc=16.9 min CN=69 Runoff=2.41 cfs 0.246 af

Subcatchment PR-B1: Substation Runoff Area=0.560 ac 7.14% Impervious Runoff Depth=4.52"
Flow Length=273' Tc=6.0 min CN=96 Runoff=2.63 cfs 0.211 af

Subcatchment PR-B2: Northwest Battery Runoff Area=1.120 ac 59.73% Impervious Runoff Depth=4.64"
Flow Length=338' Slope=0.0170 '/' Tc=6.0 min CN=97 Runoff=5.30 cfs 0.433 af

Subcatchment PR-B3: 75 Hillman & West Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=117' Tc=9.6 min CN=30 Runoff=0.00 cfs 0.000 af

Subcatchment PR-C1: Southwest site Runoff Area=0.570 ac 58.77% Impervious Runoff Depth=4.64"
Flow Length=154' Slope=0.0250 '/' Tc=6.0 min CN=97 Runoff=2.70 cfs 0.220 af

Subcatchment PR-C2: East site Runoff Area=0.870 ac 61.49% Impervious Runoff Depth=4.64"
Flow Length=236' Tc=6.0 min CN=97 Runoff=4.12 cfs 0.336 af

Subcatchment PR-C3: South & West Runoff Area=0.335 ac 14.03% Impervious Runoff Depth=0.23"
Flow Length=35' Slope=0.0110 '/' Tc=7.9 min CN=40 Runoff=0.02 cfs 0.007 af

Pond B-1: Subsurface infiltration system Peak Elev=119.11' Storage=3,030 cf Inflow=7.93 cfs 0.644 af
Outflow=8.45 cfs 0.606 af

Pond B-2: Level Spreader Peak Elev=117.73' Storage=121 cf Inflow=8.45 cfs 0.606 af
Outflow=8.42 cfs 0.603 af

Pond C-1: Subsurface Infiltration System Peak Elev=118.05' Storage=1,137 cf Inflow=2.70 cfs 0.220 af
Outflow=2.68 cfs 0.199 af

Pond C-2: Subsurface Infiltration System Peak Elev=118.39' Storage=1,874 cf Inflow=4.12 cfs 0.336 af
Outflow=3.86 cfs 0.309 af

Link DP-A: Isolated Vegetated Wetland Inflow=2.41 cfs 0.246 af
Primary=2.41 cfs 0.246 af

Link DP-B: Western Properties Inflow=8.42 cfs 0.604 af
Primary=8.42 cfs 0.604 af

Link DP-C: Hillman Storm System Inflow=6.51 cfs 0.514 af
Primary=6.51 cfs 0.514 af

Total Runoff Area = 5.430 ac Runoff Volume = 1.453 af Average Runoff Depth = 3.21"
67.50% Pervious = 3.665 ac 32.50% Impervious = 1.765 ac

Summary for Subcatchment PR-A: PR-A

Runoff = 2.41 cfs @ 12.25 hrs, Volume= 0.246 af, Depth= 1.95"
Routed to Link DP-A : Isolated Vegetated Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	0.733	96	Gravel surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
*	0.139	98	Impervious Surface, HSG A
	0.268	30	Meadow, non-grazed, HSG A
	1.511	69	Weighted Average
	1.372		90.80% Pervious Area
	0.139		9.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment PR-B1: Substation

Runoff = 2.63 cfs @ 12.09 hrs, Volume= 0.211 af, Depth= 4.52"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

	Area (ac)	CN	Description
	0.520	96	Gravel surface, HSG A
*	0.040	98	Paved surface, HSG A
	0.560	96	Weighted Average
	0.520		92.86% Pervious Area
	0.040		7.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.19		**Sheet Flow, Crushed Stone** Smooth surfaces n= 0.011 P2= 3.18"
0.8	107	0.0200	2.28		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
1.2	116	0.0100	1.61		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
2.7	273	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B2: Northwest Battery

Runoff = 5.30 cfs @ 12.09 hrs, Volume= 0.433 af, Depth= 4.64"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

Area (ac)	CN	Description
0.669	98	Paved parking, HSG A
0.451	96	Gravel surface, HSG A
1.120	97	Weighted Average
0.451		40.27% Pervious Area
0.669		59.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0170	1.12		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
2.2	272	0.0170	2.10		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.1	16	0.0170	2.65		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
3.0	338	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B3: 75 Hillman & West

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link DP-B : Western Properties

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

Area (ac)	CN	Description
0.015	39	>75% Grass cover, Good, HSG A
0.449	30	Meadow, non-grazed, HSG A
0.464	30	Weighted Average
0.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0170	0.09		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.18"
0.2	10	0.0170	0.91		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
0.3	27	0.0370	1.35		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.3	30	0.0500	1.57		**Shallow Concentrated Flow, SCF-3** Short Grass Pasture Kv= 7.0 fps
9.6	117	Total			

Summary for Subcatchment PR-C1: Southwest site

Runoff = 2.70 cfs @ 12.09 hrs, Volume= 0.220 af, Depth= 4.64"
Routed to Pond C-1 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

Area (ac)	CN	Description
0.235	96	Gravel surface, HSG A
0.335	98	Paved parking, HSG A
0.570	97	Weighted Average
0.235		41.23% Pervious Area
0.335		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.7	104	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
1.3	154	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C2: East site

Runoff = 4.12 cfs @ 12.09 hrs, Volume= 0.336 af, Depth= 4.64"
Routed to Pond C-2 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

Area (ac)	CN	Description
0.335	96	Gravel surface, HSG A
0.535	98	Paved parking, HSG A
0.870	97	Weighted Average
0.335		38.51% Pervious Area
0.535		61.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.3	41	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	145	0.0200	2.87		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
1.7	236	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C3: South & West Property Outside Fence

Runoff = 0.02 cfs @ 12.47 hrs, Volume= 0.007 af, Depth= 0.23"
Routed to Link DP-C : Hillman Storm System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.99"

	Area (ac)	CN	Description
	0.288	30	Meadow, non-grazed, HSG A
*	0.047	98	Impervious Surface, HSG A
	0.335	40	Weighted Average
	0.288		85.97% Pervious Area
	0.047		14.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	35	0.0110	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.18"

Summary for Pond B-1: Subsurface infiltration system

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 4.60" for 10-yr event
Inflow = 7.93 cfs @ 12.09 hrs, Volume= 0.644 af
Outflow = 8.45 cfs @ 12.10 hrs, Volume= 0.606 af, Atten= 0%, Lag= 0.9 min
Primary = 8.45 cfs @ 12.10 hrs, Volume= 0.606 af
Routed to Pond B-2 : Level Spreader

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 119.11' @ 12.10 hrs Surf.Area= 3,520 sf Storage= 3,030 cf

Plug-Flow detention time= 65.8 min calculated for 0.605 af (94% of inflow)
Center-of-Mass det. time= 33.0 min (791.0 - 758.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.80'	316 cf	**20.00'W x 92.00'L x 1.67'H Field A** 3,073 cf Overall - 2,284 cf Embedded = 789 cf x 40.0% Voids
#2A	117.80'	1,333 cf	**Shea Leaching Chamber 4x8x1.7**x 44 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 44 Chambers in 4 Rows
#3B	117.80'	292 cf	**20.00'W x 84.00'L x 1.67'H Field B** 2,806 cf Overall - 2,076 cf Embedded = 729 cf x 40.0% Voids
#4B	117.80'	1,211 cf	**Shea Leaching Chamber 4x8x1.7**x 40 Inside #3 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 40 Chambers in 4 Rows
		3,151 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	117.00'	**15.0" Round Culvert X 2.00** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 117.00' / 115.80' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	118.45'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=8.34 cfs @ 12.10 hrs HW=119.10' (Free Discharge)
↑**1=Culvert** (Passes 8.34 cfs of 14.35 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.34 cfs @ 2.64 fps)

Pond B-1: Subsurface infiltration system - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

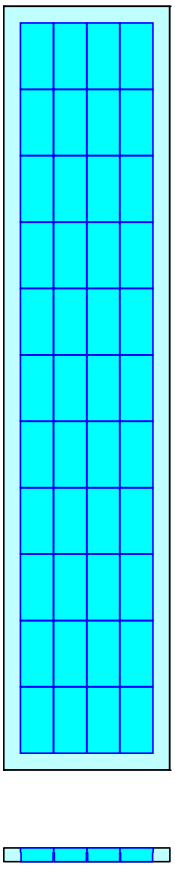
11 Chambers/Row x 8.00' Long = 88.00' Row Length +24.0" End Stone x 2 = 92.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

44 Chambers x 30.3 cf = 1,332.5 cf Chamber Storage
44 Chambers x 51.9 cf = 2,284.0 cf Displacement

3,072.8 cf Field - 2,284.0 cf Chambers = 788.8 cf Stone x 40.0% Voids = 315.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,648.0 cf = 0.038 af
Overall Storage Efficiency = 53.6%
Overall System Size = 92.00' x 20.00' x 1.67'

44 Chambers
113.8 cy Field
29.2 cy Stone



Pond B-1: Subsurface infiltration system - Chamber Wizard Field B

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

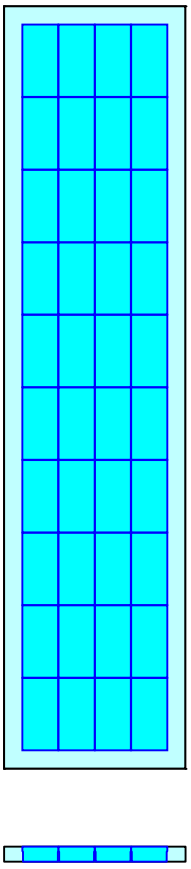
10 Chambers/Row x 8.00' Long = 80.00' Row Length +24.0" End Stone x 2 = 84.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

40 Chambers x 30.3 cf = 1,211.4 cf Chamber Storage
40 Chambers x 51.9 cf = 2,076.4 cf Displacement

2,805.6 cf Field - 2,076.4 cf Chambers = 729.2 cf Stone x 40.0% Voids = 291.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,503.0 cf = 0.035 af
Overall Storage Efficiency = 53.6%
Overall System Size = 84.00' x 20.00' x 1.67'

40 Chambers
103.9 cy Field
27.0 cy Stone



Summary for Pond B-2: Level Spreader

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 4.33" for 10-yr event
Inflow = 8.45 cfs @ 12.10 hrs, Volume= 0.606 af
Outflow = 8.42 cfs @ 12.10 hrs, Volume= 0.603 af, Atten= 0%, Lag= 0.0 min
Primary = 8.42 cfs @ 12.10 hrs, Volume= 0.603 af
Routed to Link DP-B : Western Properties

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 117.73' @ 12.10 hrs Surf.Area= 180 sf Storage= 121 cf

Plug-Flow detention time= 3.7 min calculated for 0.603 af (100% of inflow)
Center-of-Mass det. time= 1.3 min (792.2 - 791.0)

Volume	Invert	Avail.Storage	Storage Description
#1	115.30'	65 cf	**3.00'W x 30.00'L x 2.20'H Prismatoid** 198 cf Overall - 34 cf Embedded = 164 cf x 40.0% Voids
#2	117.50'	90 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#3	115.80'	34 cf	**15.0" Round Pipe Storage** Inside #1 L= 28.0'
		190 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
117.50	90	0	0
118.50	90	90	90

Device	Routing	Invert	Outlet Devices
#1	Primary	117.50'	**30.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=8.28 cfs @ 12.10 hrs HW=117.73' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 8.28 cfs @ 1.19 fps)

Summary for Pond C-1: Subsurface Infiltration System

Inflow Area = 0.570 ac, 58.77% Impervious, Inflow Depth = 4.64" for 10-yr event
Inflow = 2.70 cfs @ 12.09 hrs, Volume= 0.220 af
Outflow = 2.68 cfs @ 12.10 hrs, Volume= 0.199 af, Atten= 1%, Lag= 0.9 min
Primary = 2.68 cfs @ 12.10 hrs, Volume= 0.199 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.05' @ 12.10 hrs Surf.Area= 888 sf Storage= 1,137 cf

Plug-Flow detention time= 89.2 min calculated for 0.198 af (90% of inflow)
Center-of-Mass det. time= 40.7 min (796.5 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	116.25'	350 cf	**12.00'W x 74.00'L x 2.67'H Field A** 2,371 cf Overall - 1,495 cf Embedded = 876 cf x 40.0% Voids
#2A	116.25'	1,000 cf	**Shea Leaching Chamber 8x14x2.7**x 5 Inside #1 Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf
		1,350 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**18.0" Round Culvert** L= 150.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 116.25' / 115.30' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	117.75'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.67 cfs @ 12.10 hrs HW=118.05' (Free Discharge)
↑**1=Culvert** (Passes 2.67 cfs of 8.31 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.67 cfs @ 1.79 fps)

Pond C-1: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 8x14x2.7 (Shea Galley)
Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf
Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf

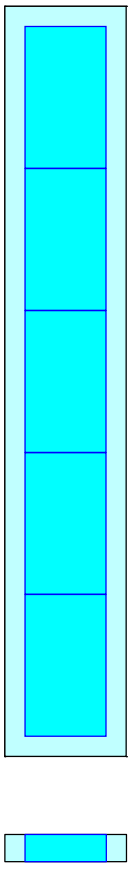
5 Chambers/Row x 14.00' Long = 70.00' Row Length +24.0" End Stone x 2 = 74.00' Base Length
1 Rows x 96.0" Wide + 24.0" Side Stone x 2 = 12.00' Base Width
32.0" Chamber Height = 2.67' Field Height

5 Chambers x 200.0 cf = 1,000.0 cf Chamber Storage
5 Chambers x 299.0 cf = 1,495.2 cf Displacement

2,371.0 cf Field - 1,495.2 cf Chambers = 875.8 cf Stone x 40.0% Voids = 350.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,350.3 cf = 0.031 af
Overall Storage Efficiency = 57.0%
Overall System Size = 74.00' x 12.00' x 2.67'

5 Chambers
87.8 cy Field
32.4 cy Stone



Summary for Pond C-2: Subsurface Infiltration System

Inflow Area = 0.870 ac, 61.49% Impervious, Inflow Depth = 4.64" for 10-yr event
Inflow = 4.12 cfs @ 12.09 hrs, Volume= 0.336 af
Outflow = 3.86 cfs @ 12.12 hrs, Volume= 0.309 af, Atten= 6%, Lag= 1.9 min
Primary = 3.86 cfs @ 12.12 hrs, Volume= 0.309 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.39' @ 12.12 hrs Surf.Area= 2,496 sf Storage= 1,874 cf

Plug-Flow detention time= 81.6 min calculated for 0.309 af (92% of inflow)
Center-of-Mass det. time= 39.4 min (795.2 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.33'	484 cf	**16.00'W x 156.00'L x 1.67'H Field A** 4,168 cf Overall - 2,959 cf Embedded = 1,209 cf x 40.0% Voids
#2A	117.33'	1,726 cf	**Shea Leaching Chamber 4x8x1.7** x 57 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 57 Chambers in 3 Rows
		2,210 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.75'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 115.75' / 115.30' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	118.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.75 cfs @ 12.12 hrs HW=118.38' (Free Discharge)
↑**1=Culvert** (Passes 3.75 cfs of 11.66 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.75 cfs @ 2.01 fps)

Pond C-2: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

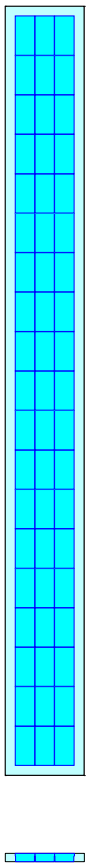
19 Chambers/Row x 8.00' Long = 152.00' Row Length +24.0" End Stone x 2 = 156.00' Base Length
3 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 16.00' Base Width
20.0" Chamber Height = 1.67' Field Height

57 Chambers x 30.3 cf = 1,726.2 cf Chamber Storage
57 Chambers x 51.9 cf = 2,958.9 cf Displacement

4,168.3 cf Field - 2,958.9 cf Chambers = 1,209.4 cf Stone x 40.0% Voids = 483.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,210.0 cf = 0.051 af
Overall Storage Efficiency = 53.0%
Overall System Size = 156.00' x 16.00' x 1.67'

57 Chambers
154.4 cy Field
44.8 cy Stone



Summary for Link DP-A: Isolated Vegetated Wetland

Inflow Area = 1.511 ac, 9.20% Impervious, Inflow Depth = 1.95" for 10-yr event
Inflow = 2.41 cfs @ 12.25 hrs, Volume= 0.246 af
Primary = 2.41 cfs @ 12.25 hrs, Volume= 0.246 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: Western Properties

Inflow Area = 2.144 ac, 33.07% Impervious, Inflow Depth = 3.38" for 10-yr event
Inflow = 8.42 cfs @ 12.10 hrs, Volume= 0.604 af
Primary = 8.42 cfs @ 12.10 hrs, Volume= 0.604 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: Hillman Storm System

Inflow Area = 1.775 ac, 51.66% Impervious, Inflow Depth = 3.47" for 10-yr event
Inflow = 6.51 cfs @ 12.11 hrs, Volume= 0.514 af
Primary = 6.51 cfs @ 12.11 hrs, Volume= 0.514 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR-A: PR-A Runoff Area=1.511 ac 9.20% Impervious Runoff Depth=2.81"
Flow Length=304' Tc=16.9 min CN=69 Runoff=3.54 cfs 0.353 af

SubcatchmentPR-B1: Substation Runoff Area=0.560 ac 7.14% Impervious Runoff Depth=5.65"
Flow Length=273' Tc=6.0 min CN=96 Runoff=3.24 cfs 0.264 af

SubcatchmentPR-B2: Northwest Battery Runoff Area=1.120 ac 59.73% Impervious Runoff Depth=5.76"
Flow Length=338' Slope=0.0170 '/' Tc=6.0 min CN=97 Runoff=6.53 cfs 0.538 af

SubcatchmentPR-B3: 75 Hillman & West Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=117' Tc=9.6 min CN=30 Runoff=0.01 cfs 0.003 af

SubcatchmentPR-C1: Southwest site Runoff Area=0.570 ac 58.77% Impervious Runoff Depth=5.76"
Flow Length=154' Slope=0.0250 '/' Tc=6.0 min CN=97 Runoff=3.32 cfs 0.274 af

SubcatchmentPR-C2: East site Runoff Area=0.870 ac 61.49% Impervious Runoff Depth=5.76"
Flow Length=236' Tc=6.0 min CN=97 Runoff=5.07 cfs 0.418 af

SubcatchmentPR-C3: South & West Runoff Area=0.335 ac 14.03% Impervious Runoff Depth=0.54"
Flow Length=35' Slope=0.0110 '/' Tc=7.9 min CN=40 Runoff=0.08 cfs 0.015 af

Pond B-1: Subsurface infiltration system Peak Elev=119.19' Storage=3,058 cf Inflow=9.77 cfs 0.801 af
Outflow=10.12 cfs 0.763 af

Pond B-2: Level Spreader Peak Elev=117.76' Storage=124 cf Inflow=10.12 cfs 0.763 af
Outflow=10.13 cfs 0.761 af

Pond C-1: Subsurface Infiltration System Peak Elev=118.10' Storage=1,166 cf Inflow=3.32 cfs 0.274 af
Outflow=3.31 cfs 0.252 af

Pond C-2: Subsurface Infiltration System Peak Elev=118.45' Storage=1,981 cf Inflow=5.07 cfs 0.418 af
Outflow=4.78 cfs 0.391 af

Link DP-A: Isolated Vegetated Wetland Inflow=3.54 cfs 0.353 af
Primary=3.54 cfs 0.353 af

Link DP-B: Western Properties Inflow=10.13 cfs 0.764 af
Primary=10.13 cfs 0.764 af

Link DP-C: Hillman Storm System Inflow=8.09 cfs 0.658 af
Primary=8.09 cfs 0.658 af

Total Runoff Area = 5.430 ac Runoff Volume = 1.865 af Average Runoff Depth = 4.12"
67.50% Pervious = 3.665 ac 32.50% Impervious = 1.765 ac

Summary for Subcatchment PR-A: PR-A

Runoff = 3.54 cfs @ 12.24 hrs, Volume= 0.353 af, Depth= 2.81"
Routed to Link DP-A : Isolated Vegetated Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	0.733	96	Gravel surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
*	0.139	98	Impervious Surface, HSG A
	0.268	30	Meadow, non-grazed, HSG A
	1.511	69	Weighted Average
	1.372		90.80% Pervious Area
	0.139		9.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment PR-B1: Substation

Runoff = 3.24 cfs @ 12.09 hrs, Volume= 0.264 af, Depth= 5.65"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

	Area (ac)	CN	Description
	0.520	96	Gravel surface, HSG A
*	0.040	98	Paved surface, HSG A
	0.560	96	Weighted Average
	0.520		92.86% Pervious Area
	0.040		7.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.19		**Sheet Flow, Crushed Stone** Smooth surfaces n= 0.011 P2= 3.18"
0.8	107	0.0200	2.28		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
1.2	116	0.0100	1.61		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
2.7	273	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B2: Northwest Battery

Runoff = 6.53 cfs @ 12.09 hrs, Volume= 0.538 af, Depth= 5.76"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

Area (ac)	CN	Description
0.669	98	Paved parking, HSG A
0.451	96	Gravel surface, HSG A
1.120	97	Weighted Average
0.451		40.27% Pervious Area
0.669		59.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0170	1.12		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
2.2	272	0.0170	2.10		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.1	16	0.0170	2.65		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
3.0	338	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B3: 75 Hillman & West

Runoff = 0.01 cfs @ 15.39 hrs, Volume= 0.003 af, Depth= 0.09"
Routed to Link DP-B : Western Properties

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

Area (ac)	CN	Description
0.015	39	>75% Grass cover, Good, HSG A
0.449	30	Meadow, non-grazed, HSG A
0.464	30	Weighted Average
0.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0170	0.09		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.18"
0.2	10	0.0170	0.91		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
0.3	27	0.0370	1.35		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.3	30	0.0500	1.57		**Shallow Concentrated Flow, SCF-3** Short Grass Pasture Kv= 7.0 fps
9.6	117	Total			

Summary for Subcatchment PR-C1: Southwest site

Runoff = 3.32 cfs @ 12.09 hrs, Volume= 0.274 af, Depth= 5.76"
Routed to Pond C-1 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

Area (ac)	CN	Description
0.235	96	Gravel surface, HSG A
0.335	98	Paved parking, HSG A
0.570	97	Weighted Average
0.235		41.23% Pervious Area
0.335		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.7	104	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
1.3	154	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C2: East site

Runoff = 5.07 cfs @ 12.09 hrs, Volume= 0.418 af, Depth= 5.76"
Routed to Pond C-2 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

Area (ac)	CN	Description
0.335	96	Gravel surface, HSG A
0.535	98	Paved parking, HSG A
0.870	97	Weighted Average
0.335		38.51% Pervious Area
0.535		61.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.3	41	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	145	0.0200	2.87		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
1.7	236	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C3: South & West Property Outside Fence

Runoff = 0.08 cfs @ 12.34 hrs, Volume= 0.015 af, Depth= 0.54"
Routed to Link DP-C : Hillman Storm System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.12"

	Area (ac)	CN	Description
	0.288	30	Meadow, non-grazed, HSG A
*	0.047	98	Impervious Surface, HSG A
	0.335	40	Weighted Average
	0.288		85.97% Pervious Area
	0.047		14.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	35	0.0110	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.18"

Summary for Pond B-1: Subsurface infiltration system

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 5.72" for 25-yr event
Inflow = 9.77 cfs @ 12.09 hrs, Volume= 0.801 af
Outflow = 10.12 cfs @ 12.10 hrs, Volume= 0.763 af, Atten= 0%, Lag= 0.6 min
Primary = 10.12 cfs @ 12.10 hrs, Volume= 0.763 af
Routed to Pond B-2 : Level Spreader

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 119.19' @ 12.10 hrs Surf.Area= 3,520 sf Storage= 3,058 cf

Plug-Flow detention time= 56.9 min calculated for 0.763 af (95% of inflow)
Center-of-Mass det. time= 29.4 min (783.1 - 753.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.80'	316 cf	**20.00'W x 92.00'L x 1.67'H Field A** 3,073 cf Overall - 2,284 cf Embedded = 789 cf x 40.0% Voids
#2A	117.80'	1,333 cf	**Shea Leaching Chamber 4x8x1.7**x 44 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 44 Chambers in 4 Rows
#3B	117.80'	292 cf	**20.00'W x 84.00'L x 1.67'H Field B** 2,806 cf Overall - 2,076 cf Embedded = 729 cf x 40.0% Voids
#4B	117.80'	1,211 cf	**Shea Leaching Chamber 4x8x1.7**x 40 Inside #3 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 40 Chambers in 4 Rows
		3,151 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	117.00'	**15.0" Round Culvert X 2.00** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 117.00' / 115.80' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	118.45'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=9.97 cfs @ 12.10 hrs HW=119.18' (Free Discharge)
↑**1=Culvert** (Passes 9.97 cfs of 14.75 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 9.97 cfs @ 2.80 fps)

Pond B-1: Subsurface infiltration system - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

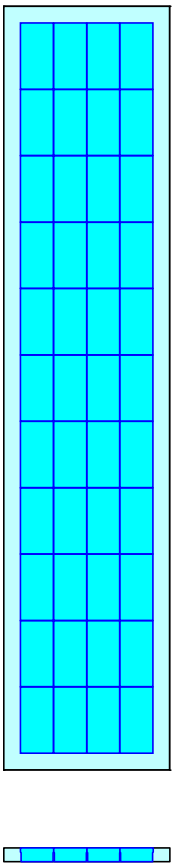
11 Chambers/Row x 8.00' Long = 88.00' Row Length +24.0" End Stone x 2 = 92.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

44 Chambers x 30.3 cf = 1,332.5 cf Chamber Storage
44 Chambers x 51.9 cf = 2,284.0 cf Displacement

3,072.8 cf Field - 2,284.0 cf Chambers = 788.8 cf Stone x 40.0% Voids = 315.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,648.0 cf = 0.038 af
Overall Storage Efficiency = 53.6%
Overall System Size = 92.00' x 20.00' x 1.67'

44 Chambers
113.8 cy Field
29.2 cy Stone



Pond B-1: Subsurface infiltration system - Chamber Wizard Field B

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

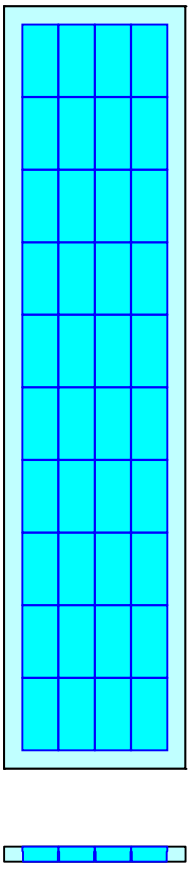
10 Chambers/Row x 8.00' Long = 80.00' Row Length +24.0" End Stone x 2 = 84.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

40 Chambers x 30.3 cf = 1,211.4 cf Chamber Storage
40 Chambers x 51.9 cf = 2,076.4 cf Displacement

2,805.6 cf Field - 2,076.4 cf Chambers = 729.2 cf Stone x 40.0% Voids = 291.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,503.0 cf = 0.035 af
Overall Storage Efficiency = 53.6%
Overall System Size = 84.00' x 20.00' x 1.67'

40 Chambers
103.9 cy Field
27.0 cy Stone



Summary for Pond B-2: Level Spreader

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 5.45" for 25-yr event
Inflow = 10.12 cfs @ 12.10 hrs, Volume= 0.763 af
Outflow = 10.13 cfs @ 12.10 hrs, Volume= 0.761 af, Atten= 0%, Lag= 0.0 min
Primary = 10.13 cfs @ 12.10 hrs, Volume= 0.761 af
Routed to Link DP-B : Western Properties

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 117.76' @ 12.10 hrs Surf.Area= 180 sf Storage= 124 cf

Plug-Flow detention time= 3.1 min calculated for 0.760 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (784.3 - 783.1)

Volume	Invert	Avail.Storage	Storage Description
#1	115.30'	65 cf	**3.00'W x 30.00'L x 2.20'H Prismatoid** 198 cf Overall - 34 cf Embedded = 164 cf x 40.0% Voids
#2	117.50'	90 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#3	115.80'	34 cf	**15.0" Round Pipe Storage** Inside #1 L= 28.0'
		190 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
117.50	90	0	0
118.50	90	90	90

Device	Routing	Invert	Outlet Devices
#1	Primary	117.50'	**30.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=10.00 cfs @ 12.10 hrs HW=117.76' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 10.00 cfs @ 1.27 fps)

Summary for Pond C-1: Subsurface Infiltration System

Inflow Area = 0.570 ac, 58.77% Impervious, Inflow Depth = 5.76" for 25-yr event
Inflow = 3.32 cfs @ 12.09 hrs, Volume= 0.274 af
Outflow = 3.31 cfs @ 12.10 hrs, Volume= 0.252 af, Atten= 0%, Lag= 0.8 min
Primary = 3.31 cfs @ 12.10 hrs, Volume= 0.252 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.10' @ 12.10 hrs Surf.Area= 888 sf Storage= 1,166 cf

Plug-Flow detention time= 78.3 min calculated for 0.252 af (92% of inflow)
Center-of-Mass det. time= 36.3 min (788.1 - 751.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	116.25'	350 cf	**12.00'W x 74.00'L x 2.67'H Field A** 2,371 cf Overall - 1,495 cf Embedded = 876 cf x 40.0% Voids
#2A	116.25'	1,000 cf	**Shea Leaching Chamber 8x14x2.7**x 5 Inside #1 Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf
		1,350 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**18.0" Round Culvert** L= 150.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 116.25' / 115.30' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	117.75'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.30 cfs @ 12.10 hrs HW=118.10' (Free Discharge)
↑**1=Culvert** (Passes 3.30 cfs of 8.44 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.30 cfs @ 1.93 fps)

Pond C-1: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 8x14x2.7 (Shea Galley)
Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf
Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf

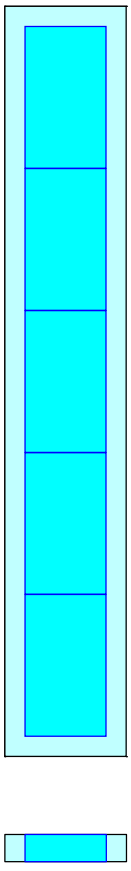
5 Chambers/Row x 14.00' Long = 70.00' Row Length +24.0" End Stone x 2 = 74.00' Base Length
1 Rows x 96.0" Wide + 24.0" Side Stone x 2 = 12.00' Base Width
32.0" Chamber Height = 2.67' Field Height

5 Chambers x 200.0 cf = 1,000.0 cf Chamber Storage
5 Chambers x 299.0 cf = 1,495.2 cf Displacement

2,371.0 cf Field - 1,495.2 cf Chambers = 875.8 cf Stone x 40.0% Voids = 350.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,350.3 cf = 0.031 af
Overall Storage Efficiency = 57.0%
Overall System Size = 74.00' x 12.00' x 2.67'

5 Chambers
87.8 cy Field
32.4 cy Stone



Summary for Pond C-2: Subsurface Infiltration System

Inflow Area = 0.870 ac, 61.49% Impervious, Inflow Depth = 5.76" for 25-yr event
Inflow = 5.07 cfs @ 12.09 hrs, Volume= 0.418 af
Outflow = 4.78 cfs @ 12.12 hrs, Volume= 0.391 af, Atten= 6%, Lag= 1.8 min
Primary = 4.78 cfs @ 12.12 hrs, Volume= 0.391 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.45' @ 12.12 hrs Surf.Area= 2,496 sf Storage= 1,981 cf

Plug-Flow detention time= 71.5 min calculated for 0.391 af (93% of inflow)
Center-of-Mass det. time= 35.2 min (787.0 - 751.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.33'	484 cf	**16.00'W x 156.00'L x 1.67'H Field A** 4,168 cf Overall - 2,959 cf Embedded = 1,209 cf x 40.0% Voids
#2A	117.33'	1,726 cf	**Shea Leaching Chamber 4x8x1.7** x 57 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 57 Chambers in 3 Rows
		2,210 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.75'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 115.75' / 115.30' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	118.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.66 cfs @ 12.12 hrs HW=118.44' (Free Discharge)
↑**1=Culvert** (Passes 4.66 cfs of 11.85 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.66 cfs @ 2.16 fps)

Pond C-2: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

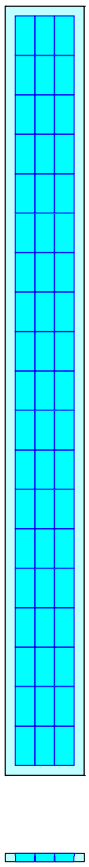
19 Chambers/Row x 8.00' Long = 152.00' Row Length +24.0" End Stone x 2 = 156.00' Base Length
3 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 16.00' Base Width
20.0" Chamber Height = 1.67' Field Height

57 Chambers x 30.3 cf = 1,726.2 cf Chamber Storage
57 Chambers x 51.9 cf = 2,958.9 cf Displacement

4,168.3 cf Field - 2,958.9 cf Chambers = 1,209.4 cf Stone x 40.0% Voids = 483.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,210.0 cf = 0.051 af
Overall Storage Efficiency = 53.0%
Overall System Size = 156.00' x 16.00' x 1.67'

57 Chambers
154.4 cy Field
44.8 cy Stone



Summary for Link DP-A: Isolated Vegetated Wetland

Inflow Area = 1.511 ac, 9.20% Impervious, Inflow Depth = 2.81" for 25-yr event
Inflow = 3.54 cfs @ 12.24 hrs, Volume= 0.353 af
Primary = 3.54 cfs @ 12.24 hrs, Volume= 0.353 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: Western Properties

Inflow Area = 2.144 ac, 33.07% Impervious, Inflow Depth = 4.28" for 25-yr event
Inflow = 10.13 cfs @ 12.10 hrs, Volume= 0.764 af
Primary = 10.13 cfs @ 12.10 hrs, Volume= 0.764 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: Hillman Storm System

Inflow Area = 1.775 ac, 51.66% Impervious, Inflow Depth = 4.45" for 25-yr event
Inflow = 8.09 cfs @ 12.11 hrs, Volume= 0.658 af
Primary = 8.09 cfs @ 12.11 hrs, Volume= 0.658 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR-A: PR-A Runoff Area=1.511 ac 9.20% Impervious Runoff Depth=3.48"
Flow Length=304' Tc=16.9 min CN=69 Runoff=4.41 cfs 0.438 af

SubcatchmentPR-B1: Substation Runoff Area=0.560 ac 7.14% Impervious Runoff Depth=6.48"
Flow Length=273' Tc=6.0 min CN=96 Runoff=3.70 cfs 0.303 af

SubcatchmentPR-B2: Northwest Battery Runoff Area=1.120 ac 59.73% Impervious Runoff Depth=6.60"
Flow Length=338' Slope=0.0170 '/' Tc=6.0 min CN=97 Runoff=7.44 cfs 0.616 af

SubcatchmentPR-B3: 75 Hillman & West Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=117' Tc=9.6 min CN=30 Runoff=0.01 cfs 0.008 af

SubcatchmentPR-C1: Southwest site Runoff Area=0.570 ac 58.77% Impervious Runoff Depth=6.60"
Flow Length=154' Slope=0.0250 '/' Tc=6.0 min CN=97 Runoff=3.79 cfs 0.314 af

SubcatchmentPR-C2: East site Runoff Area=0.870 ac 61.49% Impervious Runoff Depth=6.60"
Flow Length=236' Tc=6.0 min CN=97 Runoff=5.78 cfs 0.479 af

SubcatchmentPR-C3: South & West Runoff Area=0.335 ac 14.03% Impervious Runoff Depth=0.83"
Flow Length=35' Slope=0.0110 '/' Tc=7.9 min CN=40 Runoff=0.16 cfs 0.023 af

Pond B-1: Subsurface infiltration system Peak Elev=119.23' Storage=3,071 cf Inflow=11.14 cfs 0.919 af
Outflow=10.89 cfs 0.881 af

Pond B-2: Level Spreader Peak Elev=117.78' Storage=125 cf Inflow=10.89 cfs 0.881 af
Outflow=10.94 cfs 0.878 af

Pond C-1: Subsurface Infiltration System Peak Elev=118.13' Storage=1,187 cf Inflow=3.79 cfs 0.314 af
Outflow=3.77 cfs 0.292 af

Pond C-2: Subsurface Infiltration System Peak Elev=118.49' Storage=2,056 cf Inflow=5.78 cfs 0.479 af
Outflow=5.48 cfs 0.451 af

Link DP-A: Isolated Vegetated Wetland Inflow=4.41 cfs 0.438 af
Primary=4.41 cfs 0.438 af

Link DP-B: Western Properties Inflow=10.94 cfs 0.886 af
Primary=10.94 cfs 0.886 af

Link DP-C: Hillman Storm System Inflow=9.34 cfs 0.766 af
Primary=9.34 cfs 0.766 af

Total Runoff Area = 5.430 ac Runoff Volume = 2.180 af Average Runoff Depth = 4.82"
67.50% Pervious = 3.665 ac 32.50% Impervious = 1.765 ac

Summary for Subcatchment PR-A: PR-A

Runoff = 4.41 cfs @ 12.24 hrs, Volume= 0.438 af, Depth= 3.48"
Routed to Link DP-A : Isolated Vegetated Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	0.733	96	Gravel surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
*	0.139	98	Impervious Surface, HSG A
	0.268	30	Meadow, non-grazed, HSG A
	1.511	69	Weighted Average
	1.372		90.80% Pervious Area
	0.139		9.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment PR-B1: Substation

Runoff = 3.70 cfs @ 12.09 hrs, Volume= 0.303 af, Depth= 6.48"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

	Area (ac)	CN	Description
	0.520	96	Gravel surface, HSG A
*	0.040	98	Paved surface, HSG A
	0.560	96	Weighted Average
	0.520		92.86% Pervious Area
	0.040		7.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.19		**Sheet Flow, Crushed Stone** Smooth surfaces n= 0.011 P2= 3.18"
0.8	107	0.0200	2.28		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
1.2	116	0.0100	1.61		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
2.7	273	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B2: Northwest Battery

Runoff = 7.44 cfs @ 12.09 hrs, Volume= 0.616 af, Depth= 6.60"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

Area (ac)	CN	Description
0.669	98	Paved parking, HSG A
0.451	96	Gravel surface, HSG A
1.120	97	Weighted Average
0.451		40.27% Pervious Area
0.669		59.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0170	1.12		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
2.2	272	0.0170	2.10		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.1	16	0.0170	2.65		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
3.0	338	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B3: 75 Hillman & West

Runoff = 0.01 cfs @ 13.85 hrs, Volume= 0.008 af, Depth= 0.21"
Routed to Link DP-B : Western Properties

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

Area (ac)	CN	Description
0.015	39	>75% Grass cover, Good, HSG A
0.449	30	Meadow, non-grazed, HSG A
0.464	30	Weighted Average
0.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0170	0.09		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.18"
0.2	10	0.0170	0.91		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
0.3	27	0.0370	1.35		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.3	30	0.0500	1.57		**Shallow Concentrated Flow, SCF-3** Short Grass Pasture Kv= 7.0 fps
9.6	117	Total			

Summary for Subcatchment PR-C1: Southwest site

Runoff = 3.79 cfs @ 12.09 hrs, Volume= 0.314 af, Depth= 6.60"
Routed to Pond C-1 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

Area (ac)	CN	Description
0.235	96	Gravel surface, HSG A
0.335	98	Paved parking, HSG A
0.570	97	Weighted Average
0.235		41.23% Pervious Area
0.335		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.7	104	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
1.3	154	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C2: East site

Runoff = 5.78 cfs @ 12.09 hrs, Volume= 0.479 af, Depth= 6.60"
Routed to Pond C-2 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

Area (ac)	CN	Description
0.335	96	Gravel surface, HSG A
0.535	98	Paved parking, HSG A
0.870	97	Weighted Average
0.335		38.51% Pervious Area
0.535		61.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.3	41	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	145	0.0200	2.87		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
1.7	236	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C3: South & West Property Outside Fence

Runoff = 0.16 cfs @ 12.18 hrs, Volume= 0.023 af, Depth= 0.83"
Routed to Link DP-C : Hillman Storm System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-yr Rainfall=6.96"

	Area (ac)	CN	Description
	0.288	30	Meadow, non-grazed, HSG A
*	0.047	98	Impervious Surface, HSG A
	0.335	40	Weighted Average
	0.288		85.97% Pervious Area
	0.047		14.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	35	0.0110	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.18"

Summary for Pond B-1: Subsurface infiltration system

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 6.56" for 50-yr event
Inflow = 11.14 cfs @ 12.09 hrs, Volume= 0.919 af
Outflow = 10.89 cfs @ 12.08 hrs, Volume= 0.881 af, Atten= 2%, Lag= 0.0 min
Primary = 10.89 cfs @ 12.08 hrs, Volume= 0.881 af
Routed to Pond B-2 : Level Spreader

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 119.23' @ 12.08 hrs Surf.Area= 3,520 sf Storage= 3,071 cf

Plug-Flow detention time= 52.7 min calculated for 0.881 af (96% of inflow)
Center-of-Mass det. time= 27.2 min (778.5 - 751.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.80'	316 cf	**20.00'W x 92.00'L x 1.67'H Field A** 3,073 cf Overall - 2,284 cf Embedded = 789 cf x 40.0% Voids
#2A	117.80'	1,333 cf	**Shea Leaching Chamber 4x8x1.7**x 44 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 44 Chambers in 4 Rows
#3B	117.80'	292 cf	**20.00'W x 84.00'L x 1.67'H Field B** 2,806 cf Overall - 2,076 cf Embedded = 729 cf x 40.0% Voids
#4B	117.80'	1,211 cf	**Shea Leaching Chamber 4x8x1.7**x 40 Inside #3 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 40 Chambers in 4 Rows
		3,151 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	117.00'	**15.0" Round Culvert X 2.00** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 117.00' / 115.80' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	118.45'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=10.69 cfs @ 12.08 hrs HW=119.22' (Free Discharge)
↑**1=Culvert** (Passes 10.69 cfs of 14.92 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 10.69 cfs @ 2.87 fps)

Pond B-1: Subsurface infiltration system - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

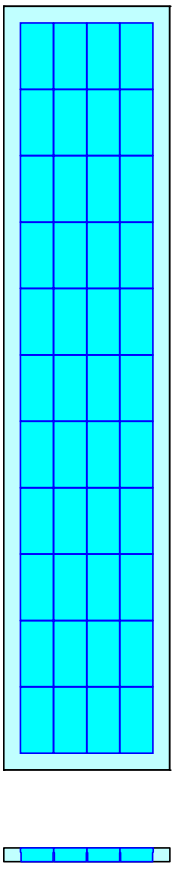
11 Chambers/Row x 8.00' Long = 88.00' Row Length +24.0" End Stone x 2 = 92.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

44 Chambers x 30.3 cf = 1,332.5 cf Chamber Storage
44 Chambers x 51.9 cf = 2,284.0 cf Displacement

3,072.8 cf Field - 2,284.0 cf Chambers = 788.8 cf Stone x 40.0% Voids = 315.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,648.0 cf = 0.038 af
Overall Storage Efficiency = 53.6%
Overall System Size = 92.00' x 20.00' x 1.67'

44 Chambers
113.8 cy Field
29.2 cy Stone



Pond B-1: Subsurface infiltration system - Chamber Wizard Field B

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

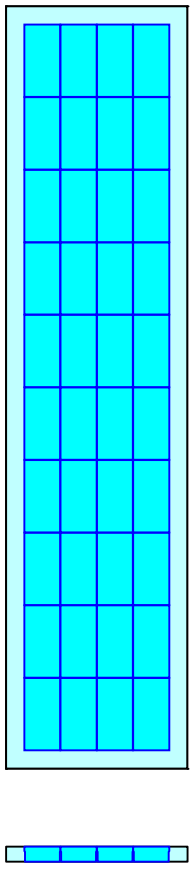
10 Chambers/Row x 8.00' Long = 80.00' Row Length +24.0" End Stone x 2 = 84.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

40 Chambers x 30.3 cf = 1,211.4 cf Chamber Storage
40 Chambers x 51.9 cf = 2,076.4 cf Displacement

2,805.6 cf Field - 2,076.4 cf Chambers = 729.2 cf Stone x 40.0% Voids = 291.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,503.0 cf = 0.035 af
Overall Storage Efficiency = 53.6%
Overall System Size = 84.00' x 20.00' x 1.67'

40 Chambers
103.9 cy Field
27.0 cy Stone



Summary for Pond B-2: Level Spreader

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 6.29" for 50-yr event
Inflow = 10.89 cfs @ 12.08 hrs, Volume= 0.881 af
Outflow = 10.94 cfs @ 12.08 hrs, Volume= 0.878 af, Atten= 0%, Lag= 0.2 min
Primary = 10.94 cfs @ 12.08 hrs, Volume= 0.878 af
Routed to Link DP-B : Western Properties

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 117.78' @ 12.08 hrs Surf.Area= 180 sf Storage= 125 cf

Plug-Flow detention time= 2.8 min calculated for 0.877 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (779.6 - 778.5)

Volume	Invert	Avail.Storage	Storage Description
#1	115.30'	65 cf	**3.00'W x 30.00'L x 2.20'H Prismatoid** 198 cf Overall - 34 cf Embedded = 164 cf x 40.0% Voids
#2	117.50'	90 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#3	115.80'	34 cf	**15.0" Round Pipe Storage** Inside #1 L= 28.0'
		190 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
117.50	90	0	0
118.50	90	90	90

Device	Routing	Invert	Outlet Devices
#1	Primary	117.50'	**30.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=10.70 cfs @ 12.08 hrs HW=117.77' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 10.70 cfs @ 1.30 fps)

Summary for Pond C-1: Subsurface Infiltration System

Inflow Area = 0.570 ac, 58.77% Impervious, Inflow Depth = 6.60" for 50-yr event
Inflow = 3.79 cfs @ 12.09 hrs, Volume= 0.314 af
Outflow = 3.77 cfs @ 12.10 hrs, Volume= 0.292 af, Atten= 0%, Lag= 0.8 min
Primary = 3.77 cfs @ 12.10 hrs, Volume= 0.292 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.13' @ 12.10 hrs Surf.Area= 888 sf Storage= 1,187 cf

Plug-Flow detention time= 71.3 min calculated for 0.292 af (93% of inflow)
Center-of-Mass det. time= 33.6 min (783.1 - 749.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	116.25'	350 cf	**12.00'W x 74.00'L x 2.67'H Field A** 2,371 cf Overall - 1,495 cf Embedded = 876 cf x 40.0% Voids
#2A	116.25'	1,000 cf	**Shea Leaching Chamber 8x14x2.7**x 5 Inside #1 Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf
		1,350 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**18.0" Round Culvert** L= 150.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 116.25' / 115.30' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	117.75'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.77 cfs @ 12.10 hrs HW=118.13' (Free Discharge)
↑└**1=Culvert** (Passes 3.77 cfs of 8.51 cfs potential flow)
↑└**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.77 cfs @ 2.01 fps)

Pond C-1: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 8x14x2.7 (Shea Galley)
Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf
Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf

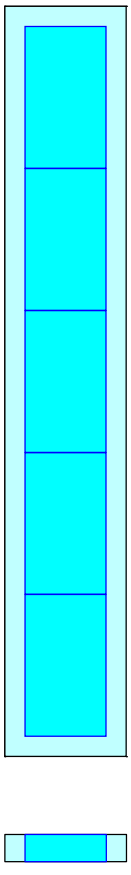
5 Chambers/Row x 14.00' Long = 70.00' Row Length +24.0" End Stone x 2 = 74.00' Base Length
1 Rows x 96.0" Wide + 24.0" Side Stone x 2 = 12.00' Base Width
32.0" Chamber Height = 2.67' Field Height

5 Chambers x 200.0 cf = 1,000.0 cf Chamber Storage
5 Chambers x 299.0 cf = 1,495.2 cf Displacement

2,371.0 cf Field - 1,495.2 cf Chambers = 875.8 cf Stone x 40.0% Voids = 350.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,350.3 cf = 0.031 af
Overall Storage Efficiency = 57.0%
Overall System Size = 74.00' x 12.00' x 2.67'

5 Chambers
87.8 cy Field
32.4 cy Stone



Summary for Pond C-2: Subsurface Infiltration System

Inflow Area = 0.870 ac, 61.49% Impervious, Inflow Depth = 6.60" for 50-yr event
Inflow = 5.78 cfs @ 12.09 hrs, Volume= 0.479 af
Outflow = 5.48 cfs @ 12.11 hrs, Volume= 0.451 af, Atten= 5%, Lag= 1.7 min
Primary = 5.48 cfs @ 12.11 hrs, Volume= 0.451 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.49' @ 12.11 hrs Surf.Area= 2,496 sf Storage= 2,056 cf

Plug-Flow detention time= 65.3 min calculated for 0.451 af (94% of inflow)
Center-of-Mass det. time= 32.7 min (782.2 - 749.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.33'	484 cf	**16.00'W x 156.00'L x 1.67'H Field A** 4,168 cf Overall - 2,959 cf Embedded = 1,209 cf x 40.0% Voids
#2A	117.33'	1,726 cf	**Shea Leaching Chamber 4x8x1.7** x 57 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 57 Chambers in 3 Rows
		2,210 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.75'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 115.75' / 115.30' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	118.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=5.34 cfs @ 12.11 hrs HW=118.48' (Free Discharge)
↑**1=Culvert** (Passes 5.34 cfs of 11.97 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 5.34 cfs @ 2.27 fps)

Pond C-2: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

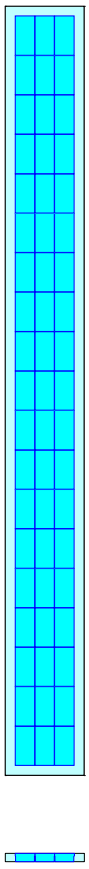
19 Chambers/Row x 8.00' Long = 152.00' Row Length +24.0" End Stone x 2 = 156.00' Base Length
3 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 16.00' Base Width
20.0" Chamber Height = 1.67' Field Height

57 Chambers x 30.3 cf = 1,726.2 cf Chamber Storage
57 Chambers x 51.9 cf = 2,958.9 cf Displacement

4,168.3 cf Field - 2,958.9 cf Chambers = 1,209.4 cf Stone x 40.0% Voids = 483.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,210.0 cf = 0.051 af
Overall Storage Efficiency = 53.0%
Overall System Size = 156.00' x 16.00' x 1.67'

57 Chambers
154.4 cy Field
44.8 cy Stone



Summary for Link DP-A: Isolated Vegetated Wetland

Inflow Area = 1.511 ac, 9.20% Impervious, Inflow Depth = 3.48" for 50-yr event
Inflow = 4.41 cfs @ 12.24 hrs, Volume= 0.438 af
Primary = 4.41 cfs @ 12.24 hrs, Volume= 0.438 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: Western Properties

Inflow Area = 2.144 ac, 33.07% Impervious, Inflow Depth = 4.96" for 50-yr event
Inflow = 10.94 cfs @ 12.08 hrs, Volume= 0.886 af
Primary = 10.94 cfs @ 12.08 hrs, Volume= 0.886 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: Hillman Storm System

Inflow Area = 1.775 ac, 51.66% Impervious, Inflow Depth = 5.18" for 50-yr event
Inflow = 9.34 cfs @ 12.11 hrs, Volume= 0.766 af
Primary = 9.34 cfs @ 12.11 hrs, Volume= 0.766 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-A: PR-A Runoff Area=1.511 ac 9.20% Impervious Runoff Depth=4.24"
Flow Length=304' Tc=16.9 min CN=69 Runoff=5.39 cfs 0.534 af

Subcatchment PR-B1: Substation Runoff Area=0.560 ac 7.14% Impervious Runoff Depth=7.39"
Flow Length=273' Tc=6.0 min CN=96 Runoff=4.19 cfs 0.345 af

Subcatchment PR-B2: Northwest Battery Runoff Area=1.120 ac 59.73% Impervious Runoff Depth=7.51"
Flow Length=338' Slope=0.0170 '/' Tc=6.0 min CN=97 Runoff=8.42 cfs 0.701 af

Subcatchment PR-B3: 75 Hillman & West Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.39"
Flow Length=117' Tc=9.6 min CN=30 Runoff=0.04 cfs 0.015 af

Subcatchment PR-C1: Southwest site Runoff Area=0.570 ac 58.77% Impervious Runoff Depth=7.51"
Flow Length=154' Slope=0.0250 '/' Tc=6.0 min CN=97 Runoff=4.29 cfs 0.357 af

Subcatchment PR-C2: East site Runoff Area=0.870 ac 61.49% Impervious Runoff Depth=7.51"
Flow Length=236' Tc=6.0 min CN=97 Runoff=6.54 cfs 0.545 af

Subcatchment PR-C3: South & West Runoff Area=0.335 ac 14.03% Impervious Runoff Depth=1.19"
Flow Length=35' Slope=0.0110 '/' Tc=7.9 min CN=40 Runoff=0.29 cfs 0.033 af

Pond B-1: Subsurface infiltration system Peak Elev=119.30' Storage=3,096 cf Inflow=12.62 cfs 1.046 af
Outflow=12.45 cfs 1.008 af

Pond B-2: Level Spreader Peak Elev=117.80' Storage=127 cf Inflow=12.45 cfs 1.008 af
Outflow=12.47 cfs 1.006 af

Pond C-1: Subsurface Infiltration System Peak Elev=118.16' Storage=1,208 cf Inflow=4.29 cfs 0.357 af
Outflow=4.27 cfs 0.335 af

Pond C-2: Subsurface Infiltration System Peak Elev=118.55' Storage=2,090 cf Inflow=6.54 cfs 0.545 af
Outflow=6.60 cfs 0.517 af

Link DP-A: Isolated Vegetated Wetland Inflow=5.39 cfs 0.534 af
Primary=5.39 cfs 0.534 af

Link DP-B: Western Properties Inflow=12.47 cfs 1.020 af
Primary=12.47 cfs 1.020 af

Link DP-C: Hillman Storm System Inflow=11.12 cfs 0.886 af
Primary=11.12 cfs 0.886 af

Total Runoff Area = 5.430 ac Runoff Volume = 2.529 af Average Runoff Depth = 5.59"
67.50% Pervious = 3.665 ac 32.50% Impervious = 1.765 ac

Summary for Subcatchment PR-A: PR-A

Runoff = 5.39 cfs @ 12.24 hrs, Volume= 0.534 af, Depth= 4.24"
Routed to Link DP-A : Isolated Vegetated Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

	Area (ac)	CN	Description
	0.315	30	Woods, Good, HSG A
	0.733	96	Gravel surface, HSG A
	0.056	39	>75% Grass cover, Good, HSG A
*	0.139	98	Impervious Surface, HSG A
	0.268	30	Meadow, non-grazed, HSG A
	1.511	69	Weighted Average
	1.372		90.80% Pervious Area
	0.139		9.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, SF-A** Woods: Light underbrush n= 0.400 P2= 3.18"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.9	87	0.0100	0.50		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
0.9	88	0.0110	1.69		**Shallow Concentrated Flow, SCF-3** Unpaved Kv= 16.1 fps
0.4	50	0.0200	2.28		**Shallow Concentrated Flow, SCF-4** Unpaved Kv= 16.1 fps
0.0	9	0.2800	3.70		**Shallow Concentrated Flow, SCF-5** Short Grass Pasture Kv= 7.0 fps
16.9	304	Total			

Summary for Subcatchment PR-B1: Substation

Runoff = 4.19 cfs @ 12.09 hrs, Volume= 0.345 af, Depth= 7.39"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

	Area (ac)	CN	Description
	0.520	96	Gravel surface, HSG A
*	0.040	98	Paved surface, HSG A
	0.560	96	Weighted Average
	0.520		92.86% Pervious Area
	0.040		7.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.19		**Sheet Flow, Crushed Stone** Smooth surfaces n= 0.011 P2= 3.18"
0.8	107	0.0200	2.28		**Shallow Concentrated Flow, SCF-1** Unpaved Kv= 16.1 fps
1.2	116	0.0100	1.61		**Shallow Concentrated Flow, SCF-2** Unpaved Kv= 16.1 fps
2.7	273	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B2: Northwest Battery

Runoff = 8.42 cfs @ 12.09 hrs, Volume= 0.701 af, Depth= 7.51"
Routed to Pond B-1 : Subsurface infiltration system

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

Area (ac)	CN	Description
0.669	98	Paved parking, HSG A
0.451	96	Gravel surface, HSG A
1.120	97	Weighted Average
0.451		40.27% Pervious Area
0.669		59.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0170	1.12		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
2.2	272	0.0170	2.10		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.1	16	0.0170	2.65		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
3.0	338	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-B3: 75 Hillman & West

Runoff = 0.04 cfs @ 12.49 hrs, Volume= 0.015 af, Depth= 0.39"
Routed to Link DP-B : Western Properties

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

Area (ac)	CN	Description
0.015	39	>75% Grass cover, Good, HSG A
0.449	30	Meadow, non-grazed, HSG A
0.464	30	Weighted Average
0.464		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0170	0.09		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.18"
0.2	10	0.0170	0.91		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
0.3	27	0.0370	1.35		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.3	30	0.0500	1.57		**Shallow Concentrated Flow, SCF-3** Short Grass Pasture Kv= 7.0 fps
9.6	117	Total			

Summary for Subcatchment PR-C1: Southwest site

Runoff = 4.29 cfs @ 12.09 hrs, Volume= 0.357 af, Depth= 7.51"
Routed to Pond C-1 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

Area (ac)	CN	Description
0.235	96	Gravel surface, HSG A
0.335	98	Paved parking, HSG A
0.570	97	Weighted Average
0.235		41.23% Pervious Area
0.335		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.7	104	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
1.3	154	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C2: East site

Runoff = 6.54 cfs @ 12.09 hrs, Volume= 0.545 af, Depth= 7.51"
Routed to Pond C-2 : Subsurface Infiltration System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

Area (ac)	CN	Description
0.335	96	Gravel surface, HSG A
0.535	98	Paved parking, HSG A
0.870	97	Weighted Average
0.335		38.51% Pervious Area
0.535		61.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.31		**Sheet Flow, Gravel** Smooth surfaces n= 0.011 P2= 3.18"
0.3	41	0.0250	2.55		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	145	0.0200	2.87		**Shallow Concentrated Flow, Road** Paved Kv= 20.3 fps
1.7	236	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment PR-C3: South & West Property Outside Fence

Runoff = 0.29 cfs @ 12.16 hrs, Volume= 0.033 af, Depth= 1.19"
Routed to Link DP-C : Hillman Storm System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.87"

	Area (ac)	CN	Description
	0.288	30	Meadow, non-grazed, HSG A
*	0.047	98	Impervious Surface, HSG A
	0.335	40	Weighted Average
	0.288		85.97% Pervious Area
	0.047		14.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	35	0.0110	0.07		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.18"

Summary for Pond B-1: Subsurface infiltration system

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 7.47" for 100-yr event
Inflow = 12.62 cfs @ 12.09 hrs, Volume= 1.046 af
Outflow = 12.45 cfs @ 12.09 hrs, Volume= 1.008 af, Atten= 1%, Lag= 0.0 min
Primary = 12.45 cfs @ 12.09 hrs, Volume= 1.008 af
Routed to Pond B-2 : Level Spreader

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 119.30' @ 12.09 hrs Surf.Area= 3,520 sf Storage= 3,096 cf

Plug-Flow detention time= 48.1 min calculated for 1.008 af (96% of inflow)
Center-of-Mass det. time= 25.2 min (774.3 - 749.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.80'	316 cf	**20.00'W x 92.00'L x 1.67'H Field A** 3,073 cf Overall - 2,284 cf Embedded = 789 cf x 40.0% Voids
#2A	117.80'	1,333 cf	**Shea Leaching Chamber 4x8x1.7** x 44 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 44 Chambers in 4 Rows
#3B	117.80'	292 cf	**20.00'W x 84.00'L x 1.67'H Field B** 2,806 cf Overall - 2,076 cf Embedded = 729 cf x 40.0% Voids
#4B	117.80'	1,211 cf	**Shea Leaching Chamber 4x8x1.7** x 40 Inside #3 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 40 Chambers in 4 Rows
		3,151 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	117.00'	**15.0" Round Culvert X 2.00** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 117.00' / 115.80' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	118.45'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=12.19 cfs @ 12.09 hrs HW=119.29' (Free Discharge)
↑**1=Culvert** (Passes 12.19 cfs of 15.25 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 12.19 cfs @ 3.00 fps)

Pond B-1: Subsurface infiltration system - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

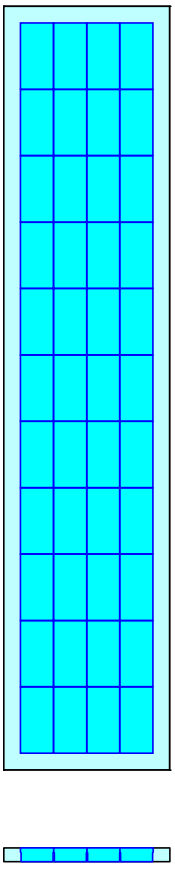
11 Chambers/Row x 8.00' Long = 88.00' Row Length +24.0" End Stone x 2 = 92.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

44 Chambers x 30.3 cf = 1,332.5 cf Chamber Storage
44 Chambers x 51.9 cf = 2,284.0 cf Displacement

3,072.8 cf Field - 2,284.0 cf Chambers = 788.8 cf Stone x 40.0% Voids = 315.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,648.0 cf = 0.038 af
Overall Storage Efficiency = 53.6%
Overall System Size = 92.00' x 20.00' x 1.67'

44 Chambers
113.8 cy Field
29.2 cy Stone



Pond B-1: Subsurface infiltration system - Chamber Wizard Field B

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

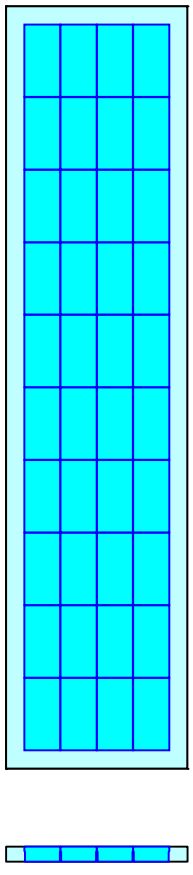
10 Chambers/Row x 8.00' Long = 80.00' Row Length +24.0" End Stone x 2 = 84.00' Base Length
4 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 20.00' Base Width
20.0" Chamber Height = 1.67' Field Height

40 Chambers x 30.3 cf = 1,211.4 cf Chamber Storage
40 Chambers x 51.9 cf = 2,076.4 cf Displacement

2,805.6 cf Field - 2,076.4 cf Chambers = 729.2 cf Stone x 40.0% Voids = 291.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,503.0 cf = 0.035 af
Overall Storage Efficiency = 53.6%
Overall System Size = 84.00' x 20.00' x 1.67'

40 Chambers
103.9 cy Field
27.0 cy Stone



Summary for Pond B-2: Level Spreader

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 7.20" for 100-yr event
Inflow = 12.45 cfs @ 12.09 hrs, Volume= 1.008 af
Outflow = 12.47 cfs @ 12.09 hrs, Volume= 1.006 af, Atten= 0%, Lag= 0.1 min
Primary = 12.47 cfs @ 12.09 hrs, Volume= 1.006 af
Routed to Link DP-B : Western Properties

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 117.80' @ 12.09 hrs Surf.Area= 180 sf Storage= 127 cf

Plug-Flow detention time= 2.5 min calculated for 1.004 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (775.4 - 774.3)

Volume	Invert	Avail.Storage	Storage Description
#1	115.30'	65 cf	**3.00'W x 30.00'L x 2.20'H Prismatoid** 198 cf Overall - 34 cf Embedded = 164 cf x 40.0% Voids
#2	117.50'	90 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#3	115.80'	34 cf	**15.0" Round Pipe Storage** Inside #1 L= 28.0'
		190 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
117.50	90	0	0
118.50	90	90	90

Device	Routing	Invert	Outlet Devices
#1	Primary	117.50'	**30.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=12.20 cfs @ 12.09 hrs HW=117.80' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 12.20 cfs @ 1.37 fps)

Summary for Pond C-1: Subsurface Infiltration System

Inflow Area = 0.570 ac, 58.77% Impervious, Inflow Depth = 7.51" for 100-yr event
Inflow = 4.29 cfs @ 12.09 hrs, Volume= 0.357 af
Outflow = 4.27 cfs @ 12.10 hrs, Volume= 0.335 af, Atten= 0%, Lag= 0.8 min
Primary = 4.27 cfs @ 12.10 hrs, Volume= 0.335 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.16' @ 12.10 hrs Surf.Area= 888 sf Storage= 1,208 cf

Plug-Flow detention time= 65.6 min calculated for 0.335 af (94% of inflow)
Center-of-Mass det. time= 31.2 min (778.6 - 747.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	116.25'	350 cf	**12.00'W x 74.00'L x 2.67'H Field A** 2,371 cf Overall - 1,495 cf Embedded = 876 cf x 40.0% Voids
#2A	116.25'	1,000 cf	**Shea Leaching Chamber 8x14x2.7**x 5 Inside #1 Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf
		1,350 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**18.0" Round Culvert** L= 150.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 116.25' / 115.30' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	117.75'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.26 cfs @ 12.10 hrs HW=118.16' (Free Discharge)
↑**1=Culvert** (Passes 4.26 cfs of 8.55 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.26 cfs @ 2.10 fps)

Pond C-1: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 8x14x2.7 (Shea Galley)
Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf
Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf

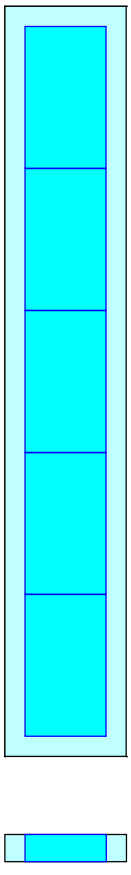
5 Chambers/Row x 14.00' Long = 70.00' Row Length +24.0" End Stone x 2 = 74.00' Base Length
1 Rows x 96.0" Wide + 24.0" Side Stone x 2 = 12.00' Base Width
32.0" Chamber Height = 2.67' Field Height

5 Chambers x 200.0 cf = 1,000.0 cf Chamber Storage
5 Chambers x 299.0 cf = 1,495.2 cf Displacement

2,371.0 cf Field - 1,495.2 cf Chambers = 875.8 cf Stone x 40.0% Voids = 350.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,350.3 cf = 0.031 af
Overall Storage Efficiency = 57.0%
Overall System Size = 74.00' x 12.00' x 2.67'

5 Chambers
87.8 cy Field
32.4 cy Stone



Summary for Pond C-2: Subsurface Infiltration System

Inflow Area = 0.870 ac, 61.49% Impervious, Inflow Depth = 7.51" for 100-yr event
Inflow = 6.54 cfs @ 12.09 hrs, Volume= 0.545 af
Outflow = 6.60 cfs @ 12.10 hrs, Volume= 0.517 af, Atten= 0%, Lag= 1.1 min
Primary = 6.60 cfs @ 12.10 hrs, Volume= 0.517 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.55' @ 12.10 hrs Surf.Area= 2,496 sf Storage= 2,090 cf

Plug-Flow detention time= 59.8 min calculated for 0.517 af (95% of inflow)
Center-of-Mass det. time= 30.4 min (777.8 - 747.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.33'	484 cf	**16.00'W x 156.00'L x 1.67'H Field A** 4,168 cf Overall - 2,959 cf Embedded = 1,209 cf x 40.0% Voids
#2A	117.33'	1,726 cf	**Shea Leaching Chamber 4x8x1.7** x 57 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 57 Chambers in 3 Rows
		2,210 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.75'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 115.75' / 115.30' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	118.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=6.49 cfs @ 12.10 hrs HW=118.55' (Free Discharge)
↑**1=Culvert** (Passes 6.49 cfs of 12.18 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 6.49 cfs @ 2.42 fps)

Pond C-2: Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = Shea Leaching Chamber 4x8x1.7 (Shea Ameration Chamber)
Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf
Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf

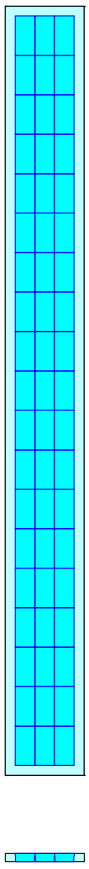
19 Chambers/Row x 8.00' Long = 152.00' Row Length +24.0" End Stone x 2 = 156.00' Base Length
3 Rows x 48.0" Wide + 24.0" Side Stone x 2 = 16.00' Base Width
20.0" Chamber Height = 1.67' Field Height

57 Chambers x 30.3 cf = 1,726.2 cf Chamber Storage
57 Chambers x 51.9 cf = 2,958.9 cf Displacement

4,168.3 cf Field - 2,958.9 cf Chambers = 1,209.4 cf Stone x 40.0% Voids = 483.8 cf Stone Storage

Chamber Storage + Stone Storage = 2,210.0 cf = 0.051 af
Overall Storage Efficiency = 53.0%
Overall System Size = 156.00' x 16.00' x 1.67'

57 Chambers
154.4 cy Field
44.8 cy Stone



Summary for Link DP-A: Isolated Vegetated Wetland

Inflow Area = 1.511 ac, 9.20% Impervious, Inflow Depth = 4.24" for 100-yr event
Inflow = 5.39 cfs @ 12.24 hrs, Volume= 0.534 af
Primary = 5.39 cfs @ 12.24 hrs, Volume= 0.534 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-B: Western Properties

Inflow Area = 2.144 ac, 33.07% Impervious, Inflow Depth = 5.71" for 100-yr event
Inflow = 12.47 cfs @ 12.09 hrs, Volume= 1.020 af
Primary = 12.47 cfs @ 12.09 hrs, Volume= 1.020 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Link DP-C: Hillman Storm System

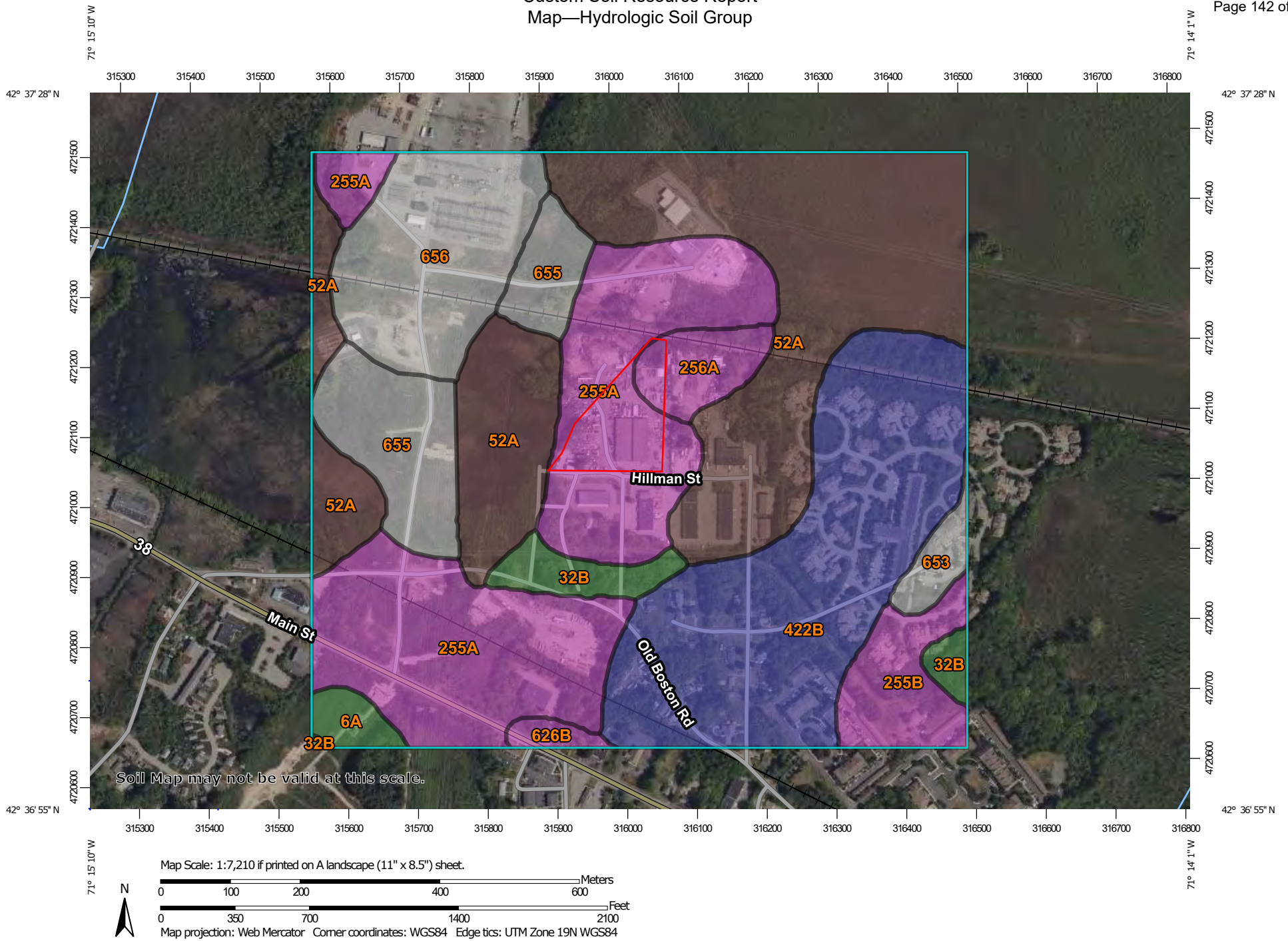
Inflow Area = 1.775 ac, 51.66% Impervious, Inflow Depth = 5.99" for 100-yr event
Inflow = 11.12 cfs @ 12.10 hrs, Volume= 0.886 af
Primary = 11.12 cfs @ 12.10 hrs, Volume= 0.886 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

APPENDIX D

Soil Test Pit Logs

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:7,210 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	2.1	1.1%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	A/D	4.9	2.5%
52A	Freetown muck, 0 to 1 percent slopes	B/D	56.2	28.3%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	47.7	24.0%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	7.4	3.7%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	4.7	2.3%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	B	39.8	20.0%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	1.2	0.6%
653	Udorthents, sandy		2.4	1.2%
655	Udorthents, wet substratum		14.2	7.2%
656	Udorthents-Urban land complex		17.8	9.0%
Totals for Area of Interest			**198.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

STORMWATER TEST PIT LOCATION PLAN

DATE: 02/27/2025
BY: LANGAN

PLAN REFERENCES

1. LAND COURT PLAN 3634 A SHOWING LAND OF LOCUS IN TEWKSBURY, MA, DATED NOIVEMBER, 1911.
2. LAND COURT PLAN 3634 B SHOWING LAND OF LOCUS (PARCEL B) IN TEWKSBURY, MA, DATED JUNE 19, 1917.
3. LAND COURT PLAN 3634 C SHOWING LAND IN TEWKSBURY, MA, DATED JULY 23, 1975 AND IS LAND EXCEPTED FROM LOCUS PARCEL B IN REFERENCE 1 SHOWN AS PARCEL 1.
4. AS-BUILT SITE PLAN, PHASE 1 ROCKLAND INDUSTRIAL CONDOMINIUMS IN TEWKSBURY, MA PREPARED FOR ROCKLAND DEVELOPMENT CORP., BY CUOCO & CORMIER, INC. DATED JUNE 22, 1990 RECORDED PLAN BOOK 175, PAGE 51.
5. PLAN OF LAND IN TEWKSBURY, MA PREPARED FOR MONICA & JOYCE CHINN, BY CHARLES E. CYR, CIVIL ENGINEER DATED SEPTEMBER, 1965 RECORDED PLAN BOOK 103, PAGE 169.

LEGEND

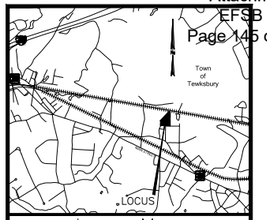
- BIT — BITUMINOUS
- BUILDING
- CB — CATCH BASIN
- X — CHAIN LINK FENCE
- CONC — CONCRETE
- CB/DH — CONCRETE BOUND/DRILL HOLE
- DMH — DRAIN MANHOLE
- DECIDUOUS TREE
- FF — FIRST FLOOR OR BUILDING HEIGHT
- HYDRANT
- LIGHT POLE
- MAILBOX
- METAL POLE
- MH — MISCELLANEOUS MANHOLE
- OHW — OVERHEAD WIRES
- SMH — SEWER MANHOLE
- SIGN
- SYL — SINGLE YELLOW LINE
- TREE OR HEDGE LINE
- UTILITY POLE
- UTILITY POLE W/TRANSFORMER
- VENT PIPE
- WATER GATE
- WETLAND
- WETLAND FLAG
- EDGE OF WETLAND
- 100' WETLAND BUFFER
- 1 FT CONTOUR
- 5 FT CONTOUR

GENERAL NOTES

1. THIS PLAN IS BASED UPON AN ON-THE-GROUND SURVEY PERFORMED BY BSC GROUP, INC. BETWEEN JUNE 27, 2024 AND JULY XX, 2024
2. HORIZONTAL DATUM IS BASED UPON NAD '83 AS DERIVED VIA GPS OBSERVATIONS PERFORMED BY BSC GROUP, INC. ON JULY 3, 2024.
3. VERTICAL DATUM IS BASED UPON NAVD '88 AS DERIVED VIA GPS OBSERVATIONS PERFORMED BY BSC GROUP, INC. ON JULY 27, 2024. SEE PLAN FOR TEMPORARY BENCH MARKS SET.
4. LOCUS IS LOCATED WITHIN ZONE X AS GRAPHICALLY DEPICTED ON FLOOD INSURANCE RATE MAP NUMBER 25017C0276F, EFFECTIVE DATE JULY 6, 2016.
5. LOCUS HAS DIRECT VEHICULAR AND PEDESTRIAN ACCESS TO HILLMAN STREET AND CLINTON STREET, PUBLIC STREETS IN THE TOWN OF TEWKSBURY.
6. THE PARCELS COMPRISING LOCUS FORM ONE CONTIGUOUS TRACT OF LAND, AND THERE ARE NO GAPS, GORES OR OVERLAPS.
7. WETLAND RESOURCE AREAS SHOWN HEREON WERE DELINEATED BY BSC GROUP, INC. ON

UTILITY NOTE

EXISTING UTILITIES, WHERE SHOWN HEREON, ARE APPROXIMATE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROPERLY LOCATING AND COORDINATING ANY ON-SITE ACTIVITY WITH DIG-SAFE AND THE APPROPRIATE UTILITY COMPANY AND MAINTAINING EXISTING UTILITY SYSTEM SERVICE. DIG-SAFE SHALL BE NOTIFIED PER THE COMMONWEALTH OF MASSACHUSETTS STATUTE CHAPTER 82, SECTION 40, AT 1-888-344-7233. NO GUARANTEE IS IMPLIED OR INTENDED AS TO THE ACCURACY, LOCATION OR THAT ALL UTILITIES AND/OR SUBSURFACE STRUCTURES ARE SHOWN. THE CONTRACTOR SHALL VERIFY SIZE, LOCATION AND INVERTS OR UTILITIES AND STRUCTURES AS REQUIRED PRIOR TO THE START OF CONSTRUCTION.



Locus Map
(NOT TO SCALE)

TOPOGRAPHIC PLAN OF LAND

HILLMAN STREET
IN
TEWKSBURY
MASSACHUSETTS
(MIDDLESEX COUNTY)

JULY 17, 2024

EXISTING CONDITIONS

REVISIONS:

NO.	DATE	DESC.

PREPARED FOR:
EAST POINT ENERGY
310 4TH STREET N.E., 3RD FLOOR
CHARLOTTESVILLE, VA 22902

BSC GROUP
BUILD | SUPPORT | CONNECT
1 Mercantile Street, Suite 610
Worcester, Massachusetts
01608
508 792 4500

SCALE: 1" = 40'
0 20 40 80 FEET

FILE: 008545801EC.DWG
DWG. NO: --
JOB. NO: 0085458.01
SHEET 1 OF 1

LANGAN

Log of Test Pit **TP-01** Sheet 1 of 1

Project	Project No.	Date
BESS Energy	151043401	2/26/2025
Location	**Elevation and Datum**	
73 Hillman Street, Tewksbury MA	Approx. el. 120.0 (NAVD 88)	
Excavation Company	**Depth**	**Water Level - First** / **Water Level - Completion**
F.E. French	10.0 ft	10.0 ▽ / 8.5 ▼
Excavation Equipment	**Excavation Foreman**	**Field Engineer**
CAT 305.5E Mini Excavator	Scott Perachi	Shawn OConnor

SYMBOL	Elev. (ft)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
	+120.0					
	+119.8	ASPHALT (3in)				
		Tannish brown Gravelly medium SAND, trace cobble, trace silt (moist) [FILL]		S-1	GRAB	S-1 from 1ft to 1.5ft
	+118.0					
		Light gray fine SAND, some subrounded gravel, some silt, trace cobble (moist) [SP-SM]		S-2	GRAB	S-2 from 3.5ft to 4ft
						Orange staining at 4.67ft.
				S-3	GRAB	S-3 from 6.5ft to 7ft
			▽			Groundwater first visible in test pit at 10ft. Water level rose in test pit to 8.5ft. Water appeared to weep into test pit at 7ft.
				S-4	GRAB	S-4 from 9.5ft to 10ft
	+110.0	End of Test Pit at 10.0ft.	▽			Test pit bottom at 10ft. Test pit backfilled to grade in 1ft lifts and tamped with the excavator bucket to grade. Vibratory plate compactor used at 1ft below grade. Cold patch used to seal test pit at grade.

LANGAN

Log of Test Pit **TP-02** Sheet 1 of 1

Project	Project No.	Date
BESS Energy	151043401	2/26/2025

Location	Elevation and Datum
73 Hillman Street, Tewksbury MA	Approx. el. 119.2 (NAVD 88)

Excavation Company	Depth	Water Level - First	Water Level - Completion
F.E. French	10.0 ft	8.0 ▽	8.0 ▼

Excavation Equipment	Excavation Foreman	Field Engineer
CAT 305.5E Mini Excavator	Scott Perachi	Shawn OConnor

SYMBOL	Elev. (ft)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
	+119.2					
	+119.0	ASPHALT (3in) Tannish brown Gravelly medium SAND, trace cobble, trace silt (moist) [FILL]	0	S-1	GRAB	S-1 from 0.5ft to 1ft
			1			
			2	S-2	GRAB	S-2 from 2ft to 2.5ft
			3			
			4			
			5	S-3	GRAB	S-3 from 4.5ft to 5ft Orange staining at 5ft. Broken black irrigation line at 5.5ft. Abandoned per property owner.
	+113.8			S-4	GRAB	S-4 from 5.5ft to 6ft
		Light gray fine SAND, some subrounded gravel, some silt, trace cobble (moist) [SP-SM]	6			
			7			
			8 ▽	S-5	GRAB	S-5 from 7.5ft to 8ft Groundwater first visible in test pit at 8ft. Water level remained at 8ft.
			9			
				S-6	GRAB	S-6 from 9.5ft to 10ft
	+109.2		10			Test pit bottom at 10ft. Test pit backfilled to grade in 1 lifts and tamped with the excavator bucket to grade. Vibratory plate compactor used at 1ft below grade. Top 2ft of test pit replaced with dense grade fill.
		End of Test Pit at 10.0ft.	11			
			12			
			13			
			14			
			15			
			16			
			17			
			18			
			19			
			20			

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Log of Test Pit **TP-03** Sheet 1 of 1

Project	Project No.	Date
BESS Energy	151043401	2/26/2025

Location	Elevation and Datum
73 Hillman Street, Tewksbury MA	Approx. el. 119.8 (NAVD 88)

Excavation Company	Depth	Water Level - First	Water Level - Completion
F.E. French	8.0 ft	7.0 ▽	6.0 ▼

Excavation Equipment	Excavation Foreman	Field Engineer
CAT 305.5E Mini Excavator	Scott Perachi	Shawn OConnor

SYMBOL	Elev. (ft)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
	+119.8					
	+119.5	ASPHALT (3in)	0			
		Gray Gravelly medium SAND, trace cobble, trace silt, woody vegetation, brick (moist) [FILL]	1	S-1	GRAB	S-1 from 0.5ft to 1ft
	+116.8		2			
		Light gray medium SAND, trace subrounded gravel, trace silt (moist) [SP-SM]	3			
			4			Orange staining at 4ft.
			5	S-2	GRAB	S-2 from 4.5ft to 5ft
			6 ▽			Groundwater first visible in test pit at 7ft. Water level rose in test pit to 6ft.
			7 ▽			
			8	S-3	GRAB	S-3 from 7.5ft to 8ft.
	+111.8	End of Test Pit at 8.0ft.				Test pit bottom at 8ft. Test pit backfilled to grade in 1ft lifts and tamped with the excavator bucket. Vibratory plate compactor used at 1ft below grade. Cold patch used to seal test pit at grade.
			9			
			10			
			11			
			12			
			13			
			14			
			15			
			16			
			17			
			18			
			19			
			20			

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Log of Test Pit **TP-04** Sheet 1 of 1

Project	Project No.	Date
BESS Energy	151043401	2/26/2025

Location	Elevation and Datum
73 Hillman Street, Tewksbury MA	Approx. el. 119.2 (NAVD 88)

Excavation Company	Depth	Water Level - First	Water Level - Completion
F.E. French	10.0 ft	9.0 ▽	7.0 ▼

Excavation Equipment	Excavation Foreman	Field Engineer
CAT 305.5E Mini Excavator	Scott Perachi	Shawn OConnor

SYMBOL	Elev. (ft)	DESCRIPTION	Depth Scale	SAMPLE Number	SAMPLE Type	REMARKS
	+119.2	Gray Gravelly medium SAND, trace cobble, brick, woody vegetation, metal, nylon, roots (moist) [FILL]	0	S-1	GRAB	S-1 from 0ft to 0.5ft
			1			
			2			
			3	S-2	GRAB	S-2 from 2.5ft to 3ft
			4			
	+114.8	Tannish brown medium SAND, trace surrounded gravel, trace silt (moist) [SP-SM]	5			
			6	S-3	GRAB	Orange staining at 5.5ft. S-3 from 6ft to 6.5ft
			7 ▽			Groundwater first visible in test pit at 9ft. Water level rose in test pit to 7ft.
			8			
			9 ▽			
	+109.2		10	S-4	GRAB	S-4 from 9.5ft to 10ft
		End of Test Pit at 10.0ft.				Test pit bottom at 10ft. Test pit backfilled to grade in 1ft lifts and tamped with the excavator bucket. Top 2ft of test pit replaced with dense grade fill.
			11			
			12			
			13			
			14			
			15			
			16			
			17			
			18			
			19			
			20			

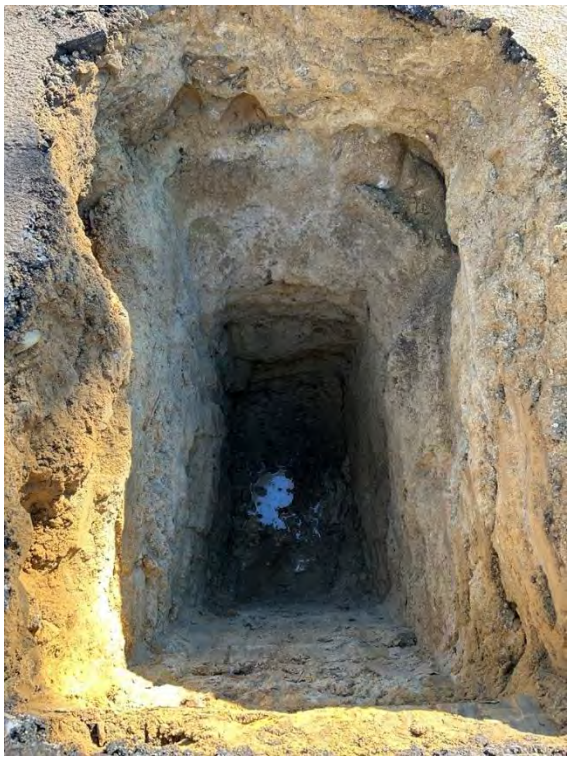

Photo 1: General View of Excavated Test Pit TP-01

Photo 2: Test Pit TP-01 Sidewall

Photo 3: Test Pit TP-01 Soil Stockpile

Photo 4: General View of Excavated Test Pit TP-02

Photo 5: Test Pit TP-02 Sidewall

Photo 6: Test Pit TP-02 Soil Stockpile

Photo 7: General View of Excavated Test Pit TP-03

Photo 8: Test Pit TP-03 Sidewall

Photo 9: Test Pit TP-03 Soil Stockpile

Photo 10: Test Pit TP-03 Fill Debris

Photo 11: General View of Excavated Test Pit TP-04

Photo 12: Test Pit TP-04 Sidewall

Photo 13: Test Pit TP-04 Soil Stockpile

Photo 14: Test Pit TP-04 Fill Debris

APPENDIX E

TSS Removal Worksheets

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TSS Removal Calculation Worksheet

100 Cambridge Street
Boston, MA 02114

Project Name:	**Hillman Energy Center**	Sheet:	**1 of 1**
Project Number:	**151043401**	Date:	**10-Mar-2025**
Location:	**Tewksbury MA**	Computed by:	**HH**
Discharge Point:	**DP-B and DP-C**	Checked by:	
Drainage Area(s):	**PR B-1, PR B-2, PR C-1, PR C-2 (Pre-Treatment)**		

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Water Quality Unit	**80%**	**1.00**	**0.80**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)

Treatment Train TSS Removal = **80%**

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TSS Removal Calculation Worksheet

100 Cambridge Street
Boston, MA 02114

Project Name:	**Hillman Energy Center**	Sheet:	**1 of 1**
Project Number:	**151043401**	Date:	**10-Mar-2025**
Location:	**Tewksbury MA**	Computed by:	**HH**
Discharge Point:	**DP-B and DP-C**	Checked by:	
Drainage Area(s):	**PR B-2, PR C-1, PR C-2**		

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Subsurface Infiltration Structure	**80%**	**1.00**	**0.80**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)

Treatment Train TSS Removal = **80%**

NJCAT TECHNOLOGY VERIFICATION
(See Disclaimer in Section 1.2)

First Defense® HC Stormwater Treatment Device

Removal Efficiency of Suspended Sediment for Varying Particle Size Distributions

Hydro International

September, 2016
(Expanded Section 4.4 February 2017)

1. Inlet pipe
2. Vortex treatment chamber
3. Sediment storage sump
4. Internal bypass chamber
5. Internal bypass weir
6. Outlet pipe

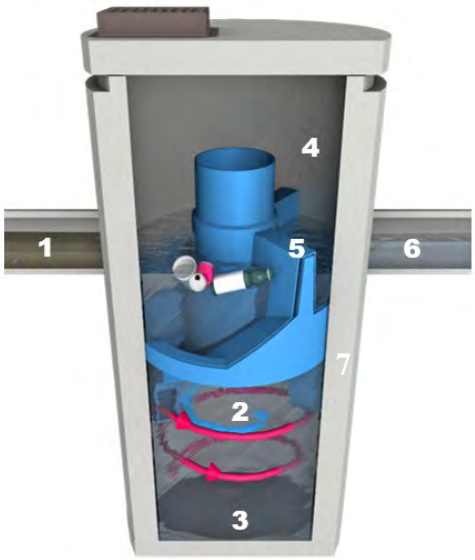

Figure 1 First Defense® HC

The FDHC is available in the standard model sizes shown in **Table 1.**

Table 1 First Defense® HC Model Size Range

First Defense® HC Model	Manhole Diameter (ft)	Hydraulic Capacity (cfs)	Maximum Pipe Diameter (in)	Oil Storage Capacity (gal)	Sediment Storage Capacity (yd^3)
3-ft	3-ft	15	18	125	0.4
4-ft	4-ft	18	24	191	0.7
5-ft	5-ft	20	24	300	1.1
6-ft	6-ft	32	30	496	1.6
8-ft	8-ft	50	48	1,120	2.8

3. First Defense® HC Performance Evaluation

The objective of this performance evaluation was to determine the Total Suspended Solids removal efficiencies of the FDHC within specific particle sizes ranges when tested with the NJDEP-specified test sediment, which ranges from 1 µm to 1000 µm in diameter. The test setup and procedures were conducted in accordance with the New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device dated January 25, 2013.

The testing was conducted on a 4-ft FDHC at Hydro International's laboratory in Portland, Maine. In compliance with the requirement that the performance evaluation be independent, all testing and set-up was conducted under the supervision of third party witnesses from FB Environmental Associates, Inc. FB Environmental is a Portland, Maine based environmental

engineering consultancy with prior experience serving as the independent observer for several hydrodynamic separator laboratory testing programs.

Hydro followed the sediment analysis methods as required by the ETV-Canada protocol, which uses the New Jersey Particle Size Distribution as a test blend, for analyzing the feed sediment and the sediment in the effluent water quality samples. The ETV-Canada procedure was written by a panel of independent governing bodies, independent testing laboratories and manufacturers. The procedure requires that the influent determinations be based on the ASTM D422-63 method because of the test blend's broad spectrum of particle sizes. This method, which uses a hydrometer, was deemed the best fit to analyze concentrations at particle sizes at the specified cut points, though one of the limitations of the method is its accurateness below 20 micron. For the effluent, however, the assumption is that much of the coarse material (>250 microns) has been removed and therefore the ISO 13320 (2009) method is preferable because laser diffraction is more accurate at analyzing fines (at many different cut points) than a hydrometer.

All water quality samples were collected, labeled and sealed under the direct supervision of the independent observer from FB Environmental. Maine Environmental Laboratory in Yarmouth, Maine conducted the water quality analysis and Microtrac, Inc. of York, Pennsylvania conducted the particle size distribution analysis.

3.1 Test Unit

The test unit was a 4-ft FDHC comprised of full scale, commercially available 4-ft FDHC internal components installed in a 4-ft round plastic manhole chamber consistent in all key dimensions with the precast chambers used for commercial sales (**Figure 2**). Both the inlet and outlet pipe diameters of the test model were 24 inches, which is the standard pipe size for a 4-ft FDHC.

Table 13 Removal Efficiency for Particles Larger Than ("down to") 50 µm

Flow Rate	0.38 cfs		0.75 cfs		1.13 cfs		1.5 cfs		1.88 cfs	
Range (µm)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)
500 to 1,000	202.6	0	229.4	0	244.0	0	287.1	0	308.4	0
250 to 500	303.8	0	344.2	0	366.0	0	430.6	0	462.5	0
150 to 250	506.4	2.2	573.6	2.9	610.0	0	717.7	4.3	770.9	21.4
100 to 150	957.1	20.1	1,084.1	27.7	1,153.0	19.0	1,356.4	42.5	1457.0	58.1
75 to 100	359.5	23.7	407.3	33.5	433.1	28.5	509.5	50.8	547.3	70.1
50 to 75	238.0	63.3	269.6	89.6	286.7	79.7	337.3	133.4	362.3	175.6
Sum	2,567.4	109.3	2,908.2	153.7	3,092.8	127.2	3,638.6	231	3,908.4	325.2
Efficiency	**95.7%**		**94.7%**		**95.9%**		**93.7%**		**91.7%**	

Table 14 Removal Efficiency for Particles 50 µm – 150 µm

Flow Rate	0.38 cfs		0.75 cfs		1.13 cfs		1.5 cfs		1.88 cfs	
Range (µm)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)	Influent (g)	Effluent (g)
100 to 150	957.1	20.1	1,084.1	27.7	1,153.0	19.0	1,356.4	42.5	1457.0	58.1
75 to 100	359.5	23.7	407.3	33.5	433.1	28.5	509.5	50.8	547.3	70.1
50 to 75	238.0	63.3	269.6	89.6	286.7	79.7	337.3	133.4	362.3	175.6
Sum	1,554.6	107.1	1,761.0	150.8	1,872.8	127.2	2,203.2	226.7	2,366.6	303.8
Efficiency	**93.1%**		**91.4%**		**93.2%**		**89.7%**		**87.2%**	

5. Conclusions

Performance testing of a 4-ft diameter FDHC was completed using test procedures that complied with the New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device dated January 25, 2013.

Additional effluent particle size analysis was also completed at five flow rates and compared to the test sediment particle size distribution to evaluate the performance of the FDHC based on seven particle size bands: 500-1000 µm, 250-500 µm, 150-250 µm, 100-150 µm, 75-100 µm, and 50-100 µm and 1- 50 µm. Five different flow test runs were completed to report removal efficiencies for the entire distribution, for the entire distribution less particles finer than 50 µm, for particles in the 50-150 µm range, and by particle size band.

As shown in **Figure 11**, the effluent particle size analysis showed that the FDHC removed greater than 80% of test sediment in the particle size bands larger than 75-100 µm for all tested

flow rates between 0.38 cfs and 1.88 cfs. The removal efficiency was greater than 60% for the test sediment in the particle size band 50-100 µm for flow rates up to 1.5 cfs and greater than 50% at the maximum flow rate tested. For particles in the range of 1-50 µm, the removal efficiency ranged from 25.5% at the lowest tested flow rate to zero at flow rates above 1.13 cfs.

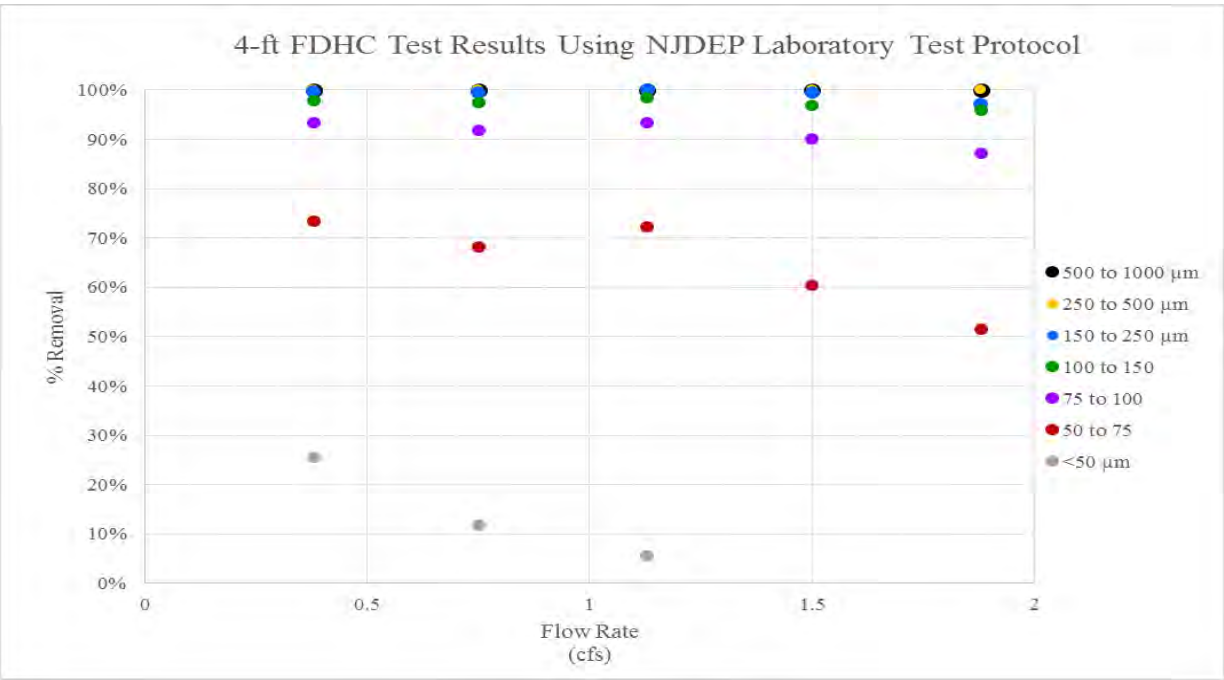

Figure 11 FDHC Particle Size Band Removal Rates vs Flow Rate

As shown in **Figure 12**, the effluent particle size analysis demonstrates the FDHC is capable of removing greater than 90% of the test sediment for all particles larger than (or "down to") 50 µm at all the tested flow rates.

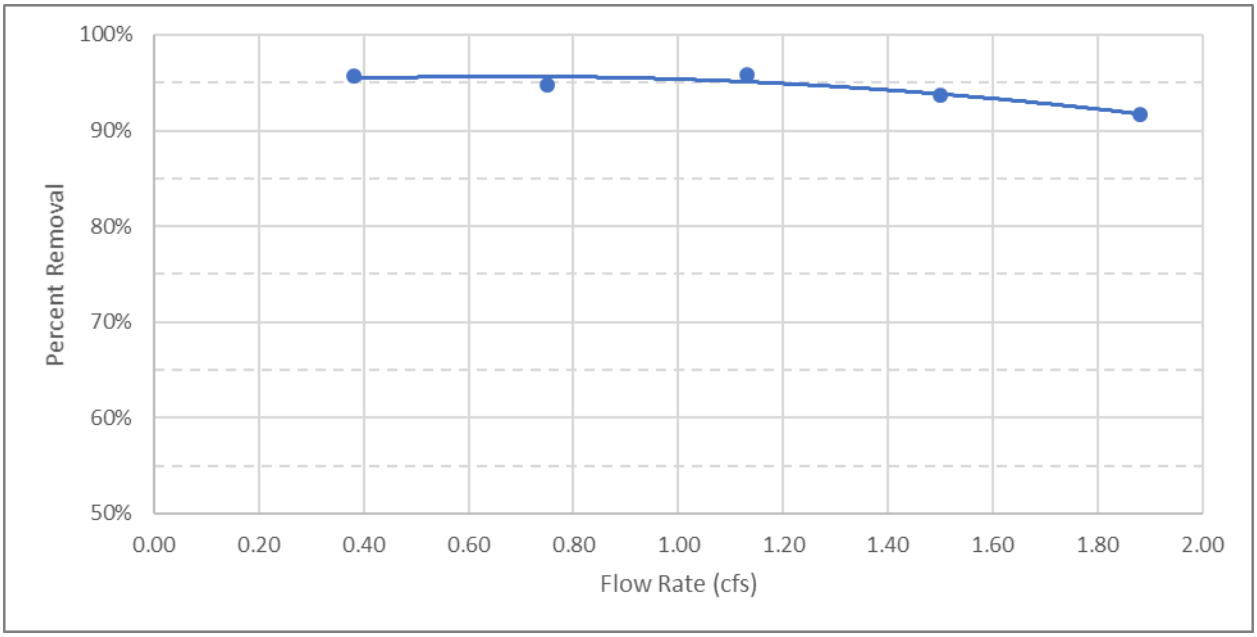

Figure 12 FDHC Removal Efficiency for Particles Larger Than ('down to") 50 µm

As shown in **Figure 13**, the effluent particle size analysis demonstrates the FDHC can remove greater than 85% of the test sediment for particles between 50 and 150 microns at all the tested flow rates.

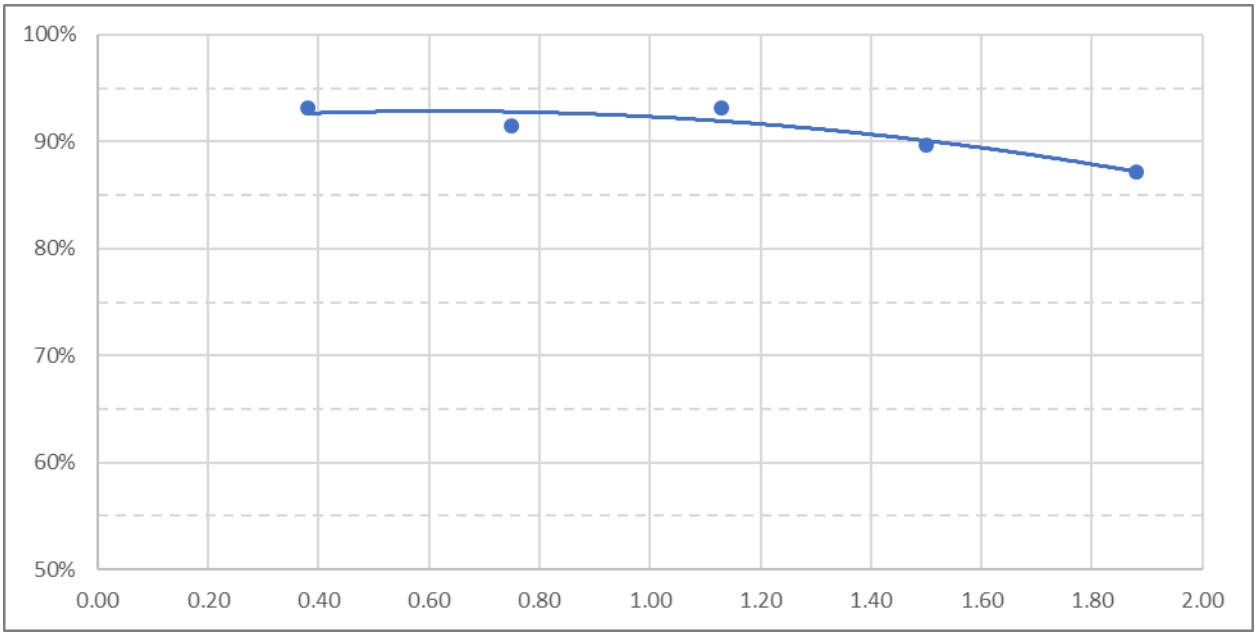

Figure 13 FDHC Removal Efficiency for Particles 50-150 µm

APPENDIX F

Recharge, Draindown, WQV Calculations

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Standard 3: Recharge

Total Impervious Coverage Site	70,830	sf	*1.626*	*ac*
Impervious Coverage HSG-A	70,830	sf	*0.00*	*ac*
Impervious Coverage HSG-B		sf	*0.000*	*ac*
Impervious Coverage HSG-C	0	sf	*0.00*	*ac*
Impervious Coverage HSG-D	0	sf	*0.00*	*ac*
Total Impervious Site Area Draining to Recharge Facilities	68,805	sf	*1.580*	*ac*
% Site Impervious Area Draining to Recharge Facilities			97%	
Recharge Adjustment = Site Impervious / Imp Draining to Recharge Facilities =			1.03	

HSG	F (in)	A_{Imp} (sf)	Rv (cf)
A	0.60	70,830	3,542
B	0.35	0	0
C	0.25	0	0
D	0.10	0	0
Total Required Recharge Volume, Rv			**3,542**
Adjusted Total Required Recharge			**3,646**

Total Recharge Volume Provided	**3,795**

Summary for Pond B-1: Subsurface infiltration system

Inflow Area = 1.680 ac, 42.20% Impervious, Inflow Depth = 2.80" for 2-yr event
Inflow = 4.95 cfs @ 12.09 hrs, Volume= 0.392 af
Outflow = 4.44 cfs @ 12.13 hrs, Volume= 0.354 af, Atten= 10%, Lag= 2.5 min
Primary = 4.44 cfs @ 12.13 hrs, Volume= 0.354 af
Routed to Pond B-2 : Level Spreader

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.87' @ 12.13 hrs Surf.Area= 3,520 sf Storage= 2,742 cf

Plug-Flow detention time= 89.2 min calculated for 0.354 af (90% of inflow)
Center-of-Mass det. time= 41.7 min (810.5 - 768.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.80'	316 cf	**20.00'W x 92.00'L x 1.67'H Field A** 3,073 cf Overall - 2,284 cf Embedded = 789 cf x 40.0% Voids
#2A	117.80'	1,333 cf	**Shea Leaching Chamber 4x8x1.7**x 44 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 44 Chambers in 4 Rows
#3B	117.80'	292 cf	**20.00'W x 84.00'L x 1.67'H Field B** 2,806 cf Overall - 2,076 cf Embedded = 729 cf x 40.0% Voids
#4B	117.80'	1,211 cf	**Shea Leaching Chamber 4x8x1.7**x 40 Inside #3 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 40 Chambers in 4 Rows
		3,151 cf	Total Available Storage

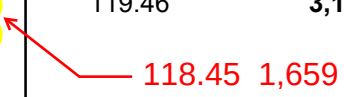
Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	117.00'	**15.0" Round Culvert X 2.00** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 117.00' / 115.80' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	118.45'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.35 cfs @ 12.13 hrs HW=118.87' (Free Discharge)
↑**1=Culvert** (Passes 4.35 cfs of 13.18 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.35 cfs @ 2.11 fps)

Stage-Area-Storage for Pond B-1: Subsurface infiltration system

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
117.80	0	118.82	2,604
117.82	51	118.84	2,655
117.84	102	118.86	2,706
117.86	153	118.88	2,757
117.88	204	118.90	2,808
117.90	255	118.92	2,859
117.92	306	118.94	2,909
117.94	357	118.96	2,960
117.96	408	118.98	2,988
117.98	459	119.00	2,995
118.00	511	119.02	3,001
118.02	562	119.04	3,008
118.04	613	119.06	3,015
118.06	664	119.08	3,021
118.08	715	119.10	3,028
118.10	766	119.12	3,035
118.12	817	119.14	3,041
118.14	868	119.16	3,048
118.16	919	119.18	3,055
118.18	970	119.20	3,061
118.20	1,021	119.22	3,068
118.22	1,072	119.24	3,075
118.24	1,123	119.26	3,081
118.26	1,174	119.28	3,088
118.28	1,225	119.30	3,094
118.30	1,276	119.32	3,101
118.32	1,327	119.34	3,108
118.34	1,378	119.36	3,114
118.36	1,430	119.38	3,121
118.38	1,481	119.40	3,128
118.40	1,532	119.42	3,134
118.42	1,583	119.44	3,141
118.44	1,634	119.46	**3,148**
118.46	1,685		
118.48	1,736		
118.50	1,787		
118.52	1,838		
118.54	1,889		
118.56	1,940		
118.58	1,991		
118.60	2,042		
118.62	2,093		
118.64	2,144		
118.66	2,195		
118.68	2,246		
118.70	2,297		
118.72	2,349		
118.74	2,400		
118.76	2,451		
118.78	2,502		
118.80	2,553		



Summary for Pond C-1: Subsurface Infiltration System

Inflow Area = 0.570 ac, 58.77% Impervious, Inflow Depth = 2.84" for 2-yr event
Inflow = 1.69 cfs @ 12.09 hrs, Volume= 0.135 af
Outflow = 1.67 cfs @ 12.10 hrs, Volume= 0.113 af, Atten= 1%, Lag= 1.0 min
Primary = 1.67 cfs @ 12.10 hrs, Volume= 0.113 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 117.97' @ 12.10 hrs Surf.Area= 888 sf Storage= 1,086 cf

Plug-Flow detention time= 117.9 min calculated for 0.113 af (84% of inflow)
Center-of-Mass det. time= 51.2 min (817.4 - 766.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	116.25'	350 cf	**12.00'W x 74.00'L x 2.67'H Field A** 2,371 cf Overall - 1,495 cf Embedded = 876 cf x 40.0% Voids
#2A	116.25'	1,000 cf	**Shea Leaching Chamber 8x14x2.7**x 5 Inside #1 Inside= 84.0"W x 24.0"H => 15.38 sf x 13.00'L = 200.0 cf Outside= 96.0"W x 32.0"H => 21.36 sf x 14.00'L = 299.0 cf
		1,350 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**18.0" Round Culvert** L= 150.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 116.25' / 115.30' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	117.75'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.65 cfs @ 12.10 hrs HW=117.97' (Free Discharge)
↑**1=Culvert** (Passes 1.65 cfs of 8.00 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.65 cfs @ 1.53 fps)

Stage-Area-Storage for Pond C-1: Subsurface Infiltration System

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
116.25	0	117.27	644	118.29	1,268
116.27	13	117.29	656	118.31	1,270
116.29	25	117.31	669	118.33	1,273
116.31	38	117.33	682	118.35	1,276
116.33	50	117.35	694	118.37	1,278
116.35	63	117.37	707	118.39	1,281
116.37	76	117.39	720	118.41	1,283
116.39	88	117.41	732	118.43	1,286
116.41	101	117.43	745	118.45	1,289
116.43	114	117.45	757	118.47	1,291
116.45	126	117.47	770	118.49	1,294
116.47	139	117.49	783	118.51	1,297
116.49	151	117.51	795	118.53	1,299
116.51	164	117.53	808	118.55	1,302
116.53	177	117.55	821	118.57	1,304
116.55	189	117.57	833	118.59	1,307
116.57	202	117.59	846	118.61	1,310
116.59	215	117.61	858	118.63	1,312
116.61	227	117.63	871	118.65	1,315
116.63	240	117.65	884	118.67	1,318
116.65	252	117.67	896	118.69	1,320
116.67	265	117.69	909	118.71	1,323
116.69	278	117.71	922	118.73	1,325
116.71	290	117.73	934	118.75	1,328
116.73	303	117.75	947	118.77	1,331
116.75	316	117.77	959	118.79	1,333
116.77	328	117.79	972	118.81	1,336
116.79	341	117.81	985	118.83	1,338
116.81	353	117.83	997	118.85	1,341
116.83	366	117.85	1,010	118.87	1,344
116.85	379	117.87	1,023	118.89	1,346
116.87	391	117.89	1,035	118.91	**1,349**
116.89	404	117.91	1,048		
116.91	417	117.93	1,060		
116.93	429	117.95	1,073		
116.95	442	117.97	1,086		
116.97	454	117.99	1,098		
116.99	467	118.01	1,111		
117.01	480	118.03	1,124		
117.03	492	118.05	1,136		
117.05	505	118.07	1,149		
117.07	518	118.09	1,161		
117.09	530	118.11	1,174		
117.11	543	118.13	1,187		
117.13	555	118.15	1,199		
117.15	568	118.17	1,212		
117.17	581	118.19	1,225		
117.19	593	118.21	1,237		
117.21	606	118.23	1,250		
117.23	619	118.25	1,262		
117.25	631	118.27	1,265		

Summary for Pond C-2: Subsurface Infiltration System

Inflow Area = 0.870 ac, 61.49% Impervious, Inflow Depth = 2.84" for 2-yr event
Inflow = 2.58 cfs @ 12.09 hrs, Volume= 0.206 af
Outflow = 2.37 cfs @ 12.12 hrs, Volume= 0.178 af, Atten= 8%, Lag= 2.1 min
Primary = 2.37 cfs @ 12.12 hrs, Volume= 0.178 af
Routed to Link DP-C : Hillman Storm System

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 118.28' @ 12.12 hrs Surf.Area= 2,496 sf Storage= 1,684 cf

Plug-Flow detention time= 109.0 min calculated for 0.178 af (87% of inflow)
Center-of-Mass det. time= 49.6 min (815.8 - 766.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	117.33'	484 cf	**16.00'W x 156.00'L x 1.67'H Field A** 4,168 cf Overall - 2,959 cf Embedded = 1,209 cf x 40.0% Voids
#2A	117.33'	1,726 cf	**Shea Leaching Chamber 4x8x1.7**x 57 Inside #1 Inside= 41.0"W x 14.0"H => 4.08 sf x 7.42'L = 30.3 cf Outside= 48.0"W x 20.0"H => 6.49 sf x 8.00'L = 51.9 cf 57 Chambers in 3 Rows
		2,210 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	115.75'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 115.75' / 115.30' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	118.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.31 cfs @ 12.12 hrs HW=118.27' (Free Discharge)
↑**1=Culvert** (Passes 2.31 cfs of 11.33 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.31 cfs @ 1.71 fps)

Stage-Area-Storage for Pond C-2: Subsurface Infiltration System

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
117.33	0	118.35	1,811
117.35	36	118.37	1,846
117.37	71	118.39	1,882
117.39	107	118.41	1,917
117.41	142	118.43	1,953
117.43	178	118.45	1,988
117.45	213	118.47	2,023
117.47	249	118.49	2,058
117.49	284	118.51	2,078
117.51	320	118.53	2,084
117.53	355	118.55	2,089
117.55	391	118.57	2,094
117.57	426	118.59	2,100
117.59	462	118.61	2,105
117.61	497	118.63	2,111
117.63	533	118.65	2,116
117.65	568	118.67	2,121
117.67	604	118.69	2,127
117.69	639	118.71	2,132
117.71	675	118.73	2,137
117.73	710	118.75	2,143
117.75	746	118.77	2,148
117.77	781	118.79	2,154
117.79	817	118.81	2,159
117.81	852	118.83	2,164
117.83	888	118.85	2,170
117.85	923	118.87	2,175
117.87	959	118.89	2,180
117.89	994	118.91	2,186
117.91	1,030	118.93	2,191
117.93	1,065	118.95	2,197
117.95	1,101	118.97	2,202
117.97	1,136	118.99	**2,207**
117.99	1,172		
118.01	1,207		
118.03	1,243		
118.05	1,278		
118.07	1,314		
118.09	1,349		
118.11	1,385		
118.13	1,420		
118.15	1,456		
118.17	1,491		
118.19	1,527		
118.21	1,562		
118.23	1,598		
118.25	1,633		
118.27	1,669		
118.29	1,704		
118.31	1,740		
118.33	1,775		

Standard 3: 72-hour Drawdown Analysis

Table 2.3.3. 1982 Rawls Rates[18]

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

$$\text{Drawdown Time} = \frac{Rv}{(K)\,(\text{Bottom Area})}$$

where:

Rv = Storage Volume Below Outlet [Ac-ft]
K= Infiltration Rate [in/hr]
Bottom Area= Bottom Area of Recharge System [Ac]

Infiltration System B-1

Rv =	0.038	Ac-ft	
K =	2.410	in/hr	
Bottom Area =	0.081	Acres	
Drawdown Time =	**2.3**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Infiltration System C-1

Rv =	0.022	Ac-ft	
K =	2.410	in/hr	
Bottom Area =	0.020	Acres	
Drawdown Time =	**5.3**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Infiltration System C-2

Rv =	0.027	Ac-ft	
K =	2.410	in/hr	
Bottom Area =	0.057	Acres	
Drawdown Time =	**2.4**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Stormwater Quality Calculations

Calculation	Design Guideline
Stormwater Quality Volume (WQV)	Massachusetts Stormwater Handbook / MS4 Watershed
Stormwater Quality Flow (WQF)	MassDEP & Ubran Hydrology for Small Watersheds TR-55

Proposed Watershed **B-1**

Watershed Characteristics

Total Watershed Area	0.56	ac			
Impervious Area, A_{imp}	0.04	ac	>>>	**0.0001**	**mi^2**
Time of Concentration , T_c	6	min	>>>	**0.1**	**hr**

Water Quality Volume (WQV)

WQV = $(Q_{WQV})*(A_{Imp})$

Water Quality Depth, Q_{WQV}	1.0	in
Impervious Area, A_{imp}	0.04	ac

Water Quality Volume, WQV **0.00** **ac-ft** >>> **145** **ft^3**

Water Quality Flow (WQF)

WQF = $(q_u)*(A_{Imp})*(Q_{WQV})$
q_u = Unit Peak Discharge (csm/in)
A = drainage area (mi^2)

Water Quality Depth, Q_{WQV}	1.0	in	
CN =	98		
Tc =	0.100	hr	
Ia =	0.041		
P =	1.2	in	
Ia / P =	0.034		
Unit Peak Discharge, q_u	774	csm/in	Determine qu, using *MassDEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices* Figure 3 or 4 for Ia/P =0.034 for 1" Q_{WQV}
Water Quality Flow, WQF =	**0.08**	**cfs**	

Hillman Energy Center Tewksbury, MA	BY	HH	DATE	3/10/2025	PROJ NO. 151043401
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Stormwater Quality Calculations

Calculation	Design Guideline
Stormwater Quality Volume (WQV)	Massachusetts Stormwater Handbook / MS4 Watershed
Stormwater Quality Flow (WQF)	MassDEP & Ubran Hydrology for Small Watersheds TR-55

Proposed Watershed **B-2**

Watershed Characteristics

Total Watershed Area	1.12	ac			
Impervious Area, A_{imp}	0.67	ac	>>>	**0.001**	**mi^2**
Time of Concentration , T_c	6	min	>>>	**0.1**	**hr**

Water Quality Volume (WQV)

WQV = $(Q_{WQV})*(A_{Imp})$

Water Quality Depth, Q_{WQV}	1.0	in			
Impervious Area, A_{imp}	0.67	ac			
Water Quality Volume, WQV	**0.06**	**ac-ft**	>>>	**2,428**	**ft^3**

Water Quality Flow (WQF)

WQF = $(q_u)*(A_{Imp})*(Q_{WQV})$
q_u = Unit Peak Discharge (csm/in)
A = drainage area (mi^2)

Water Quality Depth, Q_{WQV}	1.0	in	
CN =	98		
Tc =	0.100	hr	
Ia =	0.041		
P =	1.2	in	
Ia / P =	0.034		
Unit Peak Discharge, q_u	774	csm/in	Determine qu, using *MassDEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices* Figure 3 or 4 for Ia/P =0.034 for 1" Q_{WQV}
Water Quality Flow, WQF =	**0.77**	**cfs**	

Hillman Energy Center Tewksbury, MA	BY	HH	DATE	3/10/2025	PROJ NO. 151043401
	REV		DATE		SHEET 2

Stormwater Quality Calculations

Calculation	Design Guideline
Stormwater Quality Volume (WQV)	Massachusetts Stormwater Handbook / MS4 Watershed
Stormwater Quality Flow (WQF)	MassDEP & Ubran Hydrology for Small Watersheds TR-55

Proposed Watershed **C-1**

Watershed Characteristics

Total Watershed Area	0.57	ac			
Impervious Area, A_{imp}	0.34	ac	>>>	**0.0005**	**mi^2**
Time of Concentration , T_c	6	min	>>>	**0.1**	**hr**

Water Quality Volume (WQV)

WQV = $(Q_{WQV})*(A_{Imp})$

Water Quality Depth, Q_{WQV}	1.0	in
Impervious Area, A_{imp}	0.34	ac

Water Quality Volume, WQV **0.03** **ac-ft** >>> **1,216** **ft^3**

Water Quality Flow (WQF)

WQF = $(q_u)*(A_{Imp})*(Q_{WQV})$
q_u = Unit Peak Discharge (csm/in)
A = drainage area (mi^2)

Water Quality Depth, Q_{WQV}	1.0	in
CN =	98	
Tc =	0.100	hr
Ia =	0.041	
P =	1.2	in
Ia / P =	0.034	
Unit Peak Discharge, q_u	774	csm/in
Water Quality Flow, WQF =	**0.39**	**cfs**

Determine qu, using *MassDEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices*
Figure 3 or 4 for Ia/P =0.034 for 1" Q_{WQV}

Hillman Energy Center Tewksbury, MA	BY HH	DATE 3/10/2025	PROJ NO. 151043401
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Stormwater Quality Calculations

Calculation	Design Guideline
Stormwater Quality Volume (WQV)	Massachusetts Stormwater Handbook / MS4 Watershed
Stormwater Quality Flow (WQF)	MassDEP & Ubran Hydrology for Small Watersheds TR-55

Proposed Watershed **C-2**

Watershed Characteristics

Total Watershed Area	0.87	ac			
Impervious Area, A_{imp}	0.54	ac	>>>	**0.0008**	**mi^2**
Time of Concentration , T_c	6	min	>>>	**0.1**	**hr**

Water Quality Volume (WQV)

WQV = $(Q_{WQV})*(A_{Imp})$

Water Quality Depth, Q_{WQV}	1.0	in			
Impervious Area, A_{imp}	0.54	ac			
Water Quality Volume, WQV	**0.04**	**ac-ft**	>>>	**1,942**	**ft^3**

Water Quality Flow (WQF)

WQF = $(q_u)*(A_{Imp})*(Q_{WQV})$
q_u = Unit Peak Discharge (csm/in)
A = drainage area (mi^2)

Water Quality Depth, Q_{WQV}	1.0	in	
CN =	98		
Tc =	0.100	hr	
Ia =	0.041		
P =	1.2	in	
Ia / P =	0.034		
Unit Peak Discharge, q_u	774	csm/in	Determine qu, using *MassDEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices* Figure 3 or 4 for Ia/P =0.034 for 1" Q_{WQV}
Water Quality Flow, WQF =	**0.62**	**cfs**	

Hillman Energy Center Tewksbury, MA	BY	HH	DATE	3/10/2025	PROJ NO. 151043401
	REV		DATE		SHEET 4

First Defense® High Capacity

A Simple Solution for your Trickiest Sites

Verified by NJCAT and NJDEP

Product Profile

The First Defense® High Capacity is an enhanced vortex separator that combines an effective stormwater treatment chamber with an integral peak flow bypass. It efficiently removes sediment total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® High Capacity is available in several model configurations to accommodate a wide range of pipe sizes, peak flows and depth constraints (**Table 1**, next page).

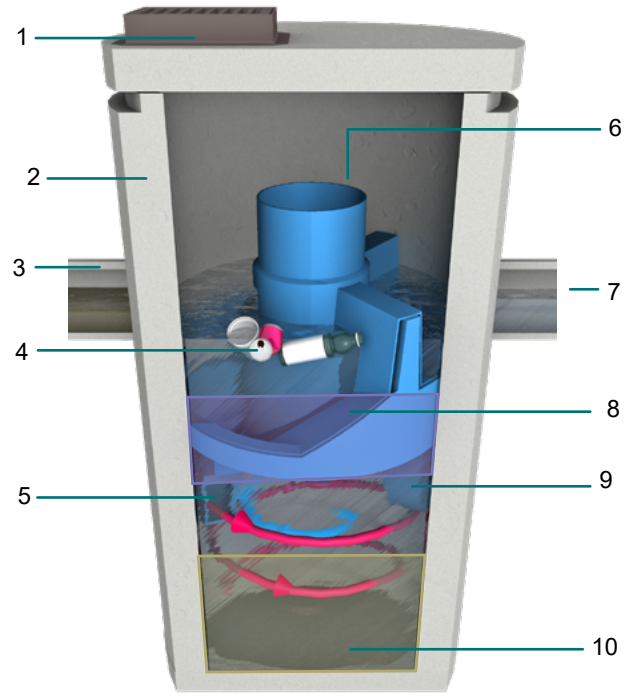
Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for “offline” arrangements using separate junction manholes
- Proven to prevent pollutant washout at up to 450% of its treatment flow
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

Fig.1 The First Defense® High Capacity has internal components designed to efficiently capture pollutants and prevent washout at peak flows.



Components

1. Inlet Grate (optional)
2. Precast chamber
3. Inlet Pipe (optional)
4. Floatables Draw Off Slot (not pictured)
5. Inlet Chute
6. Internal Bypass
7. Outlet pipe
8. Oil and Floatables Storage
9. Outlet chute
10. Sediment Storage Sump

How it Works

The First Defense® High Capacity has internal components designed to remove and retain gross debris, total suspended solids (TSS) and hydrocarbons (**Fig.1**).

Contaminated stormwater runoff enters the inlet chute from a surface grate and/or inlet pipe. The inlet chute introduces flow into the chamber tangentially to create a low energy vortex flow regime (magenta arrow) that directs sediment into the sump while oils, floating trash and debris rise to the surface.

Treated stormwater exits through a submerged outlet chute located opposite to the direction of the rotating flow (blue arrow). Enhanced vortex separation is provided by forcing the rotating flow within the vessel to follow the longest path possible rather than directly from inlet to outlet.

Higher flows bypass the treatment chamber to prevent turbulence and washout of captured pollutants. An internal bypass conveys infrequent peak flows directly to the outlet eliminating the need for, and expense of, external bypass control structures. A floatables draw off slot functions to convey floatables into the treatment chamber prior to bypass.

Hydro International, 94 Hutchins Drive, Portland, ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212
Email: stormwaterinquiry@hydro-int.com Web: www.hydro-int.com

First Defense® High Capacity

Sizing & Design

This adaptable online treatment system works easily with large pipes, multiple inlet pipes, inlet grates and now, contains a high capacity bypass for the conveyance of large peak flows. Designed with site flexibility in mind, the First Defense® High Capacity allows engineers to maximize available site space without compromising treatment level.

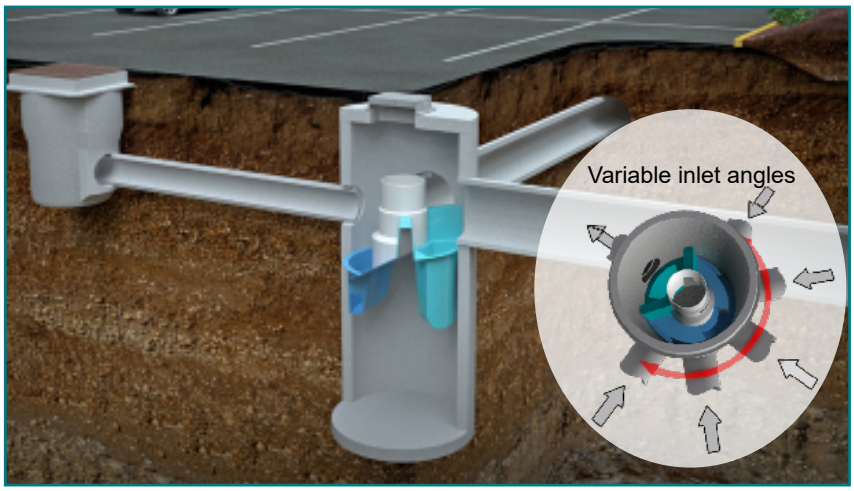


Fig 2. Works with multiple inlet pipes and grates

Inspection and Maintenance

Nobody maintains our systems better than we do. To ensure optimal, ongoing device performance, be sure to recommend Hydro International as a preferred service and maintenance provider to your clients.

Call **1 (800) 848-2706** to schedule an inspection and cleanout or learn more at **hydro-int.com/service**

Sizing Calcula t or for Engineers

This simple online tool will recommend the best separator, model size and online/offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.

Fig 3. Maintenance is done with a vactor truck

Table 1. First Defense® High Capacity Design Criteria.

First Defense® High Capacity Model Number	Diameter	Typical TSS Treatment Flow Rates		Peak Online Flow Rate	Maximum Pipe Diameter[1]	Oil Storage Capacity	Typical Sediment Storage Capacity[2]	Minimum Distance from Outlet Invert to Top of Rim[3]	Standard Distance from Outlet Invert to Sump Floor
		NJDEP Certified	110µm						
	(ft / m)	(cfs / L/s)	(cfs / L/s)	(cfs / L/s)	(in / mm)	(gal / L)	(yd^3 / m^3)	(ft / m)	(ft / m)
FD-3HC	3 / 0.9	0.84 / 23.7	1.06 / 30.0	15 / 424	18 / 457	125 / 473	0.4 / 0.3	2.0 - 3.5 / 0.6 - 1.0	3.71 / 1.13
FD-4HC	4 / 1.2	1.50 / 42.4	1.88 / 53.2	18 / 510	24 / 600	191 / 723	0.7 / 0.5	2.3 - 3.9 / 0.7 - 1.2	4.97 / 1.5
FD-5HC	5 / 1.5	2.35 / 66.2	2.94 / 83.2	20 / 566	24 / 600	300 / 1135	1.1 / .84	2.5 - 4.5 / 0.7 - 1.3	5.19 / 1.5
FD-6HC	6 / 1.8	3.38 / 95.7	4.23 / 119.8	32 / 906	30 / 750	496 / 1,878	1.6 / 1.2	3.0 - 5.1 / 0.9 - 1.6	5.97 / 1.8
FD-8HC	8 / 2.4	6.00 / 169.9	7.52 / 212.9	50 / 1,415	48 / 1219	1120 / 4239	2.8 / 2.1	3.0 - 6.0 / 0.9 -1.8	7.40 / 2.2

[1]Contact Hydro International when larger pipe sizes are required.
[2]Contact Hydro International when custom sediment storage capacity is required.
[3]Minimum distance for models depends on pipe diameter.

APPENDIX G

Long Term Pollution Prevention Operation and Maintenance Plan

LANGAN

OPERATION AND MAINTENANCE PLAN

Long Term Pollution Prevention Operation and Maintenance Plan

for

Hillman Energy Center
73 & 75 Hillman Street
Tewksbury, Massachusetts

Parcels 96-60 and 96-61

Prepared By:

Langan Engineering and Environmental Services, Inc.
100 Cambridge Street, Suite 1310
Boston, MA 02114

Prepared For:

East Point Energy, LLC
310 4th Street NE, 3rd Floor
Charlottesville, VA 22902

March 2025
Langan Project No. 151043401

LANGAN

Operation and Maintenance Plan
73 & 75 Hillman Street, Tewksbury, MA

Long Term Pollution Prevention Operation and Maintenance Plan

The purpose of this Long-Term Pollution Prevention Operation and Maintenance Plan ("O&M") is to provide project specific information related to the long term operation, maintenance, inspection, documentation, and performance of the structural and non-structural stormwater features. Regular inspection and maintenance of the stormwater management system is necessary to ensure proper operation of the system. The following O&M has been prepared to ensure the proposed system functions as intended. This O&M plan identifies maintenance procedures, schedules, and responsible parties.

The Long-Term Pollution Prevention Operation and Maintenance Plan has been compiled in general accordance with Federal, State, and Local requirement in addition to stormwater best management practices ("BMPs").

Responsible Parties

East Point Energy LLC, or any successor of, shall be the party responsible for implementing this O&M plan.

East Point Energy, LLC
310 4th Street NE, 3rd Floor
Charlottesville, VA 22902
Contact: Tyler Rynne

Stormwater Operation and Maintenance Procedures

Procedures are obtained from the Massachusetts Stormwater Handbook. These procedures are for all structural and non-structural BMPs and are intended to eliminate or reduce the long-term soil erosion and degradation of stormwater features following construction completion. The inspection and successful implementation of all stormwater measures shall be the Property Manager's responsibility. The Property Manager is responsible for training employees to perform O&M and to provide ongoing training as needed in response to staff changes. Implement employee training program and hold session at least once a year.

Estimated Annual Costs

The estimated annual cost for the implementation of this plan is $15,000.

Stormwater Management Plan Overview

Stormwater runoff is managed on site with an underground closed pipe network, manholes, water quality units, and underground infiltration systems.

Operation and Maintenance Plan
73 & 75 Hillman Street, Tewksbury, MA

Structural Pretreatment BMPs

Proprietary Water Quality Units (Hydrodynamic Separators - Inlet Structures)

Activity	Frequency
Inspect in accordance with manufacturer requirements, but no less than twice a year following installation, and no less than once a year thereafter.	See activity
Remove sediment and other trapped pollutants at frequency or level specified by manufacturer.	See manufacturer information

- Refer to manufacturer's maintenance procedures attached to this document.

Underground Structural BMPs

Underground Infiltration Systems

Activity	Frequency
Inspect inlets	Twice a year
Remove sediment, trash and other trapped pollutants.	Annually.

- Refer to manufacturer's maintenance procedures attached to this document.

Material and Equipment Storage

Material and equipment storage shall be done in a safe and orderly fashion. All debris and waste shall be collected and disposed of offsite in a legal manner in accordance with local and federal guidelines.

Snow Removal & Storage & Deicing Materials

Snow shall be shoveled and plowed from access roads and parking areas as soon as practical during and after winter storms and stored in snow storage areas on site.

Deicing materials may be applied to areas such as site access drives and parking areas before a storm event. Alternative materials to salt, such as calcium chloride and calcium magnesium acetate should be considered. Use of salt for deicing should be minimized on site. Deicing materials should be used with discretion in accordance with standard practices and over application must be avoided. Deicing materials shall be stored inside a building.

After the winter season, all parking areas and roads shall be cleaned of sediment and debris.

Spill Control & Containment

The following measures must be implemented to minimize, control, and contain spills:

- Store chemicals inside, when applicable

Operation and Maintenance Plan
73 & 75 Hillman Street, Tewksbury, MA

- Pick up litter
- The spill shall be contained as close to the source as possible with a dike of absorbent materials from the spill cleanup equipment (such as socks, pads, pillows, or "pigs"). Additional dikes must be constructed to protect swales or other stormwater conveyances or streams. A cover or dike will shall protect any other stormwater structures such as catch basins.
- Implement employee training program and hold session at least once a year
- Identify spill control team. The name(s) of the responsible spill personnel will be posted on-site.
- Each employee will be instructed that all spills are to be reported to the spill prevention and cleanup coordinator. The supervisor will assess the incident and initiate proper containment and response procedures immediately upon notification. Workers should avoid direct contact with spilled materials during the containment procedures.
- In the event of a release of oil or hazardous waste to the storm drainage system, the person shall immediately notify the Town's Fire and Public Works Departments and the Board of Health.
- Notifications in person or by phone shall be confirmed by written notice addressed and mailed to the Town within three business days of the phone notice.
- If the discharge of prohibited materials emanates from a commercial facility, the facility owner or operator of the facility shall retain on-site a written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained in accordance with the Massachusetts Public Records Law.

Pesticides and Fertilizers

- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow-release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary

Operation and Maintenance Plan
73 & 75 Hillman Street, Tewksbury, MA

STORMWATER MANAGEMENT SYSTEM INSPECTION AND MAINTENANCE CHECKLIST

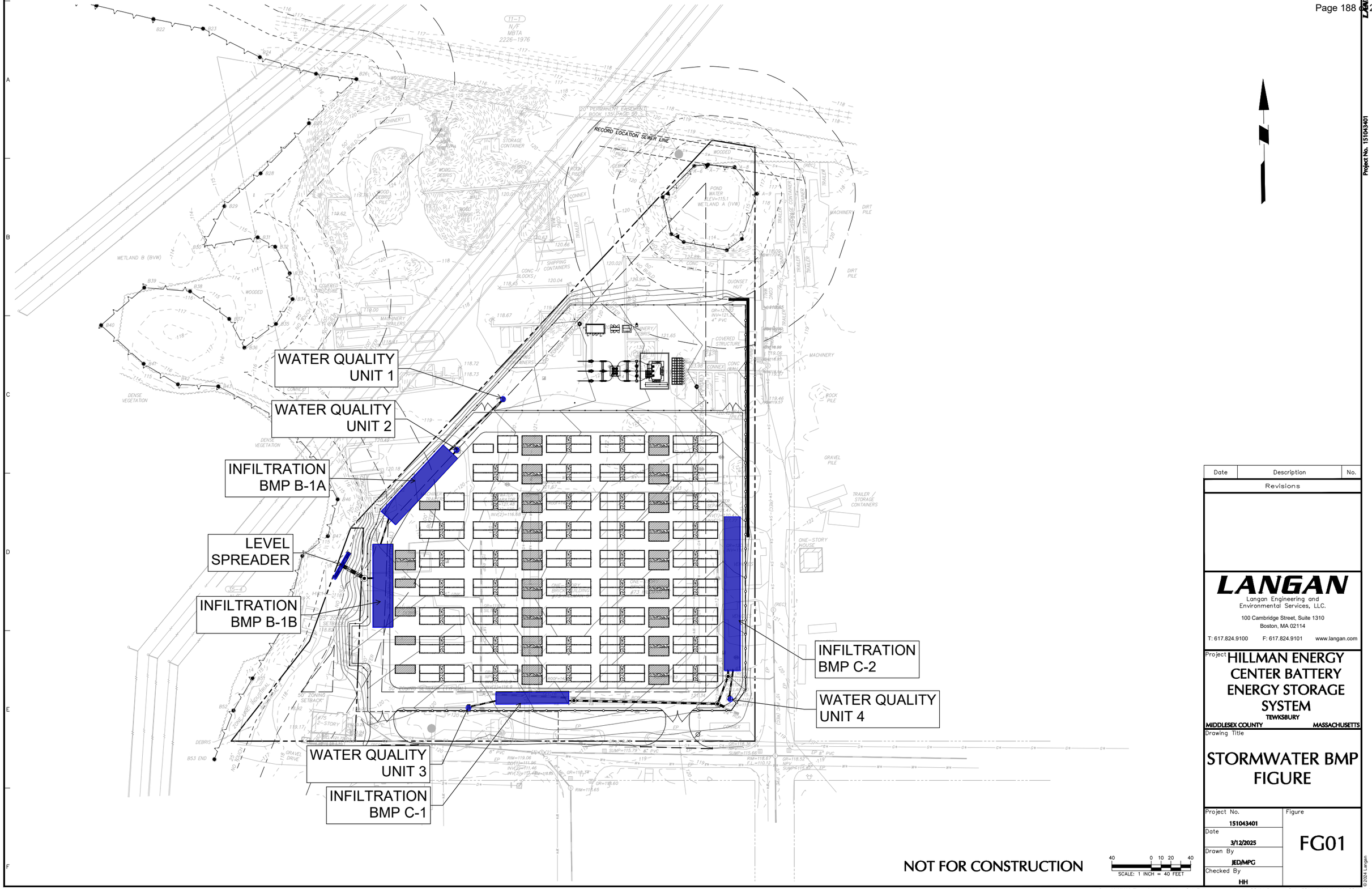
73 & 75 Hillman Street, Tewksbury, MA Date:		Time :	Inspector: Site Conditions:
Inspection & Maintenance Item	**Schedule**	**Satisfactory? Yes (Y) or No (N)**	**Comments or Corrective Measures Taken**
Proprietary Water Quality Units (Hydrodynamic Separators)			
Inspect per Manufacture Recommendations - **See manufacturer maintenance guide**	2x a year	Y N	
Remove Sediments and Pollutants	Level of sediment has reached 50% of sump capacity	Y N	
Underground Infiltration System			
Inspect outlet and inlet structures	2x a year	Y N	
Remove Sediments and Pollutants	Annually	Y N	

Operation and Maintenance Plan
73 & 75 Hillman Street, Tewksbury, MA

STORMWATER MANAGEMENT SYSTEM MAINTENANCE LOG FORM

73 & 75 Hillman Street, Tewksbury, MA

No.	Description of Maintenance Activity	Date	Staff or Contractor	Comments or Follow-up Items



Date	Description	No.
Revisions		

LANGAN
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100 Cambridge Street, Suite 1310
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T: 617.824.9100 F: 617.824.9101 www.langan.com

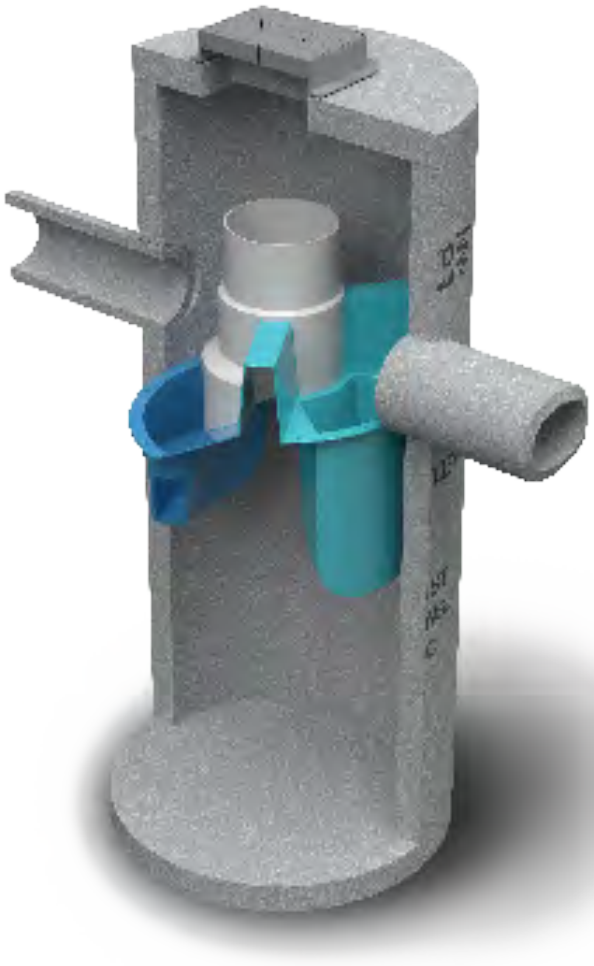
Project HILLMAN ENERGY CENTER BATTERY ENERGY STORAGE SYSTEM
TEWKSBURY
MIDDLESEX COUNTY MASSACHUSETTS

Drawing Title
STORMWATER BMP FIGURE

Project No.	Figure
151043401	FG01
Date: 3/12/2025	
Drawn By: JED/MPG	
Checked By: HH	

Project No. 151043401

Hydro International



Operation and Maintenance Manual

First Defense® High Capacity and First Defense®Optimum

Vortex Separator for Stormwater Treatment

Table of Contents

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

I. First Defense® by Hydro International

Introduction

The First Defense® is an enhanced vortex separator that combines an effective and economical stormwater treatment chamber with an integral peak flow bypass. It efficiently removes total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations to accommodate a wide range of pipe sizes, peak flows and depth constraints.

The two product models described in this guide are the First Defense® High Capacity and the First Defense® Optimum; they are inspected and maintained identically.

Operation

The First Defense® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The First Defense® has been designed to allow for easy and safe access for inspection, monitoring and clean-out procedures. Neither entry into the unit nor removal of the internal components is necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the First Defense® have been designed to optimize pollutant capture. Sediment is captured and retained in the base of the unit, while oil and floatables are stored on the water surface in the inner volume (Fig.1).

The pollutant storage volumes are isolated from the built-in bypass chamber to prevent washout during high-flow storm events. The sump of the First Defense® retains a standing water level between storm events. This ensures a quiescent flow regime at the onset of a storm, preventing resuspension and washout of pollutants captured during previous events.

Accessories such as oil absorbent pads are available for enhanced oil removal and storage. Due to the separation of the oil and floatable storage volume from the outlet, the potential for washout of stored pollutants between clean-outs is minimized.

Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for “offline” arrangements using separate junction manholes
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

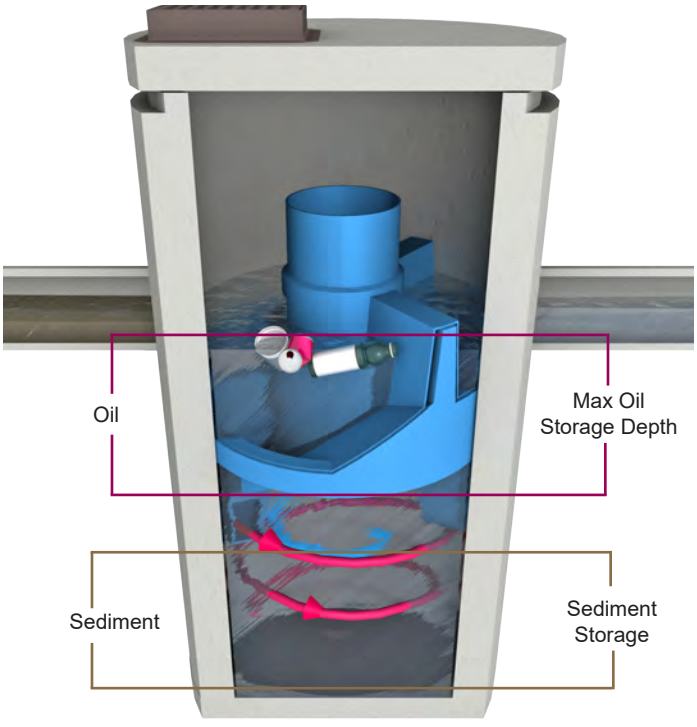


Fig.1 Pollutant storage volumes in the First Defense®.

II. Model Sizes & Configurations

The First Defense® inlet and internal bypass arrangements are available in several model sizes and configurations. The components have modified geometries allowing greater design flexibility to accommodate various site constraints.

All First Defense® models include the internal components that are designed to remove and retain total suspended solids (TSS), gross solids, floatable trash and hydrocarbons (Fig.2). First Defense® model sizes (diameter) are shown in Table 1.

III. Maintenance

First Defense® Components

1. **Built-In Bypass**
2. **Inlet Pipe**
3. **Inlet Chute**
4. **Floatables Draw-off Port**
5. **Outlet Pipe**
6. **Floatables Storage**
7. **Sediment Storage**
8. **Inlet Grate or Cover**

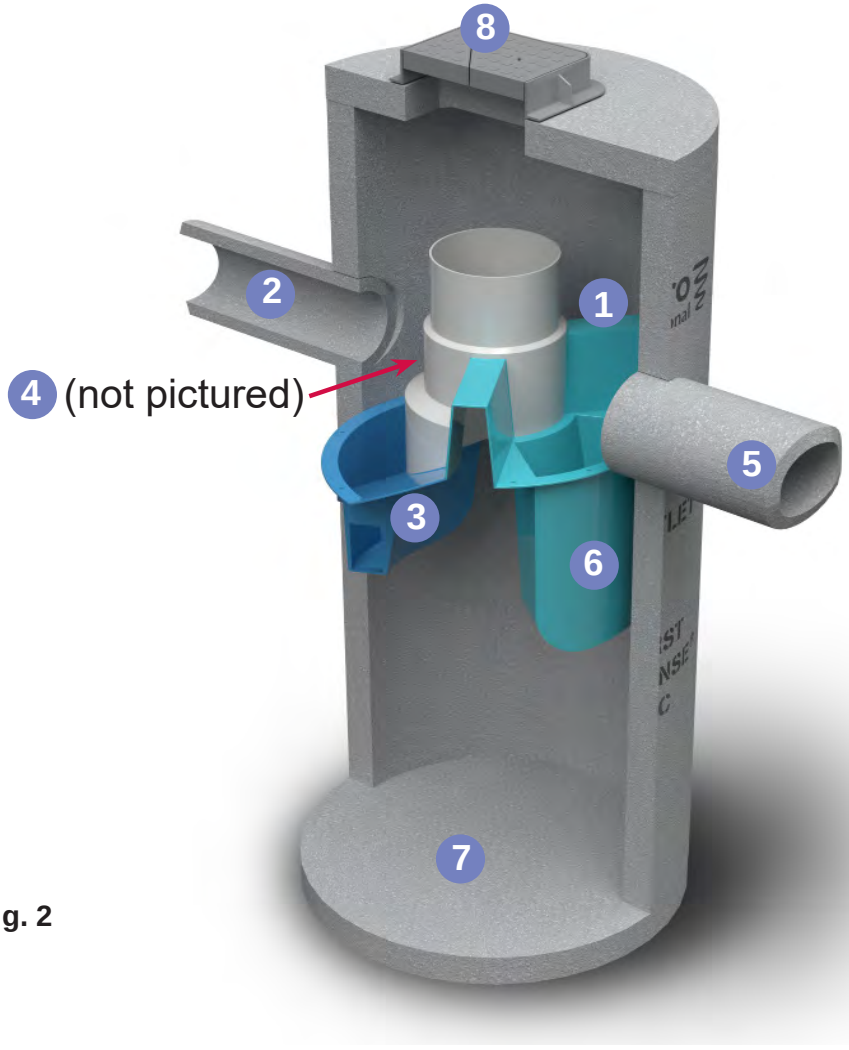


Fig. 2

Table 1

First Defense® Model Sizes
(ft / m) diameter
3 / 0.9
4 / 1.2
5 / 1.5
6 / 1.8
7 / 2.1
8 / 2.4
10 / 3.0

Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the First Defense® will no longer be able to store removed sediment and oil.

The First Defense® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the First Defense®, nor do they require the internal components of the First Defense® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Maintenance Equipment Considerations

The internal components of the First Defense® have a centrally located circular shaft through which the sediment storage sump can be accessed with a sump vac hose. The open diameter of this access shaft is 15 inches in diameter (Fig.3). Therefore, the nozzle fitting of any vactor hose used for maintenance should be less than 15 inches in diameter.

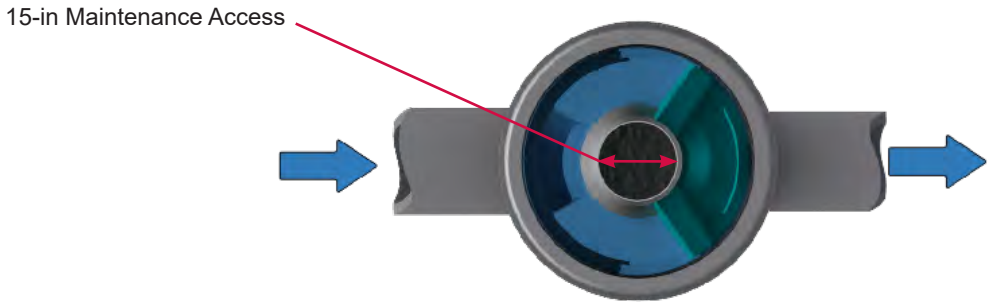


Fig.3 The central opening to the sump of the First Defense®is 15 inches in diameter.

Determining Your Maintenance Schedule

The frequency of clean out is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge-Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil / flotables removal, for First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 765 gallons.

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Fig.4 shows the standing water level that should be observed.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the components and water surface.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel.

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

Floatables and Sediment Clean Out

Floatables clean out is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.4).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose to be lowered to the base of the sump.

Scheduling

- Floatables and sump clean out are typically conducted once a year during any season.

- Floatables and sump clean out should occur as soon as possible following a spill in the contributing drainage area.

Fig.4 Floatables are removed with a vactor hose

Recommended Equipment

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (flexible hose recommended)
- First Defense® Maintenance Log

Floatables and Sediment Clean Out Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the grate or lid to the manhole.
3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.
4. Remove oil and floatables stored on the surface of the water with the vactor hose or with the skimmer or net
5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (page 9).
6. Once all floatables have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris off the sump floor
7. Retract the vactor hose from the vessel.
8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components, blockages, or irregularly high or low water levels.
9. Securely replace the grate or lid.

Maintenance at a Glance

Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area
NOTE: For most clean outs the entire volume of liquid does not need to be removed from the manhole. Only remove the first few inches of oils and floatables from the water surface to reduce the total volume of liquid removed during a clean out.	

First Defense® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL SIZE (CIRCLE ONE): [3-FT] [4-FT] [5-FT] [6-FT] [7-FT] [8-FT] [10-FT]

INLET (CIRCLE ALL THAT APPLY): GRATED INLET (CATCH BASIN) INLET PIPE (FLOW THROUGH)

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

First Defense® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment Depth Measured	Volume of Sediment Removed	Site Activity and Comments

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

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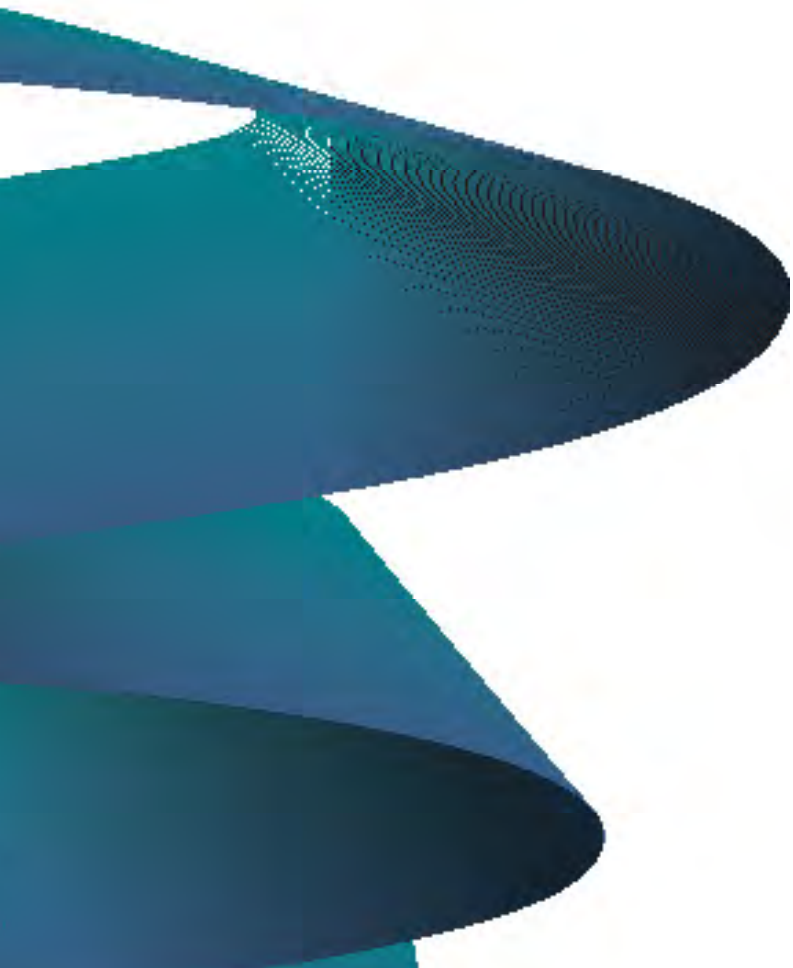
Notes

Hydro International



Stormwater Solutions

94 Hutchins Drive
Portland, ME 04102

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stormwaterinquiry@hydro-int.com

www.hydro-int.com

Turning Water Around...®

FD_O+M_K_2105

APPENDIX H

Groundwater Mounding Analysis

LANGAN

Groundwater Mounding Analysis Summary

LANGAN

Project Name: Hillman Energy Center
Project Number: 151043401
Location: Tewksbury, MA
Date: 3/10/2025
Computed By: HH

	HANTUSH INPUTS											
SW BMP Location & Description	**Storage Volume[1]** *(cf)*	**Bottom Surface Area** *(sf)*	**Recharge Rate[2]** *(ft/day)*	**Vertical Permeability Rate (Rawls Rate)** *(in/hr)*	**Specific Yield[3]**	**Horizontal Hydraulic Conductivity[4]** *(feet/day)*	**1/2 Length of BMP** *(ft)*	**1/2 Width of BMP** *(ft)*	**Drawdown Time[5]** *(hrs)*	**Drawdown Time[5]** *(days)*	**Initial Thickness of Saturated Zone** *(feet)*	**Drawdown Time < 72 hrs**
Infiltration System B-1	1,659	3,520	0.16	2.41	0.21	48.20	88	10	2	0.10	4.00	YES

GROUNDWATER MOUNDING RESULTS					
Max GW Mounding *(ft)*	**Groundwater Elevation[7]** *(ft)*	**Reference Test Pit**	**BMP Bottom Elev.** *(ft)*	**Top Elev. of Mounding** *(ft)*	**Is Top Elev. Of Mounding Less Than BMP Bottom Elevation?**
0.056	115.80	TP-03	117.80	115.86	YES

Notes:
1. Storage Volume based on static recharge volume
2. Recharge Rate = (Storage Volume/Bottom Surface Infiltration Area)/ 3 days
3. Specific Yield for fine sand = 0.21
4. Horizontal Hydraulic Conductivity = Rawls Rate x 24 hours/day x 1 ft/12 inches x 10
5. Drawdown Time = Storage Volume/(Bottom Surface Infiltration Area x Rawls Rate)
6. Initial Thickness of Saturated Zone = Depth of Boring - Depth of Groundwater
7. Estimated seasonal high water table

Groundwater Mounding Analysis Summary

LANGAN

Project Name: Hillman Energy Center
Project Number: 151043401
Location: Tewksbury, MA
Date: 3/10/2025
Computed By: HH

	HANTUSH INPUTS											
SW BMP Location & Description	**Storage Volume[1]** *(cf)*	**Bottom Surface Area** *(sf)*	**Recharge Rate[2]** *(ft/day)*	**Vertical Permeability Rate (Rawls Rate)** *(in/hr)*	**Specific Yield[3]**	**Horizontal Hydraulic Conductivity[4]** *(feet/day)*	**1/2 Length of BMP** *(ft)*	**1/2 Width of BMP** *(ft)*	**Drawdown Time[5]** *(hrs)*	**Drawdown Time[5]** *(days)*	**Initial Thickness of Saturated Zone** *(feet)*	**Drawdown Time < 72 hrs**
Infiltration System C-1	947	888	0.36	2.41	0.21	48.20	37	6	5	0.22	5.00	YES

GROUNDWATER MOUNDING RESULTS					
Max GW Mounding *(ft)*	**Groundwater Elevation[7]** *(ft)*	**Reference Test Pit**	**BMP Bottom Elev.** *(ft)*	**Top Elev. of Mounding** *(ft)*	**Is Top Elev. Of Mounding Less Than BMP Bottom Elevation?**
0.132	114.20	TP-02	116.25	114.33	YES

Notes:
1. Storage Volume based on static recharge volume
2. Recharge Rate = (Storage Volume/Bottom Surface Infiltration Area)/ 3 days
3. Specific Yield for fine sand = 0.21
4. Horizontal Hydraulic Conductivity = Rawls Rate x 24 hours/day x 1 ft/12 inches x 10
5. Drawdown Time = Storage Volume/(Bottom Surface Infiltration Area x Rawls Rate)
6. Initial Thickness of Saturated Zone = Depth of Boring - Depth of Groundwater
7. Estimated seasonal high water table

Groundwater Mounding Analysis Summary

LANGAN

Project Name: Hillman Energy Center
Project Number: 151043401
Location: Tewksbury, MA
Date: 3/10/2025
Computed By: HH

	HANTUSH INPUTS											
SW BMP Location & Description	**Storage Volume[1]** *(cf)*	**Bottom Surface Area** *(sf)*	**Recharge Rate[2]** *(ft/day)*	**Vertical Permeability Rate (Rawls Rate)** *(in/hr)*	**Specific Yield[3]**	**Horizontal Hydraulic Conductivity[4]** *(feet/day)*	**1/2 Length of BMP** *(ft)*	**1/2 Width of BMP** *(ft)*	**Drawdown Time[5]** *(hrs)*	**Drawdown Time[5]** *(days)*	**Initial Thickness of Saturated Zone** *(feet)*	**Drawdown Time < 72 hrs**
Infiltration System C-2	1,189	2,496	0.16	2.41	0.21	48.20	78	6	2	0.10	5.33	YES

GROUNDWATER MOUNDING RESULTS					
Max GW Mounding *(ft)*	**Groundwater Elevation[7]** *(ft)*	**Reference Test Pit**	**BMP Bottom Elev.** *(ft)*	**Top Elev. of Mounding** *(ft)*	**Is Top Elev. Of Mounding Less Than BMP Bottom Elevation?**
0.037	114.20	TP-02	116.25	114.24	YES

Notes:
1. Storage Volume based on static recharge volume
2. Recharge Rate = (Storage Volume/Bottom Surface Infiltration Area)/ 3 days
3. Specific Yield for fine sand = 0.21
4. Horizontal Hydraulic Conductivity = Rawls Rate x 24 hours/day x 1 ft/12 inches x 10
5. Drawdown Time = Storage Volume/(Bottom Surface Infiltration Area x Rawls Rate)
6. Initial Thickness of Saturated Zone = Depth of Boring - Depth of Groundwater
7. Estimated seasonal high water table

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

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

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

Input Values		
0.1600	***R***	**Recharge (infiltration) rate (feet/day)**
0.210	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1]**
48.20	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
88.000	**x**	**1/2 length of basin (x direction, in feet)**
10.000	**y**	**1/2 width of basin (y direction, in feet)**
0.100	**t**	**duration of infiltration period (days)**
4.000	**hi(0)**	**initial thickness of saturated zone (feet)**

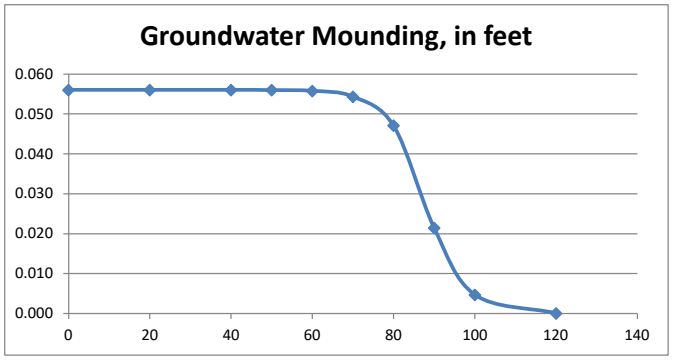
Conversion Table	
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

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

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

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.056	**0**
0.056	**20**
0.056	**40**
0.056	**50**
0.056	**60**
0.054	**70**
0.047	**80**
0.021	**90**
0.005	**100**
0.000	**120**

Re-Calculate Now



Disclaimer

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

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

Input Values		
0.3600	***R***	**Recharge (infiltration) rate (feet/day)**
0.210	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
48.20	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
37.000	**x**	**1/2 length of basin (x direction, in feet)**
6.000	**y**	**1/2 width of basin (y direction, in feet)**
0.220	**t**	**duration of infiltration period (days)**
5.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

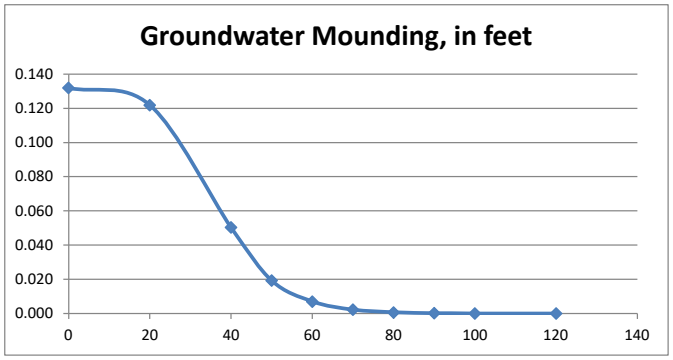
hours	days
36	1.50

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

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

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.132	**0**
0.122	**20**
0.050	**40**
0.019	**50**
0.007	**60**
0.002	**70**
0.001	**80**
0.000	**90**
0.000	**100**
0.000	**120**

Re-Calculate Now



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

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

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

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

Input Values		
0.1600	***R***	**Recharge (infiltration) rate (feet/day)**
0.210	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1]**
48.20	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
78.000	**x**	**1/2 length of basin (x direction, in feet)**
6.000	**y**	**1/2 width of basin (y direction, in feet)**
0.100	**t**	**duration of infiltration period (days)**
5.330	**hi(0)**	**initial thickness of saturated zone (feet)**

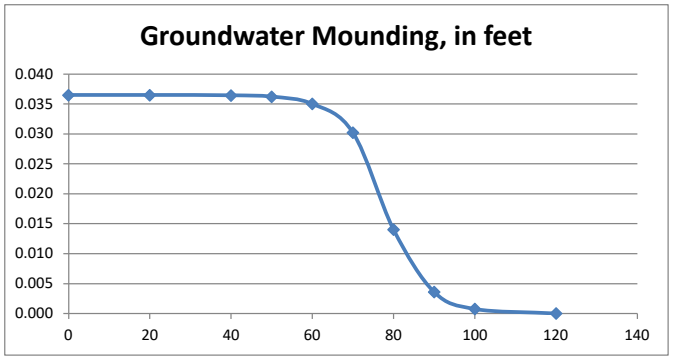
Conversion Table	
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

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

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

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.037	**0**
0.037	**20**
0.036	**40**
0.036	**50**
0.035	**60**
0.030	**70**
0.014	**80**
0.004	**90**
0.001	**100**
0.000	**120**

Re-Calculate Now



Disclaimer

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